May 7, 1940. R. M. SMITH 2,199,762

REFRIGERATING APPARATUS

Filed Jan. 30, 1937 4 Sheets-Sheet 1

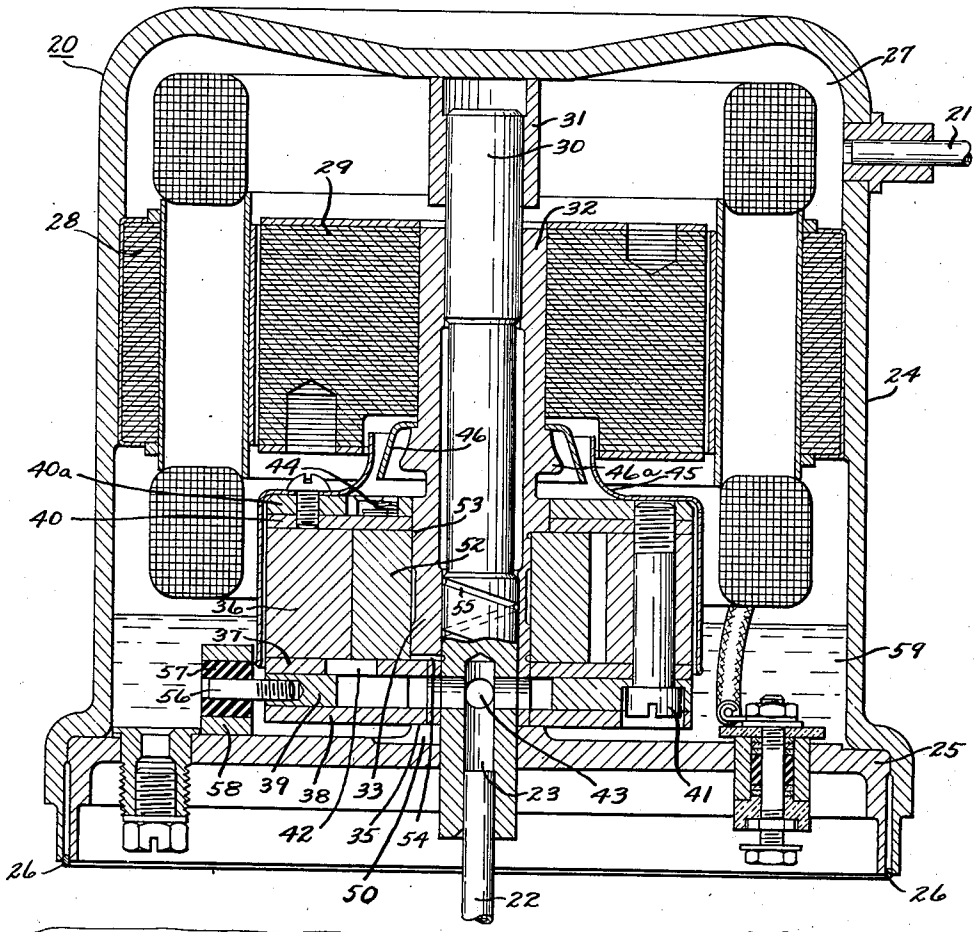

Fig. 1

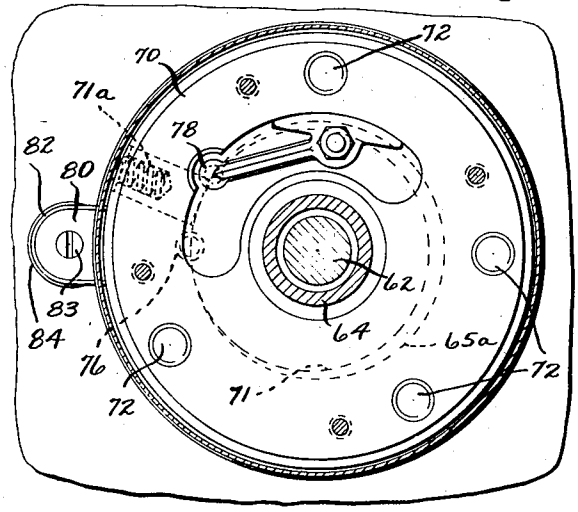

Fig. 8

INVENTOR.
Rolf M. Smith
BY Spencer, Hardman & Fehr
HIS ATTORNEYS.

