US00RE37099E

(19) **United States**

(12) **Reissued Patent**

Hanada

(10) **Patent Number: US RE37,099 E**

(45) **Date of Reissued Patent: Mar. 20, 2001**

(54) **BRAKE APPARATUS FOR A BICYCLE**

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(73) Assignee: **Shimano, Inc.**, Osaka (JP)

(21) Appl. No.: **08/869,593**

(22) Filed: **Jun. 5, 1997**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **5,421,435**
Issued: **Jun. 6, 1995**
Appl. No.: **08/018,409**
Filed: **Feb. 17, 1993**

(30) **Foreign Application Priority Data**

Mar. 23, 1992 (JP) 4-064691

(51) **Int. Cl.**[7] **G05G 7/00**; B62L 3/02; F16H 59/04

(52) **U.S. Cl.** ..... **188/24.14**; 74/388 R

(58) **Field of Search** ..... 68/24.11, 24.14, 68/26; 192/6 R; 74/388 R

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(57) **ABSTRACT**

A brake apparatus for use on a hub shaft (**11**) supporting a hub (**2**) of a bicycle has a brake ring (**13**), and a coupling device for coupling the brake ring and the hub to rotatable together. The coupling device includes outer splines (**13**a) formed on the brake ring (**13**) and inner splines (**2**d) formed in the hub (**2**) to allow relative axial movement between the brake ring (**13**) and hub (**2**) while preventing relative rotation therebetween. The brake apparatus includes brake shoes (**6**) disposed inside the brake ring (**13**) to be movable into contact with the brake ring (**13**). A restrictor is provided far restricting axial movement of the brake shoes (**6**) relative to the brake ring (**13**). The restrictor includes stoppers (**27**a) projecting radially outwardly from peripheral positions of an annular shoe presser spring (**27**) fitted circumferentially of the brake shoes (**6**), and grooves (**13**b) formed in an inner peripheral wall of the brake ring (**13**). The brake apparatus further includes a brake controller (**7**) for varying a radial distance of the brake shoes (**6**) from an axis of the hub shaft (**11**).

