Dec. 23, 1930. T. M. GUNN 1,786,110

REFRIGERATING APPARATUS

Filed April 23, 1924

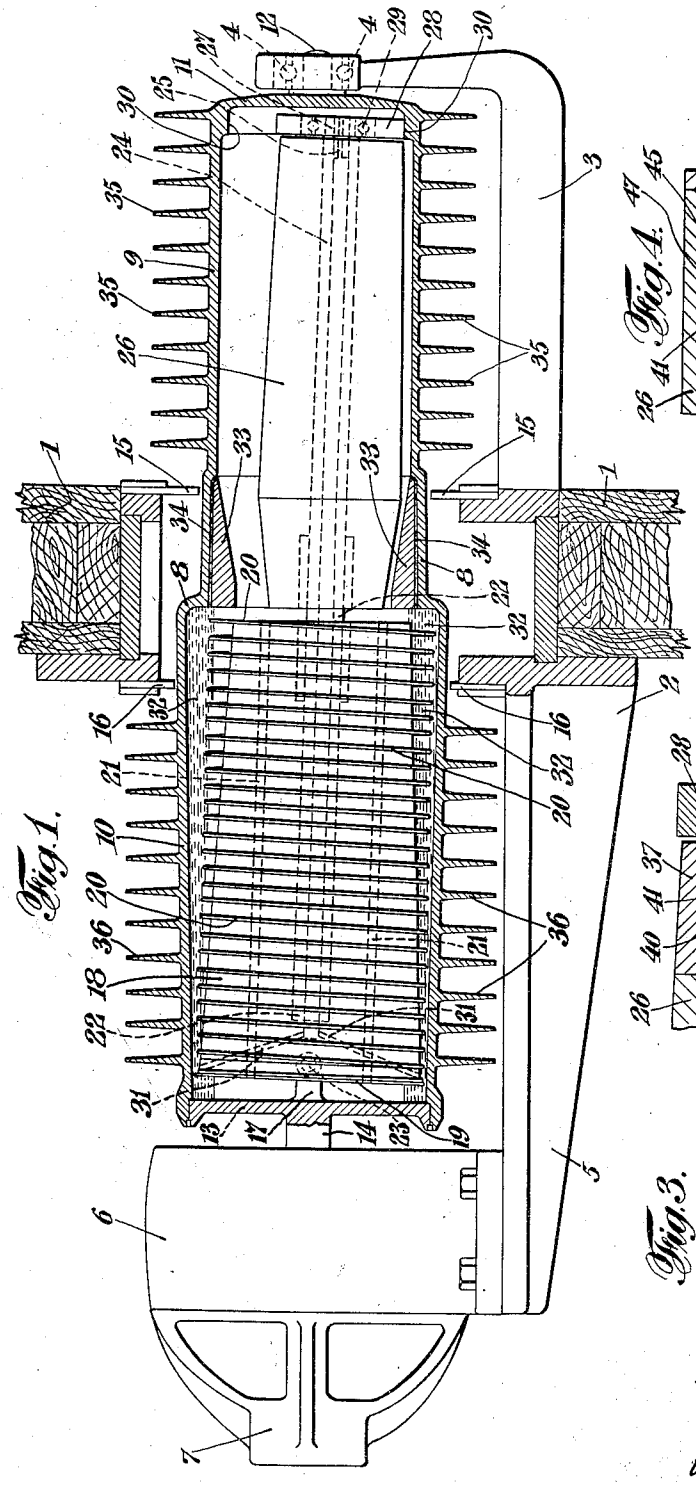


Fig. 1.

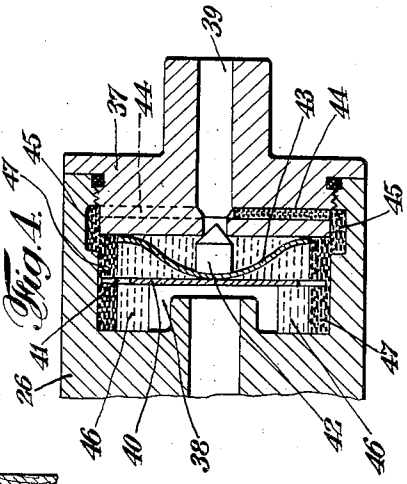


Fig. 4.