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REFRIGERATING APPARATUS

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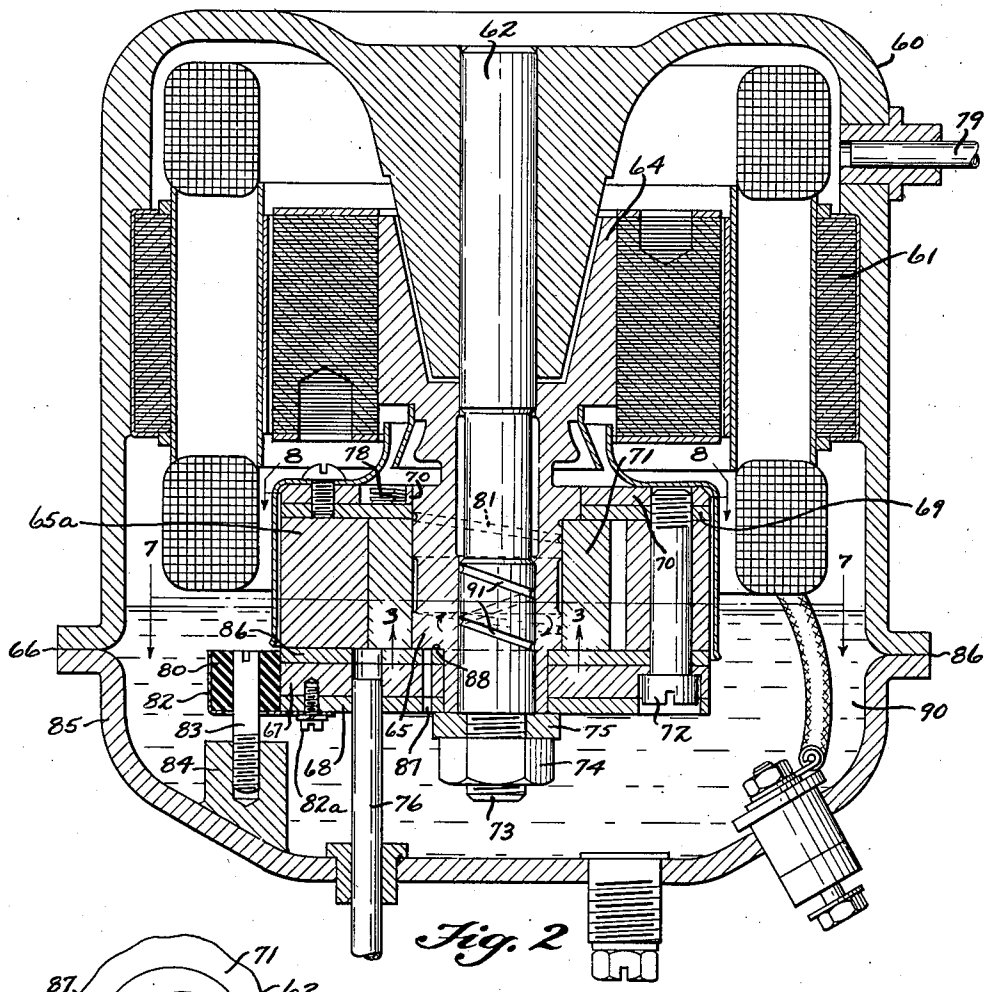

