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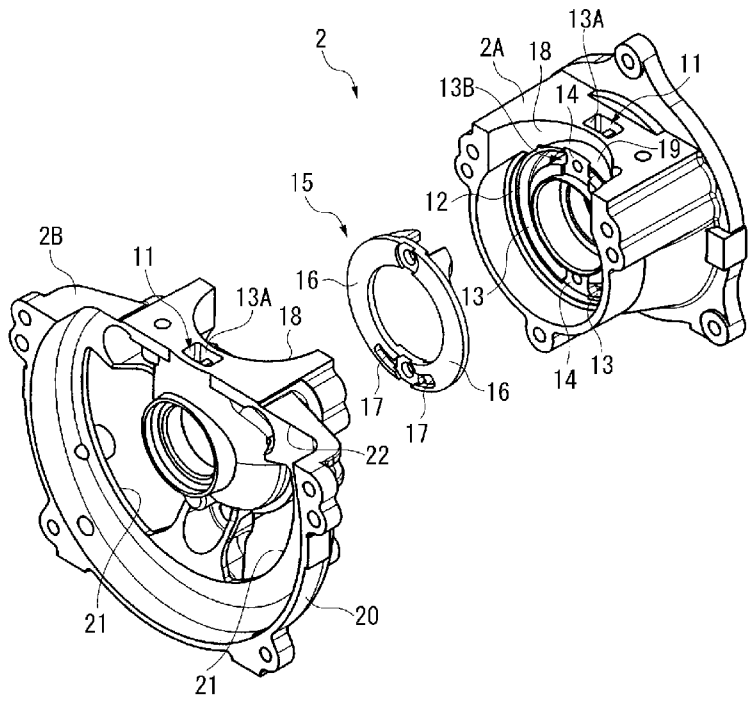
(54) Title: TWO-STROKE ENGINE

[Fig. 2]



(57) Abstract: A two-stroke engine (1) includes a crankcase (2), a cylinder (3) and a scavenging passage (11) extending through the crankcase (2) and the cylinder (3). The crankcase (2) includes a side wall (12) penetrated by a crankshaft (5). The side wall (12) includes a circular groove-shaped portion (13) that is extended along a rotation direction of the crankshaft (5) and is concaved in a direction of the crank axis. The groove-shaped portion (13) is covered by a lid (15) having a closure (16) to define the scavenging passage (11).

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Description

Title of Invention: TWO-STROKE ENGINE

Technical Field

[0001] The present invention relates to a two-stroke engine, and more particularly to improvement in a scavenging passage of the two-stroke engine.

Background Art

[0002] There has traditionally been known such a technique to reduce a scavenging speed at which air-fuel mixture is fed from a crankcase to a cylinder through a scavenging passage in a two-stroke engine, thereby reducing an amount of the air-fuel mixture to be mixed with exhaust gas in a course of a scavenging process to prevent blow-by of fuel components (Patent Literature 1).

[0003] In the two-stroke engine disclosed in Patent Literature 1, the crankcase includes an opening on a flat side wall penetrated by a crankshaft, i.e., a side wall to be attached with bearings for supporting the crankshaft. By gradually opening and closing the opening by a rotatable crankweb, the scavenging speed of the air-fuel mixture is reduced.

Citation List

Patent Literature

[0004] PLT 1:JP-A-2001-12249

Summary of Invention

Technical Problem

[0005] In Patent Literature 1, the opening on the side wall is directly communicated with the scavenging passage. Such a scavenging passage is bulged from an outer surface of the crankcase, which causes the following problems.

[0006] On an exterior of the crankcase, a cooling fan for cooling an engine is installed to an end of the crankshaft projecting from the crankcase. However, when the scavenging passage largely bulges from the crankcase, a flow of the cooling air sucked by the cooling fan is impeded to lower cooling efficiency of the engine.

On the other hand, in order not to impede the flow of the cooling air, a large-sized cooling fan and a fan housing for such a large-sized cooling fan are required, which prevents downsizing of the engine.

[0007] In Patent Literature 1, the crankweb is used as an opening/closing valve for the opening by disposing the opening and the crankweb closely to each other. However, since the crankweb is also located closely to the side wall in a large area, liquefied fuel components intervening in a gap between the side wall and the crankweb may enter the opening in accordance with a rotation of the crankweb, so that blow-by of the fuel

components may not be sufficiently restrained.

[0008] An object of the invention is to provide a two-stroke engine capable of reliably restraining blow-by of fuel components without impeding a cooling air flow and a size reduction of the engine.

Solution to Problem

[0009] A two-stroke engine according to an aspect of the invention includes: a crankcase; a cylinder; and a scavenging passage extending through the crankcase and the cylinder, in which the crankcase includes a side wall penetrated by a crankshaft, the side wall including a circular groove-shaped portion that is extended along a rotation direction of the crankshaft and is concaved in a direction of a crank axis, the groove-shaped portion being covered by a lid having a closure and defining the scavenging passage.

[0010] According to the above aspect of the invention, by forming the scavenging passage including the groove-shaped portion provided on the side wall of the crankshaft, the scavenging passage is much longer than typical one. Accordingly, flow resistance in the scavenging passage can be increased and a flow speed of an air-fuel mixture supplied from the crankcase to the cylinder through the scavenging passage can be sufficiently reduced. Consequently, at the reduced flow speed of the air-fuel mixture, an amount of the air-fuel mixture blowing into an exhaust port is also reduced during a course from when a piston descends in an explosion process to open a scavenging port to when the piston ascends in a compression process to close the scavenging port, thereby reliably preventing blow-by of fuel components.

Since the arrangement of the invention does not require a typical bulging portion for ensuring the scavenging passage, the cooling air can smoothly flow and downsizing of the engine can be promoted.

[0011] The two-stroke engine according to the above aspect of the invention is a stratified scavenging engine in which leading air is fed into the scavenging passage.

