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3,234,749

COMPOUND REFRIGERATION SYSTEM

Filed July 31, 1962

2 Sheets-Sheet 1

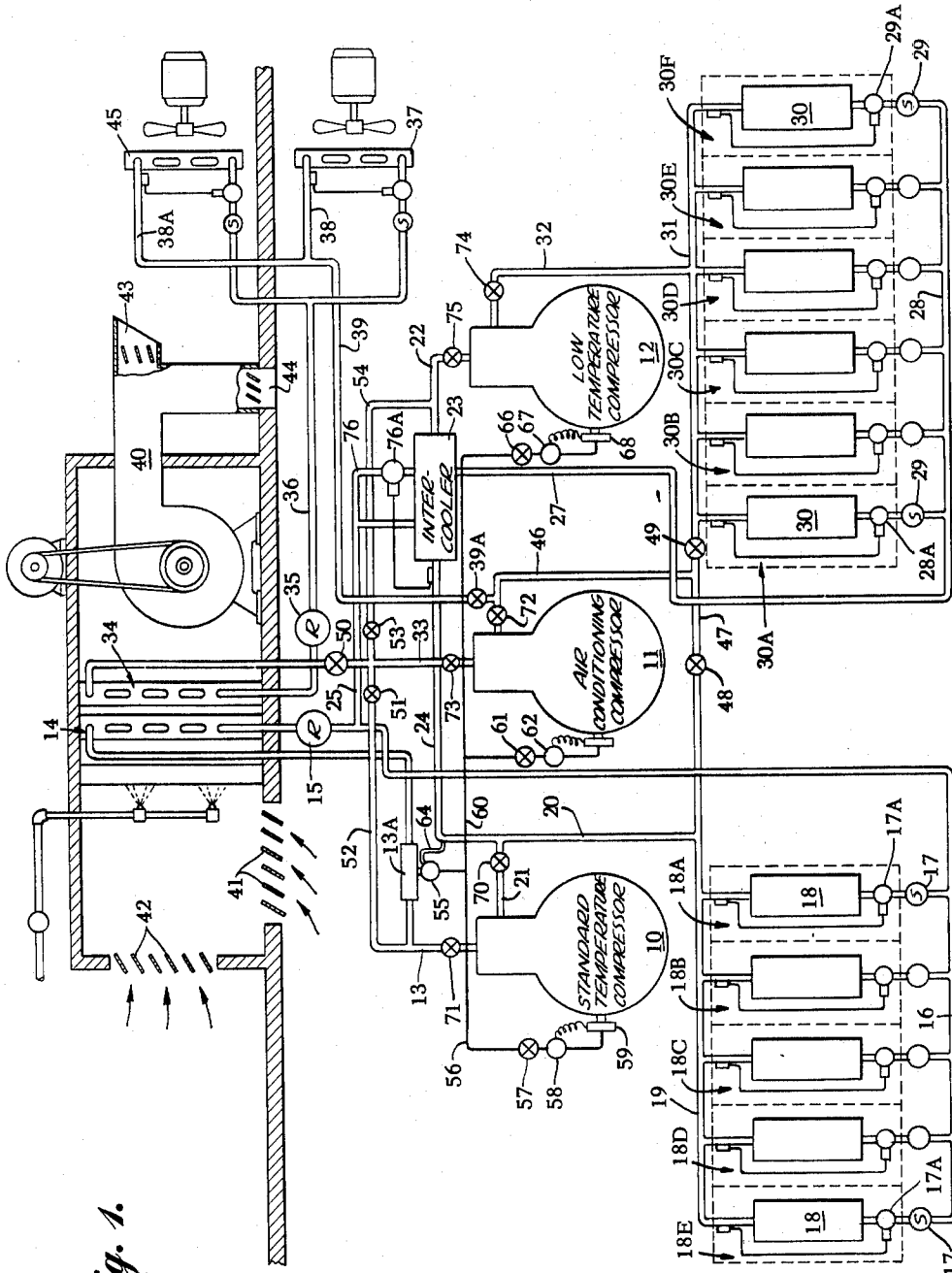


Fig. 1.

