United States Patent

[11] **3,575,538**

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[73] Assignee **Curtiss-Wright Corporation**

[54] **HOUSING SEALING MEANS FOR ROTARY ENGINES**
6 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **418/83,** 418/149
[51] **Int. Cl.** **F01c 21/06,** F03c 3/00, F04c 29/04
[50] **Field of Search** ..... 418/85, 83, 149, (Inquired); 123/8 (CC), 8 (SS); 103/130; 230/145, 210; 91/56

[56] **References Cited**
UNITED STATES PATENTS

3,196,849	7/1965	Paschke	123/8SS
3,309,011	4/1967	Osakada et al.	123/8SS
3,384,025	5/1968	Chabica	103/111F

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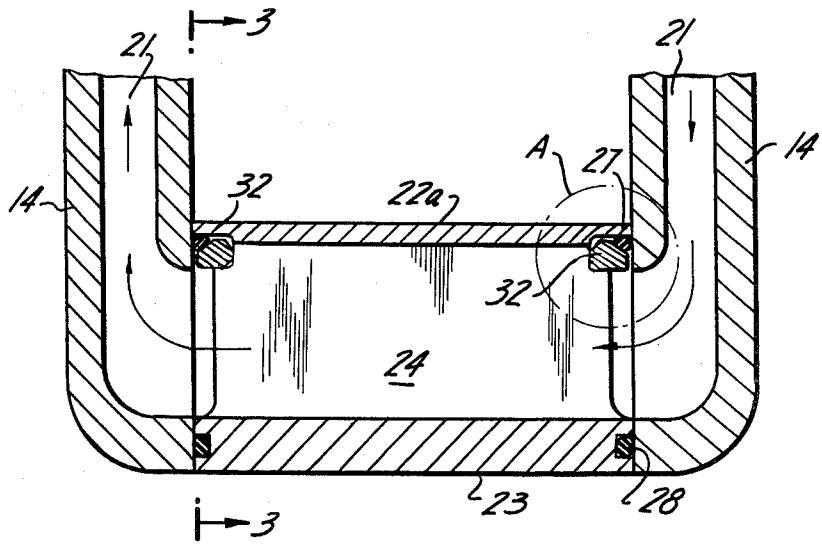
ABSTRACT: A means of sealing an engine housing against coolant leakage, by positioning a gasket ring with a small retainer ring lodged against a housing shoulder, thus obviating the former heavy wall thickness required for seating a gasket in a groove in the edge thereof, and thereby resulting in reduced fabrication costs and improved cooling by the use of thinner wall.



