W. F. KRIEGER.

AUTOMATIC REGULATOR FOR REFRIGERATING MACHINES.

APPLICATION FILED APR. 4, 1914.

1,135,196.

Patented Apr. 13, 1915.

3 SHEETS—SHEET 1.

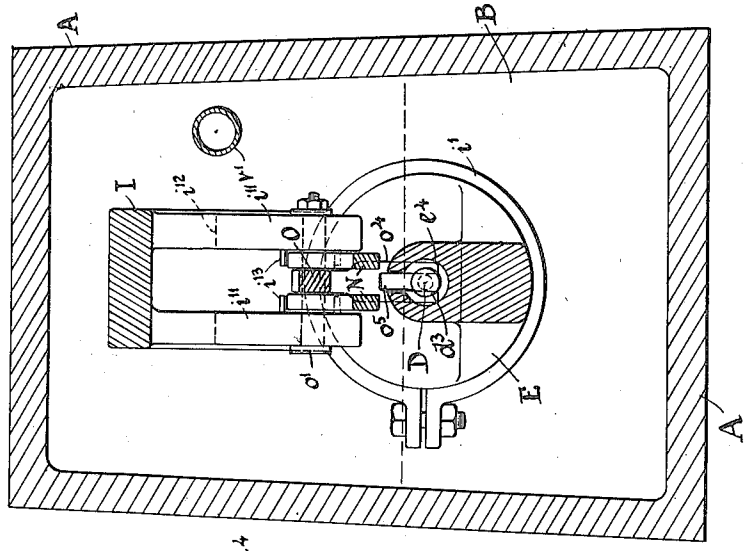


Fig. 1a

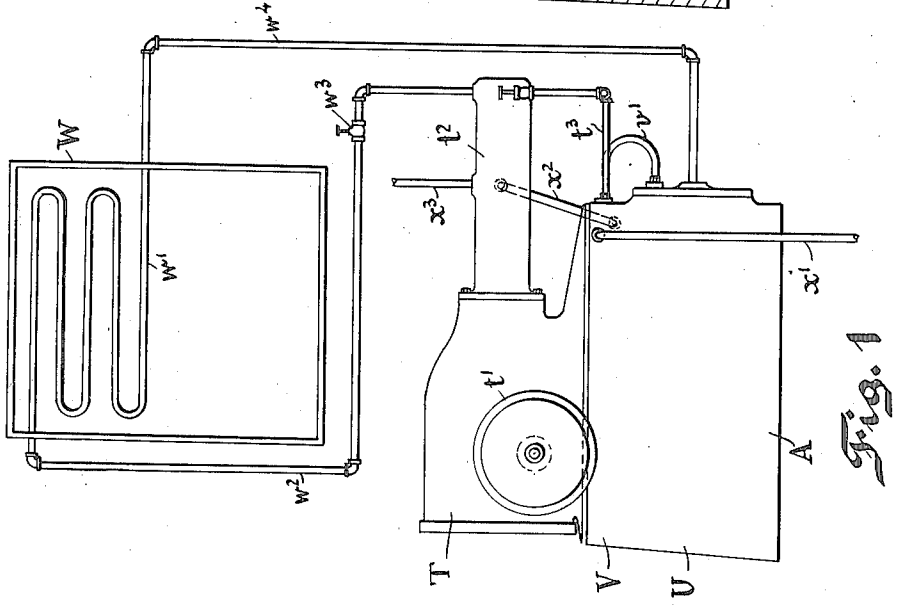


Fig. 1

Witnesses