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2 Sheets-Sheet 2

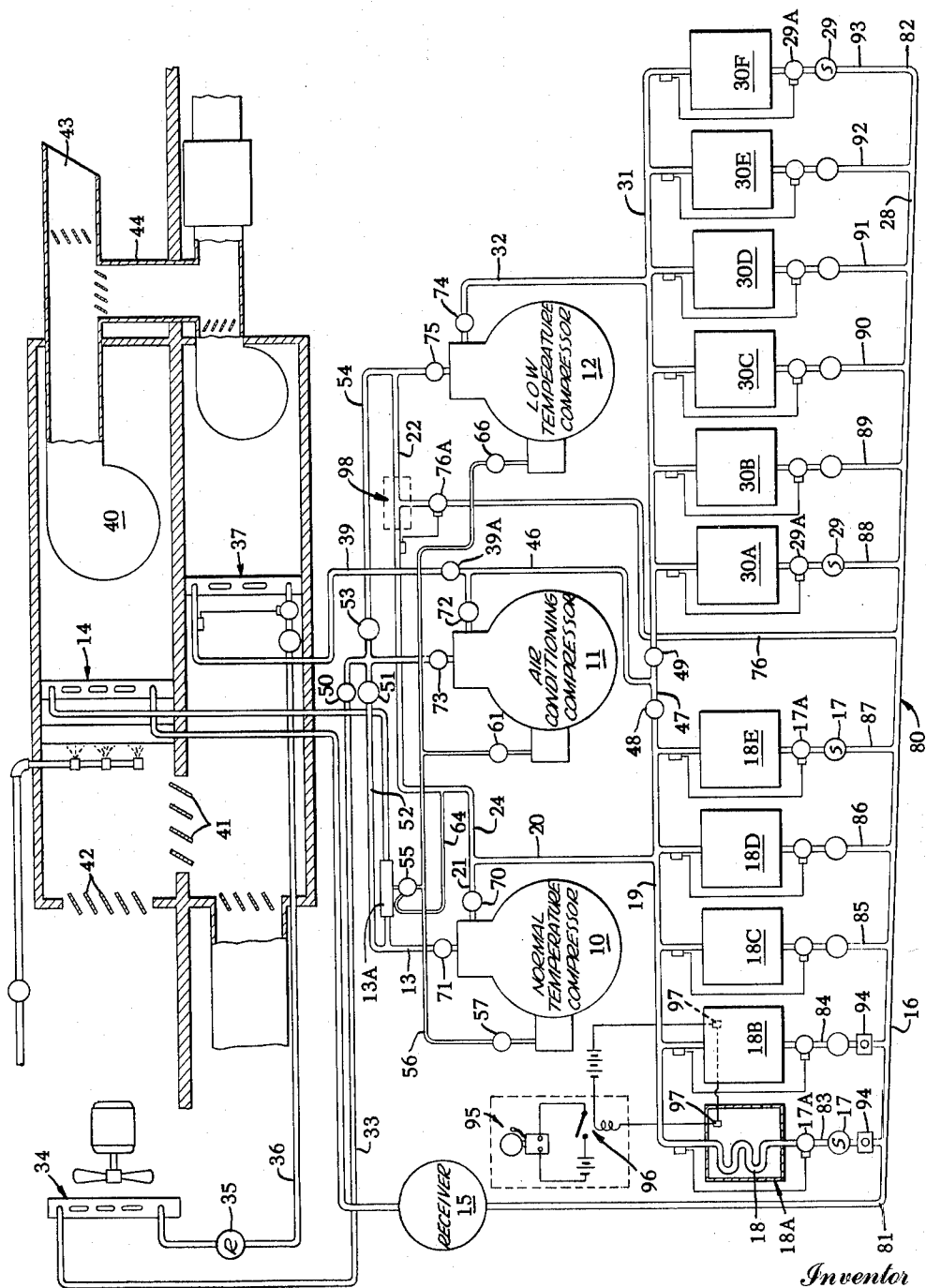


Fig. 2.

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3,234,749

COMPOUND REFRIGERATION SYSTEM

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16 Claims. (Cl. 62-129)

This application is a continuation-in-part of my co-pending application Serial No. 126,471 filed July 14, 1961, for Compound Refrigeration Compressor System, now abandoned.

This invention relates generally to the heat pump and refrigeration arts, and more specifically to the thermocycle integration of commercial refrigeration, air conditioning and heating systems in a permanent installation.

The invention further relates to a refrigeration system for a commercial installation such as a supermarket or the like, and more particularly to an arrangement of compressors wherein three large compressors provide refrigeration for the low temperature display and storage fixtures, the normal or commercial temperature display and storage fixtures and the air-conditioning system; and wherein the low temperature compressor discharges its load to the normal temperature compressor, thereby stabilizing the normal temperature compressor and preventing on and off cycling thereof.

In a typical conventional refrigeration system for a refrigerating fixture, a supply of liquid refrigerant is stored in the receiver to accommodate fluctuations in the fixture requirements for additional or less refrigerant to maintain a substantially uniform fixture temperature. The temperature of the liquid refrigerant in the receiver is usually above room temperature, and the receiver is on the high pressure side of the system whereby the pressure causes the liquid to move through a liquid outlet line to a refrigerant metering control responsive to fixture temperature for admitting refrigerant as needed to a metering device, such as an expansion valve. Such a valve meters refrigerant into the evaporator of the fixture and reduces the pressure of the refrigerant, the evaporator thus being on the low pressure side of the system. Most of the refrigerant in the evaporator immediately downstream from the expansion valve is in liquid state, but this refrigerant is at a lower temperature than the refrigerant upstream of the valve due to the reduction in pressure. Refrigerant in the evaporator absorbs heat from the fixture and its contents in order to cool the fixture and contents, and the refrigerant is thus vaporized and superheated so that at the evaporator outlet it is entirely a gas. Since the pressure and temperature of a refrigerant vary directly in a known relationship, the expansion valve may be responsive to the refrigerant pressure or temperature at the evaporator outlet to assure complete vaporization of the refrigerant, and the valve will open and close as required to maintain a proper refrigerant flow in the evaporator. The refrigerant vapor from the evaporator outlet is drawn through a suction line into the intake or low pressure side of a refrigerant compressor where the refrigerant is compressed into high pressure-high temperature vapor (heat of compression being added to superheated vapor). The hot refrigerant gas is discharged from the high pressure side of the compressor into a condenser in which a heat exchange takes place with the cooling medium causing the gas to condense or liquify, and the liquid refrigerant flows into the receiver to complete the cycle. It will be clearly understood by those skilled in the art that the function of the compressor in any refrigerant system is to remove the heat-laden refrigerant vapor from the evaporator, to raise the pressure of this vapor high enough to be condensed

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to a liquid in the condenser, and to move the refrigerant through the entire system.

