(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 100 241**
B1

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **06.05.87**

(51) Int. Cl.^{4}: **F 01 L 1/24**

(21) Application number: **83304368.0**

(22) Date of filing: **28.07.83**

(54) **Hydraulic lash adjustor in a valve operating mechanism.**

(30) Priority: **30.07.82 JP 133375/82**
26.08.82 JP 148106/82

(43) Date of publication of application:
08.02.84 Bulletin 84/06

(45) Publication of the grant of the patent:
06.05.87 Bulletin 87/19

(84) Designated Contracting States:
DE FR GB

(56) References cited:
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FR-A-1 558 800
GB-A-1 345 530
US-A-2 694 388
US-A-2 700 965
US-A-3 967 602

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EP 0 100 241 B1

Courier Press, Leamington Spa, England.

Description

The present invention relates to a hydraulic valve head clearance eliminating device, that is a so-called hydraulic lash adjustor, in a valve-operating mechanism and more particularly to an improved hydraulic lash adjustor for automatically eliminating valve head clearance in the valve operating mechanism for an internal combustion engine with the aid of resilient force given by a resilient means and hydraulic force so that the valve operating mechanism can be reliably and quietly operated for a long period of time and excellent durability is assured.

In general, a hydraulic lash adjustor is equipped with a check valve located in the interior thereof so as to open or close a hydraulic passage formed in the adjustor and due to the fact that the check valve moves violently within a valve cage which serves to contain the valve therein there is necessity for firmly holding the valve cage in order to assure that the check valve operates properly at all time.

To facilitate understanding of the present invention it will be helpful that a hitherto known hydraulic lash adjustor will be described below with reference to Figs. 1 and 2 of the accompanying drawings, Fig. 1 being a vertical sectional view of the whole lash adjustor and Fig. 2 being a fragmentary vertical sectional view of an important detail of the lash adjustor, shown on an enlarged scale.

Referring to Figs. 1 and 2, the hydraulic lash adjustor includes a cylinder 1 which serves as a housing therefor. As is apparent from the drawings, the cylinder 1 is designed in the form of a bottomed hollow cylinder which is open at upper end part 1a while having a closed bottom wall 1b at the lower end part thereof and which is fitted into a support hole Ea of an engine casing E. A plunger 2 with a semi-spherical top part 2a formed at its upper end is slidably inserted into the cylinder 1 through the open end part 1a and a hydraulic chamber 3 is defined between the lower end part of the plunger 2 and the bottom wall 1b of the cylinder 1. Further, the plunger 2 is formed with a hydraulic oil reservoir chamber 4 in the interior and has a valve bore 5 at its bottom portion by way of which bore the hydraulic oil reservoir chamber 4 is in communication with the hydraulic chamber 3. The hydraulic oil reservoir chamber 4 is in communication with a hydraulic oil supply passage 10 via a through hole 6 on the side wall of the plunger 2, an annular hydraulic passage 7 between both the sliding surfaces of the cylinder 1 and the plunger 2, a through hole 8 on the side wall of the cylinder 1 and an annular hydraulic passage 9 on the outer surface of the cylinder 1 so that the chamber 4 is always filled with hydraulic oil which is delivered through the hydraulic oil supply passage 10.

The plunger 2 includes a cylindrical portion 11 at its lower end which is adapted to abut against a shoulder 1c formed on the inner side wall of the cylinder 1 at a position located in the proximity of the bottom of the latter so as to define a positional limit of downward movement of the plunger 2.

A valve cage 12 is disposed in the hydraulic chamber 3. Specifically, the valve cage 12 comprises a main body 12a and a flange portion 12b made integral with the former and extending radially outward from the upper end of the body 12a. A through hole 13 is formed on the side wall of the main body 12a and the outer peripheral part of the flange portion 12b is fitted into an annular engagement groove 14 on the inner side wall of the cylindrical portion 11 of the plunger 2.

A check valve 15 in the form of a ball is floatably housed in the valve cage 12 so as to open or close the valve bore 5. The conventional hydraulic lash adjustor is so constructed that the check valve 15 is caused to open as hydraulic pressure in the hydraulic chamber 3 decreases and close as it increases and a stopper 16 is provided at the bottom of the valve cage 12 so as to confine a working stroke of the check valve 15. Further, to assure that the plunger 2 projects upward above the upper end of the cylinder 1 a resilient spring 17 in the form of a coil spring is contained in the hydraulic chamber 3 to apply thrusting force to the plunger 2 from the bottom side therof.

The semi-spherical top end part 2a of the plunger 2 abuts against the righthand end part of a rocker arm R as seen in Fig. 1 and the lefthand end part of the latter abuts against the valve head of a poppet valve V which serves to open or close an intake valve or an exhaust valve on the engine casing E, wherein an operating cam C is disposed at a position intermediate between both the righthand and lefthand end parts of the rocker arm R so that the poppet valve V is opened by rotation of the operating cam C. The poppet valve V is usually equipped with a valve spring S in the form of a coil spring which is adapted to urge the valve in the closing direction. It should be noted that resilient force of the valve spring S is set far stronger than that of the resilient spring 17 in the hydraulic chamber 3.

Next, operation of the conventional hydraulic lash adjustor will be described below.

While the poppet valve V is kept closed, the plunger 2 is caused to move upward under the influence of resilient force of the resilient spring 17 until the righthand end part of the rocker arm R is raised up and thereby clearance between the lefthand end part of the rocker arm R and the valve head of the poppet valve V is eliminated. As the plunger 2 is raised up and thereby hydraulic pressure in the hydraulic chamber 3 decreases, the check valve 15 is opened and hydraulic oil in the hydraulic oil reservoir chamber 4 flows into the hydraulic chamber 3 via the valve bore 5 whereby the hydraulic chamber 3 is filled with hydraulic oil again.

Next, when the cam face on the operating cam C comes in contact with the rocker arm R as it is rotated, the rocker arm R is depressed its intermediate part and thereby valve opening force is generated. In response to valve opening force, hydraulic pressure is developed in the hydraulic

chamber 3 which has been kept closed by means of the check valve 15 and it results that the plunger 2 is supported under application of the thus developed hydraulic pressure onto the bottom surface thereof. Thus, the rocker arm R is caused to pivot downwardly toward the poppet valve V about the semi-spherical end part 2a of the plunger 2 which serves as a fulcrum, whereby the poppet valve V is opened against resilient force of the valve spring S. During the downward pivoting movement of the rocker arm R, a very small amount of hydraulic oil in the hydraulic chamber 3 leaks through close clearance between the sliding surfaces of the cylinder 1 and the plunger 2 but the leaked amount of hydraulic oil will be compensated by an auxiliary supply from the hydraulic oil reservoir chamber 4 during next closing operation of the poppet valve V.

However, it has been found that a conventional hydraulic lash adjustor of the above type has the following drawbacks because of the fact that the valve cage 12 with the check valve 15 housed therein is held in place merely by fitting its flange portion 12b into the annular engagement groove 14 on the inner side wall of the cylindrical portion 11 of the plunger 2.

(1) There is fear of causing disconnection of the valve cage 12 from the annular engagement groove 14 when a considerably large volume of air enters the hydraulic chamber 3 during operation of an engine at a high speed or oil feeding, because the check valve 15 resonates in the valve cage 12 and a high intensity of impulsive force caused by such resonance is adversely transmitted to the valve cage 12.

