



(11) **EP 2 703 893 A1**

(12) **EUROPEAN PATENT APPLICATION**  
published in accordance with Art. 153(4) EPC

(43) Date of publication:  
**05.03.2014 Bulletin 2014/10**

(51) Int Cl.:  
**G03G 15/00 (2006.01)**

(21) Application number: **12868927.0**

(86) International application number:  
**PCT/CN2012/086505**

(22) Date of filing: **13.12.2012**

(87) International publication number:  
**WO 2014/005403 (09.01.2014 Gazette 2014/02)**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

- **PENG, Qingfei**  
**Guangdong 519075 (CN)**
- **CAO, Jianxin**  
**Guangdong 519075 (CN)**
- **LIU, Jinlian**  
**Guangdong 519075 (CN)**

(30) Priority: **05.07.2012 CN 201210232590**

(71) Applicant: **Zhuhai Seine Technology Co., Ltd.**  
**Guangdong 519075 (CN)**

(74) Representative: **Jansen, Cornelis Marinus et al**  
**V.O.**  
**Johan de Wittlaan 7**  
**2517 JR Den Haag (NL)**

(72) Inventors:  
• **WU, Junzhong**  
**Guangdong 519075 (CN)**

(54) **PHOTOSENSITIVE DRUM DRIVING HEAD AND IMAGE FORMING DEVICE DRIVING MECHANISM**

(57) The invention relates to a photosensitive drum driving head, which comprises a drum flange, a drum shaft and a boss, wherein the drum flange is disposed on the end portion of a photosensitive drum and connected with the photosensitive drum; the drum shaft is axially extended from the end portion of the drum flange; the boss is axially extended from the end face of the drum shaft and engaged with a recess in a driving head of an image forming apparatus; three vertical convex teeth which are radially extended along the boss and engaged with power transmission portions are formed on the side

wall of the boss, perpendicular to the drum shaft, extended along an axial line of the photosensitive drum, and provided with mating surfaces which are formed by longitudinal cutting angles on end faces of the vertical convex teeth; and at least one mating surface is engaged with an edge of a twisted bevel of the recess for power transmission. The photosensitive drum driving head solves the technical problem of high accuracy requirement on the twist angles of the twisted boss and the twisted recess due to the engagement between the twisted boss and the twisted recess.

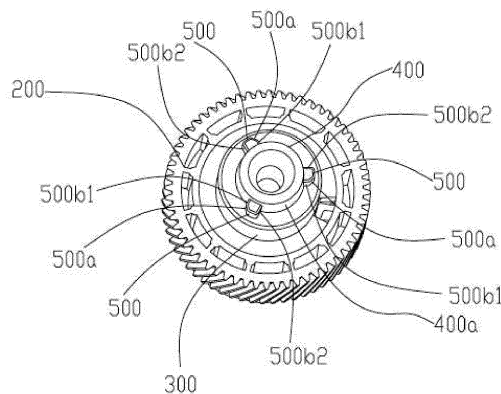


FIG. 21

**EP 2 703 893 A1**

**Description**

## FIELD OF THE TECHNOLOGY

5 **[0001]** The invention relates to a photosensitive drum driving head and a driving mechanism for an image forming apparatus.

## BACKGROUND

10 **[0002]** The traditional, image forming apparatus comprises a motor, a driving head for an image forming apparatus and a process cartridge, wherein the process cartridge is detachably mounted in the image forming apparatus and provided with a photosensitive drum and a photosensitive drum driving head fixedly connected to the end portion of the photosensitive drum. During the operation of the image forming apparatus, the power is generated by the motor and transmitted to the process cartridge via the engagement between the driving head for the image forming apparatus and the photosensitive drum driving head, so as to make the photosensitive drum on the process cartridge rotate.

15 **[0003]** As illustrated in FIGS. 1 and 2, the photosensitive drum driving head is fixedly arranged at one end of a photosensitive drum 7 and comprises a convex connection shaft 17 provided with a twisted projection 17a having an end surface 17a1; a rotation center of the convex connection shaft 17 and a rotation center of the photosensitive drum 7 are aligned; and a concave connection shaft 18 comprise a twisted recess 18a and a bottom surface 18a1 is provided on the recess 18a.

20 **[0004]** During the operation of the image forming apparatus, the driving head 18 for the image forming apparatus receives the rotary power from the motor; the convex connection shaft 17 is engaged with the driving head 18 for the image forming apparatus; and the rotary power is transmitted to the convex connection shaft 17 through the driving head 18 of the image forming apparatus and finally makes the photosensitive drum rotate. When the convex connection shaft 17 is engaged with the driving head 18 of the image forming apparatus, the twisted projection 17a on the convex connection shaft 17 is interposed into the twisted recess 18a in the driving head 18 of the image forming apparatus; the end face 17a1 is directly opposite to the bottom surface 18a2; and the rotary power on the driving head 18 of the image forming apparatus is transmitted to the convex connection shaft 17 via the engagement between the twisted projection 17a and the recess 18a.

