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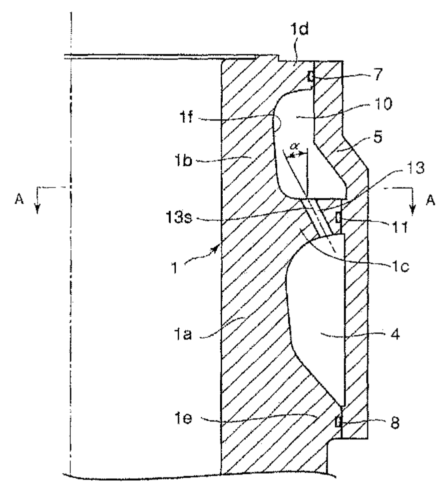
(54) CCOLING STRUCTURE OF CYLINDER LINER

(57) Provided with a cooling structure of a cylinder liner which can cope with high Pme of an engine by enhancing heat transfer coefficient of the outer surface of the cylinder liner on the side of cooling water with an inexpensive cooling means of cylinder liner having an extremely simple structure and requiring little processing man-hours. The cooling structure of the cylinder liner provided with a cooling fluid space between the outer periphery of the cylinder liner and the inner periphery of a cover covering the outside of the outer periphery of the cylinder liner fluid-tightly is **characterized in that** the cooling space is divided into an upper cooling space and a lower cooling space, the partition boss is covered with the cover which seals the upper cooling chamber and the lower cooling chamber fluid-tightly, nozzle holes for ejecting cooling fluid from the lower cooling space to the upper cooling space are bored through the partition boss, and a plurality of nozzle holes are bored in the circumferential direction while directing the opening direction toward the outer surface of the upper cooling space.

Fig. 1



EP 2 224 119 A1

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a cylinder liner cooling structure for cooling a cylinder liner of a large diesel engine whereby a cooling space is provided between the outer periphery surface of the cylinder liner and the inner periphery of a cover that is placed at the outside of the cylinder liner for covering (the upper part of) the cylinder liner fluid-tightly.

Background of the Invention

[0002] Fig. 5 shows a half (left or right part) of a cross-section as to an assembly structure of the cylinder liner and a cylinder cover (a cylinder head for the cylinder) in a large diesel engine.

[0003] In Fig.5, the numeral 1 denotes a cylinder liner; the numeral 2 denotes a cylinder cover that is placed on or over the cylinder liner 1 and tightened to the cylinder liner 1 with a plurality of bolts (not shown). The cylinder liner 1 and the cylinder cover 2 are fluid-tightly tightened to each other via a metal gasket 6 . The numeral 5 denotes a cover (not the cylinder cover) ; the top end of the cover 5 is detachably fixed to the cylinder cover 2, and the lower end of the cover 5 is detachably fixed to the cylinder liner 1; further, the cover 5 surrounds the outer (circumferential) periphery of the cylinder liner 1 and fluid-tightly jackets the outer (circumferential) periphery surface If of the cylinder liner 1 so that a cooling space 4 is configured between the outer (circumferential)periphery of the cylinder liner 1 and the inner (circumferential)periphery of the cover 5.

[0004] Further, the bottom face of the cover 5 is placed at and fixed to an upper surface of a cylinder block 10 (the numeral 9 denotes the fixing surface area) : and, an inner circumferential side surface of the lower end of the cover 5 is connected to the side surface (an outer circumferential periphery) of the cylinder liner 1 via an O-ring 8 so that the fluid-tightness of the cooling space 4 is not spoiled (the bearing seal between the contact surfaces is not spoiled).

[0005] The cooling water for the cylinder liner 1 as well as for the cylinder cover 2 is firstly introduced into the cooling space 4 through at least one water inlet hole 16 of the cylinder block 10 and at least one cooling water passage 15 of the cover 5; thereby, the cooling water cools the cylinder liner wall 1a (the cylinder liner body) and the outer periphery surface If of the cylinder liner 1; further, the cooling water reaches a plurality of cooling boreholes 3 of the cylinder cover 2 after passing through a plurality of cooling holes 16 (that are different from the water inlet hole 16 of the cylinder block 10) of the cover 5, so that the cooling water also cools the cylinder cover 2.

[0006] In addition, the patent reference 1 (JP1987-253945) discloses a means for cooling the cylinder liner 1 in a large diesel engine.