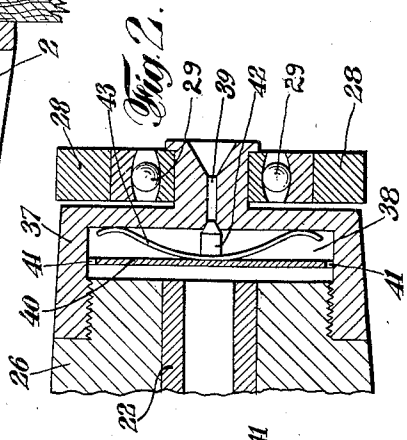


Fig. 2.

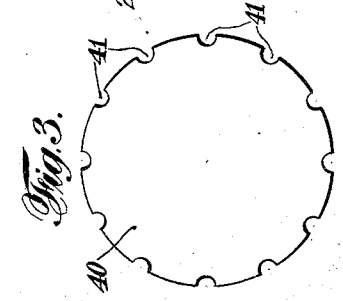


Fig. 3.

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UNITED STATES PATENT OFFICE

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REFRIGERATING APPARATUS

Application filed April 23, 1924. Serial No. 708,345.

My invention relates to improvements in refrigerating apparatus and while the same may be used for various sizes of plants, it is particularly adapted to small plants for domestic or household use. The main object of the invention is to provide an apparatus which is not only simple, efficient and economical in construction and operation, but one which is unlikely to get out of order, has few parts and is relatively compact. Further and more specific objects, features and advantages will more clearly appear from the detail description given below taken in connection with the accompanying sheet of drawings, which form a part of this specification.

In the drawings Fig. 1 is a vertical section through most of the parts of an apparatus embodying my invention in one form. Fig. 2 is a detail vertical section through the end of the expansion valve portion of the apparatus and illustrating a modified form. Fig. 3 is a face view of the plate shown in Fig. 2. Fig. 4 is a view similar to Fig. 2 and illustrating a still further modification.

Referring to Fig. 1, 1 represents an outer wall or partition of an "ice" box or refrigerator such as is commonly employed in household or domestic use. 2 represents a suitable frame having an arm 3 extending into the "ice" compartment of the ice box and provided with a ball bearing 4. 5 represents an arm on the frame extending outwardly from the ice box and having rigidly secured thereon an electric motor 6, the frame of which is provided with ball bearings in the frame at 7. It will be understood that the space at the left of the partition 1 as viewed in Fig. 1, is outside of the refrigerator while the space shown at the right of the partition 1 in Fig. 1 is within the ice compartment of the refrigerator.

8 represents a casing of general cylindrical shape. That is, it is provided with general cylindrical end portions at 9 and 10. At the end of portion 9 the casing is provided with an end 11 having an integral axle portion 12 extending therefrom, journaled in the ball bearing at 4. At the opposite end the casing is closed and sealed to the outside atmosphere by an end plate 13 which is provided with an integral axle portion 14, rigidly connected with the armature or rotor shaft of the electric motor so as to be driven thereby. In this way the rotary casing 8 is journaled at one end in ball bearings 4 and at the other end is rigidly connected to the armature or rotor of the electric motor 6 so that it is journaled at this end in the motor bearings in the frame of the motor at 7. It will be understood that the partition 1 of the ice box is apertured so that the casing may extend conveniently therethrough, suitable plates 15 and 16 being secured to the wall at the opening and apertured so as to receive the casing and just clear the same in order to prevent as much as possible the passage of air currents into and out of the ice compartment of the refrigerator from and to the outside atmosphere and the transfer of heat from one to the other, as much as possible.

