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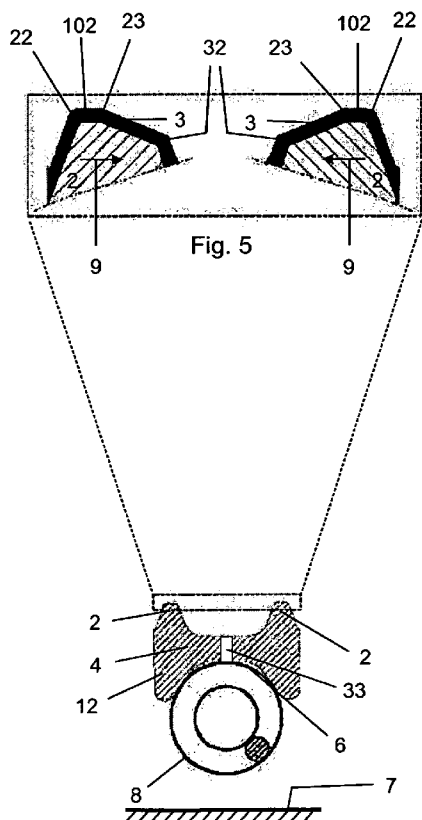
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[Continued on next page]

(54) Title: OIL CONTROL RING OF FERROUS BODY FOR INTERNAL COMBUSTION ENGINES



(57) Abstract: This invention refers to an oil control ring (1) idealized for internal combustion engines, formed by a ferrous body that includes two external contact surfaces (102) where each surface (102) contains a first (22) and second (23) extremity edges, two tilted faces (3) where each tilted face (3) starts from the respective second edge (23), a peripheral transversal section (4) directed at the cylinder wall (5) and an internal circular section (6) directed at the side of the piston (7), where the projections of contact (2) are directed, so that the respective tilted faces (3) are turned one facing the other, symmetrically, in a preferred concretization. The ring (1) allows the maintenance of appropriate levels of contact pressure, even under reduced expanding loadings due to the use of profile that brings reduced contact of the ring with the interface of the cylinder. Additionally, it brings better dynamic stability and consequent distribution of the contact pressure of the set. It also makes it possible to apply superficial hardening treatments on oil rings with reduced contact surface, by its different geometry, offering constructive, handling and operation robustness.

Fig. 4



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Title: "OIL CONTROL RING OF FERROUS BODY FOR INTERNAL COMBUSTION ENGINES".

The present invention refers to an oil control ring formed by a ferrous body idealized for internal combustion engines that allows the maintenance of appropriate levels of contact pressure, even under reduced expanding loads due to the use of profile that offers reduced contact of the ring with the interface of the cylinder.

Additionally, it offers better dynamic stability and the consequent distribution of the contact pressure of the set. It also allows the application of surface hardening treatments in oil rings with reduced contact surfaces, through its different geometry, offering construction, handling and operation robustness.

Description of the State of the Art

The internal combustion engines are mechanisms that transform energy used by the great majority of automotive vehicles, and they basically include two main parts: the engine block and one or more cylinder head(s). On the base of the cylinder head(s) are the combustion chambers (in diesel engines in general the combustion chambers are in the piston heads) and in the engine block we find the cylinders and the set of the crankshaft. The set of the crankshaft is composed of pistons, connecting rods and by the crankshaft.

The engine converts the energy produced by the combustion of the mixture (fuel and air) in the combustion chambers, into mechanic energy capable of giving movement to the wheels.

Since the driving force necessary to move the automobile comes from burning the air/fuel mixture in the combustion chamber, and in order to guarantee a homogeneous combustion without burning oil and also avoid the excessive passage of gases from the cylinder to the pan, it is necessary to use rings to offer a good sealing of the backlash that exists between the piston and the cylinder wall.

Normally, engine designers use three rings, in that two are compression rings, positioned more adjacently to the piston head, and one oil ring, positioned more to the opposite direction. The compression rings' function is to stop the passage of the combustion gases to the interior of the pan, and the oil ring's function is to scrape the excess of oil from the cylinder wall and take it back to the pan.

Another important function of the rings is to be used as a bridge to transmit heat from the piston to the cylinder wall/liner where the dissipation of heat occurs through the engine cooling system.

The oil rings can be composed of one, two or three pieces, and the most commonly used type in internal combustion engines are the ones with two or three pieces.

As main characteristics, the one-piece ring uses the elastic properties inherent to the base material in order to meet the expansion force requested for the application, whereas the two-piece ring includes basically a body and an elastic element and the three-piece ring includes basically a support body and two segments of ring to meet the same purpose.

Currently, the oil rings found in the prior art have slits or holes distributed along the peripheral transversal section of the body. These slits or holes have the function to drain the excess of oil accumulated between the two external work faces of the ring and increase its flexibility by means of the reduction of rigidity of the transversal section that contains the slits, offering more conformity of the piece/set with the cylinder wall.

