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Lamm

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[54] **ROTARY PISTON INTERNAL COMBUSTION ENGINE, ESPECIALLY OF TROCHOIDAL CONSTRUCTION**

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[52] **U.S. Cl.** **418/142,** 418/61, 418/144

[51] **Int. Cl.** **F01c 19/00**

[58] **Field of Search** 418/142, 61, 144

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[57] **ABSTRACT**

A rotary piston internal combustion engine, especially of trochoidal construction, which includes a housing consisting of a housing casing and of lateral parts and a piston that is provided at its end faces with bar grooves; at least two sealing bars are arranged in each bar groove which are axially movable; the two or more sealing bars arranged in a respective bar groove may also be mutually different in shape and size and/or may be made of different types of materials.

12 Claims, 7 Drawing Figures

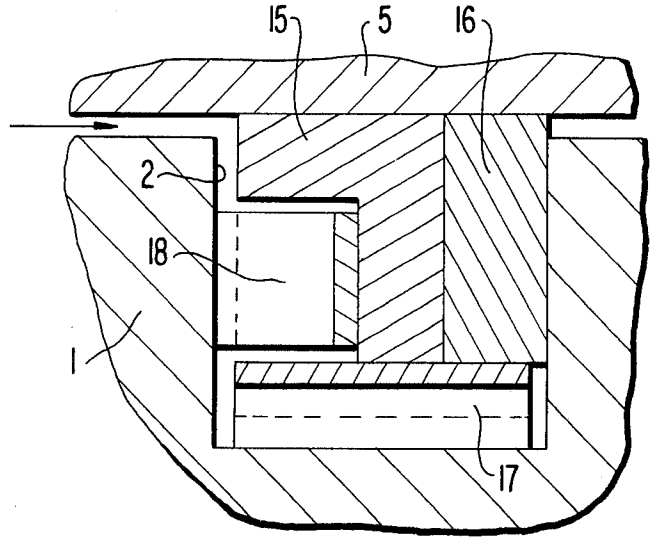


FIG. 1

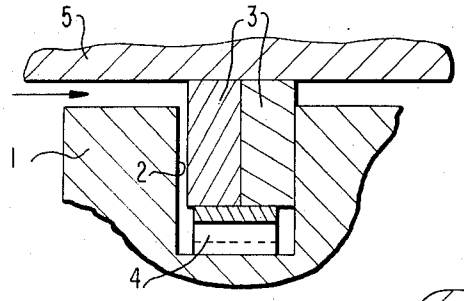


FIG. 2

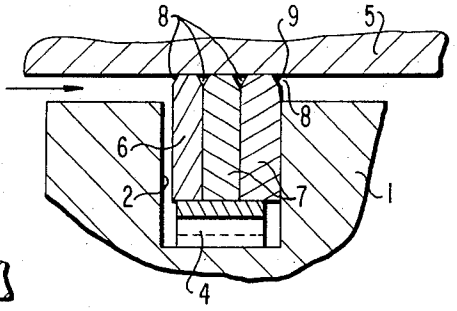


FIG. 3

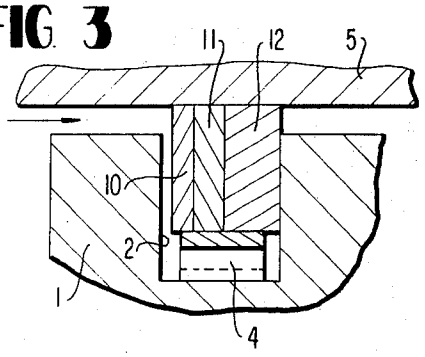
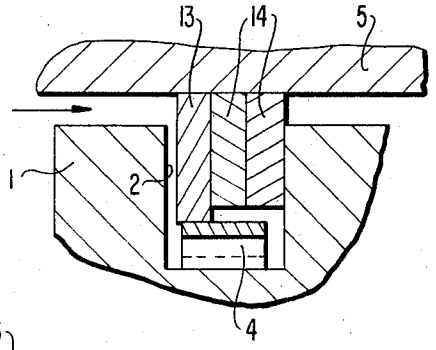


