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Cassidy

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[54] **ROTARY VANE REFRIGERANT GAS COMPRESSOR**

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[73] Assignee: **Chrysler Corporation, Highland Park, Mich.**

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[52] **U.S. Cl.**..... **418/89**, 418/97, 418/267, 55/186, 55/487

[51] **Int. Cl.**.... **F01c 21/04**, F04c 29/02, B01d 19/00

[58] **Field of Search**..... 418/88, 89, 97–100, 418/266–268; 55/186, 437, 439, 487, 485; 62/84, 468, 470

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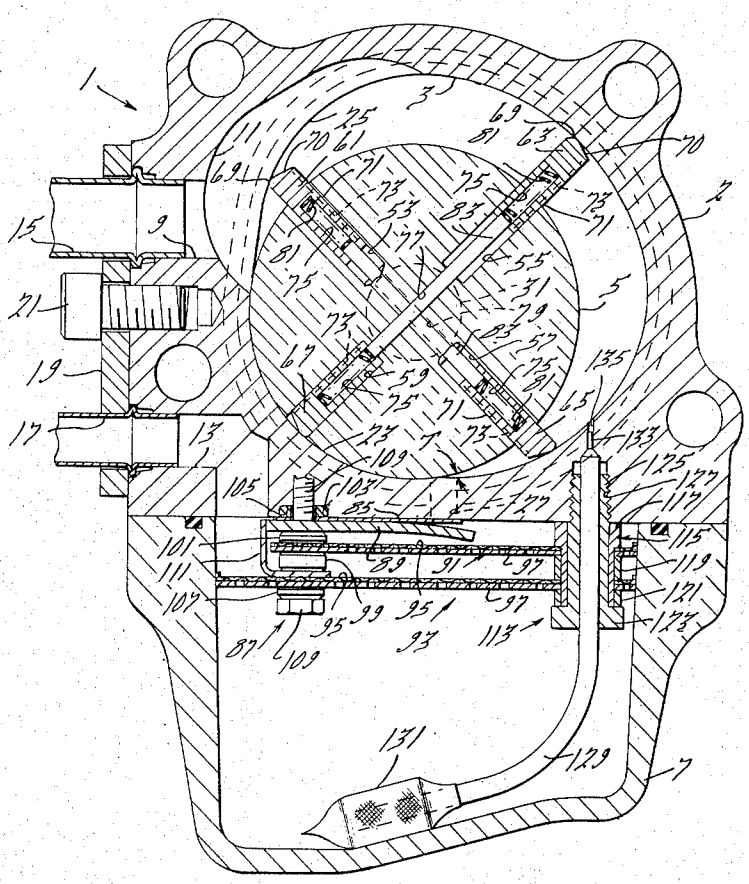
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[57] **ABSTRACT**

Rotary vane compressor having a plurality of radially directed vanes. The vanes are movable and are biased toward engagement with a cavity surface. An oil sump containing a separator assembly is attached to the rotor housing.

