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1,520,248

C. H. JACOBSEN ET AL

REFRIGERATOR UNIT FOR DOMESTIC REFRIGERATORS

Filed June 23, 1920

5 Sheets-Sheet 1

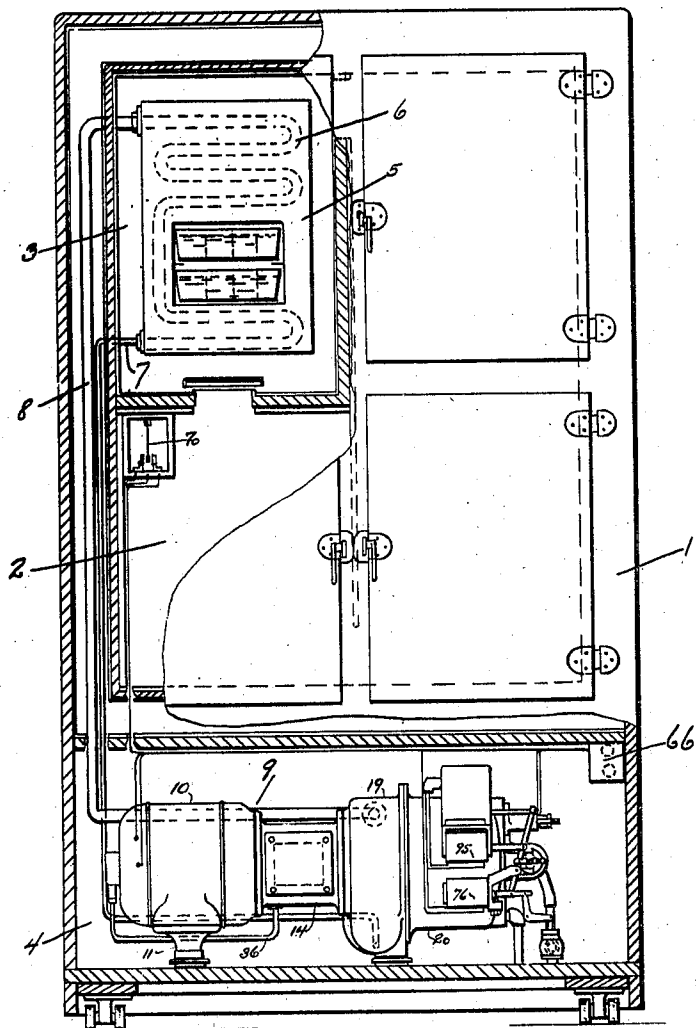


Fig-1

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5 Sheets-Sheet 2

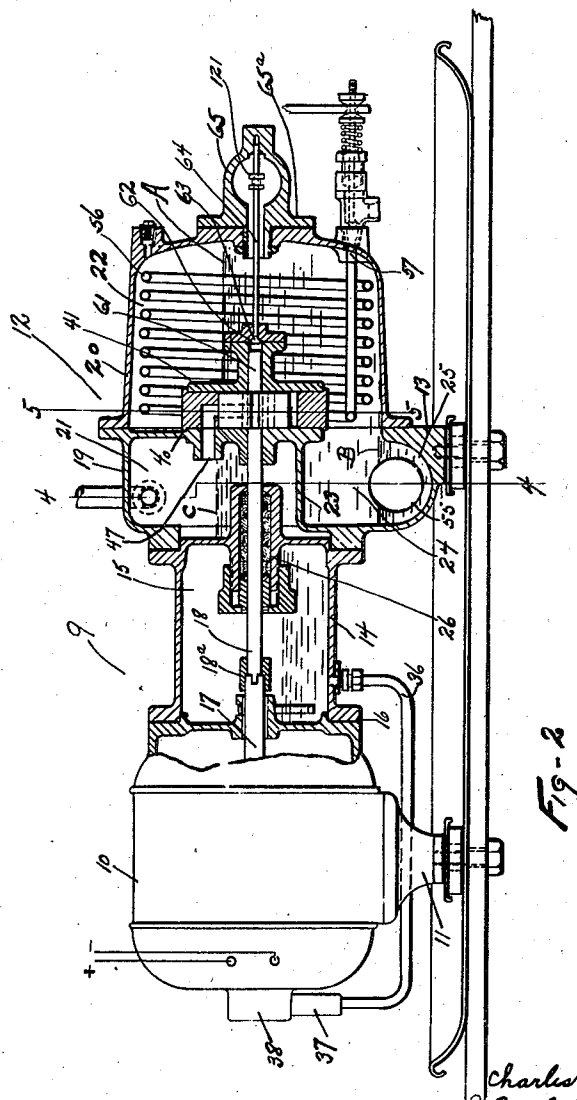


Fig. 2

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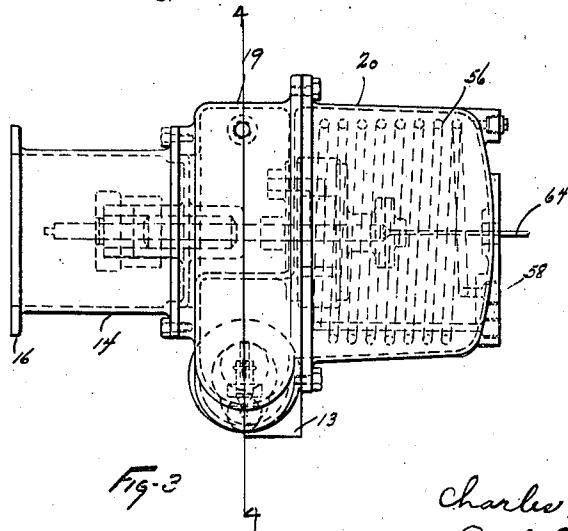
