Nov. 5, 1935. R. E. MARBURY 2,019,689

REFRIGERANT COMPRESSOR

Filed July 7, 1933 4 Sheets-Sheet 1

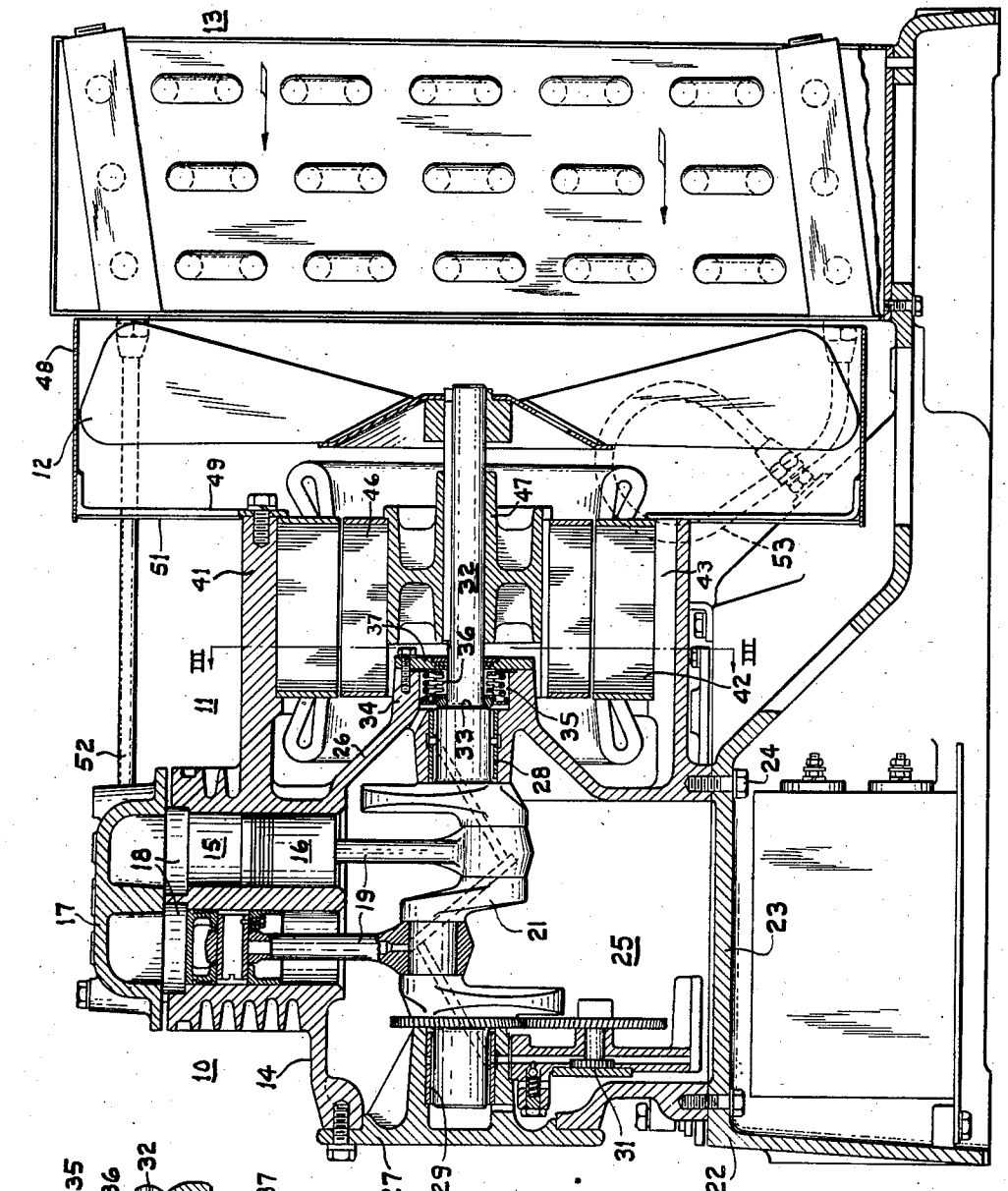

Fig. 1.