FIG. 4



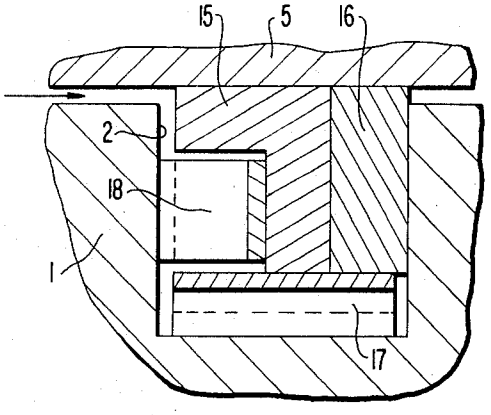


FIG. 5

FIG. 6

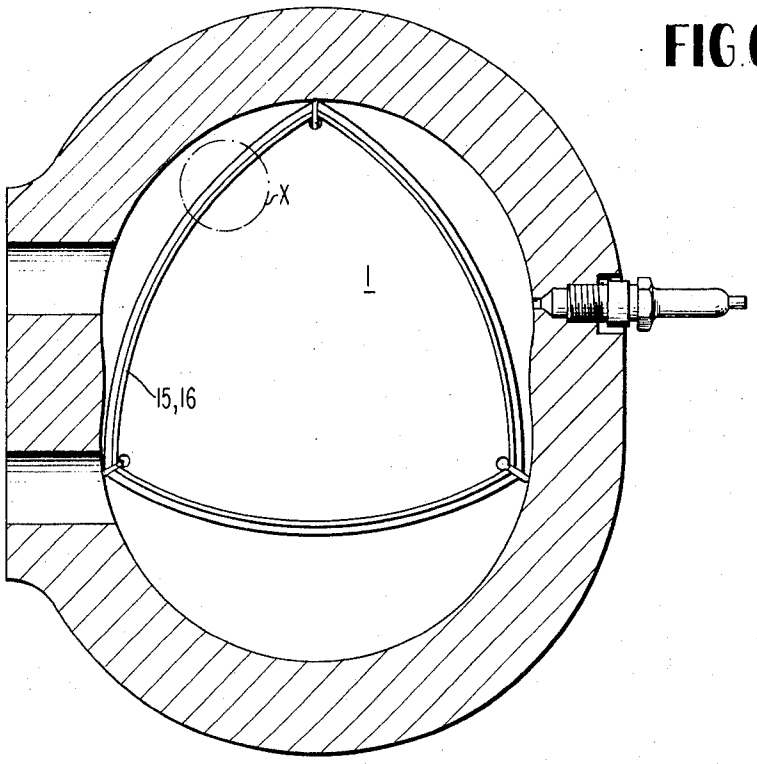
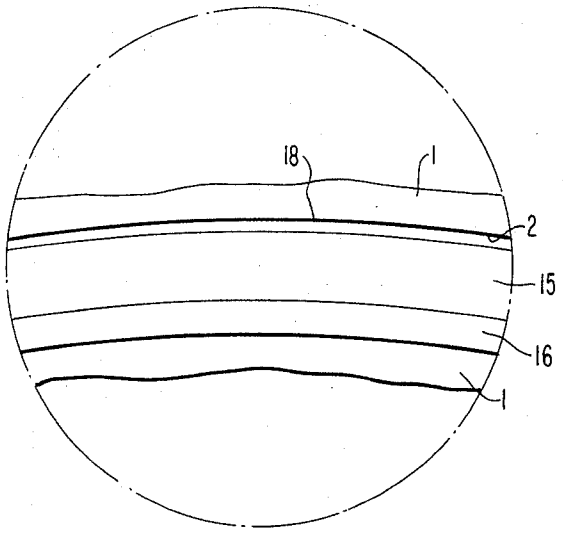


FIG. 7



ROTARY PISTON INTERNAL COMBUSTION ENGINE, ESPECIALLY OF TROCHOIDAL CONSTRUCTION

The present invention relates to a rotary piston internal combustion engine, especially of trochoidal construction with a housing consisting of lateral parts and of a casing and with a piston that is provided at its end faces with bar grooves, into which is inserted respectively an axially movable sealing bar with a sealing bar spring.

