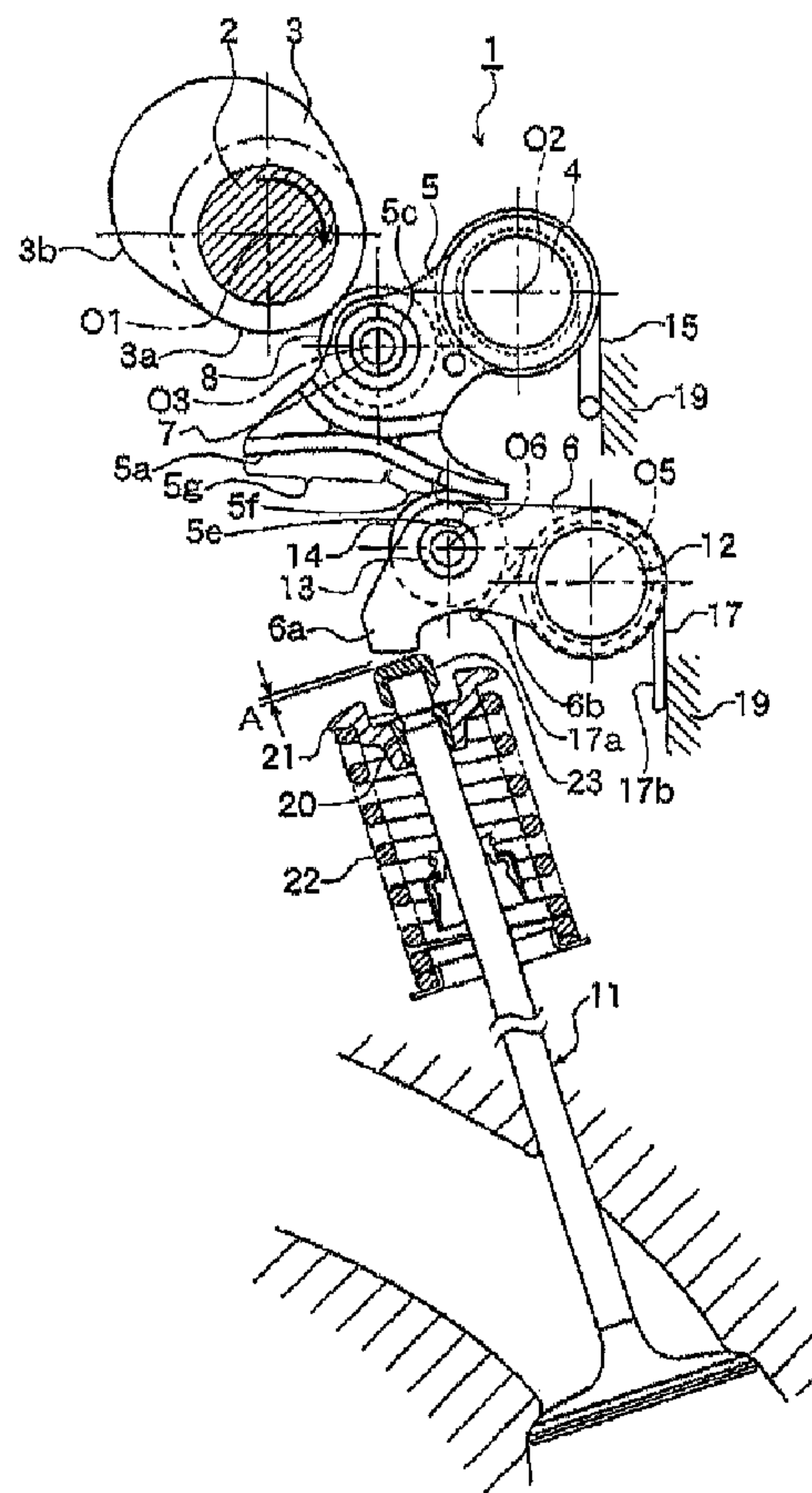




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(71) Demandeurs/Applicants:
YAMAHA HATSUDOKI KABUSHIKI KAISHA, JP;
HATAMURA, KOICHI, JP
(72) Inventeurs/Inventors:
HATAMURA, KOICHI, JP;
FUJITA, HIDEO, JP
(74) Agent: BARRIGAR INTELLECTUAL PROPERTY LAW

(54) Titre : TRAIN DE SOUPAPE POUR MOTEUR THERMIQUE
(54) Title: VALVE MECHANISM FOR AN INTERNAL COMBUSTION ENGINE



(57) Abrégé/Abstract:

A valve gear of an internal combustion engine, wherein a swing cam performs reciprocating motion by swinging about a swing shaft in a specified range, and a rocker arm performs reciprocating motion by swinging interlockingly with the swing cam in a



(57) Abrégé(suite)/Abstract(continued):

specified range. A roller for interlocking the swing of the swing cam with the rocker arm is fitted to the rocker arm, and a cam face in contact with the roller is formed on the swing cam. When the roller is positioned at the base circular part of the cam face, a clearance is formed between parts on the downstream side of the contact portion of the roller with the cam face in a force transmitting route. The valve gear comprises a spring member to always bring the roller into contact with the cam face while the swing cam and the rocker arm perform the reciprocating operation.

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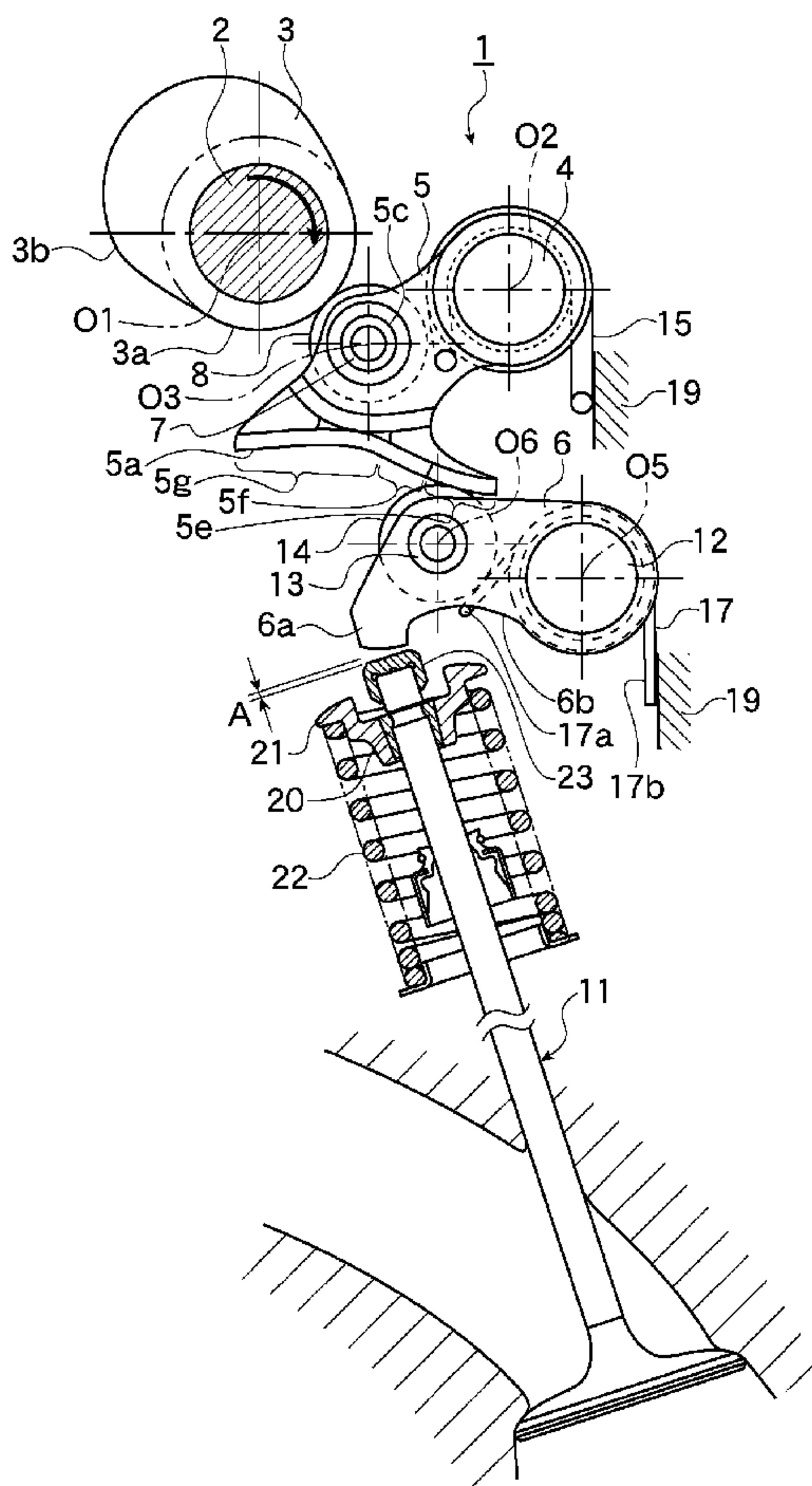
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(21) 国際出願番号: PCT/JP2004/012192 (72) 発明者: 畑村 耕一 (HATAMURA, Koichi) [JP/JP]; 〒7320813 広島県広島市南区段原山崎町 2 0 - 1 6 Hiroshima (JP).
(22) 国際出願日: 2004 年 8 月 25 日 (25.08.2004) (72) 発明者; および
(25) 国際出願の言語: 日本語 (75) 発明者/出願人 (米国についてのみ): 藤田 秀夫 (FUJITA, Hideo) [JP/JP]; 〒4388501 静岡県磐田市新貝 2 5 0 0 番地 ヤマハ発動機株式会社内 Shizuoka (JP).
(26) 国際公開の言語: 日本語 (74) 代理人: 佐野 弘 (SANO, Hiroshi); 〒1040042 東京都中央区入船 1 丁目 2 番 9 号 八丁堀MFビル 9 F Tokyo (JP).
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(71) 出願人 (米国を除く全ての指定国について): ヤマハ発動機株式会社 (YAMAHA HATSUDOKI KABUSHIKI KAISHA) [JP/JP]; 〒4388501 静岡県磐田市新貝 2 5 0 0 番地 Shizuoka (JP).

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(54) Title: VALVE GEAR OF INTERNAL COMBUSTION ENGINE

(54) 発明の名称: 内燃機関の動弁機構



(57) Abstract: A valve gear of an internal combustion engine, wherein a swing cam performs reciprocating motion by swinging about a swing shaft in a specified range, and a rocker arm performs reciprocating motion by swinging interlockingly with the swing cam in a specified range. A roller for interlocking the swing of the swing cam with the rocker arm is fitted to the rocker arm, and a cam face in contact with the roller is formed on the swing cam. When the roller is positioned at the base circular part of the cam face, a clearance is formed between parts on the downstream side of the contact portion of the roller with the cam face in a force transmitting route. The valve gear comprises a spring member to always bring the roller into contact with the cam face while the swing cam and the rocker arm perform the reciprocating operation.

(57) 要約: 内燃機関の動弁機構の揺動カムは、揺動シャフトを中心に所定範囲で揺動して往復運動し、ロッカーアームは、揺動カムに連動して所定範囲で揺動して往復運動し、ロッカーアームには揺動カムの揺動をロッカーアームに連動させるローラが設けられ、揺動カムにはローラが接触するカム面が設けられており、ローラがカム面のベース円部に位置する時に、隙間を、ローラとカム面との接触部位を基準として、力の伝達経路中の下流側の部品間に設け、揺動カム及びロッカーアームの往復運転時において、常にローラとカム面とを接触させるばね部材を有する。

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SPECIFICATION

VALVE MECHANISM FOR AN INTERNAL COMBUSTION ENGINE

Technical Field

[0001]

The present invention relates to a valve mechanism for opening and closing the intake valve or exhaust valve of an internal combustion engine.

Related Art

[0002]

Conventionally, a valve mechanism for an internal combustion engine for opening and closing an intake valve or exhaust valve of the internal combustion is known. Such a valve mechanism has, between the respective valves and a rotating cam that operates in synchronization with a crankshaft of the internal combustion engine and rotated via a camshaft, a rocking cam that operates in synchronization with the rotating cam and rocks within a predetermined range so as to be reciprocated, and a rocker arm operating in synchronization with the rocking cam so as to open and close the intake valve or the exhaust valve. Further, in many of such valve mechanisms, in order to reduce the frictional resistance between the rocking cam and the rocker arm operated in synchronization with the rocking cam, the rocker arm is provided with a roller, and a contact surface with which the roller comes into contact is formed in the rocking cam, the rocking cam rocking the rocker arm via the roller to drive the respective valves, thereby effecting opening and closing of the valves.

[0003]

Further, in the conventional valve mechanism for an internal combustion engine, when the rocker arm and the respective valves are held in constant contact with each other, as each of the valves undergoes thermal expansion due to a rise in the temperature of the internal combustion engine, this causes upward jumping of the valve so that each valve presses the rocker arm to the rocking cam side. The valve closure action thus

becomes unreliable, and gas leakage occurs to cause a decrease in output. Accordingly, in order to prevent this upward jumping of the valve, a predetermined valve clearance is provided between the rocker arm and each valve.

[0004]

As the rocking cam for opening and closing each valve is caused to reciprocate in the state where the valve clearance is provided as described above, when the rocking direction of the rocking cam is reversed on the base circle of the rocking cam, if there is a clearance between the roller and the contact surface as described above, the rotation of the roller rotated by the rocking cam is retained due to inertia, so the rocking direction of the rocking cam and the rotation direction in which the roller rotates becomes opposite to each other. Then, when the roller comes into contact with the contact surface under the state where the rocking direction of the rocking cam and the rotation direction of the roller are opposite to each other, adhesive wear occurs to causes a decrease in durability, and the rocking motion of the rocking cam cannot be accurately transmitted to the rocker arm, which makes it impossible to actuate each valve with reliability.

[0005]

In particular, when the rotation of the roller is completely retained due to inertia, the relative speed at the time when the roller is separated from the rocking cam and that at the time when the roller comes into contact with the rocking cam are the same in magnitude but opposite in direction. Thus, the contact surfaces of the two members when in the contact state exhibit speeds of the same magnitude acting in different directions. According to the elastic hydrodynamic lubrication theory, such a condition is least conducive to the formation of an oil film, and thus it can be said that this condition can easily result in oil film breakage to cause adhesive wear.

[0006]

In view of this, as a valve mechanism for an internal combustion engine designed to prevent adhesive wear between the roller and

the contact surface, there is one in which the rocker arm is rockably supported by means of a hydraulic lash adjustor, and the support position of the rocker arm is appropriately corrected by the hydraulic lash adjustor to thereby correct the relation between the roller of the rocker arm and the contact surface of the rocking cam. Accordingly, when the rocking cam makes reciprocating motion, the rocking cam and the roller can be always brought into contact with each other. This eliminates a situation where the rocking direction of the rocking cam and the rotation direction of the roller become opposite to each other, thereby making it possible to prevent adhesive wear between the contact surface and the roller (see, for example, Patent Document 1).

Patent Document 1: JP-A-2001-263015 (page 10, paragraph 0089, FIG. 24)

Disclosure of the Invention

Problem to be Solved by the Invention

[0007]

However, in the case of the above-described valve mechanism for an internal combustion engine in which the rocker arm is rockably supported by the hydraulic lash adjustor, since the hydraulic lash adjustor is complicated in structure and requires a large number of steps for its manufacture or assembly, the hydraulic lash adjustor is expensive and thus drives up cost.

[0008]

Further, since the oil used for the lubrication of the internal combustion engine serves as the working fluid for the hydraulic lash adjustor, reliable operation is often hindered when, during high speed rotation of the internal combustion engine, in particular, air is sucked up into the oil or when the viscosity changes due to the oil temperature.

[0009]

In view of the above, the present invention has been made in order to solve the above-mentioned problems of the prior art. Accordingly, it is an object of the present invention to provide a valve mechanism for an internal combustion engine which is

simple in structure and prevents adhesive wear between the roller and the contact surface from occurring even when the internal combustion engine is rotating at high speed, thereby realizing high level of reliability through secure operation.

