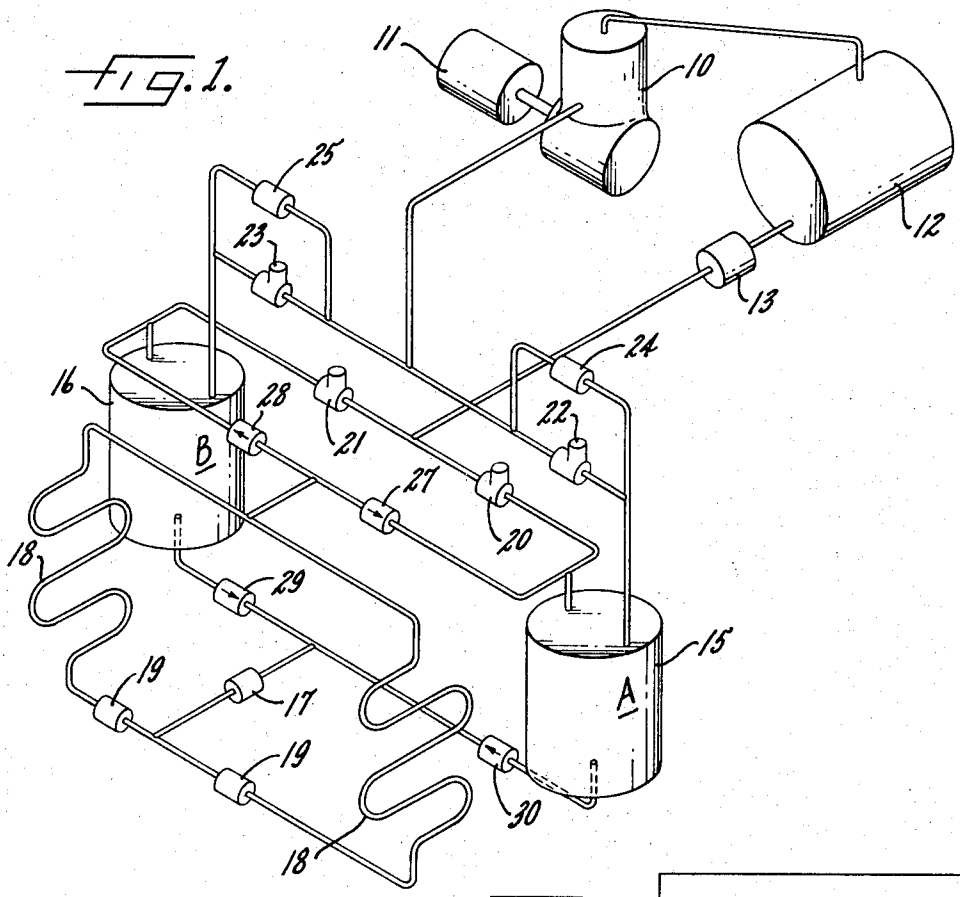
Nov. 14, 1967 J. E. WATKINS 3,352,124

LIQUID REFRIGERANT RECIRCULATING SYSTEM

Filed Feb. 11, 1966 2 Sheets-Sheet 1

Fig. 1.



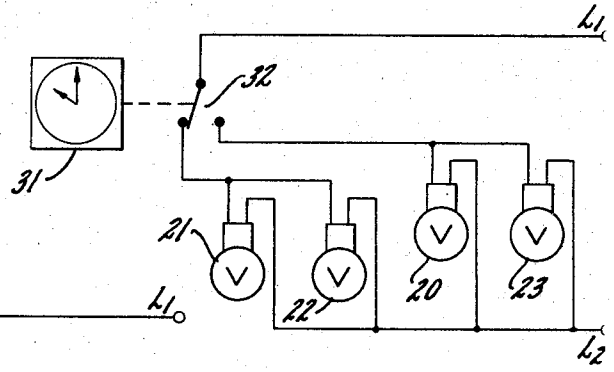


Fig. 2.

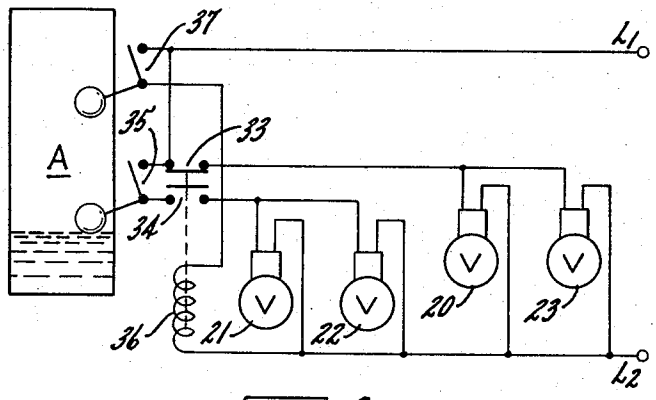


Fig. 3.

