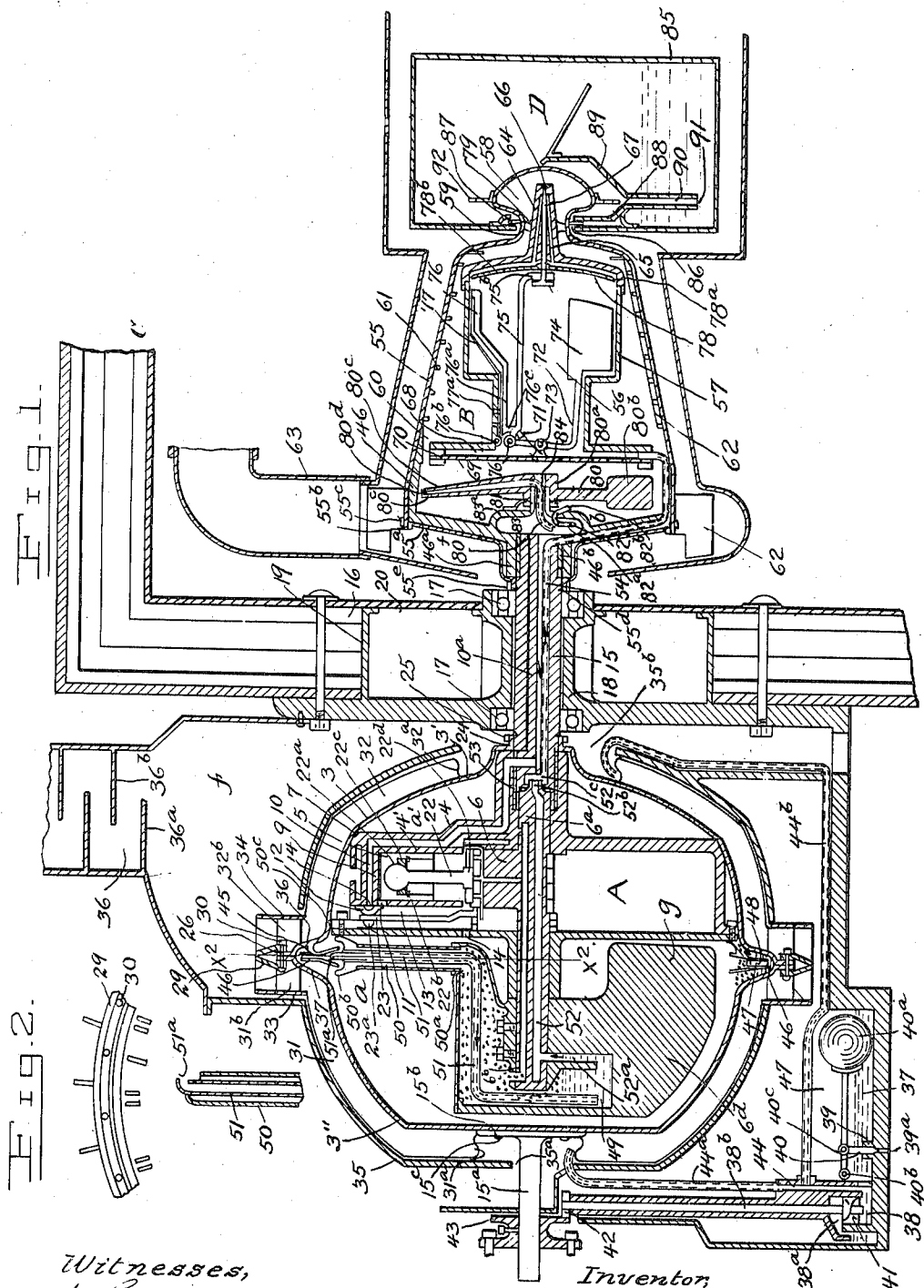


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REFRIGERATION APPARATUS.
APPLICATION FILED DEC. 1, 1916.

1,315,282.

Patented Sept. 9, 1919.



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UNITED STATES PATENT OFFICE.

HOWARD H. CARPENTER, OF ALTADENA, CALIFORNIA.

REFRIGERATION APPARATUS.

1,315,282.

Specification of Letters Patent.

Patented Sept. 9, 1919.

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To all whom it may concern:

Be it known that I, HOWARD H. CARPENTER, a citizen of the United States, residing at Altadena, in the county of Los Angeles and State of California, have invented new and useful Improvements in Refrigeration Apparatus, of which the following is a specification.

This invention relates to rotary refrigeration apparatus, and it has for its object to provide an improved apparatus of this general nature wherein an expansible fluid is employed as a refrigerant. One of the principal objects of the invention is to provide a refrigerating apparatus by means of which articles placed in a suitable box-like casing, such as an ordinary refrigerator, may be efficiently cooled, and to that end, a refrigerating chamber is provided within such refrigerator box or casing while the condenser and other features of the system may be disposed externally of such box, communication as between the refrigerating chamber and the condenser or other features being had through a hollow shaft which passes through a wall of the refrigerator box and through which the fluid refrigerant may be circulated. A further object of the invention is to provide rotary refrigerating apparatus in which the refrigerant, as for instance sulfur dioxide may be effectively separated from the oil and other fluids employed in such apparatus, and I have found that such separation may be made centrifugally.

In accordance with the invention, a refrigerating apparatus is provided which may be applied to any air-cooled refrigerator, or the same may enter structurally into the organization of a refrigerator.

