United States Patent [19]

Gannaway

[11] **3,807,907**

[45] **Apr. 30, 1974**

[54] **HERMETIC MOTOR-COMPRESSOR**

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[73] Assignee: **Copeland Corporation,** Sidney, Ohio

[22] Filed: **July 23, 1973**

[21] Appl. No.: **381,627**

Related U.S. Application Data

[63] Continuation of Ser. No. 259,694, June 5, 1972, abandoned, Continuation-in-part of Ser. No. 6,158, Jan. 27, 1970.

[52] **U.S. Cl.** **417/415,** 417/312, 417/534, 417/902

[51] **Int. Cl.** **F04b 17/00**

[58] **Field of Search** 417/312, 313, 360, 415, 417/534, 902

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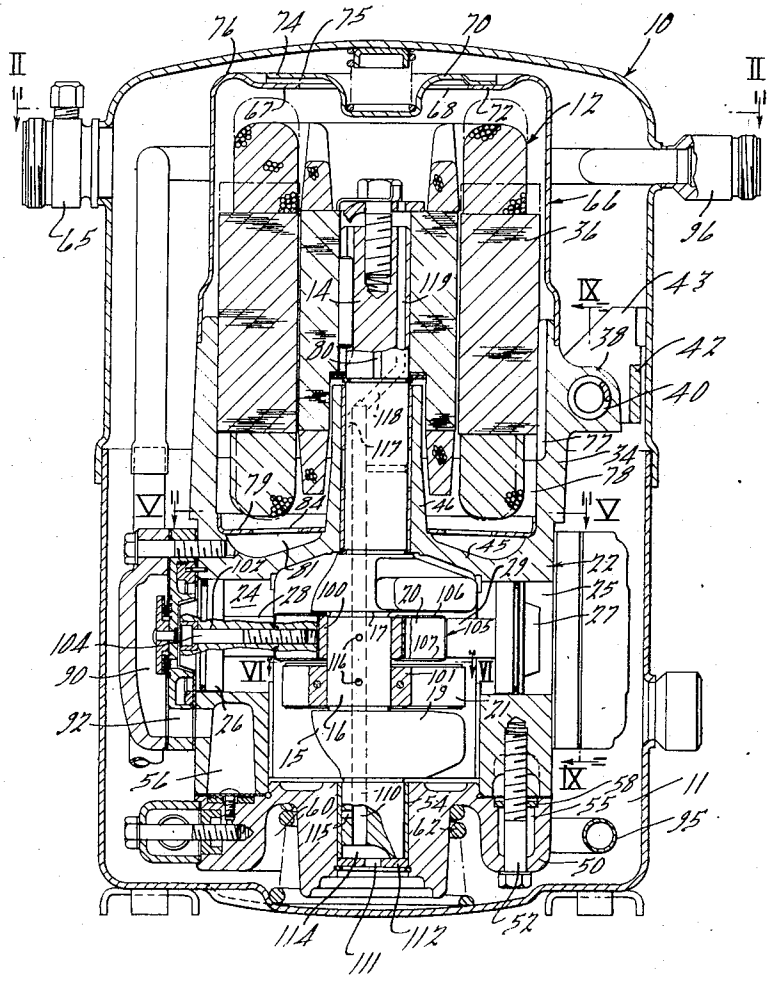
Primary Examiner—C. J. Husar

Attorney, Agent, or Firm—John C. L. Cowen

[57] **ABSTRACT**

A hermetic motor-compressor assembly includes a direct-coupled motor and compressor spring mounted as a unit in a sealed container. The compressor is of the four cylinder Scotch yoke type, with two pairs of opposed coaxial cylinders at right angles on horizontal axes, the pistons of the opposed aligned cylinders being paired by means of a rigid combined yoke and dual connecting rod assembly. The yokes are actuated by rectangular slide blocks fitted on a common crank throw. The yokes and blocks are keyed against displacement with respect to the axes of the cylinders. Suction gas is separated from entrained liquid and guided downwardly in paths close to the motor and through connected passages in the compressor body and out at the bottom.

