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Rinehart

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[54] **ROTARY COMPRESSOR INCLUDING MEANS FOR REDUCING VANE SLOT WEAR**

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[52] **U.S. Cl.** **418/63,** 418/243, 418/248

[51] **Int. Cl.** **F01c 1/02,** F04c 1/02, F04c 17/02

[58] **Field of Search** 418/63, 235, 243–251

[56] **References Cited**

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[57] **ABSTRACT**

A hermetically sealed rotary refrigerant compressor comprising a compression cylinder, a rotor eccentrically rotatable in the cylinder, and a vane slidably mounted in a slot in the cylindrical wall of the cylinder includes means for introducing high pressure refrigerant into the vane slot at wall areas of maximum slot wear and connecting wall areas opposite the areas of maximum wear to low pressure.

3 Claims, 5 Drawing Figures

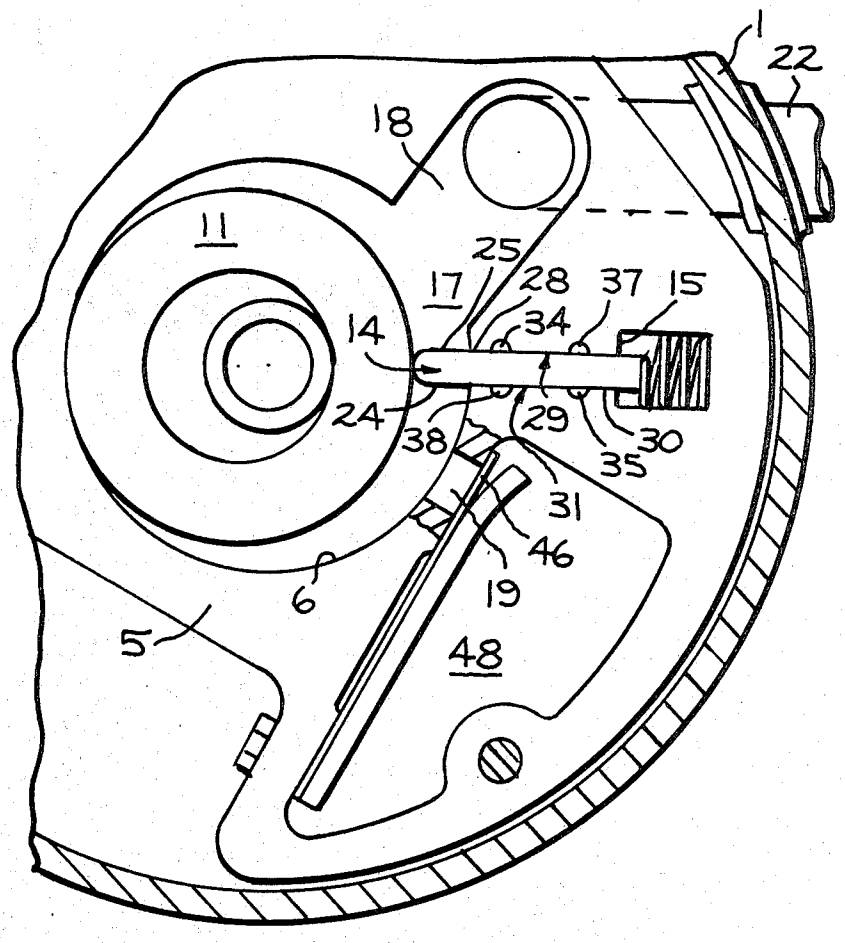
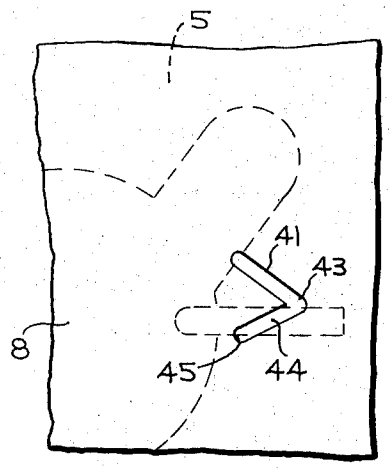