(2) To inhibit disconnection of the valve cage 12 in that way there has been proposed an arrangement that interferencial dimension is provided for the flange portion 12b of the valve cage 12 so as to allow it to be forcibly fitted into the annular engagement groove 14. The valve cage 12 is generally manufactured by press forming, because a machining operation causes a substantially increased manufacturing cost. To practice the proposal there is necessity for maintaining dimensional tolerance of the flange portion 12b of the valve cage 12 within a strictly close range but it is difficult to meet this necessity so that interferencial dimension fluctuates. If the interferencial dimension is excessively small, there is fear of causing the valve cage 12 to drop out of its place in the same manner as in the foregoing. On the contrary, if it is excessively large, plastic deformation tends to take place with the flange portion 12b at the time of fitting into the annular engagement groove 14, resulting in an occurence of fluctuation in clearance for displacement of the check valve 15 within the valve cage 12. Furthermore, there may be a case where it becomes difficult to assure an extent of displacement of the check valve 15 required for its intended operation. In another case, there may be produced a cracking in the valve cage 12, resulting in that the valve cage 12 becomes liable to drop out of its place in the annular engagement groove 14.

(3) To assure that the flange portion 12b of the valve cage 12 is reliably fitted into the annular engagement groove 14 it is inevitably necessary to keep an appreciable amount of dimensional clearance between the width of the annular engagement groove 14 and the thickness of the flange portion 12b of the valve cage 12. However, this in turn causes the valve cage 12 to move toward and away from the plunger 2 or to rotate in the groove 14 and moreover unpleasant noise is generated due to abutment or frictional sliding movement of the former with respect to the latter. Thus, it becomes impossible to keep constant the extent of displacement of the check valve. Also in this case there is fear of causing the check valve to drop out in the above-described manner.

A prior art device as disclosed in U.S. Patent 3,967,602 also suffers from the above disadvantages because its cup-shaped valve cage having a radial flange is held against axial movement by spring means which merely urges the flange onto the bottom face of the plunger.

According to the present invention there is provided a hydraulic lash adjustor in a valve operating mechanism of the type including a cylinder, a plunger slidably fitted into said cylinder, a hydraulic chamber defined between both the cylinder and the plunger, a hydraulic oil reservoir chamber formed in the plunger, said hydraulic oil reservoir chamber being in communication with the hydraulic chamber by way of a valve bore which is formed in the plunger, a check valve mounted to said valve bore so as to open when hydraulic pressure in the hydraulic chamber decreases and close when it increases, and a valve cage disposed on the plunger and accommodating therein the check valve, wherein the plunger is so biased by a resilient means as to project outwardly of the cylinder to support at its outermost end a rocker arm of the valve operating mechanism and wherein valve opening force generated by an operating cam of the valve operating mechanism is transmitted to the plunger as a force depressing the plunger in the axial direction, the valve cage comprising a cup-shaped main body and a flange portion integrally extending radially outward from the peripheral end part of said main body; characterised in that the flange portion is firmly held in place onto the inner end surface of the plunger by a holding member fitted into an annular engagement groove formed in the plunger. In this hydraulic lash adjustor the valve cage with the check valve housed therein is firmly secured to the plunger without any fear of causing dropping of the valve cage and of generating unpleasant noise, while the extent of displacement of the check valve is always maintained within a predetermined range so as to ensure proper operation of the check valve. Further, the flange portion of the valve cage is firmly secured to the plunger irrespective of fluctuated machining errors of holding members for firmly securing the valve cage to the plunger.

Since the present hydraulic lash adjustor is constructed such that the valve cage comprises

the cup-shaped main body and the flange portion extending radially outward from the peripheral end part of the main body and the flange portion is firmly held between the inner end surface of the plunger and the holding member fitted into the annular engagement groove formed in the plunger, it is assured that the valve cage is firmly secured to the plunger without any fear of causing deformation, damage or injury and of generating unpleasant noise due to abutment or frictional sliding movement of the valve cage with respect to the plunger and moreover the check valve accommodated in the valve cage is reliably and quietly operated for a long period of time while the extent of displacement of the check valve within the valve cage is kept constant at all times.

As described hereinafter, in a particular form the holding member is supported by a retainer fitted into the lower end part of the plunger from the bottom side thereof and the retainer is in turn resiliently supported by the resilient member. In this construction the holding member can be retained more reliably, thus further enhancing advantageous functional effects.

By forming at least a lower side wall surface constituting the annular engagement groove located at the bottom side of the cylinder as a tapered face extending radially inward in such a manner as to cause the open width of the annular engagement groove to enlarge toward the axis of the plunger, as hereinafter described, the holding member can be smoothly fitted into the annular engagement groove by way of expansive displacement of the holding member along the tapered face during the fitting operation until it is located at the predetermined position within the annular engagement groove and therefore the flange portion of the valve cage can be reliably secured to the plunger.

For a better understanding of the present invention and to show how the same may be carried into effect, reference will now be made, by way of example, to Figs. 3 to 11 of the accompanying drawings which illustrate several preferred embodiments of the present invention.

The accompanying drawings will be briefly described below.

Figs. 1 and 2 illustrate a hitherto known hydraulic lash adjustor, wherein Fig. 1 is a vertical sectional view of the whole lash adjustor and Fig. 2 is a fragmentary vertical sectional view of an essential part of the lash adjustor, shown in an enlarged scale.

Figs. 3 and 4 illustrate a hydraulic lash adjustor in accordance with a first embodiment of the present invention, wherein Fig. 3 is a fragmentary vertical sectional view of an essential part of the lash adjustor, shown in an enlarged scale and Fig. 4 is a plan view of a caulking ring as seen in the plane taken in line IV—IV of Fig. 3.

Figs. 5 and 6 illustrate a hydraulic lash adjustor in accordance with a second embodiment of the present invention, wherein Fig. 5 is a fragmentary vertical sectional view of an essential part of the lash adjustor, shown in an enlarged scale and Fig. 6 is a plan view of a snap ring as seen in the plane taken in line VI—VI of Fig. 5.

Fig. 7 is a fragmentary vertical sectional view of an essential part of a hydraulic lash adjustor in accordance with a third embodiment of the present invention, shown in an enlarged scale.

Fig. 8 is an enlarged fragmentary vertical sectional view of a hydraulic lash adjustor in accordance with a fourth embodiment of the present invention.

Figs. 9 to 11 illustrate a hydraulic lash adjustor in accordance with a fifth embodiment of the present invention, wherein Fig. 9 is an enlarged fragmentary vertical sectional view of an essential part of the lash adjustor, while Figs. 10 and 11 are enlarged fragmentary vertical sectional views similar to Fig. 9, respectively, illustrating exemplified fitted states of caulking rings into an annular engagement groove formed on the inner side wall of the cylindrical portion of the plunger.

Now, the present invention will be described in a greater detail hereunder with reference to Figs. 3 to 11 of the accompanying drawings which illustrate preferred embodiments of the invention. It should be noted that the same parts and components as those in Figs. 1 and 2 are identified with the same reference characters and numerals.

First, a hydraulic lash adjustor in accordance with the first embodiment of the invention will be described with reference to Figs. 3 and 4.