5 Claims, 13 Drawing Figures



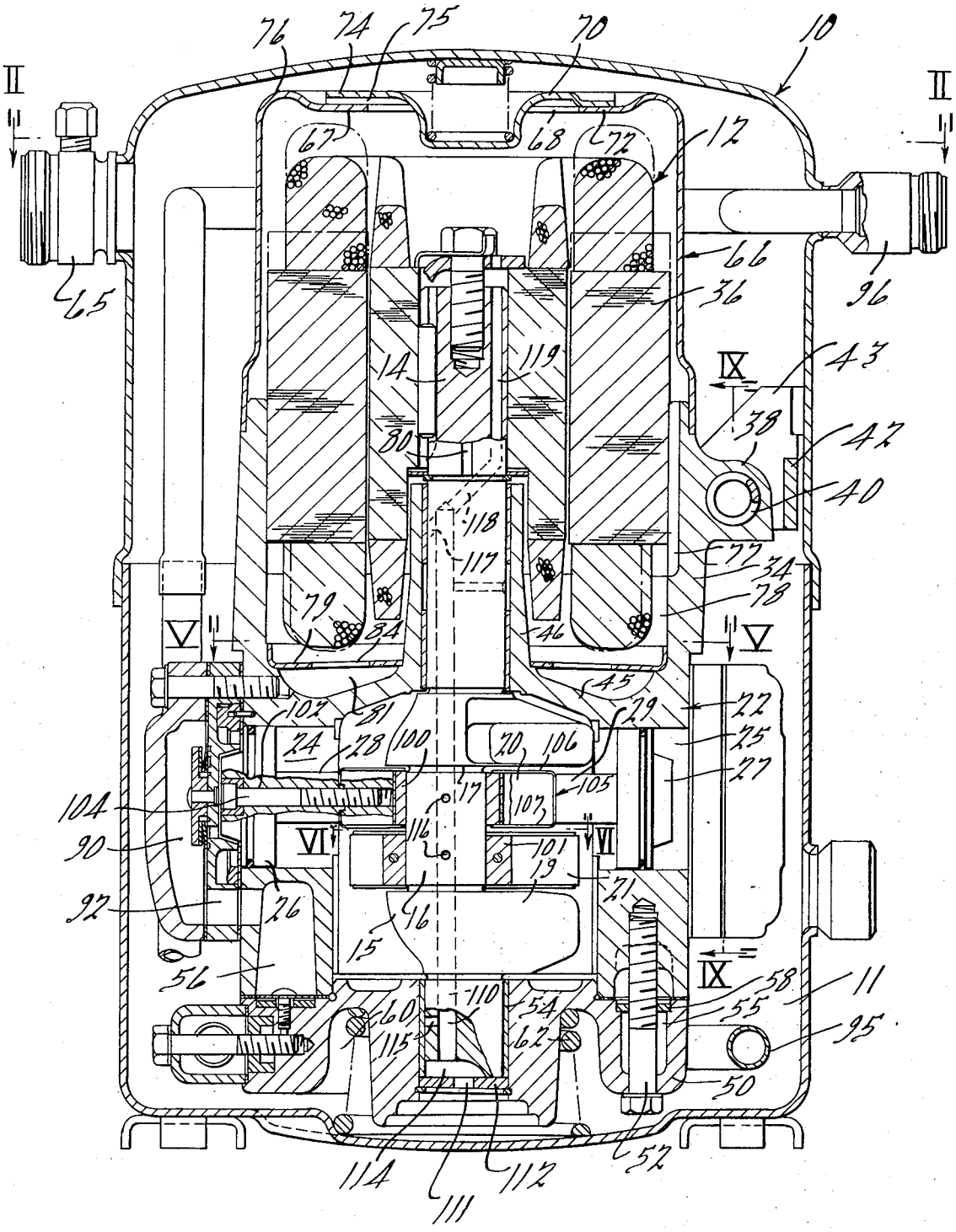

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Fig. 1.

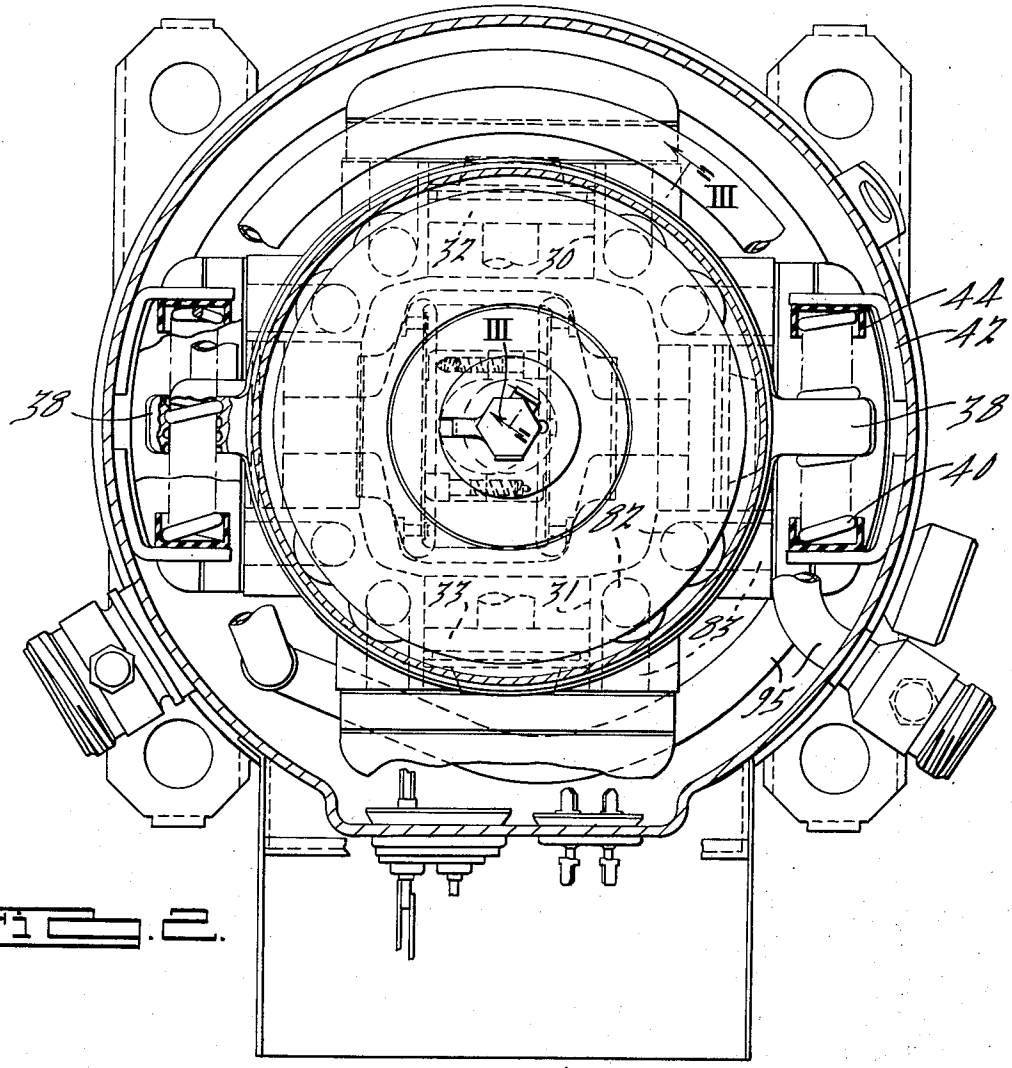

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Fig. 2.