On the inside, the end plate 13 of the casing is provided with an integral inwardly extending lug 17 and connected to this is a compressor member 18. The compressor member 18 comprises a frusto-conical body portion provided with a circular web or flange 19 on one end and a spiral web or flange 20 extending over the periphery of the member 18 substantially from the flange 19 to the opposite end of the member 18. 21 represents longitudinal holes through member 18 whereby the pressure at both ends thereof is equalized. 22 represents a tubular member on one end of which the member 18 is rigidly secured. At the left hand end as viewed in Fig. 1, the member 18 is suitably cut away and connected to the lug 17 by means of a gimbal joint 23. That is, at this point the member 18 is connected to the lug 17 by a universal joint, which permits the member 18 to be tilted in any direction in the casing 8, but which causes the member 18 to be positively driven and rotated with the casing 8 when the latter is rotated by the motor. The other end of the tubular member 22 extends well within the cylindrical end portion 9 of the casing as indicated at 24 and at this end is provided with a restricted opening at 25 leading into this part

of the casing. This restricted opening serves as an expansion valve as will be more clearly pointed out hereinafter. Rigidly secured on the portion 24 of the tubular member 22 is a weighty member 26 comprising two portions of general frustro-conical shape extending in opposite directions. The tubular member 22 at the outer end of the portion 24 thereof extends beyond the member 26 and is provided with a reduced portion 27. 28 represents a ring surrounding the end portion 27 and within the ring 28 and between it and the end portion 27 are arranged ball bearings 29. Ring portion 28 is adapted to roll upon a circular surface 30 on the inside of the end 9.

That is, when the motor 6 rotates the casing 8 about its axis which passes substantially centrally therethrough and through both end portions thereof, the member 18 is also rotated in the same direction and at the same speed, but on an axis slightly displaced and inclined with respect to the axis of rotation of the casing 8, the weight 26 acting by gravity to hold the roller ring 28 down on the surface 30. The members 18 and 26 are suitably apertured to receive the tubular member 22 and the member 18 is also provided with drill holes at 31 leading from the periphery of the member 18 at the left hand end thereof as viewed in Fig. 1, to the central aperture in the member 18 whereby a passageway is provided from the periphery of the member 18 adjacent the first turn of the web 20 to the inside of the tubular member 22. The web 20 serves to form a spiral groove on the periphery of the member 18 and these passageways 31 lead from the first turn of said groove into the tubular member 22.

There is provided in the end portion 10 of the casing a body of liquid 32. This liquid should be of greater specific gravity than that of the refrigerating medium. Any suitable compound may be used as refrigerating medium such as butane, ethyl chloride, sulphur dioxide, methyl chloride, propane or ammonia, etc., and I prefer to use mercury for the body of the liquid 32 although in some cases other liquids may be used. The depth of the web 20 varies so that the spiral groove formed thereby is of varying depth, being deepest at the right hand end of the member 18 as viewed in Fig. 1. Inside of the casing 8 between the two end portions thereof, there is provided an inwardly extending wall or ring-like projection 33. This may be made of bakelite or any suitable material which is a relatively poor heat conductor and is rigidly secured to the casing in the position shown. There is, however, provided between the ring member 33 and casing 8 a series of small passageways 34. These are in the nature of small holes leading from one end portion to the other end portion of the casing and between the ring member 33 and the casing 8.

In operation, when the motor rotates the casing and the parts within the same, at the proper speed, mercury or other liquid 32, is, by centrifugal action forced to lie against the inside periphery of the cylindrical end portion 10, and tend to form a cylindrical core space through the liquid. That is, the liquid will fly to the outside of the casing in the end portion 10 and the liquid is of such volume that a core space is formed centrally therethrough and the member 20 rotates within this core space but on an axis slightly displaced from that of the casing 8 and liquid 32. Both axes, however, pass substantially through this core space. The liquid is of such volume that when so operating, the spiral web 20 will at substantially all portions thereof dip into the face of the liquid at said core space, but on one side of the apparatus the spiral groove is completely filled with the mercury or liquid 32 while on the opposite side, the upper side, the liquid 32 only extends a short distance into the spiral groove. The casing and all parts contained therein, including liquid 32 rotate in the same direction and at substantially the same speed. When operating, the refrigerating medium with which the casing is suitably charged is drawn into the upper part of the spiral groove formed by the spiral web 20 at the right hand end of the member 18, as viewed in Fig. 1. Thus the refrigerating medium is collected in crescent shaped portions of the spiral groove and as the apparatus is rotated, these portions of the refrigerating medium are forced along the spiral groove toward the opposite or left hand end of the member 18 as viewed in Fig. 1. The depth or cross sectional area of the spiral groove gradually decreases so that the refrigerating medium is compressed against the core space surface of the liquid 32. This compression of the refrigerating medium continues until the refrigerating medium in compressed condition, reaches the last turn of the spiral groove whereupon the compressed refrigerating medium will pass through the holes 31 and into the tubular member 22, which provides a passageway for the compressed refrigerating medium to the restricted expansion opening at 25. The refrigerating medium is not only thus compressed but is cooled by its contact with the working liquid and may be condensed to a liquid depending upon the refrigerating medium used and pressure and temperature conditions, etc. The refrigerating medium passes through the expansion opening at 25 into the end portion or refrigerating part of the casing 9 and is permitted to expand therein absorbing heat from the "ice" compartment of the refrigerator. The expanded refrigerating medium then passes back towards the compressor