10 Claims, 2 Drawing Figures



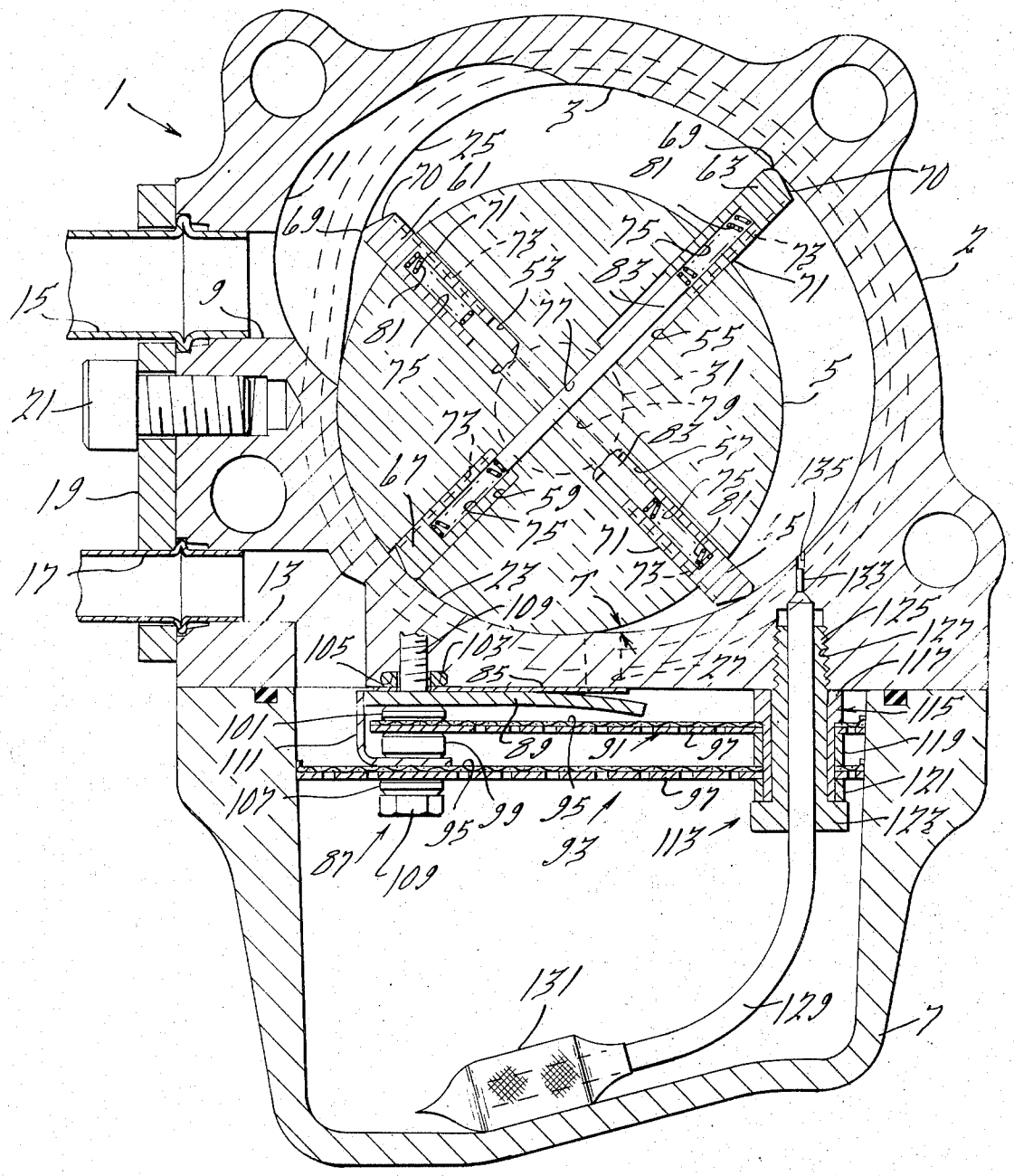

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Fig. 1.