The invention has for a further object to provide apparatus of the general character stated which will be relatively simple and inexpensive in construction and organization, when its high efficiency and compactness in size are considered, and which will be generally superior in reliability and serviceability.

With the above and other objects in view, the invention consists in the novel and useful provision, formation, combination, association and relative arrangement of parts, members and features, all as hereafter described, shown in the drawing, and finally pointed out in claims.

In the drawing:

Figure 1 is a central longitudinal sectional view of refrigerating apparatus constructed, organized and applied in accordance with the invention; and

Fig. 2 is a fragmentary sectional view taken on the line x^2-x^2 , Fig. 1, and looking in the direction of the appended arrows, showing certain details of construction.

Corresponding parts in all the figures are designated by the same reference characters.

Referring with particularity to the drawing, in the embodiment of the invention therein shown, A designates a rotary condenser, B designates a rotary refrigerator, C designates a refrigeration box or the like in which the rotary refrigerator B is preferably located, A designates lubricant and refrigerant separation means for use in connection with the condenser A, B designates lubricant and refrigerant separation means at the refrigerator B, D designates a brine chamber used in connection with the refrigerator, and E designates cooling water supply means for the condenser.

The rotary condenser A is shown as comprising a compressor a' , a rotatable shell 3 in which said compressor is located, air supply means f whereby the rotary condenser is cooled and means g whereby compressor elements may be prevented from rotating with the shell 3 and other compressor features. The compressor a' is shown as comprising a rotatable cylinder member 4, a plurality of pistons one of which is shown at 5, means 6 for actuating said pistons 5, and the means g for preventing rotation of the actuating means 6 with the cylinder member 4. The cylinder member 4 is united with the rotatable shell 3 as at 7, and such cylinder member is of the type in which three radially disposed cylinders are employed, such cylinders being disposed 120° apart about the axis of rotation of the rotary compressor. Only one of such cylinders is shown at 4', the construction of the remaining cylinders being readily understood from a description of the cylinder 4'. The cylinder 4' is formed in the casting constituting the cylinder member 4 and has an inwardly facing bore, and a head 9 closing the outer end of the cylinder. A refrigerant intake duct 10 is formed in the cylinder casting and leads to an intake port 11 provided in the wall of the cylinder 4' and near the head thereof and controlled by a slide valve 12. A slide

valve chamber 13 is likewise provided in the cylinder casting and such chamber communicates with the interior of the shell 3 through a port 14. The intake duct 10 communicates with a duct 10^a provided in a shaft 15 upon which the cylinder casting is mounted for rotation, such casting being secured to the shaft 15, as is the rotatable refrigerator member B. The shaft 15 extends through a wall 16 of the refrigerator box C, anti-friction bearings 17 being provided for the shaft 15 in a suitable supporting bushing 18 inset in an orifice 19 in the wall 16. The rotating parts of the entire apparatus are preferably supported from the bushing 18, and such bushing 18 may have an internal chamber 20 adapted to be filled with heat insulating substance. A piston 5 is fitted in each of the cylinders and connected with the piston actuating means 6, shown as an eccentric, by means of a connecting rod 22 having a ball and socket joint in the piston as at 22^a, a retaining ring 22^b being provided to retain a plug 22^c having a suitable hemispherical cavity provided internally of the piston to hold the piston and the connecting rod 22 in assemblage. The opposite end of the rod 22, in each instance, terminates in an eccentric strap 22^d encircling the eccentric 6. An eccentric rod 23 extends to each of the slide valves 12 and each such eccentric rod 23 encircles the eccentric 6 and extends to the slide valve to a pivotal connection 23^a thereon. The eccentric 6 is formed on a hollow shaft 6^a journaled in the cylinder member *a'* as at 6^b and at an overhanging end such shaft is provided with a depending weight 6^d, constituting the means *g*. The shell 3 comprises a pair of matched hemispherical drawn or spun metal members 3' and 3'' rigidly secured to the shaft 15 at its point of emergence from the refrigerating box C as by welding an annular outwardly facing portion 24 provided on the shell portion 3'' to such shaft 15 and then applying a brazed or welded annulus 25 over the annular portion 24 to further secure the same. The opposite shell portion 3', is secured at its axis to an extension shaft 15^a coaxial with the shaft 15 as by riveting the shell to a lateral extension 15^b of the shaft 15^a as at 15^c. The hemispherical shells 3' and 3'' are outwardly flared at their meeting edges where they are provided with laterally extending matched flanges 26. These flanges are welded together and a two-part clamping ring 29 is fitted over the flanges 26^a and 27^a after the welding of the same, the parts of the clamping ring 29 being held in assemblage by means of bolts or the like 30 passed therethrough. The shell portions 3' and 3'' are provided, respectively, with external fins or blades 31 and 32, such blades ranging from a point a slight distance from the axis of rotation of

