United States Patent [19]

Glanvall

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[54] **ROTARY COMPRESSOR OF THE SLIDING VANE TYPE**

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[73] Assignee: **Stal Refrigeration AB,** Norrkoping, Sweden

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **418/150;** 418/259

[51] **Int. Cl.^{2}** **F04C 1/00**

[58] **Field of Search** 418/260, 265, 266, 267, 418/268, 269, 259, 261, 262, 263, 264, 150

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[57] **ABSTRACT**

A rotary compressor of the sliding vane type, in which the vanes of the rotor slide resiliently along the inner surface of the stator the cross section profile of which defines three separate substantially circular arcs one of which has the same radius as the rotor and forms a transition zone or sealing area between the high pressure side and the low pressure side, the profile defining the inlet side or low pressure side having a radius of curvature which is greater than the mean radius of the stator and the profile defining the outlet side or high pressure side having a radius smaller than the mean radius of the stator, whereby the space between the inner surface of the stator increases continuously from substantially zero at the inlet side of the transition zone to its predetermined optimum and thereafter decreases continuously back to substantially zero at outlet side of the transition zone.

2 Claims, 7 Drawing Figures

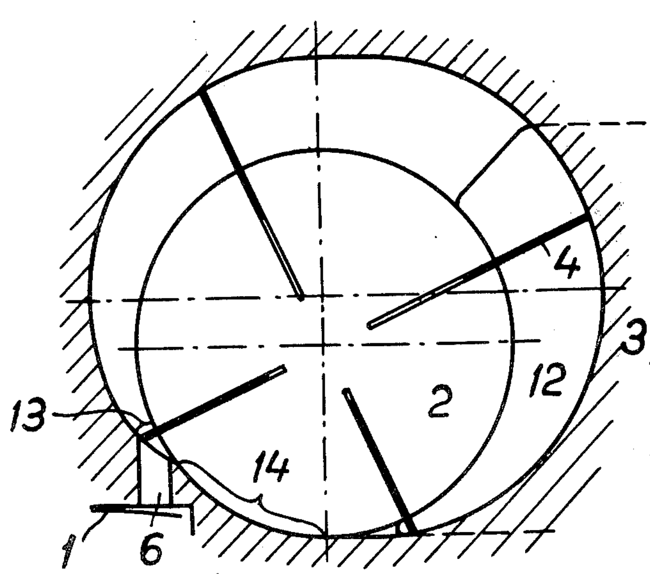


Fig. 1

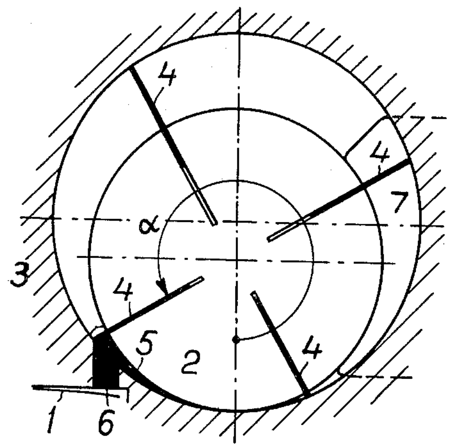


Fig. 2

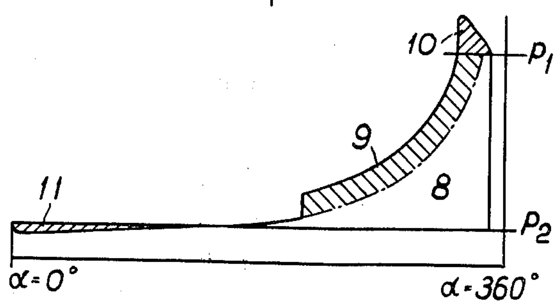


Fig. 3

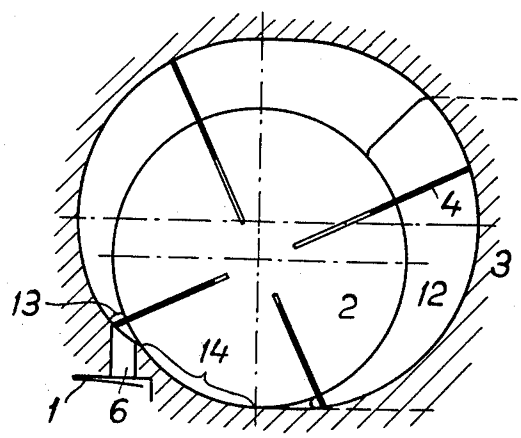


Fig. 7

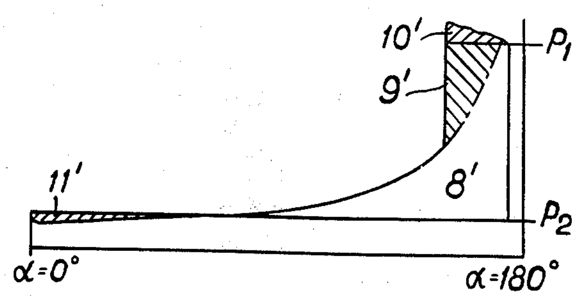


Fig. 4

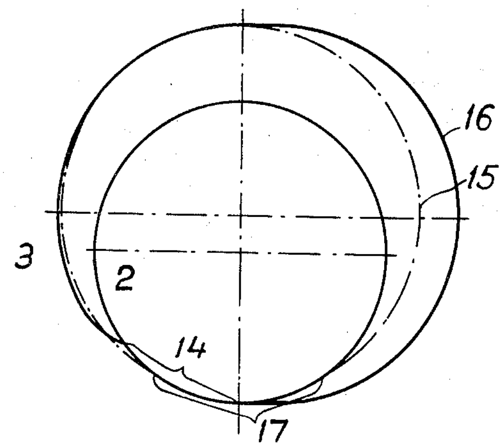


Fig. 5

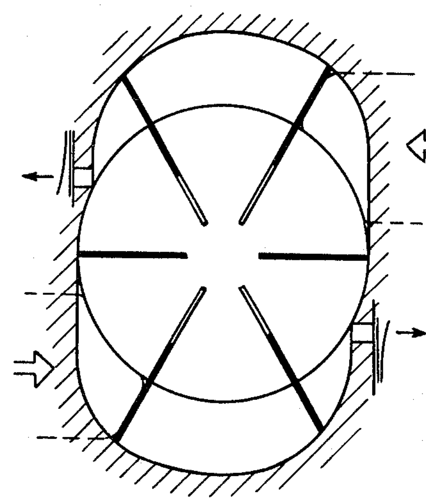
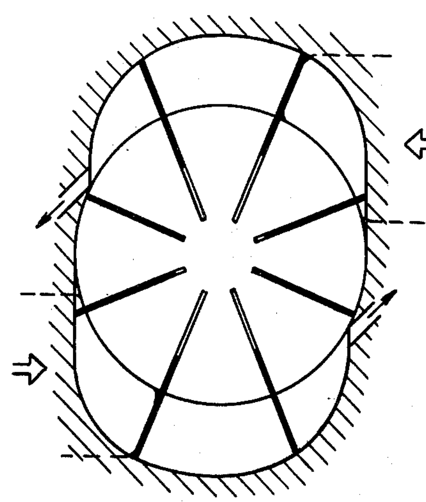


Fig. 6



ROTARY COMPRESSOR OF THE SLIDING VANE TYPE

BACKGROUND OF THE INVENTION