member 18, suitable passageway being provided between the member 33 and around the member 26 therefor.

The casing 8 on both its ends 9 and 10 which are fixed with respect to one another to form a unitary casing is provided with integral circular projections or webs 35 and 36, which serve to aid in causing the refrigerating part 9 of the apparatus to absorb heat from the "ice" compartment and to transfer heat from the compressor compartment 10 to the outside atmosphere whereby the walls of the compressor part are cooled so that the refrigerating medium is condensed by cooling as it is compressed by reason of the cooling action transmitted from said walls through the liquid 32.

As shown in Fig. 2 the end of the weighty member 26 has a cap 37 screwed thereon providing a circular space 38 between the cap member 37 and the end of the member 26. The cap member 37 is provided with an expansion opening 39 therethrough leading from the space 38 to the space in the chamber 9. The cap 37 is provided with a suitable extension on which are arranged the ball bearings 29 and ring 28. Within the circular space 38 is arranged a disk 40 provided with cut out or notched portions around its periphery at 41. The plate 40 has secured thereto a valve member 42 adapted to close the expansion opening 39 under certain conditions. A leaf spring 43 tends to force the disk 40 and valve 42 to the left as viewed in Fig. 2 so as to open the opening 39.

In operation when the refrigerating medium is compressed in the compressor end of the apparatus and delivered through the passageway in the hollow tube 22, it is usually comprised partly of liquid and partly of vapor. When thus starting up the spring 43 will force the plate and valve 42 to the left as viewed in Fig. 2, and some vapor will pass readily through the notched openings 41 around the spring 43 and out through the expansion opening 39. The pressure will soon build up to such an extent, however, as to overcome the spring and close the valve thereby causing an increase in pressure which will cause a greater amount of the refrigerating medium to be liquefied. The liquid refrigerant will collect in the space 38 until the pressure on both sides of the disk 40 is equalized whereupon the spring 43 will open the valve 42 and permit the liquefied refrigerant to pass out through the expansion opening 39. Sufficient of the liquid refrigerant, however, will during normal operation, always be retained at the periphery of the space 38 to seal the notched openings 41 against the passage therethrough of any refrigerant in vaporized form, so that in normal operation the refrigerant may be delivered into the refrigerating part of the apparatus in liquid form thereby obtaining great efficiency.

Referring to Fig. 4 substantially the same arrangement is shown as in Fig. 2, except that the cap member 37 is of somewhat different shape and is drilled with radial holes 44 and the end of the member 26 is suitably recessed to provide passageway 45 from the circular space 38 to the outer ends of the holes 44. The holes 44 enter the opening 39.

Should any of the mercury 32 get into the hollow tube 22 as when the apparatus is stopped or when it is tilted for any reason in handling, such mercury will run into the space 38 and upon operation of the machine, will be thrown to the periphery thereof. Then when compression starts the pressure exerted in the tube 22 will cause the mercury to be gradually forced inwardly toward the axis of the members 18 and 26 through the drill holes 44 and out through the opening 39 into the chamber 9. This will occur until the inner surface of the mercury in the chamber 38 is such that more or less of the notched openings 41 are uncovered whereupon the refrigerating liquid indicated at 46 therein will be forced through the notched openings 41 and the valve 42 will be opened and the refrigerating medium expelled through the expansion opening 39 as before. Any mercury or liquid 32 which may thus or otherwise get into the chamber 9, will during operation flow back into the chamber 10 through the small holes or passageways 34.

