

May 7, 1957

E. W. ZEARFOSS, JR

2,791,101

PLURAL TEMPERATURE REFRIGERATOR

Filed Feb. 23, 1954

3 Sheets-Sheet 1

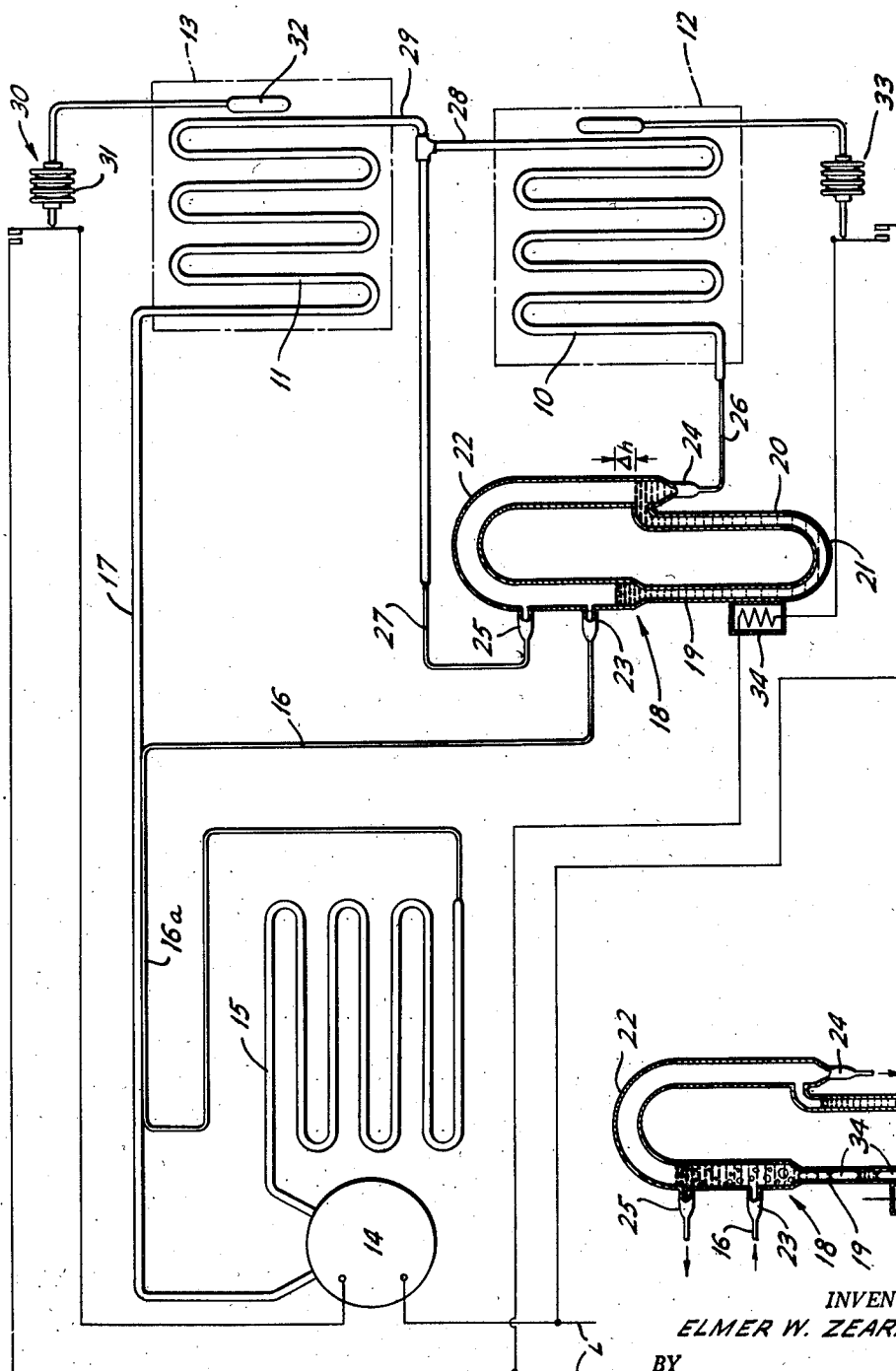


FIG. 1.

FIG. 2.

INVENTOR.
ELMER W. ZEARFOSS JR.

