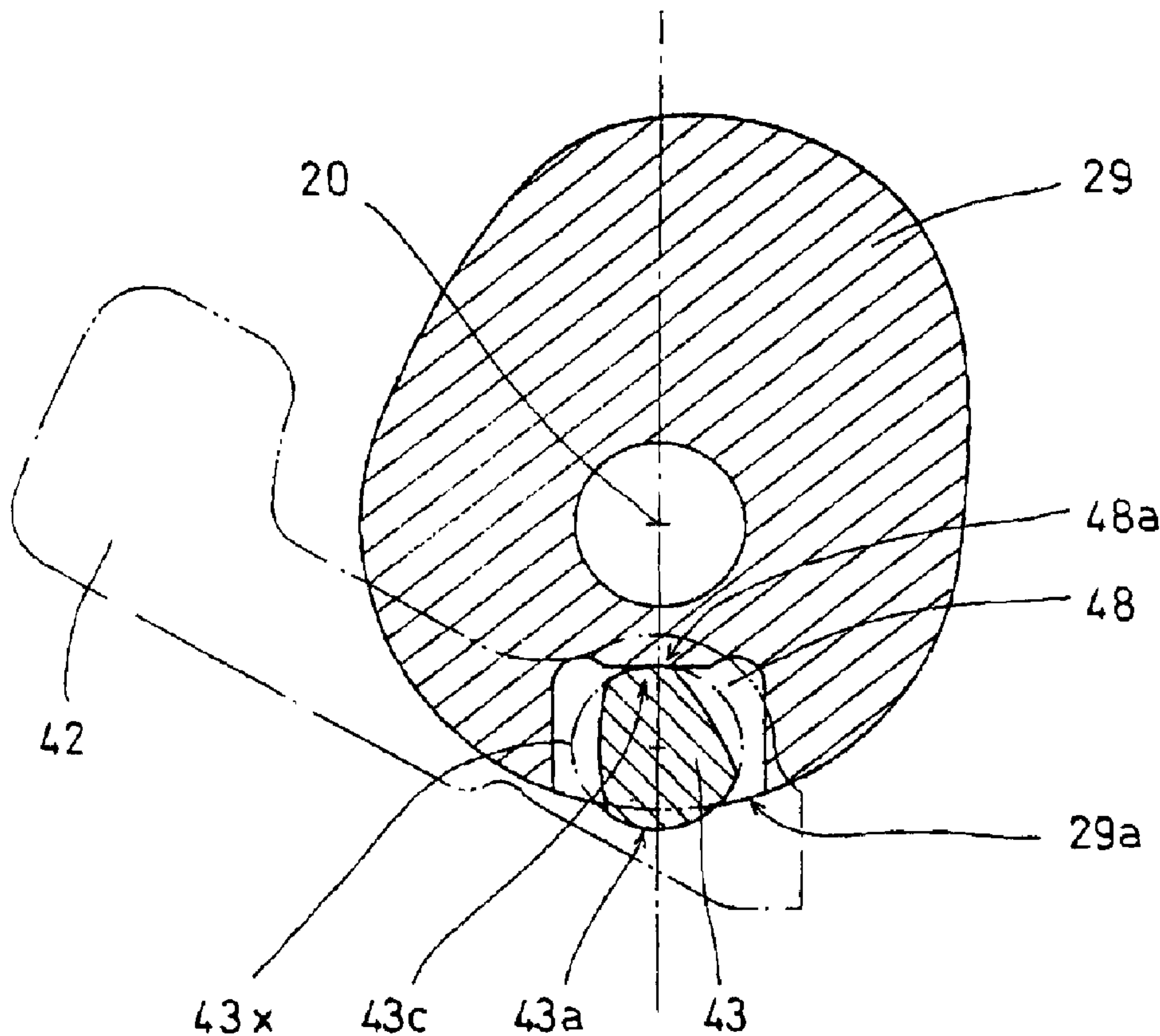




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(54) Titre : DECOMPRESSEUR POUR MOTEUR A COMBUSTION INTERNE  
 (54) Title: DECOMPRESSION DEVICE FOR INTERNAL COMBUSTION ENGINE



(57) Abrégé/Abstract:

To provide a decompression device for an internal combustion engine having a cylinder head provided with a pair of left and right camshaft bearings sandwiching intake valves and exhaust valves with a structure that is both simple and small. There is provided a

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

camshaft having cam projections for at least a pair of intake cams between camshaft side bearings corresponding to the pair of left and right bearings, and a decompression member with a decompression cam with a centrifugal weight arranged at a camshaft end passing through the bearing close to the camshaft end so that a tip thereof is arranged in the vicinity of the cam projections, with the decompression member comprising the centrifugal weight, the decompression cam, and a rotatable shaft coupling the centrifugal weight and the decompression cam in an integral manner.

### **ABSTRACT OF THE DISCLOSURE**

To provide a decompression device for an internal combustion engine having a cylinder head provided with a pair of left and right camshaft bearings sandwiching intake valves and exhaust valves with a structure that is both simple and small. There is provided a camshaft having cam projections for at least a pair of intake cams between camshaft side bearings corresponding to the pair of left and right bearings, and a decompression member with a decompression cam with a centrifugal weight arranged at a camshaft end passing through the bearing close to the camshaft end so that a tip thereof is arranged in the vicinity of the cam projections, with the decompression member comprising the centrifugal weight, the decompression cam, and a rotatable shaft coupling the centrifugal weight and the decompression cam in an integral manner.

## DECOMPRESSION DEVICE FOR INTERNAL COMBUSTION ENGINE

### 5 FIELD OF THE INVENTION

The present invention relates to a decompression device for lower compression pressure to enable easy starting when starting a four-stroke cycle internal combustion engine.

### 10 BACKGROUND OF THE INVENTION

An example of a related valve gear is equipped with a camshaft supported in a freely rotatable manner via a pair of main bearings at camshaft holder fastened to a cylinder head using a bolt, a pair of valve lifters for opening and closing a pair of intake valves, a rocker shaft fixed and supported at a  
15 camshaft holder having an axis parallel with the axis of rotation of the camshaft, and a rocker arm supported in a freely swinging manner at the same rocker shaft.

A pair of intake cams having the same prescribed cam surface, and a single  
20 exhaust cam having a prescribed surface positioned at a substantially central position between the intake cams are then formed at the camshaft.

The pair of intake cams make sliding contact with the top surfaces of the pair of valve lifters, the valve lifters slide according to the cam surface,  
25 and the pair of intake valves open and close at a prescribed opening and closing timing by a prescribed lift amount.

A roller making rolling contact with one exhaust cam is supported in a freely rotating manner at one side of the rocker arm camshaft, and a  
30 branch dividing into two is formed at the other side. The end of each

branch makes contact with the upper end surfaces of the stems of the pair of exhaust valves, and both of the exhaust valves open and close at a prescribed timing and by a prescribed lift amount according to the exhaust cam surface.

5

With related decompression devices, a centrifugal weight and a decompression cam linking with this centrifugal weight are provided at the outer side of one of the bearings supporting the camshaft, a decompression cam arm making contact with one end of a slipper so as to perform sliding driving is provided at one end of the decompression cam, with one end of the rocker arm branching section being driven by the other end of the decompression arm, so that the exhaust valve is driven so as to be opened and closed for decompression. (For example, refer to Japanese Patent Laid-open No. 2002-242631 (FIG. 2)).

15

With decompression devices of the related art, because the decompression cam is arranged on the outside of the bearings, a decompression cam extending to the tip of the branching part for driving the exhaust valves to open and close from the decompression cam is required, the structure becomes complex, and the cylinder head also becomes large. The present invention therefore sets out to provide a decompression device that is simple in structure and small in size.

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### SUMMARY OF THE INVENTION

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In order to resolve the aforementioned problems, the present invention is directed to is a decompression device for an internal combustion engine equipped with intake valves and exhaust valves and having a cylinder head provided with a pair of left and right camshaft bearings sandwiching the intake valves and exhaust valves, comprising a camshaft having cam projections for at least a pair of intake cams between camshaft side bearings corresponding to the pair of left and right bearings, and a decompression member with a decompression cam with a centrifugal weight arranged at a camshaft end passing through the bearing close to the camshaft end so that a tip thereof is arranged in the vicinity of the cam projections, with the decompression member comprising the centrifugal weight, the decompression cam, and a rotatable shaft coupling the centrifugal weight and the decompression cam in an integral manner.

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As described above, in the present invention, a centrifugal weight is arranged at a camshaft end and the end of a decompression cam linked to the centrifugal weight via a rotatable axis is passed through a bearing close to the end of the camshaft so as to be arranged close to the cam projections.

5 The decompression arm of the related art is therefore no longer required, the structure is simplified, and the cylinder head can be made smaller.

In an aspect of the invention, with the decompression device for an internal combustion engine as described above, a power transmission

10 member for transmitting power from the crankshaft to the camshaft is provided at the outer side of one of the bearings of the pair of left and right camshaft bearings, the intake valve cam projection of the intake/exhaust cam projections is provided close to the bearing on the opposite side to the side where the power transmission member is installed, and the pair of

15 bearings supporting a rotating shaft of the decompression member is formed split to the left and right of the intake valve cam projection.

As described in the above, bearings supporting a rotatable shaft of the decompression member are formed positioned spaced to the left and right

20 from intake cam projections. The gap between the bearings can therefore be kept large, and the durability of the decompression device can be improved.

In another aspect of the invention, with the decompression device for an internal combustion engine described above, a bearing member with

25 common internal and external diameters is provided between the cylinder head and the camshaft.

The present invention therefore enables the bearing members to be made

30 common, the types of parts can be reduced, and ease of assembly can be enhanced.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

Preferred embodiments of the invention are shown in the drawings,

35 wherein:

FIG. 1 is a vertical cross-sectional view of a valve chamber for an internal combustion engine to which each embodiment of the present invention relates.

5 FIG. 2 shows the inside of the valve chamber as viewed from above with the cylinder head cover of the internal combustion engine removed.

FIG. 3 is a longitudinal cross-sectional view of a camshaft and portions linked to this camshaft.

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FIG. 4 is an enlarged cross-sectional view of the camshaft.

Fig. 5 is a view along V of FIG. 4.

15 Fig. 6 is a cross sectional drawing along VI-VI in Fig. 4.

Fig. 7 is a cross sectional drawing along VII-VII in Fig. 4.

Fig. 8 is a cross sectional drawing along VIII-VIII in Fig. 4.

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Fig. 9 is a cross sectional drawing along IX-IX in Fig. 4.

Fig. 10 is a cross sectional drawing along X-X in Fig. 4.

25 Fig. 11 is a view along XI of FIG. 4.

FIG. 12 is an enlarged cross-sectional view of the decompression member.

Fig. 13 is a view along XIII of FIG. 12

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Fig. 14 is a cross sectional drawing along XIV-XIV in Fig. 12

FIG. 15 is a view showing the camshaft and members linked to the camshaft from the right side of the camshaft, and shows the position of  
35 the decompression member of the camshaft during stopping and during low-speed rotation.

Fig. 16 is a view along arrow XVI of FIG. 15.

FIG. 17 is a view showing the camshaft and members linked to the camshaft from the right side of the camshaft, and shows the position of the decompression member of the camshaft during low-speed rotation.

FIG. 18 is a view showing the positional relationship of the exhaust valves, decompression cam, and centrifugal weight, and shows the position during low-speed rotation of the camshaft.

FIG. 19 is a view showing the positional relationship of the exhaust valves, decompression cam, and centrifugal weight, and shows the position during high-speed rotation of the camshaft.

#### 15 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a vertical cross-sectional view of a valve chamber for an internal combustion engine to which each embodiment of the present invention relates. The internal combustion engine to which the decompression device of the present invention is applied is an overhead camshaft-type single-cylinder reciprocating four-stroke cycle internal combustion engine mounted on a motorcycle. An arrow F designates the front direction when the internal combustion engine is mounted on the vehicle. A valve chamber 3 is formed between a cylinder head 1 coupled to an upper end surface of a cylinder block (not shown) into which pistons (not shown) are inserted so as to freely move in a reciprocal manner and a cylinder head cover 2 coupled to an upper end surface of the cylinder head 1. A combustion chamber 4 is formed between the lower surface of the cylinder head 1 and the pistons.