25 **[0005]** FIGS. 3 and 4 are sectional views respectively illustrating the state when the twisted projection 17a and the twisted recess 18a do not rotate and rotate. As shown in the figures, both cross sections of the twisted projection 17a and the twisted recess 18a take the shape of triangles (such as equilateral triangles), and the dimension of the triangular projection 17a is less than that of the triangular recess 18a. As illustrated in FIG. 3, when the projection 17a is interposed into the recess 18a but does not rotate along with the recess 18a, a rotation axis X1 of the convex connection shaft on the photosensitive drum is not aligned with a rotation axis X2 of the driving head of the image forming apparatus. As illustrated in FIG. 4, when the projection 17a is engaged with the recess 18a and rotates along with the recess 18a, three vertex angles 17a2 of the triangular projection 17a are engaged with three edges of the triangle on the recess 18a, and the power is transmitted to the twisted projection 17a from the recess 18a, and the rotation axis X1 of the convex connection shaft on the photosensitive drum is aligned with the rotation axis X2 of the driving head of the image forming apparatus, so that the stable transmission between the twisted projection 17a and the twisted recess 18a during the operation can be guaranteed. In the figure, R0 refers to the diameter of a rotation circle of the three vertex angles 17a2 of the projection 17a; R1 refers to the diameter of an inscribed circle of the triangular recess 18a; and R2 refers to the diameter of a rotation circle of three vertex angles of the recess 18a. In order to achieve the power transmission between the twisted projection 17a and the recess 18a of the image forming apparatus, R0, R1 and R2 must satisfy the condition of  $R1 < R0 < R2$ .

30 **[0006]** FIG. 5 illustrates another embodiment of the prior art. In the embodiment, both the twisted projection 17a and the twisted recess 18a take the shape of quadrilaterals (such as squares) and are engaged with each other for power transmission.

35 **[0007]** In the prior art, the driving head of the image forming apparatus may also adopt the mode as illustrated in FIG. 6. As illustrated in FIG. 6, a twisted recess 28a is formed at one end of a driving head 28 of the image forming apparatus and provided with a bottom surface 28a1 and a projection 28a2 which is disposed at the center of the twisted triangular recess 28a (a rotation center of the boss is aligned with a rotation axis X2 of the driving head of the image forming apparatus). In addition, the height of the projection 28a2 is substantially the same with the depth of the recess 28a, and the projection may be conical.

40 **[0008]** The photosensitive drum with the photosensitive drum driving head is widely used in a process cartridge for the traditional image forming apparatus. The process cartridge at least comprises a photosensitive drum, a developer and a developing roller, wherein the photosensitive drum used for forming an electrostatic latent image is provided with the photosensitive drum driving head; the developer is used for developing the electrostatic latent image; and the

developing roller is used for transmitting the developer to the photosensitive drum. When the process cartridge is mounted into the image forming apparatus for use, the rotary power from the motor of the image forming apparatus is received by the driving head of the image forming apparatus, so as to make the photosensitive drum and the developing roller rotate.

**[0009]** The power transmission structure in the prior art has the defects that:

**[0010]** 1. When the twisted projection is engaged with the twisted recess, the twist angles of twisted surfaces on the projection and the recess ask for high accuracy. In the case of inconsistent twist angles of the twisted surfaces on the projection and the recess due to the problem of the manufacturing accuracy, the twisted surface on the projection makes point-to-surface contact with the twisted surface on the recess, and one of the twisted surfaces may be deformed during the engagement between the projection and the recess, so that the rotation axis X1 of the convex connection shaft on the photosensitive drum cannot be aligned with the rotation axis X2 of the driving head for the image forming apparatus, and hence the stability of power transmission may be affected. In order to avoid the above problem, the manufacturing accuracy of the twisted surfaces of the projection and the recess must be very high, and thus the manufacturing cost can be increased and the problems of difficult manufacturing and the like can be caused.

**[0011]** 2. As the polygonal shapes of the projection and the recess are difficult to process, the projection and the recess ask for high manufacturing accuracy. Taking an equilateral triangle for example, the accuracy of centers of triangles can only be guaranteed under the condition of high accuracy requirement on the equilateral triangle projection and the equilateral triangle recess, or else, the rotation axis X1 of the convex connection shaft on the photosensitive drum may be not aligned with the rotation axis X2 of the driving head for the image forming apparatus when the projection and the recess are engaged with each other, so that the instable transmission may be caused. Moreover, during the engagement between the projection and the recess, the vertex angles of the triangle on the projection, for the reason of power transmission, tend to be deformed due to the application of force and are vulnerable to wear or damage during long term operation. Furthermore, the three vertex angles of the triangle simultaneously have the functions of rotating due to the application of force and supporting and positioning during the operation, so that the centers X1 and X2 tend to be not aligned with each other during the engagement between the worn or damaged triangle and the recess, and thus the transmission stability may be affected. Therefore, in order to guarantee the accuracy and stability of transmission, the requirements on the hardness and wear resistance of materials of the triangular projection are very high. Similarly, the positions, making contact with the three vertex angles of the projection, on the edges of the triangular recess are also vulnerable to wear or damage during the operation, so that the requirements on the hardness and wear resistance of the triangular recess are also high.

## SUMMARY

**[0012]** The invention provides a photosensitive drum driving head and a driving mechanism for an image forming apparatus to solve the technical problem of high accuracy requirement on the twist angles of a twisted projection and a twisted recess of the traditional photosensitive drum driving head due to the engagement between the twisted projection and the twisted recess.

