This invention relates to refrigerating apparatus, and more particularly to motor-compressor units for use in connection with such apparatus.

It is an object of the present invention to provide a compact and efficient compression mechanism for refrigeration purposes, in which the gas pump, or compressor, is enclosed with its driving motor in a fluid tight casing, and also to provide within the casing an improved arrangement for permitting the driving motor to attain a certain speed before the compressor assumes its working load.

Another object of my invention is to divide the fluid tight casing into a compressor or high pressure compartment and a motor, or low pressure compartment, which latter compartment is arranged to receive the fluid to be compressed before its admission to the compressor, and to provide a simple and effective unloading device for equalizing the pressures in said compartments during periods when the compressor is inoperative, so that high pressure fluid is supplied to the compressor upon starting operation and low pressure fluid is supplied after the motor attains a certain speed and the high pressure fluid is exhausted from the motor compartment.

Another object of the invention is to provide an improved lubricating system for moving elements of the motor compressor unit.

Still another object of the invention is to provide a compressor of the pendulum rotary type, having a radial abutment member rigidly attached thereto, which abutment member is arranged to operate with a flat surface contact with a single oscillating rocker, the surface contact being maintained by a yieldable push rod whereby the operation of the parts is such that a compressor of high efficiency for gas compressing purposes is provided.

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

In the drawings:

Fig. 1 is a view of the motor compressor unit in elevation and partly broken away, and also shows diagrammatically a refrigerating system associated with the motor compressor unit;

Fig. 2 is a vertical section of the motor compressor unit taken along the line 2–2 of Fig. 3;

Fig. 3 is a view taken along the line 2–2 of Fig. 2, showing a portion partly broken away;

Fig. 4 is a view taken along the line 4–4 of Fig. 2;

Fig. 5 is a view taken along the line 5–5 of Fig. 4;

Fig. 6 is a view taken along the line 6–6 of Fig. 3;

Fig. 7 is a vertical view in cross section of an unloading valve;

Fig. 8 is a view taken along the line 8–8 of Fig. 7;

Fig. 9 is a vertical view in cross section of a modified form of unloading valve; and

Fig. 10 is a view along the line 10–10 of Fig. 9.

Referring to the drawings, numeral 10 designates, in general, a motor compressor unit which withdraws evaporated refrigerant from a refrigerant evaporator 12 through a vapor conduit 14, compresses the evaporated refrigerant and delivers same to a condenser 16, wherein it is liquefied and from which it is delivered to a high side float mechanism 18. The float mechanism controls the flow of liquid refrigerant to the evaporating element 12. The operation of the motor compressor unit is controlled by a thermostatic switch 20.

The motor compressor unit comprises, in general, a casing 25, which is formed preferably in three sections, namely; a central section 27 and end sections 28 and 29. The central section is provided with a tubular shaped bearing 31 in which a shaft 33 is journaled. A compressor 35 is carried on one end of the shaft 33 in a compressor compartment 37, and an electric motor 39, which includes stator 40 and rotor 42, is associated with the opposite end of the shaft 33. The stator 40 is carried by the central casting 27, and the rotor 42 is carried by the shaft 33, with the motor 39 being disposed in a motor compartment 45. The central section also includes a partition member 46 which carries bearing 31 and separates the motor and compressor compartments.

The compressor is of the rotary type and includes a cylinder 50 in which is located a piston 52. The piston is moved about the cylinder 50 by means of an eccentric portion 53, which is preferably formed integral with the shaft 33. The movement of the piston is in a clockwise direction. In order to seal the high pressure side of the pump from the low pressure side, a blade 55 is attached to the piston 52. The blade 55 cooperates with a semi-cylindrical rocker 57. Thus, it will be noted that one side of the blade has a flat contact with the flat side of the rocker 57, while the curved portion of the rocker 57 is 55.
arranged in slidable contact with the cylinder block 50. During operation of the compressor, the blade 55 not only slides back and forth over the roller 57 but has a tendency to nod or oscillate within a recess 60. In order to insure a good contact between the blade 55 and the roller 57 and a good engagement between the roller 57 and the cylinder block, a push rod 62 has been provided. The push rod is constantly tending to urge the blade toward the rocker due to a spring 63.