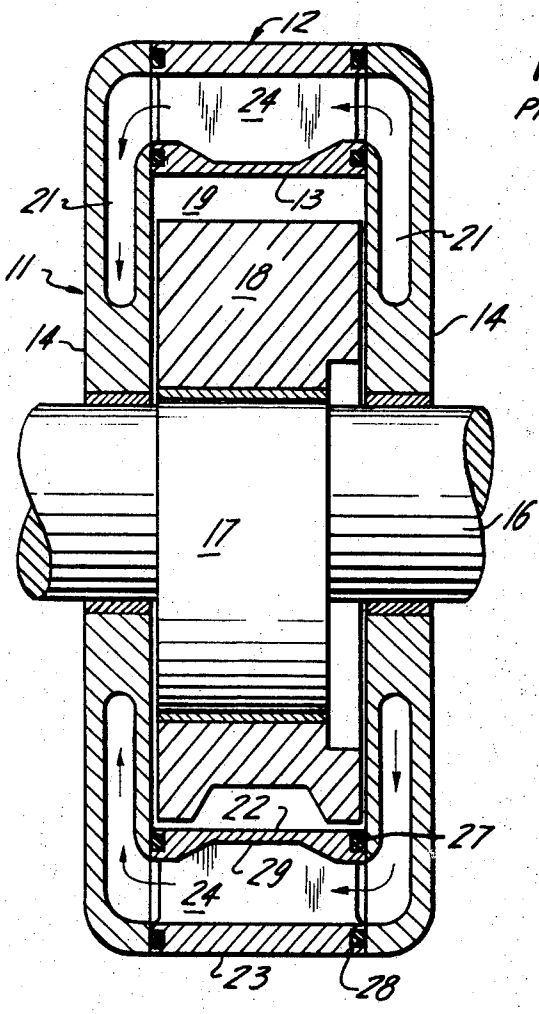


FIG. 1
PRIOR ART

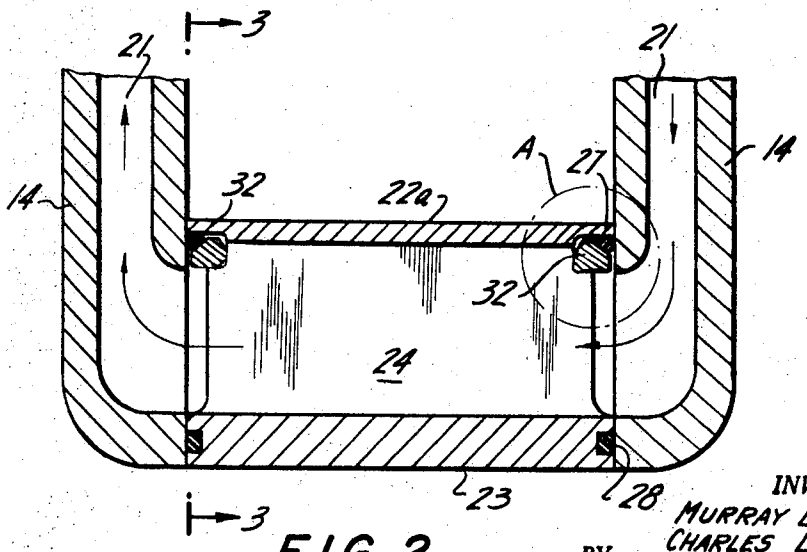


FIG. 2

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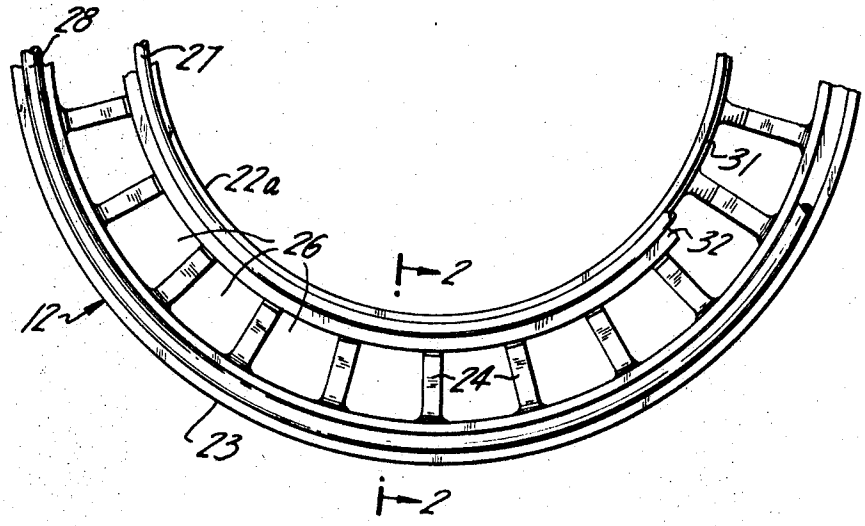
FIG. 3