[0007] In the disclosed technology, a plurality of cut-outs (of an open longitudinal slit shape) is equidistantly and radially provided toward the outside of the outer periphery of the cylinder liner (namely, toward the outside and along the radial directions), in the upper outer periphery of the cylinder liner; a reinforcing jacket ring covers the upper part of the outer periphery of the cylinder liner whereby the reinforcing jacket ring configures a common passage that communicates with each one of the cut-outs, so that cooling fluid flows through the common passage and each one of the cut-outs.

[0008] In recent years, the brake mean effective pressure Pme of the large diesel engines as described above has been raised up more and more; accordingly, the temperature of the outer periphery If of the cylinder liner 1 has increased in response to the enhanced brake mean effective pressure Pme.

[0009] According to the conventional technology as described in Fig.5, the wall thickness of the cylinder liner 1 has to be increased in response to the increase of the brake mean effective pressure Pme; thus, the cooling effect (namely, the cooling water capacity, the cooling water flow rate and so on) regarding the cylinder liner 1 has to be enhanced so as to restrain the temperature of the outer periphery If of the cylinder liner 1, within a limit temperature.

[0010] According to the conventional technology, however, the outer periphery If of the cylinder liner 1 is simply cooled; in other words, the heat transfer coefficient derived from the cooling waterside is too low to enhance the whole heat transfer coefficient so as to cope with the enhanced brake mean effective pressure Pme.

[0011] Further, according to the technology of the reference 1 (JP1987-253945), a large number of the open cut-outs has to be formed in the radial directions of the cylinder liner 1 around the outer periphery along the hoop direction of the cylinder liner 1; thus, a great deal of machining man-hours is required; as a result, the cost effectiveness is spoiled.

[0012] Instead of the above described cooling structure of the cylinder liner with the cut-outs, the cylinder liner of a so-called bore cool type can be adopted whereby a plurality of cooling bore holes of a L-shape or a dog-leg shape (bore holes with a sharp bend) is provided; however, this approach also accompanies a great deal of man-hours in machining a number of long and narrow bore-holes; as a result, the cost effectiveness is also spoiled..

DISCLOSURE OF THE INVENTION

[0013] In view of the above described difficulties of the conventional technologies, the present invention aims at providing a cooling structure for cooling a cylinder liner, thereby the cooling structure realizes a low cost cylinder liner cooling means of a significantly simple structure that requires fewer machining man-hours; the cooling structure enhances the heat transfer coefficient on the cooling water side around the outer periphery of the cylinder liner; and, the cooling structure can cope with the enhanced brake mean effective pressure Pme.

[0014] In order to reach the goals for the above-described subjects, this application discloses

a cooling structure for cooling a cylinder liner, the structure comprising a cooling fluid space between an outer periphery of the cylinder liner and an inner periphery of a cover that fluid-tightly jackets said outer periphery of the cylinder liner,

wherein the cooling fluid space is partitioned into an upper cooling space and a lower cooling space, by a partition boss provided on the outer periphery of the cylinder liner, thereby the cover fluid-tightly seals the clearance between the partition boss and the cover, so that the upper cooling space and the lower cooling space are fluid-tightly sealed by the cover;

the partition boss is provided with a plurality of nozzle holes that are bored in the partition boss in a circumferential direction thereof, thereby cooling fluid gushes from the lower cooling space into the upper cooling space through the nozzle holes in such a way that the cooling fluid from each nozzle hole is directed toward the outer surface of the cylinder liner in the upper cooling space.

[0015] A preferable example of the above disclosure is the cooling structure for cooling a cylinder liner, wherein said nozzle holes are provided circumferentially to said partition boss in such a way that each of the nozzle holes is bored to incline in a same direction circumferentially toward the outer surface of the cylinder liner, thereby an outlet of each of the nozzle holes is formed in an ellipse shape.

[0016] Another preferable example of the above first disclosure is the cooling structure for cooling a cylinder liner,

wherein said nozzle holes are provided to said partition boss in such a way that each of the nozzle holes is bored to incline radially toward the outer surface of the cylinder liner in the upper cooling space, thereby an outlet of each of the nozzle holes is formed in a ellipse shape.

[0017] Hereby, it is noted that the cross section of the nozzle hole, which is orthogonal to the axis of the nozzle hole may be an ellipse shape or a crushed (splat) ellipse rather than a perfect circle, for the purpose of relieving the stress concentration around the nozzle hole outlet.

[0018] Another preferable example of the above first disclosure is the cooling structure for cooling a cylinder liner,

wherein each nozzle hole is provided with a nozzle which is fixed to said partition boss at a root part thereof, and each nozzle plays the role of the nozzle hole.