During operation of the compressor, the pumping action draws evaporated refrigerant from the evaporator through the vapor conduit 14, whence it passes through an inlet 65 formed in the partition 46 between the motor and compressor compartments. Evaporated refrigerant passes from the inlet passage 65 through check valve 71, whence it flows through passage 72 into the motor compartment 45. In order to prevent any dust, lint or dirt from the motor windings or from the system from being introduced into the pump, a shield 73 has been provided within the motor compartment 45 and includes screen 75 for filtering such dirt or lint. After the evaporated refrigerant passes into the motor compartment, it is filtered, whence it flows through a passage 76, which is formed in the partition 46, into a pump inlet 78. Thus, any vapor pumped from the compressor into the system and into the evaporator is taken along with the evaporated refrigerant by entrainment to the motor compartment. This oil is withdrawn from the motor compartment through passage 78 along with the evaporated refrigerant into the pump. The compressed refrigerant is discharged from the pump through the pump outlet 80, whence it passes through a reed valve 81 into a discharge chamber 82, which has a passage 83 associated therewith and which leads to a lubricant collecting bore 85. The discharged refrigerant then passes into the compressor compartment 37, which is, as will be noted, on the high pressure side of the refrigerating system. It will also be noted that during operation of the motor compressor unit, that the motor compartment 45 contains low pressure refrigerant at a pressure equivalent to that existing in the evaporator and return conduit 14.

In order to provide for the lubrication of the motor, a quantity of lubricant is disposed within the compressor compartment 37 to a level as indicated at 87. In view of the fact that this oil is under pressure, a passage 88 has been provided for conducting the oil to a bearing 80 of the compressor, whence it flows to the eccentric 53 on the shaft 33. The eccentric 53 is provided with an oil hole 91 so that lubricant may freely pass from one side of the eccentric to the other, whence it flows to the bearing member 31 and any overflow passes into the motor compartment and is later returned to the oil reservoir in the compressor compartment by the action of the compressing unit, as previously set forth herein. In order to filter the oil before passage into the pump, a screen 85 has been provided at the head of the inlet passage 88.

In order that a motor having a low starting torque may be used in this sealed motor compressor unit, it is necessary to provide some sort of unloading mechanism. Thus, an unloading valve 102 has been provided. The valve 102 includes a weight 101, to which is attached a needle valve 102, which is arranged to cooperate with the valve seat 103. During operation of the compressor, the valve 102 is in engagement with its seat 103, due to the centrifugal force which moves the weight 101 towards the seat 103. Whenever the compressor is at rest, a spring 104 moves the weight towards a plug 105 so that the valve 102 is removed from its seat 103. In order to prevent a discharging of the valve housing, the weight 101 is provided with slots 106. The slots also permit the flow of oil and refrigerant along the side of weight 101.

During the operation of the compressor unit, the valve 102 is closed and prevents the high pressure gas in the compressor compartment 35 from flowing into the motor compartment 45. However, when the compressor is at rest, the valve 102 is open and the gas from the compressor compartment is free to flow through passages 85 and 110, through a longitudinal bore 112 in the motor compressor shaft and through valve seat 103 into the motor compartment. Thus, when the compressor is at rest, the pressures within the compressor and motor compartments equalize and the motor compartment is of sufficient size so that when the compressor resumes operation, only high pressure gas being taken into the pump until the motor attains a certain speed, and, consequently, the pump is doing little, if any, work so that dissipation of burning out the motor of low starting torque is prevented. However, the unloading valve 100 also prevents the loading of the pump until a certain speed of the motor had been attained. Thus, it is necessary for the motor to reach a certain speed so that the valve 100 closes off the passage between the compressor compartment and the motor compartment, and also it is necessary for the pump to draw the high pressure gas from the motor compartment before the compressor again becomes loaded.

In order to counter-balance the unloader valve and the moving elements on the compressor, counter-weights 110 and 111 have been attached to the motor rotor.

The modified form of unloading valve 113, as shown in Figs. 9 and 10, operates substantially the same as that disclosed in Figs. 7 and 8. The valve 113 includes a casing 114 having a valve port 115 and a movable valve proper 116. The valve proper is in the position shown in Fig. 9 during operation of the compressor so as to close off the valve port 115. When the compressor is inoperative, a spring 117 moves the valve proper into engagement with a plug 118 so that a reduced portion 119 is opposite port 115 thus permitting the passage of fluid through port 115. The valve proper 116 is provided with cross bores 120 and 121 and a longitudinal bore 123 to establish communication between passage 112 and port 115 when the valve 113 is in open position.

