

March 15, 1960

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2,928,588

COMPRESSOR

Filed Oct. 24, 1956

3 Sheets-Sheet 1

FIG. 1.

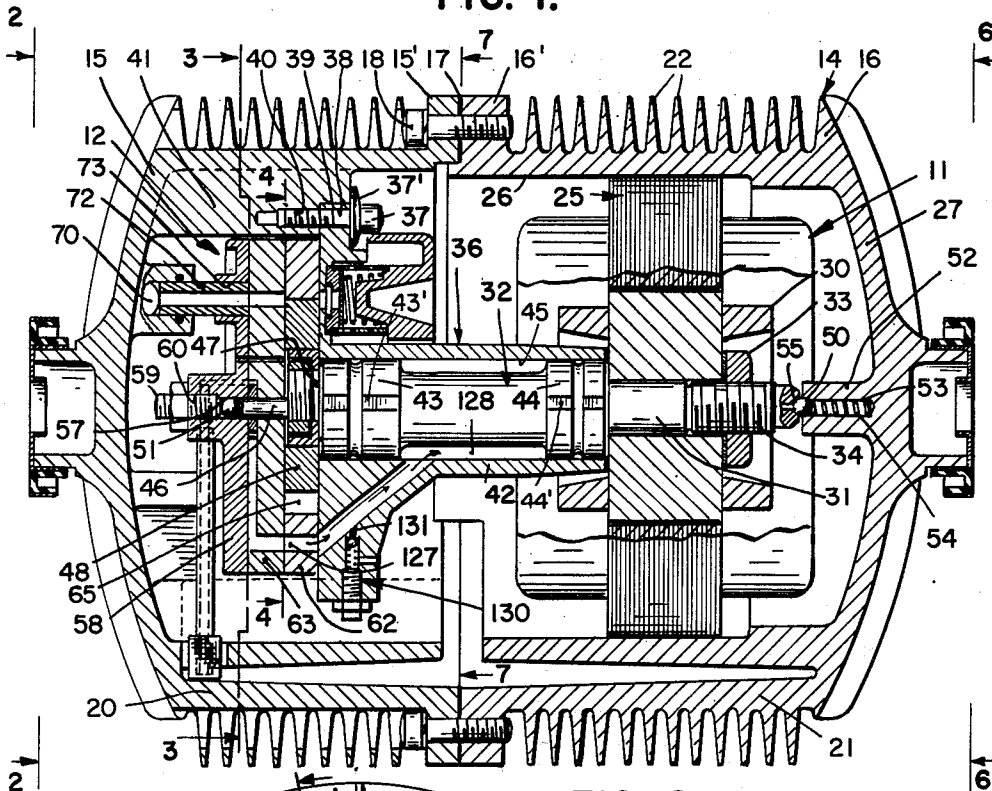
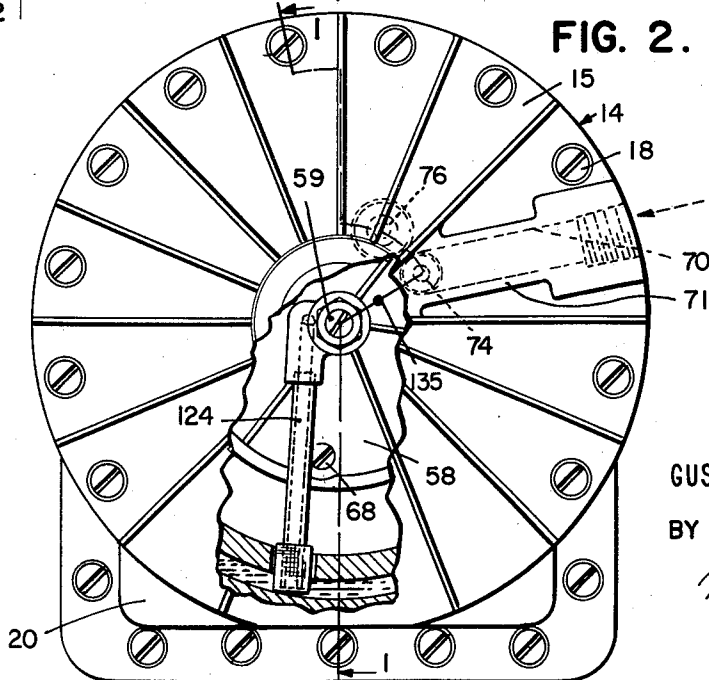


FIG. 2.