the shell as at 31^a and 32^a to the point of merger of the two shells where such fins are extended to form peripheral fan blades 31^b and 32^b. Side flanges 33 and 34 are provided to act as supports for the fan blades 33 and 34 and further to provide for more efficient fan or blower action. A fixed casing of sheet metal or the like 35 surrounds the shell 3 and the fan blades and fins thereon and provides a fan casing for the fins, such casing terminating at the points of termination of the fins at 31^a and 32^a. The casing further extends upwardly to an air discharge duct 36, and downwardly to form a water well 37 adapted to receive cooling water. A plurality of oppositely arranged baffles 36^a and 36^b are provided in the discharge duct or passage 36 so that discharged air must take a tortuous course and deposit any liquid contained therein on the baffles from where it may be returned to the water well 37. The arrangement of casing, fins, and fan blades, just described, constitutes the means *f*. In the lowermost portion of the well 37 the casing is formed into a water receiving chamber 38 connected by a duct 39 shown in dotted lines in Fig. 1, with the interior of the well 37, the outlet 39^a of the duct 39 being controlled by a valve 40 operated by a float 40^a pivotally connected as at 40^b with a wall of the chamber 38 and pivotally connected with the valve as at 40^c. A pump 41 enters the water in an extension 38^a of the water chamber 38 and is arranged to be driven by means of friction disks 42 and 43 provided respectively on the shaft 38^b of the pump and on the extension shaft 15^a. The pump is arranged to deliver water through a divided conduit 44 one of the branches 44^a of which leads to the orifice 35^a provided in the casing 35 near the axis of rotation of the rotary condenser, and the other branch 44^b of which leads to a similar orifice 35^b provided at the opposite side of the rotary condenser and near the axis of rotation thereof, such branch pipes being arranged to discharge water into the space between the shell 3 and the casing 35. This means of water supply constitutes the means *E*.

The means *a* for separating the refrigerant and lubricant in the condenser chamber are organized as follows: A member 45 of annular form and groove or channel section is mounted for rotation with the shell 3 and the compressor cylinder member *a'* and is disposed within the inwardly facing groove 46 in the shell 3 provided by the flared edges 36 and 37, though such member 45 with its inwardly facing groove, is of slightly less diameter than the groove 46 the bottoms of the grooves being spaced apart. Bridges 47 are provided transversely of the groove 46 and ducts 48 are arranged at intervals about the circumference of the mem-

ber 45 to extend into the groove 46 nearly to the bottom or portion of greatest diameter thereof. A combined refrigerant and lubricant receiving reservoir 49 is provided at the upper portion of the weight 6^a and such reservoir is closed save for a plurality of tubes 50 and 51 which communicate therewith, the tube 51 extending nearly to the bottom of the reservoir and the tube 50 which surrounds the tube 51 terminating at one end at the top of the reservoir as at 50^a. The outer end of the tube 50 which is mounted on the reservoir casing extends radially upward and terminates in a plurality of scoops or fingers 50^b and 50^c which are arranged to just enter the groove 46. The tube 51, which ranges through the tube 50, is extended slightly further upward than the fingers 50^b and 50^c and extends into the groove 45^a provided in the channel member 45 as at 50^b the bifurcated end of the tube 50 straddling the member 45. A duct 52 is provided in the shaft 6^a and extends into the weight 6^a as at 52^a where communication is had with the interior of the reservoir 49 and only at the bottom thereof, the duct 52 terminating at its other end in a reduced extension 52^b of the shaft 6^a, which extension 52^b enters a central chamber 52^c provided in the shaft 15 near the condenser end thereof. Packing means 53 may be provided at this point as the shafts 6^a and the shaft 15 are here arranged in end to end relation, the shaft 15 being arranged for rotation, and the shaft 6^a being held against rotation by the weight 6^a. A refrigerant duct 54 extends through the hollow shaft 15 parallel to or in the duct 10^a and such duct 54 communicates at one end with the chamber 52^c and ranges through refrigerator features as will presently be described.

The rotary refrigerator member B which is shown as disposed interiorly of the box C comprises a conical shell 55 mounted upon an end plate 46 which plate is provided with a hub 46^a secured to the shaft 15 as at 46^b, a refrigerant reservoir 56 formed in a casing 57 provided interiorly of the shell 55, an expansion chamber 58 provided in an extension of the shell 55 and in the brine chamber D, and means *b* for controlling the discharge of refrigerant from the refrigerant chamber 56 into the expansion chamber 58. The shell 55 is preferably of spun metal and may have a closure 55^a welded thereto as at 55^b and further secured by a ring 55^c applied over the joint and such closure may extend inwardly and over the hub 46^a and be applied to the shaft by welding as at 55^d, a retaining ring 55^e being applied over the annular portion of the closure 55^a where it is applied to the shaft. The conical shell 55 is constricted at 59 to produce a neck through which the expansion chamber 58 communicates with the further expansion chamber 60

formed within the shell 55, the expansion chamber 58 being preferably formed integrally with the shell 55. Interiorly of the shell 55 a plurality of internal ribs 61 are provided and other longitudinal ribs 62 may intersect the ribs 61. At the point of largest diameter of the shell 55 a plurality of spaced vanes or fan blades 62 are provided and such fans are adapted for rotation with the shell in a casing 63 surrounding the shell, such casing being apertured near the shaft 15 and extending completely over the shell 55 and the brine chamber D where it terminates in an air inlet orifice. In the plane of rotation of the fan blades 62 the casing is formed to conduct air inducted by the fan blades at the air inlet orifice and at the aperture 15 to a discharge duct 63 which may lead to any suitable point in the refrigerator box C. The casing 57 provided interiorly of the shell 55 terminates at the expansion chamber in the nozzle 64 provided with refrigerant ducts 65 extending from the chamber to the expansion chamber 52 and into the expansion chamber 58 where an orifice 66 is provided in the nozzle 64, such orifice being controlled by a needle valve 67, and at the other end the casing is laterally extended to provide a diaphragm chamber 68 which is spanned by a diaphragm 69 secured to the casing as at 70. A bracket 71 springs from the diaphragm 69 interiorly of the chamber 56 within the casing 57 and a bent lever 72 is pivotally secured to the bracket 71 as at 73, a float 74 being provided at one end of the lever 72 and a needle valve controlling link 75 being pivotally secured to the other end of the lever 72 as at 76. The needle valve 67 is formed with a head 67^a and such valve is passed through an orifice provided in a laterally extending portion 75^b of the link 75. The float 74 is disposed in an enlargement 56^a of the chamber 56 and at a point in such chamber opposite the float a weight 76 is provided, such weight having a shank 76^a which is pivotally mounted on the wall of the casing 57 near the diaphragm as at 76^b. A curved bell-crank arm 76^c springs from the shank 76^a of the weight and such bell-crank arm is disposed in the path of travel of a portion 72^a of the lever 72. A flat spring 77 is provided between the weight 76 and the wall of the casing 57 and such spring may be secured as by riveting at 77^a, the spring tending to urge the weight toward the axis of rotation. A circular disk 78 surrounds the stem of the valve 67 and is disposed near the nozzle end of the chamber 56, a slight interspace being provided at 78^a between the disk and the circular walls of the chamber 56, and a slight interspace 78^b is provided between the end wall of the chamber adjacent the nozzle and the circular disk 78. The nozzle 64 is joined to the shell 55 by a spider at 79.