FIG. 5



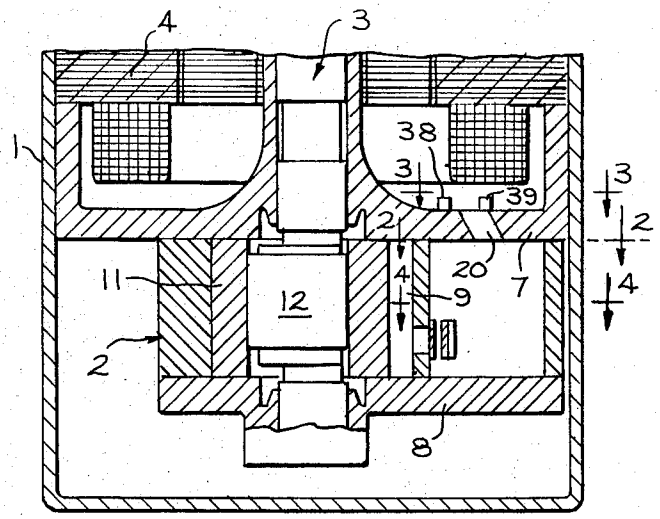


FIG. 1

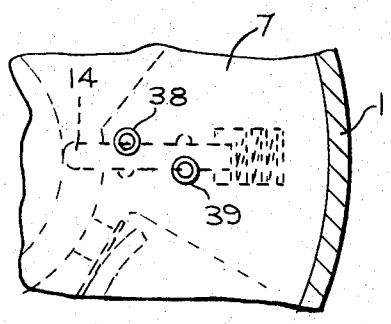


FIG. 3

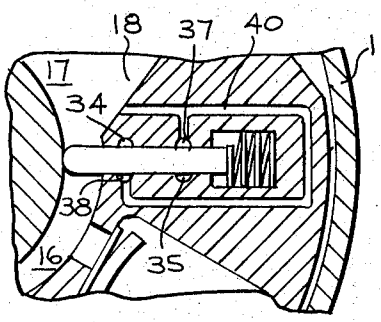


FIG. 4

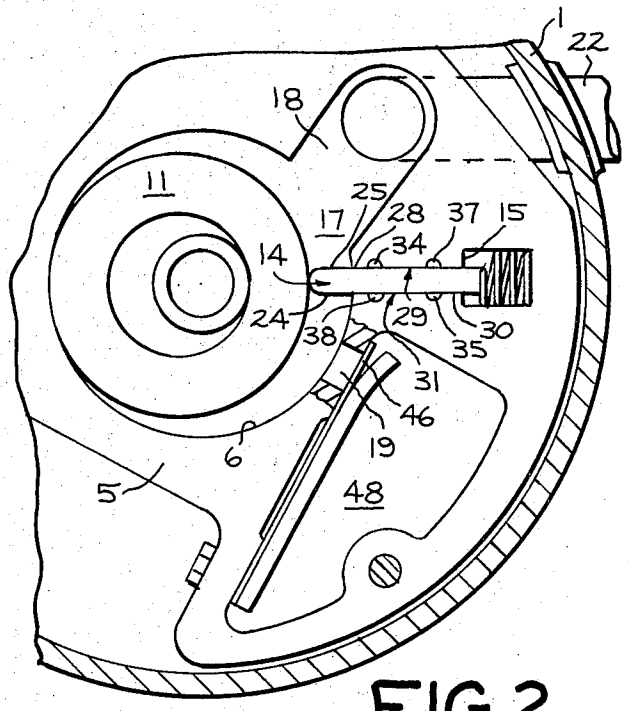


FIG. 2

ROTARY COMPRESSOR INCLUDING MEANS FOR REDUCING VANE SLOT WEAR

BACKGROUND OF THE INVENTION

A well known type of hermetically sealed rotary compressor for refrigeration systems comprises a hermetic casing containing a compressor comprising a cylindrical wall member and end plates defining a compression cylinder, a rotor eccentrically mounted within the cylinder and a vane slidably mounted within a vane slot provided in the cylinder wall. The vane engages the periphery of the rotor to divide the chamber into a high pressure side and a low pressure side. In the operation of such a compressor, rotation of the rotor draws gas into the low pressure side and discharges the compressed gas through a discharge port communicating with the high pressure side. During the operation of a compressor of this type, especially a compressor of large displacement, there is a considerable side force exerted on the vane or, more specifically, the portion thereof extending into the compression cylinder, due to the fact that one side or face of the vane is exposed to high or discharge pressure and the other to low or suction pressure. This side force is exerted on the vane slot walls at certain reaction points, these points or areas of maximum pressure being at the cylinder edge of the vane slot wall on the suction side of the vane and at the opposite or inner end of the vane slot wall on the discharge side of the vane. The result is a concentration of vane slot wear in these areas.

SUMMARY OF THE INVENTION

It is a general object of the present invention to provide means for employing refrigerant pressures available within the compressor to counteract this side force and reduce vane slot wear at the critical wear points.

