

July 21, 1936.

L. A. PHILIPP

2,048,218

REFRIGERATING APPARATUS

Original Filed May 10, 1932

2 Sheets-Sheet 1

Fig. 1.

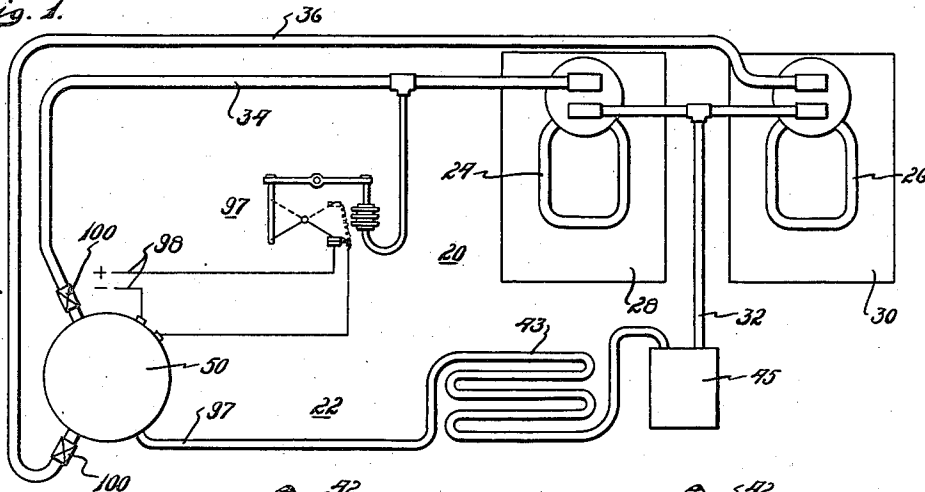


Fig. 5.

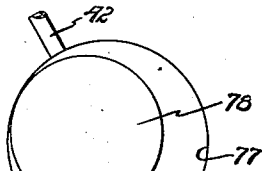


Fig. 6.

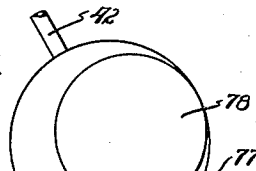


Fig. 7.

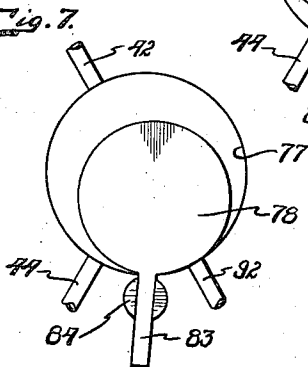


Fig. 8.

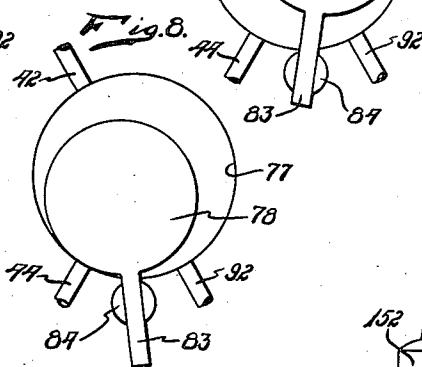
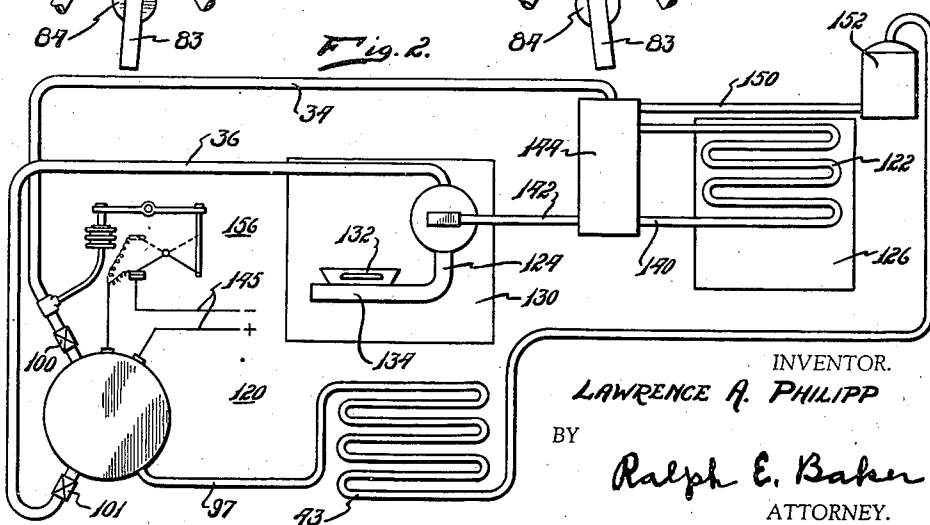