The separation means *b* comprises a member 80 rotatably mounted upon a hollow arbor 81 springing from the hub 46^a of the end plate 46, and a drain tube 82 provided in a circular chamber 83 formed in the hub 46^a. The drain tube 82 is of U-form and has its longest leg 82^a disposed in the chamber 83 and its short leg 82^b extending through a wall 83^a of the chamber so as to return refrigerant to the interior of the shell 55. The chamber 83 communicates with the duct 10^a in the shaft 15 and likewise communicates with the interior of the shell 55 through a duct 84 extending centrally through the extension 81. The member 80 comprises a central hub 80^a, a weight 80^b depending from such hub, and an up-standing finger 80^c provided with a duct 80^d extending to the highest point in the chamber 60 within the shell 55 and the head plate 46 as at 80^e, such duct extending from this point through the finger 80^c and through the duct 84 in the extension 81 and being curved downwardly in the chamber 83 for a short distance only as at 80^f.

The brine chamber D is shown as comprising a suitable tank 85 disposed at the nozzle 64 and through an orifice 86 in which the neck 59 of the shell 55 extends so as to position the expansion chamber 58 within the brine tank 85. A flange 87 surrounds the neck 59 and is arranged to be rotated therewith to prevent the loss of brine through the orifice where the neck enters the brine tank, a wall 88 of a trough 89 being arranged to lie adjacent to the flange 87. The trough 89 is provided with a duct 90 at its bottom portion, such duct ranging to a point adjacent the bottom of the brine tank as at 91. An annular flange 92 is provided on the expansion chamber 58 in the plane of rotation thereof and such flange 92 dips into the brine in the trough 89 and in the rotation of the expansion chamber circulates such brine, brine being drawn into the trough through the duct 90 and lifted by the circular flange 92.

The operation, method of use and advantages of the invention will be readily understood from the foregoing description, taken in connection with the accompanying drawing and the following statement:

Power being applied to the shaft extension 15^a, the shell 3 with the cylinder member *a'* secured thereto will be rotated and power will be transmitted through the shaft 15 to the rotary refrigerator B and rotate the shell 55 and other features thereof. The circulatory system within the refrigerator apparatus being filled with lubricant and refrigerant such for instance as sulfur dioxide, the rotation of the cylinder member will cause the reciprocation of the pistons 5 in their respective cylinders 4', due to the maintenance of the eccentric 6 in vertical

position by means of the weight 6^d which is sufficiently heavy to provide for the desired degree of compression in the cylinders, and on the instroke of each piston as it with its cylinder is drawn under the eccentric, refrigerant will be inducted from the refrigerator B through the duct 10^a in the shaft 15 through the passage 10 and into the respective cylinder in position to receive such refrigerant, the slide valve of the respective cylinder uncovering its intake port. As the cylinder member *a'* is further rotated, a cylinder containing a charge of the refrigerant will be brought to vertical position, and the eccentric 6 acting through the respective connecting rod 22 will have expelled the refrigerant from the respective cylinder, the slide valve being then in position to permit the transfer of the compressed refrigerant through the duct 13 and port 14 to the interior of the shell 3. As the refrigerant has intermixed therewith a sufficient quantity of lubricating oil to maintain the parts in proper working condition, lubricating oil will likewise be inducted into the cylinder and expelled therefrom with the lubricant and as such refrigerant and intermixed lubricating oil comes in contact with the shell 3 it will due to gravitation seek the lowermost point in such shell and find the groove 46. As the now liquid refrigerant and intermixed lubricant finds its way to the groove 46 it will follow the shell in its rotation due to the provision of the bridges 47 and frictional contact with the sides of the grooves 46. The rotation of the shell will cause a separation of the lubricant and the refrigerant, after the manner of a centrifuge, the refrigerant being, in the case of sulfur dioxide, of considerably greater weight (when in liquid form) than the lubricant, and such sulfur dioxide refrigerant will find its way to the bottom of the groove 46 and will issue through the ducts 48 into the groove formed in the V-shaped or channel section member 45, leaving the lighter lubricant at the surface or disposed in an annular body at the innermost portions of the groove 46 and at the sides of the channel-section member 45. The sulfur dioxide being so separated from the lubricant, which is preferably a good grade of lubricating oil, may be picked up by the scoop or finger 50 as the annular body of such liquid refrigerant is propelled with the shell and is presented to the finger 50^b, which finger it will be understood, is always maintained in vertical position, due to the influence of the weight 6^d which is suspended below the axis of rotation of the rotary condenser or the shell and cylinder features thereof. The liquid refrigerant gravitating through the tube 51 which terminates in the finger 50^b, enters the well or reservoir 49 which, as before stated, is a combined liquid refrigerant