BY

Brown, Deak & Synnestvedt
AGENTS

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E. W. ZEARFOSS, JR

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3 Sheets-Sheet 2

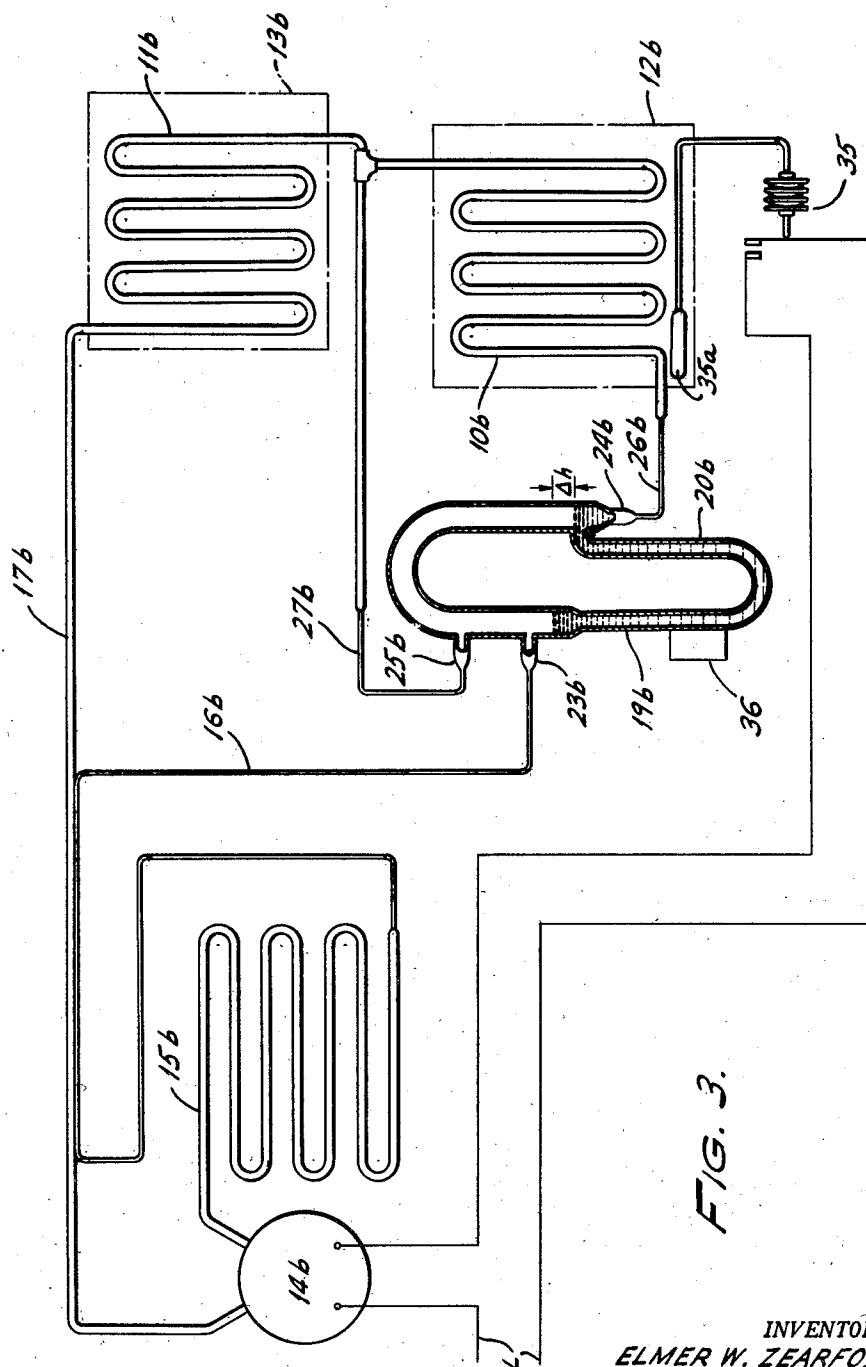


FIG. 3.

INVENTOR.
ELMER W. ZEARFOSS JR.

BY

Brown, Denk & Synnestvedt
AGENTS

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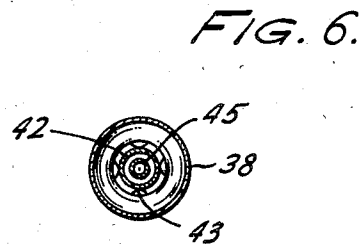
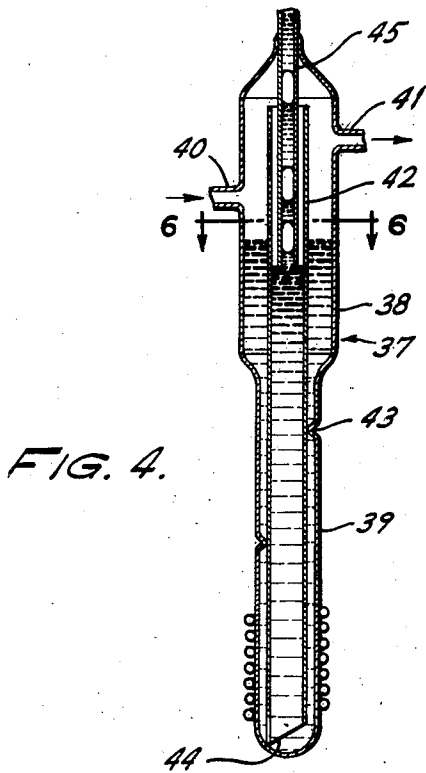
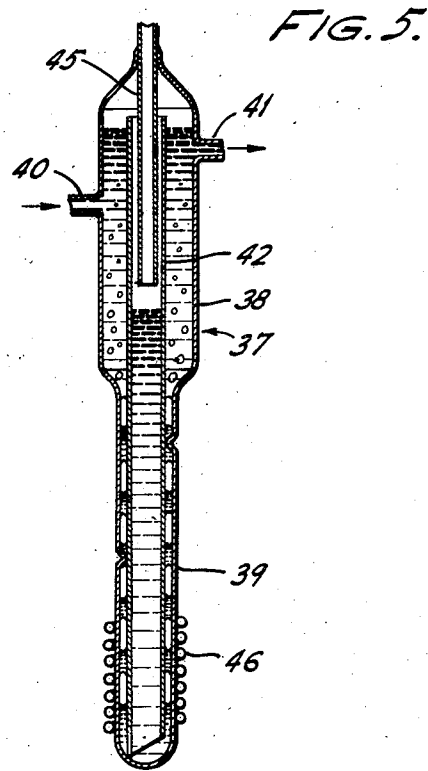
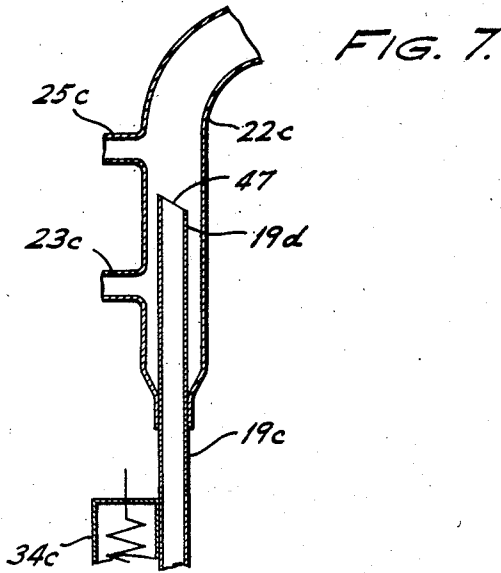
E. W. ZEARFOSS, JR