Fig. 2

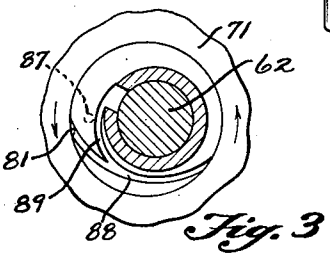

Fig. 3

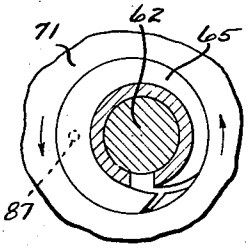

Fig. 5

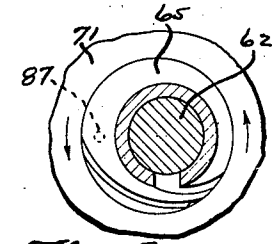

Fig. 6

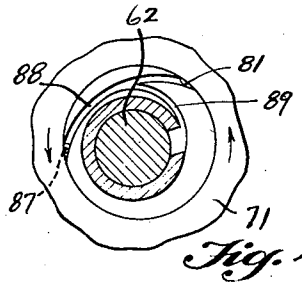

Fig. 4

INVENTOR.
Ralf M. Smith
BY
Spencer, Hardman & Fehr
HIS ATTORNEYS.

May 7, 1940. R. M. SMITH 2,199,762

REFRIGERATING APPARATUS