**[0013]** In order to solve the technical problem, the invention adopts the technical proposal that:

**[0014]** The invention relates to a photosensitive drum driving head, engaged with a driving head of an image forming apparatus for power transmission, the driving head of the image forming apparatus comprising a twisted recess having a triangular cross section, and a power transmission portion respectively arranged inside three vertex angles of the twisted recess and provided with a twisted bevel on the top of which an edge engaged with the photosensitive drum driving head is formed, characterized in that the photosensitive drum driving head comprises a drum flange, a drum shaft, a boss and three vertical convex teeth, wherein the drum flange is disposed on the end portion of a photosensitive drum and connected with the photosensitive drum; the drum shaft is axially extended from the end portion of the drum flange; the boss is axially extended from the end face of the drum shaft and engaged with a recess in the driving head of the image forming apparatus; the three vertical convex teeth which are radially extended along the boss and engaged with the power transmission portions are formed on the side wall of the boss, perpendicular to the drum shaft, extended along an axial line of the photosensitive drum, and provided with mating surfaces which are formed by longitudinal cutting angles of end faces of the vertical convex teeth; and at least one mating surface is engaged with the edge on the twisted bevel of the recess for power transmission.

**[0015]** The vertical convex tooth has a first side face and a second side face which are parallel to each other and perpendicular to the end face of the drum shaft.

**[0016]** The vertical convex tooth also has a first side face and a second side face, wherein the first side face is perpendicular to the end face of the drum shaft; the second side face is obliquely arranged; and the width of the vertical convex tooth is gradually increased towards the root of the vertical convex tooth along the end face of the vertical convex tooth.

**[0017]** By adoption of the technical proposal, the convex teeth, engaged with the power transmission portions, of the photosensitive drum driving head are configured to be vertical teeth. Therefore, the technical problem of high accuracy

requirement on the twist angles of the twisted boss and the twisted recess of the traditional photosensitive drum driving head due to the engagement between the twisted boss and the twisted recess can be solved.

## BRIEF DESCRIPTION OF THE DRAWINGS

5

**[0018]**

FIG. 1 is a perspective view of a photosensitive drum with a photosensitive drum driving head in the prior art.  
 FIG. 2 is a perspective view of a convex connection shaft and a concave connection shaft in the prior art.  
 FIG. 3 is a sectional view illustrating the state when a twisted projection and a twisted recess in the prior art do not rotate.  
 FIG. 4 is a sectional view illustrating the state when the twisted projection and the twisted recess in the prior art rotate.  
 FIG. 5 is a perspective view of a quadrilateral projection and a quadrilateral recess in another embodiment of the prior art.  
 FIG. 6 is a schematic diagram illustrating the state when the projection is disposed at the center of the recess in the prior art.  
 FIG. 7 is a perspective view of a driving head of an image forming apparatus.  
 FIG. 8 is a top view of the driving head of the image forming apparatus.  
 FIG. 9 is a perspective view of a photosensitive drum driving head in an embodiment 1.  
 FIG. 10 is a force diagram illustrating the assembly of the photosensitive drum driving head in the embodiment 1 and the driving head of the image forming apparatus.  
 FIG. 11 is a perspective view of a photosensitive drum driving head in an embodiment 2.  
 FIG. 12 is a front view of the photosensitive drum driving head in the embodiment 2.  
 FIG. 13 is a top view illustrating the assembly of the photosensitive drum driving head in the embodiment 2 and the driving head of the image forming apparatus.  
 FIG. 14 is a schematic diagram illustrating the assembly of the photosensitive drum driving head in the embodiment 2 and the driving head of the image forming apparatus.  
 FIG. 15 is a force diagram illustrating the state after the engagement between the photosensitive drum driving head in the embodiment 2 and the driving head of the image forming apparatus.  
 FIG. 16 is a perspective view of a photosensitive drum driving head in an embodiment 3.  
 FIG. 17 is a perspective view of a photosensitive drum driving head in an embodiment 4.  
 FIG. 18 is a partial enlarged view of a boss for the invention.  
 FIG. 19 is a front view of FIG. 18 along the B direction.  
 FIG. 20 is a top view of the boss for the invention.  
 FIG. 21 is a perspective view of a photosensitive drum driving head in an embodiment 5.  
 FIG. 22 is a top view of the photosensitive drum driving head in the embodiment 5.  
 FIG. 23 is a top view illustrating the assembly of the photosensitive drum driving head in the embodiment 5 and the driving head of the image forming apparatus.  
 FIG. 24(a) is a right view illustrating the assembly of the photosensitive drum driving head in the embodiment 5 and the driving head of the image forming apparatus.  
 FIG. 24(b) is a sectional view of FIG. 24(a) along the C direction.  
 FIG. 25 is a sectional view of FIG. 23 along the A direction.  
 FIG. 26 is a sectional view of FIG. 23 along the B direction.  
 FIG. 27 is a partial structural perspective view of the photosensitive drum driving head, adopting end faces of convex teeth of positioning, in the embodiment 5.  
 FIG. 28 is a perspective view of a photosensitive drum driving head in an embodiment 6.  
 FIG. 29 is a right view of FIG. 28.  
 FIG. 30 is a partial structural perspective view of the photosensitive drum driving head, adopting end faces of convex teeth for positioning, in the embodiment 6.  
 FIG. 31 is a schematic diagram illustrating the state when the vertical convex teeth in the embodiment 6 are connected with each other through a cambered surface.  
 FIG. 32 is a partial structural perspective view of the photosensitive drum driving head provided with non-run portions in the embodiment 6.  
 FIG. 33 is a sectional view illustrating the internal structure after the engagement between the driving head of the image forming apparatus and the photosensitive drum driving head provided with the non-run portions in the embodiment 6.