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PLURAL TEMPERATURE REFRIGERATOR

Filed Feb. 23, 1954

3 Sheets-Sheet 3



INVENTOR.
ELMER W. ZEARFOSS JR.
BY

Brown, Denk & Synnestvedt
AGENTS

1

2,791,101

PLURAL TEMPERATURE REFRIGERATOR

Elmer W. Zearfoss, Jr., Philadelphia, Pa., assignor to Philco Corporation, Philadelphia, Pa., a corporation of Pennsylvania

Application February 23, 1954, Serial No. 411,759

13 Claims. (Cl. 62—4)

My invention, which is disclosed and claimed in what follows, has to do with refrigeration apparatus, relating particularly to the problem of effecting controlled distribution of liquid refrigerant within refrigerating systems. Broadly, it is the objective of my invention to provide novel means for transferring flow of refrigerant from one circuit to an alternative circuit.

While certain aspects of the invention are of broad applicability in the field of refrigeration, principles of the invention may to advantage be embodied in refrigerators of the kind which include separate compartments each provided with evaporator means adapted to maintain the associated compartment within a predetermined temperature range.

It is now common practice in the art to provide refrigerators having two or more separate compartments, for example freezing and food storage compartments, disposed within a single cabinet structure. Commonly each of these compartments is provided with evaporator means individual to that compartment, and the refrigerating circuit includes suitable control means adapted to establish flow of refrigerant to both evaporators, or, as determined by temperature conditions prevailing in the system, to terminate flow of refrigerant to one of the evaporators while continuing flow of refrigerant to the other. Most commonly the two evaporators, when both are receiving refrigerant, are fed in series.

In certain machines of this type the flow of liquid refrigerant is controlled in such manner as to cause the first evaporator, which is usually the evaporator associated with the higher temperature food storage compartment, to cycle between a predetermined minimum temperature well below the freezing point of water and a predetermined maximum temperature sufficiently above freezing to permit melting and consequent removal of frost deposited upon said first evaporator. If such apparatus be used, defrosting "shut-downs" are not required, except on very infrequent occasions when it may become desirable to defrost and clean the evaporator which cools the freezing compartment.

Frequently refrigerators of this known type employ valve devices operating in conjunction with relatively complicated thermo-sensitive switches to achieve the desired distribution of refrigerant within the system. A novel and advantageous refrigerator of this latter type is disclosed and claimed in U. S. Patent 2,706,894 issued April 26, 1955, to Malcolm G. Shoemaker, and assigned to the assignee of the present invention. Broadly, it is a primary objective of this invention to provide simpler and less expensive apparatus adapted to attain the objectives achieved by the system of said co-pending disclosure.

With more particularity it is an object of this invention to eliminate problems inherent in prior refrigeration apparatus of the plural temperature type, by providing a simple dependable arrangement which makes it possible to maintain each of several separate zones or compartments within a predetermined temperature range, and this without recourse to complicated and frequently unre-

2

liable control devices, such as electromechanically operated valves.

Another and more specific object of my invention contemplates a multi-evaporator system in which provision is made to cause liquid refrigerant to flow selectively to one or to another evaporator, in accordance with desired modes of operation, by the simple expedient of applying heat to a portion of the circulating system. Attempts have, in the past, been made to control refrigerant distribution by the application of heat and, as compared with the devices of such earlier attempts, the apparatus of this invention is featured by the fact that positive and absolutely reliable distribution control is achieved at very low cost. Further, and perhaps more importantly, minimal heating energy is required. This latter feature has of course the corollary advantage that the heater element is of the most simple and least expensive type. In this latter regard it has been found that the few watts required may be supplied by use of a small lamp or a length of resistance wire.

In accordance with one embodiment of the invention it is an object to modulate, or control automatically, the supply of refrigerant to one of a pair of evaporators in accordance with ambient temperature, whereby the quantity of refrigerant delivered to the evaporator in the warmer compartment very closely approximates that which is required to obtain optimum refrigerating temperatures in that compartment throughout a wide range of ambient temperatures, and without substantially affecting the low temperature desired in the freezing compartment. With more particularity it is an object of the invention, in this aspect, to accomplish this general purpose by delaying flow of liquid refrigerant to the evaporator in the warmer compartment during a portion of each "on" cycle of the refrigerating apparatus.

Certain other embodiments of the invention are particularly featured by low cost and simplicity of manufacture and assembly.

In achievement of the foregoing objects and advantages, and first briefly described, the apparatus of my invention includes a novel modulator or control means to which is delivered the refrigerant flowing from the restrictor and from which refrigerant flows to the evaporator, or evaporators, of the system. While the specific construction of this flow control means is dependent upon the type of use to which the apparatus is to be put, essentially it comprises means for transferring flow of liquid refrigerant from one passage to an alternative passage, said means, in the preferred embodiment, taking the form of a conduit shaped to define a depending loop providing spaced columns of liquid refrigerant within two upstanding interconnected loop portions. One of said portions is provided with an inlet communicating with the restrictor—as a source of refrigerant—and the other of said portions has an outlet communicating with one passage to provide, under one condition of operation, for flow of refrigerant outwardly to said one passage. The portion which includes the inlet is also provided with an outlet disposed at a level above that of said first-mentioned outlet and in communication with the mentioned alternative passage. Finally, the apparatus includes means operable under a modified condition of operation to volatilize refrigerant below said inlet to lighten the column of liquid in the inlet portion of said control means, whereby flow of refrigerant to one of said outlets is substantially terminated and the refrigerant delivered through said inlet rises to a level sufficient to establish flow of refrigerant through the outlet which leads to said alternative passage.