A plunger 2 has a cylindrical portion 11 at its lower end part and an annular engagement groove 24 is formed around the inner wall surface of the cylindrical portion 11 at a position located away from the inner end surface of the plunger 2 by a distance substantially equal to the thickness of a flange portion 12b of a valve cage 12. The outer periphery of the flange portion 12b of the valve cage 12 is fitted into the inner periphery of the cylindrical portion 11 of the plunger 2. In this embodiment, there is appreciably small dimensional difference between the outer diameter of the flange portion 12b and the inner diameter of the cylindrical portion 11 of the plunger 2 and therefore no interferential dimension exists with respect to the cylindrical portion 11 of the plunger 2. Next, a caulking ring 30 to serve as a holding member is inserted into the cylindrical portion 11 of the plunger 2 and it is then expanded by operating a caulking punch P so as to cause it to be forcibly fitted into the engagement groove 24 whereby the flange portion 12b of the valve cage 12 is firmly held between the caulking ring 30 and the inner end surface of the plunger 2. Since the caulking ring 30 is subjected to plastic deformation during caulking operation until the flange portion 12b is tightly fitted into the annular engagement groove 24, it results that the valve cage 12 is immovably secured to the plunger 2 without any fear of causing vertical displacement or turning movement which may generate unpleasant noise due to collision or frictional sliding movement of the valve cage 12 with respect to the

plunger 2. Accordingly, the distance of displacement of a check valve 15 within the valve cage 12 can be always kept constant.

Next, a hydraulic lash adjustor in accordance with the second embodiment of the invention will be described with reference to Figs. 5 and 6.

A plunger 2 has a cylindrical portion 11 at its lower end part and an annular engagement groove 25 having a female tapered face t_1 is formed around the inner wall surface of the cylindrical portion 11 at a position located away from the inner end surface of the plunger 2 by a distance appreciably less than the thickness of a flange portion 12b of a valve cage 12. The outer periphery of the flange portion 12b of the valve cage 12 is fitted into the inner periphery of the cylindrical portion 11 of the plunger 2. Accordingly, no interferential dimension exists between the outer diameter of the flange portion 12b and the inner diameter of the cylindrical portion 11 either in this embodiment.

Next, a snap ring 31 having a male tapered face t_2 corresponding to the female tapered face t_1 on the annular engagement groove 25 is resiliently fitted into the groove 25. As is apparent from Fig. 6, the snap ring 31 has a cutout formed at a part thereof and it is so dimensioned to have its outer diameter larger than the inner diameter of the cylindrical portion 11 of the plunger 2 in a freely expanded state. When it is resiliently fitted into the annular engagement groove 25, clearance between the flange portion 12b and the snap ring 31 disappears due to tight engagement of the male tapered face t_2 to the female tapered face t_1 whereby the flange portion 12b of the valve cage 12 is immovably held between the inner end surface of the plunger 2 and the snap ring 31 without causing vertical displacement or turning movement of the valve cage 12. If a coil spring 17 is so arranged to provide only a small clearance between itself and the snap ring 31, the snap ring 31 can be prevented from dropping out of the annular engagement groove 25 by abutment against the spring 17.

Next, a hydraulic lash adjustor in accordance with the third embodiment of the invention will be described with reference to Fig. 7.

The third embodiment provides a special means for preventing a snap ring 32 from dropping out of the annular engagement groove 26 in addition to the arrangement as disclosed in the above-described second embodiment. Specifically, after the snap ring 32 is resiliently fitted into the annular engagement groove 26, a retainer 22 is additionally inserted into the cylindrical portion 11 of the plunger 2 and a coil spring 17 is then disposed below the retainer 22 in such a manner as to resiliently support the retainer 22 from the bottom side thereof.

Next, Fig. 8 illustrates a hydraulic lash adjustor in accordance with the fourth embodiment of the invention wherein a caulking ring having a specific cross-sectional configuration is employed as a holding member. As is apparent from the drawing, a plunger 2 has a cylindrical portion 11 at its lower end part and an annular engagement groove 27 is formed around the inner wall surface of the cylindrical portion 11 at a position spaced from the inner end surface of the plunger 2 by a distance equal to or appreciably less than the thickness of a flange portion 12b of a valve cage 12. The annular engagement groove 27 has its lower side wall surface formed to be a tapered face t_3 inclined downward in the radially inward direction so that its open width increases towards the axis of the plunger. Owing to the cross-sectional configuration of the annular engagement groove 27 as described above, fitting of a caulking ring 33 into the groove 27 is precisely carried out by plastic deformation of said caulking ring 33 along the tapered face t_3 at its outside lower edge portion until the caulking ring 33 assumes a predetermined position. Thus, fitting of the caulking ring 33 into the annular engagement groove 27 can be achieved more smoothly and easily than in case of the first embodiment where the annular engagement groove has its lower side wall surface extending at right angles to the axis of the plunger 2. Generally, a caulking ring is so designed that its lower surface is located below the lower side wall surface of an annular engagement groove prior to carrying out caulking operation in order to assure that the caulking ring is fitted into the annular engagement groove with an engagement strength higher than certain level, i.e., the outer peripheral surface of the caulking ring partially overlaps the inner wall surface of the cylindrical portion of the plunger immediately below and continuous with the lower side wall surface of the engagement groove. However, the extent of overlapping fluctuates within a certain range due to machining errors of caulking rings to be used. Assuming here that the amount of overlapping is large and a caulking load is insufficiently applied to the caulking ring 30 of the first embodiment where the lower side wall surface of the annular engagement groove 24 extends inward at right angles to the axis of the plunger 2, it is expected that irregular plastic deformation may take place, for example, a part of the caulking ring 30 may be cut away by the corner edge of the annular engagement groove 24 and/or stress concentration may appear at contact areas of the caulking ring 30 brought in point contact or line contact with bottom and side wall surfaces of the annular engagement groove. However, such fear as described above never arise in a case where the lower side wall surface is inclined in the form of a tapered face as in the fourth embodiment. Accordingly, the caulking ring 33 can serve as an effective holding member for a long period of time and therefore a valve operating mechanism can work reliably and quietly for a longer period of time. It should also be noted that a larger extent of overlapping is permissible than in the case of the first embodiment.

Incidentally, an inclination angle of the tapered face t_3 in the annular engagement groove 27 is selectively determined in the range of 15 to 45

degrees with respect to the plane extending at right angles to the axis of the plunger 2, taking into account the direction of application of caulking load when the caulking ring 24 is mounted.

Next, Figs. 9 to 11 schematically illustrate a hydraulic lash adjustor in accordance with the fifth embodiment of the invention, wherein the structure of the hydraulic lash adjustor is partially modified from that of the fourth embodiment. Specifically, in this embodiment, an annular engagement groove 28 has an upper tapered face t_4 in addition to the lower tapered face t_3 which has already been proposed in the foregoing fourth embodiment. Both the tapered faces t_3 and t_4 extend radially inward in a diverging manner, that is, in opposite inclined directions to one another with respect to a plane extending at right angles to the axis of the plunger 2. In other words, the tapered face t_3 extends inward at a downward inclination angle of θ, whereas the tapered face t_4 extends inward at an upward inclination angle of θ'. The inclination angles θ and θ' of both the tapered faces t_3 and t_4 are selectively determined in the range of 15 to 45 degrees in the same manner as in the case of the foregoing fourth embodiment. They may be enlarged to the maximum of 60 degrees without any loss of advantageous functional features. Thus, the arrangement made in accordance with this embodiment ensures that there is formed no useless escape area for the caulking ring 34 at the time of fitting of the latter into the annular engagement groove 28 and moreover caulking operation is performed more smoothly and reliably. Further, since the caulking ring 34 is fitted into the annular engagement groove 28 until its outer peripheral surface comes in close contact with the innermost end wall of the groove 28, there is no fear of causing unexpected displacement of the caulking ring 34 within the annular engagement groove 28 or locating it at any geometrically unstable position. As a result, the flange portion 12b of the valve cage 12 can be immovably held between the inner end surface of the plunger 2 and the caulking ring 34.