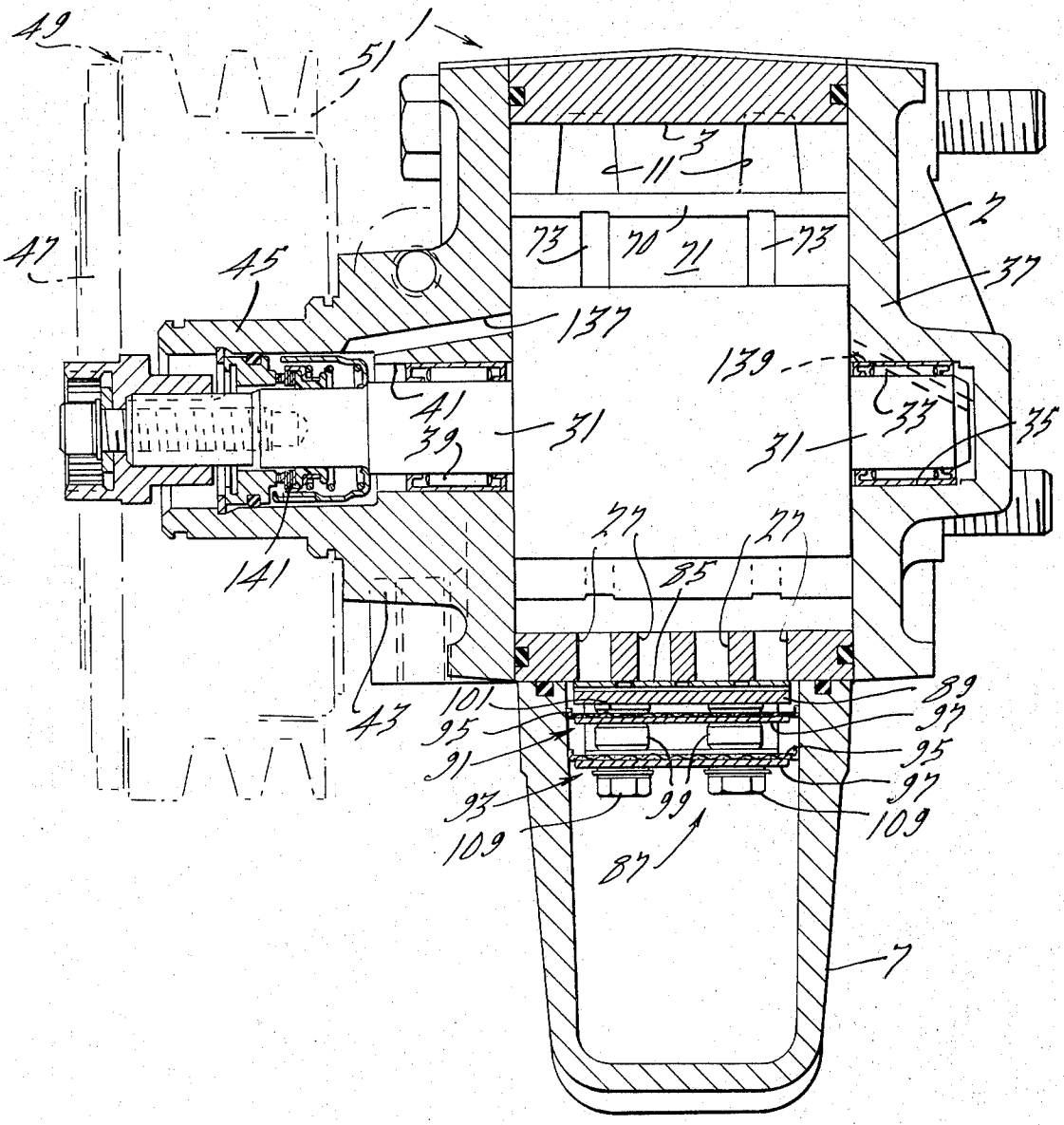

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Fig. 2.

ROTARY VANE REFRIGERANT GAS COMPRESSOR

BACKGROUND OF THE INVENTION

This invention relates to compressors and more particularly to a rotary vane compressor for an automotive air conditioning system.

Rotary vane compressors for air conditioning systems are old and conventionally include a rotor mounted eccentrically in an enlarged chamber with the rotor being tangent to a portion of the chamber wall. One or more vanes are slideably mounted in slots in the rotor and engage the wall of the chamber. The present invention relates to an improved compressor of this type.

BRIEF SUMMARY OF THE INVENTION

Briefly, this invention comprises a rotor housing, a rotor in such housing, vanes carried by such rotor, and an oil sump connected to the discharge side of such compressor.

One of the primary objects of this invention is to provide an improved vane compressor wherein refrigerant fluid is introduced into the chamber, compressed between the rotor, the chamber walls, and two vanes, before being discharged through an oil separator assembly, the compressor performance being high in comparison to its size.