[P3/L14]

[0019] According to the present invention, the partition boss provided on the outer periphery of the cylinder liner around the outer periphery along the circumferential direction divides the cooling fluid space that surrounds the cylinder liner, into the upper cooling space and the lower cooling space; the clearance between the partition boss and the cover is fluid-tightly sealed, so that the upper cooling space and the lower cooling space are fluid-tightly sealed by the cover; the partition boss is provided with the nozzle holes through which the cooling water (fluid) gushes from the lower cooling space into the upper cooling space; a plurality of nozzle holes is arranged along the circumferential direction around the cylinder liner; and the axis line of each nozzle hole at the hole outlet is directed toward the outer surface of the cylinder liner in the upper cooling space.

[0020] Further, the cooling fluid space is divided into two stages: one is the upper cooling space that faces the upper part of the cylinder liner to be intensively cooled; the other is the lower cooling space from which the cooling water (fluid) gushes into the upper cooling space through the nozzle holes that are bored in the partition boss.

[0021] Thus, the cooling water intensively cools the outer surface as the location of the outer surface corresponds to the location of a top piston ring when the piston is at the top dead center, in which the temperature thereof becomes outstandingly high, and the upper part of the cylinder liner needs to be intensively cooled. In this way, the jet stream (the gushing-out cooling fluid flow) of the cooling water collides with the outer surface, and effectively cools the upper part of the cylinder liner, as the collision of the jet stream with the outer surface enhances the heat transfer coefficient between the outer surface 1f and the cooling water; therefore, the temperature at the outer surface of the cylinder liner can be lowered.

[0022] As described thus far, the cooling water (fluid) space around the cylinder liner is divided into the upper cooling space and the lower cooling space; whereby, the cover jackets both the spaces, and the clearance between the partition boss and the cover is fluid-tightly sealed; further, the partition boss is provided with a plurality of nozzle holes through which the cooling water (fluid) gushes from the lower cooling space into the upper cooling space toward the cylinder liner outer surface in the upper cooling space; namely, the axis line of each nozzle hole is directed toward the outer surface.

[0023] With this cylinder liner cooling means of an extremely simplified and cost-effective structure whereby the machining man-hours are reduced, and the heat transfer coefficient between the outer surface of the cylinder liner and the cooling water (fluid) can be enhanced; thus, a cylinder liner cooling structure that can cope with the increasing of the brake mean effective pressure Pme of an engine is realized.

[0024] Especially, as the nozzle holes are provided circumferentially to the partition boss in a way that the nozzle holes are bored to incline in a same direction, thereby, forming the outlet of the each nozzle holes in an ellipse shape, a swirl flow in the circumferential direction around the outer periphery of the upper part of the cylinder liner is formed. Therefore, the heat transfer coefficient on the cooling water side can be enhanced.

[0025] The outlet of the each nozzle holes through which the cooling water (fluid) gushes into the upper cooling space forms an ellipse shape, thereby the R-dimension as to the stress concentration in a hoop direction can be larger in comparison with the nozzle hole radius; thus, the hoop stress can be reduced.

[0026] Further, instead of the nozzle holes, a plurality of nozzles can be provided. The root part of the nozzle is fixed to the partition boss, and the nozzle plays the role of the nozzle hole; further, by changing the length, direction or inner diameter of the nozzles, the heat transfer coefficient on the cooling water side of the cylinder liner due to the collision of the cooling water to the outer surface of the cylinder liner can be adjusted, thereby, the nozzle 12 that brings a most suitable temperature condition can be selected.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

Fig. 1 shows a half (left or right part) of an upper cross-section as to an assemble structure of the cylinder liner in a large diesel engine, according to a first embodiment of the present invention;

Fig. 2(A) shows an A-A cross-section (a first cross section) of Fig. 1;

Fig. 2(B) shows an enlargement of the part Y in Fig. 2(A);

Fig. 3 shows an A-A cross-section (a second cross section) of Fig. 1;

Fig. 4(A) shows a half (left or right part) of an upper cross-section as to an assemble structure of the cylinder liner in a large diesel engine, according to a second embodiment of the present invention;

Fig. 4(B) shows an enlargement of the part Z in Fig. 4(A);

Fig. 5 shows a half (left or right part) of a cross-section as to an assemble structure of the cylinder liner and a cylinder cover (a cylinder head for the cylinder) in a large diesel engine.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] Hereafter, the present invention will be described in detail with reference to the embodiments shown in the figures. However, the dimensions, materials, shape, the relative placement and so on of a component described in these embodiments shall not be construed as limiting the scope of the invention thereto, unless especially specific mention is made.

