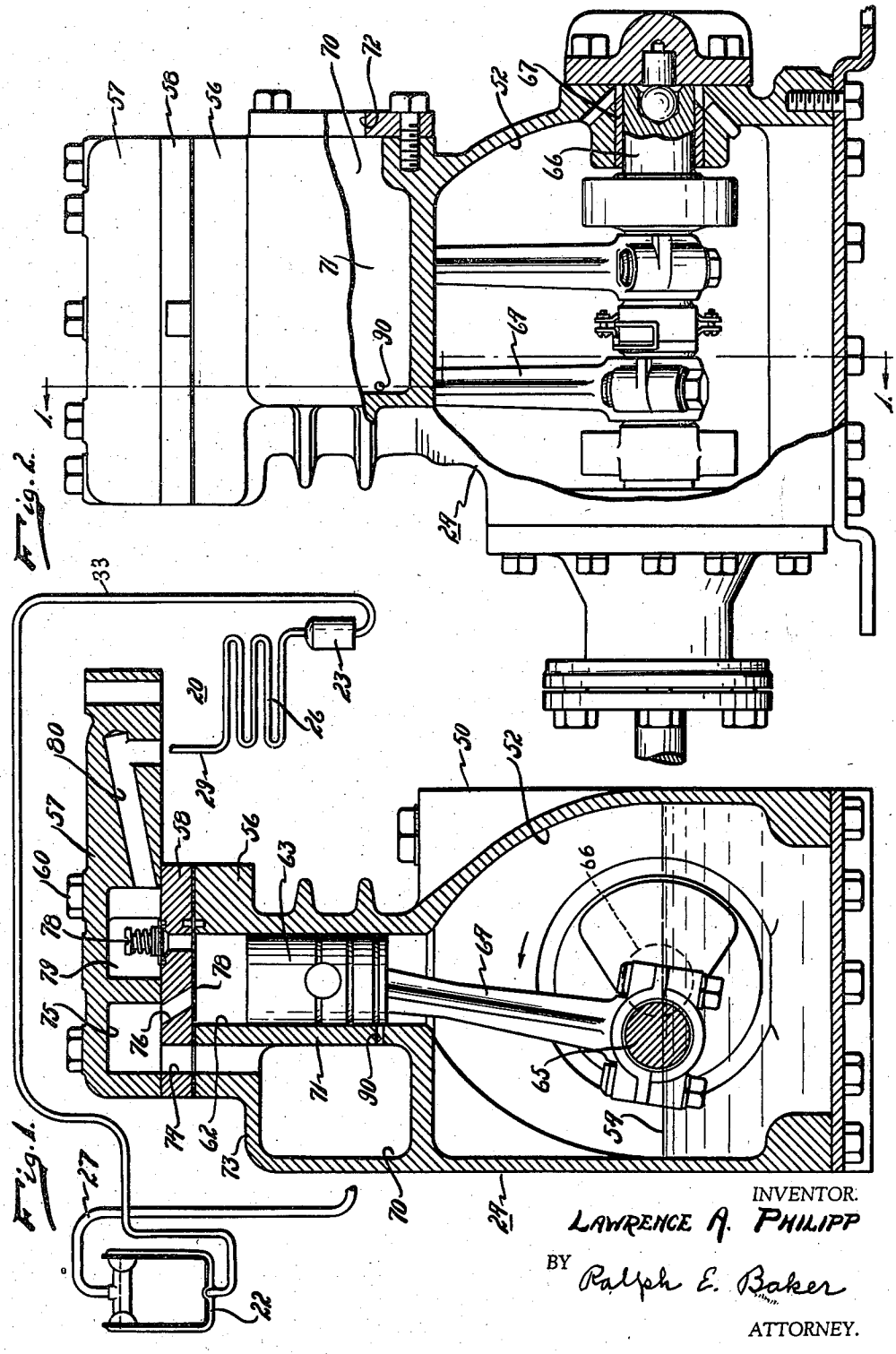
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REFRIGERATING APPARATUS

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INVENTOR.
LAWRENCE A. PHILIPP
BY Ralph E. Baker
ATTORNEY.

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REFRIGERATING APPARATUS

Lawrence A. Philipp, Detroit, Mich., assignor to Kelvinator Corporation, Detroit, Mich., a corporation of Michigan

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This invention relates to refrigerating apparatus, and more particularly to refrigeration apparatus of the motor compressor condenser type.