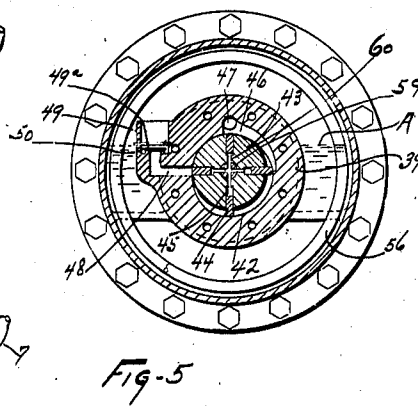
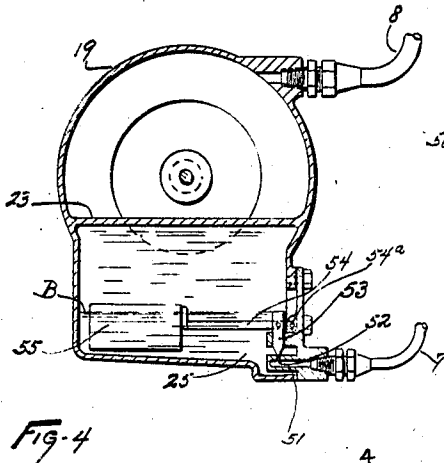
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REFRIGERATOR UNIT FOR DOMESTIC REFRIGERATORS

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5 Sheets-Sheet 3



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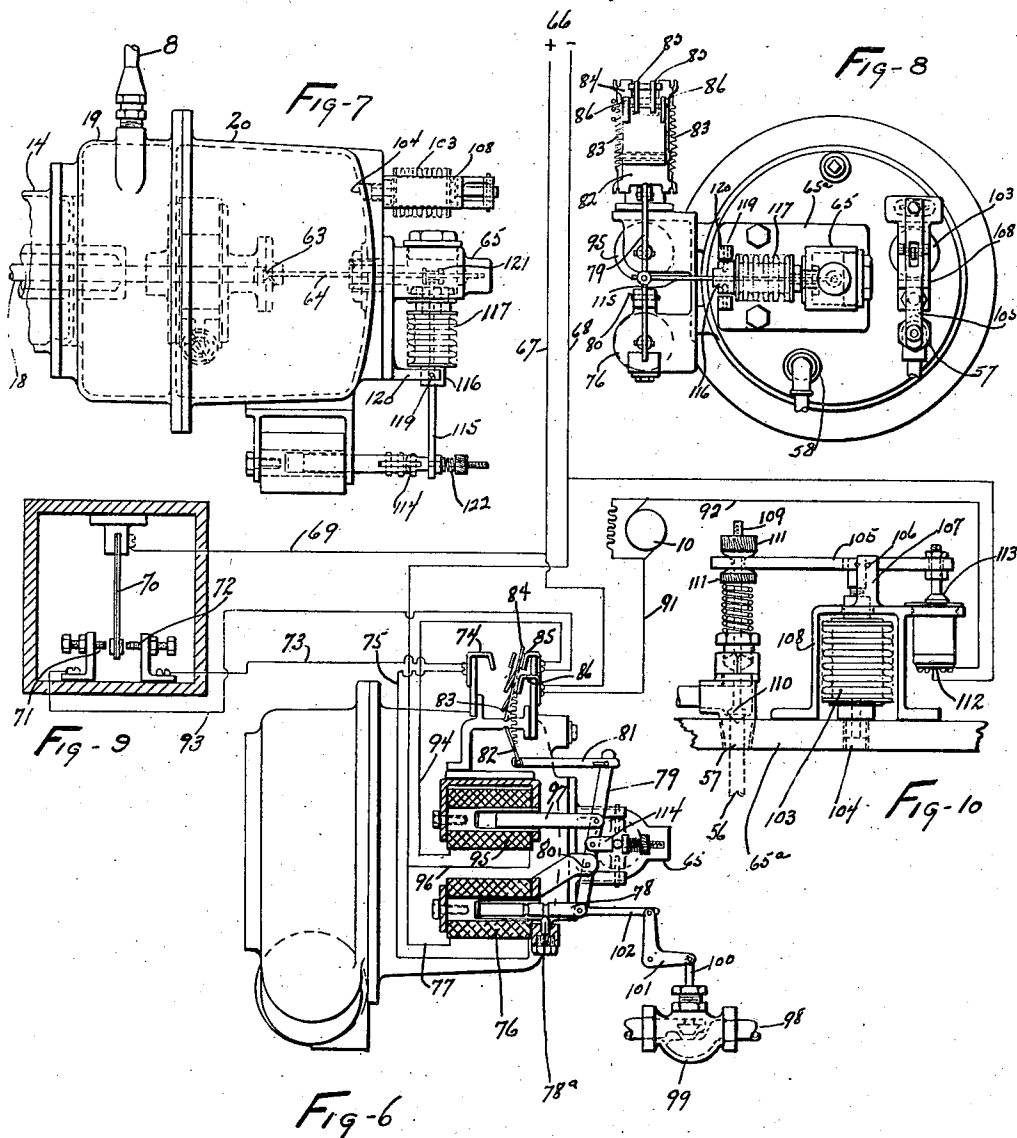
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REFRIGERATOR UNIT FOR DOMESTIC REFRIGERATORS