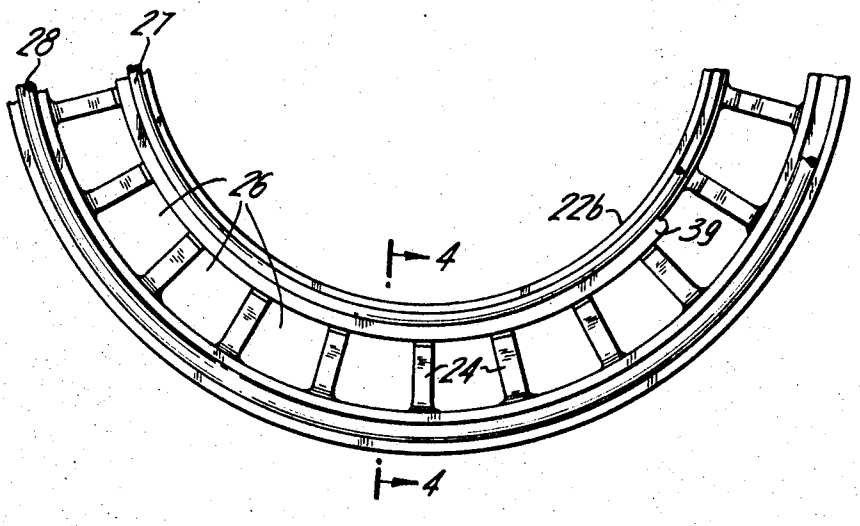


FIG. 5

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FIG. 4

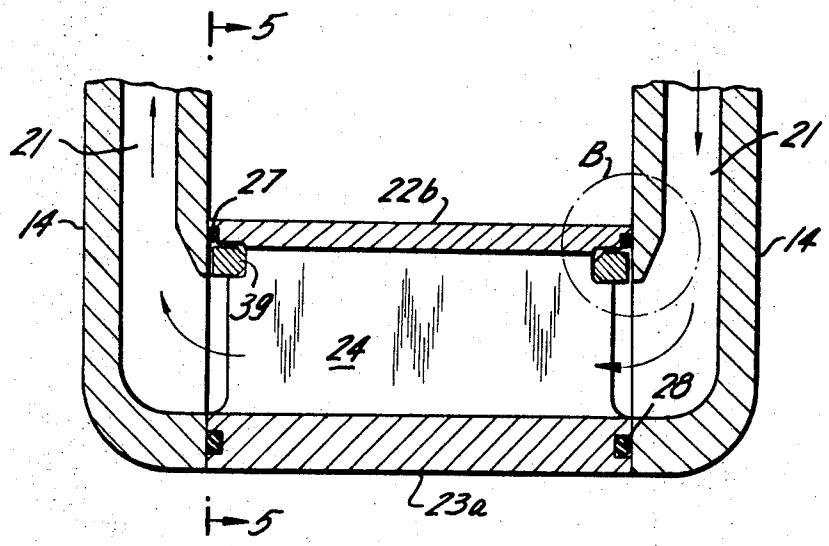


FIG. 6

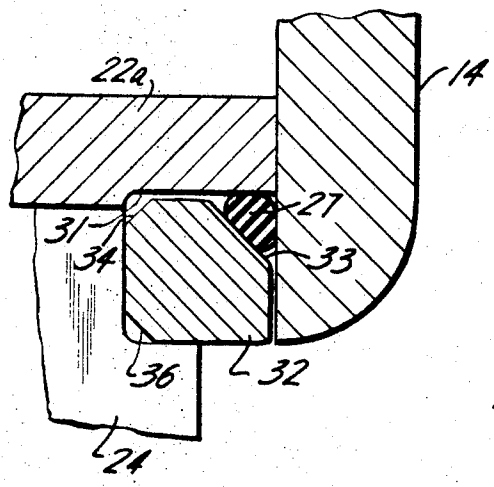
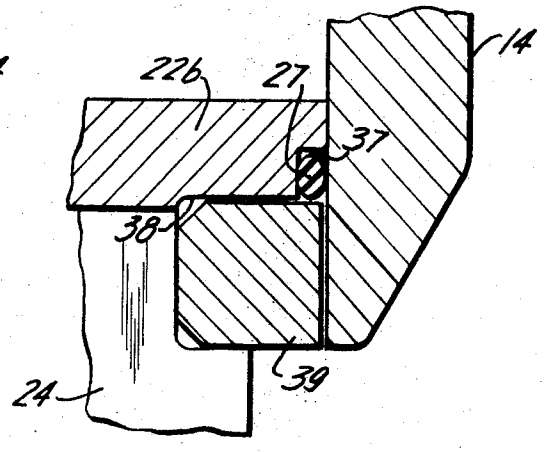


FIG. 7



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HOUSING SEALING MEANS FOR ROTARY ENGINES

BACKGROUND OF THE INVENTION

This invention relates to rotary internal combustion engines, and more particularly to such engines having a peripheral housing closed by a pair of end walls, the peripheral housing and end walls having intercommunicating cavities comprising a jacket for the flow of liquid coolant.