In refrigerating systems of the compression type which include a low side, such as a cooling element or evaporating zone, and a high side, such as a refrigerant compressor and condenser, it is usual to provide a body of lubricating fluid, for instance, within a reservoir or lubricating zone provided within a casing which houses the compressor for lubricating moving parts of the compressor. During operation of the compressor, it has been found that some of the lubricant is pumped to other parts of the system where it is not needed and where it is likely to affect the efficiency of the system. This lubricant is usually returned to the lubricant reservoir along with the vaporized refrigerant by the action of the compressor by entrainment and/or by gravity. Such systems are usually intermittently operated, and during the off-phase of the refrigerating cycle the pressure in the low side builds up. In systems of this type, which are provided with a refrigerant which is miscible with the lubricant, it has been found by experience that when the lubricant is placed in the low pressure side of the system, any sudden reduction of the pressure on the body of the lubricant will cause considerable foaming to take place. In such systems, which are in open communication with the low side of the system to provide for the return of the lubricating fluid to the reservoir, it has been found that a large part of the lubricant which forms a portion of the foam is drawn into the compressor whence it is discharged into other parts of the system. Under these conditions, an abnormal amount of lubricant is being pumped to other parts of the system and the return thereof, as aforesaid, is less than the amount so pumped to other parts of the system. Accordingly, the compressor would soon be without lubricant and the efficiency of the system would be impaired.

By my invention, I obviate the above difficulties by providing an improved arrangement which prevents the sudden reduction of pressure on the body of the lubricant.

Another object of my invention consists in a new method of refrigeration wherein the evaporated refrigerant in the lubricant reservoir is withdrawn during only a part of the time when evaporated refrigerant is being withdrawn from the evaporating zone.

Another object of my invention is to provide for the return of the lubricant from the cooling element through a restricted orifice or valve which is so positioned as to be controlled by a moving element of the compressor, to thus provide for reducing the pressure of the refrigerant vapor on the body of lubricant gradually by withdrawing the vapor through said restricted orifice or valve when opened for withdrawal of fluid therethrough.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form of the present invention is clearly shown.

In the drawing:

Fig. 1 is a diagrammatic representation of a refrigerating system embodying features of my invention, and showing an enlarged full sized view in cross section of the compressor taken along line 1—1 of Fig. 2; and

Fig. 2 is a view partly in elevation and partly in cross section of the compressor embodying features of my invention.

Referring to the drawing, numeral 20 designates a condensing element, and the numeral 22 designates a cooling element or evaporator of the flooded type, in which a substantially constant level of liquid refrigerant is maintained by means of a float valve mechanism 23. The condensing element comprises, in general, a compressor 24 which may be operated by any suitable means, such, for example, as an electric motor (not shown), and a condenser 26. Evaporated refrigerant is withdrawn from the evaporator through a vapor conduit 27. The evaporated refrigerant thus withdrawn is compressed by the compressor, as is hereinafter more fully described. The compressed refrigerant is discharged into a conduit 29 through which it passes to the condenser 26 wherein it is condensed and from which it passes to the float valve mechanism 23. Liquid refrigerant is supplied to the evaporator from the mechanism 23 through a liquid supply conduit 33.

The compressor 24 comprises, in general, an outer casing 50, which includes a crank case portion 52 adapted to contain a quantity of lubricating oil, the level of which I have indicated at 54, and a cylinder block portion 56. The compressor also includes a head portion 57 and a valve plate 58 clamped between the head portion and the cylinder block by screws 60. Within the cylinder block there is provided a compression chamber 62 in which is disposed for reciprocation a piston 63 which, in turn, is connected to a pitman 64 actuated by an eccentric portion 65 of

the compressor shaft 66. The compressor shaft is journaled in a suitable bearing 67 carried by casing 50 on one end thereof and in a second bearing (not shown) carried by the opposite side of casing 50. During the operation of the compressor the pitman 64, eccentric 65 and a counter weight 68, which is secured to the shaft, are adapted to dip into the body of the lubricating oil 54 and throw oil for lubricating various moving parts of the compressor.

Surrounding a portion of the cylinder block is an intake chamber 70 formed by a portion of the outer wall of the cylinder block, designated 71, and a laterally extending wall 72 which is joined to the cylinder block wall. This intake chamber 70 includes inlet 73 which is in communication with the vapor conduit 27. The evaporated refrigerant which is withdrawn through the vapor conduit 27 from the evaporator 22 passes through the intake chamber 70 and opening 74 provided in the valve plate 58, and into a recessed chamber 75 provided in the head portion 57, whence it passes through a second opening 76 provided in valve plate 57, and into the compression chamber 62 under the control of a suction valve 78. The refrigerant is compressed within the chamber 62 whence it is discharged therefrom through a discharge valve 78 into a recessed chamber 79 provided in the head portion, and a passage 80 which is also provided in the head portion and which is in communication with the conduit 29 which leads to the condenser. Preferably, the compressor is provided with two cylinders spaced apart in close relation in block 56. The second cylinder, pitman and piston are the same as compression chamber 62, piston 63 and pitman 64, and for this reason further description is unnecessary.