Earl Dale
Cycle Krenz

Walter F. Krieger, Inventor

By Pierce, Schmore & Fallo

Attorney

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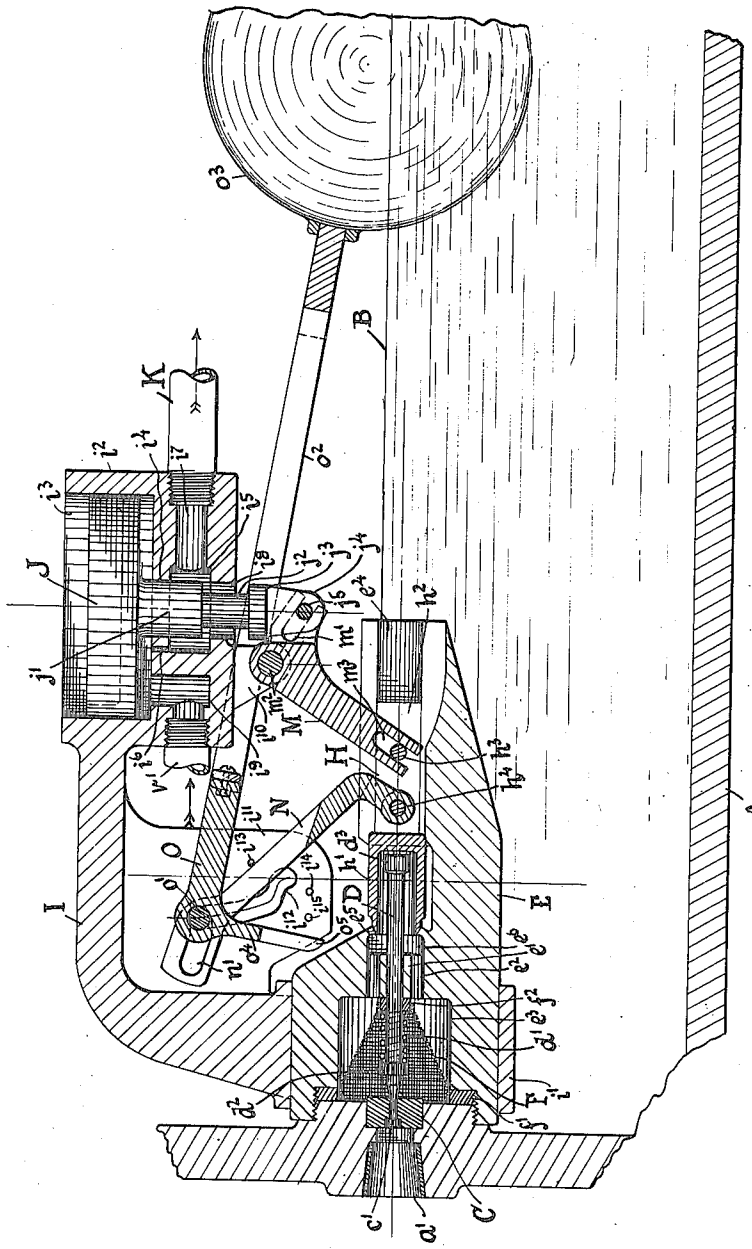


Fig. 2

Witnesses

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3 SHEETS—SHEET 3.