(First Embodiment)

[0029] Fig. 1 shows a half (left or right part) of an upper cross-section as to an assemble structure of the cylinder liner in a large diesel engine, according to a first embodiment of the present invention; Fig. 2(A) shows an A-A cross-section (a first cross section) of Fig. 1; Fig. 3 shows an A-A cross-section (a second cross section) of Fig. 1.

[0030] In Fig.1, the numeral 1 denotes a cylinder liner on which a cylinder cover 2 (in Fig. 5) that is tightened to the cylinder liner 1 with a plurality of bolts (not shown) is placed as is the case with the structure of Fig.5.

[0031] The numeral 5 denotes a cover of which the top end is fluid-tightly fixed to an upper supporting part Id of the cylinder liner 1 via an O-ring 7.

[0032] The cover 5 forms, around the cylinder liner, a cooling (water) space comprising two divisions, namely, an upper cooling space 10 and a lower cooling space 4 partitioned by a partition boss 1c. An O-ring 11 fluid-tightly seals the clearance between the outer periphery of the partition boss 1c and the inner surface of the cover 5.

[0033] The lower end of the cover 5 is fluid-tightly fixed to a lower supporting part 1e of the cylinder liner 1 via an O-ring 8.

[0034] A plurality of nozzle holes 13 through which cooling water is ejected into the upper cooling space 10 from the lower cooling space 4 is formed in the partition boss 1c; the detail of the nozzle holes is as follows.

[0035] As a first example shown in Fig. 2, the plurality of nozzle holes 13 is provided circumferentially to the partition boss 1c, the nozzle holes are formed so that an axis line 13s of the each nozzle hole 13 has an aperture angle α that opens toward an outer surface If of the cylinder liner 1.

[0036] The aperture angle α is predetermined by experiments or simulation calculations. The nozzle holes 13 are formed to the partition boss 1c in a form that the axis line 13s of the each nozzle hole inclines in one direction circumferentially so that the positions of the inlet and outlet of the each nozzle hole are out of alignment in circumference direction. Accordingly, as shown in Fig. 2(B), the cross-section of each nozzle hole 13 forms an ellipse shape 13a at the nozzle hole outlet through which cooling water gushes into the upper cooling space 10.

[0037] According to the above described configuration as to each nozzle hole 13, the cooling water ejected from each nozzle hole having the axis line thereof inclined in one direction circumferentially, forms a swirl flow in the circumferential direction around the outer periphery 1f of the upper part of the cylinder liner 1; therefore, the heat transfer coefficient on the cooling water side can be enhanced

[0038] Further, as described above, the outlet of the nozzle hole through which the cooling water gushes into the upper cooling space 10 forms the ellipse shape 13a thereby the R-dimension as to the stress concentration in a hoop direction can be larger in comparison with the nozzle hole radius; thus, the hoop stress can be reduced.

Thus far, the cross section of the nozzle hole 13 may be formed in an ellipse or a crushed (splat) ellipse with a purpose of reducing the hoop stress.

[0039] A second example of a plurality of nozzle holes 13 is shown in Fig. 3. In Fig. 3, a plurality of nozzle holes is formed circumferentially to the partition boss 1c in a form that an axis line 13s of the each nozzle hole 13 to be radially inclined in such a way that the position of the outlet of the each nozzle hole 13 is located more inward than the position of the inlet thereof in radial direction, with an aperture angle α that opens toward the outer surface If of the cylinder liner 1. In this case, as the axis line 13s of the each nozzle hole 13 is not inclined in circumferential direction but is inclined radially toward a center axis 100, thereby, boring of the nozzle holes 13 to the partition boss 1c is simpler.

[0040] Except this point, the configuration of the second example is the same as that of the first example.

