June 6, 1933.

F. A. WEGENER

1,912,926

COMPRESSOR

Filed March 3, 1927

3 Sheets-Sheet 1

Fig. 1.

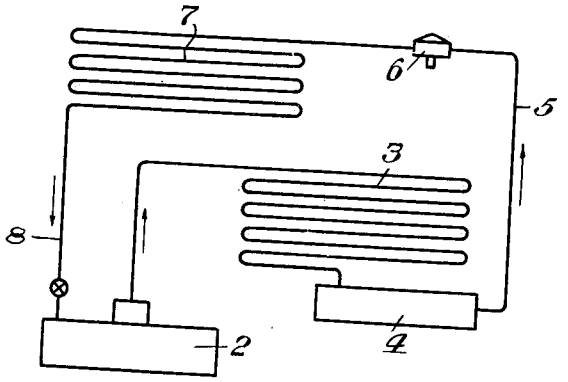


Fig. 2.

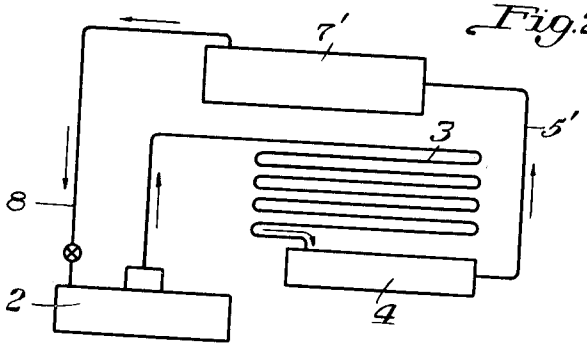
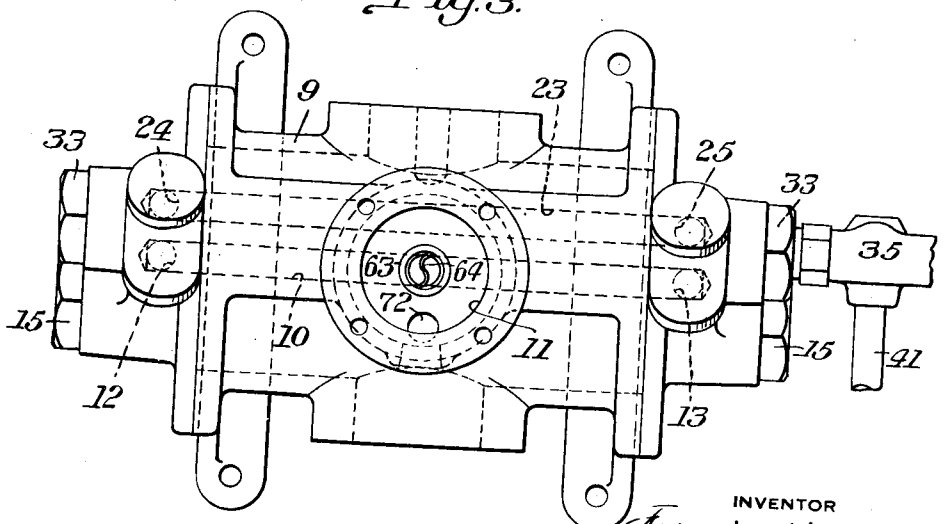


Fig. 3.



INVENTOR

Francis A. Wegener,

by Byrnes, Galbraith & Darmell,

his Attys.

June 6, 1933.

F. A. WEGENER

1,912,926

COMPRESSOR

Filed March 3, 1927

3 Sheets-Sheet 2

Fig. 4.