In the past the practice has been to provide independent and separate refrigeration systems for individual refrigerated fixtures, such as storage or display cabinets for food products, or for a small number of fixtures all operating at about the same temperature to be operated by one refrigeration system (sometimes called multiplexing). Both types of prior systems have required careful engineering design and sizing of components for the efficient operation thereof. For instance, the purpose of any system is to maintain uniform cooling temperatures in the evaporators of the fixtures and to this end the compressor capacity must be balanced against the refrigeration requirements of such evaporators so that vapor will be removed from the suction lines at substantially the same rate it is produced by evaporation in the evaporators. In single fixture systems, on and off cycling of the compressor is an accepted method of controlling temperature variations of the fixture evaporator even though it is well recognized that on and off compressor cycling is not an efficient technique for compressor operation per se. In larger, multicylinder compressors for multiplexed systems having several fixtures operated thereby, compressor cycling is highly undesirable and various capacity control means of conventional and well-known construction have been devised for sequentially or selectively disabling and enabling (unloading and loading) cylinders or otherwise varying the efficiency or capacity of the compressor so that refrigerant vapor is removed from the suction lines of the fixtures at substantially the rate as is produced therein. Representative of such capacity control means is an unloader piston arrangement for holding the suction valve of one or more cylinders in open condition thereby preventing vapor compression by the pistons in such cylinders; and other devices have been devised for by-passing selected cylinders as the returning refrigerant requirements demand.

It will be understood that in stores or other installations requiring several of such prior systems that the duplication of compressors, condensers, and other equipment in the several systems increased purchase, installation, power and service costs and require a relatively large space for the installation. In addition, independent and separate systems were also required for winter heating and summer cooling.

In modern large supermarkets or stores where a large number of storage and display fixtures are required for the various products requiring refrigeration in a wide range of temperatures varying between about -20° F. up to about 50° F., the provision of numerous separate refrigeration systems brought the cost, space and service problems into acute focus and emphasized the need for more efficient, economical and space saving refrigeration for commercial installations.

The principal object of the present invention is to provide a single novel compound refrigeration system integrating the entire refrigeration and air-conditioning requirements of an installation having numerous refrigerated fixtures by employing only three compressors and two condenser-receiver means in a manner to assure stability and economy of operation, reduced costs and improved control and safety features.

Another object is to reclaim heat from the refrigeration function for utilization in building heating.

It is another feature of this invention that the air-conditioning compressor is available as a stand-by for either of the other compressors, thereby minimizing loss

of essential refrigeration in the event of compressor failure or service needs.

It is another feature of this invention that oil entrained in the refrigerant is collected in a common oil-separator and returned to the compressors as needed, controlled by a float switch or the like.

A still further object is to provide a common liquid refrigerant source for all refrigeration fixtures, and to provide a novel arrangement of fixtures to assure safe and efficient operation particularly where refrigeration temperatures are critical.

Still another feature of the invention is to provide a novel audible and visual alarm system to assure early warning of malfunction.

Still a further object of this invention is to provide a common liquid refrigerant source and novel arrangement of refrigerating fixtures, whereby any malfunction in the refrigeration system resulting in an inadequate supply of liquid refrigerant in turn results first, in a lack of refrigerant available to the least critical fixture; and lastly, in a lack of refrigerant available to the most critical fixture.

These and still other objects and advantages of the present invention will become readily apparent from the annexed specification and the accompanying drawings.

In the drawings:

FIGURE 1 is a diagrammatic representation of a compound refrigeration system embodying the invention; and

FIGURE 2 is a diagrammatic representation of a modified embodiment of a compound refrigeration system.

Referring now more particularly to FIGURE 1, of the drawings, the system includes a compressor 10, which is denominated herein as the standard or commercial temperature compressor and serves to operate a bank of refrigerating fixtures, such as commercial or normal temperature refrigerators 18A through 18E operating in the range of about 25° F. to about 50° F. The system also includes a high temperature compressor 11, which operates an air-conditioning system; and a low temperature compressor 12, which operates a bank of low temperature refrigeration fixtures 30A through 30F operating generally in the range from about -20° F. to about 5° F.

The function of each of the individual compressors 10, 11 and 12 is basically the same as their individual compressor function in prior conventional systems. However, due to the large number of fixture evaporators and the large variants in refrigerant vaporization thereby, capacity control means for each of the compressors must be capable of maintaining the necessary balance of each compressor with the suction side of its respective portion of the system, including the accommodation of refrigerant vapor discharged between those compressors in the compounded relationship hereinafter described.

The refrigerant from the standard temperature compressor 10 is discharged through conduit 13 to an oil-separator 13A and thence to condenser 14 and receiver 15, which forms a liquid refrigerant reservoir. A liquid header or conduit 16 is provided for feeding refrigerant through solenoid operated valves 17 and expansion valves 17A to the individual standard temperature refrigerating evaporators 18, and thence through suction header 19 and conduits 20 and 21 back to the suction side of the compressor 10. Each fixture 18 inherently has a variable refrigerant demand to maintain a substantially constant temperature thereof, and the refrigerant vapor return load in the suction header 19 to the compressor 10 is subject to relatively large fluctuations. In comparison, the fixtures 30 inherently provides a relatively constant refrigerant vapor return load in the suction header 31 to the compressor 12.