It is known in connection with pistons of rotary piston internal combustion engines to arrange in each of the bar grooves a single sealing bar with a corresponding sealing bar spring. Furthermore, it is known in the prior art in order to obtain a more favorable lateral gas-tightness at the piston, that respectively two separate bar grooves extending alongside one another and each provided with the aforementioned assembly parts are arranged in the piston. However, this prior art construction entails the disadvantage that a larger space requirement is necessary which is not always available depending on design dimensions of a given construction. Furthermore, the machining of the altogether 12 bar grooves at the piston which result from such an arrangement in a three-cornered piston, is time-consuming and costly.

The present invention is concerned with the task to provide an arrangement for the sealing bars at the piston which in a simple manner is superior compared to the prior art constructions.

Accordingly, it is proposed according to the present invention that at least two sealing bars are arranged in a respective bar groove which have mutually different forms and dimensions and/or different types of materials used therewith.

It is achieved thereby that the bar groove receives a greater width--as viewed in cross section--by the installation of several sealing bars and therefore can be machined more easily and readily. The required surface quality of the bar groove flanks can be achieved more readily and can be controlled more easily.

Notwithstanding this wider bar groove, the space requirement is considerably smaller compared to the two individual sealing bar constructions arranged adjacent one another.

In a preferred embodiment, two sealing bars of identical form and size which are springily supported, may be provided in each bar groove according to the present invention.

Several sealing bars adapt themselves well to the bar groove flanks and to one another. They form a labyrinth seal which is gas-tight in an optimum manner and avoids the passing through of gas by way of the oil seal into the oil circulatory system.

As a further feature of the present invention, three sealing bars may be arranged in each bar groove, of which the sealing bar disposed on the gas side is constructed narrower in its width--as seen in cross section. Furthermore, the three sealing bars disposed adjacent one another in a bar groove may have mutually different sealing bar widths.

In order to permit the occurrence of as small as possible a friction between the sealing bars and the lateral or intermediate part of the housing during the starting of the engine, two of the three sealing bars arranged adjacent one another in a bar groove may be constructed according to the present invention shorter in their structural height so that during the standstill of the engine only one sealing bar is pressed against the side part or intermediate part of the housing by the spring pressure. After the starting of the engine, all sealing bars receive gas pressure and are then pressed outwardly uniformly.

In an advantageous manner, only one axially effective sealing bar spring is necessary according to the present invention for several sealing bars in a sealing bar groove.

In order to obtain an abutment of the sealing bars which is as force-locking as possible, the present invention additionally provides that two sealing bars are guided in a bar groove, of which one sealing bar is constructed of rectangular shape and the other of L-shape—as viewed in cross section—, and that the L-shaped sealing bar, in addition to abutting against the axially effective sealing bar spring, abuts against a radially effective sealing bar spring.

Accordingly, it is an object of the present invention to provide a rotary piston internal combustion engine, especially of trochoidal construction which avoids by simple means the aforementioned shortcomings and drawbacks encountered in the prior art.

Another object of the present invention resides in a rotary piston internal combustion engine, especially of trochoidal construction, which is equipped with a sealing bar arrangement at the end faces of the piston that is more favorable in its space requirements than the prior art constructions.

A further object of the present invention resides in a rotary piston internal combustion engine, especially of trochoidal construction, which involves a less time-consuming and a less costly manufacture of the bar grooves for the sealing bars at the end faces of the pistons.

Another object of the present invention resides in a sealing bar arrangement in the end faces of the piston of a rotary piston internal combustion engine of trochoidal construction which permits easier manufacture and improved control of the surface quality of the sealing bar groove flanks.

A still further object of the present invention resides in a rotary piston internal combustion of trochoidal construction provided with several sealing bars arranged in a bar groove of the end surface of the piston which improves the gas-tightness thereof notwithstanding a saving in space.

These and other objects, features and advantages of the present invention will become more apparent from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, several embodiments in accordance with the present invention, and wherein:

FIG. 1 is a partial cross-sectional view through a rotary piston internal combustion engine of trochoidal construction equipped with two sealing bars in accordance with the present invention;

FIGS. 2 to 4 are partial cross-sectional views through three modified embodiments of rotary piston internal combustion engines provided with three sealing bars in a respective bar groove in accordance with the present invention which have mutually different shapes and sizes;

FIG. 5 is a partial cross-sectional view through a still further modified embodiment of a rotary piston inter-

nal combustion engine of trochoidal construction with two sealing bars and two sealing bar springs each in a respective bar groove according to the present invention.

