

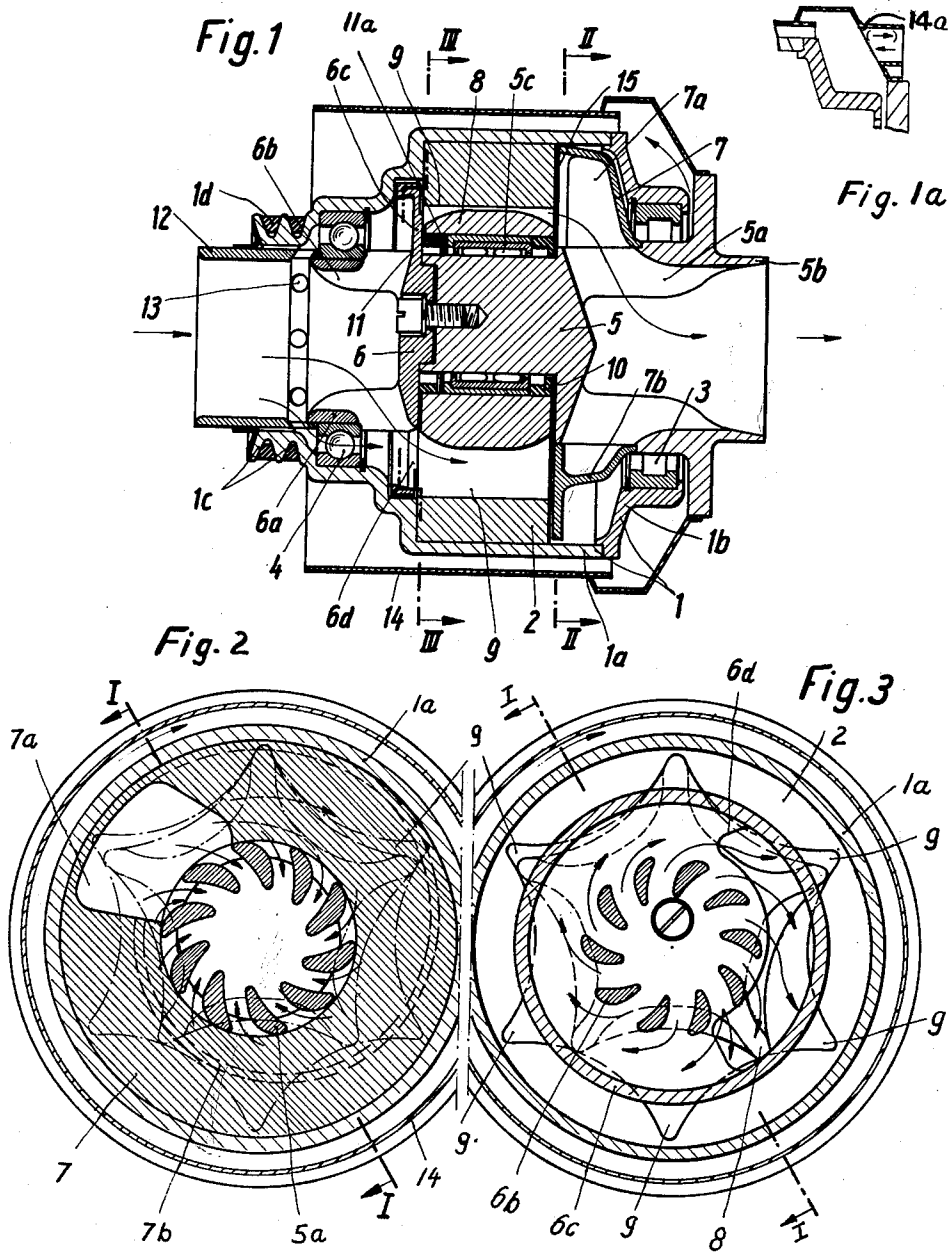
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ROTARY PISTON ENGINE