Another object of this invention is to provide a rotary vane compressor of the class described wherein a fluid pressure is applied to the vanes for urging them outwardly against the chamber wall.

A further object of this invention is to provide a rotary vane compressor such as described wherein overcompression of refrigerant is minimized.

Still another object of this invention is to provide a rotary vane compressor of the type described wherein lubrication of bearings is enhanced.

A further object of this invention is to provide a rotary vane compressor of the type described wherein lubrication of the vanes is easily accomplished.

Still another object of this invention is to provide a rotary vane compressor such as described which is economical in construction and effective in operation.

Other objects and advantages will be made apparent as the description progresses.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings, in which one of various possible embodiments are shown.

FIG. 1 is a vertical section taken through a compressor constructed in accordance with this invention, the section being perpendicular to the axis of rotation of the rotor; and

FIG. 2 is a vertical section taken through the compressor on the axis of rotation of the rotor, certain parts being rotated and other parts being removed for clarity, with a pulley and clutching device being shown in broken lines.

Like parts are shown by corresponding reference characters throughout the several views of the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, a compressor of this invention is indicated at **1** and generally includes a

housing **2** having a rotor cavity **3** therein, a rotor **5** in such cavity, and a sump housing **7** attached to the housing **1**.

More particularly, housing **2** has an inlet **9** through a wall thereof into slots **11** opening into cavity **3**. An outlet **13** is also formed in the housing wall. An inlet line or tube **15** and a discharge line or tube **17** are respectively clamped in the inlet **9** and outlet **13** by a clamping plate **19** secured to the housing by a fastener **21**.

Cavity **3** has one wall portion **23** having a curvature substantially the same as the curvature of the rotor and mating therewith, and a second intake and compression portion **25** having a smaller curvature, i.e., being generally formed with one or more radii larger than the radius of curvature of portion **23**. The second portion **25** extends from the opposite ends of portion **23** and also from approximately the inlet or the ends of slots **11** to a point adjacent a plurality of discharge ports **27**. The housing **2** is adapted to be connected to suitable brackets or ears (not shown) attached to an automotive vehicle engine.

Rotor **5** includes a shaft **31** which may be connected in any suitable manner, such as by brazing, for example, mounted by bearings **33** in a bore **35** in one wall **37** of housing **2** and by bearings **39** in a bore **41** in another wall **43**. The axis of rotation of shaft **31** is offset with respect to the center of the cavity **3**. Shaft **31** extends outwardly from bearings **39** through a hollow nose portion **45** on wall **43** and is adapted to be connected to an armature **47** of a magnetic clutch **49** having a pulley portion **51** mounted on the nose **45**. The magnetic clutch is shown in broken lines in FIG. **2** and it will be understood that such clutch is merely exemplary, with many other types and designs of clutches being usable with the compressor.

The rotor **5** is of generally solid cylindrical shape and has four rectangular radial slots **53, 55, 57** and **59** extending axially of the rotor and spaced at 90° intervals around the rotor. Vanes **61, 63, 65** and **67** are respectively slideably mounted in slots **53, 55, 57** and **59**. The vanes are identical in construction and a description of one will suffice for all.

The vanes have a length substantially equal to the width of the rotor **5** and cavity **3**. Each vane has a tip edge portion **69** at its outer end which is adapted to engage the curved surface of the cavity **3** during its traverse of such surface. The outer end of each vane is tapered inwardly as indicated at **70** from the tip or edge portion **69** toward the leading side **71** of the vanes so that such taper does not sealingly engage the cavity surface for a purpose to be made apparent hereinafter.

Each side **71** has a pair of generally radially directed slots **73** therein extending from taper **70** to the inner end of the vane for forming passages between the vanes and their respective slots from the cavity **3** to the inner ends of the slots.

