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Leptien

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[54] **COOLING ARRANGEMENT FOR A COMBUSTION ENGINE HAVING A ROTARY TYPE PISTON**

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[52] **U.S. Cl.** **418/83,** 123/8.01

[51] **Int. Cl.** **F01c 19/02**

[58] **Field of Search** 418/83; 123/8.01

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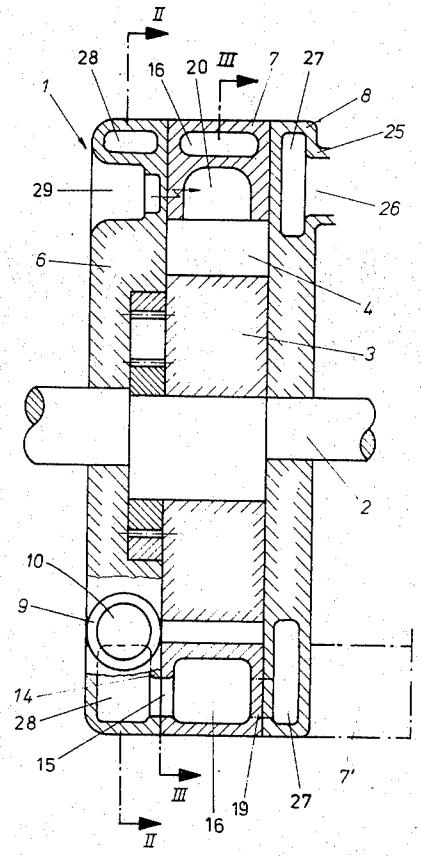
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[57] **ABSTRACT**

In a combustion engine having a rotary-type piston arrangement, and wherein the engine has a housing adapted to be cooled by a cooling medium, a piston of the rotary type mounted for rotation on an eccentric shaft and forming operating spaces of variable volume during rotation with a portion of the housing wall, such operating spaces being defined by arched portions of the housing and by the piston, the housing has a pair of side members and at least a central peripheral member in which the piston is placed, an inlet opening for the entry of the cooling medium, passages formed in the side member and passages formed in the central member and communicating with the passages of the side member, an outlet passage formed in the other of the side member and communicating with the passage formed in the intermediate or peripheral member, wherein a cooling medium entering the inlet opening into at least a pair of streams and imparting a direction to the streams opposite to each other.