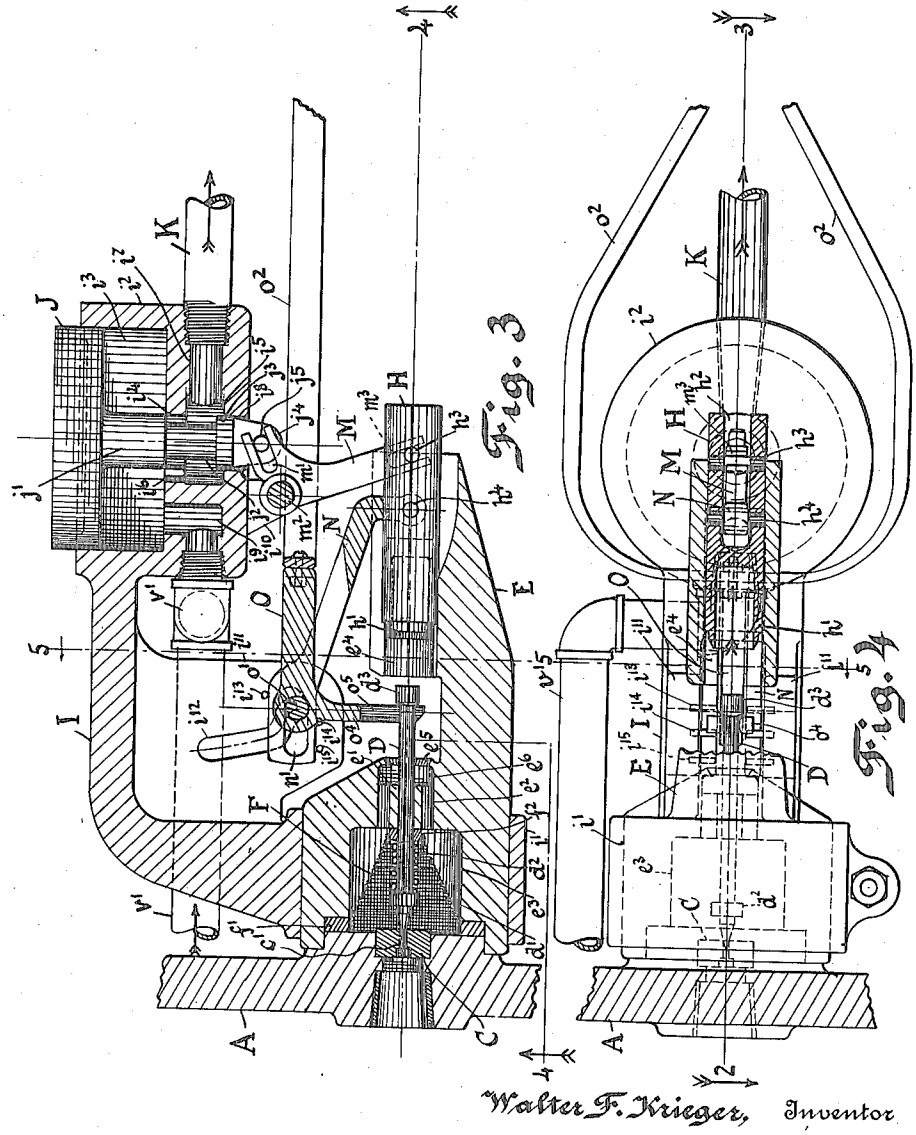


Fig. 3

Fig. 4

Walter F. Krieger, Inventor

Witnesses

Earl Dole

Cycele Krenz

By Pierce Adams & Hopkins

Attorney

UNITED STATES PATENT OFFICE.

WALTER F. KRIEGER, OF MILWAUKEE, WISCONSIN.

AUTOMATIC REGULATOR FOR REFRIGERATING-MACHINES.

1,135,196. Specification of Letters Patent. Patented Apr. 13, 1915.

Application filed April 4, 1914. Serial No. 829,410.

To all whom it may concern:

Be it known that I, WALTER F. KRIEGER, of Milwaukee, Wisconsin, have invented an Automatic Regulator for Refrigerating-Machines, of which the following is a specification.

This invention relates to refrigerating machines, especially those which work on what is called the flooded system, in which the evaporating-tank or coil is kept constantly provided with a predetermined quantity of refrigerant in liquid form, which occupies the lower part thereof up to a certain predetermined level, the supply of liquid refrigerant being kept up by being allowed to pass into the refrigerating-tank or coil from the condensing-tank.

The object of my invention is to provide a means for automatically regulating the quantity of refrigerant in liquid form which passes from the condensing-tank to the refrigerating tank or coil in such manner that the level of liquid refrigerant in the latter shall be kept substantially constant under all conditions. The manner in which I accomplish this object consists in placing a regulating-valve between the condensing tank and the refrigerating-tank or coil and providing it with automatic governing means, which is operated in accordance with the level of liquid refrigerant in the condensing-tank so that in case the latter should rise it will cause the valve to open wider and so permit enough refrigerant to pass into the refrigerating coil or tank to return it to its proper level in the condensing-tank; and in case the level of the refrigerant in the condensing tank should fall below its predetermined level it will cause said valve to close until it has returned again to its proper level by reason of the supply brought over to it from the refrigerating tank or coil by the compressor.

Furthermore, my invention embodies means for automatically shutting off the valve entirely when the compressor is shut off, so as to prevent a slow leakage through the valve that might otherwise take place and might cause all the condensed refrigerant to pass into the refrigerating coil while the compressor is shut down, or at least enough thereof to overfill it; and in that case would lead to a flooding of the compressor and consequent liability to injury from liquid passing through the cylinder thereof.

According to my invention the hand-regulation of a refrigerating plant aside from the operating of the compressor becomes totally unnecessary, as all necessary regulation is performed automatically.

For the better understanding of my invention and to illustrate the principle thereof, I have shown a preferred form thereof in the accompanying drawings, wherein—

Figure 1 is a general view of a refrigerating plant according to my invention; Fig. 2 represents a longitudinal section through the condenser-tank or liquid receiver on the plane 2—3 of Fig. 4, showing my apparatus with the parts in the position which they occupy when the plant is shut down; Fig. 3 is a similar view of the same parts in the position in which the apparatus is working; Fig. 4 is a bottom plan-view sectioned on the plane 4 of Fig. 3; and Fig. 5 is a transverse section on the plane 5 of Figs. 3 and 4.