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3 Sheets-Sheet 2

FIG. 3.

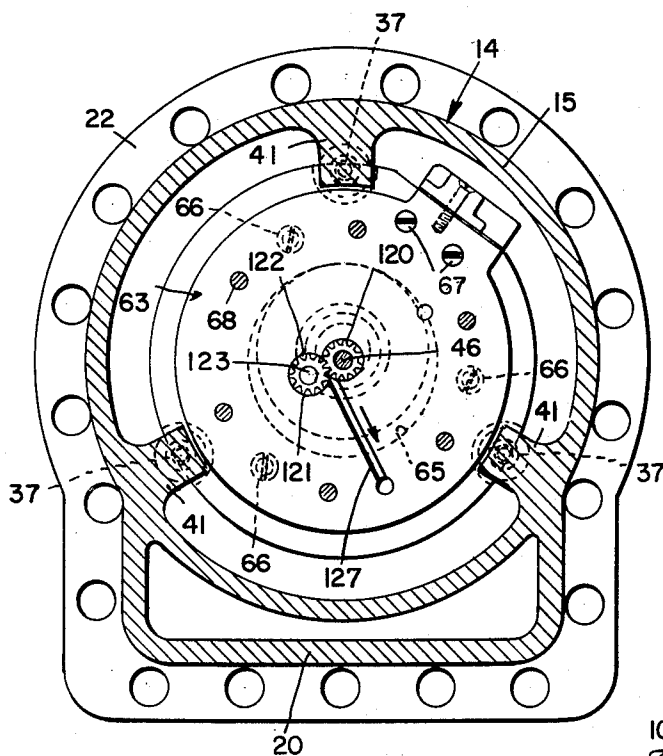


FIG. 4.

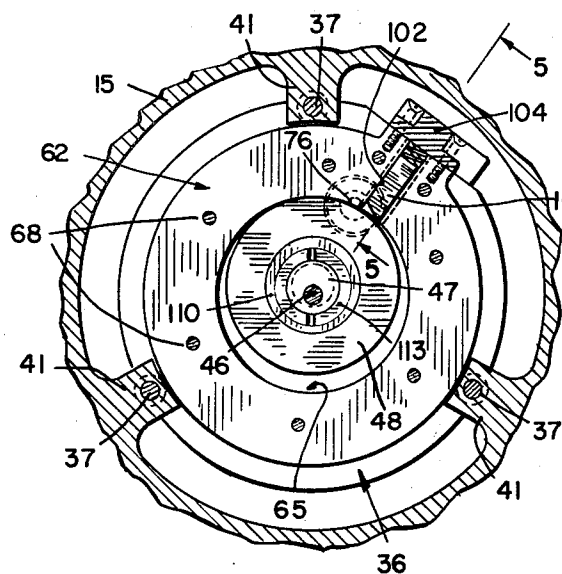


FIG. 1A.

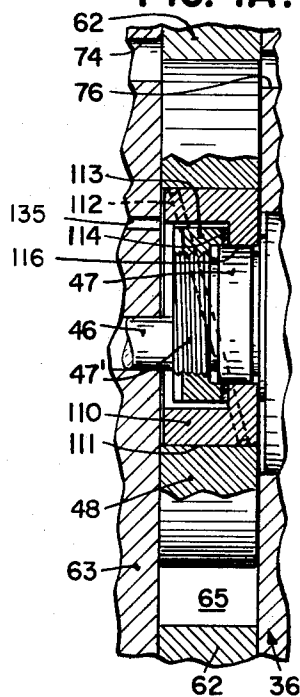
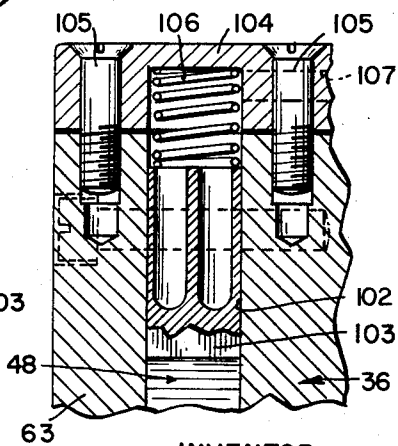