Fig. 2.



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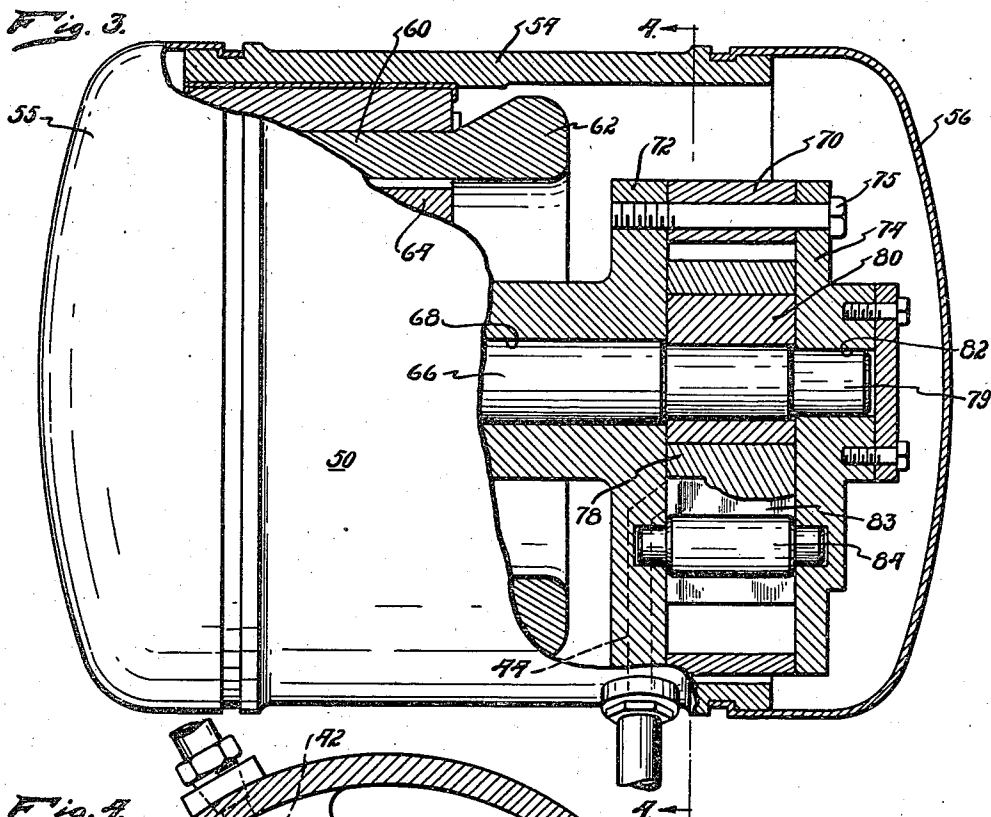
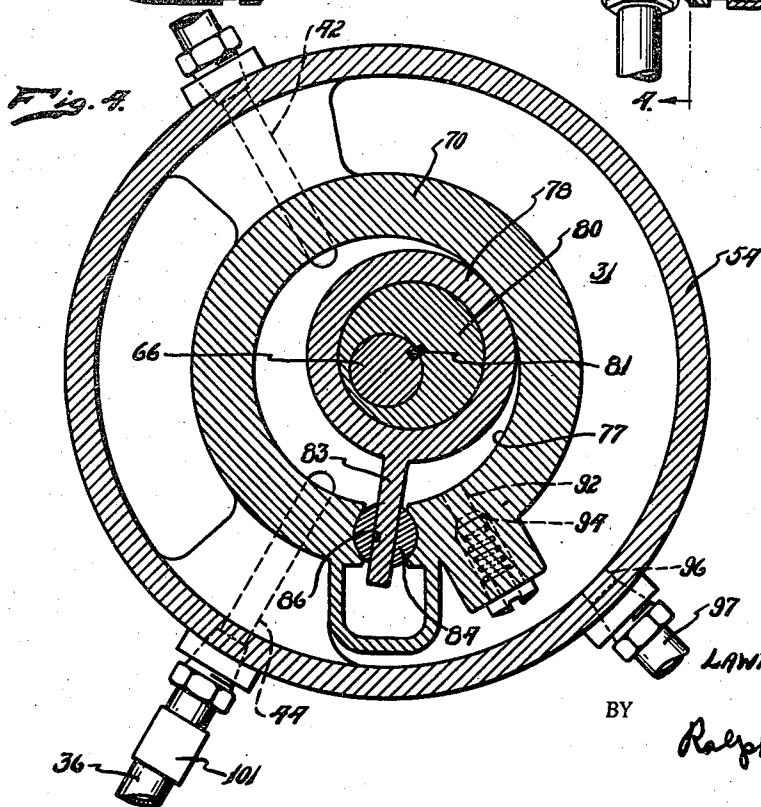
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REFRIGERATING APPARATUS

