Sept. 20, 1938. C. STEENSTRUP 2,130,862

MOTOR COMPRESSOR UNIT FOR A REFRIGERATING MACHINE

Filed Jan. 11, 1935 2 Sheets-Sheet 1

Fig. 1.

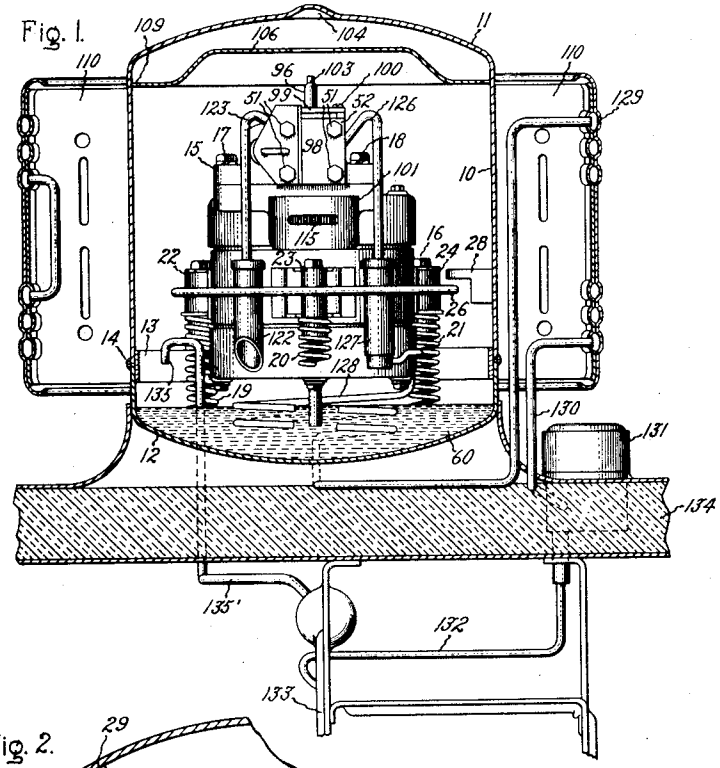
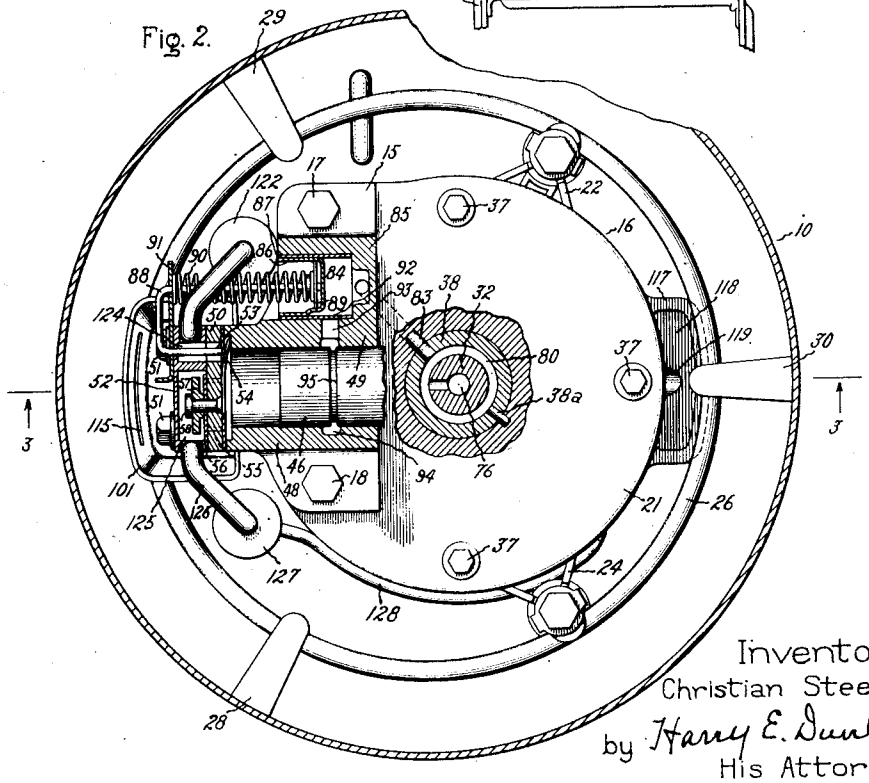


Fig. 2.



Inventor:
Christian Steenstrup,
by Harry E. Dunham
His Attorney.

Sept. 20, 1938. C. STEENSTRUP 2,130,862

MOTOR COMPRESSOR UNIT FOR A REFRIGERATING MACHINE

Filed Jan. 11, 1935 2 Sheets-Sheet 2

Fig. 3.

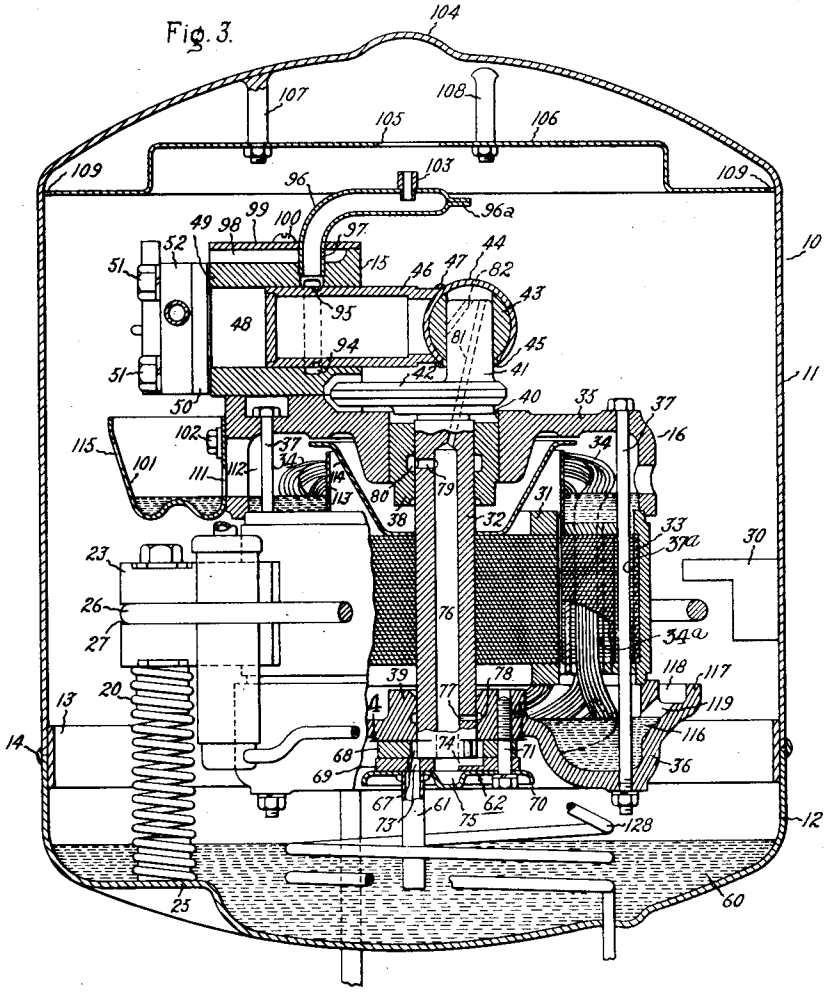


Fig. 4.