In accordance with one embodiment of the invention the means for volatilizing refrigerant comprises a heater disposed in heat exchange relation with the column of

3

liquid standing below the inlet. In another embodiment a body of material of relatively high thermal mass is utilized in place of the heater. This body is disposed to absorb heat from the ambient atmosphere during periods of idleness of the refrigerant circulating means, and the heat so absorbed is transferred to the liquid column whereby to vapor block the normal outlet for a period of time, following initiation of operation of the circulating means, required to cause the temperature of said body closely to approach the temperature of the refrigerant within the column. In this way flow of liquid refrigerant through one of the passages or paths is delayed for a period of time which is a function of the quantity of heat contained in the said body.

The manner in which the foregoing objects and operational advantages may best be achieved will be understood from a consideration of the following detailed description taken together with the accompanying drawings, in which several embodiments of the invention are illustrated.

In the drawings:

Figure 1 is a diagrammatic view of a plural evaporator refrigerating system incorporating apparatus constructed in accordance with a preferred embodiment of the invention;

Figure 2 is a fragmentary view illustrating the refrigerant control means of the system of Figure 1, and showing the condition of refrigerant within said control means under a modified condition of operation;

Figure 3 is a diagrammatic view of a modified embodiment of the invention, this embodiment differing from that of Figure 1 as respects the electrical control circuitry and the manner in which heat is applied to the refrigerant;

Figure 4 shows a modified form of refrigerant control means and illustrates the liquid levels which obtain under a normal condition of operation when two evaporators are fed in series;

Figure 5 is a view similar to Figure 4, and illustrates the condition of the refrigerant within the control means under a modified condition of operation when one of the evaporators is by-passed;

Figure 6 is a sectional view taken on the line 6-6 of Figure 4; and,

Figure 7 is a fragmentary view illustrative of another form of control device which may be resorted to in accordance with the general principles of the invention.

Now making more detailed reference to the drawings, and initially to Figures 1 and 2 thereof, it is to be understood that the invention is therein illustrated diagrammatically as embodied in a refrigerator including two evaporators 10 and 11 each of which is adapted to cool a separate zone or space, as is represented by dotted lines shown at 12 and 13. Preferably, although not necessarily, the space 12 constitutes the food storage compartment of a household refrigerator and the space 13 comprises the low temperature freezing compartment of such a machine. It will of course be understood that the apparatus would be enclosed in a suitable insulated cabinet having partition means separating the aforesaid compartments.

In addition to evaporators 10 and 11, and in accordance with conventional practice, the system includes refrigerant circulating means 14, which in the embodiment shown takes the form of a compressor, and a condenser 15 from which liquid refrigerant flows toward the evaporators through expansion means of known type, for example through a capillary tube restrictor of the kind shown at 16, which has a portion 16a disposed in heat exchange relation with the suction line 17. The restrictor delivers a mixture of liquid refrigerant and flash gas to the modulating device or control means designated generally by reference numeral 18 and which device embodies the principles characteristic of my invention.

The modulator device, or control means, in this embodiment takes the form of a closed loop of tubing hav-

4

ing a left-hand conduit portion 19 and a right-hand conduit portion 20, these conduit portions being in fluid flow communication through a lower loop 21. The device is closed by an upper loop 22.

A mixture of liquid refrigerant and flash gas is delivered from the restrictor 16 to the device 18 through an inlet port shown at 23 and, as indicated above, the control device is provided with a pair of outlet ports one of which is shown at 24 and the other at 25. From the outlet ports or passages 24 and 25 lead, respectively, a conduit 26 and a conduit 27, conduit 26 being arranged to feed evaporator 10 from whence refrigerant flows to evaporator 11 through the connecting pipes shown at 28 and 29. As is apparent from the drawing, conduit 27 leads to pipe 29 which feeds evaporator 11 and, when flow through conduit 27 and pipe 29 is established, refrigerant flows directly to evaporator 11 without passing through evaporator 10. As will be understood, volatilized refrigerant leaving the evaporator means returns to the compressor 14 through suction line 17. Each of the conduits 26 and 27 has a portion of slightly restrictive dimensions, this restriction being present in order to overcome the hydrostatic differential which results from differences in elevation between the inlet regions of the two evaporators. Such restriction is introduced into the conduits to insure that the pressure developed in the modulator device 18 is sufficient to overcome the aforesaid differential.

In operation the modulating device 18 distributes refrigerant between the two evaporators in such manner as to maintain a desired temperature within each of the compartments 12 and 13, this result being accomplished in accordance with the determinations of control circuitry to be later described, and without the use of valves.

Under a normal operating condition, which can be considered to be the condition when the two evaporators are fed in series, spaced columns of liquid refrigerant stand within the two upstanding interconnected loop portions or conduits 19 and 20, and there exists a differential head (Δh in Figure 1) which is a function of the rate of refrigerant flow through the inlet port 23 and of the restrictive effect of the passage leading from the outlet port 24 and through the evaporator system. Under the normal condition of operation when flow is through the two evaporators in series, the differential head drives liquid downwardly through the loop portion 21, upwardly through the portion 20, and thence through outlet port 24 and to the evaporators. The flash gas which is not entrained in the flow through outlet port 24 is collected in the upper portion 22 of modulator device 18 and returns to the compressor through conduit 27 and evaporator 11.

The compressor 14 is under control of a thermo-sensitive switching device 30 which includes a bellows-actuated switch 31 of known type and a temperature sensitive bulb 32 so disposed as to be responsive to temperatures prevailing at the freezing evaporator 11. It is to be understood that bulb 32 may be disposed in heat exchange relation with evaporator 11, or it may be spaced somewhat from the evaporator, these locations being contemplated by definition of the bulb as being responsive to temperatures prevailing "at" the evaporator. When the evaporator temperature has been reduced to a predetermined lower limit, for example -10° F., the contacts associated with bellows 31 are opened and operation of the motor compressor is terminated. When the temperature at evaporator 11 has risen to a predetermined upper limit, for example in the neighborhood of 0° F., the mentioned contacts are reclosed and the compressor is again placed across the line L, with consequent resumption of the above described refrigerant feeding cycle.