Another advantageous feature of this embodiment is that a lathing bit for machining the annular engagement groove 28 may be designed in such a configuration as to correspond to the cross-sectional configuration of the groove 28, i.e., in a trapezoidal configuration with a tapered tip end portion, thereby elongating running life of the lathing bit.

Further, also in this embodiment, the caulking ring 34 is plastically deformed smoothly along the lower tapered face t_3 during caulking operation in the same manner as in the case of the fourth embodiment even if the amount of overlapping of the caulking ring 34 with respect to the annular engagement groove 28 is excessively large, and therefore the caulking ring 34 is brought in surface contact with the tapered side face t_3 as illustrated in Fig. 10. As a result, there is no fear of reducing durability of the hydraulic lash adjustor. On the other hand, when the extent of overlapping is small, the caulking ring 34 is necessarily brought in contact with at least part of the tapered face t_3 on the side of the bottom surface of the groove 28 as illustrated in Fig. 11 and therefore downward displacement of the caulking ring 34 is reliably inhibited. Thus, the flange portion 12b of the valve cage 12 can be held firmly in place. As will be apparent from the foregoing, the caulking ring 34 can be reliably fitted into the annular engagement groove 28 by caulking operation irrespective of the amount of overlapping.

It will be noted that in all the embodiments of the invention described the valve cage 12 has a cup-shaped main body 12a.

Claims

1. A hydraulic lash adjustor in a valve operating mechanism of the type including a cylinder (1), a plunger (2) slidably fitted into said cylinder (1), a hydraulic chamber (3) defined between both the cylinder (1) and the plunger (2), a hydraulic oil reservoir chamber (4) formed in the plunger (2), said hydraulic oil reservoir chamber (4) being in communication with the hydraulic chamber (3) by way of a valve bore (5) which is formed in the plunger (2), a check valve (15) mounted to said valve bore (5) so as to open when hydraulic pressure in the hydraulic chamber (3) decreases and close when it increases, and a valve cage (12) disposed on the plunger (2) and accommodating therein the check valve (15), wherein the plunger (2) is so biased by a resilient means (17) as to project outwardly of the cylinder (1) to support at its outermost end a rocker arm (R) of the valve operating mechanism and wherein valve opening force generated by an operating cam (C) of the valve operating mechanism is transmitted to the plunger (2) as a force depressing the plunger (2) in the axial direction, the valve cage (12) comprising a cup-shaped main body (12a) and a flange portion (12b) integrally extending radially outward from the peripheral end part of said main body (12a); characterised in that the flange portion (12b) is firmly held in place onto the inner end surface of the plunger (2) by a holding member (30, 31, 32, 33, 34) fitted into an annular engagement groove (24, 25, 26, 27, 28) formed in the plunger (2).

2. A hydraulic lash adjustor in a valve operating mechanism as defined in claim 1, wherein said holding member is constructed as a caulking ring (30, 33, 34) adapted to be fitted into said annular engagement groove (24, 27, 28) by caulking operation so that the flange portion (12b) of the valve cage (12) is firmly held between the inner end surface of the plunger (2) and the caulking ring (30, 33, 34).

3. A hydraulic lash adjustor in a valve operating mechanism as defined in claim 1, wherein said holding member is constructed as a snap ring (31, 32) with a cutout formed thereon, said snap ring (31, 32) being resiliently fitted into said annular engagement groove (25, 26) so that the flange portion (12b) of the valve cage (12) is firmly held

between the inner end surface of the plunger (2) and the snap ring (31, 32).

4. A hydraulic lash adjustor in a valve operating mechanism as defined in any one of claims 1 to 3, wherein said annular engagement groove (24, 25, 26, 27, 28) has a lower side wall surface designed in the form of a tapered face (t_1, t_3) extending radially inward at a downward inclination angle with respect to a plane vertical to the axis of the plunger (2).

5. A hydraulic lash adjustor in a valve operating mechanism as defined in any one of claims 1 to 4, wherein said annular engagement groove (28) has its upper and lower side wall surfaces designed in the form of tapered faces (t_4; t_3), the upper tapered face (t_4) extending radially inward at an upward inclination angle while the lower tapered face (t_3) extends radially inward at a downward inclination angle with respect to a plane vertical to the axis of the plunger (2).

6. A hydraulic lash adjustor in a valve operating mechanism as defined in claim 4 or 5, wherein said inclination angle of the tapered face (t_1, t_3, t_4) is selectively determined in the range of 15 to 45 degrees.

7. A hydraulic lash adjustor in a valve operating mechanism as defined in claim 4, 5, 6 wherein said inclination angle of the tapered face (t_3, t_4) is selectively determined in the range of 15 to 60 degrees.

8. A hydraulic lash adjustor in a valve operating mechanism as defined in claim 4 or in any one of claims 5 to 7 when appendant to claim 4, wherein said holding member has a lower face adapted to engage the tapered face (t_1), said lower face being formed as a tapered face (t_2) extending radially outward in an uprising manner at the same angle as the downward inclination angle of the tapered face (t_1).

9. A hydraulic lash adjustor in a valve operating mechanism as defined in claim 1, wherein said holding member is supported by a retainer (22) fitted into the lower end part of the plunger (2) from the bottom side thereof, said retainer (22) being resiliently supported by the resilient means (17).

10. A hydraulic lash adjustor in a valve operating mechanism as defined in any of claims 1 to 3 or 9, wherein said annular engagement groove (24, 25, 26, 27, 28) is formed on the inner side wall of the plunger (2) at a position spaced from the inner end surface of the plunger (2) by a distance equal to or appreciably shorter than the thickness of the flange portion (12b) of the valve cage (12).

11. A hydraulic lash adjustor in a valve operating mechanism as defined in any preceding claim, wherein no interferential dimension exists between the outer diameter of the flange portion (12b) of the valve cage (12) and the inner diameter of the cylindrical portion (11) of the plunger (2).