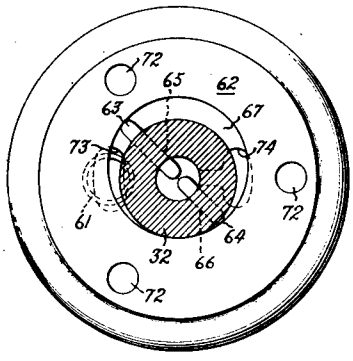


Fig. 5.

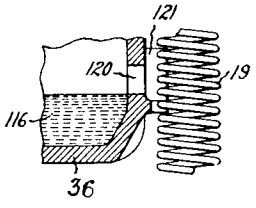
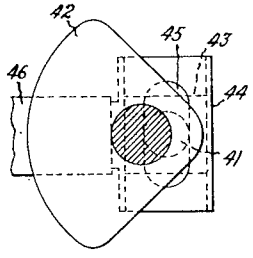


Fig. 6.



Inventor:
Christian Steenstrup,
by Harry E. Dunham
His Attorney.

Patented Sept. 20, 1938

2,130,862

UNITED STATES PATENT OFFICE

2,130,862

MOTOR-COMPRESSOR UNIT FOR A REFRIGERATING MACHINE

Christian Steenstrup, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

Application January 11, 1935, Serial No. 1,319

31 Claims. (Cl. 230—206)

My invention relates to refrigerating machines.

Compression type refrigerating machines include a compressor for compressing gaseous refrigerant, the compressor being driven by an electric motor or the like. The compressor and its driving motor are frequently enclosed in a casing, which is preferably hermetically sealed, thus obviating the necessity of using connections with packing glands or the like between the motor and compressor, and minimizing refrigerant leaks from the machine, as any gaseous refrigerant which escapes from the compressor is confined in the casing. It is desirable to use a supply of lubricant confined in the machine which is recirculated through the bearings of the compressor and the motor without the necessity of variation or replenishment, thus simplifying the operation and maintenance of the machine. This is particularly desirable in the case of machines designed for domestic use, which are used without skilled supervision. Machines of the type described, having encased motor driven compressors, present particularly difficult problems with respect to the cooling of the motor and compressor as well as of the lubricant therefor, especially if the use of a cooling element within the casing connected to some external source of cooling medium is to be avoided. The latter arrangement is undesirable both because of the increased complication of the apparatus, as well as the increase in casing connections if an hermetically sealed casing is employed.

It is an object of my invention to provide a refrigerating machine of the type described having an improved lubricating system which will be quiet and efficient in operation.

It is a further object of my invention to provide a refrigerating machine of the type described including an encased motor driven compressor having an improved arrangement for cooling the lubricant therefor.

It is another object of my invention to provide a refrigerating machine of the type described including an encased motor driven compressor having an improved arrangement for utilizing the lubricant therefor to dissipate heat from the motor and compressor.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention, reference may be had to the accompanying drawings, in which Fig. 1 is a side elevation, partly in section, of a refrigerating machine embodying my invention; Fig. 2 is a plan view of the casing and motor driven compressor included in the refrigerating machine shown in Fig. 1, the top of the compressor and part of the top of the motor being broken away; Fig. 3 is a sectional view on the line 3—3 of the apparatus shown in Fig. 2; Fig. 4 is a view on the line 4—4 of Fig. 3 of the rotary lubricant pump of the refrigerating machine; Fig. 5 is a fragmentary sectional view of the casing of the motor shown in Fig. 3; and Fig. 6 is a partial bottom plan view of the Scotch Yoke mechanism of the compressor shown in Fig. 3.

Referring to the drawings, in Fig. 1 I have shown a refrigerating machine provided with an hermetically sealed casing 10 made up of an upper casing section 11 and a lower casing section 12, the adjacent edges of these sections being welded together at 14 over a reinforcing ring 13. The casing sections 11 and 12 are preferably made of steel. A refrigerant compressor 15 and an electric driving motor 16 therefor are contained within the hermetically sealed casing 10.

The compressor 15 is secured to the top of the driving motor 16 by bolts 17 and 18 thus forming a compact unitary structure. This unitary structure is mounted in the casing 10 on three vertical helical springs 19, 20 and 21. The upper ends of the springs 19, 20, and 21 are secured to feet 22, 23 and 24, respectively, these feet being welded to the periphery of the frame of the motor 16 at equally spaced intervals of approximately 120°. The lower end of the spring 20 is supported on an indentation 25 formed in the lower section 12 of the casing 10, as shown in Fig. 3. The springs 19 and 21 are also supported on similar indentations formed in the lower section 12 of the casing 10. A bumper ring 26 surrounds the unitary structure and is secured in a slot 27 in the foot 23 as illustrated in Fig. 3. Similar slots are formed in the feet 22 and 24 for supporting the bumper ring 26. A series of stops 28, 29 and 30 are welded to the inner side wall of the casing 10 at spaced intervals of approximately 120° as best shown in Fig. 2. These stops limit the vertical movement of unitary structure by engagement with the bumper ring 26.

The mounting arrangement for the unitary compressor and motor structure described above is not my invention but is the invention of Harley H. Bixler, and is described and claimed in his Patent No. 2,028,584 of January 21, 1936, and

assigned to the General Electric Company, the assignee of my present invention.

As best shown in Fig. 3, the driving motor 16 is provided with a squirrel cage rotor 31 which is mounted on a hollow vertical shaft 32 within a stator 33, the stator 33 having energizing windings 34 which are mounted in slots therein in the usual manner. The energizing windings 34 have upper and lower ends projecting from the upper and lower ends respectively of the stator 33. End shields 35 and 36 are provided at the upper and lower ends, respectively, of the stator 33 being secured thereto by stay-bolts 37. The shaft 32 is supported in upper and lower bearings 38 and 39, respectively. The upper bearing 38 is of the self-aligning sleeve type having a relatively large axial length as compared to its diameter and is loosely mounted in a bore 40 in the upper end shield 35 with a sucking fit. Rotation of the bearing 38 in bore 40 is prevented by a pin 38a. The lower bearing 39 is a cylindrical machined surface of a bore in the lower end shield 36 in axial alinement with the shaft 32. Most of the lateral thrust is taken up by the upper bearing 38 since the compressor 15 is closely adjacent thereto and the lower bearing 39 may consequently be rather short and hence need not be of the self-aligning type. It will be noted that the bearings 38 and 39 are thus contained within the housing of the motor 16 and a compact structure having a minimum vertical height is provided.