FIG. 6 is a partial cross-sectional view of a rotary piston internal combustion engine of trochoidal construction with the two sealing bars and two sealing bar springs of FIG. 5 disposed in the piston; and

FIG. 7 is an enlarged view of the embodiment of FIG. 5 taken in the area designated X in FIG. 6.

Referring now to the drawing wherein like reference numerals are used throughout the various views to designate like parts, and more particularly to FIG. 1, reference numeral 1 designates in this figure a piston of a rotary piston internal combustion engine, particularly of otherwise conventional trochoidal construction, in which case the piston is of polygonal shape and the housing casing is provided with a multi-arched contact or running surface along which slides the piston with its piston corners as shown in FIG. 6. Bar grooves 2 are arranged in the usual manner at the end faces of the piston 1; two sealing bars 3 disposed adjacent one another and having the same shape and size are thereby elastically supported in each sealing bar groove 2 in accordance with this invention. The sealing bars 3 are pressed against the end face of a lateral part 5 of the housing by a sealing bar spring 4 which extends nearly over the entire width of the two sealing bars 3. The lateral part 5, in case of a multi-disk rotary piston internal combustion engine may also represent an intermediate housing part between adjacent disks of the multi-disk engine.

The rotary piston internal combustion engines illustrated in part in FIGS. 2–5, differ from the rotary piston internal combustion engine of FIG. 1 only by the particular sealing bar constructions in accordance with the present invention.

An embodiment is illustrated in FIG. 2, in which three sealing bars 6, 7, 7 are accommodated in a respective bar groove 2 whereby the sealing bar 6 arranged on the gas side is constructed narrower in width. In order to avoid a cutting or digging-in of the sealing bar into the lateral part 5 even after long operating periods of the rotary piston internal combustion engine, small chamfers 8—as indicated in FIG. 2 through applicable also in all other embodiments—may be appropriate at the engaging or contact surface of the sealing bars 6 and 7, which at their points of contact 9 retain a fine oil film also between the individual sealing bars so that, on the one hand, the wear is reduced, and on the other, the gas-tightness is increased.

Three sealing bars 10, 11 and 12 also arranged in one bar groove 2 adjacent one another are illustrated in FIG. 3 which, however, are all constructed different in their respective width. The narrowest and therewith the most flexible sealing bar 10 is disposed on the gas side. The three sealing bars 10, 11 and 12 together are held or engaged by a single sealing bar spring 4—as is also indicated in FIG. 2—whereas only one of the three sealing bars 13, 14, 14 arranged in a single bar groove 2 according to FIG. 4 is held by the sealing bar spring 4. The other two sealing bars 14 of FIG. 4 are constructed shorter in their structural height.

The two sealing bars 15 and 16 illustrated in FIGS. 5, 7 which are disposed in a single bar groove 2 have different shapes. The sealing bar 15 arranged on the gas side is L-shaped in cross section and the adjacent sealing bar 16 is constructed rectangularly shaped in cross section. Furthermore, two sealing bar springs 17 and 18 having different pressure or force directions are arranged in the bar groove 2, of which the axially effective spring 17 presses both sealing bars 15 and 16 against the lateral housing part 5 and the radially effective spring 18 presses laterally against the L-shaped sealing bar 15.

All of the embodiments whose arrows disposed between piston 1 and lateral part 5 indicate the gas side, offer the advantage that several sealing bars also result in a greater gas-tightness at the bolt because the thinner individual sealing bars can adapt themselves better to the bolt contour. Furthermore, several sealing bars abut more elastically at the lateral part or intermediate part. They thus conduct or transfer the heat more favorably to the lateral housing. Of the several sealing bars disposed adjacent one another, only the sealing bar disposed on the gas side is exposed to the highest temperature whereas the further sealing bar or bars are protected against high temperatures. As a result thereof, different longitudinal plays or length clearances of the individual sealing bars are possible which influence extraordinarily favorably the gas-tightness at the junction point or contact point to the bolt.

In order to obtain optimum running properties, gas tightness and an increase of the length of life by the several sealing bars arranged in a single bar groove, different materials may be used such as, for example, gray cast iron, bronze, aluminum, ceramics, carbon, steel, synthetic plastic materials, such as, synthetic resinous materials, sintered metals, etc. The sequence of the arrangement of the materials to be used can be different.