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2 Sheets-Sheet 1



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Fig. 4

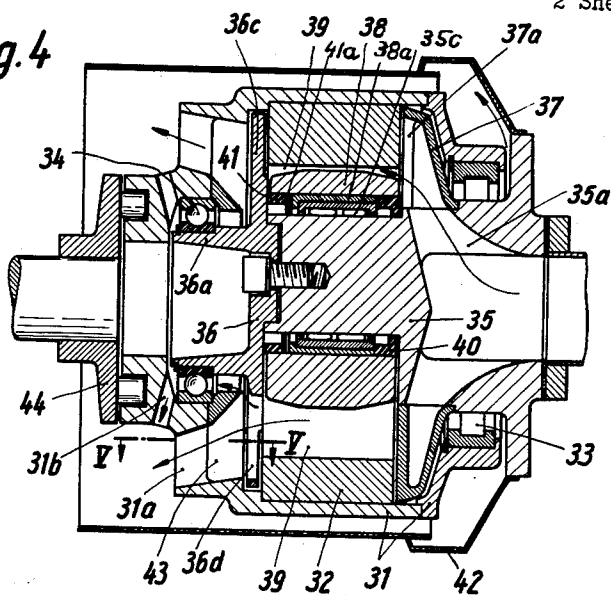


Fig. 5

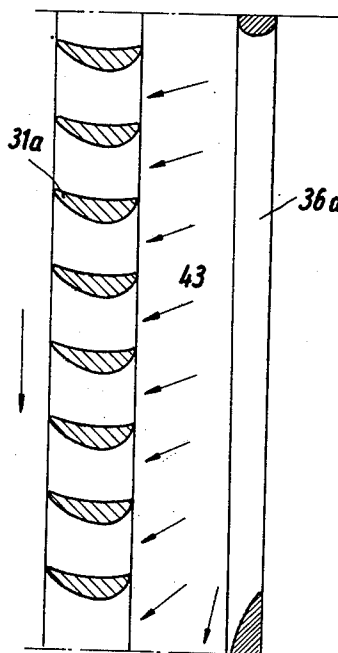
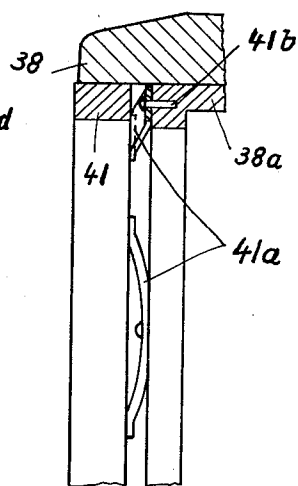


Fig. 4a



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ROTARY PISTON ENGINE

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The present invention concerns a rotary piston machine with two rotary pistons arranged eccentrically with regard to each other and provided with either straight or inclined teeth, in which one of the rotary pistons moves the other rotary piston while the working medium is introduced into and discharged from the machine in axial direction thereof.

Machines of this type are known and designed, for instance, in such a way that the working medium is drawn into the working chambers at one open end face of the machine and is discharged from the machine again at the same end face. For controlling this operation, there is provided at one and the same end face a stationary or a rotatable disc or housing wall which is equipped with the necessary inlet and outlet openings and the corresponding control edges. Both rotary pistons are surrounded by a housing in which the rotary pistons are journaled, in most instances, in an overhung position, i.e. at only one of the two sides of the working chamber.

While machines of this type are advantageous in various respects, they also have drawbacks. Thus, for instance, the flow has to be reversed in axial direction within the working chamber. Furthermore, the rotary pistons are surrounded by a relatively large and heavy housing. Also the mounting of the adjacently located inlet and outlet connections causes difficulties, particularly when a high-speed machine of great delivery per time unit is involved.

It is therefore an object of the present invention to provide a rotary piston machine of the above-mentioned general type which will overcome the drawbacks outlined above.

It is a further object of this invention to provide a rotary piston machine in which the working medium will pass through the machine while retaining one and the same direction.

It is also an object of this invention to provide a rotary piston machine which will make it possible to convert the pressure energy into flow energy with a minimum of losses.

Still another object of this invention consists in the provision of a rotary piston machine as set forth above, which will greatly facilitate the lubrication of bearing means.

It is a further object of this invention to provide a rotary piston machine of the above-mentioned type, which will excel in compactness.

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:

FIGURE 1 represents a longitudinal section through a 6:5 teeth compressor, said section being taken along the line I—I of FIGURE 3;

FIGURE 2 is a cross-section through the compressor of FIGURE 1, said section being taken along the line II—II of FIGURE 1;

FIGURE 3 is a cross-section through the compressor of FIGURE 1 as taken along the line III—III of FIGURE 1;

FIGURE 4 represents a longitudinal section through an expansion machine according to the invention;

FIGURE 4a is a cross-section showing a modification of the means to axially guide the inner rotary piston.