FIG. 5.



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3 Sheets-Sheet 3

FIG. 6.

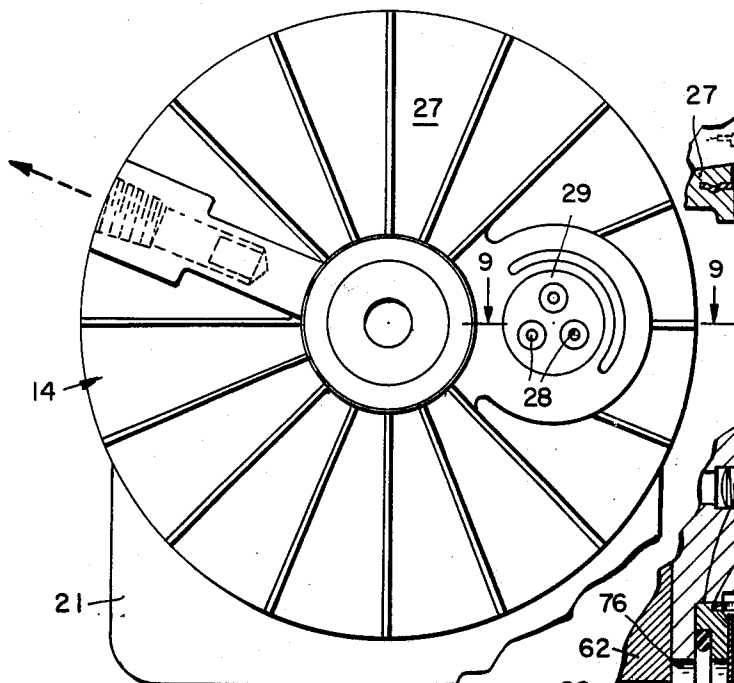


FIG. 9.

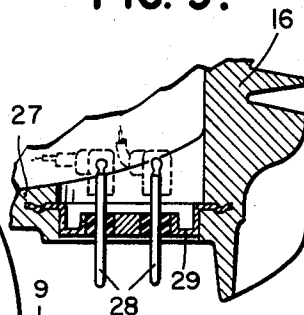


FIG. 8.