As shown in Figs. 3 and 6, the upper end of the shaft 32 of the driving motor 16 is provided with a crank arm 41 through which the motor 16 drives the refrigerant compressor 15, a counterweight 42 being connected to the crank 41. The compressor 15 is of the Scotch Yoke type and includes a cylindrical slide 43 which, upon reciprocation of a piston 46, is reciprocated in the cross-head 44 by the crank 41, the crank 41 passing through an elongated opening 45 in the lower side of the cross-head 44. The piston 46 is welded to the cross-head 44 as indicated at 47 and is reciprocated in a bore 48 of a compression cylinder 49. The rotary movement of the crank 41 is converted into what amounts to reciprocatory movement in two directions. As will be seen from an inspection of Fig. 6, the crank 41 is free to reciprocate in one direction in the slot 45 thus forming in effect a lost motion connection therewith formed in the cross-head 44, and by means of this lost motion connection the piston 46 is reciprocated in the bore 48 of the cylinder 49 in a direction at right angles to the movement of the crank 41 in the slot 45.

The particular construction of the piston and yoke illustrated forms no part of my present invention but is described and claimed in my Patent No. 2,059,822, granted November 3, 1936, and assigned to the General Electric Company, the assignee of my present invention.

One end of the bore 48 of the cylinder 49 is closed by a flat valve plate 50, which is secured to the cylinder 49 by bolts 51. The bolts 51 also hold a muffle box 52 in place on top of the valve plate 50. As best shown in Fig. 2, the valve plate 50 is provided with an intake opening 53 which is closed by a flexible intake valve 54. A series of exhaust ports 55 are also provided in the valve plate 50 and are normally closed by a disk-shaped flexible exhaust valve 56 in the muffle box 52. The exhaust valve 56 is provided with a disk-shaped retainer 57, the retainer 57 and exhaust valve 56 being secured to the valve plate 50 by a rivet 58 which passes through registering central apertures in the retainer and exhaust valve.

The general arrangement of the valve assembly, described above, is not my invention but is the invention of Harley H. Bixler, and is described and claimed in his application, Serial No. 26,067, filed June 11, 1935, and assigned to the General Electric Company, the assignee of my present invention.

I have provided an arrangement in which lubricant is circulated over the bearings and other contacting relatively moving surfaces of the motor 16 and the compressor 15, the lubricant then being circulated over a substantial portion of the inner surface of the casing 10 to cool the lubricant. Lubricant is also circulated over the surfaces of the motor 16 and the compressor 15 in order to cool the same. In the preferred form of my invention illustrated in the drawings, a reservoir is formed by the lower section 12 of the casing 10, which contains a body of oil or other liquid lubricant 60. When the motor 16 is in operation, lubricant is drawn upwardly through a conduit 61 by a rotary pump 62, which is driven by the shaft 32 of the motor 16. As best shown in Fig. 4, the rotary pump 62 includes a pair of oppositely extending blades 63 and 64, which are slidably mounted in slots 65 and 66, respectively, formed in a lower end of the shaft 32. The lower end of the shaft 32 and the blades 63 and 64 rotate in a chamber formed by a bore 67 in a casing plate 68, the center of the bore 67 being eccentric with respect to the axis of the shaft 32. A retaining plate 69 and a cover plate 70 are secured to the lower side of the casing plate 68. The cover plate 70, the retaining plate 69, and the casing 68 are held in their assembled position by a series of bolts 71, which are in threaded engagement with tapped holes 72 formed in the lower end shield 36 of the motor 16. A smooth upper surface is ground on the retaining plate 69 and it serves as a lower thrust bearing for the shaft 32. As the blades 63 and 64 rotate in the chamber 67 in a clockwise direction, for example, as viewed in Fig. 4, lubricant is drawn into the chamber 67 through the conduit 61 and an intake opening 73 formed in the retaining plate 69 due to the increasing volume of the space behind the blade 63. Upon further rotation of the shaft 32, the lubricant is expelled under pressure from the chamber 67 through an outlet opening 74 formed in the retaining plate 69 due to the decreasing volume of the space in front of the blade 64 as the rotation of the shaft 32 continues. The blades 63 and 64 are pushed outwardly against the wall of the chamber 67 by centrifugal force and by the pressure of the lubricant in an axial passage 76 in the shaft 32. Lubricant discharged through the outlet opening 74 in the retaining plate 69 passes into a depression 75 formed in the cover plate 70 and then upwardly through the central, axially extending passage 76. A portion of the lubricant passing upwardly through the passage 76 is diverted into a horizontal passage 77 which communicates with the lower portion of the passage 76 and passes therethrough to a groove 78 formed in the lower bearing 39 of the shaft 32, thus lubricating the bearing 39. A horizontal passage 79 communicating with the upper portion of the passage 76 is also formed in the shaft 32 and communicates with a circular groove 80 formed in the upper bearing 38. Lubricant for the bearing 38 is supplied thereto from the passage 76 through the passage 79 and groove 80. A further portion of the lubri-

cant under pressure in the passage 76 passes upwardly therefrom through a passage 81 formed in the crank 41 to the top of the latter and lubricates the contacting surfaces of the crank 41 and slide 43, as well as the contacting surfaces of the slide 43 and the cross-head 44. A second passage 82 is also provided in the top of the crank 41 in order to allow lubricant to pass downwardly from the top of the crank 41 to the contacting surfaces of the slide 43 and the crank 41 in order to insure thorough lubrication of the same. An arrangement is thus provided which insures an adequate supply of lubricant under pressure to the contacting relatively moving bearing surfaces of the shaft bearings of motor 16 and of the piston, slide and crank of the compressor 15.

