

May 7, 1940.

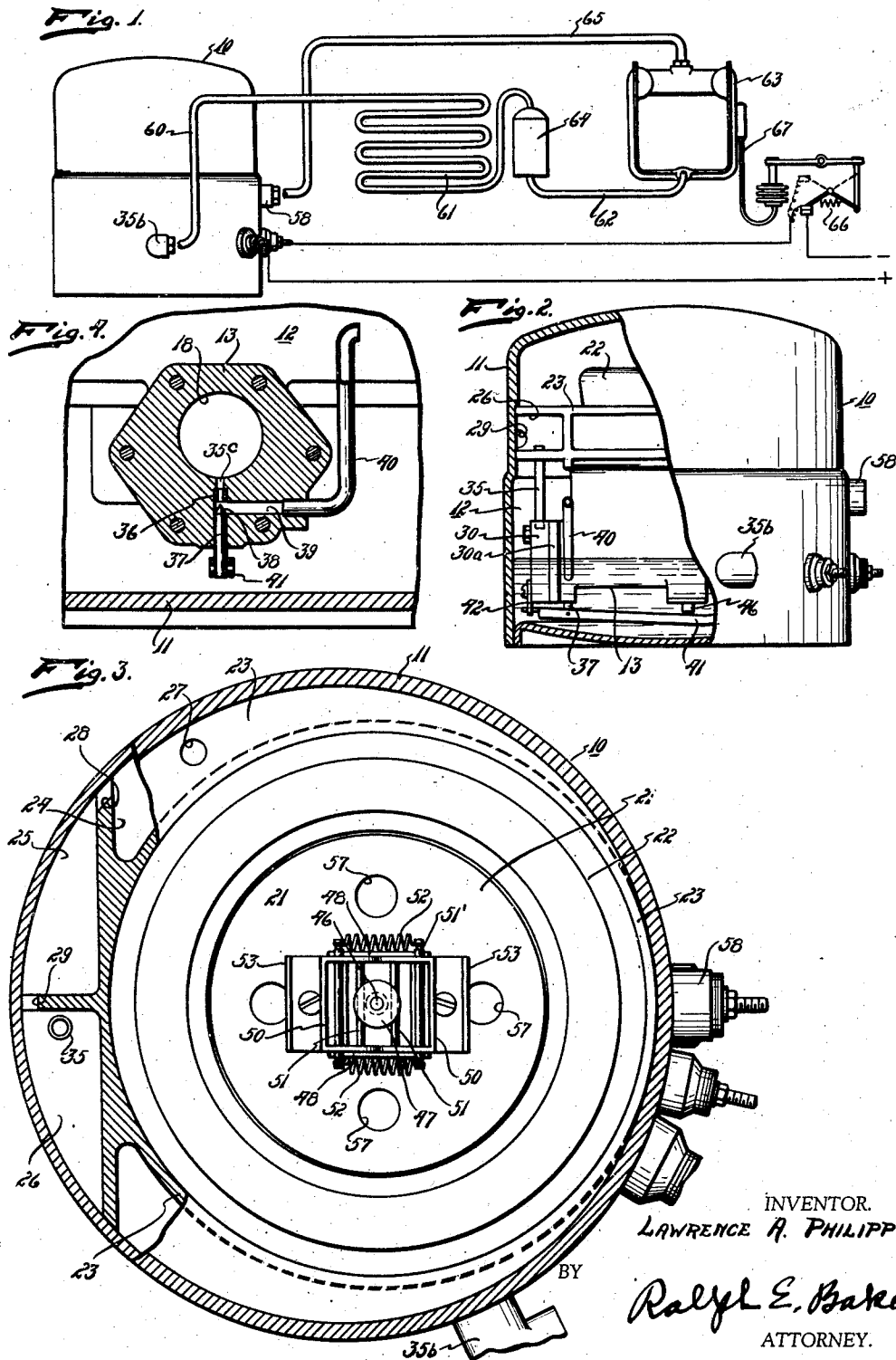
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2,199,415

REFRIGERATING APPARATUS

Original Filed Oct. 17, 1936

5 Sheets-Sheet 1



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Fig. 5.