Filed Jan. 30, 1937 4 Sheets-Sheet 3

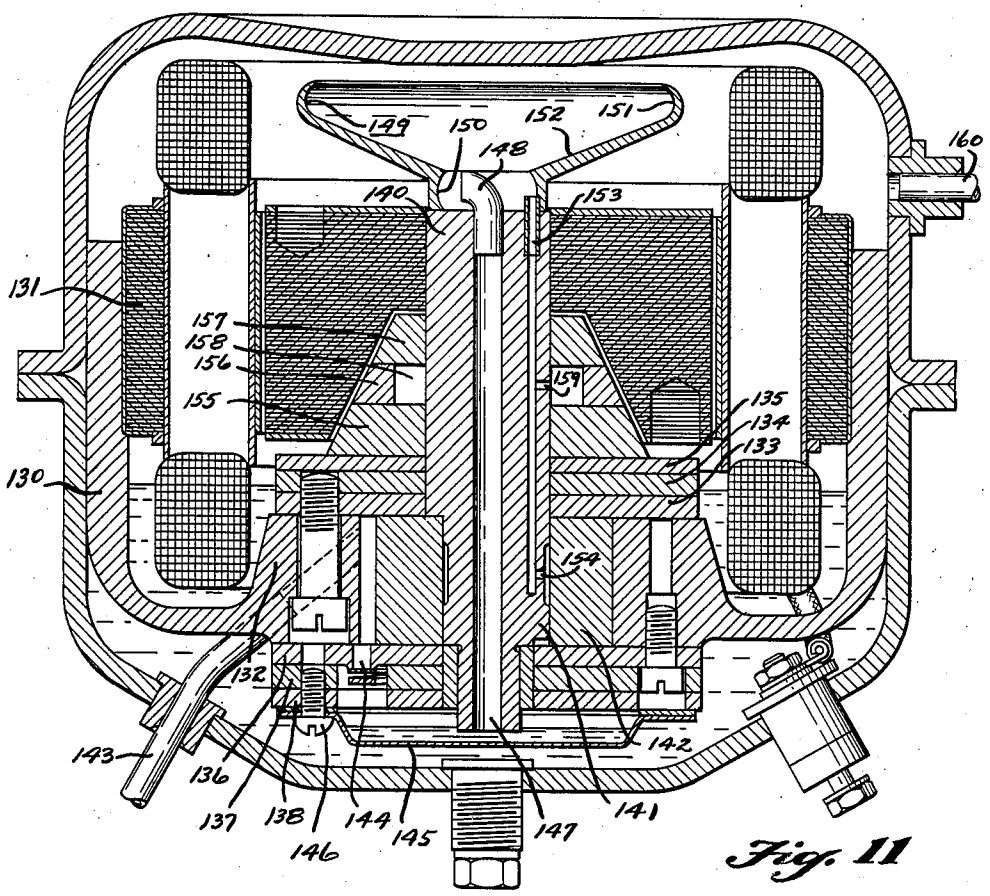

Fig. 11

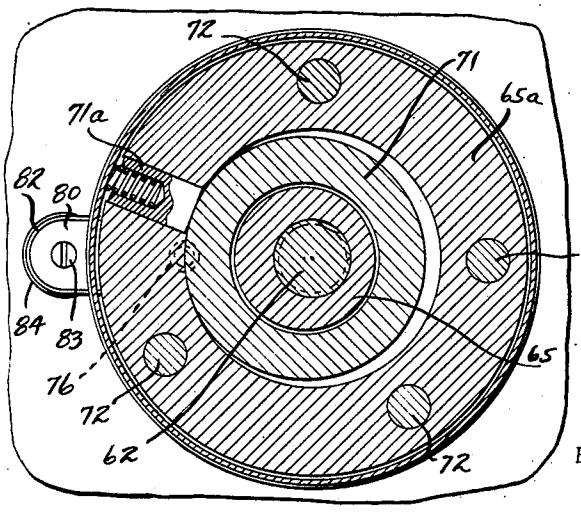

Fig. 7

INVENTOR.

Ralph M. Smith

BY Spencer Hardman & Fehr

HIS ATTORNEYS.

May 7, 1940. R. M. SMITH 2,199,762

REFRIGERATING APPARATUS

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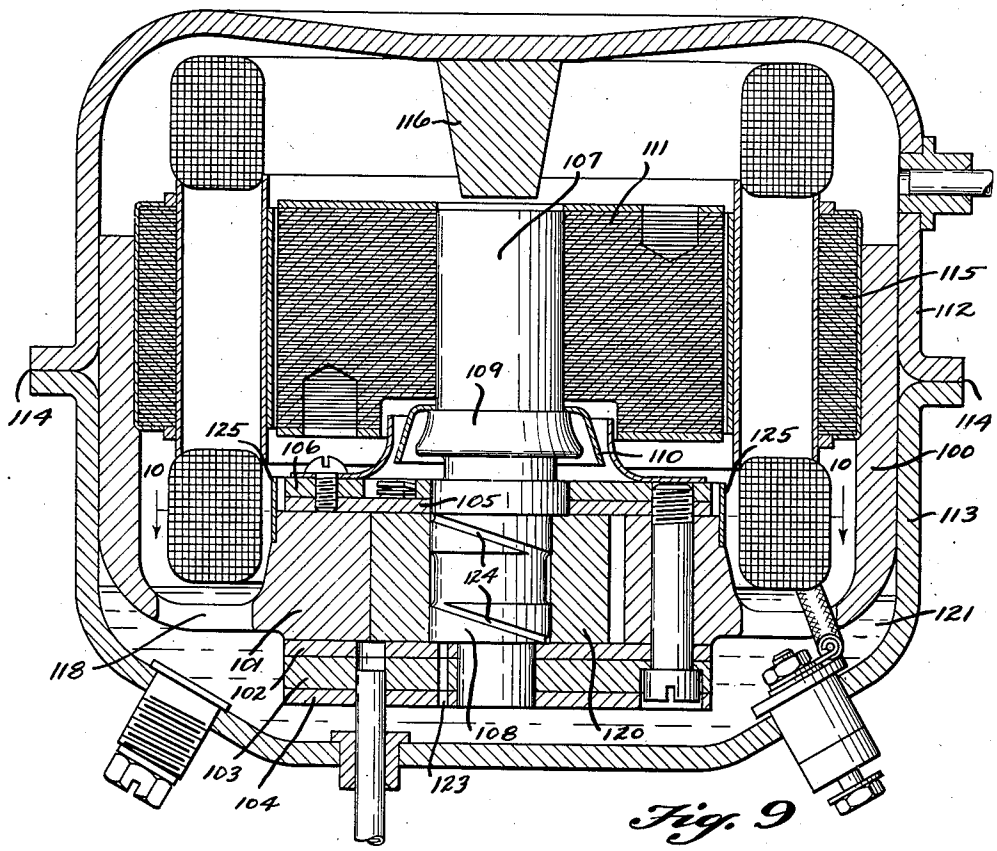