Means for Solving the Problem

[0010]

In order to attain the above object, the invention as described in Claim 1 provides a valve mechanism for an internal combustion engine, having: a cam including a cam surface having a base circle portion and a lift portion; and a roller that contacts the cam surface and rotates, the cam and the roller being adapted to make relative reciprocating motion to open and close an intake valve or an exhaust valve, in which at a time when the roller is located in the base circle portion, a gap for absorbing errors and thermal expansion of respective portions of a valve mechanism system is provided between components, excluding the roller that makes the relative reciprocating motion, on a downstream side in a force transmission path with respect to a contact portion between the roller and the cam surface, and in which a spring member is provided, for bringing the roller and the cam surface into constant contact with each other during the relative reciprocating motion between the cam and the roller.

[0011]

In the invention as described in Claim 2, in addition to the construction as described in Claim 1, the valve mechanism further includes: a roller supporting member that supports the roller and makes reciprocating motion; and a valve pressing member having a valve pressing portion for pressing the intake valve or the exhaust valve, and an abutting portion that abuts the roller supporting member, the valve pressing member being adapted to make reciprocating motion so as to operate in synchronization with the roller supporting member via the abutting portion, in which the spring member is provided between the roller supporting member and the valve pressing member, and exerts urging force so as to cause the abutting portion between

the roller supporting member and the valve pressing member to open. In the invention as described in Claim 3, in addition to the construction as described in Claim 2, the valve pressing member is a rocker arm pivotally supported by a pivot shaft so as to be rockable, and the valve supporting member is a roller arm pivotally supported on the pivot shaft.

[0012]

In the invention as described in Claim 4, in addition to the construction as described in Claim 3, an axial center of the pivot shaft of the roller arm is eccentric to an axial center of the pivot shaft of the rocker arm, and by rotating the pivot shaft of the rocker arm about its axial center, a position of the abutting portion between the rocker arm and the roller arm becomes variable, enabling a lift amount or the like of the valve to be variable.

[0013]

In the invention as described in Claim 5, in addition to the construction as described in Claim 3 or 4, the spring member is a leaf spring for urging the roller arm and the rocker arm so as to spread apart from each other with respect to the pivot shaft.

[0014]

The invention as described in Claim 6 provides a valve mechanism for an internal combustion engine, having: a shaft rotated by a crankshaft of the internal combustion engine; drive force transmitting means provided to the shaft; a rocking shaft provided coaxially or in parallel to the shaft; a rocking cam supported on the rocking shaft and is freely rockable by the drive force transmitting means; and a roller follower that is caused to make reciprocating motion by the rocking cam to open and close an intake valve or an exhaust valve of the internal combustion engine, in which the rocking cam makes reciprocating motion while rocking within a predetermined range about the rocking shaft, and the roller follower makes reciprocating motion within a predetermine range in synchronization with the rocking cam, in which one of the rocking cam and the roller

follower is provided with a roller for causing the roller follower to operate in synchronization with rocking motion of the rocking cam, and the other is provided with a contact surface with which the roller comes into contact, in which at a time when the roller is located in the base circle portion, a gap for absorbing errors and thermal expansion of respective portions of a valve mechanism system is provided between components, excluding the roller that makes the relative reciprocating motion, on a downstream side in a force transmission path with respect to a contact portion between the roller and the cam surface, and in which a spring member is provided, for bringing the roller and the contact surface into constant contact with each other during the reciprocating motion of the rocking cam and the roller follower.

[0015]

In the invention as described in Claim 7, in addition to the construction as described in Claim 6, the spring member has a torsion spring brought into fitting engagement with a rocker arm shaft that rockably supports a rocker arm having the roller, the torsion spring being locked onto the rocker arm at one end and locked onto a cylinder head main body at the other end and urging the rocker arm toward the rocking cam.

[0016]

In the invention as described in Claim 8, in addition to the construction as described in Claim 6, the spring member is provided between a rocker arm, which has the roller, and a cylinder head main body, and the spring member includes a coil spring for urging the rocker arm toward the rocking cam.

[0017]

The invention as described in Claim 9 provides a valve mechanism for an internal combustion engine, having: a cam including a cam surface having a base circle portion and a lift portion; and a roller that contacts the cam surface and rotates, the cam and the roller being adapted to make relative reciprocating motion to open and close an intake valve or an exhaust valve, in which at a time when the roller is located

in the base circle portion, a gap is provided between the roller that makes reciprocating motion and the cam surface, and braking means for restraining the roller from continuing to rotate due to inertia is provided.

[0018]

The invention as described in Claim 10 provides a valve mechanism for an internal combustion engine, having: a shaft rotated by a crankshaft of the internal combustion engine; drive force transmitting means provided to the shaft; a rocking shaft provided coaxially or in parallel to the shaft; a rocking cam supported on the rocking shaft and is freely rockable by the drive force transmitting means; and a roller follower that is caused to make reciprocating motion by the rocking cam to open and close an intake valve or an exhaust valve of the internal combustion engine, in which the rocking cam makes reciprocating motion while rocking within a predetermined range about the rocking shaft, and the roller follower makes reciprocating motion within a predetermine range in synchronization with the rocking cam, in which one of the rocking cam and the roller follower is provided with a roller for causing the roller follower to operate in synchronization with rocking motion of the rocking cam, and the other is provided with a contact surface with which the roller comes into contact, and in which braking means is provided, for restraining rotation of the roller due to inertia in a state in which the contact surface and the roller are not in contact with each other during the reciprocating motion of the rocking cam and the roller follower.

[0019]

In the invention as described in Claim 11, in addition to the construction as described in Claim 9 or 10, the braking means is arranged between the roller and the rocking cam or a rocker arm as the roller follower to which the roller is provided, and is a braking member for restraining the rotation of the roller due to inertia.

[0020]

The invention as described in Claim 12 provides a valve

mechanism for an internal combustion engine, that when a rotating cam is rotated, a roller makes reciprocating motion on an upper surface of a rocker arm, and the rocker arm is rocked by a pressing force exerted by the roller during the reciprocating motion, causing an intake valve or an exhaust valve to open and close, in which at a time when the valve is in a closed state, a gap for absorbing errors and thermal expansion of respective portions of a valve mechanism system is provided between the rocker arm and the valve, and in which a spring member is provided, for bringing the roller and the upper surface of the rocker arm into constant contact with each other during relative reciprocating motion between the upper surface of the rocker arm and the roller.

Effect of the Invention

[0021]

According to the invention as described in Claim 1 above, at the time when the roller is located in the base circle portion, a gap for absorbing errors and thermal expansion of respective portions of a valve mechanism system is provided between components, excluding the roller that makes the relative reciprocating motion, on a downstream side in a force transmission path with respect to a contact portion between the roller and the cam surface. Accordingly, since it is not necessary to use a hydraulic lash adjuster as is conventionally used, adhesive wear between the roller and the contact surface can be prevented by means of a simple structure and even when the internal combustion engine is rotating at high speed, thereby making it possible to achieve high level of reliability through secure operation.

[0022]

Further, there is provided a spring member for bringing the roller and the cam surface into constant contact with each other during the relative reciprocating motion between the cam and the roller. Accordingly, adhesive wear can be prevented merely by adding a simple structure.

[0023]

According to the invention as described in Claim 2, the valve mechanism further includes: a roller supporting member that supports the roller and makes reciprocating motion; and a valve pressing member having a valve pressing portion for pressing the intake valve or the exhaust valve, and an abutting portion that abuts the roller supporting member, the valve pressing member being adapted to make reciprocating motion so as to operate in synchronization with the roller supporting member via the abutting portion, and the spring member is provided between the roller supporting member and the valve pressing member and exerts urging force so as to cause the abutting portion between the roller supporting member and the valve pressing member to open. Accordingly, any spring member may be used as long as it has a stroke corresponding to the clearance provided between the roller supporting member and the valve pressing member, thereby allowing compact construction.

[0024]

According to the invention as described in Claim 3, the valve pressing member is a rocker arm pivotally supported by a pivot shaft so as to be rockable, and the valve supporting member is a roller arm pivotally supported on the pivot shaft. Accordingly, although the roller arm and the rocker arm are formed as separate components and the number of components thus increases, they are pivotally supported by the common pivot shaft, whereby the construction of the support structure can be simplified.

[0025]

According to the invention as described in Claim 4, an axial center of the pivot shaft of the roller arm is eccentric to an axial center of the pivot shaft of the rocker arm, and by rotating the pivot shaft of the rocker arm about its axial center, a position of the abutting portion between the rocker arm and the roller arm becomes variable, thereby enabling a lift amount or the like of the valve to be variable. Accordingly, adhesive wear can be prevented even in the case of a construction having a variable valve mechanism.

[0026]

According to the invention as described in Claim 5, the spring member is a leaf spring for urging the roller arm and the rocker arm so as to spread apart from each other with respect to the pivot shaft, and the use of the leaf spring allows a simple structure.

[0027]

According to the invention as described in Claim 6, the rocking cam makes reciprocating motion while rocking within a predetermined range about the rocking shaft, and the roller follower makes reciprocating motion within a predetermine range in synchronization with the rocking cam; one of the rocking cam and the roller follower is provided with a roller for causing the roller follower to operate in synchronization with rocking motion of the rocking cam, and the other is provided with a contact surface with which the roller comes into contact; at the time when the roller is located in the base circle portion, a gap for absorbing errors and thermal expansion of respective portions of a valve mechanism system is provided between components, excluding the roller that makes the relative reciprocating motion, on a downstream side in a force transmission path with respect to a contact portion between the roller and the cam surface; and there is provided a spring member for bringing the roller and the contact surface into constant contact with each other during the reciprocating motion of the rocking cam and the roller follower. Accordingly, since it is not necessary to use a hydraulic lash adjuster as is conventionally used, adhesive wear between the roller and the contact surface can be prevented by means of a simple structure and even when the internal combustion engine is rotating at high speed, thereby making it possible to achieve high level of reliability through secure operation.

[0028]

According to the invention as described in Claim 7, the spring member has a torsion spring brought into fitting engagement with a rocker arm shaft that rockably supports a rocker arm having

the roller, the torsion spring being locked onto the rocker arm at one end and locked onto a cylinder head main body at the other end and urging the rocker arm toward the rocking cam. Accordingly, the construction of the valve mechanism can be simplified to achieve a reduction in cost. Further, since the torsion spring is provided to the valve mechanism while being in fitting engagement with the rocker arm shaft, the assembly process is simplified, and it is possible to achieve compact construction of the valve mechanism.

[0029]

According to the invention as described in Claim 8, the spring member is provided between a rocker arm, which has the roller, and a cylinder head main body, and includes a coil spring for urging the rocker arm toward the rocking cam. Accordingly, it suffices to simply arrange the coil spring between the rocker arm and the cylinder head main body, whereby the assembly process for the valve mechanism can be simplified.

[0030]

According to the invention as described in Claim 9, at the time when the roller is located in the base circle portion, a gap is provided between the roller that makes reciprocating motion and the cam surface, and braking means for restraining the roller from continuing to rotate due to inertia is provided. Accordingly, since it is not necessary to use a hydraulic lash adjuster as is conventionally used, adhesive wear between the roller and the contact surface can be prevented by means of a simple structure and even when the internal combustion engine is rotating at high speed.

[0031]

According to the invention as described in Claim 10, the rocking cam makes reciprocating motion while rocking within a predetermined range about the rocking shaft, and the roller follower makes reciprocating motion within a predetermined range in synchronization with the rocking cam; one of the rocking cam and the roller follower is provided with a roller for causing the roller follower to operate in synchronization with rocking

motion of the rocking cam, and the other is provided with a contact surface with which the roller comes into contact; and braking means is provided, for restraining rotation of the roller due to inertia in a state in which the contact surface and the roller are not in contact with each other during the reciprocating motion of the rocking cam and the roller follower. Accordingly, since it is not necessary to use a hydraulic lash adjuster as is conventionally used, adhesive wear between the roller and the contact surface can be prevented by means of a simple structure and even when the internal combustion engine is rotating at high speed.

[0032]

According to the invention as described in Claim 11, the braking means is arranged between the roller and the rocking cam or a rocker arm as the roller follower to which the roller is provided, and is a braking member for restraining the rotation of the roller due to inertia. Accordingly, the construction of the valve mechanism can be simplified to achieve a reduction in cost. Further, since it suffices to simply dispose the restraining member in position, the assembly process is simplified, and it is possible to achieve compact construction of the valve mechanism.

[0033]

According to the invention as described in Claim 12, at a time when the valve is in a closed state, a gap for absorbing errors and thermal expansion of respective portions of a valve mechanism system is provided between the rocker arm and the valve. Accordingly, since it is not necessary to use a hydraulic lash adjuster as is conventionally used, adhesive wear between the roller and the cam surface can be prevented by means of a simple structure and even when the internal combustion engine is rotating at high speed, thereby making it possible to achieve high level of reliability through secure operation.

[0034]

Further, there is provided a spring member for bringing the roller and the upper surface of the rocker arm into constant

contact with each other during relative reciprocating motion between the upper surface of the rocker arm and the roller. Accordingly, adhesive wear can be prevented merely by adding a simple structure.

Brief Description of the Drawings

[0035]

FIG. 1 is a longitudinal sectional view of the main portion of valve mechanism for an internal combustion engine according to Embodiment 1 of the present invention, illustrating a state in which an intake valve is closed.

FIG. 2 is a longitudinal sectional view of the valve mechanism for the internal combustion engine according to Embodiment 1 of the present invention, illustrating a state in which the intake valve is open.

FIG. 3 is a longitudinal sectional view of the main portion of valve mechanism for an internal combustion engine according to Embodiment 2 of the present invention, illustrating a state in which the intake valve is closed. ,

FIG. 4 is a longitudinal sectional view of a modification of the valve mechanism for the internal combustion engine according to Embodiment 2 of the present invention, illustrating a state in which the intake valve is closed.

FIG. 5 is a longitudinal sectional view of the main portion of valve mechanism for an internal combustion engine according to Embodiment 3 of the present invention, illustrating a state in which the intake valve is closed.

FIG. 6 is a longitudinal sectional view of the main portion of valve mechanism for an internal combustion engine according to Embodiment 4 of the present invention, illustrating a state in which the intake valve is closed.

FIG. 7 is a longitudinal sectional view of the main portion of valve mechanism for an internal combustion engine according to Embodiment 5 of the present invention, illustrating a state in which the intake valve is closed.

FIG. 8 is a longitudinal sectional view of the main portion of valve mechanism for an internal combustion engine

according to Embodiment 6 of the present invention, illustrating a state in which the intake valve is closed.

FIG. 9 is a longitudinal sectional view of the main portion of valve mechanism for an internal combustion engine according to Embodiment 7 of the present invention, illustrating a state in which the intake valve is closed.

FIG. 10 is a longitudinal sectional view of the main portion of valve mechanism for an internal combustion engine according to Embodiment 8 of the present invention, illustrating a state in which the intake valve is closed.

FIG. 11 is an enlarged view, as seen in the direction of the arrow B of FIG. 8, of the main portion of a rocker arm according to Embodiment 8 of the present invention.

Best Mode for Embodying the Invention

[0036]

Hereinafter, embodiments of the present invention will be described with reference to the drawings.

[Embodiment 1 of the Invention]

[0037]

FIGS. 1 and 2 are views according to Embodiment 1 of the present invention. FIG. 1 is a longitudinal sectional view of the main portion of a valve mechanism for an internal combustion engine, illustrating a state in which an intake valve is closed. FIG. 2 is a longitudinal sectional view of the main portion of the valve mechanism for the internal combustion engine, illustrating a state in which the intake valve is open.