In a system of the type disclosed herein, I prefer to use a refrigerant of the type which is somewhat miscible with the lubricant, such, for example, as CCl₄F₂, CH₂Cl, CCl₃F₂, CFC₁H₂ and CCl₃FCL. Thus, the refrigerant and lubricant would form a homogeneous mixture and would be such that the same would probably be, to a large extent, inseparable by mechanical agitation and require heat in order to vaporize off the refrigerant from the lubricant. In order to order, I prefer to use a heating element 130, which has been provided. This heating element is placed in a recessed portion 131 of the casting 29 where it will be in close thermal conductive relationship with the lubricant stored in the reservoir provided in the compressor compartment 37. This
heater element operates only when the compressor is not in operation. In order to control the operation of the heating element the same has been connected with the thermostatic switch so that when the switch has its contacts closed, the heater element is short circuited, and when the switch contacts are open the heater element is in circuit with the power mains where it receives current from the power mains. If desired, however, 50 may be used as the refrigerant.

In order to seal the unloading valve during operation of the compressor so as to prevent possibilities of leakage between the valve proper 102 and its seat 103, any oil which is discharged by the compressor along with the compressed refrigerant, will pass into the bore 85, whence, by reason of the change of velocity, the compressed refrigerant passes upwardly into the compressor compartment and the oil entrained therewith has a tendency to drop downwardly into the passage 110 and into the bore 112 of the shaft 33, when it passes to the valve proper 102. Thus, the bore 85 and passages 110 and 112 serve as lubricant collecting and storing chambers for lubricant to be used for sealing the unloading valve 100.

From the foregoing, it will be noted that I have provided a simplified form of refrigerant-pumping apparatus which may be easily manufactured and assembled and one which will operate with a high degree of efficiency. It will also be noted that the high and low pressure parts of the compression mechanism are effectively sealed by a movable blade which cooperates with a movable rocker having an elongated flat surface so as to positively prevent back flow of the refrigerant from the high pressure to the low pressure side of the system. Furthermore, it will be noted that refrigerant to be compressed is first conducted through the motor compartment whence it passes to the compressor and in so doing any oil collected in the motor compartment will be conducted to the compressor along with the refrigerant to be compressed, and this oil and refrigerant is discharged into the compressor compartment which is at a relatively high pressure or at condensing pressure. The oil which is discharged by the compressor is collected in a small reservoir which is in open communication with an automatic unloading valve in the motor compartment. In practice, it has been found that such valves are noisy and due to the present arrangement, which permits flow of oil to the unloading valve, such noise is eliminated. By conducting the low pressure refrigerant through the motor compartment, it will be noted that during operation of the motor compressor unit after the motor attains a certain speed, the motor rotor is operating in the low pressure refrigerant which may have some cooling effect and because it is of low pressure it is not so difficult for the motor to break up the fine particles of refrigerant as in cases where the motor is operating in the presence of high pressure refrigerant. During periods when the pump begins operation, the automatic unloading valve effects equalization of pressures in the motor and compressor compartments so as to aid in starting operation under substantially no load conditions while the automatic unloading valve cooperates so as to prevent any material load being placed upon the motor compressor until the motor has reached a certain speed. It will also be noted that I have provided an improved arrangement for separating particles of lubricant from the refrigerant contained in the reservoir in the compressor compartment.

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 device of the character described comprising a casing having a motor compartment and a compressor compartment, said motor compartment having an inlet for refrigerant and lubricant, a motor in said motor compartment, a compressor in said compressor compartment having an outlet for discharging refrigerant into said compressor compartment, means for conducting to said compressor refrigerant and lubricant from said motor compartment, means providing a reservoir for receiving the lubricant discharged from said compressor, and means including a centrifugally operable valve arranged for periodically passing refrigerant from said compressor compartment to said motor compartment, and said valve being in open communication with said reservoir for receiving lubricant to seal said valve.

2. Refrigerating apparatus comprising a compressor, a motor, a shaft connecting the motor to said compressor, said shaft having a passage, means providing a reservoir for lubricant discharged from said compressor above said passage in said shaft and in open communication with said passage, and a valve responsive to rotation of said shaft for controlling said passage and being arranged to receive said lubricant from said reservoir.

3. Refrigerating apparatus comprising a compressor, a motor, a shaft connecting the motor to said compressor, said shaft having a passage, means associated with said compressor providing a reservoir for lubricant discharged from said compressor, and arranged above said passage in said shaft and in open communication with said passage and a valve responsive to the rotation of said shaft for controlling said passage and being arranged to receive said lubricant from said reservoir.

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