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Fig. 4.

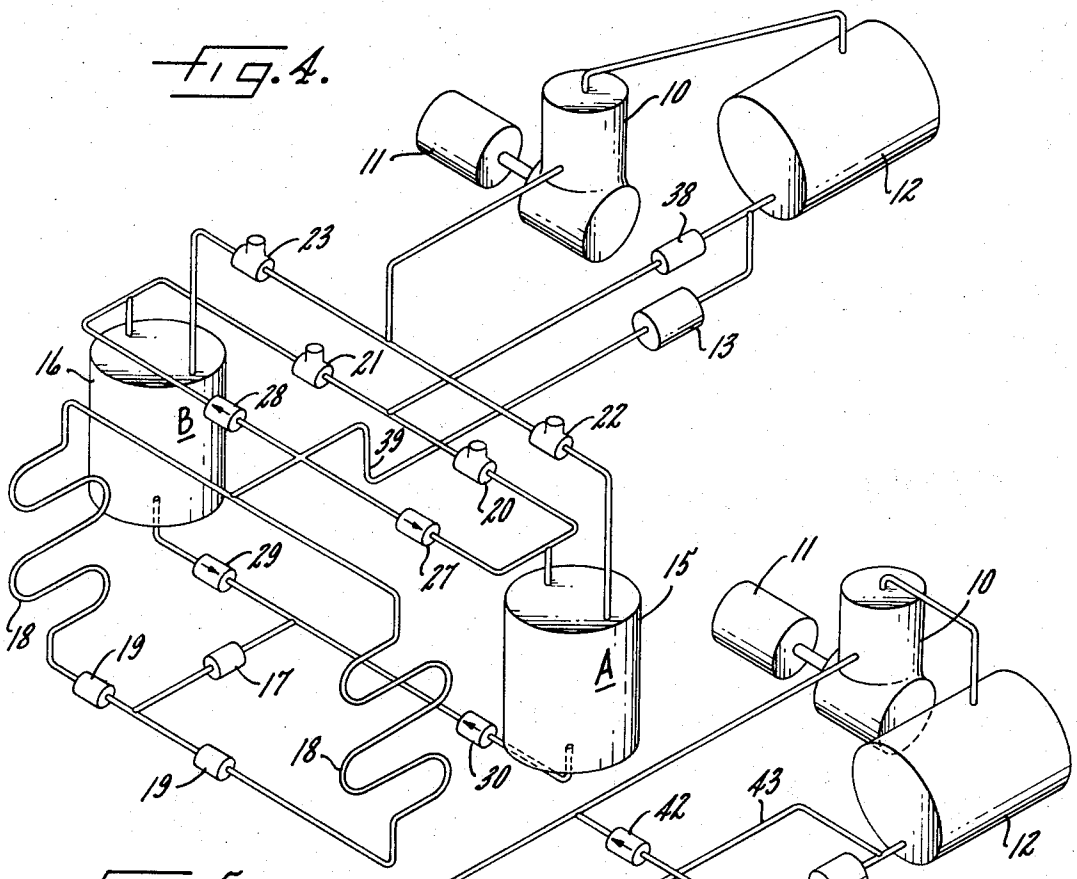
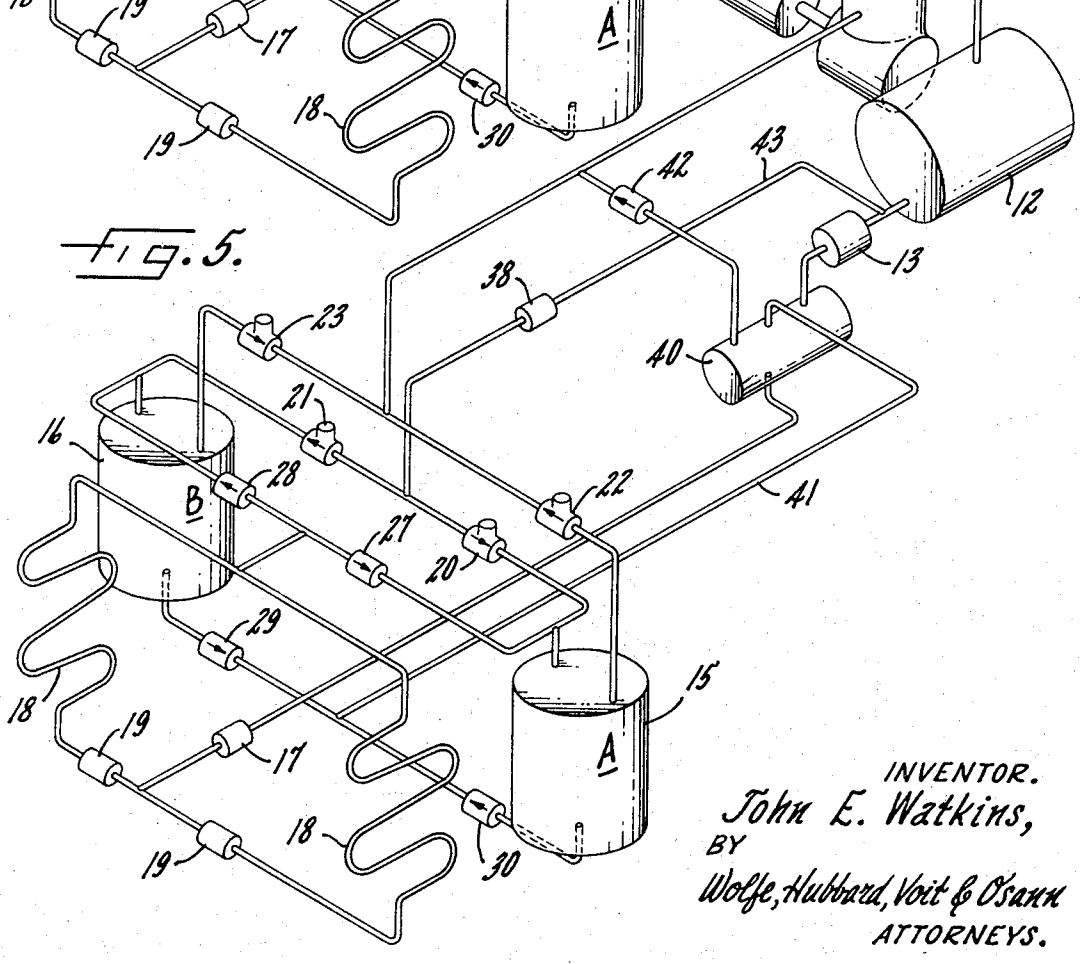


