United States Patent

Lamm

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[45] **Aug. 22, 1972**

[54] **ROTARY PISTON INTERNAL COMBUSTION ENGINE**

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[73] Assignee: **Daimler-Benz Aktiengesellschaft,** Stuttgart-Unterturkheim, Germany

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[21] Appl. No.: **43,128**

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Jan. 20, 1970 Germany.....P 20 02 311.4

[52] **U.S. Cl.** **418/113,** 418/121, 418/122
[51] **Int. Cl.**.....**F01c 19/02,** F03c 3/00, F04c 27/00
[58] **Field of Search**.....418/61, 113, 114, 115, 117, 418/120–124; 277/81 P

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Primary Examiner—Carlton R. Croyle
Assistant Examiner—John J. Vrablik
Attorney—Craig, Antonelli & Hill

[57] **ABSTRACT**

A rotary piston internal combustion engine, particularly of trochoidal construction, which has a piston that is provided at its corners with sealing bars which include support and wear parts with the latter forming the head portions; the wear part of the sealing bar is either superfinish-machined at its bottom side and, wetted with a lubricant, placed on the support part, also superfinish-machined at its corresponding surface, so that the wear part can be displaced parallel to its bottom side whereas it cannot be lifted perpendicularly to the bottom side by reason of the effect of the air pressure, or in which, in the alternative, the wear part of the sealing bar is subdivided perpendicularly to its longitudinal axis and each subdivided wear part is connected with the support part of the sealing bar at its bottom side within only a small area of its length by soldering, cementing or the like; the bottom side of the wear part or of the individual subparts of the wear part and/or the top side of the support part may also be provided with recesses which are preferably arranged symmetrically to the center of the length of the wear part or the length of its individual subparts, particularly along the longitudinal axis or pairwise symmetrically thereto.