[0038]

First, the construction will be described. In FIG. 1, reference numeral 1 denotes the valve mechanism for an intake valve 11 of the internal combustion engine. The valve mechanism 1 has a camshaft 2 as a "shaft" that is rotated by a crankshaft (not shown) of the internal combustion engine, a rotating cam 3 serving as "drive force transmitting means" that is provided to the camshaft 2, a rocking shaft 4 provided in parallel to the camshaft 2, a rocking cam 5 that is supported on the rocking shaft 4 and can be freely rocked by the rotating cam 3, and a

rocker arm 6 that can be freely rocked (can be freely reciprocated) by the rocking cam 5 and serving as a "cam follower" for opening and closing the intake valve 11 of the internal combustion engine.

[0039]

It should be noted that the construction of the valve mechanism is the same between the intake valve 11 and exhaust valve of the internal combustion engine. Accordingly, Embodiment 1 will focus on the mechanism on the intake valve side, and the description of the mechanism on the exhaust valve side will be omitted.

[0040]

As shown in FIG. 1, the camshaft 2 is arranged with its longitudinal direction extending toward the front and back (i.e. in the direction perpendicular to the sheet plane) of FIG. 1. The camshaft 2 is rotated about a center axis O1 at 1/2 of a rotational speed of that of the crankshaft in the internal combustion engine.

[0041]

Further, the rotating cam 3 is fixed onto the outer peripheral surface of the camshaft 2 and, as shown in FIG. 1, the outer peripheral portion thereof is configured with a base surface 3a that is arc-shaped in plan view, and a nose surface 3b projecting from the base surface 3a.

[0042]

A center axis O2 of the rocking shaft 4 is in parallel to the center axis O1 of the camshaft 2. That is, the rocking shaft 4 is arranged at a position different from that of the camshaft 2 so as to be parallel to the camshaft 2.

[0043]

The rocking cam 5 is in fitting engagement with the outer peripheral surface of the rocking shaft 4, and is supported so as to be rockable about the center axis O2 of the rocking shaft 4. Further, formed in the lower end portion of the rocking cam 5 is a contact surface 5a which is curved in a concave shape on the rocking shaft 4 side and on which a roller 14 provided

to a rocker arm 6 that will be described later can roll.

[0044]

Further, a through-hole 5c is formed in the middle portion of the rocking cam 5. A roller shaft 7 having a center axis 03 in parallel to the center axis 02 of the rocking shaft 4 is rotatably provided in the through-hole 5c. Provided to the roller shaft 7 is a roller 8 that contacts and operates in synchronization with the base surface 3a or the nose surface 3b of the rotating cam 3.

[0045]

As shown in FIG. 1, the roller 8 is formed in a circular shape as seen in side view and arranged on the outer peripheral surface of the roller shaft 7. The outer peripheral surface of the roller 8 is capable of sliding on the base surface 3a and nose surface 3b of the rotating cam 3.

[0046]

Further, a torsion spring 15 for urging the rocking cam 5 toward the rotating cam 3 side is in fitting engagement with the rocking shaft 4. In more detail, one end of the torsion spring 15 is locked onto the rocking cam 5, and the other end thereof is locked onto a cylinder head main body 19. Thus, the rocking cam 5 is urged to the rotating cam 3 side by the urging force of the torsion spring 15, so that the outer peripheral surface of the roller 8 is in constant contact with the base surface 3a or nose surface 3b of the rotating cam 3, and the rocking cam 5 rocks within a predetermined range in synchronization with the rotating cam 3 to make reciprocating motion.

[0047]

Further, the rocker arm 6 is disposed below the rocking cam 5 while being rockably supported on a rocker arm shaft 12 having a center axis 05 that is in parallel to the center axis 02 of the rocking shaft 4.

[0048]

The rocker arm 6 has at its distal end portion a valve pressing portion 6a for pressing the upper surface of a shim 23 fitted on the intake valve 11 which will be described later. Further,

provided in the middle portion of the rocker arm 6 is a roller shaft 13 having a center axis O6 in parallel to the center axis O5 of the rocker arm shaft 12.

[0049]

A roller 14 is rotatably provided to the roller shaft 13. The outer peripheral surface of the roller 14 is capable of contacting and sliding on the cam surface 5a of the rocking cam 5. The cam surface 5a has a base circle portion 5e, a lift portion 5f, and a ramp portion 5g connecting therebetween.

[0050]

Further, the rocker arm shaft 12 has the torsion spring 17 as a "spring member" for bringing the roller 14 and the cam surface 5a into contact with each other.

[0051]

The torsion spring 17 is in fitting engagement with the rocker arm shaft 12. One end 17a thereof is locked onto a lower surface portion 6b of the rocker arm 6, and the other end 17b is locked onto the cylinder head main body 19 and urging the rocker arm 6 to the rocking cam 5 side. Further, the spring force of the torsion spring 17 is set to a level capable of urging the rocker arm 6 to the rocking cam 5 side to thereby press the roller 14 against the cam surface 5a of the rocking cam 5 while, when the rocking cam 5 is rocked, allowing the rocker arm 6 to rock in synchronization with this rocking movement. Thus, the rocker arm 6 is urged to the rocking cam 5 side by the urging force of the torsion spring 17, so the outer peripheral surface of the roller 14 is held in constant contact with the cam surface 5a of the rocking cam 5, and the rocker arm 6 rocks within a predetermined range in synchronization with the rocking cam 5 to make reciprocating motion.

[0052]

Further, the intake valve 11 pressed on by the valve pressing portion 6a is arranged so as to be vertically movable below the valve pressing portion 6a of the rocker arm 6 and at a position where a predetermined gap A is provided in order to prevent the closure of the intake valve 11 from becoming unreliable due to

the thermal expansion of the intake valve 11 caused by an increase in the temperature of the internal combustion engine.

[0053]

When the gap (A) is too large, noise is generated or the intake valve 11 cannot be opened with reliability. Further, when the gap (A) is too small, the intake valve 11 cannot be reliably closed due to upward jumping of the valve. Thus, the gap (A) is set by taking into account the rocking range of the rocker arm 6, the thermal expansion of the intake valve 11, and the like.

[0054]

The intake valve 11 has a collet 20 and an upper retainer 21 that are provided in its upper portion. A valve spring 22 is arranged below the upper retainer 21. The intake valve 11 is urged toward the rocker arm 6 side by the urging force of the valve spring 22. Further, the shim 23 for adjusting the valve clearance is fitted on the upper end portion of the intake valve 11.

[0055]

Accordingly, the intake valve 11 can be vertically moved by rocking the rocker arm 6 in synchronization with the rocking motion of the rocking cam 5, thereby making it possible to open and close the intake valve 11.

[0056]

Next, the operation of the valve mechanism 1 constructed as described above will be described in detail with reference to FIGs. 1 and 2.

[0057]

The valve mechanism 1 operates as described below to bring the intake valve 11 from the closed state to the open state.

[0058]

First, in the valve mechanism 1, the camshaft 2 is rotated by the crankshaft of the internal combustion engine at 1/2 of a rotational speed of that of the crankshaft. The rotation of the camshaft 2 causes the rotating cam 3 to be rotated in the direction indicated by the arrow in FIG. 1 about the center axis

01 of the camshaft 2.

[0059]

Further, as shown in FIG. 1, while the roller 8 provided to the rocking cam 5 is in contact with the base surface 3a of the rotating cam 3, the rocking cam 5 is not rocked to the intake valve 11 side, the rocker arm 6 is urged to the rocking cam 5 side by the urging force of the torsion spring 17, and also the intake valve 11 is urged to the rocker arm 6 side by the urging force of the valve spring 22. Thus, there is no lift on the intake valve 11 so the intake valve 11 is in the closed state.

[0060]

Then, when the rotating cam 3 is rotated via the camshaft 2 by the crankshaft of the internal combustion engine and, as shown in FIG. 2, the roller 8 is pressed on by the nose surface 3b, the rocking cam 5 is pressed via the roller shaft 7, causing the rocking cam 5 to rock counterclockwise in FIG. 1 against the urging force of the torsion spring 15.

[0061]

When the rocking cam 5 is further rocked counterclockwise in FIG. 1, the roller 14, which is in contact with the cam surface 5a of the rocking cam 5 due to the urging force of the torsion spring 17, operates in synchronization with the rocking cam 5 so as to slide on the cam surface 5a while rotating clockwise in FIG. 1 to be pressed to the intake valve 11 side. This causes the rocker arm 6 to be rocked via the roller shaft 13 to the intake valve side against the urging force of the torsion spring 17.

[0062]

Then, the rocker arm 6 rocked to the intake valve 11 side presses on the upper surface of the shim 22 by means of the valve pressing portion 6a formed at the distal end portion thereof, thereby pushing down the intake valve 11 to open the intake valve 11. In this way, the rocker arm 6 is urged to the rocking cam 5 side by the torsion spring 17 and the valve spring 22, and the roller 14 of the rocker arm 6 is in constant contact with the cam surface 5a of the rocking cam 5, so the rocking direction

of the rocking cam 5 and the rotation direction of the roller 14 are the same at all times, and the intake valve 11 can be brought into the open state as shown in FIG. 2.

[0063]

Next, the valve mechanism 1 operates as described below to bring the intake valve 11 from the open state to the closed state.

[0064]

First, in the state where the roller 8 is pressed by the nose surface 3b of the rotating cam 3 to bring the intake valve 11 into the opened state as shown in FIG. 2 because of the operation of the valve mechanism 1 as described above, when the rotating cam 3 is rotated via the camshaft 2 by the crankshaft of the internal combustion engine, as shown in FIG. 1, this causes the roller 8 of the rocking cam 5 previously located on the nose surface 3b of the rotating cam 3 to slide on the base surface 3a. Then, due to the urging force of the torsion spring 15, with the roller 8 being held in contact with the rotating cam 3, the rocking direction of the rocking cam 5 is reversed so that the rocking cam 5 is rocked clockwise in FIG. 1.

[0065]

Then, when the rocking cam 5 is reversed in its rocking direction to rock clockwise in FIG. 1, the rocker arm 6 is rocked to the rocking cam 5 side with the roller 14 being held in contact with the cam surface 5a of the rocking cam 5 by the urging force of the torsion spring 17. Since the roller 14 is in contact with the cam surface 5a of the rocking cam 5 at this time, simultaneously with the reversing of the rocking direction of the rocking cam 5, the rotation of the roller 14 is reversed from the clockwise rotation in FIG. 1 to the counterclockwise rotation in FIG. 1, causing the roller 14 to roll on the cam surface 5a.

[0066]

Then, when the rocker arm 6 is rocked to the rocking cam 5 side, the intake valve 11 is urged to the rocker arm 6 side by the urging force of the valve spring 22, causing the intake valve 11 to be closed. In this way, the rocker arm 6 is urged to the

rocking cam 5 side by the torsion spring 17, and the roller 14 of the rocker arm 6 is in constant contact with the cam surface 5a of the rocking cam 5, so the rocking direction of the rocking cam 5 and the rotation direction of the roller 14 are the same at all times, and the intake valve 11 can be brought into the closed state as shown in FIG. 1.

[0067]

Since the roller 14 is held in constant press contact with the cam surface 5a of the rocking cam 5 by the torsion spring 17, and the rocking direction of the rocking cam 5 and the rotation direction of the roller 14 are made to be the same at all times, it is possible to prevent adhesive wear from occurring due to the reversing of the rocking direction of the rocking cam 5 and of the rotation direction of the roller 14.

[0068]

That is, conventionally, when the valve state shifts from the open state to the closed state, and the roller is moved up to the base circle portion, if a gap is present between the roller and the base circle portion, the roller continues to rotate in a predetermined direction. Then, as the valve state shifts to the valve open state from this state, the roller abuts the ramp portion and the above-mentioned rotation is stopped. At the same time, the roller is rapidly rotated in the reverse direction. As a result, adhesive wear occurs.

[0069]

In contrast, according to the present invention, even when a change occurs from the valve open state as shown in FIG. 2, in which the roller 14 is pressed on by the lift portion 5f of the rocking cam 5, to the valve closed state as shown in FIG. 1 in which the roller 14 has moved to the base circle portion 5e of the rocking cam 5, the torsion spring 17 allows the roller 14 to move while being in constant contact with the base circle portion 5e. Further, the gap (A) is adapted to be present at a downstream-side portion, that is, between the valve pressing portion 6a of the rocker arm 6 and the intake valve 11 in this case. Thus, unlike in the related art, the roller 14 does not

keep rotating in a predetermined direction by inertia in this valve closed state. Then, when the valve shifts from the closed state to the open state again, as the roller 14 moves from the base circle portion 5e to the lift portion 5f via the ramp portion 5g, the roller 14 rolls from a position on the base circle portion 5e onto the lift portion 5f. Thus, the roller 14 does not undergo rapid reverse rotation as it moves from the base circle portion 5e to the lift portion 5f as is the case with the related art, thereby making it possible to prevent adhesive wear from occurring.

[0070]

It should be noted that while the roller 14 is provided to the rocker arm 6, and the cam surface 5a with which the roller 14 comes into contact is formed in the lower end portion of the rocking cam 5; however, the present invention is not limited to this construction. Also in the case where the roller 14 is provided to the lower end portion of the rocking cam 5, and the cam surface 5a with which the roller 14 comes into contact is formed in the upper end portion of the rocker arm 6, the rocker arm 6 can be rocked by the rocking cam 5 without adhesive wear occurring between the roller 14 and the cam surface 5a.

[0071]

In the valve mechanism 1 for an internal combustion engine constructed as described above, the rocking cam 5, which makes reciprocating motion while rocking within a predetermined range about the rocking shaft 4, is provided with the cam surface 5a with which the roller 14 comes into contact, and the rocker arm 6, which makes reciprocating motion while rocking within a predetermined range in synchronization with the rocking cam 5, is provided with the roller 14 for operating the rocker arm 6 in synchronization with the rocking motion of the rocking cam 5. Further, since the valve mechanism 1 has the torsion spring 17 for bringing the roller 14 and the cam surface 5a into constant contact with each other during the reciprocating motion of the rocking cam 5 and rocker arm 6, it is not necessary to use a hydraulic lash adjuster as is conventionally used. Accordingly,

adhesive wear between the roller 14 and the cam surface 5a can be prevented by means of a simple structure and even when the internal combustion engine is rotating at high speed, thereby making it possible to achieve high level of reliability through secure operation.

[0072]

Further, the torsion spring 17 is in fitting engagement with the rocker arm shaft 12 that rockably supports the rocker arm 6, with the one end 17a thereof being locked onto the rocker arm 6 and the other end 17b being locked onto the cylinder head main body 19, and urges the rocker arm 6 to the rocking cam 5 side. Accordingly, the valve mechanism can be simplified in structure to achieve a reduction in cost. Further, since the torsion spring 17 is provided to the valve mechanism 1 while in fitting engagement with the rocker arm shaft 12, the assembly process can be simplified, thereby achieving compact construction of the valve mechanism 1.

[0073]

It should be noted that while in Embodiment 1 the rotating cam 3 of the camshaft 2 is used as the "drive force transmitting means", this should not be construed restrictively. The drive force from a shaft not provided with the rotating cam 3 may be transmitted to the rocking cam 5 via a link. Further, while the rocker arm 6 is used as the "cam follower", the rocker arm 6 may not be used and the drive force from the rocking cam 5 may be directly transmitted to the valve 11 side via the roller 8.

[Embodiment 2 of the Invention]

[0074]

FIGs. 3 and 4 are longitudinal sectional views of the main portion of a valve mechanism for an internal combustion engine according to Embodiment 2 of the present invention, illustrating a state in which the intake valve is closed.

[0075]

In Embodiment 2, unlike the spring member used in Embodiment 1, a coil spring 26 provided between the rocker arm 6 and the

cylinder head main body 19 is used to urge the rocker arm 6 to the rocking cam 5 side to bring the roller 14 provided to the rocker arm 6 and the cam surface 5a of the rocking cam 5 into contact with each other.