In accordance with the illustrated embodiment of the present invention, there is provided a rotary refrigerant compressor contained in a hermetic casing and including end plates and a cylindrical wall defining an annular compression cylinder. A rotor is eccentrically rotatable within the cylinder. Spaced suction and discharge ports communicate with the cylinder and a vane slidably mounted in a slot provided in the cylinder side walls divides the cylinder into low and high pressure sides or chambers. In order to reduce vane slot side wall wear due to high side pressures on the vane, means are provided to produce an opposing gas pressure on the vane in the vane slot wall areas subjected to maximum vane pressure. Preferably, means are also provided for connecting vane slot areas on the opposite side of the vane from the points of introduction of high pressure refrigerant to suction pressure to assure a pressure differential across the vane opposing the gas forces on the exposed or overhanging end of the vane.

BRIEF DESCRIPTION OF THE DRAWING

With reference to the accompanying drawing:

FIG. 1 is a side elevational view, partly in section, of a hermetic refrigeration compressor incorporating the present invention;

FIG. 2 is a partial plan view taken along line 2—2 of FIG. 1;

FIG. 3 is a partial plan view taken along line 3—3 of FIG. 1;

FIG. 4 is a partial sectional view taken along line 4—4 of FIG. 1; and

FIG. 5 is a plan view illustrating a second embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to FIGS. 1 and 2 of the drawing, there is illustrated a hermetic compressor comprising a casing 1 containing a rotary compressor 2 connected by a drive shaft 3 to a motor 4.

The compressor includes a wall member or block 5 having an inner cylindrical wall 6 which, in combination with an upper end plate 7 and a lower end plate 8, define an annular compression cylinder 9. A rotor 11 within the compression cylinder 9 is eccentrically rotated, in a counterclockwise direction as viewed in FIG. 2, by means of an eccentric 12 formed on the shaft 3. A vane 14 slidably disposed within a radial vane slot 15 in the cylindrical side wall is continuously biased into engagement with the periphery of the rotor to divide the compression cylinder into a high pressure side or chamber 16 and a low pressure side or chamber 17.

The compressor further includes a suction or inlet port 18 on one side of the vane 14 communicating with the low side 17 and a discharge port 19 on the other side of the vane 14 communicating with the high pressure side 16. The high pressure refrigerant discharged through the discharge port 19 flows through a passage 20 in the upper end plate 7 into the interior of the case 1 from which it is discharged through a conduit (not shown) to the high pressure side of a refrigeration system. Low pressure refrigerant is withdrawn from the refrigeration system through a conduit 22 and enters the compression chamber through the suction port 18.

During operation of the compressor, as for example, when the rotor is in the position shown in FIG. 2 of the drawing in which the vane 14 extends into the compression chamber 16, one exposed side or face 24 of the vane is subjected to the high pressure of refrigerant gas being compressed in chamber 16 while the other face of the vane, indicated by the numeral 25, is exposed to low or suction pressure. This pressure differential on the vane exerts a lever action on the vane biasing the exposed portion of the vane in the direction of rotation of the rotor 11. This results in points of maximum vane pressure, these reaction points being adjacent end 28 of the slot side wall 29 on the suction or low pressure side of the vane and at the inner end 30 of the vane slot wall 31 on the high pressure side of the vane. Vane slot wear is at its maximum at these reaction points or areas 28 and 30.

In accordance with the present invention, slot wear in these maximum wear areas or points is substantially reduced by providing opposing or counteracting gas pressures on the vane within the vane slot. In the illustrated embodiment of the invention the slot wall areas are connected to a source of high pressure refrigerant gas, and the slot wall areas on the opposite side of the vane from the maximum wear areas are connected to suction pressure. To this end, there are provided a laterally extending groove 34 in the forward or cylinder end of the slot side wall 29 on the suction side of the vane and a similar groove 35 at or adjacent the inner or remote end of the high side vane slot wall 31. In FIGS. 1 and 2 of the drawing, these grooves 34 and 35

are connected respectively by means of tubes **38** and **39** extending through the upper end plate **7** to the source of high pressure refrigerant in the upper portion of the case **1.** The case pressure gaseous refrigerant thereby introduced into the grooves **34** and **35** exerts high pressure or pressures on the areas of the vane at these points.

To assure a positive and substantial opposing gas pressure on the vane within the slot under all operating conditions, areas of the slot walls on the opposite side of the vane from the areas of maximum wear are connected to suction or low pressure. The vane slot side wall **29** is provided with a groove **37** at its inner end opposite groove **35,** and the slot side wall **31** includes a groove **38** adjacent its cylinder end and on the opposite side of the vane from groove **34.** These grooves are connected, for example, by passages **40** in the block to the suction port as illustrated in FIG. **4** of the drawing.