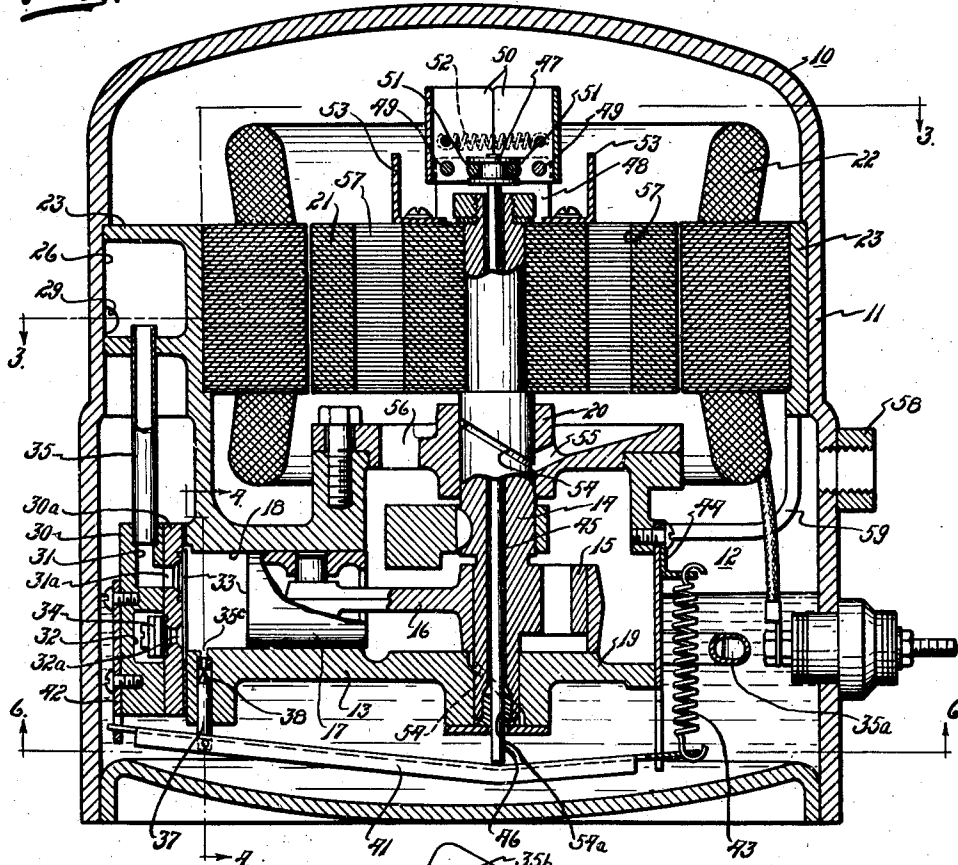


Fig. 6.

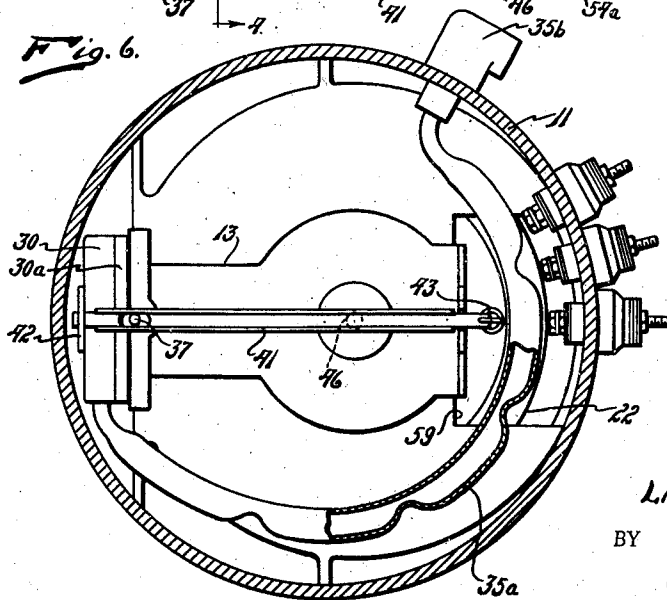
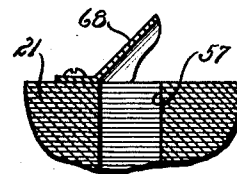


Fig. 7.



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Fig. 8.

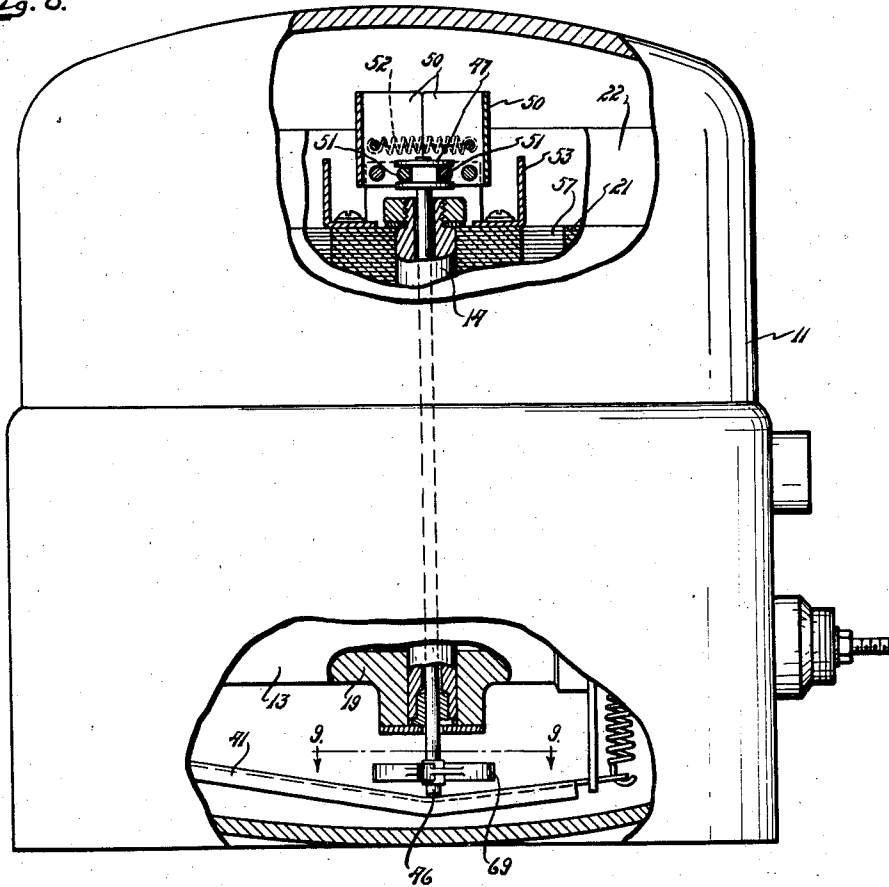
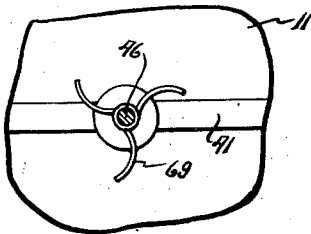


Fig. 9.