Each vane has two radial bores **75** extending from its inner end toward the tips **69**. The bores **75** of vanes **63** and **67** are aligned with each other and with bores **77** extending through the rotor and shaft between the inner ends of slots **55** and **59**. Likewise the bores **75** of the vanes **61** and **65** are aligned with each other and with bores **79** extending through the rotor and shaft between the inner ends of slots **53** and **57**. The bores in the vanes **63** and **67** and bores **77** are axially offset from the bores in the vanes **61** and **65** and bores **79** to pre-

vent intersection of the bores at the center of the shaft.

One end of a spring **81** is seated in each bore **75** and the other end of each spring engages an end of a rod **83** extending from the respective bore in the vane through the respective bore **77** or **79** into the bore of the opposite vane. The springs **81** thus exert an outwardly directed bias on the vanes. The length of the rods **83** is such that the springs **81** do not bottom when the distance from tip to tip of two opposed vanes is the least, nor do the ends of the rods come out of the bores **75** when the distance from tip to tip of two opposed vanes is the greatest.

Referring now to the discharge side of the compressor, a multi-fingered reed valve **85** is secured to the housing **2** on the outside of discharge ports **27** by a stop and oil separator assembly **87.**

Assembly **87** includes a curved stop **89** for the reed valve **85** and two separator sections **91** and **93** each of which includes a screen **95** on the upper face thereof and a perforated plate **97** on the lower face thereof. The sections **91** and **93** are spaced from one another by spacers **99.** Spacer **101** also separates the section **91** from the stop **89.** Tubular sleeves **103** extend up through the sections **91** and **93** at one end thereof and through spacers **99,** stop **89** and reed valve **85** into cavities **105** formed in housing **2.** Spacer **107** is located on the lower ends of the sleeves **103** and bolts **109** extend through such spacers and sleeves **103** for securing one end of the assembly **87** to the housing.

The lower section **93** is larger than section **91** and substantially corresponds to the shape and size of the sump housing cavity so that all gas and lubricant must pass through the section before leaving the sump. An oil deflector **111** prevents oil and gas from bypassing one or both sections **91** and **93.**

The other end of assembly **87** is connected together and to housing **2** by a single connector assembly **113** which also performs a second function as a lubricating passage. Assembly **113** includes a sleeve **115** having a head **117** at the upper end thereof and spacers **119** and **121** located respectively below sections **91** and **93.** A sleeve connector **123** extends through sleeve **115** and has a threaded end **125** connected to a threaded passage **127** in housing **2.**

A tube **129** having a filter **131** on one end extends through sleeve **123** and passage **127,** and has a reduced diameter end portion **133** extending into a lubricating port **135** opening into cavity lubricating port **135** opening into cavity **3** at a point thereof in which the pressure of gas is at times less than the pressure of gas and lubricant in sump **7.** The opening of port **135** is approximately midway between the side walls of the cavity.

It will be noted that outlet **13** opens into the sump cavity **7** above the extended portion of section **93** outside the deflector **111.**

A lubricating port or passage **137** extends from cavity **3** through wall **43** to the inside of nose **45** which is in communication with the bearings **39,** and a port or passage **139** extends from cavity **3** through wall **37** to the bore **35** in which bearings **33** are mounted. The inner ends of ports **137** and **139** are aligned with the inner ends of the vane slots **53, 55, 57** and **59** as the latter pass thereby while the respective vane slot is in communication with gas and lubricant which are at a low pressure, such as inlet pressure. This places ports **137** and **139** at a low pressure, and causes gas and lubricant at high compressed pressure to migrate across the sides of the rotor to and through the bearings **33** and **39,** and adjacent a seal **141,** thereby lubricating the latter three elements.

Operation of the compressor of this invention is as follows:

Refrigerant gas to be compressed is delivered to the compressor through suction tube **15** to inlet **9.** As will be understood, the rotor **5** is being rotated in a clockwise direction as viewed in FIG. **1** by the drive pulley **51** and clutch **49** and creates a low pressure in inlet **9** thus causing the flow of gas into slots **11** and cavity **3.** When the tip **69** of vane **71** passes the end of slots **11** the gas, and any lubricant mist mixed therewith, is trapped in the moving chamber formed by the side walls of cavity **3,** the outer wall of such cavity, the rotor surface and the vanes **61** and **63.** As this chamber becomes smaller due to the rotation of the rotor the gases are compressed.