Fig. 5.



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3,352,124

LIQUID REFRIGERANT RECIRCULATING SYSTEM

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ABSTRACT OF THE DISCLOSURE

A refrigeration system using flooded evaporator coils is described, in which the evaporator overfeed of liquid refrigerant is accumulated in pumping tanks for eventual return to the evaporator, with the system being characterized by a configuration and method of operation which eliminates the requirement of a separate accumulator or other vessel for the separation of liquid from gaseous refrigerant.

This invention relates to refrigerating systems and more particularly to improvements in systems in which the evaporator coils are supplied with an excess of liquid refrigerant, which excess is collected and re-circulated back through the evaporator.

It is well known in the refrigerating art that there are many advantages to be obtained by operating the coils of an evaporator in a "flooded" condition, in which an excess of liquid refrigerant is supplied to the coils so that not all is evaporated and an overflow is obtained which may be collected and accumulated for later recirculation through the coils. Such a system is disclosed in my U.S. Patents 2,590,741, Liquid Return Trap in Refrigerating Systems, and 2,952,137, Low Pressure Refrigerating Systems, in which the advantages of such a system are described in detail. In brief, these advantages include the reduction of superheating of the spent refrigerant, allowing higher compressor volumetric efficiency, and the control of flash gas entering and of excess liquid leaving the evaporator, resulting in higher coil efficiency. These advantages result in efficient operation as well as in a system which is easy and inexpensive to maintain. However, such systems as have heretofore existed have required the use of suction accumulator tanks and their attendant bulk, complexity and added expense. These tanks, it was believed, were necessary to provide a "belly" or reservoir for the purpose of collecting the liquid overfeed from the evaporator and to positively eliminate "slugging" of the compressor, in which a quantity of unevaporated liquid refrigerant may be drawn into the compressor suction, thereby causing damage to the compressor.

Accordingly, it is a primary object of the present invention to provide a refrigerating system which will feed the evaporator an excess of liquid refrigerant over that which can be vaporized, and to collect and sequentially recirculate the excess in a simple and inexpensive manner. An allied object is the elimination of the suction accumulator tank and its associated equipment which has heretofore been necessary in such systems.

Another object is to provide a refrigeration system of the above description which may be controlled in a simple and direct manner by either a time clock mechanism or liquid-level control switches.

A further object is to provide a refrigerating system of the above description which will positively prevent slugging of the compressor under all operating conditions.

A still further object is to provide a refrigerating system of the above description which is simple to install and service, and may be easily understood and adjusted by maintenance personnel.

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings, in which the invention is illustrated in connection with a refrigerating system such as might be found in a commercial freezer or cold storage room, and having a relatively large refrigerating capacity.