Since the two-stroke engine is a stratified scavenging engine, leading air is fed in the scavenging passage in advance and, in a scavenging process, the leading air is mixed with exhaust gas before the air-fuel mixture is mixed with exhaust gas. With this arrangement, since the scavenging passage is lengthened by the groove-shaped portion, a greater amount of the leading air can be fed in the groove-shaped portion, thereby further reducing blow-by of the fuel components. Moreover, with this arrangement, when the leading air is fed, the leading air and the air-fuel mixture are less likely to be mixed and a further stratified scavenging can be expected.

[0012] In the two-stroke engine according to the above aspect of the invention, the groove-shaped portion includes a pair of groove-shaped portions that are opposed to each other by interposing the crank axis.

When the groove-shaped portions are provided, since the flow speed of the air-fuel mixture in the groove-shaped portions decreases, a supply of the air-fuel mixture to the cylinder through may become insufficient. However, with this arrangement, since the air-fuel mixture is supplied through the pair of the groove-shaped portions, a total cross-sectional area of a flow path for supplying the air-fuel mixture is enlarged, so that the supply of the air-fuel mixture can be sufficiently obtained to prevent large reduction of engine output.

[0013] In the two-stroke engine according to the above aspect of the invention, an end of one of the pair of the groove-shaped portions is communicated with an end of the other of the pair of the groove-shaped portions through a communication portion provided near a joint surface of the crankcase with the cylinder, and the communication portion is open to the cylinder at a communication opening provided on the joint surface.

With this arrangement, since the pair of the groove-shaped portions is communicated with each other through the communication portion, the number of the communication opening to be provided does not need to be equal to the number of the groove-shaped portions. Accordingly, an arrangement of the joint surface between the crankcase and the cylinder can be simplified.

[0014] In the two-stroke engine according to the above aspect of the invention, the lid is ring-shaped continuously in a circumferential direction and includes a scavenging passage opening that communicates an interior of the groove-shaped portions and an interior of the crankcase. Since the lid is ring-shaped, favorable handleability of the lid is obtained and operability when the lid is installed into the crankcase can be enhanced.

Brief Description of Drawings

[0015] [fig.1]Fig. 1 is a partially-sectioned perspective view showing a structure of a stratified scavenging two-stroke engine according to a first exemplary embodiment of the invention.

[fig.2]Fig. 2 is an exploded perspective view of a crankcase according to the above exemplary embodiment.

[fig.3]Fig. 3 is a front view showing one of crankcase bodies of the crankcase.

[fig.4]Fig. 4 is a plan view of the crankcase body.

[fig.5]Fig. 5 is a cross sectional view of the crankcase body and a cross sectional view taken along V-V line.

[fig.6]Fig. 6 is a front view of a lid constituting the crankcase body.

[fig.7]Fig. 7 is a plan view of the lid.

[fig.8]Fig. 8 is a perspective view showing a second exemplary embodiment of the invention.

[fig.9]Fig. 9 schematically shows a primary portion according to a third exemplary em-

bodiment of the invention.

[fig.10]Fig. 10 schematically shows a primary portion according to a fourth exemplary embodiment of the invention.

[fig.11]Fig. 11 schematically shows a primary portion according to a fifth exemplary embodiment of the invention.

Description of Embodiments

[0016] First Exemplary Embodiment

A first exemplary embodiment of the invention will be described below with reference to the drawings. In a below-described second exemplary embodiment and subsequent exemplary embodiments, the same reference numerals will be attached to portions and members identical to or functionally similar to those in the first exemplary embodiment so as to omit or simplify the explanation thereof.

[0017] A stratified scavenging two-stroke engine 1 shown in Fig. 1 includes: a crankcase 2 composed of halved-type crankcase bodies 2A and 2B; a cylinder 3 fixed on the crankcase 2 with a bolt; a piston 4 housed in the cylinder in a vertically-slidable manner; and a crankshaft 5 coupled with the piston 4 through a con rod and pivotally supported by the crankcase 2 through bearings. In the engine 1, a carburetor (not shown), serving as an auxiliary machine, is attached on a side of the cylinder 3 through an insulator. An air clear is attached to the carburetor.

[0018] In Fig. 1, the cylinder 3 includes: an intake port 6, a scavenging port 7, an exhaust port 8 and a pair of air-supplying ports 9. Among these ports, the intake port 6 is connected with an air-fuel passage of the insulator made of resin. The air-supplying port 9 is connected with an air passage of the insulator. The scavenging port 7 is formed by a die that is radially removed from the cylinder. A space formed by the die provides a part of a scavenging passage 11, which is covered by a cover 3A from outside.

[0019] A pair of recesses 10 is formed on an outer circumference of the piston 4 (only one of the recesses 10 is shown). When the piston 4 is lifted, the scavenging port 7 of the cylinder 3 and the air-supplying port 9 thereof are communicated through the recess 10. With this arrangement, the leading air supplied through an air passage of the insulator is fed from the air-supplying port 9 to the scavenging passage 11 through the recess 10 by using negative pressure in the crankcase 2. In other words, the piston 4 works as a valve for supplying the leading air into the scavenging passage 11 at a predetermined timing.

[0020] In Fig. 2, the crankcase 2 is provided with scavenging passages that are in communication with scavenging passages on the cylinder 3. The scavenging passages define the entire scavenging passages 11. The scavenging passages 11 are provided on both

sides of the cylinder axis.

[0021] The crankcase body 2A will be described below. In the crankcase body 2A, groove-shaped portions 13 are respectively formed on both left and right sides of a flat side wall 12 that is orthogonal to a crank axis of the crankshaft 5, in other words, a side wall 12 to which bearings for supporting the crankshaft 5 are attached. The circular groove-shaped portions 13 are concaved along a rotation direction of the crankshaft 5 and in a direction of the crank axis. The scavenging passages 11 include the groove-shaped portions 13. Ends of the groove-shaped portions 13 near the cylinder 3 are communicated with each other through a below-described communication portion provided near a joint surface of the crankcase 2 with the cylinder 3. The communication portion is open to the cylinder 3 at a communication opening 13A provided on the joint surface.

[0022] At a top and a bottom of the side wall 12 of the crankcase body 2A, attachment portions 14 are provided at positions interposed between the ends of the groove-shaped portions 13. A screw (not shown) is screwed into each of the attachment portions 14 for attaching a ring-shaped lid 15.