An intake port 5 for the cylinder head 1 is formed to the rear of the vehicle (left side in FIG. 1), and branches into two so as to form a pair of intake openings 6 opening at the combustion chamber 4. An exhaust port 7 for the cylinder head 1 is formed to the front of the vehicle (right side in FIG. 1), and branches into two so as to form a pair of exhaust openings 8 opening at the combustion chamber 4.

A pair of intake valves 9 for opening and closing the intake openings 6 and a pair of exhaust valves 10 for opening and closing the exhaust openings 8 are fitted in a freely slidable manner into valve sleeves 11, 12 press-fitted at the cylinder head 1. The intake valves 9 and exhaust valves 10 are urged so as to close the corresponding intake openings 6 and the exhaust openings 8 using spring force of valve springs 13, 14. An intake pipe (not shown) is connected to an upstream side of the intake port 5, and a carburetor (not shown) for forming a fuel/air mixture provided to the combustion chamber 4 is fitted to the end of the intake pipe. An exhaust pipe (not shown) for exhausting combusted gas from the combustion chamber 4 is connected to a downstream-side opening of the exhaust port 7.

FIG. 2 shows the inside of the valve chamber as viewed from above with the cylinder head cover of the internal combustion engine removed. A description is now given with reference to FIG. 1 and FIG. 2. The valve assembly housed in the valve chamber 3 comprises a lower camshaft holder 15 formed at the cylinder head 1 so as to be vertically split into two from a camshaft center line position, an upper camshaft holder 16 fastened to the lower camshaft holder 15 using a bolt 17, a camshaft 20 supported in a freely rotatable manner via a pair of main bearings 18, 19 of common internal diameter, a pair of valve lifters 21 for opening and closing the pair of intake valves 9, a rocker shaft 22, having an axis parallel with the axis of rotation of the camshaft 20, and being supported in a fixed manner by the upper and lower camshaft holders 15, 16, and a rocker arm 23 supported in a freely sliding manner at the same rocker shaft 22.

The camshaft 20 is rotatably driven by the pistons and has an axis of rotation parallel with the axis of rotation of the crankshaft. The camshaft 20 is rotatably driven at a rotational speed that is half that of the crankshaft as a result of power of the crankshaft via a timing chain spanning a driving sprocket coupled to the crankshaft and a driven sprocket 26 coupled to the left end of the camshaft 20.

A pair of intake cams 27, 28 having the same prescribed cam surface and a single exhaust cam 29 having a prescribed cam surface positioned substantially at the center of the intake cams 27, 28. The pair of intake cams

27, 28 make sliding contact with a top faces of the valve lifters 21 fitted in a freely slidable manner within a guide tube 30 (FIG. 1) formed at the cylinder head 1, with the valve lifters 21 sliding in accordance with the cam surface, with the pair of intake valves 9 opening and closing at a prescribed opening and closing timing and lift amount.

A roller 31 making rolling contact with an exhaust cam 29 is supported in a freely rotating manner by a roller shaft 32 at a side of the camshaft 20, with two-way branches 23a and 23b being formed at the other side. The ends of each branch 23a, 23b make contact with valve stem end surfaces 10a of the pair of exhaust valves 10. The exhaust cam 29 causes the rocker arm 23 to swing via the contacting roller 31 according to the cam surface, and both exhaust valves 10 are opened and closed at the prescribed timings and by the prescribed lift amounts.

FIG. 3 is an enlarged vertical cross-sectional view of portions comprised of the camshaft 20 shown in FIG. 2, the driven sprocket 26 linked to the camshaft 20, and the main bearings 18, 19, etc. A decompression member insertion hole 40 is provided at the camshaft 20 parallel with the axis of rotation of the camshaft 20, and a decompression member 41 is inserted in a freely rotatable manner therein. The details of the shape of the decompression member 41 are described in detail later, but it comprises a centrifugal weight 42, a decompression cam 43, and a rotatable shaft 44 formed so as to integrally couple the centrifugal weight 42 and the decompression cam 43. The decompression member 41 is prevented from slipping by a slipping prevention plate 46 fastened by a bolt 45 to the end of the camshaft 20. Each cam projection of each of the intake cam 27, exhaust cam 29, and intake cam 28 are provided between the pair of main bearings 18, 19 in order from the right side. A through-hole 27a provided at the cam projection of the intake cam 27 is a hole used for deciding relative position in the direction of rotation at the time of coupling the camshaft 20 and the driven sprocket 26.

FIG. 4 is a vertical cross-sectional view of the camshaft 20 shown in FIG. 3. In the drawings, a decompression cam-containing hole 48 is formed at the back end of the decompression member insertion hole 40, and the decompression cam 43 is contained in the decompression cam containing

hole 48. A bolt hole at the right end of the camshaft 20 is an insertion hole 47 for the plate fastening bolt 45 for fastening the slipping prevention plate 46. A funnel-shaped hole at the center of the left end surface of the camshaft 20 is an engaging hole 50 for a rotation prevention pawl forming part of the slipping prevention plate 46. The left end of the camshaft 20 constitutes a stopper 51 with which the centrifugal weight 42 of the decompression member 41 comes into contact at both ends of the range or rotation. A hollow section 20a is provided at the central part of the camshaft 20 to ensure lightness in weight.

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A view taken along V of FIG. 4 is shown in FIG. 5, a cross-sectional view taken along VI-VI of FIG. 4 is shown in FIG. 6, a cross-sectional view along VII-VII of FIG. 4 is shown in FIG. 7, a cross-sectional view taken along VIII-VIII of FIG. 4 is shown in FIG. 8, a cross-sectional view taken along IX-IX of FIG. 4 is shown in FIG. 9, a cross-sectional view taken along X-X in FIG. 4 is shown in FIG. 10, and a view along XI of FIG. 4 is shown in FIG. 11. As can be seen from FIG. 4, FIG. 9 and FIG. 11, a flat bottom surface 48a is formed at the bottom part of the decompression cam-containing hole 48 formed by making a hole in part of the exhaust cam 29. The decompression cam then frequently appears from an opening 48b (FIG. 9) of the decompression cam-containing hole 48. As can be seen from FIG. 4, FIG. 5 and FIG. 6, a stopper 51 for the centrifugal weight 42 of the decompression member 41 to make contact with both ends of the range of rotation is formed at the right end of the camshaft 20.

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FIG. 12 is an enlarged vertical cross-sectional view of the decompression member 41 shown in FIG. 3. FIG. 13 is a view along XIII of the centrifugal weight 42 of FIG. 12 viewed from the right side. FIG. 14 is a cross-sectional view along XIV-XIV of the decompression cam of FIG. 12. The centrifugal weight 42 and the decompression cam 43 are coupled by the rotatable shaft 44 of circular cross-section formed integrally with these portions. The decompression cam 43 is equipped with a decompression acting surface 43a consisting of the same curved surface as that of a decompression cam outer cylinder surface 43x, a decompression releasing surface 43b cut so as to be formed from the same curved surface as an exhaust cam outer surface 29a, a decompression cam supporting surface 43c constituted by the same curved surface as for the decompression cam outer cylinder surface

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43x, and an escape surface 43d formed by cutting away part of the outside of the decompression cam 43. The relationship between the relative position of the decompression cam 43 with respect to the exhaust cam 29 and the actions of each surface are described in the following.

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FIG. 15 is a view showing the camshaft 20 and the centrifugal weight 42 as viewed from the right of the camshaft 20. The decompression member slipping prevention plate 46 is omitted from the drawings in order to prevent the drawings becoming complex.

10

FIG. 16 is view taken along XVI of FIG. 15. A coil spring 52 is provided at the rotatable shaft 44 of the decompression member. The coil spring 52 urges the arm of the centrifugal weight 42 in the direction of the stopper surface 51 at the time of low speed rotation of the stopper 51 shown in FIG.

15

15 when the internal combustion engine is stopped.

FIG. 15 and FIG. 16 show the situation when the camshaft 20 is rotating at a low speed less than the decompression operation release rotational speed set by adjusting the coil spring force of the coil spring 52, or is stopped.

20

When the driven sprocket 26 rotates in accompaniment with rotation of the crankshaft, the camshaft 20 rotates in the direction of arrow W. When the camshaft 20 is rotating at a low rotational speed less than the rotational speed set as described above, a side surface 42a of the arm comes into contact with the stopper surface 51a at the time of low-speed rotation of one side surface of the stopper 51 and comes to a halt due to the urging force of the coil spring 52, as shown in FIG. 15.

25

FIG. 17 is a view of the camshaft 20 and the centrifugal weight 42 as viewed from the right of the camshaft 20 when the rotational speed of the engine increases so that the camshaft 20 rotates at a high speed greater than the decompression operation release rotational speed set as described above. When the centrifugal weight 42 rotates in a relative manner with respect to the camshaft 20 against the urging force of the coil spring 52 when the rotational speed of the camshaft 20 exceeds the set rotational speed due to application of centrifugal force, an end part 42b of the arm on the opposite side to the weight of the centrifugal weight 42 is then stopped at a position of making contact with stopper surface 51b at the time of

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high-speed rotation at a side surface different to the aforementioned one of the stopper 51. In this example, the centrifugal weight 42 is rotated through ninety degrees and then stopped.

Both FIG. 18 and FIG. 19 show the relative positional relationships of the exhaust cam 29, the centrifugal weight 42, and the decompression cam 43, with FIG. 18 showing the situation when the camshaft 20 is rotating at low-speed and FIG. 19 showing the situation when the camshaft 20 is rotating at high-speed. The centrifugal weight 42 and the decompression cam 43 are interlocking, and therefore their relative positional relationships do not change with rotation to front and back of the centrifugal weight 42. When the centrifugal weight 42 rotates, the relative positional relationship of the decompression cam 43 and the exhaust cam 29 changes.

When the camshaft 20 is rotating at low speed as shown in FIG. 18, the decompression acting surface 43a formed by one part of a cylinder-shaped outer surface 43x of the decompression cam projects further outwards than the exhaust cam outer surface 29a. This then pushes the roller 31 (FIG. 1) of the rocker arm 23 up, and the exhaust valves 10 are opened and closed for decompression at prescribed opening and closing timings and lift amounts.

The decompression cam 43 is subjected to pushing force from the roller 31 when the roller 31 makes contact with the decompression acting surface 43a. A decompression cam supporting surface 43c formed on the opposite side to the decompression acting surface 43a of the decompression cam 43 comes into contact with the flat bottom surface 48a of the decompression cam containing hole 48. The decompression cam supporting surface 43c is a surface formed from part of the decompression cam outer cylinder surface 43x. The combination of the decompression cam supporting surface 43c and the flat bottom surface 48a constitutes a type of bearing. When the rotational speed of the engine is increased so that the camshaft 20 starts high-speed rotation, the decompression cam 43 operating in unison with the centrifugal weight 42 rotates relatively with respect to the camshaft 20, i.e. with respect to the exhaust cam 29, and the state shown in

FIG. 19 is adopted. The decompression releasing surface 43b formed by cutting away part of the outer surface of the decompression cam 43 so as to coincide with the exhaust cam outer surface 29a then faces in the direction of the opening 48b of the decompression cam containing hole 48. The decompression releasing surface 43b does not project further outwards than the exhaust cam outer surface 29a and the decompression cam 43 therefore cannot be pressed by the roller 31 of the rocker arm 23. As a result, the decompression action is released.

10 The escape surface 43d formed by cutting away part of the outer surface of the decompression cam 43 is formed on the opposite side to the decompression releasing surface 43b of the decompression cam 43. The decompression releasing surface 43b does not project further outwards than the exhaust cam outer surface 29a when the camshaft 20 is rotating at high-speed, and pushing force is therefore not applied from the roller 31 at the decompression cam 43. When the camshaft 20 rotates at low speed, the type of bearing configured from a combination of the decompression cam supporting surface 43c and the flat bottom surface 48a is not required. When the decompression cam 43 rotates from a position of low-speed rotation to a position of high-speed rotation, it is necessary for the rotation to take place smoothly. Because of this, the escape surface 43d is formed and it is ensured that the decompression cam 43 does not make contact with the flat bottom surface 48a of the decompression cam containing hole 48 so as to reduce frictional resistance.