Original Filed May 10, 1932

2 Sheets-Sheet 2



INVENTOR.
LAWRENCE A. PHILIPP

BY

Ralph E. Baker

ATTORNEY.

UNITED STATES PATENT OFFICE

2,048,218

REFRIGERATING APPARATUS

Lawrence A. Philipp, Detroit, Mich., assignor to
Kelvinator Corporation, Detroit, Mich., a cor-
poration of Michigan

Original application May 10, 1932, Serial No.
610,472. Divided and this application January
29, 1934, Serial No. 708,840

1 Claim. (Cl. 230-47)

This invention relates to refrigerating appa-
ratus, and more particularly to an apparatus for
and a method of maintaining a number of dif-
ferent refrigerating compartments at different
temperatures.

This application is a division of my co-pending
application Serial No. 610,472 filed May 10th,
1932, for "Refrigerating apparatus".

Heretofore, it has been the practice to maintain
a temperature differential between a number of
different refrigerant evaporators by means of
pressure responsive valves associated with some
or all of the refrigerant evaporators. These
valves prevented the withdrawal of refrigerant
vapor and heat from the different evaporators
until a predetermined pressure existed therein.
Usually, these evaporators are joined to a com-
mon refrigerant vapor conduit connected to an
intermittently operated compressing unit, the
operation of which was controlled by changes in
pressures in the vapor conduit. Valves of this
type have been found to be undesirable in that
they are very likely to become out of proper
adjustment or misadjusted by someone unfamiliar
with the operation of the system. This causes
abnormal operation of the system. In addition,
the valves are usually complicated and expensive
to manufacture. Also, in systems of this type,
refrigerant vapor was frequently drawn into the
compressor at the low pressure existing in the
evaporator operating at a lower temperature than
the others in response to a demand for refriger-
ation by that evaporator. This low pressure
vapor was then compressed to its condensing pres-
sure. Under these conditions, the compressor
was required to do more work than it would if the
refrigerant to be compressed was at a higher
pressure.

One of the objects of my invention is to provide
an improved and simplified arrangement for
maintaining a number of different compartments
at a number of different temperatures by means
of a multiple suction pressure compressor.

Another object of my invention consists in pro-
viding a compressor with a plurality of fluid suc-
tion ports whereby the fluid to be compressed is
drawn into the compressor at different times dur-
ing the suction stroke of the compressor.

Another object of my invention consists in the
provision and adaption of a rotary compressor for
operation at a plurality of suction pressures and
the simultaneous compression of the fluid re-
ceived at different suction pressures.