21 Claims, 23 Drawing Figures

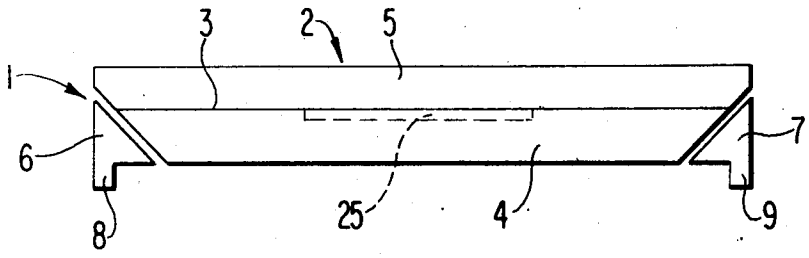


FIG. 1

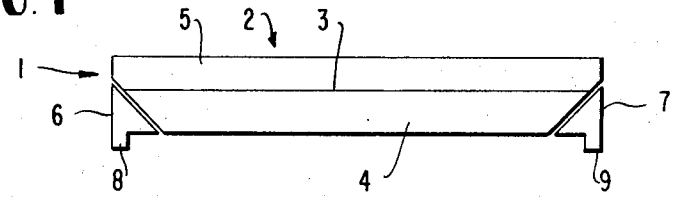


FIG. 2

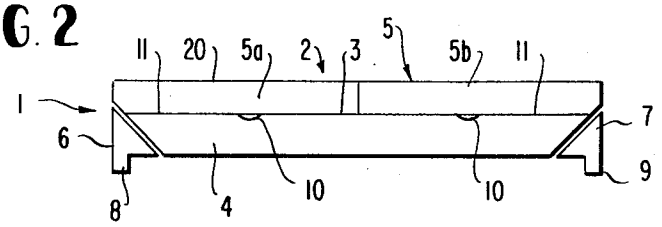


FIG. 3

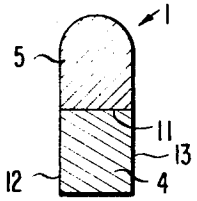


FIG. 4

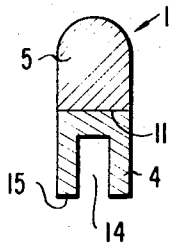


FIG. 5

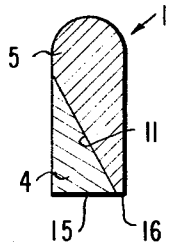


FIG. 6

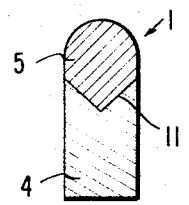


FIG. 7

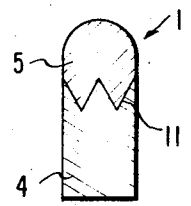


FIG. 8

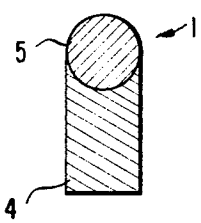


FIG. 9

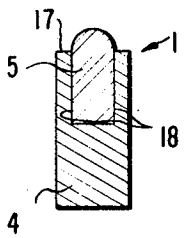


FIG. 10

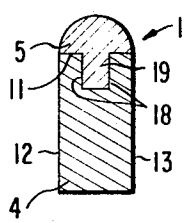


FIG. 11

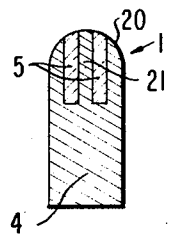
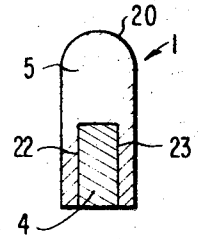