25 As described above, in this embodiment, the centrifugal weight 42 is arranged at the end of the camshaft 20, and the decompression cam 43 coupled to the centrifugal weight 42 via the rotatable shaft 44 is arranged to as to pass through the bearing 18 close to the end of the camshaft 20 and extend as far as the cam projection of the exhaust cam 29. A decompression arm such as in the related art extending from the position of the decompression cam to the tip of the rocker arm is therefore not necessary. As a result, in this embodiment, the structure is simplified, and the cylinder head can be made small.

35 In this embodiment, the bearing 44a (FIG. 3, FIG. 12) supporting the rotatable shaft 44 at the right end of the rotatable shaft 44 of the

decompression member, and the type of bearing (FIG. 18) supporting the  
decompression cam 43 configured from the decompression cam  
supporting surface 43c and the bottom surface 48a of the decompression  
cam containing hole 48 are formed so as to be spaced away at the left and  
5 right of the cam projection of the intake cam. The bearing gap can  
therefore be kept substantial, and durability of the decompression device is  
improved.

The camshaft holder of this embodiment is in the form of a holder  
10 divided into two upper and lower parts above and below a center line  
position of the camshaft 20, of the lower camshaft holder 15 formed at the  
cylinder head 1 and the upper camshaft holder 16 fastened using the bolt  
17. The camshaft 20 can therefore be supported by the pair of main  
bearings 18 and 19 having common internal and external diameters. The  
15 bearing members can therefore be made common, the types of parts can be  
reduced, and ease of assembly can be enhanced.

The decompression cam 43 of this embodiment is such that the roller 31  
comes into direct contact with the decompression cam 43 in combination  
20 with the exhaust cam 29 touching the roller 31 of the rocker arm 23.  
Therefore, as a point of difference from the structure in the related art  
where contact is made with the decompression cam by a slipper, the  
sliding friction of the projection portions of the decompression cam can be  
reduced. The cam projection of the decompression cam can therefore be  
25 made smaller, and this contributes to making the bearing for supporting  
the decompression cam smaller.

Although various preferred embodiments of the present invention have  
been described herein in detail, it will be appreciated by those skilled in the  
30 art, that variations may be made thereto without departing from the spirit  
of the invention or the scope of the appended claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A decompression device for an internal combustion engine equipped with intake valves and exhaust valves and having a cylinder head provided with a pair of left and right camshaft bearings sandwiching the intake valves and exhaust valves, comprising a camshaft having cam projections for at least a pair of an intake cam and an exhaust cam between the pair of left and right bearings, and a decompression member with a decompression cam with a centrifugal weight arranged at a camshaft end passing through the bearing close to the camshaft end so that a tip thereof is arranged in the vicinity of the exhaust cam, with the decompression member comprising the centrifugal weight, the decompression cam, and a rotatable shaft coupling the centrifugal weight and the decompression cam in an integral manner.
2. The decompression device for an internal combustion engine as claimed in claim 1, wherein a power transmission member for transmitting power from the crankshaft to the camshaft is provided at the outer side of one of the bearings of the pair of left and right camshaft bearings, the intake cam is provided close to the bearing on the opposite side to the side where the power transmission member is installed, and a pair of bearing portions supporting a rotating shaft of the decompression member is formed either side of the intake cam.
3. The decompression device for an internal combustion engine as claimed in claim 2, further comprising a bearing member with common internal and external diameters provided between the cylinder head and the camshaft.