An arrangement is also provided for utilizing the lubricant under pressure from the pump 62 to control the loading of the compressor 15. As shown in Fig. 2, a passage 83 is formed in the upper end shield 35 of the motor 16, which communicates with the groove 80 formed in the bearing 38 and with a bore 84 of an unloader cylinder 85. When the motor 16 is in operation, lubricant under pressure is supplied through the passage 83 to the bore 84 of the unloader. The unloader includes a cup-shaped piston 86, which is provided with a cylindrical sleeve 87, the piston and sleeve being brazed or otherwise secured together. One end of a U-shaped operating rod 88 is provided with a disk 89 which is secured to the piston 86. A helical compression spring 90, which is held in place between the disk 89 and a retaining plate 91, secured to the muffle box 52 by the bolt 51, biases the operating rod 88 toward a position in which it holds the intake valve 54 in the open position. A part of the lubricant supplied under pressure to the bore 84 through the passage 83 passes therefrom through a sharp edged orifice 92 in the sleeve 87 to a passage 93. The orifice 92 is made sufficiently small that it will not divert all of the lubricant supplied to the bore 84. When the motor 16, which drives the rotary pump 62, reaches a predetermined speed, about 60% of full running speed, the lubricant will accumulate in the bore 84 and will force the piston 86 outwardly, thus compressing the biasing spring 90 and release the inlet valve 54 to operate freely and consequently, to load the compressor 15. The orifice 92 is so positioned in the sleeve 87 with respect to the passage 93 that it registers with the latter when the sleeve 87 is at the extremity of its travel to the right, as viewed in Fig. 2, and is also so positioned that when the sleeve 87 is at the left hand extremity of its travel that the orifice 92 is not covered by the wall of the cylinder 85 until the end of the passage 83 is uncovered by the edge of the sleeve 87, so that lubricant is continually supplied from the bore 84 to the passage 93 irrespective of the position of the sleeve 87 and piston 86 and a continuous flow of lubricant to the compressor is thus ensured. Since the intake valve 54 is held open until the motor 16 reaches a predetermined speed of about 60% full speed, only a slight friction load is placed on the motor during starting.

The particular form of unloader, described above, is not my invention but is the invention of Harley H. Bixler, and is described and claimed in his Patent No. 2,102,403, granted December 14, 1937, and assigned to the General Electric Company, the assignee of my present invention.

Lubricant passing through the passage 83 enters an annular groove 94 formed in the wall of the compression cylinder 49 surrounding the bore 48. A cooperating groove 95 is provided in the piston 46 which registers with the groove 94 when the piston 46 is in its extreme retracted position shown in Fig. 3. When in this position, lubricant flows into the groove 95 from the groove 94. At the same time, the refrigerant in the cylinder bore 48 is not under compression and hence there is little or no tendency for it to leak past the piston. As the piston 46 is moved to the left, the refrigerant in the cylinder bore 48 is compressed and at the same time the groove 95 moves out of register with the groove 94. The compressed gaseous refrigerant in the cylinder bore 48 tends to leak between the piston 46 and the surrounding wall of the cylinder 49. This leaking refrigerant enters the groove 94 however, and displaces a portion of the lubricant therefrom. This displaced lubricant is pushed into the small clearance space between the piston 46 and the wall of the cylinder 49 and forms a seal, thus effectually preventing the escape of compressed refrigerant from the cylinder bore 48. When the piston 46 is again moved to its retracted position, the groove 95 comes into register with the groove 94 and since the lubricant is being rapidly circulated through the groove 94, the small amount of gaseous refrigerant, which is entrapped in the groove 95, is carried away by the stream of lubricant and is later returned to the main body of gaseous refrigerant in the casing 10, as is explained below. In this manner, the compressed refrigerant in the cylinder bore 48 effectually prevents leakage therefrom and at the same time the necessity of using piston rings or other similar packing means on the piston 46 is avoided.

As shown in Fig. 3, lubricant in the groove 94 is forced upwardly therefrom through an L-shaped conduit 96 which communicates with the upper side of the groove 94, the outer end 96a of the conduit 96 being closed. A small hole 97 is provided in the side of the conduit 96 and allows a portion of the lubricant in the conduit 96 to pass therefrom into a recess 98 formed in the top of the compressor 15. The recess 98 is covered by a plate 99 which is secured to the compressor 15 by a screw 100. Lubricant passing through the recess 98 drains down across the valve head end of the compressor 15 into a cup 101 which is secured to the side of the motor 16 by a bolt 102.

The main portion of the lubricant in the conduit 96 passes upwardly therethrough and is discharged therefrom in a stream through a vertically extending nozzle 103. The term "nozzle" is employed to designate an arrangement providing an orifice for discharging lubricant. An outwardly extending recess 104 of relatively small area as compared with the area of the top of the casing is provided in the top of the casing 10 opposite the nozzle 103 and serves to distribute the lubricant discharged from the nozzle 103 evenly over the inner surface of the top of the casing 10. This particularly is advantageous in that heat is conducted more readily to the casing 10 from the distributed lubricant and also the gurgling sound due to a concentrated stream of liquid flowing into the body of lubricant 60 is also avoided. The lubricant discharged from the nozzle 103 passes through an aperture 105 formed in a horizontal baffle 106 which is supported on studs 107 and 108, these studs being welded or otherwise secured to the top of the casing 10. The lubricant thus distributed over the top of the casing 10 by the recess 104 flows through notches

109 provided about the periphery of the horizontal baffle 106 and drains down the vertical side walls of the casing 10 to the reservoir formed in the bottom thereof. The exterior of the casing 10 is in contact with the surrounding air and heat from the oil flowing over the inner surface of the casing 10 is dissipated thereto. An annulus of fins 110 made of steel or other good heat conducting material surrounds the casing 10 in heat conducting relationship therewith and aids in the dissipation of heat therefrom. In the normal operation of the machine illustrated, the lubricant is discharged from the nozzle 103 at about 150° F. and is cooled about 10° F. in passing over the inner surfaces of the casing 10.

The lubricant which collects in the cup 101 flows therefrom through an aperture 111 into an annular chamber 112 formed between the top of the stator 33 and the end shield 35, the upper projecting ends of the windings 34 being located in the chamber 112. A vertical cylindrical shield 113 surrounds the air gap between the rotor 31 and stator 33 in order to prevent the entrance of lubricant therein. The rotor 31 is also provided with a cup-shaped deflector 114 having upwardly and outwardly flaring sides extending over the upper edge of the shield 113 and any lubricant escaping from the upper bearing 38 falls into the deflector 114 and is thrown outwardly thereby into the annular chamber 112 by centrifugal force.

The lubricant contained in the chamber 112 flows downwardly therefrom through the slots 34*a* in the stator 33 in which the windings 34 are placed, and also through the holes 37*a* in the stator 33 through which the bolts 37 pass. An overflow hole 115 is provided in the outer side of the cup 101 in order that lubricant may escape therefrom if the clearances in the slots and holes in the stator 33 prove to be insufficient to carry off all of the lubricant which accumulates in the chamber 112. The lower edge of the aperture 115 is positioned below the top of the cylindrical shield 113, so that there will be no danger of lubricant overflowing into the air gap between the rotor 31 and stator 33. The clearance in the slots in the stator 33 in which the energizing windings 34 are placed and the clearance in the bolt holes are so proportioned that all of the lubricant collected in the chamber 112 during the normal operation of the machine will pass downwardly through the stator 33 and past the windings 34, thus cooling the same. It will be understood that the proportion of the lubricant flowing through these clearance spaces depends on the viscosity of the oil, which in turn depends on its temperature. The clearances are calculated to pass all of the oil when at its normal operating temperature of about 140° F. The lubricant passing downwardly from the chamber 112 is collected in an annular chamber or reservoir 116 formed in the lower end shield 36, the lower end of the windings 34 being located in the chamber 116. The lower end shield 36 is provided with an outwardly extending portion 117 having a recess 118 formed therein which is adapted to catch lubricant flowing downwardly over the right hand side of the motor 16, as viewed in Fig. 3, from the crank 41. Lubricant collected in the recess 118 flows into the reservoir 116 in the lower end shield 36 through a passage 119.

