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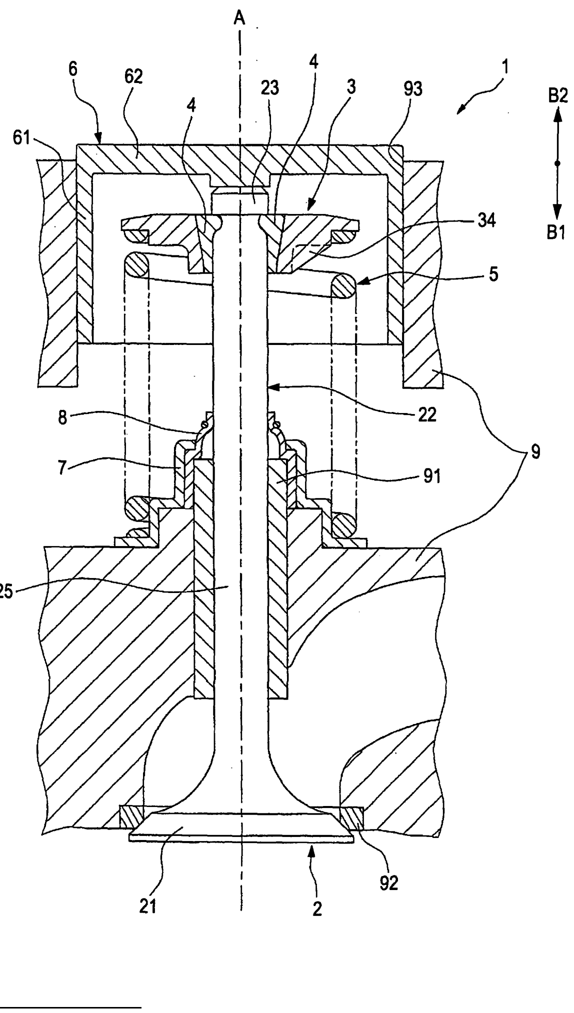
(54) Valve train for internal combustion engine

(57) A valve train (1) includes a valve (2), a spring retainer (3), a pair of cotters (4), a valve spring (5), and a valve lifter (6). The valve (2) includes a stem (22) supported by a cylinder head (9) movably in an axial direction, and a valve head (21) provided at an end portion of the stem (22) at a B1 side. The spring retainer (3) is mounted at an end portion of the stem (22) at a B2 side via the cotters (4). The valve spring (5) is arranged between the cylinder head (9) and the spring retainer (3). The valve lifter (6) is in contact with a head portion (23) of the stem (22). The spring retainer (3) includes a supporting portion (35) that supports an end portion of the valve spring (5), and a rib (34) that guides the end portion to the supporting portion (35).

FIG. 1



EP 2 034 140 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a valve train for an internal combustion engine.

2. Description of the Related Art

[0002] Conventionally, an internal combustion engine has a valve train for intake and exhaust in a combustion chamber. Such a valve train mainly includes a valve, a spring retainer, a pair of cotters, a valve spring, and a valve lifter.

[0003] The valve includes a stem movably supported by a cylinder head, and a valve head provided at an end of the stem. The spring retainer is mounted at another end of the stem via the pair of cotters. A valve spring seat is fixed to the cylinder head. The valve spring is arranged between the spring retainer and the valve spring seat. The valve lifter is provided at an end portion of the valve spring so as to cover the end portion of the valve spring and the spring retainer (for example, see Japanese Unexamined Patent Application Publication No. 2004-27978).

[0004] With the conventional valve train, an inner diameter of the valve lifter is larger than an outer diameter of the valve spring, and hence, a clearance is formed between the valve lifter and the valve spring in a radial direction. Accordingly, the valve lifter can be placed at a predetermined position, for example, even when the end portion of the valve spring is deviated from the spring retainer in the radial direction during assembly. In this case, since the end portion of the valve spring and the spring retainer are covered with the valve lifter, it is difficult to recognize whether the end portion of the valve spring is deviated from the spring retainer or not, from the outside. Thus, a product with the valve spring defectively assembled may be shipped.

SUMMARY OF THE INVENTION

[0005] Accordingly, it is an object of the present invention to provide a valve train for an internal combustion engine capable of preventing defective assembly of parts.

[0006] A valve train for an internal combustion engine according to an aspect of the present invention includes a valve, a supporting member, a valve spring, and a valve lifter. The valve includes a stem supported by a cylinder head movably in an axial direction, and a valve head provided at a first end portion of the stem. The supporting member is mounted at a second end portion of the stem. The valve spring is arranged between the cylinder head and the supporting member. The valve lifter provided to be in contact with the second end portion of the stem. The supporting member includes a supporting portion that supports an end portion of the valve spring. The supporting portion includes a circular contact surface that comes into contact with the end portion of the valve spring in the axial direction, and a restriction surface arranged at the inside of the contact surface in a radial direction along a direction orthogonal to the axial direction, the restriction surface being capable of coming into contact with the end portion of the valve spring. At least one of the supporting member and the valve lifter includes a guide portion that guides the end portion of the valve spring to the supporting portion.

[0007] With the valve train, since the end portion of the valve spring is guided to the supporting portion by the guide portion, the end portion of the valve spring can be guided to a predetermined position even when the position of the valve spring is deviated from the supporting member during assembly. Accordingly, the defective assembly of parts can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

Fig. 1 is a partial cross section showing a valve train according to a first embodiment of the present invention;

Fig. 2 is a partial cross section showing a spring retainer and its periphery according to the first embodiment;

Fig. 3A is a plan view showing the spring retainer according to the first embodiment;

Fig. 3B is a cross section showing the spring retainer according to the first embodiment;

Fig. 4A is an example phase diagram showing the spring retainer during assembly according to the first embodiment;

Fig. 4B is an example phase diagram showing the spring retainer during assembly according to the first embodiment;

Fig. 5 is an example phase diagram showing the spring retainer during assembly according to the first embodiment;

Fig. 6 is a partial cross section showing a valve train according to a second embodiment of the present invention;

Fig. 7 is a partial cross section showing a valve lifter and its periphery according to the second embodiment;

Fig. 8A is an example phase diagram showing the valve lifter during assembly according to the second embodiment;

Fig. 8B is an example phase diagram showing the valve lifter during assembly according to the second embodiment;

Fig. 9 is an example phase diagram showing the valve lifter during assembly according to the second embodiment;

Fig. 10A is a plan view showing a spring retainer according to a modification;

Fig. 10B is a cross section showing the spring retainer according to the modification;

Fig. 11A is a plan view showing a spring retainer according to another modification;

Fig. 11B is a cross section showing the spring retainer according to the modification;

Fig. 12A is a cross section showing a spring retainer according to still another modification; and

Fig. 12B is a cross section showing the spring retainer according to yet another modification.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] Hereinafter, embodiments of the present invention are described below with reference to the attached drawings.

First Embodiment

General Configuration of Valve Train

[0010] A valve train 1 according to a first embodiment of the present invention is described with reference to Fig. 1. Fig. 1 is a partial cross section of the valve train 1.

[0011] Referring to Fig. 1, the valve train 1 mainly includes a valve 2, a spring retainer 3, a pair of cotters 4, a valve spring 5, and a valve lifter 6.

[0012] The valve 2 includes a stem 22 and a valve head 21. The stem 22 is movably supported by a cylinder head 9. The stem 22 is a rod-like portion having a central axis A, and includes a rod-like stem body 25, and a head portion 23 provided at an end portion of the stem body 25. The stem body 25 is supported by a cylindrical valve guide 91 fixed to the cylinder head 9, in a movable manner in a direction along the central axis A (hereinafter, referred to as an axial direction). The valve head 21 is provided at an end portion of the stem 22 at a B1 side in the axial direction (first end portion). The valve head 21 can come into contact with a valve seat 92 fixed to the cylinder head 9 in the axial direction. A valve spring seat 7 and an oil seal 8 are provided at an outer peripheral side of the stem 22.

[0013] The valve spring 5 is, for example, a coil spring, which is arranged at the outer peripheral side of the stem 22 so as to be compressed in the axial direction. In particular, an end portion of the valve spring 5 at the B1 side in the axial direction is supported by the valve spring seat 7. An end portion of the valve spring 5 at a B2 side in the axial direction is supported by the spring retainer 3 mounted at an end portion of the stem 22 at the B2 side in the axial direction (second end portion). The valve spring seat 7 and the spring retainer 3 restrict the movement of the valve spring 5 in a direction orthogonal to the central axis A (hereinafter, referred to as a radial direction). A central axis of the valve spring 5 is substantially aligned with the central axis A of the stem 22. The valve spring 5, which is initially in a compressed state, is arranged between the cylinder head 9 and the spring retainer 3. A spring force of the valve spring 5 causes the valve head 21 to be pressed to the valve seat 92 fixed to the cylinder head 9.

[0014] The valve lifter 6 is a member on which a cam fixed to a camshaft (not shown) slides. The valve lifter 6 covers an end portion of the valve spring 5 and the spring retainer 3. In particular, the valve lifter 6 includes a cylindrical portion 61 arranged at the outer peripheral side of the spring retainer 3, and a disk-like cap portion 62 provided at an end portion of the cylindrical portion 61 at the B2 side in the axial direction.

[0015] The valve lifter 6 is supported by the cylinder head 9 movably in the axial direction, and also supported by the valve 2 in the axial direction. In particular, the cylindrical portion 61 is inserted to a tappet hole 93 of the cylinder head 9. The cap portion 62 is in contact with the head portion 23 of the stem 22 in the axial direction. A clearance is provided between the cylindrical portion 61 and an end of the valve spring 5 in the radial direction.

Configurations of Spring Retainer and Peripheral Members thereof

[0016] The valve train 1 features a configuration of the spring retainer 3. Referring to Figs. 2, 3A, and 3B, the configurations of the spring retainer 3 and peripheral members thereof are described. Fig. 2 is a partial cross section showing the spring retainer 3 and its periphery. Figs. 3A and 3B are a plan view and a cross section of the spring retainer 3.

[0017] Referring to Fig. 2, the spring retainer 3 is a member to support the end portion of the valve spring 5 with respect to the valve 2. The spring retainer 3 is mounted at the end portion of the stem 22 at the B2 side in the axial direction via the pair of cotters 4.

[0018] The pair of cotters 4 include two semi-cylinder members, which are mounted at the B1 side in the axial direction of the head portion 23 so as to sandwich the stem body 25. The cotters 4 include protrusions 41 protruding inward in the radial direction. The protrusions 41 are fitted into grooves 24 formed at the stem body 25 at the B2 side in the axial direction. Hence, the positions of the cotters 4 in the axial direction are determined with respect to the stem 22.