FIG. 1

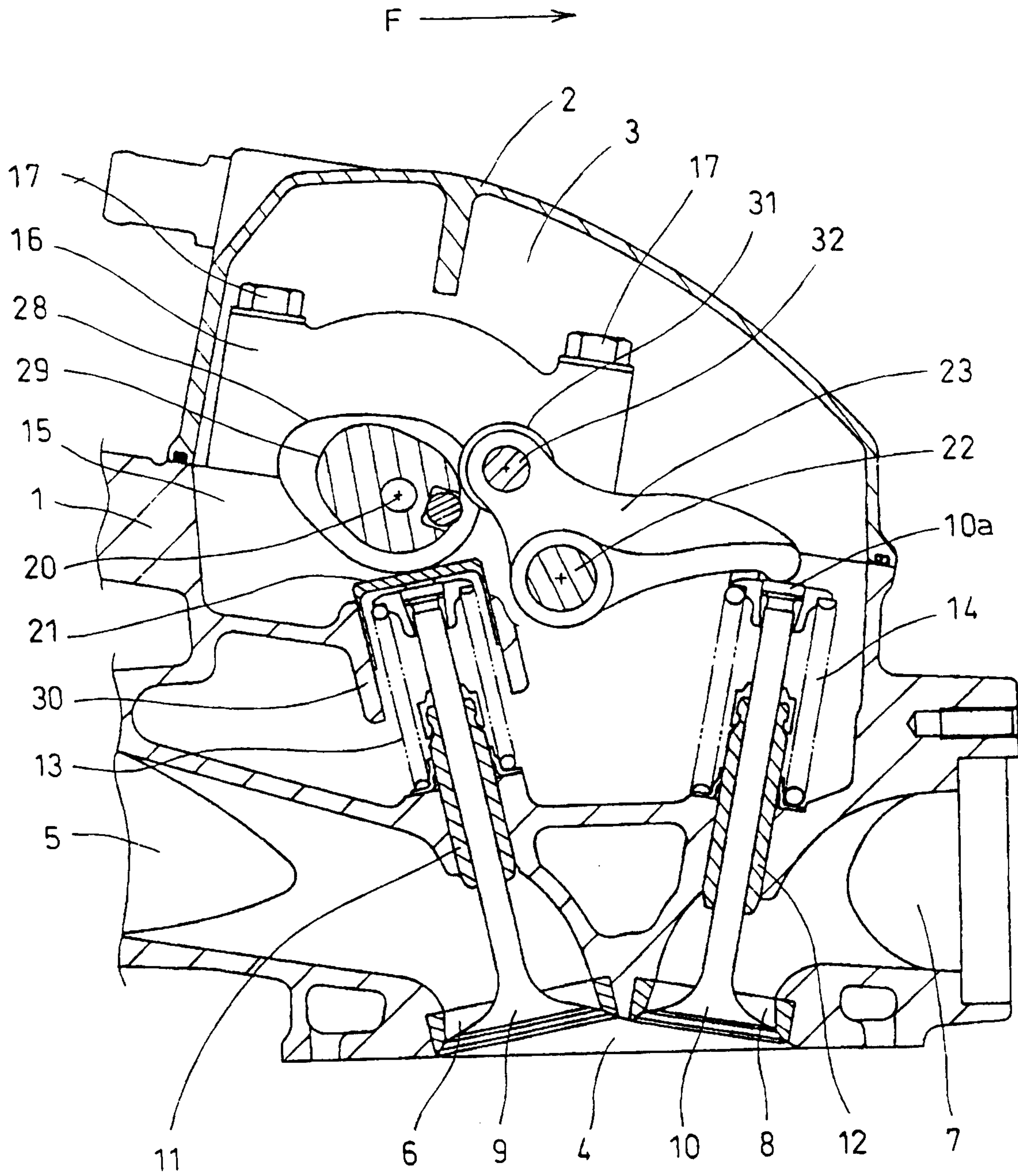


FIG. 2

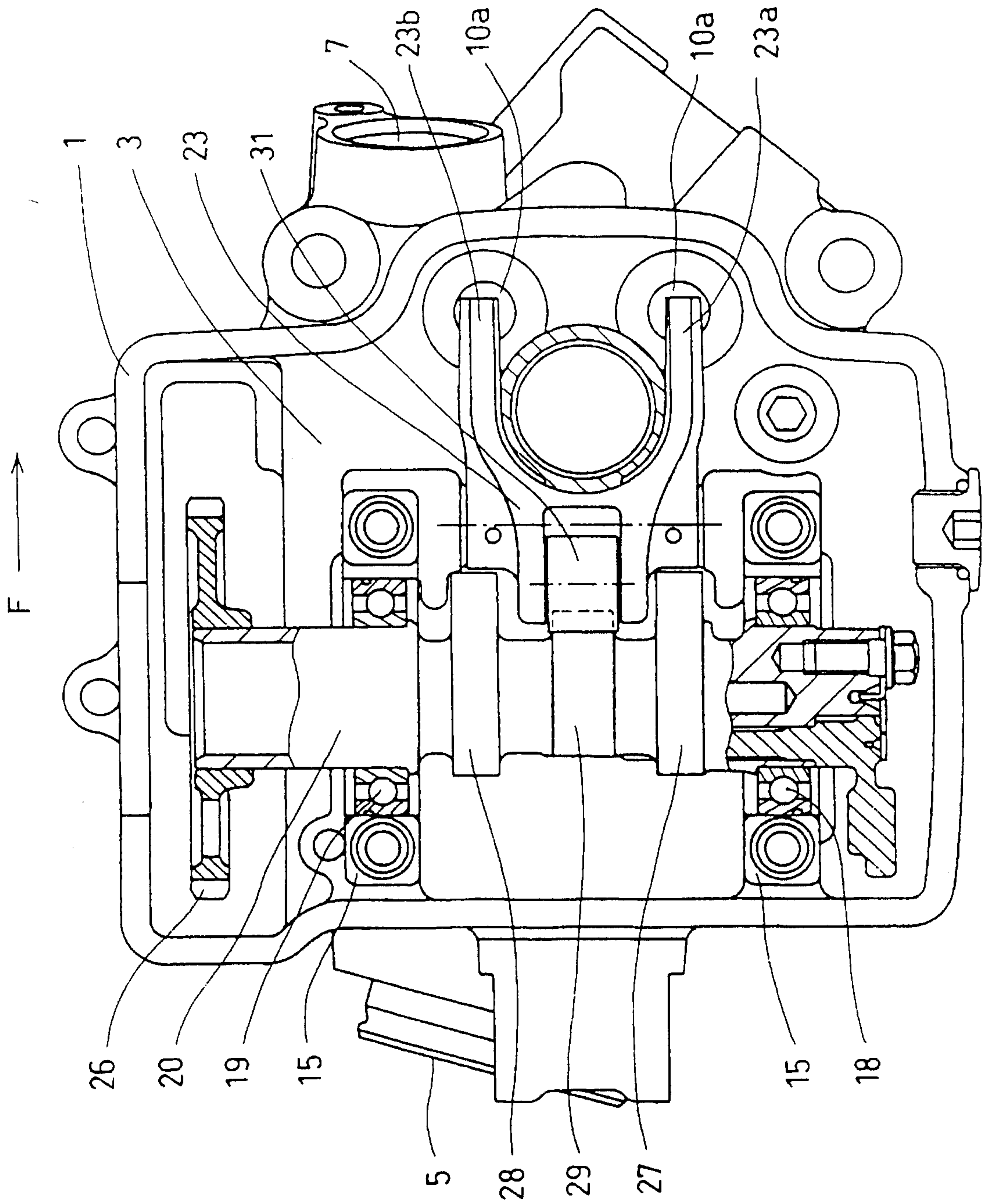


FIG. 3

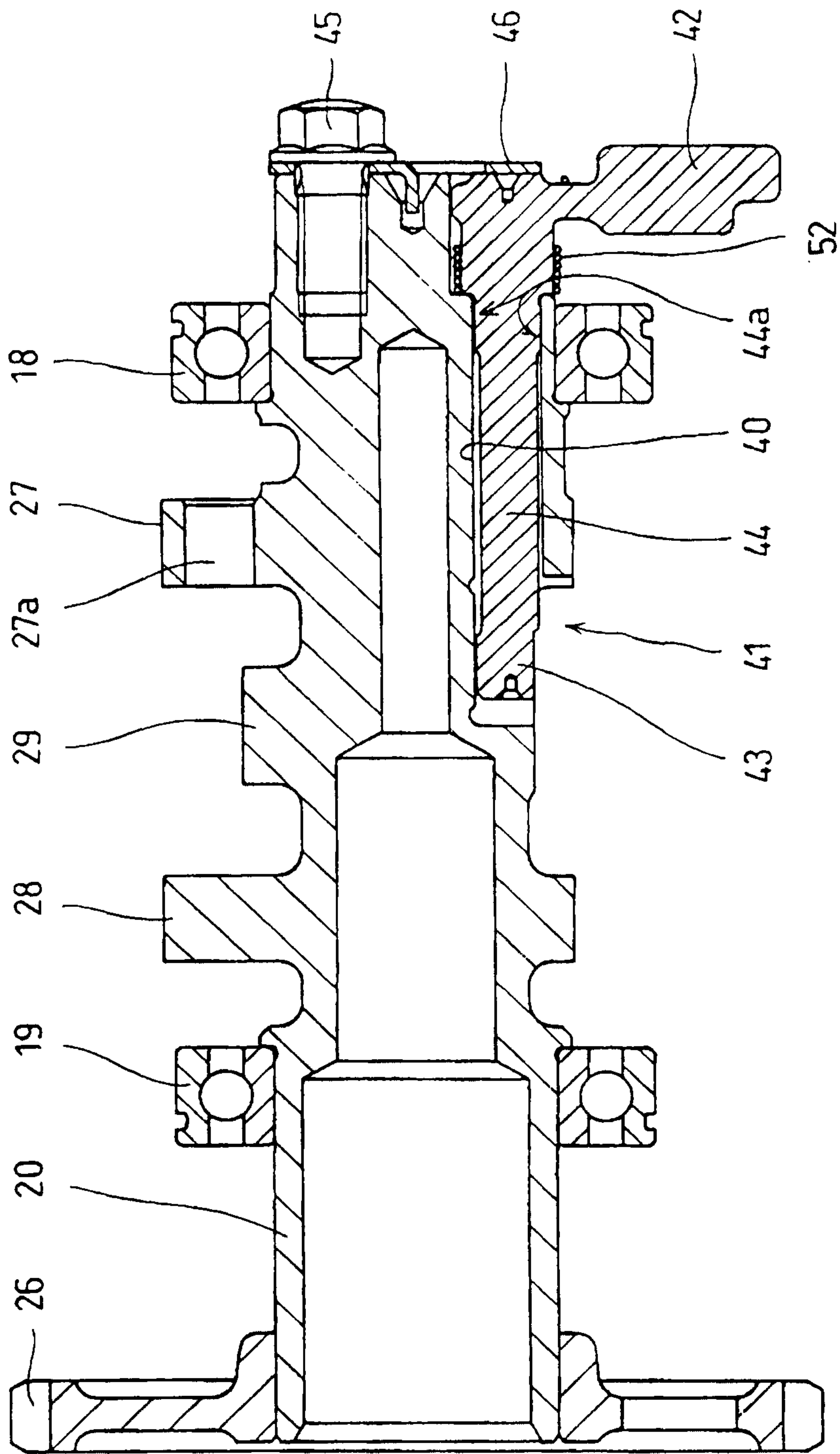


FIG. 4.