[0023] The lid 15 is provided with a pair of closures 16 covering the groove-shaped portions 13. Insert holes 15A into which the screw is inserted are formed at positions interposed between ends of the respective closures 16. In each of the closures 16, a scavenging passage opening 17 is formed at a position corresponding to a lower end of the groove-shaped portions 13. When the lid 15 is installed to cover the groove-shaped portions 13, interiors of the groove-shaped portions 13 and crankcase 2 are communicated with each other through the scavenging passage opening 17. In other words, the groove-shaped portions 13 are mostly covered by the closures 16 except for the small scavenging passage openings 17. A series of long scavenging passages 11 include such a covered portion.

[0024] The crankcase body 2A is attached with a recoil starter (not shown) to be used for starting the engine 1 in this exemplary embodiment in which the engine 1 is used in portable working machines such as brushcutters, chainsaws, and blowers. On the other hand, the crankshaft 5 protruding from the crankcase body 2B is coupled with a centrifugal clutch constituting a power transmission mechanism to transmit power to a long shaft on an output-side of the centrifugal clutch. A nylon cutter or a disc-shaped tip-saw is attached to an end of the long shaft through a gear mechanism such as a bevel gear.

[0025] The crankcase body 2B will be described below with reference to Figs 3 to 5. The crankcase body 2B includes the side wall 12 similar to that of the crankcase body 2A. A pair of the groove-shaped portions 13 is similarly formed on the side wall 12. The lid 15 is attached to the groove-shaped portions 13 by a screw.

[0026] Herein, the groove-shaped portions 13 will be described in more detail. As shown in Fig. 3, the pair of the groove-shaped portions 13 extends substantially along a half of a circumference of the crankshaft 5 in the rotation direction of the crankshaft 5 while being opposed to each other by interposing the crank axis. A depth of each of the groove-shaped portions 13 from a front surface of the side wall 12 stays substantially constant except for a depth thereof near the communication opening 13A shown on an upper side in Fig. 3. A communication portion 13B is mortar-shaped in a planar view in a manner such that the groove-shaped portions 13 are gradually deepened near the communication opening 13A toward an upper side (toward the cylinder 3) as shown in Fig. 4 (see dotted lines) and Fig. 5 (see a left side from the center). Ends of the groove-shaped portions 13 near the cylinder 3 are communicated with each other through the communication portion 13B. The communication portion 13B is open to the cylinder 3 through the communication opening 13A at a deeper position.

[0027] A fitting opening 18 to which a skirt 3B of the cylinder 3 (Fig. 1) is fitted is formed on an upper part of the crankcase body 2B (and similarly on the crankcase body 2A). An eave 19 protrudes in the fitting opening 18 from a position corresponding to an upper part of each of the groove-shaped portions 13 (see Fig. 2 for the eave 19 of the crankcase body 2A). An edge surface of the eave 19 on the protruding side is flush with the side wall 12. Due to presence of the eave 19, the mortar-shaped communication portion 13B is not exposed in the communication opening 13A to the upper side and the entire groove-shaped portions 13 are reliably covered by the lid 15.

[0028] The lid 15 is made of resin in Figs. 6 and 7. A flange 15B corresponding to the communication portion 13B of the groove-shaped portions 13 protrudes from an upper portion of each of the closures 16 in the lid 15 toward the depth side of the communication portion 13B. The flange 15B is fitted to the communication portion 13B. Also the flange 15B protrudes into a space in the communication portion 13B to substantially equalize a cross section of a flow path of the groove-shaped portions 13 along the whole length of the groove-shaped portions 13.

[0029] In each of the closures 16, each of the scavenging passage openings 17 correspondingly provided at the ends of the groove-shaped portions 13 is formed at the same width in the rotation direction of the crankshaft 5 while being open only at the ends of the groove-shaped portions 13. Even when a crankweb (not shown) integrated with the crankshaft 5 faces the scavenging passage openings 17, the crankweb does not work as an opening/closing valve of the scavenging passage openings 17. The scavenging passage openings 17 are constantly communicated with the interior of the crankcase 2. In other words, a gap enough to allow the crankweb not to work as the opening/closing valve exists between the scavenging passage openings 17 and the crankweb.

[0030] As described above, the groove-shaped portion 13 which defines a part of the scavenging passages 11 is formed by hollowing a thick portion originally provided for attaching bearings for supporting the crankshaft 5 in the crankcases 2A and 2B. The groove-shaped portion 13 is not formed by bulging the outer surface of the crankcase and hollowing the bulging portion to provide the scavenging passage as described in the above Patent Literature 1. In other words, the thick portion around the bearings has conventionally no components. However, in the invention, the thick portion is utilized to form the longer scavenging passages 11 including the groove-shaped portions 13.

[0031] With use of the longer scavenging passages 11, flow resistance increases in the scavenging passages 11. Accordingly, a flow speed of the air-fuel mixture in the scavenging passages 11 is decreased, thereby preventing blow-by of the fuel components in the air-fuel mixture. At this time, since the scavenging passages 11, especially the groove-shaped portions 13 are formed with a narrow width at a limited portion of the thick portion, the flow resistance can be sufficiently obtained to more reliably prevent blow-by of the fuel components. Further, the stratified scavenging engine 1 according to this exemplary embodiment can feed more leading air in the longer scavenging passages 11, thereby further preventing blow-by of the fuel components.

[0032] A cooling fan (not shown) for cooling the engine is attached to the end of the crankshaft 5 exposed from the crankcase body 2B. Accordingly, a fan housing 20 enclosing the outer circumference of the cooling fan is integrally provided in the crankcase body 2B. The fan housing 20 is penetrated by a plurality of ventilation openings 21. Cooling air sucked from outside by the cooling fan is fed toward the crankcase 2 and the cylinder 3 through the ventilation openings 21 and a cut portion 22 formed thereabove, thereby cooling the entire engine 1.