FIG. 12



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ATTORNEYS

FIG. 13

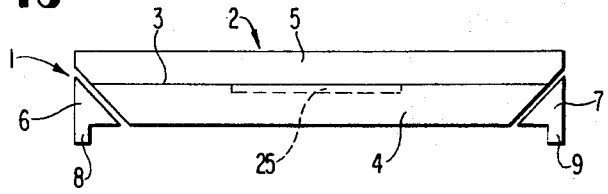


FIG. 14

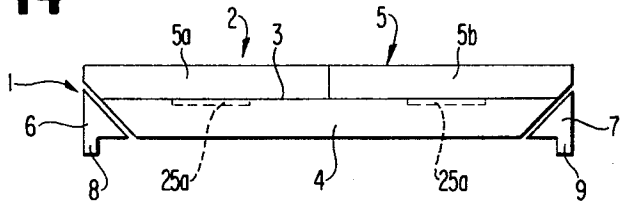


FIG. 15

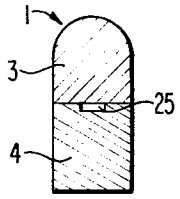


FIG. 16

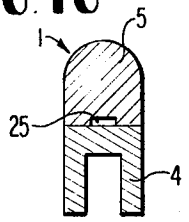


FIG. 17

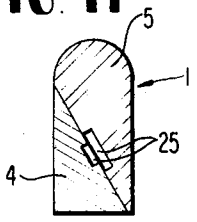


FIG. 18

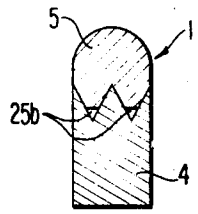


FIG. 19

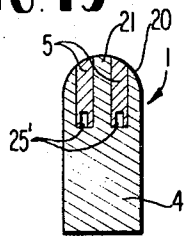


FIG. 20

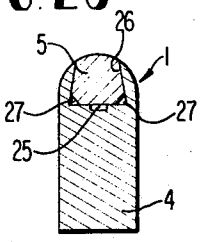


FIG. 21

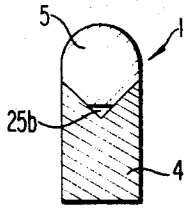
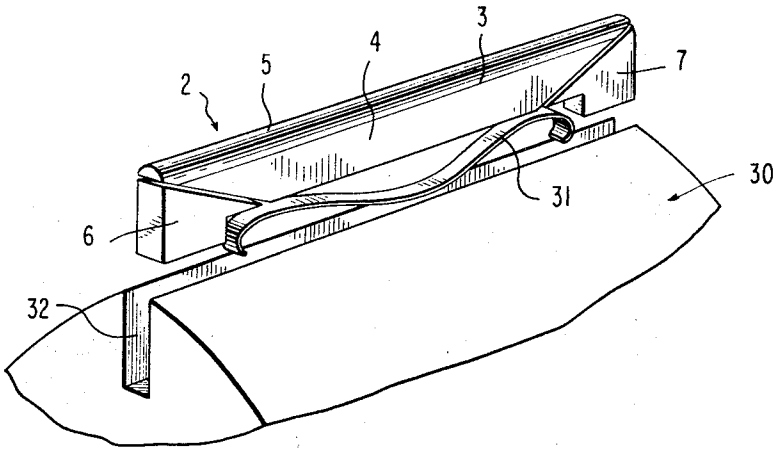


FIG. 22



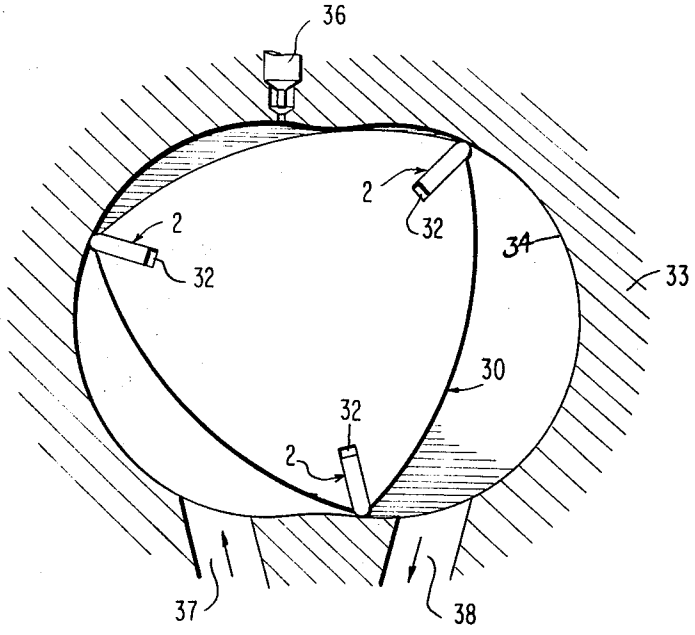


FIG. 23

ROTARY PISTON INTERNAL COMBUSTION ENGINE

The present invention relates to a rotary piston internal combustion engine of especially trochoidal-type of construction with a piston that is provided at its corners with sealing bars that consist of a support part and whose head portions are equipped with wear parts.

With the presently known sealing bar constructions as combination bars, the support and wear parts are rigidly connected with each other into a unit. The different thermal expansion coefficients of the two parts and of the connecting means such as solder, cement and the like, however, cause with this type of construction of the sealing bar undesirable stresses that lead frequently already during the manufacture to the formation of cracks.

The present invention is concerned with the task to so construct composite bars that an unimpaired expansion of support and wear parts is made possible.

The underlying problems are solved according to the present invention in that the wear part of the sealing bar whose head portion is rounded off, is superfinish-machined at its bottom side and, wetted with a lubricant, is slid or slipped on the support part also superfinish-machined at its corresponding surface so that it can be displaced parallel to its bottom side, but a lifting perpendicular to its bottom side is not possible by reason of the effect of the air pressure thereby in effect adheringly connecting the wear part to the support part, yet permitting relative sliding movement therebetween.