[0076]

Specifically, as shown in FIG. 3, the coil spring 26 is arranged so as to be substantially in parallel to the intake valve 11. One end 26a thereof is locked onto the lower surface portion 6b of the rocker arm 6, and the other end 26b is locked onto the cylinder head main body 19. The coil spring 26 urges the rocker arm 6 to the rocking cam 5 side. Further, as in Embodiment 1, the spring force of the coil spring 26 is set to a level capable of urging the rocker arm 6 to the rocking cam 5 side to press the roller 14 against the cam surface 5a of the rocking cam 5 while, when the rocking cam 5 is rocked, to allow the rocker arm 6 to rock in synchronization with this rocking movement. Thus, the rocker arm 6 is urged to the rocking cam 5 side by the urging force of the coil spring 26, so the outer peripheral surface of the roller 14 is held in constant contact with the cam surface 5a of the rocking cam 5.

[0077]

It should be noted that while in Embodiment 2 the coil spring 26 is provided between the lower surface portion 6b of the rocker arm 6 and the cylinder head main body 19 to bring the outer peripheral surface of the roller 14 into contact with the cam surface 5a of the rocking cam 5, the present invention is not limited to this construction. As shown in FIG. 4, the rocker arm 6 is formed in the shape of a seesaw that rocks about the rocker arm shaft 12, and, as described above, the valve pressing portion 6a is formed at the distal end portion of one end portion 6c of the rocker arm 6, with the roller shaft 13 and the roller 14 being provided between the valve pressing portion 6a and the rocker arm shaft 12. Further, by providing the coil spring 26 between the upper surface portion of the other end portion 6d and the cylinder head main body 19, with the one end 26a thereof being onto the upper surface portion of the rocker arm 6 and

the other end 26b thereof being locked onto the cylinder head main body 19, the rocker arm 6 is urged to the rocking cam 5 side, thereby making it possible to bring the roller 14 provided to the rocker arm 6 into contact with the cam surface 5a of the rocking cam 5.

[0078]

While the valve mechanism 1 for an internal combustion engine constructed as described above uses the coil spring 26 that is different from the spring member according to Embodiment 1, an urging force acts on the roller 14 in the same direction as that in Embodiment 1. Thus, since Embodiment 2 is of the same operation as Embodiment 1 in this regard, description of the operation of Embodiment 2 will be omitted.

[0079]

Further, since the spring member has the coil spring 26 provided between the rocker arm 6 and the cylinder head main body 19 and urging the rocker arm 6 to the rocking cam 5 side, the roller 14 and the cam surface 5a can be brought into contact with each other by simply arranging the coil spring 26 between the rocker arm 6 and the cylinder head main body 19, whereby the assembly process for the valve mechanism 1 can be simplified.

[0080]

Otherwise, Embodiment 2 is of the same construction and operation as Embodiment 1 of the present invention, so repetitive description will not be repeated.

[Embodiment 3 of the Invention]

[0081]

FIG. 5 is a longitudinal sectional view of the main portion of valve mechanism for an internal combustion engine according to Embodiment 3 of the present invention, illustrating a state in which the intake valve is closed.

[0082]

The valve mechanism 1 for an internal combustion engine according to Embodiment 3 is capable of adjusting the lift amount or the like of each valve by making the rocking shaft 4 movable to a predetermined position.

[0083]

Specifically, as shown in FIG. 5, a roller 33 is arranged on the outer peripheral surface of the rocking shaft 4. The roller 33 is in contact with a guide portion 19a formed in the cylinder head main body 19 for guiding the rocking shaft 4 to a predetermined position. Further, the rocking shaft 4 is provided to the cylinder head main body 19 such that, when the rocking cam 5 is pressed by a control cam 34 that will be described next, the rocking shaft 4 can move in synchronization with the rocking cam 5 within a range from a position indicated by the solid line in FIG. 5 to that indicated by the chain double-dashed line in FIG. 5.

[0084]

The control cam 34 is fixed onto the outer peripheral surface of a control shaft 35 provided in parallel to the camshaft 2. Further, the outer peripheral portion of the control cam 34 contacts the rocking cam 5 and is formed in a configuration allowing the rocking shaft 4 to be guided to a predetermined position by rotating the control cam 34 in a predetermined angle.

[0085]

Further, an actuator (not shown) for rotating the control shaft 35 within a predetermined angle range about a center axis 08 of the control shaft 35 is connected to one end portion of the control shaft 35. Connected to the actuator is control means (not shown) for controlling the angle of the actuator according to the operational state of the internal combustion engine.

[0086]

Further, the rocker arm 6, which makes reciprocating motion while rocking within a predetermined range in synchronization with the rocking cam 5, is of the same construction as that of Embodiment 1. That is, the rocker arm 6 has the valve pressing portion 6a formed therein, is provided with the roller shaft 13 and the roller 14, and is rockably supported on the rocker arm shaft 12.

[0087]

Further, as in Embodiment 1, the rocker arm shaft 12 is provided

with the torsion spring 17 as a spring member for bringing the roller 14 and the cam surface 5a into constant contact with each other.

[0088]

Thus, when the control shaft 35 is turned by a predetermined angle by the actuator, the control cam 34 is rotated by a predetermined angle about the center axis O8 of the control shaft 35. Further, when the control cam 34 is rotated by the predetermined angle, by the control cam 34, the roller 33 is caused via the rocking cam 5 to slide on the guide portion 19a of the cylinder main body so as to be moved, for example, from the position indicated by the solid line in FIG. 5 to a predetermined position indicated by the chain double-dashed line in FIG. 5. Then, as the rocking shaft 4 is moved, the position of the cam surface 5a of the rocking cam 5 changes. The rocking amount of the rocker arm 6 can be thus changed, which makes it possible to adjust the lift amount or the like of the intake valve 11 that is vertically moved by the rocker arm 6.

[0089]

It should be noted that while in Embodiment 3 the roller 14 and the cam surface 5a are brought into contact with each other by using the same torsion spring 17 as that of Embodiment 1 as the spring member, this should not be construed restrictively. For instance, as the same spring member as that of Embodiment 2, the coil spring 26 may be used to bring the roller 14 and the cam surface 5a into contact with each other.

[0090]

Also with the valve mechanism 1 constructed as described above, which makes the lift amount or the like of each valve variable by moving the rocking shaft 4 to a predetermined position, the rocker arm 6 is urged to the rocking cam 5 side by the torsion spring 17, so even when the rocking shaft 4 has been moved to the predetermined position, and the position of the cam surface 5a of the rocking cam 5 changes, the roller 14 of the rocker arm 6 and the cam surface 5a of the rocking cam 5 come into contact with each other. Adhesive wear can be thus prevented.

[0091]

Otherwise, Embodiment 3 is of the same construction and operation as Embodiment 1 of the present invention, so repetitive description will not be repeated.

[Embodiment 4 of the Invention]

[0092]

FIG. 6 is a longitudinal sectional view of the main portion of valve mechanism for an internal combustion engine according to Embodiment 4 of the present invention, illustrating a state in which the intake valve is closed.

[0093]

Embodiment 4 provides the valve mechanism 1 for an internal combustion engine in which the rotating cam 3 has a tapered configuration, and the contact position between the outer peripheral portion of the rotating cam 3 and the rocking cam 5 is changed by moving the rotating cam 3 in the direction of the center axis O1 of the camshaft 2, thereby making it possible to adjust the lift amount or the like of each valve.

[0094]

Specifically, as shown in FIG. 6, the rotating cam 3 is fixed onto the outer peripheral surface of the camshaft 2. The outer peripheral portion of the rotating cam 3 is constructed with the base surface 3a that is arc-shaped in plan view, and the nose surface 3b projecting from the base surface 3a. Further, the rotating cam 3 is tapered as it extends toward the front and back (i.e. in the direction perpendicular to the sheet plane) of FIG. 6. That is, the base surface 3a and nose surface 3b of the outer peripheral portion of the rotating cam 3 are inclined with respect to the center axis O1 of the camshaft 2.

[0095]

Further, an actuator (not shown) for moving the camshaft 2 within a predetermined range in the direction of the center axis O1 is connected to one end portion of the camshaft 2. Connected to the actuator is control means (not shown) for controlling the angle of the actuator according to the operational state of the internal combustion engine.

[0096]

Further, the outer peripheral surface of the roller 8 provided to the rocking cam 5 rocked by the rotating cam 3 is capable of sliding on the base surface 3a and nose surface 3b of the rotating cam 3 formed in the tapered configuration.

[0097]

Further, the rocker arm 6, which makes reciprocating motion while rocking within a predetermined range in synchronization with the rocking cam 5, is of the same construction as that of Embodiment 1. That is, the rocker arm 6 has the valve pressing portion 6a formed therein, is provided with the roller shaft 13 and the roller 14, and is rockably supported on the rocker arm shaft 12.

[0098]

Further, as in Embodiment 1, the rocker arm shaft 12 is provided with the torsion spring 17 as a spring member for bringing the roller 14 and the cam surface 5a into constant contact with each other.

[0099]

Thus, when the camshaft 2 moves within a predetermined range in the direction of the center axis 01 by the actuator, the rotating cam 3 moves within a predetermine range in the direction of the center axis 01 of the camshaft 2. Further, since the rotating cam 3 is formed in the tapered configuration, when the rotating cam 3 is moved with the predetermined range, the rocking cam 5 is caused via the roller shaft 7 and the roller 8 to move, for example, from the position indicated by the solid line in FIG. 6 to a predetermined position indicated by the double-dashed chain line in FIG. 6. Then, when the rocking cam 5 has been moved to the predetermined position, the position of the cam surface 5a of the rocking cam 5 changes. Therefore, the rocking amount of the rocker arm 6 can be changed, which makes it possible to adjust the lift amount or the like of the intake valve 11 that is vertically moved by the rocker arm 6.

[0100]

It should be noted that while in Embodiment 4 the roller 14

and the cam surface 5a are brought into contact with each other by using the same torsion spring 17 as that of Embodiment 1 as the spring member, this should not be construed restrictively. For instance, as the same spring member as that of Embodiment 2, the coil spring 26 may be used to bring the roller 14 and the cam surface 5a into contact with each other.

[0101]

Also with the valve mechanism 1 constructed as described above, in which the rotating cam 3 is tapered, and the lift amount or the like of each valve variable is made variable by moving the rotating cam 3 in the direction of the center axis O1 of the camshaft 2 and changing the contact position between the outer peripheral portion of the rotating cam 3 and the rocking cam 5, the rocker arm 6 is urged to the rocking cam 5 side by the torsion spring 17, so even when the rocking shaft 4 has been moved to the predetermined position, and the position of the cam surface 5a of the rocking cam 5 changes, the roller 14 of the rocker arm 6 and the cam surface 5a of the rocking cam 5 come into contact with each other. Adhesive wear can be thus prevented.

[0102]

Otherwise, Embodiment 4 is of the same construction and operation as Embodiment 1 of the present invention, so repetitive description will not be repeated.

[Embodiment 5 of the Invention]

[0103]

FIG. 7 is a longitudinal sectional view of the main portion of valve mechanism for an internal combustion engine according to Embodiment 5 of the present invention, illustrating a state in which the intake valve is closed.

[0104]

In the valve mechanism 1 for an internal combustion engine according to Embodiment 5 the roller shaft 7 provided to the rocking cam 5 with the roller 8 that comes into contact with the rotating cam 3 is moved within a predetermined range to make the relative distance between the center axis O3 of the roller

shaft 7 and the center axis O2 of the rocking shaft 4 variable, thereby making it possible to adjust the lift amount or the like of each valve.

[0105]

Specifically, as shown in FIG. 7, the through-hole 5c through which the roller shaft 7 of the rocking cam 5 is penetrated is formed along the longitudinal direction of the roller shaft 7 so as to guide the roller shaft 7 over a predetermined distance. The guiding direction is inclined with respect to the radial direction of the camshaft 2.

[0106]

Further, the valve mechanism 1 is provided with a variable roller mechanism for guiding the roller shaft 7 inserted through the through-hole 5c over a predetermined distance. The variable abutment portion mechanism has an eccentric shaft 9 fixedly provided onto the rocking shaft 4, and an arm 10 whose one end portion 10a is connected to the roller shaft 7 and the other end portion 10b is connected to the eccentric shaft 9.

[0107]

The eccentric shaft 9 is provided to the rocking shaft 4 in such a manner that a center axis O4 thereof is located in parallel and eccentrically to the center axis O2 of the rocking shaft 4.

[0108]

Further, an actuator (not shown) for rotating the rocking shaft 4 within a predetermined angle range about the center axis O2 is connected to one end portion of the rocking shaft 4. Connected to the actuator is control means (not shown) for controlling the angle of the actuator according to the operational state of the internal combustion engine.

[0109]

The arm 10 is formed in a configuration allowing the distance between the center axis O3 of the roller shaft 7 and the center axis O4 of the eccentric shaft 9 to be kept constant.

[0110]

Thus, when the rocking shaft 4 is rotated by a predetermined

angle by the actuator, the eccentric shaft 9 provided to the rocking shaft 4 is turned by a predetermined angle about the center axis 02 of the rocking shaft 4, and the roller shaft 7 is operated in synchronization with this turning movement through the arm 10. Then, by means of the arm 10, the roller shaft 7 can be moved within the guide portion 5b while keeping the distance between the center axis 03 of the roller shaft 7 and the center axis 04 of the eccentric shaft 9 constant, whereby the relative distance between the center axis 02 of the rocking shaft 4 and the center axis 03 of the roller shaft 7 can be made variable.

[0111]

Further, the rocker arm 6, which makes reciprocating motion while rocking within a predetermined range in synchronization with the rocking cam 5, is of the same construction as that of Embodiment 1. That is, the rocker arm 6 has the valve pressing portion 6a formed therein, is provided with the roller shaft 13 and the roller 14, and is rockably supported on the rocker arm shaft 12.

[0112]

Further, as in Embodiment 1, the rocker arm shaft 12 is provided with the torsion spring 17 as a spring member for bringing the roller 14 and the cam surface 5a into constant contact with each other.

[0113]

Thus, when the roller shaft 7 moves within a predetermined range, the relative distance between the center axis 03 of the roller shaft 7 and the center axis 02 of the rocking shaft 4 is made variable, whereby the rocking cam 5 is moved, for example, from the position indicated by the solid line in FIG. 7 to a predetermined position indicated by the chain double-dashed line in FIG. 7. Then, when the rocking cam 5 has been moved to the predetermined position, the position of the cam surface 5a of the rocking cam 5 changes. The rocking amount of the rocker arm 6 can be thus changed, which makes it possible to adjust the lift amount or the like of the intake valve 11 that is

vertically moved by the rocker arm 6.

[0114]

It should be noted that while in Embodiment 5 the roller 14 and the cam surface 5a are brought into contact with each other by using the same torsion spring 17 as that of Embodiment 1 as the spring member, this should not be construed restrictively. For instance, as the same spring member as that of Embodiment 2, the coil spring 26 may be used to bring the roller 14 and the cam surface 5a into contact with each other.

[0115]

Also with the valve mechanism 1 constructed as described above, in which the roller shaft 7 is moved within the predetermined range to make the relative distance between the center axis 03 of the roller shaft 7 and the center axis 02 of the rocking shaft 4 variable, thereby making the lift amount or the like of each valve variable, the rocker arm 6 is urged to the rocking cam 5 side by the torsion spring 17. Thus, even when the rocking shaft 4 has been moved to the predetermined position, and the position of the cam surface 5a of the rocking cam 5 changes, the roller 14 of the rocker arm 6 and the cam surface 5a of the rocking cam 5 come into contact with each other. Adhesive wear can be thus prevented.

[0116]

Otherwise, Embodiment 5 is of the same construction and operation as Embodiment 1 of the present invention, so repetitive description will not be repeated.

[Embodiment 6 of the Invention]

[0117]

FIG. 8 is a longitudinal sectional view of the main portion of valve mechanism for an internal combustion engine according to Embodiment 6 of the present invention, illustrating a state in which the intake valve is closed.