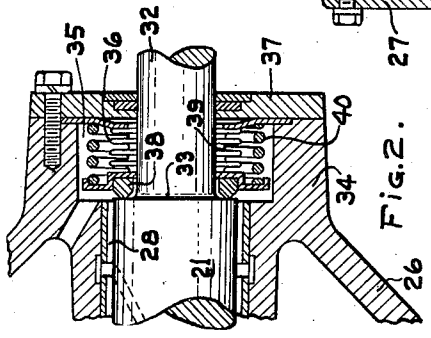

Fig. 2.

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REFRIGERANT COMPRESSOR

Filed July 7, 1933 4 Sheets-Sheet 2

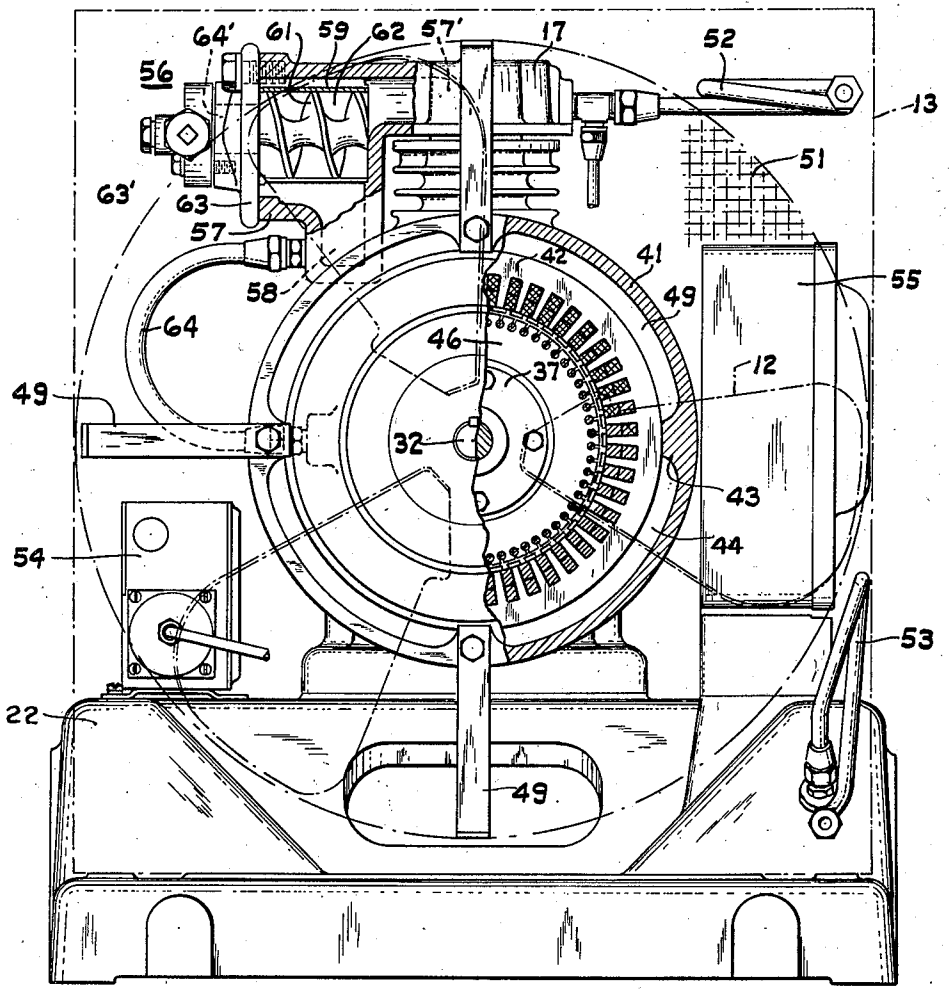

Fig. 3.

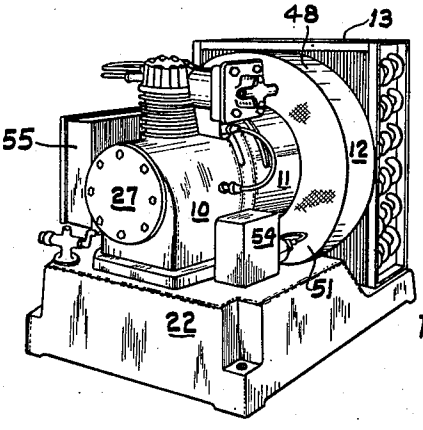

Fig. 4.