In these drawings every reference numeral or letter refers to the same part in all the views.

Fig. 1 exhibits the general arrangement of a refrigerating plant to illustrate the principle of my invention, but it is to be understood that the arrangement here shown is merely for the purpose of fixing ideas and any preferred arrangement of the various members of the system may be adopted. T represents a compressor which is driven through a fly-wheel pulley t^1 and has a cylinder t^2. This compressor is mounted on a hollow base U, which contains at the upper part the condenser V and in the lower part the tank or receiver A, adapted to receive the liquid refrigerant from the condenser V. W is a refrigerator-box which contains a refrigerating coil w^1, and this is connected by a pipe w^2, containing a valve w^3, to the compressor-cylinder and delivers the evaporated refrigerant thereinto, while another pipe t^3 leads the compressed refrigerant from the compressor-cylinder t^2 to the condenser V, and thence it flows in liquid form through the pipe v^1 to the tank A. From this tank it is released into the refrigerator-coil w^1 again through the pipe w^4. x^1, x^2 and x^3 represent pipes for conveying the cooling water to the condenser and compressor-cylinder respectively.

In the other figures a part only of the condenser-tank A is shown, which under conditions of normal operation contains a portion of the refrigerant B in liquid form,

being that part which has been condensed after passing through the compressor and condenser according the usual or any preferred plan of refrigeration. At one side of this tank is shown an aperture a^1, which contains a wear-block of hardened steel or the like, C, which is perforated by a passage c^1, on the inner face of which is formed a valve-seat for the needle-valve D, which is arranged to reciprocate in line with the axis of the perforation c^1. The needle-valve D is mounted to reciprocate in a bearing e^1 formed in a block or member E, which is secured to the wall of the tank A opposite the orifice a^1 as shown, surrounding the bearing e^1, the block E is perforated by passageways e^2 which conduct the liquid from the condensing-tank into a chamber e^3. Within this chamber is mounted a member consisting of a conical wire screen F, which is secured at its wide end to a ring-piece f^1 confined between the block E and the wall of the tank A as shown, and at its other end the conical wire screen F has secured to it a ring f^2, which abuts upon the end of the bearing e^1 and through it the needle-valve D passes. The needle-valve is held with its pointed end upon the seat so as to close the orifice c^1 by means of a coiled spring d^1, surrounding and abutting at one end of the ring f^2 and at the other on a collar d^2 carried by the stem of the needle-valve. The latter extends rearwardly and carries an enlarged head d^3 for the purpose of enabling it to be engaged by the member o^4 hereinafter described, and retracted for opening the valve. The purpose of the screen F is to prevent any scale or other solid matter from coming into contact with the needle-valve, which might interfere with the flow of the liquid therethrough.

The block E extends back of the bearing e^1 and is provided with a slotted bearing e^4, in which is arranged to slide longitudinally a member H, which has a hollow head h^1 at its left-hand end, adapted to form a cap for the end of the needle-valve and also is formed as an annular valve-plug to fit upon the valve-seat e^5, which guards the opening from the tank into the chamber e^6 from which the liquid passes through the passageways e^2. This arrangement is such that when the member H is moved to the left the hollow head h^1 thereof comes against the valve-seat e^5, and thereby completely shuts off access of the liquid in the tank to the needle-valve, at the same time capping the latter so as to prevent its becoming displaced.

The member H is reciprocated by the following mechanism: Within the tank A as shown in the drawings, is a bracket-arm I which is provided with a clamp-collar i^1 by which it is secured to the member E. The bracket-arm I carries at its free end a casing i^2, provided with a cylindrical recess i^3, within which reciprocates the piston J, having a downwardly extending stem j^1 which fits and moves in a circular opening i^4, which connects the recess i^3 with a chamber i^5 below it. The chamber i^3 is also connected with the chamber i^5 by a narrow passage i^6 at one side of the aperture i^4 (or if preferred the passage i^6 may be omitted provided the aperture i^4 is made slightly larger than the piston-stem j^1) the object being to give a slow leakage from the chamber i^3 into the chamber i^5 when the stem j^1 is in the opening i^4. From the chamber i^5 leads a lateral passage i^7, from which a pipe K leads to the rear of the condenser-tank where a sump or other collector (not shown) for foreign substances is provided. At the bottom of the chamber i^5 is also an aperture i^8, concentric with the aperture i^4, and of the same size, this aperture i^8 being filled by the head j^3 when it is raised. With the chamber i^3 also communicates, at one side of the chamber i^5, a third chamber i^9, into which delivers the pipe v^1, which leads from the condenser V.

