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(11) **EP 0 752 516 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
08.01.1997 Bulletin 1997/02

(21) Application number: **95906493.2**

(22) Date of filing: **20.01.1995**

(51) Int. Cl.⁶: **F01L 1/22**

(86) International application number:
PCT/JP95/00054

(87) International publication number:
WO 96/22454 (25.07.1996 Gazette 1996/34)

(84) Designated Contracting States:
DE FR GB

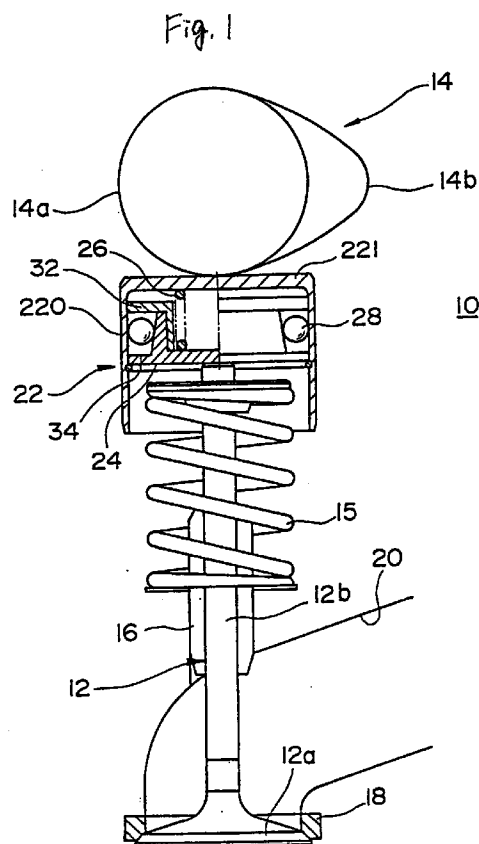
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(54) **LASH-ADJUSTER FOR AN INTERNAL COMBUSTION ENGINE**

(57) A lash adjuster (10) is interposed between an exhaust valve (12) and a cam (14). The lash adjuster (10) comprises a bucket (22), a plunger (24), a first elastic member (26) and rolling members (28). The bucket (22) has an outer wall part (220) and a ceiling part (221) and is hollow cylindrical with its upper end closed. The plunger (24) is in contact with the upper end of the exhaust valve (12), and is arranged freely displaceable in the bucket (22) and has an upper guide (32) and a lower guide (34). The first elastic member (26) has its upper end in contact with the ceiling part (221) of the bucket (22) and its lower end in contact with the lower guide (34) and is arranged in a pre-compressed form. A plurality of rolling members (28) are arranged in the tapered part.



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Description

[FIELD OF THE INVENTION]

The present invention relates to a rush adjuster for an internal combustion engine, especially a mechanical and direct-driven rush adjuster provided with an automatic gap adjusting function.

[PRIOR ART AND BACKGROUND OF THE INVENTION]

Directly interposed between a cam and a valve of an internal combustion engine for transmitting the motion of the cam to the valve a rush adjuster is known as a member having a function of adjusting the gap therebetween. As such a rush adjuster there are known two alternatives of mechanical type and hydraulic type but relatively widely adopted is the mechanical type which needs no pressure control with its construction being relatively simple. The mechanical rush adjuster normally has a cylindrical bucket and, with the ceiling part of this bucket in sliding contact with the cam, transmits the motion of the cam to the valve.

When the ceiling part of the bucket is brought into sliding contact with the cam, however, wearing takes place between the cam and the ceiling part of the bucket; since the inside of the bucket is also in contact with the shaft end portion of the valve, wearing occurs also in this part, thereby resulting in an increased valve clearance and failure to open the valve completely or to prevent wearing between the valve seat part and the valve face part, this similarly interfering with perfect closing of the valve.

For such problems a means to solve these problems has been disclosed in Japanese Laid-open Utility Model Publication No. Sho-48-65908. The rush adjuster disclosed in this publication has a hole made in the bucket perpendicular to the valve stem and has provided in this hole a spring and a wedge-shaped member.

The wedge-shaped member has its slanted tapered part in sliding contact with the upper end of the valve stem and, when any gap has occurred between the ceiling part of the bucket and the cam, causes the wedge-shaped member to slidably move along the hole against the elastic force of the spring to thereby adjust the gap between the ceiling part and the cam.

With the rush adjuster of such composition, it was impossible to automatically adjust the gap resulting from wearing; for example, in a periodical inspection, the head cover of an engine had to be removed for necessary adjustment by the use of tools and, worse, since it was impossible to cope with change of the gap between the cam and the valve due to temperature variation, it was necessary to have an unnecessarily large valve clearance. Hence, in Japanese Laid-open Publication No. Sho-55-131513, for example, there is proposed a rush adjuster being capable of adjusting a

change of gap caused by temperature variation.

The rush adjuster disclosed in this publication has disposed in the ceiling part of the bucket a rotatably movable member and there is interposed a spiral or vortex spring between the bucket and the movable member. The spring urges the movable member rotating upward and the rotating member is combined to be unable to rotate in the direction inverse to the aforementioned upward rotating motion.

The rush adjuster disclosed in the same publication, too, had the following technical problem.

That is, with the adjuster transmitting the motion of the cam to the valve the nose of the cam is required to be in contact with the ceiling part of the bucket and, for opening the valve, operation control of the internal combustion engine may fail if the motion of the cam is not faithfully transmitted to the valve. In transmitting motion in such a manner, therefore, it is necessary for a rush adjuster to make a rigid connection between between the cam and the valve, hence in the rush adjuster disclosed in the aforementioned publication, the movable member is combined so that it can not be rotated in the inverse direction, thereby making a rigid connection therebetween.

If such composition is adopted, loud hitting noise might be heard from the threaded part; the movable member moves upward and the adjustment of the cam and the valve is feasible when the valve contracts due to temperature variation, when wearing takes place between the cam and the ceiling part of the bucket, when wearing takes place between the inside of the bucket and the end part of the valve stem or when the valve clearance becomes larger, but when the valve elongates due to temperature variation or when wearing has taken place between the valve seat and the valve face, the movable member is unable to move downward beyond the play of the screw, this resulting in failure to adjust the gap between the cam and the valve and eventually in failure to close the valve completely.

Meanwhile, in the specification of U.S. Pat. No. 3038460, a push-rod type rush adjuster as shown in Fig. 16 is disclosed. The rush adjuster shown in the drawing comprises a hollow cylindrical member "a" with its upper end closed, a sleeve "b" freely slidable into the member "a" and with both its ends open and a plunger "c" freely slidable into the sleeve "b" with its upper end closed.

On the periphery of the opening on the upper end side of the sleeve "b", a first tapered part "d" is formed spreading upward while a second tapered part "e" spreading downward is formed on the outer periphery of the sleeve "b". At the upper end side of the plunger "c" is formed a tapered face "f" slanting from center downward. A first rolling member "h" is disposed to be in contact with slanted face "f", the first tapered part "d" and the inside of the ceiling part "g" of the member "a".

A second rolling member "j" with its upper and lower parts held by a pair of solid rings "i" is placed so that it is brought into contact with the second tapered

part "e" and the inner peripheral face of the member "a", and this second rotatory member "j" is constantly urged upward by the spring "k" stopped by the inner peripheral face of the member "a" from below. On the lower end side of the plunger "c", there is provided a spherical seat face and the push rod 1 is in contact therewith.

The push-rod-type rush adjuster of this composition is also usable as a direct-driven type rush adjuster when the valve is brought into contact instead of the push rod 1 and the cam is contact with the upper end of the ceiling part "g" of the member "a". The rush adjuster of such composition, however, had the following problems.

Namely, in the rush adjuster shown in Fig. 16 the cam - valve gap adjustment is feasible with the sleeve "b" moved upward by the spring force of the spring "k". When the valve elongates due to temperature variation or wearing takes place between the valve sheet part and the valve face part, the sleeve "b" cannot move downward for it is in rigid connection with the second rolling member "j" constantly urged upward by the spring "k" and as a result the cam - valve gap adjustment is infeasible, and the valve can not be closed completely.

The invention is made in view of such conventional problems, and its object is to provide a rush adjuster for an internal combustion engine enabling automatic gap adjustment through faithful transmission of the motion of the cam to the valve with the possibility of it being in rigid connection, when necessary, and also enabling automatic gap adjustment for elongation/contraction of the valve clearance caused by temperature variation and wearing.

