Oct. 3, 1939. R. M. SMITH 2,174,536

MOTOR-COMPRESSOR UNIT FOR REFRIGERATING APPARATUS

Original Filed Aug. 30, 1934 2 Sheets-Sheet 1

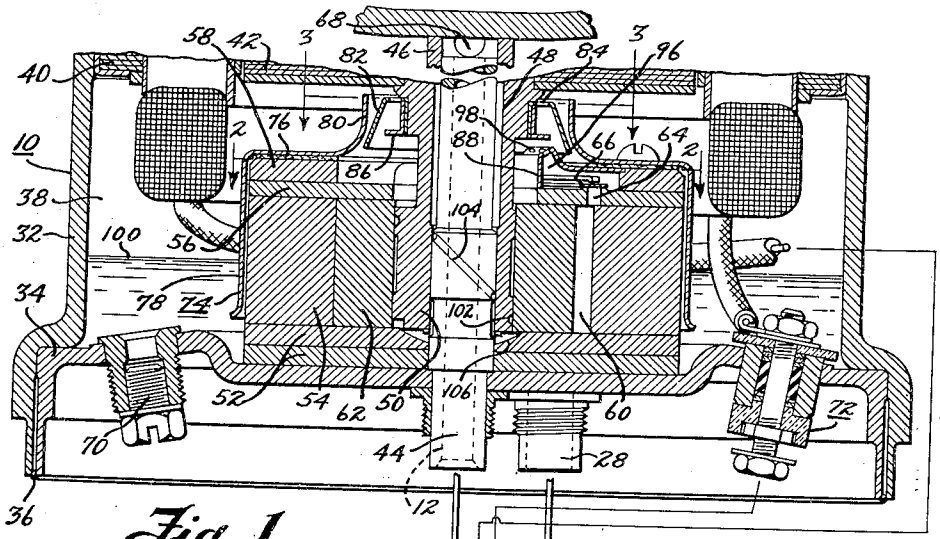
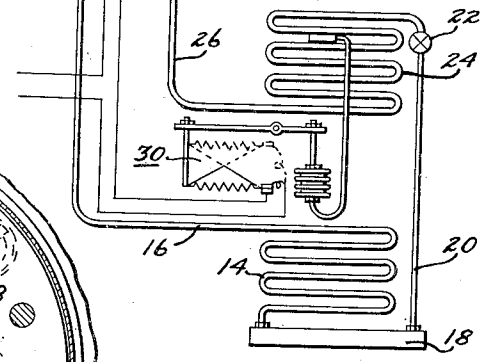