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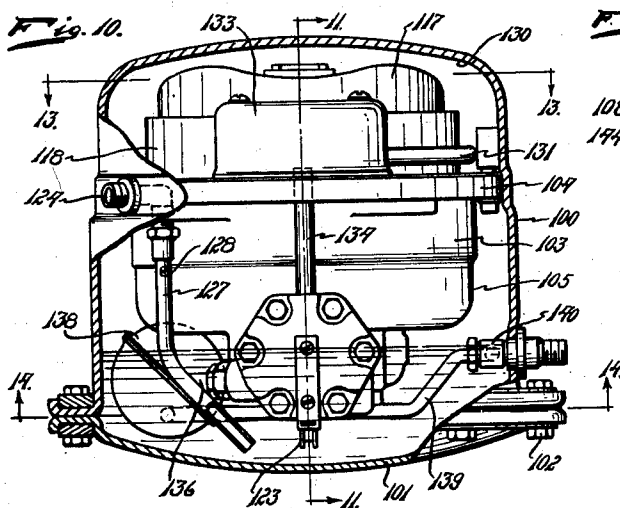
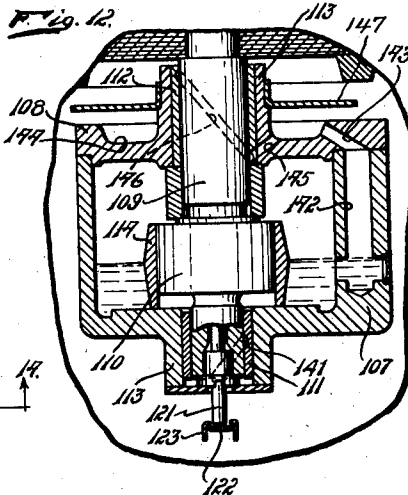
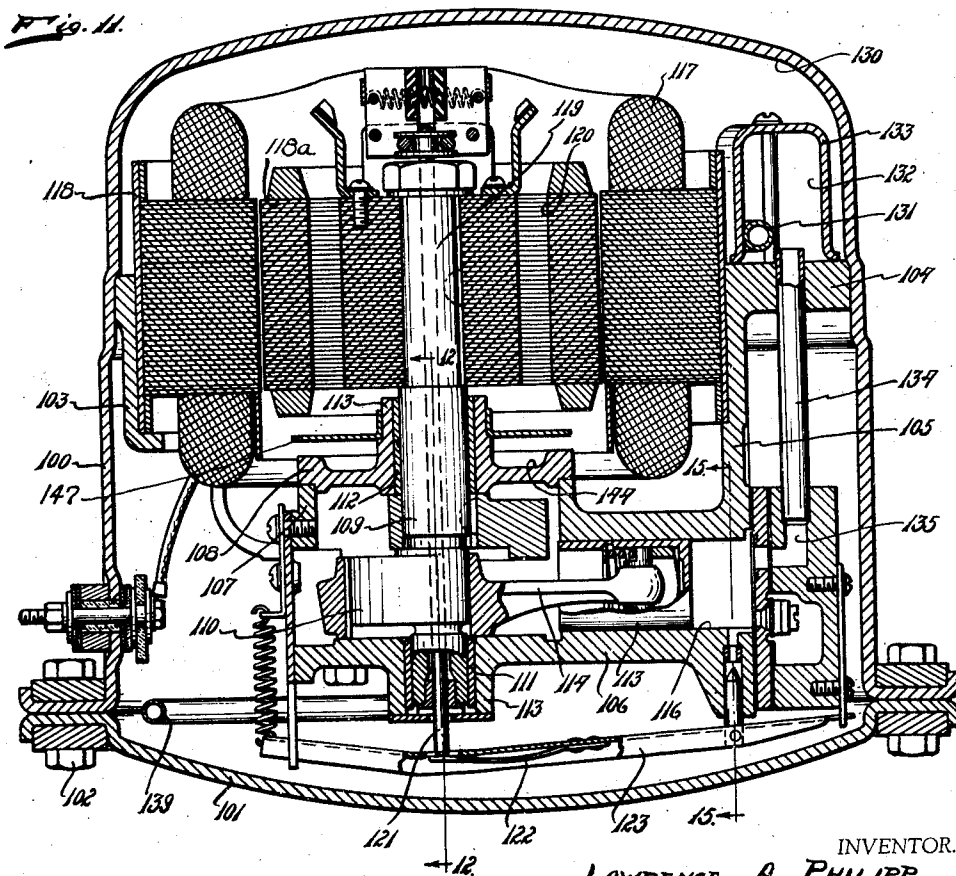
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Fig. 15.

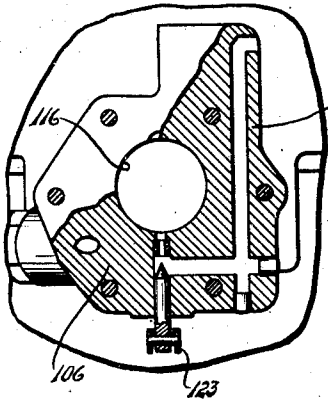


Fig. 13.