[0041] According to the above first embodiment, the partition boss 1c partitions the cooling water space that surrounds the cylinder liner into the upper cooling space 10 and the lower cooling space 4; the clearance between the partition boss 1c and the cover 5 is fluid-tightly sealed; the partition boss 1c is provided with the nozzle holes 13 through which the cooling water gushes from the lower cooling space 4 into the upper cooling space 10; a plurality of nozzle holes 13 is arranged circumferentially around the cylinder liner; and the axis line 13s of each nozzle hole 13 at the hole outlet is directed toward the outer surface If of the cylinder liner that is in the upper cooling space 10. Further, the cooling water space is divided into two stages: one is the upper cooling space 10 that faces the upper part of the cylinder liner to be intensively cooled; the other is the lower cooling space 4 from which the cooling water gushes into the upper cooling space through the nozzle holes 13 that are bored in the partition boss 1c. Thus, the cooling water intensively cools the outer surface If as the location of the outer surface If corresponds to the location of a top piston ring when the piston is at the top dead center, in which the temperature thereof becomes outstandingly high, and the upper part of the cylinder liner needs to be intensively cooled. In this way, the jet stream (the gushing-out cooling fluid flow) of the cooling water collides with the outer surface If, and effectively cools the upper part of the cylinder liner, as the collision of the jet stream with the outer surface If enhances the heat transfer coefficient between the outer surface If and the cooling water; therefore, the temperature at the outer surface If of the cylinder liner 1 can be lowered.

[0042] According to the above described embodiment, the upper cooling space 10 and the lower cooling space 4 are formed by the partition boss 1c that divides the cooling water space into the upper and lower cooling spaces by being fluid-tightly sealed to the cover 5 that jackets both the spaces 10 and 4, and the nozzle holes 13 through which the cooling water from the cooling space 4 gushes into the cooling space 10 toward the outer surface If thereof are provided to the partition boss 1c circumferentially, namely, the axis of each nozzle hole is directed toward the outer surface 1f . With this cylinder liner cooling means of an extremely simplified and cost-effective structure whereby the machining man-hours are reduced, and the heat transfer coefficient between the outer surface If of the cylinder liner 1 and the cooling water can be enhanced; thus, a cylinder liner cooling structure that can cope with the increasing of the brake mean effective pressure Pme of an engine is realized.

(Second Embodiment)

[0043] Fig. 4(A) shows a half (left or right part) of an upper cross-section as to an assembly structure of the cylinder liner in a large diesel engine, according to a second embodiment of the present invention, and Fig. 4(B) shows an enlargement of the part Z in Fig. 4(A).

[0044] In this second embodiment, the role of the nozzle holes 13 in the first embodiment is replaced by a plurality of nozzles 12; thereby, the root part of each nozzle 12 is fixed to the partition boss 1c, and each nozzle 12 is provided with a nozzle passage 12b and a discharge orifice 12a, as Fig. 4(B) shows.

[0045] In addition, the circumferential direction arrangement as to the nozzles 12 is performed in a same manner as shown in Fig. 2(A) and Fig. 3. The other configuration except this arrangement of the nozzles is the same as the configuration of the first embodiment; thus , the same numeral is used for a configuration member common to both embodiments.

[0046] According to the second embodiment, by changing the length, direction or inner diameter of the nozzles, the heat transfer coefficient on the cooling water side of the cylinder liner due to the collision of the cooling water to the outer surface If of the cylinder liner 1 can be adjusted, thereby, the nozzle 12 that brings a most suitable temperature condition can be selected.

Industrial Applicability

[0047] According to the above-described cylinder liner cooling means of an extremely simplified and cost-effective structure whereby the machining man-hours are reduced, the heat transfer coefficient between the outer surface If of the cylinder liner 1 and the cooling water can be enhanced; thus, a cylinder liner cooling structure that can cope with the increasing of the brake mean effective pressure Pme of an engine is realized.

Claims

1. A cooling structure for cooling a cylinder liner, the structure comprising a cooling fluid space between an outer periphery of the cylinder liner and an inner periphery of a cover that fluid-tightly jackets said outer periphery of the cylinder liner,

wherein the cooling fluid space is partitioned into an upper cooling space and a lower cooling space, by a partition boss provided on the outer periphery of the cylinder liner, thereby the cover fluid-tightly seals the clearance between the partition boss and the cover, so that the upper cooling space and the lower cooling space are fluid-tightly sealed by the cover;
the partition boss is provided with a plurality of nozzle holes that are bored in the partition boss in a circumferential direction thereof, thereby cooling fluid gushes from the lower cooling space into the upper cooling space through the nozzle holes in such a way that the cooling fluid from each nozzle hole is directed toward the outer surface of the cylinder liner in the upper cooling space.

2. The cooling structure for cooling a cylinder liner according to claim 1,
wherein said nozzle holes are provided circumferentially to said partition boss in such a way that each of the nozzle holes is bored to incline in a same direction circumferentially toward the outer surface of the cylinder liner, thereby an outlet of each of the nozzle holes is formed in an ellipse shape.