Alternatively, the passage connecting slots **34** and **35** to suction pressure may be provided in the form of milled grooves in the surface of end plate **8** overlying the cylinder block. These milled end plate grooves may have the same configuration as the passages **40** or may cross the vane slot **15** at suitable points. For example, as shown in FIG. **5,** the end plate may include a V-shaped groove including one leg **41** one end **42** of which communicates with port **18** and the other end **43** of which communicates with the lower end of groove **37.** The second leg **44** of the milled groove crosses the slot **15** between and spaced from grooves **34** and **35** and terminates in an end **45** communicating with the lower end of low pressure groove **38.** The discharge pressure connections to the high pressure grooves **34** and **35** may be similarly made by means of a groove or grooves in the lower surface of the upper end plate **7** with the inlet end thereof connected to the discharge chamber **48** (FIG. **2**) in the block **5.**

The operation and advantages of the present invention will be specifically described by first considering the various gas pressure conditions on the vane in the usual rotary compressor. During most of the time any portion extends into the cylinder **9,** the pressure in chamber **16** is higher than the suction pressure in chamber **17** so that there is a side or lateral gas pressure differential on the extended portion of the vane in the direction of rotation of rotor **11.** In the fully extended position of the vane illustrated in FIG. **2** of the drawing, the high side pressure is about triple the suction pressure. During the subsequent 180° rotation of the rotor, the surface area of the vane exposed to chamber **16** decreases but the pressure differential in the cylinder continues to increase until the discharge valve **46** opens when the high side pressure exceeds case pressure, for example, at about four times suction pressure. When the rotor has rotated to the point at which the vane is retracted within the vane slot, the cylinder pressure differential is substantially zero. However, since there is some leakage of high pressure refrigerant into the slot on the high pressure side of the vane and as the slot area on the opposite or suction side of the vane is at suction pressure, there is still a net pressure differential across the cylinder end of the vane causing increased wear particularly of the cylinder end of suction side slot wall **29.**

By the present invention, pressure differentials are provided within the slot for opposing or relieving these wear producing forces on the vane. The high pressure refrigerant introduced into the slot at the points of maximum wear, that is, into the grooves **34** and **35,** provides gas pressures opposing the cylinder pressures on the vane while the connections of the slot wall areas opposite these wear areas to suction pressure assures a positive pressure differential on or across the vane opposing the wear producing pressures. In addition, at the cylinder end of the slot, the groove **38** relieves any pressure on the vane caused by leakage of high cylinder pressure into the slot.

Since the high pressures in the slot grooves **34, 35** and the low pressures in grooves **37, 38** remain substantially constant, the pressure differentials within the slot across the cylinder end and rear or inner end of the vane also remain substantially constant, and these differentials continuously oppose the cylinder gas forces on the vane to substantially decrease slot wear.

While there has been shown and described particular embodiments of the present invention it will be understood that it is not limited thereto and it is intended by the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

I claim:

1. A rotary gas compressor comprising:

means including a cylindrical wall defining an annular compression cylinder;

a rotor eccentrically rotatable within said cylinder, spaced suction and discharge ports communicating with said cylinder;

a radially extending slot in said cylindrical wall between said ports and including spaced side walls;

a vane slidably mounted in said slot between said slot side walls and having one end engaging said rotor to divide said cylinder into low and high pressure chambers within said cylinder whereby the difference in gas pressure on the opposite faces of said vane exerts forces on said vane concentrating wear at first slot side wall areas adjacent the outer cylinder end of one slot side wall on the low pressure side of said vane and adjacent the inner end of the other slot side wall on the high pressure side of said vane

means for reducing slot wear in said first areas comprising means connecting said first areas to a source of high pressure gas; and

means connecting areas of said slot side walls on opposite sides of said vane from said first areas to low pressure gas.

2. A hermetic, rotary refrigerant compressor comprising:

a hermetic casing containing high pressure refrigerant gas;

a compressor positioned in said casing and including end plates and a cylindrical wall member defining an annular compression cylinder;

a rotor eccentrically rotatable within said cylinder;

spaced suction and discharge ports communicating with said cylinder;

a radially extending slot in said wall member between said ports and including spaced side walls;

a vane slidably mounted in said slot between said side walls and biased into engagement with said rotor to divide said cylinder into low and high pressure chambers whereby the difference in gas pressure on said vane during operation of said compressor exerts a side force on said vane concentrating wear

at first slot side wall areas adjacent the outer cylinder end of one slot side wall on the low pressure side of said vane and adjacent the inner end of the other slot side wall on the high pressure side of said vane; and

means for reducing said slot side wall wear comprising means for conducting high pressure refrigerant to said first slot side wall areas, and means connecting an area of each slot side wall on the opposite side of said vane from said first areas to low refrigerant pressure.

3. The compressor of claim **2** which includes:

laterally extending grooves adjacent the outer and inner ends of both of said slot side walls;

the grooves of the outer end of said one slot side wall and at the inner end of said other side wall receiving the high pressure refrigerant; and

the grooves at the inner end of said one slot side wall and the outer end of said other side wall being connected to the low refrigerant pressure.

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