24 Claims, 12 Drawing Sheets

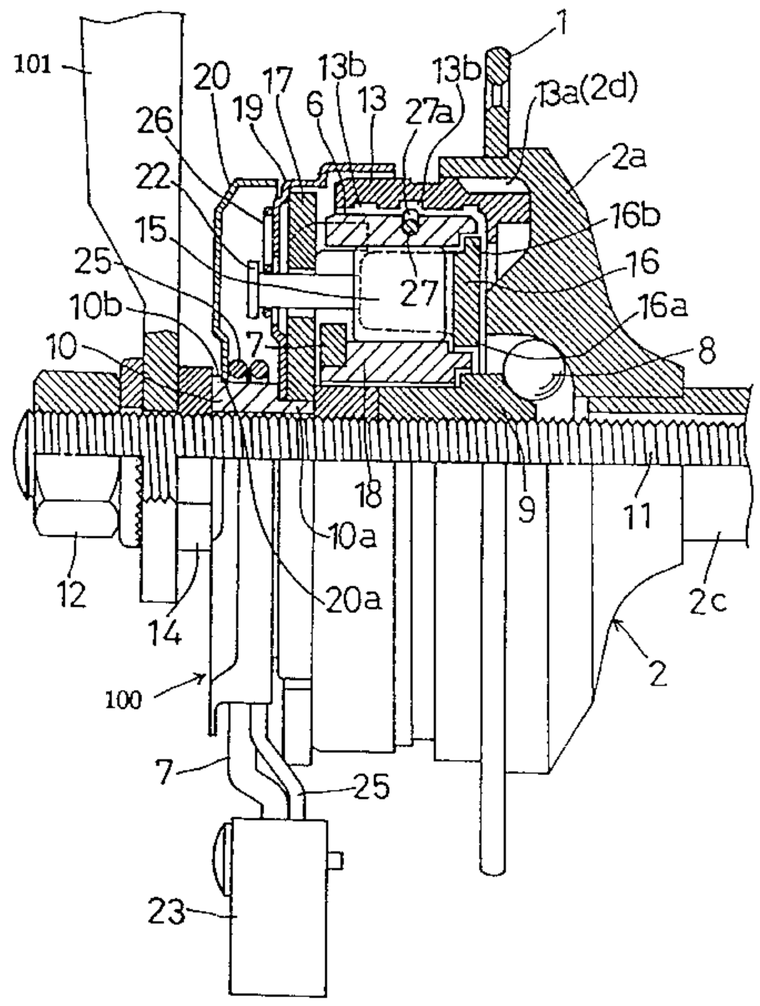


FIG. 1

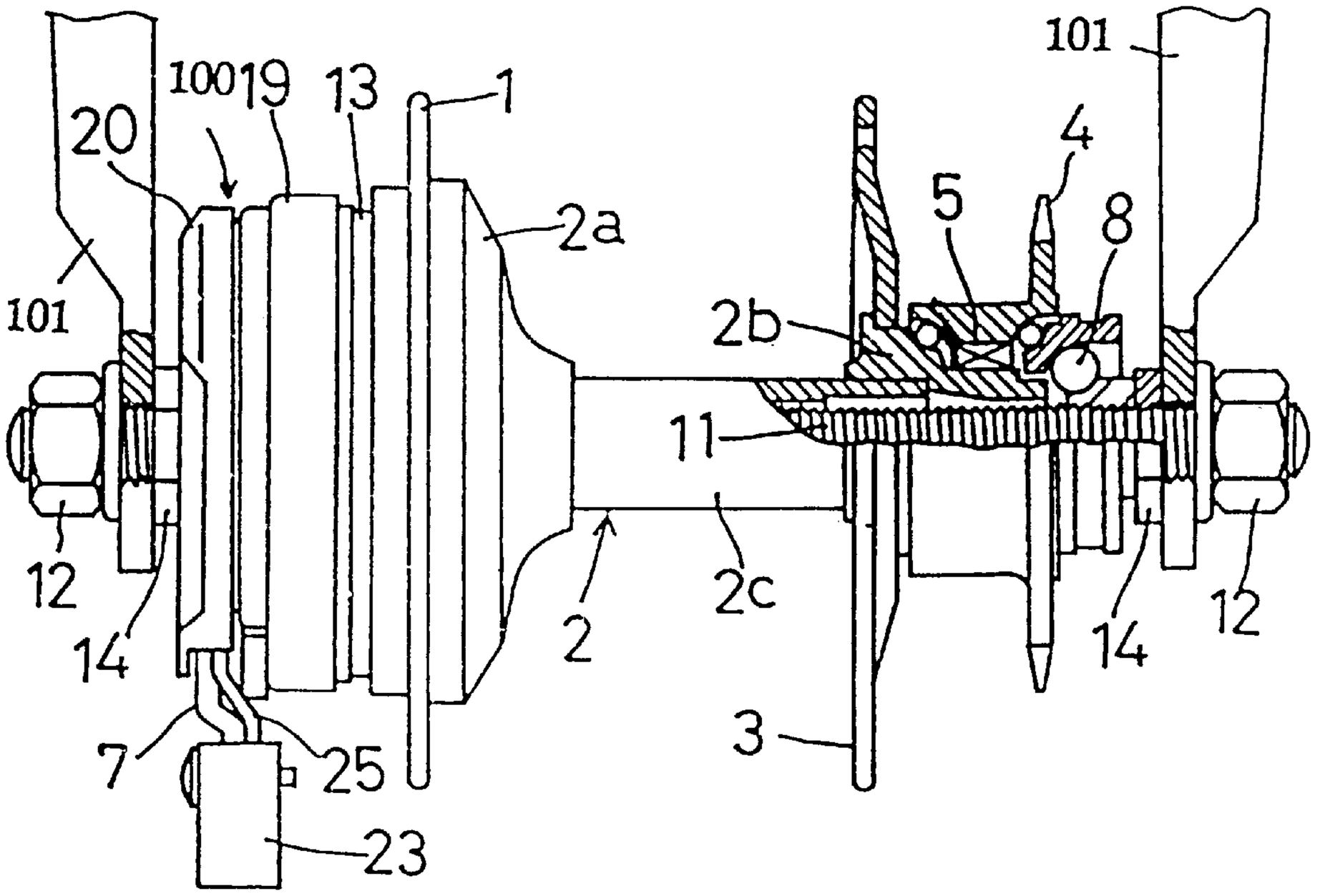

20
100
19
13
1
2a
101
12
14
7
25
23
2
101
4
5
8
2b
11
2c
12
14
3

FIG. 2

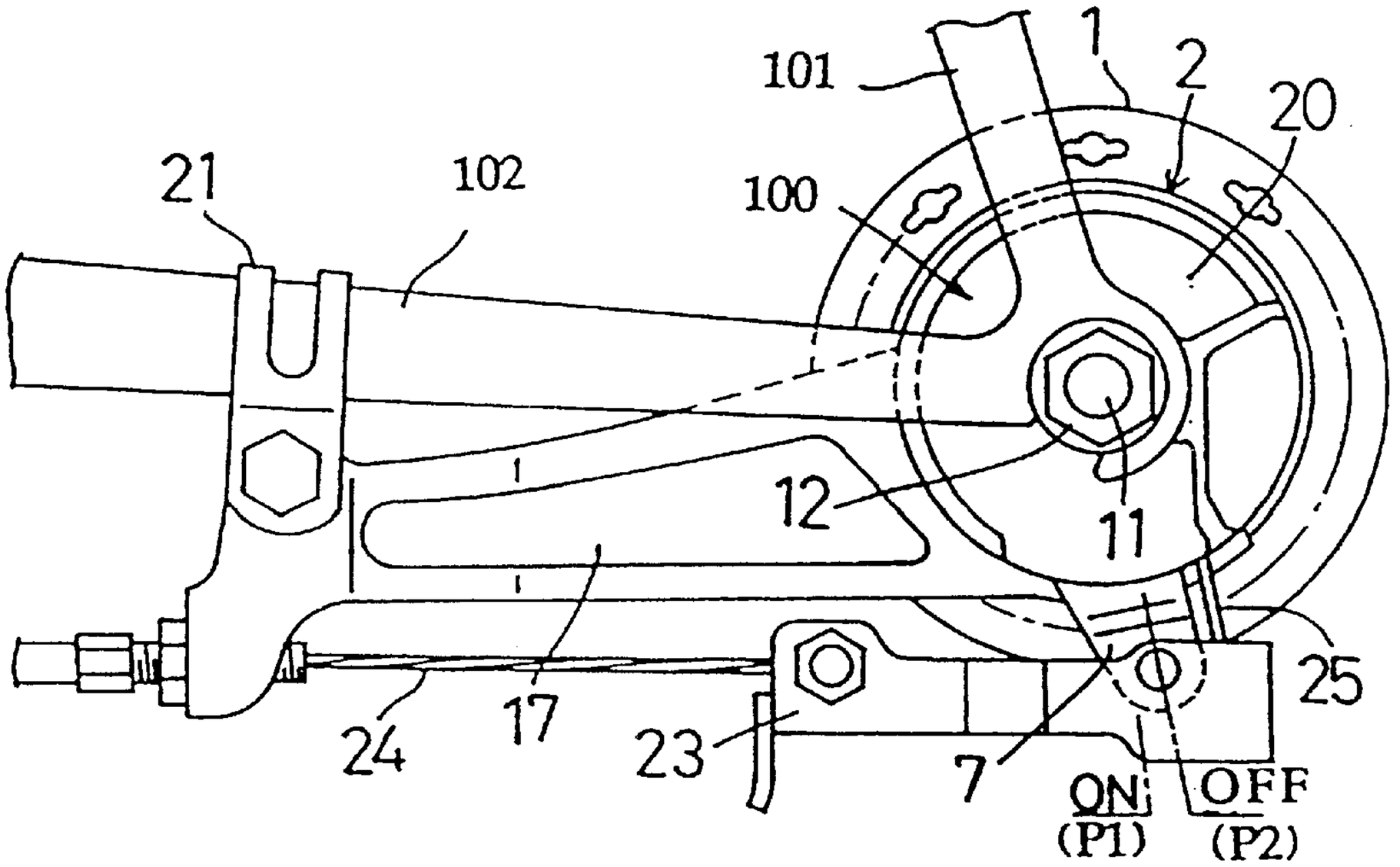
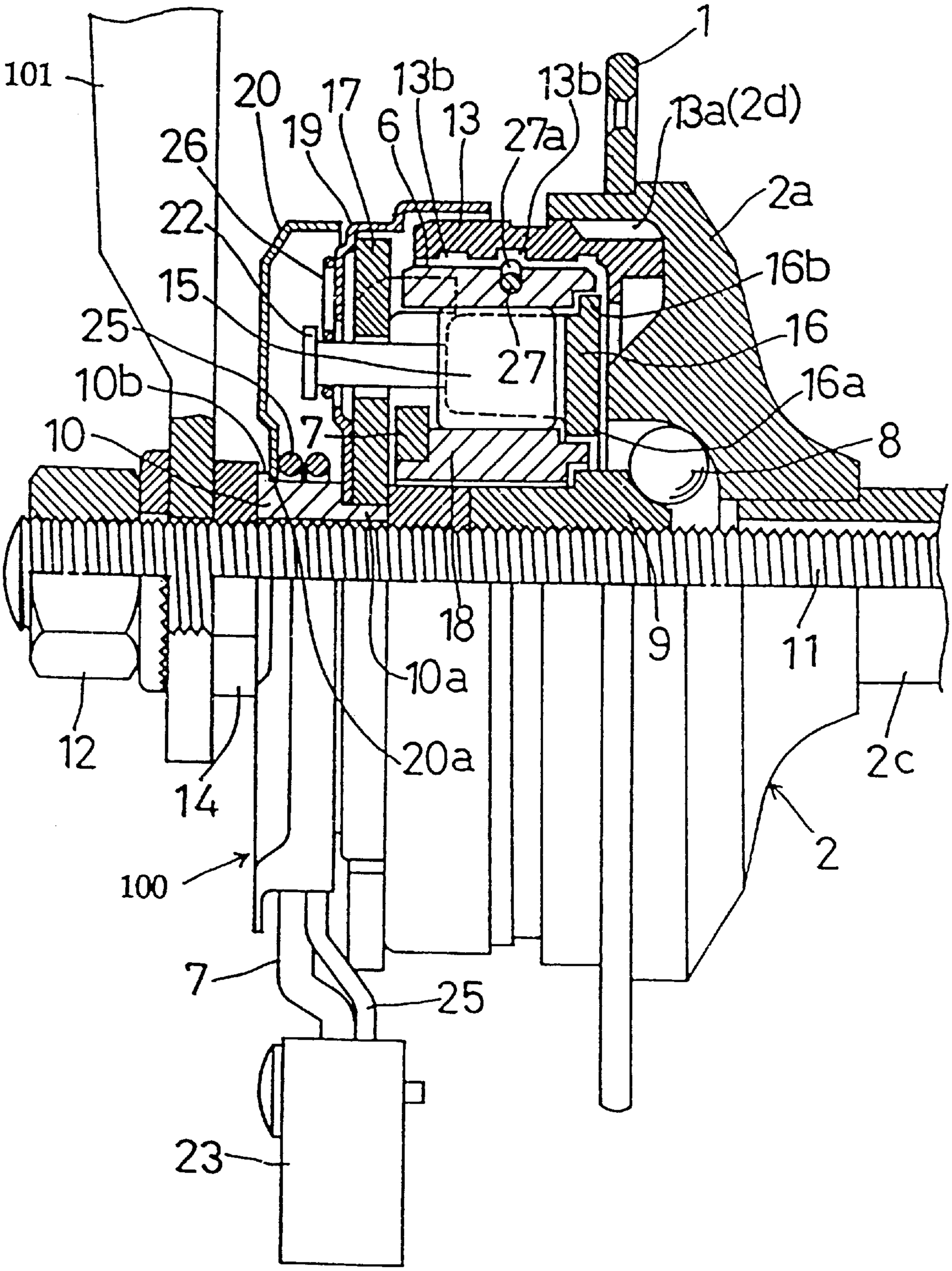

101
1
2
20
21
102
100
12
11
25
24
17
23
7
ON
(P1)
OFF
(P2)

FIG. 3


101
20
17
13b
13b
1
19
6
13
27a
13a(2d)
26
2a
22
16b
15
16
25
27
16a
10b
7
8
10
18
9
11
10a
12
20a
2c
14
2
100
7
25
23