Fig. 9

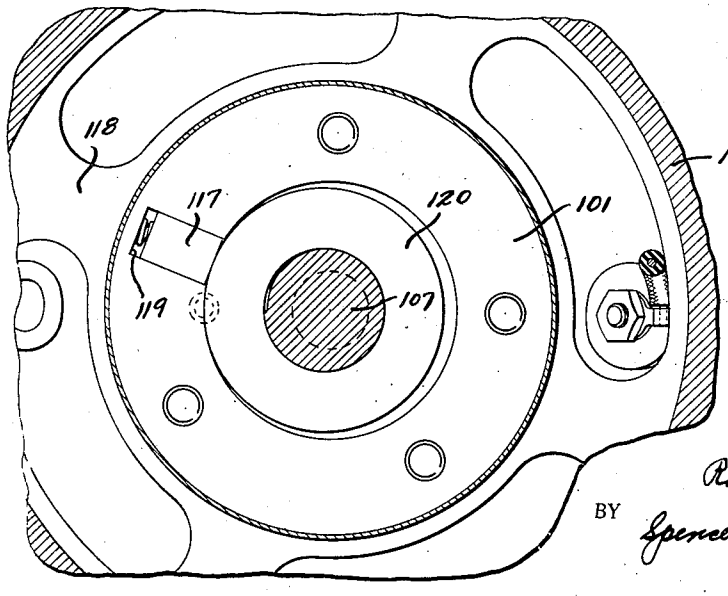

Fig. 10

INVENTOR.
Rolf M. Smith
BY
Spencer, Hardman & Fehr
HIS ATTORNEYS.

Patented May 7, 1940 2,199,762

UNITED STATES PATENT OFFICE

2,199,762

REFRIGERATING APPARATUS

Rolf M. Smith, Cincinnati, Ohio, assignor to General Motors Corporation, Dayton, Ohio, a corporation of Delaware

Application January 30, 1937, Serial No. 123,258

4 Claims. (Cl. 230—207)

This invention relates to refrigerating apparatus and more particularly to a novel motor-compressor unit of the hermetically sealed type for use in a refrigeration system.

It is an object of this invention to provide a motor-compressor unit in which there is no solid metal-to-metal contact between the supporting structure and the housing for the compressor.

Another object is to provide an improved arrangement for providing lubrication for the wearing surfaces.

Another object of this invention is to provide a simplified mounting for the rotating elements.

It is also an object to provide a mechanism of a character described which is simple, reliable in operation, durable, and at the same time inexpensive.

Still another object of this invention is to provide means for thoroughly separating the mixture of lubricant and refrigerant which is delivered from the outlet of the compressor.

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 vertical cross-sectional view of a motor-compressor unit constructed in accordance with this invention;

Fig. 2 is a vertical cross-sectional view of a modified form of motor-compressor unit embodying features of the present invention;

Fig. 3 is a fragmentary sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a view similar to Fig. 3 with the rotor in a different position;

Fig. 5 is a view similar to Fig. 3 but showing a modified construction;

Fig. 6 is a view similar to Fig. 3 but showing a still further modified arrangement;

Fig. 7 is a fragmentary cross-sectional view taken on line 7—7 of Fig. 2;

Fig. 8 is a fragmentary cross-sectional view taken on line 8—8 of Fig. 2;

Fig. 9 is a vertical cross-sectional view of a still further modified motor-compressor unit embodying features of this invention;

Fig. 10 is a fragmentary cross-sectional view taken on line 10—10 of Fig. 9; and

Fig. 11 is a vertical cross-sectional view of still another modification.

Referring now to Fig. 1, there is shown a motor-compressor unit 20 having an outlet 21 from which compressed refrigerant is adapted to be delivered to the usual condenser unit (not shown). Conduit 22 delivers expanded refrigerant to the inlet 23. The motor-compressor unit comprises a housing 24 having an open bottom which is closed by a base member 25 which in turn is welded to the housing 24 at 26 to form a hermetically sealed chamber 27. Within the chamber 27 in the upper portion thereof, there is mounted an electric motor comprising a stator 28 and a rotor 29. A stationary shaft 30 is located centrally of the housing 24 and mounted rigidly as by welding in the base 25. A socket member 31 secured to the top of the housing 24 positions the upper end of the shaft 30. A hollow compressor drive shaft 32 is journaled on the shaft 30, carrying at its upper portion the rotor 29 while at the lower end there is provided an eccentric journal 33. The vertical bearing load is carried on the thrust surface 35 formed on the base 25 of the casing. The bottom surface of the compressor bears against this thrust surface.