[SUMMARY OF THE INVENTION]

In order to accomplish the aforementioned object, the invention features that a rush adjuster interposed between the valve and cam of an internal combustion engine comprise a cylindrical bucket with its upper end in contact with the aforementioned cam, a plunger in contact with the top side of the aforementioned valve and freely displaceable vertically in the aforementioned bucket, a first elastic member interposed between the inside of the ceiling part of the bucket and the aforementioned plunger and the compressive preliminary pressure is applied in the initial state, a tapered part formed on the outer periphery of the aforementioned plunger so that the gap between the inner periphery of the aforementioned bucket and the outer periphery of the aforementioned plunger is increased upward and a plurality of rolling members interposed between this tapered part and the inner periphery of the aforementioned bucket.

Also, another invention features that the tapered part of the aforementioned first invention is formed on the inner periphery of the aforementioned bucket instead of the aforementioned plunger and a ring supporting the aforementioned rolling members is secured to the inner periphery of the aforementioned bucket.

In the aforementioned invention, it is possible to

provide a second elastic member for urging the aforementioned rolling members between the aforementioned tapered parts in the spreading direction.

In this case it is possible to interpose a washer between the aforementioned second elastic member and the aforementioned rolling members. Also, the aforementioned bucket may have at the underside of the aforementioned ceiling part an annular inner wall part and the aforementioned plunger may be disposed on the inner periphery side of this annular inner part.

Further, the aforementioned tapered part has provided therein a plurality of tapered grooves at peripheral intervals, and these tapered grooves may be represented by any one of the sections selected from the mono-arc section having a larger curvature than the curvature of the aforementioned rolling member, a section conjugated by arc faces of curvature larger than the curvature of the aforementioned rolling member, V-section and trapezoidal-section.

Also, either of the inner periphery of the aforementioned bucket or the outer periphery of the aforementioned plunger where the aforementioned tapered part is not formed may have formed therein arcuate grooves opposed to this tapered part, and these arcuate grooves may be represented by any one of the section selected from mono-arc section having a larger curvature than the curvature of the aforementioned rolling member, conjugated by arc faces of curvature larger than the curvature of the aforementioned rolling member, V-section and trapezoidal section.

Further, the aforementioned tapered grooves or arcuate grooves may also be formed helically.

Since the rush adjuster for the internal combustion engine of the aforementioned composition has interposed between the first elastic members with a compressive preliminary pressure applied thereto, has interposed between the inside of the ceiling part of the bucket and the plunger, the cam and the ceiling part of the bucket are pressed together by the urging force of this primary elastic member while the base circle of the cam and the ceiling part of the bucket are in contact with each other.

And, as the cam rotates and the nose of the cam comes into contact with the ceiling part of the bucket, the first elastic member is somewhat contracted and the bucket is pushed down.

Then, since a plurality of rolling members are interposed between the tapered part of the outer periphery of the bucket and the inner periphery of the plunger so that the distance between the inner periphery of the bucket and the outer periphery of the plunger, hence, when the bucket is pushed down, the rolling members are moved downward by the frictional force between them and the bucket and the action of their own weight (such behavior of the rolling member is called initial sliding).

In this case, since the rolling members are interposed between the surfaces tapered to be narrower downward, the rolling members are caught between the

tapered part and the inner periphery of the bucket, this resulting in slid combination (called "locked state" hereinafter) of the bucket and the plunger.

Under such locked state the motion of the cam is transmitted to the bucket and the plunger faithfully.

Meanwhile, when the cam further rotates, the valve reaches the upper dead point, the nose of the cam departs from the ceiling part of the bucket and the base circle of the cam is about to come into contact with the bucket, the upward motion of the plunger in contact with the upper end part of the valve is stopped. When the upward motion of the plunger is stopped and the base circle of the cam comes into contact with the bucket, the bucket is somewhat lifted by the elastic force of the contracted first elastic member.

When the bucket is moved upwardly, the rolling members caught between the tapered part and the inner periphery of the bucket are disengaged from each other and as a result the locked state is dissolved and the bucket and the plunger are unlocked.

That is, when the rush adjuster is used, the bucket and the plunger are unlocked when the base circle of the cam is in contact with the ceiling part of the bucket, while, when the nose of the cam and the ceiling part of the bucket is in contact, the bucket and the plunger are locked by means of the rolling members.

With a rush adjuster of such behavior, the distance between the bucket and the plunger is increased for automatic compensation of valve clearance and the contact state between the ceiling part of the bucket and the cam and the contact state between the valve and the plunger for automatic compensation for the increase for the valve clearance, when the valve is contracted due to temperature variation, when wearing has taken place between the cam and the ceiling part of the bucket, when wearing takes place between the cam and the bucket ceiling or resulting in an increased valve clearance.

Meanwhile, when the valve is elongated due to temperature variation or when wearing occurs between the valve seat and the valve face with resultant decrease of the valve clearance, the distance between the bucket and the plunger is decreased, resisting the elastic force of the first elastic member, similarly compensation for decrease of the valve clearance is done automatically and the contact state between the ceiling part of the bucket and the cam and the contact state between the valve and the plunger is maintained.

Such action and effect are attained also when the tapered part for increasing the distance between the inner periphery of the bucket and the outer periphery of the plunger is formed on the inner periphery of the bucket instead of the plunger and the rolling member supporting ring is fixedly secured on the inner periphery of the plunger.

Also, according to claim 3, a second elastic member is provided for urging the rolling members in the direction in which the distance between the tapered parts increases, the rolling members can be moved in

the spreading direction so that the bucket and the plunger is unlocked, this resulting in sure and quick motions toward the unlocked state, quick response for compensation is feasible when the valve clearance is decreased and enlargement of compensation allowance becomes possible.

Further, according to claim 4, a washer is provided between the second elastic member and the rolling members, and the individual rolling members are uniformly subjected to the elastic force of the second elastic member.

Furthermore, according to claim 5, the ceiling part of the bucket has an annular inside wall on its underside and the plunger is arranged on the inner peripheral side of the annular inside wall, and the strength of the ceiling part is able to be increased by the annular wall part.

Also, according to claim 6, the tapered part has a plurality of tapered grooves at peripheral distances, these tapered grooves have any one section selected from mono-arc section of a curvature larger than the curvature of the rolling member, a section conjugated by arc faces of curvature larger than the curvature of the aforementioned rolling member, V-section and trapezoidal section, hence the rolling members and the tapered grooves come into contact with one or a plurality of points and rotation of rolling members can be ensured with prevention of galling and can further lower the surface pressure.

Further, according to claim 7, either of the inner periphery of the aforementioned bucket or the outer periphery of the aforementioned plunger where the aforementioned tapered part is not formed may have formed therein arcuate grooves opposed to this tapered part, and these arcuate grooves may be represented by any one of the sections selected from the mono-arc section having a larger curvature than the curvature of the aforementioned rolling member, conjugated arc faces of curvature larger than the curvature of the aforementioned rolling member, V-section and trapezoidal section, hence the surface pressure may further be lowered.

Furthermore, according to claim 8, the tapered grooves and arcuate grooves are formed helically, hence the rolling members are forcibly rotated by the vertical motion of the plunger and galling of the rolling members is prevented, the moving distance of the rolling members is longer than the curvature of linear groove and wearing between rolling members and grooves becomes less.

[BRIEF DESCRIPTION OF DRAWINGS]

Fig. 1 is a general arrangement drawing showing the first embodiment of the rush adjuster according to the invention. Fig. 2 is an enlarged view of the essential parts in Fig. 1. Fig. 3 is a horizontal sectional view of Fig. 2.

Fig. 4 is a general arrangement drawing showing the second embodiment of the rush adjuster according

to the invention. Fig. 5 is an enlarged view of the essential part of Fig. 4. Fig. 6 is a horizontal sectional view of Fig. 4.

Fig. 7 is a general arrangement drawing showing the third embodiment of the rush adjuster according to the invention. Fig. 8 is an enlarged view of the essential part of Fig. 7.

Fig. 9 is a sectional view showing the fourth embodiment of the rush adjuster according to the invention. Fig. 10 is a horizontal view of Fig. 9.

Fig. 11 is a general arrangement drawing showing the fifth embodiment of the rush adjuster according to the invention. Fig. 12 is an enlarged view of the essential part of Fig. 11.

Fig. 13 is a sectional view of the sixth embodiment of the rush adjuster according to the invention.

Fig. 14 is a sectional view of the seventh embodiment of the rush adjuster according to the invention.

Fig. 15 is a sectional view showing a modified example of the section of the tapered groove or arc-groove according to the invention.

Fig. 16 is a sectional view showing an example of conventional rush adjuster.

[DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION]

Hereinafter a preferred embodiment according to the invention will be described in detail referring to the annexed drawings 1-3. Fig. 1 to Fig. 3 show the first embodiment of the rush adjuster for internal combustion engine. The rush adjuster 10 shown in the figure is directly interposed between a valve for internal combustion engine such as exhaust valve 23 and a cam 14. The exhaust valve 12 has a cone part 12a and a stem part 12b, the exhaust valve 12b is supported freely movable vertically and on the outer periphery of the stem part 12b is disposed a return spring 15.

The cone part 12a of the exhaust valve 12 has its back side in contact or apart from valve sheet 18 and serves to open/close the exhaust port of the combustion chamber and this exhaust port is formed to communicate with the exhaust channel 20. Cam 14 is driven to rotate as the internal combustion engine is operated, and includes a base disc part 14a and a nose part 14b. The rush adjuster 10 has a bucket 22, a plunger 24, a first elastic member 26 and a rolling member 28.

The bucket 22 has an annular outer wall part 220 with its lower end open and a ceiling part 221 which is to close the upper end of the outer wall part 221, and its upper end is formed a closed hollow cylinder.

The plunger 24 is in contact with the topside of the exhaust valve 12, is disposed in the bucket 22 freely movable vertically and comprises a plunger guide 32 and a plunger lower guide 34. The plunger upper guide 32 is formed substantially inverted hat-like, has at its center a hollow cylindrical part 320 and a disc part 321 integral with the upper end of this hollow cylindrical part 320, and the outer periphery of the disc part 321 is in

sliding contact with the inner periphery of the outer wall part 220 of the bucket 22.

The plunger lower guide 34 is formed substantially hat-like, has a convex part 340 at its center and a flange part 341 along the lower periphery of the convex part 340. At the center of the convex part 340 there is formed a concave part 342 with its upper end open and the plunger upper guide 32 is attached to the lower guide 34 by setting a hollow cylindrical part 320 in the concave part 342.

Along the outer periphery of the convex part 340 there is formed a tapered part 343 with its diameter reducing toward the top and by means of this tapered part 343 the distance between the inner periphery of the outer wall part 220 of the bucket 22 and the outer periphery of the plunger lower guide 34 is increased toward the top.

The first elastic member 26 used in this embodiment comprises a compression coil spring with its elastic force smaller than the curvature of the restoration spring 15 and is so arranged that its upper end side comes into contact with the inner side of the ceiling part 221 and its lower end side comes into contact with the bottom of the concave part 342 of the plunger lower guide 34 and (the elastic member 26) passes through the hollow cylindrical part 320 of the plunger upper guide 32.

The rolling members 28 are, for example, steel balls and a plurality thereof are disposed along the outer periphery of the plunger lower guide 34 at equal angular intervals. The members represented by reference numeral 38 in Fig. 2 are snap rings which come into contact with the lower part of the outer periphery of the plunger lower guide 34 for prevention of falling-off thereof.

The rush adjuster 10 of the aforementioned composition is so arranged that the top of the stem part 12b of the exhaust valve 12 comes into contact with the lower side of the plunger lower guide 34 and the topside of the ceiling part 221 comes into contact with the cam 14. The rush adjuster 10 according to the invention is arranged as follows.

First, the exhaust valve 12 blocks the exhaust port with its cone part 12a, with the return spring 15 not acting yet, and with the topside of the ceiling part 221 in contact with the base disc 14a of the cam 14 on top of the ceiling part 221, the first elastic member 26 is compressed axially for application of preliminary pressure and setting

When the rush adjuster 10 is set in such a manner, preliminary pressure is applied to the first elastic member 26, hence the bucket 22 and the plunger 24 (as well as the base disc part 14a of the cam 14 and the ceiling part 221 of the bucket) are pressed together by the urging force of this first elastic member.

When the cam 14 rotates until the nose part 14b of the cam 14 is in contact with the ceiling part 221 of the bucket, the first elastic member is somewhat contracted and the bucket 22 is pushed down.

Then, since a plurality of rolling members 28 are interposed between the tapered part 343 formed on the outer periphery of the plunger 24 and the inner periphery of the bucket 22 so that the distance between the inner periphery of the bucket 22 and the outer periphery of the plunger 24 increases upward, if the bucket 22 is lowered, the rolling members 28 are caused to lower because of the friction force against the bucket 22 as well as its own weight (Such behavior of rolling members is called "initial sliding").

Since, in this case, the rolling members 28 are interposed between surfaces, the distance therebetween decreases downward, if the rolling members 28 are lowered, the rolling members 28 are caused to bite into the inner periphery of the tapered part 343 and the bucket 22, this resulting in slid combination of the bucket 22 and the plunger 24 over the rolling members 28 (called "locked state" hereinafter).

Under such locked state the motion of the cam 14 is faithfully transmitted to the exhaust valve 12 over the bucket 22 and the plunger 24.

Meanwhile, when the cam 14 further rotates for the exhaust valve 12 to reach the upper dead point and for the nose 14b of the cam 14 to depart from the ceiling part of the bucket and the base disc 14a of the cam 14 is about to contact the bucket 22, the up ward motion of the plunger 24 in contact with the topside of the exhaust valve 12 is stopped.

When the upward motion of the plunger 24 is stopped and the base disc 14b of the cam 14 comes into contact with the bucket 22, the bucket 22 moves upwardly to some extent by the elastic force of the contracted first elastic member 26.

When the bucket 22 is thus lifted, the rolling members 28 bitten between the tapered part 343 and the bucket 22 are released, and the bucket 22 and the plunger 24 are released to be unlocked.

Namely, when the rush adjuster 10 according to the invention is used, the bucket 22 and the plunger 24 are in an unlocked state while the base disc 14a of the cam 14 and the ceiling part 221 of the bucket are in contact, and the bucket 22 and the plunger 24 are in a locked state while the nose part 14b of the cam 14' sand the ceiling part 221 of the bucket are brought into contact with each other.

By the use of rush adjuster 10 of such behavior the distance between the bucket 22 and the plunger 24 is increased, compensation for increase of the valve clearance is done automatically and the contact condition of the bucket ceiling plate 221 and the cam 14 and the contact condition of the exhaust valve 12 and the plunger 24 are retained, when the valve is contracted due to temperature variation, when wearing has occurred between the cam 14 and the ceiling part 221 of the bucket or when wearing takes place between the plunger 24 and the valve stem end, this resulting in increased valve clearance.

Meanwhile, when the exhaust valve 12 has extended due to temperature variation and the valve

clearance has become small due to wearing between the valve seat part 18 and the valve face part, the distance between the bucket 22 and the plunger 24 is decreased against the elastic force of the elastic member and the contact status between the ceiling part 221 of the bucket 22 and the cam 14 and that between the exhaust valve 12 and the plunger 24 is retained.

The stroke, for which distance compensation by the first elastic member 26 is feasible, is changeable through adjustment of the elastic member 26.

Fig. 4 to Fig. 6 show the second embodiment of the rush adjuster according to the invention, and explanation is given below about the features thereof. In the rush adjuster 10a shown in the figure a plurality of arc grooves extending linearly along the axis direction are formed on the inner periphery of the basket 22a at peripheral intervals. The section of this arcuate groove is of an arcuate section slightly larger in curvature than the curvature of the rolling member 28 and the rotary member 28 and the arcuate groove are brought into contact with each other at a point.

Meanwhile, a plurality of linear tapered grooves 344 are provided at peripheral intervals and at the same inclination angle as the tapered part 343.

This tapered groove 344 is arranged opposed to the arcuate groove part 222, its sectional shape is an arcuate section of a curvature slightly larger than the curvature of the rolling member 28, and a part of the outer periphery of rolling member 28 is brought into contact with this groove 344 at a point. The rolling members 28 are positioned and interposed between the rolling members 28 and the tapered groove 344.

According to the rush adjuster 10a of such composition, action and effect same as those described in the aforementioned first embodiment and, in this embodiment, since the tapered groove 344 and arc groove 222 which come into contact with the rolling member 28, when the rolling member 28 comes into contact with the grooves 344 and 222, the contact state there between is point contact and it is possible to ensure rotation of the rotary member with prevention of galling and the surface pressure is lower.

Fig. 7 and Fig. 8 show the third embodiment of the rush adjuster according to the invention, and hereinafter its features only will be described. According to the rush adjuster 10b shown in the same figures, a second elastic member 30 urging the rolling members in the direction required for spreading the tapered parts 343 is provided. The second elastic member 30 is in a ring form having through-holes to enable insertion of the convexes 340 of the plunger lower guide, and e.g. a wave-like bent washer is placed on the flange part 341 of the plunger lower guide 34.

