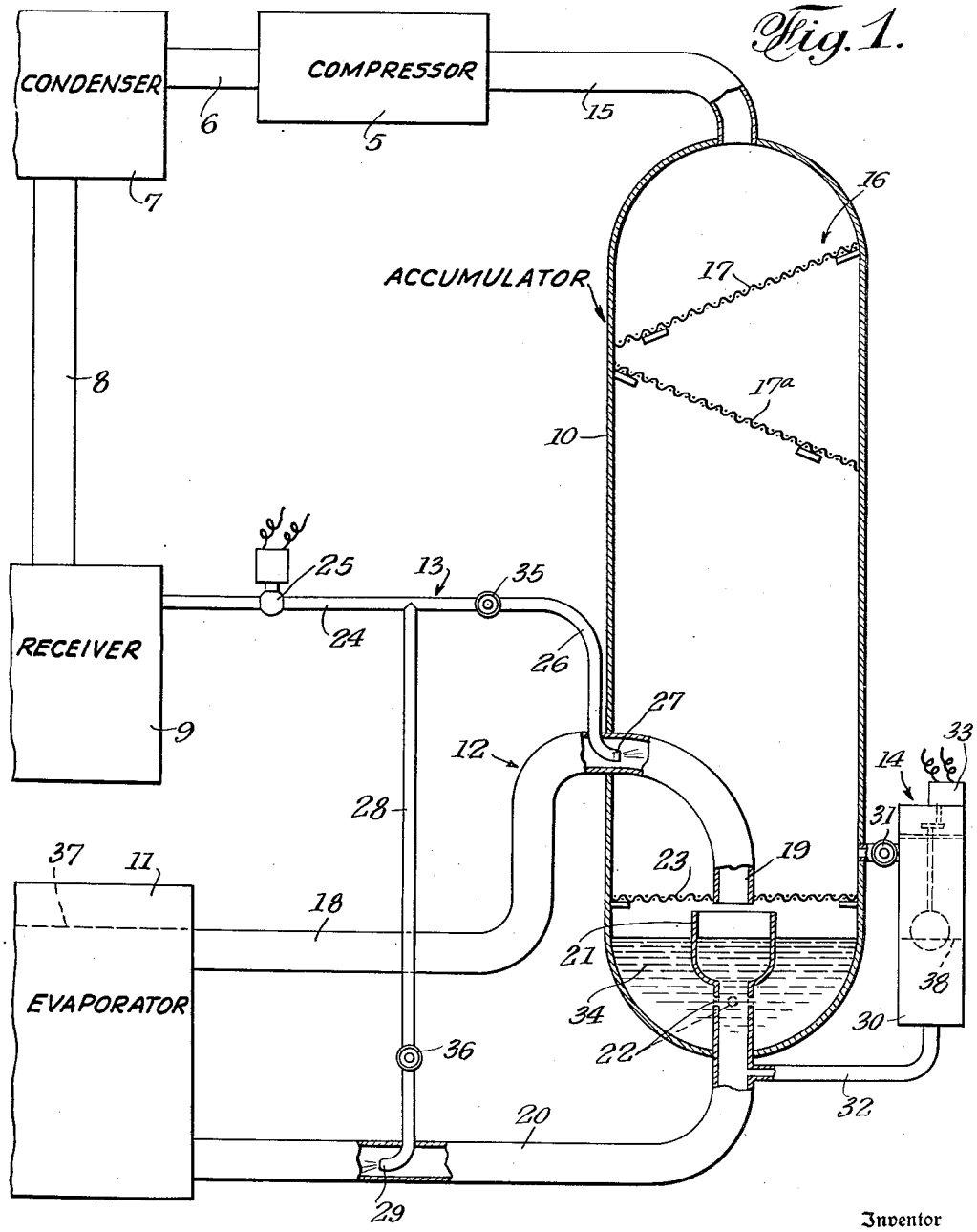
June 27, 1950 J. C. McBROOM 2,512,869

METHOD AND APPARATUS FOR CIRCULATING REFRIGERANTS

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Fig. 1.



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Fig. 2.