The apparatus is provided with a second thermo-sensitive switching device shown at 33, which device also includes contacts, a bellows actuator, and a control bulb. all as described with reference to the device 30. Until

5

the aforesaid normal portion of the operating cycle has continued for a period of time sufficient to reduce the temperature in the vicinity of the food compartment evaporator 10 to a predetermined lower limit, for example 0° F., flow of refrigerant through the outlet port 24 continues under the influence of the differential head mentioned. When the lower control temperature is reached, however, the contacts associated with switch device 33 are closed and a heater shown at 34a is energized by being connected across the line L. It is a feature of this invention that the mentioned heater may be of very low wattage, for example something less than 5 watts would usually be sufficient; and energization of this heater is all that is required to effect the "modulation" referred to above.

Heat thus applied to the conduit or portion 19 of the control device 18 volatilizes liquid refrigerant within the conduit portion 19 with the result that the left-hand column is lightened to the extent that bubbles of gaseous refrigerant are formed therein and displace liquid refrigerant present under the normal condition of operation. This condition is illustrated in Figure 2 wherein a number of such bubbles have been designated by the numeral 35, these bubbles being in sufficient quantity to establish a new condition of equilibrium between the right and left-hand columns of refrigerant, thereby to terminate flow of refrigerant from the left-hand column to the right-hand column and to cause the level of refrigerant to drop, in the right-hand column, below a level at which outlet 24 is fed. The left-hand column, on the other hand, rises until liquid refrigerant reaches the outlet 25 from whence it flows through conduit 27 and pipe 29, to feed the evaporator 11 directly, and without passage through evaporator 10. In effect, the left-hand conduit 19 has been vapor blocked and, as a result of such blocking, flow of liquid refrigerant is transferred from the normal conduit 26 to the alternative conduit 27.

The condition illustrated in Figure 2 obtains until the temperature prevailing at evaporator 10 has reached the upper control point of switch device 33, this point having a temperature value sufficiently above the freezing point of water to insure complete defrosting of the evaporator 10. When this upper control point is reached the heater 34a is deenergized, and flow through both evaporators is resumed by virtue of reestablishment of the differential head Δh . It will be recognized that, under either condition of operation, the desired low temperature is maintained in the freezing compartment 13, whereas the mentioned cyclic flow of refrigerant to the evaporator which cools the warmer compartment 12 is controlled within limits which maintain the latter compartment at an average temperature, for example 38° F., suitable for the storage of fresh foods.

The quantity of energy required at heater 34 is a function of physical design, being determined by the cross-sectional area of conduits 19 and 20, by the restrictive effect of the circuit through the evaporators in series, and by the rate of flow of refrigerant within the system. In an embodiment which has yielded very satisfactory results the wattage of the heater has been less than the rated wattage of the solenoid valves frequently used in dual compartment refrigerators.

Now making reference to the embodiment of the invention illustrated in Figure 3, it will be observed that this system is generally similar to that already described, but that it does not include the heater device, and a single temperature control switch is sufficient to achieve all phases of operation. Parts of the system of Figure 3 which coincide with similar portions of the embodiment of Figure 1 have, for convenience, been identified by similar reference numerals, in each case bearing the subscript "b."

Under the normal condition of operation, that is the condition when flow of refrigerant is through the evaporators 10b and 11b in series, the operation of the embodi-

6

ment of Figure 3 is virtually identical to the operation already described with reference to Figure 1. The difference resides in the fact that a single thermo-sensitive switch device, shown at 35, is utilized to control the system, no heater being employed. In this embodiment it is preferable that the control bulb 35a be so disposed as to be affected by the temperature of air in compartment 12b as well as by the temperature of the evaporator 10b, and the cut-off calibration temperature of the control device 35 is somewhat above the minimum desired evaporator temperature. The cut-in calibration temperature of the device 35 is sufficiently above the freezing point of water to insure complete defrosting of the evaporator 10b. It is to be borne in mind that when the cut-in temperature of the control has been reached, the evaporator 10b having become completely defrosted, the freezer evaporator 11b has not risen substantially above its normal value, since the freezing evaporator 11b is so proportioned with respect to the size of the freezing compartment 13b as to permit relatively little rise in the temperature of the latter evaporator during even rather extended periods of compressor idleness.

In the embodiment of Figure 3 the warmer food storage compartment is maintained at a substantially constant above-freezing temperature, regardless of wide fluctuations in ambient temperature, and without the use of heaters and the like. No this end a body of material of relatively high thermal mass is arranged in heat exchange relation with the left-hand conduit portion 19b of the modulator device. This body is shown at 36, and it is to be understood that it is also disposed in heat exchange relation with the ambient atmosphere. By virtue of being disposed in heat exchange relation with the ambient air, body 36—which may comprise metal or some suitable liquid—absorbs heat, which heat is transferred to the liquid within the conduit portion 19b at the initiation of each operating cycle. This heat transfer results in vaporization of refrigerant within the left-hand column, in the manner already described with reference to Figure 2, and the consequent lightening of the left-hand column results in delaying initiation of the normal series feed condition for the period of time required to cause the temperature of body 36 closely to approach the temperature of the refrigerant within conduit portion 19b. In this way flow of refrigerant from the left-hand conduit to the right-hand conduit, and thence to the evaporator 10b, is delayed for a period of time which is a function of the quantity of heat contained in said body. It will be understood, of course, that during the delay period liquid refrigerant rises in the left-hand column and flows through the outlet port 25b directly to the evaporator 11b, by-passing the evaporator 10b.

The delay period, or length of time during which liquid refrigerant is prevented from flowing to evaporator 10b, is influenced by several factors such as the thermal capacity of the mass 36, the insulating value of the cabinet structure, and by the ambient temperature. By proper control of these factors the flow of refrigerant to evaporator 10b may be controlled to the desired extent and in this way predetermined temperatures may be maintained within the warmer compartment 12b. It is to be understood that the heat exchange relation between the mass 36 and the ambient atmosphere should be such that inflow of heat from the ambient air to the mass is at a rate considerably less than 5 watts, at the highest ambient temperatures encountered in practice. This prevents permanent vapor blocking of the normal outlet.