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REFRIGERANT COMPRESSOR

Filed July 7, 1933 4 Sheets-Sheet 3

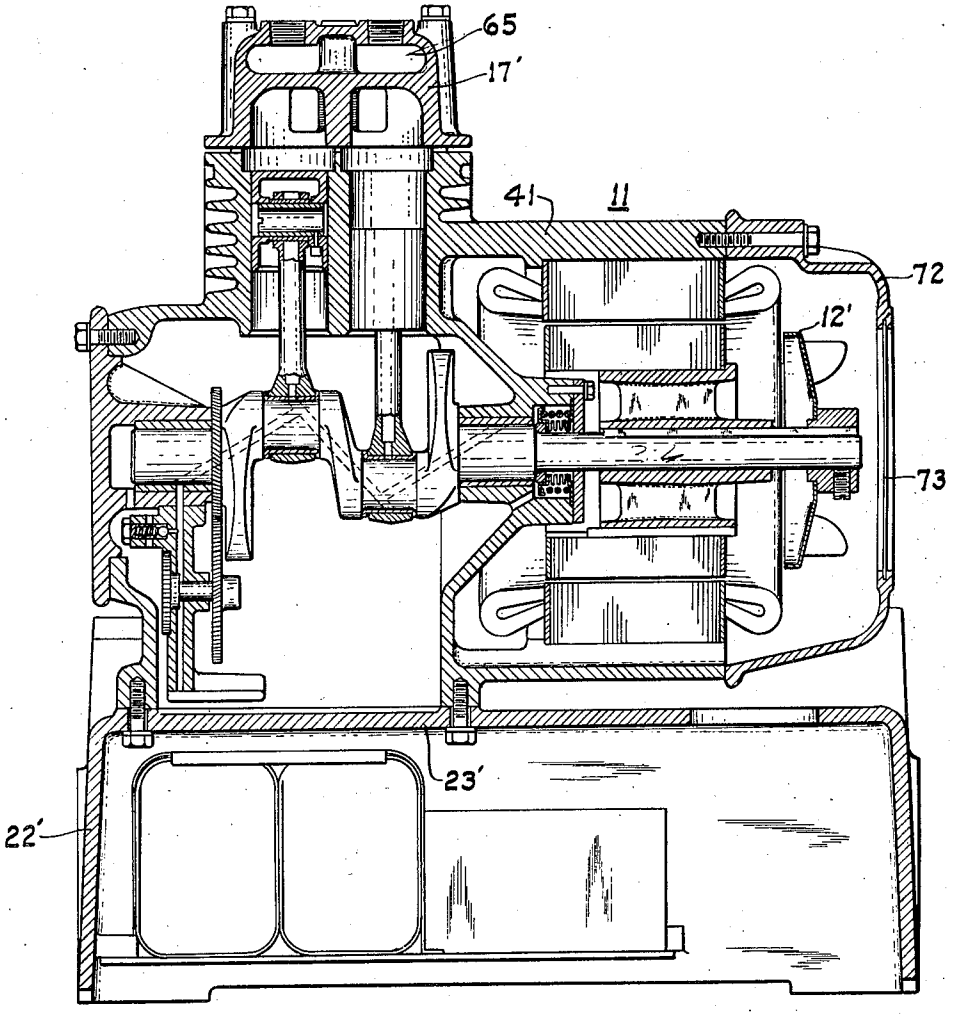

Fig. 5.