Further objects and advantages of the present

invention will be apparent from the following
description, reference being had to the accom-
panying drawings, wherein a preferred form of
the present invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatic representation of a
refrigerating system embodying features of my
invention;

Fig. 2 is a diagrammatic representation of a
modified form of refrigerating system embodying
features of my invention;

Fig. 3 is a side view in cross section of a motor-
compressor unit embodying features of my inven-
tion;

Fig. 4 is a view taken along the line 4-4 of 15
Fig. 3; and

Figs. 5 to 8, inclusive, show diagrammatically
different positions of the compressor piston dur-
ing operation thereof.

Referring to the drawings, and particularly 20
Fig. 1, the numeral 20 designates, in general, a
refrigerating system diagrammatically represent-
ing as including a condensing element 22 and re-
frigerant evaporators 24 and 26, which may be of
the flooded float control type, although other
types may be used. Evaporators 24 and 26 are
adapted to refrigerate compartments 28 and 30,
respectively, at different temperatures by means
of a multiple suction compressor 31 (see Fig. 4)
forming a part of the condensing element 22,
which is hereinafter described in detail.

Liquid refrigerant is supplied to the evapora-
tors 24 and 26 by means of a common liquid supply
conduit 32 and evaporated refrigerant is with-
drawn from the evaporators 24 and 26 through
vapor conduits 34 and 36 at different suction
pressures by means of the multiple suction com-
pressor 31, the conduit 34 being connected to a
relatively high suction pressure port 42, and the
conduit 36 being connected to a lower suction
pressure port 44 of compressor 31. The com-
pressor 31 compresses the refrigerant vapor and
delivers it to a condenser 43 wherein it is lique-
fied and from which it is delivered to a liquid
refrigerant receiver 45 to which the conduit 32 is
connected.

Under the above conditions, the temperature
of evaporator 24 and the temperature in com-
partment 28 will be maintained lower than the
temperature of evaporator 26 and the tempera-
ture in the compartment 30, although the evap-
orators 24 and 26 may be of the same capacity
and the insulation surrounding the compartments
be the same. This is due to the difference in suc-
tion pressures of the compressor 31 and the

difference in removal of heat from evaporators 24 and 26 caused thereby. Consequently, it will be noted that I have arranged for maintaining a temperature differential between a number of different refrigerant evaporators by means of a multiple suction compressor.

As shown in Figs. 3 and 4, the compressor 31 is enclosed in a hermetically sealed casing 50. The casing 50 is formed preferably of three parts; namely, a central casting member 54 and sheet metal enclosures 55 and 56 joined to the casting 54 at opposite ends thereof. An electric motor 60 is also enclosed within the casing 50. The motor includes stator 62 and rotor 64. Rotor 64 is carried by shaft 66, which shaft is journaled in a bearing 68, preferably formed integrally with the casting member 54. On the opposite end of the shaft 66, I have mounted the compressor 31. This compressor is of the so-called rotary type and includes a cylinder block 70 clamped between a vertically extending wall member 72 formed preferably integral with the casting member 54, and an outer plate member 74 by means of screws 75. Within the cylinder block 70 there is provided a piston chamber 77 in which there is disposed a piston member 78 arranged for movement about the cylindrical wall of the chamber 77 by means of an eccentric member 80 carried by shaft 66 and locked thereto by means of key 81. The shaft 66 extends through the chamber 77 and the shaft end 79 is journaled in a bearing 82 carried by plate 74. The piston is provided with a blade 83, which extends through an opening 86 in an oscillating member 84. The oscillating member 84 is arranged for movement within the walls of the cylinder block 70, while the blade 83 is arranged for reciprocation within the opening 86 provided in the member 84. By this arrangement, rotation of shaft 66 and the eccentric member 80 will cause movement of the piston 78 about the wall of the chamber 77, while the blade 83 will oscillate with respect to the axis of the member 84.

As shown in Fig. 4, I have disposed the low suction pressure port 44 in close proximity to the left side, as viewed in the drawings, of the blade 83, and I have disposed the relatively higher suction pressure port 42 at an angle considerably less than 180° therefrom. However, it is to be understood that the port 42 may be disposed at any place about the periphery of the chamber 77, depending upon the capacity of the compressor desired. A discharge port 92 is provided for the discharged gas compressed within the chamber 77. A suitable discharge valve 94 is provided in the discharge port 92. As shown, the high compressed gas is discharged within the sealed casing 50 whence it passes through the outlet 96 provided in casing 50, through conduit 97 to the condenser 43.