FIGURE 1 is a diagrammatic view of the invention as incorporated in a refrigerating system in which refrigerant overflow from the coils is mixed with incoming liquid refrigerant from the condenser within the pumping cylinders.

FIG. 2 is a schematic circuit diagram of a time clock control circuit for the refrigerating system of FIG. 1.

FIGURE 3 is a schematic circuit diagram of an alternative liquid-level control circuit for the refrigerating system of FIG. 1.

FIG. 4 is a diagrammatic view of an alternative embodiment of the refrigerating system of the present invention.

FIG. 5 is a diagrammatic view of still another alternative embodiment of the refrigerating system of the present invention.

While the invention will be described in connection with particular preferred embodiments and processes, it is understood that the invention is not so limited. On the contrary, it is intended to cover all modifications, alternatives or equivalents falling within the spirit and scope of the invention as defined in the appended claims.

Turning now to the drawings, there is shown in FIGURE 1 a refrigerating system constructed according to one aspect of the present invention. A compressor **10** is powered by a motor **11**, and pumps warm refrigerant at a high pressure into a condenser **12**, where it is cooled and condensed into liquid. A receiver (not shown) may be incorporated with the condenser **12** to store the liquid refrigerant produced in the condenser, in service emergencies or in a special application, later mentioned. The use of a separate receiver is optional, however, and is not necessary for the practice of the present invention. All of the foregoing elements may be of conventional construction.

From the condenser **12** (or the receiver if one is used), the high pressure liquid refrigerant is directed through a condensate dump valve **13** alternately to one of two pumping tanks **15, 16** in a manner which will be hereinafter described. From one or the other pumping tanks **15, 16** the liquid refrigerant is directed through a fixed-flow feed valve **17** which serves to regulate the rate of flow of liquid refrigerant to an evaporator which comprises a plurality of cooling coils **18**, each fed through an expansion valve or feed device **19**, which cause the liquid refrigerant to drop to a lower temperature and pressure, as is well known in the refrigerating art. The valves **19** may be hand valves or orifices or of the fixed feed type. The fixed-flow feed valve **17** is preferably of the balanced pressure type, and provides a fixed rate of flow regardless of the level of refrigerant pressure applied to it. In the cooling coils **18**, the liquid refrigerant is evaporated by absorption of heat from the surroundings which comprise the area to be refrigerated. To maintain a flooded condition in the coils **18**, the fixed-flow feed valve **17** is sized such that an excess of liquid refrigerant is constantly fed to the coils over that which can be evaporated within the coils at their normal operating refrigeration load. With the feed devices **19** sized or adjusted to divide the liquid feed, the coils **18** will therefore operate in a flooded condition because of the overfeed, and will discharge a mixture of liquid and gaseous refrigerant.

In accordance with the invention, the liquid portion of the coil discharge will be trapped and subsequently re-

turned to the coils, while the gaseous portion is separated and returned to the compressor **10** where it is again pressurized and passed to the condenser **12** in the manner previously described. The pumping tanks **15, 16** are utilized in alternative sequence to catch and accumulate the excess low pressure liquid refrigerant discharging from the coils **18**, and are alternately pressurized to return the accumulated liquid to the coils.

In carrying out the invention, four solenoid valves **20, 21, 22, 23** are utilized to control the flow of refrigerant through the pumping tanks **15, 16**. In addition, two pressure-operated hold-back valves **24, 25** are connected in parallel with their associated solenoid valves **22, 23**. Finally, four one-way checkvalves **27, 28, 29, 30** are provided in the lines leading to and from the cooling coils **18**. Two checkvalves **29, 30** are provided to prevent reverse flow into the pumping tanks **15, 16**, and the other two checkvalves **27, 28** prevent reverse flow back into the coils **18**. As is best shown in the circuit diagram of FIG. 2, the inlet solenoid valve **20** for tank A is electrically interconnected with the discharge solenoid valve **23** of tank B, and the inlet solenoid valve **21** and discharge solenoid valve **22** of pumping tanks B and A are similarly interconnected. When one pair of valves is open, the other pair is closed, and vice-versa.