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5 Sheets-Sheet 4



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REFRIGERATOR UNIT FOR DOMESTIC REFRIGERATORS

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5 Sheets-Sheet 5

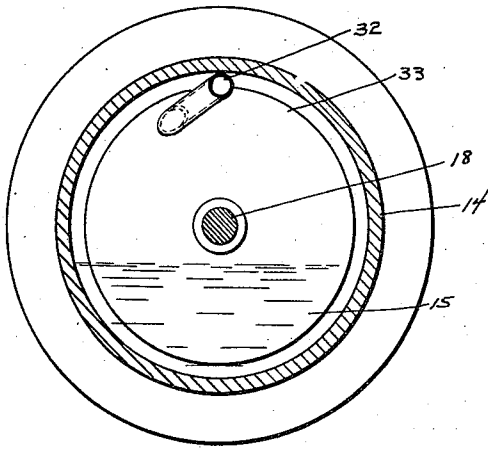


Fig-12

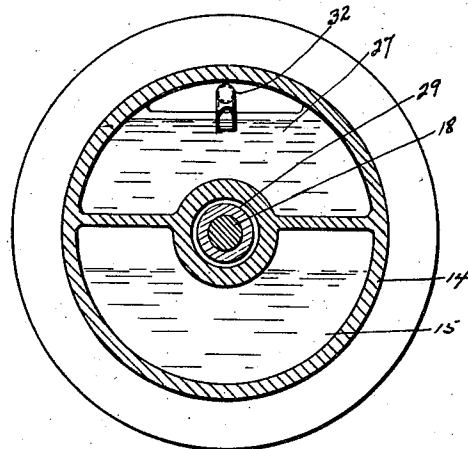


Fig-13

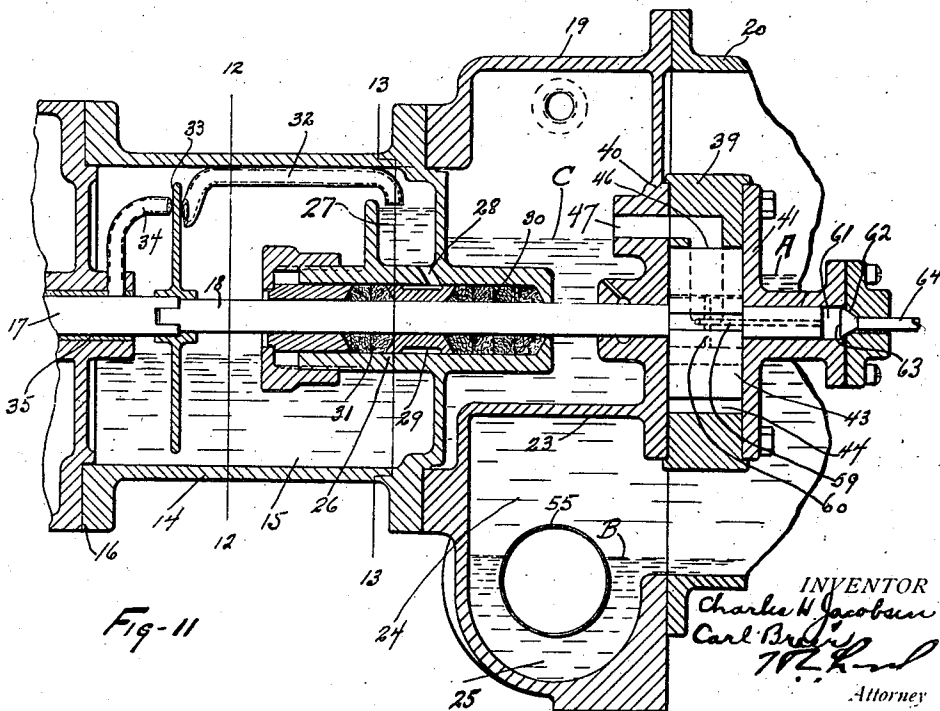


Fig-11

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UNITED STATES PATENT OFFICE.