However, the automotive industry currently has been guided by the challenge of meeting environmental regulations that are more and more restrict, resulting in developments more and more guided by the search for lower frictions and smaller, energetically more efficient engines.

Also following these trends of reduction of attrition in the operation of the engine, the main contribution of the rings is the reduction of the load necessary to offer the sufficient pressure against the cylinder wall(s) of the engine.

In more details, it is possible to obtain the maintenance of an appropriate contact pressure in the ring/cylinder interface, reducing the area of contact of the ring, even under the action of reduced expansion loads. However, difficulties regarding the manufacturing, handling of pieces and even an occasional breaking during the work are some obstacles that must be overcome in projects that aim at reducing the area of contact of the oil control rings.

Also, the improvement in the operations of reconditioning and burnishing of the cylinders, associated with the low load rings, can lead to an increased time of operation of the engine for the "breaking in" of the pieces. The breaking in period is necessary because, although there is a lot of care in the production of coinciding parts, the variability that is inherent to the production and the deformities of operation of the engine require some wearing before matching the sliding surfaces of the piece. The consumption of lubrication oil in this phase is higher until the appropriate adjustment is reached.

The ring defined in the Brazilian patent application PI 9202268 tries to solve the problem of reduction of contact area by using truncated conical contact surfaces. Additionally, the referred ring presents good behavior during the breaking-in phase of the engine, since the very high contact pressure that occurs in the first operation hours helps stabilize the consumption of engine oil.

As for patent US 7,117,594, it tries to solve the problem mentioned above by using a profile of a stepped contact surface, in the shape of steps. The proposal on the one hand shows a certain efficiency since it allows a higher constructive robustness to the region of the projections of contact of the ring. However, on the other hand, there is the possibility of occurrence of storage of oil in the stepped region of the projections of contact of the ring, increasing, therefore, the consumption of oil of the vehicle driving set.

Another document worth mentioning is the North-American patent application US2006/0006604, which brings an oil ring whose projections of contact end in a bulged shape, which brings as its main result the reduction of the attrition to the movement against the associated cylinder wall and the significant reduction of the oil consumption during the operation.

However, this type of ring has as an unfavorable characteristic the expensive manufacturing process in order to obtain the referred bulged profile in the projections of contact.

Therefore, we can note that an oil control ring capable of maintaining appropriate levels of contact pressure still has not been developed, even under low loading due to the use of profile that enables reduced contact of the ring with the interface of the cylinder and that offers constructive, handling and operation robustness.

Objectives of the Invention

A first objective of the present invention is to propose an oil control ring which, by using the peripheral face of work with reduced contact surface, allows a better distribution of the pressure, guaranteeing an appropriate thickness of the oil pellicle between the cylinder ring and wall and enabling the reduction of the loading given by the expanding force of ring project (and, therefore, the corresponding reduction of power dissipated by friction).

Also, an objective of the present invention is to propose an oil control ring where the use of profile of peripheral face of work with reduced contact surface, associated with the use of higher conical angle of the face of contact against the internal cylinder wall aims at minimizing the effect of radial wearing on the increase of the axial width of the face of contact, offering, therefore, the maintenance of the pressure of project and consequently the control of the oil pellicle between the cylinder ring and wall during the service life of the engine.

Another an objective of the present invention is the possibility of being applied together with various types of surface treatments and covers, because given its constructive and handling robustness, it significantly reduces the chances of breaking and cracks during the operation and even the phases of assembly and disassembly of the ring in the piston and the piston in the cylinder.

Brief Description of the Invention

The goals of this invention are met by an oil control ring for internal combustion engines, formed by a ferrous body including two contact projections, each one defining a respective surface of external contact which contains a first and second extremity edges and each one having a tilted face that starts as of the respective second edge, the projections of contact being turned so that the respective tilted faces are turned one facing the other, in a symmetrically.

Also, the goals of this invention are met by an oil control ring for internal combustion engines, formed by a ferrous body including two projections of contact, each one defining a respective surface of external contact which contains a first and second extremity edges and each one having a tilted face that starts as of the respective second edge, where each surface of contact has a height between the first and second extremity edge between 0.02 and 0.20 millimeters and the angle of each tilted face is included between 5 and 25 degrees. In order to increase the robustness of the product regarding the sealing, a solution brought by this invention is the possibility of a higher 21 radial removal during the lapping operation, without significant increase of the contact range, given the higher conical angle of the profile. When in operation, the flat part of the ring guarantees an appropriate contact range and minimizes the risk of chipping that could occur if the vertex were maintained.

Also, another benefit of this invention is the possibility of enabling the use of reduced contact surfaces in oil rings with the use of surface hardening treatments of the contact surface in order to make the product more resistant to wearing, such as, for example, nitriding. In the descriptions found in the prior art, the use of this technology on reduced contact surfaces can result in high levels of located tension

because the relation between the thickness of the hardened layer and the contact portion is approximately unitary.