It will be seen from the above that the quantity of refrigerant in the machine is relatively very small, which in addition to other features makes for safety. No leakage is possible since the refrigerant is sealed within a strong metal casing of simple form. No parts relatively movable to the casing pass therethrough from the inside to the outside, such as relatively rotating shafts, around which refrigerating medium or liquid might escape, and all friction or leakage which might accompany such parts as is usual in stuffing boxes, is avoided. Mechanical friction is practically eliminated being reduced to that experienced in the roller bearings. There is no speed reduction to produce mechanical loss as the electric motor may be directly connected to the machine and no eccentrics or pistons are necessary. Fluid friction is reduced to an extremely small amount since the rotating parts all rotate in the same direction at substantially the same speed and the liquid or mercury 32 rotates therewith at substantially the same speed. That is, although the speed or rotation is high all solid and liquid parts are revolving in the same direction at substantially the same speed, the mercury having only slight, relative motion with respect to the rotating parts. The air friction on the outside is reduced to a minimum because of the general cylindrical arrangement of the casing and the power required to overcome this is no more than that

of the ordinary electric fan for the cooling of the condenser in many air cooled domestic refrigerating machines. Heat transmission to the refrigerating chamber 9 and from the compressor chamber 10 is accelerated because of the rapid rotation of the outer surfaces of these chambers in the surrounding air. The rapid heat transmission results in small temperature difference and therefore, high cycle efficiency. The complete apparatus is a unit in itself and all outside piping valves, and leaky joints are done away with. If used with a thermostat the apparatus becomes automatic and if hand controlled, the control need be only a single small lever to start and stop the apparatus. The apparatus is extremely small in size relative to its capacity and is easily applied to common forms of refrigerators. The simplicity of the apparatus and the elimination of the mechanical friction enormously increases the wearing qualities of the apparatus and there is practically nothing that requires frequent attention during operation. The power requirements for a given capacity are far below that of other machines and in view of its simplicity, the cost of manufacture is extremely small.

While I have described my improvements in great detail and with respect to a preferred form thereof, I do not desire to be limited to such details or forms since many changes and modifications may be made and the invention embodied in widely different forms without departing from the spirit and scope thereof in its broader aspects. Hence I desire to cover all modifications and forms coming within the language or scope of any one or more of the appended claims.

What I claim as new and desire to secure by Letters Patent, is:

1. Refrigerating apparatus having in combination a rotary casing in one part of which a refrigerating medium is compressed and in another part of which the refrigerating medium is permitted to expand to effect refrigeration, said casing being sealed to the outside atmosphere but having communication between its said parts for the refrigerating medium, a body of liquid in the compressor part, said liquid lying against the outer walls of said compressor part, said walls being fixed with respect to the refrigerating part, a rotary compressor member in the compressor part cooperating with said liquid to compress the refrigerating medium, the axis of said compressor member being slightly displaced from the axis of said rotating casing.

2. Refrigerating apparatus having in combination a rotary casing in one part of which a refrigerating medium is compressed and in another part of which the refrigerating medium is permitted to expand to effect refrigeration, said casing being sealed to the outside atmosphere but having communication between its said parts for the refrigerating medium, a body of liquid in the compressor part, a rotary compressor member in the compressor part cooperating with said liquid to compress the refrigerating medium, said compressor member having compressing means extending into the liquid in the compressor part while said liquid is lying against the walls thereof, said walls being fixed with respect to the refrigerating part, and said compressor member having a part extending into the refrigerating part for conducting the refrigerating medium between the compressor end and the refrigerating end of the casing.

3. Refrigerating apparatus having in combination a rotary casing in one part of which a refrigerating medium is compressed and in another part of which the refrigerating medium is permitted to expand to effect refrigeration, said casing being sealed to the outside atmosphere but having communication between its said parts for the refrigerating medium, a body of liquid in the compressor part, a rotary compressor member in the compressor part cooperating with said liquid to compress the refrigerating medium, the axis of said compressor member being displaced from the axis of rotation of the casing.