Fig. 1



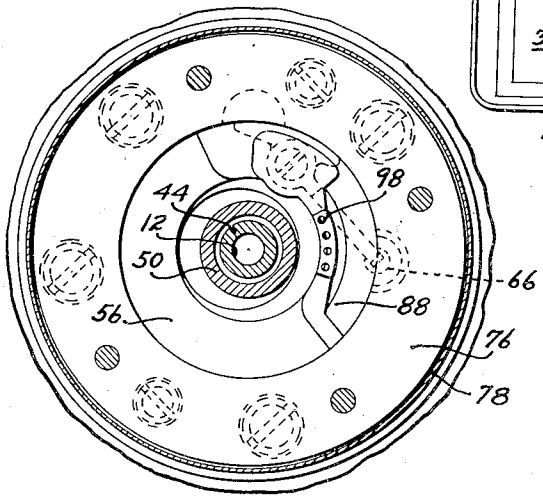


Fig. 2

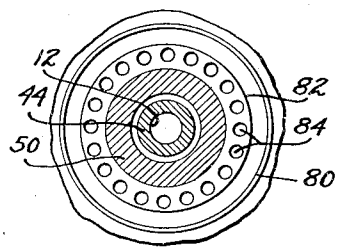


Fig. 3

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MOTOR-COMPRESSOR UNIT FOR REFRIGERATING APPARATUS

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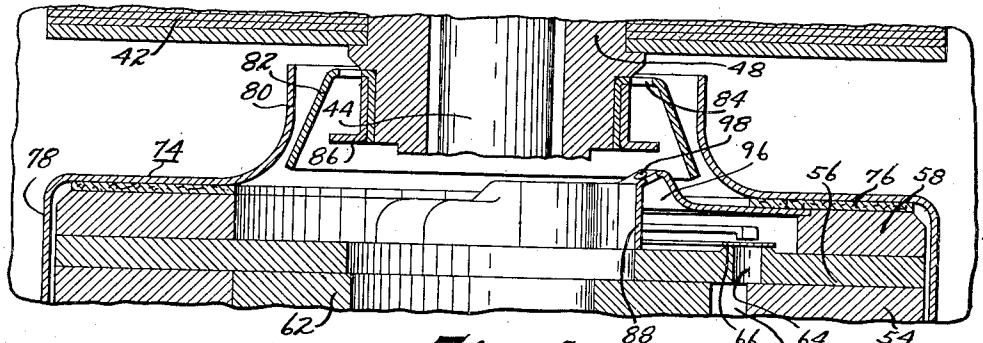

Fig. 4

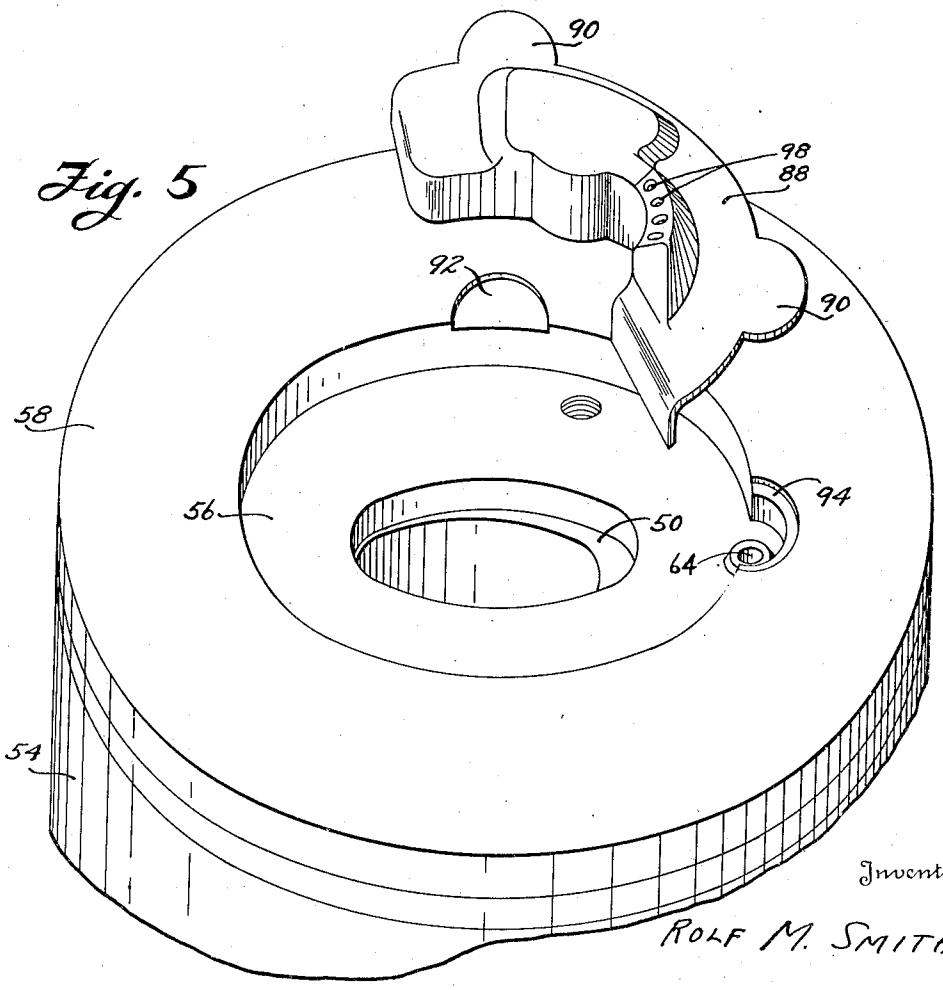

Fig. 5

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MOTOR-COMPRESSOR UNIT FOR REFRIGERATING APPARATUS

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Application August 30, 1934, Serial No. 742,122
Renewed February 10, 1937