9 Claims, 3 Drawing Figures



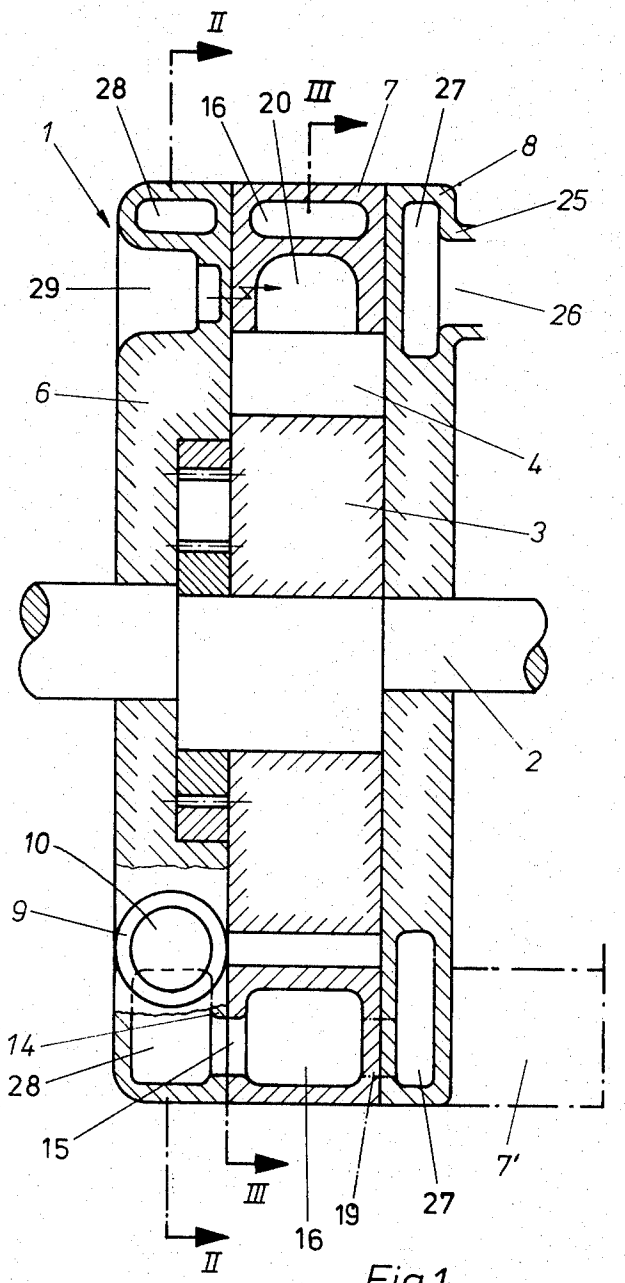


Fig.1

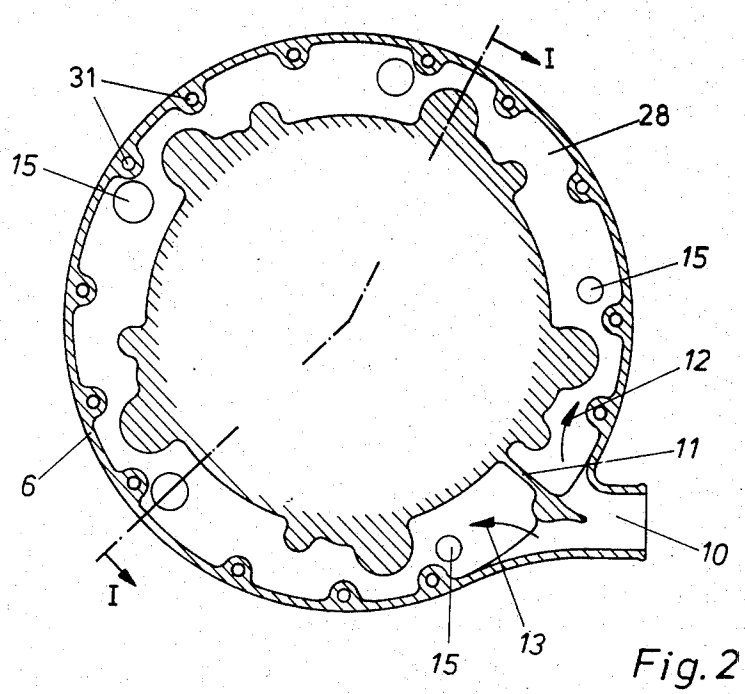

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Fig. 2

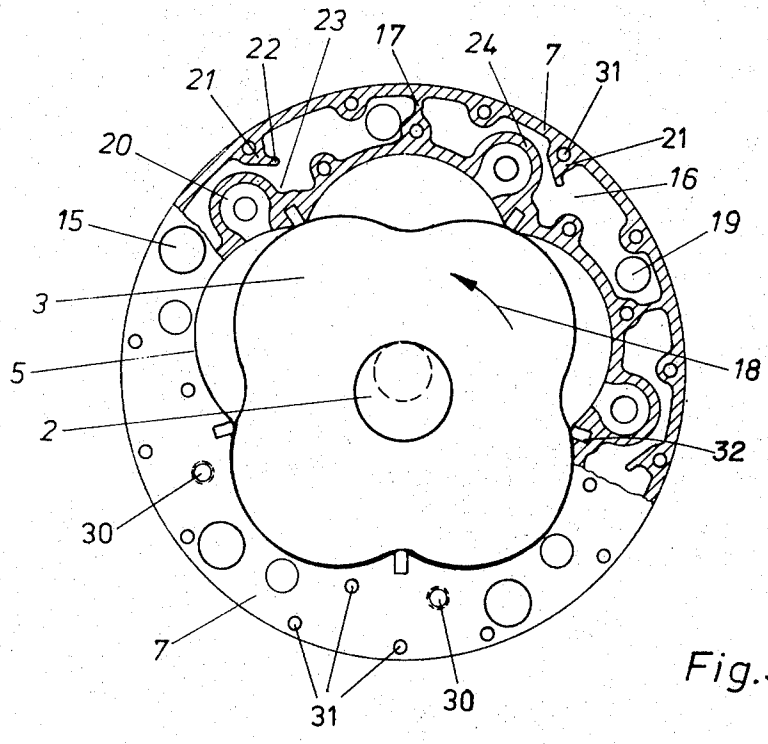

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Fig. 3

COOLING ARRANGEMENT FOR A COMBUSTION ENGINE HAVING A ROTARY TYPE PISTON

FIELD OF THE INVENTION

The present invention relates to the cooling of a combustion engine having a rotary piston arrangement therein wherein in a housing cooled by a liquid a piston is rotated about an eccentric shaft and forms operating spaces of variable volume by means of the piston and of arched portions of the housing which define such variable volume and wherein the housing consist of a pair of side members and at least one intermediate or peripheral member and, in the event the engine having several piston discs therein, there are a corresponding number of intermediate or peripheral members which are flown through by a cooling medium which passes from an input opening through apertures or passages formed in the side members as well as in the intermediate member or members and reaches an outlet opening.

BACKGROUND OF THE INVENTION

Due to the small specific structural volume of combustion engines having a rotary-type piston therein with respect to the conventional combustion engine having a vertical displacement-type piston therein and having similar capacity, the requirement with respect to cooling of such machines is very high. In order that a heat quantity depending from the power output of the engine could be led away, such engines should use the cooling medium to an optimum degree. For this reason the shaping of the passages involved in the guiding of the cooling medium as well as the path of the cooling medium should be carefully designed.

Such problems are considered in connection with a Ka-engine described in the German OLS 1,526,392, however, no serious solution is offered to such problems. There have been several unsuccessful attempts made and constructions became known which involve the cooling of the piston of a combustion engine having an epitrochoidal piston arrangement therein in an optimum fashion, such as described by French Pat. No. 1,398,965 which, however, still doesn't offer a satisfactory solution to this problem and does not find a reliable cooling solution to the housing of such type of engine.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a novel cooling arrangement for a combustion engine having a piston arrangement of the rotary-type therein in which the peripheral portions of the housing where the combustion spaces are located are efficiently cooled.