[0033] In this exemplary embodiment without a dedicated bulging portion for forming the scavenging passages in the crankcase 2, the ventilation openings 21 are not covered by the bulging portion and ventilation of cooling air is not blocked by the bulging portion. Moreover, since the bulging portion is not provided, the cooling air after passing the ventilation openings 21 is also smoothly flowed, which entails no block of the cooling air flow. Consequently, in order to secure the cooling air flow and reliably cool the engine, there is no need to increase a size of the fan housing 20 and an opening area of each of the ventilation openings 21 provided to the fan housing 20 or to use a large-sized cooling fan, which promotes downsizing of the engine 1.

[0034] Second Exemplary Embodiment

In a second exemplary embodiment of the invention as shown in Fig. 8, a conventional two-stroke engine, which is not a stratified scavenging one, is shown. Accordingly, the engine 1 of this exemplary embodiment does not include the air-

supplying port 9 and the recesses 10 provided in the piston 4 as described in the first exemplary embodiment. Other arrangements are the same as those in the first exemplary embodiment.

This exemplary embodiment can also provide the same advantages as the first exemplary embodiment except for the advantages inherent in the stratified scavenging engine, thus achieving an object of the invention.

[0035] Third Exemplary Embodiment

Fig. 9 exemplarily shows the groove-shaped portions 13 formed in a substantially-circular shape according to a third exemplary embodiment of the invention. In this exemplary embodiment, a single groove-shaped portion 13 longer than that in the first exemplary embodiment is formed around the crank axis. Accordingly, both ends of the groove-shaped portion 13 are located on an upper side of the crankcase 2. The attachment portion and the like (not shown) for attaching the lid are provided at an appropriate position in the groove-shaped portion 13 in a manner not to choke the groove-shaped portion 13 (the same arrangement is applied to fourth and fifth exemplary embodiments). A single closure is provided on the lid. A single scavenging passage opening 17 is provided on an upper side (end) of the closure. Solid arrows show an air-fuel mixture flow.

According to this exemplary embodiment, since the length of the scavenging passages 11 including the groove-shaped portion 13 can be further extended, flow resistance in the scavenging passages 11 can be more increased to reduce the flow speed of the air-fuel mixture.

[0036] Fourth Exemplary Embodiment

Fig. 10 exemplarily shows a fourth exemplary embodiment of the invention in which partitions 31 are provided in the groove-shaped portions 13 having the same width as those in the first exemplary embodiment along a communicating direction. Moreover, a plurality of partitions 32 (three partitions in this exemplary embodiment) are provided not only in the scavenging passages in the crankcase 2 but also in the scavenging passages in the cylinder 3.

According to this exemplary embodiment, since the entire scavenging passages 11 are divided by the partitions 31 and 32, an area of wall surfaces in the flow path can be increased, thereby increasing flow resistance.

[0037] Fifth Exemplary Embodiment

Fig. 11 exemplarily shows a fifth embodiment of the invention in which a pair of groove-shaped portions 13, one of which is prolonged and the other is shortened. In this exemplary embodiment, a partition 32 is provided in the scavenging passage in the cylinder 3. In an upstream side of the scavenging passages, the leading air (dashed-line arrow) is to flow into a first passage 33 divided by the partition 32 and a second

passage 34 is used only for the air-fuel mixture. The first passage 33 corresponds to the shorter groove-shaped portion 13 and the second passage 34 corresponds to the longer groove-shaped portion 13.

[0038] According to this exemplary embodiment, flow resistance of the shorter groove-shaped portion 13 is smaller than that of the longer groove-shaped portion 13. Since the leading air flows into the first passage 33 corresponding to the shorter groove-shaped portion 13, a scavenging speed of the leading air can be made larger than that of the air-fuel mixture supplied through the second passage. Accordingly, the leading air can be reliably used for scavenging before the air-fuel mixture is used, which effectively prevents blow-by of the fuel components.

[0039] The invention is not limited to the exemplary embodiments described above, but includes modifications as long as an object of the invention can be achieved. In the above exemplary embodiments, the stratified scavenging two-stroke engine 1 of a piston valve type is described. However, the invention may be applied to, for instance, a stratified scavenging engine of a reed valve type. Specifically, without the air-supplying port opening into the cylinder or without the recess of the piston, the air passage of the insulator and the scavenging passage of the cylinder may be communicated through the air passage of the cylinder and a reed valve may be provided in the air passage of the cylinder.

Industrial Applicability

[0040] The invention is applicable as a two-stroke engine mounted on a portable work machinery such as a brushcutter, a chain saw, an engine blower or a hedge trimmer.

Reference Sings List

[0041] 1...two-stroke engine
2...crankcase
3...cylinder
5...crankshaft
11...scavenging passage
12...side wall
13...groove-shaped portion
13A...communication opening
13B...communication portion
15...lid
16...closure
17...scavenging passage opening

Claims

[Claim 1] A two-stroke engine comprising:
a crankcase;
a cylinder; and
a scavenging passage extending through the crankcase and the cylinder, characterized in that
the crankcase includes a side wall penetrated by a crankshaft,
the side wall including a circular groove-shaped portion that is extended along a rotation direction of the crankshaft and is concaved in a direction of a crank axis of the crankshaft, and
the groove-shaped portion being covered by a lid with a closure and defining the scavenging passage.