The compressor comprises the cylindrical casing member 36 which is provided with lower end plates 37, 38 and 39, an upper valve cover plate 40, and a retainer plate 40a. Bolts 41 hold members 36 through 40 in assembled relationship. The lower end of the shaft 30 is provided with a passage 43 through which low pressure refrigerant entering through the conduit 22 may pass on its way to the inlet port 42 of the compressor. The compressor is provided with the usual type of divider block (not shown) which separates the inlet port from the outlet port. The usual type of flap valve 44 is placed over the outlet port for the compressor. The compressed refrigerant, leaving the outlet port, is forced to pass between the cap member 45 and oil throwing means 46. The outside diameter of the means 46 is approximately equal to the inside diameter of the upper opening in cap 45 with the result that the lubricant and refrigerant leaving the compressor cannot escape very readily without being subjected to the centrifugal forces resulting from the rotation of member 46 which together with the flange 46a tends to throw the lubricant outwardly. The above action tends to separate the lubricant from the refrigerant. Further oil separation will take place as the compressed refrigerant passes between the motor rotor and the motor stator on its way to the outlet 21 for the compressed refrigerant. A sufficient supply of lubricant will be maintained on the upper end of the compressor so that oil will flow downwardly onto the eccentric portion 33 and will work its way onto the impeller 52. The usual type of feed screw ar-

rangement 53 causes oil to be forced downwardly through the passage 54 to the lower shaft bearing. From this point the feed screw 55 carries the oil upwardly between the rotating member 32 and the stationary shaft 30 in the usual manner. A supply of any kind of suitable lubricant 59 is provided in the lower end of the compressor. The thrust surface 35 is provided with an oil groove 50 which supplies lubricant to the surface 35.

It will be noted that with this arrangement the compressor housing, that is the member 36, and all parts secured thereto are floatingly mounted on the rotating part 32. In order to prevent rotation, however, a stud 56, which is threaded into the member 39, is anchored in a flexible bushing 57 carried by the member 58 which is rigidly secured to the bottom plate 25 of the motor-compressor housing. The bushing member 57 may be made of any rubber-like material unaffected by the refrigerant and lubricant, as for example, a polymer of chloro-2-butadiene-1,3.

In Fig. 2 I have shown a modified arrangement in which the bell member 60, which serves as a portion of the motor-compressor housing, carries the stator 61 of the motor as well as the supporting shaft 62 which in turn carries the working loads of the compressor. It will be noted that in this arrangement there is no rigid connection between the central shaft 62 and the motor-compressor housing except through that end of the shaft which is attached to the bell member 60. As shown in Fig. 2, the upper end of the shaft 62 is rigidly held by the bell member 60. The lower end of the shaft member 62 supports the rotating parts of a motor-compressor unit including the motor rotor 64 and the compressor eccentric 65.

The general arrangement of the compressor has not been changed. The compressor is provided with the usual cylindrical housing 65*a*, lower end plates 66, 67 and 68 and an upper valve plate 69 together with a retaining plate 70, all of which are held together by means of bolts 72 in the usual manner. Fig. 7 is a cross-sectional view showing the relationship of the various moving parts of the compressor. The lower end of the shaft 62 has a reduced portion 73 which is threaded. A nut member 74 cooperates with the threaded portion and holds in place the end thrust washer 75.

Expanded refrigerant is admitted to the compressor through the pipe 76 which delivers low pressure refrigerant to the compressor in the usual manner. Compressed refrigerant leaves through the usual outlet port which is provided with a flap valve 78. The compressed refrigerant leaving the compressor is caused to pass through the oil separator which is of the same general type as the oil separator shown in Fig. 1. The compressed refrigerant leaves the motor-compressor housing through the outlet 79.

A resilient bushing member 80 is secured to the stationary part of the compressor by means of a housing 82 which is anchored to the compressor by means of a bolt 82*a*. In order to prevent rotation of the compressor housing the threaded stud member 83 has been provided, which has its upper end passing through the resilient bushing 80 and its lower end threaded into a projection 84 which is rigidly secured to the lower cup-shaped member 85 which in turn is welded or otherwise secured to the bell member 60 at 86.