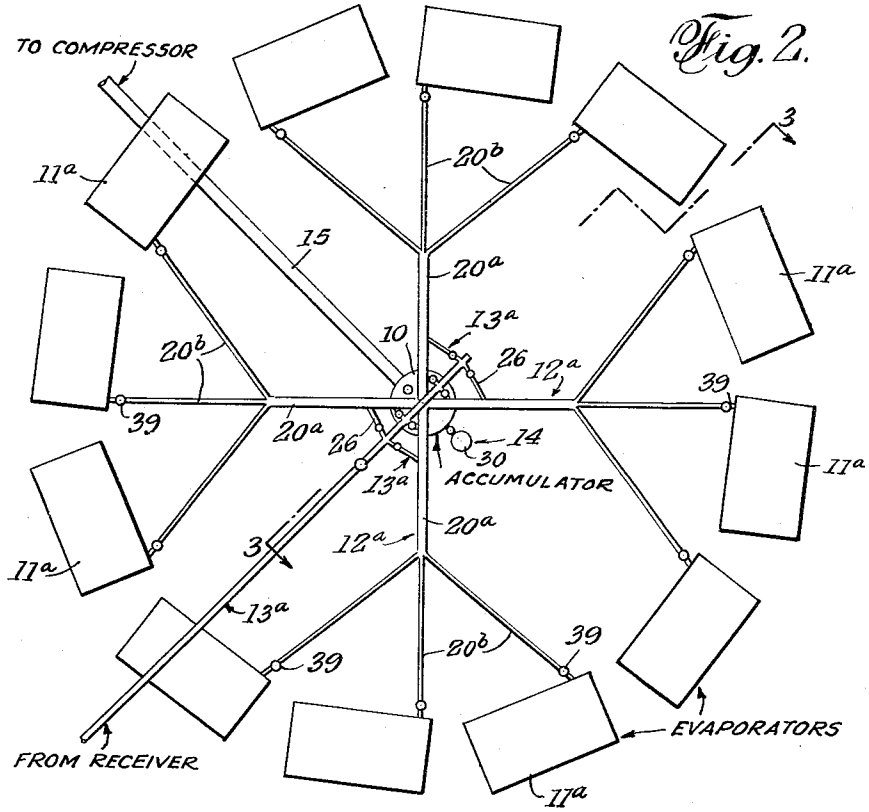
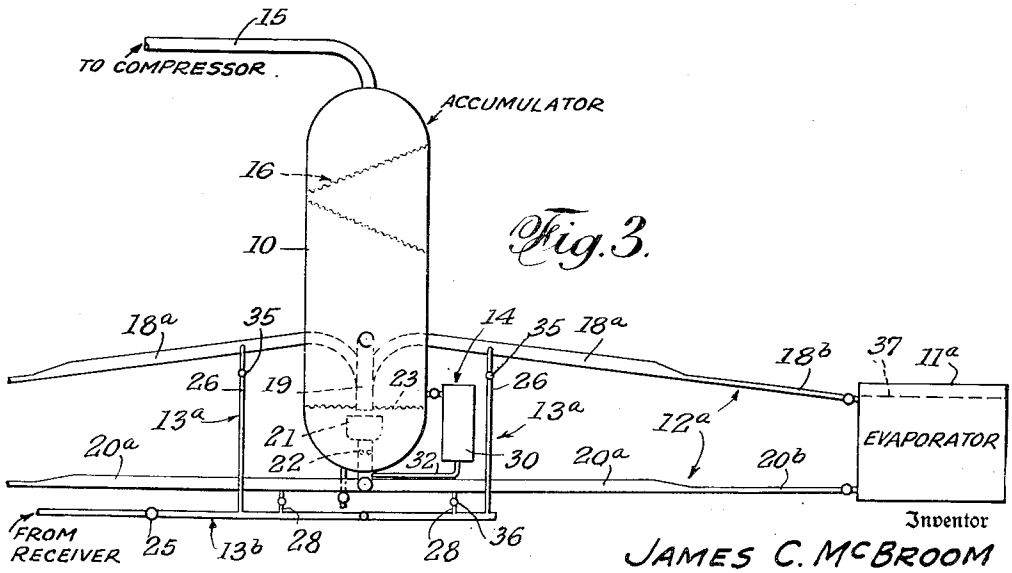


Fig. 3.



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METHOD AND APPARATUS FOR CIRCULATING REFRIGERANTS

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Application April 24, 1948, Serial No. 23,005

7 Claims. (Cl. 62—126)

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This invention relates to a method and apparatus for circulating refrigerant and is a continuation-in-part of my pending application Ser. No. 790,093, filed December 6, 1947 and entitled "Means for Intercepting Liquid Refrigerant."