The vanes are forced outwardly by the centrifugal force thereon, by the pressure of the compressed gas which is passed through the slots **73,** and by the spring force exerted on the vanes by the springs **81.** These forces are opposed by the force created by the pressure of the gas between the curved surface face of the cavity and the tapered surfaces **70** of the vanes. This pressurized gas is biasing the vanes inwardly. If the pressure of the refrigerant and lubricant mixture in the moving chamber becomes exceedingly high as the chamber moves toward the discharge ports **27,** the vane will be forced inwardly slightly against spring **81** permitting the escape of some of the mixture into the following chamber. Thus, the vanes act as their own safety valves and prevent the mixture from being compressed and pressurized beyond a predetermined or objectionable value. The throat area provided in the area of the discharge ports **27** and indicated by T also tends to prevent overcompression.

As the vanes are moved inwardly during rotation of the rotor, the springs **81** and pins **83,** along with the centrifugal force, cause the opposite vanes to move outwardly against the curved surface of the cavity.

When the pressure of the gas in the moving chamber reaches a predetermined value, the reed valve **85** will open to allow the compressed gas and oil mixed therewith to be discharged downwardly through the screen and separator sections **91** and **93.** The oil collects on the screens and passes through the perforated plates, dropping as droplets into the sump **7.** The gas passes through the screen and separator sections to the sump, above the level of oil therein, and then passed upwardly through an extension of section **93,** past baffle **111** into the outlet **13** and to the tube **17.**

The pressure of gas in the sump **7** is at times higher than the pressure of gas in the moving chamber into which port **135** opens. Accordingly, oil is forced upwardly through the tube **129,** to such port from which it is discharged into the cavity.

This oil lubricates the various moving parts within the cavity. However, due to the construction of the compressor and particularly the vanes thereof, the oil is not capable of creating slugging, such as might occur if some means were not provided for relieving pressure if a chamber were somehow filled with liquid. In such case the lubricant acts on the tapered portions **70** to force the vane inwardly, thereby preventing slugging and damage to the compressor and clutch.

In view of the foregoing it will be seen that the several objects and advantages of the invention are achieved.

Although only one embodiment of the invention has been disclosed and described, it is apparent that other embodiments and modifications of the invention are possible.

I claim:

1. A rotary vane refrigerant gas compressor comprising a compressor housing having a cavity therein, an inlet into said cavity and a discharge outlet from said cavity, a rotor means mounting said rotor for rotation in said cavity, the axis of rotation of said rotor being offset from the center of said cavity, said rotor having a plurality of slots therein, vanes movably located in said slots separating said cavity into a plurality of moving chambers, said vanes cooperating with said cavity walls and said rotor to compress gas supplied to said cavity from said inlet and to discharge said compressed gas through said discharge outlet, an oil sump housing attached to said compressor housing, means for supplying oil from said sump housing to said cavity, said discharge outlet opening into said oil sump housing, a valve normally closing said discharge outlet and adapted to open when the pressure of gas and oil on the upstream side thereof exceeds a predetermined value, and a separator device in said sump in the path of gas and oil discharged from said discharge outlet, at least one fastening device securing said separator device to said compressor housing, said separator device comprising at least two sections spaced apart from one another, each section including a screen and a perforated plate adjacent and on the downstream side of said screen, said separator device including an L-shaped deflector to prevent gas and oil discharged from said discharge port from bypassing said separator, said fastening device passing through one leg of said L-shaped deflector.

2. A rotary vane refrigerant gas compressor as set forth in claim 1 wherein said compressor has an outlet passage, one of said sections extending beyond said deflector and causing gas and oil passing through said separator to pass through the portion of said one section extending beyond said deflector before passing to said outlet passage.