Another equivalent solution of the underlying problems according to the present invention provides that the wear part of the sealing bar, whose head portion is rounded off, is subdivided perpendicularly to its longitudinal axis, whereby each subpart of the wear part is connected by itself at the bottom side within only a small area of its length by soldering, brazing, bonding, gluing, cementing or the like with the support part of the sealing bar. Even though a rigid connection exists in this case between the wear part and the support part, the fact that such rigid connection is limited to a relatively small area permits unimpaired thermal expansion of the wear and support parts

Both solutions entail the advantage that materials with different thermal expansion coefficients can be used for the support and wear part. In this manner, the wear part may be manufactured of ceramics, quartz glass, sintered materials and the like whereby no thermal stresses can occur between support and wear part since longer soldering, cementing or spray-on surfaces are dispensed with. Hence, the disadvantage is eliminated that certain materials do not withstand the required mechanical load or stress. Particularly with the first solution, the superfinish-machined parts slipped one upon the other, possess a good mutual adhesion by reason of the lubricant and can be considered as one part during the assembly. Consequently, an economic manufacture is assured. The wear part, made, for example, from ceramic oxides, acts in an insulating manner with respect to the support part whence the support part and the sealing bar spring have lower temperatures. Further advantages result therefrom: the play or clearance of the sealing bar in its groove can be made smaller; a more heat-resistant and

wear-resistant material can be used with the elimination of its disadvantages; furthermore, the temperature in the gas space underneath the sealing bar is lower, and the corners of the sealing bar become cooler which has as a consequence better lubricating conditions and lesser wear; last but not least, it should be mentioned that the engine becomes more gas-tight by a better adaptation of support and wear parts of the sealing bar with respect to the corner.

The present invention additionally aims at a further improved construction of sealing bars of the type described above. The underlying problems, to increase the gas-tightness between the support and the wear part is solved in that recesses are provided in the bottom side of the wear part or of the individual parts of the wear part and/or in the top side of the support part, symmetrically to the center of the length of the wear part or the length of its individual parts, preferably along the longitudinal axis or pairwise symmetrical thereto. These recesses accommodate liquid, for example, oil, gasoline or also a mixture whereby the wetting and consequently also the adhesion of the two parts is increased. An increased gas tightness results therefrom. As an advantageous feature is to be additionally considered the fact that no stresses whatsoever can occur between the two parts as a result of the sliding adhesion.

In an advantageous construction of the present invention, the length of the recesses may correspond preferably at least to about one-third of the length of the wear part or of the corresponding subpart of the wear part in each case, without attaining the length thereof. The recesses should not extend over the entire length of the wear part as otherwise the gas-tightness is endangered. Liquid is continuously pumped through and replenished in operation through the play of the two parts. The recesses may also absorb slight quantities of impurities or dirt. Furthermore, an adherence point that is dissolved again during operation, may be temporarily provided thereat which serves the purpose of the elastic fixing of the two parts during machining and assembly.

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

Another object of the present invention resides in a rotary piston internal combustion engine in which undesired stresses in the sealing bar are far-reachingly eliminated.

A further object of the present invention resides in a sealing bar for rotary piston internal combustion engines which permits an unimpaired expansion of the support and wear parts thereof.

Still a further object of the present invention resides in a sealing bar construction for rotary piston internal combustion engines which permits the ready use of materials with different thermal expansion coefficients.

Another object of the present invention resides in a sealing bar construction for rotary piston internal combustion engines which assure improved gas-tightness due to smaller clearances of the sealing bar in its groove while at the same time reducing the temperatures in the gas space underneath the sealing bar and lowering the temperature of the corners thereof.

A further object of the present invention resides in a sealing bar of the type described above which assures improved lubrication accompanied with increased gas-tightness.

A further object of the present invention resides in a sealing bar construction for rotary piston internal combustion engines which facilitates manufacture and assembly thereof.

