Oct. 26, 1965 F. W. LÜCK 3,214,087

ROTARY PISTON MACHINE

Filed Jan. 25, 1963

Fig. 1

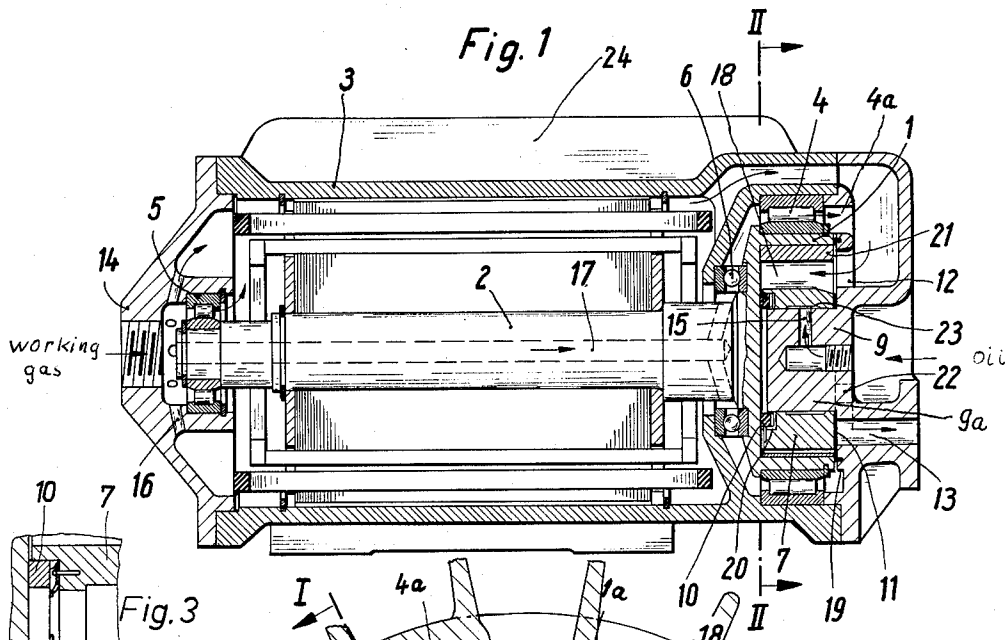
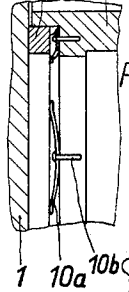