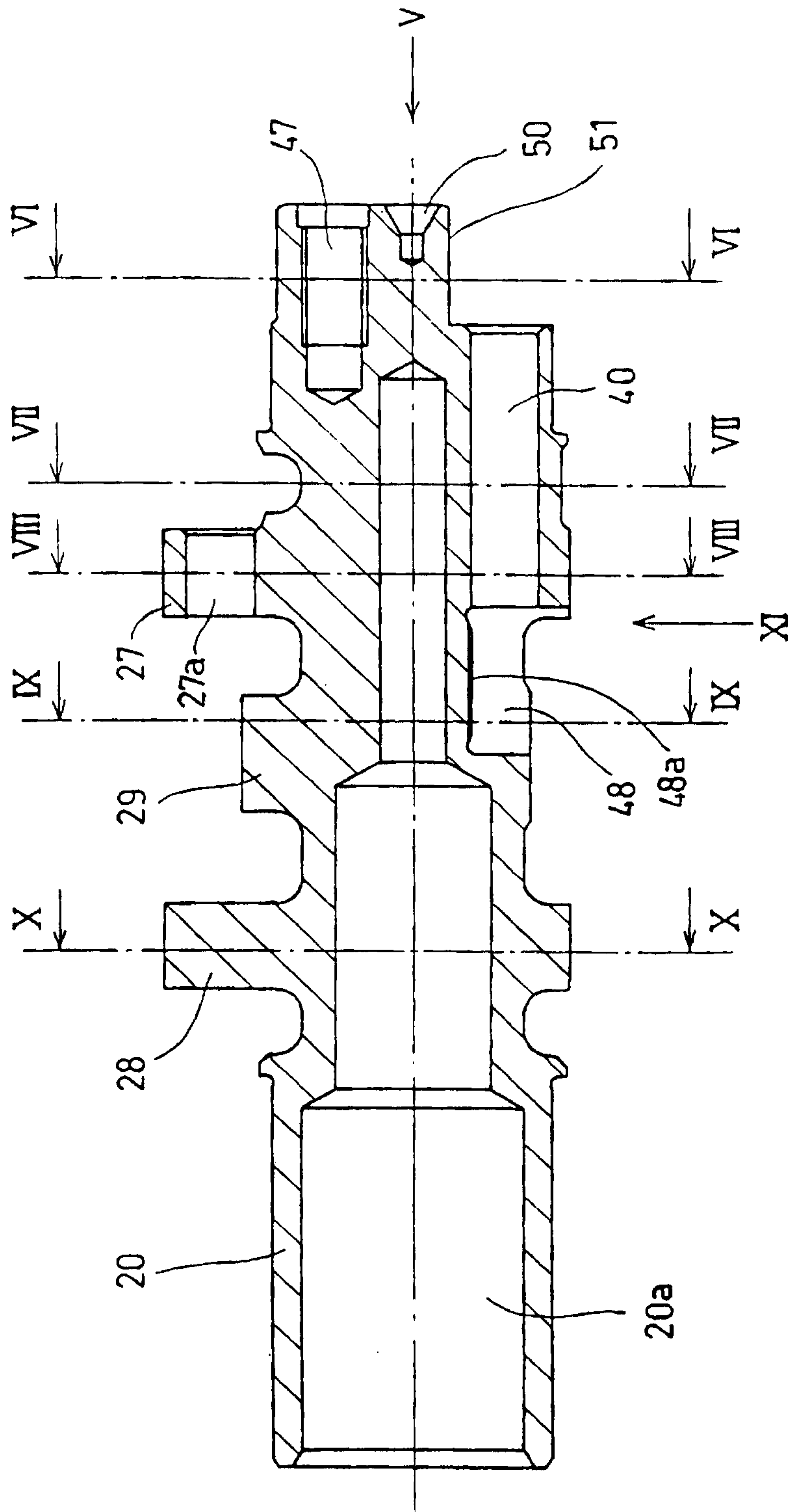


FIG. 5

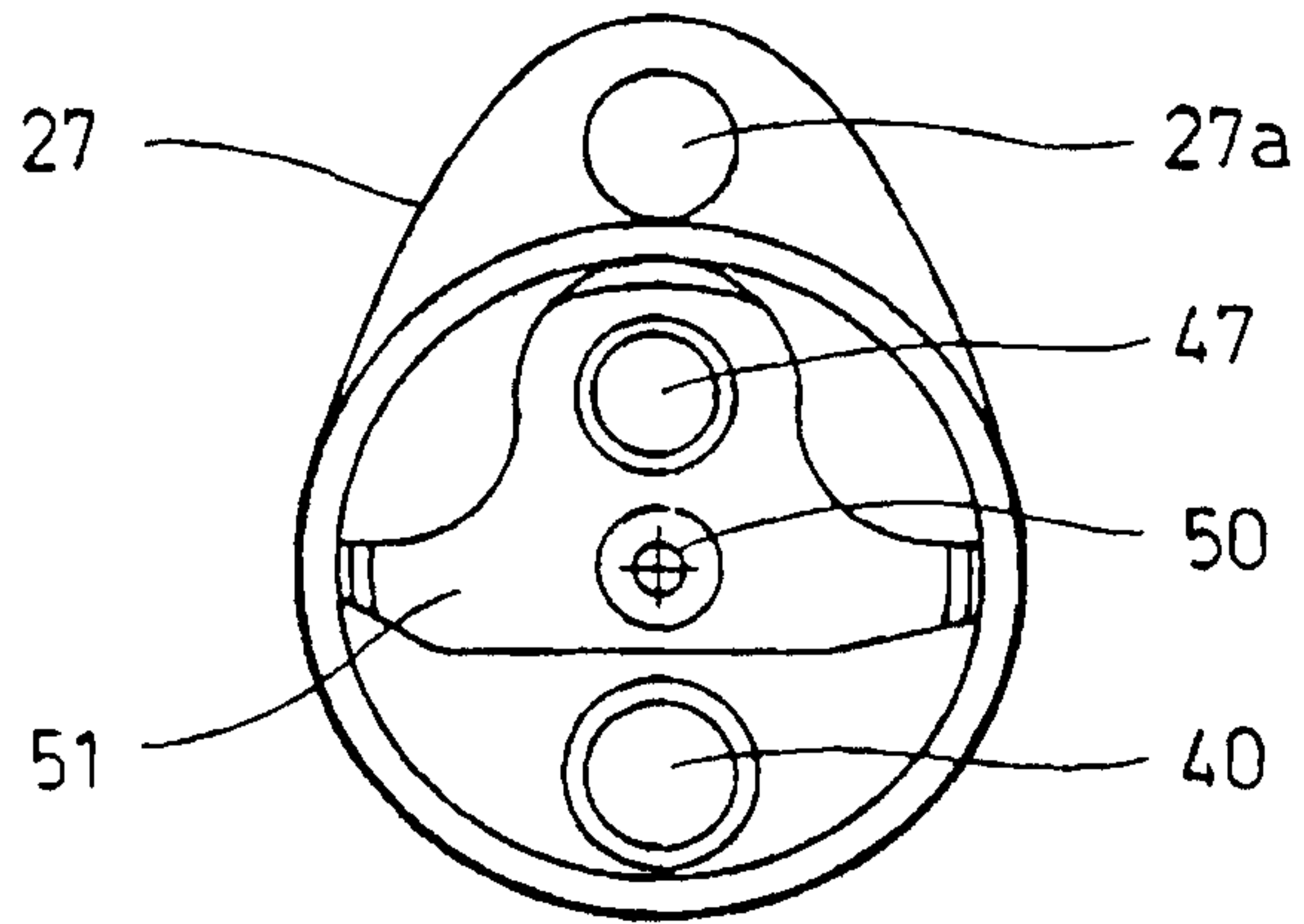


FIG. 6

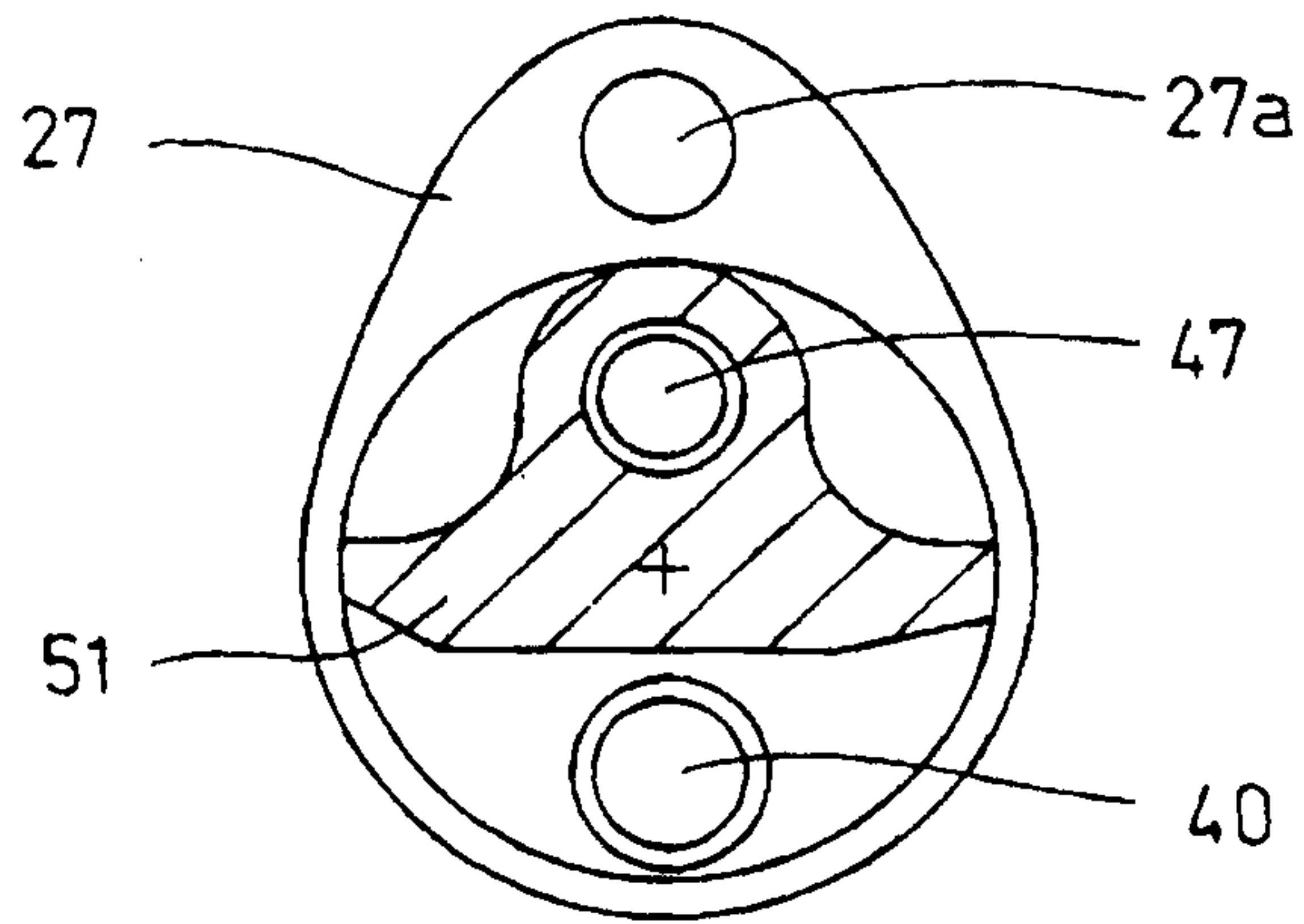


FIG. 7

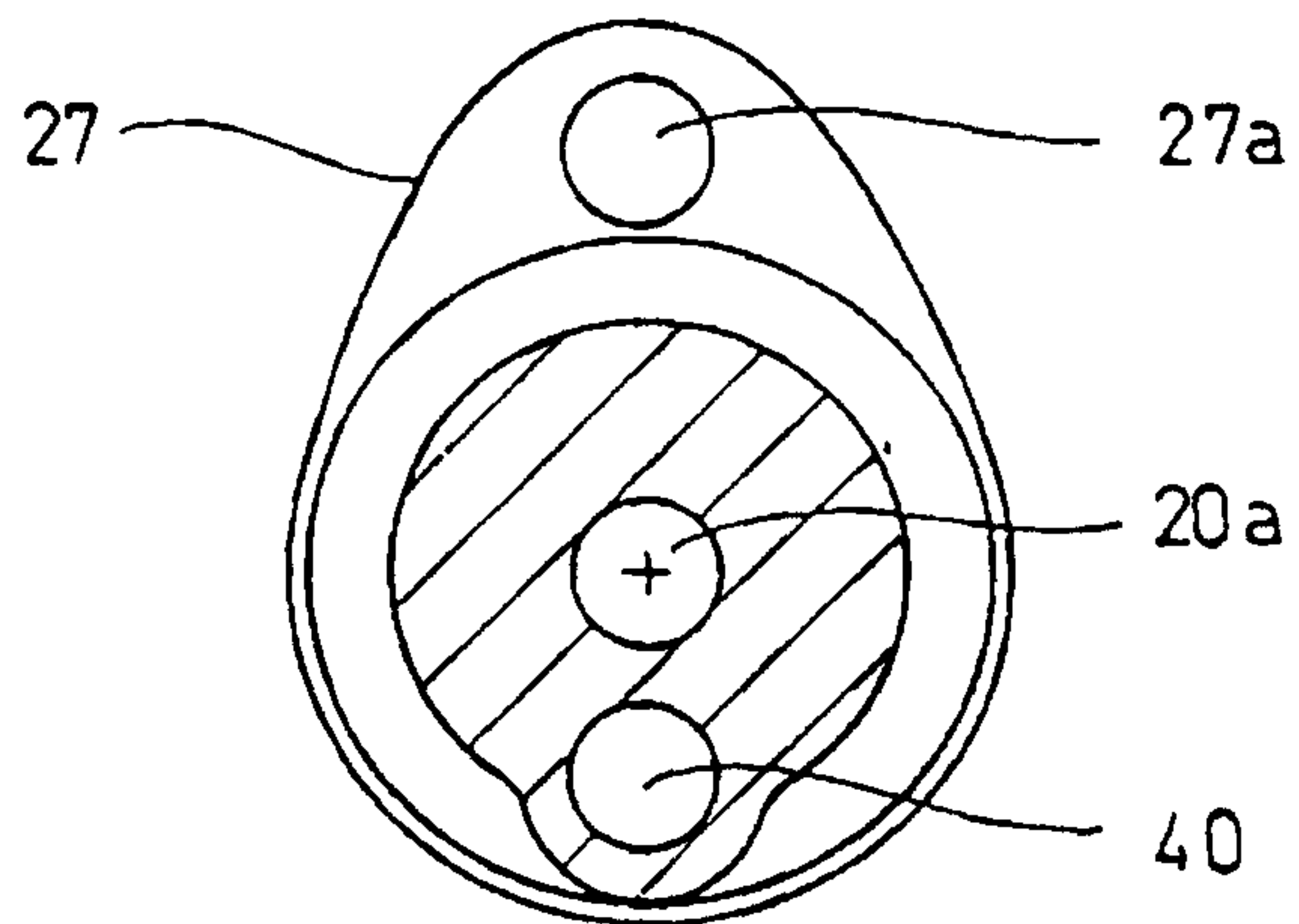


FIG. 8