The low temperature compressor 12 has its discharge connected by conduit 22 to an inter-cooler 23 and through another conduit 24 and the conduit 21 to the suction

side of compressor 10. As is well-known to those skilled in the refrigeration art, the suction pressure from the low temperature refrigerating fixtures will be lower than the suction pressure from the standard temperature refrigerating fixtures and the compressor 12 compresses the return refrigerant from the evaporators 30 to the suction pressure maintained by the compressor 10. The relatively constant refrigerant load from the low temperature compressor 12 is combined with the fluctuating return refrigerant load from the evaporators 18 to thereby produce a stabilizing volume of refrigerant to the suction of the compressor 10, and this refrigerant is compressed by compressor 10 and discharged through the conduit 13 to the condenser 14 and receiver 15. The refrigerant flow from the receiver 15 is divided and a portion passes through conduit 25, through the inter-cooler 23 and conduit 27 to a liquid header 28 feeding refrigerant through solenoid operated valves 29 and expansion valves 29A to the individual low temperature evaporators 30. Refrigerant then flows from the evaporators 30 through a suction header 31 and conduit 32 back to the suction side of low temperature compressor 12.

Compressor 11 discharges refrigerant through conduit 33 to condenser 34, thence to receiver 35 and conduit 36 to an air-conditioner evaporator 37 and back through suction conduits 38 and 39 to the suction side of compressor 11. A blower 40 draws air either from within the building or from the outside, as controlled by louvers 41 and 42, respectively, over the condensers 14 and 34 for removing heat from the refrigerant in condensers 14 and 34. The heated air may be discharged to the outside air as through a duct 43 or into the building through a damper-controlled duct 44 to heat the building. The reclaiming of heat from the condensers for space heating within the building or like confined area is more fully disclosed in Quick Patent No. 2,892,324. However, in the present invention, the condenser 34 forms a supplemental air heater by operation of the air-conditioning compressor 11 as a heat pump and using an external evaporator 45 as an auxiliary heat source, whereby the refrigerant passes from receiver 35 through conduit 36 to external evaporator 45 and back through suction conduits 38A and 39 to the suction side of compressor 11.

The air-conditioning compressor 11 also has a suction line 46 connected to the suction line 39 on the downstream side of a normally open valve 39A. The suction line 46 is connected to a suction header 47 extending between the standard temperature suction header 19 and the low temperature suction header 31, normally closed valves 48 and 49 preventing return flow of refrigerant vapor from the headers 19 and 31 to the compressor 11. It should also be noted that a valve 50 is placed in conduit 33 and a valve 51 is arranged in conduit 52 which is in communication with the oil separator 13A. It will be seen that by closing the valves 50 and 39A, the air-conditioning circuit can be isolated from the compressor 11, and that by opening the valves 51 and 48, the compressor 11 may be connected in the refrigeration system in place of the standard temperature compressor 10. The compressor 10 is made inoperative by closing the normally open valves 70 and 71 in the suction and pressure lines 21 and 13 thereto. The air-conditioning compressor also has similar service valves 72 and 73 on its intake and discharge lines. Similarly, the low temperature compressor 12 has intake and discharge control valves 74 and 75. A valve 53 controls a conduit 54 between conduits 33 and 22. It will be seen that by closing the valves 50 and 39A to isolate the air-conditioning circuit and closing valves 74 and 75 to isolate the compressor 12 and by opening the valves 49 and 53, the compressor 11 may be connected in the refrigeration system in place of the compressor 12. The chart set forth below summarizes the positions of the various valves under the three above-described conditions of operation of the three compressors.

Valves	Normal operation of all compressors	Compressor 11 substituted for compressor 10	Compressor 11 substituted for compressor 12
39A.....	Open.....	Closed.....	Closed.
48.....	Closed.....	Open.....	Do.
49.....	do.....	Closed.....	Open.
50.....	Open.....	do.....	Closed.
51.....	Closed.....	Open.....	Do.
53.....	do.....	Closed.....	Open.
70.....	Open.....	do.....	Do.
71.....	do.....	do.....	Do.
72.....	do.....	Open.....	Do.
73.....	do.....	do.....	Do.
74.....	do.....	do.....	Closed.
75.....	do.....	do.....	Do.

In the oil return arrangement shown in FIGURE 1, an oil receiver or reservoir 55 collects oil from the oil separator 13A and is vented in a conventional manner by a degassing line 64 connecting the upper portion of the reservoir to the suction side of the standard temperature compressor 10. The oil from the reservoir 55 passes through conduit 56, valve 57, solenoid operated valve 58, float switch 59 to compressor 10, and similarly, oil is passed through lines 60 and 65, valves 61 and 66, solenoid operated valves 62 and 67, float switches 63 and 68 to compressors 11 and 12.

The inter-cooler 23 is provided to desuperheat the refrigerant vapor discharged from the low temperature compressor 12 to prevent over-heating of the compressor 10. It will be noted that the conduit 25 from receiver 15 to conduit 27 and the liquid header 28 are connected through the inter-cooler in a typical manner. A liquid supply line 76 may also be provided to the chamber of the inter-cooler 23 and an expansion valve 76A responsive to vapor pressure or temperature at the inter-cooler discharge assures proper desuperheating in the inter-cooler 23.

The refrigerated fixtures 18A through E and 30A through F are representative of the different types of fixtures that may be required in a modern supermarket, and are not intended to be inclusive. The fixtures are required to maintain product temperatures in a range from about -20° F. up to about 50° F., the standard or commercial temperatures fixtures 18A-E being in the upper part of the range from about 25° F. to about 50° F. and the low temperature fixtures 30A-F being in the lower part of the range from about -20° F. to about 5° F. For instance, produce cases or coolers will have product temperatures at about 45° F. to 50° F., dairy cases or coolers at about 35° F. to 40° F., and fresh meat cases or coolers at about 30° F. to 35° F., all in the normal temperature range, whereas most frozen food products will be maintained within a range of 10° F. temperature variation at about 0° F. except ice cream coolers or cases, which require a temperature of about -20° F. to keep the product firm. It will be apparent that several of each type of case or storage cooler may be required and represented in the drawings by a single fixture unit.

