United States Patent

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[33] **Japan**
[31] **43/39162**

[54] **SIDE HOUSING OF ROTARY PISTON ENGINE**
5 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **418/60,** 418/61, 418/178
[51] **Int. Cl.** **F01c 1/02,** F01c 1/42, F01c 21/00
[50] **Field of Search** ..... 103/126, 126 (M), 130, 216 (M); 230/145; 123/8 (GOK), 8 (SS), 8 (CD); 91/56; 418/60, 61, 178

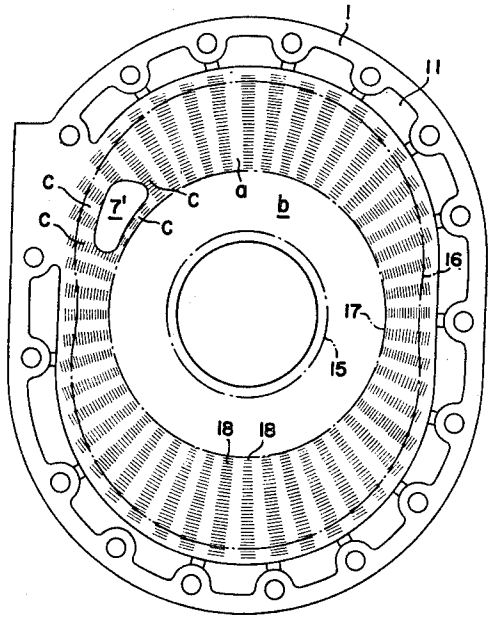
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Primary Examiner—Carlton R. Croyle
Assistant Examiner—Wilbur J. Goodlin
Attorney—Stevens, Davis, Miller & Mosher

ABSTRACT: A side housing for a rotary piston engine of trochoidal configuration having an inner surface exposed to the combustion gas and heat treated in striped pattern only in the restricted area located outwardly of an envelope of loci delineated by the oil sealing member mounted on the rotor means so as to alleviate the adverse effect due to heat treatment.