These and further objects, features, and advantages of the present invention will become more obvious 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 longitudinal view of a sealing bar consisting of support, wear and corner parts in accordance with the present invention;

FIG. 2 is a longitudinal view of a modified embodiment of a sealing bar in accordance with the present invention consisting of support, wear and corner parts in which the wear part is subdivided perpendicularly to its longitudinal axis;

FIGS. 3 to 12 are cross-sectional views through the support and wear parts of the sealing bars illustrated in FIGS. 1 or 2, and illustrating various cross-sectional possibilities thereof;

FIG. 13 is a longitudinal view of a still further modified embodiment of a sealing bar in accordance with the present invention consisting of support, wear and corner parts, similar to FIG. 1 but provided with a recess;

FIG. 14 is a longitudinal view of a sealing bar similar to FIG. 13, in which the wear part is subdivided perpendicularly to its longitudinal axis; and

FIGS. 15 through 21 are transverse cross-sectional views through the support and wear parts of the sealing bar illustrated in FIG. 13 or FIG. 14 and showing various cross-sectional possibilities thereof. FIG. 22 is a partial perspective, exploded view of a piston corner and sealing bar in accordance with the present invention for a rotary piston internal combustion engine of trochoidal construction, and

FIG. 23 is a schematic cross-sectional view through a rotary piston internal combustion engine of trochoidal construction.

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 generally designates in this figure the sealing bar whose center part generally designated by reference numeral 2 is separated in the longitudinal direction by a surface 3 into a lower support part 4 and an upper wear part 5. The center part 2 is separated at the ends thereof by one plane of separation each, perpendicular to the plane of the drawing and disposed at an acute angle to the longitudinal axis thereof, from two essentially triangularly shaped corner parts 6 and 7 that include extensions 8 and 9 for the support of the sealing bar spring.

FIG. 2 illustrates essentially the same sealing bar 1 as is shown in FIG. 1 with a wear part 5 that is divided perpendicularly to its longitudinal axis in the center into two subparts 5*a* and 5*b* whereby each of the two subparts 5*a* and 5*b* is connected by itself at its bottom side within a small area 10 of its length by brazing, soldering, gluing, cementing, bonding or the like with the support part 4 of the sealing bar 1.

It can be seen from FIG. 3 that the bottom side 11 of the wear part 5 is constructed as a flat surface perpendicular to the flanks 12 and 13 of the sealing bar 1 whereby the height of the wear part 5 is approximately equal to the height of the support part 4.

According to FIG. 4, a chamber 14 rectangular in cross section for accommodating a sealing bar spring (not shown) is provided in the support part 4 extending inwardly from the bottom side 15 thereof in the center of its cross section whereby the width of the chamber 14 corresponds approximately to half the width of the sealing bar 1 and the height of the chamber 14 amounts to about three-quarters the entire height of the support part.

According to FIG. 5, the bottom side 11 of the wear part 5 is constructed as a flat surface which, perpendicularly to the cross section of the sealing bar, intersects approximately diagonally the cross section of the sealing bar 1 at an acute angle to the bottom side 15 of the support part 4 starting from a lower edge 16 of the support part 4.

In FIG. 6, the bottom side 11 of the wear part 5 is V-shaped in cross section and in FIG. 7 is constructed W-shaped in cross section whereby the height of the wear part 5 corresponds to about half the height of the support part 4.

According to FIG. 8, the wear part 5 has a circular cross section whereby the height of the wear part 5 corresponds approximately to half the height of the support part 4.

According to FIG. 9, the support part 4 is rectangularly shaped in cross section whereby the wear part 5 also substantially rectangularly shaped in cross section is received in a longitudinal groove 18 in the center of the upper boundary surface 17 of the support part 4.

It can be seen from FIG. 10 that the wear part 5 and the support part 4 are separated essentially by a plane perpendicular to the flanks 12 and 13 of the sealing bar 1 whereby the wear part 5 is provided at its bottom side 11 in the center thereof with a longitudinal bar portion 19 that is retained in a corresponding longitudinal groove 18 in the support part 4 which is constructed nearly square in cross section and whose width corresponds approximately to one-third of the width of the sealing bar 1.

According to FIG. 11, the wear part 5 which is essentially rectangularly shaped in cross section, is inserted within the area of the peak or head portion 20 of the sealing bar 1 and is subdivided in the longitudinal direction by a bar-like projection 21 of the support part 4.

