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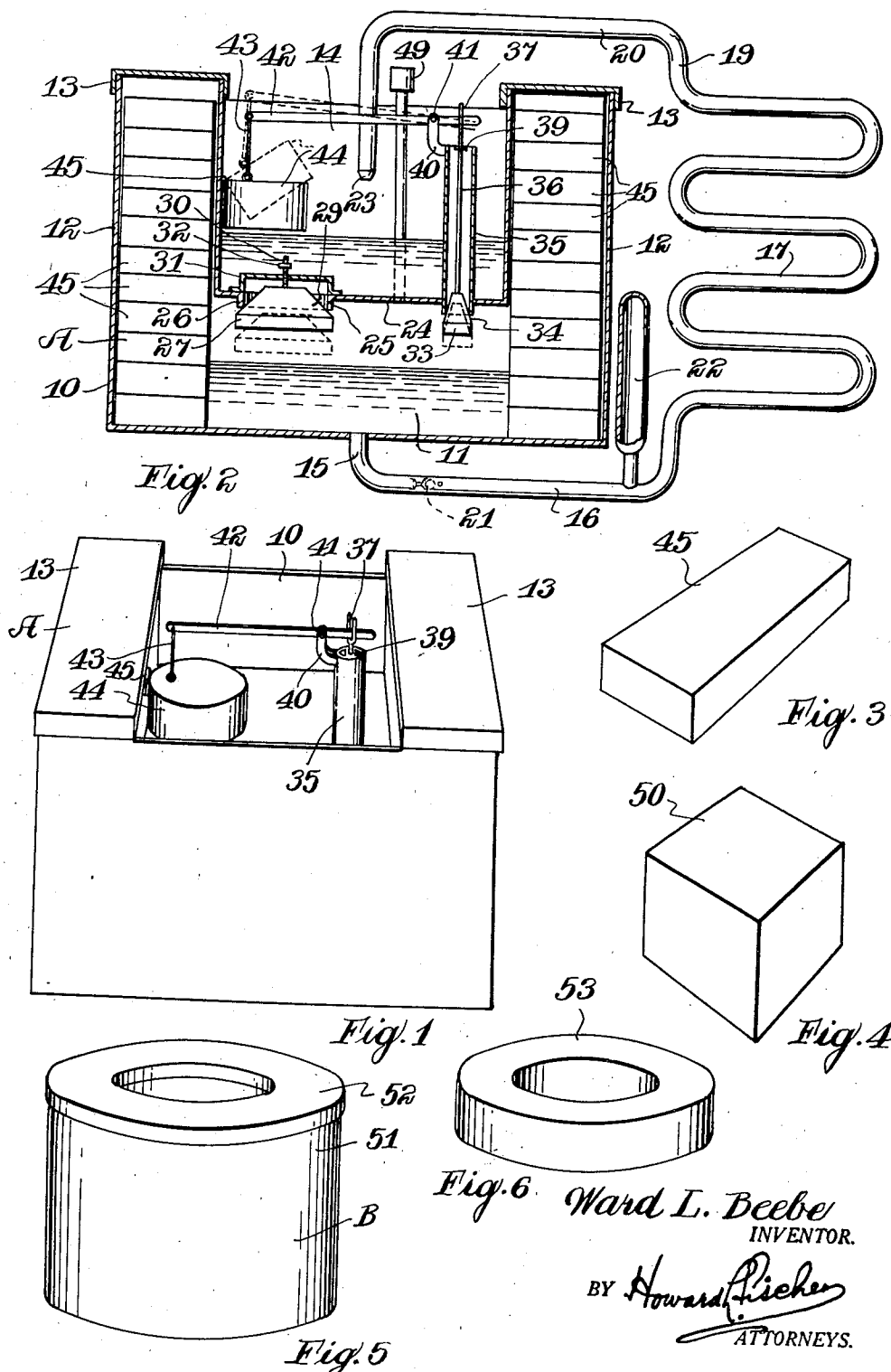
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REFRIGERATING APPARATUS