Fig. 3



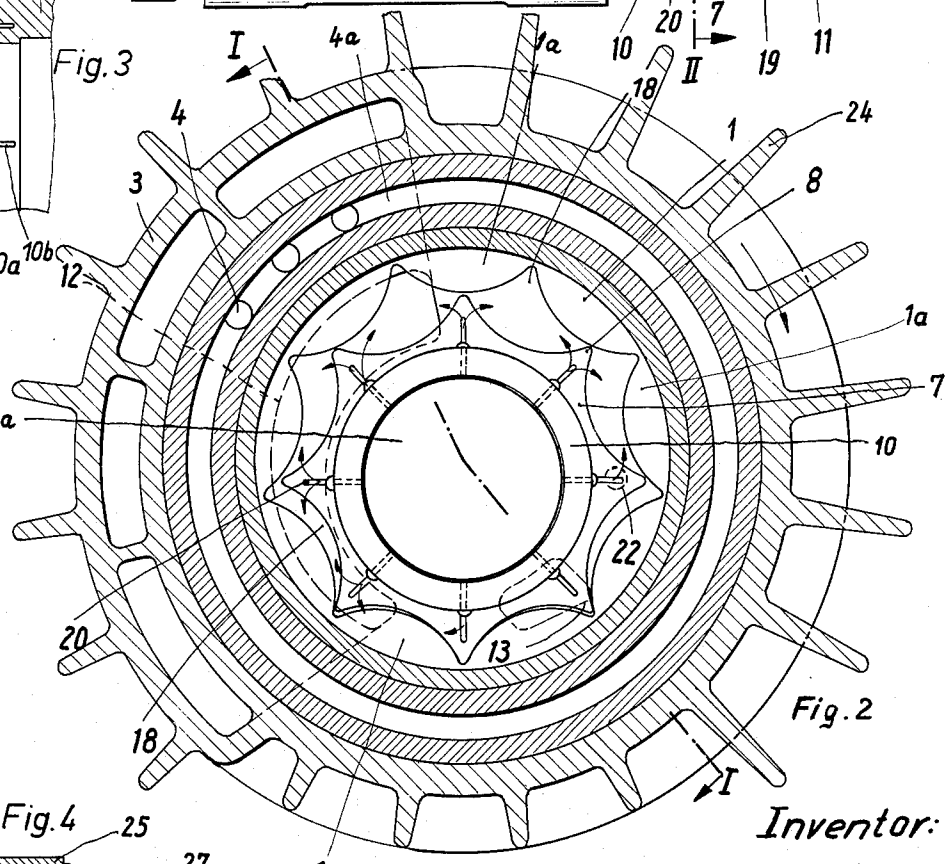


Fig. 2

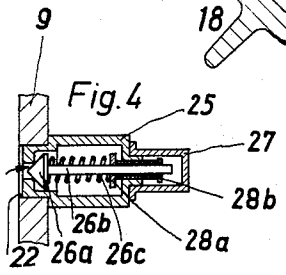


Fig. 4

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ROTARY PISTON MACHINE

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9 Claims. (Cl. 230—141)

The present invention is directed to a rotary piston machine, especially rotary piston compressor, which comprises two rotary pistons arranged eccentrically within each other and provided with intermeshing teeth. One of said rotary pistons rotates the other one while the working medium is drawn in axial direction at the open end face of the machine into the working chambers and is also exhausted from the machine at the same end face.

In order that such machines, which have their outer rotary piston journalled in a cantilever manner, be suitable for high pressure conditions as they frequently occur or are required in refrigerating machines, special means are required.

In particular, the sealing at the end faces and at the edges of the inner rotary piston cause particular difficulties because at these places it is difficult to mount movable sealing strips in a suitable manner, in other words inasmuch as only gap sealing is to be selected. Such gap sealing can be effectively realized only when the gaps are parallel, extremely narrow and are further narrowed or even closed by liquid sealing means, as for instance lubricating oil. The oil circulation necessary to this end has to be within such limits that an undue flooding of the chambers or of the entire circuit of the working medium at each working condition will be avoided.

It is, therefore, an object of the present invention so to design a rotary piston machine of the above mentioned type that a satisfactory sealing will be obtained.

It is a further object of the present invention to provide gap sealing means in a rotary piston machine of the above mentioned type which will be simple and highly effective.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

FIG. 1 is an axial section through a rotary piston refrigerating compressor according to the invention forming a closed unit with a driving motor therefor, said section being taken along the line I—I of FIG. 2.

FIG. 2 illustrates on a somewhat larger scale than FIG. 1 a section taken along the line II—II of FIG. 1.

FIG. 3 is a part sectional view of the spring supported ring.

FIG. 4 is a sectional view of the relief valve

The rotary piston machine according to the present invention is characterized primarily in that the main supporting bearing means for the outer rotary piston has its axial direction transverse to and extends through the plane of rotation of the intermeshing teeth of the rotary piston. Such an arrangement greatly reduces the bending of the shaft for the rotary piston machine which shaft is subjected to considerable gas pressures. Furthermore, an inclination of the rotary piston end wall as it would be caused by a considerable bending of the said shaft and also correspondingly large gaps at the end faces and at the tooth ridges will be prevented. In view of the axial guiding of the inner rotary piston by the rotating end wall of the outer rotary piston and by the stationary wall of the housing lid, i.e. while avoiding guiding means as for instance ball bearings which require additional manufacturing tolerances, the total of the width of the gaps can be kept to a minimum.

Due to the fact that the gap located in front of the housing lid which is provided with inlet and outlet openings, in particular has the tendency to discharge leakage gases and can only under great difficulties be sealed by oil, and since furthermore the gas pressure acting upon the respective tooth located in front of the outlet slot has the tendency to move the inner rotary piston away from the lid, a spring-biased slide ring is advantageous which in cooperation with the end face which is under gas or oil pressure presses the inner rotary piston against the housing lid.

The oil required for the gap sealing and supplied under high pressure is simultaneously employed for lubricating the bearing for the inner rotary piston. After the oil has passed through that end face gap which is adjacent the inlet side, it passes into the tooth spaces of the outer rotary piston where it seals the gap at the tooth tips of the inner rotary piston. Also the narrow gap between the outer rotary piston and the housing lid is due to the centrifugal force filled with oil which in turn prevents leakage from chamber to chamber.

Slight flooding and pressure excesses inherent thereto prior to the end of the compression will be taken care of by a small relief valve which permits a premature exhaust into the pressure conduit.

The arrangement of the rotary piston machine according to the present invention leads to a particularly simple construction when the shaft of the outer rotary piston simultaneously serves as shaft for the driving motor. In this instance, due to the elimination of the coupling between two separate machines, a closed unit will be obtained while the oil containing working medium is drawn in through the bearing, through the shaft and through the gap of the motor.