And, on this second elastic member 30, a washer 36 is placed, and on this washer 36, a rolling member 30 is placed. The washer 36 is provided for uniform transmission of the elastic force of the second elastic member 30, and this has to be provided when a wave washer is used as the second elastic member 30.

Even with a rush adjuster 10b of such composition action and effect are the same as described in the aforementioned first embodiment, and in this embodiment, when the bucket 22 is pushed down, the rolling member 28 moves downward compressing the second elastic member 30 and since, when the rolling member 28 is unlocked, the rolling members 28 are pushed by the elastic force of the second elastic members 30 in the direction required for spreading the tapered parts 343, that is, upwardly, hence shifting to the unlocked state can be done securely and quickly and, when the valve clearance has become small, compensation can be responded to quickly, and increase of compensation allowance becomes feasible.

In this embodiment of the described composition, a washer 36 is interposed between the second elastic member 30 and the rolling member 28, hence the elastic force of the second elastic member 30 is uniformly distributed to the individual rolling members 28

Fig. 9 and Fig. 10 show the fourth embodiment of the rush adjuster according to the invention, and only the features thereof will be described hereinafter. In the embodiment shown in the drawings, an annular inner wall part 223 is provided inside the outer wall part 220 of the bucket 22c. This inner part 223 is open on the lower side, its upper side is integrally formed with the lower side of the ceiling part 221 and in its inner periphery arcuate grooves 222 are formed peripherally at given intervals.

The plunger 24, as in the aforementioned first embodiment, has upper and lower guides 32, 34, and this plunger 34, first and second elastic members 26, 30 and the rolling member 28 etc. are substantially in the same construction as described in the second embodiment except for size, and all these members are stored inside the inner wall part 223.

With the rush adjuster 10c of such construction, the same action and effect as those of the aforementioned first embodiment are able to be obtained. Since in this embodiment the annular inner wall part 223 is provided on the underside of the ceiling part 221 of the bucket 22c and the plunger 24 etc. are disposed on the inner periphery of the inner part 223, the ceiling part 221 of the bucket 22b can be reinforced by this inner part 223. In a case of this embodiment the plunger 24 etc. is smaller than in the first embodiment and general weight saving is feasible.

Fig. 11 and Fig. 12 show the fifth embodiment of the rush adjuster according to the invention, and its features only will be described. The rush adjuster 10d shown in the figure is the same as that corresponding to the tapered part 343 provided on the outer periphery of the convex part 340 of the plunger lower guide 34 (tapered part 224), this formed on the inner periphery of the outer wall 220 of the bucket 22d.

The plunger 24d comprises a substantially cup-like main body 241 with its top open, an annular projected part 242 projecting at the center of the bottom of this main body 241 and an arcuate groove 243 provided

along the axial direction of the outside of the main body 241, with the first elastic member 26 housed in the main body 241 and the upper end of the exhaust valve 12 in contact with the underside of the annular projection 242.

The tapered part 224 provided on the outer wall part 220 is so formed that the distance between it and the outer periphery of the main body 241 of the plunger 24d increases downward. The rolling member 28 is supported by a ring 40 fixed on the inner periphery of the bucket 22d.

The ring 40 comprises an annular main body 40b having a hole 40a and a ring-shaped projection 40c on the topside of the ring proper, and on top of this ring-shaped projection 40c is placed the rolling member 28.

With the rush adjuster 10d of such composition, action and effect similar to those described in the aforementioned embodiment are obtained and, especially in this embodiment, the rolling members 28 move downward on the inclined face of the tapered part 224 when the bucket 22d is pushed down, this resulting in quick locking of the rolling member 28.

Fig. 13 shows the sixth embodiment of the rush adjuster according to the invention, and only the features thereof will be described hereinafter. In the embodiment shown in the drawing, it is so arranged that the washer 36 and the second elastic member 30 are fixed to the stepped part 225 provided on the topside of the tapered part 224 of the bucket 22e, and the underside of the washer 36 comes into contact with the rolling members 28.

With the sixth embodiment of the rush adjuster 10e according to the invention so composed, the rolling members 28 are moved downward by the elastic force of the second elastic member 30 toward the opening end of the tapered part 224, hence action and effect similar to those of the third embodiment shown in Figs. 7, 8 are obtained. Fig. 14 shows the seventh embodiment of the rush adjuster according to the invention, and its features only will be described hereinafter.

In the embodiment shown in the drawing, the annular inner wall part 223 is provided in the outer wall part 220 of the bucket 22f. The tapered part 224 and the stepped part 225 are provided on the inner periphery of the inner wall part 223. The tapered part 224 and the stepped part 225 are provided on the inner periphery of the inner wall part 223. And on the stepped part 225 are fixed the second elastic member 30 and the washer 30. With the rush adjuster 10f according to the seventh embodiment, action and effect similar to those described in the fourth embodiment shown in Fig. 4, 10 are substantially attainable.

Fig. 15 shows an example of variation of the sectional shape of the tapered groove 344 of the plunger and the arcuate grooves 222 of the bucket. The section shown in this drawing (A) is a section of conjugated arcuate face with a curvature greater than the curvature of the rolling member 28, (B) is V-sectioned and (C) is trapezoid-sectioned.

The tapered groove 344 and arcuate groove 222

are not necessarily in the same sectional form and may as well be of different sectional shapes.

Although in the aforementioned embodiment the tapered groove 344 and the arcuate groove 222 are illustrated in a linearly formed state, the invention is not limited to the form, and either or both of the grooves 344, 222 may as well be formed helically. When these grooves 344, 222 are helically formed, the rolling members 28 are forcedly rotated with vertical displacement of the plunger, galling of the rolling of the rolling member is prevented, the moving distance of the rolling member 28 becomes longer than in the case of linear groove, and wearing between the transmitting members 28 and grooves 222, 344 become less.

[POSSIBILITY OF INDUSTRIAL USE]

As described above in detail, by the use of a rush adjuster for an internal combustion engine according to the invention, a state of rigid connection is realized as necessary, whereby the motion of the cam can be transmitted to the valve faithfully, and automatic gap adjustment is feasible even for elongation and contraction due to wearing of mechanical parts and temperature changes generated in line with sliding with the cam and opening or closing of the valve, whereby it is useful for a power valve system of an internal combustion engine.

Claims

1. A rush adjuster for an internal combustion engine featuring having a plurality of rolling members interposed between the valve and the cam of an internal combustion engine, comprising:
 - a cylindrical bucket with its top end in contact with said cam;
 - a first elastic member interposed between the inner face of ceiling part of the bucket and the plunger;
 - a tapered part formed on the outer periphery of said plunger so that the gap between said inner periphery of the bucket and the external periphery of said plunger increases upwardly; and
 - a plurality of rolling members interposed between the tapered part and the inner periphery of said bucket.
2. A rush adjuster for an internal combustion engine according to claim 1, wherein the tapered part is formed on said inner periphery of the bucket instead of said plunger so that the gap between the inner periphery of said bucket and the outer periphery of said plunger is widened downwards, and a ring for supporting the rolling member is fixed on the inner periphery of the aforementioned bucket.
3. A rush adjuster for an internal combustion engine according to claim 1 or 2, wherein said second elastic member is provided for urging said rolling members in a direction for increasing the distance between said tapered parts.
4. A rush adjuster for an internal combustion engine according to claim 3, wherein a washer is interposed between said second elastic member and said rolling members.
5. A rush adjuster for an internal combustion engine according to any of claims 1 to 3, wherein said bucket is provided with an annular inner part on the underside of said ceiling part and said plunger is disposed at the inner periphery side of the annular inner part.
6. A rush adjuster for an internal combustion engine according to any of claims 2 to 5, wherein said tapered part has a plurality of tapered grooves secured with an interval in the circumferential direction and these tapered grooves has any one section selected from mono-arc section of a curvature greater than the curvature of said rolling members and has a section selected from any of a section at which an arc section having a greater curvature than the curvature of the rolling member is composed, V-section, and trapezoid-section.
7. A rush adjuster for an internal combustion engine according to any one of claims 1 to 5, wherein an arcuate groove part opposed to the tapered part is formed on said surface having no tapered part of either said inner periphery of the bucket and said outer periphery of the plunger, the arcuate groove part has any one of a section conjugated of arcuate surfaces of curvatures greater than the curvature of the aforementioned rolling member, V-section and trapezoid section.
8. A rush adjuster for an internal combustion engine according to any one of claims 1 to 7, wherein said tapered groove or arcuate groove is formed helically.