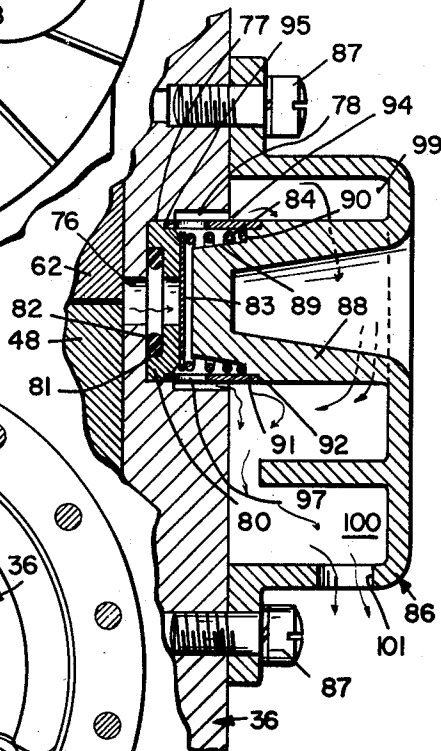
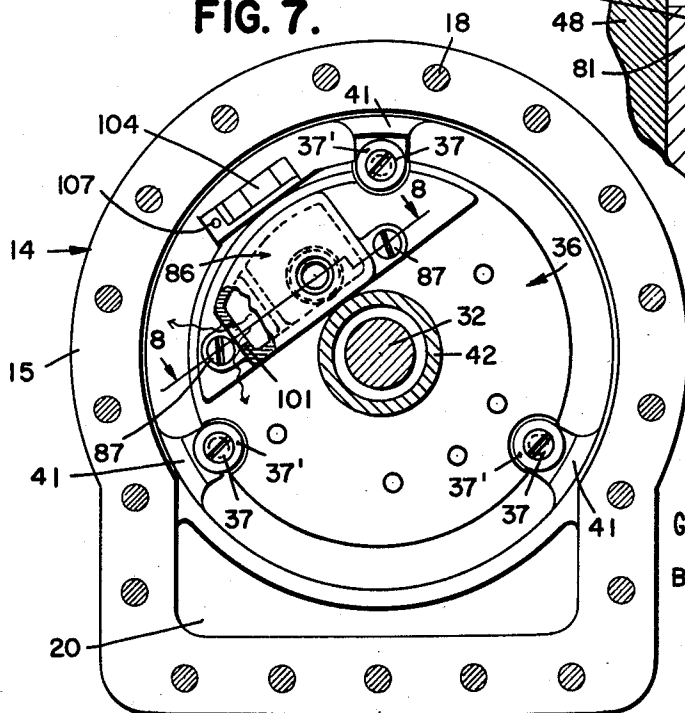


FIG. 7.



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## COMPRESSOR

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Application October 24, 1956, Serial No. 618,127

7 Claims. (Cl. 230—139)

This invention has to do with rotary compressors of the type commonly employed in refrigeration equipment.

An object of the invention is to provide a rotary-type compressor having several novel features of construction and possessing increased efficiency over prior compressors of this type.

Another object is to provide a novel construction in a rotary compressor which makes for ease of assembly. In this connection it is an object to provide novel means of mounting the roller on the crank section of the crank shaft which permits of radial adjustment of the roller during assembly. This enables the provision of close tolerances and the necessary adjustment of the roller for a perfect fit within the roller housing.

A further object is to provide a rotary compressor which is so constructed that it can be installed to run in either a horizontal or vertical position.

Another object of the invention is to provide a rotary compressor having a free or floating motor-compressor shaft with a single bearing ball at each end and means for adjusting the spacing of the balls.

A further object is to provide a rotary compressor which is exceptionally quiet in operation and, in this connection, it is an object to provide a novel exhaust valve and housing which is designed to muffle the ordinary sound generated by the exhaust gases and restrict the action of the valve.

Still another object is to provide a novel lubrication system wherein oil at a greater pressure than the pressure of the compressed gas is fed through the bearings of the motor-compressor shaft and fed to the roller in a manner to provide an oil seal for and around the roller, thereby greatly increasing the efficiency of the compressor over conventional devices.

A further object is to provide a compressor having a housing of aluminum or other light-weight metal and having novel mounting means which precludes the compressor elements being adversely affected by the relatively greater expansion and contraction of the housing.

Another object is to provide a compressor in which the motor rotor serves as a centrifuge to minimize the possibility of oil getting into the intake port.

A further object is to provide a compressor which is so constructed that the displacement can be readily varied merely by substitution of a different sized roller and a crank shaft of different throw.

These and other objects will be apparent from the drawings and the following description. Referring to the drawings:

Fig. 1 is a sectional elevation of a compressor embodying the invention, the plane of the view being indicated by line 1—1 on Fig. 2;

Fig. 1-A is an enlarged fragmentary sectional view of the roller mounting on the same plane as Fig. 1;

Fig. 2 is an end elevational view in the plane 2—2 of Fig. 1, the view being partly broken away;

Fig. 3 is a sectional view on line 3—3 of Fig. 1;

Fig. 4 is a fragmentary sectional view on line 4—4 of Fig. 1;

Fig. 5 is an enlarged fragmentary sectional view on line 5—5 of Fig. 4;

Fig. 6 is an end elevational view as indicated by line 6—6 of Fig. 4;

Fig. 7 is a sectional view on line 7—7 of Fig. 1;

Fig. 8 is an enlarged fragmentary sectional view on line 8—8 of Fig. 7; and

Fig. 9 is an enlarged fragmentary sectional view on line 9—9 of Fig. 6.