5 Claims. (Cl. 230—232)

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

It is common practice in the refrigerating art to provide a motor-compressor unit which is completely enclosed in a hermetically sealed casing within which refrigerant and lubricant for the compressor are circulated, one of the principal advantages of this class of construction being that the use of a stuffing box or other shaft seal is avoided. In motor-compressor units of this type, however, certain problems are incurred in connection with the maintenance of proper lubrication for the compressor which are peculiar to this type of unit since the hermetically sealed casing makes the compressor mechanism inaccessible for service and necessitates great care in insuring that all parts of the mechanism will operate properly for the life of the machine. In refrigerators intended for household use, present-day standards also require that noise of operation of the motor-compressor unit be reduced to a value which is substantially imperceptible and it has been found that particularly with units employing a rotary-compressor, the maintenance of an unfailing supply of substantially undiluted lubricant for feed to the compressor is a major factor in insuring quiet operation.

It is an object of the present invention, therefore, to provide a motor compressor unit preferably of the hermetically sealed type in which provision is made for insuring the maintenance of an unfailing supply of lubricant for the moving parts of the compressor.

It is a further object to provide a novel separator in a unit of the present type for thoroughly separating the mixture of lubricant and refrigerant which is delivered from the outlet of the compressor.

Another object is to provide a compressor of this character which will be quiet in operation throughout its useful life.

It is also an object to provide a mechanism of the character described which is simple, reliable in operation and which is not only inexpensive in construction, but which also involves the addition of no wearing parts.

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 embodiment of the invention is clearly shown.

In the drawings—

Fig. 1 is a vertical cross section of a portion of a motor-compressor unit embodying the present invention, and shows diagrammatically the elements of a complete refrigerating system;

Fig. 2 is a fragmentary cross section on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary cross section on line 3—3 of Fig. 1;

Fig. 4 is a view corresponding to Fig. 1 showing a portion of the mechanism on a larger scale, and

Fig. 5 is a perspective view showing parts of the mechanism in disassembled relation.

Referring now to Fig. 1, there is shown a motor-compressor unit **10** having an outlet **12** from which compressed refrigerant is adapted to be delivered to a condenser **14** by a conduit **16**. The condenser **14** feeds liquefied refrigerant to a receiver **18**, whence it is delivered by conduit **20** to an expansion valve **22** for expanding refrigerant into an expansion coil **24**. A conduit **26** delivers expanded refrigerant to the inlet **28** of the compressor **10**. A thermostatic switch **30** controls the motor-compressor unit **10** in accordance with the temperature of the expansion coil **24**. The parts thus far described constitute the conventional elements of a refrigerating system and are well known in the art.

The motor-compressor unit **10** comprises a housing **32** having an open bottom which is closed by a base member **34** which in turn is welded to the housing **32** at **36**, to provide a hermetically sealed chamber **38**. Within the chamber **38** in the upper portion thereof, there is mounted an electric motor comprising a stator **40** and a rotor **42**. A hollow stationary shaft **44** is located centrally of the housing **32** and mounted rigidly, as by welding, in the base **34**. A socket member **46** secured to the top of the housing **32** positions the upper end of the shaft **44**. A hollow compressor drive shaft **48** is journaled on the shaft **44** carrying at its upper portion the rotor **42**, while at the lower end, there is provided an eccentric journal **50**. Secured to the base **34** is a compressor body member which may comprise a pair of bottom plates **52**, a cylinder member **54**, a valve cover plate **56** and a retainer plate **58**. The parts **52** through **58** inclusive are rigidly secured together and to the base **34** and provide a cylindrical compression chamber **60** which is concentric to the axis of the shaft **44**. The cylinder member **54** is provided with a radial slot, not shown, for receiving a divider block in the well known manner. Mounted within the compression chamber **60** is a cylindrical impeller **62** which is journaled on the eccentric journal **50**

and is adapted to revolve in the compression chamber 60 without rotating. The customary divider block, not shown, is provided for dividing the chamber 60 into a compression space and a suction space. The inlet connection 28 communicates with the suction space immediately adjacent one side of the divider block, while the discharge orifice 64 communicates with the compression space immediately adjacent the other side of the divider block as is well known in the art. The discharge orifice 64 is provided with a flapper valve 66 to prevent the return of high pressure gas from the chamber 38 to the chamber 60. Communication between the chamber 38 and the outlet connection 12 is provided through the hollow shaft 44 and through one or more apertures 68 provided in the socket 46. A removable plug member 70 is provided in the base for charging the unit with liquid refrigerant and lubricant. Connections to the motor are brought through the base 34 by the sealed lead-in connections 72.