The stem j^1 has an extension j^2 of lesser diameter carrying on its end the head j^3, which has an ear j^4 upon which is mounted the cross-pin j^5, and this engages in the slots m^1 in the forked arm of the bell-crank lever M, which is pivoted upon the pin m^2, supported by a pair of lugs i^{10} depending from the casing i^2. The other arm of the lever M extends downwardly and into the diametral longitudinal slot h^2 of the member H, and is provided with a slot m^3 to engage a cross-pin h^3 extending across the slot h^2, the construction being such that when the piston J rises, being forced upward by liquid refrigerant accumulating under it in the manner hereinafter described, it turns upon its pivot the lever M and causes the member H to be retracted in its bearings so as to draw away the valve-head h^1 from its seat and to uncover the head d^3 of the needle-valve D; and when the piston J falls, of course the reverse operation takes place. The retractile movement of the member H involves also another sequence. It carries a second pin h^4 projecting across the slot h^2 and having pivoted on it the end of a link N, whose other end is bifurcated as shown and the two arms provided with a transverse slot n^1, through which extends a pin o^1. The bifurcated end of the link N extends between two cheek-plates i^{11} carried by the bracket-member I and transversely perforated by similarly shaped slots i^{12} of special form. The pin o^1 is of such length as to pass through the slots i^{12} in addition to the slots n^1, and it forms the movable pivot of a float-arm O, the middle portion of which is divided so that the two arms o^2 thereof pass around the members J and M and the hous-

ing i^2, and carry upon their distant ends a float o^3 which rests upon the surface of the liquid refrigerant B in the condenser-tank. The lever O has another arm o^4 extending downwardly from the pivot-pin o^1 and bifurcated by a terminal slot o^5, which is of such size as to admit the stem of the needle-valve D, but not to pass the head d^3 thereof through it. The apparatus is completed by three pairs of pins i^{13}, i^{14}, and i^{15}, which project inwardly from the opposing faces of the cheek-plates l^{11} sufficiently to engage the shank of the link N respectively in its upper and lower positions, but not to cross the path or interfere with the movement of the float-lever O. The action of the mechanism is therefore as follows: When the compressor is not working there will be no influx from the condenser into the tank A, so that the piston J will remain in its lowered position shown in Fig. 2 of the drawings, and in this position it will be noted that the needle-valve is disengaged from the float-arm o^4 and is kept closed by the spring d^1, and moreover the valve-head h^1 is kept tightly closed against the seat e^5 by the weight of the piston J. In this position, therefore, no refrigerant can pass through the aperture c^1 into the refrigerator-tank or coil, and this will be the case even if the needle-valve D is not perfectly tight, because access of liquid to the needle-valve is cut off at the valve-seat e^5 due to the head h^1 being pressed thereagainst. Now if the compressor be started and the refrigerant begins to flow from the condenser into the pipe v^1, it will first reach the chamber i^9, and in filling the chamber i^3 will cause the piston J to rise. In doing so a small amount of the liquid refrigerant will of course flow through the passage i^6 and thereby escape without raising the piston J, but the hole is too small to let any considerable proportion of the condenser output thus escape, so that the piston J will continue to rise until it has reached the position shown in Fig. 3, that is to say, until the large-diametered portion j^1 of the stem has risen out of the aperture d^4, thereby permitting the liquid refrigerant to escape through said aperture into the chamber i^5 and thence into the tank A, and as long as the liquid continues to flow in from the condenser the piston J will remain in this elevated position. In assuming this position it will be seen from Fig. 2 that it causes the member H to be drawn back so as to remove the valve-head h^1 from the valve-seat e^5 and also uncover the end of the needle-valve D, and at the same time the link N is drawn after the member H, and because of its first fulcruming upon the pins i^{14}, the pin o^1 will first be drawn down in the slots i^{12} and afterward to the lower ends of said slots. In this position any further retractile movement of the member H will not affect the position of the pin o^1, because, as seen from Fig. 3, the slot n^1, or rather the left-hand end thereof, is now horizontal, and the pins i^{13}, i^{14} and i^{15} will act as guides for the end of the link N as it moves backward and forward with the varying elevation of the piston J, while holding the pin o^1 at the bottom of the slots i^{12}. The latter will therefore be a fulcrum-position, and in reaching this position it will be seen that the forked end o^4 of the lever O is brought down so as to engage with the head d^3 of the needle-valve D, and in this position the needle-valve is ready to be acted on by the float-lever so that any increase in the elevation of the liquid level which raises the position of the float o^3 will correspondingly retract and open the needle-valve D, so as to readjust said level by permitting a sufficient quantity of the liquid to pass through the orifice c^1 over into the low-pressure side of the system.