As disclosed in said pending application, complete vaporization in the evaporator of the refrigerant handled by the compressor of a system, is desired. An object of the present invention, in addition to obtaining full vaporization of the refrigerant in the evaporator, is to provide refrigerating apparatus for effecting complete flooding of an evaporator or a plurality of evaporators in a refrigerating system to increase the efficiency of operation thereof. The method of circulating said refrigerant to obtain such flooding of the evaporators is also an important feature of the invention.

Another object of the invention is to provide, in a refrigerating system, automatic means, controlled by the level of liquid refrigerant in the accumulator of said system to control the flow between the receiver and the flow lines connecting the accumulator and evaporator to insure full flooding of the evaporator.

A further object of the invention is to provide a refrigerating system, while automatic in its function as above indicated, that is safe in operation even upon mechanical or electrical failure of the automatic controls, said safety being obtained, primarily, by providing an accumulator of such larger capacity than the evaporator coils, that assurance is had against slugs of liquid refrigerant reaching the compressor to deleteriously affect the same.

My invention also has for its objects to provide such means that are positive in operation, convenient in use, easily installed in a working position and easily disconnected therefrom, economical of manufacture, relatively simple, and of general superiority and serviceability.

The invention also comprises novel details of construction and novel combinations and arrangements of parts, which will more fully appear in the course of the following description. However, the drawings merely show and the following description merely describes embodiments of the present invention, which are given by way of illustration or example only.

In the drawings, like reference characters designate similar parts in the several views.

Fig. 1 is a semi-schematic view of a typical refrigerating system embodying the improvements of the present invention and showing the accumulator in sectional detail.

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Fig. 2 is a schematic view showing, in bottom plan, an enlargement of said system wherein a plurality of evaporators are connected to a common accumulator.

Fig. 3 is a sectional view as taken substantially along line 3—3 of Fig. 2.

The refrigerating system shown in Fig. 1 comprises, generally, a compressor 5, a pipe 6 that conducts refrigerant from the compressor to a condenser 7 in which a heat exchange occurs liquefying the refrigerant, a pipe 8 that conducts said liquid refrigerant into a receiver 9, an accumulator 10, an evaporator 11, a circulating system 12 for liquid refrigerant between the accumulator and the evaporator, a system of pipes 13 for conducting liquid refrigerant into the circulating system 12, automatic means 14 controlled by the level of refrigerant in the accumulator for controlling flow in the pipes 13, a flow connection 15 from the accumulator to the compressor, and refrigerant slug-breaking means 16 in the accumulator to insure the passage only of vaporized refrigerant to the compressor.

The compressor 5, condenser 7, receiver 9, and evaporator 11 are generally conventional components of a refrigerating system. The slug-breaking means 16 is similar to the comparable means disclosed in my earlier application and comprises the angularly disposed screens 17 and 17a.

The circulating system 12 comprises a pipe 18, from the evaporator, that extends into the accumulator and is formed with a downwardly directed discharge end 19, a pipe 20, that extends from the accumulator bottom to the evaporator and is formed with an upwardly directed funnel 21 beneath and aligned with pipe end 19. Below the funnel, pipe 20 is provided with a plurality of orifices 22. A screen 23 extends across the accumulator above the funnel, the pipe end 19 projecting therethrough.

The system of pipes 13 comprises a pipe 24 in which is embodied a flow-controlling solenoid valve 25, a valved branch or extension pipe 26 of pipe 24 and which enters into pipe 18 with a restricted end or orifice 27 that is turned in the direction of flow in pipe 18, and a valved branch or extension pipe 28 which enters into pipe 20 with a restricted end or orifice 29 that is turned in the direction of flow in pipe 20.

The automatic control means 14 that is illustrated comprises a float chamber 30 that has a valved connection 31 to the accumulator above the screen 23 and a connection 32 to pipe 20 and a float-controlled switch 33 electrically connected

to solenoid valve 25. The float chamber is so positioned with relation to the accumulator that a desired level of liquid 34 in the latter reflects a similar liquid level in the former.