The lubricant accumulated in the reservoir 116 normally flows therefrom through an aperture 120 formed in the lower end shield 36 as best shown in Fig. 5, the aperture 120 being arranged to immerse the lower ends of the winding 34 in lubricant. After passing through the opening 120, the lubricant is directed on to the supporting spring by a deflector 121. The lubricant then flows down the helical spring 19 into the reservoir formed in the lower portion 12 of the casing 10 and the gurgling noise, which would otherwise be caused by the lubricant running into the body of lubricant 60 in this reservoir, is thus avoided. The fact that the spring 19 is a good heat conductor also plays some part in promoting quiet operation as some of the agitation otherwise caused by a stream of lubricant from the reservoir 116 entering the body of lubricant 60 is due to the difference in temperatures thereof. The spring 19 serves to aid in cooling the lubricant passing over it.

In the operation of the refrigerating machine described above, gaseous refrigerant in the casing 10 enters an intake muffler 122, passes through a conduit 123 to a chamber 124 formed in the muffle box 52 and is drawn therefrom through the valved intake passage 53 into the bore 48 of the compressor cylinder 49. Gaseous refrigerant compressed in the cylinder 49 by the piston 46 passes therefrom through the valved exhaust passages 55 into an exhaust chamber 125 formed in the muffle box 52, through a conduit 126 to an exhaust muffler 127, and from there through a conduit 128. The lower portion of the conduit 128 is helical in form, thus providing a resilient connection between the unitary compressor and motor structure which is free to vibrate on the springs 19, 20, and 21 and the rigidly mounted casing 10. The compressed gaseous refrigerant passes through the conduit 128 to a condenser 129 cooled by natural draft and which surrounds the casing 10 and is mounted on the annulus of heat conducting fins 110. The compressed gaseous refrigerant is liquefied in the condenser 129 and flows therefrom through a conduit 130, a flow controlling float valve 131 and a conduit 132 to an evaporator 133. The evaporator 133 is supported in a cooling compartment, a removable top wall 134 of which is insulated. The liquid refrigerant contained in the evaporator 133 is vaporized by the absorption of heat from articles contained in the cooling compartment in which the evaporator is located and the refrigerant thus vaporized passes from the evaporator 133 through a suction conduit 135' back to the casing 10, which is maintained at the low pressure existing in the evaporator. It will be noted that the discharge end 135 of the suction conduit 135' is located above the normal level of the lubricant 60 in the reservoir formed in the lower section 12 of the casing 10. The vaporized refrigerant thus discharged in the casing 10 is again drawn into the intake muffler 122 and the cycle above described is repeated.

It will be seen that the casing 10 is normally filled with low pressure vaporized gaseous refrigerant above the level of the lubricant 60, and any refrigerant which may have been entrapped in the lubricant while the latter is passing through the compressor 15 and motor 16 will be released from the relatively quiet body of lubricant 60 and will be again mingled with the low pressure gaseous refrigerant thereabove. I have provided an arrangement in which a body of lubricant is circulated over the surfaces of the compressor 15 and the motor 16, as well as over the energizing windings 34 of the motor 16, thus cooling the same. During the normal op-

eration of the machine, the projecting upper and lower end turns of the energizing windings 34 are immersed in lubricant in the chamber 112 and reservoir 116, respectively, which materially aids in dissipating heat therefrom. I have also provided an arrangement in which the heat absorbed by the lubricant in passing through the bearings and over the surfaces of the motor and compressor may be readily and efficiently dissipated to the surrounding air or other cooling medium.

While I have shown one embodiment of my invention in connection with a compression type refrigerating machine, I do not desire my invention to be limited to the particular construction shown and described, and I intend in the appended claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A refrigerating machine comprising a compressor, a motor having a vertically extending shaft and arranged to drive said compressor, a casing enclosing said compressor and motor, said casing having a lubricant reservoir formed in the lower portion thereof and having an upwardly extending recess formed in the top portion thereof, the area of said recess being small as compared with the total area of the inner surface of said top portion of said casing, means for cooling the wall of said casing, means including a pump driven by said shaft for circulating lubricant from said reservoir, means for conveying a portion of the lubricant from said pump to the bearing surfaces of said compressor and motor, means circulating a second portion of said lubricant from said pump over the surfaces of said compressor and motor for cooling the same, and means including an upwardly extending nozzle opposite said recess in said casing and circulating a third portion of said lubricant from said pump in a stream into said recess and then over the inner surface of said casing continuously during operation of said machine for cooling said lubricant.

2. A refrigerating machine comprising a compressor, a motor having a vertically extending shaft and arranged to drive said compressor, a casing enclosing said compressor and motor, said casing having a lubricant reservoir formed in the lower portion thereof and an upwardly extending recess formed in the top portion thereof, the area of said recess being small as compared with the total area of said top portion of said casing, means for cooling the wall of said casing, means including a pump driven by said shaft for circulating lubricant from said reservoir to the bearing surfaces of said compressor and motor, means including a stationary horizontal baffle located above said motor and compressor and a vertically extending nozzle below said recess for circulating the lubricant in a stream into said recess and then over the inner surface of said casing continuously during operation of said machine and for cooling said lubricant, and means for conveying lubricant from said pump to said nozzle.

3. A refrigerating machine comprising a compressor, a motor for driving said compressor, said motor including a stator and a rotor having an air gap therebetween, a vertical shaft for said rotor, a casing enclosing said compressor and motor, a bearing for said shaft above said rotor, means for supplying lubricant to said bearing, means including a deflector carried by said shaft below said bearing for preventing lubricant escaping from said bearing from entering said air gap, and means including a vertical cylindrical shield mounted on the top of said stator for preventing the entrance of lubricant in a lateral direction into said air gap.