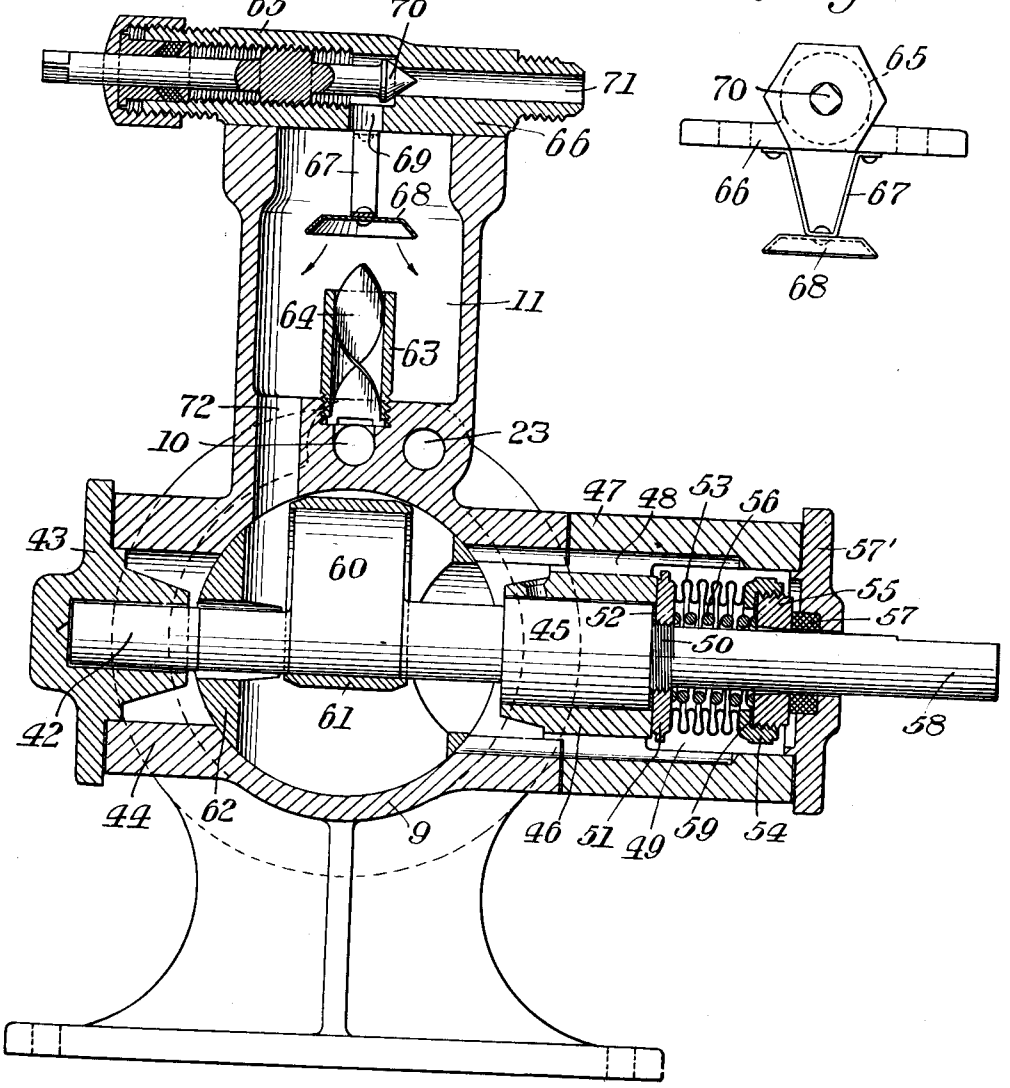


Fig. 5.

INVENTOR

Francis A. Wegener

By Fitzpatrick, Cella, Harper & Scinto

his attys.

June 6, 1933. F. A. WEGENER 1,912,926

COMPRESSOR

Filed March 3, 1927 3 Sheets-Sheet 3

Fig. 8.

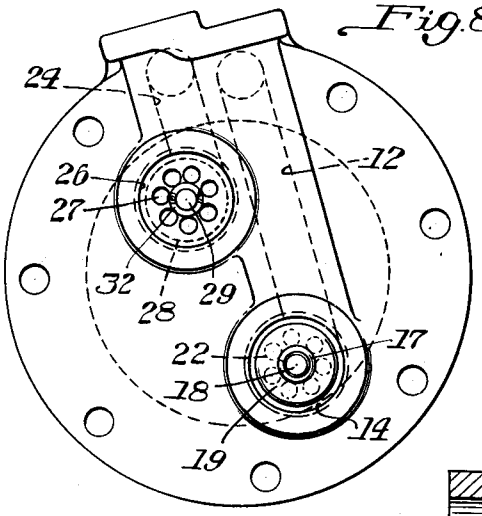


Fig. 9.

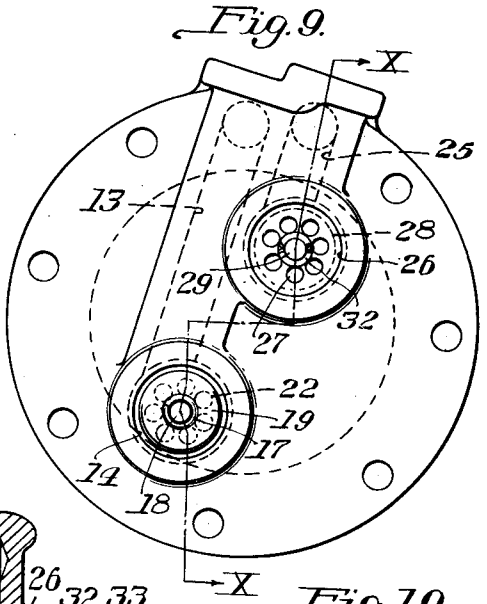


Fig. 11.

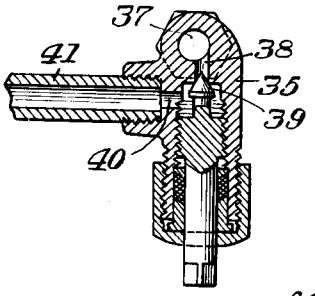


Fig. 10.

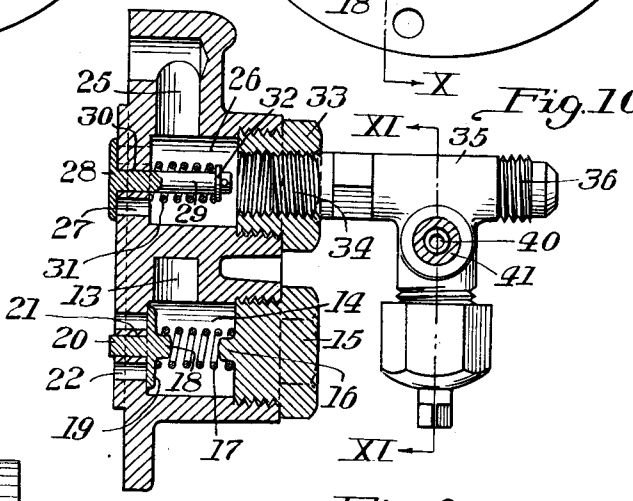
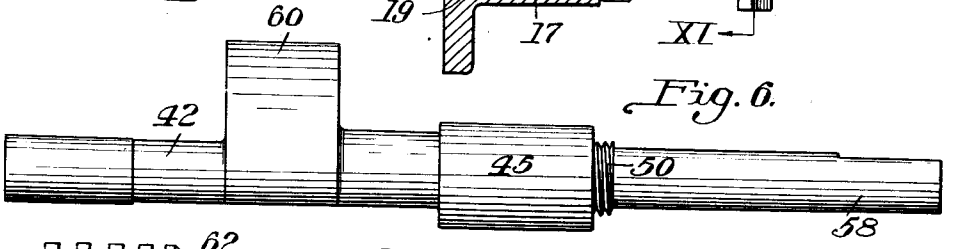