[0118]

In Embodiment 6, the rocker arm 6 serving as a "valve pressing member" is provided to the roller 14 that comes into contact with the cam surface 5a of the rocking cam 5. The rocker arm

6 has a roller arm 6c as a "roller supporting member" operated in synchronization with the rocking motion of the rocking cam 5, and a rocker arm main body 6d that rocks in synchronization with the roller arm 6c to vertically move the intake valve 11. Further, unlike the spring member used in Embodiment 1, a leaf spring 28 is used to urge the roller arm 6c to the rocking cam 5 side to bring the roller 14 and the cam surface 5a of the rocking cam 5 into contact with each other. Further, by making the roller arm 6c movable to a predetermined position to change the contact position between the roller 14 provided to the roller arm 6c and the cam surface 5a of the rocking cam 5, whereby the valve mechanism 1 for an internal combustion engine according to Embodiment 6 can adjust the lift amount or the like of each valve.

[0119]

Specifically, as shown in FIG. 8, an eccentric shaft 29 is fixedly provided to the rocker arm shaft 12 serving as a "pivot shaft" in such a manner that a center axis O7 thereof is located in parallel and eccentrically to the center axis O5 of the rocker arm shaft 12. The roller arm 6c of the rocker arm 6 is rotatably locked onto the eccentric shaft 29 by means of the leaf spring 28.

[0120]

The roller arm 6c has an engaging portion 6e formed at its one end. The engaging portion 6e engages with the outer peripheral surface of the eccentric shaft 29, and is so shaped as to be capable of sliding on the outer peripheral surface of the eccentric shaft 29. Further, formed at a position adjacent to the engaging portion 6e is a fitting engagement portion 6f with which the leaf spring 28 for integrally locking the roller arm 6c and the eccentric shaft 29 in place is brought into fitting engagement so as to prevent dislodging thereof. Further, a through-hole 6g, with which the roller shaft 13 supporting the roller 14 that slides on the cam surface 5a of the rocking cam 5 is brought into fitting engagement, is formed at the other end of the roller arm 6c. Formed below the through-hole 6g is

a pressing portion 6h for pressing the rocker arm main body 6d to the intake valve 11 side when the roller arm 6c rocks to the intake valve 11 side in synchronization with the rocking motion of the rocking cam 5.

[0121]

Further, the rocker arm main body 6d of the rocker arm 6 is rockably supported and arranged on the rocker arm shaft 12, and has the valve pressing portion 6a formed at its distal end portion. The valve pressing portion 6a presses on the upper surface of the shim 23 fitted on the intake valve 11. Further, a contact surface 6i with which a distal end portion 28b of the leaf spring 28, which will be described later, comes into contact is formed above the valve pressing portion 6a, and a pressing surface 6j pressed on by the pressing portion 6h formed in the rocker arm 6c is formed above the contact surface 6i.

[0122]

Further, the leaf spring 28 as a spring member is formed into a predetermined configuration by bending a planar spring at several locations. More specifically, the leaf spring 28 is formed in a configuration allowing fitting engagement with the fitting engagement portion 6f of the roller arm 6c and with the eccentric shaft 29, and has formed therein a locking portion 28a for integrally locking the roller arm 6c and the eccentric shaft 29 onto each other. Further, the distal end portion 28b on the roller arm 6c side extends to the rocker arm main body 6d side and comes into contact with the contact surface 6i formed in the rocker arm main body 6d. Further, the leaf spring 28 is formed in such a configuration as to urge the roller arm 6c and the rocker arm main body 6d so as to spread out from each other when the roller arm 6c and the eccentric shaft 29 are integrally locked onto each other by the locking portion 28a.

[0123]

Further, the predetermined gap (A) is provided between the valve pressing portion 6a of the roller arm 6c and the pressing surface 6j of the rocker arm main body 6d. The gap (A) is the same as the gap (A) of Embodiment 1 provided between the valve

pressing portion 6a and the intake valve 11.

[0124]

Thus, since the roller arm 6c is integrally locked onto the eccentric shaft 29 by the leaf spring 28 so that the roller arm 6c can slide on the outer peripheral surface of the eccentric shaft 29, when the rocking cam 5 is rocked, the roller arm 6c is caused via the roller 14 and the roller shaft 13 to rock to the intake valve 11 side against the urging force of the leaf spring 28. Further, as the rocker arm 6c is rocked to the intake valve 11 side, the pressing portion 6h of the roller arm 6c presses on the pressing surface 6j of the rocker arm main body 6d, causing the rocker arm main body 6d to rock to the intake valve 11 side, thereby making it possible to open and close the intake valve 11.

[0125]

Further, the roller arm 6c is urged to the rocking cam 5 side by the leaf spring 28, so the outer peripheral surface of the roller 14 provided to the roller arm 6c is held in constant contact with the cam surface 5a of the rocking cam 5.

[0126]

Further, an actuator (not shown) for rotating the rocker arm shaft 12 within a predetermined angle range about the center axis O5 is connected to one end portion of the rocker arm shaft 12. Connected to the actuator is control means (not shown) for controlling the angle of the actuator according to the operational state of the internal combustion engine.

[0127]

Thus, when the rocker arm shaft 12 is rotated by a predetermined angle by the actuator, the eccentric shaft 29 provided to the rocker arm shaft 12 is turned by a predetermined angle about the center axis O5 of the rocker arm shaft 12. Further, when the eccentric shaft 29 is turned by the predetermined angle, the roller arm 6c operating in synchronization therewith is moved, for example, from the position indicated by the solid line in FIG. 8 to a predetermined position indicated by the chain double-dashed line in FIG. 8. Then, once the roller arm 6c has

been moved to the predetermined position, the contact point where the cam surface 5a of the rocking cam 5 and the roller 14 provided to the roller arm 6c come into contact with each other changes. The rocking amount of the rocker arm main body 6d can be thus changed, which makes it possible to adjust the lift amount or the like of the intake valve 11 that is vertically moved by the rocker arm 6.

[0128]

Further, even in the case where a predetermined gap is not provided between the valve pressing portion 6a of the rocker arm main body 6d and the intake valve 11, the predetermined gap (A) provided between the pressing portion 6h and the pressing surface 6j allows the intake valve 11 to be reliably opened/closed even when, due to a rise in the temperature of the internal combustion engine, the intake valve 11 undergoes thermal expansion to cause upward jumping of the valve.

[0129]

Also with the valve mechanism 1 for an internal combustion engine constructed as described above, in which the lift amount or the like of each valve can be adjusted by making the roller arm 6c be movable to the predetermined position and changing the contact position between the roller 14 provided to the roller arm 6c and the cam surface 5a of the rocking cam 5, the roller arm 6c is urged toward the rocking cam 5 side by the leaf spring 28. Accordingly, when the roller arm 6c has been moved to the predetermined position and the contact position between the roller 14 and the cam surface 5a changes, the roller 14 of the rocker arm 6 and the cam surface 5a of the rocking cam 5 come into contact with each other, thereby making it possible to prevent adhesive wear.

[0130]

Further, any leaf spring 28 may be used as long as it has a stroke corresponding to the gap (A) provided between the roller arm 6c and the rocker arm 6, thereby allowing compact construction. Also, the use of the leaf spring 28 enables a simple structure.

[0131]

Further, although the roller arm 6c and the rocker arm 6 are formed as separate components and the number of components thus increases, they are pivotally supported by the common rocker arm shaft 12, whereby the construction of the support structure can be simplified.

[0132]

Otherwise, Embodiment 6 is of the same construction and operation as Embodiment 1 of the present invention, so repetitive description will not be repeated.

[Embodiment 7 of the Invention]

[0133]

FIG. 9 shows Embodiment 7 of the present invention and is a longitudinal sectional view of the main portion of valve mechanism for an internal combustion engine, illustrating a state in which the intake valve is closed.

[0134]

According to Embodiment 7, which is an embodiment corresponding to Claim 12, the rocker arm 6 is arranged so as to be vertically movable with respect to the cylinder head main body 19 via the rocker arm shaft 12; the shim 23 provided to the upper end portion of the intake valve 11 is pressed by the pressing portion 6a of the rocker arm 6, whereby the intake valve 11 is pushed downwards to open against the urging force of the valve spring 22.

[0135]

Further, a distal end portion 40b of a presser spring 40 as a "spring member" whose proximal end portion 40a is fixed to the cylinder head main body 19 is abutted against the lower surface portion 6b of the rocker arm 6, urging the rocker arm 6 so as to turn counterclockwise.

[0136]

A first roller 41a as a small "roller" of a roller member 41 is abutted against the upper surface 6c of the rocker arm 6. The first roller 41a and the upper surface 6c are adapted to make reciprocating motion relative to each other. Further, a

large second roller 41b of the roller member 41 is held in abutment between the rotating cam 3 and a control member 42. The control member 42 is constructed with a cam surface 42a having a ramp portion and a lift portion, and a base circle 42b. The upper surface 6c is formed concentrically with the base circle 42b. The first and second rollers 41a, 41b are adapted to rotate about an axis 41c.

[0137]

Thus, the roller member 41 is arranged between the three components of the rocker arm 6, the rotating cam 3, and the control member 42, and the rocker arm 6 is urged upwards by the presser spring 40, so the roller member 41 is always held in between the three components. Further, under the state where, as shown in FIG. 9, the intake valve 11 is closed, the second roller 41b of the roller member 41 is in contact with the base surface 3a of the rotating cam 3 and with the base circle 42b of the control member 42, and the first roller 41a of the roller member 41 is in contact with the upper surface 6c of the rocker arm 6, a gap (A) is produced between the pressing portion 6a of the rocker arm 6 and the intake valve 11.

[0138]

Further, the roller member 41 is urged by a return spring 43 to bring the roller member 41 into press contact with the rotating cam 3 and the control member 42.

[0139]

A proximal end portion 43a of the return spring 43 is attached onto the intake valve side 11, and a distal end portion 43b thereof is abutted against the roller member 41. Thus, the roller member 41 is urged by the return spring 43 into press contact with the rotating cam 3 and the control member 42.

[0140]

Next, the operation will be described.

[0141]

As the rotating cam 3 is turned in the direction indicated by the arrow in the drawing, the pressing position of the rotating cam 3 with respect to the roller member 41 shifts from

the base surface 3a to the nose surface 3b. The roller member 41 is thus pressed by the nose surface 3b, causing the roller member 41 to move downwardly in the drawing along the portion from the base surface 42b of the control member 42 to the cam surface 42a thereof against the urging force of the return spring 43.

[0142]

Due to this movement of the roller member 41, the upper surface 6c of the roller arm 6 is pressed, causing the rocker arm 6 to turn about the locker arm turn 12. Then, the pressing portion 6a of the rocker arm 6 is lowered to close the gap (A) and abuts against the shim 23 of the intake valve 11. By being pressed by the pressing portion 6a, the intake valve 11 is pushed down so as to open against the urging force of the valve spring 22.

[0143]

On the other hand, as the pressing position of the rotating cam 3 with respect to the roller member 41 shifts from the nose surface 3b to the base surface 3a, the rocker arm 6 is turned upwards by the urging force of the valve spring 22 to thereby close the intake valve 11.

[0144]

Further, since the rocker arm 6 is urged upwards by the presser spring 40, the roller member 41 is pressed upwards by the rocker arm 6, and the roller member 41 is pressed upwards by the return spring 43. Thus, the roller member 41 is always held in between the three components of the rotating cam 3, the rocker arm 6, and the control member 42.

[0145]

In this state, the gap (A) is formed between the pressing portion 6a of the rocker arm 6 and the shim 23 of the intake valve 11.

[0146]

As described above, when, with the intake valve 11 being closed, the second roller 41b of the roller member 41 is located at the base circle 42b of the control member 42, the gap (A) for absorbing errors and thermal expansion of respective portions

of the valve system is provided between the pressing portion 6a of the rocker arm 6 and the shim 23 of the intake valve 11. Therefore, since it is not necessary to use a hydraulic lash adjuster as is conventionally used, adhesive wear between the first roller 41a of the roller member 41 and the upper surface 6c of the rocker arm 6 can be prevented by means of a simple structure and even when the internal combustion engine is rotating at high speed, thereby making it possible to achieve high level of reliability through secure operation.

[0147]

Further, the presser spring 40 for bring the first roller 41a of the roller member 41 and the upper surface 6c of the rocker arm 6 into contact with each other during the relative reciprocating motion between the rocker arm 6 and the roller member 41 is provided, whereby adhesive wear can be prevented only by adding a simple structure.

[Embodiment 8 of the Invention]

[0148]

FIGs. 10 and 11 show Embodiment 8 of the present invention. FIG. 10 is a longitudinal sectional view of the main portion of valve mechanism for an internal combustion engine, illustrating a state in which the intake valve is closed, and FIG. 11 is an enlarged view of the main portion of the rocker arm as seen in the direction indicated by the arrow B of FIG. 10.

[0149]

In Embodiment 7, the rocker arm 6 has, instead of the spring member of Embodiment 1, braking means for restraining the roller 14 provided to the rocker arm 6 from rotating due to inertia under the state in which, during the reciprocating motion of the rocking cam 5 and the rocker arm 6, the cam surface 5a of the rocking cam 5 and the roller 14 are not in contact with each other .

[0150]

Further, as shown in FIGs. 10 and 11, as the braking means, a waved washer 37 as a restraining member is arranged between

the roller 14 and the rocker arm 6 to which the roller arm 14 is provided. Specifically, the waved washer 37 is arranged between the rocker arm 6 and the roller 14 while being arranged on the side surface side of the roller 14 so as to be in fitting engagement with the outer peripheral surface of the roller shaft 13.

[0151]

When the rocking cam 5 finishes its lift, and the cam surface 5a and the roller 14 are separated from each other, the roller 14 tries to keep rotating due to inertia; at this time, since the waved washer 37 is provided to the roller shaft 3, the rotation of the roller 14 is restrained due to the frictional resistance. Then, when the rocking cam 5 tries to start its lift again, and the cam surface 5a and the roller 14 come into contact with each other, since the relative speed between the rocking cam 5 and the roller 14 has been reduced, adhesive wear between the roller 14 and the cam surface 5a can be prevented.

[0152]

It should be noted that while in Embodiment 7 the rotation of the roller 14 due to inertia is restrained by bringing the waved washer 37 as the restraining member into fitting engagement with the roller shaft 13, there is no particular limitation as to the restraining member used as long as it is capable of restraining the rotation of the roller 14 due to inertia.

[0153]

In the valve mechanism 1 for an internal combustion engine constructed as described above, the cam surface 5a with which the roller 14 comes in contact is provided to the rocking cam 5 that makes reciprocating motion while rocking the rocking shaft 4 within the predetermined range, and the roller 14 for causing the rocker arm 6 to operate in synchronization with the rocking motion of the rocking cam 5 is provided to the rocker arm 6 that makes reciprocating motion while rocking within the predetermined range in synchronization with the rocking cam 5. The valve mechanism 1 also has the braking means for restraining

the rotation of the roller 14 due to inertia in the state where the cam surface 5a of the rocking cam 5 and the roller 14 are not in contact with each other during the reciprocating motion of the rocking cam 5 and the rocker arm 6, whereby it is not necessary to use a hydraulic lash adjustor as is conventionally used. Accordingly, adhesive wear between the roller 14 and the cam surface 5a can be prevented by means of a simple structure and even when the internal combustion engine is rotating at high speed.

[0154]

Further, the braking means used is the waved washer 37 that is arranged between the roller 14 and the rocking cam 5 or rocker arm 6 to which the roller 14 is provided, and serves as the restraining member for restraining the rotation of the roller 14 due to inertia. Accordingly, the construction of the valve mechanism can be simplified to allow a reduction in cost. Further, since the waved washer 37 is simply brought into fitting engagement with the roller shaft 13, whereby the assembly process can be simplified and it is possible to achieve compact construction of the valve mechanism 1.

[0155]

Otherwise, Embodiment 7 is of the same construction and operation as Embodiment 1 of the present invention, so repetitive description will not be repeated.