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REFRIGERANT COMPRESSOR

Filed July 7, 1933 4 Sheets-Sheet 4

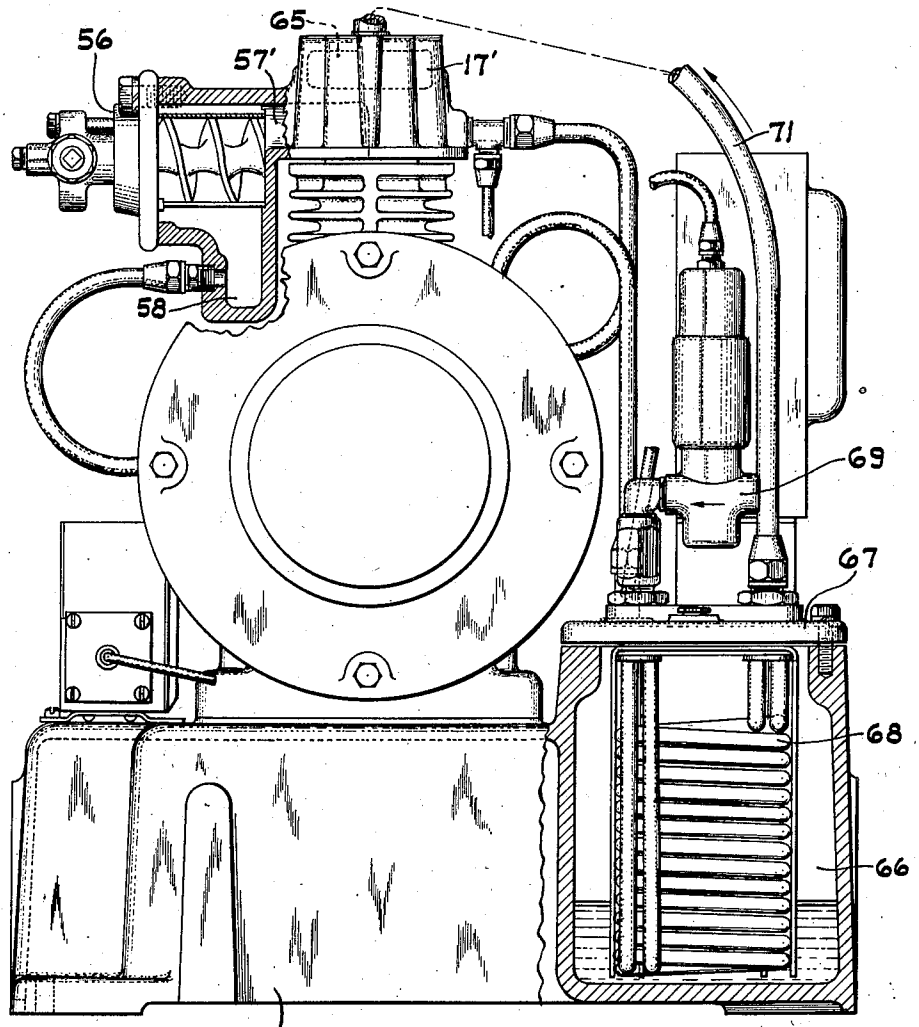

Fig. 6.

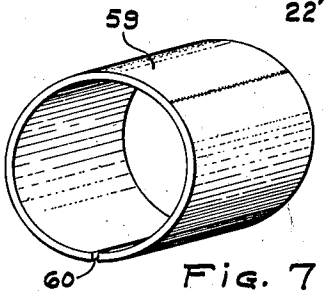

Fig. 7.

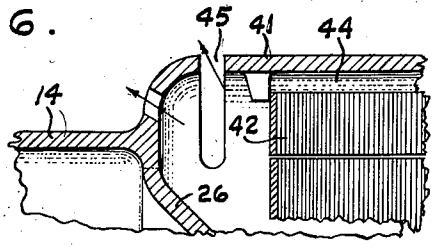

Fig. 8.

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UNITED STATES PATENT OFFICE

2,019,689

REFRIGERANT COMPRESSOR

Ralph E. Marbury, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application July 7, 1933, Serial No. 679,406

16 Claims. (Cl. 230—58)

My invention relates to refrigeration apparatus, more particularly to a motor-compressor and to a refrigerating unit comprising the motor-compressor and the condenser, and it has for an object to provide improved apparatus of the character set forth.

One object of my invention is to provide a simple, compact motor-compressor unit.

A further object is to provide a motor-compressor unit, the parts of which are readily removable.

A further object is to provide a motor-compressor unit having improved features of construction.

A further object is to provide a simple and compact refrigerating or motor-compressor-condenser unit.

Another object is to provide a refrigerating unit having an improved arrangement for air-cooling the motor, the compressor and the condenser.

In accordance with my invention, the motor is carried by the compressor, the compressor casing being provided with an extension of tubular or sleeve form to provide the motor casing. The armature of the motor is detachably mounted on an overhung extension of the compressor shaft, which is journaled in the compressor casing and projects through the wall of the compressor casing into the sleeve extension. A shaft seal is provided where the shaft projects through said wall and is removable through said sleeve extension upon removing said armature. A stator for the motor is mounted in the sleeve extension, and the stator and the rotor are partially telescoped with said shaft seal.