DETAILED DESCRIPTION

Embodiment 1

5 **[0019]** FIGS. 7 and 8 are respectively a perspective view and a top view of a driving head of an image forming apparatus. As shown in the figures, the driving head 20 of the image forming apparatus comprises a recess 11, power transmission portions 11a and retainer portions 11b, wherein the recess 11 has an equilateral triangle cross section; the power transmission portions 11a are arranged at three vertex angles of the triangle and have twisted structures; the retainer portions 11b are disposed on three edges of the triangle; and the power transmission portions 11a are provided with twisted bevels 11a1 and guide bevels 11a2. As shown in the top view of FIG. 7, the twisted bevels 11a1 are invisible; the included angle between the twisted bevels 11a1 and a bottom surface of the recess is less than 90 DEG; edges 11a3 are formed on the top of the twisted bevels 11a1; the guide bevels 11a2 are visible; and the included angle between the guide bevels 11a2 and the bottom surface of the recess is more than 90 DEG. Moreover, the driving head of the image forming apparatus is connected with a motor in the image forming apparatus to transmit power.

15 **[0020]** The driving head 20 of the image forming apparatus is the same with that the driving head of the image forming apparatus in the prior art.

**[0021]** FIG. 9 is a perspective view of a photosensitive drum driving head in the embodiment 1. As shown in the figure, the photosensitive drum driving head comprises a drum flange 2, a drum shaft 3 and a boss 4, wherein the drum flange 2 is disposed on the end portion of a photosensitive drum 1, connected with the photosensitive drum 1 and used for transmitting the received power to the photosensitive drum 1; the drum shaft 3 is axially extended from the end portion of the drum flange 2 and used for rotationally supporting the photosensitive drum 1 during the operation of a process cartridge; the boss 4 is axially extended from the end face of the drum shaft 3 and used for receiving the power from the driving head 20 of the image forming apparatus; and a first convex teeth 5a radially extended along the boss 4 is formed on a side wall 4b of the boss 4. More specifically, the first convex tooth 5a is obliquely formed on the side wall 4b of the boss.

25 **[0022]** During the power transmission, the first convex tooth 5a on the boss 4 of the photosensitive drum driving head is engaged with any power transmission portion 11a for power transmission. Moreover, the side wall 4b of the boss of the photosensitive drum driving head is tangential to and engaged with the retainer portions 11b of the recess of the driving head of the image forming apparatus at three tangential points P1, P2 and P3, so that the center alignment between the photosensitive drum driving head and the driving head 20 of the image forming apparatus during the power transmission can be achieved.

30 **[0023]** FIG. 10 is a force diagram illustrating the assembly of the photosensitive drum driving head and the driving head of the image forming apparatus. "A" refers to the rotation direction of the driving head for the image forming apparatus; F11 refers to the force applied to the first convex tooth 5a by the driving head of the image forming apparatus and is resolved into a normal force F12 and a radial force F14; F15 refers to the force applied to the driving head for the image forming apparatus at the tangential point P1; F13 refers to the force applied to the driving head for the image forming apparatus at the tangential point P2; and no force is applied at the tangential point P3. In summary, the following force formulas can be obtained:

40

$$\begin{cases} F13 = F14 + F15 \cdot \sin 30^\circ \\ F12 = F15 \cdot \sin 60^\circ \\ F12 = \sqrt{3} \cdot F14 \end{cases}$$

45

50 **[0024]** Hence,  $F13=2 \cdot F14$  and  $F15 = \frac{2\sqrt{3}}{3} F12$ . That is to say, the force of  $\frac{2\sqrt{3}}{3} F12$  is applied to the driving head of the image forming apparatus or the photosensitive drum driving head at the tangential point P1, and the force of  $2 \cdot F14$  is applied to the driving head of the image forming apparatus or the photosensitive drum driving head at the tangential point P2.

55 **[0025]** Due to mutual wear between the photosensitive drum driving head and the driving head of the image forming apparatus during the engagement and power transmission, in the proposal, the convex teeth, engaged with the power transmission portions, and a cylindrical surface of a boss, taken as a positioning portion, of the photosensitive drum driving head, are disposed at different positions, so that the functions of power transmission and positioning cannot be

affected by each other due to wear.