Fig. 6.



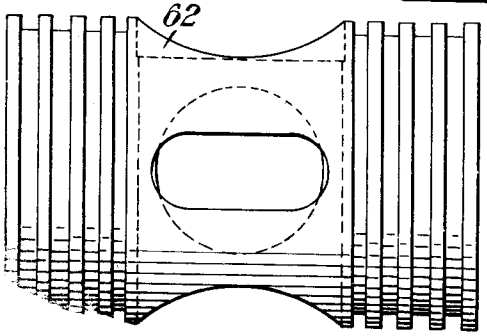


Fig. 7.

INVENTOR
Francis A. Wegener,
by Byrnes, Lawrence & Parmelee
his attys.

Patented June 6, 1933

1,912,926

UNITED STATES PATENT OFFICE

FRANCIS A. WEGENER, OF GLOUCESTER CITY, NEW JERSEY, ASSIGNOR TO WELSBACH COMPANY, OF GLOUCESTER CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY

COMPRESSOR

Application filed March 3, 1927. Serial No. 172,327.

The present invention relates broadly to the art of pumps or compressors, and more particularly to an improved compressor structure specially adaptable for use in refrigerating systems for effecting compression of the refrigerant used therein. The utility of the invention, however, is not limited with respect to its particular use, it being equally adaptable for use in other systems wherein leakage in either direction with respect to the compressor or system is objectionable.

It is customary in the refrigeration art to provide systems both of the so-called "flooded" type and also of the so-called "dry" type. In all of these systems, however, it is necessary to utilize a compressor, and in a large number of systems it is necessary to provide control valves, these valves comprising expansion valves, check valves or the like for control purposes.

Provision must be made in refrigerating systems for not only effectively lubricating the compressor parts but also for sealing the compressor against leakage in either direction, leakage from the compressor to the atmosphere or in the reverse direction being objectionable. It is also important to provide means which will prevent sticking of the valves and also prevent freezing thereof under the low temperature conditions to which they are subjected.

I have found that very desirable results may be obtained in a refrigerating system by so constructing a compressor as to maintain, in effect, a liquid seal effective for preventing leakage of gas past the piston, and at the same time tending to improve the efficiency thereof. It is essential, however, in well lubricated systems, to prevent undue circulation of the lubricating or sealing liquid with a refrigerant. It is one of the objects of the present invention, therefore, to provide an improved compressor structure including a piston, preferably liquid sealed as referred to, and including means for effectively separating the liquid so utilized from the refrigerant.

Another of the objects of the present invention is to provide an improved compressor structure having an effectively sealed and lubricated stuffing box, whereby leakage therethrough in either direction is decreased to a minimum. The preferred structure contemplates sealing the stuffing box by completely submerging the same, thereby precluding the possibility of gas leakage past the same. When so sealed it will be apparent that if any leakage of any character occurs, the leakage must be of the liquid utilized for sealing purposes.

Still another object of the present invention is to provide in a refrigerating system, means for effectively lubricating the different valves therein and preventing freezing thereof without possibility of undue liquid circulation. The prevention of freezing applies to the various control valves throughout the system, including the expansion valve or floor valve.

Still another object of the present invention is to provide an improved separator cooperating with the refrigerating medium being circulated to control not only the head pressure available on the liquid for sealing purposes, but also for limiting the maximum amount of liquid which can be circulated.

In the accompanying drawings, I have shown for purposes of illustration only, certain preferred embodiments of the present invention, it being understood that the drawings do not define the limits of my invention as changes in the construction and operation disclosed therein may be made without departing either from the spirit of my invention or the scope of my broader claims.

In the drawings:

Fig. 1 is a diagrammatic view of a so-called dry system;

Fig. 2 is a view similar to Fig. 1 illustrating diagrammatically a so-called flooded system;

Fig. 3 is a top plan view of one form of compressor constructed in accordance with the present invention;

Fig. 4 is a vertical sectional view on a line IV—IV of Fig. 3, this figure illustrating the improved separator and shut-off valve in cooperative position;

Fig. 5 is an end elevation of the shut-off

valve illustrating the separator baffle and method of supporting the same.

Fig. 6 is a side elevational view illustrating the compressor shaft;

Fig. 7 is a side elevational view illustrating the compressor piston;

Fig. 8 is an end elevation of the left hand compressor head as viewed in Fig. 3;

Fig. 9 is a view similar to Fig. 8 of the right hand compressor head; and,

Fig. 10 is a vertical sectional view on a line X—X of Fig. 9 looking in the direction of the arrows.