The motor casing is formed with end openings for the circulation of air through the motor to cool the same, and a fan is overhung on the end of said shaft for effecting circulation of air. In the case of the air-cooled unit, the fan is of larger diameter than the motor and the condenser is disposed on the opposite side of the fan. The fan effects circulation of air through the condenser, interiorly and exteriorly of the motor and over the compressor.

The above and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a longitudinal sectional view of a refrigerating unit comprising a motor-compressor and an air-cooled condenser;

Fig. 2 is an enlarged sectional view of the shaft seal;

Fig. 3 is partly an end view and partly a sectional view on line III—III of Fig. 1, the outlines of the condenser and the fan being shown in dot and dash lines;

Fig. 4 is a perspective view of the air-cooled unit shown in Figs. 1 to 3;

Fig. 5 is a longitudinal sectional view of the motor-compressor of a water-cooled refrigerating unit;

Fig. 6 is an end view of the refrigerating unit shown in Fig. 5;

Fig. 7 is a perspective view of a sleeve embodied in the oil separator of each embodiment; and,

Fig. 8 is a detail sectional view showing the air-circulating openings in the motor casing, also provided in each embodiment.

Referring now to the drawings in detail, the air cooled refrigerating unit shown in Figs. 1 to 4 comprises a compressor 10, a motor 11 and a fan 12 carried by the compressor, and a condenser 13. The compressor comprises a casing 14 having cylinders 15 formed therein, pistons 16 in the cylinders, a cylinder head 17, valve assemblies 18 between the cylinders and the cylinder head, connecting rods 19, and a crank shaft 21. The compressor casing 14 is mounted on a bed plate 22, which has an upper wall 23 secured by bolts 24 in sealed relation to the bottom edge of the compressor crank case 25 and forming a closure for the open bottom of the crank case.

The compressor casing has an end wall 26 at one end of the crank case 25 and a bearing cap 27 at the opposite end, said end wall and bearing cap carrying inwardly extending bearings 28 and 29, respectively, in which the crank shaft 21 is mounted. An oil pump 31 provides pressure lubrication for the compressor. The end wall 26 is formed with a shaft opening, at the bearing 28, through which the crank shaft 21 is extended to provide an overhung shaft portion 32 for the motor and the fan, said overhung portion being of smaller diameter, providing a shoulder 33 at the outer end of the bearing 28.

On its outer side, the end wall 26 is formed with a hub extension 34 surrounding the shaft. The hub extension is formed with an inner recess extending to the outer end of the bearing 28 and forming, with the overhung shaft portion, an annular chamber 35 in which there is located a gland construction or shaft seal 36 for effecting a fluid-tight joint or seal between the compressor casing and the shaft.

The shaft seal 36 prevents leakage of refrigerant outwardly through the shaft opening to the motor when the pressure in the crank case is above the pressure in the motor, and leakage of air through the shaft opening into the crank case when the pressure therein is below the pressure in the motor, which, in the present case, is atmospheric pressure. As shown more clearly in Fig. 2, the shaft seal 36 includes an annular plate 37 bolted to the outer end of the hub extension, a packing member 38 acting against the shoulder 33, a bellows 39 connecting the plate 37 and the member 38 and a spring 40 biasing the member 38 against the shoulder 33.

The compressor casing 14 is formed with an integral extension 41 of tubular or sleeve form, forming with the wall 26 a socket or motor casing for housing the motor 11. The extension 41 carries a motor stator 42, which is positioned therein in spaced relation by ribs 43 on the inside of the extension, as may be seen in Fig. 3. The intervening spaces 44 provide for circulation of air or other cooling medium. Arcuate slots 45 are formed in the extension 41 at the end adjacent the compressor casing 14 for discharging the air, as shown in Fig. 8.

An armature 46 for the motor is mounted on the overhung shaft portion 32 by means of a spider or hub 47, and cooperates with the stator 42 for driving the compressor. As shown on the drawings, the stator and the armature partially telescope the shaft seal 36.

The fan 12 is mounted on the outer end of the overhung shaft portion 32, being disposed immediately adjacent and between the motor and the condenser. The diameter of the fan is substantially equal to the height and width of the condenser 13, but greater than the diameter of the motor 11. An annular shroud 48 for the fan is mounted on the extension 41 by brackets 49 which are bolted to the end of the extension 41. A coarse mesh screen 51 forms a guard between the shroud 48 and the extension 41.