Patentansprüche

1. Hydraulische Ventilspielausgleichsvorrichtung in einem Ventilbetätigungsmechanismus, mit

einem Zylinder (1),

einem in dem Zylinder (1) verschiebbar aufgenommenen Kolben (2),

einer zwischen dem Zylinder (1) und dem Kolben (2) definierten Hydraulikkammer (3),

einer in dem Kolben (2) ausgebildeten Hydrauliköl-Vorratskammer (4), die mit der Hydraulikkammer (3) über eine in dem Kolben (2) ausgebildete Ventilbohrung (5) in Verbindung steht,

einem Rückschlagventil (15), das an der Ventilbohrung (5) so angebracht ist, daß es öffnet, wenn der hydraulische Druck in der Hydraulikkammer (3) abnimmt, und schließt, wenn er zunimmt, und

einem an dem Kolben (2) angeordneten Ventilkäfig (12), der das Rückschlagventil (15) aufnimmt, wobei der Kolben (2) durch eine Federeinrichtung (17) so vorgespannt ist, daß er aus dem Zylinder (1) nach außen ragt und an seinem äußersten Ende einen Kipphebel (R) des Ventilbetätigungsmechanismus trägt, und wobei die durch einen Betätigungsnocken (C) des Ventilbeätigungsmechanismus erzeugte Ventilöffnungskraft auf den Kolben (2) als eine Kraft übertragen wird, die diesen in der Axialrichtung niederdrückt, wobei der Ventilkäfig (12) einen schüsselförmigen Hauptkörper (12a) und einen Flanschabschnitt (12b) aufweist, der von dem Umfangs-Endteil des Hauptkörpers (12a) einteilig radial nach außen ragt, dadurch gekennzeichnet,

daß der Flanschabschnitt (12b) an der inneren Endfläche des Kolbens (2) durch ein Halteglied (30, 31, 32, 33, 34) fest in Lage gehalten ist, das in eine in dem Kolben (2) ausgebildete ringförmige Eingriffsnut (24, 25, 26, 27, 28) eingesetzt ist.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Halteglied als Stemmring (30, 33, 34) ausgeführt ist, der zum Einsetzen in die Eingriffsnut (24, 27, 28) durch einen Stemmvorgang vorgesehen ist, so daß der Flanschabschnitt (12b) des Ventilkäfigs (12) fest zwischen der inneren Endfläche des Kolbens (2) und dem Stemmring (30, 33, 34) gehalten ist.

3. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Halteglied als Sprengring (31, 32) ausgeführt ist mit einem daran ausgebildeten Ausschnitt, wobei der Sprengring (31, 32) federnd in die ringförmige Eingriffsnut (25, 26) eingesetzt ist, so daß der Flanschabschnitt (12b) des Ventilkäfigs (12) fest zwischen der inneren Endfläche des Kolbens (2) und dem Sprengring (31, 32) gehalten ist.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß eine untere Seitenwandfläche der ringförmigen Eingriffsnut (24, 25, 26, 27, 28) in Gestalt einer Schrägfläche (t_1, t_3) ausgeführt ist, die sich radial einwärts unter einem Neigungswinkel nach unten bezüglich einer zur Achse des Kolbens (2) senkrechten

Ebene erstreckt.

5. Vorrichtung nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die oberen und unteren Seitenwandflächen der ringförmigen Eingriffsnut (28) in Gestalt von Schrägflächen (t_4; t_3) ausgeführt sind, wobei sich die obere Schrägfläche (t_4) radial einwärts unter einem Neigungswinkel nach oben und sich die untere Schrägfläche radial einwärts unter einem Neigungswinkel nach unten bezüglich einer zur Achse des Kolbens (2) senkrechten Ebene erstrecken.

6. Vorrichtung nach Anspruch 4 oder 5, dadurch gekennzeichnet, daß der Neigungswinkel der Schrägfläche (t_1, t_3, t_4) selektiv im Bereich von 15 bis 45 Grad bestimmt ist.

7. Vorrichtung nach Anspruch 4, 5 oder 6, dadurch gekennzeichnet, daß der Neigungswinkel der Schrägfläche (t_3, t_4) selektiv im Bereich von 15 bis 60 Grad bestimmt ist.

8. Vorrichtung nach Anspruch 4 oder einem der Ansprüche 5 bis 7 in Verbindung mit Anspruch 4, dadurch gekennzeichnet, daß das Halteglied eine Unterseite zum Kontaktieren der Schrägfläche (t_1) aufweist, wobei die Unterseite als Schrägfläche (t_2) ausgebildet ist, die sich radial auswärts ansteigend unter dem gleichen Winkel wie der Neigungswinkel der Schrägfläche (t_1) erstreckt.

9. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Halteglied durch einen Haltering (22) gehalten ist, der in den unteren Endteil des Kolbens (2) von dessen Bodenseite her eingesetzt ist, wobei der Haltering (22) federnd durch die Federeinrichtung (17) gestützt ist.

10. Vorrichtung nach einem der Ansprüche 1 bis 3 oder 9, dadurch gekennzeichnet, daß die ringförmige Eingriffsnut (24, 25, 26, 27, 28) an der inneren Seitenwand des Kolbens (2) an einer Stelle ausgebildet ist, die von der inneren Endfläche des Kolbens (2) um eine Strecke beabstandet ist, die gleich der Dicke des Flanschabschnitts (12b) des Ventilkäfigs (12) oder merklich kürzer ist.

11. Vorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß keine störende Abmessung besteht zwischen dem Außendurchmesser des Flanschabschnitts (12b) des Ventilkäfigs (12) und dem Innendurchmesser des zylindrischen Abschnitts (11) des Kolbens (2).

Revendications

1. Dispositif hydraulique de rattrapage du jeu des soupapes d'un mécanisme à soupapes du type comportant un cylindre (1), un plongeur (2) ajusté coulissant dans ledit cylindre (1), une chambre hydraulique (3) définie entre le cylindre (1) et le plongeur (2), une chambre de réserve d'huile hydraulique (4) formée dans le plongeur (2), cette chambre de réserve d'huile hydraulique (4) étant en communication avec la chambre hydraulique (3) par l'intermédiaire d'un alésage de soupapes (5) qui est ménagé dans le plongeur (2), une soupape d'arrêt (15) montée sur ledit alésage de soupapes (5) de façon à s'ouvrir lorsque la pression hydraulique régnant dans la chambre hydraulique (3) diminue, et à se fermer lorsqu'elle augmente et une chambre à soupapes (12) disposée sur le plongeur (2) et dans laquelle est logée la soupape d'arrêt (15), dans lequel le plongeur (2) est soumis à la force exercée par un dispositif élastique (17) de manière à faire saillie vers l'extérieur du cylindre (1) afin de soutenir à son extrémité extérieure un culbuteur (R) du mécanisme à soupapes, et dans lequel la force d'ouverture de soupape est produite par une came d'actionnement (C) du mécanisme à soupape, et transmise au plongeur (2) en tant que force d'abaissement du plongeur (2) dans la direction axiale, la chambre à soupapes (12) comprenant un corps principal ayant la forme d'une coupe (12a) et un rebord (12b) intégral s'étendant radialement vers l'extérieur vers la partie d'extrémité périphérique dudit corps principal (12a); caractérisé en ce que le rebord (12b) est solidement maintenu en place sur la surface d'extrémité intérieure du plongeur (2) à l'aide d'un organe de retenue (30, 31, 32, 33, 34) ajusté dans une gorge d'engagement annulaire (24, 25, 26, 27, 28) formée dans le plongeur (2).

2. Dispositif hydraulique de rattrapage du jeu des soupapes d'un mécanisme à soupapes selon la revendication 1, dans lequel ledit organe de retenue est réalisé sous la forme d'une bague d'étanchéité (30, 33, 34) adaptée à être ajustée dans ladite gorge d'engagement annulaire (24, 27, 28) par une opération de mattage de manière à ce que le rebord (12b) de la chambre à soupapes (12) soit solidement maintenu entre la surface d'extrémité intérieure du plongeur (2) et la bague d'étanchéité (30, 33, 34).