Description of Symbols

[0156]

- 1: valve mechanism
- 2: camshaft (shaft)
- 3: rotating cam (drive force transmitting means)
- 4: rocking shaft
- 5: rocking cam
- 5a: contact surface
- 6: rocker arm (roller follower)
- 11: intake valve
- 12: rocker arm shaft
- 14: roller

17: torsion spring (spring member)
17a: one end of torsion spring
17b: other end of torsion spring
19: cylinder head main body
26: coil spring (spring member)
28: leaf spring (spring member)
37: waved washer (braking means, braking member)
40: presser spring
41: roller member
41a: first roller (roller)
41b: second roller
A: gap

CLAIMS

1. A valve mechanism for an internal combustion engine, having: a cam including a cam surface having a base circle portion and a lift portion; and a roller that contacts the cam surface and rotates, the cam and the roller being adapted to make relative reciprocating motion to open and close an intake valve or an exhaust valve,

wherein at a time when the roller is located in the base circle portion, a gap for absorbing errors and thermal expansion of respective portions of a valve mechanism system is provided between components, excluding the roller that makes the relative reciprocating motion, on a downstream side in a force transmission path with respect to a contact portion between the roller and the cam surface, and

wherein a spring member is provided, for bringing the roller and the cam surface into constant contact with each other during the relative reciprocating motion between the cam and the roller.

2. The valve mechanism for an internal combustion engine according to Claim 1, further comprising: a roller supporting member that supports the roller and makes reciprocating motion; and a valve pressing member having a valve pressing portion for pressing the intake valve or the exhaust valve, and an abutting portion that abuts the roller supporting member, the valve pressing member being adapted to make reciprocating motion so as to operate in synchronization with the roller supporting member via the abutting portion,

wherein the spring member is provided between the roller supporting member and the valve pressing member, and exerts urging force so as to cause the abutting portion between the roller supporting member and the valve pressing member to open.

3. The valve mechanism for an internal combustion engine according to Claim 1, wherein the valve pressing member is a rocker arm pivotally supported by a pivot shaft so as to be rockable, and the valve supporting member is a roller arm pivotally supported on the pivot shaft.

4. The valve mechanism for an internal combustion engine according to Claim 3, wherein an axial center of the pivot shaft of the roller arm is eccentric to an axial center of the pivot shaft of the rocker arm, and by rotating the pivot shaft of the rocker arm about its axial center, a position of the abutting portion between the rocker arm and the roller arm becomes variable, enabling a lift amount or the like of the valve to be variable.

5. The valve mechanism for an internal combustion engine according to Claim 3 or 4, wherein the spring member is a leaf spring for urging the roller arm and the rocker arm so as to spread apart from each other with respect to the pivot shaft.

6. A valve mechanism for an internal combustion engine, having: a shaft rotated by a crankshaft of the internal combustion engine; drive force transmitting means provided to the shaft; a rocking shaft provided coaxially or in parallel to the shaft; a rocking cam supported on the rocking shaft and is freely rockable by the drive force transmitting means; and a roller follower that is caused to make reciprocating motion by the rocking cam to open and close an intake valve or an exhaust valve of the internal combustion engine,

wherein the rocking cam makes reciprocating motion while rocking within a predetermined range about the rocking shaft, and the roller follower makes reciprocating motion within a predetermine range in synchronization with the rocking cam,

wherein one of the rocking cam and the roller follower is provided with a roller for causing the roller follower to operate in synchronization with rocking motion of the rocking cam, and the other is provided with a contact surface with which the roller comes into contact,

wherein at a time when the roller is located in the base circle portion, a gap for absorbing errors and thermal expansion of respective portions of a valve mechanism system is provided between components, excluding the roller that makes the relative reciprocating motion, on a downstream side in a force transmission path with respect to a contact portion between the

roller and the cam surface, and

wherein a spring member is provided, for bringing the roller and the contact surface into constant contact with each other during the reciprocating motion of the rocking cam and the roller follower.

7. The valve mechanism for an internal combustion engine according to Claim 6, wherein the spring member has a torsion spring brought into fitting engagement with a rocker arm shaft that rockably supports a rocker arm having the roller, the torsion spring being locked onto the rocker arm at one end and locked onto a cylinder head main body at the other end and urging the rocker arm toward the rocking cam.

8. The valve mechanism for an internal combustion engine according to Claim 6, wherein the spring member is provided between a rocker arm, which has the roller, and a cylinder head main body, and

wherein the spring member includes a coil spring for urging the rocker arm toward the rocking cam.

9. A valve mechanism for an internal combustion engine, having: a cam including a cam surface having a base circle portion and a lift portion; and a roller that contacts the cam surface and rotates, the cam and the roller being adapted to make relative reciprocating motion to open and close an intake valve or an exhaust valve,

wherein at a time when the roller is located in the base circle portion, a gap is provided between the roller that makes reciprocating motion and the cam surface, and braking means for restraining the roller from continuing to rotate due to inertia is provided.

10. A valve mechanism for an internal combustion engine, having: a shaft rotated by a crankshaft of the internal combustion engine; drive force transmitting means provided to the shaft; a rocking shaft provided coaxially or in parallel to the shaft; a rocking cam supported on the rocking shaft and is freely rockable by the drive force transmitting means; and a roller follower that is caused to make reciprocating motion

by the rocking cam to open and close an intake valve or an exhaust valve of the internal combustion engine,

wherein the rocking cam makes reciprocating motion while rocking within a predetermined range about the rocking shaft, and the roller follower makes reciprocating motion within a predetermine range in synchronization with the rocking cam,

wherein one of the rocking cam and the roller follower is provided with a roller for causing the roller follower to operate in synchronization with rocking motion of the rocking cam, and the other is provided with a contact surface with which the roller comes into contact, and

wherein braking means is provided, for restraining rotation of the roller due to inertia in a state in which the contact surface and the roller are not in contact with each other during the reciprocating motion of the rocking cam and the roller follower.

11. The valve mechanism for an internal combustion engine according to Claim 9 or 10, wherein the braking means is arranged between the roller and the rocking cam or a rocker arm as the roller follower to which the roller is provided, and is a braking member for restraining the rotation of the roller due to inertia.

12. A valve mechanism for an internal combustion engine, that when a rotating cam is rotated, a roller makes reciprocating motion on an upper surface of a rocker arm, and the rocker arm is rocked by a pressing force exerted by the roller during the reciprocating motion, causing an intake valve or an exhaust valve to open and close,

wherein at a time when the valve is in a closed state, a gap for absorbing errors and thermal expansion of respective portions of a valve mechanism system is provided between the rocker arm and the valve, and

wherein a spring member is provided, for bringing the roller and the upper surface of the rocker arm into constant contact with each other during relative reciprocating motion between the upper surface of the rocker arm and the roller.