Referring now to FIGURE 2 of the drawings, liquid refrigerant stored in the receiver 15 flows through the liquid header 16 to each of the expansion valves 17A of the standard temperature evaporators 18 and through the liquid header 28 to the expansion valves 29A of the low temperature evaporators 30. In this embodiment of the invention, the liquid headers 16 and 28 are combined as one continuous header, shown generally at 80, extending from its upstream end 81 connected to the receiver 15 to its downstream end 82 connected to the last low temperature fixture 30F. The evaporators 18 of standard temperature fixtures 18A-E are connected to the header portion 17 by supply lines 83-87, respectively, and the evaporators of low temperature fixtures 30A-F are connected to the header portion 28 by supply lines 88-93, respectively. The solenoid valves 17, 29 and expansion valves 17A, 29A are connected in the supply lines and to the evaporator inlets in a usual manner. The header 80 is sized to accommodate the total refrigerant require-

ments of the fixtures and, as long as a supply of liquid refrigerant is maintained in the receiver 15, the inherent pressure of the liquid refrigerant will cause it to flow downstream through the header to maintain the supply lines to all of the fixtures in a liquid filled condition to meet the demands of the various fixtures for refrigeration. Due to the inertia of the liquid refrigerant flow, the refrigerant will tend to flow to the downstream end 82 first and "pile up" so that any refrigerant vapor in the header 80 will be excluded from the downstream end 82 by liquid refrigerant. The presence of refrigerant vapor in the header 80 would normally occur either when refrigerant demands are high and the receiver 15 is emptied or when a refrigerant loss occurs in the system.

In the event of such loss, or unusually high demand, the liquid refrigerant flow from the condenser 14 through the receiver 15 into the header 80 will fill the downstream end 82 of the header portion 28 and create a pseudo liquid level somewhere along the header, depending on the quantity of liquid present at any time. Due to inertia and the "piling up" effect, the surface of the pseudo liquid level would be inclined to both the vertical and horizontal. It will be noted that the liquid header 80 is shown in a vertically inclined position sloping downwardly from the upstream end 81 to the downstream end 82, and this is a preferred physical arrangement as the gravitational force adds to the refrigerant flow inertia to create an even more distinct pseudo liquid level.

If a small loss occurs and the pseudo level is to the left of the supply line 83 to the standard temperature fixture 18A, liquid refrigerant will continue to be supplied to all fixtures for normal operation. However, if the liquid refrigerant being supplied to the header 80 is insufficient to balance the liquid refrigerant demand by all of the fixtures, the pseudo liquid level will begin moving from upstream end 81 toward the downstream end 82. A large loss or lack of liquid refrigerant would result in refrigerant vapor being present in the supply line 83 and possibly additional successive supply lines, whereby the evaporators connected thereto will cease to cool properly when the residual liquid therein has boiled away.

A feature of the invention is the provision of audible and visual warning means for indicating a loss of liquid refrigerant to the upstream supply lines 83 and 84. The visual means comprises a sight glass 94 positioned in each of the upstream supply lines 83 and 84 by which the presence or absence of liquid refrigerant may be observed. The audible warning device comprises an alarm 95 with a relay 96 for energizing same. The relay 96 is controlled by temperature responsive switch elements 97 in the fixtures 18A and 18B or by temperature or pressure switch means in the evaporators 18 for these fixtures. Upon an undesirable temperature increase in both fixtures 18A and 18B at the same time, the relay 96 will be closed to activate the alarm 95. The switch means 97 are connected in series to prevent false alarms during the defrost cycles of either fixture, and the fixture defrosts are time controlled to prevent simultaneous defrosting. The switches 97 are also responsive to a higher temperature than would occur during normal cooling and non-cooling cycling of the evaporators 18.

In order to insure that the refrigerated fixtures that are operated at the lowest temperatures and contain the most temperature-change sensitive products have all of the liquid refrigerant present in the system available for their evaporators, the supply lines to these evaporators are connected to header 80 near the downstream end 82. Conversely, the fixtures that operate at the highest temperatures and contain products that are not extremely sensitive to temperature changes have their evaporator supply lines connected to header 80 near the upstream end 81. Thus, as described above, if there is an inadequate supply of liquid refrigerant and the pseudo liquid level in header 80 moves from left to right toward end 82, then the highest temperature fixtures will be the first to have an inadequate supply of refrigerant and the lowest temper-

ature fixtures will be the last to be effected by the lack of liquid refrigerant. In accordance with this plan of arrangement, a preferred installation would be; produce case 18A, produce cooler 18B, dairy case or cooler 18C, fresh meat case or cooler 18D, fresh meat cooler 18E, smaller frozen fish cases 30A, frozen meat case 30B, frozen fruit and vegetable cooler 30C, frozen fruit and vegetable case 30D, ice cream cooler 30E and ice cream case 30F. Additional or similar cases or coolers would be arranged in the same or similar relationship with respect to the length of header 80 as those specifically set forth.

The compressors 10 and 12 are compounded and the oil is returned from reservoir 55 in the FIGURE 2 system in essentially the same manner as disclosed in FIGURE 1. It will be noted that a desuperheater 98 is provided in the pressure stream 22 from the low temperature compressor 12 to the suction side of the compressor 10 rather than an inter-cooler 23 shown in FIGURE 1. The refrigerant line 76 is connected to the liquid header 80 intermediate to the supply lines 87 and 88 to normal and low temperature fixtures for introducing refrigerant into the desuperheater through expansion valve 76A.