[0019] The spring retainer 3 is fitted onto outer peripheral portions of the pair of cotters 4. In particular, referring to Figs. 2, 3A, and 3B, the spring retainer 3 includes a cylindrical boss 31, a circular supporting portion 35 extending outward in the radial direction from the boss 31, and three ribs 34 (first ribs) functioning as a first guide portion.

[0020] Referring to Figs. 2, 3A, and 3B, the boss 31 includes a tapered hole 31a. The pair of cotters 4 are fitted into the hole 31a. The outer peripheral portions of the cotters 4 are tapered like the hole 31a. Hence, the movement of the spring retainer 3 to the B2 side in the axial direction relative to the cotters 4 is restricted. With the configurations, the position and angle of the spring retainer 3 in the axial direction can be determined with respect to the valve 2.

[0021] The supporting portion 35 includes a contact portion 32 that supports an end turn 51 (end portion) of the valve spring 5 in the axial direction, and a restriction portion 33 that supports the end turn 51 in the radial direction. The contact portion 32 is a circular portion for supporting the end turn 51 of the valve spring 5, and has a circular contact surface 32a that comes into contact with the end turn 51 in the axial direction. For example, the contact surface 32a is arranged in parallel to a plane orthogonal to the central axis A.

[0022] The restriction portion 33 is formed at the B1 side in the axial direction of the contact portion 32. The restriction portion 33 includes a restriction surface 33a capable of coming into contact with the end turn 51 in the radial direction, and a circular surface 33b directed to the B1 side in the axial direction. The restriction surface 33a is a peripheral surface perpendicular to the radial direction, and is arranged at the inside of the contact surface 32a in the radial direction. The restriction portion 33 restricts the movement in the radial direction of the end turn 51 of the valve spring 5 relative to the spring retainer 3. The contact surface 32a and the restriction surface 33a define a housing space S at the outer peripheral portion of the spring retainer 3. The housing space S houses the end turn 51.

[0023] The ribs 34 are plate portions extending outward from the boss 31 in the radial direction. For example, the ribs 34 are integrally formed with the boss 31 and the supporting portion 35. Referring to Fig. 3A, the three ribs 34 are arranged at even pitches around the central axis A. The ribs 34 are arranged at the B1 side in the axial direction of the restriction portion 33 so as to couple the boss 31 and the supporting portion 35. The ribs 34 are formed on the circular surface 33b.

[0024] Each of the ribs 34 has a guide surface 34a functioning as a first guide surface inclined toward the radial direction with respect to the central axis A. The guide surface 34a is a plane directed to the B1 side in the axial direction and to the outside in the radial direction. The guide surface 34a is formed such that the position thereof in the radial direction approaches the contact surface 32a and the restriction surface 33a, toward the B2 side in the axial direction. That is, the guide surface 34a is formed such that the position in the axial direction approaches the contact surface 32a and the restriction surface 33a, toward the outside in the radial direction (as being away from the central axis A).

[0025] In the view in the axial direction, the rib 34 extends from the boss 31 toward an inner peripheral edge of the contact surface 32a, toward the outside in the radial direction. In particular, the rib 34 extends from an end surface 31b of the boss 31 toward the contact surface 32a and the restriction surface 33a, toward the outside in the radial direction. An edge of the guide surface 34a at the inside in the radial direction substantially corresponds to an outer peripheral edge of the end surface 31b. An edge of the guide surface 34a at the outside in the radial direction substantially corresponds to an edge of the restriction surface 33a at the B1 side in the axial direction. Hence, the end surface 31b, the guide surface 34a, and the restriction surface 33a are continuously formed (connected with each other).

Assembly Procedure

[0026] In the valve train 1, since the spring retainer 3 includes the ribs 34, defective assembly of parts can be prevented. Here, an assembly procedure of the valve train 1 is described with reference to Figs. 1 through 5. Figs. 4A, 4B, and 5 show example phase diagrams of the spring retainer 3 during assembly.

[0027] Referring to Fig. 1, first, the stem 22 is inserted to the valve guide 91 of the cylinder head 9. The valve 2 is supported by a jig (not shown) from a combustion engine side so as to prevent the stem 22 from falling to the combustion engine side (in Fig. 1, B1 side in the axial direction). Then, the oil seal 8 and the valve spring seat 7 are fitted onto the stem 22, and the valve spring 5 is arranged on the valve spring seat 7.

[0028] Then, the spring retainer 3 is temporarily placed at the end portion of the valve spring 5. The pair of cotters 4 are inserted into the hole 31a of the spring retainer 3. The spring retainer 3 and the cotters 4 are pushed down to the B1 side in the axial direction with respect to the stem 22 until the protrusions 41 of the cotters 4 are fitted into the grooves 24 of the stem 22. After the protrusions 41 of the cotters 4 are fitted into the grooves 24, a pressing force to the spring retainer 3 is released. As a result, the spring retainer 3 is pushed up to the B2 side in the axial direction by a spring force of the valve spring 5, and hence, the tapered cotters 4 are fitted into the tapered hole 31a. As described above, the spring retainer 3 is positioned with respect to the valve 2 by the tapered cotters 4 and the spring force of the valve spring 5.

[0029] Further, the valve lifter 6 is fitted into the tappet hole 93. The valve lifter 6 is mounted at the spring retainer 3 and the end turn 51 of the valve spring 5. Then, the camshaft (not shown) is assembled with the cylinder head 9. Thus, the assembly of the valve train 1 is completed.

[0030] Herein, a case is assumed in which the spring retainer 3 is temporarily placed at the end turn 51 of the valve spring 5 with a deviation (Fig. 4A). In this case, the end turn 51 of the valve spring 5 is not fitted to the restriction portion 33, but comes into contact with the rib 34.

[0031] After the spring retainer 3 is temporarily placed, since the spring retainer 3 is pushed down with respect to the stem 22, a pressing force F1 to the B1 side in the axial direction acts on the spring retainer 3, and a force F2 to the outside in the radial direction acts on the end turn 51 via the guide surface 34a (Fig. 4A). As a result, the valve spring 5 is moved in the radial direction along the guide surface 34a of the rib 34 relative to the spring retainer 3 (or the spring retainer 3 is moved in the radial direction relative to the valve spring 5), and the end turn 51 is guided to the housing space S of the spring retainer 3. Accordingly, the end turn 51 is fitted to the restriction portion 33 (Fig. 4B). After the cotters 4 are mounted at the stem 22, when the pressing force F1 to the spring retainer 3 is released, the spring retainer 3 is positioned at a predetermined position with respect to the valve 2 by the cotters 4 and the spring force of the valve spring 5 (Fig. 5). Accordingly, the valve spring 5 is also arranged at the predetermined position with respect to the valve 2 and the spring retainer 3.

[0032] As described above, with the valve train 1, the valve spring 5 is guided to the predetermined position by the rib 34 with respect to the spring retainer 3. Accordingly, the defective assembly of parts such as the valve spring 5 and the spring retainer 3 can be prevented.

Features

[0033] Features of the valve train 1 are described below.

(1) As described above, with the valve train 1, the end turn 51 of the valve spring 5 is guided to the supporting portion 35 by the rib 34 (in particular, to the housing space S defined by the restriction portion 33 and the contact surface 32a) even when the end turn 51 is deviated from the spring retainer 3 during assembly. As a result, after the assembly is completed, the end turn 51 and the spring retainer 3 are arranged at the predetermined positions without a deviation.
Accordingly, with the valve train 1, the defective assembly of parts such as the valve spring 5 and the spring retainer 3 can be prevented.

(2) In the view in the axial direction, each rib 34 having the guide surface 34a extends from the boss 31 to the inner peripheral edge of the contact surface 32a, toward the outside in the radial direction. In particular, in the view in the axial direction, the rib 34 extends from the inner peripheral edge of the contact surface 32a, toward the inside in the radial direction. The edges of the three guide surfaces 34a at the outside in the radial direction substantially correspond to the edge of the restriction surface 33a.
As described above, since no additional plane or the like is provided between the guide surface 34a and the restriction surface 33a, and the guide surface 34a and the restriction surface 33a are continuously formed, the end turn 51 is reliably guided to the supporting portion 35 by the guide surface 34a.

(3) Each rib 34 has the guide surface 34a inclined toward the radial direction with respect to the central axis A of the stem 22. In particular, the guide surface 34a is formed such that the position thereof in the radial direction approaches the contact surface 32a, toward the B2 side in the axial direction. Accordingly, the pressing force F1 in the axial direction acting between the spring retainer 3 and the valve spring 5 is converted into the force F2 to the outside in the radial direction by the rib 34. Accordingly, the end turn 51 of the valve spring 5 can be guided to the predetermined position by the pressing force in the axial direction during assembly.

(4) The portion (guide portion) for guiding the end turn 51 of the valve spring 5 is defined by the plate-like ribs 34. Accordingly, an increase in weight of the spring retainer 3 can be minimized. Also, the ribs 34 can efficiently increase the strength of the spring retainer 3.

[0034] Further, since the three ribs 34 are arranged at the even pitches around the central axis A, defective assembly of parts can be prevented while the number of ribs 34 is minimized, that is, the increase in weight of the spring retainer 3 is minimized.

Second Embodiment

[0035] In the above-described first embodiment, the portion for guiding the end turn 51 of the valve spring 5 is provided at the spring retainer 3. However, the member having the guide portion is not limited to the spring retainer 3. Here, a valve train 101 according to a second embodiment is described with reference to Figs. 6 and 7. Fig. 6 is a partial cross section showing the valve train 101. Fig. 7 is a partial cross section showing a valve lifter 106 and its periphery.

[0036] Components having substantially similar functions to those of the first embodiment refer reference numerals similar to those of the first embodiment, and detailed description thereof is omitted.

Configuration of Valve Train

[0037] In the valve train 101, a guide portion is provided at the valve lifter 6. In particular, referring to Fig. 6, a spring retainer 103 does not have a rib 34 unlike the above-described spring retainer 3. Accordingly, the spring retainer 103 does not have a function of guiding the end turn 51 of the valve spring 5 to the supporting portion 35.

[0038] Referring to Fig. 7, the valve lifter 106 includes a cylindrical portion 161, a cap portion 162 formed at the B2 side in the axial direction of the cylindrical portion 161, and three ribs 163 (second ribs) serving as a second guide portion.