In conventional rotary compressors the stator housing as well as the rotor has circular cross-section. The power losses incurred in such compressors are substantial due to throttling in the inlet and outlet openings, leakage between the high pressure and low pressure sides and, in the case of compressors having discharge valves, re-expansion of the compressed medium confined in the area between the high pressure side and the lower pressure side.

Various attempts have been made to minimize these losses, among others by providing a so-called "countersunk rotor", which means that a recess has been made in the wall of the otherwise circular rotor housing, which recess has the same radius as the rotor which will then slide closely the stator housing surface along a certain portion thereof. This arrangement will considerably reduce leakage between the high pressure and low pressure side, but at the same time, it will cause an uneven movement of the vanes which, along the rear edge of said recess, may give rise to a jumping or ricocheting of the vanes on the stator surface.

SUMMARY OF THE INVENTION

The invention is based on a more thorough transformation of the stator cross section in accordance with the requirements made within the different sectors of the compressor, the stator cross section being substantially composed of three arcs or curves of substantially circular shape. One of these curves has the same radius as the rotor and forms a transition zone between the high pressure and low pressure side, as in the embodiment with countersunk rotor type. The two other curves have respectively a somewhat greater and somewhat smaller radius of curvature than the mean radius of curvature of the stator, the greater radius of curvature being imparted to the inlet side and the smaller one to the outlet side.

The stator housing thus acquires a cross-section acoording to the accompanying claims, resulting in reduced power losses both at the inlet and outlet as well as of waste space, while at the same time securing smooth movements of the vanes along the stator surface.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** shows a conventional rotary compressor with a stator having circular cross-section.