In order to provide for a constant supply of lubricant to the running surfaces of the compressor, the following mechanism is provided. A cover or can member 74 is attached to the compressor body member and sealed thereto at the top by a gasket 76. The can 74 has a downwardly depending skirt 78 which embraces the compressor body member. At its top, the can member 74 is provided with an upwardly directed neck portion 80 having at its base a widening curved portion of rather large radius. Secured to the drive shaft 48 is a member 82 having a conical portion which extends downwardly within the neck 80 and has a base diameter substantially equal to the interior diameter of the neck 80. The bottom portion of the member 82 is positioned, however, to lie opposite the widening curved portion of the neck 80, so that when assembled, a substantial clearance is provided between the members 80 and 82. A plurality of gas outlets 84 are provided in the upper portion of the member 82. Within the member 82, there is provided a flinger member 86 made in the form of a flanged ring. The parts 82 and 86 are preferably pressed onto the shaft 48.

Secured to the valve plate 56 and the retainer plate 58 is a member 88 of peculiar shape and which may be best described as simulating a denture or set of false teeth. The member 88 is retained in position by a pair of lugs 90 which are adapted to be received in recesses 92 and 94 formed on the retainer plate 58, and are clamped therein by the gasket 76 and the can member 74. The member 88 is formed with sufficient accuracy to generally fit the plates 56 and 58 without being sealed thereto in an absolutely fluid tight manner, particularly along the top face of plate 56. The member 88 forms with the plates 56 and 58 a chamber 96 enclosing the exhaust valve 66 and the proportions of the parts are such that the volume of the chamber 96 bears a predetermined relation to the volume of the compression space of the compressor at the instant the exhaust valve 66 opens. This relation will vary with different designs of compressors but merely by way of example it may be stated that in one particular design it has been found that a volume for the chamber 96 of approximately 10 times the volume of the compression space at the instant the exhaust valve opens is satisfactory. The member 88 is provided with one or more discharge orifices 98. These orifices are disposed in a position laterally spaced from the exhaust valve 66 and are so formed as to operate as jets giving a pronounced directional effect to the fluid discharged therefrom. The size of the orifices 98 is such that sufficient restriction is provided to maintain a slight preponderance of pressure in the chamber 96 over that in the chamber 38.

The members 74, 82, 86 and 88 may conveniently be formed of stamped sheet metal, since their functions do not require greater accuracy of dimension than is readily obtainable in stamping operations. After assembly of the unit, a charge of oil or other lubricant is placed in the chamber 38 through the plug 70 sufficient to maintain a level in the chamber 38 such as indicated by the line 100. Lubricant feed screws are provided for insuring lubrication of the bearings associated with the shaft 48 and may comprise a downwardly directed helical groove 102 on the eccentric journal 50 and an upwardly directed helical groove 104 on the lower journal of the shaft 44. A slot 106 is formed at the central portion of the uppermost plate 52 to provide a lubricant passage from the eccentric journal 50 to the inner lower shaft bearing.

In operation, whenever current is fed to the motor, by the closing of the switch 30, the shaft 48 is caused to rotate which in turn causes the impeller 62 to revolve within the compression space 60, drawing in gaseous refrigerant through the inlet connection 28 and discharging it through the exhaust orifice 64, all as is well known in compressors of the type described. The body of lubricant in the lower portion of the chamber 38 is drawn under the lower edge of the skirt 78 of the can 74 and up between cylinder 54 and skirt 78 by leakage between cylinder 54 and plate 56 from the suction side of the compression chamber and is fed to the compression chamber 60 at a very slow rate by seepage through the running joint at the divider block. This constitutes the only direct feed of lubricant to the compression chamber 60 from the main body of lubricant in the chamber 38. Fluid discharged through the orifice 64 is, therefore, a mixture of compressed gaseous refrigerant and lubricant, the lubricant carrying a considerable amount of refrigerant in solution. It will be noted that the orifice 64 is located within the recess 94 and the orifices 98 are considerably spaced from the orifice 64. This results in considerable turbulence being produced within the chamber 96 which causes some separation of the lubricant from the compressed refrigerant gas. Since the orifices 98 maintain a slight preponderance of pressure in the chamber 96, it will be seen that any lubricant which collects at the bottom of the chamber 96 will be forced out through the joint between the member 88 and the valve plate 56 which as described heretofore is not a perfect seal. It will be understood that if desired this joint may be made tight and other means provided for the egress of lubricant such as an opening at the level of the top surface of plate 56.