According to the present invention the input opening for the cooling medium has a partition wall provided therein so that the stream of the cooling medium is subdivided into two portions and guided, into two opposite directions and, from such partition wall on the cooling medium reaches through passages or cooling spaces or cavities in the peripheral or piston containing member of the engine, such successive apertures being provided with an increasingly inclined diameter. The input opening in such construction is at one side member of the engine while the outlet opening is in the other side of the engine. The engine housing includes side members

or end plates which, if a single piston is used, are attached to the piston containing central member which has in it the combustion spaces. If several central members that is, also pistons are present, then adjacent central members are separated by an intermediate member.

In the side member or intermediate member of the engine which is adjacent to the central member, there are provided at least one input opening and apertures leading to the adjacent central member.

According to a further aspect of the present invention, the overall cooling chamber in the central member is subdivided into individual sub-chambers or cavities according to the number of the operating spaces present in the combustion engine. The individual cooling cavities are disposed in an offset fashion with respect to each operating space half of the engine as will be more clearly seen in one of the sectional views of the central member.

In order that the stream of the cooling medium could be guided around at a 90° angle and in order that a directional flow could be attained against the direction of rotation of the piston, the opening for the input of the cooling medium in the central member is ahead with respect to the direction of rotation of the piston, while the opening for the exit of the cooling medium is located behind with respect to the direction of rotation of the piston. In connection with this it is noted that "ahead" with respect to the direction of rotation should be understood a region which is swept by the piston during its rotation later than other regions.

According to a further aspect of the present invention the anchor screw channels are provided with ribs which guide the cooling medium adjacent to an otherwise shaded portion of the combustion space containing member.