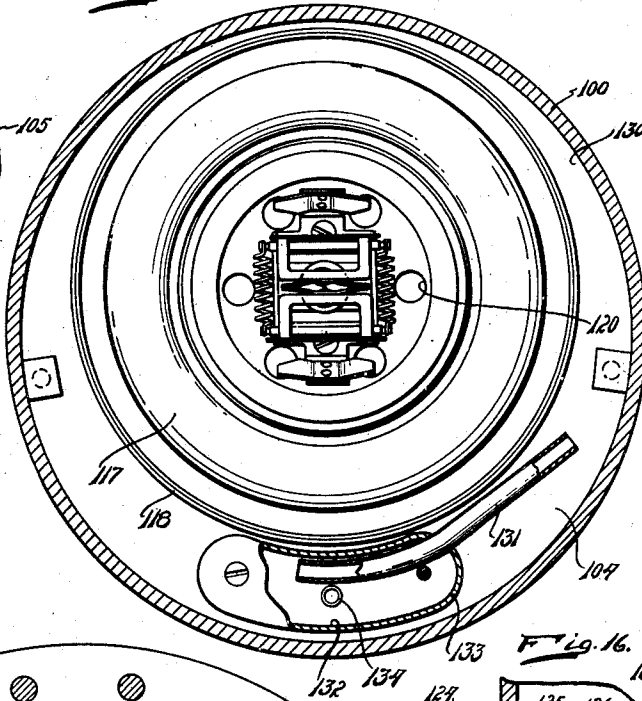


Fig. 14.

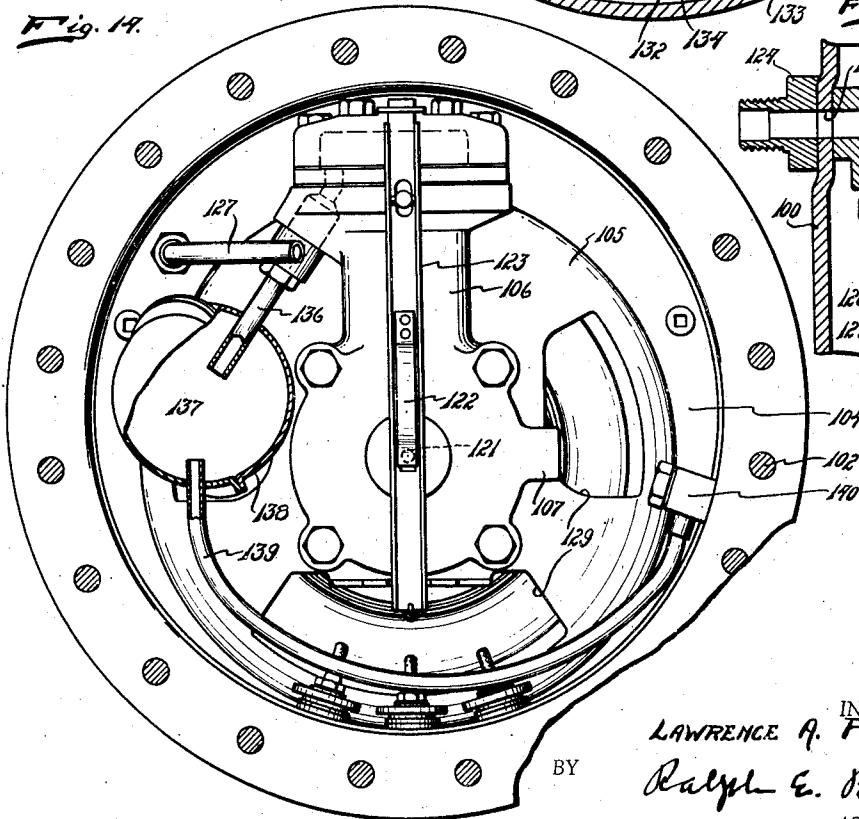
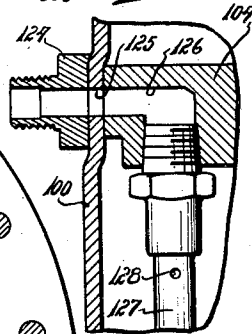


Fig. 16.



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UNITED STATES PATENT OFFICE

2,199,415

REFRIGERATING APPARATUS

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mesne assignments, to Nash-Kelvinator Cor-
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Application October 17, 1936, Serial No. 106,118
Renewed January 9, 1940

15 Claims. (Cl. 62—115)

This invention relates to refrigerating systems and processes, and more particularly to refrigerating systems in which a pump or compressor is employed for compressing the refrigerant.

One of the objects of the present invention is to provide a new and improved process of refrigeration wherein lubricant particles entrained in the gaseous refrigerant withdrawn from the evaporating element are separated from the refrigerant prior to the compression of the same.

Another object is to provide a process of refrigeration wherein lubricant particles entrained in the gaseous refrigerant withdrawn from the evaporator are separated therefrom in a low pressure zone by centrifugal force.

Another object is to provide a system and process of refrigeration wherein the gaseous refrigerant passing from the evaporator to the compressor is caused to pass through a rotating device and thereby subjected to centrifugal action whereby lubricant particles entrained in the refrigerant will be separated therefrom.

Another object is to provide a system and process of refrigeration in which gaseous refrigerant and lubricant are transferred from a vaporizing zone through a low pressure zone to a compressing zone and in which the refrigerant and lubricant are subjected to centrifugal action in the low pressure zone in such a manner that the lubricant particles entrained in the refrigerant will be separated therefrom and accumulated in the low pressure zone.

A further object is to provide a system and process of refrigeration employing a compressor and driving motor therefor arranged within a hermetically sealed casing, which comprises admitting gaseous refrigerant and lubricant into the casing under low pressure and causing the refrigerant during its passage from within the casing to the compressor to pass through the rotating element of the driving motor whereby to separate entrained lubricant particles from the refrigerant by the centrifugal action of the rotating element.

A further object is to provide a system and process of refrigeration wherein the passage of lubricant particles entrained in the gaseous refrigerant through the pumping mechanism is minimized.

A still further object is to provide a system and process of refrigeration in which lubricant is accumulated in a reservoir and agitated in a new and novel manner to provide for a rapid heat transfer to thus cool the accumulated refrigerant.