To describe the invention in operation, it will be assumed that at some point during operation, pumping tank A is nearly filled with liquid refrigerant, and that pumping tank B is nearly emptied. The compressor **10** and condenser **12** are supplying a steady flow of liquid refrigerant to pumping tank B, while the coil overfeed accumulates in pumping tank A. As pumping tank A becomes filled to the desired level, the inlet solenoid valve **20** is opened and the other inlet solenoid valve **21** is closed, thereby redirecting the flow of liquid refrigerant from the condensate dump valve **13** into pumping tank A and the overfeed into tank B. Simultaneously, the suction solenoid valve **23** for pumping tank B is opened, and the corresponding suction solenoid valve **22** for pumping tank A is closed. In this condition, pumping tank A now becomes pressurized by the flow of compressed liquid refrigerant from the condenser **12**, and its liquid contents are forced through the checkvalve **30** into the coils **18**. Because pumping tank A is now pressurized, the coil discharge cannot pass through the checkvalve **27** and re-enter this tank, but must instead pass through the other checkvalve **28** and flow into pumping tank B, which has dropped to suction pressure by the opening of its suction solenoid valve **23**. It will be remembered that the inlet solenoid valve **21** is now closed, preventing flow through this portion of the supply lines. But the pressure-operated hold-back valve **24** now operates to bleed off vapor to the compressor suction, maintaining tank A at a pressure determined by the valve setting.

As has been described, the sizing of the fixed-flow feed valve **17** insures a degree of overfeed such that the coils **18** operate in a flooded condition, and the discharge into pumping tank B therefore consists of both gaseous and liquid refrigerant. Pumping tank B serves as a separator, being of sufficient diameter so that the flow of gaseous refrigerant through the suction solenoid valve **23** (which is now in an open condition) does not carry with it any entrained liquid refrigerant. In this way, the excess flow of liquid refrigerant is accumulated in pumping tank B while the gaseous refrigerant which has been evaporated by passage through the coils **18** is returned to the suction line of the compressor **10** by way of the suction solenoid valve **23**.

It may be seen that the flow of liquid refrigerant from the pumping tank A into the coils **18** comprises a mixture of that liquid which had been previously accumulated as overfeed plus that which is supplied from the condenser **12** during pressurization.

The pressurization of pumping cylinder A is accomplished by closing its suction solenoid valve **22** and opening its inlet solenoid valve **20** as has been described. However, the pressure drop in the flow of liquid refrigerant from the condenser **12** through the condensate dump valve **13** and the inlet valve **20** causes a certain amount of flash gas as the refrigerant enters the pumping cylinder. This gas is utilized to pressurize the liquid contents of pumping tank A, at predetermined pressure and any excess is vented back to the compressor suction. For this purpose, the regulating valve **24** is provided, with a similar valve **25** being used to control the pressure within the other pumping tank. As the pressure within the pumping tank reaches the desired level, this regulating valve vents the excess to suction pressure to be returned to the compressor **10**.

As the coils **18** are being fed from pumping tank A, the excess liquid refrigerant resulting from the overfeed is accumulated in pumping tank B, with the evaporated gaseous refrigerant being returned to the compressor suction through the suction solenoid valve **23**. As the liquid refrigerant in the pumping tank B reaches a high level, the positions of the inlet and suction solenoid valves **20, 21, 22, 23** are reversed, thereby reversing the roles of the pumping tanks. Pumping tank A, previously pressurized, is now vented to the compressor suction by the opening of the suction solenoid valve **22**, and now serves to accumulate the liquid refrigerant overfeed from the coils **18** by way of the checkvalve **27**. Pumping tank B, previously vented to the compressor suction and used to accumulate the liquid refrigerant overfeed, is now pressurized by the closing of suction solenoid valve **23** and opening of the inlet solenoid valve **21**. Liquid refrigerant, again a mixture of returned overfeed and fresh liquid from the condenser **12**, is now supplied from pumping tank B to the coils **18** by way of the checkvalve **20**.

In keeping with two primary aspects of the invention, the positions of the inlet and suction solenoid valves **20, 21, 22, 23** are determined by automatic means. One aspect of the invention comprises a time clock mechanism **31** shown in FIG. 2 which switches the solenoid valves from their one alternative position to the other at predetermined time intervals in order to effect the reversal of the roles of the pumping tanks **15, 16**. The valves are actuated electrically from power lines L1 and L2, and are controlled by a switch **32** which is actuated by the clock mechanism **31**. In an alternative construction shown in FIG. 3, the valves are controlled by liquid-level switches located within one or both of the pumping tanks **15, 16**.

It may be seen that the volume of the pumping tanks **15, 16** must be sufficient to avoid over-filling which would send slugs of liquid refrigerant through the suction solenoid valves **22, 23** or regulating valves **24, 25** and into the compressor **10**, thereby causing damage. Therefore, in accordance with another aspect of the invention, each of the pumping tanks **15, 16** is constructed with sufficient volume to accommodate the entire system charge of liquid refrigerant, thereby eliminating any possibility that slugs of liquid might reach the compressor through a system malfunction.