The cooling arrangement of a combustion engine having a rotary-type arrangement according to the present invention has its advantage with respect to the known cooling arrangements in that the heat absorbing capacity of the cooling medium has been used to an optimum fashion by providing for a forced flow of the cooling medium. The cooling medium which is supplied to the engine body is subdivided into two flow streams whereupon the cooling is performed in each direction by a relatively cool half of the stream. Both of the cooling streams are passed through several axially lying openings into the cooling spaces located in the peripheral body of the housing of the epitrochoidal type engine housing. The diameter of the successive openings is made gradually increasing so that in case the first opening after a subdivision of the cooling medium has been taken place is smaller than the diameter of the opening lying last along the direction of the flow of the cooling medium, which is the largest and, as a result, the cooling spaces located in the epitrochoidally shaped housing are supplied with a cooling medium in a relatively uniform fashion. The cooling spaces in the epitrochoidally-shaped housing are formed by partition walls which, in addition, have the function that the forces which act on the epitrochoidally-shaped wall (the surfaces over which the piston is running) are transmitted to the side walls and to the remotely lying housing walls. The openings for the input of the cooling medium and for the exit of the cooling medium are offset in a fashion so that the cooling medium is shifted around by 90° and flows against the direction of rota-

tion of the piston over the epitrochoidally shaped wall of the combustion spaces whereupon the wall portions, which undergo a very high thermal loading, are preferably cooled.

In order that the region surrounding the sealing strips which lie in a shadow of the combustion space containing member, could be cooled more efficiently, there are provided short ribs on the plurality of channels which contain the anchor screws about the circumference of the engine, which ribs quide the cooling medium forcibly into the shadowed portion of the combustion space containing member.

After the cooling medium has passed through one of the side members and the peripheral (the epitrochoidal) housing one or several intermediate members and a corresponding number of peripheral members, it will enter into the other side member at the output end of the engine and from then on will be returned to the cooler or head exchanger.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will become more readily apparent from the following description of a preferred embodiment thereof shown, by way of example, in the accompanying drawings, in which:

FIG. 1 is a longitudinal section through a combustion engine having a rotary-type piston arrangement and a cooling arrangement according to the present invention, the section being taken along a line I—I as seen in FIG. 2;

FIG. 2 is a sectional view along the line II—II of FIG. 1;

FIG. 3 is a sectional view along the line III—III in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to FIG. 1 it is seen that in a housing 1 of a combustion engine having a circular rotary-type piston arrangement therein, a piston 3 is rotated about an eccentric shaft 2 and forms operating spaces having variable volumes which are defined on one hand by the piston 3 and on the other hand by the arched portions 5 of the housing profile 1. The housing 1 comprises a side plate or member 6, a peripheral member 7 (the so-called epitrochoidally shaped central housing member) and another side plate or member 8. The last mentioned-side member 8 in the event of an engine having several piston discs therein, will be replaced by an intermediate member onto which then another peripheral member 7' indicated with a dashed line is joined. Such peripheral member 7' would be then joined by a side member similar to side member 8, or in case of an even larger machine having further piston parts therein, would be joined by another intermediate member and again by a peripheral or central member and, then only by a side member indicated by 8 representing the end of the assembly.

In the following the description there will be considered only an engine having a single piston disc therein, therefore, only a pair of end plates and a central member.

With reference to FIGS. 1 and 2, it is seen that the cooling medium enters the engine housing 1 by means of an input stub 9 and enters into the side member 6. In the input opening 10 there is provided a separating or partition wall 11 which divides the cooling medium into a first flow direction 12 and into another stream following the arrow 13. From this partition wall 11 on along the peripheral direction of the engine body 1, there are provided in a side wall 14 of the side member 6 openings 15 which have an increasing diameter as they progress along the peripheral direction. The openings 15 lead into cooling spaces 16 in the peripheral member 7. The side member 6 contains a cooling space 28 formed peripherally therein and having the shape as seen in FIG. 2 which has a function, for example, to provide cooling for the spaces 29 containing the spark plugs the spark of which is symbolically being indicated by an arrow entering the combustion space 20.