4. A refrigerating machine comprising a compressor, a motor for driving said compressor, said motor including a stator and a rotor having an air gap therebetween, a vertical shaft for said rotor, a casing enclosing said compressor and motor, a bearing for said shaft above said rotor, means for supplying lubricant to said bearing, means including a deflector carried by said shaft below said bearing for preventing lubricant escaping from said bearing from entering said air gap, means circulating lubricant over the outer surface of said stator for cooling the same, and means including a vertical cylindrical shield mounted on the top of said stator for preventing the entrance of lubricant in a lateral direction into said air gap.

5. A refrigerating machine comprising a compressor, a motor for driving said compressor, said motor including a stator and a rotor having an air gap therebetween, a vertical shaft for said rotor, a casing enclosing said compressor and motor, a bearing for said shaft above said rotor, means for supplying lubricant to said bearing, means including a deflector carried by said shaft below said bearing for preventing lubricant escaping from said bearing from entering said air gap, means circulating lubricant in heat exchange relation with said stator for cooling the same, and means including a vertical cylindrical shield mounted on the top of said stator for preventing the entrance of lubricant in a lateral direction into said air gap.

6. A refrigerating machine comprising a compressor, means including a spring for supporting said compressor, means for circulating a cooling liquid over the surface of said compressor, a liquid reservoir arranged below said compressor, and means for receiving substantially all of the cooling liquid passing over said compressor and for directing said cooling liquid from said compressor over said spring into said reservoir.

7. A refrigerating machine comprising a compressor, means including a spring for supporting said compressor, means for circulating a cooling liquid in heat exchange relation with said compressor, a liquid reservoir arranged below said compressor, and means for receiving substantially all of the liquid passing in heat exchange relation with said compressor and for directing said liquid over the surfaces of said spring into said reservoir.

8. An electric motor or the like which is subjected to internal heating during the normal operation thereof, a reservoir containing a cooling liquid and arranged below said motor, means including a spring for supporting said motor above the liquid in said reservoir, said spring extending from the motor to the liquid level in said reservoir, means for circulating a cooling liquid over the surface of said motor, and means for receiving substantially all of the cooling liquid after circulating over the surface of said motor and for directing said cooling liquid over the surfaces of said spring into said reservoir.

9. An electric motor or the like which is subjected to internal heating during the normal operation thereof, a reservoir containing cooling liquid arranged below said motor, means including a spring for supporting said motor, said spring extending from said motor to the level of liquid

in said reservoir, means for circulating a cooling liquid in heat exchange relation with said motor, and means for receiving substantially all of the cooling liquid after circulating in heat exchange relation with said motor and for directing said cooling liquid over the surfaces of said spring into said reservoir.

10. A refrigerating machine comprising a motor, a compressor mounted on said motor, means including a vertical helical compression spring for supporting said motor and compressor, means for circulating a cooling liquid over the surfaces of said motor and compressor, a liquid reservoir arranged below said motor and compressor, and means for receiving substantially all of the cooling liquid circulating over the surfaces of said motor and compressor and for directing said cooling liquid over the surfaces of said spring into said reservoir.

11. A refrigerating machine comprising a compressor, a motor for driving said compressor, a casing enclosing said compressor and motor, means including a nozzle arranged to discharge a stream of lubricant upwardly against the wall of said casing for directing lubricant over the inner surface of said casing and downwardly over the side wall thereof, a horizontal baffle arranged above said compressor and motor having an aperture in alignment with said nozzle and extending adjacent the side wall of said casing, means for containing a body of lubricant and for receiving lubricant flowing downwardly over the side wall of said casing, means for cooling the wall of said casing and for cooling the lubricant flowing downwardly over the side wall of said casing, and means for supplying lubricant from said body of lubricant to said nozzle and to the bearing surfaces of said compressor and motor continuously during operation of said machine.

12. A refrigerating machine comprising a compressor, a motor for driving said compressor, a casing enclosing said compressor and motor, said casing having an outwardly extending recess formed inside a wall thereof, the area of said recess being small as compared to the area of said wall, means including a nozzle opposite said recess for directing a stream of lubricant into said recess and for utilizing said recess to distribute the stream of lubricant over the inner surface of said casing, means for cooling said casing and for cooling the lubricant flowing over the inside wall of said casing, means for containing a body of lubricant and for receiving lubricant flowing downwardly over the walls of said casing, and means for supplying lubricant from said body of lubricant to said nozzle and to the bearing surfaces of said compressor and motor continuously during operation of said machine.

13. A refrigerating machine comprising a compressor, a motor for driving said compressor, a casing enclosing said compressor and motor, the top portion of said casing having an upwardly extending recess formed therein, the area of said recess being small as compared to the total area of said top portion of said casing, means including a nozzle opposite said recess for directing a stream of lubricant upwardly into said recess and for utilizing said recess to distribute said stream of lubricant over the inner surface of said casing continuously during operation of said machine, means for containing a body of lubricant and for receiving lubricant flowing downwardly over the side wall of said casing, means for cooling said casing and for cooling the lubricant flowing over the inner surface of said casing, and means for supplying lubricant from said body of lubricant to said nozzle and to the bearing surfaces of said compressor and motor continuously during operation of said machine.

14. A refrigerating machine comprising a compressor, a motor for driving said compressor, a casing enclosing said compressor and motor, the top of said casing having an upwardly extending recess formed therein, the area of said recess being small as compared to the area of the upper inner surface of said casing, means including a nozzle opposite said recess for directing a stream of lubricant upwardly into said recess and for utilizing said recess to distribute said lubricant over the inner surface of said casing, a stationary horizontal baffle located above said compressor and motor and having an aperture therein below said recess and in alignment with said nozzle, means for containing a body of lubricant and for receiving lubricant flowing downwardly over the side wall of said casing, means for cooling said casing and for cooling the lubricant flowing downwardly over the side wall of said casing, and means for supplying lubricant from said body of lubricant to said nozzle and to the bearing surfaces of said compressor and motor during operation of said machine.

15. A refrigerating machine comprising a compressor, a motor having a vertically extending shaft arranged to drive said compressor, a casing enclosing said compressor and motor, said casing having a lubricant reservoir formed in the lower portion thereof and having an upwardly extending recess formed in the top portion thereof, the area of said recess being small as compared to the total area of said top portion of said casing, means for cooling the wall of said casing, means including a pump driven by said shaft for circulating lubricant from said reservoir, means for conveying a portion of the lubricant from said pump to the bearing surfaces of said compressor and motor, means circulating a second portion of said lubricant from said pump over the surfaces of said compressor and motor for cooling the same, and means including an upwardly extending nozzle opposite said recess in said casing for circulating a third portion of said lubricant from said pump in a stream into said recess and then over the inner surface of said casing continuously during operation of said machine for cooling said lubricant.