4. Refrigerating apparatus having in combination a rotary casing in one part of which a refrigerating medium is compressed and in another part of which the refrigerating medium is permitted to expand to effect refrigeration, said casing being sealed to the outside atmosphere but having communication between its said parts for the refrigerating medium, a body of liquid in the compressor part, a rotary compressor member in the compressor part cooperating with said liquid to compress the refrigerating medium, said compressor member having a part rotating therewith extending into the refrigerating part of the casing and means thereon for maintaining the axis of the compressor member slightly displaced from the axis of the casing.

5. Refrigerating apparatus having in combination a rotary casing in one part of which a refrigerating medium is compressed and in another part of which the refrigerating medium is permitted to expand to effect refrigeration, said casing being sealed to the outside atmosphere but having communication between its said parts for the refrigerating medium, a body of liquid in the compressor part, said liquid being of greater specific gravity than the vapor of the refrigerating medium, a rotary compressor member in the compressor part cooperating with said liquid to compress the refrigerating medium, said compressor member having a part rotating therewith extending into the refrigerating part of the casing, said part being weighted and having a roller bearing cooperating with

part of the refrigerating part to maintain the axis of the compressor member slightly displaced from the axis of the casing.

6. Refrigerating apparatus having in combination a rotary casing in one part of which a refrigerating medium is compressed and in another part of which the refrigerating medium is permitted to expand to effect refrigeration, said casing being sealed to the outside atmosphere and free of relatively moving parts passing through the casing from the inside to the outside thereof, a body of liquid in the compressor part, and rotating with the casing, the axis of the casing being such as to cause the liquid to lie against the inside of the periphery thereof by centrifugal action, and tend to form a cylindrical core space through the body of liquid, and a compressor member in the compressor part cooperating with said liquid to compress the refrigerating medium, and means whereby said compressor member is rotated about an axis slightly displaced from the axis of said casing.

7. Refrigerating apparatus having in combination a rotary casing in one part of which a refrigerating medium is compressed and in another part of which the refrigerating medium is permitted to expand to effect refrigeration, said casing being sealed to the outside atmosphere and free of relatively moving parts passing through the casing from the inside to the outside thereof, a body of liquid in the compressor part, said liquid being of greater specific gravity than the vapor of the refrigerating medium and rotating with the casing, the axis of the casing being such as to cause the liquid to lie against the inside of the periphery thereof by centrifugal action, and tend to form a cylindrical core space through the body of liquid, and a compressor member in the compressor part cooperating with said liquid to compress the refrigerating medium, said compressor member being connected to the casing by a universal joint permitting the axis of the compressor member to be displaced with respect to the axis of the casing but causing the compressor member to rotate with the casing and at the same speed.

8. Refrigerating apparatus having in combination a rotary casing in one part of which a refrigerating medium is compressed and in another part of which the refrigerating medium is permitted to expand to effect refrigeration, said casing being sealed to the outside atmosphere and free of relatively moving parts passing through the casing from the inside to the outside thereof, a body of liquid in the compressor part, said liquid being of greater specific gravity than the vapor of the refrigerating medium and rotating with the casing, the axis of the casing being such as to cause the liquid to lie against the inside of the periphery thereof by centrifugal action, and tend to form a cylindrical core space through the body of liquid, and a compressor member in the compressor part cooperating with said liquid to compress the refrigerating medium, said compressor member being connected to the casing by a universal joint permitting the axis of the compressor member to be displaced with respect to the axis of the casing but causing the compressor member to rotate with the casing and at the same speed, and said compressor member having a part extending well into the refrigerating part of the casing for conveying the refrigerating medium from the compressor end into the refrigerating part of the casing.

9. Refrigerating apparatus having in combination, a rotary casing in one part of which a refrigerating medium is compressed and in another part of which the refrigerating medium is permitted to expand to effect refrigeration, said casing being sealed to the outside atmosphere and free of relatively moving parts passing through the casing from the inside to the outside thereof, a body of liquid in the compressor part, and rotating with the casing, the axis of the casing being such as to cause the liquid to lie against the inside of the periphery thereof by centrifugal action, and tend to form a cylindrical core space through the body of liquid, and a compressor member in the compressor part cooperating with said liquid to compress the refrigerating medium, and the compressor member while rotating, being relatively movable with respect to the casing and so weighted that gravity causes its axis to be slightly displaced with respect to the axis of the casing.