It may also be seen that the length of the operating cycle during which one pumping tank is emptied while the other is filled through the overfeed is dependent upon the degree of overfeed to the coils **18** as well as upon the volume of the pumping tanks themselves. In order to avoid discharging gaseous refrigerant into the cooling coils **18**, it is necessary to switch the coil feed from one tank to the other prior to the time when the pressurized tank becomes completely empty. Because the condenser discharges its condensate as rapidly as it appears, the simple procedure of charging sufficient refrigerant into the system and adjusting the clock mechanism **31** for equal A and B cycle periods will assure such operation. Since the flow rate from each pumping tank into the coils **18** is determined by the fixed-flow feed valve **17**, the time for a given pumping tank to empty may be calculated if the rate of liquid refrigerant delivery from the condenser **12** and the percentage of coil overfeed are

known. Such a calculation must, of course, take into consideration the portion of liquid refrigerant from the condenser **12** which flashes into gaseous form in the course of pressurizing the pumping cylinders. When the time required to complete each pumping cycle has been determined, the clock mechanism **32** is adjusted accordingly, and shifts the system feed from one tank to the other prior to the complete exhaustion of liquid in either tank.

While a time clock control such as the one described has advantages of simplicity, it may not be desirable for use in installations in which large variations of cooling load are imposed on the coils **18**, causing corresponding changes in the rate of refrigerant overfeed for a fixed compressor capacity. A large increase in cooling load will result in a smaller percentage of liquid refrigerant overfeed being returned into the pumping tank then being used for accumulation, and a correspondingly larger amount of refrigerant being fed to the compressor **10** in the form of evaporated gas. This in turn will cause a change in the rate of liquid refrigerant delivered to the pumping tank then being pressurized and a corresponding variation in the rate at which that tank becomes empty.

For such installations, a liquid-level control system may be provided, although the steady drainage of condensate from the condenser and its being directed into the pumping tank then being pressurized should make the time clock control generally preferable. As will be seen by reference to the circuit diagram in FIG. 3, the solenoid valves **20, 21, 22, 23** are arranged in pairs across two conductors L1 and L2 on a suitable current supply line. The pair of solenoid valves **20, 23**, when open, effect the discharge of liquid refrigerant from pumping tank A while collecting the overflow in pumping tank B. When these valves are closed and the other pair of valves **21, 22** are opened, the roles of the pumping tanks are reversed. The former pair of solenoid valves is connected across the power supply lines through normally closed switch contacts **33**. The latter pair of solenoid valves are connected through normally open switch contacts **34**, and additionally through a float-operated switch **35** located near the bottom of one of the pumping tanks **15, 16**, in this case pumping tank A. The switch contacts **33, 34** are opened and closed by means of a relay coil **36** which is connected across the power lines through a second float-operated switch **37** disposed at a higher level within pumping tank A.

In operation, the normally closed contacts **33** cause the solenoid valves **20, 23** to be energized and thereby direct the overflow of liquid refrigerant from the coils **18** into pumping tank A. As the level of refrigerant in pumping tank A rises, the lower liquid-level switch **35** closes, but this initial closure is without effect. Closure of the liquid-level switch **37**, however, energizes the coil **36** of the relay, and actuates it to open the switch contacts **33** and to close the switch contacts **34**. The solenoid valves **20, 23** are thereby de-energized, and the solenoid valves **21, 22** are actuated. This reverses the roles of the pumping tanks as has been heretofore described, and the level of liquid refrigerant in pumping tank A will now fall as it is pressurized and its contents returned to the system.

It will be seen that the liquid-level switch **35** comprises a holding circuit with the relay contacts **34** to keep the relay coil **36** energized as the level of liquid in pumping tank A falls. Even though the upper liquid level switch **37** opens, the relay is still energized because of the action of this holding circuit. As the level falls further, it will cause the lower liquid-level switch **35** to open, breaking the holding circuit, and allowing the switch contacts **33** to return to their normally closed position, and allowing the switch contacts **34** to open in a similar fashion. Thus, the cycle is repeated, with the solenoid valves **20, 23** again being energized to once again cause liquid refrigerant overflow to enter pumping tank A and causing its level to rise.

In an alternative embodiment of the invention, illustrated in FIG. 4, most of the condensate discharging from the condenser **12** is directed to the pumping tank then being filled, rather than to the tank being discharged as in the foregoing embodiment. Also, instead of the entire condensate flow from the condenser **12** being used to pressurize the pumping tank then being discharged, only a small portion is drawn off through a pressure-reducing valve **38** and selectively directed to the pumping tank then being discharged by way of the inlet solenoid valves **20, 21**. The pressure drop through the pressure-reducing valve **38** creates a quantity of flash gas which then serves to pressurize the discharging pumping tank. This portion of the flow from the condenser **12** will constitute only a small part of the condensate available from the condenser **12**, thereby allowing the bulk of the liquid refrigerant to be drawn off through the condensate dump valve **13** and directed through a liquid supply conduit **39** to a point where it joins the flow of spent refrigerant from the coils **18** and is directed to the pumping tank then being filled by way of the one-way valves **27, 28** in the manner previously described.