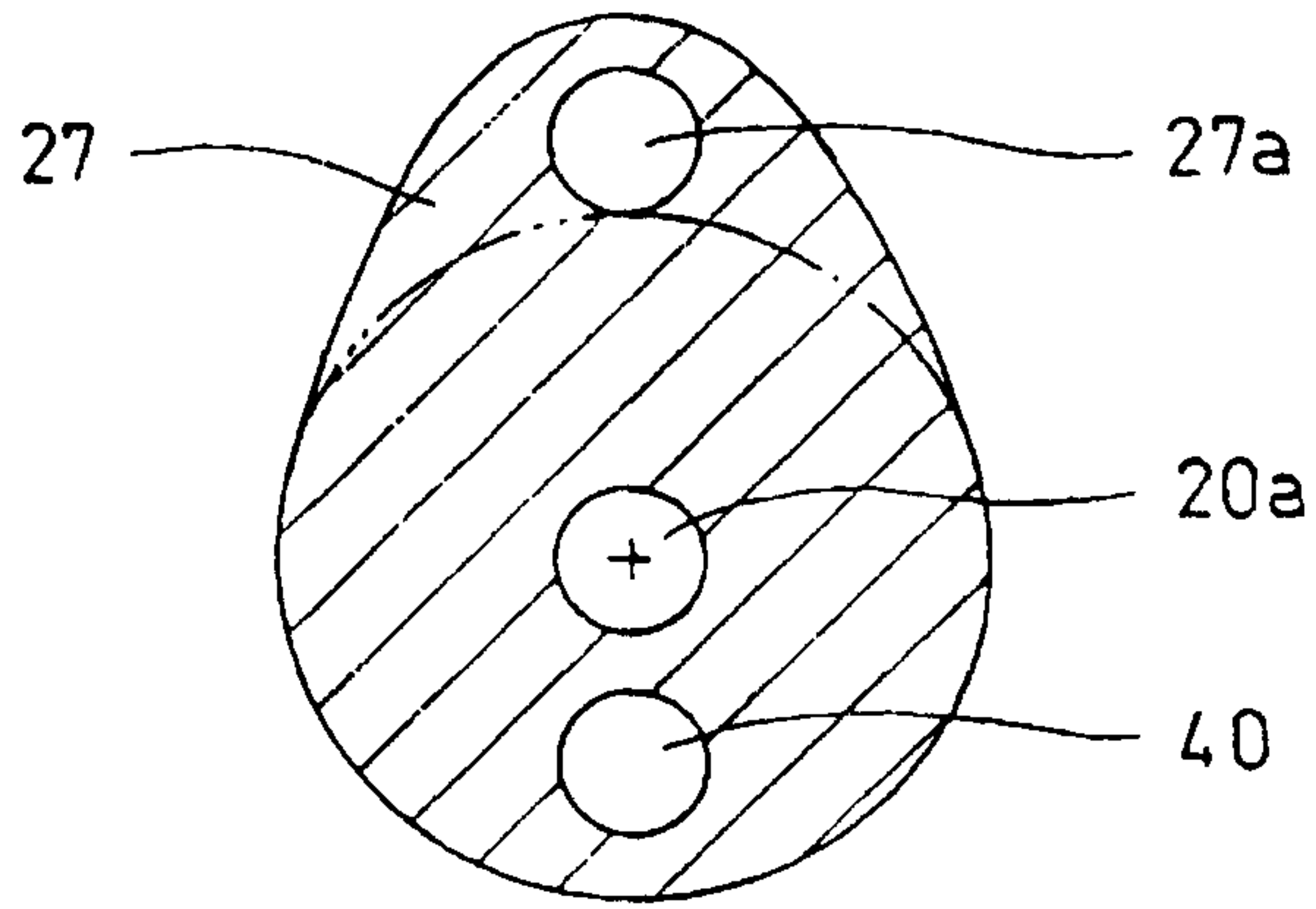


FIG. 9

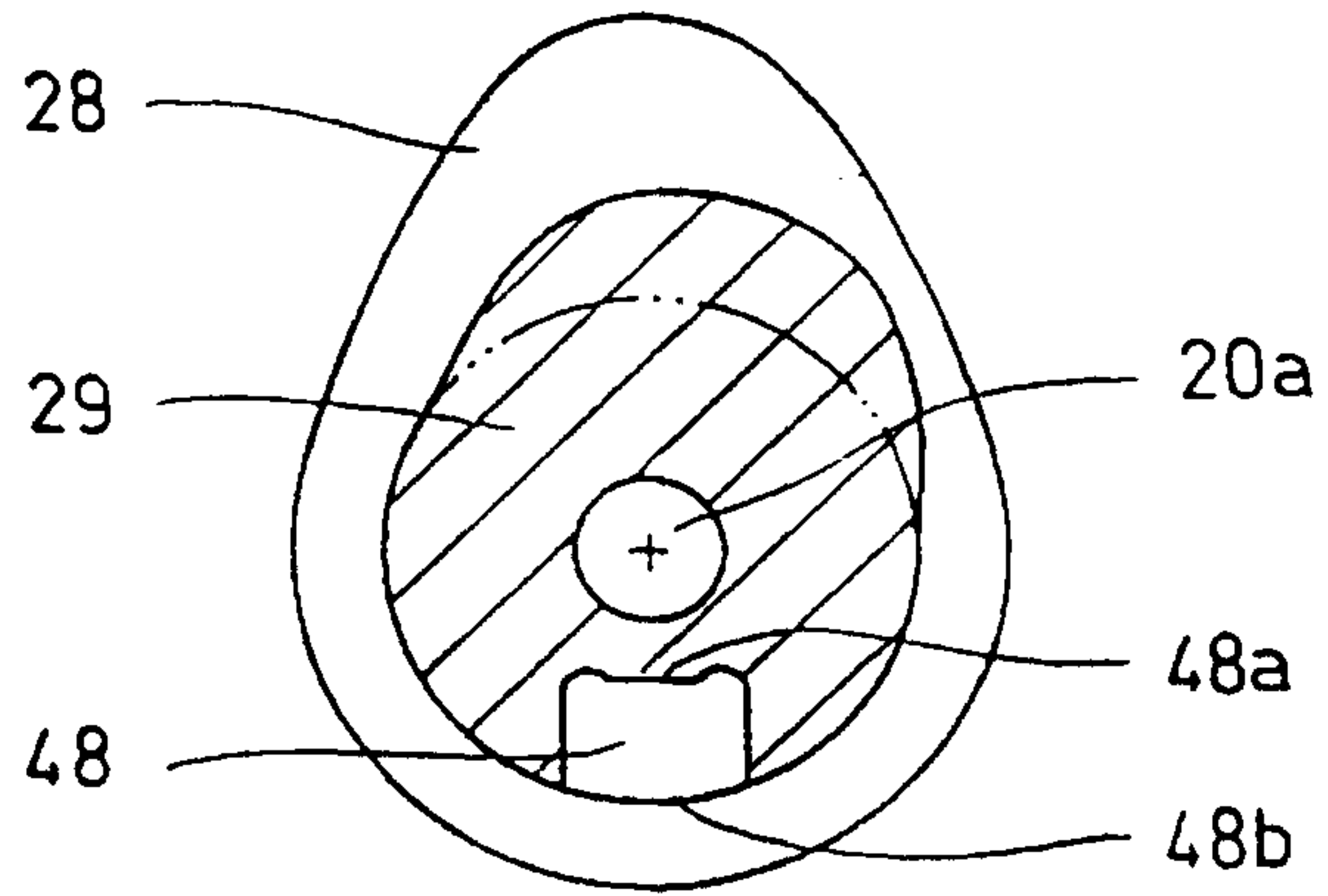


FIG. 10

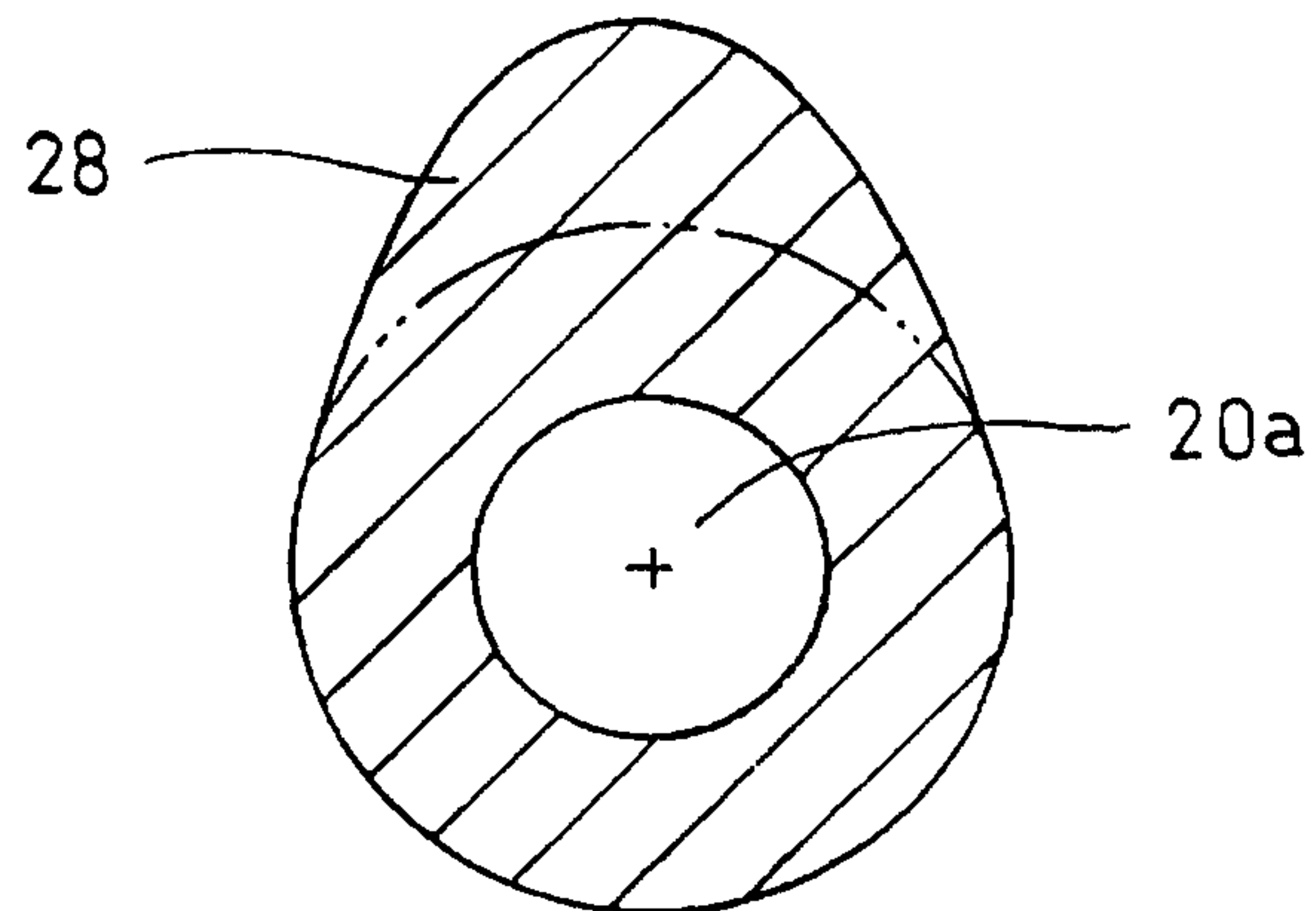


FIG. 11

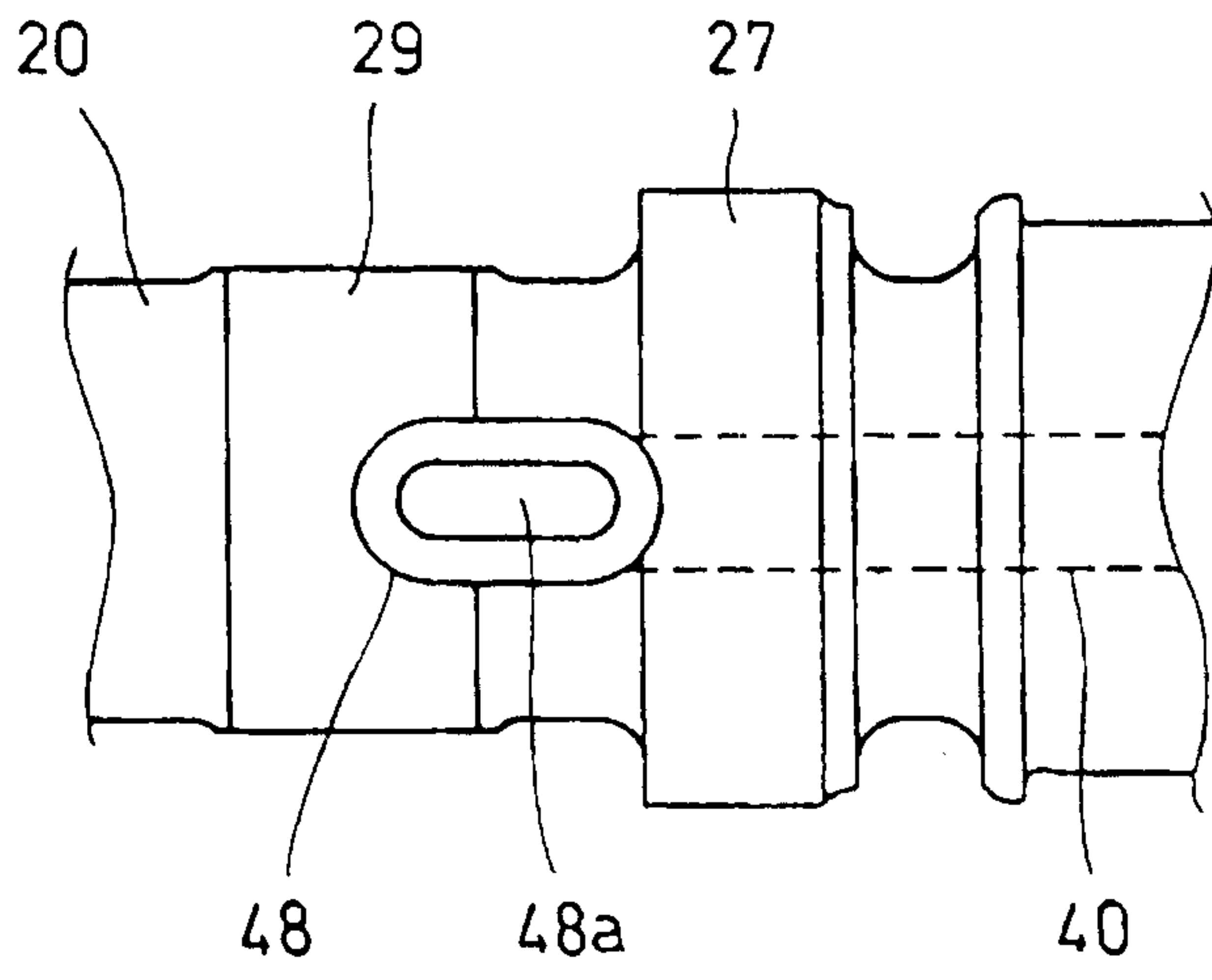


FIG. 12