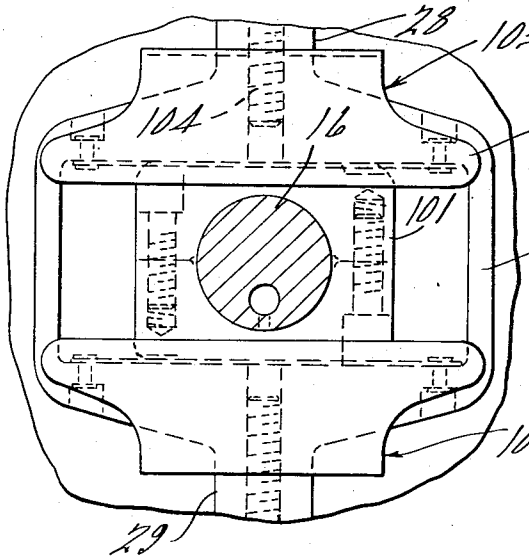

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Fig. 6.

FIG. 3.

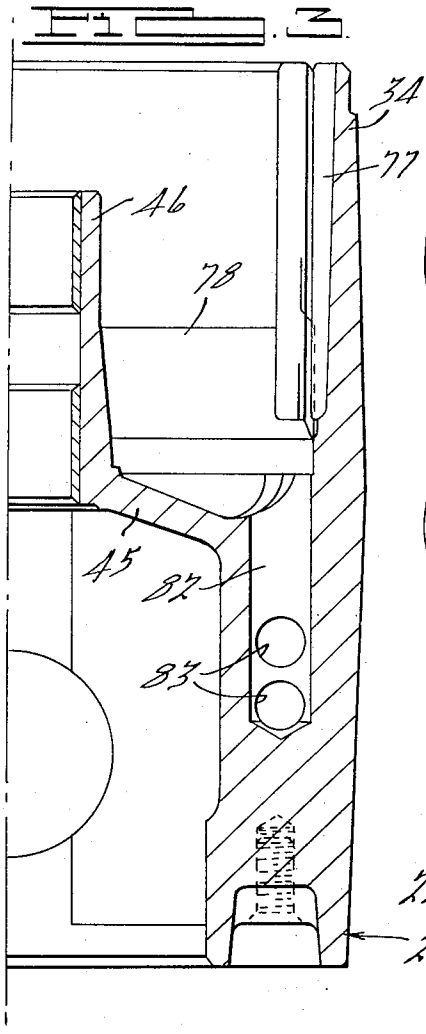
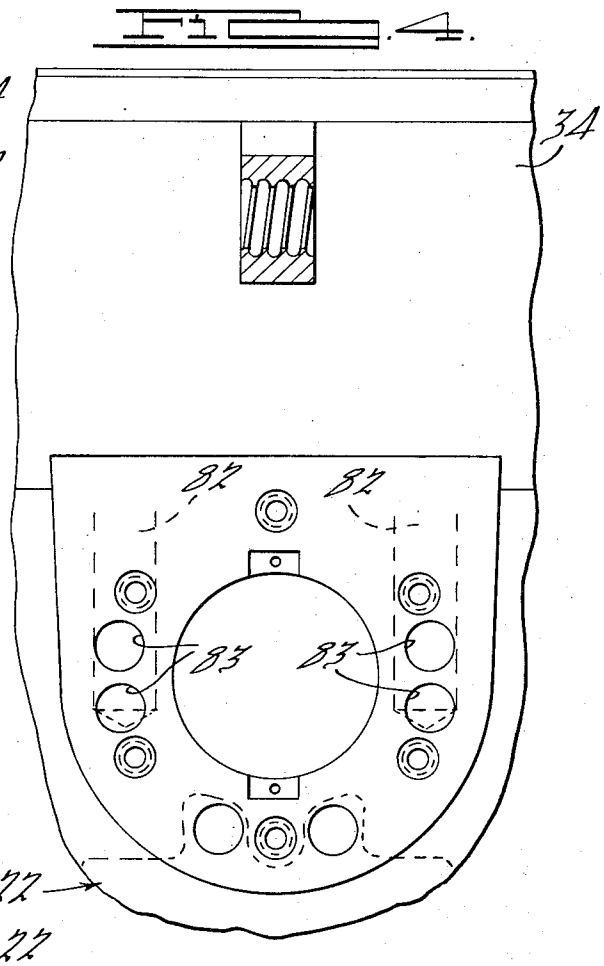


FIG. 4.