The air handling arrangement in the FIGURE 2 system is similar to the arrangement in the FIGURE 1 system except that condenser 34 of the air conditioning system is positioned apart from condenser 14 and is not part of the heat reclaiming arrangement in this embodiment. Furthermore, the single evaporator 37 in the air conditioning system of FIGURE 2 is arranged with ducts and a blower for drawing and discharging air either inside or outside of the building.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth or the details illustrated in the drawings, but my invention is of the full scope of the appended claims.

I claim:

1. In a compound refrigeration system having a plurality of evaporators adapted to operate a plurality of separate and independent refrigerated fixtures subjected to ambient and varying load conditions and maintaining such fixtures within the inclusive range of refrigeration temperatures of about 50°F. to about -20°F., condenser-receiver means for supplying liquid refrigerant to all of said evaporators, separate first and second suction header means, at least two serially connected and continuously operating compressors having different suction pressures, the evaporators adapted to operate in the upper range of refrigeration temperatures each being connected to said first suction header means, said first suction header means connected directly to the suction side of the downstream compressor, the evaporators adapted to operate in the lower range of refrigeration temperatures each being connected to said second suction header means, said second suction header means connected directly to the suction side of the upstream compressor, said upstream compressor receiving a continuous and relatively stable load from said evaporators operating in the lower range of refrigeration temperatures to assure the continuous operation thereof and said upstream compressor adding said relatively stable load to a fluctuating load received by the downstream compressor.

2. In a system for indicating the presence of refrigerant vapor in the compressed-condensed refrigerant supplied to a plurality of evaporator means from a single receiver, the combination of: a relatively long and straight header having its upstream end communicating with the receiver, a separate supply conduit operably connecting each evaporator means to said header, each of said conduits being substantially smaller in cross-sectional area than said header, visual means positioned in the two supply conduits nearest said upstream end of the header for indicating the presence of refrigerant vapor in the conduits and audible warning means respon-

sive to a non-refrigerating condition of said evaporator means connected to said two supply conduits nearest said upstream end of said header.

3. The combination of claim 2 wherein said header is inclined downwardly between said upstream end and its downstream end.

4. A refrigeration system comprising a multitude of separate and independent first fixtures spaced apart from each other and operating at normal refrigeration temperatures, a multitude of separate and independent second fixtures spaced apart from each other and operating at low refrigeration temperatures, said first and second fixtures being subjected to varying heat loads resulting from product and ambient conditions, first evaporators with at least one positioned in each of said first fixtures and operating at relatively high suction pressures, said first evaporators producing a fluctuating load by reason of said normal temperature operation and said subjection to varying heat loads, second evaporators with at least one positioned in each of said second fixtures and operating at relatively low suction pressures, said second evaporators producing a continuous and stable load relative to the first evaporator load, condenser-receiver means for supplying liquid refrigerant to all of said evaporators, first continuously operating compressor means having a discharge side connected to said condenser-receiver means, said first compressor means having a suction side, first suction header means connected directly between said suction side of said first compressor means and each of the outlets of said first evaporators, second continuously operating compressor means having a suction side, second suction header means connected directly between said suction side of said second compressor means and each of the outlets of said second evaporators, and said second compressor means operating continuously and having the discharge side connected to said suction side of the first compressor means for discharging gaseous refrigerant to said first compressor means to add the relatively stable and continuous load of said second evaporators to the fluctuating load of said first evaporators for stabilizing the load to and maintaining continuous operation of the first compressor means.

5. A refrigeration system in a commercial installation comprising a first plurality of separate and independent refrigerated fixtures spaced from each other and operating at normal temperatures, a second plurality of separate and independent refrigerated fixtures spaced from each other and operating at low temperatures, said first and second refrigerated fixtures being subjected to ambient and varying load conditions, a first plurality of evaporators with at least one positioned in each of said first plurality of fixtures and operating at relatively high suction pressures, said first plurality of evaporators producing a fluctuating load by reason of said normal temperature operation, and said subjection to ambient and load conditions, a second plurality of evaporators with at least one positioned in each of said second plurality of fixtures and operating at relatively low suction pressures, a condenser-receiver means for supplying liquid refrigerant to all of said evaporators, a first compressor means having a discharge side connected to said condenser-receiver means, said first compressor means having a suction side, first suction header means connected directly between said suction side of said first compressor means and each of the outlets of said first plurality of evaporators, a second compressor means having a suction side, second suction header means connected directly between said suction side of said second compressor means and each of the outlets of said second plurality of evaporators, said second compressor means operating continuously and having the discharge side connected to said suction side of the first compressor means for continuously discharging gaseous refrigerant to said first compressor means for stabilizing the load on and maintain-

ing continuous operation of the first compressor means, and third compressor means for operating an air conditioning system of the installation and having valve controlled means on the suction and discharge sides thereof in fluid communication with the suction and discharge sides of said first and second compressor means for selectively substituting said third compressor means for either said first or second compressor means.

6. A compounded refrigeration system comprising a plurality of separate and independent first fixtures spaced from each other and each having evaporator means for the normal temperature refrigeration of said first fixtures, a plurality of separate and independent second fixtures spaced from each other and each having evaporator means for the low temperature refrigeration of said second fixtures, said first and second fixtures being subjected to ambient and varying load conditions, liquid refrigerant supply means including condenser-receiver means connected by liquid header means to the evaporator means of all of said first and second fixtures, a continuously operating first compressor means having a suction side, first suction header means connected directly between said first compressor means suction side and the outlets of the evaporator means of all of said first fixtures, a continuously operating second compressor means having a suction side, second suction header means connected directly between said second compressor means suction side and the outlets of the evaporator means of all of said second fixtures, said second compressor means having a suction pressure relatively lower than the suction pressure of said first compressor means, said second compressor means having a pressure side connected to the suction side of said first compressor means, said second compressor means operating continuously for providing a continuous and stabilizing load to said first compressor means, said first compressor means operating continuously for compressing the refrigerant vapor from said second compressor means and from said first fixtures, and said first compressor means having a pressure side connected to said condenser-receiver means.