CHARLES H. JACOBSEN AND CARL BREER, OF DETROIT, MICHIGAN.

REFRIGERATOR UNIT FOR DOMESTIC REFRIGERATORS.

Application filed June 23, 1920. Serial No. 391,135.

To all whom it may concern:

Be it known that we, CHARLES H. JACOBSEN and CARL BREER, citizens of the United States, and residing at Detroit, in the county of Wayne and State of Michigan, have invented new and useful Improvements in a Refrigerator Unit for Domestic Refrigerators, of which the following is a specification.

The invention is particularly designed as a refrigerator unit for domestic refrigerators. Such units ordinarily involve the motor, compressor or pump, expansion chamber and a thermally sensitive control. These elements are comprised in the present invention. It is very desirable in such a device that the compressor or pump operate noiselessly and with this in view a rotary pump is used. Difficulty is experienced in providing against leakage in such a pump and in the present invention this is accomplished by utilizing an oil seal which supplies oil in sufficient quantities to prevent such leakage.

The invention also involves an efficient and simplified control for the unit, also the structural arrangement of the unit, details as to lubrication and other features as will be more fully described in the specification.

The invention is illustrated in the accompanying drawings as follows:—

Fig. 1 shows a front elevation of a refrigerator, a part being broken away to disclose the elements of the refrigerator unit.

Fig. 2 a front elevation of the motor and compressor, a part being in section to better show construction.

Fig. 3 a side elevation of the pump.

Fig. 4 a section on the line 4—4 in Figs. 2 and 3.

Fig. 5 a section on the line 5—5 in Fig. 2.

Fig. 6 a view of the controlling switches and immediate parts.

Fig. 7 a side elevation of the pump showing the mounting of the controlling devices thereon.

Fig. 8 an end elevation of the same parts.

Fig. 9 a section of the thermally sensitive controlling switch.

Fig. 10 an elevation of a controlling mechanism sensitive to heat and pressure in the high pressure chamber of the pump.

Fig. 11 an enlarged section of the connect-

ing devices between the motor and the pump. 55

Fig. 12 a section on the line 12—12 in Fig. 11.

Fig. 13 a section on the line 13—13 in Fig. 11.

1 marks the refrigerator. It has the food compartment 2, the expansion chamber compartment 3, and the refrigerator unit compartment 4. These may be arranged in any convenient manner but the arrangement shown is the ordinary one. A brine tank 5 65 is arranged in the expansion chamber and an expansion coil 6 is arranged in this tank. A refrigerant ordinarily SO_2 is delivered to the expansion chamber through the pipe 7 leading from the compressor unit 9 and the 70 expanded gases are returned through the pipe 8.

The compressor unit comprises a motor 10 which is mounted on a base 11 and a pump 12 which is mounted on a base 13. These 75 are united by a connecting case 14 forming an intermediate lubricating chamber 15. The case 14 is secured to the motor by a flange construction 16. A motor shaft 17 drives a pump shaft 18 through a clutch 18^a. 80 The pump chamber comprises the cases 19 and 20 in which are arranged the low pressure chamber 21 and high pressure chamber 22 respectively. A diaphragm 23 extends across the case 19 so that the high pressure 85 chamber is carried into the lower part 24 of the case 19 forming a settling chamber 25 into which the refrigerant is carried by gravity, the refrigerant being ordinarily heavier than the lubricant, and the lubricant 90 being maintained in the high pressure chamber at A and the refrigerant at B on a line approximating the line indicated at B.

One of the difficulties experienced in a 95 structure of this kind is to provide efficient packing insulating chambers one from another that the unit may run for long periods without attention. The shaft 18 extends through a stuffing box 26, the details of 100 which are shown in Fig. 11. A pocket 27 is arranged above the stuffing box to which the lubricant is delivered and it passes from this through an opening 28 into a distributor 29 within the stuffing box. From 105 the distributor it passes to the packing 30 and 31 arranged in the stuffing box. The lubricating oil is normally maintained in

the low pressure chamber of the pump at a level C which is above the stuffing box. By flooding the material in the stuffing box with a lubricating oil the stuffing box is effectually sealed against leakage to or from the low pressure chamber.