3. Dispositif hydraulique de rattrapage du jeu des soupapes d'un mécanisme à soupapes selon la revendication 1, dans lequel ledit organe de retenue est réalisé sous la forme d'une bague à ressort (31, 32), une encoche étant formée sur celle-ci, ladite bague à ressort (31, 32) étant ajustée de manière élastique dans ladite gorge d'engagement annulaire (25, 26) de manière à ce que le rebord (12b) de la chambre à soupapes (12) soit solidement maintenu entre la surface d'extrémité intérieure du plongeur (2) et la bague à ressort (31, 32).

4. Dispositif hydraulique de rattrapage du jeu des soupapes d'un mécanisme à soupapes selon l'une quelconque des revendications 1 à 3, caractérisé en ce que ladite gorge d'engagement annulaire (24, 25, 26, 27, 28) présente une paroi latérale intérieure dont la surface est réalisée sous forme d'une face conique (t_1, t_3). s'étendant radialement vers l'intérieur avec un angle d'inclinaison vers le bas par rapport à un plan vertical à l'axe du plongeur (2).

5. Dispositif hydraulique de rattrapage du jeu des soupapes d'un mécanisme à soupapes, selon l'une quelconque des revendications 1 à 4, dans lequel ladite gorge d'engagement annulaire (28) a des parois latérales supérieure et inférieure dont les surfaces sont réalisées sous la forme de faces coniques (t_4; t_3), la face conique supérieure (t_4)

s'étendant radialement vers l'intérieur avec un angle d'inclinaison vers le haut, alors que la face conique inférieure (t_3) s'étend radialement vers l'intérieur avec un angle d'inclinaison vers le bas par rapport à un plan vertical à l'axe du plongeur (2).

6. Dispositif hydraulique de rattrapage du jeu des soupapes d'un mécanisme de soupapes selon la revendication 4 ou 5, dans lequel ledit angle d'inclinaison de la face conique (t_1, t_3, t_4) est sélectivement déterminé dans l'intervalle de 15 à 45°.

7. Dispositif hydraulique de rattrapage du jeu des soupapes d'un mécanisme à soupapes selon la revendication 4, 5 ou 6, dans lequel ledit angle d'inclinaison de la face conique (t_3, t_4) est sélectivement déterminé dans l'intervalle de 15 à 60°.

8. Dispositif hydraulique de rattrapage du jeu des soupapes d'un mécanisme à soupapes selon la revendication 4 ou l'une quelconque des revendications 5 à 7, lorsqu'elles sont associées à la revendication 4, dans lequel ledit organe de retenue présente une face inférieure adaptée à s'emboîter sur la face conique (t_1), ladite face inférieure étant sous la forme d'une face conique (t_2) s'étendant radialement vers l'extérieur de manière inclinée vers le haut avec le même angle que l'angle d'inclinaison vers le bas de la face conique (t_1).

9. Dispositif hydraulique de rattrapage du jeu des soupapes d'un mécanisme à soupapes selon la revendication 1, dans lequel ledit organe de retenue est soutenu par un élément de retenue (22) ajusté dans la partie d'extrémité intérieure du plongeur (2) à partir de sa paroi inférieure, ledit élément de retenue (22) étant soutenu de manière élastique par le dispositif élastique (17).

10. Dispositif hydraulique de rattrapage du jeu des soupapes d'un mécanisme à soupapes, selon l'une quelconque des revendications 1 à 3 ou 9, dans lequel ladite gorge d'engagement annulaire (24, 25, 26, 27, 28) est formée sur la paroi latérale intérieure du plongeur (2) en un point éloigné de la surface d'extrémité intérieure du plongeur (2), à une distance égale ou sensiblement inférieure à l'épaisseur du rebord (12b) de la chambre à soupapes (12).

11. Dispositif hydraulique de rattrapage du jeu des soupapes d'un mécanisme à soupapes, selon l'une quelconque des revendications précédentes, dans lequel il n'existe pas de dimension interférentielle entre le diamètre extérieur du rebord (12b) de la chambre à soupapes (12) et le diamètre intérieur de la portion cylindrique (11) du plongeur (2).