7. A compounded refrigeration system comprising a plurality of separate and independent first fixtures spaced from each other and with each having evaporator means for the normal temperature refrigeration of said first fixtures, a plurality of separate and independent second fixtures spaced from each other and with each having evaporator means for the low temperature refrigeration of said second fixtures, said first and second fixtures being subjected to ambient and varying load conditions, liquid refrigerant supply means including condenser-receiver means connected by liquid header means to the evaporator means of all of said first and second fixtures, first compressor means having a suction side, first suction header means connected directly between said suction side of the first compressor means and the evaporator means of all of said first fixtures for receiving refrigerant vapor therefrom, second compressor means having a suction side, second suction header means connected directly between said suction side of the second compressor means and the evaporator means of all of said second fixtures for receiving refrigerant vapor therefrom, said second compressor means having a pressure side connected to the suction side of said first compressor means, said first compressor means having a pressure side connected to said condenser-receiver means, each of said evaporator means having metering means for regulating the flow of refrigerant to said evaporator means to thereby produce substantially constant preset temperatures in each of said first and second fixtures, the regulation of refrigerant flow in said evaporator means producing variations in the cumulative refrigerant vapor loads on the suction sides of said first and second compressor means, and each of said compressor means operating continuously for compressing and varying refrigerant vapor loads on the suction sides thereof.

8. A compounded refrigeration system comprising a plurality of separate and independent first fixtures spaced from each other and with each having evaporator means for the normal temperature refrigeration of said first fixtures, a plurality of separate and independent second fixtures spaced from each other and with each having evaporator means for the low temperature refrigeration of said second fixtures, said first and second fixtures being subjected to ambient and varying load conditions, liquid refrigerant supply means including condenser-receiver means connected by liquid header means to the evaporator means of all of said first and second fixtures, a continuously operating first compressor means having a suction side, first suction header means connected directly between said suction side of the first compressor means and the evaporator means of all of said first fixtures for receiving refrigerant vapor therefrom, a continuously operating second compressor means having a suction side, second suction header means connected directly between said suction side of the second compressor means and the evaporator means of all of said second fixtures for receiving refrigerant vapor therefrom, the evaporator means of each of said first and second fixtures being subjected to different refrigerant flow requirements in maintaining the refrigerating temperatures for each fixture, said second fixtures requiring a more constant refrigerant flow to maintain the evaporator means at low refrigeration temperatures than the refrigerant flow required to maintain the temperatures in said first fixtures and the cumulative refrigerant vapor load from said second fixtures to said second compressor means being stable relative to the fluctuating cumulative refrigerant vapor load from said first fixtures to said first compressor means, said second compressor means having a pressure side connected to the suction side of said first compressor means and discharging its refrigerant vapor load thereto for stabilizing the total refrigerant vapor load at the suction side of said first compressor means, and said first compressor means having a pressure side connected to said condenser-receiver means.

9. A refrigeration system in which there are a multitude of separate and independent low temperature fixtures and a multitude of separate and independent higher temperature fixtures with at least some of said fixtures being spaced from each other and subjected to different and varying loads and ambient conditions, a continuously operating first compressor means having a suction side header connected directly to all of the higher temperature fixtures for operation thereof, second compressor means having a suction side header connected directly to all of the low temperature fixtures, said second compressor means operating continuously for discharging compressed refrigerant gas to the suction side of said first compressor means and providing a continuous load that is relatively more stable than the refrigerant load from said higher temperature fixtures, the cumulative load from said second compressor means and said higher temperature fixtures constituting substantially the only load upon said first compressor means and being sufficient to maintain continuous operation of said first compressor means, said first compressor means discharging the total refrigerant load to condenser means and thence to said low and higher temperature fixtures.

10. A compounded refrigeration system comprising a plurality of separate first fixtures each having evaporator means for the normal temperature refrigeration of said first fixtures, a plurality of separate second fixtures each having evaporator means for the low temperature refrigeration of said second fixtures, liquid refrigerant supply means including condenser-receiver means connected by liquid header means to the evaporator means of all of said first and second fixtures, first compressor means having a suction side connected to the evaporator means of all of said first fixtures, second compressor means having a suction side connected to the evaporator means

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of all of said second fixtures, said second compressor means having a pressure side connected to the suction side of said first compressor means, said first compressor means having a pressure side connected to said condenser-receiver means, third compressor means having suction and pressure sides, means including valve controlled conduit means for selectively substituting said third compressor means for either of said first and second compressor means, and air conditioning means, said third compressor means normally being connected to said air conditioning means and being isolated from said first and second compressor means.

11. A compounded refrigeration system comprising a plurality of separate first fixtures each having evaporator means for the normal temperature refrigeration of said first fixtures, a plurality of separate second fixtures each having evaporator means for the low temperature refrigeration of said second fixtures, liquid refrigerant supply means including condenser-receiver means connected by liquid header means to the evaporator means of all of said first and second fixtures, first compressor means having a suction side connected to the evaporator means of all of said first fixtures, second compressor means having a suction side connected to the evaporator means of all of said second fixtures, said second compressor means having a pressure side connected to the suction side of said first compressor means, said first compressor means having a pressure side connected to said condenser-receiver means, normally open valve means at the suction and pressure sides of each of said first and second compressor means adapted to be closed for selectively isolating said first and second compressor means from said system, and other compressor means having suction and pressure sides with normally closed valve controlled means adapted to be opened for selectively substituting said other compressor means in said system for said isolated first or second compressor means.