A conduit 52 connects the discharge of the compressor with the inlet of the condenser, and a conduit 53 connects the outlet of the condenser with a liquid receiver formed in the bedplate 22. Applicable control devices 54 and 55 are mounted on the bedplate 22 on opposite sides of the compressor 10.

An oil separator 56, in the low pressure or suction side of the refrigerating system, is embodied in the cylinder head 17. It includes a housing 57, which is formed integrally with the cylinder head and with a well 58 at the bottom, a sleeve 59 within the housing 57, and a spiral or screw-shaped member 61 disposed within the sleeve 59 and forming therewith a spiral passage 62. The sleeve 59 is slotted at the bottom as shown at 60 in Fig. 7. A closure 63 for the open end of the housing 57 is formed integrally with the spiral member 61. The closure 63 carries a fitting 63' connected to the evaporator (not shown) and has an opening 64' therethrough, for conveying low pressure vaporous refrigerant returned from the evaporator to the spiral passage 62. The interior of the housing 57 forms part of a return refrigerant passage extending from the exterior of the cylinder head to the cylinders 15.

As the vaporous refrigerant passes through the spiral passage 62, the oil therein is thrown outwardly by centrifugal force against the sleeve 59. It flows downwardly on the wall of the sleeve, through the slot 60 at the bottom to the well 58 and through a connecting conduit 64 to the compressor crank case 25.

The apparatus operates in the usual manner of refrigerating apparatus. Low pressure vaporous refrigerant admitted through the oil separator 56 and the passage 57' is compressed by the compressor 10, which is driven by the motor 11, and then delivered through the conduit 52 to the condenser 13. It is condensed therein and delivered through the conduit 53 to the liquid receiver to be supplied to cooling apparatus.

The fan 13 is arranged to effect circulation of air to the left as seen in Fig. 1. The air passes first through the condenser, and then to the fan. The radially inner portion passes through the interior of the motor casing, through the spaces 44 and between the stator and the rotor, out through the openings 45, and over the compressor, while the radially outer portion passes over the exterior of motor casing and then over the compressor, particularly the cylinders and cylinder head. The latter project upwardly beyond the motor casing.

The shaft seal 36 may be assembled and removed through the motor casing after removing the fan 12 and the armature 46, which are readily removable from the shaft 32. In the case where the condenser is disposed adjacent the fan 12, it is first removed.

The above-described arrangement is particularly advantageous in that, as the armature and stator telescope the shaft seal, the fan 12 may be overhung on the shaft without unduly lengthening the same, thereby avoiding the necessity for an outboard bearing.

In the refrigerating unit shown in Figs. 5 and 6 embodying a water cooled condenser, the casting or other integral member providing the compressor and motor casings is the same as in the air cooled unit. The cylinder head 17' is similar except that it embodies water cooling passages 65. The bottom of the crank case is closed by the top wall 23' of a bed plate 22', which is formed with an integral chamber 66 (see Fig. 6) arranged at the side of the motor-compressor and extending down substantially to the bottom of the bed plate. The chamber 66 is provided with a cover 67, from which a water cooling coil 68 is suspended. The chamber 66 provides a combined condenser and liquid receiver, the upper portion of the chamber providing the condenser and the lower portion the liquid receiver. Cooling water is admitted to the coil 68 through a valve 69, which acts in response to the compressor discharge pressure. The water discharged from the coil 68 is conveyed through a conduit 71 to the water cooling passage 65 in the cylinder head 17'.

In this embodiment, the overhung shaft portion 32 carries a fan 12' which is of smaller diameter than the fan 12, since it only serves to circulate air through the interior of the motor 11. An end cap 72 is bolted to the end of the sleeve extension 41 and embodies a coarse mesh screen 73 through which air is admitted to the fan 12'. In other respects, the apparatus of this embodiment is the same as that of the first embodiment.

The operation of the second embodiment is the same as that of the first embodiment except that the compressed refrigerant discharged from the compressor passes to the chamber 66, in which it is condensed by the water cooling coils 68 and collected in the bottom of the chamber, from which it is conveyed to the cooling apparatus.

From the above description, it will be seen that

I have provided simplified and improved construction of motor compressor and refrigerating unit for compression refrigeration systems.

While I have shown my invention in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In a refrigerating unit, a compressor including a casing, interior working parts and a drive shaft extending through one wall of the casing; a gland for effecting a seal between the casing and the shaft; means providing for the assembly and removal of the gland exteriorly of the casing, said casing having an integral extension forming a socket; and a motor having its armature mounted on the extending portion of the drive shaft and having its stator telescopically fitting the interior of the socket.