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FIGURE 5 is a section through a portion of the blade ring of the rotor, said section being taken along the line V—V of FIGURE 4.

The above-mentioned objects have been realized by the present invention by the employment of relatively large bearing diameters so that the housing forms, so-to-speak, a hollow shaft which simultaneously permits the flow of the working medium through the machine in axial direction thereof and also permits the introduction and withdrawal of the working medium by means of large connections.

Accordingly, the cylinder chambers between the rotary pistons are open toward both sides and here are covered by two end discs. These discs are provided with two openings through which the working medium passes while flowing in one and the same direction. The chambers at or in the end discs are connected with the inlet and outlet connections for the working medium through two guide blade rings respectively. In this way, a low loss-conversion of pressure energy into flow energy at the in-flow side is greatly aided and also the exploitation of the introduced flow energy for a shock-free conveyance of the working medium in the outlet conduit, while the inner friction is greatly reduced. Furthermore, with compressors, the flow in the discharge end disc may be improved by a spiral configuration of the annular chamber, whereas with expansion machines, the discharge may be conveyed through rotor blades of the outer rotary piston whereby flow and still-prevailing pressure energy can be converted into useful work.

A structurally favorable configuration of the control disc, the guide blade ring, and the outer rotary piston bearing at the low pressure side of the rotary piston machine can be obtained by making these parts of a single piece and connecting the same with the main part of the hollow shaft by means of screws.

Furthermore, the particular gas path including the selected arrangement of the bearing body may be employed for feeding lubricants added to the working medium prior or during the entrance thereof into the machine, to all bearing portions. In this connection, also the oil-containing leakage gases become active which pass through the bearing at the pressure side of the outer rotary piston and the bearing of the inner rotary piston. The bearing for the outer rotary piston on the expansion side or the suction side of the machine will be safely lubricated by passing a portion of the in-flowing and out-flowing oil-containing gas through auxiliary passages through the respective bearing.

The arrangement of the suction slot in one end face and the arrangement of the pressure slot in the other end face brings about a considerable thrust upon the inner rotary piston in axial direction. This thrust is absorbed by sliding rings which are resiliently connected to the inner rotary piston and are pressed against the end faces.

Referring now to the drawing in detail, the compressor illustrated in FIGS. 1 to 3 comprises the two parts 1a and 1b together forming the outer rotary piston 1 which is equipped with six inserted teeth 2, and by means of the bearings 3 and 4 is journaled on the stationary hollow shaft 5 or the likewise hollow supporting body 6 connected thereto. The supporting body 6 comprises the supporting ring 6a, the guiding blades 6b and the control disc 6c with the inlet slot 6d. Hollow shaft 5 is likewise provided with a guide blade ring 5a and carries the control disc 7 with the discharge opening 7a and the spiral shaft wall 7b.

At that side of the outer rotary piston which represents the inlet side, there are provided V-belts 1d for driving the outer rotor.

The inner rotor 8, which is equipped with five teeth, is likewise journaled on hollow shaft 5, for instance, by

means of needle bearings 5c. The teeth of the inner rotary piston and the teeth 2 of the outer rotary piston confine with each other five working chambers 9 which, during a clockwise rotation, alternately increase and decrease in conformity with their respective positions. Together with the inner rotary piston 8, axially resilient sliding rings 10 and 11 rotate which respectively rest on parts 5 and 6a of the hollow shaft.

Connected to the inlet side of the hollow shaft 6a is the inlet connection 12 which comprises a plurality of openings 13. The machine is surrounded by a protective mantle 14 which in addition to discharging leakage gas and leakage oil, may also form an air-cooling jacket.