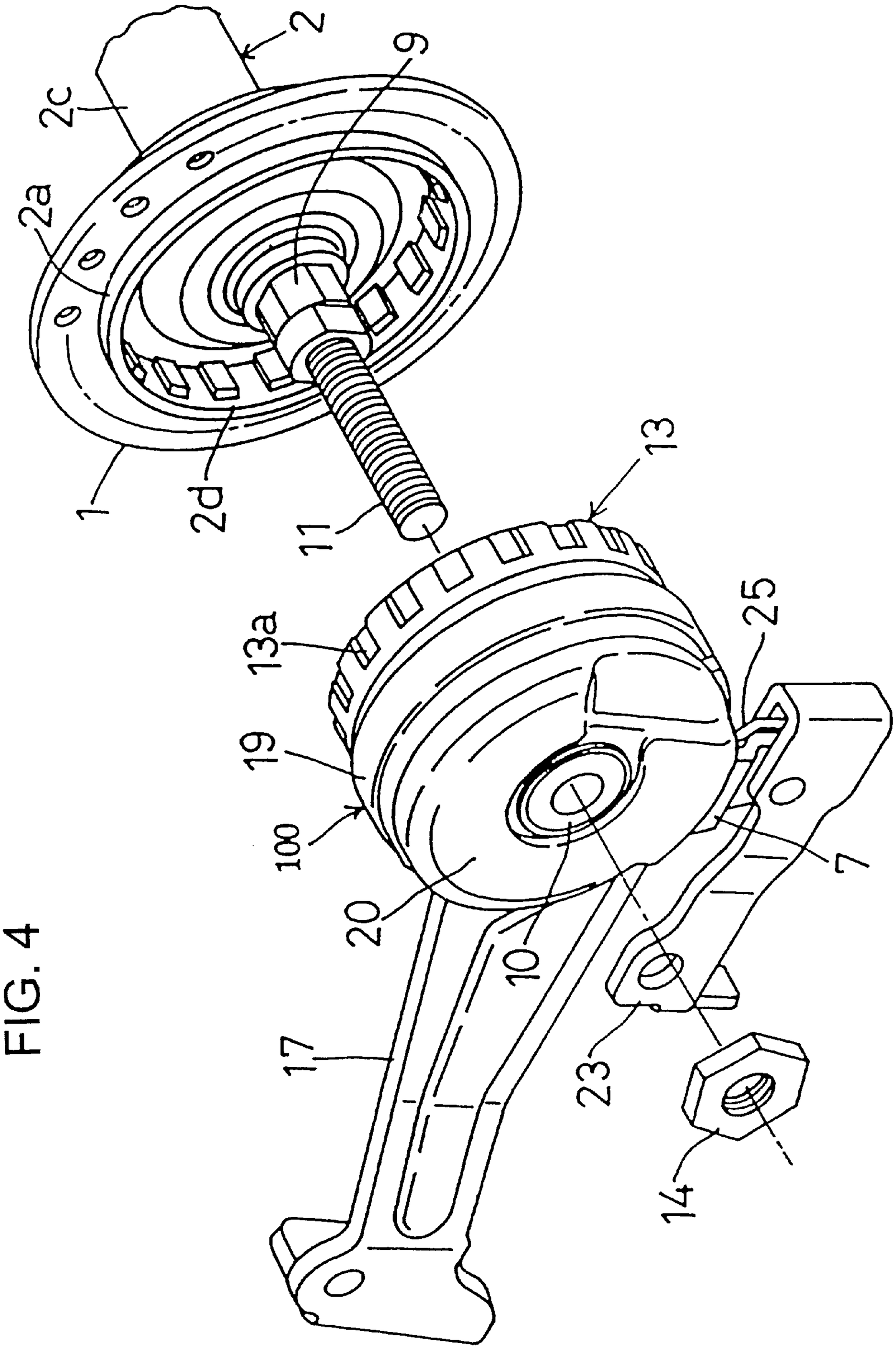
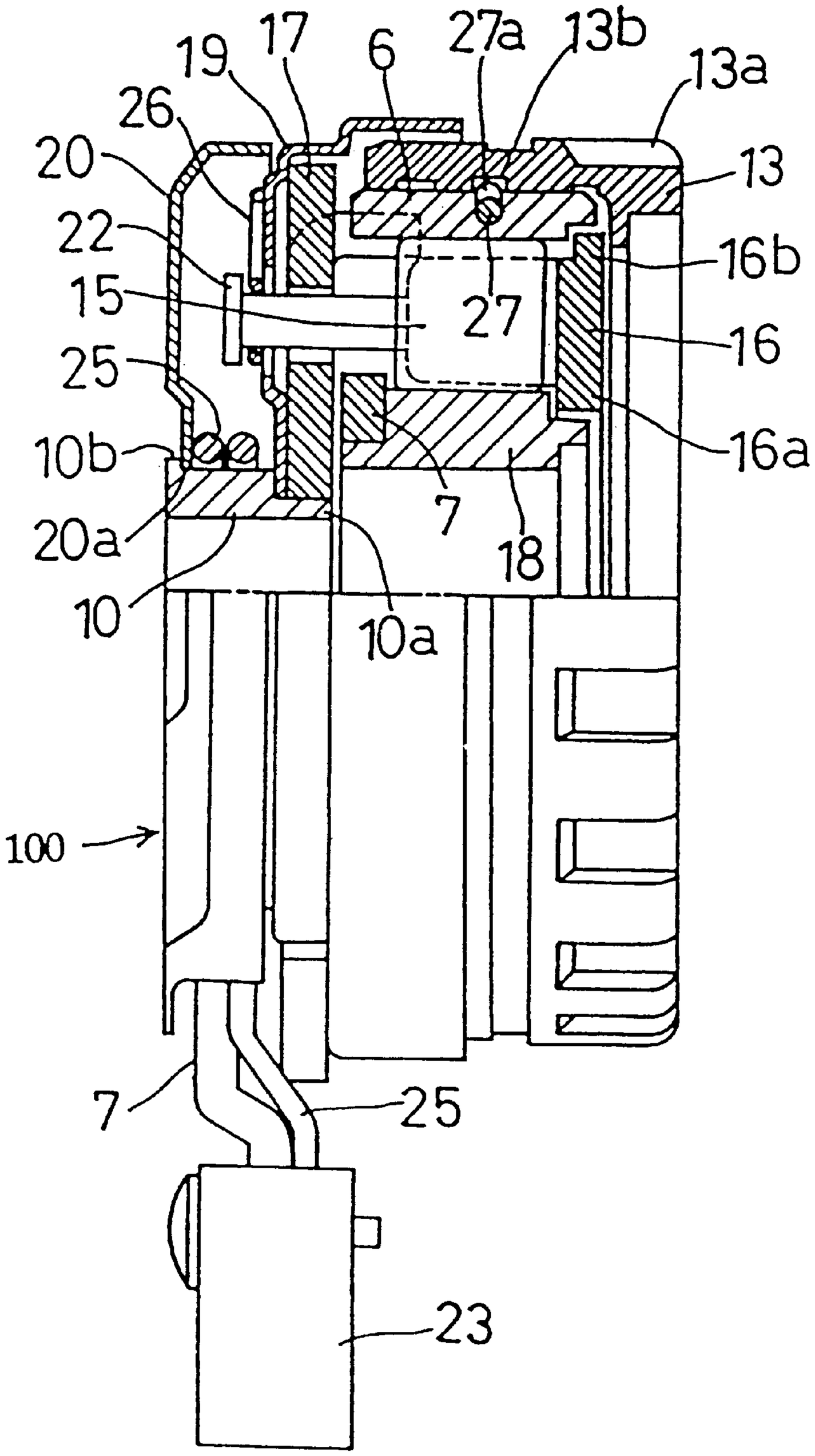


FIG. 4

FIG. 5


19
17
6
27a
13b
13a
26
20
13
22
16b
15
27
16
25
16a
10b
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18
20a
10
10a
100
7
25
23