[0039] The ribs 163 are plate-like portions extending from an inner peripheral edge of the cylindrical portion 161 to the inside in the radial direction. For example, the ribs 163 are integrally formed with the cylindrical portion 161 and the cap portion 162. The three ribs 163 are arranged at even pitches around the central axis A, with a clearance arranged at the outside of the supporting portion 35 in the radial direction.

[0040] Each of the ribs 163 includes a guide surface

163a functioning as a second guide surface inclined toward the radial direction with respect to the central axis A. The guide surface 163a is a plane directed to the B1 side in the axial direction and to the inside in the radial direction. The guide surface 163a is formed such that a position thereof in the radial direction approaches the contact surface 32a, toward the B2 side in the axial direction. That is, the guide surface 163a is formed such that the position thereof in the axial direction approaches the contact surface 32a and the restriction surface 33a, toward the inside in the radial direction (approach to the central axis A). An edge of the guide surface 163a at the inside in the radial direction is arranged at the position corresponding to the position of the contact surface 32a in the axial direction while the cap portion 162 is in contact with the head portion 23.

Assembly Procedure

[0041] For example, a case is assumed in which the spring retainer 103 is fixed to the valve 2, and the end turn 51 of the valve spring 5 is deviated from the spring retainer 103 (Fig. 8A). In this case, since a part of the end turn 51 protrudes from the contact portion 32 outward in the radial direction, when the valve lifter 106 is mounted at the valve spring 5, the guide surface 163a of the rib 163 comes into contact with the end turn 51 of the valve spring 5 (Fig. 8B). In this state, the cap portion 162 of the valve lifter 106 is not in contact with the head portion 23.

[0042] For example, when the valve lifter 106 is pressed by an operator or an assembly apparatus, a pressing force F11 to the B1 side in the axial direction acts on the valve lifter 106. As a result, a force F12 acts to the inside in the radial direction via the guide surface 163a. Accordingly, referring to Fig. 9, the end turn 51 of the valve spring 5 is fitted to the restriction portion 33, and the valve lifter 106 is placed at a predetermined position.

[0043] The pressing force F11 may be a pressing force applied by the operator or the assembly apparatus, or, for example, a pressing force transmitted from the cam to the valve lifter 106 when the camshaft is rotated.

[0044] Also, as shown in Fig. 8B, when the rib 163 of the valve lifter 106 comes into contact with the end turn 51, the position of the valve lifter 106 is at the B2 side in the axial direction with respect to the predetermined position of the valve lifter 106. Accordingly, the position of the valve lifter 106 in the axial direction can be checked after the assembly of the valve lifter 106. Thus, it is possible to recognize whether the valve spring 5 is arranged at the predetermined position or not, from the outside.

Features

[0045] Features of the valve train 101 are described below.

(1) With the valve train 101, the end turn 51 of the valve spring 5 is guided to the supporting portion 35 by the rib 163 (in particular, to the housing space S defined by the restriction portion 33 and the contact surface 32a) even when the end turn 51 is deviated from the spring retainer 3 during assembly. As a result, after the assembly is completed, the end turn 51 and the spring retainer 103 are arranged at the predetermined positions without a deviation. Accordingly, with the valve train 101, defective assembly of parts such as the valve spring 5 and the spring retainer 103 can be prevented.
In addition, since the position of the valve lifter 106 in the axial direction is checked, it is possible to recognize whether the valve spring 5 is arranged at the predetermined position or not, from the outside. For example, the positions of parts can be readjusted accordingly.
As described above, with the valve train 101, the defective assembly of parts such as the valve spring 5 and the spring retainer 103 can be prevented.

(2) Each rib 163 has the guide surface 163a inclined toward the radial direction with respect to the central axis A of the stem 22. In particular, the guide surface 163a of the rib 163 is formed such that the position thereof in the radial direction approaches the contact surface 32a to the B2 side in the axial direction. Accordingly, the pressing force F11 acting between the valve lifter 106 and the valve spring 5 is converted by the rib 163 into the force F12 to the inside in the radial direction. Thus, the end turn 51 of the valve spring 5 can be guided to the predetermined position by the pressing force in the axial direction during assembly.

(3) The portion (guide portion) for guiding the end turn 51 of the valve spring 5 is defined by the plate-like ribs 163. Accordingly, an increase in weight of the valve lifter 106 can be minimized. Also, the ribs 163 can efficiently increase the strength of the valve lifter 106.
Further, since the three ribs 163 are arranged at the even pitches around the central axis A, the defective assembly of parts can be prevented while the number of ribs 163 is minimized, that is, the increase in weight of the valve lifter 106 is minimized.

(4) When the valve lifter 106 is arranged at the predetermined position (when the cap portion 162 of the valve lifter 106 is in contact with the head portion 23 of the stem 22), the edges of the guide surfaces 163a at the inside in the radial direction are arranged at the positions corresponding to the position of the contact surface 32a in the axial direction. Accordingly, the end turn 51 of the valve spring 5 can be reliably guided to the supporting portion 35 by the rib 163.

Modifications

[0046] The specific configuration of the present invention is not limited to the above-described embodiments, and may include various modifications and changes within the scope of the present invention.

(A) The first embodiment may be combined with the second embodiment. In particular, the valve train 1 according to the first embodiment may employ the valve lifter 106 according to the second embodiment, instead of the valve lifter 6.

(B) In the first and second embodiments, while the guide portion is defined by the three ribs 34 or 163, the number of ribs 34 or 163 is not limited to three. Also, while the ribs 34 are the plate-like portions, a guide portion may be part of an integrally formed structure. For example, referring to Figs. 10A and 10B, a spring retainer 203 includes the boss 31, the supporting portion 35, and a guide portion 234. The guide portion 234 has a guide surface 234a inclined with respect to the central axis A.

In this case, the weight of the spring retainer 203 is increased as compared with, for example, the spring retainer 3, however, the end turn 51 of the valve spring 5 reliably comes into contact with the guide surface 234a even when the end turn 51 of the valve spring 5 is deviated from the spring retainer 203. Accordingly, the end turn 51 of the valve spring 5 can be reliably guided to the supporting portion 35.

Alternatively, the valve lifter 106 may be changed from the plate-like guide portions into a circular guide portion.

(C) In the first embodiment, the restriction surface 33a of the spring retainer 3 is provided at the restriction portion 33. However, for example, restriction surfaces 33a may be provided at the ribs 34. In particular, a spring retainer 303 shown in Figs. 11A and 11B includes the boss 31, the supporting portion 35, and three ribs 334. The ribs 334 include guide surfaces 334a and restriction surfaces 334b. The guide surfaces 334a correspond to the above-mentioned guide surfaces 34a. The restriction surfaces 334b correspond to the above-mentioned restriction surface 33a. The guide surfaces 334a and the restriction surfaces 334b are connected with each other, and are continuously formed.

In this case, since the restriction portion 33 for restricting the movement of the end turn 51 in the radial direction is part of the ribs 334, reduction in weight can be further promoted as compared with the above-described spring retainer 3.

(D) In the first embodiment, the guide surface 34a of the spring retainer 3 is a plane. However, the guide surface 34a is not limited to a plane, and may be, for example, a curved plane or combination of a plane and a curved plane.

For example, in a spring retainer 403 shown in Fig. 12A, a rib 434 has a curved guide surface 434a protruding outward in the radial direction. In this case, an inclination of the guide surface 434a with respect to a plane orthogonal to the central axis A is increased near the restriction surface 33a as compared with an inclination of the rib 34. Hence, in particular, a guide function of the rib 434 near the restriction surface 33a is increased.

Alternatively, in a spring retainer 503 shown in Fig. 12B, a rib 534 has a curved guide surface 534a being depressed inward in the radial direction. In this case, the weight of the spring retainer 503 can be reduced as compared with the case with the above-mentioned rib 34.

(E) In the first embodiment, the ribs 34 of the spring retainer 3 are arranged at the even pitches around the central axis A. However, the ribs 34 may be arranged at uneven pitches unless the guide function of the ribs 34 is degraded.

Also, similarly to the ribs 34, the ribs 163 may be arranged at positions deviated from the even pitches unless the guide function of the ribs 163 is degraded.

(F) In the first embodiment, the edge of the guide surface 34a at the outside in the radial direction substantially corresponds to the edge of the restriction surface 33a at the B1 side in the axial direction. Herein, the phrase "substantially corresponding" includes a situation in which the edge of the guide surface 34a at the outside in the radial direction is deviated from the edge of the restriction surface 33a at the B1 side in the axial direction unless the guide function of the ribs 34 is degraded.

(G) In the second embodiment, the edge of the guide surface 163a of the rib 163 is arranged at the position corresponding to the position of the contact surface 32a in the axial direction while the cap portion 162 is in contact with the head portion 23. However, the guide surface 163a may be arranged at the B1 side of the contact surface 32a in the axial direction. That is, the rib 163 may be elongated to the B1 side in the axial direction. In this case, although the weight of the valve lifter 106 is increased as compared with the case in the second embodiment, a function of guiding the end turn 51 of the valve spring 5, or a function of recognizing a deviation of the valve spring 5 from the outside can be enhanced.

[0047] With the valve train according to the present invention, the defective assembly of parts can be prevented. Thus, the present invention is useful in the field of a valve train for an internal combustion engine.

Claims

1. A valve train (1, 101) for an internal combustion engine, comprising:

a valve (2) which includes
a stem (22) supported by a cylinder head (9) movably in an axial direction, and
a valve head (21) provided at a first end portion

of the stem (22);
a supporting member (3, 103) mounted at a second end portion of the stem (22);
a valve spring (5) arranged between the cylinder head (9) and the supporting member (3, 103); and
a valve lifter (6, 106) provided to be in contact with the second end portion of the stem (22),
wherein the supporting member (3, 103) includes
a supporting portion (35) that supports an end portion of the valve spring (5), the supporting portion which includes
a circular contact surface (32a) that comes into contact with the end portion of the valve spring (5) in the axial direction, and
a restriction surface (33a) arranged at the inside of the contact surface (32a) in a radial direction along a direction orthogonal to the axial direction, the restriction surface (33a) being capable of coming into contact with the end portion of the valve spring (5), and
wherein at least one of the supporting member (3) and the valve lifter (6, 106) includes
a guide portion (34, 163) that guides the end portion of the valve spring (5) to the supporting portion (3, 103).

2. The valve train (1, 101) for an internal combustion engine according to Claim 1, wherein the guide portion (34, 163) has a guide surface (34a, 163a) inclined with respect to a central axis (A) of the stem (22).

3. The valve train (1) for an internal combustion engine according to Claim 2, wherein the supporting member (35) includes a first guide portion (34) functioning as the guide portion (34, 163) arranged near the central axis (A) with respect to the restriction surface (33a) and near the first end portion of the stem (22).