## Embodiment 2

5 **[0026]** FIGS. 11 and 12 are respectively a perspective view and a front view of a photosensitive drum driving head in the embodiment, and FIG. 13 is a top view illustrating the assembly of the photosensitive drum driving head in the embodiment and a driving head of an image forming apparatus. The driving head for the image forming apparatus in the embodiment adopts the driving head for the image forming apparatus in the embodiment 1 and will not be described further. As shown in the figures, the photosensitive drum driving head comprises a drum flange 2, a drum shaft 3 and a cylindrical boss 4, wherein the drum flange 2 is fixedly connected to the end portion of a photosensitive drum 1; the drum shaft 3 is axially extended from the end portion of the drum flange 2 and used for rotationally supporting the photosensitive drum 1 during the operation of a process cartridge; the cylindrical boss 4 is axially extended from the end face of the drum shaft 3 and used for receiving power from the driving head 20 of the image forming apparatus; and a pair of convex teeth 4a, which are radially extended along the cylindrical boss 4 and engaged with any two power transmission portions in the driving head of the image forming apparatus, are formed on a side wall 4b of the cylindrical boss 4. More specifically, the convex teeth 4a are obliquely formed on the side wall 4b of the cylindrical boss 4. In addition, the convex teeth 4a are provided with mating surfaces 4a1, and the area of the mating surfaces 4a1 is between 5 and 20 mm<sup>2</sup> and preferably between 7 and 16 mm<sup>2</sup>. During the power transmission, the mating surfaces 4a1 are engaged with inner walls of the power transmission portions in the driving head of the image forming apparatus to transmit power. By arrangement of the mating surfaces 4a1 on the convex teeth 4a, the wear between the photosensitive drum driving head and the driving head of the image forming apparatus can be reduced. The included angle  $\beta$  between the convex teeth 4a and a rotation axis of the photosensitive drum driving head is between 3 and 40 degrees and preferably between 25 and 30 degrees, so that smooth engagement between the photosensitive drum driving head and the driving head of the image forming apparatus can be guaranteed and meanwhile the phenomenon that the photosensitive drum driving head is disengaged from the driving head of the image forming apparatus during the power transmission can be prevented, and thus the stable power transmission between the driving head of the image forming apparatus and the photosensitive drum driving head can be achieved. L1 refers to the length of the convex teeth 4a beginning from the side wall 4b along the radial direction and is between 2 and 5 mm and preferably between 2.3 and 3.3 mm, so that guarantee is made that the photosensitive drum driving head has sufficient moment for power transmission. The minimum included angle  $\alpha$  between the two convex teeth 4a has a standard angle of 120 degrees, and the upper limit angle tolerance is generally within 2 degrees. In the proposal, the convex teeth 4a are allowed to have the manufacturing accuracy error  $\theta$ , which is between 2 and 10 degrees and preferably between 2 and 4 degrees. If  $\theta$  refers to angular error, the minimum included angle  $\alpha$  between the two convex teeth 4a is converted into  $\alpha+\theta$ . At this point, the two convex teeth 4a may not be engaged with the power transmission portions 11a of the recess 11 at the same time, and the convex tooth disposed on the upmost upstream of the rotation direction is engaged with the power transmission portion on the driving head of the image forming apparatus first and has the function of buffering. If the convex teeth 4a have the manufacturing error of  $\theta$  along the downstream of the rotation direction, a graded mating surface may be formed on each convex tooth and has the function of buffering the convex tooth 4a during the engagement between the convex tooth 4a and the power transmission portion 11a of the recess, and hence the damage between the driving head of the image forming apparatus and the photosensitive drum driving head can be reduced. In addition, a boss cylindrical surface between the two convex teeth 4a makes contact with the retainer portions 11b of the driving head of the image forming apparatus to achieve the positioning of the photosensitive drum driving head. Moreover, round angles are also formed at joints of the convex teeth 4a and the boss cylindrical surface to reduce stress concentration. Furthermore, the drum flange 2, the drum shaft 2, the cylindrical boss 4 and the convex teeth 4a of the photosensitive drum driving head may be integrally formed by the same material and may also have buffer structures, and the drum flange 2 may also be provided with a drum gear 2a used for transmitting the power to other elements (such as a developing element).

10 **[0027]** FIG. 14 is a schematic diagram illustrating the assembly of the photosensitive drum driving head and the driving head of the image forming apparatus, and FIG. 15 is a force diagram illustrating the state after the engagement of the driving head of the image forming apparatus and the photosensitive drum driving head. As shown in the figures, the photosensitive drum driving head is tangential to and engaged with the retainer portions 11b of the recess of the driving head for the image forming apparatus at three tangential points P4, P5 and P6. "A" refers to the rotation direction of the driving head for the image forming apparatus; forces F24 and F56 which are the same with each other are applied to the photosensitive drum driving head by the driving head of the image forming apparatus; when the torsional moment born by the photosensitive drum driving head is twice that in the embodiment 1, F24 and F56 are the same with F11 in the embodiment 1; F24 is resolved into a normal force F2 and a radial force F4; F56 is resolved into a normal force F5 and a radial force F6; F2 and F5 are the same with F12 in the embodiment 1; and F4 and F6 are the same with F14 in the prior art. Supposing that is the force applied to the driving head of the image forming apparatus at the tangential

point P5, F3 is the force applied to the driving head of the image forming apparatus at the tangential point P6, and no force is applied at the tangential point P4, the following force formulas can be obtained:

5  
10

$$\begin{cases} F1 + F6 \cdot \sin 30^\circ = F4 + F5 \cdot \sin 60^\circ + F3 \cdot \sin 30^\circ \\ F2 + F3 \cdot \sin 60^\circ = F6 \cdot \sin 60^\circ + F5 \cdot \sin 30^\circ \\ F2 = F5 = \sqrt{3}F4 = \sqrt{3}F6 \end{cases}$$

[0028] Hence, F1=2 • F4 and F3=0. That is to say, the force of 2 • F4 is applied to the driving head of the image forming apparatus and the photosensitive drum driving head at P5 and the force of 0 is applied to the driving head for the image forming apparatus and the photosensitive drum driving head at P6. Compared with the embodiment 1, the number of the force points of the proposal is reduced, so that the wear of the driving head of the image forming apparatus and the photosensitive drum driving head at the tangential points P5 and P6 can be reduced, and thus the positioning stability of the photosensitive drum driving head can be improved, and consequently more stable power transmission can be achieved.

[0029] The invention relates to a driving mechanism of the image forming apparatus, which comprises the photosensitive drum driving head in the embodiment and the driving head 20 for the image forming apparatus in the prior art. The driving head 20 of the image forming apparatus comprises a recess 11, power transmission portions 11a and retainer portions 11b, wherein the recess 11 is provided with an equilateral triangle cross section; the power transmission portions 11a are arranged at three vertex angles of the triangle and have twisted structures; and the retainer portions 11b are disposed on three edges of the triangle. In addition, the driving head of the image forming apparatus is connected with a motor in the image forming apparatus for power transmission.