It will be observed that in this embodiment the pumping tank then being filled receives a flow of liquid refrigerant from the condenser **12** as well as the liquid overfeed from the coils **18**, while the pumping tank then being discharged receives only that refrigerant which is needed for pressurizing and is drawn off through the pressure-reducing valve **38**. This requires that the pumping tanks **15, 16** be constructed with somewhat more capacity than in the previous embodiment, or that the operating cycles as controlled by the time clock **31** be decreased in duration. It will also be appreciated that the pressurizing gas obtained through the pressure-reducing valve **38** by partaking of the condensate discharge could be obtained equally well by connecting the valve **38** ahead of the condenser **12**, and obtaining pressurizing gas directly from the compressor **10**.

In another alternative embodiment of the invention, illustrated in FIG. 5, a receiver **40** is employed to collect the liquid refrigerant accumulated in the pumping tanks **15, 16** during each operating cycle. This embodiment permits the use of the invention in systems where a receiver may already be present, or where for servicing purposes a receiver is desired to accommodate the system charge refrigerant, thereby allowing the rest of the system to be conveniently drained. As in the preceding embodiments, condensed liquid refrigerant from the condenser **12** flows through the condensate dump valve **13**, but in this case enters the receiver **40** from which it enters the coils through the feed valves **17, 19** as before. In contrast to the previous embodiments, however, the liquid refrigerant discharged from each pumping tank **15, 16** as it is pressurized does not enter the coils directly from the respective pumping tanks, but does so indirectly by way of a liquid return line **41** and the receiver **40**. The receiver pressure is controlled by a settable hold-back regulator **42**, similar to the regulators **24** of the previously described embodiment. The pressure within the receiver **40** will therefore lie between the condenser and suction pressures, and is sufficiently high to supply the desired amount of liquid through the feed valves **17, 19** to the coils.

Condenser pressure is used for the purpose of pressurizing the pumping tanks **15, 16** to force their liquid contents through the return line **41** and the receiver **40** to the coils **18**. This pumping pressure may again be alternatively obtained from either of two sources, the compressor outlet or the condenser outlet. In the embodiment illustrated in FIG. 5, the latter source has been chosen. The condenser outlet pressure has been utilized by providing a pressurizing conduit **43** containing the additional pressure reducing valve **38** for the purpose of causing a pressure drop with accompanying flash gas for use in pressurizing the pumping tanks **15, 16**. Refrigerant from the pressurizing conduit **43**, comprising a mixture of liquid and flash gas, is directed to the proper pumping tank by means of the solenoid valves **20, 21** as before. It will be

appreciated that the pressurizing conduit 43 could also obtain pressurizing gas directly from the compressor 10 with equal success. The pressure-reducing valve 38 could again be utilized to minimize re-expansion from the pumping tanks 15, 16. In either case, the pumping tanks 15, 16 are relieved of the requirement of having to accommodate the condenser discharge flow in addition to their primary purpose of receiving the coil overfeed and recirculating it. The pumping tanks 15, 16 may consequently be made smaller than in the previously described embodiment of FIG. 4, or the operating cycles as controlled by the time clock 31 may be correspondingly increased in duration.

I claim as my invention:

1. A flooded-coil refrigeration system comprising, in combination, an evaporator, means for feeding said evaporator with liquid refrigerant at a flow rate in excess of that which the evaporator is capable of vaporizing, a first and a second pumping tank, a condenser, a compressor discharging pressurized refrigerant into said condenser, and control means for alternately directing the discharge from said evaporator into one of said pumping tanks and directing the vaporized refrigerant from said one pumping tank into said compressor, while discharging the liquid refrigerant from the other of said pumping tanks into said refrigeration system whereby it may be returned to said evaporator.

2. The flooded-coil refrigeration system of claim 1 in which said control means includes a time clock means which generates operating signals, and power-operated refrigerant control valves responsives to said signals.

3. The flooded-coil refrigeration system of claim 1 in which said control means includes liquid-level switches responsive to the level of liquid refrigerant within one of said pumping tanks, and power-operated refrigerant control valves responsive to signals from said liquid-level switches.

4. The flooded-coil refrigeration system of claim 1 in which said control means comprises first conduit means for directing liquid refrigerant from said condenser into one of said pumping tanks, thereby pressurizing the liquid contents thereof, second conduit means for directing said pressurized liquid contents from said one pumping tank into said evaporator, third conduit means for directing said evaporator discharge from said evaporator into the other of said pumping tanks, fourth conduit means for directing refrigerant vaporized within said evaporator into said compressor, valve means for controlling said first, second, third and fourth conduit means, and valve actuating means for alternately feeding said evaporator with liquid refrigerant from one of said pumping tanks while accumulating said overfeed in the other of said pumping tanks.