FIG 1 PRIOR ART

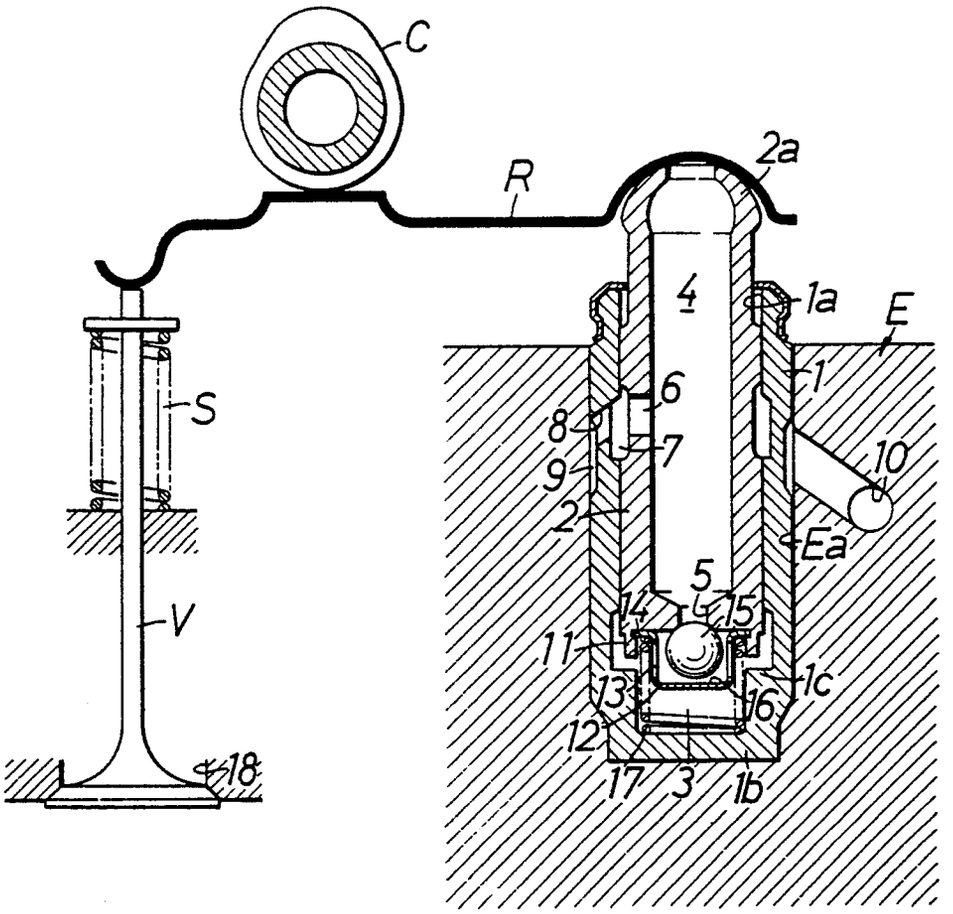

FIG 2 PRIOR ART

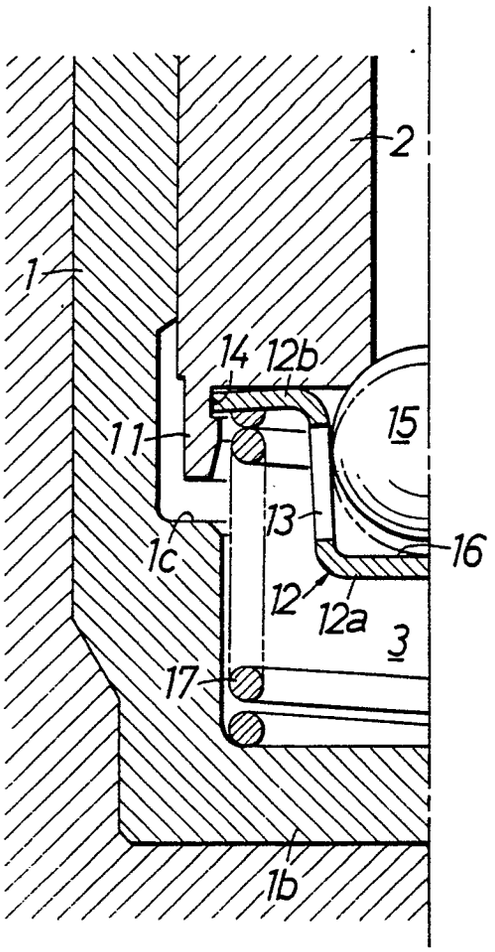

FIG 3

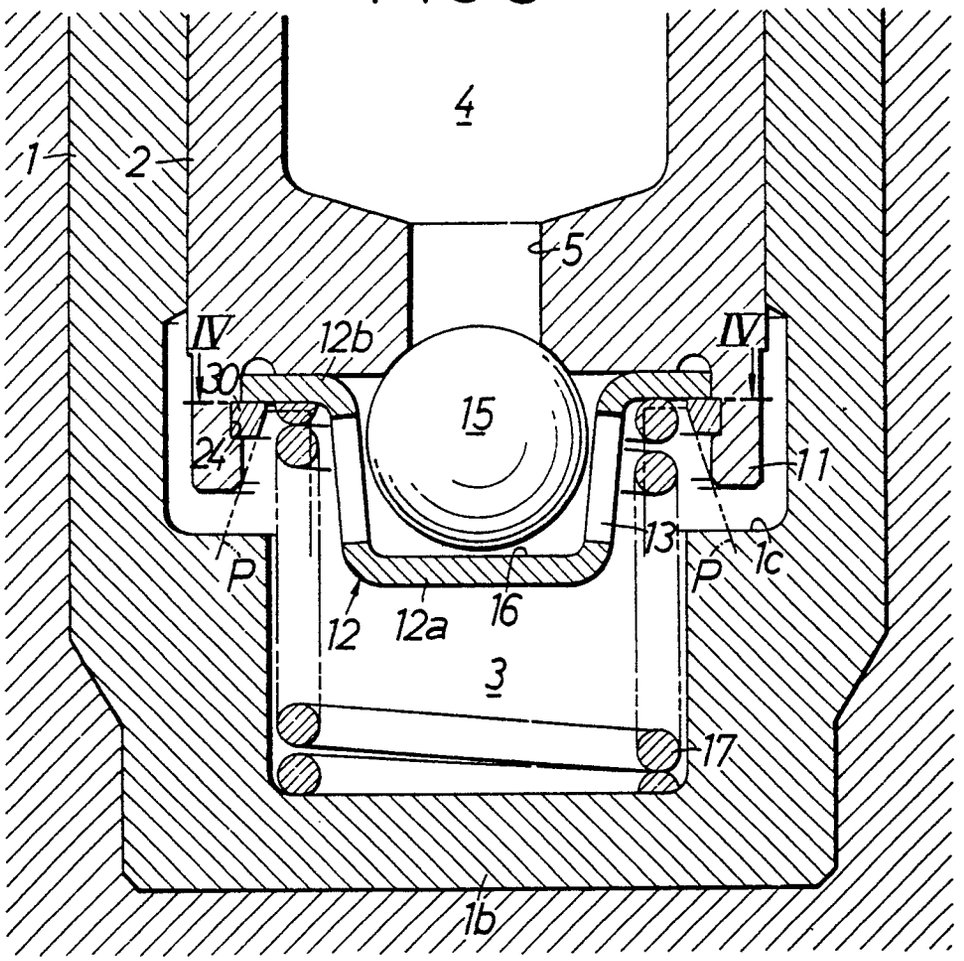

FIG 4

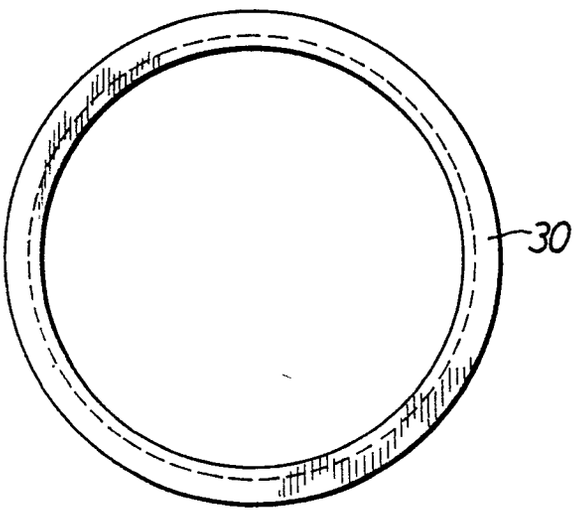

FIG 5

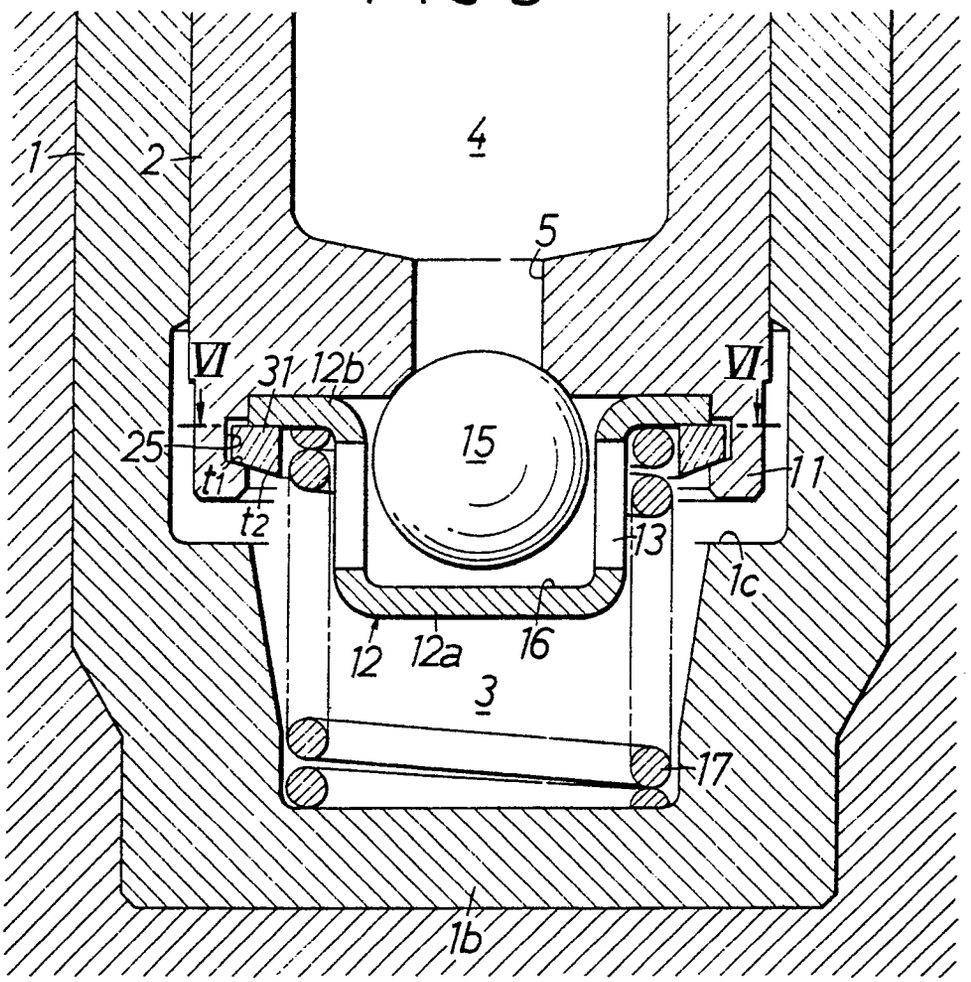