FIG. 6

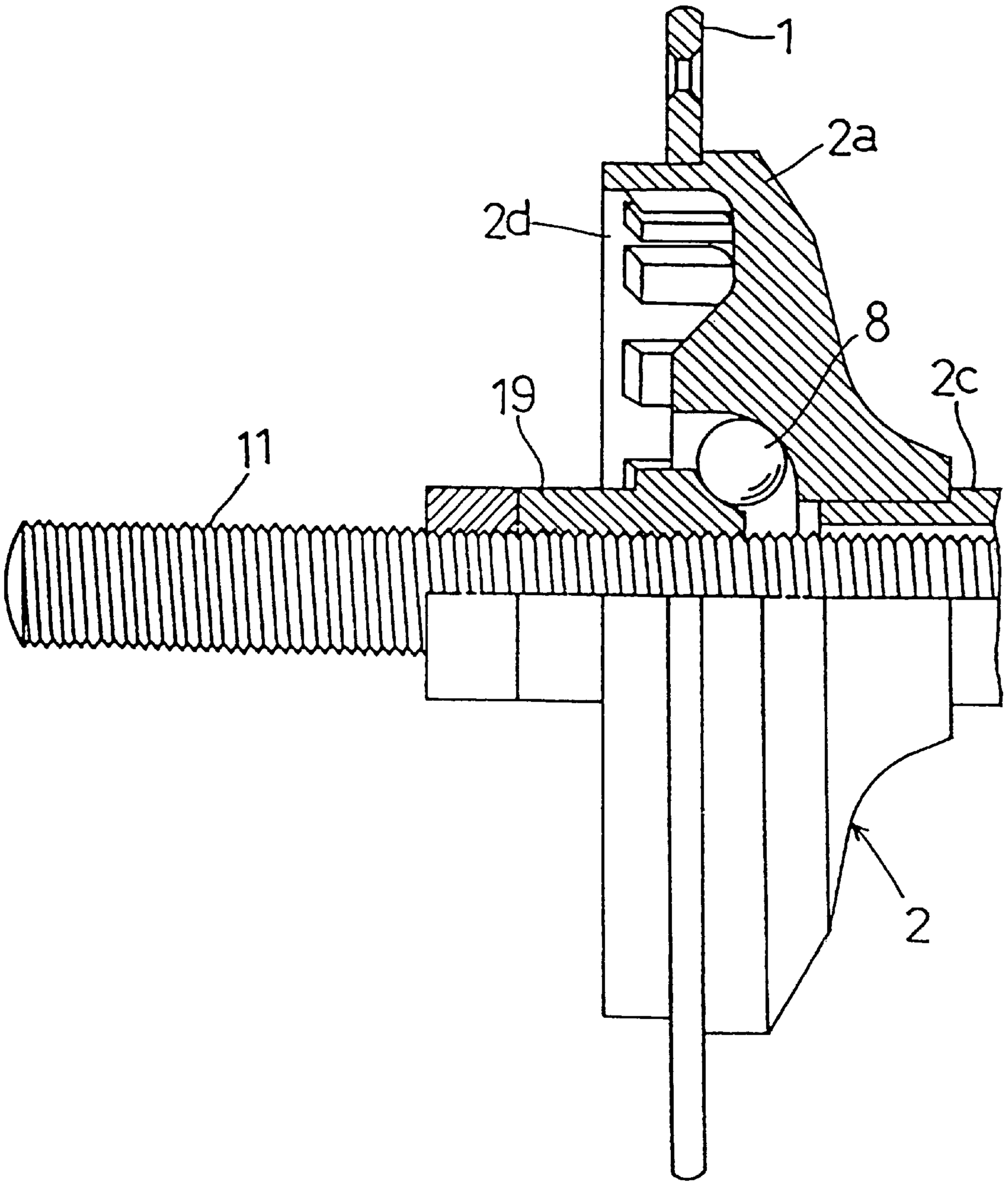


FIG. 7

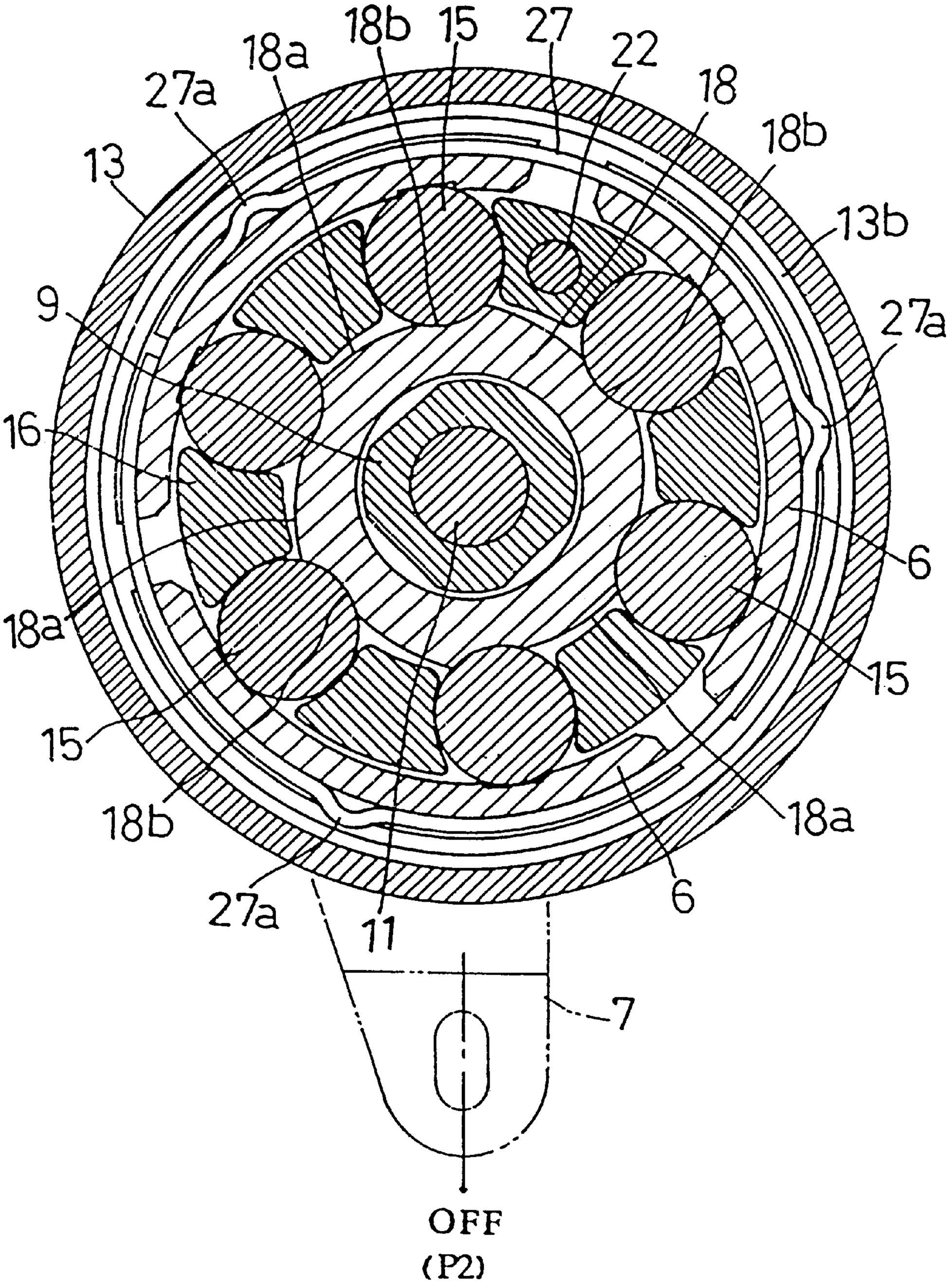

18a
18b
15
27
22
27a
18
18b
13
13b
9
27a
16
6
18a
15
15
18b
18a
27a
6
11
7
OFF
(P2)

FIG. 8

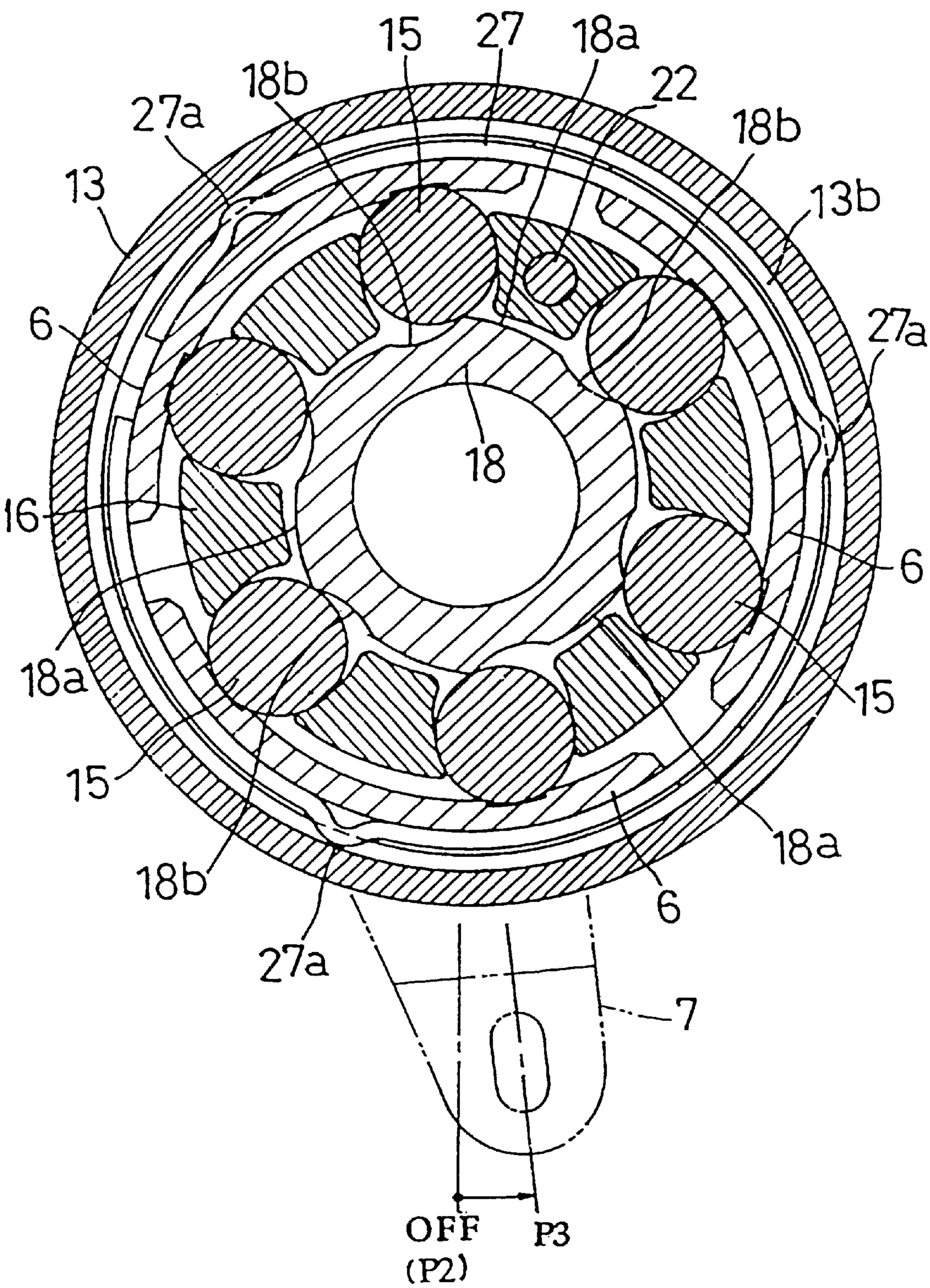

15
27
18a
18b
22
18b
27a
13
13b
6
27a
18
16
6
18a
15
15
18a
18b
6
27a
7
OFF
(P2)
P3