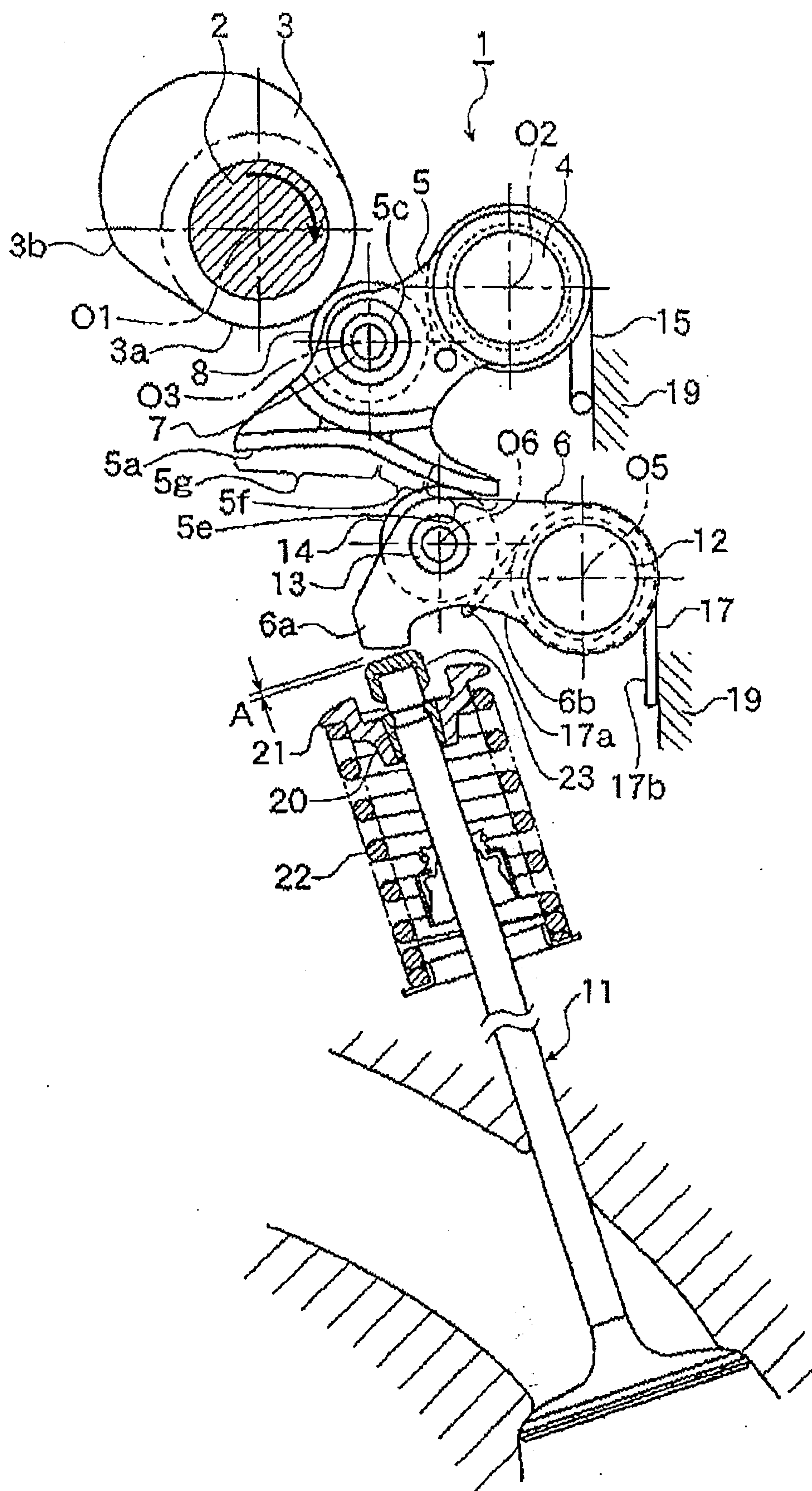


FIG. 1

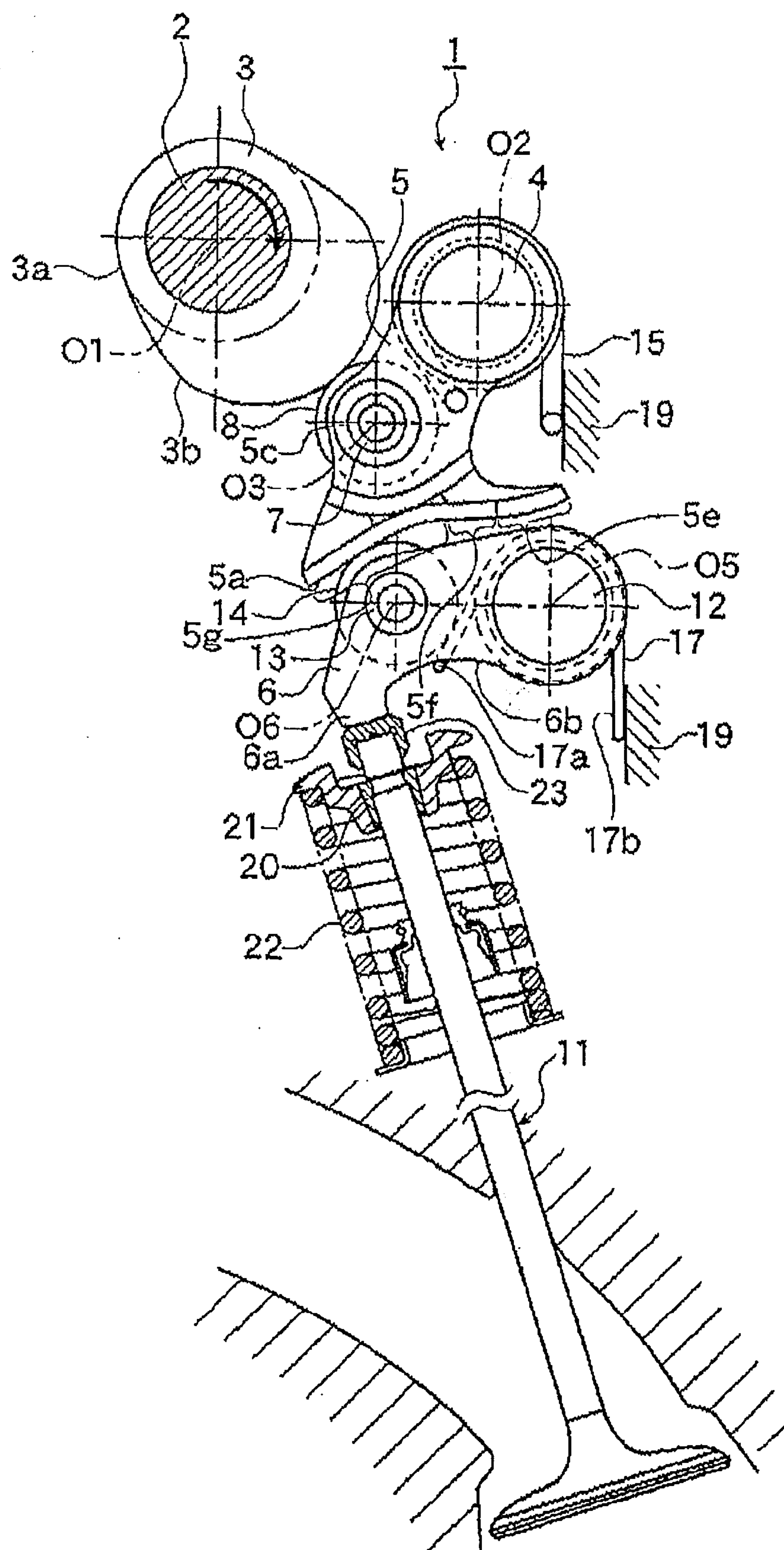


FIG. 2

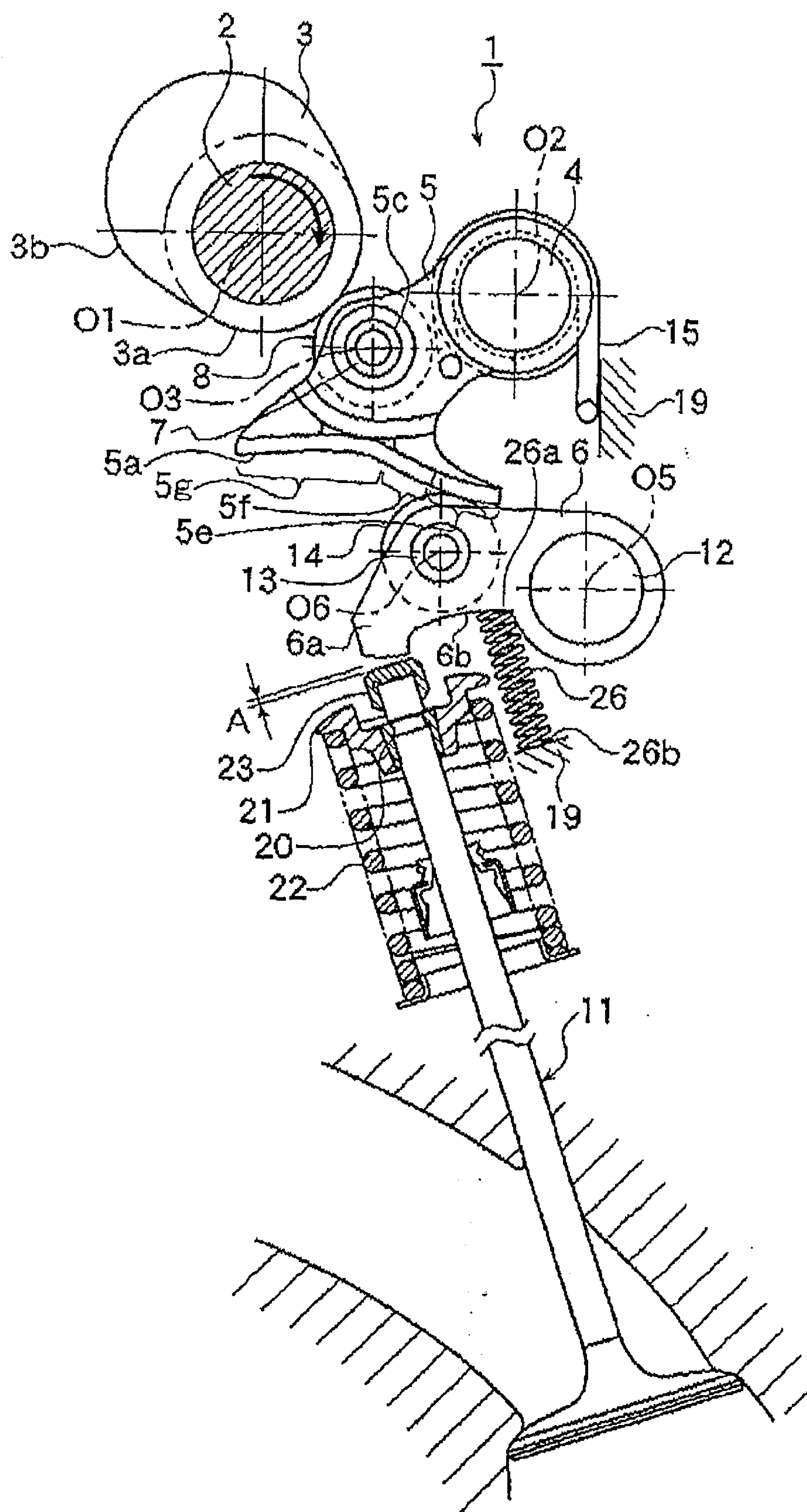


FIG. 3

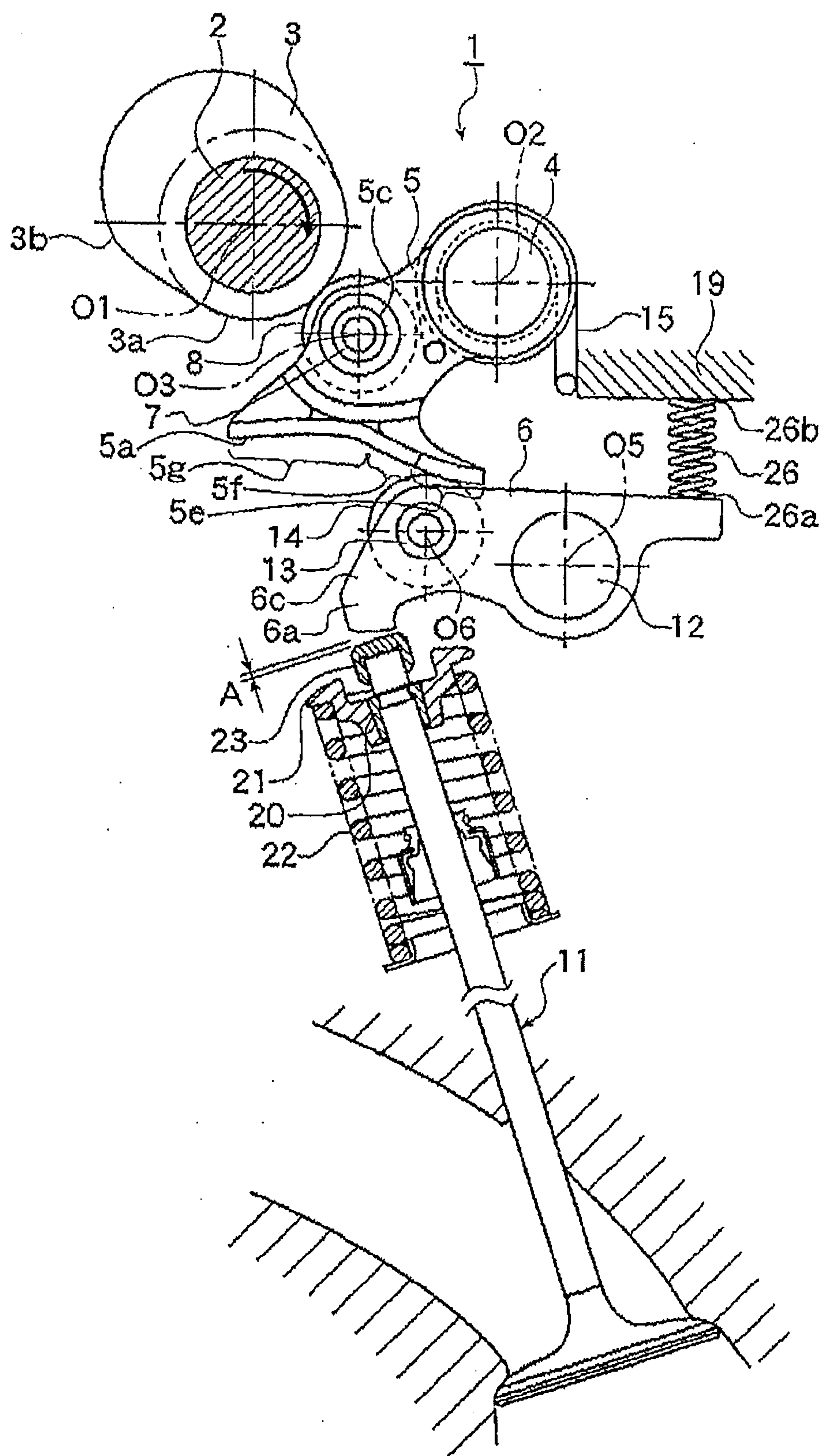


FIG. 4

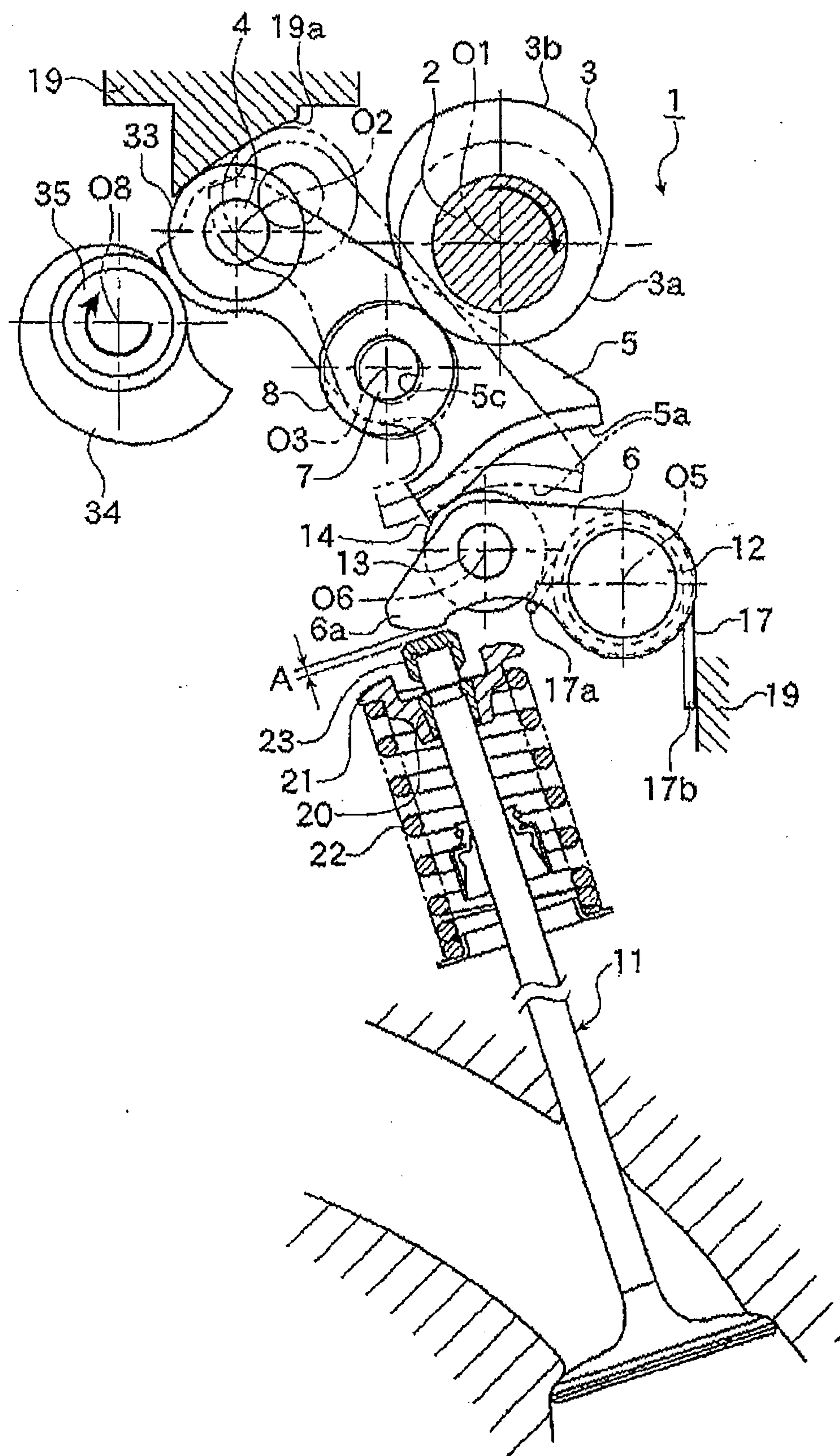


FIG. 5

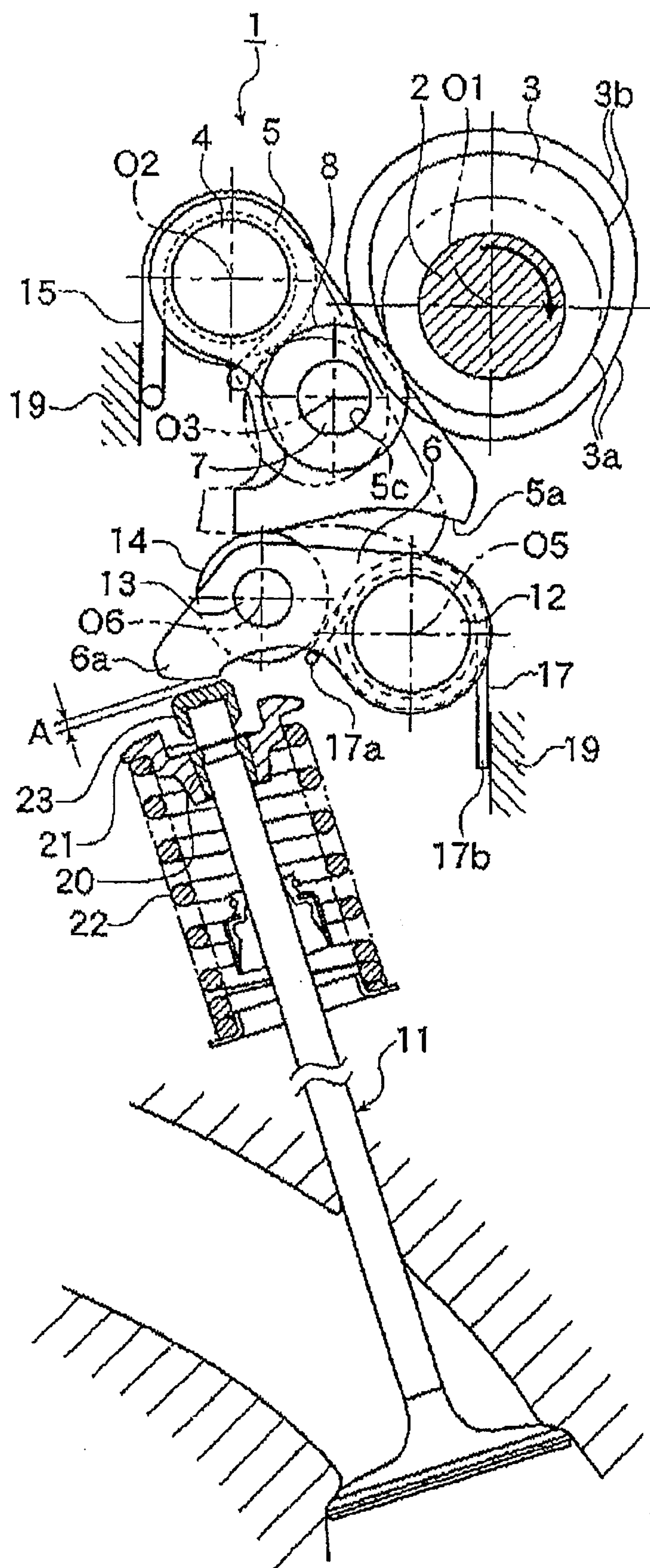