With the above and other objects in view the

present invention comprises certain features of arrangements of parts and steps in the process to be hereinafter described with reference to the accompanying drawings, and then claimed.

In the drawings which illustrate suitable embodiments of the invention Fig. 1 is a diagrammatic view of one form of refrigeration system in which the present invention may be incorporated.

Fig. 2 is a side elevation of the compressor device employed in the system, a portion of the casing being broken away to show the interior thereof.

Fig. 3 is an enlarged transverse section taken approximately upon the lines 3—3 of Fig. 5.

Fig. 4 is a vertical section taken approximately on the line 4—4 of Fig. 5.

Fig. 5 is an enlarged vertical section of the compressor device shown in Fig. 2.

Fig. 6 is a section taken approximately on line 6—6 of Fig. 5 showing the compressor in bottom plan view.

Fig. 7 is a fragmentary view through the rotating element of the driving motor showing a deflecting member which may be associated therewith.

Fig. 8 is a side elevation of a slightly modified form of the compressor element, portions of the casing being broken away to show a means which may be employed to agitate lubricant which may accumulate within the casing;

Fig. 9 is a transverse section taken approximately on line 9—9 of Fig. 8 showing the lubricant agitating means.

Fig. 10 is a side elevation of a motor compressor unit of modified form, the casing portion being broken away.

Fig. 11 is an enlarged vertical section taken approximately on line 11—11 of Fig. 10.

Fig. 12 is a fragmentary section taken approximately on line 12—12 of Fig. 11.

Fig. 13 is a transverse section taken approximately on line 13—13 of Fig. 10.

Fig. 14 is a transverse section taken approximately on line 14—14 of Fig. 10 showing a bottom plan view of the compressor.

Fig. 15 is a section taken approximately on line 15—15 of Fig. 11 showing the passageways and valve of the unloading device, and

Fig. 16 is a fragmentary section showing the suction or inlet passage.

Briefly stated, the system and process of the present invention employs a suitable refrigerant which, for the purpose of illustration, is caused to pass through a cycle which consists in com-

pressing the refrigerant in the gaseous or vaporized form, removing the heat therefrom to cause it to condense into liquid form, allowing the refrigerant in the liquid form to evaporate and thus absorb heat, and causing the refrigerant in the gaseous form during its passage to the compressor, to enter a low pressure zone, wherein, prior to the compression step, the refrigerant is subjected to centrifugal action whereby lubricant particles which may be entrained therewith are separated therefrom by centrifugal force, and the separated lubricant allowed to accumulate in the low pressure zone. Furthermore, the accumulated lubricant is agitated in a new and novel manner so as to provide for a rapid transfer of heat whereby to prevent the same from becoming excessively heated.

In the accompanying drawings, in which like numerals refer to like parts throughout the several views, I have shown, for the purpose of illustration, a compression device of the hermetically sealed type.

The casing surrounding the compressor and driving motor forms a low pressure chamber or zone in which the gaseous refrigerant passes through passages in the rotating element of the driving motor in its passage to the compressor and is acted upon by centrifugal force for separating entrained lubricant particles therefrom. It is to be understood, however, that means other than the rotating element of the compressor motor may be employed for separating the lubricant particles by centrifugal force in this low pressure zone. It is to be understood also that the present invention is not limited to refrigeration systems of the compressor-condenser-expander type.

The compressor 10, shown for the purpose of illustration, is of the hermetically sealed type having, as shown in Figs. 2, 3 and 5, a sealed casing 11 providing a chamber 12 within which there is a horizontal pump cylinder 13 located near the bottom thereof.

Associated with the pump cylinder 13 is a vertical shaft 14 having an eccentric 15 thereon which actuates a connecting rod 16, the rod 16 being pivoted to a piston 17 reciprocally mounted in the bore 18 of the cylinder 13.

The crankcase portion 19 of the cylinder 13 is provided with a closure plate 20, the shaft 14 being journaled in the side wall of the crankcase portion 19 and in the closure plate 20 as shown in Fig. 5.

The shaft 14 projects upwardly beyond the plate 20 and carries the rotating element 21 of the electric motor, and surrounding the element 21 is the motor winding 22 which is supported by an annular element 23 connected with and supporting the cylinder 13 and crankcase portion 19, the closure plate 20 being surrounded by the element 23. The element 23 closely and continuously fits the interior wall of the casing 11 and forms at one side thereof with said inner wall chambers 24, 25 and 26, as shown in Fig. 3. The upper portion of the element 23 is provided with an opening 27 which places that portion of chamber 12 which is above the element 23 in communication with the chamber 24, the chambers 24 and 26 being in communication with each other through an opening 28, and the chambers 25 and 26 being in communication with each other through an opening 29.

The cylinder bore 18 is closed in by a cylinder head 30 and valve plate 30a, the valve plate 30a being disposed between the cylinder 13 and cylinder head 30. The cylinder head 30 is provided

with a suction passage 31 which communicates with the inlet port 31a of the plate 30a, and with an outlet passage 32, which communicates with the outlet port 32a of the plate 30a. Associated with the plate 30a is a suitable valve 33, which may be of the reed type for closing the port 31a during the compression stroke of the piston 17, and associated with the port 32a is a valve 34 for closing the port 32a during the suction stroke of the piston 17. The valves 33 and 34 however may be of any suitable type.

The inlet passage 31 is provided with a conduit 35 which communicates with the chamber 26, and connected with the outlet passage 32 is an outlet conduit 35a which extends to an outlet connection 35b extending through the wall of the casing 11 in sealed relation.

In order to relieve the electric motor of the starting load of the compressor, I prefer to employ an unloading device. Any suitable device may be employed. However, I have shown a form of device in the drawings which is particularly adaptable to the motor and compressor unit illustrated.