It is desirable to minimize the refrigerating effect of the evaporator disposed within the food storage compartment under conditions of low ambient temperature since, under these conditions, there is a risk of freezing foods stored in that compartment. During cyclic operation at lower ambient temperatures the delay time is relatively short, due to the fact that less heat has been absorbed by

7

the body 36. However this is offset by the fact that under lower ambient temperature conditions the refrigerating unit cycles frequently. Each cycle produces delay as set forth, and in this way passage of active liquid refrigerant to the evaporator 10b is minimized. Under high ambient temperature conditions although the delay time is longer for each individual period of delay, the aggregate delay time is relatively short since the unit tends toward steady operation rather than cycling frequently. In practice the accumulated delay time at lower ambient temperatures is considerable and operates to limit the refrigerating effect of the evaporator 10b as compared with the refrigerating effect of that evaporator under higher ambient temperatures. In this way the desired modulation is achieved.

In Figures 4, 5 and 6 are illustrated a modified form of modulator or control device. This device differs from that shown and described with reference to Figures 1 to 3 primarily in that the embodiment of Figures 4 to 6 is more compact and is simpler to manufacture and assemble.

Referring first to Figure 4 it will be seen that the device comprises an outer tubular shell 37 having a larger upper portion 38 and a smaller lower portion 39. This shell corresponds to the left-hand column or conduit of the device described above, and is provided with an inlet port 40 adapted for connection to the capillary tube restrictor, and with an outlet port 41 which is adapted for connection to the second of the two evaporators which comprise the series circuit (for example the evaporator 11 of Figure 1).

Disposed within the shell 37 is a standpipe 42, this pipe being open at both ends and being supported within the shell 37 in any convenient manner as by "dimples" or indentations 43 provided in the shell 37 (see particularly Figure 6). The lower end of the standpipe is cut angularly in order that one edge portion 44 may be supported by the bottom of the standpipe without interfering with freedom for passage of liquid refrigerant from the lower part of the shell to the standpipe. An outlet pipe 45 extends from the top of the shell 37 downwardly within the standpipe 42.

Under the normal condition of operation, that is when the two evaporators are fed in series, liquid refrigerant accumulates within shell 37 and rises within the standpipe 42 until it reaches the outlet 45 which leads to the two evaporators in series. As is the case with the embodiments earlier described, liquid flows from the restrictor to the inlet 40 at a rate sufficient to create a differential head between the outer and inner liquid columns, and under the influence of this head slugs of liquid refrigerant flow outwardly through pipe 45 and thence to the two evaporators.

When it is desired to by-pass the first of the two evaporators in the series circuit, and as is best illustrated in Figure 5, a heater 46 is energized, the resultant absorption of heat causing volatilization of the refrigerant standing within the shell 37. This has the effect of unbalancing the two liquid columns, the outer column becoming considerably lighter, with the result that the inner column falls below the outlet 45 and the outer column rises until liquid refrigerant passes through the outlet 41 and to the second evaporator in the series circuit. In the vicinity of heater 46, and for some distance above the same, the shell portion 39 is closely spaced from standpipe 42. This minimizes the quantity of gas required to achieve the liquid levels shown in Figure 5. Under the operating condition, illustrated in Figure 5, the gaseous refrigerant collected within the upper part of shell 37 flows downwardly within the upper portion of standpipe 42 and returns to the suction line through outlet 45.

In the last of the illustrated embodiments (Figure 7) there is provided apparatus generally similar to that shown at 18 in Figure 1, Figure 7 illustrating a fragmentary part of the left-hand column of such a device.

8

The modification resides in extending the upper part of the looped circuit 19c (corresponding to conduit 19 in the form of Figure 1) upwardly within the top looped port 22c to a position such that its inlet 47 lies above the port 23c through which refrigerant flows into the modulator. The second outlet port 25c, which corresponds to the outlet shown at 25 in Figure 1, leads directly to the second evaporator, for example, to evaporator 11 in Figure 1. A heater 34c is disposed in heat exchange relation with the lower part of extended conduit 19c.

In the embodiment of Figures 1 to 3 it has been observed that there is occasionally a tendency, when the heater is energized, for bubbles of gas to pass downwardly through the loop 21 and upwardly into right-hand conduit 20. To the extent that this takes place a percolator or vapor lift action occurs in the right-hand conduit and the desired complete termination of flow through that conduit is not achieved.

In the form shown in Figure 7 the mentioned revision, that is the addition of a standpipe extension 19d to the conduit 19c, eliminates any possibility of such vapor lift taking place. When heat is not being applied, the liquid level rises and falls somewhat in a region just above the inlet 23c in such manner that gaseous and liquid refrigerant alternately enter the mouth of standpipe 19d. While the mode of operation has not been precisely established, it is believed that, at the moment a bubble of gas enters the mouth of the standpipe, the flow of refrigerant downwardly through conduit 19c is virtually halted because the gas is of low density and the requisite differential head is, therefore, momentarily lacking. However when the next droplet or "slug" of liquid enters the mouth of standpipe 19d there occurs another impulse of liquid flow downwardly through the conduit 19c and, accordingly, intermittent but continual progress of refrigerant downwardly through the conduit 19c takes place. The existence of a bubble of gas at the mouth 47 of the standpipe 19d is only a transient condition and the subsequent displacement of any such bubble by a droplet of liquid constitutes the mechanism of operation.

When the heater 34c is energized the resultant gas flows upwardly from its zone of origin and prevents entry of the small droplets of liquid necessary to produce the normal intermittent feed of conduit 19c. In this manner flow of liquid downwardly around the loop is positively terminated and the liquid level rises within the modulator until refrigerant passes outwardly through the port 25c leading to the second evaporator in the series circuit.