Fig. 11 is a sectional view of inlet fitting 35 on line XI—XI of Fig. 10.

The present invention is not limited in its application to any particular art or compressor details, and the accompanying drawings and specification refer to the refrigerating art and to a particular compressor, in many cases, merely for the purpose of a clearer understanding of the invention. Certain of the features are of particular advantage in a refrigerating system, however, as will be more clearly apparent from the following detailed description.

In all systems of this general nature water is present in varying amounts. This water tends to freeze and thereby produce sticking of the valves. I have found that very desirable results can be obtained in such refrigerating systems by the use of glycerine or a glycerine mixture as hereinafter referred to, the glycerine serving not only to seal the system and give the desired lubrication, but also to lower the freezing point of the water. The glycerine or glycerine mixture is therefore effective for thawing out or preventing freezing of the different valves with which the water comes into contact.

Further, in accordance with the present invention there is preferably provided a compressor of the piston type having a double stroke and effective upon movement in each direction for compressing gas in one end thereof and for drawing into the opposite end a fresh charge of gas to be compressed.

The compressor is advantageously so constructed as to maintain at all times a body of sealing liquid such as glycerine, intermediate the ends of the piston, whereby the piston is completely liquid sealed against the leakage of gas under pressure between the same and the cylinder walls. It is also desirable that the pressure conditions shall be such at all times as to tend to force the sealing liquid into the gas space to thereby not only improve the efficiency of the pump, but also to effectively lubricate the moving parts.

All of the foregoing results, together with an effective control of the amount of liquid in circulation in the system are obtained by providing a compressor in combination with separating means so positioned as to effect a separation of the refrigerant and glycerine or other liquid, while maintaining such liquid in position to serve the purposes referred to.

All of these results may be obtained in accordance with the present invention either with a dry system or a flooded system. Each of these systems, as illustrated in Figs. 1 and 2, comprises a compressor 2, a condenser 3, and a receiver 4 for the condensed refrigerant. The receiver in the so called dry system has a suitable connection 5 with an expansion valve 6 leading to the refrigerating or evaporating coils 7, while in the flooded system a similar connection 5′ leads to a float controlled evaporator 7′. In each case, the evaporating unit has a return connection 8 to the intake of the compressor. It will be apparent that in such systems, unless special means is provided for effecting a separation of lubricating liquid from the gaseous refrigerating medium, such liquid would tend at all times to pass from the compressor with the refrigerant, thereby not only interfering with the desired operation of the parts by reason of too great an amount of liquid in the system, but also by reason of the fact that the compressor would be robbed correspondingly of its lubricating and sealing material.

As illustrated in the drawings, the compressor may comprise a suitable cylinder 9, the opposite ends of which are of substantially similar construction except that one is necessarily reversed bodily with respect to the other. The cylinder 9 has formed in the upper wall thereof a longitudinally extending port 10 communicating at its central portion with an outlet and collecting reservoir 11. At its opposite ends the port 10 communicates with a passage 12 in the left hand head of Fig. 8 and a similar passage 13 in the right hand head of Fig. 9. Each of these passages communicates at its lower end with a valve chamber 14, having suitable closing means 15 for the outer end thereof. The closing means is preferably of such construction as to provide a projection 16 adapted to cooperate with a compression spring 17 at one end and hold the same in position. Each of these springs, at its opposite end cooperates with a similar projection 18 on a disk valve 19 having a guide stem 20 movable in a central port 21 in the head. Each disk is of such diameter as to effectively cooperate with a series of outlet ports 22.

The cylinder 9 is provided with a second longitudinally extending port 23 similar to the port 10 before referred to, and communicating at its opposite ends with a passage 24 in the left hand head of Fig. 8 and a passage 25 in the right hand head of Fig. 9. Each of these passages in turn communicates with a valve chamber 26 adapted to permit the passage of a gaseous refrigerant into the respective ends of the compressor. Each of

these intake chambers 26 has a series of ports 27 communicating with the interior of the cylinder, and preferably of a construction generally similar to that of the outlet ports 22 leading to the outlet casings 14. Each of the inlet valves may comprise a disk-like body 28 cooperating with the openings 27 and carried by a stem 29 extending through a central opening 30. Each stem 29 has positioned therearound a compression spring 31 held in position by a suitable washer and cotter assembly 32 as well understood in the art, whereby the springs 31 are effective for normally holding the valves 28 in position to seal the openings 27.

The inlet chamber closing means 33 for one of the inlet members may be tapped, as indicated for example in Fig. 10 to receive the threaded end 34 of the inlet fitting 35. The opposite end of this fitting has a threaded connection 36 to cooperate with the refrigerant return line 8 before referred to. This fitting is preferably formed with an axial port 37 with which communicates a lateral port 38 adapted to be controlled by a valve 39. When the valve 39 is unseated it permits the refrigerant to pass from the port 37 through the port 38 to a port 40. This last mentioned port may communicate with a suitable connection 41 leading to a gauge by means of which the pressure in the return to the compressor may be determined at will.