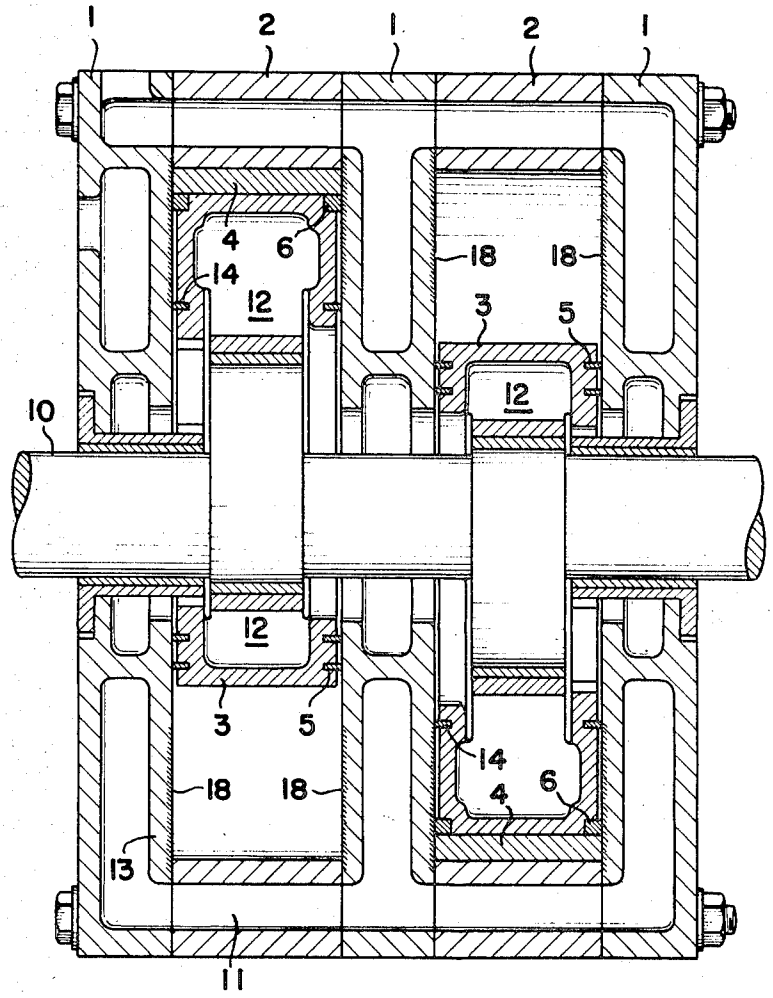


FIG. 1

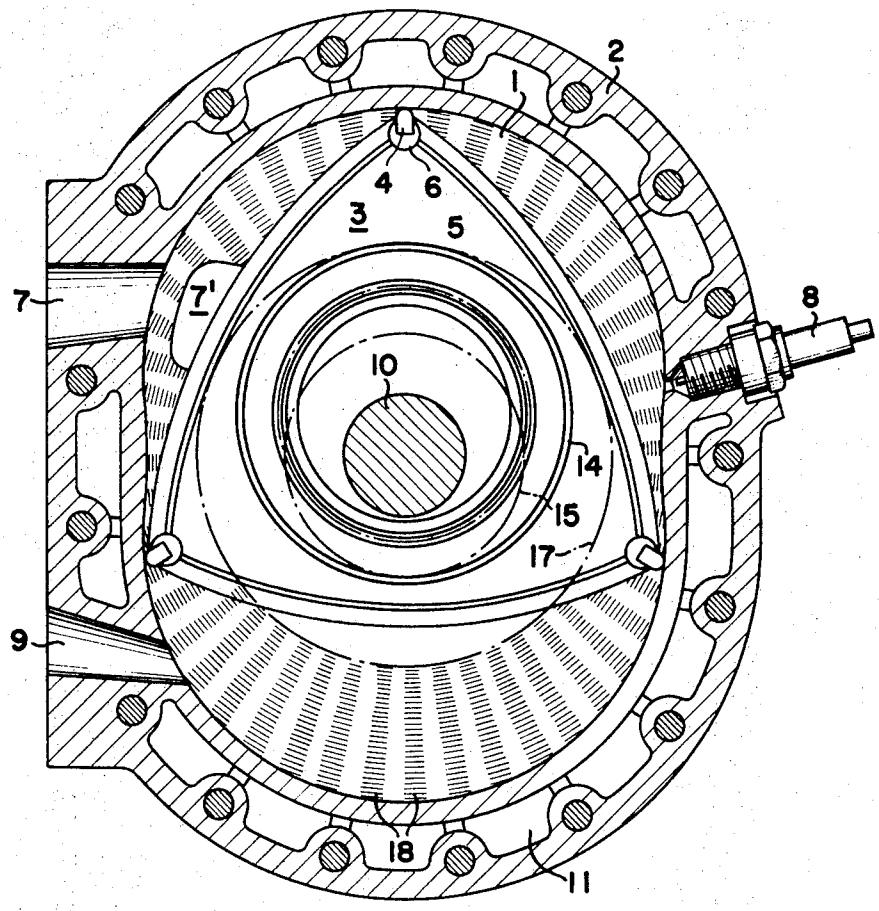


FIG. 2

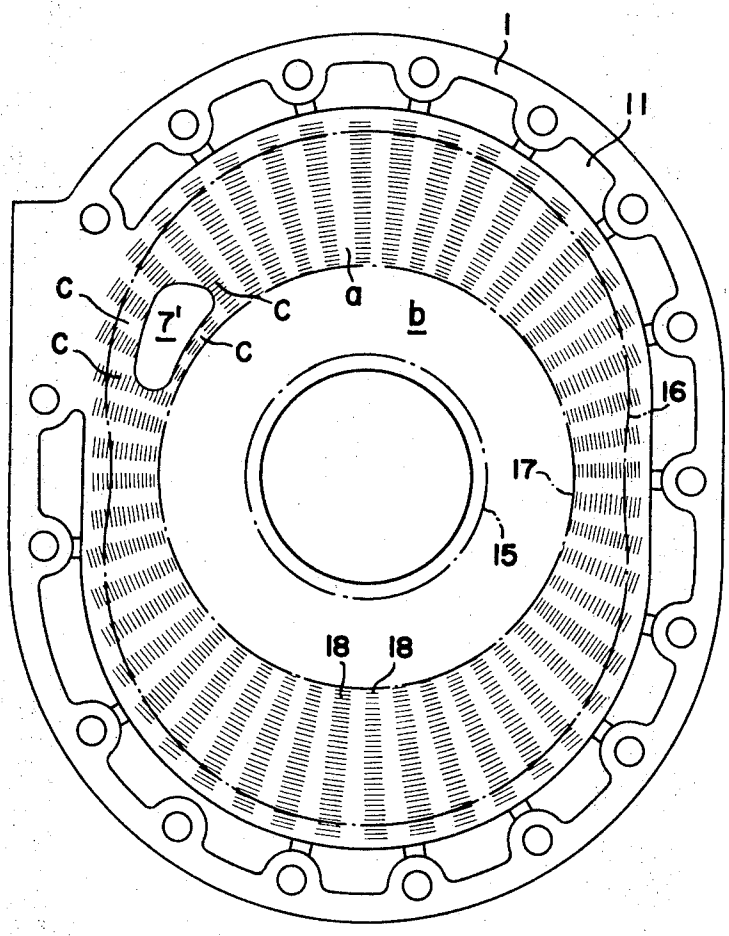


FIG. 3

SIDE HOUSING OF ROTARY PISTON ENGINE

This invention relates to a side housing for a rotary piston engine, more particularly to a side housing for a rotary piston engine of a trochoidal configuration having its inner surface heat treated in a striped pattern.