An efficient means of delivering lubricant to the pocket 27 is provided by the following devices: A pipe 32 leads to the pocket 27. 10 The end of the pipe is adjacent to a disc 33. The disc 33 runs in a lubricant which is carried in the lower part of the chamber 15 and picks up this lubricant which is taken off by the end of the pipe 32 and through its 15 impact is carried through the pipe 32 so as to maintain a supply of lubricant in the pocket 27. The same disc 33 is utilized for lubricating the bearing 35 of the shaft 17. A pipe 34 operates on the disc 33 opposite 20 the pipe 32 and takes the lubricant from the disc and carries it to the bearing 35. The lubricant is also carried from the chamber 15 by a pipe 36 to a lubricating well 37 arranged to furnish lubricant to the outer 25 bearing 38 of the motor 10. A pump chamber 39 is arranged between the wall 40 of the case 19 and the cover plate 41. The chamber has its walls 42 formed practically cylindrical in shape but eccentric to the 30 rotor shaft 18. A rotor 43 is mounted on the shaft 18 and has the pump blades 44 which are carried in the radial slots 45. These blades are free to move radially in the slots 45 so as to follow the wall 42 of 35 the chamber 39, pressure contact being maintained for the most part by centrifugal force. An inlet passage 46 leads to the chamber, the passage 46 leading from a port 47 extending in an axial direction into the low pressure 40 chamber 21. The chamber has a discharge port 48 which is controlled by a check 49. The check 49 leads to a seal passage 49^a which extends upwardly to a point above the level of lubricant at A in the high 45 pressure chamber. It is desirable to have a liquid or oil seal for the discharge valve 49 and a minute opening 50 is provided in the walls of the passage 49^a so that when the pump stops lubricant enters through this 50 opening to the passage 49^a and covers the valve 49, thus affording a liquid seal. When the pump is in action the lubricant is discharged from the passage 49^a and the return flow of liquid through the opening 50 is so 55 slight as to disturb but little the free discharge from the passage. This arrangement is desirable in that where the discharge is directly into the lubricant foaming ensues.

The refrigerant as it is condensed being 60 heavier than the lubricant settles in the chamber 25. The pipe 7 leads from the discharge fitting 51 at the bottom of the chamber 25. The fitting has a valve-controlled opening 52 on which a needle valve 53 operates. The needle valve is carried by

a lever 54 which is pivoted on the fitting at 54^a. A float 55 is secured to the lever and controls the needle valve so as to maintain a level of refrigerant approximately at the level B. When the refrigerant accumulates above this, the needle valve opens 70 and permits refrigerant to discharge through the pipe 7 to the expansion chamber from which it is returned to the low pressure chamber by the pipe 8. A cooling coil 56 is 75 arranged in the high pressure chamber. It has an inlet 57 and an outlet, or discharge opening 58.

The rotary pump is a very desirable one 80 both from simplicity of construction and from its noiseless operation but difficulty is experienced in so sealing the blades so as to prevent leakage. This is very largely accomplished in this case by a flooding of the 85 blades with lubricant which forms a seal. If desired the blade and surfaces which are sealed may be grooved forming sealing grooves. In the construction here shown the rotor is driven by a shaft from the low pressure side so that very little sealing pressure 90 is required so far as the drive shaft is concerned. The sealing of the rotor itself and the blades is accomplished by driving a lubricant from the high pressure chamber into 95 the rotor and letting it pass through the pump and permitting it to pass back with the gases into the high pressure chamber. By utilizing lubricant from the high pressure chamber the pressure is always such as 100 to force a circulation of the lubricant through the pump chamber. The rotor is provided with an axial opening 59 from which extends radial openings 60 to the slots 45. A lubricant is delivered to the axial opening 59 and under pressure from the high 105 pressure chamber and with this pressure and centrifugal force is carried out to the ends and edges of the blades and to the surfaces between the blades and the walls of the slots, thus very effectually sealing these points 110 of contact so as to prevent any leakage. The opening 59 leads from an opening 61 in the cover plate 41 and the opening terminates in a valve opening 62 which is controlled by a valve 63. A stem 64 extends from the 115 valve 63 through the end wall of the case 20 and into a fitting 65, the fitting having a base plate 65^a which is secured in the end of the case 20. The valve stem is actuated so as to operate the valve 63 by a mechanism hereinafter described. This valve is necessary because when the pump stops if the lubricating passages were open the lubricant would pass 120 from the high pressure chamber to the low pressure chamber until it uncovered the opening and then there would be an equalization of the gases in the two chambers.