FIG. 9

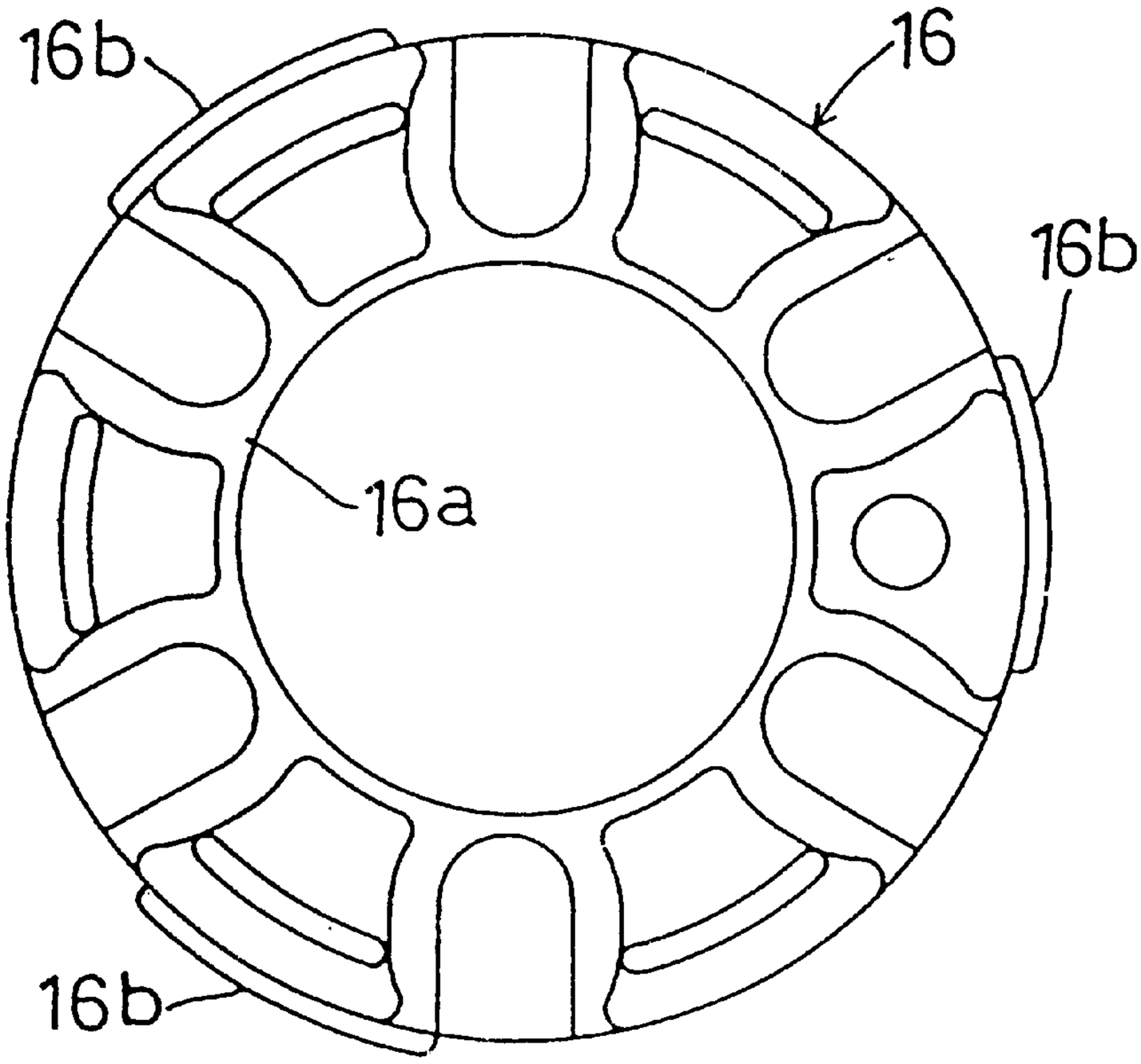


FIG. 10

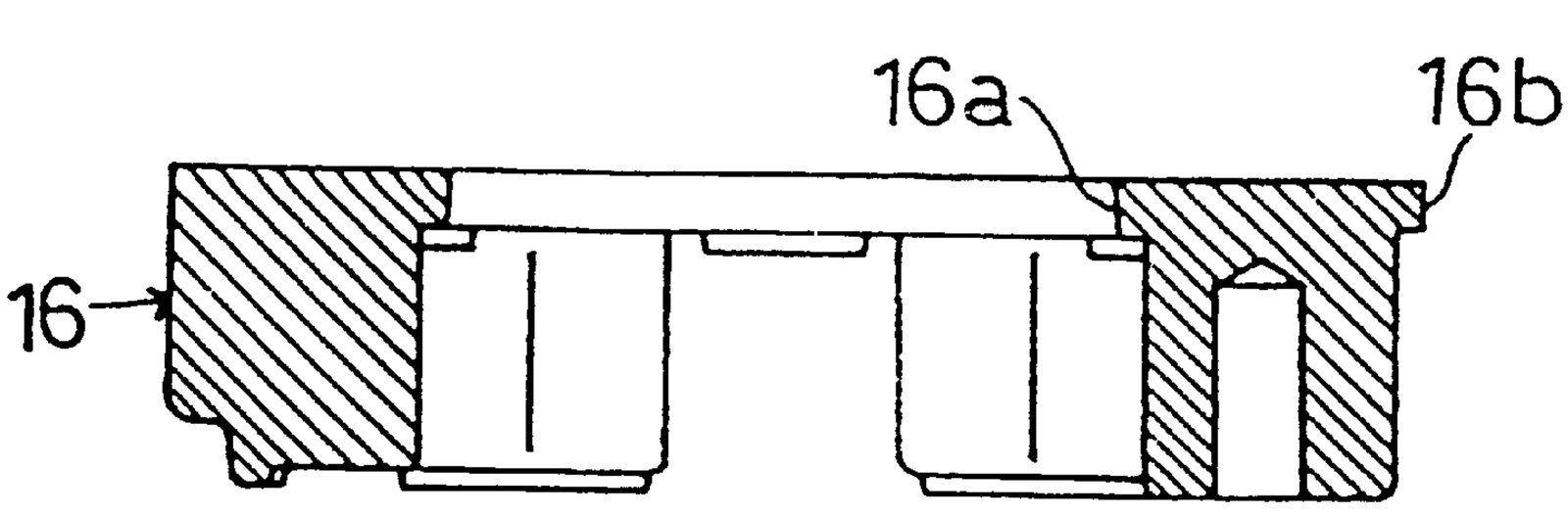


FIG. 11

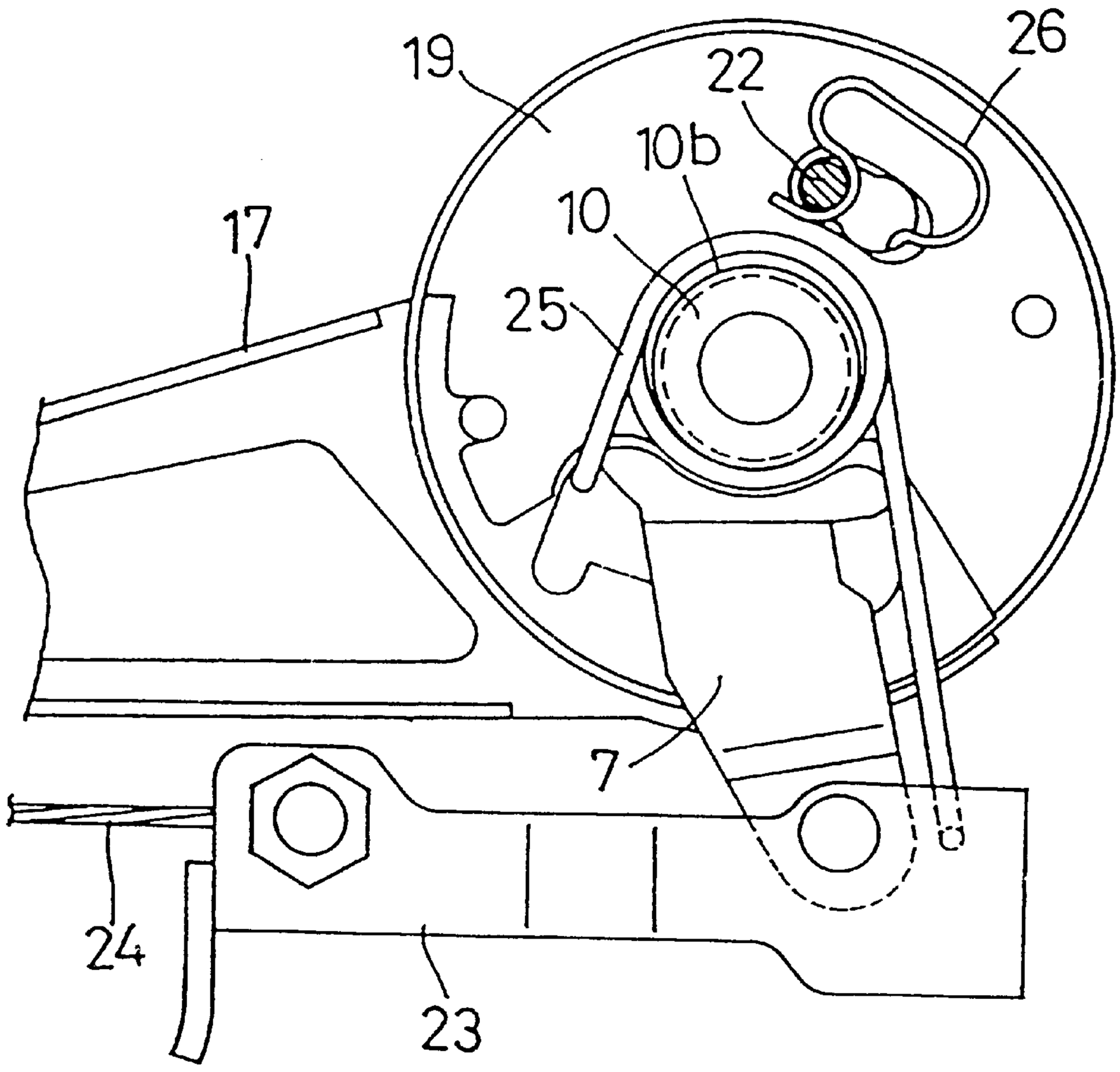


FIG. 12

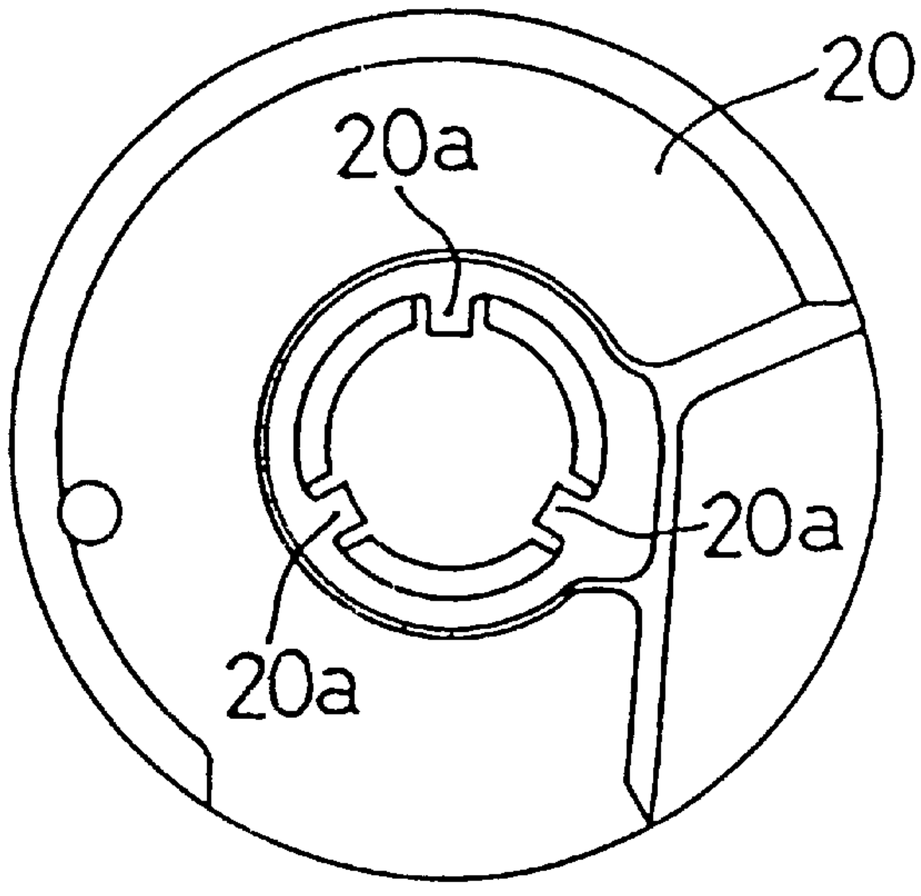


FIG. 13

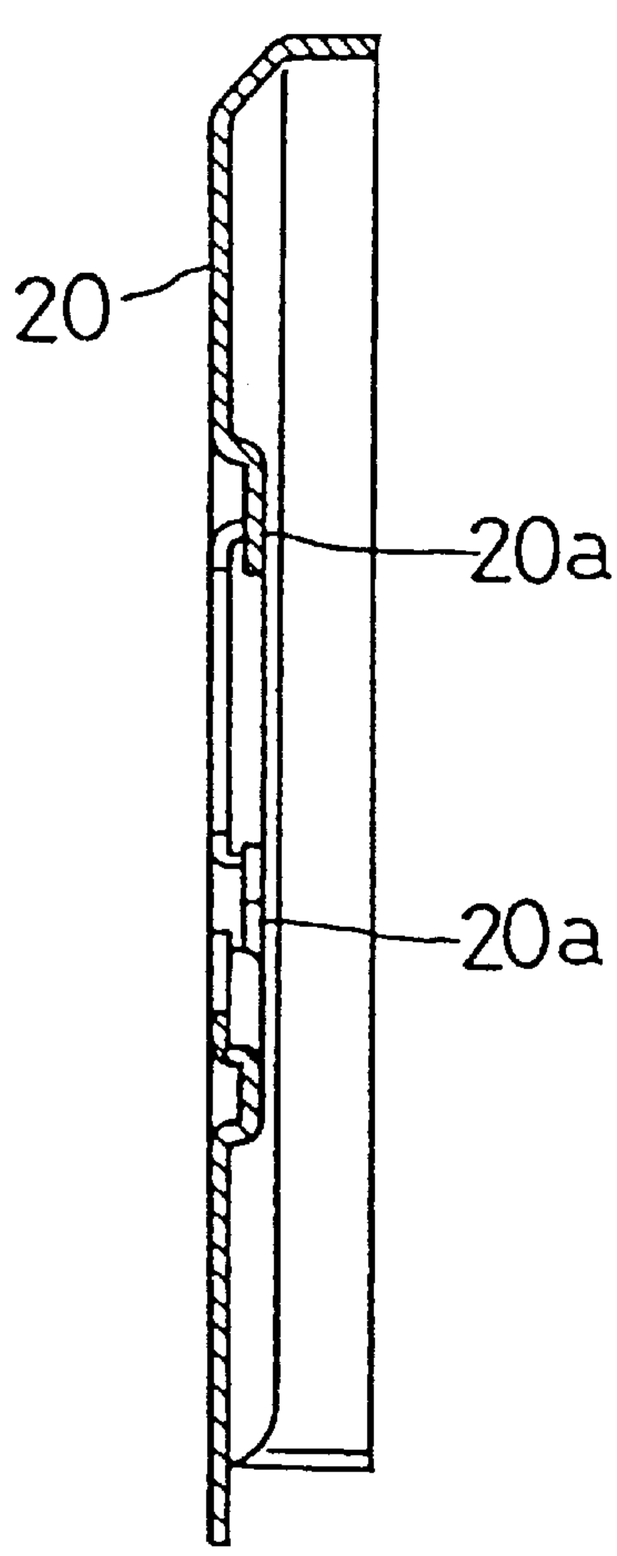


FIG. 14
(PRIOR ART)

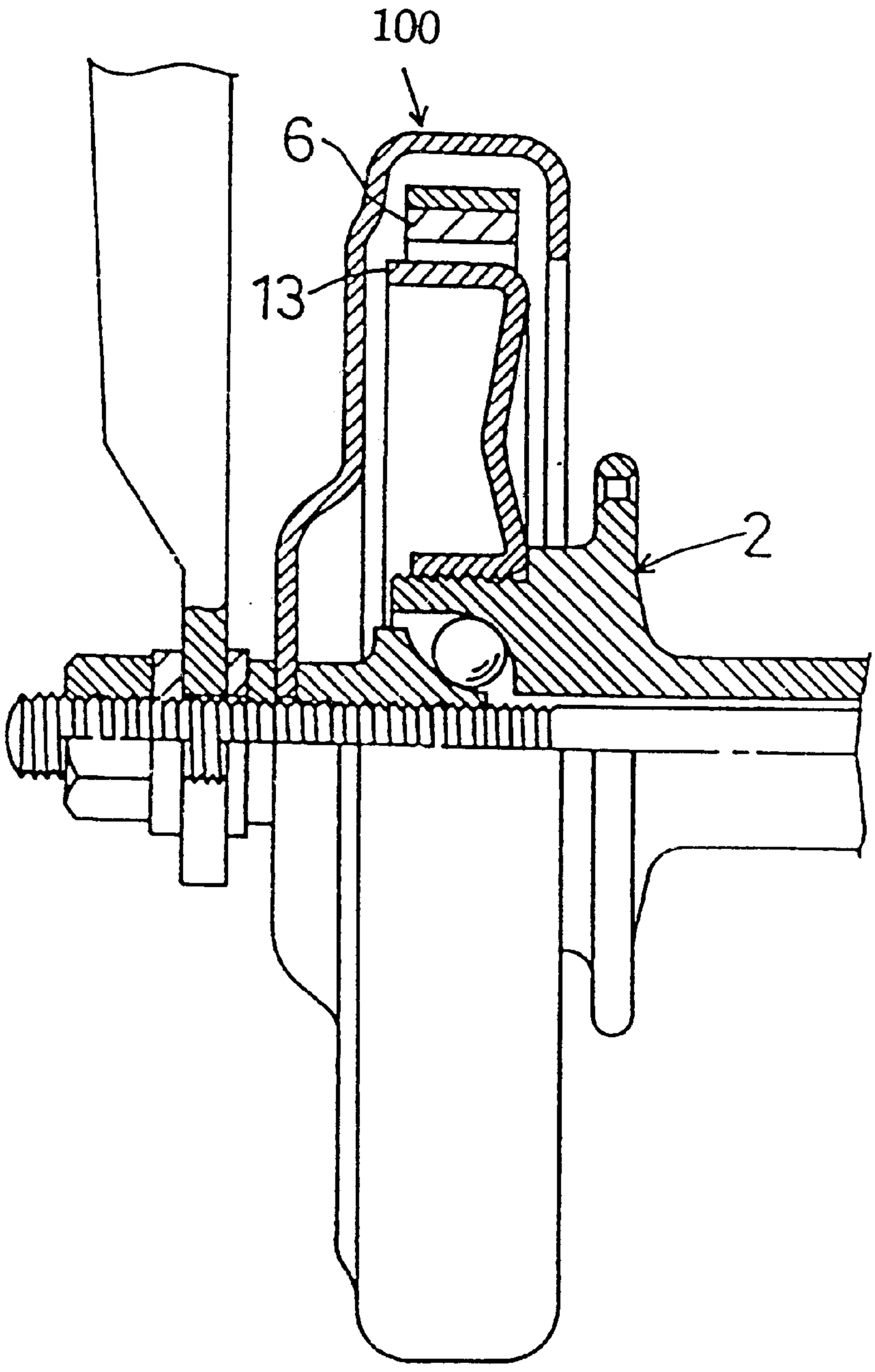
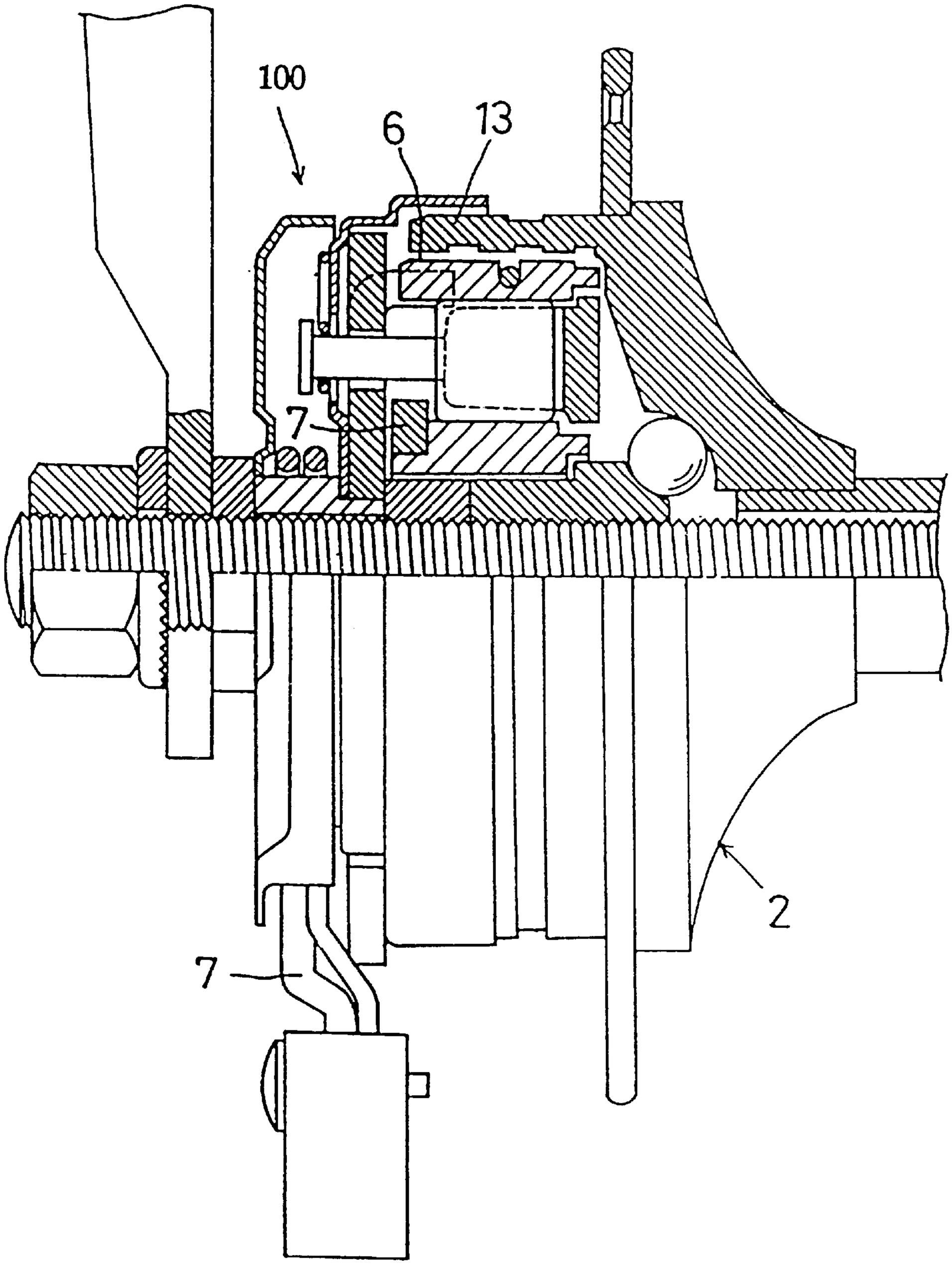


FIG. 15
(PRIOR ART)



BRAKE APPARATUS FOR A BICYCLE

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

This invention relates to a brake apparatus for a bicycle including a main brake body having a braking device and a brake controller, in which the brake controller is operable to switch the braking device between a braking position and a release position.