As can be seen in FIG. 2 the cooling space 28 formed in the side member 6 has a plurality of openings 15 the diameter of which progressively increases with the distance at which a particular opening 15 is placed from the inlet opening 10. That is, the openings 15 which are further away from the inlet opening 10 are largest in diameter. The openings 15 serve to communicate the space 28 with the individual cooling chambers 16 formed in the central member 7. The central member 7 has a plurality of cooling chambers 16 which are shaped as seen in FIG. 3 and which are individual cooling cavities which are shaped to perform the various cooling functions most efficiently, such as by surrounding the individual combustion spaces 20, or extending all the way down to the sealing strips 32 which otherwise represent a shadowed area within the engine body 1. To this latter effect, that is, in order that the region of the sealing strips 32 could be most efficiently cooled, the cooling space 16 has a rib formation 22 near the anchor bolt 21 and such rib 22 is being directed to force the stream of the cooling liquid towards a portion of the individual cooling space 16 near the associated cooling strip 32. Each cooling space 16 communicates through outlet apertures 19 with an annular cooling space 27 formed in the side member 8.

As has been already pointed out in the description of the broad aspects of the present invention, the inlet openings 15 communicate with the cooling spaces 16 formed in the central member 7 in a fashion that they are located ahead with respect to the direction of the rotation of the piston 3, while the exit openings 19 communicate the cooling spaces 16 with the cooling space 27 in the side member 8 and are located behind with respect to the direction of the rotation of the piston 3. In this connection it is noted that the term "ahead" with respect to the direction of the rotation should be understood to mean a region which is swept by the piston 3 during its rotation later than the region lying "behind" of such rotation and, where the exit openings 19 are located. The cooling spaces 16 in the central member 7 are separated by a partition wall 17 lying approximately at the highest point of the arch 5 of the individual operating space of the engine.

With reference to FIG. 3 it is seen that the cooling medium enters an individual cooling space 16 through an associated opening 15 from the cooling space 28 of the side member 6 and progresses through the odd shape cavity of the individual cooling space 16 by sweeping the region surrounding the combustion space 20 and being deflected by the rib 22 to cool the sealing strip area 12 and then exits through the associated exit opening 19 into the cooling space 27 formed in the side member 8 and from it is lead to a heat exchanger, not shown, through the outlet opening 26 formed in the

member 8. It can be also seen in the showing of FIG. 3 that the partitioning wall 17 separating the individual cooling spaces or cavities 16 is adjacent the outlet opening 19, that is, placed at a region which is swept first by the piston 3 during its rotation, while the inlet openings 15 are at the other end of the cooling space or cavity 16 which is swept later by the piston 3 during its rotation. The reference numerals 30 generally denote the passages provided for the sparkplugs in the central member 7 and the reference numerals 31 denote the passages provided for the anchor screws which hold the several housing parts 6, 7 and 8 together into the unitary housing 1.

From the above it is seen that the cooling medium enters through the stub 9 and through the inlet openings 10 in the side member 6 and it is split into two oppositely directed flow stream and performs the cooling of the sparkplug area and through openings 15 enters the individually formed cavities 16 formed in the central member to perform the various cooling functions of the operating spaces, sealing strips, etc. and then it is lead through exit openings 19 to the side cooling space 27 formed in the side member 8 and returned to heat exchanger from which it is returned again to the inlet opening 10. As can be seen in the showing of FIG. 2, the cooling space 28 is a single chamber having the shape as seen in FIG. 2 and the openings 15 are increased in diameter so that each of the individual cavities 16 formed in the central member 7 receive substantially equal amount of cooling medium due to the increased dimensions of the opening 15 as they are progressively removed away from the inlet opening 10. As a result, an individual cavity 16 which lies further away in the central member 7 with respect to the inlet opening 10 receives a similar amount of cooling medium as the cavity 16 lying closer to the inlet opening 10. At the same time both halves of the engine body 1 are cooled by an individual stream. One stream is shifted 90° and is opposite to the direction of the piston rotation.