As shown in Fig. 4, the piston member 78 is compressing gas on the right hand side thereof and gas is being drawn into the chamber 77 on the left hand side thereof. In order to more clearly describe the operation of the compressor, I have shown in Figs. 5 to 8, inclusive, various positions assumed by the piston within the chamber 77 during operation thereof. In Fig. 5, the piston 78 is just starting on its suction stroke whereby refrigerant vapor is being drawn into the chamber 77 through the port 44 and the piston 78 is compressing gas in the chamber 77 between its right hand side and the wall of the chamber 77. Fig. 6 shows the piston after it has moved past the high suction pressure port 42 whereby refrigerant vapor is being drawn into the chamber 77 through

the port 42, and in so doing, this refrigerant vapor, which is at a higher pressure than the vapor which enters the chamber 77 through port 44, will tend to compress the vapor previously drawn into the chamber 77 through port 44 and prevents the further flow of vapor into chamber 77 through port 44 at this time. Thus, the high pressure vapor compresses the low pressure vapor within the chamber 77 so that upon compression of the precompressed gas, less work will be required of the compressor than if it were required to compress gas at a pressure which is equal to that which enters into the chamber 77 through port 44. As will be noted in the drawings, the suction stroke of the piston 78 from port 42 to the discharge port is greater than the distance between the ports 44 and 42. Thus, by the present arrangement of the high and low pressure suction ports, more refrigerant will be drawn into the chamber 77 through port 42 than through port 44. In order to prevent back flow of gas into the conduits 34 and 36, I have provided these conduits with check valves 100 and 101, respectively. Fig. 7 shows the piston member in the down stroke just after the refrigerant has been discharged through the discharge valve 94. Fig. 8 shows the piston about to start on its suction stroke.

Preferably, the system is intermittently operated in response to changes in pressures within the conduit 34. The evaporators 24 and 26 are of the flooded type, in which the pressure of the refrigerant bears a direct relation to the temperature of the evaporators. Consequently, the operation of the system will be controlled in response to changes in temperature within the evaporator 24. In a system of this type, it is immaterial, however, whether the operation of the compressor is controlled by changes in pressure in the vapor conduit 34 or in the vapor conduit 36, as the compressor withdraws vapor from both evaporators during its operation. In order to control the operation of the motor-compressor unit in response to changes in pressure within the conduit 34, I have provided an automatic switch 97 which is adapted to connect and disconnect the motor to and from the power mains 98 at predetermined pressures.

From the foregoing, it will be apparent that I have provided a refrigerating system of a type including a plurality of refrigerant evaporators and that I have provided for maintaining a temperature differential between the evaporators whereby a number of different compartments are cooled at different temperatures by means of a multiple suction compressor, and that I have further taken advantage of such an arrangement by precompressing some of the vapor before it is compressed by the compressor. This arrangement is particularly advantageous in that the compressor is required to do less work and the capacity thereof is greater than if it were required to compress gas from a pressure equivalent to that existing in a lower temperature evaporator to a pressure at which the refrigerant would condense. Thus, it will be noted that I have provided a simplified form of maintaining a temperature differential within a number of refrigerant evaporators and that I have accomplished this in a simplified and inexpensive manner.

Referring to Fig. 2 of the drawings, there is shown a modified form of refrigerating system which is of the type suitable for installation in any of the so-called household refrigerators.

The system includes a condensing element 120 and refrigerant evaporators 122 and 124. Evaporator 122 is adapted to cool compartment 126, which compartment may be a food storage compartment of a household refrigerator.