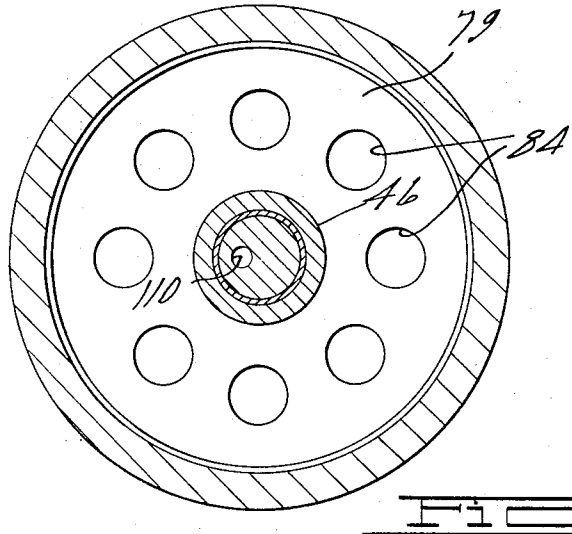


FIG. 5.

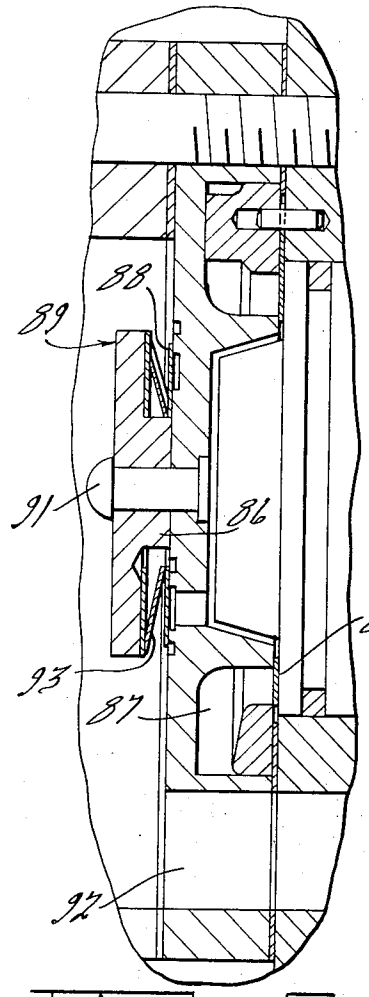


FIG. 7.

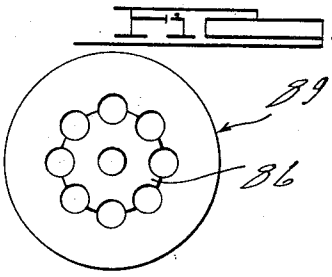


FIG. 8.

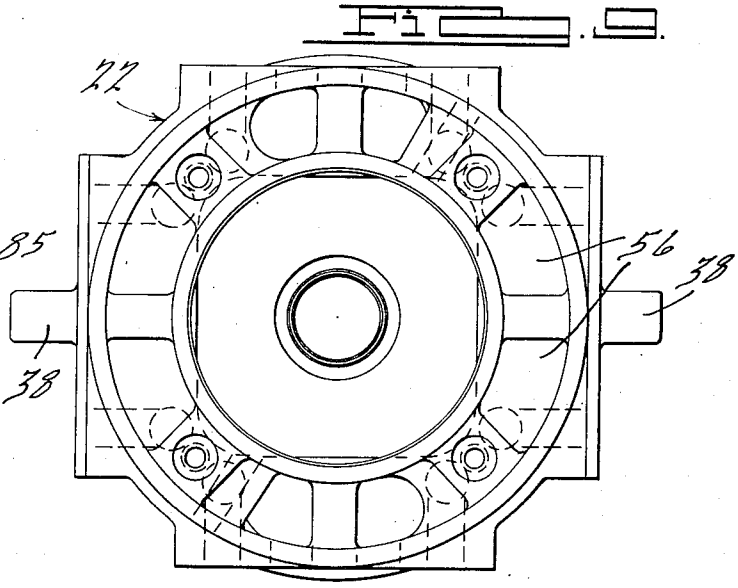


FIG. 9.

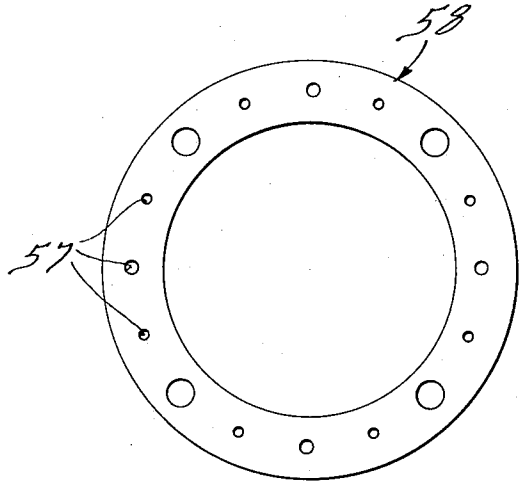


FIG. 10.

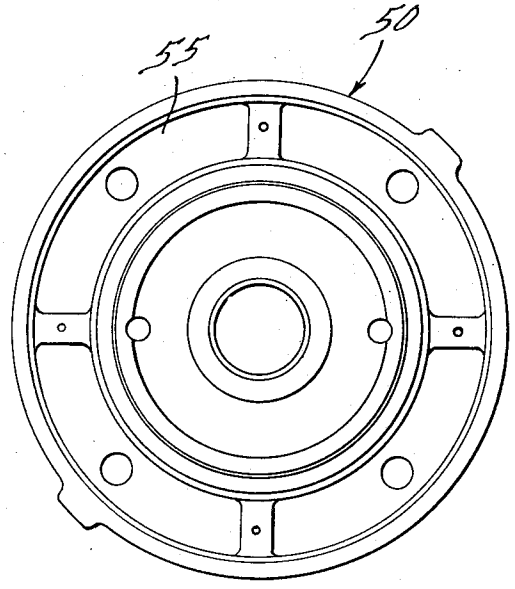


FIG. 11.