4. The valve train (1) for an internal combustion engine according to Claim 3, wherein the first guide portion (34) has a first guide surface (34a) functioning as the guide surface (34a, 163a) formed such that a position thereof in the direction orthogonal to the axial direction approaches the contact surface (32a) toward the second end portion in the axial direction.

5. The valve train (1) for an internal combustion engine according to Claim 4, wherein an edge of the first guide surface (34a) located farthest from the central axis (A) substantially corresponds to an edge of the restriction surface (33a).

6. The valve train (1) for an internal combustion engine according to any of Claims 3 to 5, wherein the first guide portion (34) is at least three plate-like first ribs (34) extending in the axial direction.

7. The valve train (1) for an internal combustion engine according to Claim 6, wherein the at least three first ribs (34) are arranged at substantially even pitches around the central axis (A).

8. The valve train (101) for an internal combustion engine according to Claim 2, wherein the valve lifter (6) includes a second guide portion (163) functioning as the guide portion (34, 163) arranged at the outside of the supporting portion (35).

9. The valve train (101) for an internal combustion engine according to Claim 8, wherein the second guide portion (163) has a second guide surface (163a) functioning as the guide surface (34a, 163a) formed such that a position thereof in the direction orthogonal to the axial direction approaches the contact surface (32a) toward the second end portion in the axial direction.

10. The valve train (101) for an internal combustion engine according to Claim 8 or 9, wherein the second guide portion (163) is at least three plate-like second ribs (163) extending in the axial direction.

11. The valve train (101) for an internal combustion engine according to claim 10, wherein the at least three second ribs (163) are arranged at substantially even pitches around the central axis (A).

12. The valve train (101) for an internal combustion engine according to any of Claims 8 to 11, wherein an edge of the second guide surface (163a) located nearest to the central axis (A) is arranged at a position corresponding to a position of the contact surface (32a) or at a position near the first end portion of the stem (22) with respect to the contact surface (32a).

FIG. 1

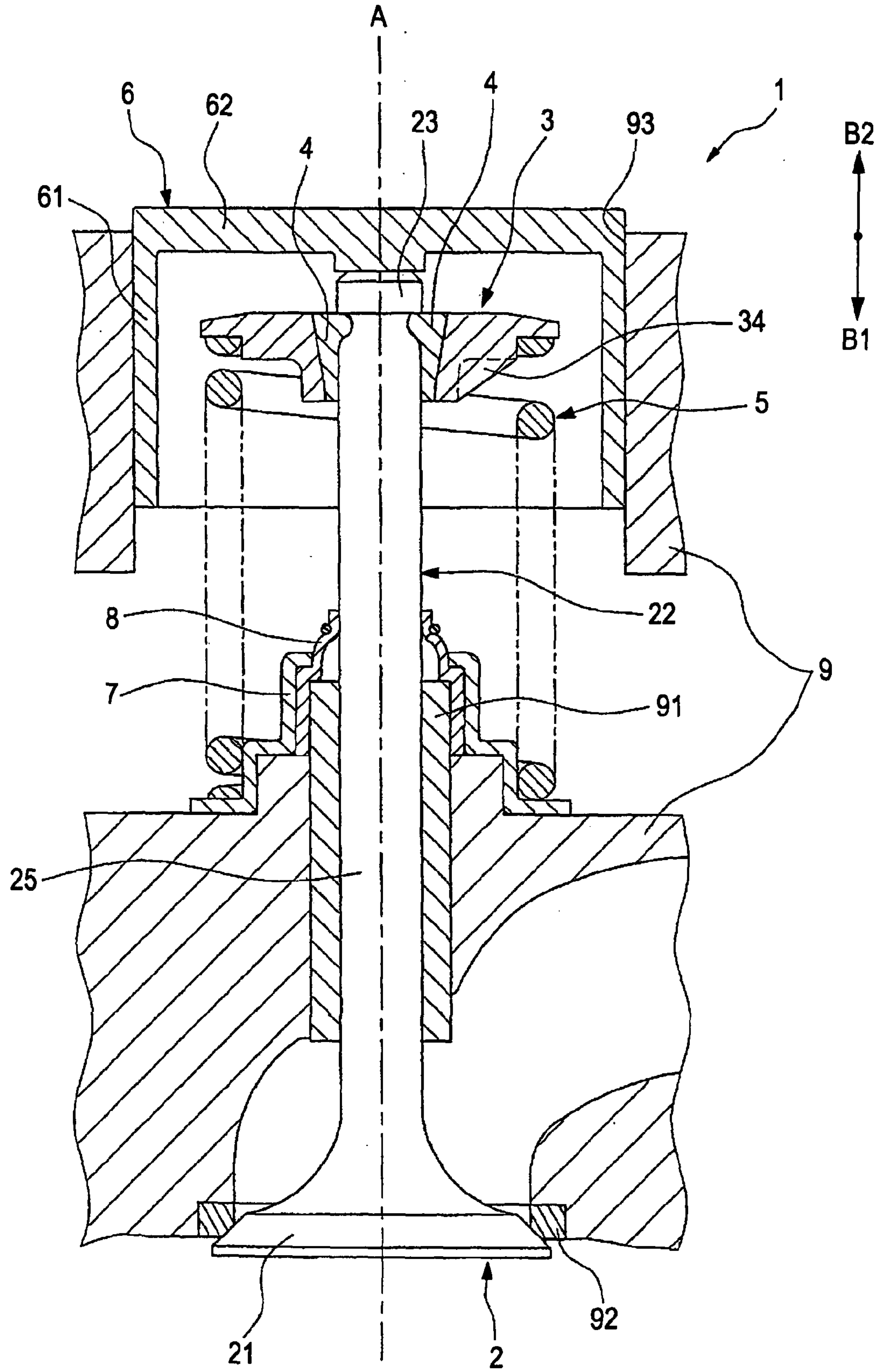


FIG. 2

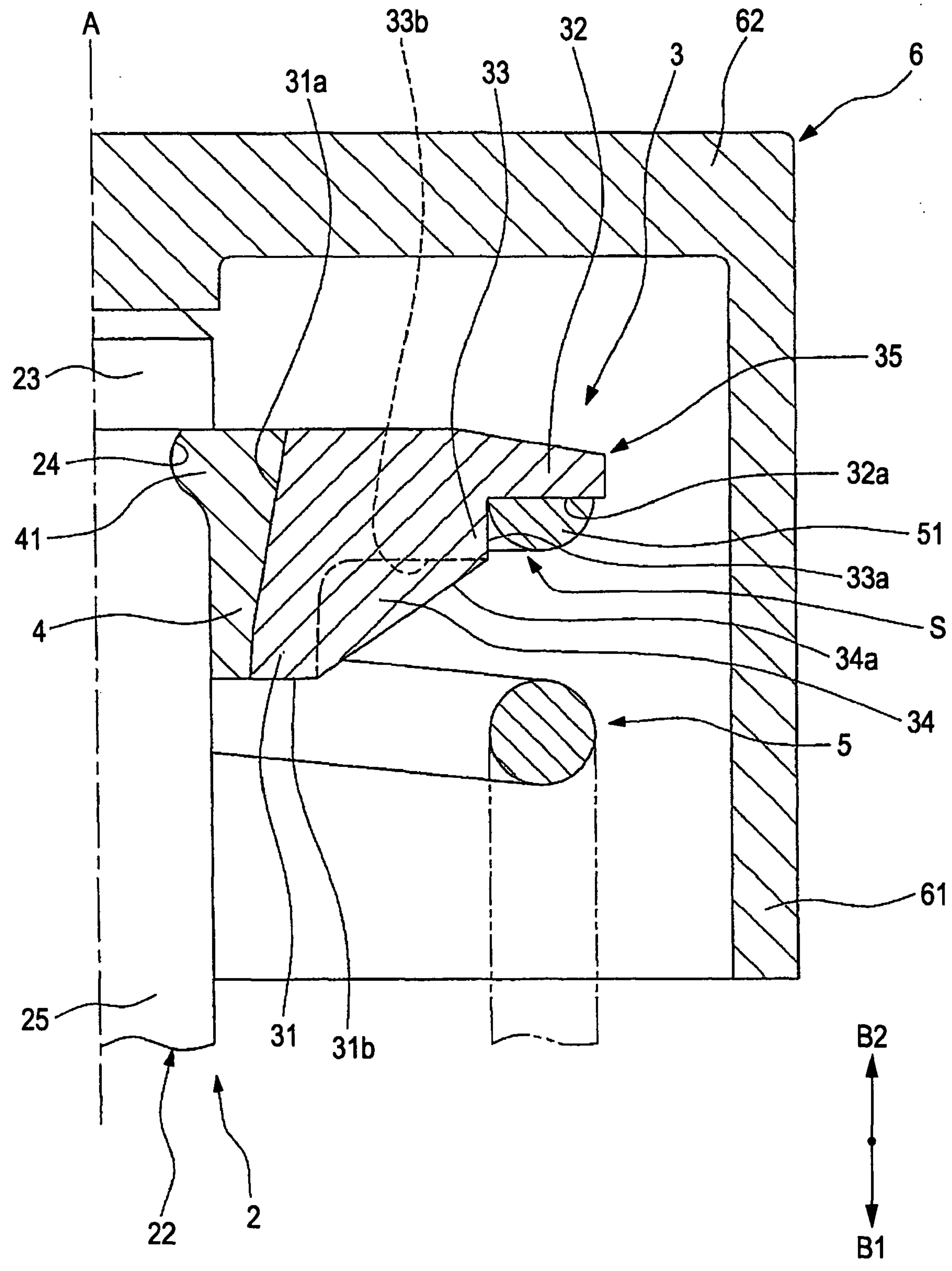

A
33b
32
62
3
6
31a
33
23
35
24
32a
41
51
33a
4
S
34a
34
5
61
25
31
31b
22
2
B2
B1