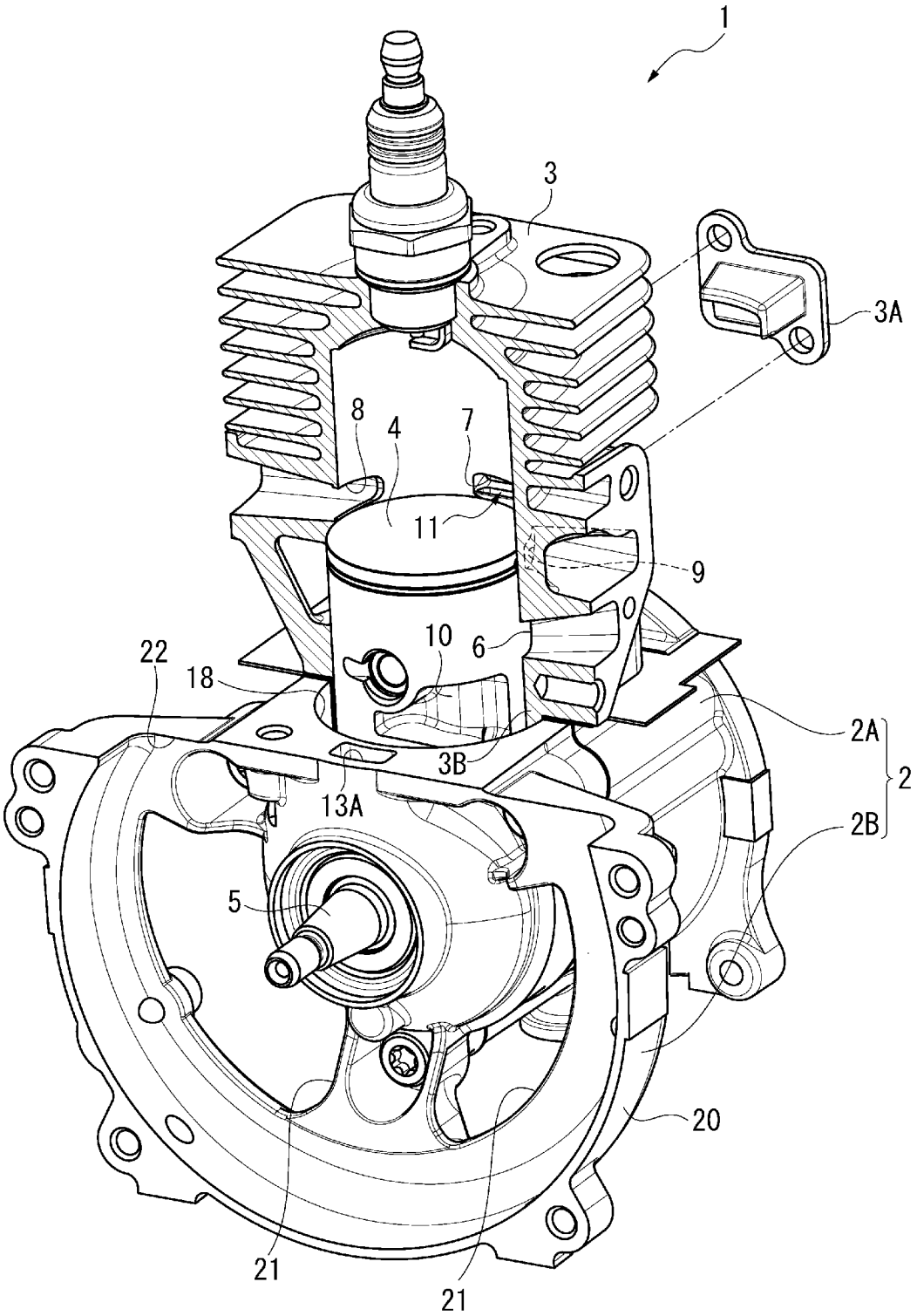
[Claim 2] The two-stroke engine according to claim 1, wherein
the engine is a stratified scavenging engine in which leading air is fed into the scavenging passage.

[Claim 3] The two-stroke engine according to claim 1 or 2, wherein
the groove-shaped portion includes a pair of groove-shaped portions that are opposed to each other by interposing the crank axis.

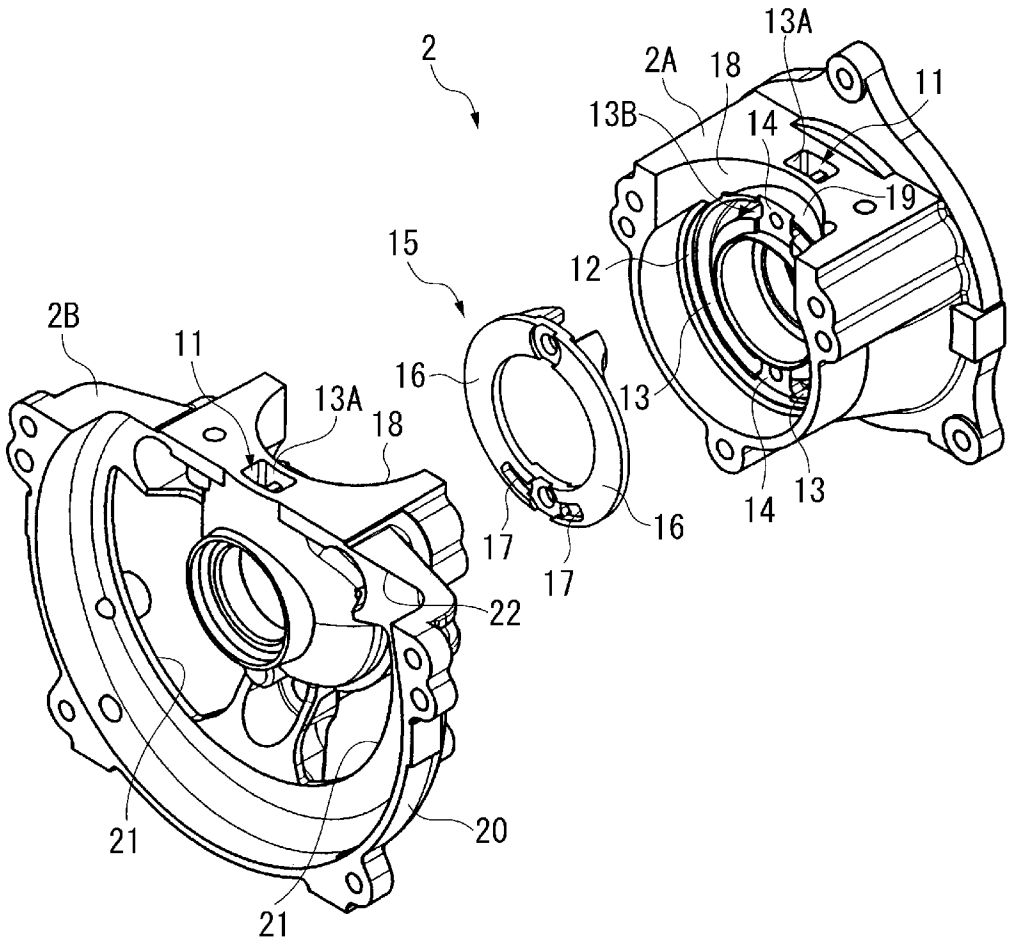
[Claim 4] The two-stroke engine according to claim 3, wherein
an end of one of the pair of the groove-shaped portions is communicated with an end of the other of the pair of the groove-shaped portions through a communication portion provided near a joint surface of the crankcase with the cylinder, and
the communication portion is open to the cylinder at a communication opening provided on the joint surface.