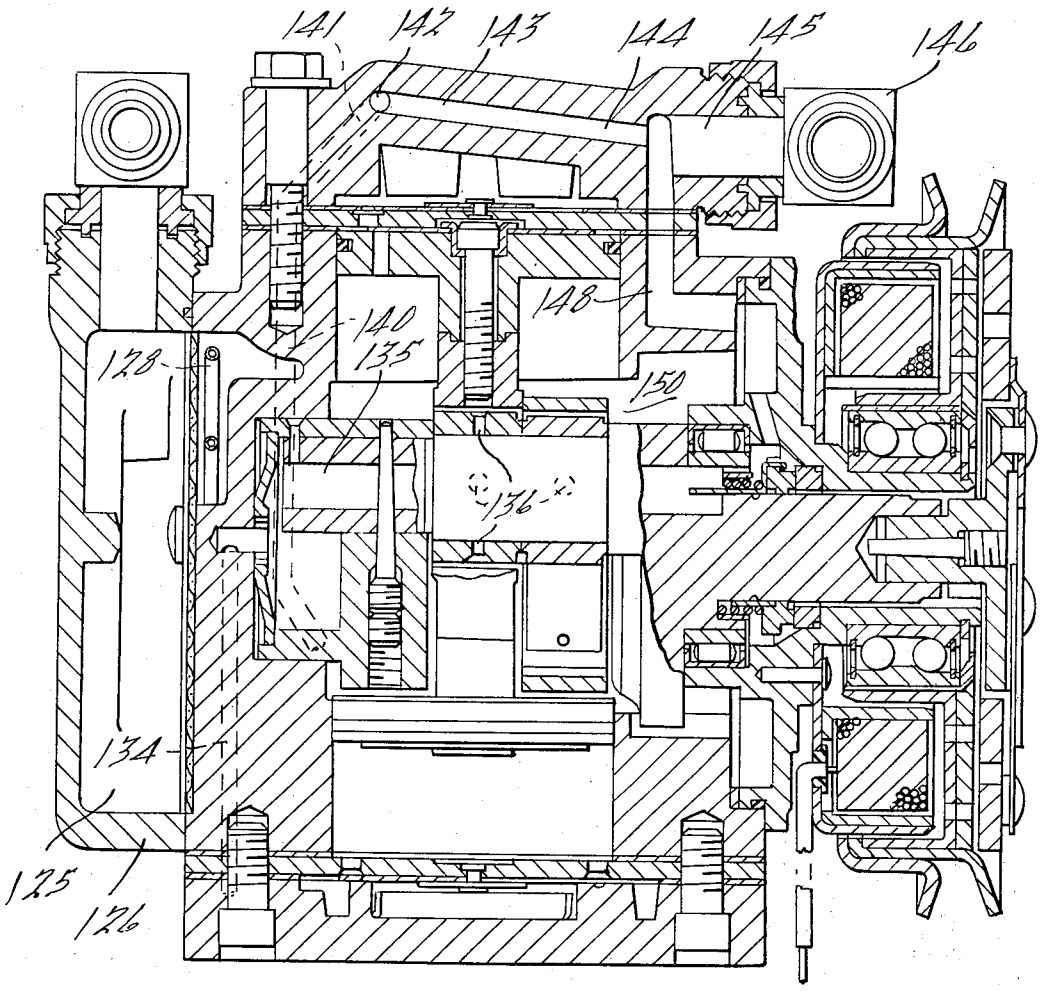

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Fig. 12.

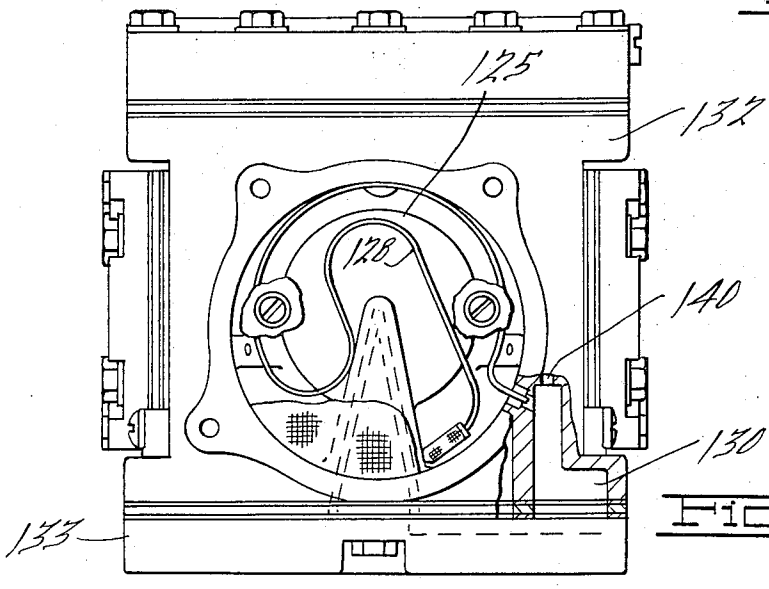

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Fig. 13.