According to FIG. 12, the support part 4 is rectangularly shaped in cross section and is surrounded by the wear part 5 at the side of the head portion 20 of the sealing bar 1 as also along sides of its flanks 22 and 23, whereby the width of the support part 4 corresponds to approximately half the width of the entire sealing bar 1, and the height of the support part 4 corresponds to about three-quarters of the entire height of the sealing bar 1.

FIGS. 13 and 15 illustrate in longitudinal and cross-sectional views a sealing bar 1 which includes a center portion 2 and two corner portions 6 and 7 provided with supporting extensions 8 and 9, respectively. The center part 2 consists of a support part 4 and of a wear part 5 whereby a recess 25 is provided in the top side of

the support part **5** symmetrical to the center of its length, in the center of its cross section, whose length corresponds approximately to a third of the length of the wear part and whose depth corresponds to about one-tenth to one-eighth of the height of the support part **4**.

FIG. **14** illustrates substantially the same sealing bar as shown in FIG. **13** with a wear part **5** subdivided in the center of its length into subparts **5***a* and **5***b*, whereby two recesses **25***a* are provided in the top side of the support part **4** each symmetrical to the center of the two parts **5***a* and **5***b* of the wear part **5**. The length of the recesses **25***a* corresponds each to about one-third of the length of the individual parts **5***a* and **5***b* of the wear part **5**.

In FIG. **16**, the recess **25** or, respectively, the recesses **25***a* are located in the bottom side of the wear part **5** and in FIG. **17** these recesses **25** or **25***a* are located in the wear part **5** as well as in the support part **4** whereby the recess **25** or recesses **25***a* in the wear part **5** is or are constructed somewhat wider than the opposite recess or recesses in the support part **4**.

According to FIG. **18**, two recesses **25**b which are triangularly shaped in cross section and are obtained by the removal of material in the wear part **5**, are provided symmetrically on both sides of the longitudinal axis of the sealing bar **1** in the lower peaks of the bottom side of the wear part **5** which is W-shaped in cross section.

FIG. **19** illustrates an arrangement similar to FIG. **11** in which the wear parts **5** subdivided by the extension **21** of the support part **4** are each provided with substantially rectangular recesses **25'** extending inwardly from the bottom thereof.

In FIG. **20**, a wear part **5** essentially trapezoidally shaped in cross section is inserted into a dovetailed groove **26** within the support part **4**; a recess **25** is provided in the top side in the center of the support part **4**. The lower edges **27** of the wear part **5** are bevelled off over their entire length for avoiding stresses that may occur as a result of a canting or tilting in the dovetailed groove **26**.

FIG. **21** corresponds in a simplified form to the construction according to FIG. **18** and represents the use of a recess with the construction illustrated in FIG. **6**. FIGS. **22** and **23** schematically illustrate a rotary piston internal combustion engine of trochoidal construction which includes a casing **33** provided with an internal running surface **34** along which the piston generally designated by reference numeral **30** slides with its corners. The corners of the piston **30** are provided with grooves **32** extending in the axial direction of the piston for accommodating therein a sealing bar generally designated by reference numeral **2** which is urged into engagement with its wear part **5** against the running surface **34** by the spring **31**. The spark plug **36** as well as an inlet channel **37** and an exhaust channel **38** are provided in the casing **33** in a conventional manner. The sides of the casing **33** are closed by lateral parts (not shown) in a conventional manner.

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 known to those skilled in the art. Thus, the the various features of the foregoing description, shown in the drawing and disclosed in the appended claims may be used either individually or also in any suitable combination with each other for the realization of the present invention. Additionally, recesses may be provided in either the wear part and/or the support part in connection with each of the illustrated cross-sectional possibilities shown in FIGS. **3** through **12**, some of which are shown in FIGS. **15** through **21**.