Extending transversely through the cylinder 9 is a compressor shaft 42 journaled at one end in a closed cap 43 cooperating with the bearing extension 44. The opposite end of the shaft 42 is formed with an enlargement 45 adapted to work in a bearing 46 within an extension 47. The bearing 46 is preferably in the form of a spider providing a series of channels 48 communicating with the interior of the cylinder 9 at one end and with the stuffing box chamber 49 at the opposite end. The shaft 42 is provided adjacent the bearing portion 45 with a threaded portion 50 adapted to receive a thrust nut 51, a suitable gasket 52 preferably being interposed between the thrust nut 51 and the end of the bearing portion 45 to preclude possibility of leakage from the stuffing box chamber 49 past the thrust nut and around the threaded portion. Secured at one end to the thrust nut 51, preferably in such manner as to form a hermetic seal or closure in connection therewith, is a flexible casing 53, the casing preferably being soldered to the thrust nut. At its opposite end the casing 53 is similarly secured to a lock-nut 54 which is threaded or otherwise secured onto a hardened steel bearing nut 55. The bearing nut and thrust nut are urged in opposite directions by a spring 56 located within the flexible casing 53. Since the thrust nut 51 is incapable of axial movement, the nut 50 is urged to the right as viewed in Fig. 4 and into engagement with a ring 57 of sealing and lubricating material, such for example as the well known "Genelite" material. This ring of lubricating material is carried in a head 57' through which the shaft 42 projects to provide a driving portion 58.

By reason of the stuffing box connection just described, leakage of gas from the stuffing box casing 49 into the interior of the flexible casing 53 is prevented at one end by the gasket 52 and at the opposite end by the gasket 59 between the lock nut 54 and the hardened steel nut 55. The opposite end of the casing is effectively sealed by the contact between the nut 55 and the bearing ring 57. This construction, therefore, is not only effective for preventing leakage of material from the interior of the stuffing box outwardly around the shaft in cases of an excess pressure within the compressor, but likewise for preventing leakage in the opposite direction in cases of decreased pressure within the condenser. The construction is therefore extremely desirable in cases where a tight joint is desired. This particular construction is made the subject matter of my copending application Serial No. 114,466 filed June 8th, 1926.

Intermediate its ends the shaft 42 is provided with a cam 60 adapted to cooperate with a cross head 61 within the piston 62 whereby upon rotation of the shaft the piston will alternately be reciprocated in alternate directions as will be understood.

On each stroke of the piston, compression will occur in one end thereof which compression will be effective for unseating one of the outlet valves 19 and forcing the compressed mixture into the corresponding passage 12 or 13 and thence into the longitudinally extending port 10. At the same time a mixture will be drawn into the opposite end of the cylinder past one of the inlet valves 28. The compressed mixture will pass from the port 10 into the outlet and collecting reservoir 11 for distribution to the system. Unless special means were provided in this outlet, any liquid with the refrigerant would be carried into the system as rapidly as it passed into the outlet chamber. To preclude such an operation, and to effectively maintain a desired condition of liquid within the system and within the compressor, there is provided a special form of separator illustrated in Figs. 4 and 5. This comprises a tube 63 threaded into the cylinder 9 and projecting upwardly into the chamber 11. Suitably mounted within the tube 63 is a spiral 64 which may be conveniently formed of comparatively thin sheet material twisted to the desired pitch. By reason of this construction, the mixture under compression leaving the port 10 will be whirled violently with the result that the liquid will be thrown outwardly by centrifugal action and will collect in the reservoir 11,

the gas tending to pass upwardly to the outlet valve 65. This valve comprises a cover plate 66 adapted to be secured above the reservoir, and has depending therefrom a bracket 67 carrying a baffle 68, the baffle being adapted, with the parts in position, to overlie the outlet from the tube 63. This causes the gas to be deflected downwardly in the general direction indicated by the arrows in Fig. 4 whereby it again tends to pick up a certain quantity of the liquid and carry the liquid so entrained into the port 69 and thence past the control needle 70 to the outlet 71 leading to the condenser, as will be apparent to those skilled in the art. Since the compressor operates at a constant speed and serves to produce at all times a given degree of compression on the material handled thereby, the gas leaving the tube 63 and sweeping across the surface of the liquid will tend to limit and control the maximum liquid level in the chamber 11 at all times. If the system contains the required amount of liquid, the control will obviously be such as to maintain a substantially constant liquid level in the chamber 11, the maximum level being controlled by baffle 68, and the minimum by the quantity in the system, which minimum can be regulated by the initial charge. This liquid is permitted to flow back into the compressor through a port 72 thereby tending at all times to keep the piston completely sealed and also to maintain the stuffing box chamber 49 filled with liquid which enters through the ports 48. The pressure of the refrigerant is at all times effective on the surface of the liquid in the chamber 11 for forcing the liquid back into the compressor and maintaining the desired lubricating and sealing conditions. While a large number of different liquids might be utilized if desired, I preferably employ glycerine since it not only has lubricating properties referred to but is also effective for lowering the freezing point of any water present thereby tending to prevent freezing of the valves and also serve, in the event a valve should become frozen, to assist in thawing it out.

While I have heretofore referred to the use of material such as genelite, it will be apparent that other materials may be used if desired.