Operation of the Embodiment of FIG. 1

The machine shown in FIGS. 1 to 3 operates in the following manner: The outer rotary piston 1 driven in clockwise direction by the V-belts 1d, due to the engagement of its teeth 2 with the teeth of the inner rotor 8, rotates the latter thereby drawing gas through the opening 6d into chambers 9, whereupon the thus drawn-in gas is compressed and discharged through opening 7a. After the gas has entered the suction connection 12, the main quantity of the working medium passes between the guiding blades 6b in the direction of rotation while being accelerated and deviated, and then together with the remaining oil-containing quantity drawn through the anti-friction bearing 4, passes into the working chambers 9. The flow is indicated by arrows in FIGS. 1 and 3 as to its direction of flow. The outlet of the working medium from the machine following the working substance leaving the opening 7a is again effected through a guide blade 5a toward the open end 5b of the hollow shaft 5. During this flow the initially rather tangentially directed flow will be converted into an approximately central and eventually approximately straight movement (see arrows in FIGS. 1 and 2). The spirally shaped guiding wall 7b reduces the losses which would otherwise occur in view of the formation of turbulence.

The gear tips and all bearing portions are lubricated by the oil entering the machine and admixed to the gas. In this way lubricant is supplied to the bearing 4, especially through the opening 13, furthermore to the bearing 3 through the considerably oil-containing leakage gases leaking through gap 15, and to the bearing for the inner rotary piston 8 and by the likewise oil-containing leakage gases which pass along the slide rings 10 and 11.

FIG. 4 illustrates an expansion machine which structurally is very similar to the compressor of FIGS. 1 to 3. The outer rotary piston of the expansion machine of FIG. 4 likewise comprises a two-sectional mantle 31 with inserted teeth 32 while the outer rotary piston is supported by bearings 33 and 34 on hollow shaft 35 and the supporting body 36 connected thereto. The supporting body 36 comprises the supporting ring 36a and the control disc 36c which latter contains the outlet slot 36d. In contrast to FIG. 1, the supporting body 36 of FIG. 4 has no guide blades and consequently has no outlet opening located in the central axis. Instead, the outer rotary piston has a blade ring 31a through which the outlet is effected. Moreover, the arrangement comprises a plurality of circumferentially distributed bores 31b. On the other hand, hollow shaft 35 has a guide blade ring 35a and carries the mounted control disc 37 with the inlet opening 37a.

The inner rotary piston 36a together with the outer rotary piston forms a plurality of working chambers 39, for instance, five chambers, as illustrated in FIG. 2. The axially resilient slide rings 40 and 41 axially guide the inner rotary piston. Finally, the machine is provided with a protective mantle 42.

Operation of Embodiment of FIG. 4

The expansion machine of FIG. 4 operates in a manner inverse to that of the compressor of FIG. 1. More

specifically, with reference to FIG. 4, the gas under pressure which enters the working chambers 39 through hollow shaft 35 and control slot 37a exerts a torque upon the outer rotary piston 31 and 32. This torque imparts a rotational movement upon the two rotary pistons coupled to each other. The simultaneously starting working cycle may be explained in connection with FIG. 2 while it is assumed that the slot 7a shown therein represents the inlet slots 37a. The rotary pistons will then be forced to carry out a movement in counter-clockwise direction. As soon as during this movement a working chamber passes by the inlet slot, an expansion will occur in said respective chamber and when the outlet slot 36d has been reached (slot 36d corresponding to slot 6d in FIG. 3), the gas is exhausted in nearly expanded condition. The gas first enters the annular chamber 43 and from here passes primarily between blades 31a and leaves the machine while the flow and pressure energy is exploited. Through the intervention of a coupling 44 of any desired type, the torque of the outer rotary piston may be conveyed to a machine to be driven.

The lubrication of the tooth tips and of the bearings is effected in such a way that lubricant is intermixed with the entering gas and is conveyed to the parts to be lubricated either directly or by means of leakage gases. In this connection, the bores 31b are particularly helpful inasmuch as through said bores 31b, a portion of the outgoing gases is passed over the bearing 34.

FIG. 5 illustrates on an enlarged scale a section of the guide blade ring 31a ahead of the outlet opening 36d of the end face disc.

It is, of course, to be understood that the present invention is, by no means, limited to the particular constructions shown in the drawings, but also comprises any modifications within the scope of the appended claims. Thus, the present invention may with equal advantage also be employed in connection with rotary piston machines the rotary pistons of which have inclined teeth instead of the straight teeth shown in the drawings.