FIG. 3A

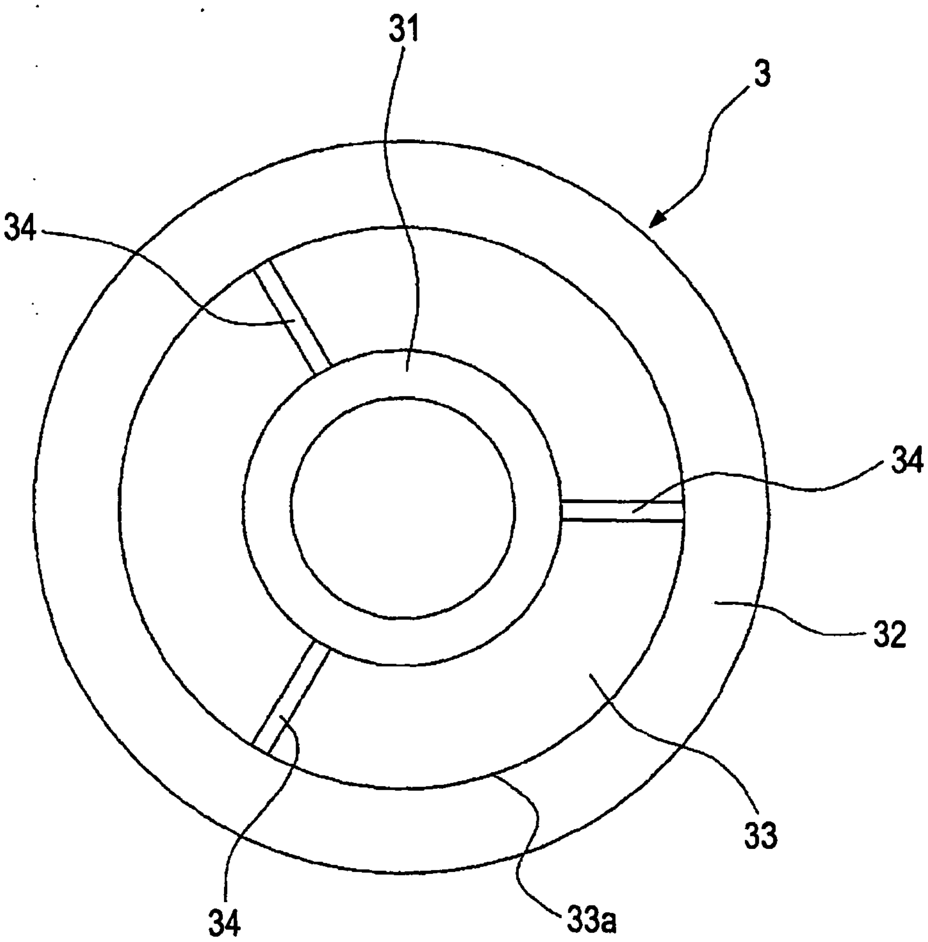

31
3
34
34
32
33
34
33a

FIG. 3B

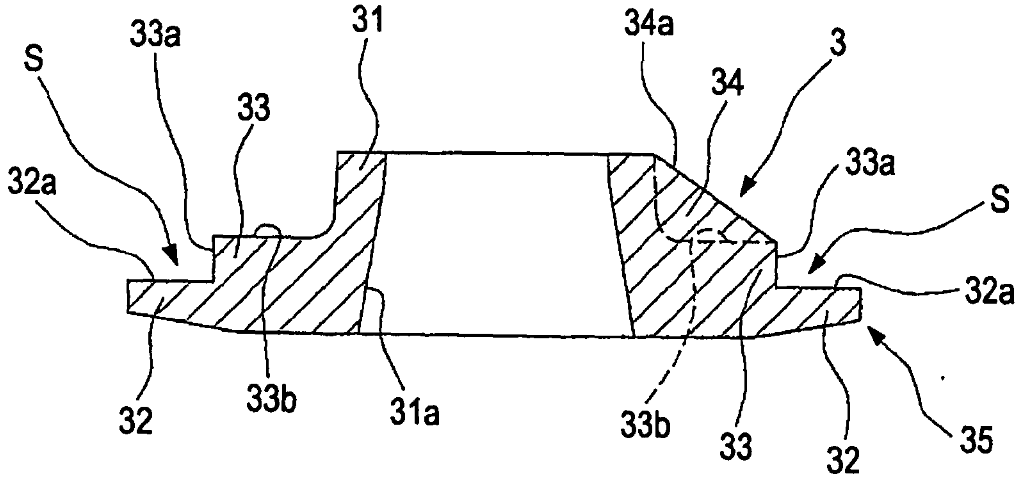

S
33a
31
34a
3
34
33
32a
33a
S
32a
32
33b
31a
33b
33
32
35

FIG. 4A

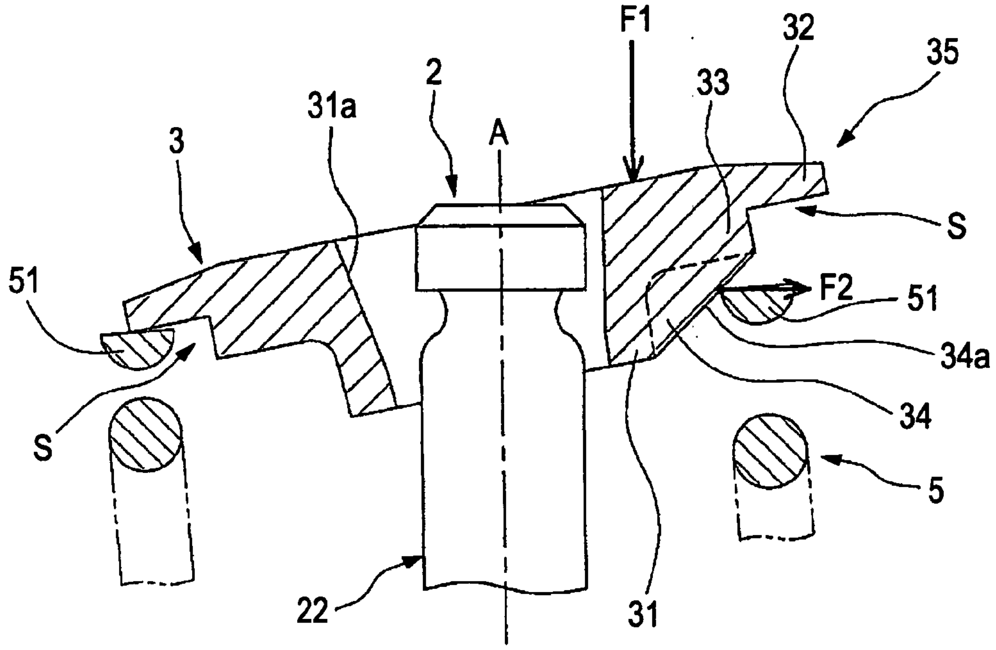

F1
32
35
2
33
31a
A
3
S
51
F2
51
34a
S
34
5
22
31

FIG. 4B

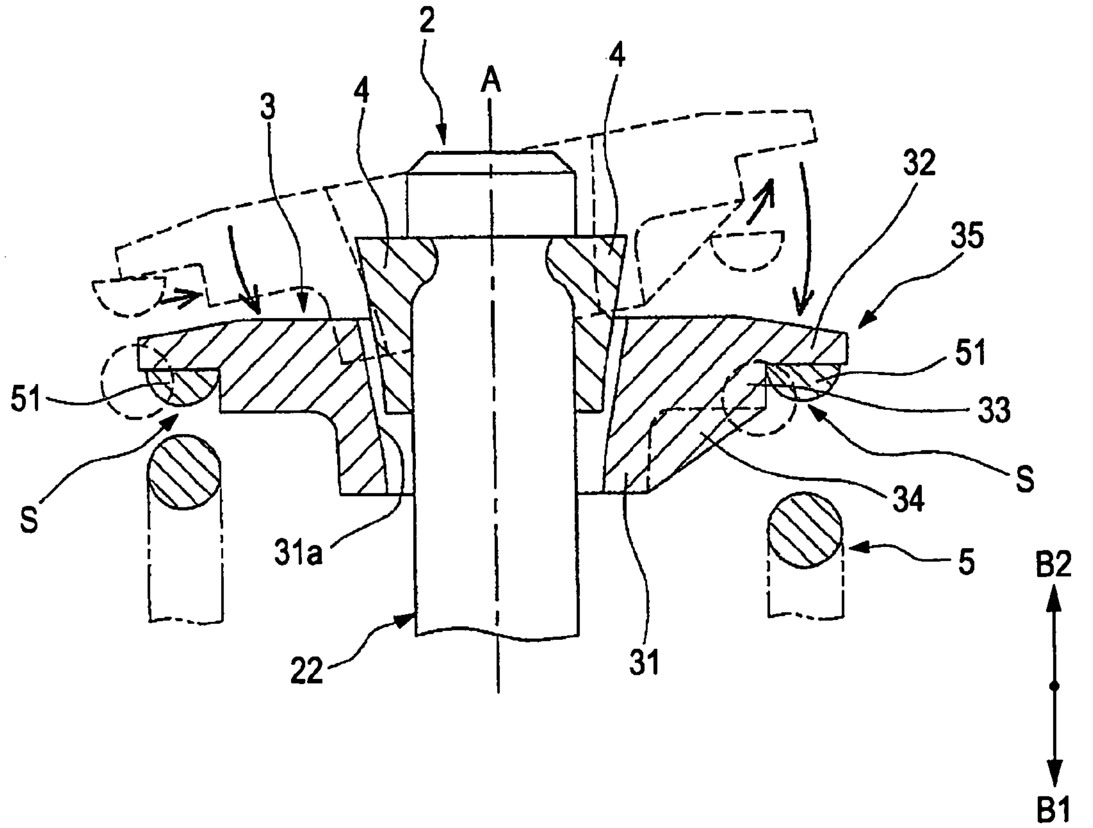