[Claim 5] The two-stroke engine according to any one of claims 1 to 4, wherein
the lid is ring-shaped continuously in a circumferential direction and includes a scavenging passage opening that communicates an interior of the groove-shaped portions and an interior of the crankcase.

[Fig. 1]



[Fig. 2]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13A
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13B
14
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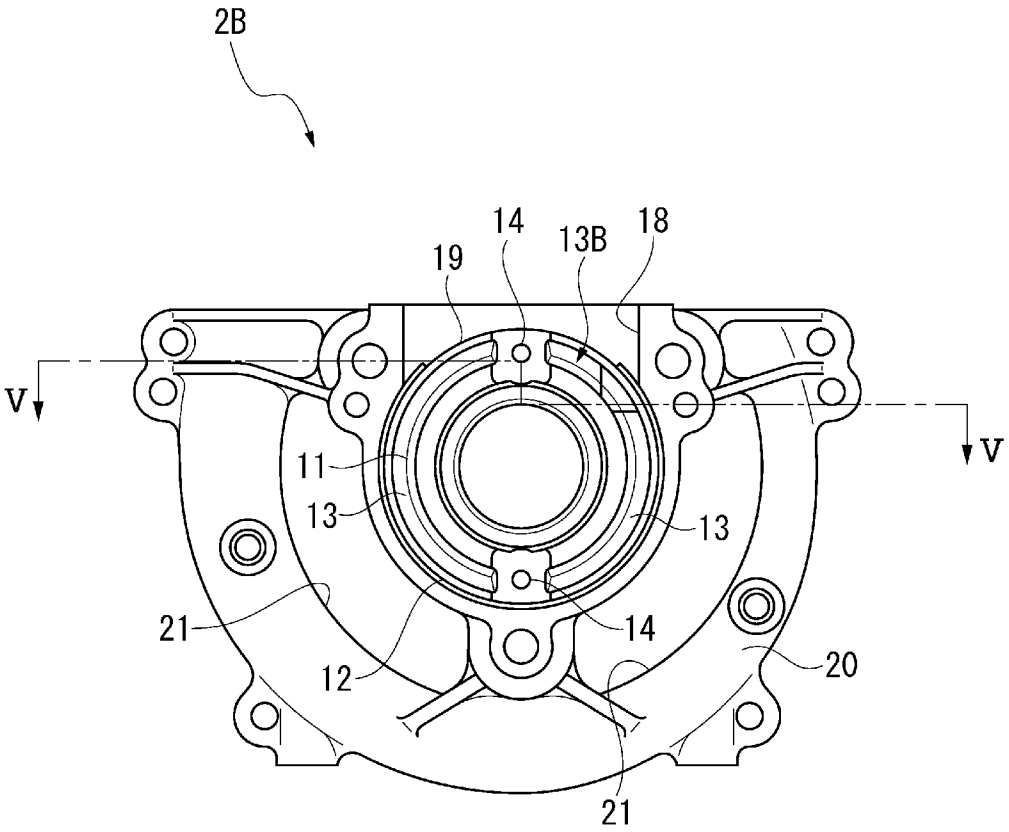
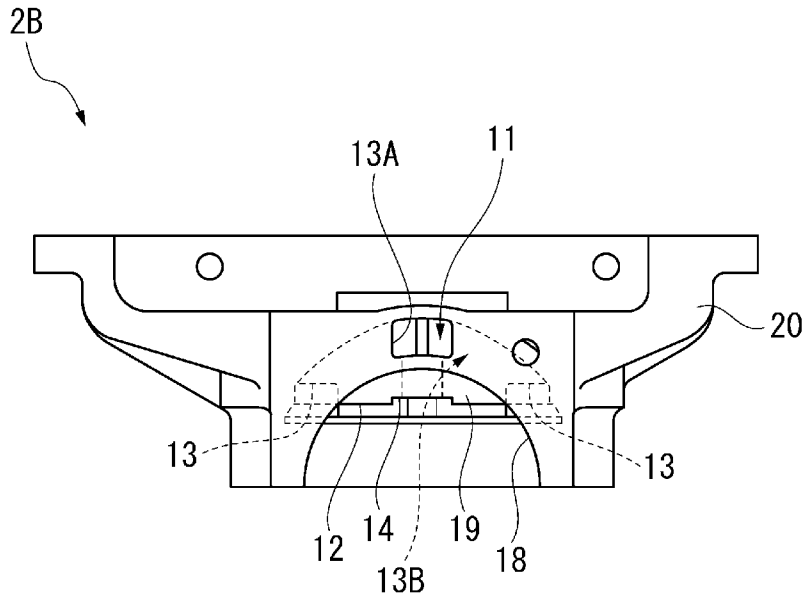
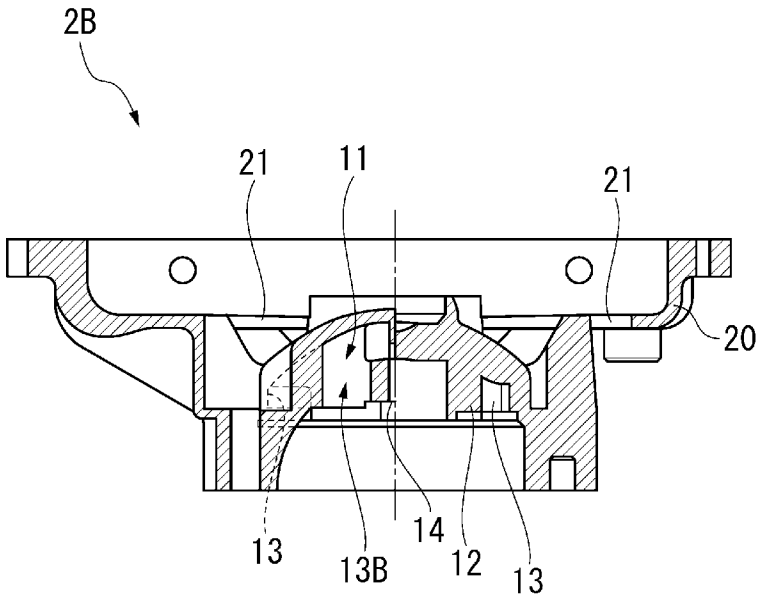
[Fig. 3]