What I claim is:

1. In a rotary piston machine: stationary supporting shaft means having at least one hollow end section, an outer annular rotor rotatably supported by said shaft means and having its inner periphery provided with inwardly extending teeth, said outer rotor forming the housing for the device, an inner annular rotor arranged eccentrically within said outer rotor and rotatably supported by said shaft means, said inner rotor having its outer periphery provided with outwardly extending teeth in meshing engagement with said inwardly extending teeth of said outer rotor, said inner rotor being journaled on an intermediate portion of said shaft means and said outer rotor being journaled at its opposite ends on said shaft means at regions of the shaft means spaced outwardly from the ends of said inner rotor, and side wall means non-rotatably supported by said shaft means and respectively extending in planes substantially perpendicular to the axes of rotation of said rotors and arranged on opposite sides of said inner rotor, said side wall means together with said inwardly and outwardly extending teeth confining the working chambers of said rotary piston machine, said side wall means being provided with passage means at least one of which communicates with the hollow end section of said shaft means, said passage means respectively forming an inlet at one end of the rotors, an outlet at the other end thereof for respectively admitting fluid into and discharging fluid from said working chambers.

2. A rotary piston machine according to claim 1 including guide blade means arranged within said hollow end section of said shaft means for guiding the gaseous medium.

3. A rotary piston machine according to claim 1 in which said supporting shaft means is in two parts fixed together in end to end relation and the said side wall

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means at the lower pressure end of said rotors being integral with the part of said shaft means adjacent thereto.

4. A rotary piston machine according to claim 1 in which said supporting shaft means is in two parts fixed together in end to end relation and the said side wall means at the lower pressure end of said rotors being integral with the part of said shaft means adjacent thereto, said side wall means at the higher pressure end of the rotors comprising an annular hollow chamber forming a part of the said passage means therein and the said side wall means also having a peripheral portion adjacent the outer rotor substantially sealing the higher pressure end of the device.

5. A rotary piston machine according to claim 1 in which said supporting shaft means is in two parts fixed together in end to end relation and the said side wall means at the lower pressure end of said rotors being integral with the part of said shaft means adjacent thereto, said side wall means at the higher pressure end of the rotors comprising an annular hollow chamber forming a part of the said passage means therein and the said side wall means also having a peripheral portion adjacent the outer rotor substantially sealing the higher pressure end of the device, said annular chamber being substantially spiral shaped and narrowing in the direction of rotation of the rotors.

6. In a rotary piston machine: stationary supporting shaft means having hollow end sections, an outer annular rotor rotatably supported by said shaft means and having its inner periphery provided with inwardly extending teeth, said outer rotor forming the housing for the device, an inner annular rotor arranged eccentrically within said outer rotor and rotatably supported by said shaft means, said inner rotor having its outer periphery provided with outwardly extending teeth in meshing engagement with said inwardly extending teeth of said outer rotor, said inner rotor being journaled on an intermediate portion of said shaft means and said outer rotor being journaled at its opposite ends on said shaft means at regions of the shaft means spaced outwardly from the ends of said inner rotor, and side wall means non-rotatably supported by said shaft means and respectively extending in planes substantially perpendicular to the axes of rotation of said rotors and arranged on opposite sides of said inner rotor, said side wall means together with said inwardly and outwardly extending teeth confining the working chambers of said rotary piston machine, said side wall means being provided with passage means communicating with respective ones of said hollow end sections of said shaft means, said passage means respectively forming an inlet at one end of the rotors, an outlet at the other end thereof for respectively admitting fluid into and discharging fluid from said working chambers, the side wall means at the lower pressure end of the rotors being integral with said shaft means, and means communicating the passage means in the side wall means at the lower pressure end of the rotors with the said hollow end section adjacent thereto including guide vanes carried by said shaft means.

7. In a rotary piston machine: stationary supporting shaft means having at least one hollow end section, an outer annular rotor rotatably supported by said shaft means and having its inner periphery provided with inwardly extending teeth, said outer rotor forming the housing for the device, an inner annular rotor arranged eccentrically within said outer rotor and rotatably supported by said shaft means, said inner rotor having its outer periphery provided with outwardly extending teeth in meshing engagement with said inwardly extending teeth of said outer rotor, said inner rotor being journaled on an intermediate portion of said shaft means and said outer rotor being journaled at its opposite ends on said shaft means at regions of the shaft means spaced outwardly from the ends of said inner rotor, and side wall means non-rotatably supported by said shaft means and respectively extending in planes substantially perpendicu-

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lar to the axes of rotation of said rotors and arranged in opposite sides of said inner rotor, said side wall means together with said inwardly and outwardly extending teeth confining the working chambers of said rotary piston machine, said side wall means being provided with passage means at least one of which communicates with the hollow end section of said shaft means, said passage means respectively forming an inlet at one end of the rotors, an outlet at the other end thereof for respectively admitting fluid into and discharging fluid from said working chambers, and a blade ring carried by said outer rotor at the discharge end thereof through which the medium handled by the machine passes.