3. A rotary vane refrigerant gas compressor as set forth in claim 2 further including a second fastening device having an opening therethrough, said means for supplying oil from said sump housing to said cavity including a tube extending from said sump through said second fastening device, said compressor housing having a port therein opening into said cavity, said tube opening into said port.

4. A rotary vane refrigerant gas compressor comprising a compressor housing having a cavity therein, an inlet into said cavity and a discharge outlet from said cavity, a rotor, means mounting said rotor for rotation in said cavity, the axis of rotation of said rotor being offset from the center of said cavity, said rotor having a plurality of slots therein, vanes movably located in said slots separating said cavity into a plurality of moving chambers, said vanes cooperating with said cavity walls and said rotor to compress gas supplied to said cavity from said inlet and to discharge said compressed gas through said discharge outlet, an oil sump housing attached to said compressor housing, means for supplying oil from said sump housing to said cavity, said discharge outlet opening into said oil sump housing, a valve normally closing said discharge outlet and adapted to open when the pressure of gas and oil on the upstream side thereof exceeds a predetermined value, and a separator device in said sump in the path of gas and oil discharged from said discharge outlet, fastening means securing said separator device to said compressor housing, said fastening means including one fastening device having an opening therethrough, said means for supplying oil from said sump to said cavity including a tube extending from said sump housing through said one fastening device, said compressor housing having a port therein opening into said cavity, said tube opening into said port.

5. A rotary vane refrigerant gas compressor as set forth in claim 4 wherein said cavity is noncircular, and has a first portion having a curvature generally corresponding to the curvature of said rotor, and a second portion having less curvature than said first portion.

6. A rotary vane refrigerant gas compressor as set forth in claim 4 wherein each vane includes a tip edge extending along the outer periphery thereof adjacent the trailing side of the vane, and a tapered portion extending from said tip edge to the leading side of said vane.

7. A rotary vane refrigerant gas compressor comprising a compressor housing having a cavity therein, an inlet into said cavity and a discharge outlet from said cavity, a rotor, means mounting said rotor for rotation in said cavity, the axis of rotation of said rotor being off-set from the center of said cavity, said rotor having a plurality of slots therein, vanes movably located in said slots separating said cavity into a plurality of moving chambers, said vanes cooperating with said cavity walls and said rotor to compress gas supplied to said cavity from said inlet and to discharge said compressed gas through said discharge outlet, an oil sump housing attached to said compressor housing, means for supplying oil from said sump housing to said cavity, said discharge outlet opening into said oil sump housing, a valve normally closing said discharge outlet and adapted to open when the pressure of gas and oil on the upstream side thereof exceeds a predetermined value, and a separator device in said sump in the path of gas and oil discharged from said discharge outlet, at least one fastening device securing said separator device to said compressor housing, said means for supplying oil from said sump hosuing to said cavity including a tube extending from said sump housing to a lubricating passage in said housing, said lubricating passage opening into said cavity, said tube having a filter on the end thereof in said sump housing, said separator device including a generally L-shaped deflector to prevent gas and oil discharge from said discharge port from bypassing said separator, said fastening device passing through one leg of said generally L-shaped deflector.

8. A rotary vane refrigerant gas compressor as set forth in claim 7 wherein said compressor has an outlet passage, one of said sections extending beyond said deflector and causing gas and oil passing through said separator to pass through the portion of said one section extending beyond said deflector before passing to said outlet passage.

9. A rotary vane refrigerant gas compressor as set forth in claim 7 wherein each vane includes a tip edge extending along the outer periphery thereof adjacent the trailing side of the vane, and a tapered portion ex-

tending from said tip edge to the leading side of said vane.

10. A rotary vane refrigerant gas compressor as set forth in claim **7** wherein said cavity is noncircular, and has a first portion having a curvature generally corresponding to the curvature of said rotor, and a second portion having less curvature than said first portion.

* * * * *