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ENCLOSED MOTOR COMPRESSOR UNIT

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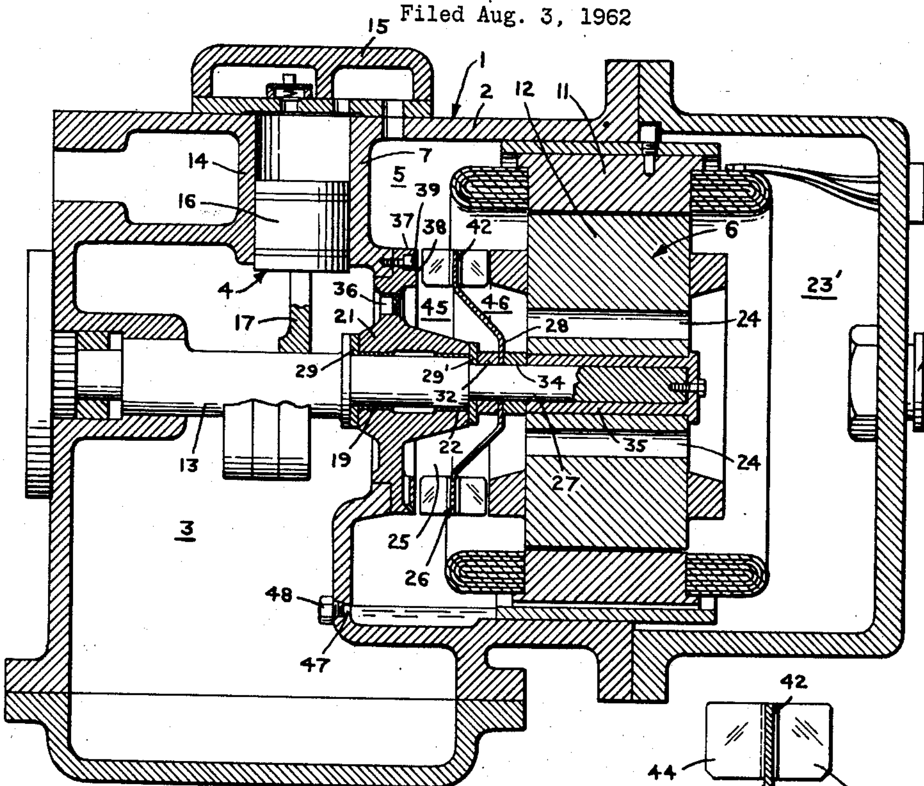

FIG. 1

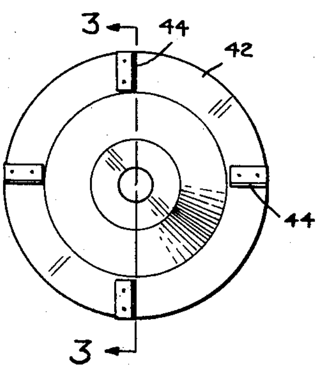

FIG. 2

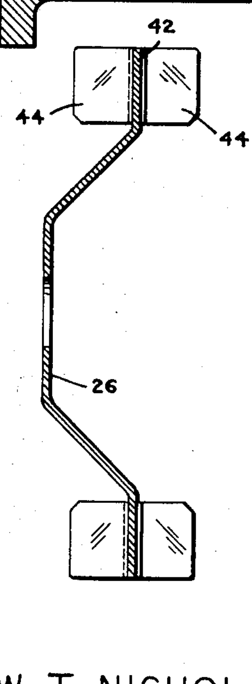

FIG. 3

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ENCLOSED MOTOR COMPRESSOR UNIT

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This invention is related to a hermetically enclosed motor-compressor unit. It relates in particular to such a unit which maintains a sufficient lubricant supply for the components of the compressor and which utilizes return refrigerant vapors for motor cooling.

The application of enclosed motor-compressor units as a fluid circulating element in refrigeration systems embodies distinct advantages over known prior art units. However, inherent defects in the construction of hermetic compressors has created serious operational difficulties and particularly in hermetic units of the horizontal type where high and low pressure compartments are communicated to assure proper lubrication and motor cooling.

These disadvantages are varying in nature; by way of example, there normally results a lubricant shortage in the compressor compartment caused by passage of lubricant carrying gas into the driving portion of the unit. This condition is further aggravated due to dilution of lubricant by refrigerant collected in the crank case on shutdown.

More specifically, for a period of time after shutdown of the machine, refrigerant is absorbed by lubricant in the compression compartment. Subsequently, upon start up, gaseous refrigerant flows from the compressor carrying with it a certain amount of lubricant leaving an insufficient amount of the latter for proper lubrication of the compressor.