2. In a motor compressor unit, the combination of a compressor including casing and a drive shaft extending outwardly therefrom, a sleeve element projecting from the compressor casing and forming therewith a motor casing about said drive shaft, a motor including a stator element telescopically secured within said motor casing and a rotor element detachably mounted on said drive shaft, and a shaft seal for effecting a fluid-tight joint between the compressor casing and the shaft, said shaft seal being insertable and removable through the motor casing when the rotor element of the motor is removed.

3. In a motor compressor unit, the combination of a compressor casing having a projecting portion forming a motor housing, a shaft in the compressor casing extending through a wall of the compressor casing into the motor housing, a motor including cooperating stator and rotor parts carried by said motor housing and extending portion of the shaft, respectively, a shaft seal mounted on said wall at the shaft opening and removable through the motor housing, the shaft seal and rotor being in partially telescoped relation.

4. In a motor compressor unit, the combination of a reciprocating compressor including a crank case and a drive shaft extending outwardly therefrom, a sleeve element projecting from the compressor casing and forming therewith a motor casing about said crank shaft, a motor including a stator element telescopically secured within said motor casing and a rotor element detachably mounted on said drive shaft, and a shaft seal for effecting a gas and fluid-tight joint between the compressor crank case and the shaft, said shaft seal being arranged in partially telescoped relation with said stator and rotor elements and adapted to be assembled and removed through the outer end of the motor casing when the rotor element is removed.

5. In a motor compressor unit, the combination of a compressor casing including a crank case having a shaft opening in one wall thereof, a compressor crank shaft projecting through said shaft opening, said shaft having an outwardly facing shoulder adjacent the shaft opening, a shaft seal device secured to said wall exteriorly thereof adjacent the shaft opening and cooperating with said shoulder for effecting a seal between said wall and said shaft, said casing having a tubular extension forming a motor casing with said one wall, and a motor including cooperating stator and rotor elements carried by said motor casing and the projecting shaft portion, respectively, said rotor element being removable and said shaft seal device being insertable and removable through the motor casing when the rotor element is removed.

6. In a motor compressor unit, the combination of a casing structure having two bearings, a drive shaft journaled in said bearings and having a compressor driving portion between the bearings and an overhung extension beyond one of the bearings, an armature detachably mounted on said overhung extension, said casing having a sleeve extension encompassing said armature, a stator mounted in the sleeve around the armature, and a fan mounted on the end of said overhung extension for circulating air through the motor and past the compressor.

7. In a motor driven reciprocating compressor, the combination of a compressor casing including a crank case having two bearings, a crank shaft journaled in said bearings with its compressor driving portion between said bearings, said shaft having an overhung extension projecting beyond one of said bearings and through one wall of the crank case, a removable shaft seal secured to said crank case on the outer side of said one wall to prevent leakage between the crank case and the shaft, said casing having a sleeve-like extension encompassing said overhung extension, and a motor including a stator mounted in said sleeve-like extension and an armature removably mounted on said overhung extension of the shaft, whereby access to said shaft seal may be had by removing said armature.

8. In a motor-compressor unit, the combination of a reciprocating compressor comprising a compressor housing having a shaft opening in one wall of the crank case thereof, a shaft bearing on the inner side of said wall at the shaft opening, said crank case having an opening in the wall opposite said one wall for the insertion and removal of a shaft, a closure member for the last-mentioned opening carrying a second shaft bearing, a shaft mounted in said bearings and having an overhung portion extending through said shaft opening, a removable shaft seal secured on the exterior side of said one wall adjacent the shaft opening, and a motor including a tubular motor casing portion carried by the compressor housing and extending from said one wall and encompassing said overhung shaft portion, said motor further including cooperating stator and rotor parts disposed on the interior of the tubular motor casing portion and the overhung shaft portion, respectively, in telescoping relation to said shaft seal.

9. In a motor compressor unit, a compressor including a casing and a drive shaft extending outwardly therefrom, a sleeve member connected to the compressor casing and providing a socket having inwardly projecting ribs, said sleeve member having openings extending through the wall thereof adjacent to the compressor, a motor having its armature mounted on the outwardly extending portion of the drive shaft and having its stator supported by said ribs, and means providing for the circulation of cooling air externally of the stator between adjacent ribs and through said openings.