2
A
4
3
4
32
35
51
51
33
S
S
34
31a
5
B2
22
31
B1

FIG. 5

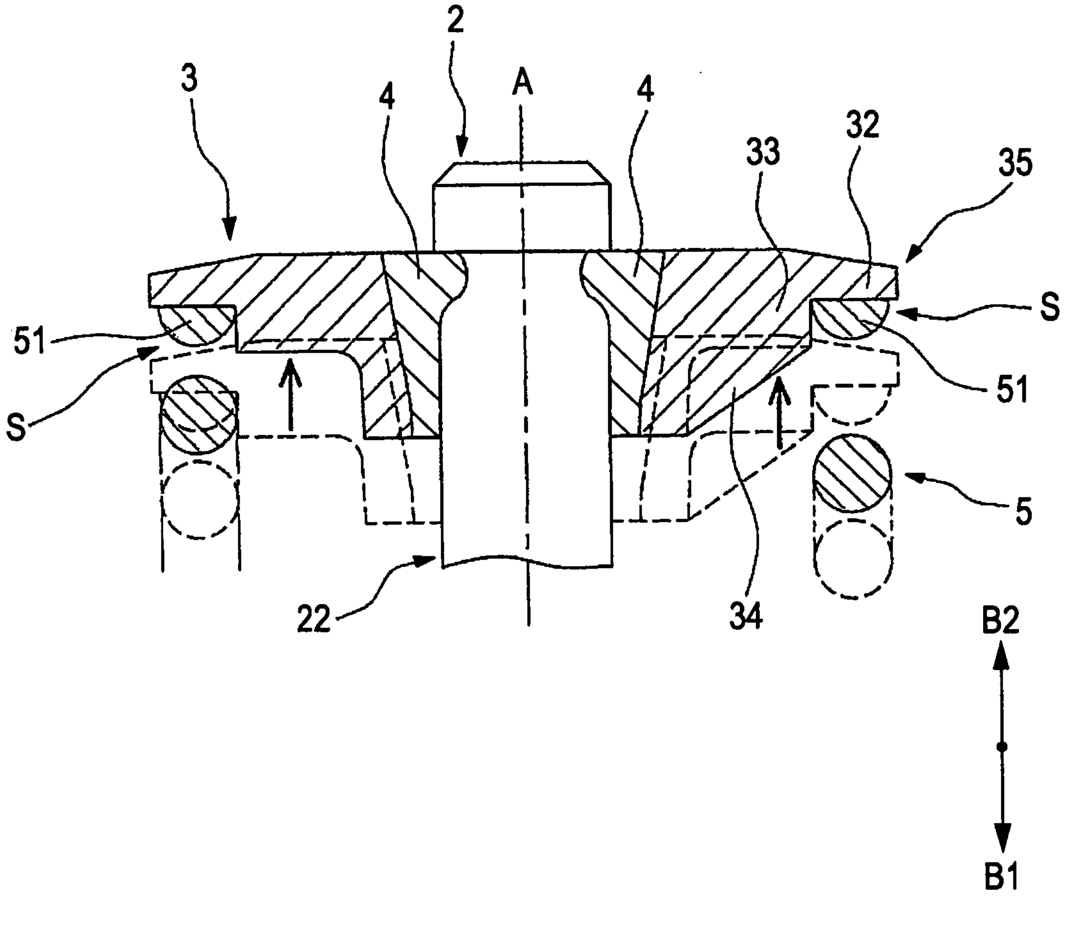


FIG. 6

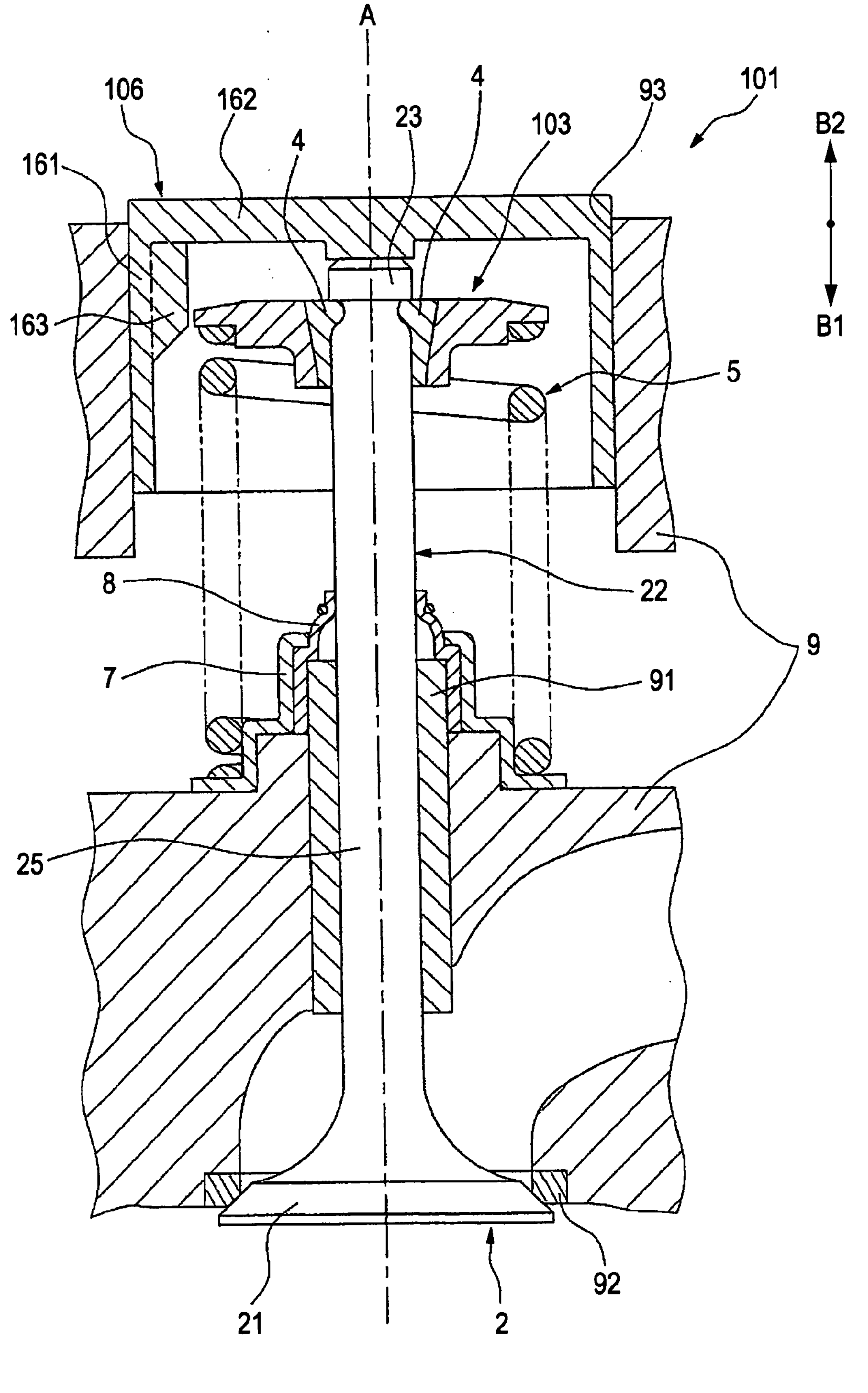


FIG. 7

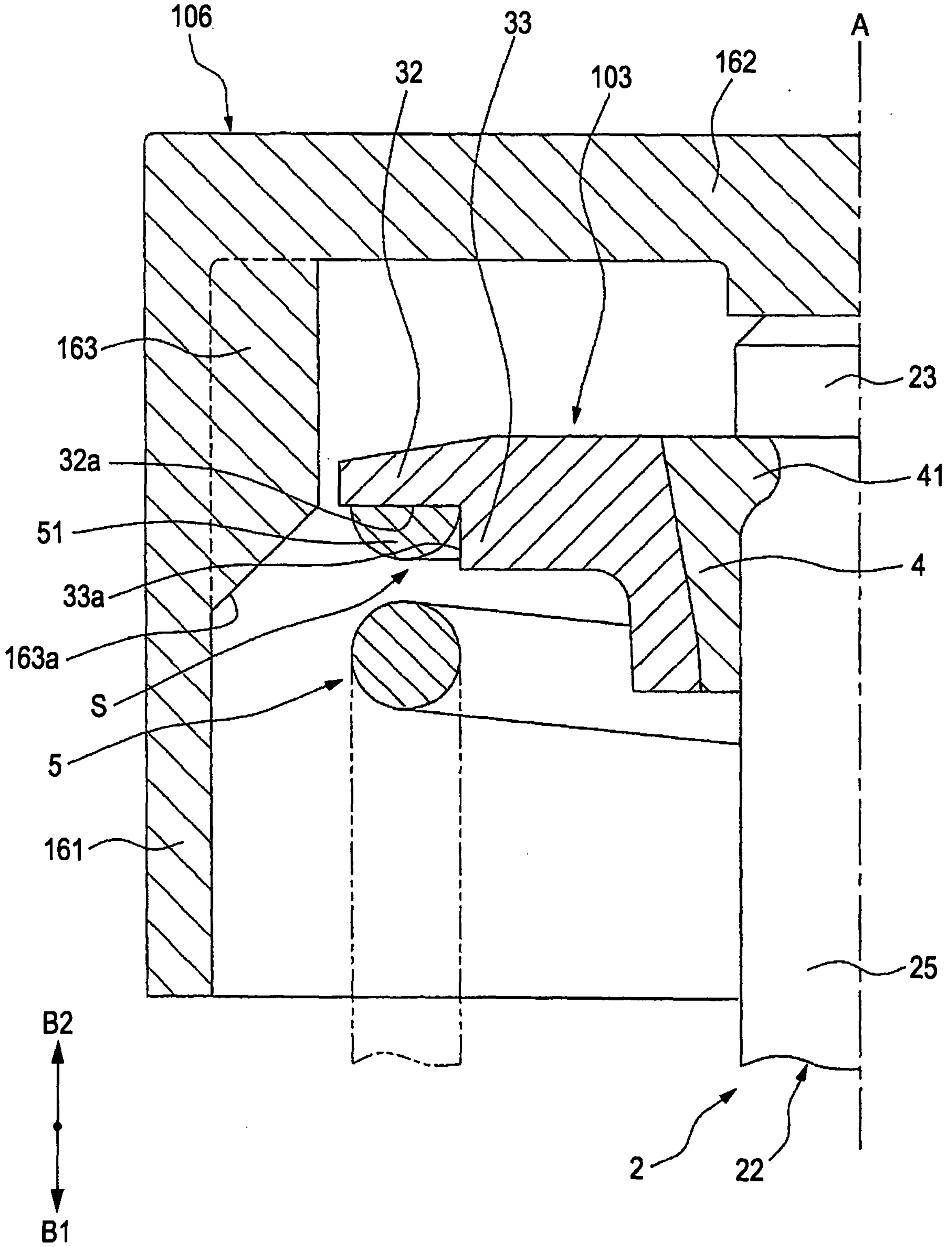


FIG. 8A

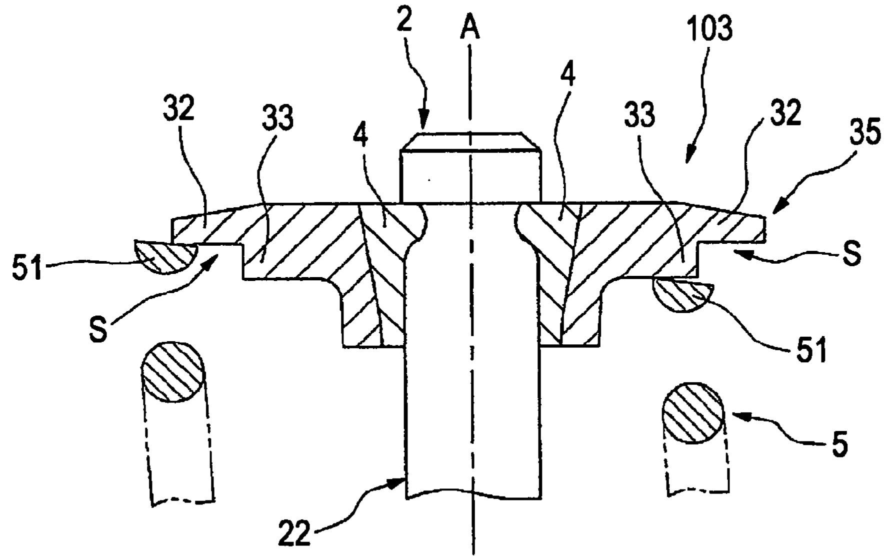

2
A
103
4
32
33
4
33
32
35
51
S
S
51
5
22

FIG. 8B