Filed Jan. 14, 1938

2 Sheets-Sheet 1



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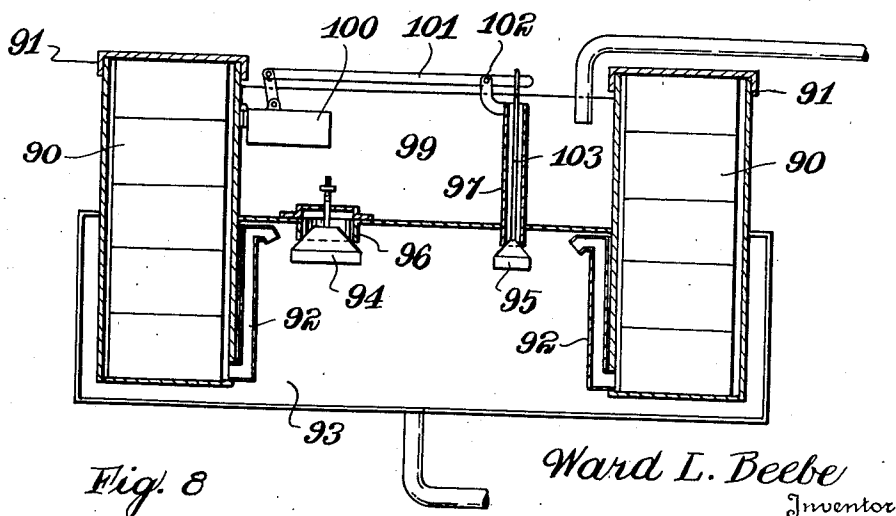
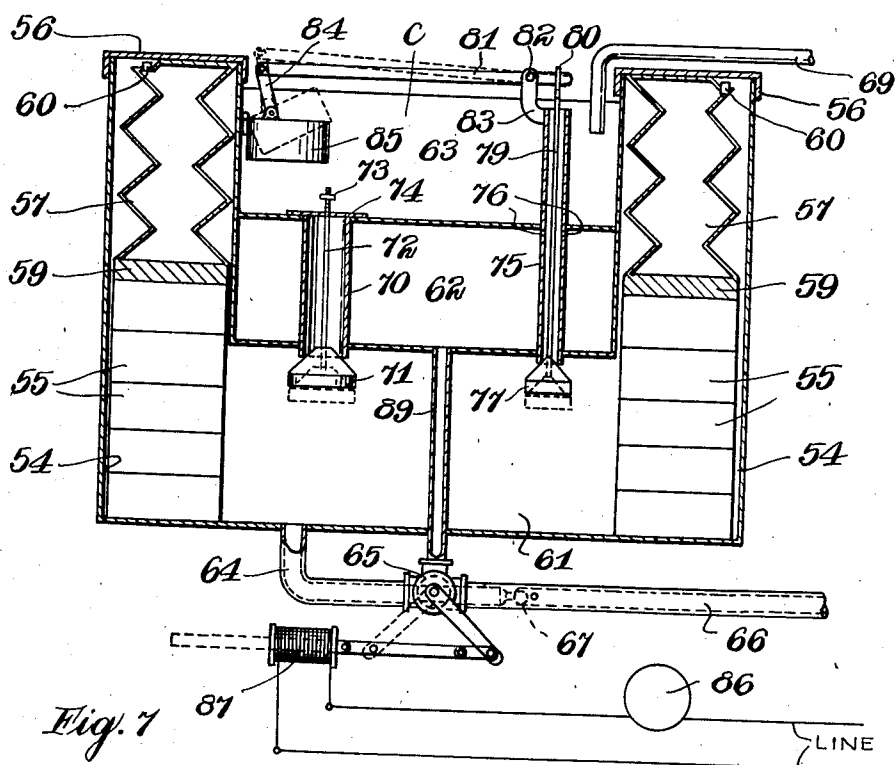
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2 Sheets-Sheet 2



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REFRIGERATING APPARATUS

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11 Claims. (Cl. 62—91.5)

My invention relates to an improvement in refrigerating systems wherein it is desired to provide a system employing solidified carbon dioxide or similar material as the cooling medium. It is also the object of the present invention to provide a device employing solidified carbon dioxide or similar material for operation of the same.