Inasmuch as the seat of the valve 66 is somewhat raised from the surface of the plate 46 as shown in Fig. 5, it is impossible while the compressor is running for lubricant to accumulate in the chamber 96 sufficiently to envelop the flapper valve 66. It has been found that the flapper valve 66 operates without noise only when it is maintained comparatively dry and it will thus be seen that the pressure difference created by the orifices 98 within the chamber 96 results

in keeping lubricant away from the valve 66 and thus insuring its quiet operation.

The chamber 96 also acts as a surge chamber in smoothing out the pulsations normally produced by the compressor. With the volume of the chamber 96 proportioned in predetermined relation to the volume of the compression space at the instant valve 66 opens so that the pulsations are substantially completely smoothed out there results a substantially continuous flow of compressed gas through the orifices 98.

While some lubricant separation takes place in the chamber 96, due to the turbulence created therein, this separation is not complete and in order to further separate the refrigerant and lubricant, the mixture is discharged from the orifices 98 in jets which are directed upwardly and inwardly onto the flinger member 86. The pressure difference between the chamber 96 and the chamber 38 gives a substantial velocity to the mixture issuing from the jets 98 so that some separation takes place by the inertia action which occurs at the flinger 86. It will be seen that the direction of the orifices 98 is such that the gas is deflected by the flinger 86 first inwardly toward the shaft 48 and then downwardly in a rather sharply curved path. The comparatively great inertia of the entrained lubricant makes it impossible for the lubricant to change its direction of flow so suddenly and it therefore, impinges on the bottom surface of the flinger 86. The oil which is thus collected on the flinger 86 is continuously removed therefrom by the centrifugal action which tends to throw the oil outwardly onto the inner surface of the cone 82.

Centrifugal force also causes the lubricant to travel downwardly on the cone 82 and around the bottom edge thereof to form a running film of lubricant between the cone 82 and the curved portion of the neck 80. It will be seen that the film thus formed will completely bridge the space between the members 80 and 82 to form a seal which is impervious to the passage of gas, since the pressures above and below this seal are equal. Thus, there is provided by means of the can member 74 and the cone-shaped member 82 together with the oil film formed therebetween, a shroud which encloses the upper portion of the compressor and from which the only outlet is through the ports 84. The gas which is deflected inwardly and downwardly at the flinger member 86 returns upwardly to pass between the cone member 82 and the flinger 86 and out through the ports 84 substantially free of lubricant. Due to this separating action and due to the fact that gas is taken from the center of the chamber 38 through ports 68, the gas discharged through the outlet 12 is practically entirely free from entrained lubricant and the difficulties encountered when lubricant gets into the evaporator are therefore avoided. Inasmuch as the film between the members 80 and 82 is constantly being replenished from the flinger 86 and since the greatest diameter of the neck 80 and the cone 82 is at the bottom thereof, centrifugal action tends to feed lubricant downwardly along the bottom of the curved portion of the neck 80 and into storage on the plate 56. Since the lubricant is in direct contact with the compressor at this point, it is brought to a high temperature by the heat of compression and substantialy all of the refrigerant dissolved therein is driven out by this heat.

Thus, it will be seen that a substantial body of practically undiluted oil is maintained above the valve plate 56 from which it flows downwardly onto the eccentric 50 and impeller 62. Thus, substantially undiluted oil is fed to the eccentric bearing and by the feed screw 102 is forced downwardly through the passage 106 to the lower shaft bearing. From this point, the feed screw 104 feeds lubricant upwardly to the upper shaft bearing, not shown. The substantially undiluted oil is also fed to the surfaces between the impeller 62 and the plates 56 and 52 respectively, providing lubrication and acting as a sealing fluid therefor. It has been found that considerable noise in compressors of the present type has heretofore been caused by lack of maintenance of a sufficient supply of lubricant for these surfaces, particularly at starting, which lets the lubricant film break down and permits a slight oscillating action of the impeller 62 about a horizontal axis. The resultant noise is therefore avoided by the present invention.