It is also noted with reference to the showing of FIG. 3 that the individual cooling cavities 16 in the central member 7 are arranged so that each individual cavity 16 cools two halves of a pair of adjacent operating spaces, that is, the partition walls 17 by being located at the highest point of the arch 5 of the adjacent operating spaces of the engine attains that an individual cavity 16 at the inlet 15 cools a combustion space 20 and an adjacent sealing strip 32 and at its remaining portion the individual cavity 16 cools the portions of the next operating space which does not contain a combustion space. Such arrangements of the individual cavities 16 in the central member 7 can be clearly seen in FIG. 3.

As an alternative solution to supply the cooling medium to central member 7, one may provide the wall 14 in central member 7 and an annular opening in the side member 6.

In the event instead of the side member 8 an engine having several piston discs would be considered, then there would be instead of the side member 8 an intermediate member provided so then the formation of the passages for the cooling medium would repeat itself in the same sequence as described above.

I wish it to be understood that I do not desire to be limited to the exact details of constructions shown and described, for obvious modifications will occur to a person skilled in the art.

Having thus described the invention, what I claim as new and desire to be secured by Letters Patent, is as follows:

I claim:

1. In a combustion engine having a rotary-type piston arrangement, and wherein the engine comprises a housing adapted to be cooled by a cooling medium, a piston means of the rotary type mounted for rotation on an eccentric shaft means and forming operating spaces of variable volume during rotation with a portion of the housing wall, such operating spaces being defined by arched portions of said housing and by said piston means, said housing comprises a pair of side members and at least a central peripheral member in which said piston means is placed, an inlet opening formed in one of said side members for the entry of said cooling medium, passage means formed in said side member, a plurality of passage means formed in said central member and communicating with said passage means of said side member, an outlet passage formed in the other of said side member and communicating with said plurality of individual cooling passage means formed in said central member, wherein a partitioning wall means is provided in said inlet opening for breaking up the cooling medium entering said inlet opening into at least a pair of streams and imparting a direction to each stream opposite to each other, means for communicating said passage means in one of said side members and in said central member, said communicating means having diameters increasing away from said inlet opening said passages in said peripheral member forming cooling spaces in the vicinity of said operating or combustion spaces of the engine.

2. The combination as claimed in claim 1, wherein said exit opening is provided in the other of said side members.

3. The combination as claimed in claim 1 for a combustion engine having a plurality of said piston means, wherein a plurality of central members are provided each for one piston means, an intermediate member placed between adjacent central members, said intermediate member containing at least one passage for communicating the cooling medium between said adjacent central members.

4. The combination as claimed in claim 1, wherein said plurality of cooling spaces are provided in a number corresponding to the number of the operating spaces of the combustion engine.

5. The combination as claimed in claim 4, wherein said individual cooling spaces are separated from each other at a region corresponding to the region of the highest point of an individual operating space.

6. The combination as claimed in claim 4, wherein said passages for the inlet of the cooling medium to the individual cooling spaces in the central member are provided ahead of the direction of the rotation of said piston and said exit opening for the cooling medium are provided behind the piston when viewed in the direction of the rotation thereof.

7. The combination as claimed in claim 4, wherein said housing comprises channels for the anchor screws holding said side and central members together, said channels having a wall portion formed in the shape of a rib and extending into said individual cooling spaces for deflecting the cooling medium into a remote portion in said central member adjacent a remote portion

of said operating spaces containing the sealing strips between the adjacent operating spaces.

8. The combination as claimed in claim **6,** wherein said inlet passages to said individual cooling spaces in said central member are placed in a region ahead of an associated combustion space of the operating space and said exit openings from said individual cooling spaces are provided behind said region when viewed against the direction of the rotation of said piston.

9. The combination as claimed in claim **1,** wherein said individual cooling passages are cooling cavities which are elongated in form in the peripheral direction along the direction of the rotation of said piston, said individual cavity being separated from each other at a region adjacent the highest point of an associated operating space of the engine whereby said individual cavity extends from a region associated with the highest point of an operating space to a region associated with the highest point of an adjacent operating space of said engine, said individual cavity having said communicating means at a portion thereof lying ahead with respect to the rotation of the piston and having said exit opening for the cooling medium at a portion thereof lying at the region of the opposite end of the cavity with respect to the rotation of the piston.

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