In the past it has been desired to use material such as solidified carbon dioxide for refrigerating systems. These systems have in some cases used the surplus of evaporated carbon dioxide gas to affect the circulation of the refrigerating medium. Attempts have been previously made to control the refrigeration employing carbon dioxide in solid form in one way or another.

The present invention discloses a simple and effective device for controlling the refrigerating system whereby the device operates automatically as long as the cooling is desired and may be stopped in a simple manner through the use of a suitable valve when cooling is no longer necessary.

It is the purpose of the present invention to provide a device embodying a pressure chamber and an open chamber and arranging these chambers in such a way that pressure created in the pressure chamber by the evaporation of the solid carbon dioxide will create a flow of refrigerant through a system of coils or any suitable refrigerating system. The flow of the refrigerant through the system may be stopped at any time by merely venting the evaporated gas to prevent the building up of a pressure within the pressure chamber.

It is a feature of my invention to provide a system in which the refrigerant is forced by pressure through the refrigerating system into an open chamber. The compression chamber is sealed by suitable valve means until a certain amount of the refrigerant has been forced into the receiving chamber. A means is provided for opening the valve separating the pressure and receiving chambers to permit the refrigerant to flow quickly into the compression chamber, whereupon the valve is again closed and a new cycle of operation may be started. Any desired source of pressure may be provided for circulating the refrigerant in place of carbon dioxide.

It is a feature of the present invention that the mechanism necessary for operating the same is simple and may be made at an extremely low cost. There are few moving parts in the entire device, and accordingly, the system will operate automatically with little or no attention over a long period of time.

It is also a feature in the preferred form of my

invention to provide valves connecting the pressure chamber and the receiving compartment which are operated by floats which act to seal the compression chamber when the liquid refrigerant reaches a predetermined level in the compression chamber and which operate to break the seal between the compartments when the liquid reaches a predetermined level in the receiving compartment. Such floats are positive in action and form virtually all of the moving parts of the device.

It is an added object of my invention to provide a device for containing solid carbon dioxide or similar material for permitting the material to be inserted in superimposed blocks or layers. The lower-most block or layer or the lower-most series of blocks or layers is preferably in contact with the liquid refrigerant so that the heat in the refrigerator is dissipated through contact with the solid material. This construction permits the operation of my device as an automatically fed cooling unit and permits the solid carbon dioxide to be fed into the refrigerant as it is evaporated.

These and other objects and novel features of my invention will be more clearly and fully set forth in the following specification and claims.

In the drawings forming a part of my specification:

Figure 1 is a perspective view of my device illustrating the arrangement of parts therein.

Figure 2 is a cross-sectional view through my device diagrammatically illustrating the operation of the same.

Figure 3 is a perspective view of a block of solid material for use in the device illustrated in Figures 1 and 2.

Figure 4 illustrates a slightly different form of block used for the operation of the system.

Figure 5 is a perspective view similar to Figure 1, but showing a differently shaped compartment containing the device.

Figure 6 illustrates a ring of carbon dioxide material which may be used in the device illustrated in Figure 5.

Figure 7 is a sectional view through a slightly modified form of construction.

Figure 8 illustrates in section another modified form of construction.

My refrigerating control unit A comprises a closed container 10 including a central pressure chamber 11 and integrally connected side feed magazine compartments 12. The compartments 12 are closed at the top by means of removable covers 13 which are attached to the top of the magazines 12 to prevent the leakage of pressure

about these covers 13. Positioned above the central compression chamber or compartment 11 I provide a compartment 14 which is either open at the top as illustrated in Figures 1 and 2, or which is provided with a suitable vent at the top to permit this open compartment 14 to remain at atmospheric pressure at all times.

At the bottom of the pressure chamber or compartment 11, I provide an outlet 15 connected to a pipe line 16 extending through refrigerating coils 17 or through a suitable heat transfer device. The coil 17 is connected at the top 19 to the pipe 20 which delivers the refrigerant into the open compartment 14.

A check valve 21 is provided in the pipe 16 to prevent refrigerant from within the coil 17 from flowing back into the pressure chamber 11 and if desired, an expansion tank 22 may be provided in the system for maintaining a proper pressure within the pipe. If the expansion tank 22 is provided, the end 23 of the pipe 20 is restricted to enable a pressure to be built up within the expansion tank 22.