HERMETIC MOTOR-COMPRESSOR

This is a continuation, division, of application Ser. No. 259,694, filed June 5, 1972 now abandoned.

BACKGROUND OF THE INVENTION

This application is a continuation-in-part of my prior application Ser. No. 6,158, filed Jan. 27, 1972, now U.S. Pat. No. 3,695,786.

The objects of the present invention can be summarized as to provide an improved hermetically sealed motor-compressor assembly designed for refrigeration service and which incorporates, to a degree which is high in proportion to the cost of the unit, the following characteristics, to wit: low noise, effective separation of liquid entrained with returning gas, efficient cooling of the motor, compactness, and rugged, reliable construction, and to provide improved lubrication with reduced likelihood of drawing oil into the valves of compressors designed to be employed in refrigeration service.

Other objects and advantages will become apparent upon consideration of the present disclosure in its entirety.

BRIEF DESCRIPTION OF THE FIGURES OF DRAWING

FIG. **1** is a vertical diametric sectional elevational view of a refrigeration motor-compressor of the hermetic type, incorporating a preferred form of the invention;

FIG. **2** is a cross section taken substantially on the line II—II of FIG. **1**, and looking in the direction of the arrows;

FIG. **3** is a fragmentary sectional view of the compressor body with other parts omitted, taken substantially as indicated by the line and arrows III—III on FIG. **2**;

FIG. **4** is a fragmentary elevational view of the body, with other parts removed, taken substantially as indicated by the line and arrows IV—IV on FIG. **1**;

FIG. **5** is a cross section taken substantially on the line V—V of FIG. **1** and looking in the direction of the arrows;

FIG. **6** is a sectional detail taken as indicated by the line VI—VI of FIG. **1**, and looking in the direction of the arrows, but with the crank throw in a different position;

FIG. **7** is a fragmentary diametric sectional view on a larger scale of the valve mechanism and associated parts;

FIG. **8** is a bottom plan view of the discharge valve retainer;

FIG. **9** is a bottom plan view of the compressor body;

FIG. **10** is a plan view of the discharge baffle plate;

FIG. **11** is a plan view of the discharge cover;

FIG. **12** is a vertical longitudinal sectional view of a belt-driven compressor incorporating a modified form of lubricating system; and

FIG. **13** is a rear view of the compressor of FIG. **12** with the discharge cover removed and the body partly broken away.

DETAILED DESCRIPTION OF PREFERRED FORMS OF THE INVENTION

Reference character **10** designates generally the

welded casing of a refrigeration motor-compressor containing in its upper portion, on a vertical axis, an induction-type electric motor generally designated **12**, the armature shaft **14** of which projects downwardly from the electric motor and is formed with an integral crankshaft portion **15** having a single throw **16** which is of sufficient axial length to accommodate two Scotch yokes **20, 21** mounted side-by-side thereon in perpendicular horizontal planes.

The compressor body **22** is formed as a rigid casting bored transversely to provide two pairs of coaxial cylinders, one pair, comprising cylinders **24, 25**, being aligned with the upper yoke **20** and having pistons **26, 27** rigidly connected to the yoke **20** by colinear connecting rod portions **28, 29**, while the cylinders **30, 31** of the other pair, upon an axis perpendicular to the axis of cylinders **24, 25**, have their pistons **32, 33** similarly connected to and aligned with the lower yoke **21**.

The compressor body **22** is provided with an integral upwardly extending open-topped cylindrical support portion **34** in which the stator **36** of the motor is fitted and supported. The support portion **34** is also provided with radial ears **38** which carry horizontally arranged helical compression springs **40** trapped between and coacting with spaced inwardly projecting arms **43** of U-brackets **42** secured to the interior of the casing **10** to absorb torsional forces. The ears **38** are internally threaded conformably to, and to receive, the springs **40**, but mid convolutions of each spring are distorted, as by having a different lead, so that when fully threaded into the centered position the spring is frictionally held. A rubber-like cup **44** is fitted over each end of each spring to further reduce sound conduction to the case.

A web section **45** of the body **22** positioned between the motor and compressor sections carries a central bearing neck **46** for the shaft. A bottom discharge cover **50** secured to the body by machine screws as **52** incorporates a bottom bearing **54** for the shaft and also includes discharge chamber areas **55** communicating with coacting discharge cavity portions as **56** in the body, such portions being proportioned to provide muffling action.

A downwardly opening concentric annular recess **60** formed in the discharge cover **50** accommodates and positions a helico-spiral compression spring **62** which supports the motor compressor vertically as well as resisting lateral forces.

In the preferred construction shown, suction gas is delivered to the interior of the casing **10** via a fitting **65**. A sheet metal partitioning sleeve **66** is fitted around the upper portion of the stator **36** of the motor and connected in sealed relation to the upper extremity of the supporting portion **34** of the compressor body. The sleeve **66** has an inwardly projecting flange **67** at its upper end bounding a relatively large central opening **68** leading into the interior of the sleeve **66** from the upper interior of the casing. A dished shield and spring locating member **70** overlies the opening **68** and is secured as by tack welds, designated **72**, to the flange **67**, the principal area of the overlying flange portion **7** of the member **70** being spaced above the flange **67**, thereby providing an annular horizontal entrance opening **75** for the suction gas between the flanges **67, 74**. The flange **67** is defined by a depressed top portion of the shielding sleeve **66** so that the entrance **75** is surrounded by an annular upwardly bulged bead **76**. Oil

and/or liquid refrigerant which may be entrained with the returning suction gas tends to fall to the oil sump area at the bottom of the casing, but if any droplets are carried upwardly and radially inwardly toward the entrance **75**, their inertia will be such that they are guided away from the entrance by the bulge **76** so that as a practical matter only dry gas finds its way into the space within the sleeve **66**.