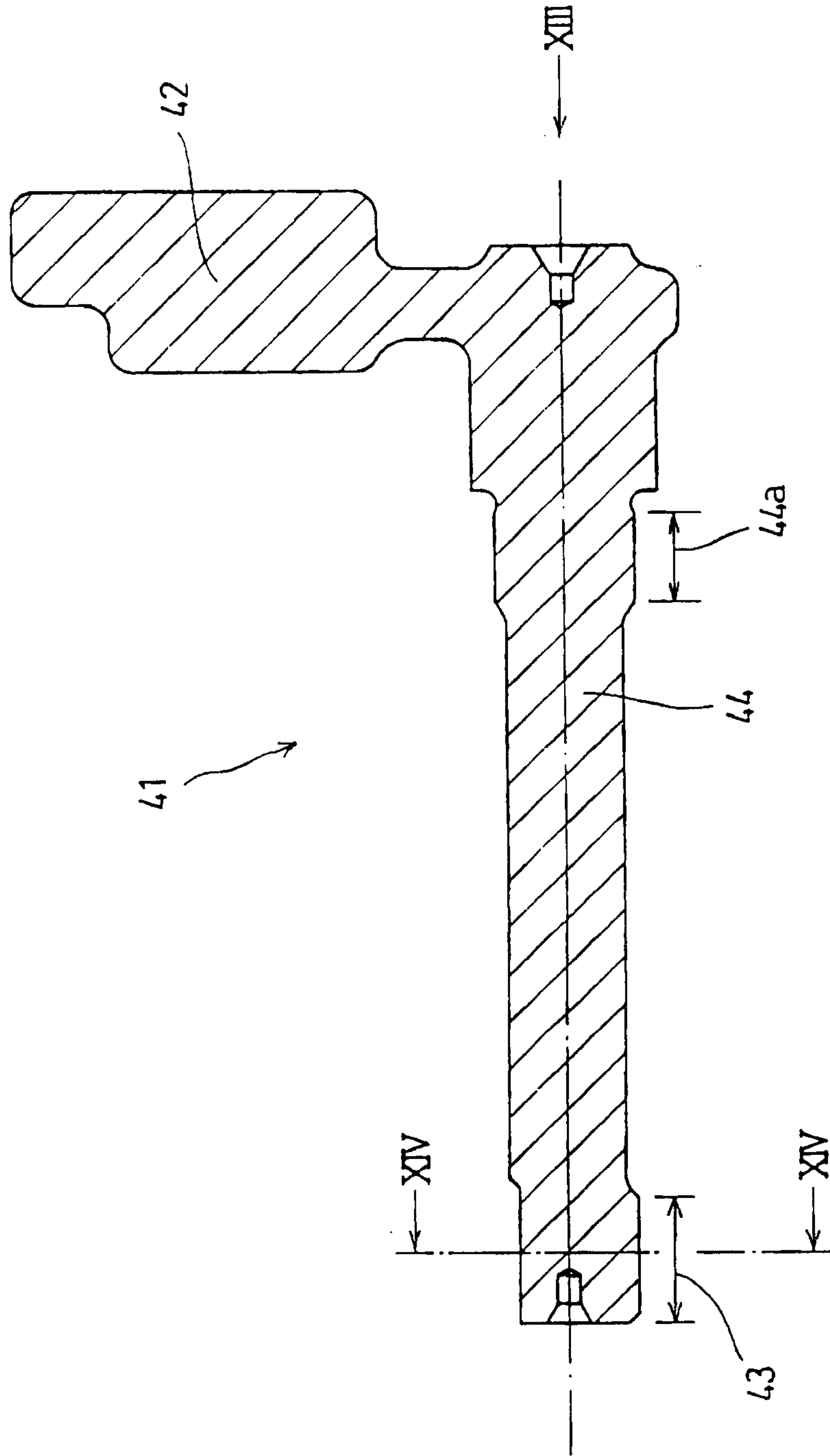


FIG. 13

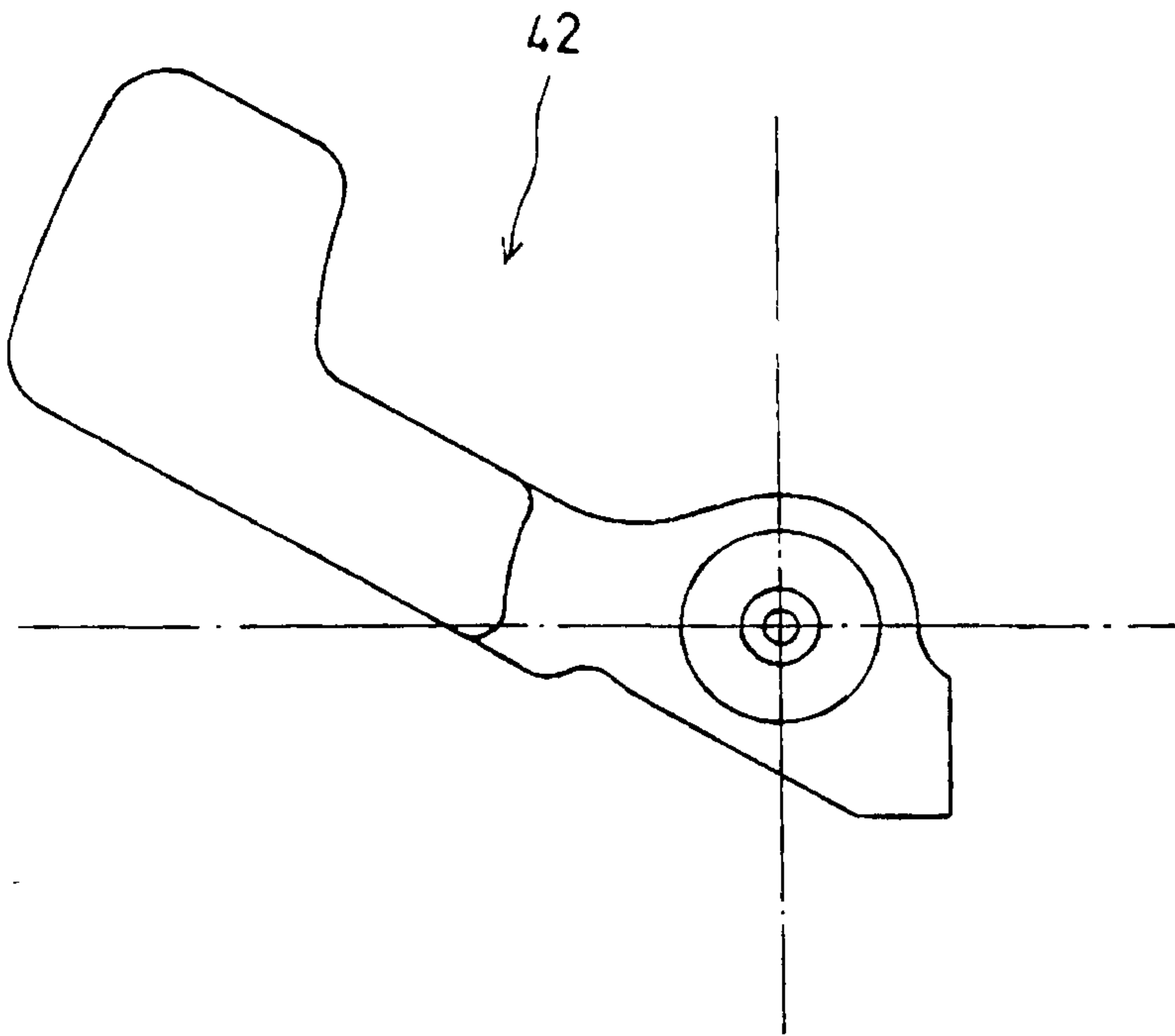


FIG. 14

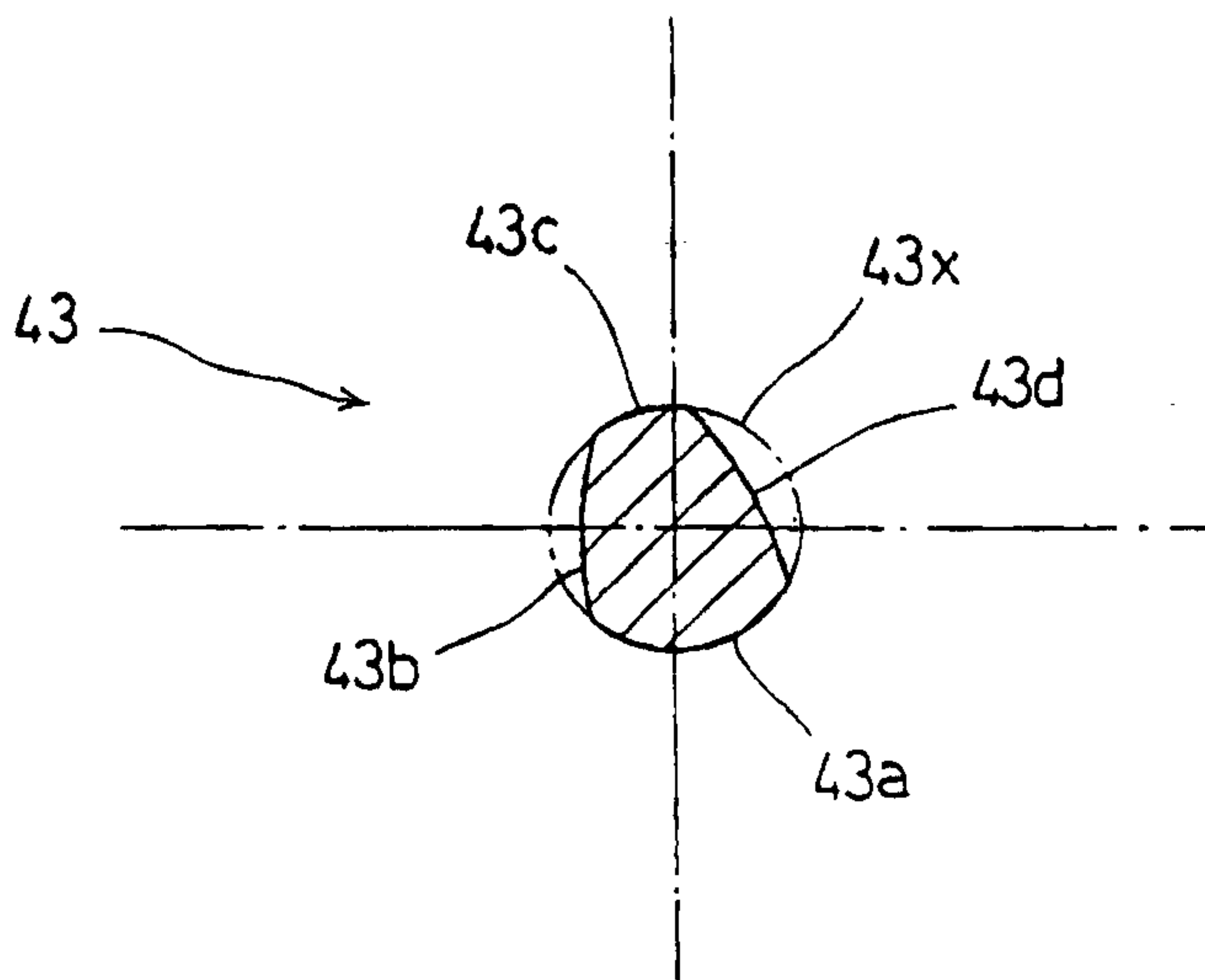


FIG. 15

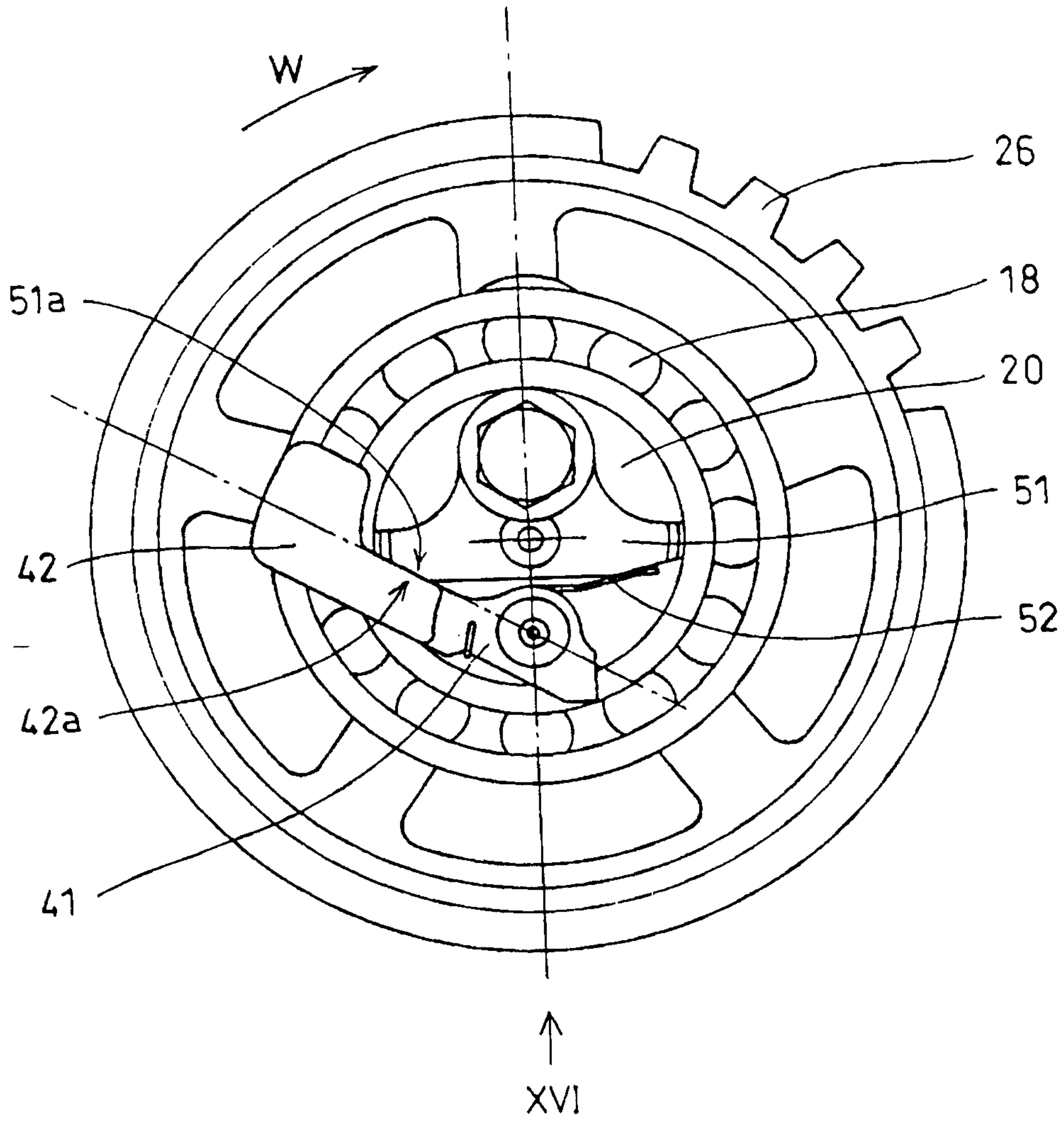


Fig 16.