Now were the member H and its operating attachments to be omitted, or to be held fixed in its retracted position as shown, the apparatus would still be operative to keep the liquid at the proper level in the condenser-tank; but it will be understood that the needle-valve D is subject to possible leakage which is due to the fact that the point of the valve and the seat on which it rests are subjected to a strong scouring action of the liquid passing through under high pressure, which causes the parts to wear unevenly. The effect of any such leakage as long as the apparatus is running is of no consequence, but if the apparatus is closed down, its effect would be gradually to cause all the liquid in the tank to be forced over to the low-pressure side until the pressure between them was equalized. By provision of the member H, however, such action is prevented, because as soon as the compressor is closed down, the flow of condensed refrigerant ceases and the amount of liquid remaining under the piston J escapes gradually through the small passage i^6, thus letting the piston J down to its lower position until the valve-head h^1 closes the seat at e^5, and this valve-seat can easily be kept tight because there is no scouring action upon it, for it will be seen that there is substantially no passage of liquid through this valve-seat until the valve-head h^1 is fully drawn back, and then the area of the passageway is so much greater than that of the needle-valve that no scouring action can take place. Of course, as the member H returns to its closed position, the pin o^1 is pushed up again into the position of Fig. 1, and thus the float-lever O is disengaged from the needle-valve.

It is to be observed that governing the level of the liquid in the condenser-tank is equivalent to governing the level thereof on

the low-pressure side so long as the total quantity of refrigerant in the system remains constant, but it has the advantage that in case the total quantity of refrigerant decreases by leaks from the system, the level will be lowered on the low-pressure and not on the high-pressure side, so that at no time can the needle-valve be uncovered so as to permit uncondensed refrigerant to flow through, and the loss of refrigerant from the system can be easily detected by the lowering of the level on the low-pressure side, which is indicated by corresponding lowering of the frost-line; whereas if such lowering took place on the high-pressure side it would not be apparent until a sudden blow-out of uncondensed refrigerant through the regulating valve occurred.

Various changes and modifications in the construction as herein shown may be made without departing from the spirit of my invention, and I wish it understood therefore that the latter is not otherwise limited than by the proper scope of my claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a closed-circuit refrigerating system, the combination of a tank adapted to contain liquefied refrigerant, means for delivering liquefied refrigerant into the tank, a valve opening out of said tank, means located in said tank for opening said valve when the level of liquid therein rises above a predetermined height and closing it again as the liquid level returns to said height, and a second valve in series with the first and adapted to be opened whenever the liquefied refrigerant is flowing into said tank and closed when it is not flowing in.

2. In a closed-circuit refrigerating system containing an evaporator and a condenser, and means for withdrawing the refrigerant from the refrigerator and delivering it into said condenser, in combination with a tank adapted to receive the condensed refrigerant from the condenser, a valve through which the condensed refrigerant passes from said tank into the refrigerator, a float located in said tank and resting on the liquid therein and governing said valve and having a disconnectible engagement therewith, and a device adapted to hold said float normally out of engagement with said valve and cause it to become engaged therewith whenever liquid refrigerant from the condenser flows into said tank.

3. In a closed-circuit refrigerating system containing an evaporator and a condenser and means for withdrawing the refrigerant from the refrigerator and delivering it into said condenser, in combination with a tank adapted to receive the condensed refrigerant from the condenser, a valve through which the condensed refrigerant passes from said tank into the refrigerator, a float located in said tank and resting on the liquid therein and governing said valve, a second valve in series with the first, said second valve being kept normally closed so as to shut off connection between the liquid in the tank and the first valve, and a mechanism operated to open said second valve whenever liquid flows from said condenser into the tank.

4. In a refrigerating system, the combination of a tank adapted to contain liquefied refrigerant, a conduit through which liquefied refrigerant is delivered into the tank, a valve opening out of the tank and adapted to allow the liquid contents thereof to flow out, means governing the said valve by the level of liquid in the tank a second valve intercalated between the first valve and the tank, adapted when closed to shut off access of the liquid refrigerant to the first valve, and a device operated by the flow of liquid from said conduit to open and close said second valve.