From the foregoing description it will be understood that by the present invention there is provided simple, positive, and inexpensive apparatus capable of effecting controlled distribution of liquid refrigerant between alternative paths in a refrigerating system whereby to maintain desired temperatures automatically, and without resort to costly and unreliable valves or complicated control circuitry.

The disclosed apparatus is of course subject to certain changes and modifications without departing from the essential spirit of the invention. For example, the described modulating means could be used to by-pass the evaporator means completely, rather than being employed to distribute refrigerant between two evaporator portions. In such event provision would be made (as by means of a suitable auxiliary heat exchanger or accumulator) to re-evaporate or store the by-passed liquid refrigerant prior to return thereof to the compressor pump. In addition, the conduits of the control device need not necessarily extend vertically as shown in the drawings, but could be inclined from the vertical, and such a modification is contemplated by the term "upstanding," as used in the claiming. However, it will be understood that such changes and modifications are contemplated as come within the scope of the appended claims.

I claim:

1. In a refrigerating system including means for sup-

plying liquid refrigerant and means defining a pair of paths to be fed, selectively, from said supply means; flow control means, comprising: first and second upstanding conduit means having their lower portions in fluid flow communication, the said first conduit means being provided with a refrigerant inlet port through which liquid refrigerant from said supply means is fed directly to said first conduit means, said first conduit means also being provided with a refrigerant outlet port disposed above the level of said inlet port and adapted to feed one of said paths, said second conduit means being ported for outlet communication with the other of said paths at a level below the level of the said outlet port and accommodating flow of liquid refrigerant from said second conduit means to the other of said paths; and means operable to volatilize refrigerant in said first conduit means.

2. In a refrigerating system including means for supplying liquid refrigerant and means defining a pair of paths to be fed, selectively, from said supply means, flow control means, comprising: first and second upstanding conduit means having their lower portions in fluid flow communication, said first and second conduit means constituting a pair of tubing sections forming a depending loop of tubing; the said first conduit means being provided with a refrigerant inlet port through which liquid refrigerant from said supply means is fed directly to said first conduit means, said first conduit means also being provided with a refrigerant outlet port disposed at a level above the level of said inlet port and adapted to feed one of said paths, said second conduit means being ported for outlet communication with the other of said paths at a level below the level of the said outlet port; and means operable to volatilize refrigerant in said first conduit means.

3. In a refrigerating system including means for supplying liquid refrigerant and means defining a pair of paths to be fed, selectively, from said supply means, flow control means, comprising: first and second upstanding conduit means having their lower portions in fluid flow communication, said second conduit means being nested within said first conduit means; the said first conduit means being provided with a refrigerant inlet port through which liquid refrigerant from said supply means is fed directly to said first conduit means, said first conduit means also being provided with a refrigerant outlet port adapted to feed one of said paths, said second conduit means being ported for outlet communication with the other of said paths at a level below the level of the said outlet port; and means operable to volatilize refrigerant in said first conduit means.

4. In a refrigerating system including means for supplying liquid refrigerant and means defining a pair of paths to be fed, selectively, from said supply means, flow control means, comprising: first and second upstanding conduit means having their lower portions in fluid flow communication; the first conduit means being provided with a refrigerant inlet port through which liquid refrigerant from said supply means is fed directly to said first conduit means, said first conduit means also being provided with a refrigerant outlet port adapted to feed one of said paths, said second conduit means being ported for outlet communication with the other of said paths at a level below the level of the said outlet port; and means operable to volatilize refrigerant in said first conduit means comprising a body of material of relatively high thermal mass associated in heat exchange relation with said first conduit means and being disposed to absorb heat from the ambient atmosphere during periods of idleness of said refrigerant supply means, the construction and arrangement being such that heat passes from said body to said conduit means and is effective to evaporate liquid refrigerant normally flowing through the latter whereby to vapor-block the same for the period of time, following initiation of operation of said means

for supplying liquid refrigerant, required to cause the temperature of said body closely to approach the temperature of the refrigerant flowing through said conduit means, whereby the flow of liquid refrigerant through the said conduit is delayed for a period of time which is a function of the quantity of heat contained in said body.

5. In a refrigerating system including means for supplying liquid refrigerant and means defining a pair of paths to be fed, selectively, from said supply means, flow control means, comprising: first and second upstanding conduit means having their lower portions in fluid flow communication, said second conduit means being nested within said first conduit means, the said first conduit means comprising an enclosed, ported, tubular shell, and said second conduit means comprising a tubular member open at its ends and disposed within said tubular shell in spaced relation with respect to at least major portions of the inside wall of the latter; the said first conduit means being provided with a refrigerating inlet port through which liquid refrigerant from said supply means is fed directly to said first conduit means, said first conduit means also being provided with a refrigerant outlet port adapted to feed one of said paths said second conduit means being ported for outlet communication with the other of said paths at a level below the level of the said outlet port; and means operable to volatilize refrigerant in said first conduit means.

6. In a refrigerating system including means for supplying liquid refrigerant and means defining a pair of paths to be fed, selectively, from said supply means, flow control means, comprising: first and second upstanding conduit means having their lower portions in fluid flow communication, said second conduit means being nested within said first conduit means, the said first conduit means comprising an enclosed, ported, tubular shell, and said second conduit means comprising a tubular member open at its ends and disposed within said tubular shell in spaced relation with respect to at least major portions of the inside wall of the latter; the said first conduit means being provided with a refrigerating inlet port through which liquid refrigerant from said supply means is fed directly to said first conduit means, said first conduit means also being provided with a refrigerant outlet port adapted to feed one of said paths, said second conduit means being ported for outlet communication with the other of said paths at a level below the level of the said outlet port; and means operable to volatilize refrigerant in said first conduit means comprising heating means disposed in high heat exchange relation with a lower portion of said tubular shell.