The characteristics mentioned above, in addition to other aspects of this invention, shall be better understood by means of the examples and the detailed description of the figures below.

Brief Description of the Drawings

The present invention will now be described in greater detail, with reference to the appended drawings, wherein:

Figure 1 – is a view of the transversal section of an oil ring for internal combustion engines of the prior art;

Figure 2 – is a view of the profile of the stepped work face of an oil ring for internal combustion engines of the prior art;

Figure 3A - is a detailed view of the profile of the contact surface of a ring of the prior art;

Figure 3B - is a detailed view of the profile of the contact surface of the ring object of this invention;

Figure 4 – is a schematic view of the transversal section of the oil ring for internal combustion engines of this invention;

Figure 5 – is a detailed view of the profile of the preferred concretization of the contact surface of the ring of this invention;

Figure 6 – is a detailed view of the profile of an alternative concretization of the contact surface of the ring object of this invention;

Figure 7 – is a schematic representation of the high concentration of tensions in a ring of the prior art;

Figure 8 – is a schematic representation of the higher robustness brought by the profile of the ring object of this invention; and

Figure 9 – is a schematic view of the ring object of this invention in operation.

Detailed Description of the Drawings

The Brazilian patent application PI9202268 defines an oil control ring 100 that enables an efficient scraping of oil by means of the contact surface in the truncated conical shape 11. It also brings, as illustrated in figure 1, oblong ribs 16 for the return of the oil to the engine pan.

Figure 2 represents the ring revealed by patent US 7,117,594, which brings, as solution for the reduction of contact face the use of a manufacturing technique that increases the constructive robustness of the contact surface by the stepping of the projection of contact (see the stepping, identified in figure 2 with reference 200). However, as compensation, this solution does not eliminate the possibility or probability of occurrence of storage of oil in the stepped region of the projections of contact of the ring, increasing, therefore, the consumption of oil in the vehicle driving set.

As can be seen in figure 3A, a general ring belonging to the prior art has the profile of the contact surface 16 with a slightly tilted face 17 (between 30' and 4°), where such configuration allows only a precise contact on edge 18 with the cylinder wall, bringing high pressure in the phase of engine breaking-in.

However, this high pressure can in some situations cause the rupture and consequently damage the cylinder wall, in addition to being more susceptible to the increase of the contact region due to the radial wearing.

According to a preferred concretization and as can be seen from figure 3B, the oil control ring 1 object of this invention is formed by a preferably ferrous body 12, such as cast iron or any steel, such as nitrided steel, and by a resilient/elastic element 8, such as an helicoidal spring, flat spring or even another expanding means, to bring the expansion force necessary to this type of application.

Alternatively, it is possible to conceive a ring in which the own mechanical properties/characteristics of the base material of the body 12 are sufficient to generate the expansion force desired. Also, alternatively, it is possible to conceive a body 12 which is not ferrous, such as, for example, constituted by non-metallic material, polymer or compound.

Preferably, the body 12 has total height (illustrated especially in figure 9 as HT) above 2 millimeters (mm) taken in the axial direction, in order to offer a little more rigidity, although it is perfectly possible to conceive a ring included in the scope of protection of this invention whose body has height below 2 mm.

Body 12, regardless of its HT height being above or below 2 mm, it has two external projections of contact 2 each one containing an extreme triangular region 21 (which is illustrated with hachure in figure 3B, but will be later removed in a process of final lapping), a segment of triangular trunk (which gives the form to the projection of contact 2 itself after the removal of the external triangular region) bordered by a parallel face or surface of contact 102 and a tilted face 3, an intermediary section 4 directed at the cylinder wall 5 and a circular section 6 turned to the side of the piston 7. As can be seen in figure 9, the projections 2 project towards the cylinder wall 5 when the set is assembled.

As can also be seen in figure 3B, each projection of contact 2 of the oil control ring 1 contains a first 22 and second 23 extremity edges, and brings initially a distance d3, also identified as the height (H), formed from edge 22 to edge 23, where the tilted face 3 starts. This distance corresponds, as we will see below, exactly to the parallel surface of contact 102.

The angle of the tilted face 3 must be included between 5° and 25° (degrees), preferably between 13° and 17° in relation to the axial length of the ring, which maximizes its performance properties.

One of the possible processes to use in order to manufacture the ring object of this invention uses as base a metallic annular segment of rectangular transversal section, and the two projections of contact 2 are created by means of removing material from the region between both. However, alternatively, it is possible to use for the manufacturing of the oil ring a metallic tape whose transversal section already brings the projections 2 (pre-profiled), making the procedure of removing material unnecessary.

After the projections of contact 2 have been obtained, the triangular extremity 21 is removed so that the ring reaches its final format, by lapping the contact face or even any other similar process.