More particularly describing the invention, the compressor is of the hermetic or semi-hermetic, loose-roller, rotary type in which the motor, designated generally by 11, and the compressor unit, designated 12, are sealed within a housing 14 into which the compressor unit exhausts. The housing comprises a pair of mating sections, designated 15 and 16, which are provided with flanges 15', 16' for abutting relation, a suitable gasket 17 being provided therebetween. The housing sections are secured by a plurality of cap screws 18. In this connection it may be noted that the housing sections are generally cylindrical except for the bottom portions thereof, designated 20 and 21. Peripheral fins 22 are provided on the housing for cooling. The fin area is extremely large, resulting in efficient cooling, which contributes to the over-all efficiency of the device.

Housing section 16 supports the motor 11 which is preferably mounted therein by means of a shrink-fit of the motor stator 25 within the cylindrical wall 26. End wall 27 of the housing section 16 is provided with suitable electrical terminals 28 mounted in a plate 29 for the purpose of passing electrical current through the casing to the motor, plate 29 being embedded in the housing at the time of die casting thereof.

The motor rotor 30 is shown mounted upon a reduced end portion 31 of a motor-compressor shaft 32. The rotor is retained by means of a nut 33 engaging a threaded end portion 34 of the shaft.

Shaft 32 is journaled in a bearing flange, designated generally 36. This is mounted in housing section 15 by means of cap screws 37 which pass through recesses 38 in the rim of flange portion 39 of member 36 and into threaded bores 40 in three circumferentially spaced mounting bosses 41 of the casing. In order to compensate for the expansion and contraction of the housing, which is preferably made of a light-weight metal, I provide a conical-type washer 37' or the like between the head of the screw 37 and the parts 36 and 40. With this construction, the expansion and contraction of the housing has no effect upon the compressor unit's close tolerances.

Member 36 has an elongated tubular section 42 in which the shaft 32 is received. The latter has two axially spaced, grooved bearing areas 43 and 44 which are journaled within the bore 45 of member 36. At the compressor unit end, the shaft terminates in a cylindrical section 46 of reduced diameter and intermediate this and the bearing section 43 is an eccentric section 47 upon which is mounted the rotor or roller 48 of the compressor. The shaft is substantially free-floating and its axial movement is limited by a pair of bearing balls one at each end of the shaft, designated by 50 and 51. The ball 50 is mounted at the inner end of a boss 52 formed in the housing section 16. A bore 53 containing a compression spring 54 is provided behind the ball 50, and the end of the shaft 32 is recessed at 55 to partially receive the ball.

The other ball, 51, is adjustable within a bore 57 in a cap 58, an adjustment screw 59 being threaded into a counterbore 60 of the cap.

Mounted against the bearing flange 36 is the cylinder

62 of the compressor unit. Adjacent this is a plate 63 which forms one side of the cylinder chamber 65 in which the roller operates. The cap 58 completes this assembly. Three screws 66 secure the cylinder 62 to the bearing flange. A pair of screws 67 fasten plate 63 to the cylinder and the bearing flange. Several screws 68 fasten the cap 58, passing through members 62 and 63 and threading into member 36.

The housing section 15 is provided with an inlet passage 70 which terminates in the inwardly projecting tubular section 71 of the housing. Mounted in this is a short tube 72 which extends into a bore 73 in the cap 58. Tube 72 continues the inlet passage to a bore 74 in member 63, the latter providing communication to chamber 65 in the cylinder 62.