Referring to Figs. 3, 4 and 5 the compressor cylinder 13 is provided with a passageway 35c opening into the compression space of the cylinder. This passageway is provided with an annular valve seat, and mounted in the passageway is a slidable pin 37 having a tapered end 38 which is cooperable with the valve seat 36 to provide an unloader valve.

Communicating with the passageway 35c adjacent the tapered end of pin 37 is a passage 39 provided with an upwardly extending conduit 40 which terminates above the level of liquid in the chamber 12 as seen in Fig. 2.

The slide pin 37 is pivoted intermediate the ends of a bar 41 located below the axis of the shaft 14, one end of the bar 41 being pivotally supported by a plate 42 secured to the cylinder head 30, and the other end being connected by a tension spring 43 to a bracket 44 secured to the crankcase portion 19. The shaft 44 is provided with an axial passage 45 within which a rod 46 is positioned, the upper end of the rod extending above the rotating part 21 of the motor, and having a spool-like member 47 fixed thereto. Secured to the upper side of the rotating element 21 of the motor are spaced brackets 48 having spaced interconnecting pivot pins 49 upon which a pair of upwardly extending members 50 are pivoted. The members 50 are provided with fixed pins 51 disposed at opposite sides of the bottom of the groove in the spool-like member. As shown in Figs. 3 and 5, the members 50 normally engage each other and are urged to this position by tension springs 47 which interconnect the same. With the members 50 in the position shown in Fig. 5, the rod 46, through the medium of the bar 41, and against the tension of the spring 43, holds the pin 37 away from the valve seat 36, whereby the cylinder bore 18 will be in open communication with the chamber 12 above the level of the liquid therein, so that during the starting period the refrigerant drawn into the piston bore is by-passed to the chamber 12. Also secured to the upper surface of the rotating element 21, outwardly of the members 50, are brackets 53, which serve as stops to limit the pivoting movement of the members 50. During the time that the motor is gaining speed, the members 50 gradually move away from each other and allow the spring 43 to close the valve seat so that the refrigerant drawn into the piston bore will be

compressed and discharged during normal operation through the discharge passageway 32.

Referring to Figs. 3 and 5, it will be noted that the rotating element 21 is provided with a plurality of apertures 57 extending therethrough, which are for a purpose to be later described. The casing 11 is provided with an inlet fitting 58 which opens into the chamber 12 above the level of the liquid therein, and the member 23 is also cut away to provide an opening 59 adjacent the inlet fitting.

Referring to the diagrammatic illustration in Fig. 1 the outlet connection 35b is connected through conduit 60 with a suitable condenser 61, which, in turn, connects through liquid conduit 62 with the evaporator 63, the flow of liquid refrigerant to the evaporator 63 being under the control of any suitable device, such as for example, a float mechanism 64 associated with the conduit 62. The evaporator 63 is, in turn, connected with the inlet connection 58 by means of conduit 65.

Preferably, the system is intermittently operated and, in order to control the operation of the compressor, I have provided, as a suitable control means, an automatic control switch 66 which is responsive to changes in temperature of the evaporator 63 through the medium of a thermostat control device 67 associated with the evaporator. Obviously, other control means may be employed.

In the operation of the system of the present invention the gaseous refrigerant, compressed in the bore 18 of the compressor, flows through conduit 35a and into the condenser 61 through the conduit 60 where it is liquified and from which it is delivered to the evaporator 63 by means of the liquid conduit 62 under the control of the float mechanism 64.

The chamber 12 provides a low pressure zone and the gaseous refrigerant is withdrawn from the evaporator 63 through conduit 65 into this zone by the compressor. Due to the fact that the element 23 has sealed engagement with the wall of the casing 11 and that the inlet 27 to the chamber 24 which communicates with the compressor inlet passageway 31 opens into the chamber 12 above the element 23, the gaseous refrigerant entering the chamber 12 is drawn upwardly through the opening 59, and, thence, upwardly through the apertures 57 in the rotating element 21 of the motor, and then passes through opening 27 into the chamber 24 from where it passes through chambers 25 and 26 and conduit 35 into the compressor inlet passageway 31.

Due to the centrifugal action of the rotating element 21 upon the refrigerant being drawn through the apertures 57, entrained lubricant particles are separated by centrifugal force and thrown outwardly beyond the rotating element 21, and drain back to the lower or reservoir portion of the chamber 12 through the annular space between the rotating element 21 and the motor winding. Also some of the lubricant particles drain back along the outer sides of the apertures 57.

In order to facilitate the centrifugal action in separating the lubricant particles from the refrigerant, suitable outwardly directed deflectors 68, such as shown in Fig. 7, may be associated with each of the apertures 57 of the rotating element 21. Lubrication of the bearings of the shaft 14 is provided for by spiral grooves 54, the upper of which receives lubricant through a recess and passageway 55 in the plate 20, the re-

cess and passageway forming a pocket for catching some of the lubricant which drains back toward the lower portion of the chamber 12. The spiral groove 54 at the lower end of the shaft 14 in crankcase portion 19 conducts lubricant to the bearing surface of the lower end of shaft 14.

As will be noted the closure plate is formed with an opening 56 therethrough, and the recess or pocket 55 which communicates with opening 56. The lower end of the spiral 54 formed in crankcase portion 19 is in open communication with the lubricating oil in the crankcase through a slot 54a and the upper end extends to the upper surface of crankcase portion 19 for conducting lubricant to the moving parts of the compressor. Rotation of shaft 14 will cause lubricant in slot 54a to be flung outwardly into spiral groove 54 in crankcase portion 19 by centrifugal force. Thus the lubricant is delivered to the moving parts of the compressor under pressure. Should too much lubricant be introduced to the piston and connecting rod chamber the surplus is free to overflow through opening 56 back to the crankcase reservoir and some to the pocket 55.