FIG. **2** shows an indicator diagram for such a compressor.

FIG. **3** shows a rotary compressor according to the invention in which the stator defines a single operating cycle of **360°**.

FIG. **4** is similar to FIG. **3,** and shows a comparison with the compressor with countersunk rotor.

FIGS. **5** and **6** show compressors according to the invention designed with double chambers defining two operating cycles of **360°** each, the first with and the second without discharge valves.

FIG. **7** shows an indicator diagram for the latter embodiment.

DESCRIPTION OF A PREFERRED INVENTION

FIG. **1** shows a rotary compressor of the sliding vane type comprising a single chamber having a pressure valve **1,** a rotor **2** and a stator **3** and vanes **4.** The vertical diameter in the compressor is the dividing line between the inlet portion and the outlet portion. The inlet opening is designated by ref. numeral **7.** The dead space is shown in solid and consists of an outlet **6** and the space **5** between the rotor **2,** the stator **3** and the vane **4** in the position where the vane **4** is about to pass across the entrance of the outlet **6.**

FIG. **2** shows a schematical indicator diagram which applies to the working cycle of a vane, in which **8** designates useful compressor work, **9** loss due to dead space, **10** loss due to throttlings in gaps and valve system at the outlet side and **11** loss due to throttling effects at the inlet side. The power loss **9** may be reduced by reducing the dimensions of **5** or **6** or both by reducing the outlet area **6** and/or relocating the position of the outlet opening **6** to $\alpha = 360°$. However, such modifications result in reduced flow areas and thus an increased pressure drop over gap and outlet opening areas, and consequently the power loss **10** would increase. The volumetric loss **11** may be reduced by increasing the flow areas on the inlet side.

In order to minimize these efficiency-reducing factors, a new stator profile has been designed as shown in FIG. **3** characterised by its unsymmetrical shape which provides an increased inlet area **12,** and an increased gap area **13** while simultaneously reducing the waste space **5.** This profile also provides a more efficient sealing in the area **14** between the high- and the low pressure sides where the stator- and the rotor radii are the same, but it should not be confused with the conventional so called "countersunk rotor", the only object of which is to provide an improved sealing in this same area. The difference will be clear from FIG. **4** in which **15** is a countersunk rotor profile and **16** is the profile according to the invention, the respective sealing gaps of the two profiles being indicated by ref. numerals **17** and **14.** It is important to note that the wedge shaped space **5** after the outlet holes **6** is reduced or fully eliminated, which implies that the work which would otherwise have been required for draining the working medium from this volume is regained.

Another considerable advantage resulting from the new profile is the fact that, the profile extends tangentially beyond the gap **14,** as opposed to the countersunk rotor profile which, beyond the sealing gap **17,** changes abruptly into a new profile shape, causing a rapid change of movement of the vane which may jeopardize proper vane function with constant contact between the vane tips and the stator surface. FIG. **5** shows the present invention adapted to a rotary compressor of the sliding vane type in a double-chamber embodiment, and of course the adaptation can be made to an optional number of working chambers.

FIG. **6** shows the unsymmetrical stator profile adapted to a rotary compressor without pressure valves and FIG. **7** a schematic indicator diagram for this embodiment.

It should be noted that all of the figures have been drawn to somewhat exaggerated proportions in order to give as clear a picture as possible.

I claim:

1. A rotary compressor of the sliding vane type comprising:

a. a stator;

b. a cylindrical rotor housed within said stator and defining therebetween a low pressure portion yaving an inlet for the working fluid and a high pressure portion having an outlet for the working fluid;

c. a plurality of vanes extending from the exterior surface of said rotor in resilient slidable engagement with the inner surface of said stator;

d. the cross sectional profile of said stator defining three separate, substantially circular arcs;

e. one of said arcs having the same radius as said rotor and forming a transition zone providing a sliding seal between the stator and the rotor in said zone;

f. a second arc extending from one end of said transition zone having a radius of curvature greater than the mean radius of the stator and defining together with said rotor a low pressure zone increasing progressively in volume from said transition zone to a predetermined optimum; and

g. a third arc extending from said second arc having a radius of curvature smaller than the mean radius of the stator defining together with the rotor a high pressure zone decreasing progressively in volume to merge with the other end of said transition zone.

2. A rotary compressor according to claim 1, in which the tangential plane of said third arc at the point of merger with said transition zone crosses the rotor and in which the transition zone and said second arc have a common tangential plane at their point of merger.

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