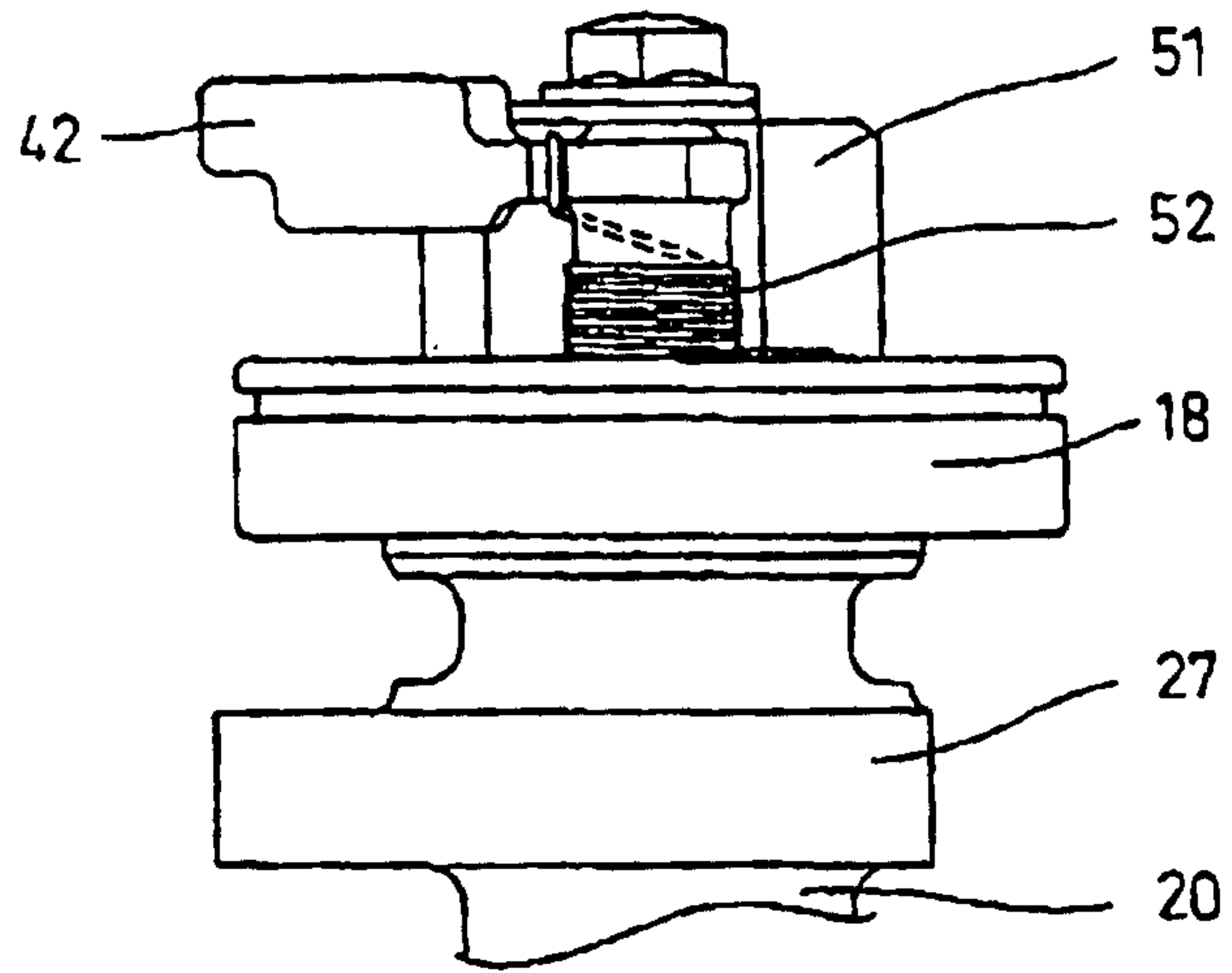


FIG. 17

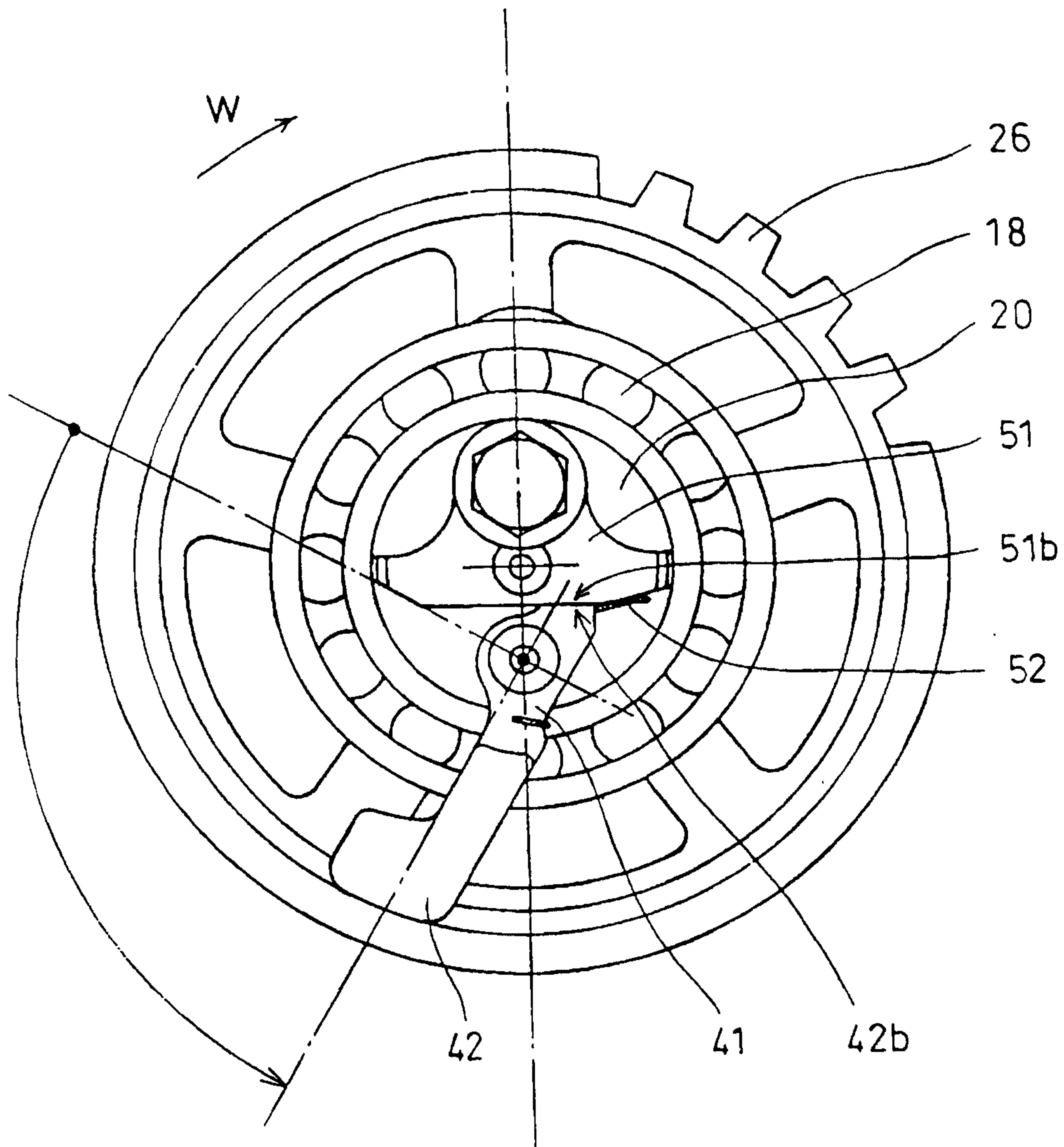


FIG. 18

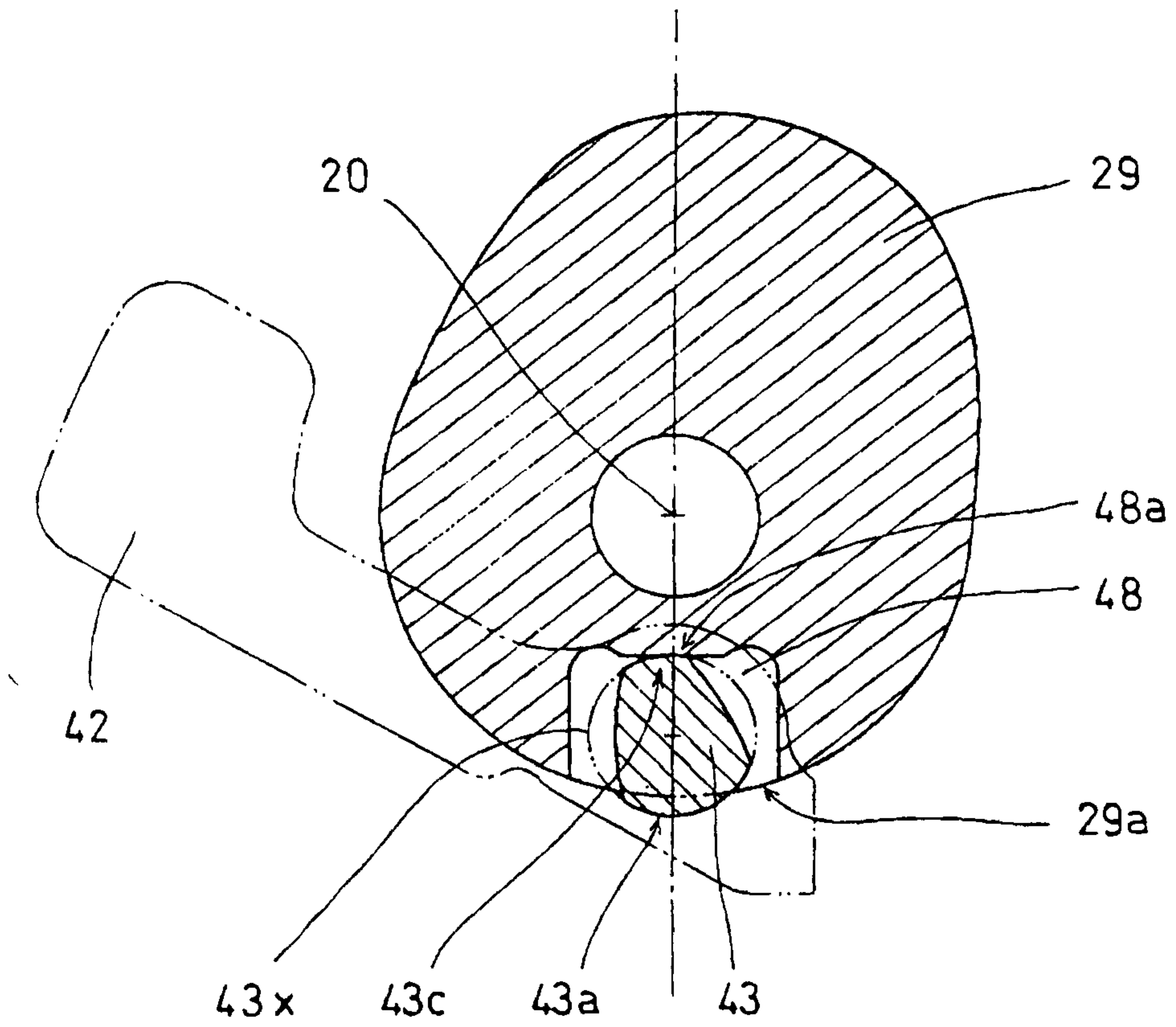


FIG. 19