and lubricant reservoir and as the tube 51 leads to the bottom of such reservoir 49, the bottom of such reservoir will always be supplied with liquid refrigerant during the operation of the apparatus. The lubricant or oil which is disposed at both sides of the channel-section member 45 will be picked up by the fingers or scoops 50^b and 50^c of the tube 50, and as such fingers are not of as great a radial extension as the finger or scoop 50^b, they will only pick up oil and not penetrate the groove 46 to a sufficient depth to scoop or pick up liquid sulfur dioxide, and the oil or other lubricant so gathered by the fingers 50^c and 50^b which are branches of the pipe 50, will be conveyed by such pipe 50 to the upper portion of the combined lubricant and liquid refrigerant receiving reservoir. Due to the great difference in specific gravity of the lubricant and sulfur dioxide or other refrigerant, in its liquid form, further separation by gravity takes place, and such liquid sulfur dioxide as may still remain intermixed with the oil delivered to the reservoir 49 will find its way to the bottom portion of the reservoir 49. The ideal line of separation between the oil and the liquid refrigerant will be had approximately at the axis of rotation of the rotary compressor, and the reservoir being associated with the weight 6^a may deliver liquid refrigerant through the duct 52^a and the duct 52, through connected parts, to the refrigerator B, while lubricant will be delivered from the upper portion of the reservoir 49 through the duct in the shaft 6^c which duct may lead to all bearings of the apparatus not otherwise lubricated. The liquid refrigerant finding its way along the duct 52 will issue at the extension 52^b into the chamber 52^c and from thence into the duct 54 provided interiorly of the shaft 15 and the refrigerant will be conveyed by such duct 54 to the chamber 56 provided interiorly of the casing 57 into which the duct 54 discharges, such duct leaving the shaft 15 and entering the end plate 46 so that the duct may be carried about the separation means *b* and lead into the chamber 56. In the rotation of the refrigerator member D, the weight 76 will overcome the resistance of its spring 77, due to centrifugal action and likewise due to such centrifugal action the liquid refrigerant will seek the peripheral walls of the chamber 56 causing the float 74 to be moved inwardly or toward the axis of rotation, and in the inward movement of such float the needle valve 77 will be actuated through its link 75 which is actuated with its arm 72^a and the float lever 72, and during such operation only such portion of the refrigerant as remains in liquid form will be able to pass the expansion valve 67 as any refrigerant issuing from the chamber 56 must issue through the interspace 78^a at

the periphery of the circular disk 78 and then through the interspace 78^b to the ducts 65 and through the orifice 56 which will be uncovered by the valve. This insures the delivery of liquid refrigerant by the nozzle 64 into the expansion chamber where such liquid refrigerant is free to expand and return to the compressor through the spaces provided between the arms of the spider 79 through the interior of the shell 55, and such shell 55, including the expansion chamber portion thereof will be maintained at a low temperature due to the expansion of the refrigerant or the conversion thereof from its liquid to its gaseous form. The liquid refrigerant having been expanded into a gas in the expansion chamber 58 and the remaining portions of the conical shell 55, may pass through the orifice in the hub 80^a of the member 80 and into the chamber 83 and therethrough to the duct 10^a in the shaft 15 to be therefrom drawn by the rotary condenser compression means. Such portion of the refrigerant as may remain or be in liquid form within the shell 55 will be rotated by such shell and centrifugally find its way to the point of the greatest diameter of the shell and such point will be at the gatherer or finger or scoop 80^c of the member 80 and such refrigerant which may be in the form of an emulsion of refrigerant and lubricating oil will be gathered by the finger 80^c, due to the maintenance of such finger in vertical position by the weight 80^b and will be passed through the duct 80^d into the chamber 83 and discharged at the terminus 80^e of the duct 80^d. Due to the rotation of the plate 46, with other portions of the apparatus, the sulfur dioxide being, as above stated, considerably heavier than the oil or lubricant will be by centrifugal action thrown outwardly in the chamber 83 while the oil will in consequence of such centrifugal action be moved toward the axis of rotation to be returned to the compressor through the duct 10^a, with refrigerant escaping through the orifice in the extension 81. The liquid refrigerant in the chamber 83 being disposed in an annular body at the outer walls of such chamber 83 will be picked up by the U-shaped tube 82 and will be discharged therethrough into the interior of the shell 55 for further expansion therein. As the expansion chamber 58 is located in the brine tank D, and the flange 92 keeps the brine in circulation, such brine will be cooled by the expansion of the liquid refrigerant as it is converted into gaseous form in the expansion chamber in its escape through the nozzle 64. The casing 63 being arranged for the entrance of air thereinto around the brine chamber, air will be inducted into such casing over the chilled surface of the brine tank and the surface of the shell 55 and such air being cooled by