16. A refrigerating machine comprising a motor provided with windings, a compressor mounted on said motor and driven thereby, a casing enclosing said motor and compressor and having a lubricant reservoir formed in the lower portion thereof below said motor and compressor, a conduit having a nozzle carried by said compressor for discharging lubricant upwardly against the wall of said casing and for directing lubricant over the inner surface of said casing and downwardly over the side wall thereof, means for cooling the wall of said casing and for cooling the lubricant flowing downwardly over the side wall thereof, said conduit having an auxiliary outlet for directing lubricant over the surface of said compressor, means for receiving lubricant flowing over the surface of said compressor and for directing the same into said motor, means for retaining said lubricant about the upper end turns of said winding of said motor and for directing said lubricant to the lower portion of said motor, means for retaining said lubricant about the lower end turns of said wind-

ing and for returning said lubricant to said reservoir, and means for supplying lubricant from said reservoir to the bearing surfaces of said motor and compressor and to said nozzle.

17. A refrigerating machine comprising a motor provided with windings, a compressor mounted on said motor and driven thereby, a casing enclosing said motor and compressor and having a lubricant reservoir formed in the lower portion thereof below said motor and compressor, means including springs for resiliently supporting said compressor in said casing, a conduit having a nozzle carried by said compressor for discharging lubricant upwardly against the wall of said casing and for directing lubricant over the inner surface of said casing and downwardly over the side wall thereof, means for cooling the wall of said casing and for cooling the lubricant flowing downwardly over the side wall thereof, said conduit having an auxiliary outlet for directing lubricant over the surface of said compressor, means for receiving lubricant flowing over the surface of said compressor and for directing the same into said motor, means for retaining said lubricant about the upper end turns of said winding of said motor and for directing said lubricant to the lower portion of said motor, means for retaining said lubricant about the lower end turns of said winding and for returning said lubricant over the surface of at least one of said springs to said reservoir, and means for supplying lubricant from said reservoir to the bearing surfaces of said motor and compressor and to said nozzle.

18. A refrigerating machine comprising a motor, a compressor having a cylinder supported by said motor, a reciprocating piston in said cylinder, said motor having a vertically extending shaft and arranged to reciprocate said piston, a casing enclosing said motor and compressor, said casing having a lubricant reservoir formed in the lower portion thereof containing a body of lubricant, means including a pump driven by said shaft for circulating lubricant from said reservoir, means for conveying a portion of said circulated lubricant to the bearing surfaces of said motor and compressor, means for directing a second portion of said circulated lubricant to said piston and cylinder, and means including a nozzle arranged in the upper portion of said casing continuously directing a third portion of said circulated lubricant to the inner surface of said casing to be circulated downwardly thereover and back into said reservoir during normal operation of said machine after the starting period for producing substantial cooling of the body of lubricant contained in said reservoir by dissipating heat to said casing.

19. A refrigerating machine comprising a motor, a compressor having a cylinder supported on top of said motor, a reciprocating piston in said cylinder, said motor having a vertically extending shaft and arranged to reciprocate said piston, a casing enclosing said motor and compressor, said casing having a lubricant reservoir formed in the lower portion thereof containing a body of lubricant, means including a pump driven by said shaft for circulating lubricant from said reservoir, means for conveying a portion of said circulated lubricant to the bearing surfaces of said motor and compressor, means for directing a second portion of said circulated lubricant to said piston and cylinder, and means including a nozzle arranged in the upper portion of said casing continuously directing a third portion of said circulated lubricant to the inner surface of said casing to be circulated downwardly thereover and back into said reservoir during normal operation of said machine after the starting period for producing substantial cooling of the body of lubricant contained in said reservoir by dissipating heat to said casing.

20. A refrigerating machine comprising a motor having a stator and a rotor, a vertical shaft for said rotor, a bearing for said shaft arranged above said rotor, a bearing for said shaft arranged below said rotor, a compressor having a cylinder supported on top of said motor, a reciprocating piston in said cylinder, a crank carried by the upper end of said shaft above said upper bearing and arranged to reciprocate said piston, a casing enclosing said motor and compressor, said casing having a lubricant reservoir formed in the lower portion thereof containing a body of lubricant, means including a pump driven by said shaft for circulating lubricant from said reservoir, means for conveying a portion of said circulated lubricant to said upper and lower bearings, means for conveying a second portion of said circulated lubricant to said crank, and means including a nozzle arranged in the upper portion of said casing continuously directing a third portion of said circulated lubricant to the inner surface of said casing to be circulated downwardly thereover and back into said reservoir during normal operation of said machine after the starting period for producing substantial cooling of the body of lubricant contained in said reservoir by dissipating heat to said casing.

21. A refrigerating machine comprising a motor, a compressor having a cylinder supported on top of said motor, a reciprocating piston in said cylinder, said motor having a vertically extending shaft and arranged to reciprocate said piston, a casing enclosing said motor and compressor, said casing having a lubricant reservoir formed in the lower portion thereof containing a body of lubricant, means including a pump driven by said shaft for circulating lubricant from said reservoir, means for conveying a portion of said circulated lubricant to the bearing surfaces of said motor and compressor, means for directing a second portion of said circulated lubricant to said piston and cylinder, means for directing a third portion of said circulated lubricant over the surface of said compressor for cooling the same, and means including a nozzle arranged in the upper portion of said casing continuously directing a fourth portion of said circulated lubricant to the inner surface of said casing to be circulated downwardly thereover and back into said reservoir during normal operation of said machine after the starting period for producing substantial cooling of the body of lubricant contained in said reservoir by dissipating heat to said casing.

22. A refrigerating machine comprising a motor having a stator and a rotor, a vertical shaft for said rotor, an upper end shield for said motor having a bearing for said shaft arranged above said rotor, a lower end shield for said motor having a bearing for said shaft arranged below said rotor, a compressor having a cylinder supported on said upper end shield, a reciprocating piston in said cylinder, a crank carried by the upper end of said shaft above said upper end shield and arranged to reciprocate said piston, a casing enclosing said motor and compressor, said casing having a lubricant reservoir formed in the lower portion thereof, means including a pump driven by said shaft for circulating lubri-

cant from said reservoir, means for conveying a portion of said circulated lubricant to said upper and lower bearings, means for conveying a second portion of said circulated lubricant to said crank, means for directing a third portion of said circulated lubricant to said piston and cylinder, and means for directing a fourth portion of said circulated lubricant to the inner surface of said casing for circulation downwardly thereover and back into said reservoir continuously during operation of said machine for cooling said lubricant.