Furthermore, lubricant leaving the unit with refrigerant gas tends to collect in the driving compartment. Return of this accumulated lubricant is found to be substantially arrested by the above mentioned higher pressure existing in the compression part of the machine.

The prior art teaches means adapting hermetic compressors for return of lubricant collected in the driving compartment. From a practical standpoint however, these devices embody components which are often complex and detract from the simplicity of the hermetic compressor. Further, these added components appreciably increase the overall cost of the manufacture of the unit.

The present invention meets the problem of reducing the arresting influence exerted by high pressure gas in the compression compartment on the lubricant collected in the adjacent motor compartment. This is accomplished in a manner so as not to interfere with the cooling effect that circulated fluid has on the motor.

Specifically, there is provided in the present embodiment a means by which the high pressure compression compartment and the low pressure suction compartment of the unit are communicated through a pair of intermediate pressure sections. These intermediate sections are arranged in such a manner as to promote cooling by refrigerant vapors which pass thereover.

The dual function of the arrangement is achieved by providing a motor-compressor arrangement in which a pair of low pressure sections function within the motor suction compartment only during operation of the unit. These sections receive separate flows of fluid from the high pressure compartment and the motor inlet compartment respectively, and combine the flows in the suction compartment prior to discharge of the fluid into the compressor.

It is therefore a primary object of the invention to provide a motor-compressor combination of the type described having improved cooling and lubricant transfer characteristics.

It is a further object to minimize the effect of lubricant collected in the driving portion of the unit by providing efficient means for balancing the pressure differential normally existing between the compression compartment and the driving chamber to facilitate removal of said lubricant.

It is a still further object to provide a motor-compressor unit having a suction chamber positioned to receive dual flows of fluid from the high pressure and low pressure portions of the unit for discharging said flows into a compressor.

Other objects of the invention not specifically mentioned will become clear to one skilled in the art from the following description made in conjunction with the drawings in which:

FIGURE 1 is a longitudinal view partially in cross-section of the enclosed motor-compressor embodying the present invention.

FIGURE 2 is a vertical elevation of an impeller as presently employed, and

FIGURE 3 is an enlarged cross-sectional view taken along line 3—3 of FIGURE 2.

In brief, the present invention contemplates a motor driven compressor of the hermetic type for use in a system circulating a vaporizable fluid and including a casing having opposed end chambers which function as suction and intake chambers respectively. The casing is so disposed as to enclose the compressor as well as the motor including stator and rotor elements. The rotor includes means forming longitudinal passages communicating the respective opposed end chambers. An apertured partition forming a wall of a first or suction chamber divides the casing into the driving and compression compartments respectively. This partition also forms a bearing housing for receiving a power transmission shaft connecting the motor and the compressor.

An impeller mounted for rotation with the shaft is positioned in the suction chamber adjacent the partition and the motor end thus defining a pair of intermediate annular receiving sections. Vanes fastened to the periphery of the impeller induce a low pressure in the intermediate annular sections to foster refrigerant flow to said sections from the compression compartment and the intake chamber. Flows of refrigerant leaving the intermediate sections then enter the suction chamber and are directed to the compressor. Liquid lubricant collected in the first end chamber flows into the compression compartment by way of passage means formed in the partition lower portion and provided with a check valve.

Referring more particularly to the drawings, FIGURE 1, illustrates an enclosed motor-compressor unit generally designated **1** which embodies the present invention. The motor and compressor are enclosed by a casing **2** divided into a compression compartment generally designated **3** including the compression means **4**, and a driving compartment generally designated **5** having the suction chamber and including a driving means **6** made up of a stator **11** and a rotor **12**. This division is effected by a partition means **7** which maintains the respective compartments substantially sealed one from the other. Means taking the form of a crank shaft **13** is provided for interconnecting the compression means **4** to the driving means **6**. The compression means receives power from the driving means as is customary, to circulate the working fluid of the refrigeration system with which the present unit is associated.

Referring to FIGURE 1, a cylinder **14** is formed in the compression unit **3** as to be integral with the casing **2**. The usual cylinder head **15** is secured to the casing **2**. Any suitable arrangement of intake and exhaust valves for the working fluid may be employed. In order to compress the working fluid there is provided a piston **16** adapted to reciprocate within cylinder **14**. The driving mechanism for piston **16** comprises a connecting rod **17** driven from crankshaft **13** which turns in bearings **19** and **22**, spaced apart and carried in bearing housing **21**.