DESCRIPTION OF THE RELATED ART

As shown in FIG. **14**, a conventional brake apparatus for a bicycle includes a brake ring **13** engaged with an outer periphery at one end of a hub **2**, so that the brake ring **13** forms a part of the hub **2**. Brake shoes **6** acting as a braking device and other components of a main brake body **100** are assembled to the hub **2** in a separate process from assembly of the brake ring **13**. FIG. **15** shows another conventional brake apparatus in which a brake ring **13** is formed integral with a hub **2**. With a main brake body **100** assembled to the hub **2**, the brake apparatus, brake ring and hub may be carried together as a unit.

With the former, it is necessary to assemble the brake ring **13** and main brake body **100** to the hub **2** in separate steps. This assembly operation tends to be of poor efficiency with displacements of the respective components occurring at a time of adjustment.

In the latter case, the three components of the bicycle are handled as a unit which is heavy. Another disadvantage of this construction is that the end of the hub where the brake apparatus and brake ring are attached is bulky, and particularly large in diameter. It is difficult to handle the bulky construction packed for transportation.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a brake apparatus easy to assemble and adjust, and easy to transport and handle.

In order to fulfill the above object, the present invention is characterized by the following three features:

1) A braking device forming the brake ring is provided as a separate component from the bicycle hub.

2) A coupling device is provided to connect the brake ring to the hub to be rotatable together.

3) A restrictor is provided to interconnect the brake ring and the main brake body into an integral unit to be inseparable from each other.

The feature 1) allows the hub to be packed and transported separately from the brake ting. The coupling device of feature 2) is provided to facilitate connection of the brake ring to the hub. In a preferred embodiment of the invention, the coupling device includes outer splines formed on the brake ring and inner splines formed in the hub. In the preferred embodiment, the restrictor of feature 3) includes an annular shoe presser spring fitted circumferentially of the brake shoes, and grooves formed in an inner peripheral wall of the brake ring for receiving the presser spring. The brake apparatus has the brake ring and main brake body connected together through engagement between the presser spring and one of the grooves. This construction reduces the possibility of adjustment errors such as a displacement between each brake component and brake ring occurring when the brake apparatus is assembled to the hub, and realizes improved assembling efficiency.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of preferred embodiments of the invention, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings show a brake apparatus for a bicycle according to the present invention, in which:

FIG. **1** is a front view of a hub having a brake apparatus for a bicycle according to the present invention,

FIG. **2** is a side view of the brake apparatus,

FIG. **3** is a view, partly in section, of the brake apparatus as assembled,

FIG. **4** is a perspective view of the brake apparatus separated from the hub,

FIG. **5** is a view, partly in section, of the brake apparatus,

FIG. **6** is a view, partly in section, of a coupling portion of the hub,

FIG. **7** is a sectional view of a roller assembly of the brake apparatus in an OFF position (second position),

FIG. **8** is a sectional view of the roller assembly of the brake apparatus in a non-use position (third position),

FIG. **9** is a side view of a roller case of the brake apparatus,

FIG. **10** is a sectional view of the roller case,

FIG. **11** is a side view showing return springs,

FIG. **12** is a side view of an ornamental cap,

FIG. **13** is a sectional view of the ornamental cap,

FIG. **14** is a view, partly in section of a hub having a brake apparatus according to the prior art, and

FIG. **15** is a view, partly in section of another example of hub and brake apparatus according to the prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIG. **1**, a bicycle hub **2** includes a left cover **2**a having a spoke connecting flange **1**, an inner element **2**b having a spoke connecting flange **3** and a ratchet mechanism **5** for interlocking a drive gear **4** and the inner element **2**b, and a pipe portion **2**c interconnecting the left cover **2**a and inner element **2**b.

As shown in FIG. **3**, the left cover **2**a has a brake apparatus assembled thereto and including brake shoes **6** and a brake controller **7**. The hub **2** is supported by a hub shaft **11** through balls **8** and ball pressers **9**. The brake apparatus is supported by the hub shaft **11** through a bush **10**.

The hub shaft **11** has mounting nuts **12** screwed to opposite ends thereof for securing the brake apparatus and hub **2** to bicycle frames **101** connected to the hub shaft **11**. The above components constitute a brake and hub assembly of a bicycle.

As shown in FIG. **3**, the brake apparatus includes a main brake body **100** having the brake shoes **6**, brake controller **7** and other components, and a brake ring **13** coupled to the hub **2**. A basic brake operation is based on a mechanism in which the main brake body **100** applies a frictional braking force to the brake ring **13**, thereby to brake the hub **2**. The construction and working of this apparatus will be described in detail hereunder.

The brake ring **13** is in the form of a braking body which is a separate component from the left cover **2**a As shown in FIGS. **4** and **5**, the brake ring **13** has splines **13**a formed on an outer peripheral surface at one end thereof. These splines **13**a are fitted in a coupling portion of the left cover **2**a defining splines **2**d as shown in FIGS. **4** and **6**. The brake ring **13** is fixed to the hub shaft **11** by a pair of lock nuts **14** mounted on opposite end regions of the hub shaft **11**. The brake ring **13** is interlocked to the left cover **2**a through the splines **13**a and **2**d to be rotatable therewith.

As shown in FIGS. **3** and **7**, the main brake body **100** includes a plurality of brake shoes **6** and rollers **15** arranged in the circumferential direction of the brake ring **13** and supported by a brake frame **17** through a roller case **16**, and a rotary cam **18** mounted inwardly of the roller case **16** to be rotatable about an axis of rotation of the hub **2** to operate the brake shoes **6**. The rotary cam **18** is rotatable by the brake controller **7** to switch the main brake body **100** between a braking position and a release position. For consistency of terminology used in this specification, the term "first position P1" corresponds to a position of the brake controller **7** to apply the braking force, and "second position P2" corresponds to a position not to apply the braking force. In addition to the first and second positions, the main brake body **100** has a third position P3 which will be described later.

As shown in FIGS. **2** and **3**, the brake frame **17** has one end thereof supported by the hub shaft **11** through the bush **10**. A waterproof cap **19** and an ornamental cap **20** [am] *are* attached to this end of the brake frame **17**. The other end of the brake frame **17** is supported by a chain stay **102** of the bicycle frame **101** through a clamp band **21**. Thus, the brake frame **17** is in a fixed position relative to the bicycle frame **101** despite a reaction resulting from a braking operation. As shown in FIG. **7**, the roller case **16** accommodates all the rollers **15**. The roller case **16** has a fixed pin **22** extending through and contacting the brake frame **17**. The roller case **16** has a range of strokes determined by a circumferential dimension of a bore for receiving the fixed pin **22**. The fixed pin **22** serves to limit circumferential movement of the roller case **16** to the above range of strokes relative to the brake frame **17**. With the above construction, the rollers **15** are supported to be immovable circumferentially of the brake ring **13** during a braking operation. The circumferentially immovable rollers **15** push the brake shoes **6** radially outwardly toward the brake ring **13**.

The brake controller **7** extends through the brake frame **17** and rigidly interlocked to the rotary cam **18**, with one end of the brake controller **7** engaged with the rotary cam **18**. The other end of the brake controller **7** projects outwardly from the caps **19** and **20**. As shown in FIG. **2**, a cable coupler **23** is attached to the end of the brake controller **7** projecting from the caps **19** and **20**, and a brake cable **24** is connected to the coupler **24**. By a force applied through the brake cable **23**, the brake controller **7** is pivotable about the axis of rotation of the hub **2**.

As shown in FIG. **2**, when the brake cable **24** is pulled, the resulting tension switches the brake controller **7** to the braking position ON (first position P1). When the brake cable **24** is relaxed, the brake controller **7** is switched to the OFF position (second position P2) shown in FIG. **2**, under the force of a return spring **25** acting on the cable coupler **23**.

When the brake controller **7** is switched from the second position P2 to the first position P1, the rotary cam **18** is rotated relative to the rollers **15**. As shown in FIG. **7**, the rotary cam **18** has brake applying cam portions **18**a formed

peripherally thereof which push the rollers **15** radially outwardly of the roller case **16**. The rollers **15** pushed out apply a pressing force to the brake shoes **6**, whereby the brake shoes **6** are pressed on an inner peripheral wall of the brake ring **13** to brake the latter.

When the [broke] *brake* controller **7** is switched from the first position P1 to the second position P2, the rotary cam **18** rotates to the position shown in FIG. **7**. The rollers **15** rest in [broke] *brake* canceling recesses **18**b of the rotary cam **18** (that is, the rollers **15** are retracted into the roller ease **16**) as a result of the rotation of the rotary cam **18**, under a biasing force of the roller ease **16** produced by a return spring **26** acting on the fixed pin **22**, and by returning action of an annular shoe presser spring **27** extending [eircumferentially] *circumferentially* of and contacting all the brake shoes **6**. This cancels the braking action of the brake shoes **6** applied to the brake ring **13**.

As shown in FIG. **8**, the brake controller **7** lies in a non-use position opposed to the first and second positions P1 and P2 under the force of the return spring **25** when the brake cable **24** is not connected or when the brake cable **24** is connected but adjustment is not made yet. This non-use position is called the third position P3 in this specification. As shown in FIGS. **3** and **11**, the roller ease **16** is biased in a fixed direction by the return spring **26** acting on the fixed pin **22**.