10. Refrigerating apparatus having in combination a rotating casing in one part of which a refrigerating medium is adapted to be compressed and in another part of which the refrigerating medium is expanded to effect refrigeration, a body of liquid maintained in the compressor part and rotating therewith so as to lie against the inside of the periphery thereof by centrifugal action and thereby form a core space through the body of liquid, and a compressor member in the compressor part and cooperating with said liquid therein to compress the refrigerating medium, a passageway being provided for conducting the refrigerating medium from the compressor part to the refrigerating part of the casing, and a passageway being provided for conducting the refrigerating medium from the refrigerating part to the compressor part of the casing and a passageway being provided for the return to the compressor part of portions of said liquid which may get into the refrigerating part of the casing.

11. Refrigerating apparatus having in combination a rotating unitary casing in one

part of which a refrigerating medium is adapted to be compressed and in another part of which the refrigerating medium is expanded to effect refrigeration, said parts being fixed with respect to one another, a body of liquid maintained in the compressor part and rotating therewith so as to lie against the inside of the periphery thereof by centrifugal action and thereby form a core space through the body of liquid, and a compressor member in the compressor part and cooperating with said liquid therein to compress the refrigerating medium, a passageway being provided for conducting the refrigerating medium from the compressor part to the refrigerating part of the casing and a passageway being provided for conducting the refrigerating medium from the refrigerating part to the compressor part of the casing.

12. Refrigerating apparatus having in combination a rotating casing in one part of which a refrigerating medium is adapted to be compressed and in another part of which the refrigerating medium is expanded to effect refrigeration, said parts being fixed with respect to one another, a body of liquid maintained in the compressor part and rotating therewith so as to lie against the inside of the periphery thereof by centrifugal action and thereby form a core space through the body of liquid, and a compressor member in the compressor part and cooperating with said liquid therein to compress the refrigerating medium, a passageway being provided for conducting the refrigerating medium from the compressor part to the refrigerating part of the casing, and a passageway being provided for conducting the refrigerating medium from the refrigerating part to the compressor part of the casing, and said casing being substantially circular in cross section with the refrigerating part smaller in diameter than the compressor part thereof.

13. Refrigerating apparatus having in combination a rotating casing in one part of which a refrigerating medium is adapted to be compressed and in another part of which the refrigerating medium is expanded to effect refrigeration, said parts being fixed with respect to one another, a body of liquid maintained in the compressor part and rotating therewith so as to lie against the inside of the periphery thereof by centrifugal action and thereby form a core space through the body of liquid, and a compressor member in the compressor part and cooperating with said liquid therein to compress the refrigerating medium, a passageway being provided for conducting the refrigerating medium from the compressor part to the refrigerating part of the casing, and a passageway being provided for conducting the refrigerating medium from the refrigerating part to the compressor part of the casing, and the casing at a point between said parts having a circular projection extending inwardly to maintain said refrigerating medium, while in liquid condition, in the refrigerating part of the casing during operation.

14. Refrigerating apparatus having in combination a rotary casing in one part of which a refrigerating medium is compressed and in another part of which the refrigerating medium is permitted to expand to effect refrigeration, said parts being fixed with respect to one another, said casing being sealed to the outside atmosphere and free of relatively moving parts passing through the casing from the inside to the outside thereof, a body of liquid in the compressor part, and rotating with the casing, the axis of the casing being such as to cause the liquid to lie against the inside of the periphery thereof by centrifugal action, and tend to form a cylindrical core space through the body of liquid, and a compressor member in the compressor part cooperating with said liquid to compress the refrigerating medium, said compressor member rotating about an axis passing through said core space in the same general direction as the axis of the casing.

15. In refrigerating apparatus, a valve of the type adapted to permit the passage therethrough of liquid refrigerant but preventing the passage therethrough of gaseous or vaporous refrigerant during normal operation, said valve having operating means comprising a rotating casing, liquid therein rotating with the casing so as to cause the liquid to lie against the inside of the periphery thereof by centrifugal action, and tend to form a cylindrical core space through the body of liquid, and a disk so placed as to form a seal around its periphery with the rotating liquid thus intercepting the flow of gaseous refrigerant through said core space, and operative connection whereby movements of said disk may open or close said valve.