The removal of the triangular extremity 21 of each projection of contact 2 defines the contact face 102 in the flat form, parallel to the cylinder wall, with the height (H) which may vary from 0.02 to 0.20 millimeter, being preferred, but not mandatorily, with 0.20 millimeter or a close value.

Alternatively, if using a steel tape or another material already with the desired profile (pre-profiled), that is, without the triangular extremity 21 in each projection, the need of removal is eliminated.

The suppression of the triangular extremity 21 guarantees both the stability regarding the breaking or cracks in the region, and the maintenance of a more constant contact pressure during the service life of the equipment.

Figure 4 illustrates the transversal section of a preferred concretization of the oil ring 1 of this invention.

Figures 5 and 6 illustrate the detail of the contact surfaces 102 of the ring 1 of this invention. In figure 5, which illustrates a preferred concretization of the invention, the projections of contact 2 are turned so that the tilted faces 3 are turned one facing the other, that is, symmetrical, according to the direction indication 9.

This first concretization is preferred, mainly when one focus on the solution of the problem of irregular contact between the superior and inferior projection of contact of the oil ring (that is, different, the contact of a projection being higher than the other), which may occur (and in practice does occur) due to the deformation of the small channel of the piston, of the axial movement of the piston, given by the backlash between the piston/cylinder pair and the movement of the gravity center of the rings due to the singularity added to the portions of contact of the ring, when the two projections of contact are directed.

The position of the projections of contact 2 (and as a consequence of the contact surfaces 102), in a way that the respective tilted faces 3 are turned one facing the other, collaborates in a decisive manner so that the characteristics of stability and geometric counterbalancing of the ring are such that the contact of both contact surfaces are significantly uniform, even in situations of high dynamic requesting of the ring, resulting in the improved axial conformity of the oil ring.

In another possible concretization, illustrated in figure 6, the two projections of contact 2 are positioned in an asymmetrical manner, that is, directed so that the two tilted faces 3 are turned to the same direction, namely, the direction of the top of the piston, according to the indication of direction 10. This assembly focus on making feasible the reduction of viscous or hydrodynamic attrition, upon the operation of the piece; however the results obtained regarding the stability of the ring to avoid the irregular or different contact between the superior and inferior projection of contact and the cylinder become more dependent on the use of advanced manufacturing techniques, with reduced tolerances, mainly regarding the difference between the heights of the projections of contact, in order to minimize the impact of the already mentioned external effects, such as the deformation of the small channel and the axial movement of the piston.

The use of the profiles of surface of contact of the ring object of this invention, such as illustrated in figures 5 and 6, makes it possible for the resulting ring to have a better performance in relation to the control of the oil film, avoiding a problem found in the rings of the prior art, in which the stepped profile of the contact face 200 (see figure 2) acts as an oil accumulator, retaining it and causing its accumulation in the superior part of the oil ring (directed at the top of the piston). The concretization of the invention illustrated in figure 5 is especially efficient in this regard, given that it makes it possible to considerably minimize the occurrence of irregular contact between the superior and inferior projection of contact of the oil ring due to the fact that the tilted faces 3 are directed one facing the other, even in situation of high dynamic request of the ring.

Consequently, in addition to the decreased wearing of the ring and the cylinder wall, a considerable reduction occurs in the accumulation of lubricating oil in the superior part of the ring and it is better redistributed along its action field.

In order to reduce even further the accumulation of lubricant, the ring can include one or more areas to drain oil in the preferred form of oblong ribs or holes 33 positioned in the intermediary section 4 in order to enable the flow of lubricant. Because it is a solution known to those with experience in this technique, there is no need for more details in the description. The existence of these oblong ribs or holes 33 is more interesting, and preferred, when the height of the ring is above 2.0 mm, which maintains a still acceptable value of rigidity, but nothing stops them from being offered in a ring with lower height, if necessary or desired.

Figure 7 illustrates, in a schematic manner, the high concentration of tensions that occur in a ring of the prior art, by means of the relation between the contact width (c) and the thickness of the hardened layer ($D/2$), formed upon the application of superficial hardening treatments. This concentration of tensions is very considerable and makes it impossible to associate the application of the techniques of superficial hardening treatment in rings, such as, for example, nitriding, together with the reduction of the contact surfaces of the projections of contact, according to

the designs presented by the rings belonging to the prior art, such as the ones illustrated in figures 1 and 2.

Figure 8, in turn, schematically illustrates in details one of the projections of contact 2 of the ring object of this invention, which, due to its geometry, offers reduction of the contact surface associated with obtuse constructive angles, which are gentler, minimizing the accumulation of tensions upon the application of superficial hardening treatments to reduce superficial wearing, such as nitriding, or localized processes of phase change of material, such as the hardening by laser.