The electric circuits are carried into the refrigerator through the fuse block 66 by the wires 67 and 68 (see Figs. 1, 6, 7, 8, 9,

and 10). A wire 69 leads from the wire 67 to a post carrying a thermally sensitive switch element 70. This switch element is formed of dual metal and deflects under variations of temperature in a manner common to such metal. Contact posts 71 and 72 are arranged at each side of the element 70 and these are provided with adjusting screws by means of which the interval between the posts may be varied so that the variations of temperature necessary to bring about the contact of the thermal element with their switch may be adjusted as desired. A wire 73 leads from the contact post 72 to a switch 74 and from the switch 74 by means of a wire 75 to a solenoid 76 returning from the solenoid by a wire 77 to the wire 68. When, therefore, the temperature rises in the food compartment to a point to bring the thermally sensitive element 70 into contact with the post 72 current is delivered to the solenoid 76 providing the switch 74 is closed. The movable element 78 of the solenoid is connected with a lever 79. It is yieldingly locked in its outward and inward positions by a yielding detent 78^a. The lever 79 is pivotally mounted on an arm 80. A link 81 connects the upper end of the lever 79 with a switch operating lever 82. Springs 83 connect the switch operating lever 82 with a switch lever 84. The switch lever 84 and the operating lever 82 have their adjacent ends pivotally mounted and the connecting spring is carried across the pivotal point of these levers by the swinging of the lever 82. When the spring, therefore, is carried past this axis by the action of the element 78 it carries the lever 82 so as to bring the spring into position to snap the switch 84 to the position shown in Fig. 6, it being understood that the switch lever 84 prior to the action of the solenoid closes the switch 74.

With the switch lever 84 in the position shown in Fig. 6, the switches 85 and 86 are closed. The switch 86 has one side connected with a line wire 67 and the opposite side by a wire 91 with the motor 10 and a return wire 92 from the motor leads to the line wire 68 so that immediately the thermally sensitive element 70 contacts the post 72 the train of movements which have just been described take place and the motor is set in motion. The motor continues to pump thus delivering refrigerant to the expansion chamber and reducing the temperature of the brine and consequently the food chamber until the thermally sensitive element 70 contacts the post 71. A wire 93 leads from one side of the switch 85 to the post 71. A wire 94 leads from the other side of the switch 85 to a solenoid 95. A wire 96 leads from the solenoid to the line wire 68. The movable element 97 of the solenoid 95 is connected with the lever 79 above its pivot 80. Immediately, therefore, contact is made between the post 70 and the post 71 the lever 79 is moved through the action of the element 97 so as to swing the lever 82 sufficiently to bring the springs 83 past the pivotal center of the levers and the switch lever 84 snaps across closing the switch 74 and opening the switches 85 and 86, thus shutting off the current through the motor and also shutting off the current through the solenoid 95. It will be noted in this connection that when the switch lever 84 is thrown from the switch 74 in the initial movement through the action of the solenoid 76 that the current is cut off through the solenoid 76. It will also be observed that while the switch 74 is closed the thermal element 70 is out of contact with the post 72 so that there is no immediate current to the solenoid 76 when the switch lever 84 is snapped across to close the switch 74. The parts remain, therefore, in this position until the temperature rises in the food compartment sufficiently to so effect the thermal element as to bring it into contact with the post 72. The switch 74 remains closed, therefore, awaiting this event and the lag or variations in temperature which will start the motor in action and stop it may be adjusted as desired through the screws on the posts 71 and 72.

It is desirable to have the cooling water shut off when the pump is out of action. A valve 99 is arranged in the line 98, the valve having an operating stem 100. The stem is connected with a bell crank lever 101 and the bell crank lever 101 is connected by a link 102 with the movable element 78 of the solenoid 76. When, therefore, the switch is thrown to connect the motor 10 to start the pump the same movement opens the valve 99.

It is also desirable to have this water flow regulated and controlled by the heat and pressure of the high pressure chamber. A pressure and thermally sensitive element 103 is connected through an opening 104 in the plate 65^a with the chamber 22. The element operates on a lever 105, this lever being fulcrumed at 106 on a post 107 carried by a frame 108 extending from the plate 65^a. The lever operates on a stem 109 extending from a valve 110. The operation of the lever on the valve may be adjusted by the nuts 111. Through this controlling mechanism the water flowing through the cooling coil may be controlled. If, however, the pressure or temperature of the high pressure chamber is not kept under control by the valve 110 a continued movement of the lever 105 operates on a switch 112 to open the line to the motor 10. The movable element of the switch is carried by a connection 113 leading to the lever

105 and is so adjusted that at the desired pressure and temperature the switch 112 is opened. This breaks the connection through the line 92 and thus shuts down the motor or stops the pump.