Preferably, systems of the type herein disclosed are intermittently operated for maintaining predetermined temperatures within evaporator 22 and the operation of the compressor is usually controlled in response to changes in pressures within the conduit 27, which is in communication with the refrigerant vapor space of the evaporator 22. Since the evaporator 22 is of the flooded type, the pressure of evaporated refrigerant in the evaporator will bear a direct relation to the temperature in the evaporator. Any suitable pressure responsive control mechanism may be provided for connecting and disconnecting the motor which drives the compressor to and from the electric power mains.

During operation of the compressor, some of the lubricating oil contained in the crank case portion 52 of compressor 24 is carried to other parts of the system, due to the pumping of oil by the compressor 24. When this occurs, the level of lubricating oil within the crank case portion 52 gradually diminishes and the lubricating oil which is pumped to other parts of the system, for example, to the evaporator 22, has a tendency to affect the efficiency of the system. Under these conditions, it is necessary to return the oil from the evaporator to the reservoir provided in the crank case of the compressor. This oil is returned as aforesaid through conduit 27, and any oil entrained with the vapor will be separated therefrom when coming in contact with the walls of the chamber 70, and also due to the greatly reduced gas velocity upon entering said chamber from the relatively small interior diameter conduit 27. This separated oil flows to the bottom of chamber 70.

In the above described system, I prefer to use refrigerants which are to some degree miscible with the body of oil, which refrigerants may be, for example, CCl_2F_2 or SO_2. In systems of such type in which it is desired to use a refrigerant which is miscible with the body of the lubricating oil, it has been found, as previously stated herein, that any sudden reduction of pressure on the body of lubricant will cause considerable foaming. This is due to the fact that the oil absorbs a portion of the refrigerant in the crank case, the amount depending upon the pressure therein and the length of time that the compressor is not in operation. Consequently, a sudden reduction of pressure on the oil results in a large amount of foaming as the refrigerant which is absorbed in the oil tends to separate itself therefrom. Thus, it is desirable to reduce the refrigerant vapor pressure on the body of lubricating oil gradually so as to prevent foaming within the crank case 52. As previously stated, this pressure on the body of lubricant is the result of pressure which builds up in the low pressure side of the system during the off-phase of the refrigerant cycle of the system. By low pressure side of the system is meant the evaporator 22 and the low pressure portion of the compressor, which includes the crank case 52 in which the body of lubricating oil is stored. By high pressure of the system is meant between the discharge valve of the compressor and up to and including the point where the liquid refrigerant enters the evaporator 22. The building up of pressures in the low pressure side of the system during off-phase causes the pressure to build up in the crank case 52 of the body of lubricating oil 54, for the reason that it is necessary to establish communication between the suction chamber 70 and the crank case portion 52 in order to return the oil which has previously been pumped to other parts of the system to its reservoir. In view of the fact that the refrigerant is miscible with the oil, a portion of the refrigerant vapor becomes absorbed in the oil which is returned to the crank case 52. In order to provide for returning the oil to the crank case portion 52 from suction chamber 70, I have provided a restricted orifice 90 in wall 71, which is in open communication with the suction chamber 70 and is arranged so that its discharge end is adapted to be opened and closed by movement of piston 63. When a predetermined quantity of lubricant is collected in chamber 70, it will overflow into chamber 62 and by gravity or by movement of piston 63 fall into the body of lubricant in crank case 52. In practice, it has been found that during operation of the compressor, the piston maintains the orifice 90 closed approximately 40% of the operating time, due to the location of the orifice 90 in wall 71 with respect to the travel of piston 63. It has also been found that when the compressor stops the pistons stop in the position shown in Fig. 1 to cover the outlet end of orifice 90. This is due to the inherent characteristics of this type of compressor.

When the orifice 90 is open and lubricant is conducted to crank case 52, some refrigerant gas is also conducted through this orifice to the crankcase. Thus, in order to withdraw the refrigerant from the crankcase, it must pass through the orifice 90. This restricted orifice, which is controlled by the piston 63, limits the amount of refrigerant vapor which is withdrawn from the crank case so as to prevent the sudden reduction of pressure on the body of lubricant 54. This occurs because the restricted orifice is closed during part of the time when the com-

pressor is operating. The piston also limits the amount of refrigerant gas which can enter into the crank case during idle periods of the compressor, because the piston closes off orifice 90 when compression stops. By this arrangement, I may provide a valve of sufficient size to return the oil to the crankcase 52 without the possibility of clogging. This arrangement also provides for lubrication of chamber wall 62 and piston 63. Consequently, the pumping of oil by the compressor to other parts of the system is reduced to a negligible amount, since the possibility of foaming within the crank case portion 52 occurring in response to sudden reduction of pressures therein is substantially or entirely obviated by such an arrangement. Also, the orifice 90 is high enough in wall 71 so that oil from the crank case will not be splashed therethrough.