Side housings for rotary piston engines of trochoidal configuration of conventional type include inner surface thereof maintained in rubbing contact relationship with various sealing means mounted on the rotor member and applied with sprayed coatings of molybdenum or with hard platings of chromium as a wear resisting means. The above-mentioned inner surface will be referred to simply as the "sliding surface" hereinafter. However, since it will require a great deal of man power, particularly in case of the latter, a great deal of equipments will be needed in addition to the man power, to impart wear-resisting property onto the sliding surface. Conventional side housings have difficulties from the standpoint of mass production and will become expensive due to high-priced metal used. Also, the known surface hardening process cannot be satisfactorily employed for treating the side housing, since exceedingly large hardening strain will be produced in flat members particularly a flat member having a thin wall.

The present invention has been devised on the basis of our findings of the fact that even the flat members, if subjected to such surface hardening as forming a multiplicity of narrow hardened zones arranged in a striped pattern by, for example high frequency hardening, will have hardening strains much less than those having the whole surfaces hardened do. We also found that wear of the side housing is not uniform and have applied the above-mentioned hardening process on the particular sliding surface, so as to obtain the desired side housing of the type already described.

Principal object of the present invention is to provide side housings for the rotary piston engine having a sufficient wear resisting property at small cost and to improve the durability of engine.

According to the present invention, there is provided a side housing for a rotary piston engine of trochoidal configuration comprising an inner surface thereof maintained in rubbing contact with sealing members mounted on a rotor means of said engine and provided with a heat-treated area including a multiplicity of narrow heat-treated zones in striped pattern and located outwardly of an envelope of loci delineated by oil seal members fitted on said rotor means in end surfaces thereof.

The preferable embodiment of the present invention will now be described in detail hereinafter with reference to the accompanying drawings, in which:

FIG. 1 is a longitudinal section view showing a rotary piston engine in which the side housing of the present invention is incorporated;

FIG. 2 is a cross-sectional view showing the rotary piston engine of FIG. 1; and

FIG. 3 is an end view showing the side housing according to the present invention.

Referring to drawings, FIG. 1 shows a rotary piston engine of trochoidal configuration comprising a casing which consists of a pair parallel side housings 1, 1 and a trochoidal center housing 2 disposed between said side housings 1, 1 and in which a rotor 3 of polygonal shape is arranged to make eccentric rotational motion while being maintained gastight by means of an apex seal 4 mounted on the rotor means at the apex thereof. A side seal 5 mounted on the rotor means against the inner surface of the side housing through intervention of spring means and a corner seal 6, thus effecting in succession the suction stroke where mixed gas is introduced through a suction port 7 or 7'. The compression stroke where said mixture gas is compressed, the combustion stroke in which said gas is ignited by a plug 8 and burnt, and the exhaust stroke where combustion gas is exhausted through an exhaust port 9, so that gas pressure applied on the rotor 3 will be converted into a driving force of the rotating shaft 10.

The casing may be provided with a plurality of fins so as to effect air-cooling, or may be provided with a cooling passage 11 liquid-cooling, effect liquid-cooling, if desired. Also, each rotor is provided with a cooling chamber 12 in which oil is circulated to effect cooling of the engine. Said casing and rotors are preferably formed to have walls thereof as thin as possible for the reason of better cooling efficiency.

It was also found that if a multiplicity of radial hardened zones in striped pattern are formed over the entire sliding surface which is enclosed by an inner envelope 15 of the loci delineated by moving oil seals 14 and by a maximum locus 16 delineated by moving apex seals 4 in an attempt of protecting the sliding surface from abrasion due to various seal members which are in contact with the surface of the thin inner wall 13 of each side housing 1 forming the casing, there will be an excessive wear on the oil seal and, also hardening strain will be gradually increased towards the center of the side housing, so that formation of hardened zones in such a manner is undesirable from the standpoint of prevention of hardening strains. It is known fact that premature wear of the oil seal will invite increase of coil consumption and reduction of engine performance. However, according to such hardening schedule, hardened zones are required as many as possible for imparting uniform wear resistance on the sliding face, particularly in the peripheral sliding area of the side housing, which may inevitably require excessively narrow spacing between hardened zones in the central area of the sliding surface. Further, it is technically very difficult to accurately control the width of each hardened zone in an effort to meet the demand of keeping the hardness of each part substantially uniform. In practice, hardened zones will be unavoidably overlapped one with each other in the central sliding surface, thus causing hardening strains to be accumulated so as to produce local deformations, which will necessarily require an increased man power for the surface finish, such as grinding, after hardening.