Therefore, it is clear that the shape of the projections of contact 2 of the ring, object of this invention, makes its use possible with coatings and superficial treatments to increase the resistance to wearing in which the use of profiles with excessive reduction of the surface of contact, such as the rings belonging to the prior art, becomes restrictive, given the accumulation of tensions caused by the high superficial hardness brought by the coatings and superficial treatments, not to mention the other great advantage of the invention, commented above, which is the superior maintenance of the contact pressure along the service life of the engine since it has higher tilting angle of the edge that supports the contact face, making, therefore, the radial wearing have reduced effect on the increase of the contact face of the projections of contact of the oil ring.

Having described examples of preferred embodiments, it should be understood that the scope of the present invention encompasses other possible variations, being limited only by the content of the appended claims, potential equivalents being included therein.

Claims

1. Oil control ring (1) for internal combustion engines, formed by a ferrous body (12) including two projections of contact (2), each one defining a respective external contact surface which contains a first (22) and second (23) extremity edges and each one having a tilted face (3) which starts from the respective second edge (23), the ring (1) being characterized by the fact that the projections of contact (2) are directed, so that the respective tilted faces (3) are directed one facing the other, symmetrically.

2. Ring according to claim 1, characterized by the fact that it includes an intermediate section (4) which has areas to drain oil in the form of oblong rips or holes (33) positioned in order to make the flow of lubricant possible.

3. Ring according to claim 1, characterized by the fact that it includes a solid intermediary section (4), which does not have oblong rips or holes (33).

4. Ring according to any of the claims 1 to 3, characterized by the fact that the projections of contact (2) are created by means of the removal of material from the region between both.

5. Ring according to any of the claims 1 to 3, characterized by the fact that the projections of contact (2) are obtained through the use as an alternative form, of a pre-profiled tape for manufacturing of the ring (1).

6. Ring according to any of the claims 1 to 5, characterized by the fact that the face (102) is obtained through the use of pre-profiled tape for manufacturing of the ring (1).

7. Ring according to any of the claims 1 to 5, characterized by the fact that each face (102) is obtained through machining or similar process to remove material via pulling the material.

8. Oil control ring (1) for internal combustion engines, formed by a ferrous body (12) including two projections of contact (2), each one defining a respective external contact surface which contains a first (22) and second (23) extremity edges and each one having a tilted face which (3) starts from the respective second edge (23), the ring (1) being characterized by the fact that each contact surface (102) has a height (H) between the first (22) and second (23) extremity edges between 0.02 and 0.20 millimeter and the angle of each tilted face (3) is included between 5 and 25 degrees.

9. Ring according to claim 8, being characterized by the fact that the projections of contact (2) are directed, so that the respective tilted faces (3) are turned one facing the other, symmetrically, the inferior one directed at the top of the piston.

10. Ring, according to claims 8 and 9, being characterized by the fact that the tilted faces (3) are included between 13 and 17 degrees.

11. Ring according to claim 8, being characterized by the fact that the projections of contact (2) are directed, so that the respective tilted faces (3) are turned to the same direction, the top of the piston.

12. Ring according to claim 8, 9, 10 or 11, characterized by the fact that it includes an intermediary section (4) which has areas to drain oil in the form of oblong ribs or holes (33) positioned in order to make the flow of lubricant possible.

13. Ring according to claim 8, 9, 10 or 11, characterized by the fact that it includes a solid intermediary section (4), that is, it does not have oblong ribs or holes (33).

14. Ring according to any of the claims 8 to 13, characterized by the fact that the projections of contact (2) are created by means of removing material from the region between both.

15. Ring according to any of the claims 8 to 13, characterized by the fact that the projections of contact (2) are obtained by the use as an alternative form of a pre-profiled tape for manufacturing of the ring (1).

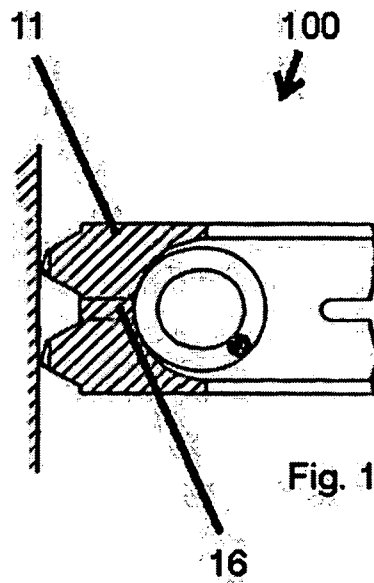
16. Ring according to any of the claims 8 to 15, characterized by the fact that the face (102) is obtained by the use of pre-profiled tape for manufacturing of the ring (1).

17. Ring according to any of the claims 8 to 15, characterized by the fact that each face (102) is obtained by machining or similar process to remove material by pulling the material.