Preferably, this compartment is to be maintained at temperatures suitable for refrigerating food articles stored therein. Evaporator 124 is adapted to cool an insulated compartment 130 at temperatures lower than that to which evaporator 122 cools compartment 126. Evaporator 124 is used primarily for freezing ice cubes, and for this purpose I have provided an ice tray 132, which is adapted to rest on a lower portion 134 of evaporator 124. The compartment 130 may be called a freezing compartment and may be located in the same household refrigerator cabinet as the compartment 126 is located. Liquid refrigerant is supplied to the evaporators 122 and 124 by means of liquid supply conduits 140 and 142, which are connected to a liquid refrigerant header 144. The evaporator 124 may be of the flooded float control type wherein a constant level of liquid refrigerant is maintained by means of a float valve mechanism (not shown). Liquid refrigerant is supplied to the header 144 through a conduit 150 under the control of a high side float 152. Evaporated refrigerant is withdrawn from the evaporator 122 through the top of the header 144 by means of the conduit 34, which is connected to the high suction pressure port 42 of compressor 31. Evaporated refrigerant is withdrawn from the evaporator 124 by means of the conduit 36 which is connected to the relatively low suction pressure port 44 of the compressor 31. Any suitable means may be provided for controlling the operation of the motor-compressor unit and, as shown herein, I have provided a pressure responsive switch 156 responsive to changes in pressure within the conduit 34 for actuating switch 156 to cut the motor in and out of circuit with the power mains 145 in response to changes in pressures in conduit 34. By the present arrangement, the evaporator 122 will be subjected to considerably more heat than the evaporator 124, and, consequently, it will be necessary to remove this heat in order to maintain predetermined temperatures within the compartment 126. This heat is due to the fact that in household refrigerators the door which leads to the food storage compartment is usually opened many times during the day and there is considerable transfer of heat from the exterior of the cabinet to the interior thereof between the door and the door opening. For this reason, I have arranged for withdrawing the evaporated refrigerant from the evaporator 122 by means of the high suction pressure portion of the compressor and have arranged for withdrawing the evaporated refrigerant from the low temperature evaporator 124 by utilizing the lower suction pressure part of the compressor. The evaporator 124 may be of a larger heat capacity than the evaporator 122 and, as shown, the evaporator 124 is utilized primarily for freez-

ing ice cubes. Thus, the possibility of heat transfer into this compartment is considerably less than the heat transfer into compartment 126. For this reason, it is desirable to connect the evaporator 122 to the high suction pressure port of the compressor. In the system shown in Fig. 2, the high temperature evaporator is shown connected to the high suction pressure port of the compressor 31, while in Fig. 1 the low temperature evaporator is shown connected to the high suction pressure port of the compressor. However, this arrangement may be changed to suit the conditions of the refrigerating system. In the system shown in Fig. 1, the evaporators are of the same heat capacity, while in Fig. 2, the evaporators shown are of different heat capacities and are arranged for cooling different sized compartments in which the heat removal problem is considerably different from that of the compartments shown in Fig. 1. Thus, it will be apparent that the compressing unit is readily adaptable for a number of different purposes where it is desired to maintain a number of different temperatures by a number of different evaporators.

Although only a preferred form of the invention has been illustrated, and that form described in detail, it will be apparent to those skilled in the art that various modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claim.

What I claim as my invention is:

A rotary fluid pump for creating different back pressures comprising, in combination, means providing a substantially cylindrical chamber for fluid to be compressed and being provided with an inlet port connected with a source of fluid to be subjected to a predetermined back pressure, an outlet port, a second inlet port located intermediate said inlet and outlet ports and connected with a second source of fluid to be subjected to a different back pressure, said means including a supporting plate providing said inlet ports, a substantially cylindrical piston within said chamber, said piston being of smaller diameter than said chamber, a shaft journaled in said supporting plate and extending into said chamber, eccentric means on said shaft associated with said piston for operating said piston in one direction only and for urging said piston toward the wall of said chamber and about said chamber wall, said second inlet port being so positioned that a movement of said piston past said second inlet port will establish open communication in said chamber between said first and second inlet ports, and a movement past said outlet will establish open communication in said chamber between said second inlet port and said outlet port, and independent check valves associated with each inlet port and operable by the differences in pressures created in the apparatus for preventing back flow of fluid through said inlet ports.

LAWRENCE A. PHILIPP.