In normal operation of the motor-compressor unit, working fluid from the low side of the refrigeration cycle is received through an inlet **23** provided in the intake chamber **23'**. This fluid is then passed in heat exchange relationship through longitudinal passages **24** formed in a rotor **12** to one of the intermediate sections to be herein further defined, and thence to the suction chamber.

Normally, passage of refrigerant through the motor will cause a pressure drop in the gas flowing therethrough. Consequently, the downstream side of the rotor passage will be at a lesser pressure than the intake chamber.

As shown in FIGURE 1, bearing housing **21** includes a web having one or more passages **36** formed therein communicating the compression compartment with the low pressure suction chamber. Said web terminates at an annular rim or flange **37** having a flange face **38** disposed substantially in a plane perpendicular to the center axis of the motor shaft **13**. A plurality of circularly arranged bolts **39** or similar fastening means transversing the flange portion to engage partition **7** for holding the bearing housing in place relative said partition and motor casing **2**.

In order to alleviate the arresting effect that the high pressure build up of gas in the compression compartment has on lubricant collected in the driving compartment, and in such manner as not to interfere with the cooling action the system fluid has on the motor, means is provided in the suction chamber for forming a pair of intermediary pressure sections.

Referring to FIGURES 1 and 3, an impeller **26** is carried on the motor shaft **13** for rotation therewith and arranged to extend outwardly into the suction chamber. The impeller comprises basically a disc like member **28** of a metallic or rigid material having a center opening slidable along shaft **13** to facilitate mounting. Washers **29** and **29'** carried on the shaft have one face in abutment with bearing housing **21** in spaced relation to the shaft to provide end play for the shaft with this bearing housing. Spacer **32** also mounted on the shaft adjacent the thrust washer **29** determines the longitudinal position of the impeller along the shaft **13**. A second spacer **34** disposed adjacent the opposed side of disc like member **28** is compressed by an elongated sleeve **35** closely fitting to and held on shaft **13**.

Member **28** is shaped to most readily function within the suction chamber and includes a substantially flat center portion having the opening slightly greater than the shaft diameter to receive said shaft. A peripheral edge **42** spaced outwardly of and concentric with the center opening is connected to the center portion by an outwardly diverging intermediate section thus providing a dish shaped configuration.

The outer peripheral edge **42** of impeller **26** is provided with a plurality of radially extending vanes **44** so positioned and arranged as to be disposed adjacent but spaced slightly from flange face **38** of the bearing housing **21**. As shown in FIGURE 2, these vanes are peripherally equispaced about the disc like member of the impeller and are of a sufficient number to provide a suitable degree of induction when the motor runs at normal rated speed. The vanes may be an integral part of the impeller disc or as shown in FIGURE 3 may be fastened thereto at opposite sides of peripheral edge **42**. Alternatively, these vanes may be applied only to the side adjacent the flange face **38**. In the latter instance, rotor **12** is provided with a plurality of laterally projecting vanes so arranged to be spaced adjacent the impeller thus assuring an efficient induced fluid flow.

It is seen that impeller **26** carried on the motor shaft **13** achieves two functions. Primarily, the disc like member **28** defines a pair of annular sections **45** and **46** formed between bearing housing **21** and the motor end respectively. Under normal operating conditions and with shaft **13** rotating at rated speed, impeller **26** creates a low pressure atmosphere within each of the sections **45** and **46**.

Section **45** immediately adjacent bearing housing **21** as seen is in communication with the compression compartment **3** through passage **36**. Thus, said section receives a high pressure flow of lubricant carrying fluid. Adjacently positioned annular section **46** is in direct communication through passage **24** with intake chamber **23'** thus receiving a flow of fluid from the refrigeration system after said fluid has passed through the motor for cooling purposes. The separate fluids are then driven by centrifugal force outwardly from the impeller and into the suction chamber to combine and contact the inside of the stator windings thus further cooling this portion of the motor.

It is readily seen that certain distinct advantages are realized through the use of the impeller. Notably, there are maintained two distinct flows of refrigerant, which are maintained through a portion of the suction compartment. A high pressure flow from the compression compartment **3** is separate and distinct from the low pressure motor cooling flow. Thus, each flow performs its individual function more efficiently and thoroughly than has previously been achieved when said flows were permitted to intermix immediately upon introduction to the suction chamber. More particularly in the instance of the low pressure cooling flow, the velocity of refrigerant passing through the motor passage **24** will not be effected as has previously been the case by the high pressure portion.