If desired, a small paddle wheel 69 may be provided on the lower end of the rod 46 to agitate the lubricant accumulated in the lower portion of the chamber 12, in order to provide for a more rapid transfer of heat whereby the lubricant in the lower portion of the chamber will be maintained at a lower temperature.

In Figs. 10 to 16, I have shown a slightly modified form of motor compressor unit, in which the same principle of separating entrained lubricant particles is employed. In this construction an inverted cup-shaped casing 100 is employed, secured thereto by bolts 102. The annular casting 103 is provided with a single eccentric flange 104, which preferably continuously engages the inner wall of the casing 100, with a press fit, near the upper end thereof.

The casting 103, as in the case of the casting 23 shown in Fig. 5, is provided with a depending portion 105, which carries an integral compressor cylinder portion 106 and crankcase portion 107, the upper side of the crankcase portion 107 being open and provided with a closure member 108. The shaft 109, having an eccentric 110 thereon, is journaled in lower and upper bushings 111 and 112, respectively, which are respectively carried by boss portions 113, formed on the lower portion of the crankcase portion 107, and the closure member 108, respectively.

The eccentric 110 carries a connecting rod 114 which operates a piston 115 slidably mounted in the bore 116 of the cylinder 106. The motor for driving the compressor comprises a winding 117 carried by an annular shell 118 which is supported by the annular casting 103, and a rotating element 118a, secured to a projecting portion 119 of the shaft 109 which extends above the closure member 108. The rotating element 118a is provided with apertures 120 extending therethrough corresponding to the apertures 57 shown in Fig. 5.

The compressor is provided with a cylindrical unloading device which is similar to the device previously described and therefore does not need to be described in detail, except to refer to the fact that the rod 121 is resiliently supported upon a flat spring member 122 carried by the valve actuating lever 123, as shown in Fig. 11.

Referring to Figs. 11, 14 and 15, the casing 100 is provided with an inlet fitting 124 which regis-

ters with an opening 125 formed in the wall of the casing 100, the opening in turn registering with a passageway 126 formed in the flange 104 of the casting 103. The passageway 126 is provided with a conduit 127 which extends downwardly within the casing to a region adjacent the closure plate 101 as shown in Fig. 10; the conduit 127 having a bleeder opening 128 at its upper end. The open end of the conduit is below the level of the lubricant in the chamber provided by the casing 100 and during the operation of the apparatus the gaseous refrigerant flows through the conduit 127 and bubbles up through the lubricant in the bottom of the casing, and then is drawn upwardly through openings 129 formed in the casting 103, and passes through the apertures 120 in the rotating element 118a, into the chamber 130, provided in the casing above the flange 104 which has sealed engagement therewith. The gaseous refrigerant then flows through the conduit 131 arranged in a chamber 130, and enters a muffling chamber 132, provided by a cup-shaped stamping 133, secured to the flange 104, which eliminates what is known as "line-hum." The refrigerant is then drawn from the muffling chamber 132 through a conduit 134 into the suction-intake passageway 135 of the compressor. The compressed refrigerant, after it leaves the compressor, flows through a conduit 136 into a muffling chamber 137, provided by a pair of cup-shaped stampings 138 which are secured together.

The compressed refrigerant flows from the muffling chamber 137 through a conduit 139 arranged adjacent the lower portion of the casing 100, to an outlet fitting 140 extending through the wall of the casing 100.

By causing the incoming gaseous refrigerant to discharge into the casing below the level of the lubricant therein, the lubricant is continuously agitated by the refrigerant escaping therefrom, which provides for a rapid transfer of heat, so as to minimize heating of the lubricant in the lower portion of the casing.

Lubricant is caused to enter the crank case portion by means of a spiral groove 141 formed in the bushing 111 as shown in Fig. 12, which also lubricates the lower bearing of the shaft 109.

Referring to Fig. 12, one wall of the crankcase portion 107 is formed with an upwardly extending passageway 142 which opens at its lower end into the crankcase chamber near the bottom thereof, and which communicates at its upper end with a passageway 143 formed in the closure member 108, the closure member 108 having an annular recess 144 in its upper surface. The closure member 108 is also provided with a passageway 145 which leads from the annular recess 144 to a groove 146 formed in the upper bushing 112. The rotation of the eccentric 101 and the action of the connecting rod 114, causes lubricant to flow from the crankcase chamber upwardly through the passageways 142 and 143 and to the recess 144. This lubricant drains through the passageway 145 and is caused to travel through the spiral groove 146 by the rotation of the shaft 109 to lubricate the upper bearing surface of the shaft. Mounted on the hub like portion 113 of the closure member 108 above the recess 144 is an annular stamping 147 which serves as a lubricant deflecting member.

One of the features of the present invention is that lubricant particles which may be entrained in the refrigerant passing from the evaporator to the compressor are separated from the re-

frigerant by centrifugal force, in a low pressure zone and just prior to the compressing of the refrigerant. This is an advantageous feature, as it is not necessary, as in previous compressors of the sealed type, to pass the lubricant through the compressor, thus avoiding vibration which subsequently occurs when the compressor is started, after standing idle for a period of time.

Another feature of the present invention is that the accumulated lubricant is continuously agitated during the operation of the apparatus, so that a rapid transfer of heat takes place with the result that the lubricant in the lowermost portion of the chamber will be cooled and that heating of the same will be minimized.