3. The cooling structure for cooling a cylinder liner according to claim 1,
wherein said nozzle holes are provided to said partition boss in such a way that each of the nozzle holes is bored to incline radially toward the outer surface of the cylinder liner in the upper cooling spcae, thereby an outlet of each of the nozzle holes is formed in a ellipse shape.

4. The cooling structure for cooling a cylinder liner according to claim 1,
wherein each nozzle hole is provided with a nozzle which is fixed to said partition boss at a root part thereof, and each nozzle plays the role of the nozzle hole.

Fig. 1

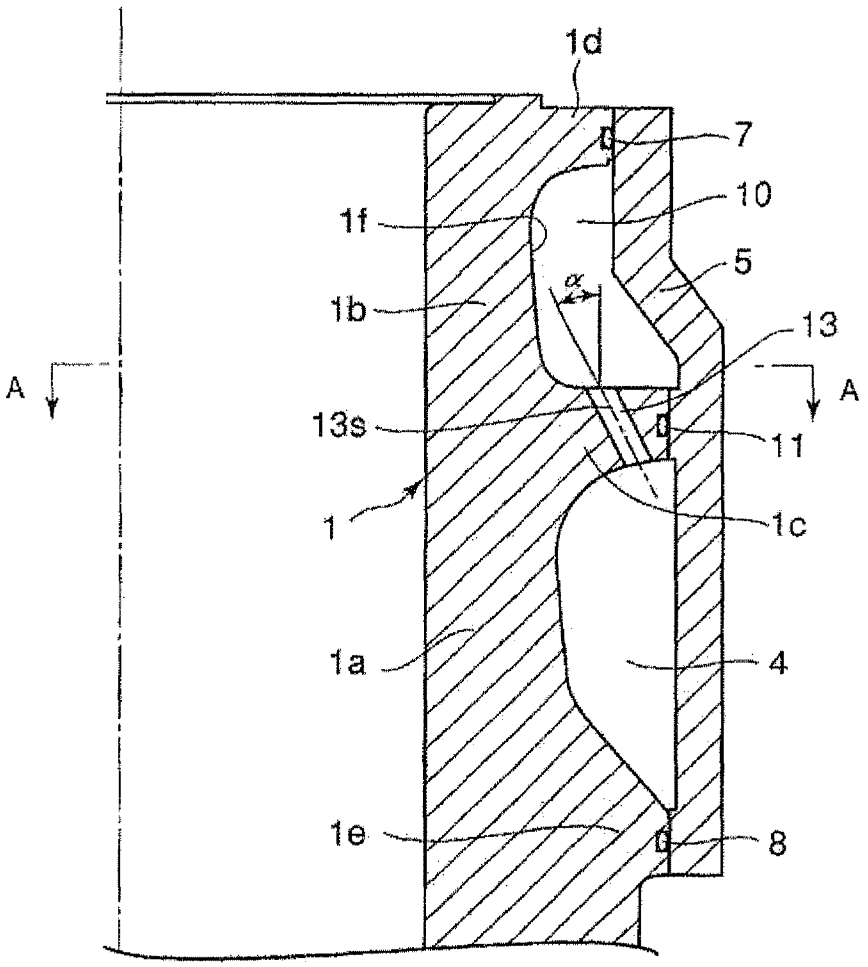


Fig. 2(A)

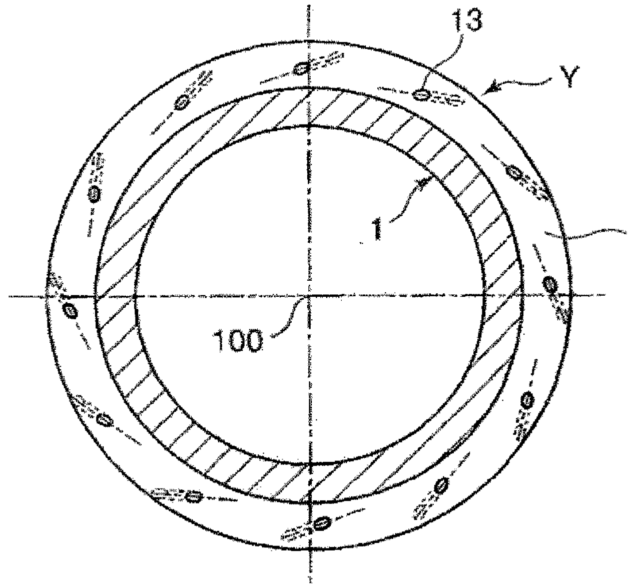


Fig. 2(B)