5. The flooded-coil refrigeration system of claim 4 which said control means additionally includes fifth conduit means for directing excess vaporized refrigerant from each of said pumping tanks into the suction of said compressor, said fifth conduit means including a pressure-regulated hold-back valve.

6. The flooded-coil refrigeration system of claim 4 in which each of said first and second pumping tanks is individually capable of containing the entire system charge of liquified refrigerant.

7. The flooded-coil refrigeration system of claim 1 in which said control means includes first conduit means for directing a portion of refrigerant flow from said condenser into one of said pumping tanks, thereby pressurizing the liquid contents thereof, said first conduit means including a pressure-reducing valve, second conduit means for directing the remaining portion of refrigerant flow from said condenser into the other of said pumping tanks, said second conduit means including a condensate dump valve, third conduit means for directing said pressurized liquid refrigerant from said one pumping tank into said evaporator, fourth conduit means for directing said evaporator discharge from said evaporator into the other of said pumping tanks, fifth conduit means for directing refrigerant vaporized within said evaporator into said compressor, valve means for controlling said first, second, third, fourth, and fifth conduit means, and valve actuating means for alternately feeding said evaporator with liquid refrigerant from one of said pumping tanks while accumulating said overfeed in the other of said pumping tanks.

8. The flooded-coil refrigeration system of claim 1 having a receiver, and in which said control means comprises first conduit means for directing refrigerant flow from said condenser into said receiver, second conduit means for directing liquid refrigerant from said receiver into said evaporator, third conduit means for directing said evaporator discharge from said evaporator into one of said pumping tanks, fourth conduit means for directing refrigerant vaporized within said evaporator into said compressor, fifth conduit means for directing pressurized refrigerant into the other of said pumping tanks, thereby pressurizing the liquid contents thereof, valve means for controlling said second, third, fourth and fifth conduit means, and valve actuating means for alternately discharging one of said pumping tanks into said receiver while accumulating said overfeed in the other of said pumping tanks.

9. The flooded-coil refrigeration system of claim 8 in which said fifth conduit means partakes of pressurized refrigerant from the discharge of said condenser, said fifth conduit means including a pressure-reducing valve.

10. The flooded-coil refrigeration system of claim 8 in which said fifth conduit means partakes of pressurized refrigerant from the discharge of said compressor.

11. The flooded-coil refrigeration system of claim 8 having sixth conduit means for bleeding excess flash gas from said receiver and returning said gas to the refrigeration system.

12. In a flooded-coil refrigeration system having a compressor, a condenser, a first and a second pumping tank, and an evaporator, the method of operation comprising the steps of pressurizing said first pumping tank and discharging the liquid contents thereof into said refrigeration system whereby said contents may be supplied to said evaporator, feeding said evaporator with liquid refrigerant at a rate in excess of that which the evaporator is capable of vaporizing, accumulating the overfeed of excess liquid refrigerant from said evaporator in said second pumping tank, returning the refrigerant vaporized within said evaporator to said compressor, and prior to the exhaustion of said liquid contents within said first pumping tank, reversing the roles of said first and second pumping tanks, thereby pressurizing said second pumping tank and discharging the liquid contents thereof into said refrigeration system whereby said contents may be supplied to said evaporator, and accumulating said overfeed in said first pumping tank.

13. The method of operation of claim 12 in which the pressurizing of said pumping tanks is accomplished by alternately directing a flow of pressurized refrigerant from said condenser into one of the other of said pumping tanks.

14. The method of operation of claim 12 in which the pressurizing of said pumping tanks is accomplished by alternately directing a portion of the flow of pressurized refrigerant from said condenser into one or the other of said pumping tanks through a pressure-reducing valve, the remainder of said flow being directed to the other of said pumping tanks through a condensate dump valve.

15. The method of operation of claim 12 in which the pressurizing of said pumping tanks is accomplished by alternately directing a portion of the flow of pressurized refrigerant from said compressor into one or the other of said pumping tanks, the remainder of said flow being directed into said condenser and thence through a condensate dump valve to the other of said pumping tanks.

16. The method of operation of claim 12 in which the pressurizing of said pumping tanks is accomplished by alternately directing a portion of the flow of pressurized refrigerant from said condenser into one or the other of said pumping tanks through a pressure-reducing valve, and the remainder of said flow being directed to said evaporator by way of a receiver.

17. The method of operation of claim 12 in which the pressurizing of said pumping tanks is accomplished by alternately directing a portion of the flow of pressurized refrigerant from said compressor into one or the other of said pumping tanks, the remainder of said flow being

directed into said condenser and thence directed to said evaporator by way of a receiver.

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