From the foregoing, it will be noted that I have provided a refrigerating system where lubricant is conducted from the evaporator to the lubricant reservoir, and that I have made provisions for withdrawing gaseous refrigerant from said reservoir at a rate that prevents foaming of lubricant in the crank case, and that I have accomplished this by periodically closing off the flow of gaseous refrigerant to the inlet of the compressor during operation of the compressor. It will also be noted that the orifice through which lubricant is returned to the crank case reservoir and through which gaseous refrigerant flows to the inlet of the compressor is so positioned as to be closed off approximately 40% of the running time of the compressor, due to location of said orifice. It is to be understood, however, that the orifice may be positioned higher or lower on wall 71 for certain other types of compressors or for use with other types of refrigerants.

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

I claim:

1. A refrigerating system for circulating a volatile refrigerant comprising a low pressure portion and a high pressure portion, said low pressure portion having a reservoir for volatile refrigerant and a reservoir for lubricant, fluid conducting conduit means including a fixed orifice associated with said reservoirs for conducting lubricant and refrigerant entrained therewith or absorbed therein from said refrigerant reservoir to said lubricant reservoir, said refrigerant being at least partially miscible in said lubricant and being adapted to create a pressure thereon whereby a portion of said refrigerant becomes absorbed in said lubricant, and pressure reducing means having an inlet associated with said fluid conducting conduit means, refrigerant and lubricant reservoirs and operable to close off said orifice to the passage of fluid therethrough during part of the time that fluid from said refrigerant reservoir is being conducted through said inlet to the pressure reducing means to provide for reducing the pressure on said lubricant at a rate below that which would cause foaming of the said lubricant.

2. A refrigerating system for circulating a volatile refrigerant comprising a low pressure portion and a high pressure portion, said low pressure portion having a reservoir for volatile refrigerant and a reservoir for lubricant, fluid conducting conduit means including a valve associated with said reservoirs for conducting lubricant and refrigerant entrained therewith or absorbed therein from said refrigerant reservoir to said lubricant reservoir, said refrigerant being at least partially miscible in said lubricant and being adapted to create a pressure thereon whereby a portion of said refrigerant becomes absorbed in said lubricant, and pressure reducing means having an inlet associated with said fluid conducting conduit means, refrigerant and lubricant reservoirs and operable to close off said valve to the passage of fluid therethrough during part of the time that fluid from said refrigerant reservoir is being conducted through said inlet to the pressure reducing means to provide for reducing the pressure on said lubricant at a rate below that which would cause foaming of said lubricant.

3. The method of refrigeration in a refrigerating system of the type wherein a volatile refrigerant and lubricant are circulated which consists in establishing liquid refrigerant and lubricant reservoirs, evaporating refrigerant in said refrigerant reservoir, conducting evaporated refrigerant and lubricant to said lubricant reservoir, withdrawing evaporated refrigerant from said refrigerant reservoir for a predetermined period of time, withdrawing evaporated refrigerant from said lubricant reservoir simultaneously with the withdrawal of gaseous refrigerant from said refrigerant reservoir during a portion only of said predetermined period of time, condensing the evaporated refrigerant and returning it to said liquid refrigerant reservoir.

4. The method of refrigeration which consists in establishing evaporating and lubricating zones in open communication with each other, withdrawing evaporated refrigerant from said evaporating zone for a period of time, withdrawing evaporated refrigerant from said lubricating zone during a portion only of the time when evaporated refrigerant is being withdrawn from said evaporating zone, condensing said evaporated refrigerant and returning same to said evaporating zone.

5. A refrigerating system comprising evaporating and lubricating zones, conduit means interconnecting said zones, and means for reducing the pressures of the refrigerant in said zones simultaneously and operable to reduce the pressure in said evaporating zone for a period of time and in said lubricating zone for a shorter period of time.

6. A refrigerating system comprising evaporating and lubricating zones, a valve interconnecting said zones, and pressure reducing means operable to close off said valve during periods when the pressure is being reduced in said evaporating zone to prevent the passage of any fluid to said pressure reducing means.

LAWRENCE A. PHILIPP.