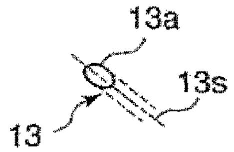


Fig. 3

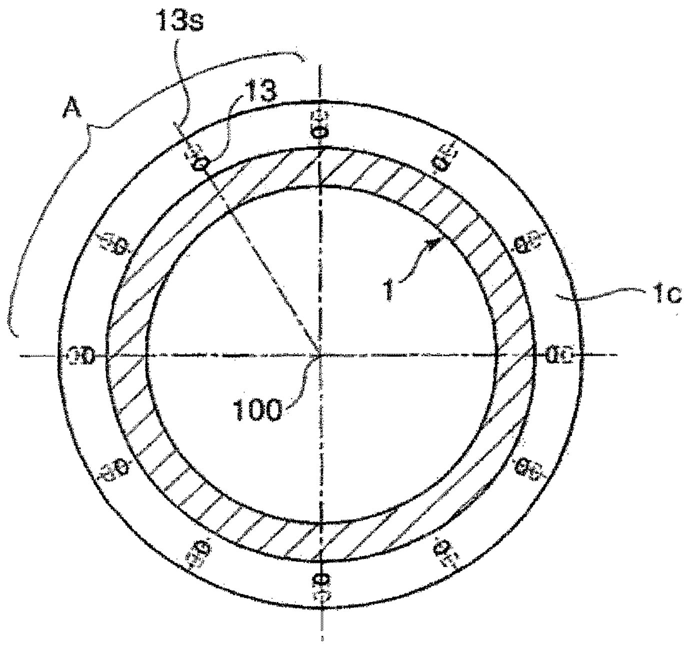


Fig. 4(A)

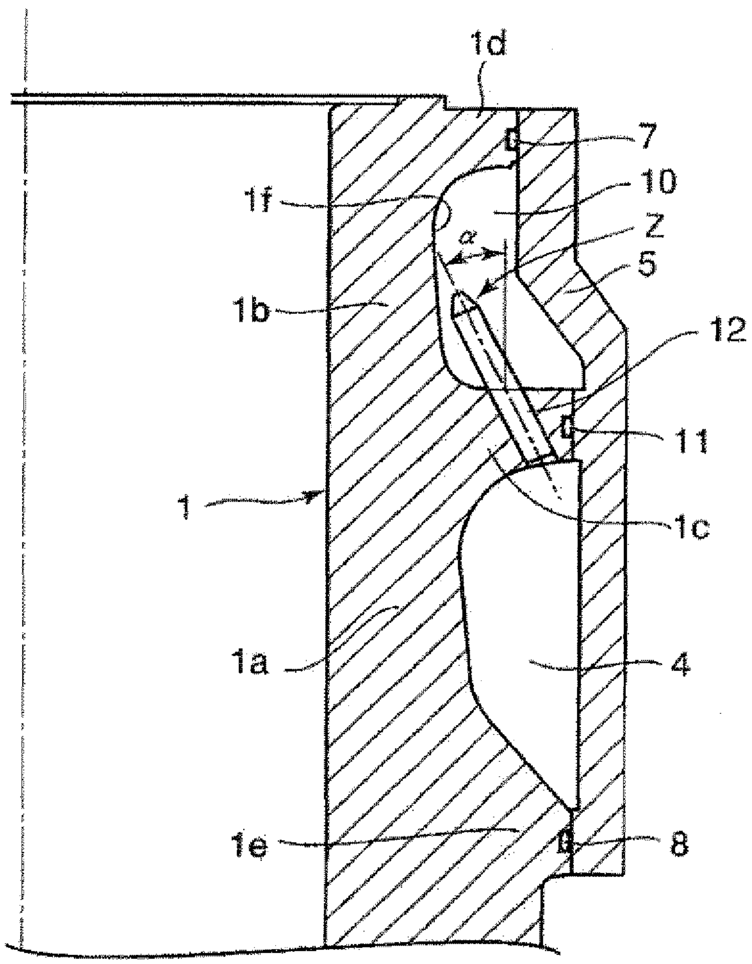


Fig. 4(B)