FIG 6

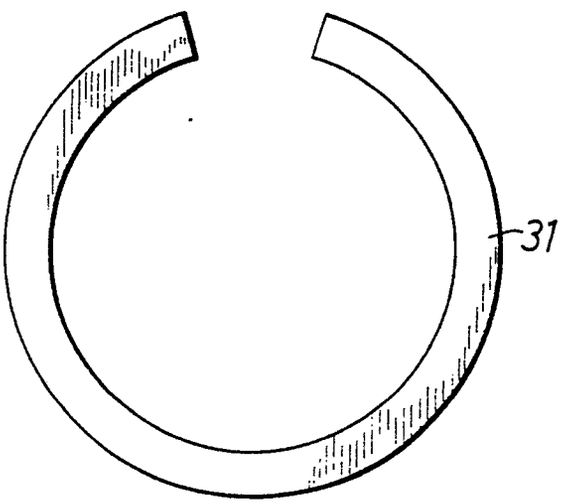

FIG 7

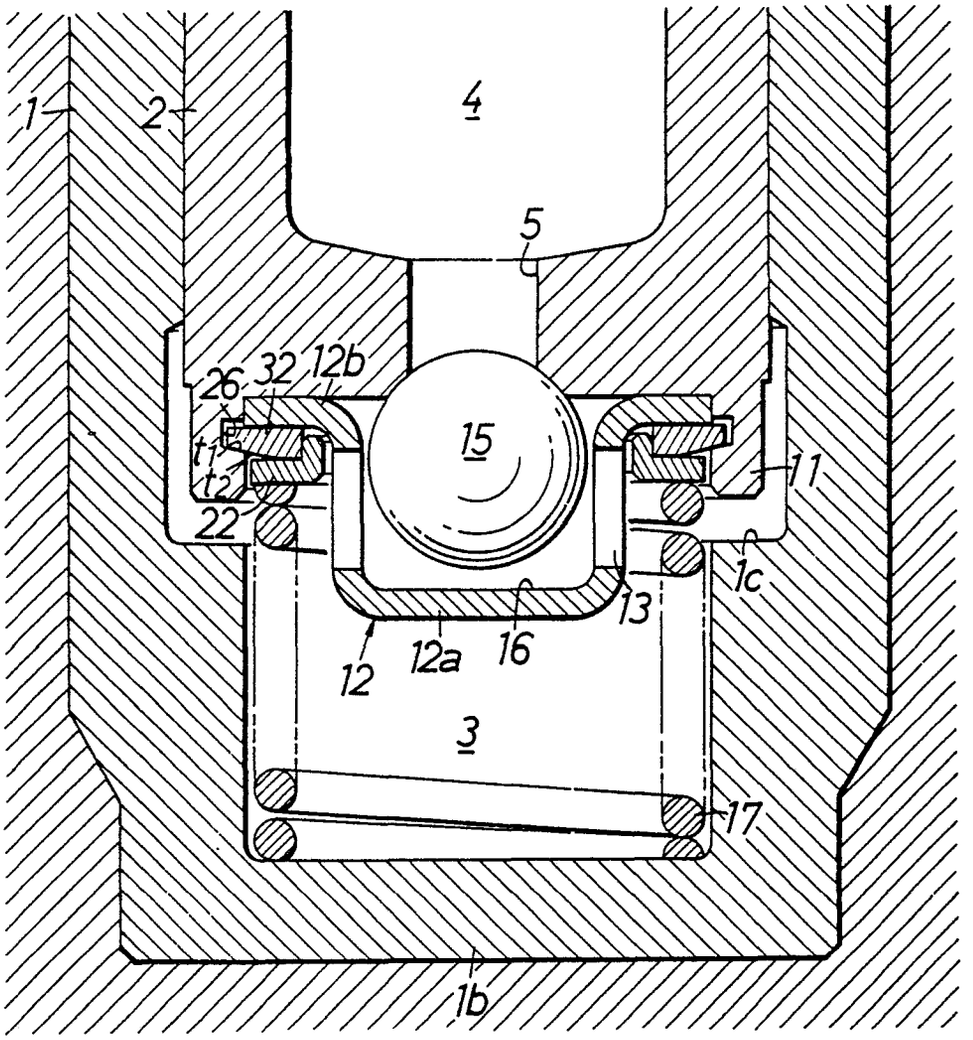

FIG 9

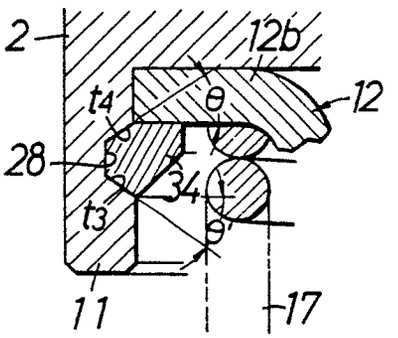

FIG 8

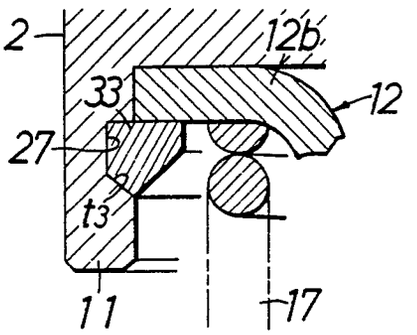

FIG 11

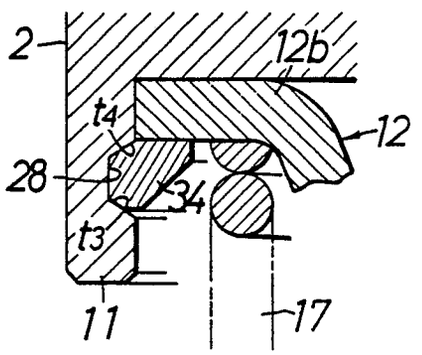

FIG 10