In rotary engines of the trochoidal type the peripheral housing is the hardest portion to cool adequately because it is of limited axial extent and therefore has only a small inner surface for heat rejection from the combustion zone. For liquid-cooled engines the peripheral housing is a double-walled structure, the inner and outer walls being spaced apart by rib members defining passages therebetween for the flow of the coolant. The end walls are hollow structures having coolant passages with apertures around the periphery of each end wall communicating with the passages through the peripheral housing. The coolant path is normally through the passages of one end wall, through the passages of the peripheral housing, and then into the other end wall. The flow path may change direction in the end walls and pass back and forth several times through alternating groups of passages in the peripheral housing.

In any case, the parallel end walls are assembled against the edges of the peripheral housing in tight relationship with the coolant apertures of the end walls aligned with those of the peripheral housing. For the purpose of preventing leakage of the coolant into the operating chambers of the engine or to the environment it is necessary that sealing means be provided around the end faces of the peripheral housing on both sides of the coolant passages, that is, both radially inward and radially outward of the passages. It has been the prior art practice that the inner and outer wall portions of the peripheral housing should be thick enough to have a groove cut into the end edge thereof, with an elastomeric gasket positioned therein and compressed by the adjacent face of the end wall.

It is particularly undesirable to have the inner wall portion of the peripheral housing thick enough to hold such a gasket groove, since a thick wall would impair the efficacy of the coolant. It has therefore been the practice to reduce the inner wall thickness in the zone between a pair of thicker end portions left for the groove, but this is also unsatisfactory because such an expedient makes diecasting or permanent-mold casting of the peripheral housing impossible, and has resulted in a slow and expensive coring procedure to produce the castings.

SUMMARY

The present invention overcomes these limitations of the prior art, requiring neither a thick inner wall nor a reduction of thickness between thicker end portions by a cumbersome coring procedure. Instead, this invention provides means for positioning the gaskets without cutting a gasket groove, whereby the peripheral housing may be die-cast or permanent-mold cast, and its inner wall portion made thin for high cooling efficiency.

This result is accomplished by casting the housing with a thin wall, either by diecasting or in a permanent mold, and then cutting a shoulder in the edges of the ribs defining the coolant passages, and positioning a retaining ring of appropriate cross-sectional shape against the shoulder, which ring holds the gasket in proper sealing relationship. The ring is isolated by coolant flow from contact with the housing wall.

It is therefore an object of this invention to provide housing sealing means for rotary engines.

It is another object to provide a rotary engine housing which can be cast in a permanent mold or a die.

Other objects and advantages will be understood on reading the following specification with reference to the annexed drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a semischematic vertical cross section on the axial plane of a rotary engine of the prior art;

FIG. 2 is an enlarged fragmentary view taken on line 2–2 of FIG. 3, similar to a portion of FIG. 1, showing one embodiment of the invention;

FIG. 3 is a partial view taken on line 3–3 of FIG. 2;

FIG. 4 is a view similar to FIG. 2, showing another embodiment of the invention, taken on line 4–4 of FIG. 5;

FIG. 5 is a partial view similar to FIG. 3, taken on line 5–5 of FIG. 4;

FIG. 6 is an enlarged view of the portion of FIG. 2 enclosed within circle *A*; and

FIG. 7 is an enlarged view of the portion of FIG. 4 enclosed within circle *B*.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a trochoidal rotary engine 11 of the prior art semischematically, omitting some elements not relevant to the present invention. Such an engine comprises a peripheral housing 12 having an epitrochoidal inner surface 13, having its ends closed by a pair of parallel end walls 14. A shaft 16 is journaled in the end walls and has an eccentric portion 17 within the housing cavity, on which is rotatably mounted a rotor 18 of generally polygonal form, bearing a sealing member 19 at each of its apexes which sweeps the epitrochoidal surface in sealing relationship. In the liquid-cooled engine shown, each of the end walls 14 is provided with internal passages 21 for the flow of coolant. The peripheral housing 12 is of double-walled construction, having an inner wall portion 22 and an outer wall portion 23 spaced apart therefrom by ribs 24 which define coolant passages 26 (better shown in FIG. 3) through the peripheral housing in a direction generally parallel to the axial dimension of the engine.