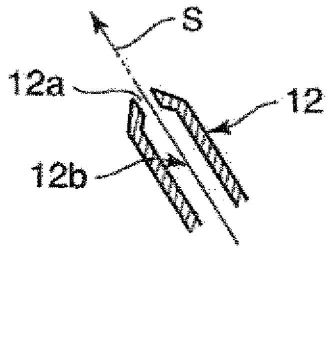
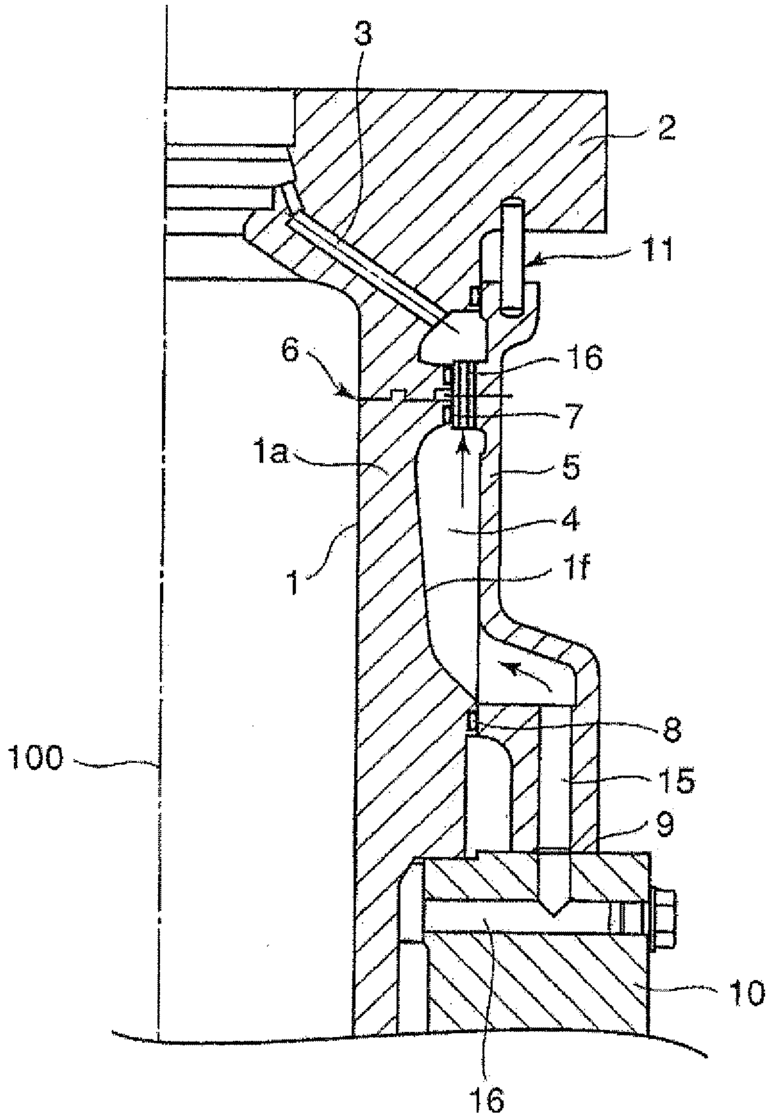


Fig. 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/052823

A. CLASSIFICATION OF SUBJECT MATTER
F02F1/14(2006.01)i, *F02F1/10*(2006.01)i, *F02F1/16*(2006.01)i

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)
F02F1/14, F02F1/10, F02F1/16

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2009
Kokai Jitsuyo Shinan Koho	1971-2009	Toroku Jitsuyo Shinan Koho	1994-2009

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 64062/1987(Laid-open No. 171642/1988) (Mitsubishi Heavy Industries, Ltd.), 08 November, 1988 (08.11.88), Description, page 3, line 7 to page 4, line 2; Fig. 1 (Family: none)	1-4
Y	JP 2002-221081 A (Yanmar Diesel Engine Co., Ltd.), 09 August, 2002 (09.08.02), Par. Nos. [0023] to [0025]; Fig. 4 (Family: none)	1-4

☒ 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
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Date of the actual completion of the international search 12 March, 2009 (12.03.09)	Date of mailing of the international search report 24 March, 2009 (24.03.09)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/052823

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 72314/1993(Laid-open No. 38641/1995) (Mitsubishi Heavy Industries, Ltd.), 14 July, 1995 (14.07.95), Par. Nos. [0001] to [0009]; Fig. 3 (Family: none)	1-4
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 126318/1985(Laid-open No. 34117/1987) (Mitsubishi Motors Corp.), 28 February, 1987 (28.02.87), Description, page 3, line 8 to page 9, line 10; Fig. 1 (Family: none)	4

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 62253945 A **[0006] [0011]**