contact with the chilled surfaces of the brine tank and the shell 55 will be expelled by the action of the fan blades 22 through the discharge duct 63 at a suitable point in the refrigerator box C. When the rotary parts are at rest, centrifugal action no longer influences the weight 76, its spring will force it inwardly, and the float 77 may likewise move inwardly and the valve 67 will be maintained in open position, whereby pressure equilibrium is restored throughout the apparatus to permit re-starting of the same, as, it will be understood, that the weight 6^d is limited in its power to maintain the eccentric 6 in vertical position and the compressor could not be started against too great a pressure head. In such case, when the machine is at rest, only refrigerant in gaseous form may flow reversely through the nozzle 64, and past the circular disk 78 and into the condenser A, as the refrigerant remaining in liquid form will seek the then bottom of the chamber 56. During the rotation of the compressor, the pump 41 will be actuated through the friction disks 42 and 43 and will force water through the branched duct 44 to the points of discharge of such duct on the fins or fan blades 31 and 32 where such water will assist the air inducted into the casing 35 by the fan action in cooling the shell 3 and dissipating the heat of the refrigerant being compressed by the compressor element. A considerable portion of such cooling water will be absorbed by the cooling air and will be carried out through the discharge pipe 36 thereby, but any water not vaporized or intimately commingling with the air will strike the baffles 36^a and 36^b to be returned to the well 37 whereby a constant supply of water is maintained. The action of the float 40^a controlling the valve 40 will maintain the water at the proper level in the chamber 38 of the means E.

It is to be noted that the valve controlling features such as the weight 76 and the float 74 are mounted upon the diaphragm 67, and it is due to the expansion of the liquid refrigerant in the chamber 56 that the diaphragm 69 is moved upwardly to permit opening of the valve 67, and such diaphragm in this manner controls the passage of the refrigerant through the ducts 55 of the nozzle 64 according to whether the pressure is greatest in the expansion chamber 60 within the shell 55 or within the chamber 56.

The construction of the shell 3 and the chamber 55 of the rotary condenser and the expansion chamber, respectively, is unique in that such shells are constructed of thin spun or compressed metal, whereas in apparatus of this general nature as heretofore constructed they have usually been made of cast iron which is porous and much trouble has occurred through leakage of the refriger-

ant therethrough; resort has been made to the tinning of the surfaces of such cast iron shells and various other methods to prevent loss of refrigerant. By use of a thin spun or pressed sheet metal shell this difficulty is overcome, resulting in a much lighter and cheaper shell. The parts of the apparatus installed within such shells are accessible by turning out, as in a lathe, the metal employed for welding the shells, both the several portions thereof to each other and such portions to the shaft. The clamp 50 and the retaining rings applied on the shaft over the shells insure great strength in the finished shell and take all strain off the yelded joints. No gaskets are needed for packing purposes.

Having thus disclosed my invention, I claim and desire to secure by Letters Patent:

1. In apparatus of the character described, a rotary condenser including a closed shell, a compressor cylinder arranged within the shell and rotatable therewith, a piston for said compressor cylinder, means for actuating said piston, a reservoir within the shell, and means for the separation of the lubricant and refrigerating medium, said separation means comprising a plurality of grooved troughs and a gatherer for each of said troughs whereby refrigerant and lubricant centrifugally separated by the rotation of the shell may be withdrawn from the troughs and deposited in the reservoir.

2. In apparatus of the character described, a rotary condenser including a closed shell, a compressor mounted within the shell and actuated by the rotation thereof, a stationary reservoir within the shell, a plurality of grooved troughs extending around the shell and providing for the centrifugal separation of the lubricant and refrigerating medium, independent gatherers extending into the respective troughs, and conduits leading from the gatherers to the reservoir, the conduit for the heavier medium extending downwardly into the reservoir.

3. In apparatus of the character disclosed, a rotary condenser, and a rotary refrigerating unit connected therewith and adapted for rotation in unison therewith; said condenser comprising a compressor cylinder, a piston in said cylinder, means for actuating said piston, a weight for maintaining said actuating means in operative position, whereby upon rotation of said cylinder said piston is reciprocated therein; and a heat radiating shell provided with fan blades for creating a circulation for cooling medium over said shell.

4. In apparatus of the character disclosed, a rotary condenser, and a rotary refrigerating unit connected therewith and adapted for rotation in unison therewith; said condenser comprising a compressor cylinder, a piston in said cylinder, means for actuating said piston, a weight for maintaining said

actuating means in operative position, whereby upon rotation of said cylinder said piston is reciprocated therein; a heat radiating shell provided with fan blades for creating a circulation of cooling medium over said shell, and a jacket wherein said shell is rotatably mounted.

5. In apparatus of the character disclosed, a rotary condenser, and a rotary refrigerating unit connected therewith and adapted for rotation in unison therewith; said condenser comprising a compressor cylinder, a piston in said cylinder, means for actuating said piston, and a weight for maintaining said actuating means in operative position, whereby upon rotation of said cylinder said piston is reciprocated therein; there being a heat radiating shell provided with fan blades for creating a circulation of cooling medium over said shell, a jacket wherein said shell is rotatably mounted; means in said shell for centrifugally separating the lubricant from the refrigerating medium.

6. In apparatus of the character disclosed, a rotary condenser, and a rotary refrigerating unit connected therewith and adapted for rotation in unison therewith; said condenser comprising a compressor cylinder, a piston in said cylinder, means for actuating said piston, and a weight for maintaining said actuating means in operative position, whereby upon rotation of said cylinder said piston is reciprocated therein; a heat radiating shell provided with fan blades for creating a circulation of cooling medium over said shell, and a jacket wherein said shell is rotatably mounted; means in said shell for centrifugally separating the lubricant from the refrigerating medium, and means for depositing centrifugally separated lubricant and refrigerating medium in a reservoir associated with said weight.

