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REFRIGERATION APPARATUS

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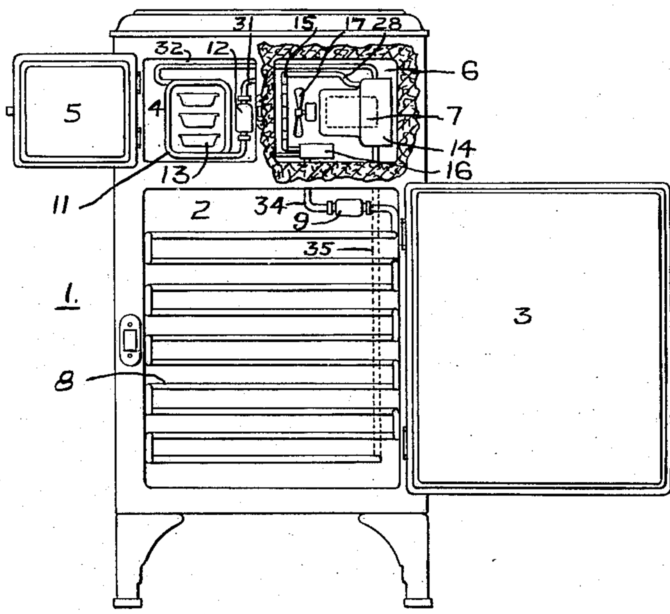

FIG. 1

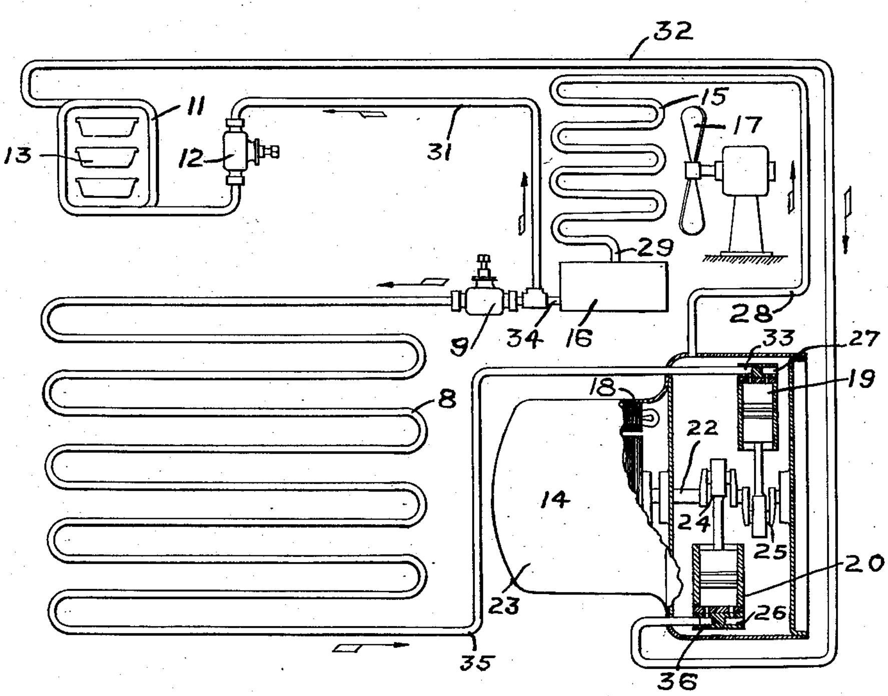

FIG. 2

WITNESS
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REFRIGERATION APPARATUS

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4 Claims. (Cl. 62—116)

My invention relates to refrigeration apparatus and particularly to refrigeration apparatus of the small compression type wherein two heat absorbing units are maintained at different temperatures and are supplied with refrigerant from a single condenser.

In refrigeration apparatus of the small compression type and which, for example, is utilized to cool a food storage compartment and to congeal liquids and store the same, the food storage compartment is usually cooled by a relatively small heat absorbing unit contained therein. Provision is made for the storing and congealing of liquids adjacent to the same heat absorbing unit. The heat absorbing unit is kept at a very low temperature, usually in the vicinity of 20° F. to supply adequate cooling for the food compartment, which is maintained at about 40° F., and to provide for the congelation of liquids disposed in or adjacent to the heat absorbing unit.

This type of refrigeration is inefficient because large quantities of frost accumulate on the heat absorbing unit which impairs heat transfer thereto and secondly, the compressor must operate at all times at a high ratio of compression, utilizing a large amount of work, to obtain sufficiently low suction pressure in the heat absorbing unit to maintain a temperature of 20° F. therein.