According to the present invention, in view of the above-mentioned results, the area of the side housing subject to hardening is restricted to the sliding surface located outwardly of the outer envelope 17 of the loci delineated by sliding oil seal 14, or the sliding surface adjacent to said envelope and a number of radial stripe-patterned hardened zones 18 are formed on this sliding surface *a*, thereby extending the life of oil seals 14 while improving the wear resistance of the side housings. There have been some doubts in connection with the wear resistance of sliding surface *b* which does not constitute one part of the hardened area 18. However, sliding velocity of the side seal 5 which slides along this area is relatively low, while sliding velocity of the oil seal 14 is lower than that of the gas seal, and also the pressing force applied on the sliding surface of the oil seal 14 is provided only by elastic force of the spring means and by a pressure of the blowby gas, and such pressing force is much smaller than the urging force of the gas seal. Thus, wear resistance that the unhardened material of the side housings has inherently in itself proved sufficient to bear the pressure applied on the surface, and no excessive wear was observed.

Now, an embodiment of the side housing made of special cast iron and used for a rotary piston engine of automobile, such as shown in FIG. 3, will be described. Hardening strains produced in a structure provided with 60 different hardened zones in radial stripe-pattern over the whole sliding surface of 5 mm. thickness was equal to one-half to one-third of the hardening strain of 0.4 to 0.7 mm. which was produced on the side housing which was hardened in the whole surface thereof in a conventional manner. However, the side housing, which was provided with the same number of hardened zones in accordance with the present invention, has a small strain of 0.1 mm. Then, we conducted actual operation testings of the above-mentioned engine using the side housings which have been treated in accordance with the present invention and subjected to cutting and grinding operation. As a result, it was found that the seals were worn evenly since they were sliding

while straddling over two adjoining hardened zones and that the amount of wear of the side seal was reduced to about one-half of that of the side seal which was in contact with the side housing which was hardened in the whole surface thereof and it was thus confirmed that the life of side seals had been extended. In another embodiment, hardening was omitted from the sliding surface in an area *c* adjacent to the suction port 7′ so as to prevent possible hardening cracks from occurring. It was consequently found that no particularly noticeable development of wear occurred in such area, partly due to the fact that no gas pressure is applied on the side seal in the above-mentioned area of the sliding surface, and the side housing could be used practically.

As shown above, only the side housings provided with hardened zones in radially striped pattern as shown in the drawing have been described. However, similar functions can be derived by modifying the pattern of hardened area into desired one, such as a spiral or concentric pattern. It will be possible to locate a number of hardened zones concentratedly on the sliding surface adjacent to the minor axis of the side housing or in the area where the combustion stroke is carried out. Or wear resistance may be imparted on the side housing depending upon the service condition by increasing the ratio of the hardened area to the whole sliding area.

As described hereinabove, the side housing for the rotary piston engine according to the present invention is provided with a multiplicity of hardened zones disposed in a stripe-pattern on the sliding surface outwardly of the outer envelope of the loci delineated by sliding oil seals. The resulting side housings have excellent wear resistance and a small amount of hardening strain, and also grinding work after hardening can be performed in an extremely short time. Further, they are fit for mass-production and can be manufactured at a cost much smaller than that required for the conventional side housings.

We claim:

1. A side housing for a rotary piston engine of trochoidal configuration comprising an inner surface thereof maintained in rubbing contact with sealing members mounted on a rotor means of said engine and provided with a heat-treated area including a multiplicity of narrow heat-treated zOnes in striped pattern and located outwardly of an envelope of loci delineated by oil seal members fitted on said rotor means in end surfaces thereof.

2. A side housing for a rotary piston engine of trochoidal configuration as described in claim 1 wherein said heat-treated area comprises a multiplicity of narrow heat-treated zones arranged radially through centerline of rotor shaft of said engine in striped pattern.

3. A side housing for a rotary piston engine of trochoidal configuration as described in claim 1 wherein said heat-treated area comprises a multiplicity of narrow heat-treated zones arranged spirally with reference to the centerline of rotor shaft of said engine in striped pattern.

4. A side housing of a rotary piston engine of trochoidal configuration as described in claim 1 wherein said heat-treated area is defined in the outer boundary thereof by maximum locus delineated by apex sealing means.

5. A side housing for a rotary piston engine of trochoidal configuration as described in claim 1 wherein there is provided a small area adjacent to a suction inlet for fuel gas in which area no heat treatment is carried out.