7. In apparatus of the character disclosed, a rotary condenser, and a rotary refrigerating unit connected therewith and adapted for rotation in unison therewith; said condenser comprising a compressor cylinder, a piston in said cylinder, means for actuating said piston, and a weight for maintaining said actuating means in operative position, whereby upon rotation of said cylinder said piston is reciprocated therein; a heat radiating shell provided with fan blades for creating a circulation of cooling medium over said shell, and a jacket wherein said shell is rotatably mounted; means in said shell for centrifugally separating the lubricant from the refrigerating medium, and means for depositing centrifugally separated lubricant and refrigerating medium in a reservoir associated with said weight; said last named means comprising a refrigerating medium gatherer and a lubricant gatherer.

8. In apparatus of the character disclosed,

a rotary condenser, and a rotary refrigerating unit connected therewith and adapted for rotation in unison therewith; said condenser comprising a compressor cylinder, a piston in said cylinder, means for actuating said piston, a weight for maintaining said actuating means in operative position, whereby upon rotation of said cylinder said piston is reciprocated therein; a heat radiating shell provided with fan blades for creating a circulation of cooling medium over said shell, and a jacket wherein said shell is rotatably mounted; means in said shell for centrifugally separating the lubricant from the refrigerating medium, and means for depositing centrifugally separated lubricant and refrigerating medium in a reservoir associated with said weight; said last named means comprising a refrigerating medium gatherer and a lubricant gatherer; said lubricant gatherer and said refrigerant gatherer being maintained in operative position by said weight.

9. In a rotary condenser, a rotatable casing provided with external fan blades, a jacket in which said casing is rotatably mounted, a compressor cylinder mounted for rotation with and disposed in said casing, a piston for said compressor cylinder, means for actuating said piston, means whereby said piston actuating means are maintained in piston actuating position during the rotation of said casing; said last named means including a weight; means for the separation of a refrigerating medium and a lubricant disposed in said casing; said separation means comprising a plurality of grooved troughs and a gatherer for each of said troughs whereby refrigerant and lubricant centrifugally separated in the rotation of said casing may be withdrawn from said troughs and suitably deposited for reuse.

10. In a rotary condenser, a rotatable casing provided with external fan blades, a jacket in which said casing is rotatably mounted, a compressor cylinder mounted for rotation with and disposed in said casing, a piston for said compressor cylinder, means for actuating said piston, means whereby said piston actuating means are maintained in piston actuating position during the rotation of said casing; said last named means including a weight; means for the separation of a refrigerating medium and a lubricant disposed in said casing; said separation means comprising a plurality of grooved troughs and a gatherer for each of said troughs whereby refrigerant and lubricant centrifugally separated in the rotation of said casing may be withdrawn from said troughs and suitably deposited for reuse; said gatherers comprising each a conduit leading to a reservoir.

11. In a rotary condenser, a rotatable casing provided with external fan blades, a

jacket in which said casing is rotatably mounted, a compressor cylinder mounted for rotation with and disposed in said casing, a piston for said compressor cylinder, means for actuating said piston, means whereby said piston actuating means are maintained in piston actuating position during the rotation of said casing; said last named means including a weight; means for the separation of a refrigerating medium and a lubricant disposed in said casing; said separation means comprising a plurality of grooved troughs and a gatherer extending into each of said troughs whereby refrigerant and lubricant centrifugally separated in the rotation of said casing may be withdrawn from said troughs and suitably deposited for reuse; said gatherers comprising each a conduit leading to a reservoir wherein further separation of refrigerating medium and lubricant may take place by gravitation.

12. In a rotary condenser, a rotatable casing provided with external fan blades, a jacket in which said casing is rotatably mounted, a compressor cylinder mounted for rotation with and disposed in said casing, a piston for said compressor cylinder, means for actuating said piston, means whereby said piston actuating means are maintained in piston actuating position during the rotation of said casing; said last named means including a weight; means for the separation of a refrigerating medium and a lubricant disposed in said casing; said separation means comprising a plurality of grooved troughs and a gatherer extending into each of said troughs whereby refrigerant and lubricant centrifugally separated in the rotation of said casing may be withdrawn from said troughs and suitably deposited for reuse; said gatherers comprising each a conduit leading to a reservoir wherein further separation of refrigerating medium and lubricant may take place by gravitation; said reservoir being associated with said weight.

13. A shell of the character disclosed, comprising a plurality of sheet metal members having abutting welded portions, and a member clamped over the welded portions to relieve the weld of strain incident to pressure internally of the shell.

14. In an improved joint for a shell and another member, a welded seam, and an annular member applied over said shell to relieve the welded seam of strain incident to pressure within the shell.

15. In a rotary refrigerating apparatus, a rotatable casing having a plurality of expansion chambers formed therein, a liquid refrigerant receiving chamber within one of said expansion chambers, a nozzle extending from said liquid refrigerant chamber into the other of said expansion chambers, a

valve to control the discharge of refrigerant through said nozzle, and means for actuating said valve.

16. In a rotary refrigerating apparatus, a rotatable casing having a plurality of expansion chambers formed therein, a liquid refrigerant receiving chamber within one of said expansion chambers, a nozzle extending from said liquid refrigerant chamber into the other of said expansion chambers, a valve to control the discharge of refrigerant through said nozzle, and means for actuating said valve; said valve actuating means comprising a diaphragm.