As shown in FIG. **3**, the bush **10** has an inward end **10**c, and a stopper **10**b projecting from the other end thereof. The inward end **10**a is press fit into the brake frame **17**, whereby the bush **10** is assembled securely.

The stopper **10**b formed on the outward end of the bush **10** serves to hold the ornamental cap **20** in place. When the ornamental cap **20** is assembled to the bush **10**, the ornamental cap **20** is elastically deformed to override the stopper **10**b before fitting in place. As shown in FIGS. **12** and **13**, the ornamental cap **20** has a plurality of lugs **20**a for contacting the stopper **10**b. Thus, the ornamental cap **20** is not easily separable from the bush **10**. The waterproof cap **19** is mounted on the end of the bush **10** press fit into the brake frame **17**, and is sandwiched between the bush **10** and brake frame **17**. The return spring **25** is fitted on the bush **10** between the two caps **19** and **20**. The brake controller **7** extends through the brake frame **17** and is securely assembled to the brake frame **17** along with the caps **19** and **20**, bush **10** and return spring **25**.

As shown in FIG. **11**, the return spring **26** is engaged with the waterproof cap **19** and fixed pin **22**, so that the fixed pin **22** is not movable out of the waterproof cap **19** toward the brake frame **17**. With the fixed pin **22** not movable out of the waterproof cap **19**, the roller case **16** is assembled to the brake frame **17** along with a case stopper **16**a and waterproof cap **19**.

As shown in FIGS. **9** and **10**, the roller case **16** includes a first stopper **16**a projecting from an inner end thereof for acting on the rotary cam **18**, and second stoppers **16**b projecting from an outer end thereof for acting on the brake shoes **6**. The first stopper **16**a of the roller case **16** assembled to the brake frame **17** contacts an end of the rotary cam **18**, so that the rotary cam **18** is not movable out of the roller case **16** toward the hub **2**. The second stoppers **16**b of the roller case **16** contact ends of the brake shoes **6** to prevent the brake shoes **6** from becoming displaced from the rollers **15** toward the hub **2**.

By the contacting action of the first and second stoppers **16**a and **16**b, the brake shoes **6**, roller case **16** and rotary cam **18** remain assembled to the brake frame **17**.

According to the above construction, all the components of the main brake body **100**, such as the brake shoes **6** and brake controller **7** remain assembled together even when the brake apparatus is detached from the hub **2**.

As shown in FIGS. **7** and **8**, the shoe presser spring **27** includes stoppers **27**a for acting on the brake shoes **6**. As shown in FIG. **3**, the brake ring **13** has grease holding grooves **13**b formed in the inner peripheral wall thereof. When the brake controller **7** is shifted to the third position P**3** as shown in FIG. **8**, the rotary cam **18** moves to the position shown in FIG. **8** with the movement of brake controller **7** from the second position P**2** to the third position P**3**. In this position, ends of the brake applying cam portions **18**a of the rotary cam **18** opposite the ends thereof used in applying the braking force contact the rollers **15** to press the brake shoes **6** on the brake ring **13**. By this pressing action, the stoppers **27**a of the shoe presser spring **27** enter one of the grease holding grooves **13**b of the brake ring **13** to engage the brake ring **13**. As a result, the brake shoes **6** are securely engaged with the brake ring **13**. The viscosity of grease present in the groove **13**b also promotes adhesion to the brake ring **13** of the brake shoes **6**, which allows the brake shoes **6** to support the brake ring **13**.

Thus, the shoe presser spring **27** acts as an engaging device for allowing the brake shoes **6** to securely support the brake ring **13** when the brake controller **7** is in the first position P**1** or the third position P**3**.

With the above construction, as shown in FIGS. **4** and **5**, the brake ring **13** and main brake body **100** remain assembled together even when the brake apparatus is detached from the hub **2**. The main brake body **100** and brake ring **13** constituting the brake apparatus do not separate from each other, so that the brake apparatus may be assembled to the hub **2** in a single operation.

The foregoing embodiment may be modified with respect to the coupling device and braking device. In the foregoing embodiment, the coupling device is in the form of splines **13**a and **2**d for coupling the brake ring **13** and hub **2** to be rotatable together. The coupling device may employ other structures such as screws or caulking. The braking device may comprise a brake band and a cam as replacement for the brake shoes **6** and rollers **15**, respectively.

What is claimed is:

1. A brake apparatus for a bicycle, comprising:

a hub shaft, and means for fixedly mounting said hub shaft on a frame of said bicycle;

a hub rotatably mounted on said hub shaft;

brake shoe means disposed on said hub shaft, said brake shoe means being non-rotatable relative to said hub shaft;

a brake ring having a contact surface for contacting said brake shoe means, said brake ring being located radially outwardly of said brake shoe means with respect to said hub shaft, such that said brake shoe means is located between said brake ring and said hub shaft;

coupling means located radially between said brake ring and said hub for coupling said brake ring and said hub to be rotatable together, and preventing said brake ring from rotating relative to said hub;

restrictor means for restricting movement of said brake shoe means relative to said brake ring axially of said hub; and

brake control means for varying a radial distance of said brake shoe means from an axis of said hub shaft.

2. A brake apparatus as defined in claim **1**, further comprising unitary means for allowing installation of said brake ring, said brake shoe means and said brake control means as a unit.

3. A brake apparatus as defined in claim **2**, wherein said brake control means includes rollers for pushing said brake shoe means radially outwardly, a roller case for retaining said rollers, and a rotary cam for actuating said rollers.

4. A brake apparatus as defined in claim **3**, wherein said roller case has a first stopper for preventing said rotary cam from being separated from said roller case, and a second stopper for preventing said brake shoe means from being separated from said roller case.

5. A brake apparatus as defined in claims **4**, wherein said unitary means includes said restrictor means, said first stopper and said second stopper.

6. A brake apparatus as defined in claim **4**, wherein said first stopper and said second stopper are flanges extending radially from said roller case.

7. A brake apparatus as defined in claim **1**, wherein said coupling means includes first **[**grooves**]** *splines* extending substantially in a direction of said hub shaft and provided on an inside face of said hub, and a plurality of second **[**grooves**]** *splines* that engage said first **[**grooves**]** *splines*.

8. A brake apparatus as defined in claim **1**, wherein said restrictor means is located between said brake ring and said brake shoe means.

9. A brake apparatus as defined in claim **8**, wherein said restrictor means includes a spring for biasing said brake shoe means radially inwardly toward said hub shaft and a groove defined in said brake ring, said spring being located within said groove.

10. A brake apparatus for coupling to and use with a bicycle hub that rotates around a hub shaft, said brake apparatus comprising:

a rotatable brake ring having a contact surface and a coupling element, said coupling element having a coupling structure which allows said brake ring to couple to said bicycle hub such that said coupling element is located radially between said brake ring and said hub and such that a relative rotation of said brake ring with respect to said bicycle hub is prohibited whenever said coupling element engages said bicycle hub while allowing said brake ring to be moved axially with respect to said bicycle hub during assembly to and disassembly from said bicycle hub;

brake shoe means located radially inside said brake ring; and

a brake control mechanism for moving said at least one brake shoe into braking contact with said contact surface of said brake ring.

11. A brake apparatus as in claim 10 wherein said coupling element, brake ring, at least one brake shoe, and brake control mechanism form part of a unitary assembly which is connectable as a unit to said hub shaft and said hub of said bicycle.

12. A brake apparatus as in claim 11 further comprising a support bushing for coupling said unitary assembly to said hub shaft of said bicycle.

13. A brake apparatus as defined in claim 12, wherein said brake control mechanism includes rollers for pushing said brake shoe means radially outwardly and into contact with said brake ring, a roller case for retaining said rollers, and a rotary cam for actuating said rollers.

14. A brake apparatus as defined in claim 13, wherein said roller case has a first stopper for preventing said rotary cam from being separated from said roller case, and a second stopper for preventing said brake shoe from being separated from said roller case.

15. A brake apparatus as defined in claim 14, wherein said unitary assembly includes said first stopper and said second stopper.

16. A brake apparatus as defined in claim 14, wherein said first stopper and said second stopper are flanges extending radially from said roller case.

17. A brake apparatus as defined in claim 10 further comprising a restrictor for axially restricting movement of said brake shoe means relative to said brake ring.

18. A brake apparatus as defined in claim 21 wherein said restrictor is located between said brake ring and said brake shoe means.

19. A brake apparatus as defined in claim 18, wherein said restrictor includes a spring for biasing said brake shoe means radially inwardly and a groove defined in said brake ring, said spring being located within said groove.

20. A brake apparatus as defined in claim 10, wherein said coupling element includes a spline.

21. A brake apparatus as defined in claim 10, wherein said coupling element includes splines extending substantially in an axial direction of said brake ring which are adapted to engage with splines provided at said hub.

22. A brake apparatus for coupling to and use with a bicycle hub that rotates around a hub shaft, said brake apparatus comprising:

a rotatable brake ring having a coupling element and a contact surface normal to a radial direction, said coupling element having a coupling structure which allows said coupling element to couple to the bicycle hub such that said coupling element is located radially between said brake ring and said hub and such that a relative rotation of said brake ring with respect to said bicycle hub is prohibited while allowing said brake ring to be moved axially of said hub shaft during assembly to and disassembly from said bicycle hub;

brake shoe means located radially inside said brake ring, said brake shoe having a brake shoe surface normal to said radial direction;

a brake control mechanism for moving said brake shoe means into braking contact with said contact surface of said brake ring; and

a lock nut adapted to engage said hub shaft to prevent said brake ring from moving axially from said bicycle hub such that disengaging said nut from said hub shaft allows said brake ring, said brake shoe means and said brake control mechanism to move axially of said hub shaft.

23. A brake apparatus as defined in claim 22, wherein said coupling element includes a spline.

24. A brake apparatus as defined in claim 22 further comprising a restrictor for axially restricting movement of said brake shoe means relative to said brake ring.

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