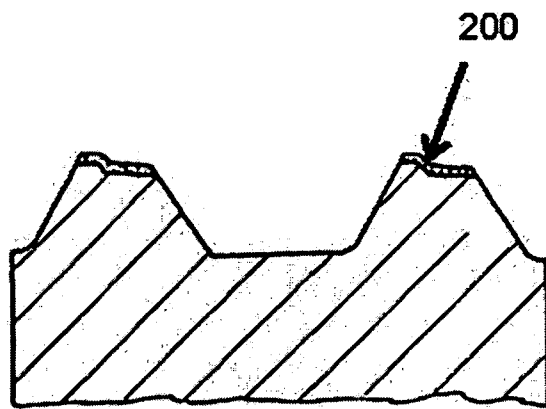
18. Ring according to any of the claims above, characterized by the fact that the external surface of the ring receives application of coatings in order to increase resistance to wearing of the ring (1).

19. Ring according to any of the claims above, characterized by the fact that the external surface of the ring receives superficial treatment in order to increase resistance to wearing of the ring (1).

20. Ring according to any of the claims above, characterized by the fact that the ferrous body (12) has total height (HT) above 2 millimeters (mm).



Prior Art



Prior Art

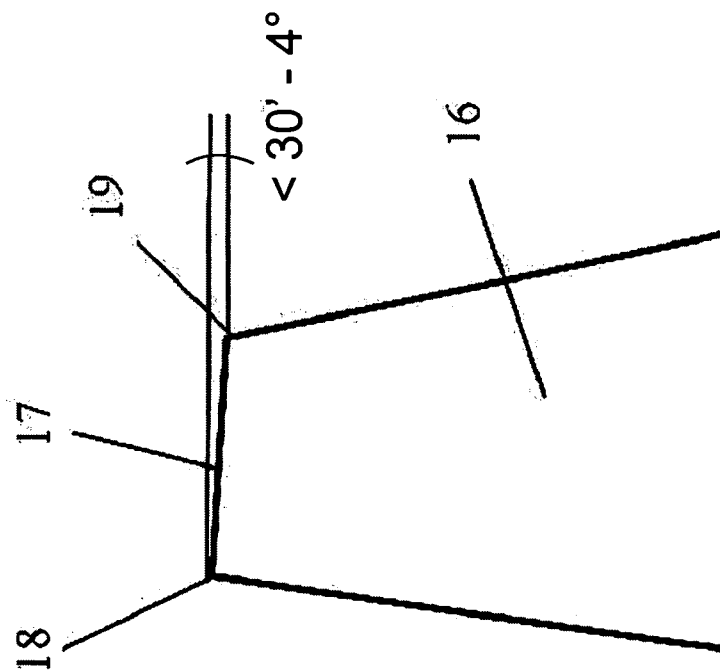


Fig 3A

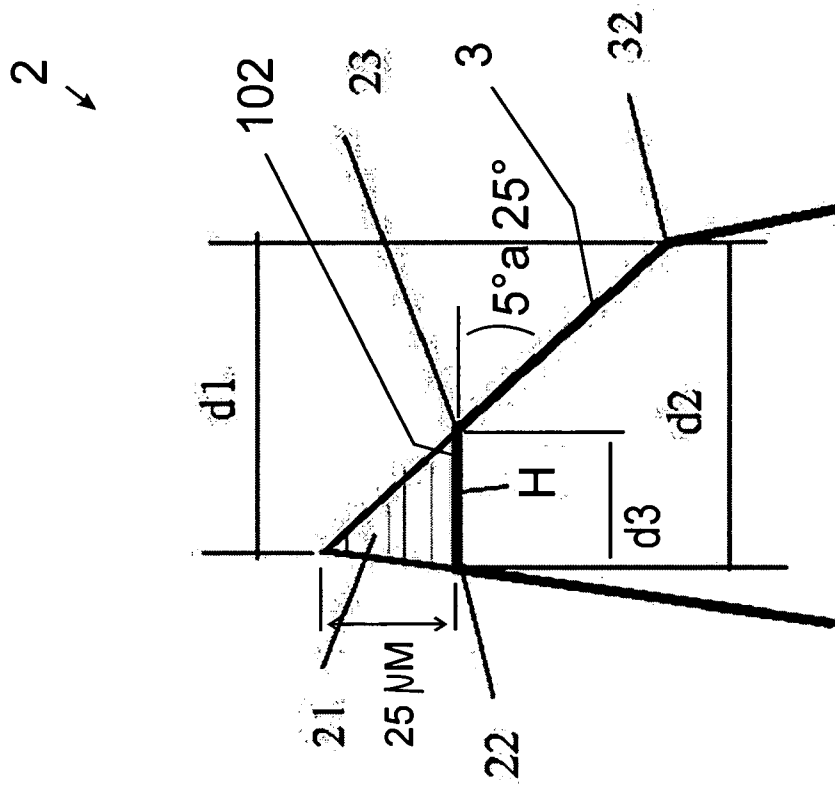
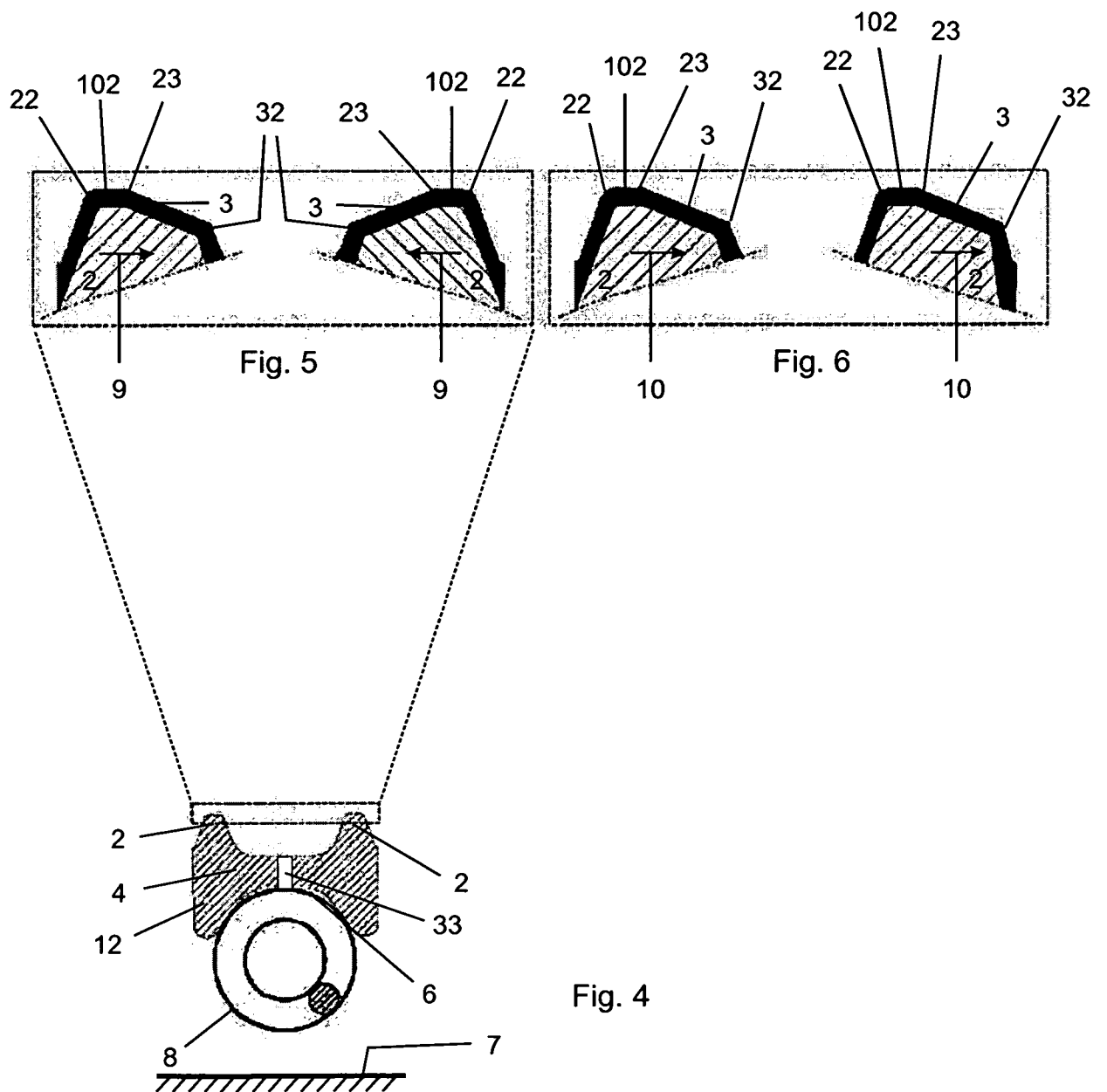


Fig. 3B



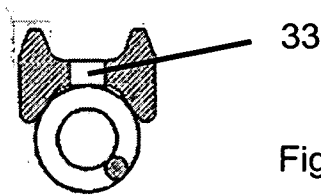
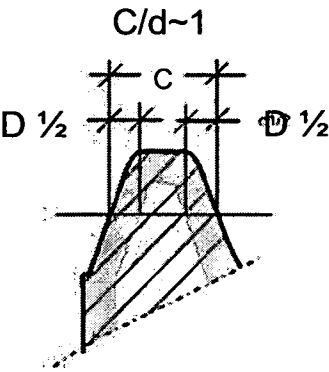