As shown in Fig. 2, a bath of lubricant 90 is provided in the lower portion of the motor-compressor housing. In order to avoid making the lubrication depend upon lubricant discharged from the compressor, I provide a groove 88 in the bottom face of the eccentric 65 which registers with the oil port 87 provided in plates 66, 67 and 68. This groove in the bottom face of the eccentric is of a peculiar shape and, as shown in Figs. 3 and 4 has one portion 88 extending substantially across the lobe of the eccentric to a spiral groove 81 on the outside of the eccentric. A branch spiral 89 extends from this first named groove on the bottom face of the eccentric to the inside of the hollow eccentric shaft. This provides for flow of lubricant directly from the lubricant collected in the bottom of the sealed unit to the bottom face of the eccentric where it is trapped and carried by the main groove 88 to the outside of the eccentric and through the branch groove 89 to the bearing surface on the inside of the eccentric. Sufficient pressure is created in these grooves to carry the lubricant without much difficulty to the bearing surfaces on the outside of the eccentric and also to the lower and upper bearing surfaces on the stationary shaft 62.

Fig. 5 shows a modified groove arrangement which may be used in lieu of the groove arrangement shown in Figs. 3 and 4.

Fig. 6 shows a still further modified groove arrangement which may be used to distribute oil to the various wearing surfaces.

The shaft 62 in each case is provided with a spiral groove 91 which serves to convey lubricant to the main bearing surfaces between the shaft 62 and the rotor 64.

In Fig. 8 I have shown a cross-sectional view taken on line 8—8 of Fig. 2. This view, in effect, is a top view of the compressor showing more clearly the relationship between the inlet port 76, the divider block 71*a* and the outlet valve 78.

In Fig. 9 I have shown a still further modification in which a main spider frame 100 is provided with a cylindrical hub 101 which serves, together with the bottom end plates 102, 103 and 104 and the upper valve plate 105 and retainer plate 106, to form a compression chamber. The various end plates 102 through 106 serve to support the main shaft 107, which is provided with an eccentric portion 108, oil-throwing portions 109 and 110, and which carries on its upper end the motor rotor 111. The two cup-shaped members 112 and 113, which are welded or otherwise held together at 114, hermetically inclose the motor and compressor as a unit. It will be noted that the motor stator 115 is carried directly by the member 100. The upper casing member 112 is provided with an end thrust bearing 116 which prevents the main shaft 107 from being displaced endwise too far.

As shown in Fig. 10, a divider block 117 has been placed directly adjacent one of the spider arms 118. With this arrangement the compressor cylinder, or in other words the hub of this spider has not been weakened to any appreciable extent by the groove 119 which accommodates the divider block 117. The usual form of impeller 120 has been provided.

A supply of oil 121 has been provided in the lower end of the motor-compressor casing. Oil for the bearing surfaces is fed up through the oil port 123 and is carried by the grooves 124 on the eccentric to the upper bearing surfaces of the shaft 107. This compressor also is provided with the same general type of oil separating means as shown in the previously described mod-

ifications and for that reason will not be described in detail. The upper end of the hub 101 carries an oil-retaining ring 125 which provides an oil seal between the members 101, 105 and 106. It is apparent that in this modification an unfailing supply of lubricant will be available at all times to lubricate the wearing parts and also to provide a lubricant seal for the compression chamber.

In Fig. 11 I have shown a still further modified arrangement embodying features of my invention. The main support is a spider member 130 which is of the same general shape as that shown in the modification shown in Fig. 9 except that it has been modified so as to provide a compressor having the discharge port on the underside of the compressor in lieu of the top side of the compressor as in the modification shown in Fig. 9. In this modification the motor stator 131 is carried by the spider 130 and the hub portion 132 of the spider has secured thereto the upper end plates 133, 134 and 135 and the lower end plates 136, 137 and 138. Members 132 through 138 form a compression chamber.

The main drive shaft 140 is provided with an eccentric portion 141 which drives the impeller 142 in the usual and well-known manner. Low pressure refrigerant is fed to the compressor through the conduit 143 and is discharged from the compressor through the outlet port 144.