I have hereinbefore referred to the use of glycerine as the lubricating and sealing material. While glycerine may be utilized alone for this purpose, I have found that glycerine alone when cool is extremely thick and viscous and enormously increases the friction load. With a ¼ H. P. motor of the lifting brush type, for example, it has been found that with pure glycerine the motor will draw as much as 1,000 watts of current and when using straight glycerine of a particularly anhydrous quality which has been permitted to drop to a low temperature, the brushes at times would not lift at all. By utilizing with the glycerine which is a tri-hydric alcohol, a mixture of ethylene glycol, very desirable results are obtained. Ethylene glycol is one of a large family of glycols or di-hydric alcohols, the family of glycols lying midway between alcohols as we ordinarily know them and tri-hydric alcohols or glycerine. It has been found that the glycols, and particularly ethylene glycol, produces with tri-hydric alcohols, and particularly glycerine, a mixture of comparatively low viscosity, moderate density and fair lubricating properties. The glycerine alone, as referred to, is objectionable under conditions of extremely low temperature by reason of the high viscosity. By combining the glycerine and glycol in different proportions, mixtures having very decidedly different characteristics may be obtained. With a mixture of almost pure glycerine the watt load remains extremely high for a period of nearly an hour which is the time required to effect a substantial change in temperature. For example, a mixture of 98% glycerine under ordinary conditions will require in excess of 400 watts at starting, the watt load dropping to approximately 260 watts after about 60 minutes of running. A mixture containing 79% glycerine and 21% glycol under the same conditions requires about the same watt load in starting. This load in about three minutes, however, drops to approximately 300 watts and in less than 10 minutes drops to a normal load of between 240 and 260 watts, thereafter retaining substantially these characteristics. Expressing the characteristics of these mixtures in terms of actual temperatures, it has been found that a 98% glycerine mixture at 60° F. will require an expenditure in excess of 420 watts, the watt load gradually dropping as the temperature increases, but not reaching a stable condition until a temperature of approximately 130° is reached. A mixture of 79% glycerine and 21% glycol on the other hand, at a temperature of 45° F. will require a watt load of about 420 watts, this dropping to 320 watts at about 54°; to 265–70 watts at 70° F. and reaching a condition of constancy of about 250 watts at 95° F. As the percentage of glycol increases, the rapidity of drop in watt load is quite marked, but the desired lubricating properties are not obtained. It has been found, however, that irrespective of variations in the mixture within certain limits, after a normal maximum operating temperature of about 140° F. is reached, all the mixtures thin out to about the same viscosity and require about the same amount of power to overcome the friction load.

In view of the characteristics referred to, I have preferably utilized a sealing and lubricating mixture comprising a tri-hydric and a di-hydric alcohol, preferably glycerine

and etylene glycol with less than 98% glycerine and more than 2% of glycol, with the glycerine preferably always in excess of the glycol in very substantial quantities.

Certain advantages of the present invention arise from the provision of a compressor automatically lubricated and sealed in combination with means limiting the amount of sealing liquid which can be circulated through the system by the compressor.

Other advantages of the invention arise from the use of a compressor including a stuffing box and piston, both of which are liquid sealed under such conditions that the pressure set up by the compressor is effective for forcing the sealing liquid into sealing and lubricating position.

Still other advantages of the invention arise from the use of a compressor sealed with glycerine in a refrigerating system whereby the freezing point of any water therein is lowered, and the freezing of valves is obviated.

Still other advantages arise from the provision of improved means for separating the compressed refrigerant and liquid and for maintaining a predetermined head of liquid available for sealing and lubricating purposes.

I claim:

1. A compressor, comprising a cylinder having inlet and outlet valves for each end thereof, a double acting piston in said cylinder, operating means for said piston, a separator cooperating with said outlet valves and including deflecting means operative under normal conditions of operation of the compressor for exerting a restraining influence on an undesirable increase in the liquid level in the separator, and means for effecting a liquid return from said separator to said cylinder at a point intermediate the ends of said piston.

2. A compressor, comprising a cylinder having inlet and outlet valves, a piston in said cylinder, operating means for said piston, a separator cooperating with said outlet valve and including deflecting means operative under normal conditions of operation of the compressor for exerting a restraining influence on an undesirable increase in the liquid lever in the separator, and means for effecting a liquid return from said separator to said cylinder.

3. A compressor, comprising a cylinder having an inlet and an outlet valve, a piston in said cylinder, operating means for said piston, an outlet reservoir into which said outlet valve discharges, means within said reservoir operative under normal conditions of operation of the compressor for tending to limit the maximum liquid level therein, said reservoir having a return connection to said cylinder, and an outlet connection from said reservoir above said means.

4. A compressor, comprising a cylinder having an inlet and an outlet valve, a piston in said cylinder, operating means for said piston, an outlet reservoir into which said outlet valve discharges, means within said reservoir operative under normal conditions of operation of the compressor for tending to limit the maximum liquid level therein, said reservoir having a return connection to said cylinder, said means comprising a separator for effecting separation of the liquid and gas discharged by said compressor, and an outlet connection from said reservoir above said means.

5. In a compressor, a cylinder, a piston therein, an operating shaft for said piston, a stuffing box for said operating shaft having both ends thereof in free communication with the interior of said cylinder, and means for liquid sealing and lubricating both said piston and said stuffing box.

6. In a compressor, a cylinder, a piston therein, an operating shaft for said piston, a stuffing box for said operating shaft having both ends thereof in free communication with the interior of said cylinder, and means for supplying liquid to and liquid sealing said stuffing box.

7. In a compressor, a cylinder, a piston therein, an operating shaft for said piston, a stuffing box for said operating shaft having both ends thereof in free communication with the interior of said cylinder, and means for liquid sealing both said piston and said stuffing box, said means including a liquid separator and means tending at all times during normal compressor operation to limit the maximum head of liquid for sealing purposes.