Substantially opposite the inlet port 74 but spaced circumferentially a few degrees therefrom is an exhaust port 76 in member 36. In the region surrounding the exhaust port, member 36 has a first counterbore 77 and beyond this, a second counterbore 78, as best shown in Fig. 8. An exhaust valve seat 80 is positioned in the counterbore 77 and this is shown as having an undercut surface 81 to accommodate a seal ring 82. Member 80 provides a flat outer surface against which a flat or reed or disk exhaust valve 83 seats. The valve is urged toward the seat by a compression spring 84.

Surrounding the valve seat area I provide a muffler, designated 86, which may be mounted on member 36 by screws 87. The muffler includes an inwardly projecting portion 88 having a conoidal surface 89 which terminates in a shoulder 90. Portion 88 limits the travel of the valve. Outwardly of the shoulder 90 is a cylindrical section 91 and beyond this a shoulder 92. The muffler 86 serves to retain the valve seat and valve spring and, for the purpose of securing the valve seat, I provide a valve guide tube 94 which extends between shoulder 92 of the muffler and an annular shoulder 95 on the valve seat. Member 94 is provided with a plurality of apertures 97 for the escape of compressed gas. In this connection, it should be noted that the counterbore section 78 of member 36 is of sufficiently large diameter to provide a passage from such apertures to a space 99 within the muffler. From the space 99 the exhaust gas must flow into a compartment 100 from which it escapes into the interior of the housing through a port 101.

Member 62 provides a radially extending slot 102 which slidably receives a divider blade 103. A cap 104, which is detachably secured to member 62 by screws 105, closes the outer end of this slot and a compression spring 106 is interposed between the cap and the outer end of the divider blade, as shown in Fig. 5. The cap has a relief passage 107.

One of the features of the invention is the manner in which the roller 48 is mounted upon shaft 32. This is accomplished in such a way that during assembly a limited amount of adjustment can be made of the rotor radially of the eccentric portion of the shaft. Referring particularly to Figs. 1 and 1-A, I provide a threaded portion 47' on the eccentric part of the shaft. On the portion 47 of the shaft I mount a cup member 110 which is provided with a cylindrical outer surface 111. The latter may be interrupted by two or more helical oil grooves 112 extending from one side to the other of the cup member. The cup member has a cylindrical inner surface 116 which rotatably receives the portion 47 of the shaft. The outer surface 111 is slightly eccentric with respect to the inner surface so that, during assembly, by rotating the cup member on the shaft portion 47 the roller may be adjusted radially slightly. When the correct adjustment is found the cup is securely tightened upon the shaft by means of a nut 113, a suitable washer 114 being used between the nut and the cup.

Another feature of the invention is the lubrication system by means of which the shaft and roller are supplied

with lubricating oil at a pressure in excess of the gas pressure developed. The lubrication system includes a gear pump comprising a drive gear 120 fixed to the reduced portion 46 of the shaft, and a driven gear 121 meshing therewith. The gears are housed in a suitably shaped recess 122 in plate 63. The driven gear rotates on a dowel pin 123. An oil tube 124 leads from the lower portion of the casing to an oil passageway 125 in the cap to supply the gear pump. An oil delivery passage, designated 127, extends from the pump through members 63, 64, and 36 to deliver oil to the interior of portion 42 of member 36 to a space 128 in the region of the central portion of the shaft. From here the oil passes axially of the shaft in both directions to lubricate the parts. In this connection, it should be noted that the shaft portions 43 and 44 are provided with axially extending flat sections 43' and 44', of which there may be two on each portion, to facilitate travel of the oil along the shaft. Preferably the flat sections 43' are wider than the others. A pressure relief valve 130 is provided in a relief passage 131 leading from oil delivery passage 127.

It will be apparent that, with the construction described, oil passes along the shaft to the eccentric portion thereof and to the cup and roller, thus affording positive lubrication of the compressor unit and oil-cooling of the parts where they are subjected to the greatest wear. Oil is returned to the bottom of the casing by the oil return passage 135 (Figs. 1 and 1-A).

Another feature of the lubrication system is the fact that oil passing along the shaft to the motor rotor assists in cooling the motor. Also, as the oil leaves the end of bore 45 of member 36, the motor rotor acts as a centrifuge thereon, separating entrapped gas in the oil from the oil.