Inasmuch as the refrigerant circulating through the system carries with it a certain amount of oil, the lubricant and refrigerant which is discharged through the port 144 is confined by means of the oil pan 145 which is secured to the lower end of the compressor by means of the bolts 146. The shaft 140 is provided with a central bore 147 through which the compressed refrigerant is forced to travel on its way to the outlet 160. The refrigerant passing through the bore 147 carries with it a certain amount of lubricant. This lubricant together with the refrigerant is discharged through the elbow member 148 which is fitted within the upper end of the bore 147. Attached to the upper end of the shaft 140 is an oil separating and retaining member 149 which receives the oil and refrigerant discharged through the elbow 148. It will be noted that the member 149 is provided with a first pocket 150 and a second pocket 151. Due to the centrifugal force a certain amount of the oil will separate out from the refrigerant, a portion of which oil will collect in the pocket 150 and the remainder of which will travel along the frustro-conical surface 152 until it reaches the pocket 151. When the pockets 150 and 151 have become filled excess oil will be thrown out at the upper end of the member 149.

In order to provide lubrication for the bearing surfaces I have provided an oil passage 153 in the shaft 140 which is supplied with oil from the pocket 150. This passage leads downwardly and communicates with the radial passage 154 which supplies lubricant to the pocket between the eccentric 141 and the impeller 142 of the compressor. In order to increase the bearing surface for the shaft 140 I have provided a plurality of plate members 155, 156 and 157 which are constructed so as to provide an oil pocket 158. This oil pocket 158 is kept supplied with oil by means of a radial passage 159 which communicates with the main oil passage 153. With this arrangement a certain amount of oil will separate out of the refrigerant immediately as the compressed refrigerant reaches the discharge port 144. Additional oil will separate out of the refrigerant as the mixture of refrigerant and oil passes through the central bore 147 in the shaft 140. Still further separation takes place after the oil leaves the elbow 148 with the result that the oil becomes sufficiently separated from the refrigerant before the refrigerant is discharged through the outlet 160. The surplus oil collects in the bottom of the motor-compressor casing as shown in Fig. 11. It is apparent that with this arrangement an unfailing supply of lubricant is provided at all times for lubricating the wearing surfaces and for providing a lubricant seal for the compression chamber.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A unit adapted to circulate a refrigerant comprising a halogen derivative of hydrocarbon and a lubricant at least one of which has a deteriorating effect on rubber, said unit having a cylinder and a piston movably mounted within said cylinder, means for moving said piston within said cylinder, a stationary shaft upon which said means is mounted, means for mounting said shaft within said unit, and a yieldable means for preventing relative rotation between said cylinder and said shaft, said yieldable means comprising a portion formed of a polymer of chloro-2-butadiene-1,3.

2. A sealed unit adapted to circulate a refrigerant and a lubricant at least one of which has a deteriorating effect on rubber, said unit having a cylinder therein and a piston movably mounted within the cylinder, a motor within said sealed unit, means drivingly connected with said motor and said piston for moving said piston within the cylinder, a vertically disposed stationary shaft upon which said means is mounted, resilient means for preventing relative rotation between said cylinder and said shaft, said resilient means comprising a portion formed of rubber-like material unaffected by the refrigerant and lubricant.

3. In a motor-compressor unit, a hermetically sealed housing partially filled with a lubricant, compressor mechanism partially submerged by said lubricant, said compressor mechanism comprising a casing, a stationary central shaft, an eccentric member rotatably mounted on said shaft, said casing having an aperture for admitting lubricant to an end surface of said eccentric member, said end surface having a substantially V-shaped groove one arm of which leads to the outside surface of said eccentric and another arm of which leads to the inside surface of said eccentric.

4. In a rotary compressor, a compressor housing, an impeller within said housing, a drive shaft having an eccentric portion within said housing in driving engagement with said impeller, said housing having a lubricant passage leading to one end surface of said eccentric, said end surface being provided with a bifurcated groove having one branch leading towards the center of rotation and another branch leading to the outside surface of said eccentric.

ROLF M. SMITH.