At the top of the pressure compartment 11, separating this compartment from the open compartment 14, I provide a partition 24. An opening 25 is formed in this partition 24 preferably having a downwardly extending circular flange 26 extending peripherally thereabout. A float valve 27 having a tapered surface 29 is adapted to seat upon the flange 26 sealing the opening 25. This float valve 29 is supported when in open position by a valve stem 30 which extends through a bracket 31 bridging the opening 25. A nut 32 threaded on the valve stem 30 engages the bridge 31 to prevent the float 27 from dropping more than a predetermined amount, and this bridge and stem act to guide the float valve 27 into proper position as the same closes.

A second valve 33 having a frustro-conical surface 34 engages within the tube 35 extending through the partition 24 to a point adjacent the top of the same. A valve 33 is provided with a stem 36 having a forked yoke 37 at the top of the same which engages a cross member 39 in the tube 35 to prevent the valve 33 from dropping more than a predetermined amount.

A bracket 40 is mounted on the outside of the tube 35 to form a pivotal support at 41 for a lever 42 engaging between the bifurcated ends of the forked yoke 37. This construction is best illustrated in Figure 1 of the drawings. The lever 42 is connected by a link 43 to a float 44 hinged at 45 to the wall of the receiving compartment 14.

In operation, the refrigerant which may be alcohol or other liquid material having a low freezing point, is poured into the open compartment 14 and flows through the opening 25 about the valve 27 until liquid rises sufficiently to raise the valve 27 into engagement with the valve seat 25. The cakes or blocks of solid carbon dioxide or other similar material indicated at 45 are fed into the magazines 12 through the top covers 13, and these covers 13 are then fastened in position. The liquid refrigerant is cooled to a considerable extent by the carbon dioxide and a small quantity of the solid is evaporated. This evaporation creates a pressure above the liquid in the compartment 11 as the opening 25 is closed by the float valve 27 and as the float 44 is in lowered position so that the valve 33 is also floated upwardly to close the lower end of the tube 35. When sufficient pressure is created within the compart-

ment 11, the liquid refrigerant is forced downwardly through the outlet 15 and the pipe 16, past the check valve 21 and flows through the refrigerating coil or heat transfer member 17. This action takes place until sufficient of the refrigerant has been forced through the system and forced into the open compartment 14 to raise the refrigerant level in this upper compartment 14 to pivot the float 44 into the position illustrated by dotted outline in Figure 2 of the drawings. This action acts through the link 43 to raise one end of the lever 42 urging the opposite end of this lever downwardly against the forked yoke 37 pressing the rod 36 downwardly and releasing the valve 33 from engagement with the tube 35. This sudden release of pressure from the compartment 11 permits the float valve 27 to drop into the position indicated by dotted outline in Figure 2 and the refrigerant within the upper compartment 14 drops through this opening 25 into the pressure compartment 11. The lower compartment thus fills with liquid until the float valves 27 and 33 are again floated upwardly into engagement with the seat 25 and the lower end of the tube 35 respectively sealing the lower compartment and permitting pressure to build up within the same to start another cycle of operation.

It will be seen that the valves 27 and 33 are closed by the raising of the liquid level within the lower compartment. However, when pressure builds up within the compartment 11, this pressure holds the valves 27 and 33 in raised position to seal the opening 25 and the tube 35 until the pressure is released by operation of the float 44. Accordingly, very few moving parts are necessary, and these parts are merely floats or pivoted levers which will not easily get out of operating order.

In order to prevent the cooling system from operation continuously as long as the carbon dioxide 45 is present, a suitable thermostatic valve is provided. This valve may be attached as illustrated in Figure 2 of the drawings if desired, the tubular member 47 connecting with the top of the lower chamber 11. The valve 49 controls the flow through this pipe and when the temperature is above a predetermined maximum, the valve 49 is closed to permit operation of the device, but when the temperature reaches a predetermined minimum, the valve 49 remains open, permitting the evaporated carbon dioxide to vent into the open air and thus preventing a building up of pressure in the chamber 11.