Referring now to the drawing in detail, which by way of example illustrates a rotary refrigeration compressor, the compressor shown therein forms a closed unit with the drive motor **3** which in this instance is an electric motor. The outer rotary piston **1** of the compressor is in the particular arrangement shown in the drawing designed as a rotary piston with nine teeth **1***a*. Shaft **2** of the electric motor **3** simultaneously serves as shaft for the outer rotary piston of the compressor. Shaft **2** is journalled in two transverse bearings **4** and **5** and in a thrust bearing **6**. The inner rotary piston **7** which is directly rotated by the outer rotary piston **1** by means of the teeth thereof is journalled on a stud-like protrusion **9***a* of the housing lid **9**. That end face of the rotary piston **7** which is adjacent the input shaft side has mounted thereon a spring supported slide ring **10** supported by spring **10***a* on pin **10***b*, whereas on the opposite end face of piston **7** there is provided a slide layer **11**. The rotary piston **7** may itself be of a material having particularly good sliding properties.

The housing lid **9** has an inlet slot **12** and an outlet passage **13**. The gas inlet into the closed unit is effected through the motor lid **14**, whereas the lubricating oil passes into the machine through a bore **15** in the stud **9***a* of lid **9**, grooves **23** on the inside of the rotary piston **7**, and grooves **20** in that end face of the rotary piston **7** which is adjacent the input shaft side.

The operation is as follows: The cooling medium still intermixed with lubricating oil passes through lid **14** into the motor housing while passing through bores **16** as well as through bearing **5** and bore **17** from where it passes through bearings **6** and **4** into the compressor. Here it passes through the inlet slot **12** into the working chambers **18** formed by the teeth of the rotary pistons. After effected compression, the working medium is conveyed through

the outlet passage **13** into the circuit of the cooling medium.

This compression can be carried out at low losses only when the working chambers **18** are properly sealed with regard to the pressure passage **13**. To this end, the inner rotary piston **7** is by means of the spring supported slide ring **10** and by the gas and oil pressure acting upon the same end face pressed against the housing lid **9** whereby the compressed gas is prevented from passing into the inlet passage and to the working chambers of lower pressure. An annular seal **19** slidably arranged on the end face of the outer rotary piston **1** serves a similar purpose, namely to seal chamber **4***a* against the working chambers **18**. At all other places, the working chambers **18** are sealed by gaps under oil pressure. This oil which simultaneously serves for lubricating the bearings of the inner rotary piston **7** and the slide ring **10** is conveyed under pressure through grooves **23** and **20** to the end gap between the end face of the inner rotary piston **7** and the end face of the outer rotary piston **1**. This oil prevents for all practical purposes the passage of leakage gases from chamber to chamber. The oil passing therethrough is collected in the tooth spaces of the outer rotary piston whereby in particular the tooth tips in the upper pressure range will be sealed. At the same time, in view of the centrifugal force, oil enters gap **21** between the teeth of the outer rotary piston and the housing lid **9** and here prevents the passage of leakage gases from chamber to chamber.

If at any stage of operation too much oil should collect in the working chambers so that already prior to the opening of the outlet passage **13** a highly excessive compression occurs, a portion of the working medium may prematurely be exhausted into the exhaust line through opening **22** which is closed by an automatic valve, for instance a pressure relief valve of any standard type such as shown in FIG. 4 having a valve seat **25** fitted in opening **22** for valve **26***a*. Valve **26***a* has a valve stem **26***b* surrounded by a spring **26***c* abutting a plate **28***a*. The valve stem **26***b* extends through a sleeve **28***b* into a housing **27**.

It is, of course, to be understood that the present invention is, by no means, limited to the particular construction shown in the drawing but also comprises any modifications within the scope of the appended claims.

What I claim is:

1. A rotary piston machine, especially compressor for refrigerating media, which includes: an outer rotor comprising an annular part with inwardly extending teeth and one side wall connected to one end face of said annular part, said annular part being open at its other end face, an inner rotor comprising an annular part eccentrically located within the annular part of said outer rotor and provided with outwardly extending teeth meshing with said inwardly extending teeth, outer bearing means supporting said annular part of said outer rotor and arranged within the range of the axial extension of said annular part of said outer rotor, housing means surrounding said rootrs and supporting said outer bearing means while being open at the open side of said annular part of said outer rotor, lid means closing said open side of said housing and being provided with inlet and outlet means for the working medium of said rotary piston machine, and means for sealing said inner rotor with regard to the adjacent side wall pertaining to said outer rotor and pressing said annular part of said inner rotor against said lid means.