8. In a refrigerating system, refrigerant circulating connections including valves, compressing mechanism for the refrigerant, and baffle means controlling the amount of liquid circulated through said system, and having a tendency during normal compressor operation to limit the level of the lubricant supply.

9. In a refrigerating system, refrigerant circulating connections including valves, compressing mechanism for the refrigerant, and means controlling the amount of liquid circulated through said system, said means comprising a separator and baffle having a tendency during normal compressor operation toward limiting the maximum head of liquid in said separator.

10. A compressor, comprising a cylinder having longitudinally extending intake and outlet passages in one of the walls thereof in adjacent parallel relationship, heads for said cylinder having ports cooperating with said passages and provided with inlet and outlet valves, an inlet connection communicating with one of said heads, and a separator cooperating with an intermediate portion of

said outlet passage and communicating directly with the inside of said cylinder to maintain a body of sealing fluid therein.

11. In a compressor, a cylinder, a double acting piston therein, an operating shaft for said piston, and gas and liquid separating means having a tendency during normal compressor operation toward limiting the maximum head of liquid seal on both the piston and shaft.

12. A compressor, comprising a cylinder having longitudinally extending intake and outlet passages in the walls thereof, heads for said cylinder having ports cooperating with said passages and provided with inlet and outlet valves, an inlet connection with said compressor and a separator cooperating with said outlet passage and communicating directly with the inside of said cylinder to maintain a body of sealing fluid therein.

13. A compressor, comprising a cylinder having inlet and outlet valves for each end thereof, a double acting piston in said cylinder, operating means for said piston, a separator cooperating with said outlet valves, said separator including a baffle effectively tending during normal compressor operation to limit the maximum liquid level in the separator, and means for effecting a liquid return from said separator to said cylinder.

14. In a compressor, a cylinder, a piston therein, an operating shaft for said piston lying in the plane of said piston with its axis substantially intersecting the axis of the piston, bearing for said shaft, a stuffing box for said operating shaft exteriorly of one of said bearings and in free communication with the interior of the cylinder, and means for liquid sealing and lubricating both said piston and said stuffing box.

15. In a compressor, a cylinder, a piston therein, an operating shaft for said piston lying substantially in the plane of said piston and having its axis substantially intersecting the axis of said piston, bearings for said shaft, a stuffing box for said operating shaft exteriorly of one of said bearings and in free communication with the interior of said cylinder, and means for supplying liquid to said stuffing box and liquid sealing the same.

16. In a compressor, a cylinder, a piston therein, an operating shaft for said piston lying substantially in the plane of said piston and having its axis substantially intersecting the axis of said piston, a stuffing box for said operating shaft in free communication with the interior of said cylinder, and means for liquid sealing both said piston and said stuffing box, said means including a liquid in said separator and means having an effective tendency during normal compressor operation toward limiting the maximum head of liquid in said separator for sealing purposes.

17. In a compressor, a cylinder, a piston, inlet and outlet connections for said cylinder, a reservoir in communication with said outlet connections, and a separator in said reservoir, there being deflecting means cooperating with said separator effectively tending during normal compressor operation to limit the maximum fluid content therein.

18. In a compressor, a cylinder, a piston therein, an operating shaft for said piston having an enclosed bearing at one end through which the shaft does not extend, an intermediate bearing adjacent the opposite end through which the shaft does extend, there being a passage from said cylinder to the side of the last mentioned bearing remote from the cylinder, a chamber into which said passage leads, and a stuffing box in said chamber having both ends in free communication with said chamber.

19. In a compressor, a cylinder, a piston therein, an operating shaft for said piston having an enclosed bearing at one end through which the shaft does not extend, an intermediate bearing adjacent the opposite end through which the shaft does extend, there being a passage from said cylinder to the side of the last mentioned bearing remote from the cylinder, a chamber into which said passage leads, and a stuffing box in said chamber having both ends in free communication with said chamber, said stuffing box being carried by and rotatable with said shaft.

20. In a compressor, a cylinder, a piston therein, an operating shaft for said piston having an enclosed bearing at one end through which the shaft does not extend, an intermediate bearing adjacent the opposite end through which the shaft does extend, there being a passage from said cylinder to the side of the last mentioned bearing remote from the cylinder, a chamber into which said passage leads, and a stuffing box in said chamber having both ends in free communication with said chamber, said stuffing box being secured to said shaft adjacent said last mentioned bearing for rotation with the shaft.

21. In a compressor, a cylinder, a piston therein, an operating shaft for said piston having an enclosed bearing at one end through which the shaft does not extend, an intermediate bearing adjacent the opposite end through which the shaft does extend, there being a passage from said cylinder to the side of the last mentioned bearing remote from the cylinder, a chamber into which said passage leads, and a stuffing box in said chamber having both ends in free communication with said chamber, said shaft being of reduced diameter within said chamber exteriorly of said bearing and having the stuffing box mounted on the portion of reduced diameter.

22. In a compressor, a cylinder, a piston therein, an operating shaft for said piston

having an enclosed bearing at one end through which the shaft does not extend, an intermediate bearing adjacent the opposite end through which the shaft does extend, there being a passage from said cylinder to the side of the last mentioned bearing remote from the cylinder, a chamber into which said passage leads, a stuffing box in said chamber having both ends in free communication with said chamber, and means for liquid sealing and lubricating both said piston and said stuffing box.