Figure 3 of the drawings illustrates one type of block 45 of carbon dioxide or similar material which may be used. Figure 4 illustrates a slightly different type of block 50 which is somewhat different in shape from that shown in Figure 3. These blocks are superimposed one upon the other in a magazine 12 and feed downwardly as carbon dioxide evaporates causing these blocks to decrease in size. Because of the constant contact of the lowermost blocks with the refrigerant, these lowermost blocks will decrease in size more quickly than the upper blocks.

In Figure 5 of the drawings I have disclosed a device which is entirely similar to that shown in Figures 1 and 2 with the exception that the casing 10 is circular in shape. In this construction, the magazine 51 for the solid carbon dioxide is ring-shaped and extends entirely about the compartments 11 and 14. The cover 52 is circular rather than rectangular. In cross section, the refrigerating device B would be vir-

tually identical with that disclosed in Figure 2 of the drawings. When the device B is of the shape illustrated in Figure 5, ring-shaped cakes of solid carbon dioxide indicated at 53 in Figure 6 of the drawings are used in place of the blocks 45 or 50.

In Figure 7 of the drawings, I disclose refrigerating device C very similar to the devices A and B. The refrigerator C includes a pair of oppositely disposed magazines 54 adapted to contain blocks of solid carbon dioxide or other suitable fuel indicated at 55, and which magazines are closed at the top by suitable covers 56 which hold the pressure within the magazines 54. Bellows 57 are designed to fit within the top of the magazines 54 to fill up this space. These bellows are readily expandable and are secured to the covers 56 at the top and are provided with a weighted bottom 59. As the bellows 57 expand gas is permitted to enter the same through a check valve 60 which seals the gas in the bellows until manually released. The bellows 57 fill the space above the blocks of solid carbon dioxide 55 and prevent the necessity of filling this upper portion of the magazines 54 with gas during each cycle of operation of the refrigerating system.

Connected between the magazines 54 and forming a part of these magazines, I provide a pressure chamber 61 for accommodating liquid refrigerant which may contact the lowermost blocks 55 of carbon dioxide. Immediately above the compression chamber 61 I provide a storage reservoir 62 and above the chamber 62 I provide an open compartment 63. The pressure chamber or compartment 61 is provided with a drain outlet 64 extending through a valve 65. A pipe line 66 connected to the valve 65 contains a check valve 67 and extends through a suitable cooling or refrigerating system. A return flow pipe 69 is provided extending from the refrigerating coils or heat transfer mechanism which delivers the liquid refrigerant back into the open chamber 63.

A tube 70 connects the chamber 63 and the pressure chamber 61 and is provided at its lower end with a float valve 71. This valve is supported by a valve rod 72 equipped with a nut 73 which engages a strip 74 bridging the top of the tube 70. A second tube 75 extends into the pressure chamber 61 through the reservoir chamber 62 and above the liquid level of chamber 63. This tube 75 is provided with vent openings 76 near the top of the reservoir chamber 62 to permit this chamber 62 to be open to atmospheric pressure at all times. A float valve 77 closes the bottom of the tube 75 and is supported by a valve rod 79 having a forked end 80 between which a lever 81 may extend. The lever 81 is pivoted at 82 to a bracket 83 mounted at the top of the tube 75, and is connected at its opposite end by a pivoted link 84 to a float valve 85.

As long as the valve 65 is in the position illustrated the device C operates in a manner identical to the refrigerator A, the liquid refrigerant within the pressure chamber 61 raising the float valves 71 and 77 into contact with the lower extremities of the tubes 70 and 75 and being held in this position by pressure created by the evaporation of the carbon dioxide until sufficient refrigerant is forced into the compartment 63 to raise the float valve 85. This action forces the valve rod 79 downwardly urging the float valve 77 out of contact with the tube 75 and breaking the seal into the pressure compartment, thus permitting the valve 71 to drop and to permit the

refrigerant within the compartment 62 to drop into the compartment 61 and start a new cycle of operation. If, however, the thermostatic control 86 reaches a predetermined minimum, a contact is made to the time solenoid 87 which opens the valve 65 for a predetermined length of time, whereupon the liquid refrigerant is forced by the pressure within the compression chamber 61 through the outlet 64 and valve 65 and through the vertical tube 89 into the compartment 62. When the thermostat 86 reaches a predetermined maximum the solenoid 87 is again operated to open the valve for a predetermined length of time, thereby permitting the liquid refrigerant to flow back into the pressure compartment 61 to start a new cycle of operation.