Fig. 1

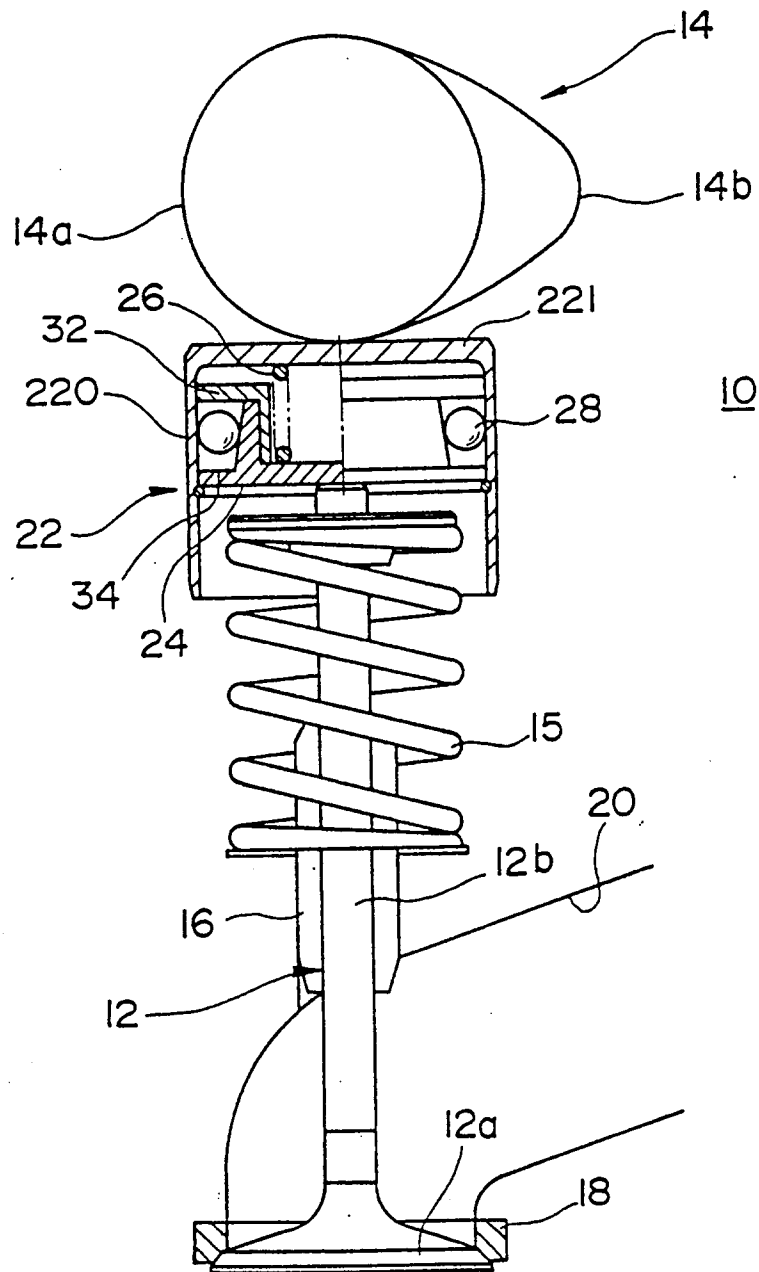


Fig. 2

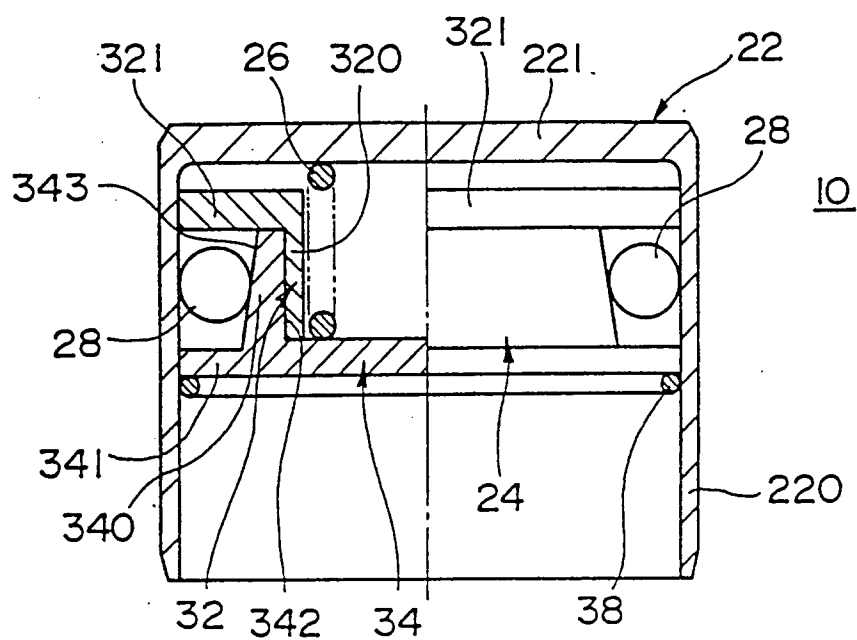


Fig. 3

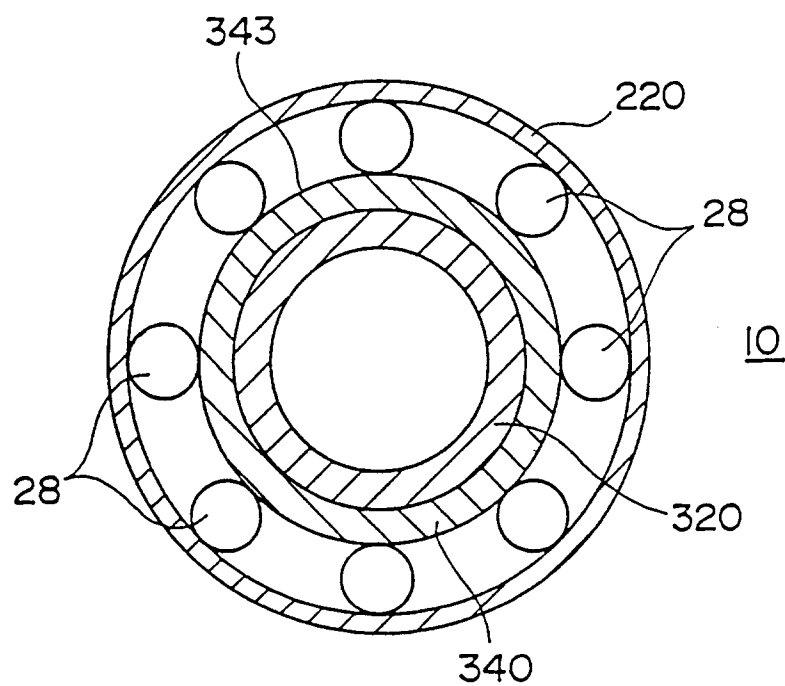


Fig. 4

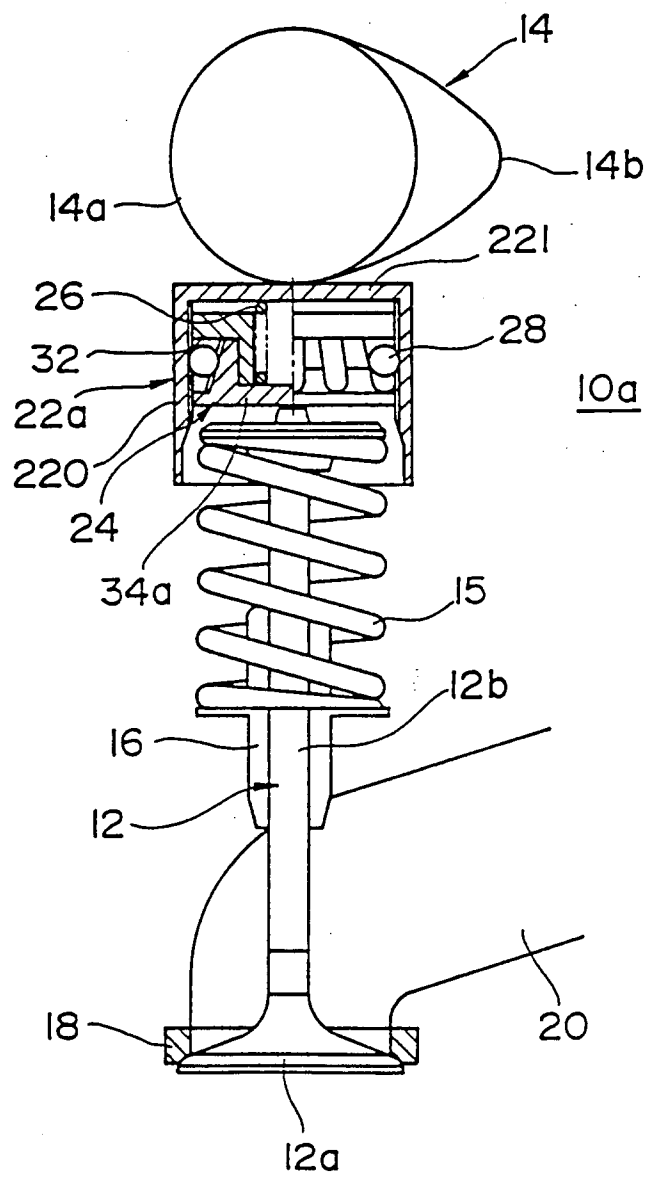


Fig. 5

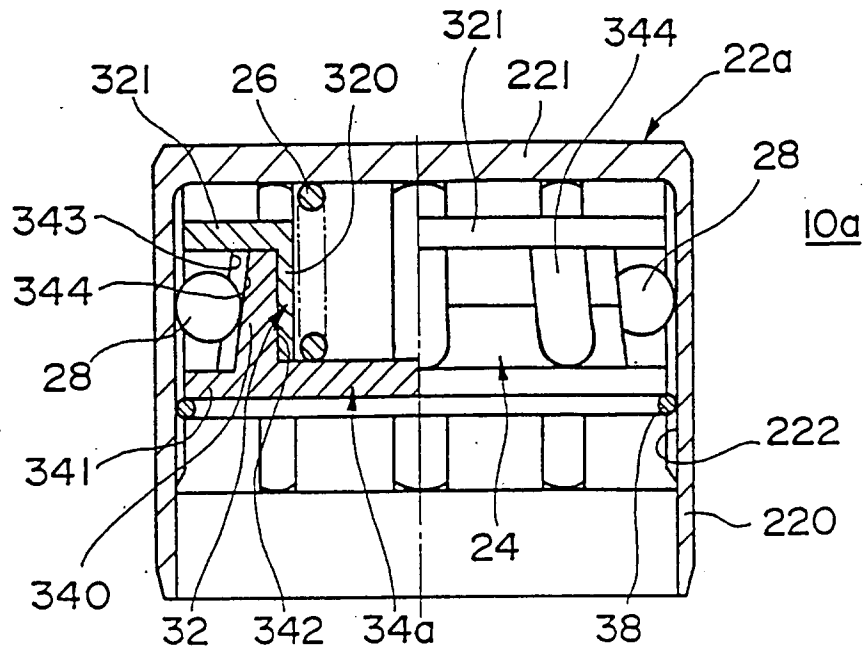


Fig. 6

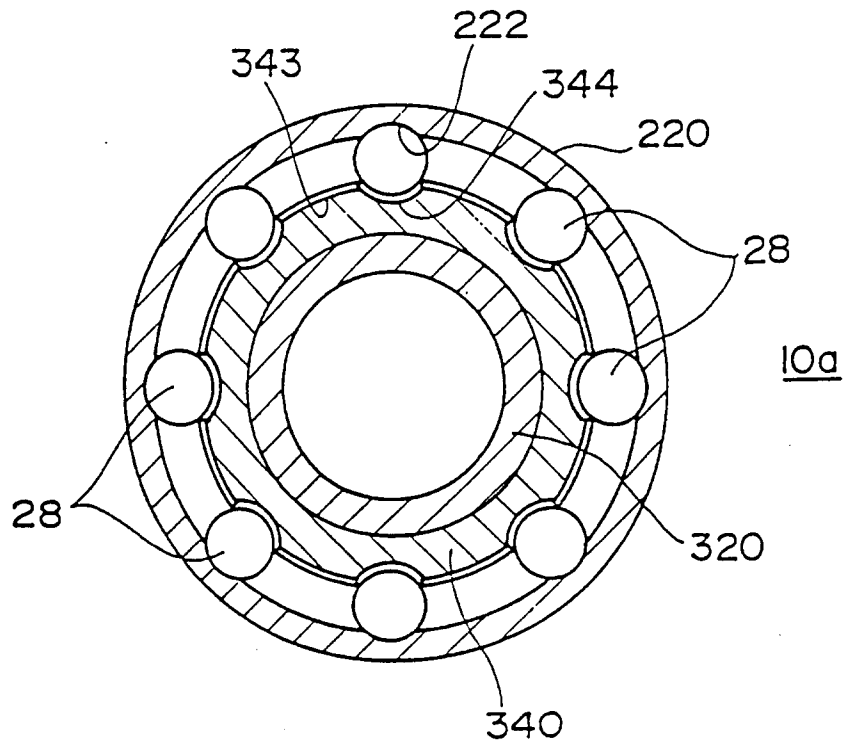


Fig. 7

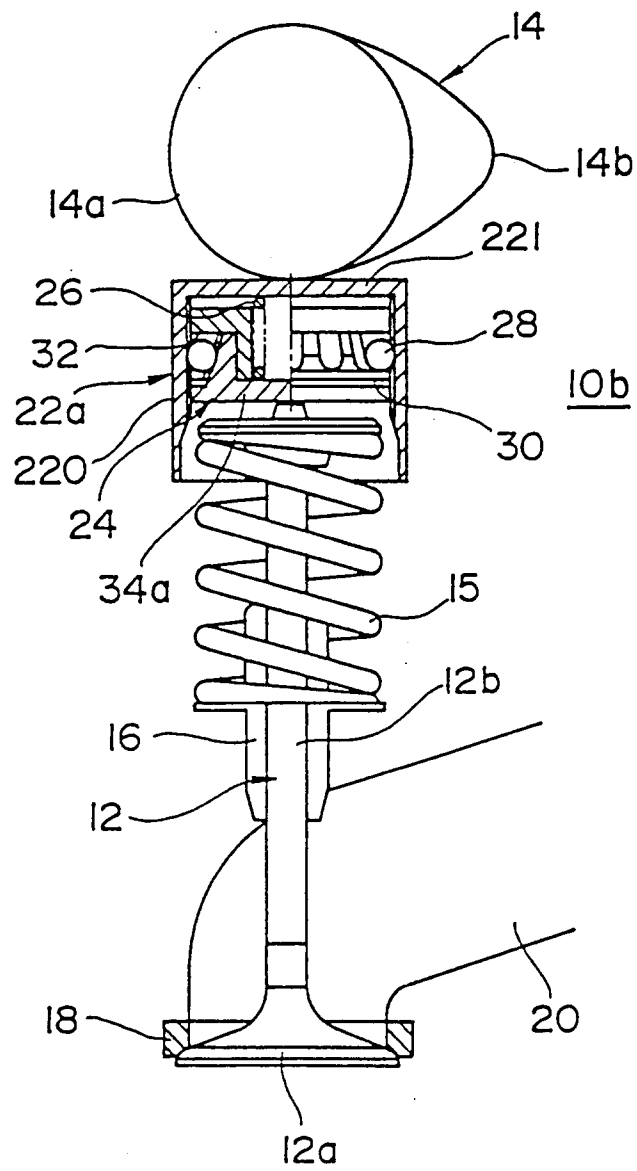


Fig. 8

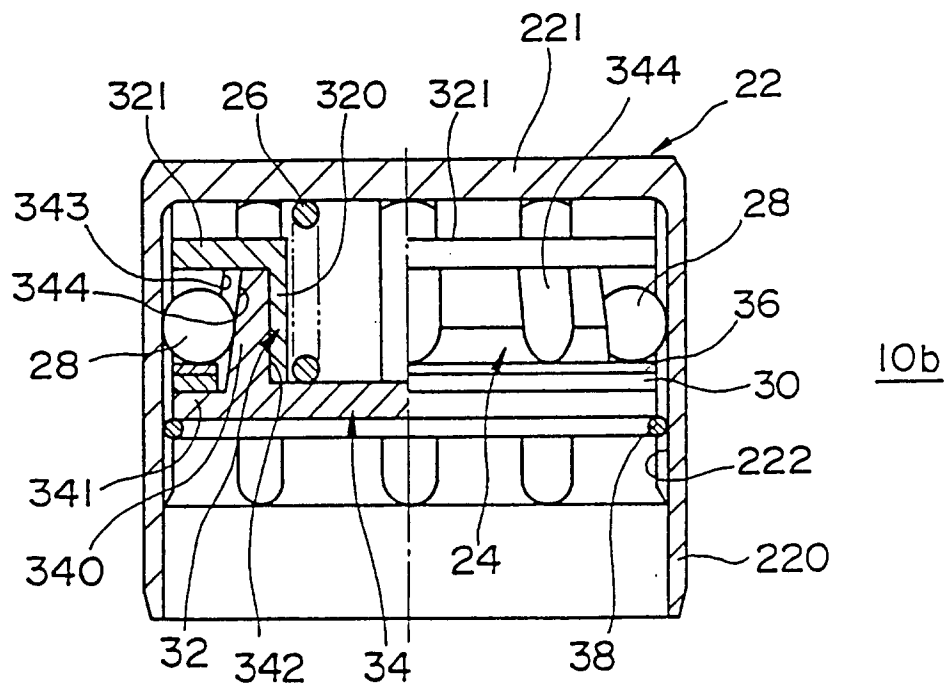


Fig. 9

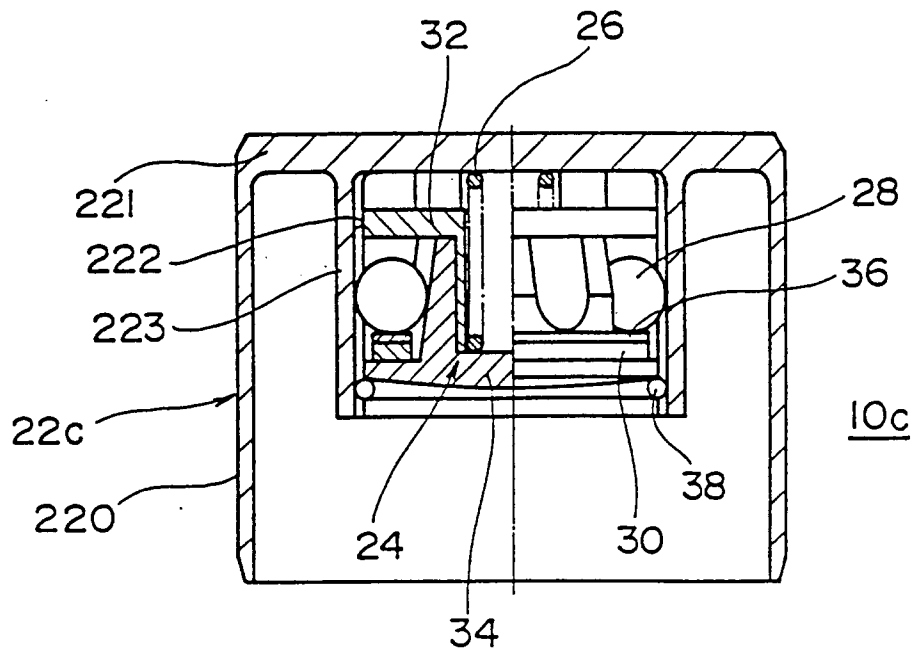


Fig. 10