When switch 30 is opened and the compressor stops, the lubricant which is being constantly collected on all the walls of the chamber 96 gradually drains to the bottom of the chamber and since there is no preponderance of pressure to force the lubricant out, it collects sufficiently to surround the valve 66 and insure a gas tight seal which prevents leakage from the chamber 38 back to the compression chamber of the compressor during the idle period.

Thus, the present invention provides for continued satisfactory operation of a hermetically sealed motor-compressor unit throughout substantially its useful life and insures quiet operation thereof by maintaining a supply of concentrated substantially undiluted lubricant for feeding to all the working surfaces of the compressor.

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

What is claimed is as follows:

1. In a motor-compressor unit, the combination of a hermetically sealed housing, a compressor in the housing and having a discharge outlet at the upper side thereof, a flapper valve at said discharge outlet, and means defining a discharge chamber enclosing said valve and having a restricted outlet to the interior of the housing, said last named means being so shaped that the size of said restricted outlet relative to the size of the discharge outlet is such that a sufficient preponderance of pressure is maintained in said chamber to prevent the accumulation of lubricant therein in sufficient quantity to cause noise at the flapper valve, said flapper valve having a seat slightly raised from the surrounding portion of the top surface of the compressor whereby only during idle periods lubricant drains from the walls of the chamber sufficiently to seal said valve.

2. In a motor-compressor unit, the combination of a hermetically sealed housing, a compressor in the housing, means forming an upwardly directed gas and lubricant discharge orifice, a rotary member projecting upwardly from said compressor, means forming a shroud for isolating said discharge orifice from the interior space of said housing and having a gas outlet, said means including a first portion attached to the stationary part of the compressor and a second portion attached to said rotary member, sealing means for maintaining a running seal of lubricant between said portions and a centrifugal lubricant slinger on said rotary member and intercepting

the direct passage of mixed gas and lubricant from said discharge orifice to said outlet.

3. In a motor-compressor unit, the combination of a hermetically sealed housing, a compressor in the housing, means forming an upwardly directed gas and lubricant discharge orifice, a rotary member projecting upwardly from said compressor, means forming a shroud for isolating said discharge orifice from the interior space of said housing and having a gas outlet, said means including a first portion attached to the stationary part of the compressor and a second portion attached to said rotary member, sealing means for maintaining a running seal of lubricant between said portions and a centrifugal lubricant slinger on said rotary member and intercepting the direct passage of mixed gas and lubricant from said discharge orifice to said outlet, said sealing means receiving lubricant from said slinger for replenishing the lubricant at the running seal.

4. In a motor-compressor unit, the combination of a hermetically sealed housing, a compressor in the housing, means forming an upwardly directed gas and lubricant discharge orifice, a rotary member projecting upwardly from said compressor, means forming a shroud for isolating said discharge orifice from the interior space of said housing and having a gas outlet, said means including a first portion attached to the stationary part of the compressor and a second portion attached to said rotary member, sealing means for maintaining a running seal of lubricant between said portions and a centrifugal lubricant slinger on said rotary member and intercepting the direct passage of mixed gas and lubricant from said discharge orifice to said outlet, said sealing means including an upstanding cylindrical part on said first portion open at the top and widening at the bottom, and a downwardly extending generally conical part on the second portion open at the bottom and wider at the bottom than at the top, the bottom of the second part being of substantially the greatest diameter capable of assembly through said first part but lying when assembled adjacent the widening portion thereof to avoid direct contact therewith.

5. In a motor-compressor unit, the combination of a hermetically sealed housing, a compressor in said housing, means forming an upwardly directed gas and lubricant discharge orifice, a rotary member projecting upwardly from said compressor, a centrifugal lubricant flinger on said rotary member having a plurality of radially disposed flinger members against which gas and lubricant is discharged, and means for directing a portion of the discharged fluid through the fluid leaving said flinger whereby the lubricant is separated from the refrigerant.

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