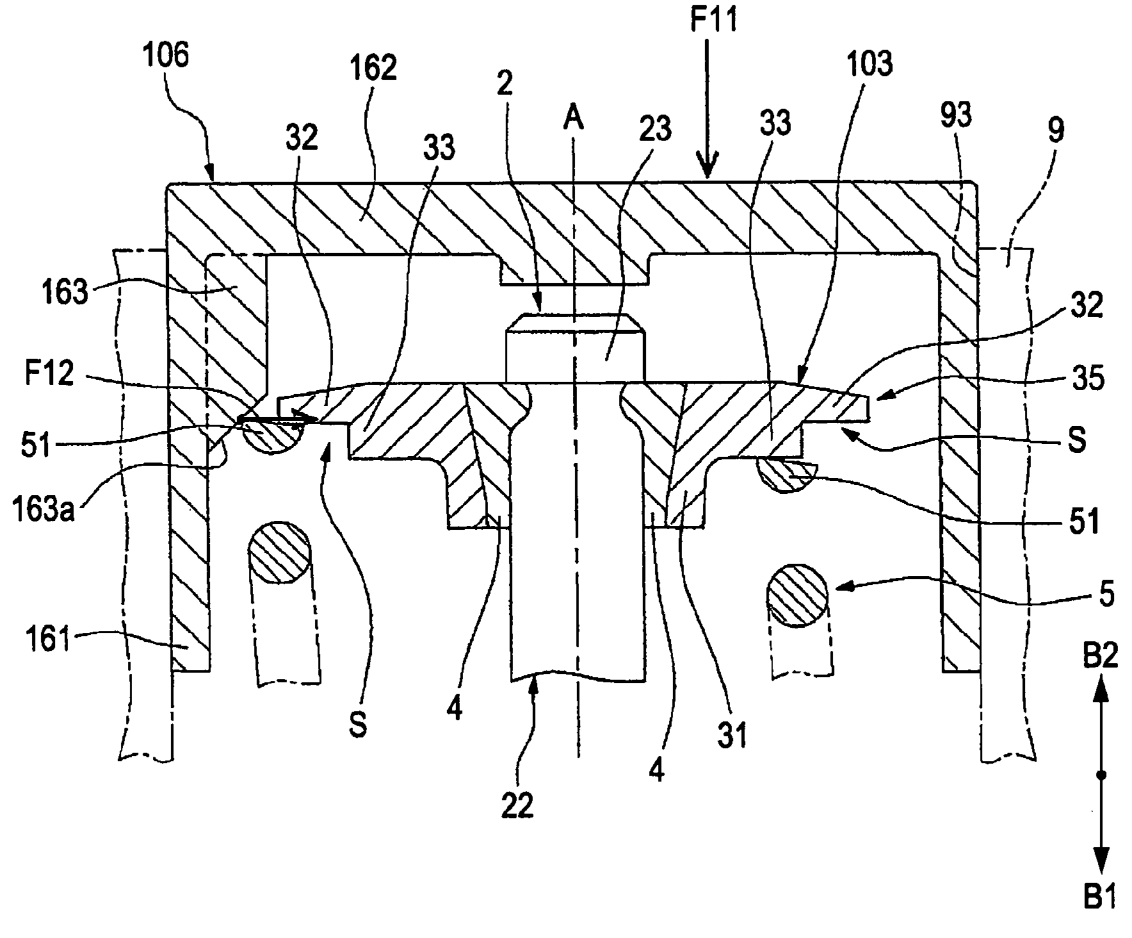

F11
106
162
2
A
23
33
103
93
9
32
33
163
32
F12
35
51
S
163a
51
5
161
B2
S
4
31
4
22
B1

FIG. 9

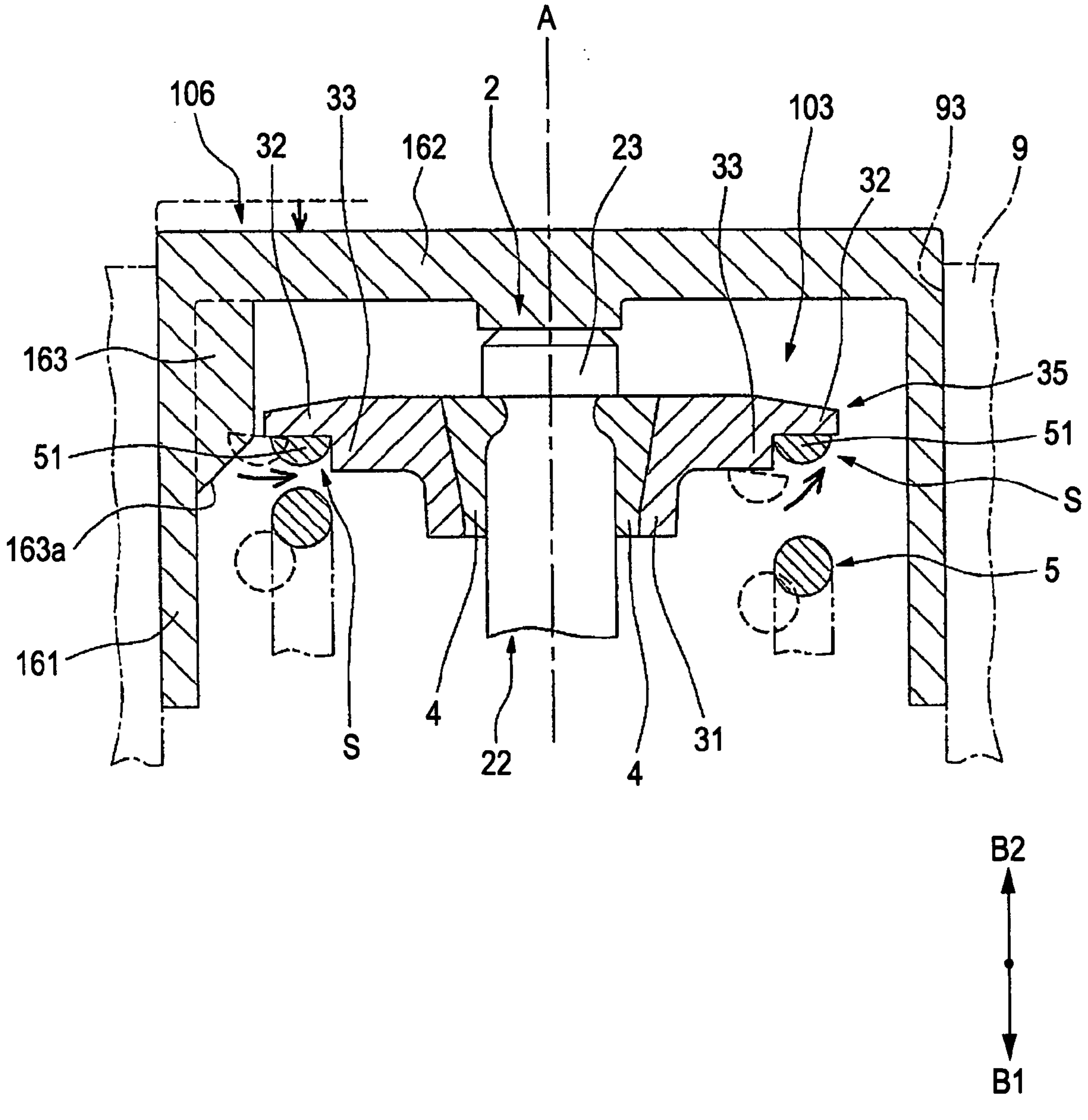

A
106
33
2
103
93
9
32
162
23
33
32
163
35
51
51
S
163a
5
161
S
4
22
4
31
B2
B1

FIG. 10A

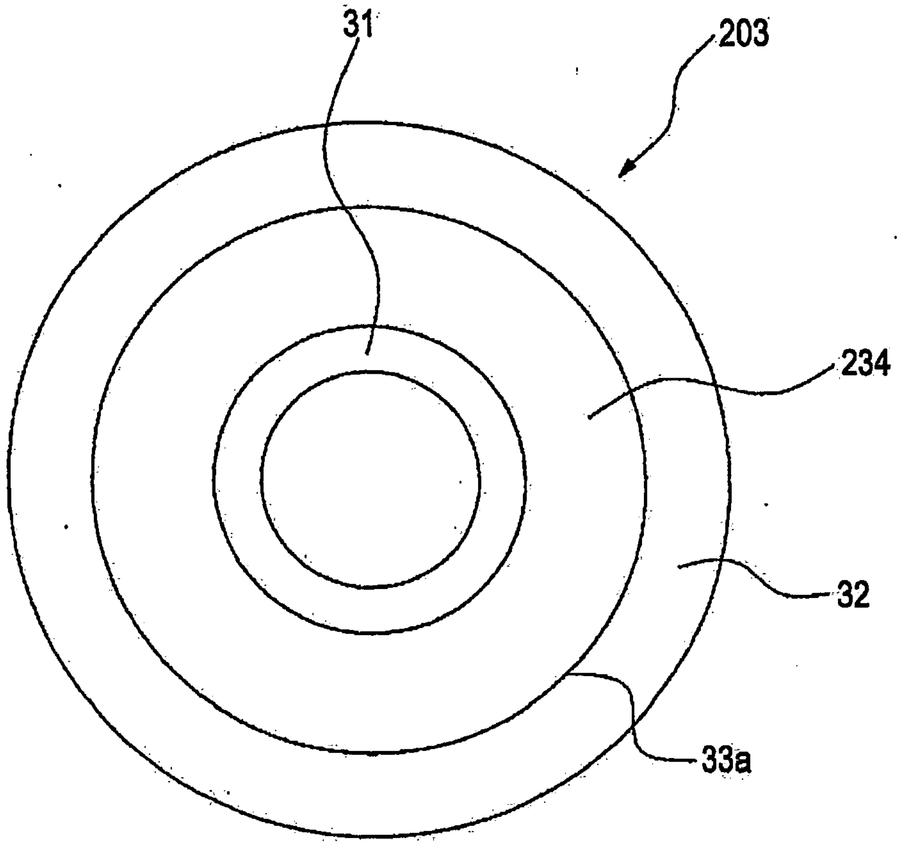


FIG. 10B

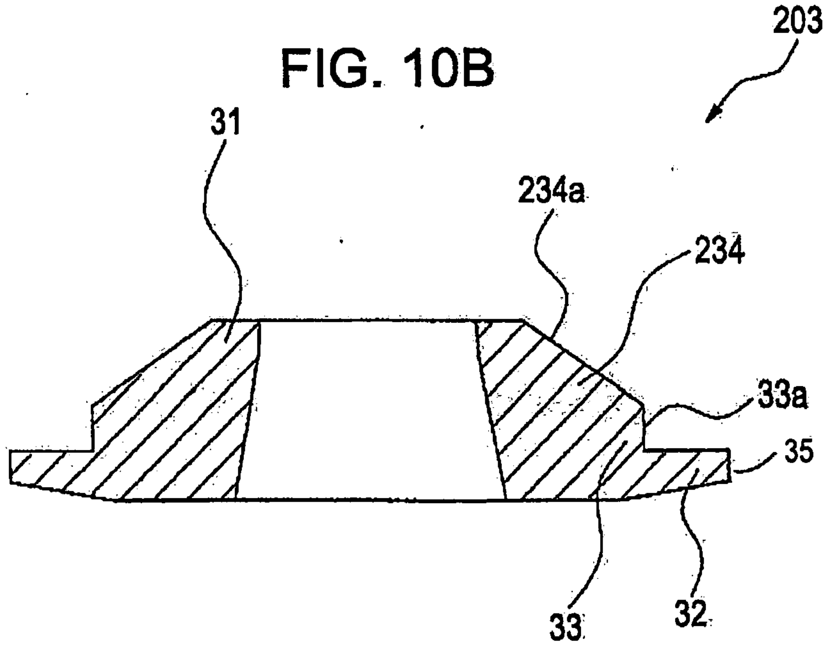