The system above described functions as follows:

Liquid refrigerant from the receiver 9, under pressure, flows in pipes 26 and 28, when valve 25 is open, and is injected through the restricted ends 27 and 29 into the respective pipes 18 and 20. The valve 35 is opened fuller than valve 36 so that most of the flow—in practice, about 90%—is directed through pipe end 27. A similar result may be obtained by suitably proportioning the orifice openings in pipe ends 27 and 29. The liquid refrigerant, ammonia being an example thereof, flowing in circulating system 12, is aided in its flow by the injector influence of the spray from pipe end 29. The purpose of injecting the greater proportion of the liquid into pipe 18 is, that since this liquid is at nominal atmospheric or room temperature in pipes 13, its temperature is lowered in the accumulator by expansion and intermixing with liquid, at 34, from the evaporator. This reduced temperature brings the refrigerant to the boiling point for the negative or suction pressure at which the system is operating. Thus, unnecessary turbulence in the coils of the evaporator is eliminated and confines said turbulence to that which is necessary to obtain a marked refrigerating effect. Thus there is produced a larger proportion of liquid to gas refrigerant in the evaporators, thereby increasing the heat exchange in the evaporator, as well as producing more useful heat exchange because the resultant liquid is lower in temperature.

The liquid refrigerant, injected at 27, is directed together with low pressure refrigerant in pipe 18 downward into funnel 21. This funnel reduces turbulence in the accumulator and tends to create a relatively less turbulent flow that utilizes the innate inertia of the liquid, from pipe end 19 to and through pipe 20 and, thus, through the evaporator. While there may be some turbulences in the funnel 21, the liquid 34 in the accumulator will rise to a pre-determined level through orifices 22 with a minimum of turbulence and, thus, with a minimum release of slugs. The latter, if present to a small degree, are initially counteracted by screen 23. Such slugs that may pass thereby are broken up by the means 16. In this manner, a liquid flow through the evaporator, that embodies a minimum of vapor, is established, at the same time establishing the level of liquid 37 in the evaporator according to the level of the liquid 34 in the accumulator. A full-flooded circulatory system is thus provided.

Should the liquid level in the evaporator and in the accumulator rise above the point that is determined to be proper for full-flooding of the coils in the evaporator, the level 38 in float chamber will rise correspondingly to cause switch or other mechanism 33 to close to operate valve 25 and close off line 24. No refrigerant is then supplied from receiver 9. Then, as the normal vaporization of liquid 34 lowers the level thereof and, consequently, levels 37 and 38, switch or the like 33 will operate to open valve 24 and re-establish flow in system 13 as hereinbefore set forth.

The apparatus above described functions in a novel manner to circulate liquid refrigerant through the evaporator with minimum inclusion of vapors in said refrigerant; provides automatic means for maintaining a full-flooded condition

of the evaporator coils and simultaneously controls the flow of refrigerant from the receiver through the accumulator to the evaporator; reduces the production of globules of liquid refrigerant while circulating the same; and breaks up such globules that are formed before the vaporized refrigerant passes through the compressor, condensed and directed to the receiver.

The refrigerating system herein described is adapted, as shown in Figs. 2 and 3, to be designed for large installations as in warehouses, freezing lockers, etc. Fundamentally, the system embodies an accumulator, compressor (there may be more than one), a condenser, and receiver. However, a plurality of evaporators 11*a*, by means of manifold connections 18*a* and 20*a* and individual connections 18*b* and 20*b*, are commonly connected to the accumulator 10. As before, each evaporator 11*a* and circulating system 12*a* thereof is serviced by a separate liquid refrigerant conducting system 13*a* from a common line 13*b* from the receiver. A solenoid valve 24 in the latter line, as before, is controlled by means 14.

The evaporators 11*a* are arranged in multiple groups or sets as best seen in Fig. 2 and said groups are arranged in such balance that flow between the accumulator and each evaporator is substantially the same. By cutting out one or two of the three evaporators of each set, through the manipulation of valves 39, said balance is maintained with a resultant reduction in the refrigerating capacity of the system.

While I have illustrated and described what I now regard as the preferred embodiments of my invention, the construction is, of course, subject to modifications without departing from the spirit and scope of my invention. I therefore, do not wish to restrict myself to the particular forms of construction illustrated and described, but desire to avail myself of all modifications that may fall within the scope of the appended claims.

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

1. In a refrigerating system, an evaporator, an accumulator, flow connection means between said evaporator and accumulator for liquid refrigerant, means embodied in said flow connection means for minimizing the turbulence of said liquid refrigerant entering the accumulator to thereby minimize the formation of globules of refrigerant in the vapors that pass off from said liquid, said latter means comprising a downwardly directed pipe terminating in the accumulator above the bottom thereof and a funnel within the accumulator and extending above the bottom thereof, said funnel being receptive of flow from the downwardly directed pipe and connected to discharge into the evaporator, said funnel having orifices that discharge part of the flow received thereby into the accumulator.