5. In a refrigerating system, the combination of a tank adapted to contain liquefied refrigerant, a conduit through which liquefied refrigerant is delivered into the tank, a valve opening out of the tank and adapted to allow the liquid contents thereof to flow out, means governing the said valve by the level of liquid in the tank, a second valve intercalated between the first valve and the tank, a weight-operated device causing said second valve to close when not held open, and means caused by the flow of liquid into the tank to open said second valve.

6. In a refrigerating system, the combination with a tank adapted to receive condensed refrigerant, a valve through which the condensed refrigerant passes from the tank into the refrigerator, a float located in said tank and resting on the liquid therein and having a disconnectible engagement with said valve whereby it governs it when engaged therewith, a second valve located between the first and the tank so as when closed to shut off supply of liquid to the first valve, said second valve being kept normally closed, and a mechanism acting when moved in one direction to simultaneously open said second valve and bring said float into said engagement with said first valve and when moved in the other direction to reverse said operation.

7. In a refrigerating system, the combination with a tank adapted to receive condensed refrigerant, a valve through which the condensed refrigerant passes from the tank into the refrigerator, a float located in said tank and resting on the liquid therein and having a disconnectible engagement with said valve whereby it governs it when engaged therewith, a second valve located between the first and the tank so as when

closed to shut off supply of liquid to the first valve, said second valve being kept normally closed, a mechanism acting when moved in one direction to simultaneously open said second valve and bring said float into said engagement with said first valve and when moved in the other direction to reverse said operation, and a duct adapted to deliver a liquid refrigerant into said tank, said mechanism being governed by the flow of liquid through said conduit to perform said opening and engaging movement.

8. In a refrigerating system, the combination with a tank adapted to receive condensed refrigerant, a valve through which the condensed refrigerant passes from the tank into the refrigerator, a float located in said tank and resting on the liquid therein and having a disconnectible engagement with said valve, whereby it governs it when engaged therewith, a second valve located between the first and the tank so as when closed to shut off supply of liquid to the first valve, said second valve being kept normally closed, a mechanism acting when moved in one direction to simultaneously open said second valve and bring said float into said engagement with said first valve and when moved in the other direction to reverse said operation, and a duct adapted to deliver a liquid refrigerant into said tank, said mechanism being governed by the flow of liquid through said conduit to perform said opening and engaging movement and being operated by gravity to perform the reverse movement whenever there is no flow of liquid through said conduit.

9. In a refrigerating system, the combination with a tank having a valve-aperture, of a reciprocating needle-valve adapted to close said aperture, a spring normally maintaining said needle-valve in the closed position in which one end closes said aperture, the other end of said needle-valve having an engaging element, a float-lever turning on a pivot and having one arm adapted to engage said engaging element so as to retract said needle-valve, said float-lever also having an arm carrying a float which is adapted to rest on the surface of the liquid in said tank so as to govern the valve, said pivot being shiftable to a position in which said float-lever engages said needle-valve, a conduit adapted to lead liquid refrigerant into said tank, and means operated by liquid flowing through said conduit to shift said pivot into the last named position.

10. In a refrigerating system, the combination with a tank having a valve-aperture, of a reciprocating needle-valve adapted to close said aperture, a spring normally maintaining said needle-valve in the closed position in which one end closes said aperture, the other end of said needle-valve having an engaging element, a float-lever depending on a pivot and having one arm adapted to engage said engaging element so as to retract to said needle-valve, said float-lever also having an arm carrying a float which is adapted to rest on the surface of the liquid in said tank so as to govern the valve, said pivot being shiftable to a position in which said float-lever engages said needle-valve, an annular valve-seat surrounding said needle-valve, a reciprocating cap-valve adapted to engage said valve-seat so as to cut off communication between the tank and the needle-valve and concomitantly inclose said needle-valve, and a mechanism operated by the flow of liquid into the tank to simultaneously reciprocate said last-named valve and bring said float-arm into the valve-engaging position, said mechanism when the liquid is not flowing into the tank normally returning to the position in which said cap-valve is closed and said float-arm is out of engagement with the needle-valve.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

WALTER F. KRIEGER.

Witnesses:

GEORGE WETMORE COLLES,

W. SCHULTZ, Jr.