The sleeve **66** is somewhat outspaced from the stator **36**, so that the space within the sleeve around the motor communicates with channels **77** formed in the inner wall of the supporting portion **34** of the body and extending downwardly from its top to the space **78** below the stator inside the support portion **34**. The support portion **34** and sleeve **66** are impervious, and the downflowing gas travels not only through the space around the stator, but also through the space between the stator and the armature, and through additional passages as **80** in the armature. The increased cross sectional area for gas flow provided by the paths around the motor reduces the pressure drop in the motor section yet guides the returning gas in close wiping engagement with the motor, to achieve maximum cooling of the motor from the residual heat absorbing capacity of the gas. The reduced pressure drop offsets the tendency of the compressor to pull oil out through any bearing clearance and into itself where objectionable noise and/or valve damage might occur.

A perforated baffle plate **79** in support portion **34** and spaced above web **45** creates a muffling chamber **81**. The holes **84** in plate **79** are proportioned to tune the muffling chamber **81** for maximum sound deadening consistent with efficient operation. Vertical passages **82** in the body **22** have their tops open in the upper surface of web **45** in chamber **81**, and conduct the gas via passages **82** and communicating horizontal passages **83** to the suction spaces **87** in the cylinder heads. Ring-type suction valves **85** admit gas to the cylinders on the suction strokes, and centrally positioned discharge valves **88** admit the compressed gas to head compression chambers **90**. The annular reed type discharge valves **88** are loosely fitted (e.g.: 0.006–0.010 inch clearance) on the hub portion **86** of the discharge valve retainer **89** which is of T-section and which is secured to the outer face of the valve plate by an axial rivet **91**. Thus the movement of compressed gas into the head is unobstructed. The valve is biased against its seat on the plate by a spring **93** between the valve and the head of the retainer. Due to the fact that the valve is formed of thin material, and due to the aforementioned clearance between the retainer hub and the hole in the valve, it has been found feasible to dispense with the more conventional cage-type retainer without loss of reliability of valve operation. Compression chambers **90** communicate via passages **92** with the discharge muffling chamber **56**, from which the gas is conducted through holes **57** in discharge baffle plate **58** into mufflering chamber portions **55** in discharge cover **50** and thence to the connecting discharge tube **95** leading to the discharge fitting **96** on the exterior of the casing. Additional sound deadening is caused by the fact that the oil in the sump constituted by the bottom of casing **10** engages the exterior of the parts which define the muffling chambers **55, 56**.

Each of the yokes **20, 21** is actuated by a rectangular slide block **100, 101**. The slide blocks are journaled on the throw **16**, and are slightly spaced from each other therealong, and from the cheeks **17, 19** of the crankshaft.

In the preferred construction shown, each connecting rod portion is integral with its piston, and an axial hole **102** is drilled through the piston and connecting rod to receive a screw **104** which secures the piston and connecting rod to the yoke, as shown in FIG. **1**. The slide block is prevented by the crank throw from rocking around the cylinder axis, and a keying device comprising a U-shaped sheet metal member **105** is secured to the yoke and is provided with flat side arm portions **106, 107** overlying the yoke and the block and preventing any relative displacement of the yoke and block. In the construction shown, the U-shaped keying member **105** has its bight portion clamped between the yoke and the connecting rod, where it is held when the screw **104** is tightened, as shown in FIG. **1**. Two of the keying devices **105** are provided for each yoke, one clamped to each connecting rod, so that movement of the parts in any plane in a manner which could result in noise-making contact is effectively prevented. The side portions **106, 107** of each keying device extend the effective length of slide block travel.

Oil is conducted to the bearing areas through an offset vertical riser passage **110** in the crankshaft. Oil from the sump area **11** is fed to the riser through a central bottom hole **111** in a disc **112** which closes the bottom of a radial pumping slot **114** formed in the lower end of the shaft and leading to the riser hole. Lateral branch passages **115, 116, 117** conduct oil from the riser to the bearings. Above the topmost lubricant feeding passage **117** an upwardly inclined blind continuation passage **118** extends back through and beyond the axis of the shaft to a position near the surface, where it communicates with an upward riser extension passage **119** which is open at the upper end of the shaft. It should be noted that the opening **119'** at the upper end of the extension portion **119** of this passage system is above any position where a material pressure drop has occurred due to gas flow through the motor, and is close to and in the path of the main flow of suction gas entering through inlet **68**. Thus a desirable (and substantially balanced) pressure is maintained at the upper and lower ends of the lubrication system, and the tendency to draw oil from the lubricant passage system is further reduced by the ram effect exerted on the upper end of the riser by the velocity head of the inflowing suction gas. Gas which has been dissolved in the oil nevertheless escapes through the opening **119'** but the oil is effectively retained.