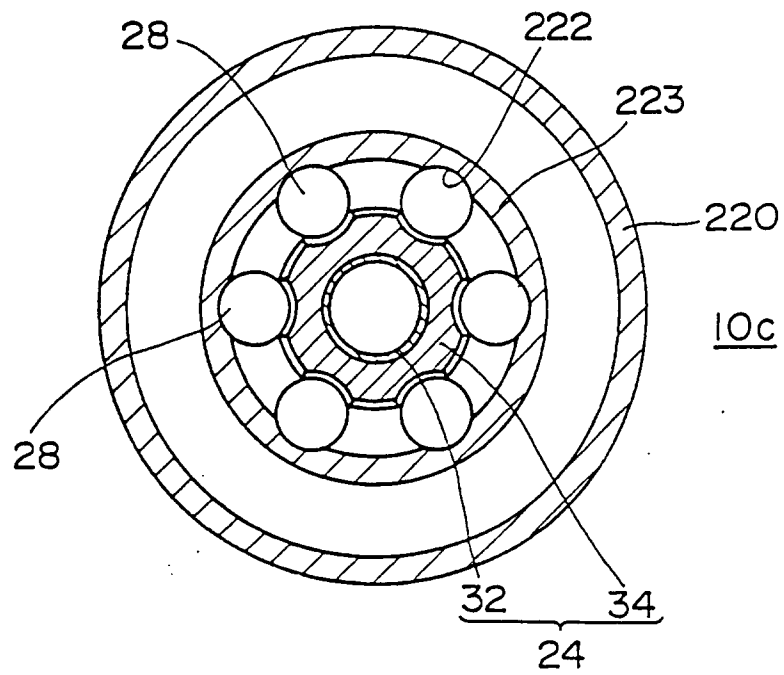


Fig. 11

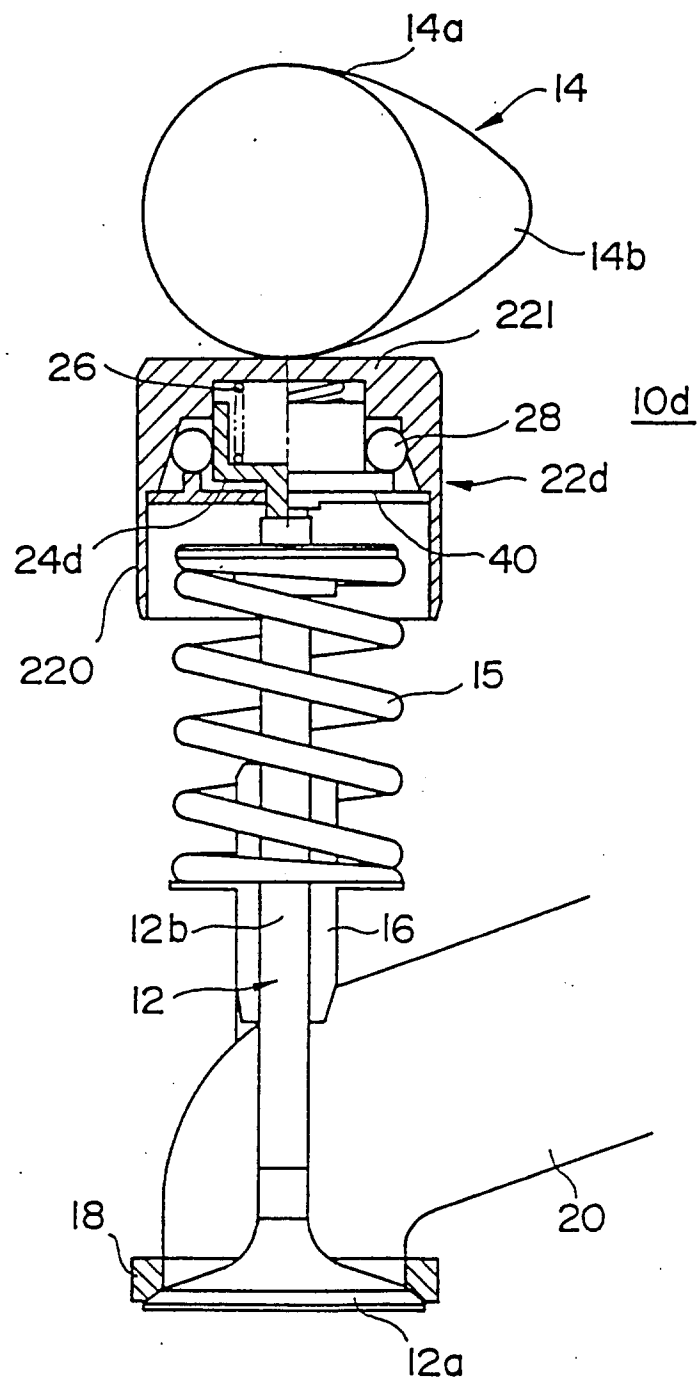


Fig. 12

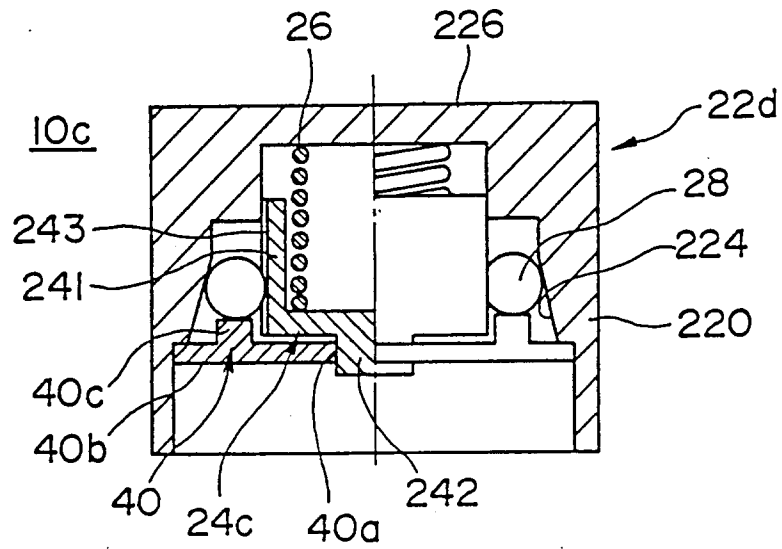


Fig. 13

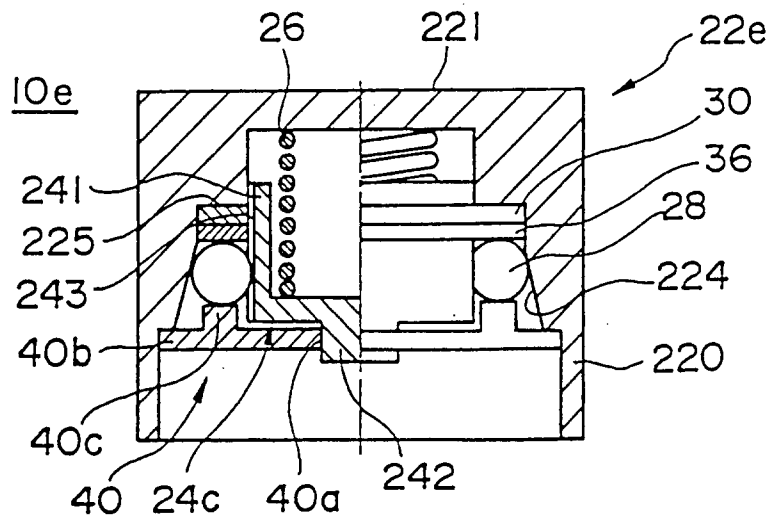


Fig. 14

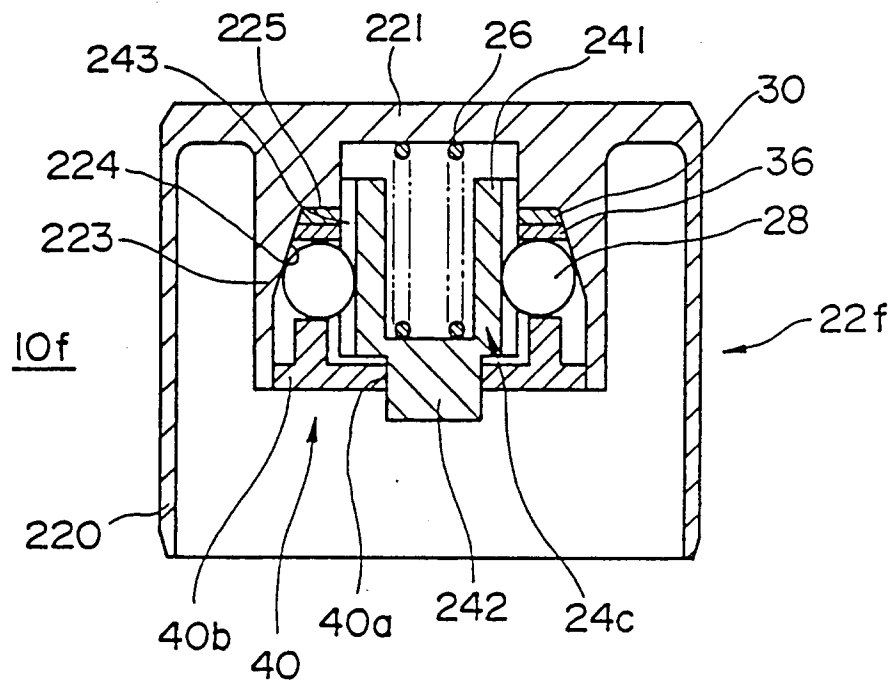


Fig. 15

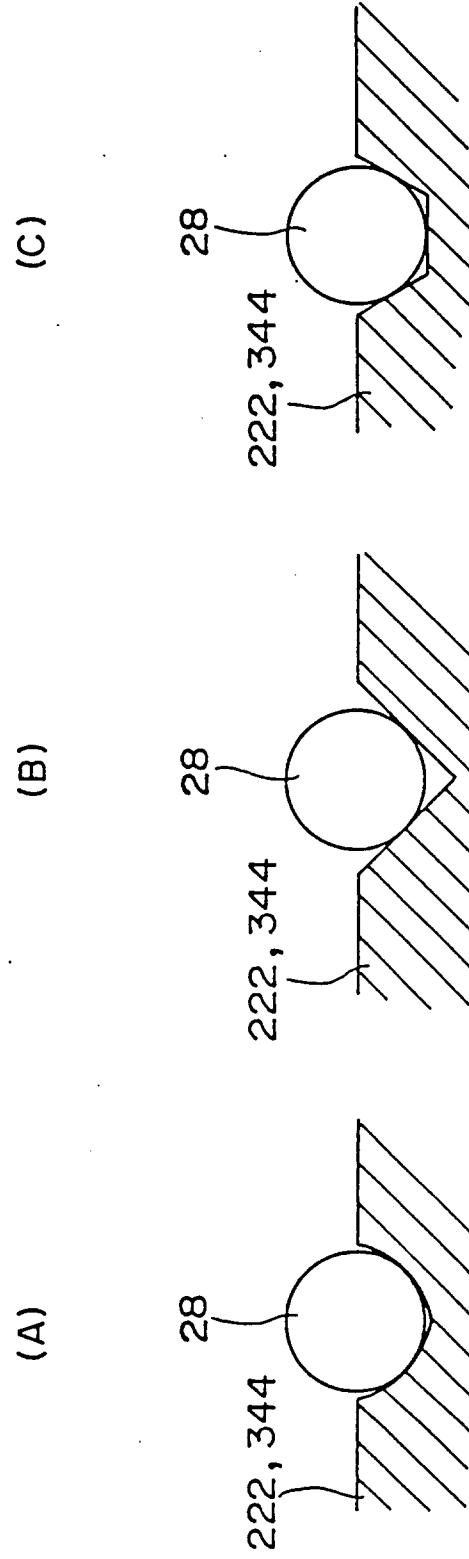
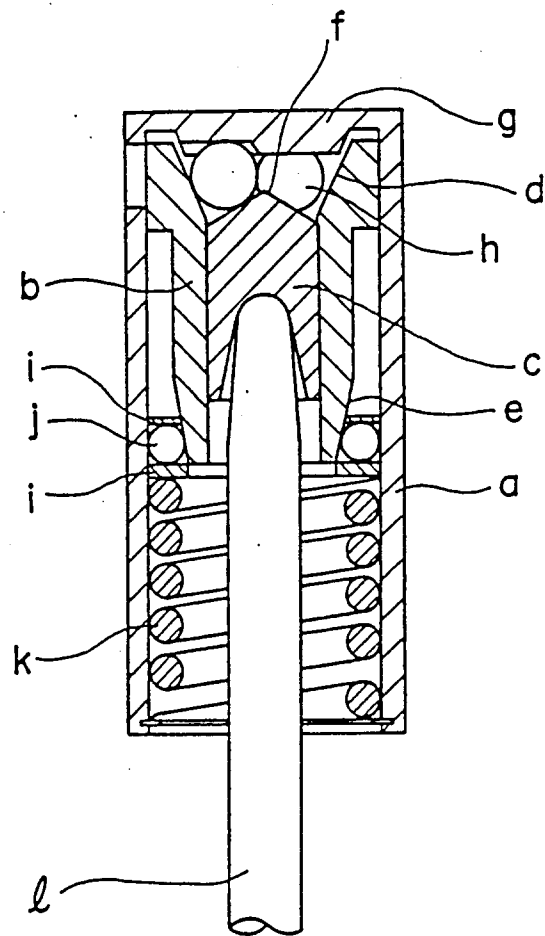


Fig. 16



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP95/00054

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl⁶ F01L1/22

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl⁶ F01L1/22

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

Jitsuyo Shinan Koho 1926 - 1995

Kokai Jitsuyo Shinan Koho 1971 - 1995

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, U, 4-100005 (Chuo Hatsujo K.K.), August 28, 1992 (28. 08. 92), Description of Summary Constitution (Family: none)	1
A	JP, A, 61-502553 (GKN Technology Ltd.), November 6, 1986 (06. 11. 86), Description of claim & US, A, 4706620 & GB, B2, 2160945 & WO, A1, 86/00372	1
A	US, A, 3038460 (John A. Mikina), June 12, 1962 (12. 06. 62), Lines 52 to 57, column 5 (Family: none)	1
A	JP, Y1, 36-14650 (Haruyoshi Okawa), June 5, 1961 (05. 06. 61), Fig. 2 (Family: none)	1

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search

April 7, 1995 (07. 04. 95)

Date of mailing of the international search report

May 16, 1995 (16. 05. 95)

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