As before stated the valve 63 should be opened and closed as the pump is started and stopped. The stem 64 controlling the valve is actuated by the following mechanism: A link 114 connects the lever 79 with a lever 115. The lever 115 extends through the base 116 of a bellows diaphragm 117, the upper end of the diaphragm opening to the fitting 65. The base 116 is pivoted by means of a pin 119 on a post 120 extending from the plate 65^a. The upper end of the lever extends into a spool 121 arranged on the stem 64. When the lever 79 is moved through the action of the element 78 of the solenoid 76 the lever 115 is moved to open the valve 63 and when the lever 79 is moved under the influence of the movable element 97 of the solenoid 95 the lever 115 is rocked to close the valve. The connection between the link 114 and the lever 115 preferably includes a spring 122 which results in a spring-pressed closure of the valve 63, thus taking up any irregularities in the adjustment. It will be noted that the bellows diaphragm permits of the rocking movement of the base, thus providing for carrying the movement of the lever 115 from without the pressure space of the high pressure chamber to within the pressure space without the use of packing. This is particularly advantageous in a device of this kind in that provision against leakage of the refrigerant is desirable if not necessary.

What is claimed as new is:—

1. In a pump, the combination of an annular pump chamber; a rotor operating in the chamber; a high pressure chamber to which the pump discharges; and means for delivering oil from the high pressure chamber to the pump chamber for sealing the pump comprising devices for opening and closing said means with the starting and stopping of the motor.

2. In a pump, the combination of a chamber having inlet and discharge openings; a rotor in the chamber having sealing surfaces operating on the walls of the chamber and having an oil opening therein leading to the surfaces; means for supplying oil under pressure to said openings and means automatically opening and closing the oil opening with the starting and stopping of the rotor.

3. In a pump, the combination of a pump chamber having inlet and discharge openings; a high pressure chamber to which the discharge opening leads; a rotor in the pump chamber having sealing surfaces operating on the walls of the chamber and having an oil opening therein leading from the high

pressure chamber; and means automatically opening and closing the oil opening upon the starting and stopping of the rotor.

4. In a pump, the combination of a pump chamber having an annular wall; a rotor in the chamber having its axis concentric to the axis of the chamber, said rotor having radial slots therein and oil openings leading to said slots; sealing blades mounted in the slots and having radial movement therein to permit them to follow the walls of the pump chamber; a high pressure chamber to which the pump discharges, said high pressure chamber communicating with the opening in the rotor; and means for opening and closing said communications with the starting and stopping of the rotor.

5. In a pump, the combination of a pump chamber; a high pressure chamber at one side of the pump chamber separated therefrom by a wall; a low pressure chamber at the opposite side of the pump chamber; a rotor arranged in the pump chamber; and a shaft operating the rotor and extending through the low pressure chamber, the wall between the high pressure chamber and the pump chamber being free from shaft openings.

6. In a pump, the combination of a pump chamber having an annular wall; a rotor arranged in the pump chamber having radial slots; blades in said slots sealing with the annular end walls of the pump chamber; a high pressure chamber at one side of the pump chamber separated from the end wall of the pump chamber; a low pressure chamber at the opposite side of the pump chamber and separated from the end wall of the pump chamber; and a shaft operating the rotor and extending through the low pressure chamber, the wall between the pump chamber and the high pressure chamber being free from shaft openings.

7. In a pump, the combination of an annular pump chamber; a rotor arranged in said chamber and having sealing surfaces operating against the walls of the pump chamber; an oil opening for delivering oil to said surfaces extending from the axis of the rotor; a high pressure chamber separated from the pump chamber by an end wall of the pump chamber; a low pressure chamber separated from the pump chamber by an end wall of the pump chamber; a shaft for driving the rotor extending through the low pressure chamber; and means for delivering oil from the high pressure chamber through the end walls of the pump chamber to the opening in the rotor.

8. In a pump, the combination of an annular pump chamber; a rotor arranged in said chamber and having sealing surfaces operating against the walls of the pump chamber; an oil opening for delivering oil to said surfaces extending from the axis of

the rotor; a high pressure chamber separated from the pump chamber by an end wall of the pump chamber; a low pressure chamber separated from the pump chamber by an end wall of the pump chamber; a shaft for driving the rotor extending through the low pressure chamber; means for delivering oil from the high pressure chamber through the end walls of the pump chamber to the opening in the rotor; and devices for automatically opening and closing said opening with the starting and stopping of the rotor.

9. In a pump, the combination of a pump chamber; a rotor in the pump chamber having sealing surfaces operating on the walls of the pump chamber and oil openings arranged therein; means for supplying oil under pressure from said pump chamber to said oil openings comprising a valve; a motor for driving the rotor; a controlling switch controlling the motor; and means controlled by the switch for actuating the valve.

10. In a pump, the combination of a pump chamber; a rotor in the pump chamber having sealing surfaces operating on the walls of the pump chamber and oil openings arranged therein; means for supplying oil under pressure from said pump chamber to said oil openings comprising a valve; a motor for driving the rotor; a thermally controlled switch controlling the motor; and means controlled by the switch for actuating the valve.

11. In a pump, the combination of an annular pump chamber; a rotor operating in the pump chamber and having sealing surfaces acting on the walls of the pump chamber and having oil openings for delivering oil to said surfaces therein; a high pressure chamber to which the pump discharges said high pressure chamber having a passage leading to the oil opening in the rotor; a valve controlling said passage; a lever actuating the valve; a diaphragm mounting for the lever; and means for actuating the lever from without the diaphragm.