An inlet and outlet (not shown) are provided in the end walls, and water or other liquid coolant flows through the passages 21 in one end wall, through passages 26 of the peripheral housing as shown by the arrows, and into the passages 21 of the other end wall, from which it is discharged. The flow path of the coolant may be directed in a predetermined pattern by the positioning of the various passages.

The inner wall portion 22 and the outer wall portion 23 of the peripheral housing as shown in FIG. 1 have circumferential grooves cut into their end faces, in which grooves are respectively positioned O-rings 27 and 28 or other suitable gaskets. When the engine is assembled with the end walls against the end faces of the peripheral housing the gaskets are compressed in their grooves and prevent leakage of the coolant, either to the interior of the engine or to the environment.

It will be apparent that the inner wall 22 which is exposed to combustion is an area from which heat must be rapidly removed and which must therefore be effectively cooled. For this reason the inner wall has in prior art engines been made thinner in its center portion 29 between the end portions which have to be thick enough to provide a gasket groove, the inner wall therefore tapering down toward the center portion from the heavy end portions. To make this center portion 29 thinner requires a difficult and expensive coring procedure in casting the peripheral housing, and at best still leaves a considerable thickness of metal at the end faces, since the slope of the tapers must be fairly long for structural reasons and good casting procedure.

The present invention overcomes this limitation of the prior art by making the peripheral housing with a thin inner wall throughout and positioning the gasket by means of a retaining ring against a shoulder cut in the edge of the inner wall, the ring having a coolant flow around it which prevents direct heat transfer to it from the housing wall.

In FIGS. 2, 3, and 6 there is shown one embodiment of the invention. Inner wall 22*a* of the peripheral housing 12 is made thin throughout, that is, of less thickness than would be required to provide a gasket groove in its end faces. At each of its end faces a circumferential shoulder 31 (better shown in FIG. 6) is cut into the inner wall on the side facing the coolant passages 26 between ribs 24. The radial extent of the cut in the end face of inner wall 22*l* need be only very slight, just sufficient to establish a smooth surface. The edges of ribs 24 do not extend quite flush with the end face of the peripheral housing, but nearly so. In the same cutting operation that establishes shoulder 31 the edges of ribs 24 are notched, and cut is given sufficient depth in the axial direction to provide a slot to hold a retaining ring 32.

As best shown in FIG. 6, the retaining ring 32 has the circumferentially inward corner of its axially outward face cut off in a chamfer 33 at an angle of approximately 45°, which leaves a circumferential annular chamber of triangular cross section between the retaining ring and the surface of shoulder 31, in which is disposed the O-ring or other elastomeric gasket 27. The size of the annular gasket chamber as formed by the chamfered retaining ring is chosen such that it does not quite accommodate the cross-sectional diameter of the O-ring in a relaxed state, so that when the end wall is pressed against the end face of the peripheral housing the gasket will be compressed and deformed into the gasket chamber in tight sealing relationship against shoulder 31, retaining ring 32, and the inner face of the end wall.

The axially inward face of retaining ring 32 is further chamfered 34 on its circumferentially inward corner, and also 36 on its circumferentially outward corner. This chamfering on the axially inward face allows the ring to be accommodated easily in its slot which will have a slight radius at its inward corners. The chamfering also has another important function in sealing, in that it allows the coolant, which is under pressure, to bleed from the coolant passages 26 to the gasket chamber, thus holding the gasket pressed firmly into the corner formed by the end wall and shoulder 31 for perfect sealing. Further, the coolant bath around the ring isolates it from contact with the housing wall and prevents direct heat transfer from the wall to the ring. The retaining ring 32 is made to have sufficient clearance in its slot that coolant may readily pass around it.

Since it is not usually important that the outer wall portion 23 of the peripheral housing 12 should be thin, the previous sealing means of a gasket 28 in a circumferential groove in each of its end faces may be utilized. However, in circumstances where it may be desirable to make the outer wall portion thin, the arrangement of a retaining ring against a shoulder in the outer wall may also be used for sealing this portion.