23. A refrigerating machine comprising a motor having a stator and a rotor, a vertical shaft for said rotor having an axially extending passage therein, a bearing for said shaft arranged above said rotor, a bearing for said shaft arranged below said rotor, a compressor having a cylinder supported by said motor, a reciprocating piston in said cylinder, a crank carried by the upper end of said shaft above said upper bearing and arranged to reciprocate said piston, a casing enclosing said motor and compressor, said casing having a lubricant reservoir formed in the lower portion thereof containing a body of lubricant, means including a pump driven by said shaft for forcing lubricant from said reservoir into said passage in said shaft, means for conveying a portion of said lubricant from said passage to said upper and lower bearings, means for conveying a second portion of said lubricant from said passage to said crank, and means including a nozzle arranged in the upper portion of said casing continuously directing a third portion of said circulated lubricant to the inner surface of said casing to be circulated downwardly thereover and back into said reservoir during normal operation of said machine after the starting period for producing substantial cooling of the body of lubricant contained in said reservoir by dissipating heat to said casing.

24. A refrigerating machine comprising a compressor, a motor for driving said compressor, a casing enclosing said compressor and motor, said casing having a lubricant reservoir formed in the lower portion thereof, said motor including a stator and a rotor having an air gap therebetween, a vertical shaft for said rotor, said stator being provided with a winding having ends projecting from said stator, means defining a chamber about the upper end of said stator and adapted to contain lubricant in contact with the upper end of said winding, means defining a chamber about the lower end of said stator and adapted to contain lubricant in contact with the lower end of said winding, and means for circulating lubricant from said reservoir into said upper chamber thence into said lower chamber and back into said reservoir continuously during operation of said machine for cooling said motor.

25. A refrigerating machine comprising a compressor, a motor for driving said compressor, a casing enclosing said compressor and motor, said casing having a lubricant reservoir formed in the lower portion thereof, said motor including a stator and a rotor having an air gap therebetween, a vertical shaft for said rotor, said stator being provided with a winding having ends projecting from said stator, means including a vertical cylindrical shield mounted on top of said stator for preventing the entrance of lubricant in a lateral direction into said air gap, means including said shield defining an annular chamber about the upper end of said stator and adapted to contain lubricant in contact with the upper end of said winding, means defining an annular chamber about the lower end of said stator and adapted to contain lubricant in contact with the lower end of said winding, and means for circulating lubricant from said reservoir into said upper chamber thence into said lower chamber and back into said reservoir continuously during operation of said machine for cooling said motor.

26. A refrigerating machine comprising a compressor, a motor for driving said compressor, a casing enclosing said compressor and motor, said casing having a lubricant reservoir formed in the lower portion thereof, said motor including a stator and a rotor having an air gap therebetween, upper and lower end shields for said motor, a vertical shaft for said rotor, said stator being provided with a winding having ends projecting from said stator, means defining an annular chamber about the upper end of said stator and adapted to contain lubricant in contact with the upper end of said winding, means including said lower end shield defining an annular chamber about the lower end of said stator and adapted to contain lubricant in contact with the lower end of said winding, and means for circulating lubricant from said reservoir into said upper chamber thence into said lower chamber and back into said reservoir continuously during operation of said machine for cooling said motor.

27. A refrigerating machine comprising a compressor, a motor for driving said compressor, a casing enclosing said compressor and motor, said casing having a lubricant reservoir formed in the lower portion thereof, said motor including a stator and a rotor having an air gap therebetween, a vertical shaft for said rotor, said stator being provided with winding slots therein, a winding positioned in said winding slots and having ends projecting from said stator, means defining a chamber about the upper end of said stator and adapted to contain lubricant in contact with the upper end of said winding, means defining a chamber about the lower end of said stator and adapted to contain lubricant in contact with the lower end of said winding, and means for circulating lubricant from said reservoir into said upper chamber thence through said winding slots into said lower chamber and back into said reservoir continuously during operation of said machine for cooling said motor.

28. A refrigerating machine comprising a compressor, a motor for driving said compressor, a casing enclosing said compressor and motor, said casing having a lubricant reservoir formed in the lower portion thereof, said motor including a stator and a rotor having an air gap therebetween, a vertical shaft for said rotor, said stator being provided with a winding having ends projecting from said stator, means defining a chamber about the upper end of said stator and adapted to contain lubricant in contact with the upper end of said winding, means defining a chamber about the lower end of said stator and adapted to contain lubricant in contact with the lower end of said winding, means including a pump driven by said shaft for circulating lubricant from said reservoir, means for directing a portion of said circulated lubricant over the surface of said compressor for cooling the same, means for receiving lubricant flowing over the surface of said compressor and for directing the same into said upper chamber, means for directing lubricant from said upper chamber into said lower chamber, and means for returning lubricant from said lower chamber to said reservoir.

29. A refrigerating machine comprising a compressor, a motor for driving said compressor, a casing enclosing said compressor and motor, said casing having a lubricant reservoir formed in the lower portion thereof, said motor including a stator and a rotor having an air gap therebetween, a vertical shaft for said rotor, said stator being provided with a winding having ends projecting from said stator, means defining a chamber about the upper end of said stator and adapted to contain lubricant in contact with the upper end of said winding, means defining a chamber about the lower end of said stator and adapted to contain lubricant in contact with the lower end of said winding, means including a pump driven by said shaft for circulating lubricant from said reservoir, means for directing a portion of said circulated lubricant over the surface of said compressor for cooling the same, means for receiving lubricant flowing over the surface of said compressor and for directing the same into said upper chamber, means for directing lubricant from said upper chamber into said lower chamber, means for returning lubricant from said lower chamber to said reservoir, and means for directing a second portion of said circulated lubricant to the inner surface of said casing for circulation downwardly thereover and back into said reservoir continuously during operation of said machine for cooling said lubricant.

30. A refrigerating machine comprising a compressor, a motor for driving said compressor, a casing enclosing said compressor and motor, said casing having a lubricant reservoir formed therein, said motor including a stator and a rotor having an air gap therebetween, a vertical shaft for said rotor, said stator being provided with a winding projecting from the upper end of said stator, means including a vertical cylindrical shield mounted on top of said stator for preventing the entrance of lubricant in a lateral direction into said air gap, means including said shield defining an annular chamber about the upper end of said stator and adapted to contain lubricant in contact with said winding, and means for circulating lubricant from said reservoir into said chamber and back into said reservoir continuously during operation of said machine for cooling said motor.

31. A refrigerating machine comprising a compressor, a motor for driving said compressor, a casing enclosing said compressor and said motor, said casing having a lubricant reservoir formed in the lower portion thereof containing a body of lubricant, means including a pump driven by said motor for circulating lubricant from said reservoir, means for directing a portion of said circulated lubricant over said motor for cooling said motor, and means including a nozzle arranged in the upper portion of said casing continuously directing another portion of said circulated lubricant to the inner surface of said casing to be circulated downwardly thereover and back into said reservoir during normal operation of said machine after the starting period for producing substantial cooling of the body of lubricant contained in said reservoir by dissipating heat to said casing.

CHRISTIAN STEENSTRUP.