These disadvantages have been recognized and schemes have been suggested for overcoming the difficulties by providing a large heat absorbing unit in the food compartment which operates at 40° F., for example, and further providing a separate heat absorbing unit for congealing liquids, and insulated from the food compartment, which operates at 20° F. Since it is not practical to use two completely separate refrigeration systems because of the expense involved, these systems are usually connected to a single compressor-condenser system driven by one prime mover and the different temperatures desired in the two compartments are obtained by various control devices.

The above system, however, is unsatisfactory because the suction pressures and the amount of refrigerant to be pumped from two or more heat-absorbing units varies over a wide range. It is well known that a compressor is designed for a certain capacity at a certain compression ratio, and operates at its best efficiency only at these values. The compressor in a system such as that described above operates at its best efficiency a small part of the time since one or both of the above mentioned values constantly change. In addition to this, close control of temperature in such a system is very difficult to obtain with relatively simple and inexpensive apparatus.

It is an object of my invention, therefore, to provide a two-temperature refrigeration apparatus which operates at maximum efficiency and maintains temperatures in two separate compartments within close limits.

It is another object of my invention to provide two temperature refrigeration apparatus in which two compressors operating at different ratios of compression, a single prime mover and a single condensing means operating at a substantially constant condensing pressure are utilized.

It is another object of my invention to provide a system such as set forth above in which the motor drives the compressors through a common shaft and wherein the compressors are balanced dynamically although their ratios of compression differ.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is a front elevational view of a refrigerator cabinet containing a two-temperature refrigerating unit constructed in accordance with one embodiment of my invention; and

Fig. 2 is a diagrammatic view of a two-temperature refrigerating apparatus constructed in accordance with one embodiment of my invention.

The objects of my invention are obtained by providing two compressor elements driven by a single prime mover which discharge refrigerant at substantially the same pressures to a common condensing system, which compressor elements are operated at different ratios of compression. The compressors therefore maintain different suction pressures on the heat absorbing units and each may withdraw and compress substantially constant amounts of refrigerant. Each compressor therefore operates at high efficiency and the heat absorbing units are closely controlled as to temperature.

Although I have shown my invention as applied to heat absorbing units of the dry type in which expansion valves are utilized, it is obvious that it may be applied with equal facility to other well known types of compression refrigeration apparatus.

Referring specifically to the drawing for a detailed description of my invention, numeral 1 designates a refrigerator cabinet having a food storage compartment 2 with a movable closure 3 therefor, a second compartment 4 for congealing liquids and desserts with a movable closure 5 therefor, and a machinery compartment 6 open to the exterior of the cabinet through aperture 7 to allow air to circulate thereover. A relatively large heat absorbing unit 8 including its expansion valve 9 are disposed in the food compartment adjacent to the walls thereof. A smaller heat absorbing unit 11 and its expansion valve 12 are disposed in the congealing compartment 4, and trays 13 are provided for containing liquids and desserts to be frozen. A motor compressor unit 14, condenser 15, receiver 16 and fan 17 are disposed in the machinery compartment 6.

Referring specifically to Fig. 2 for a description of the refrigeration apparatus as constructed and arranged in accordance with my invention, the motor compressor unit 14 comprises a motor 18, two compressor elements 19 and 20 which are driven by the motor 18 through a common drive shaft 22, eccentric members 24 and 25 to operate the compressor elements 19 and 20 and a hermetically sealed casing 23 enclosing the motor 18 and compressors 19 and 20. The compressors 19 and 20 discharge compressed refrigerant through ports 26 and 27 respectively, to the interior of the casing 23. The compressed refrigerant is forced by pressure from the casing 23 to the condenser 15 through conduit 28, wherein it is condensed by the cooling action of the fan 17. The condensed refrigerant thus flows to the receiver 16 through a conduit 29, wherein it is stored.

From the receiver 29, condensed refrigerant flows to one expansion valve 12 through conduit 31 where it expands and enters the congealing compartment evaporator 11. Refrigerant is withdrawn from the congealing compartment heat absorbing unit through conduit 32 directly to an inlet port 36 of the compressor element 20. Likewise refrigerant flows to the second expansion valve 9 through conduit 34 where it expands and enters the food compartment heat absorbing unit 8. Refrigerant is withdrawn from the cooling compartment heat absorbing unit 8 through conduit 35 directly to an inlet port 33 of the compressor 19.