7. A refrigerating system including means comprising a source of liquid refrigerant, means defining a first passage for refrigerant flowing from said source and including evaporator means, means defining an alternative passage for refrigerant flowing from said source and disposed in the system to by-pass said evaporator means, control means for transferring flow of liquid refrigerant from said first passage to said alternative passage, said control means comprising: first and second upstanding conduit means having their lower portions in fluid flow communication; the first said conduit means being provided with a refrigerant inlet port through which liquid refrigerant from said source is fed directly to said first conduit means, said first conduit means also being provided with a refrigerant outlet port at a level above that of said inlet port and communicating with said alternative passage, said second conduit means having an outlet communicating with said first passage to provide, under one condition of operation, for flow of refrigerant from said inlet port and thence outwardly to the said first passage; and means operable under a modified condition of operation, to volatilize refrigerant in said first conduit means to lighten the column of liquid in said first conduit means, whereby flow of liquid re-

frigerant from said inlet port and through the said second conduit means to its outlet is substantially terminated and refrigerant delivered through said inlet port rises in said first conduit means to a level sufficient to establish flow of refrigerant through said first-mentioned outlet port and thence to said alternative passage.

8. A refrigerating system including means comprising a source of liquid refrigerant, means defining a first passage for refrigerant flowing from said source and including evaporator means, means defining an alternative passage for refrigerant flowing from said source and disposed in the system to by-pass said evaporator means, control means for transferring flow of liquid refrigerant from said first passage to said alternative passage, said control means comprising: a conduit shaped to define a depending loop providing columns of liquid refrigerant within two upstanding interconnected loop portions, one of said portions being provided with an inlet through which liquid refrigerant from said source is fed directly to said one portion whereby to deliver refrigerant to said other portion, the other of said portions having an outlet communicating with said first passage to provide, under one condition of operation, for flow of refrigerant from said inlet and thence to said one passage, the said one portion also having an outlet disposed at a level above that of both said inlet and said first-mentioned outlet and communicating with said alternative passage; and means operable under a modified condition of operation to volatilize refrigerant in said one portion to lighten the column of liquid in said one portion, whereby flow of liquid refrigerant from the inlet and through the said other portion to its outlet is substantially terminated and refrigerant delivered through said inlet rises in said one portion to a level sufficient to establish flow of refrigerant through said first-mentioned outlet and thence to said alternative passage.

9. In a refrigerating system including means for supplying liquid refrigerant and means defining a pair of paths to be fed, selectively, from said supply means, flow control means, comprising: first and second conduit means having their lower portions in fluid flow communication; said first conduit means being provided with a refrigerant inlet port through which liquid refrigerant from said supply means is fed directly to said first conduit means, said first conduit means also being provided with a refrigerant outlet port communicating with one of said paths and disposed above the level of said inlet port, said fluid flow communication being such that refrigerant flowing from said first conduit means to said second conduit means is derived from said first conduit means at a level above the level of said inlet port, said second conduit means being provided with a refrigerant outlet port communicating with the other of said paths and disposed at a level below the level of said outlet port of said first conduit means; and means operable to volatilize refrigerant in said first conduit means.

10. In a refrigerating system including means for supplying liquid refrigerant and means defining a pair of paths to be fed, selectively, from said supply means, flow control means comprising: conduit means normally containing, during operation of the system, two columns of liquid refrigerant having their lower portions in fluid flow communication; means for feeding liquid refrigerant to one of said columns from said supply means, said one column also being in outlet communication with one of said paths at a level above that of said means for feeding liquid refrigerant; means providing for outlet communication between said other column and the other of said paths, the construction and arrangement being such that the flow of liquid refrigerant fed from said supply means is normally through said one column and thence

to said other column to said other path; and means for transferring flow from said other path to said one path, comprising means operable to volatilize refrigerant contained in said one column whereby to lighten and raise said column.

11. A refrigerating system in accordance with claim 10, further characterized in that said last-mentioned means comprises an electrical resistance heater disposed in heat exchange relation with said one column, and further including temperature responsive means effective to control operation of said heater, whereby to maintain desired refrigerating temperatures in said system.

12. For a refrigerating system including means for supplying liquid refrigerant and means defining a pair of paths to be fed, selectively, from said supply means, flow control means comprising: first and second conduit means having their lower portions in fluid flow communication; said first conduit means being provided with a refrigerant inlet port through which liquid refrigerant from said means for supplying is fed directly to said first conduit means, said first conduit means also being provided with a refrigerant outlet port disposed above the level of said inlet port and adapted to communicate with one of the mentioned paths, said second conduit means being provided with a refrigerant outlet port arranged for communication with another of the mentioned paths and disposed at a level below the level of said outlet port of said first conduit means and accommodating flow of liquid refrigerant from said second conduit means to the other of the mentioned paths; and means operable to volatilize refrigerant in said first conduit means.

13. Control means for use in a refrigerating system of the type including a source of liquid refrigerant, a first passage for refrigerant flowing from said source and including evaporator means, a second passage for refrigerant flowing from said source and disposed in the system to by-pass said evaporator means, said control means being adapted to transfer flow of liquid refrigerant from such a first passage to such a second passage, and comprising: first and second upstanding conduit means having their lower portions in fluid flow communication; the first said conduit means being provided with a refrigerant inlet port through which liquid refrigerant from such source may be fed directly to said first conduit means, said first conduit means also being provided with a refrigerant outlet port at a level above the level of said inlet port for communication with such second passage, said second conduit means having an outlet for communication with such first passage whereby to provide, under one condition of operation, for flow of refrigerant from said inlet port and thence outwardly to the first passage; and said first conduit means being shaped and disposed for association with an external heater in such manner that, under a modified condition of operation, volatilization of refrigerant in said first conduit means lightens the column of liquid therein whereby flow of liquid refrigerant from said inlet port and through the said second conduit means to its outlet is substantially terminated and refrigerant delivered through said inlet port rises in said first conduit means to a level sufficient to establish flow of refrigerant through said first-mentioned outlet port and thence to such second passage.

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