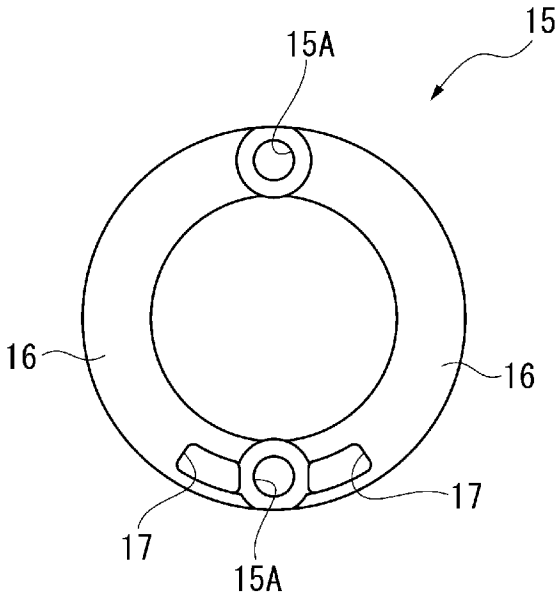
[Fig. 4]



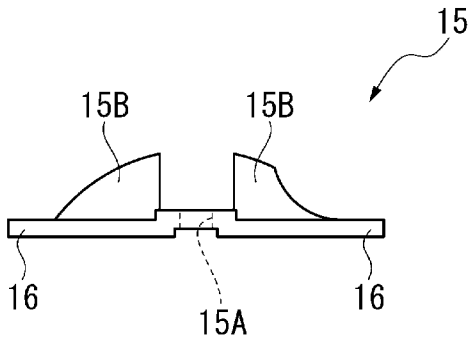
[Fig. 5]



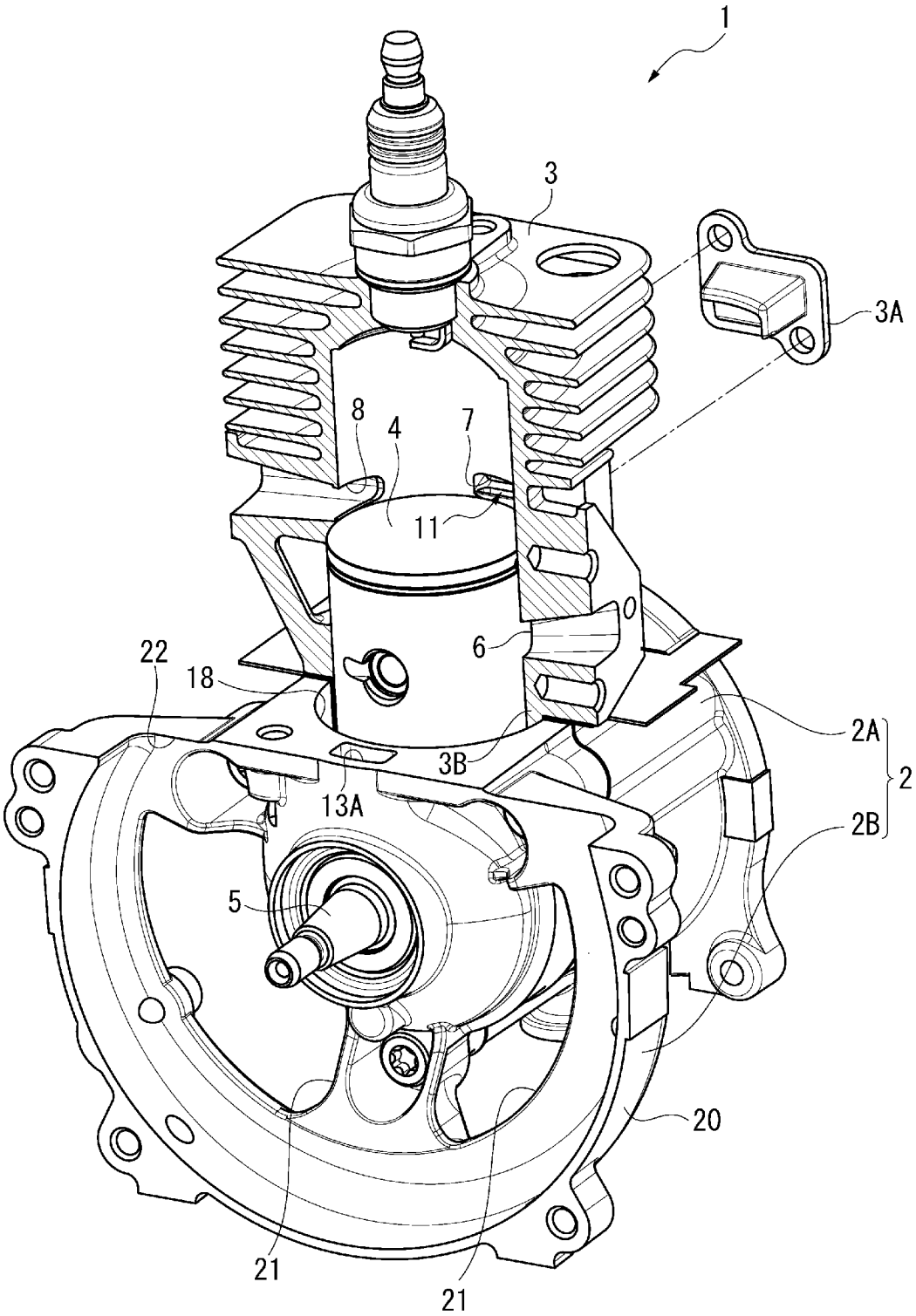
[Fig. 6]