Accordingly, the separate character of the refrigerant flows through motor casing **2** is seen to foster a greater volume of cooling fluid through the rotor **12**. Further, the radially directed streams of fluid emitted from impeller vanes **44** into direct contact with the under side of the stator turns thus maintain a desirable working temperature.

Referring again to FIGURE 1, the lower portion of partition **7** is provided with an opening or passage means **47** which communicates with the compression compartment **3** by way of a check valve **48** interposed in said passage. Normally, lubricant oil level within the suction compartment will be maintained about as shown and not permitted to exceed the preferred level. A proper flow from the suction compartment to the compression compartment is assured by maintaining the level of oil in the latter compartment below that in the suction compartment thus assuring a gravity flow therebetween.

While we have thus described the invention in terms of a preferred embodiment thereof it is understood that certain changes and modifications may be made in the specific structure and the arrangement of parts as described without departing from the spirit and scope of the invention.

What is claimed is:

1. A vapor cooled motor compressor unit of the hermetic type having an enclosing casing and comprising;
   (*a*) a partition dividing the casing into a driving compartment and a compression compartment, said latter mentioned compartment holding a supply of pressurized fluid and a liquid lubricant,
   (*b*) said motor having a shaft rotatably journalled at said partition and being positioned to form an opposed intake and suction chambers in said casing,
   (*c*) said motor having a rotor adapted to pass vaporized fluid from said intake chamber to said suction chamber for cooling motor components,
   (*d*) an impeller carried on said motor shaft and being rotatable in said suction chamber, thereby defining a pair of adjacently positioned annular chambers about said shaft,
   (*e*) one of said annular chambers being communicated with the compression chamber to receive a stream of lubricant carrying fluid from the latter,

(*f*) the other of said pair of annular chambers being positioned to receive vaporized fluid passing through said rotor from the intake chamber,

(*g*) said respective annular chambers being communicated with the suction compartment and,

(*h*) means forming a lubricant conduit communicating the respective suction and compression chambers for directing lubricant to the latter.

2. In a motor compressor unit as defined in claim 1 wherein the impeller includes;

(*a*) a rigid member spaced intermediate the partition and one end of said motor defining said pair of annular chambers, said respective annular chambers having circumferential openings in communication with said suction compartment, and

(*b*) a plurality of vanes appended to said rotatable impeller to induce fluid flow into said suction chamber from said one annular chamber communicated with the compression chamber.

3. In combination with a unitized motor driven compressor of the hermetic type including a casing, a drive motor connected to the compressor, said drive motor being positioned in the casing to define at one end of the casing an inlet chamber connected to a source of vaporized fluid and at the other end of the casing a suction compartment,

(*a*) a partition means in the casing at said suction compartment forming a compression chamber,

(*b*) a bearing housing carried in the partition,

(*c*) said motor having a shaft journalled in said bearing housing for rotation therein,

(*d*) an impeller carried on said motor shaft and positioned in said suction chamber intermediate said partition and said motor end to define adjacent annular chambers about the motor shaft having peripheral outlets communicated with the suction compartment,

(*e*) passage means in said bearing housing communicating a first of said annular chambers with said compression chamber,

(*f*) said other annular chamber being connected to receive vapor conducted through said motor from said inlet chamber,

(*g*) said impeller having a plurality of outwardly projecting vanes along one side thereof extending into said first annular chamber to induce fluid flow therefrom upon rotation of the shaft.

4. In the combination defined in claim 3 wherein;

(*a*) said vanes formed along one side of said impeller extend toward the said bearing housing, and being spaced slightly from said housing.

5. In the combination defined in claim 3 wherein said impeller includes;

(*a*) a disc-like member having;

(1) a center opening connected to said motor shaft,

(2) a radial inner portion defining said respective annular chambers about said motor shaft,

(3) a lip extending outwardly of said radial inner portion and defining said peripheral outlets communicated with suction compartment, and

(4) said impeller vanes being appended to said lip.

6. In the combination defined in claim 5 wherein said vanes are circumferentially equi-spaced along said lip.

7. In the combination defined in claim 5, including;

(*a*) spacer means carried on said shaft and longitudinally positioning said disc-like member intermediate said bearing housing and said motor end.

References Cited in the file of this patent

UNITED STATES PATENTS

2,673,026	Gerteis	Mar. 23, 1954
2,926,840	Soumerai	Mar. 1, 1960
2,948,458	Nicholas	Aug. 9, 1960
2,963,218	Tower	Dec. 6, 1960
3,051,373	Soumerai	Aug. 28, 1962