Embodiment 3

[0030] It is obvious to those skilled in the art that if in the two convex teeth, one is an oblique tooth and the other is a vertical tooth, the same technical effect can be also achieved. FIG. 16 is a perspective view of a photosensitive drum driving head in the embodiment. As shown in the figure, the oblique tooth 4a is obliquely formed on a side wall 4b of a boss and the vertical tooth 4c is vertically formed on the side wall 4b.

Embodiment 4

[0031] When the rotation speed of an image forming apparatus is low and the torsional moment of a driving head of the image forming apparatus is small, both convex teeth of a photosensitive drum driving head may be configured to be vertical teeth. As illustrated in FIG. 17 which is a perspective view of the photosensitive drum driving head in the embodiment, 4d refers to the convex teeth of the photosensitive drum driving head. In the embodiment, the manufacturing accuracy of the photosensitive drum driving head is further reduced.

[0032] In the invention, the convex teeth 4a in the embodiment are also provided with mating surfaces 4a1, and the area of the mating surfaces 4a1 is between 5 and 20 mm<sup>2</sup> and preferably between 7 and 16 mm<sup>2</sup>. During the power transmission, the mating surfaces 4a1 are engaged with inner walls of power transmission portions in the driving head of the image forming apparatus to transmit power. By arrangement of the mating surfaces 4a1 on the convex teeth 4a, the wear between the photosensitive drum driving head and the driving head of the image forming apparatus can be reduced. Moreover, each convex tooth is also provided with a vertex angle 4a4 and two parallel planes 4a2 and 4a3 connected with a side wall of the convex tooth. In addition, the included angle between the planes 4a2 and 4a3 and an axial line of a photosensitive drum is β. Furthermore, the mating surfaces are also provided with straight edges s1 and s2 and bevel edges s3, wherein the straight edges s1 and s2 are parallel to each other; the included angle φ between the bevel edges s3 and the axial line of the photosensitive drum is between 5 and 50 degrees and preferably between 10 and 40 degrees; and the included angle γ between the straight edges s1 and connecting lines from the center of the photosensitive drum driving head to the vertex angles 4a4 of the convex teeth is between 0 and 90 degrees and preferably between 25 and 45 degrees. As illustrated in FIGS. 18 to 20, the "B" direction as shown in FIG. 18 is parallel to the radial extension direction of a boss.

[0033] It is apparent to those skilled in the art from the invention that: the convex teeth may also be configured to be three symmetrical convex teeth; the three convex teeth may be all configured to be oblique convex teeth, or all configured to be vertical convex teeth, or with one configured to be an oblique convex tooth and the other two configured to be

vertical convex teeth, or with one configured to be a vertical convex tooth and the other two configured to be oblique convex teeth; and the same technical effect can be also achieved. The oblique convex tooth refers to that the convex tooth is obliquely formed on the side wall of the boss, and the vertical convex tooth refers to that the convex tooth is vertically formed on the side wall of the boss.

**[0034]** Moreover, it is apparent to those skilled in the art from the invention that the side wall of the boss and the cylindrical surface of the boss are the same component.

#### Embodiment 5

**[0035]** A driving head of an image forming apparatus in the embodiment is the same with that in the above embodiment.

**[0036]** FIGS. 21 and 22 are respectively a perspective view and a top view of a photosensitive drum driving head in the embodiment. The photosensitive drum driving head comprises a drum flange 200, a drum shaft 300, a cylindrical boss 400 and three vertical convex teeth 500, wherein the drum flange 200 is fixedly connected to the end portion of a photosensitive drum 1; the drum shaft 300 is axially extended from the end portion of the drum flange 200 and used for rotationally supporting the photosensitive drum 1 during the operation of a process cartridge; the cylindrical boss 400 is axially extended from the end face of the drum shaft 300 and used for receiving power from the driving head 20 of the image forming apparatus; the three vertical convex teeth 500, which are radially extended along the cylindrical boss 400 and engaged with the power transmission portions 11a of the driving head for the image forming apparatus, are formed on a side wall 400a of the cylindrical boss 400; the included angle between the vertical convex teeth 500 and an axial line of the photosensitive drum is 0 degree; and the extending length of the cylindrical boss 400 along the axial direction of the photosensitive drum is more than the extending length of the vertical convex teeth 500 along the axial direction of the photosensitive drum.