2. A rotary piston machine, especially compressor for refrigerating media, which includes: an outer rotor comprising an annular part with inwardly extending teeth and one side wall connected to one end face of said annular part, said annular part being open at its other end face, an inner rotor comprising an annular part eccentrically located within the annular part of said outer rotor and provided with outwardly extending teeth meshing with said inwardly extending teeth, outer bearing means supporting said annular part of said outer rotor and arranged within the range of the axial extension of said annular part of said outer rotor, housing means surrounding said rotors and supporting said outer bearing means while being open at the open side of said annular part of said outer rotor, lid means closing said open side of said housing and being provided with inlet and outlet means for the working medium of said rotary piston machine, axially spring urged slide range means interposed between said one side wall and the adjacent end face of said annular part of said inner rotor, and means for conveying oil under pressure between said slide ring means and said annular part of said inner rotor to thereby press the latter against said lid means and seal with regard to each other and the outside the working chambers of said rotary piston machine which are confined by said annular parts of said inner and outer rotors and by said one side wall and said lid means.

3. An arrangement according to claim **1**, in which the lid means has an extension extending into the annular part of said inner rotor and forming a bearing therefor.

4. A rotary piston machine, especially compressor for refrigerating media, which includes: an outer rotor comprising an annular part with inwardly extending teeth and one side wall connected to one end face of said annular part, said annular part being open at its other end face, an inner rotor comprising an annular part eccentrically located within the annular part of said outer rotor and provided with outwardly extending teeth meshing with said inwardly extending teeth, outer bearing means supporting said annular part of said outer rotor and arranged within the range of the axial extension of said annular part of said outer rotor, housing means surrounding said rotors and supporting said outer bearing means while being open at the open side of said annular part of said outer rotor, lid means closing said open side of said housing and being provided with inlet and outlet means for the working medium of said rotary piston machine, a groove in that end face of said annular part of said inner rotor which is adjacent said one side wall, a seal ring in said groove, spring means pressing said ring toward said one side wall and thereby pressing said inner rotor toward said lid means, and means for introducing oil between said one side wall and the adjacent end face of said inner rotor for sealing between the outer and inner rotors.

5. An arrangement according to claim **1**, which includes check valve means mounted in said lid and adapted to relieve excess pressure in said rotary piston machine in excess of a predetermined pressure.

6. A rotary piston machine, especially for compressing refrigerating media, which includes: an outer rotor comprising an annular part with inwardly extending teeth and one side wall connected to one end face of said annular part, said annular part being open at its other end face, an inner rotor comprising an annular part eccentrically located within the annular part of said outer rotor and provided with outwardly extending teeth meshing with said inwardly extending teeth, main supporting bearing means for the outer rotary piston which has its axial direction transverse to and which extends through the plane of rotation of the intermeshing teeth of the rotary piston, said machine also including housing means surrounding said rotors and supporting said outer bearing means while being open at the open side of said annular part of said outer rotor, lid means closing said open side of said housing and being provided with inlet and outlet means for the working medium of said rotary piston machine, said lid means extending telescopically into the annular part of said inner rotor and forming a bearing therefor, and means for sealing said inner rotor to said lid means comprising a slide ring between said inner rotor and said one wall of the outer rotor and means acting between said inner rotor and said slide ring and pressing said annular part of said inner rotor against said lid means.

7. A rotary piston compressor, especially for cold substances such as refrigerating media which comprises; a housing open at one end, a cup-like internally toothed outer piston and an annular externally toothed inner piston arranged eccentrically with regard to each other in said housing and having the teeth thereof in meshing engagement with each other, the outer piston having its open end adjacent the open end of the housing, the outer piston driving the inner piston, a cover on the open end of the housing having port means therein for introducing and withdrawing the working medium in axial direction of the housing, and means for sealing the working chambers between the pistons comprising an axially spring urged sliding ring mounted in that end face of the inner piston which faces the closed side of the outer piston and which ring rests on the closed side of the outer piston and thereby presses the inner piston against said housing cover whereby to seal the inner piston to the cover while simultaneously sealing between the said inner piston and the said closed side of the outer piston.

8. A rotary piston compressor according to claim 7 in which that end face of the inner piston which faces the closed side of the outer piston is provided with groove means through which considerable quantities of oil may pass by means of which the region between the inner piston and the closed end of the outer piston and the gap at the tips in the teeth of the piston are sealed.

9. A rotary piston compressor according to claim 7 in which a pressure operable safety valve is mounted in said cover and has an inlet connected to working chambers of the compressor and is operable to limit over-compression in said chambers by exhausting excess working media therefrom.

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