FIG. 6

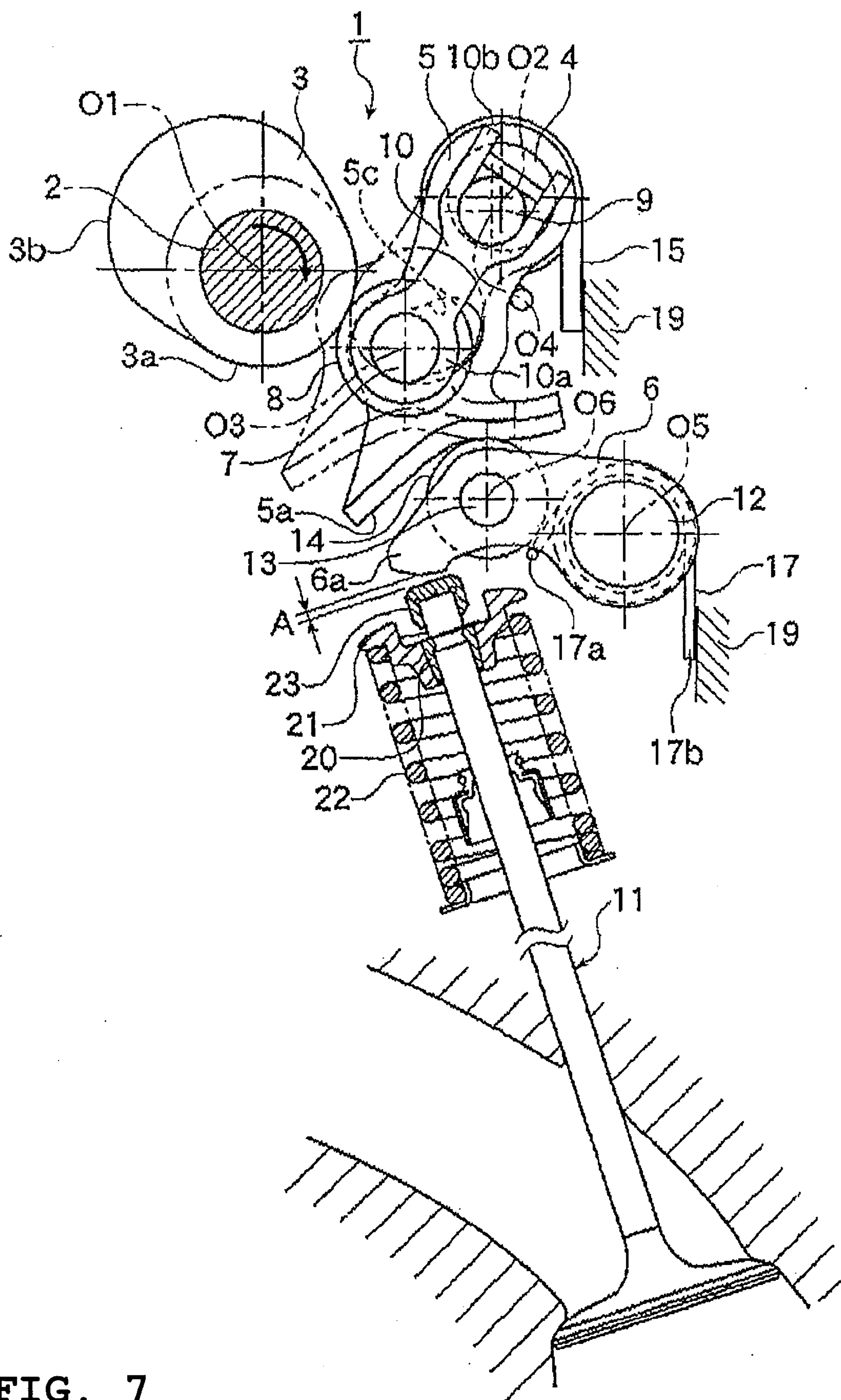


FIG. 7

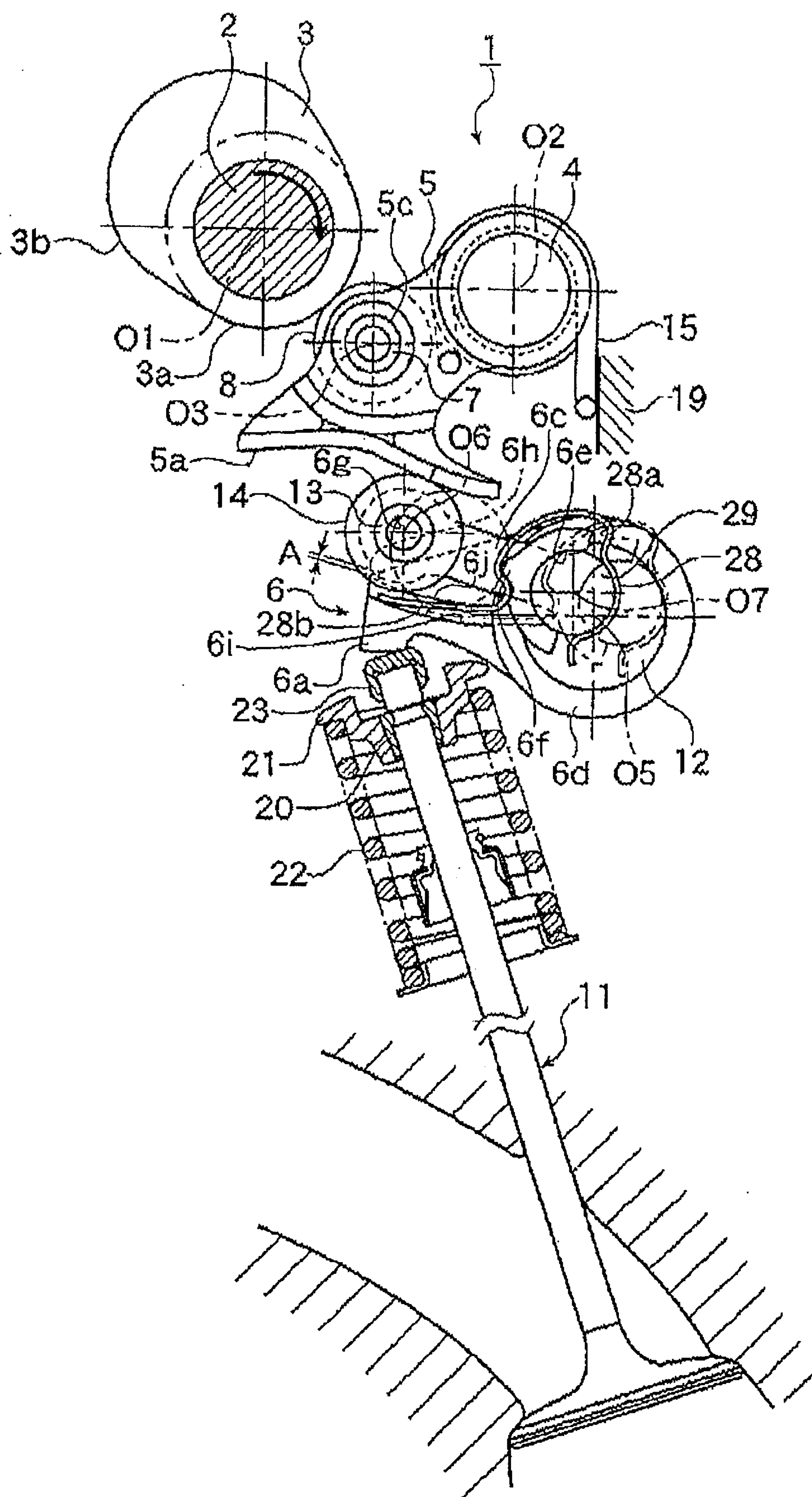


FIG. 8

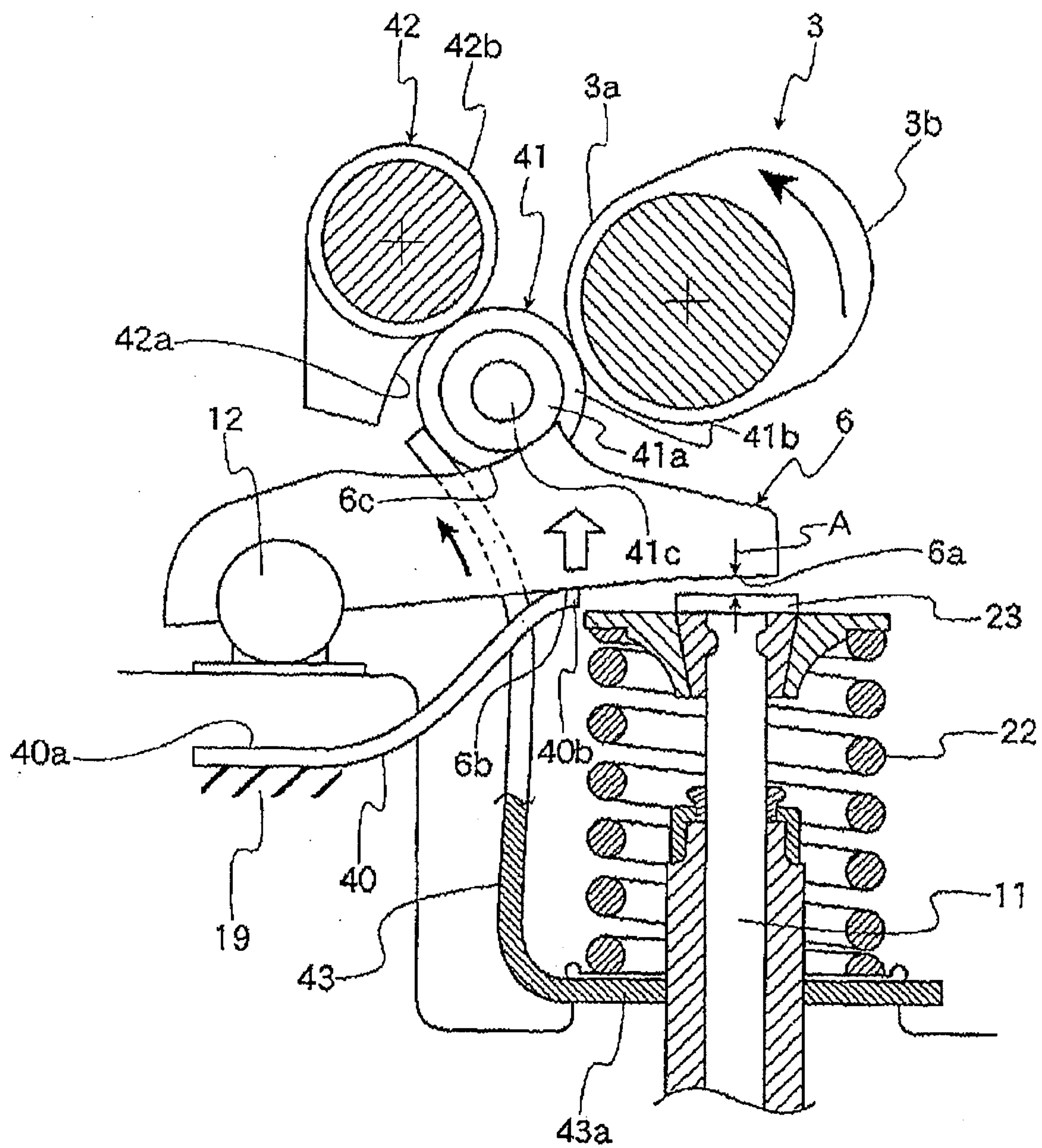


FIG. 9

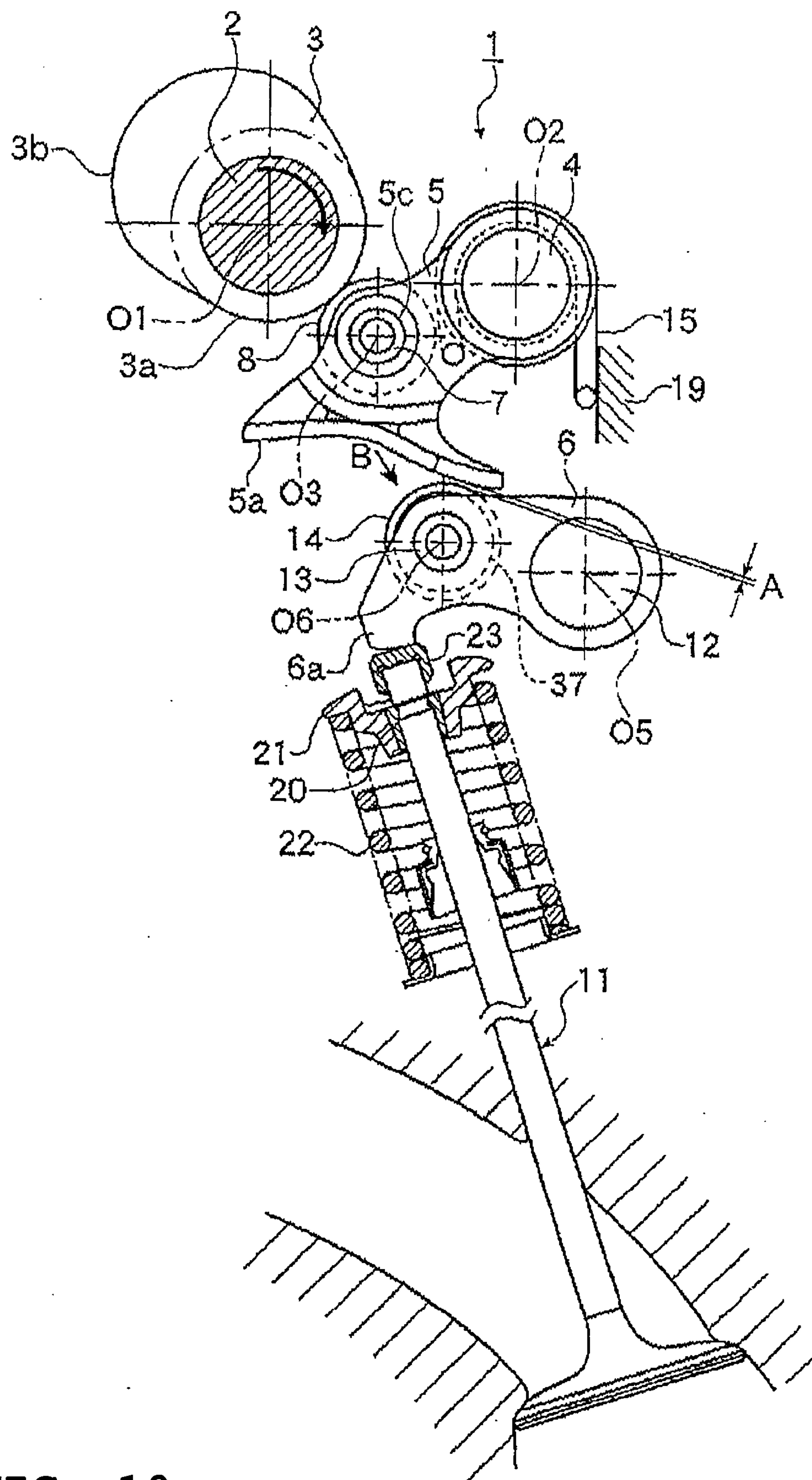


FIG. 10

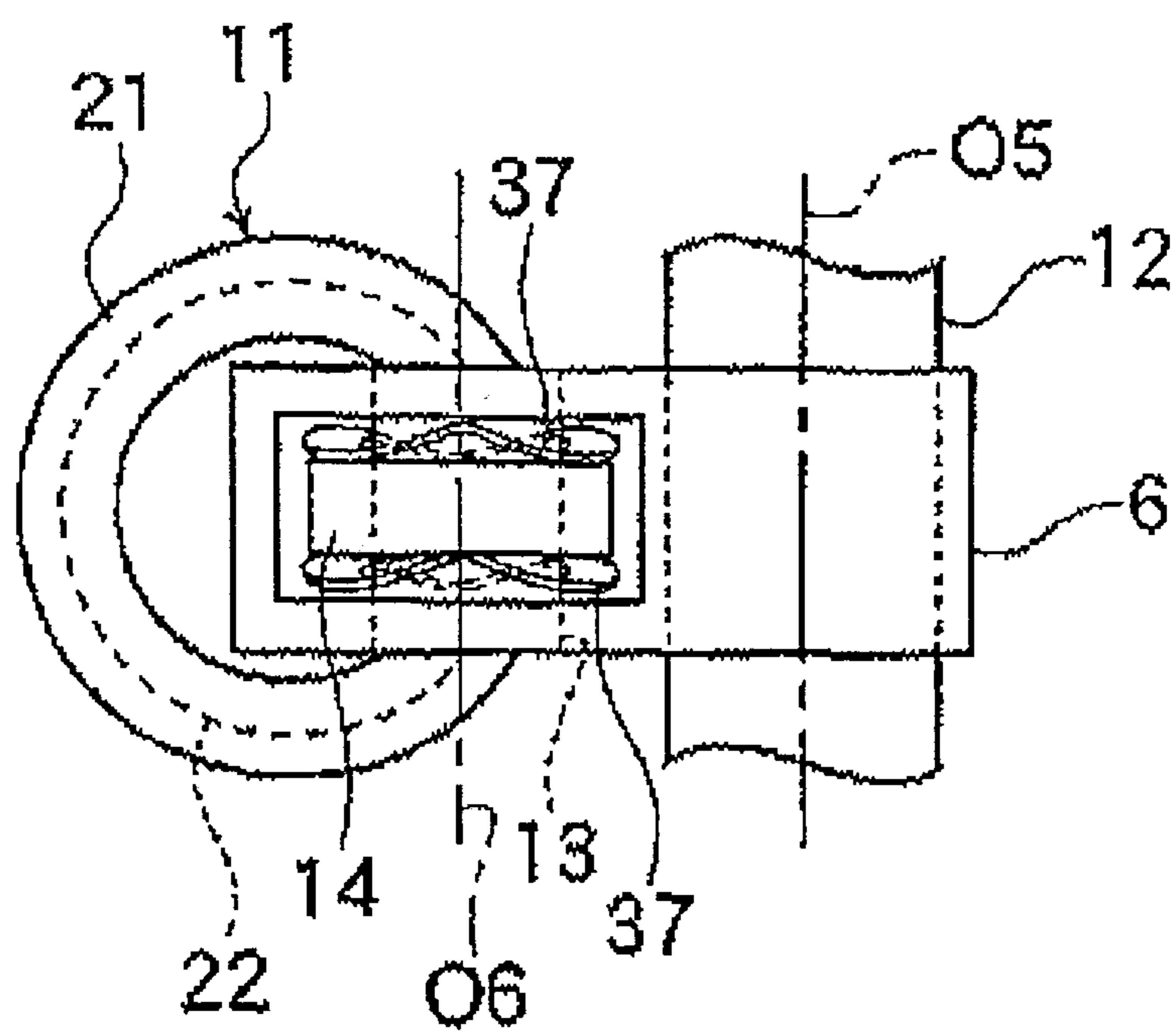


FIG. 11