It will be obvious that the refrigerant during this time will be out of contact with the solid carbon dioxide, thereby slowing the evaporation of the same. It will also be clear that when the liquid has flowed out of compartment 61, the seal holding the valves 71 and 77 will be broken permitting any gas formed by evaporation of the carbon dioxide to escape through the tubes 70 and 75.

In Figure 8 of the drawings, I disclose a refrigerating device having magazines 90 which are entirely sealed by covers 91 but which are provided with vent tubes 92 which extend above the liquid refrigerant level of the pressure chamber 93. The pressure chamber 93 surrounds the lower portion of the magazines 90 but the liquid refrigerant is not in direct contact with the solid carbon dioxide. The operation of this device is entirely similar to that described previously in connection with Figure 2, float valves 94 and 95 sealing the opening 96 and tube 97 respectively. When the liquid level in the open receiving compartment 99 reaches a predetermined level, the float valve 100 raises, operating the lever 101 pivoted at 102 to urge the valve rod 103 downwardly to release the pressure in the pressure compartment 93.

In accordance with the patent statutes, I have described the principles of construction and operation of my refrigerating system and apparatus, and while I have endeavored to set forth the best embodiment thereof, I desire to have it understood that this is only illustrative of a means of carrying out my invention, and that obvious changes may be made within the scope of the following claims without departing from the spirit of my invention.

I claim:

1. A refrigerating system comprising a heat transfer apparatus, a pipe-line extending through said heat transfer apparatus, a pressure compartment secured to one end of said pipe-line, an open compartment for receiving liquid from the other end of said pipe-line, and means connecting said receiving compartment and said pressure compartment to permit refrigerant to pass from said receiving compartment to said pressure compartment, valve means controlled by the liquid level in said receiving compartment interposed in said connecting means, and a carbon dioxide magazine connected to said pressure compartment to permit the refrigerant within said pressure chamber to be cooled by the carbon dioxide in said magazine.

2. A refrigerating system comprising a pressure tank adapted to contain refrigerant and solid carbon dioxide, a pipe-line extending from said pressure compartment, an open compartment into which said pipe-line extends, a pas-

sageway between said compartments through which refrigerant may flow, and a float valve in said passage.

3. A refrigerating system comprising a pressure compartment, an open compartment superimposed upon said pressure compartment, a passageway between said compartments, through which liquid may flow, a float valve in said passageway, a refrigerant within said pressure compartment adapted to close said float valve upon reaching a predetermined level, solidified carbon dioxide in said pressure compartment, and a pipeline connecting said pressure compartment to said open compartment whereby refrigerant in said pressure compartment may be forced by pressure of evaporated carbon dioxide into said open compartment.

4. A refrigerating system comprising a sealed compartment adapted to contain a refrigerant and solidified carbon dioxide, an open compartment above said sealed compartment, a passageway between said compartments, a float valve in said passageway, a pipe-line connecting said sealed compartment and said open compartment through which refrigerant may be forced by evaporated carbon dioxide, and means controlled by the liquid level in said open compartment for opening said float valve to permit the refrigerant to flow through said passage into said sealed compartment when the refrigerant reaches a predetermined level in said open compartment.

5. A refrigerating system comprising a sealed compartment adapted to contain a refrigerant and solid carbon dioxide, an open compartment, a passage between said compartments, a float valve for said passageway adapted to be closed by refrigerant in said sealed compartment and maintained in closed position by pressure of evaporated carbon dioxide, a passage from said sealed compartment to said open compartment through which said refrigerant may be forced by pressure of evaporated carbon dioxide, and means for reducing the pressure within said sealed compartment when said refrigerant reaches a predetermined level in said open compartment to permit said float valve to open said first named passageway.