8. In a rotary piston machine: stationary supporting shaft means having at least one hollow end section, an outer annular rotor rotatably supported by said shaft means and having its inner periphery provided with inwardly extending teeth, said outer rotor forming the housing for the device, an inner annular rotor arranged eccentrically within said outer rotor and rotatably supported by said shaft means, said inner rotor having its outer periphery provided with outwardly extending teeth in meshing engagement with said inwardly extending teeth of said outer rotor, said inner rotor being journaled on an intermediate portion of said shaft means and said outer rotor being journaled at its opposite ends on said shaft means at regions of the shaft means spaced outwardly from the ends of said inner rotor, and side wall means non-rotatably supported by said shaft means and respectively extending in planes substantially perpendicular to the axes of rotation of said rotors and arranged on opposite sides of said inner rotor, said side wall means together with said inwardly and outwardly extending teeth confining the working chambers of said rotary piston machine, said side wall means being provided with passage means at least one of which communicates with the hollow end section of said shaft means, said passage means respectively forming an inlet at one end of the rotors, an outlet at the other end thereof for respectively admitting fluid into and discharging fluid from said working chambers, and axially resilient ring means bearing between said side wall means and the ends of said inner rotor inwardly from the working chambers.

9. In a rotary piston machine: stationary supporting shaft means having at least one hollow end section, an outer annular rotor rotatably supported by said shaft means and having its inner periphery provided with inwardly extending teeth, said outer rotor forming the housing for the device, an inner annular rotor arranged eccentrically within said outer rotor and rotatably supported by said shaft means, said inner rotor having its outer periphery provided with outwardly extending teeth in meshing engagement with said inwardly extending teeth of said outer rotor, said inner rotor being journaled on an intermediate portion of said shaft means and said outer rotor being journaled at its opposite ends on said shaft means at regions of the shaft means spaced outwardly from the ends of said inner rotor, and side wall means non-rotatably supported by said shaft means and respectively extending in planes substantially perpendicular to the axes of rotation of said rotors and arranged on opposite sides of said inner rotor, said side wall means together with said inwardly and outwardly extending teeth confining the working chambers of said rotary piston machine, said side wall means being provided with passage means at least one of which communicates with the hollow end section of said shaft means, said passage means respectively forming an inlet at one end of the rotors, an outlet at the other end thereof for respectively admitting fluid into and discharging fluid from said working chambers, the rotatable support of said outer rotor on said shaft means comprising anti-friction bearings, and passages connecting said bearings with the flow passage for working medium in the machine whereby lubricant supplied to the working medium will be supplied to the bearings.

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10. A rotary piston machine according to claim 9 in which said passages include holes in at least one of said end wall means arranged to direct working medium in the machine directly to the adjacent bearing for the outer rotor.

11. In a rotary piston machine for gaseous working media; two rotary pistons arranged eccentrically one within the other and provided with meshing teeth, means for driving the outer rotary piston and therethrough the inner rotary piston, means for admitting gaseous working medium to the machine at one end thereof and for discharging said gaseous working medium from said machine at the other end thereof, discs laterally confining the working chambers formed by the said teeth, said discs having inlet and outlet openings therein for the working medium, a stationary two-piece shaft of large diameter providing a supporting member for the rotary pistons, said outer rotary piston being journaled on both ends of the shaft, said inner rotary piston being journaled on an intermediate portion of said shaft, that portion of

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the shaft which faces the working medium of higher pressure being provided with a hollow section for conveying the working medium into the machine, and that portion of the shaft which is interposed between said hollow portion and said intermediate portion of the shaft being provided with a plurality of circumferentially spaced defining guide blades therebetween.

12. A rotary piston machine according to claim 11 in which said shaft comprises two axial portions in end to end relation and fixedly secured together.

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