It may also be pointed out that one of the features of the construction described is that it is possible to change the volumetric capacity of the compressor unit by merely changing the roller and the shaft. So far as I know, in prior devices it has been necessary to change at least five parts of the compressor unit in order to alter the volumetric capacity.

It will be apparent that the above described construction accomplishes the various objects and features hereinbefore pointed out. While I have disclosed a preferred form of the invention, it is contemplated that various changes and modifications can be made therein without departing from the scope of the invention as indicated by the claims which follow.

I claim:

1. In a rotary compressor, a motor-driven shaft having an eccentric portion, means forming a cylindrical chamber around the eccentric portion of the shaft concentric with the axis of rotation of the shaft, a cup member on said eccentric portion of the shaft having a cylindrical inner surface and a cylindrical outer surface, said surfaces being eccentric with respect to each other, fastening means on said eccentric portion of the shaft within said cup member securing said cup member thereto and against rotation, said cup member being rotatable on said eccentric portion of the shaft when unsecured by said fastening means, and a compressor roller mounted for rotation on the outer surface of said cup member, said roller being adapted to make rolling contact with the inner peripheral wall of said cylindrical chamber upon rotation of said shaft.

2. The construction set forth in claim 1 in which the fastening means securing said cup member to the shaft comprises a threaded portion on the eccentric portion of the shaft and a nut on said threaded portion, and in which said cup has a counterbore receiving said nut.

3. In a compressor of the rotary type, a housing, an electric motor contained in said housing, a rotary compressor unit contained in said housing, a motor compressor shaft common to said motor and said compressor

5

unit journaled in said compressor unit, and means limiting axial movement of said shaft comprising a bearing ball at each end of the shaft, one of said bearing balls being resiliently supported by said housing and the other of said bearing balls being supported by said compressor unit, and means carried by said compressor unit for adjusting said other of said bearing balls axially of the shaft.

4. In a compressor of the rotary type having wall means forming a cylindrical chamber and having a motor-driven roller for operation therein, said means providing an exhaust port for said chamber, a valve seat in said means surrounding said port, a disk valve engageable with said seat to close said port, a valve guide tube surrounding said valve, and muffler wall means closing the outer end of said tube and securing the same in place, said muffler wall means providing a muffler chamber surrounding said tube, said tube being provided with apertures providing communication from the interior thereof to said chamber, said muffler wall means being apertured at a point remote from said valve tube to provide an outlet for gas in said muffler chamber.

5. In a compressor of the rotary type embodying a freely rotatable piston roller in a cylindrical chamber, a first housing section, a second housing section, means detachably securing said housing sections together, a motor unit rigidly mounted in said first housing section, a compressor unit in the second housing section, flexible means mounting said compressor unit in said second housing to compensate for thermal expansion and contraction of said housing, and a common rigid shaft extending from the motor unit to the compressor unit having an eccentric portion upon which the piston roller is mounted.

6. A construction as set forth in claim 5 in which said motor unit is mounted in said first housing member by a shrink-fit of the motor stator in said first housing member.

7. In a rotary compressor, a casing, a bearing flange mounted in the casing and having a cylindrical bore, a motor-driven shaft journaled in the bore of said bearing flange and having an eccentric portion, a roller carried upon the eccentric portion of said shaft, means forming a cylindrical chamber around said roller, said shaft having an extension beyond said chamber, an oil pump

6

driven by said shaft extension, means providing an oil intake passage to said pump from the lower portion of said casing, means providing an oil delivery passage from said pump to the interior of the bore of said bearing flange, said oil delivery passage terminating at a point intermediate the ends of the bore of said bearing flange, one of said shaft and said bearing flange being provided with means forming oil passage space axially along said shaft in both directions, and means providing an oil return passage from said cylindrical chamber at a region inwardly of the periphery of said roller to a region within the casing exteriorly of said chamber, said bearing flange being open at the end opposite to the end to which the cylindrical chamber is adjacent.

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