6. A refrigerating unit comprising a pair of superimposed chambers, the lowermost of said chambers providing a pressure compartment and the upper of said chambers providing an open compartment, said pressure compartment adapted to contain refrigerant and solid carbon dioxide, a passage between said compartments through which refrigerant may flow from said open compartment to said pressure compartment, a float valve in said passage operated by refrigerant in said pressure compartment to close said passage, said float valve being maintained in closed position by pressure of evaporated carbon dioxide, a passage in said pressure compartment extending above the level of refrigerant in said open chamber, a second float valve in said last named passage adapted to be closed by refrigerant in said pressure compartment and maintained in closed position by pressure of evaporated carbon dioxide, a cooling system connected to said pressure compartment through which the refrigerant may flow from said pressure compartment to said open compartment, and means operated by the level of refrigerant in said open compartment to operate said second float valve to release the pressure in said pressure compartment and to permit the refrigerant

to pass from said open compartment to said pressure compartment.

7. A refrigerating system comprising a pressure compartment adapted to contain a liquid refrigerant and solid carbon dioxide, an open compartment, a passage between said open compartment and said pressure compartment, a float valve in said passage adapted to be closed by said refrigerant and maintained in closed position by pressure of evaporated carbon dioxide, a second passage between said compartments extending above the level of refrigerant in said open compartment, a second float valve in said second passage operated in a manner similar to said first float valve, a float in said open compartment adapted to be raised by refrigerant in said open compartment, and means connecting said float and said second float valve to open said second float valve when said float reaches a certain predetermined elevation to release pressure in said pressure compartment to open said first named float valve to permit the refrigerant to flow through said first passage from said open compartment to said pressure compartment.

8. A refrigerating system comprising a pressure compartment adapted to contain refrigerant and solid carbon dioxide, an open compartment above said pressure compartment, valve means connecting said compartments to permit the refrigerant to flow from said open compartment to said pressure compartment, refrigerator coil means connected to said pressure compartment through which refrigerant may be forced into said open compartment, a passage between said compartments extending above the level of refrigerant in said open compartment, a valve in said passage, a float in said open compartment, a lever pivotally connected to said valve in said second passage to operate the same, means connecting said float and said lever to operate said lever when said float reaches a predetermined level to open said valve to release pressure within said pressure compartment whereby said first named valve may open to permit refrigerant to flow from said open compartment into said pressure compartment.

9. A refrigerating system comprising a pressure compartment, a receiving compartment, and a reservoir compartment, a carbon dioxide magazine associated with said pressure compartment to cool liquid refrigerant therein, and to deliver evaporated gas thereto to create a pressure, a pipe line connecting said pressure compartment to said receiving compartment through which refrigerant is forced by pressure, a valve in said pipe line, means connecting said valve to said reservoir compartment, and thermostatically operated means controlling said valve, to operate said valve to direct refrigerant into said reservoir compartment when a predetermined low temperature is reached.

10. A refrigerating system including a pressure chamber, a magazine for said carbon dioxide connected to said pressure chamber, an expandable member filling the space above said carbon dioxide in said pressure chamber and a check valve in said member to automatically admit gas under pressure.

11. A refrigerating unit comprising a pair of chambers one of which is positioned above the level of the other, the lowermost of said chambers providing a pressure compartment and the upper of said chambers providing an open compartment, said pressure compartment adapted

to contain refrigerant and a solid gas emitting cooling agent, a passage between said compartments through which refrigerant may flow from the open compartment to said pressure compartment, a float valve in said passage operated by refrigerant in said pressure compartment to close said passage, said float valve being maintained in closed position by pressure of evaporated cooling agent, a passage in said pressure compartment connecting said pressure compartment with atmospheric pressure, a second float valve in said last named passage adapted to be closed by refrigerant in said pressure compartment and

maintained in closed position by pressure of evaporated cooling agent, a cooling system connected to said pressure compartment through which a refrigerant may flow from said pressure compartment to said open compartment, and means operated by the level of refrigerant in said open compartment to operate said second float valve to release the pressure in said pressure compartment and to permit the refrigerant to pass from said open compartment to said pressure compartment.

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