**[0037]** FIG. 23 is a top view illustrating the assembly of the photosensitive drum driving head and the driving head of the image forming apparatus; FIG. 24(a) is a right view illustrating the assembly of the photosensitive drum driving head and the driving head of the image forming apparatus; FIG. 24(b) is a sectional view of FIG. 24(a) along the C direction; and FIGS. 25 and 26 are respectively a sectional view of FIG. 23 along the A direction and the B direction. As shown in the figures, each vertical convex tooth 500 has a mating surface 500a, a first side face 500b1 and a second side face 500b2, wherein the first side face 500b1 and the second side face 500b2 are parallel to each other, perpendicular to the end face of the drum shaft 300 and parallel to the axial line of the photosensitive drum; the mating surface 500a is perpendicular to the end face of the drum shaft 300 and parallel to the axial line of the photosensitive drum; the chamfer angle  $\gamma$  between the mating surface 500a and the first side face 500b1 is matched with the obliqueness of the twisted bevel 11a1 in the recess 11, so as to increase the contact area when the mating surface 500a is engaged with the twisted bevel 11a1 for power transmission. The chamfer angle  $\gamma$  is between 0 and 90 degrees and preferably between 20 and 45 degrees, as illustrated in FIGS. 21 and 22. When the vertical convex teeth 500 are engaged with the driving head 20 of the image forming apparatus to transmit the power, the roots of the vertical convex teeth 500 are engaged with edges 11a3 (as illustrated in FIGS. 7 and 8) of the twisted bevels 11a1, namely one line on each mating surface 500a is engaged with the edge 11a3 (as illustrated in FIGS. 7 and 8) for power transmission. The area of the mating surfaces 500a is between 2 and 20 mm<sup>2</sup> and preferably between 3 and 10 mm<sup>2</sup>, as illustrated in FIGS. 23 and 26. In order to be interposed into the recess 11 more easily, the boss 400 is configured to be conical, namely the outside diameter d1 of a cross-section circle on the end portion of the boss is less than the outside diameter d2 of a cross-section circle at the tail of the boss, as illustrated in FIG. 25. As illustrated in FIG. 26, as the internal structure of the driving head 20 of the image forming apparatus is twisted along a specified direction and the twisted bevels 11a1 and the guide bevels 11a2 (as illustrated in FIGS. 7 and 8) in the recess 11 are oblique, the width W of the convex teeth 500 interposed into the recess is inversely proportional to the height L of the convex teeth 500, i.e., the greater the width, the smaller the height; the width W of the convex teeth 500 is directionally proportional to the intensity of the convex teeth 500, i.e., the greater the width, the higher the intensity, the smaller the height, and the convex teeth can be more easily disengaged from the recess. The height L is between 1.0 and 8.0 mm and preferably between 2.0 and 4.0 mm, and the width W is between 1.0 and 5.0 mm and preferably between 1.5 and 4.0 mm, so that not only the intensity requirement during the power transmission is met but also a guarantee is made that the convex teeth 500 be not easily disengaged from the recess.

**[0038]** In the embodiment, as illustrated in FIG. 25, the axial positioning between the photosensitive drum driving head and the driving head for the image forming apparatus may be via the contact between the end face of the boss 400 and the bottom surface of the recess 11, and may also be via the contact between end faces of the convex teeth 500 and the guide bevels 11a2 in the recess 11 (as illustrated in FIGS. 7 and 8). FIG. 27 is a partial structural perspective view of the photosensitive drum driving head adopting the end faces of the convex teeth for positioning. As shown in the figure, the extending length of the cylindrical boss 400 along the axial direction of the photosensitive drum is less than the extending length of the vertical convex teeth 500 along the axial direction of the photosensitive drum.

**[0039]** The mating surfaces are formed by longitudinal cutting angles on the end faces of the vertical convex teeth,

and the longitudinal direction of the vertical convex teeth is parallel to the axial direction of the photosensitive drum.

**[0040]** The roots of the vertical convex teeth are the parts of the vertical convex teeth connected with the end portion of the drum shaft.

5 Embodiment 6

**[0041]** FIG. 28 is a perspective view of a photosensitive drum driving head in the embodiment, and FIG. 29 is a right view of FIG. 28. As shown in the figures, the differences between the photosensitive drum driving head in the embodiment and the photosensitive drum driving head in the embodiment 5 are as follows: a second side face 500b2 of each vertical convex tooth is configured to a graded bevel gradually varied towards the root of the vertical convex tooth along an end portion 500b3 of the vertical convex tooth, and other structures are consistent; and the included angle  $\omega$  between the second side face 500b2 and a first side face 500b1 is between 3 and 45 degrees and preferably between 20 and 30 degrees. In the embodiment 5, as the width W of the convex teeth 500 interposed into the recess 11 is inversely proportional to the height L of the convex teeth 500 interposed into the recess 11, the photosensitive drum driving head has the technical problems that: the greater the width W, the higher the intensity of the convex teeth, the smaller the width L, and the convex teeth are more easily to be disengaged from the recess; and in reverse, the smaller the width W, the lower the intensity of the convex teeth, the greater the height L, and the convex teeth are more uneasily to be disengaged from the recess. Moreover, as the roots of the vertical convex teeth 500 are engaged with the edges 11a3 of the twisted bevels 11a1 in the recess 11 for power transmission (as illustrated in FIG. 26), the intensity requirement on the roots of the vertical convex teeth 500 is high. By adoption of the structure of the second side face 500b2 in the embodiment, the above problems can be solved. The reasons are as follows: as the second side face 500b2 is a graded bevel gradually varied towards the root of each vertical convex tooth along the end portion of the vertical convex tooth, namely the width of the end portion of the vertical convex tooth 500 is less than the width of the root, the height of the vertical convex tooth interposed into the recess 11 can be increased by the reduction of the width of the end portion of the vertical convex tooth 500, and hence the convex tooth cannot be easily disengaged from the recess; and the intensity of the root can be increased by the increase of the width of the root, so that not only the condition of the height of the vertical convex tooth interposed into the recess can be satisfied but also the intensity of the root of the vertical convex tooth can be increased.

**[0042]** In the embodiment, the axial positioning between the photosensitive drum driving head and the driving head for the image forming apparatus may be via the contact between the end face of a boss 400 and the bottom surface of the recess 11 and may also be via the contact between end portions 500b3 of the vertical convex teeth 500 and the bottom surface of the recess 11 (as illustrated in FIGS. 7 and 8), as illustrated in FIG. 30 which is a partial structural perspective view of the photosensitive drum driving head adopting the end faces of the convex teeth for positioning. As shown in the figure, the extending length of the cylindrical boss 400 along the axial direction of a photosensitive drum is less than the extending length of the vertical convex teeth 500 along the axial direction of the photosensitive drum. FIG. 31 is a schematic diagram illustrating the state when the vertical convex teeth are connected with each other through a cambered surface. As shown in the figure, the end face of the boss 400 among the vertical convex teeth 500 is a cambered surface which is recessed towards the drum shaft, namely the three vertical convex teeth 500 are connected with each other through the cambered surface. Therefore, the stress concentration at joints of the boss and the vertical convex teeth can be reduced, and thus the phenomenon of fracture at the joints of the boss and the vertical convex teeth when the force is applied to the vertical convex teeth can be prevented.