Consequently, it is obvious that the present invention is not limited to the details shown and described herein but is susceptible of numerous changes and modifications and I therefore do not wish to be limited to these details but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

I claim:

1. A rotary piston internal combustion engine having a piston that is provided at its corners with sealing bar means that include support means and wear means, characterized in that the wear means and support means are made from different materials having different thermal expansions, in that they subdivide the sealing bar means in a substantially longitudinal direction with the wear means on the support means, and in that the wear means of the sealing bar possesses a superfinished bottom side and, provided with a lubricant wetting the surface of the bottom side, is mounted on the support means also having a superfinished corresponding top surface where it faces the super finished bottom surface of the wear means, so that the wear means can be displaced parallel to its bottom side while a lifting thereof away from the support means is substantially impossible as a result of the effect of the air pressure, whence the wear means and support means are in effect a unitary structure adhering to one another yet can expand unimpairedly with respect to one another.

2. A rotary piston internal combustion engine according to claim **1**, characterized in that the sealing bar means is provided with a rounded-off head portion.

3. A rotary piston internal combustion engine according to claim **2**, characterized in that the engine is of trochoidal construction.

4. A rotary piston internal combustion engine according to claim **1**, characterized in that the bottom side of the wear means is constructed as a flat surface perpendicular to the flanks of the sealing bar means.

5. A rotary piston internal combustion engine according to claim **4**, characterized in that the height of the wear means is approximately equal to the height of the support means.

6. A rotary piston internal combustion engine according to claim **4**, characterized in that a chamber for the accommodation of a sealing bar spring is provided in the support means from the bottom side thereof.

7. A rotary piston internal combustion engine according to claim **6**, characterized in that the width of the chamber corresponds approximately to half the width of the sealing bar means and the height of the chamber corresponds to approximately three-quarters the entire height of the support means.

8. A rotary piston internal combustion engine according to claim **7**, characterized in that the height of the wear means is approximately equal to the height of the support means.

9. A rotary piston internal combustion engine according to claim 8, characterized in that the chamber is of substantially rectangular shape and is provided substantially in the center of the cross section of the support means.

10. A rotary piston internal combustion engine according to claim 1, characterized by recess means provided in at least one of the two sides consisting of the bottom side of the wear means and the top side of the support means.

11. A rotary piston internal combustion engine according to claim 10, characterized in that said recess means are provided in pairs symmetrically to the longitudinal axis of the corresponding part.

12. A rotary piston internal combustion engine according to claim 10, characterized in that the length of the recess means corresponds at least approximately to one-third the length of a respective wear means.

13. A rotary piston internal combustion engine according to claim 10, characterized in that the recess means are provided symmetrically to the center of the length of the wear means.

14. A rotary piston internal combustion engine according to claim 13, characterized in that the recess means are provided along the longitudinal axis of the corresponding part.

15. A rotary piston internal combustion engine according to claim 1, characterized in that the sealing bar means includes at least one center part and two corner parts, said center part being constituted by said wear means and support means subdivided substantially in the longitudinal direction of the center part.

16. A rotary piston internal combustion engine according to claim 15, characterized in that said corner parts are substantially triangularly shaped and are separated from the center part along mutually complimentary plane surfaces forming an acute angle to the longitudinal direction of the center part.

17. A rotary piston internal combustion engine according to claim 1, characterized in that the sealing bar means is subdivided substantially perpendicularly to its longitudinal plane by the wear and support means.

18. A rotary piston internal combustion engine according to claim 17, characterized in that the sealing bar means is provided with a rounded-off head portion.

19. A rotary piston internal combustion engine according to claim 17, characterized in that the bottom side of the wear means is constructed as a flat surface perpendicular to the flanks of the sealing bar means.

20. A rotary piston internal combustion engine according to claim 17, characterized in that the height of the wear means is approximately equal to the height of the support means.

21. A rotary piston internal combustion engine according to claim 17, characterized by recess means provided in at least one of the two sides consisting of the bottom side of the wear means and the top side of the support means.

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