10. In a refrigeration system, a compressor comprising a cylinder, a cylinder head, a crank

case, said cylinder head being formed with an integral portion forming a housing for oil separating means, oil separating means within said housing, means for admitting return refrigerant to said housing, means for draining oil separated from the refrigerant in said housing to the crank case, and means for conveying the refrigerant from which oil has been separated to the cylinder independently of the crank case.

11. A compressor for a refrigeration system comprising a cylinder, a cylinder head, a crank case, said cylinder head being formed with an inlet passage therein extending from the exterior to the cylinder, means for admitting return vaporous refrigerant to the exterior or inlet end of said passage, means interposed in said passage for separating oil from the refrigerant, and means for conveying oil separated from the refrigerant in said separating means to the crank case.

12. In a motor compressor unit, the combination of a compressor casing having an integral extension of tubular form providing a motor casing, and an integral wall between the compressor and the motor casing, said integral wall having a shaft opening therein and a bearing at said shaft opening, said compressor having a second bearing, a crank shaft journalled in said bearings and extending through said shaft opening into said motor casing, a motor stator element mounted in said motor casing, a motor rotor element detachably mounted on the extending portion of said shaft, and a shaft seal device secured to the motor side of said integral wall at said shaft opening, said shaft seal device being insertable and removable through said motor casing upon removing said rotor element, and said stator element being in telescoping relation with said shaft seal device.

13. In a motor compressor unit, the combination of a compressor casing having an integral extension of tubular form providing a motor casing, and an integral wall between the compressor and the motor casing, said integral wall having a shaft opening therein and a bearing at said shaft opening, said compressor having a second bearing, a crank shaft journalled in said bearings and extending through said shaft opening into said motor casing, a motor stator element mounted in said motor casing, a motor rotor element detachably mounted on the extending portion of said shaft, and a shaft seal device secured to the motor side of said integral wall at said shaft opening, said shaft seal device being insertable and removable through said motor casing upon removing said rotor element, said rotor element being in telescoped relation with said shaft seal device, and said stator element being in telescoping relation with said shaft seal device and the first-mentioned bearing.

14. In a motor compressor unit, the combination of a compressor casing providing a crank case portion and having a cylinder formed therein, an integral extension of tubular form providing a motor casing, and an integral wall between the crank case of the compressor and the motor casing; said integral wall having a shaft opening therein and a bearing at said shaft opening, the crank case having an opening opposite said shaft opening for insertion and removal of a crank shaft; a cap closing said last-mentioned opening and having a shaft bearing mounted therein; a crank shaft mounted in said bearings and extending through said shaft opening into said motor casing; a motor stator element mounted in said motor casing; a motor rotor element detachably mounted on the extending portion of said shaft; and a shaft seal device secured to said integral wall at said shaft opening, said shaft seal device being insertable and removable through said motor casing upon removing said rotor element.

15. In a motor compressor unit, the combination of a compressor casing providing a crank case portion and having a cylinder formed therein, an integral extension of tubular form providing a motor casing, and an integral wall between the crank case of the compressor and the motor casing, said integral wall having a shaft opening therein and a bearing at said shaft opening, the crank case having an opening opposite said shaft opening for insertion and removal of a crank shaft; a cap closing said last-mentioned opening and having a shaft bearing mounted therein, a crank shaft mounted in said bearings and extending through said shaft opening into said motor casing; a motor stator element mounted in said motor casing; a motor rotor element detachably mounted on the extending portion of said shaft; and a shaft seal device secured to said integral wall at said shaft opening, said shaft seal device being insertable and removable through said motor casing upon removing said rotor element; said motor casing having air circulation openings therein adjacent the compressor; and a fan overhung on the extending portion of said shaft for circulating air through said motor casing and outwardly through said openings past the compressor.

16. In a motor compressor unit, the combination of a compressor casing having a cylinder formed therein and having an integral tubular extension forming a motor casing, said cylinder projecting beyond the circumference of said motor casing, said motor casing having air circulation openings adjacent said cylinder, a crank shaft mounted in said compressor and projecting into said motor casing, motor stator and rotor elements mounted in said motor casing and on the projecting portion of said shaft, respectively, and a fan overhung on the projecting portion of said shaft for circulating air through the motor, through said air circulation openings, and past said compressor.

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