16. Refrigerating apparatus having in combination a rotating casing in one part of which a refrigerating medium is adapted to be compressed and in another part of which the refrigerating medium is expanded to effect refrigeration, a body of liquid maintained in the compressor part and rotating therewith so as to lie against the inside of the periphery thereof by centrifugal action and thereby form a core space through the body of liquid, a compressor member rotating in said core space and cooperating with said liquid to compress the refrigerating medium, means providing a passageway leading from said compressor member into the refrigerating part of the casing, and an expansion valve located in said passageway, said valve having means permitting the flow of liquid refrigerant from the compressor part into the refrigerating part to expand

therein, but preventing the passage therethrough of gaseous or vaporous refrigerant during normal operation.

17. Refrigerating apparatus having in combination a part in which a refrigerating medium is compressed, a part in which the refrigerating medium is permitted to expand to effect refrigeration, means in the compressor part for compressing the refrigerating medium, a passageway being provided for conducting the refrigerating medium from the compressor part to the refrigerating part, and an expansion valve located in said passageway, said valve having means permitting the flow of liquid refrigerant from the compressor part into the refrigerating part to expand therein, but preventing the passage therethrough of gaseous or vaporous refrigerant during normal operation, and a by-pass around said valve, said by-pass being adapted to permit the passage therethrough of a liquid other than the refrigerating medium, should such liquid get into said passageway, but to retain a small part of said liquid in said bypass as a seal.

18. Refrigerating apparatus having in combination a rotating casing in one part of which a refrigerating medium is adapted to be compressed and in another part of which the refrigerating medium is expanded to effect refrigeration, a body of liquid maintained in the compressor part and rotating therewith so as to lie against the inside of the periphery thereof by centrifugal action and thereby form a core space through the body of liquid, a compressor member rotating in said core space and cooperating with said liquid to compress the refrigerating medium, means providing a passageway leading from said compressor member into the refrigerating part of the casing, and an expansion valve located in said passageway, said valve having means permitting the flow of liquid refrigerant from the compressor part into the refrigerating part to expand therein, but preventing the passage therethrough of gaseous or vaporous refrigerant during normal operation, and a by-pass around said valve, said by-pass being adapted to collect portions of said first liquid which may get into said passageway and eject all but a small part of said liquid to be returned to the compressor part, a sufficient amount of said liquid being retained in the by-pass to seal the same.

19. Refrigerating apparatus having in combination a suitable frame, two bearings supported thereby, a casing journaled in said bearings, a motor the rotating part of which is rigidly connected to said casing to rotate the casing, said casing being sealed to the outside atmosphere and free of relatively movable parts passing therethrough from the inside to the outside thereof, a body of liquid in one part of the casing and means therein cooperating with said liquid as it lies against the periphery of the casing to compress a refrigerating medium, a passageway being provided for conducting the refrigerating medium into another part of the casing where it effects refrigeration, said last mentioned part of the casing being fixed with respect to said first mentioned part of the casing.

20. Refrigerating apparatus, having, in combination, a rotating casing, in one part of which a refrigerating medium is compressed and condensed by cooling and in another part of which the liquid refrigerating medium is vaporized to effect refrigeration, a body of liquid maintained in the compressor part and rotating therewith so as to lie against the outer walls of the compressor part of the casing by centrifugal action, thereby forming a core space through the body of liquid, and a compressor member cooperating with said liquid to compress refrigerating medium, said walls being arranged to be cooled whereby the refrigerating medium is condensed by cooling as it is compressed by reason of the cooling action transmitted from said walls through said liquid.

21. Refrigerating apparatus having in combination, a rotary unitary casing of general cylindrical shape at both ends, in one end of which a refrigerating medium is adapted to be compressed and to the other end of which the refrigerating medium is conducted to effect refrigeration, said casing being sealed to the outside atmosphere and free of relatively movable parts passing therethrough from the inside to the outside thereof, a body of liquid in the compressor end, and lying against the outer walls thereof, and means cooperating with said liquid to compress the refrigerating medium, the axis of rotation of said casing passing substantially centrally through both substantially cylindrical ends thereof.

In testimony whereof I have signed my name to this specification.

THOMAS M. GUNN.