12. In a pump, the combination of an annular pump chamber; a rotor operating in the pump chamber and having sealing surfaces acting on the walls of the pump chamber and having oil openings for delivering oil to said surfaces therein; a high pressure chamber to which the pump discharges, said high pressure chamber having a passage leading to the oil opening in the rotor; a valve controlling said passage; a lever for actuating the valve; a bellows diaphragm having a base in which the lever is mounted, said diaphragm being in communication with the high pressure chamber; and a mounting for the base permitting a movement of the lever to actuate the valve.

13. In a pump, the combination of an an-

nular pump chamber; a rotor operating in the pump chamber and having sealing surfaces acting on the walls of the pump chamber and having oil openings for delivering oil to said surfaces therein; a high pressure chamber to which the pump discharges, said high pressure chamber having a passage leading to the oil opening in the rotor; a valve controlling said passage; a lever actuating the valve; a diaphragm mounting for the lever; means for actuating the lever from without the diaphragm; a motor for actuating the rotor; a switch controlling the motor; and devices operated with the starting and stopping of the motor and acting through the lever to open and close the valve.

14. In a pump, the combination of an annular chamber having a discharge opening leading therefrom, said discharge opening having a leak opening below the level of the discharge; a high pressure chamber into which the discharge opening leads and adapted to carry oil at a level below the discharge opening and above the leak opening; a valve in the discharge opening below the leak opening; and a rotor operating in the annular chamber.

15. The combination of a pump having a discharge opening, said discharge opening having a leak opening below the level of the discharge; a high pressure chamber into which the discharge opening leads adapted to carry oil at a level below the discharge opening and above the leak opening; and a valve in the discharge opening below the leak opening.

16. In a pump, the combination of an annular chamber having a discharge opening leading therefrom, said discharge opening having a leak opening below the level of the discharge; a high pressure chamber into which the discharge opening leads and adapted to carry oil at a level below the discharge opening and above the leak opening; a valve in the discharge opening below the leak opening; a rotor operating in the annular chamber; and means for supplying oil from the high pressure chamber to the pump chamber for sealing the rotor.

17. In a pump, the combination of a pump chamber; a rotor in the chamber; a low pressure chamber at the end of the pump chamber; a shaft extending through the low pressure chamber; a stuffing box through which the shaft extends; and means for continuously delivering oil to the stuffing box to form a seal, said low pressure chamber being adapted to carry oil at a level above the stuffing box.

18. In a pump, the combination of a pump chamber; a rotor in the chamber; a low pressure chamber at the end of the pump chamber; a connecting chamber; a motor at the opposite side of the connecting chamber

from the low pressure chamber; a shaft extending from the motor to the rotor; a stuffing box between the low pressure chamber and the connecting chamber; means in the
 5 connecting chamber for flooding the stuffing box with oil comprising a disc on the shaft; and a conduit from the disc to the stuffing box.

19. In a pump, the combination of a pump
 10 chamber; a rotor in the chamber; a low pressure chamber at the end of the pump chamber; a connecting chamber; a motor at the opposite side of the connecting chamber from the low pressure chamber; a shaft extending from the motor to the rotor; a stuffing
 15 box between the low pressure chamber and the connecting chamber; means in the connecting chamber for flooding the stuffing box with oil comprising a disc on the
 20 shaft; a conduit from the disc to the stuffing box; and a conduit leading from the disc to the motor.

20. In a pump, the combination of a pump chamber; a rotor in the chamber; a motor;
 25 a connecting chamber between the pump and motor adapted to contain a lubricant; bearings for the motor; and a conduit from the connecting chamber to the outer bearing of the motor.

30 21. In a pump, the combination of a

motor; a connecting case forming a chamber; a low pressure chamber in alinement with the connecting case; a pump chamber in alinement with the low pressure chamber; a high pressure chamber at the opposite side
 35 of the pump chamber; a rotor in the pump chamber; and a shaft extending from the rotor through the low pressure chamber and connecting chamber to the motor.

22. A pump having as elements a motor;
 40 a connecting chamber; a low pressure chamber; a pump chamber; a high pressure chamber, said elements being detachable; a rotor in the pump chamber; and a shaft extending from the rotor through the low
 45 pressure chamber and connecting chamber to the motor.

23. A pump having as elements a motor; a connecting chamber; a low pressure chamber; a pump chamber; a high pressure
 50 chamber, said elements being arranged in alinement and detachable; a rotor in the pump chamber; and a shaft extending from the motor through the low pressure chamber and connecting chamber to the motor.
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In testimony whereof we have hereunto set our hands.

CHAS. H. JACOBSEN.
 CARL BREER.