17. In a rotary refrigerating apparatus, a rotatable casing having a plurality of expansion chambers formed therein, a liquid refrigerant receiving chamber within one of said expansion chambers, a nozzle extending from said liquid refrigerant chamber into the other of said expansion chambers, a valve to control the discharge of refrigerant through said nozzle, and means for actuating said valve; said valve actuating means comprising a diaphragm, a pivoted weight, means urging the weight inwardly of the liquid refrigerant receiving chamber, and a float pivoted in said liquid refrigerant chamber and connected with said weight and said valve.

18. In a rotary refrigerating apparatus, a rotatable casing having a plurality of expansion chambers formed therein, a liquid refrigerant receiving chamber within one of said expansion chambers, a nozzle extending from said liquid refrigerant chamber into the other of said expansion chambers, a valve to control the discharge of refrigerant through said nozzle, and means for actuating said valve; said valve actuating means comprising a diaphragm, a pivoted weight, means urging the weight inwardly of the liquid refrigerant receiving chamber, and a float pivoted in said liquid refrigerant chamber and connected with said weight and said valve; there being means to permit the passage of only liquid refrigerant through said nozzle during the rotation of said expansion chamber and permitting only the passage of gas through said nozzle while said expansion chamber is stationary.

19. In a rotary refrigerating apparatus, a rotatable casing having a plurality of expansion chambers formed therein, a liquid refrigerant receiving chamber within one of said expansion chambers, a nozzle extending from said liquid refrigerant chamber into the other of said expansion chambers, a valve to control the discharge of refrigerant through said nozzle, and means for actuating said valve; one of said expansion chambers being disposed in a brine tank.

20. In a rotary refrigerator apparatus, a rotatable casing having an initial expansion chamber and a secondary expansion chamber

ber formed therein, a brine tank in which said initial expansion chamber is located, a liquid refrigerant receiving casing in said secondary expansion chamber, means to supply liquid refrigerant to the interior of said refrigerant receiving casing, there being a duct leading from said casing to said initial expansion chamber, a valve to control said duct, means for actuating said valve, and separation means for liquid refrigerant and lubricant within said secondary expansion chamber.

21. In a rotary refrigerator apparatus, a rotatable casing having an initial expansion chamber and a secondary expansion chamber formed therein, a brine tank in which said initial expansion chamber is located, a liquid refrigerant receiving casing in said expansion chamber, means to supply liquid refrigerant to the interior of said refrigerant receiving casing, there being a duct leading from said casing to said initial expansion chamber, a valve to control said duct, means for actuating said valve, and separation means for liquid refrigerant and lubricant within said secondary expansion chamber; said separation means comprising a duct maintained in position to gather refrigerant deposited against the casing of the expansion chamber and conducting the same to a receiving chamber where said liquid refrigerant is centrifugally separated from said lubricant and returned to the expansion chamber for further expansion therein.

22. In a rotary refrigerator apparatus, a rotatable casing having an initial expansion chamber and a secondary expansion chamber formed therein, a brine tank in which said initial expansion chamber is located, a liquid refrigerant receiving casing in said expansion chamber, means to supply liquid refrigerant to the interior of said refrigerant receiving casing, there being a duct leading from said casing to said initial expansion chamber, a valve to control said duct, means for actuating said valve, and separation means for liquid refrigerant and oil and lubricant within said secondary expansion chamber; said separation means comprising a duct maintained in position to gather refrigerant deposited against the casing of the expansion chamber and conducting the same to a receiving chamber where said liquid refrigerant is centrifugally separated from said lubricant and returned to the expansion chamber for further expansion therein.

23. In a rotary refrigerator apparatus, a rotatable casing having an initial expansion chamber and a secondary expansion chamber formed therein, a brine tank in which

said initial expansion chamber is located, a liquid refrigerant receiving casing in said expansion chamber, means to supply liquid refrigerant to the interior of said refrigerant receiving casing, there being a duct leading from said casing to said initial expansion chamber, a valve to control said duct, means for actuating said valve, separation means for liquid refrigerant and lubricant within said secondary expansion chamber; said separation means comprising a duct maintained in position to gather refrigerant deposited against the casing of the expansion chamber and conducting the same to a receiving chamber where said liquid refrigerant is centrifugally separated from said lubricant and returned to the expansion chamber for further expansion therein; fan blades provided on said rotatable expansion chamber casing, and a jacket for the same through which the circulation of air being cooled is maintained, said jacket partially inclosing said brine tank to chill air drawn into said jacket.

24. In a liquid refrigerant dispensing means, a casing having a diaphragm secured over one of its ends, and having a nozzle at its other end, a valve for controlling the discharge of liquid refrigerant through said nozzle, and means for actuating said valve; said valve actuating means including said diaphragm, a float, and a weight adapted to be centrifugally acted upon.

25. In a liquid refrigerant dispensing means, a casing having a diaphragm secured over one of its ends, and having a nozzle at its other end, a valve for controlling the discharge of liquid refrigerant through said nozzle, and means for actuating said valve; said valve actuating means including said diaphragm, a float, and a weight adapted to be centrifugally acted upon; there being means of operative connection between said weight and float and said valve.

26. In means for dispensing liquid refrigerant, a casing provided with a discharge duct, a valve to control said duct, and a baffle member arranged transversely of said casing whereby gaseous refrigerant is prevented from escaping through said duct when said casing is rotated about its axis.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

HOWARD H. CARPENTER.

Witnesses:

WADE H. MADREN,
CHARLOTTE LYON.