FIGS. **12** and **13** illustrate a belt-driven yoke-type compressor, the construction of which is fully disclosed in my prior application Ser. No. 6,158, filed Jan. 27, 1970. The lubrication system includes two oil sumps, comprising a high-pressure sump **125** contained in the discharge cover **126** and from which oil for lubrication of the working parts is forced by the discharge pressure through a capillary tube **128** into a lower pressure sump **130** formed partly in the compressor body **132** and partly in the bottom head **133**. The pressure in the low pressure sump exceeds somewhat the pressure existing in the crankcase and at the locations of the working parts, so that the pressure in the low-pressure sump forces the oil through a passage system **134, 135, 136**, the passages **136** comprising branches from the crankshaft passage **135** to the bearing surfaces.

From the top of the low-pressure sump **130** a venting passage **140** extends upwardly through the body to the top where it communicates with continuation passages **141, 142, 143,** the latter of which has a mouth **144** which opens into inlet chamber **145** at a position opposite the suction gas inlet to such chamber. The suction gas is delivered to the compressor through a fitting **146** which directs the gas, as indicated by the arrow in FIG. **12,** in a direction toward the mouth **144,** so that the velocity head of the suction gas tends somewhat to augment the pressure at the mouth **144** and oppose an undue reduction, through the vent, of the pressure in the sump **130.** The suction gas continues downwardly via passages generally designated **148** to the crankcase area **150** and due to the further pressure drop occurring during its passage to such area it will be recognized that a pressure differential is maintained such that the lubricant is forced to the bearing areas in the manner previously described. The slightly elevated pressure in the sump **130** is maintained or augmented by the above-described action through the vent system.

This "Detailed Description of Preferred Forms of the Invention," and the accompanying drawings, have been furnished in compliance with the statutory requirement to set forth the best mode contemplated by the inventor of carrying out the invention. The prior portions consisting of the "Abstract of the Disclosure" and the "Background of the Invention" are furnished without prejudice to comply with administrative requirements of the Patent Office.

What is claimed is:

1. A refrigeration motor-compressor of the type having motor and compressor components enclosed in a sealed container, which container has an inlet through which suction gas is delivered to the interior of the container at a position outside both components, the compressor component having an inlet for receiving gas from the interior of the container, a gas-conducting guide surrounding at least a part of the motor component for guiding suction gas over the motor component to the inlet of the compressor component, the guide having a gas inlet which opens thereinto from the container at a position remote from said compressor component inlet, said guide having an outlet coupled to the inlet of the compressor component in substantially gas-tight relation, the motor and compressor components of said motor-compressor being arranged substantially coaxially and coupled to a common shaft, the compressor component having a body containing said inlet of the compressor on a side toward the motor component, the guide including a part formed as an integral upward extension of said body and extending away from the compressor component around the motor, characterized by a plurality of generally annular axially spaced partitioning portions located between the motor and compressor components and defining an annular suction muffling chamber having inlet portions opening thereinto from said guide and outlet portions leading to the inlet of the compressor component, one of said partitions being integral with the body and the other partition comprising an orificed plate fitted in and occupying the full cross section of the interior of said extension.

2. A motor-compressor as defined in claim **1** wherein the lower partition is integral with the body and the upper partition is defined by said orificed plate.

3. In a refrigeration motor-compressor including a casing having an oil sump space in a bottom area thereof, a compressor mounted near the bottom therein and having a shaft extending upwardly therefrom within the casing, a motor in the casing above the compressor for driving the shaft, and means for conducting compressed fluid from the compressor and for supporting the compressor and motor as a unit within the casing comprising a generally annular discharge cover secured to the bottom of the compressor, said cover having annularly arranged muffling chamber portions therein, bearing means for said shaft carried by said cover spaced radially inwardly from said chamber portions, an annular upwardly reentrant spring pocket in said cover between said muffling chamber portions and bearing means, oil pumping, pickup and feeding means carried by the shaft and extending downwardly through the bearing means and into the oil sump space, and a compression coil spring extending upwardly into said pocket from the bottom of the casing and reacting against said cover to support the motor-compressor.

4. A refrigeration motor-compressor assembly of the type having a motor component and a compressor component, said components being enclosed in a sealed container, which container has an inlet through which suction gas is delivered to the interior of the container at a position outside both components, the compressor component having an inlet for receiving gas from the interior of the container, a gas-conducting guide surrounding at least a part of the motor component for guiding suction gas over the motor component to the inlet of the compressor component, the guide having a gas inlet which opens thereinto from the container at a position remote from said compressor component inlet, said guide having an outlet coupled to the inlet of the compressor component in substantially gas-tight relation, the two components being direct-coupled by coaxial vertical shaft portions, the inlet to the guide being generally coaxial with the shaft portions at the motor end, characterized by diverting means carried by the guide and surrounding the inlet thereto for deflecting heavier constituents away from said inlet, said guide including an inturned annular flange at its upper end defining a central inlet orifice, the diverting means including an upwardly extending rim portion surrounding and outspaced from said orifice, and a shield overlying said orifice and extending outwardly toward but spaced from the rim portion and spaced above the orificed portion of the flange.

5. A motor-compressor as defined in claim **4** wherein said shield and guide are rigidly secured to said components, and spring locating means on said shield and extending into but spaced from the periphery of said orifice.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,807,907 Dated April 30, 1974

Inventor(s) Edwin L. Gannaway

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 8, "1972" should be -- 1970 --.

Column 2, line 61, "7" should be -- 74 --.

Column 3, line 59, "connecting" should be -- connected --.

Signed and sealed this 27th day of August 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
☆ U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334