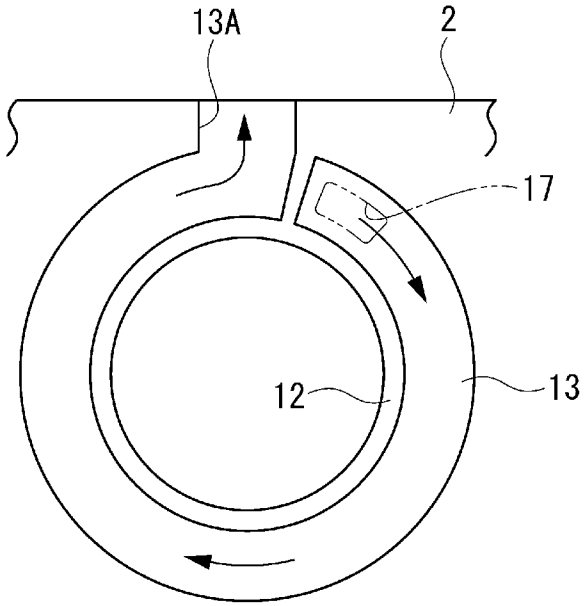
[Fig. 7]



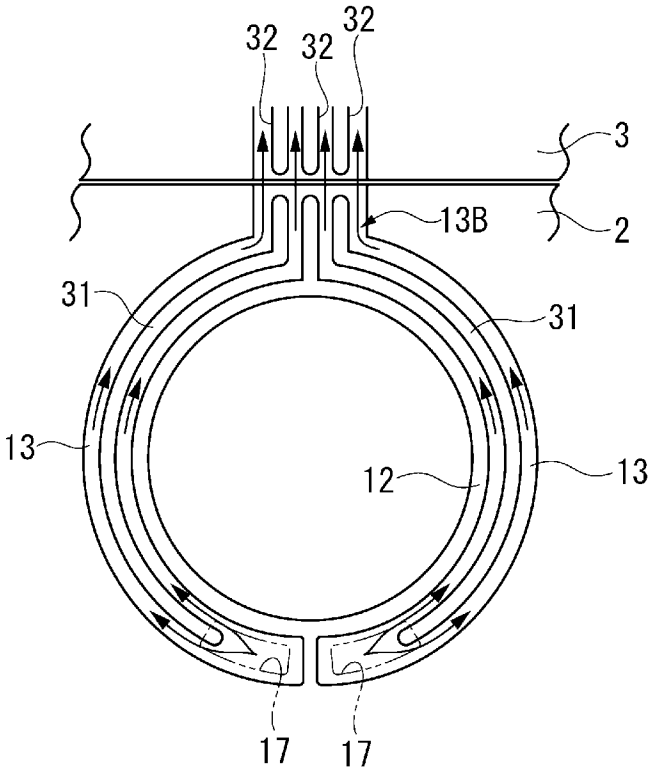
[Fig. 8]



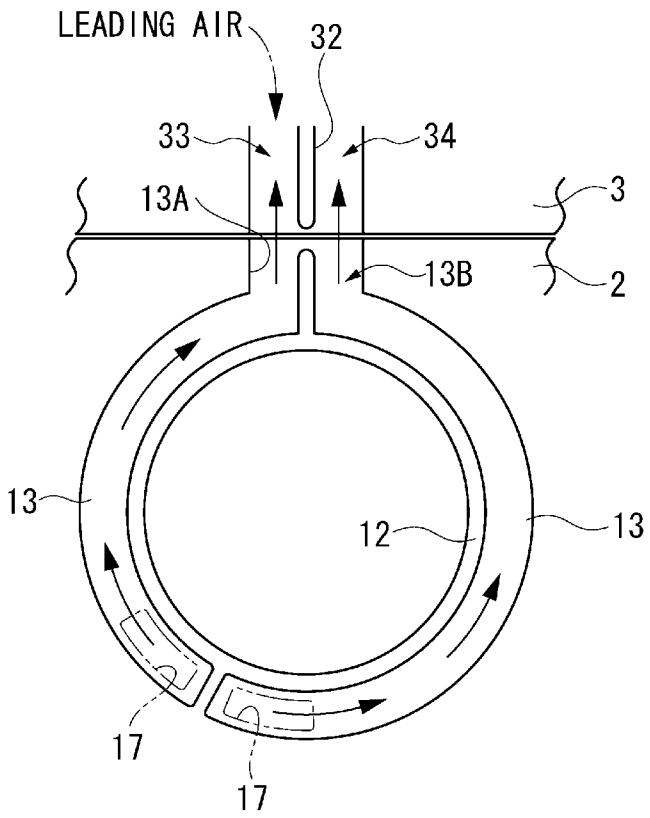
[Fig. 9]



[Fig. 10]



[Fig. 11]



INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2010/007617

A. CLASSIFICATION OF SUBJECT MATTER
INV. F02B25/14 F02F3/24 F02F7/00 F02M35/10 F02B33/02
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)
F02B F02F F02M

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

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X	US 4 204 488 A (ONISHI SIGERU [JP]) 27 May 1980 (1980-05-27) column 3, line 1 - line 68; figures 2,3	1-5
A	US 4 398 509 A (OFFENSTADT ERIC [FR] ET AL) 16 August 1983 (1983-08-16) figure 9	1
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A	FR 2 376 296 A1 (TOYOTA MOTOR CO LTD [JP]) 28 July 1978 (1978-07-28) figures 10,12	1

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
25 August 2011	02/09/2011

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	de Mateo Garcia, I

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INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2010/007617

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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