The compressor 20 for withdrawing refrigerant from the congealing compartment heat absorbing unit has a relatively large displacement in order to maintain the congealing compartment heat absorbing unit 11 at a low pressure and temperature. The compressor 19 has a smaller displacement in order to maintain the food compartment heat absorbing unit 8 at a relatively high pressure and temperature. The two compressors 19 and 20 operate at different ratios of compression because both of the compressors 19 and 20 discharge refrigerant at substantially the same pressure into the condenser 15, and each compressor maintains a different pressure on the heat absorbing unit to which it is directly connected, whereby close temperature control of low and high temperature compartments is obtained.

If the two heat absorbing units 8 and 11 absorb the same amount of heat per unit of time, it is obvious that the compressor 20 withdrawing refrigerant from the congealing compartment evaporator 11 must be larger in bore than the cooling compartment compressor (the stroke and speed being the same) in order to maintain a lower pressure and temperature in the congealing compartment heat absorbing unit 11. However, the cooling compartment compressor 20 pumps denser gas and therefore the work done per stroke of the two pistons may be made to balance. Under various conditions, when the two compartments absorb different amounts of heat, the bores may be further modified to suit the conditions.

From the foregoing description, it will be obvious that I have provided an extremely efficient two temperature refrigeration apparatus which preferably has a sealed motor compressor unit and which provides the two compressor elements used in the system with good dynamic balance. Only one motor and condensing system are necessary for the system and extremely close control may be obtained. The operation of the motor may be controlled by means well known in the art if intermittent operation is desired.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In refrigerating apparatus, the combination of a refrigerator cabinet, a relatively low temperature heat absorbing element for making ice, a relatively high temperature heat absorbing element for cooling the cabinet, means for dividing the cabinet into a low temperature compartment and a high temperature compartment wherein said heat absorbing elements are respectively disposed, first and second refrigerant compressor elements for withdrawing refrigerant vapor, respectively, from the low and high temperature heat absorbing elements, a common condensing means for condensing the refrigerant vapor discharged by both compressor elements and for supplying liquefied refrigerant to both of said heat absorbing elements, a prime mover for driving both of said compressor elements at the same speed, said compressor elements having relatively different ratios of compression so as to maintain different refrigerant pressures in the respective heat absorbing elements.

2. In refrigerating apparatus, the combination of a refrigerator cabinet, a relatively low temperature heat-absorbing element for freezing liquids, a relatively high temperature heat-absorbing element for cooling the cabinet, means dividing the cabinet into a high temperature compartment and a low temperature compartment from which the high and low temperature heat-absorbing elements respectively absorb heat, first and second refrigerant compressor elements for withdrawing refrigerant vapor, respectively, at a relatively low suction pressure from the low temperature heat-absorbing element and at a relatively high suction pressure from the high temperature heat-absorbing element to maintain the low and high temperature heat-absorbing elements at their proper temperatures and a prime mover for driving both of said compressor elements.

3. In refrigerating apparatus, the combination of a refrigerator cabinet, a relatively low temperature heat absorbing element for freezing liquids, a relatively high temperature heat absorbing element for cooling foodstuffs, a separate expansion valve associated with each of said heat absorbing elements, means dividing the cabinet into a high temperature compartment and a low temperature compartment from which the high and

low temperature heat absorbing elements, respectively, absorb heat, first and second refrigerant compressor elements for withdrawing refrigerant vapor, respectively, at a relatively low suction pressure from the low temperature heat absorbing element and a relatively high suction pressure from the high temperature heat absorbing element to maintain the low and high temperature heat absorbing elements at their proper temperatures, a common condensing means for condensing the refrigerant vapor discharged by both of said compressor elements and for supplying liquefied refrigerant to both of said heat absorbing elements, and a common driving means for said compressor elements.

4. In refrigerating apparatus, the combination of a refrigerator cabinet, a relatively low temperature heat absorbing element for freezing liquids, a relatively high temperature heat absorbing element for cooling the cabinet, means dividing the cabinet into a high temperature compartment and a low temperature compartment from which said high and low temperature heat absorbing elements respectively absorb heat, first and second refrigerant compressor elements for withdrawing refrigerant vapor, respectively, at a relatively low suction pressure from the low temperature heat absorbing element and at a relatively high suction pressure from the high temperature heat absorbing element to maintain the high and low temperature heat absorbing elements at their proper temperatures, and a single prime mover for driving both of said compressor elements, said compressor elements being of different volumetric displacements.

MATSON C. TERRY.