2. The herein-described method of obtaining a full-flooded flow of liquid refrigerant between an accumulator and an evaporator of a refrigeration system which includes a receiver for the condensate of refrigerant vapor rising in the accumulator and a compressor and a condenser supplying said condensate to the receiver, that consists in introducing liquid refrigerant from the receiver into the flow between the accumulator and the evaporator and in a direction to aid said flow, and apportioning said flow to have a larger part directed toward the accumulator than is directed toward the evaporator.

3. The herein-described method of obtaining a full-flooded flow of liquid refrigerant between an

accumulator and an evaporator of a refrigeration system which includes a receiver for the condensate of refrigerant vapor rising in the accumulator and a compressor and a condenser supplying said condensate to the receiver, that consists in introducing liquid refrigerant from the receiver into the flow between the accumulator and the evaporator and in a direction to aid said flow, apportioning said flow to have a larger part directed toward the accumulator than is directed toward the evaporator, and automatically controlling flow from the receiver in accordance with the level of refrigerant accumulation in the accumulator.

4. In a refrigerating system, an evaporator, an accumulator, flow connection means for circulating liquid refrigerant from the evaporator to the accumulator and back to the evaporator, a compressor for drawing refrigerant vapors rising from an accumulation of liquid refrigerant in the bottom of the accumulator and supplied by said flow connection means, a condenser for condensing said vapors, a receiver for receiving said condensate, a flow pipe from the receiver and connected in the flow connection means for aiding the flow therein toward the accumulator, a flow pipe extending therefrom and connected in the flow connection for aiding flow therein toward the evaporator, each flow pipe terminating in a restrictive orifice that sprays liquid in each respective flow connection in the direction of flow in said connections, and automatic means controlled by the level of said liquid in the accumulator to control the flow from the receiver.

5. In a refrigerating system, an evaporator, an accumulator, flow conducting means for liquid refrigerant between the evaporator and the accumulator and extending into the latter, means embodied in said flow conducting means for minimizing the turbulence of the liquid refrigerant flowing therefrom into the accumulator to thereby minimize formation of globules of refrigerant in the vapors that pass off from said liquid refrigerant, a compressor for drawing vapor refrigerant rising from the accumulation of liquid refrigerant in the bottom of the accumulator and supplied by said flow conducting means, a condenser for condensing said vapors, a receiver for receiving said condensate, flow piping from the receiver for introducing said condensate into the flow conducting means, and automatic means controlled by the level of liquid refrigerant in the accumulator for controlling flow in said flow piping.

6. In a refrigerating system, an evaporator, an accumulator, flow conducting means comprising a portion extending from the evaporator to and into the accumulator for circulating liquid refrigerant from the evaporator into the accumulator and comprising a portion extending from within the accumulator to the evaporator for circulating liquid refrigerant from said accumulator back to the evaporator, a compressor for drawing vapor refrigerant rising from the accumulation of liquid refrigerant in the bottom of the accumulator and supplied by said flow conducting means, a condenser for condensing said vapors, a receiver for receiving said condensate, a flow pipe from the receiver and connected to the first-mentioned portion of the flow conducting means and directed to aid flow therein toward the accumulator, and a second flow pipe from the receiver and connected to the second-mentioned portion of the flow conducting means and directed to aid flow therein toward the evaporator.

7. In a refrigerating system, an evaporator, an accumulator, flow conducting means comprising a portion extending from the evaporator to and into the accumulator for circulating liquid refrigerant from the evaporator into the accumulator and comprising a portion extending from within the accumulator to the evaporator for circulating liquid refrigerant from said accumulator back to the evaporator, a compressor for drawing vapor refrigerant rising from the accumulation of liquid refrigerant in the bottom of the accumulator and supplied by said flow conducting means, a condenser for condensing said vapors, a receiver for receiving said condensate, a flow pipe from the receiver and connected to the first-mentioned portion of the flow conducting means and directed to aid flow therein toward the accumulator, a second flow pipe from the receiver and connected to the second-mentioned portion of the flow conducting means and directed to aid flow therein toward the evaporator, and a valve in each flow pipe and operable to apportion the flow therein toward the accumulator and toward the evaporator.

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