12. In a refrigeration system for a commercial installation in which there are a plurality of separate low temperature fixtures and a plurality of separate high temperature fixtures, comprising: a first compressor for operating the higher temperature fixtures, a second compressor for operating the low temperature fixtures and passing compressed refrigerant gas to the inlet of the first compressor for providing a continuous load thereon for stabilizing said first compressor and thence to a common condenser and thence to the fixtures; and a third compressor having an inlet and outlet for operating an air conditioner for the commercial installation and having valve controlled conduit means on the inlet and outlet thereof in fluid communication with the inlets and outlets of said first and second compressors for substituting said third compressor for either said first or second compressor.

13. A compound refrigeration system comprising a plurality of separate first fixtures each having evaporator means for the normal temperature refrigeration of said first fixtures, a plurality of separate second fixtures each having evaporator means for the low temperature refrigeration of said second fixtures, liquid refrigerant supply means including condenser-receiver means connected by liquid header means to the evaporator means of all of said first and second fixtures, first compressor means having a suction side connected to the evaporator means of all of said first fixtures, second compressor means having a suction side connected to the evaporator means of all of said second fixtures, said second compressor means having a pressure side connected to the suction side of said first compressor means, said first compressor means having a pressure side connected to said condenser-receiver means; a third compressor means having suction and pressure sides, first and second conduit means between said third compressor suction side and the suction sides of said first and second compressor means respectively, third and fourth conduit means between said third

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compressor pressure side and the pressure sides of said first and second compressor means respectively, and valve means in said conduit means for selectively substituting said third compressor means for either of said first and second compressor means.

14. The compound refrigeration system according to claim 13 including an air conditioning system, said third compressor means normally being connected to said air conditioning system and being isolated from said first and second compressor means by said valve means.

15. A refrigeration system comprising a first plurality of separate and independent refrigerated fixtures spaced from each other and operating at normal temperatures and subject to ambient and varying load conditions, a second plurality of separate and independent refrigerated fixtures spaced from each other and operating at low temperatures and subject to ambient and varying load conditions, a first plurality of evaporators with at least one positioned in each of said first plurality of fixtures and operating at relatively high suction pressures, said first plurality of evaporators producing a fluctuating load by reason of said normal temperature operation and said subjection to ambient and varying load conditions, a second plurality of evaporators with at least one positioned in each of said second plurality of fixtures and operating at relatively low suction pressures, condenser-receiver means for supplying liquid refrigerant to all of said evaporators, a liquid header having an upstream end connected to said condenser-receiver means, supply conduit means operably connecting each of the plurality of evaporators to said liquid header downstream of said upstream end, said upstream end of said header being at least as high as the other portion of said header, means positioned in at least one of said supply conduit means adjacent said upstream end of said liquid header for indicating the presence of refrigerant vapor in that said supply conduit means, first compressor means having a discharge side connected to said condenser-receiver means, said first compressor means having a suction side, first suction header means connected directly between each of the outlets of said first plurality of evaporators and the suction side of said first compressor means, second compressor means having a suction side, second suction header means connected directly between each of the outlets of said second plurality of evaporators and the suction side of said second compressor means, and said second compressor means having the discharge side thereof connected to said suction side of the first compressor means and operating continuously for discharging gaseous refrigerant to said first compressor means for stabilizing the refrigerant load to said first compressor means for maintaining continuous operation of the first compressor means.

16. A refrigeration system comprising a first plurality of separate and independent refrigerated fixtures spaced from each other and operating at normal temperatures and subject to ambient and varying load conditions, a second plurality of separate and independent refrigerated fixtures spaced from each other and operating at low temperatures and subject to ambient and varying load conditions, a first plurality of evaporators with at least one positioned in each of said first plurality of fixtures and operating at relatively high suction pressures, said first plurality of evaporators producing a fluctuating load by reason of said normal temperature operation and said subjection to ambient and varying load conditions, a second plurality of evaporators with at least one positioned in each of said second plurality of fixtures and operating at relatively low suction pressures, condenser-receiver means for supplying liquid refrigerant to all of said evaporators, a single straight liquid header having an upstream end connected to said condenser-receiver means, a plurality of supply conduits connecting said evaporators to said liquid header, said liquid header having the upstream end at least as high as any other por-

tion of the liquid header, said first and second plurality of refrigerated fixtures containing products having varying sensitivity to temperature variations from the desired product temperature, said fixtures containing products least sensitive to temperature variations having the evaporators positioned therein connected by said supply conduits to the furthest upstream locations on said liquid header, said fixtures containing products most sensitive to temperature variations having the evaporators positioned therein connected by said supply conduits to the furthest downstream locations on said header, first compressor means having a discharge side connected to said condenser-receiver means, said first compressor means having a suction side, first suction header means connected directly between each of the outlets of said first plurality of evaporators and the suction side of said first compressor means, second compressor means having a suction side, second suction header means connected directly between each of the outlets of said second plurality of evaporators and the suction side of said second compressor means, and said second compressor means hav-

ing the discharge side thereof connected to said suction side of the first compressor means and operating continuously for discharging gaseous refrigeration to said first compressor means for stabilizing the refrigerant load to said first compressor means for maintaining continuous operation of the first compressor means.

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