While I have shown and described an embodiment of the invention, many changes may be effected therein without departing from the spirit and scope thereof, as shown in the appended claims:

1. In a process of refrigeration in which vaporized refrigerant and lubricant are withdrawn from an evaporating zone and compressed, accumulating lubricant in a low pressure zone, introducing the refrigerant and lubricant being withdrawn from said evaporating zone into the accumulated lubricant below the level thereof prior to the compressing of the same, whereby to effect rapid transfer of heat to the accumulated lubricant and separating the entrained particles of lubricant from the refrigerant.

2. In a system of refrigeration having a low pressure side and a high pressure side, the step in the process of refrigeration of introducing refrigerant in the low pressure side into a body of accumulated lubricant, and subjecting the refrigerant, prior to the transfer thereof to the high pressure side to centrifugal action whereby to separate entrained lubricant particles therefrom by centrifugal force.

3. In a system of refrigeration having a low pressure side and a high pressure side, the step in the process of refrigeration of introducing refrigerant in the low pressure side into a body of accumulated lubricant, and subjecting the refrigerant, prior to the transfer thereof to the high pressure side to centrifugal action whereby to separate entrained lubricant particles therefrom by centrifugal force and transferring the separated lubricant particles to said body.

4. In a refrigerating system having a compressor, a sealed chamber housing the compressor and being in the low pressure side of the system for receiving the low pressure refrigerant during its passage to said compressor and rotary means in said chamber for separating by centrifugal force lubricant particles entrained in the low pressure refrigerant prior to compression thereof.

5. In a refrigerating system having a compressor, a hermetically sealed chamber housing said compressor and being in the low pressure side of the system for receiving low pressure refrigerant immediately prior to compression by said compressor, and means in said chamber for centrifugally separating entrained lubricant particles from the low pressure refrigerant in said chamber.

6. In a refrigerating system a compressor having an inlet, a chamber in the low pressure side of the system communicating with said inlet for receiving low pressure refrigerant and for accumulating lubricant, means in said chamber in the path of the flow of refrigerant for separating by centrifugal force from the refrigerant lubri-

cant particles entrained therein, and means for agitating the lubricant in said chamber.

7. In a refrigerating system a compressor having an inlet, a chamber in the low pressure side of the system communicating with said inlet for receiving low pressure refrigerant and for accumulating lubricant, means in said chamber in the path of the flow of refrigerant for separating by centrifugal force from the refrigerant lubricant particles entrained therein, and means for agitating the lubricant in said chamber, and means for introducing low pressure refrigerant into said chamber below the level of lubricant accumulated therein.

8. In a system of refrigeration having a low pressure side, a high pressure side, and a hermetically sealed chamber in said low pressure side housing a compressor and for receiving vaporized refrigerant and lubricant, a step in the process of refrigeration of subjecting the refrigerant in the sealed chamber prior to the transfer thereof by the compressor to the high pressure side, to centrifugal action whereby to separate lubricant particles therefrom.

9. The process of refrigeration in a refrigerating system having a low pressure hermetically sealed chamber housing a compressor and employing a volatile refrigerant and a lubricant, which comprises condensing compressed refrigerant, evaporating the condensed refrigerant, withdrawing the vaporized refrigerant and lubricant through said chamber, separating lubricant particles by centrifugal force from the lubricant being drawn through said chamber and compressing the lubricant-freed refrigerant.

10. The process of refrigeration in a refrigerating system having a low pressure hermetically sealed chamber housing a compressor and employing a volatile refrigerant and a lubricant, which comprises condensing compressed refrigerant, evaporating the condensed refrigerant, withdrawing the vaporized refrigerant and lubricant through said chamber, separating lubricant particles by centrifugal force from the lubricant being drawn through said chamber, accumulating the separated lubricant in said chamber, and compressing the lubricant-freed refrigerant.

11. The process of refrigeration in a refrigerating system having a low pressure hermetically sealed chamber housing a compressor and employing a volatile refrigerant and a lubricant,

which comprises condensing compressed refrigerant, evaporating the condensed refrigerant, withdrawing the vaporized refrigerant and lubricant through said chamber, separating lubricant particles by centrifugal force from the lubricant being drawn through said chamber, agitating the accumulated lubricant, and compressing the lubricant-freed refrigerant.

12. In a refrigerating system having a compressor, a hermetically sealed chamber housing said compressor and being in the low pressure side of the system for receiving low pressure refrigerant prior to compression by said compressor, and means in said chamber for centrifugally separating entrained lubricant particles from the low pressure refrigerant in said chamber and for operating the compressor.

13. In a refrigerating system having a compressor, a sealed chamber housing the compressor and being in the low pressure side of the system for receiving the low pressure refrigerant during its passage to said compressor, and means interposed in said chamber for separating lubricant particles by centrifugal force from the low pressure refrigerant flowing to said compressor.

14. In a refrigerating system having a compressor, a sealed casing housing the compressor and providing a reservoir for a main body of lubricant containing a substantial quantity of lubricant for moving elements of the system, said casing being in the low pressure side of the system for receiving the low pressure refrigerant, and means for introducing the low pressure refrigerant below the level of lubricant during its passage to the compressor to agitate said lubricant to thereby aid in the transfer of heat thereof.

15. In a refrigerating system having a compressor, a sealed casing housing the compressor and providing a reservoir for a main body of lubricant containing a substantial quantity of lubricant for moving elements of the system, said casing being in the low pressure side of the system for receiving the low pressure refrigerant, means for introducing the low pressure refrigerant below the level of lubricant during its passage to the compressor to agitate said lubricant to thereby aid in the transfer of heat thereof, and means for separating entrained particles of lubricant from said low pressure refrigerant before it is compressed.

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