Sealing bars with different types of materials then run along the same running or contact surface of the lateral or intermediate part.

While I have shown and described several embodiments in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of numerous changes and modifications as are known to those skilled in the art, and I therefore do not wish to be limited to the details shown and described herein but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

What I claim is:

1. A rotary piston internal combustion engine with a housing including a casing and lateral parts comprising: a piston disposed within said housing, a peripheral groove provided along each end face of said piston, said peripheral groove being provided with two spaced wall portions and a bottom wall portion, one of said wall portions being disposed on the gas side of said piston, at least two axially movable sealing bar means disposed in each of said grooves, a first spring means disposed in a respective peripheral groove between said bottom wall portion and said at least two sealing bar means for axially urging said at least two sealing bar means against the lateral parts, a second spring means disposed between said sealing bar means and said wall portion on the gas side of said piston for radially urging said sealing bar means against the other wall portion of a respective peripheral groove.

2. A rotary piston internal combustion engine with a housing including a casing and lateral parts comprising: a piston disposed within said housing, a peripheral groove provided along each end face of said piston, at

least two axially movable sealing bar means disposed in each of said grooves, a first means for urging said sealing bar means against the lateral parts, a second means for urging said sealing bar means against a wall portion of a respective groove, wherein said sealing bar means have mutually different shapes.

3. A rotary piston internal combustion engine according to claim **2,** wherein said sealing bar means have mutually different sizes.

4. A rotary piston internal combustion engine with a housing including a casing and lateral parts comprising: a piston disposed within said housing, a peripheral groove provided along each end face of said piston, at least two axially movable sealing bar means disposed in each of said grooves, a first means for urging said sealing bar means against the lateral parts, a second means for urging said sealing bar means against a wall portion of a respective groove, wherein said sealing bar means have mutually different sizes.

5. A rotary piston internal combustion engine with a housing including a casing and lateral parts comprising: a piston disposed within said housing, a peripheral groove provided along each end face of said piston, at least two axially movable sealing bar means disposed in each of said grooves, a first means for urging said sealing bar means against the lateral parts, a second means for urging said sealing bar means against a wall portion of a respective groove, wherein at least one of the sealing bar means of a respective groove consists of respectively different types of materials.

6. A rotary piston internal combustion engine according to claim **5,** wherein said materials are selected from the group consisting of gray cast iron, bronze, aluminum, ceramics, carbon, steel, synthetic plastics and sintered metals.

7. A rotary piston internal combustion engine with a housing including a casing and lateral parts comprising: a piston disposed within said housing, a peripheral groove provided along each end face of said piston, at least two axially movable sealing bar means disposed in each of said grooves, a first means for urging said sealing bar means against the lateral parts, a second means for urging said sealing bar means against a wall portion of a respective groove, wherein all of said sealing bar means of a respective groove consist of respectively different types of materials.

8. A rotary piston internal combustion engine according to claim **7,** wherein said materials are selected from the group consisting of gray cast iron, bronze, aluminum, ceramics, carbon, steel, synthetic plastics and sintered metals.

9. A rotary piston internal combustion engine according to claim **1,** wherein the engine is of trochoidal construction, said piston is of polygonal shape, and said housing casing is provided with a multi-arched running surface along which the piston corners of said polygonal piston slide.

10. A rotary piston internal combustion engine with a housing including a casing and lateral parts, comprising: a piston disposed within the housing, bar groove means provided at the end faces of said piston, two axially movable sealing bar means guided in a respective bar groove means, axially effective sealing bar spring means inserted into said bar groove means for urging said sealing bar means against the lateral parts, one of said sealing bar means being constructed of substantially rectangular shape, the other of said sealing bar means being constructed of substantially L-shape as viewed in cross section, and radially effective sealing bar spring means, said L-shaped sealing bar means abutting against said radially effective sealing bar spring means and against said axially effective sealing spring means.

11. A rotary piston internal combustion engine according to claim **10,** wherein only one axially effective sealing bar spring means is provided for the sealing bar means guided in a respective bar groove means.

12. A rotary piston internal combustion engine according to claim **10,** wherein said sealing bar means are made of different materials.

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