It will be understood from the foregoing description that the arrangement of the present invention allows the inner wall of the peripheral housing to be made very thin throughout its length, eliminating the thicker end portions of the prior art and the taper therefrom toward the middle portion. The chamfering of the retaining ring and the clearance around it in its slot allow the coolant to be in contact with the thin inner wall throughout its entire axial extent, except for the very small area which is in contact with the compressed gasket.

FIGS. 4, 5, and 7 show another embodiment of the invention. Inner wall 22*b* of the peripheral housing 12 has a shoulder 37 cut into each end face on the side facing the coolant passages 26, to an axial depth somewhat less than the cross-sectional diameter of the O-ring 27, and of such dimension in the radial direction as to provide a chamber which will wholly contain the compressed gasket. Radially outward from shoulder 37 there is provided another shoulder 38, having just enough radial depth into the inner wall 22*b* to provide a smooth circumferential surface thereon, and deep enough in the axial direction in the edges of ribs 24 to provide a slot in which is positioned retaining ring 39. Retaining ring 39 is chamfered on the corners of its axially inward face, and also has a slight clearance in its slot, to allow flow of coolant therearound and the application of coolant pressure to the gasket to hold it in firm sealing relationship.

The end faces of the outer wall portion 23*a* of the peripheral housing are provided with grooves and gaskets as in the prior art, although if it is desired also to make this wall portion thin the sealing arrangement of the present invention may be employed. Outer wall 23*a* is shown in FIG. 4 as having a slight draft for casting convenience. A similar draft may be provided in the embodiment of FIG. 2, and in both embodiments a draft may also be used on the inner wall. However, with permanent-mold casting or die-casting draft may not always be necessary. In any case the amount of draft is very slight.

It will be apparent that this invention has eliminated a troublesome and expensive casting problem of the prior art, wherein a cumbersome coring procedure was necessary. With the sealing arrangement of this invention the peripheral housing may be readily die-cast or cast in permanent molds much more rapidly and less expensively than hitherto. In addition, the cooling of the inner wall portion has been much improved by enabling the wall to be made thinner throughout its length, and sealing efficiency has been increased by providing coolant pressure to push the sealing element into the critical area, in contrast to the prior art gasket groove previously described, wherein the gasket is substantially occluded from the coolant by the groove walls.

We claim:

1. In a rotary internal combustion engine having a pair of end walls having coolant passages therein, the end walls being spaced apart by a peripheral housing having double circumferential walls spaced apart by ribs defining coolant passages therethrough in communication with the coolant passages of the end walls, the improvement comprising:
   a. at least one of the peripheral housing walls having a circumferential shoulder at each of its edges on the side adjacent to the coolant passages, and a circumferential slot in the edges of the ribs adjacent to each shoulder,
   b. a retaining ring disposed in each of the slots and defining an annular gasket chamber with its adjacent shoulder and adjacent end wall,
   c. an elastomeric gasket disposed in each gasket chamber,
   d. the retaining ring having clearance in its slot providing communication between the coolant passages and the gasket chamber to allow pressurized coolant to apply pressure to the gasket and to prevent direct heat transfer from the wall to the ring.

2. The combination recited in claim 1, wherein the gasket chamber has a substantially triangular cross section and the gasket has a substantially circular cross section in the relaxed state with a diameter in the relaxed state greater than can be accommodated within the gasket chamber, the gasket being deformed into the chamber by the walls thereof.

3. The combination recited in claim 2, wherein the hypotenuse of the triangular chamber is formed by a chamfer on the retaining ring.

4. The combination recited in claim 3, wherein the corners of the retaining ring at the bottom of its slot are chamfered to provide coolant circulation therearound.

5. The combination recited in claim 1, wherein the gasket chamber has a rectangular cross section and the gasket has a substantially circular cross section in the relaxed state with a diameter in the relaxed state greater than the depth of the gasket chamber, the gasket being deformed into the chamber by the walls thereof.

6. The combination recited in claim 5, wherein the corners of the retaining ring at the bottom of its slot are chamfered to provide coolant circulation therearound.