23. In a compressor, a cylinder, a piston therein, an operating shaft for said piston having an enclosed bearing at one end through which the shaft does not extend, an intermediate bearing adjacent the opposite end through which the shaft does extend, there being a passage from said cylinder to the side of the last mentioned bearing remote from the cylinder, a chamber into which said passage leads, a stuffing box in said chamber having both ends in free communication with said chamber, said stuffing box being carried by and rotatable with said shaft, and means for liquid sealing and lubricating both said piston and said stuffing box.

24. In a compressor, a cylinder, a piston therein, an operating shaft for said piston having an enclosed bearing at one end through which the shaft does not extend, an intermediate bearing adjacent the opposite end through which the shaft does extend, there being a passage from said cylinder to the side of the last mentioned bearing remote from the cylinder, a chamber into which said passage leads, a stuffing box in said chamber having both ends in free communication with said chamber, said stuffing box being secured to said shaft adjacent said last mentioned bearing for rotation with the shaft, and means for liquid sealing and lubricating both said piston and said stuffing box.

25. In a compressor, a cylinder, a piston therein, an operating shaft for said piston having an enclosed bearing at one end through which the shaft does not extend, an intermediate bearing adjacent the opposite end through which the shaft does extend, there being a passage from said cylinder to the side of the last mentioned bearing remote from the cylinder, a chamber into which said passage leads, a stuffing box in said chamber having both ends in free communication with said chamber, said shaft being of reduced diameter within said chamber exteriorly of said bearing and having the stuffing box mounted on the portion of reduced diameter, and means for liquid sealing and lubricating both said piston and said stuffing box.

26. A compressor, comprising a cylinder having inlet and outlet valves for each end thereof, a double acting piston in said cylinder, operating means for said piston, a separator co-operating with said outlet valves and including a deflecting means disposed centrally with respect to said separator and having down-turned edges formed thereon and having an effective tendency during normal compressor operation toward limiting the maximum liquid level in the separator, and means for effecting a liquid return from said separator to said cylinder at a point intermediate the ends of said piston.

27. A compressor, comprising a cylinder having inlet and outlet valves, a piston in said cylinder, operating means for said piston, a separator cooperating with said outlet valve and including a deflecting means centrally disposed within the separator and having downturned edges and having an effective tendency during normal compressor operation toward limiting the maximum liquid level in the separator, and means for effecting a liquid return from said separator to said cylinder.

28. A compressor, comprising a cylinder having an inlet and an outlet valve, a piston in said cylinder, operating means for said piston, an outlet reservoir into which said outlet valve discharges, means in said reservoir having an effective tendency during normal compressor operation toward continuously controlling the maximum liquid level therein, said means including a centrally disposed baffle having downturned edges spaced from the walls of said reservoir, a return connection from said reservoir to said cylinder, and an outlet connection from said reservoir above said baffle.

29. In a compressor including a cylinder having removable heads each carrying an inlet and an outlet valve together with inlet and outlet passages formed therein, there being longitudinally extending passages formed in the cylinder wall and communicating ing therewith, a piston in said cylinder, operating means for said piston, a separator carried by said cylinder and communicating at one end with one of the longitudinally extending passages, and a return connection from said separator to said cylinder.

30. In a compressor including a cylinder having removable heads each carrying an inlet and an outlet valve together with inlet and outlet passages formed therein, there being longitudinally extending passages formed in the cylinder wall and communicating therewith, a piston in said cylinder, operating means for said piston, a separator carried by said cylinder and communicating at one end with one of the longitudinally extending passages, and a return connection from said separator to said cylinder, said separator including a centrally disposed baffle having downturned edges providing a liquid pick-up space therebelow.

31. In a compressor including a cylinder having removable heads each carrying an

inlet and an outlet valve together with inlet and outlet passages formed therein, there being longitudinally extending passages formed in the cylinder wall and communicating therewith, a piston in said cylinder, operating means for said piston, a separator carried by said cylinder and communicating at one end with one of the longitudinally extending passages, and a return connection from said separator to said cylinder, said separator including a centrally disposed baffle having downturned edges providing a liquid pick-up space therebelow, there being an outlet connection from said separator above said baffle.

In testimony whereof I have hereunto set my hand.

FRANCIS A. WEGENER.

inlet and an outlet valve together with inlet and outlet passages formed therein, there being longitudinally extending passages formed in the cylinder wall and communicating therewith, a piston in said cylinder, operating means for said piston, a separator carried by said cylinder and communicating at one end with one of the longitudinally extending passages, and a return connection from said separator to said cylinder, said separator including a centrally disposed baffle having downturned edges providing a liquid pick-up space therebelow, there being an outlet connection from said separator above said baffle.

In testimony whereof I have hereunto set my hand.

FRANCIS A. WEGENER.

CERTIFICATE OF CORRECTION.

Patent No. 1,912,926. **June 6, 1933.**

FRANCIS A. WEGENER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, line 61, claim 16, strike out the words "in said"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of August, A. D. 1933.

M. J. Moore.

(Seal) **Acting Commissioner of Patents.**

CERTIFICATE OF CORRECTION.

Patent No. 1,912,926. June 6, 1933.

FRANCIS A. WEGENER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, line 61, claim 16, strike out the words "in said"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of August, A. D. 1933.

M. J. Moore.

(Seal) Acting Commissioner of Patents.