Fig. 7

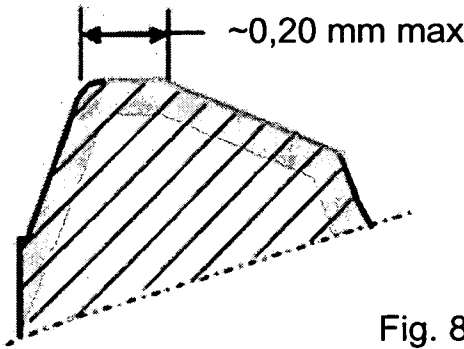


Fig. 8

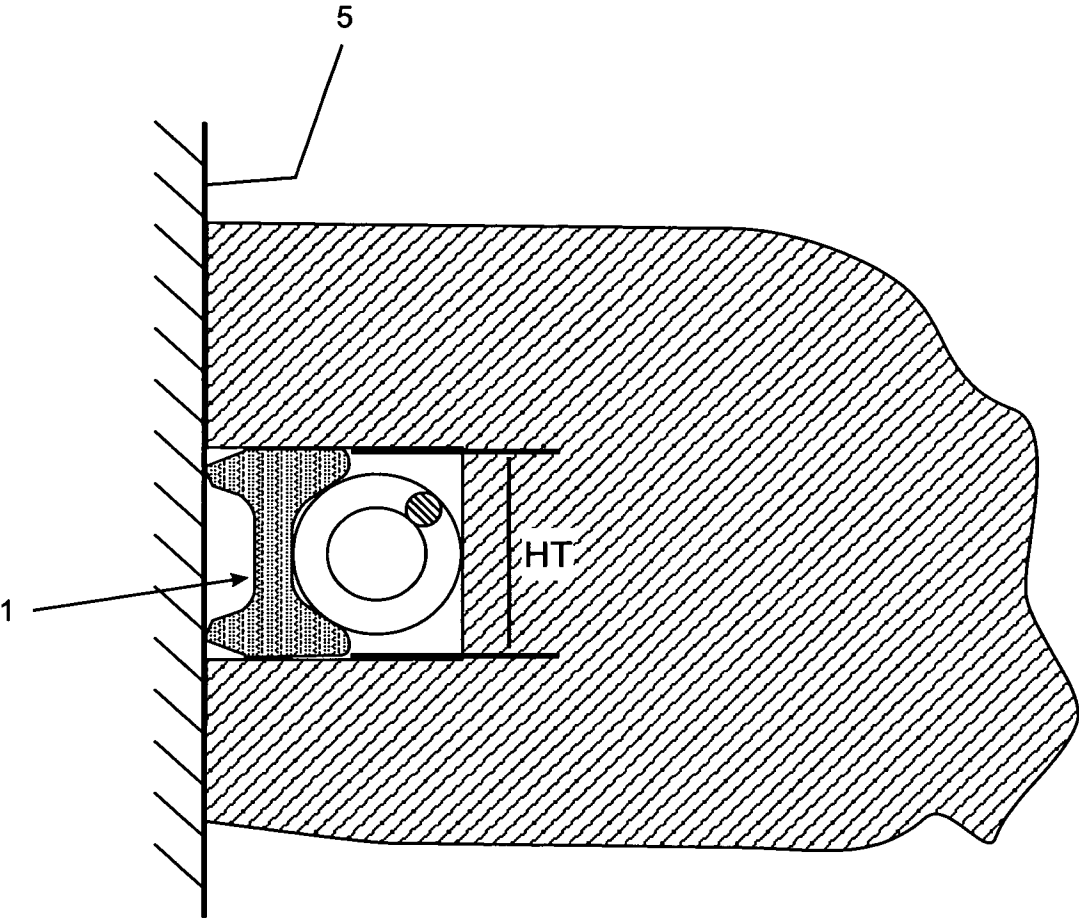


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2011/002716

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/002716

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16J9/06 F16J9/20
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 199 274 B1 (PREYER KARLFRIED [DE]) 13 March 2001 (2001-03-13) the whole document	1-7
X	US 4 247 972 A (HENDRIXON JOHN L ET AL) 3 February 1981 (1981-02-03) the whole document	1-7
X	US 5 820 131 A (TANAKA SHOJI [JP] ET AL) 13 October 1998 (1998-10-13) the whole document	1-7
X,P	WO 2010/124353 A1 (MAHLE METAL LEVE S A [BR]; RABUTE REMI DANIEL [FR]) 4 November 2010 (2010-11-04) the whole document	1-19
	----- -/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search

2 November 2011

Date of mailing of the international search report

21/11/2011

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2011/002716

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03/019050 A1 (RIKEN KK [JP]; TAKIZAWA AKIYOSI [JP]; KATAYAMA NOBUO [JP]) 6 March 2003 (2003-03-06)	1-10, 13-20
Y	the whole document -----	11
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2011/002716

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FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-7

Oil control ring for internal combustion engines wherein the projections of contact are directed, so that the respective tilted faces are directed one facing the other, symmetrically.

2. claims: 8-20

Oil control ring for internal combustion engines wherein each contact surface has a height between the first and second extremity edges between 0.02 and 0.20 millimeter and the angle of each tilted face is included between 5 and 25 degrees.