FIG. 11A

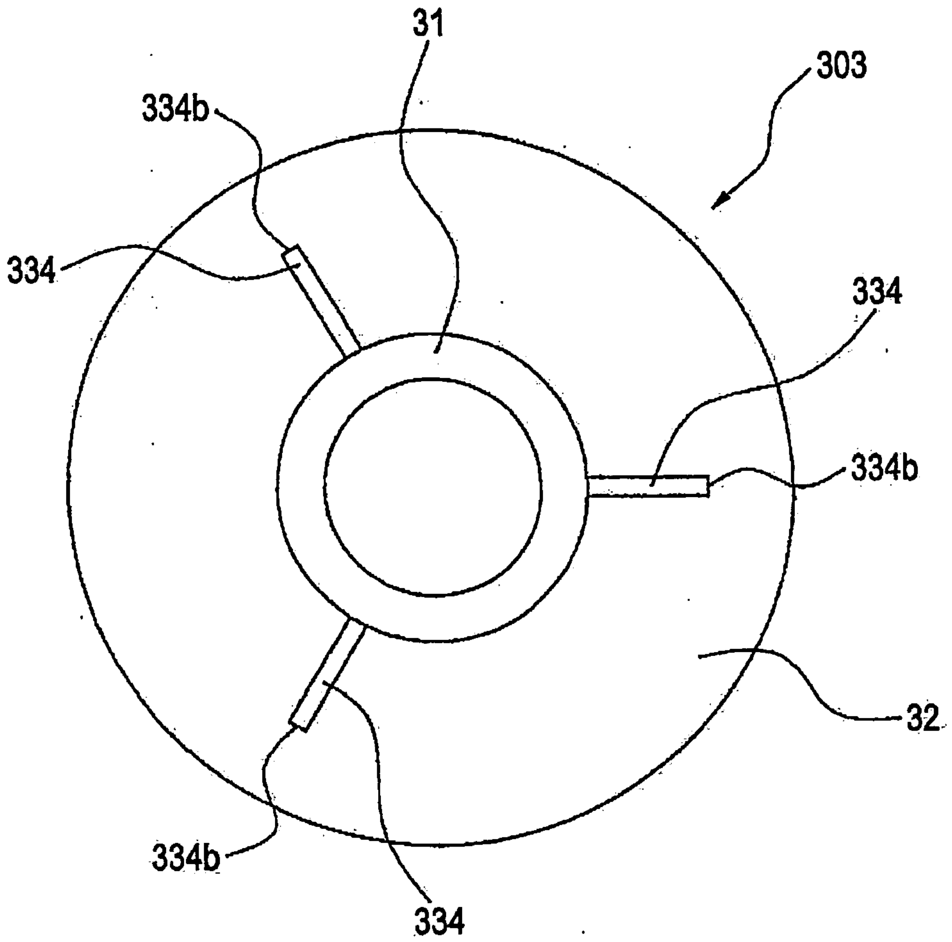


FIG. 11B

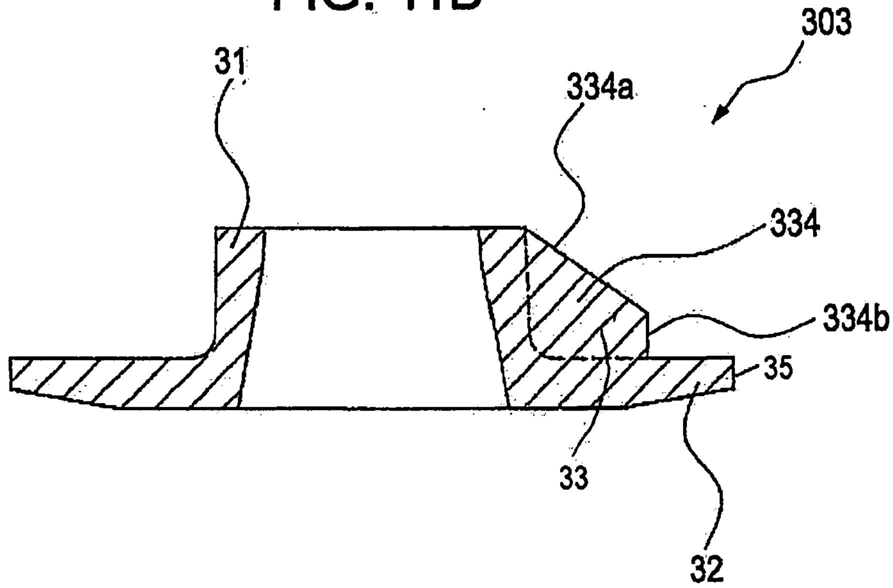


FIG. 12A

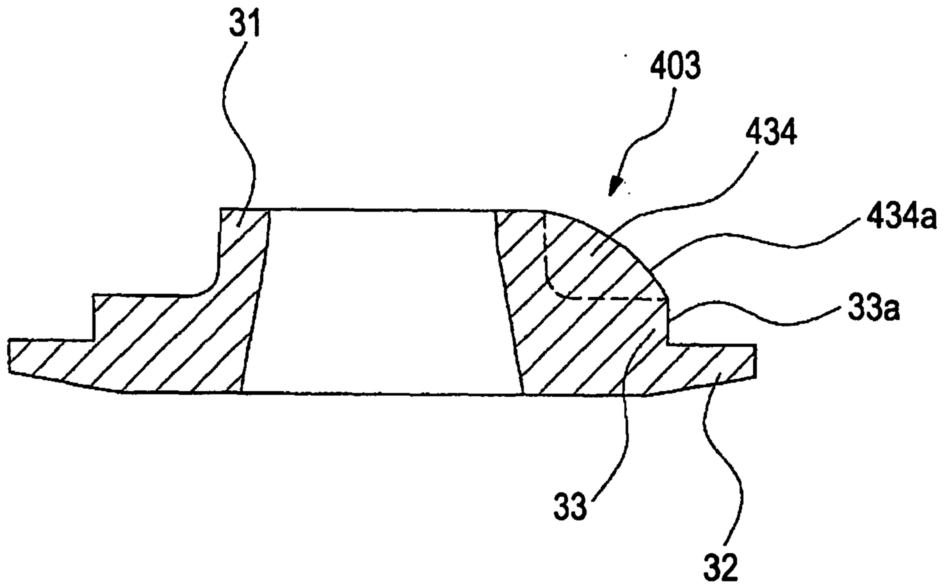
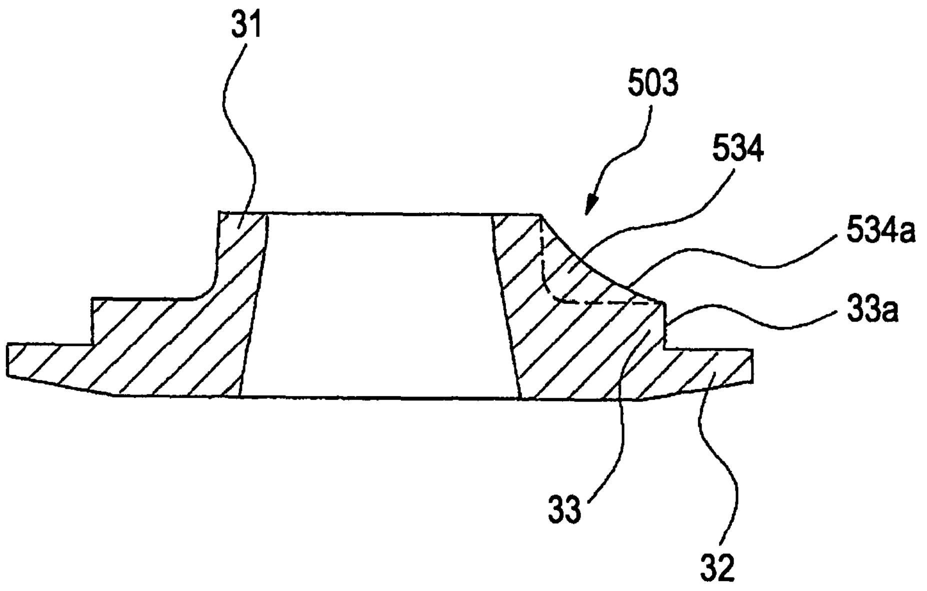


FIG. 12B



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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