**[0043]** FIGS. 32 and 33 are respectively a partial structural perspective view of the photosensitive drum driving head with non-run portions and a sectional view illustrating the internal structure after the engagement between the photosensitive drum driving head with the non-run portions and the driving head for the image forming apparatus. In order to further solve the problem that the vertical convex teeth can be easily disengaged from the recess, the non-run portions 500a2 are formed on mating surfaces 500a adjacent to the end faces of the vertical convex teeth. As shown in the figure, the non-run portions 500a2 are perpendicular to the mating surfaces 500a and extend outwards and are configured to be cambered or semispherical bodies extending outwards from the top of the mating surfaces 500a. When the photosensitive drum driving head is engaged with the driving head for the image forming apparatus to transmit power, the non-run portions 500a2 may be engaged with the twisted bevels 11a1 in the recess 11. If the photosensitive drum driving head tends to the disengaged along the axial direction, the non-run portions 500a2 may abut against the twisted bevels 11a1 in the recess 11, so that the tension in the axial direction can be produced between the photosensitive drum driving head and the driving head for the image forming apparatus to prevent the photosensitive drum driving head from being disengaged from the driving head for the image forming apparatus.

55

Claims

- 5
- 10
- 15
- 20
- 25
- 30
- 35
- 40
- 45
- 50
- 55
1. A photosensitive drum driving head, engaged with a driving head of an image forming apparatus for power transmission, the driving head of the image forming apparatus comprising a twisted recess and power transmission portions provided with twisted bevels having edges engaged with the photosensitive drum driving head, wherein the photosensitive drum driving head comprising a drum flange, a drum shaft and a boss; the drum flange disposed on the end portion of a photosensitive drum and connected with the photosensitive drum; the drum shaft axially extended from the end portion of the drum flange; the boss axially extended from the end face of the drum shaft and engaged with the twisted recess; and three vertical convex teeth, radially extended along the boss and engaged with the power transmission portions, formed on the side wall of the boss.
  2. The photosensitive drum driving head according to claim 1, wherein the vertical convex teeth are perpendicular to the drum shaft and extended along an axial line of the photosensitive drum.
  3. The photosensitive drum driving head according to claim 2, wherein the vertical convex teeth are provided with mating surfaces formed by longitudinal cutting angles on end faces of the vertical convex teeth, and at least one mating surface is engaged with an edge of the twisted bevel of the recess for power transmission.
  4. The photosensitive drum driving head according to claim 2, wherein the roots of the vertical convex teeth are engaged with the edges of the twisted bevels of the recess for power transmission.
  5. The photosensitive drum driving head according to claim 2, wherein each vertical convex tooth also has a first side face and a second side face which are parallel to each other and perpendicular to the end face of the drum shaft.
  6. The photosensitive drum driving head according to claim 2, wherein each vertical convex tooth also has a first side face and a second side face; the first side face is perpendicular to the end face of the drum shaft; the second side face is obliquely arranged; and the width of the vertical convex tooth is gradually increased towards the root of the vertical convex tooth along the end face of the vertical convex tooth.

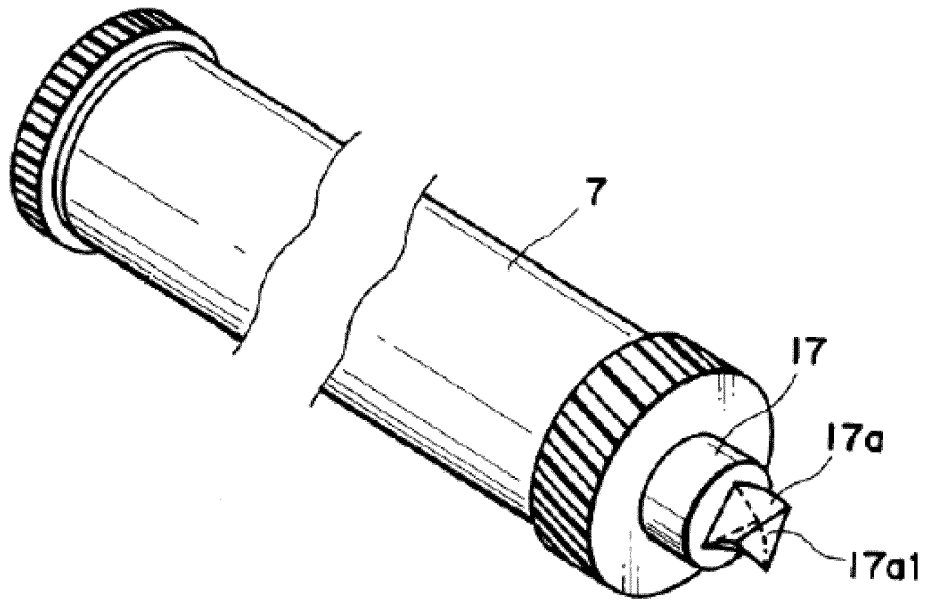


FIG. 1

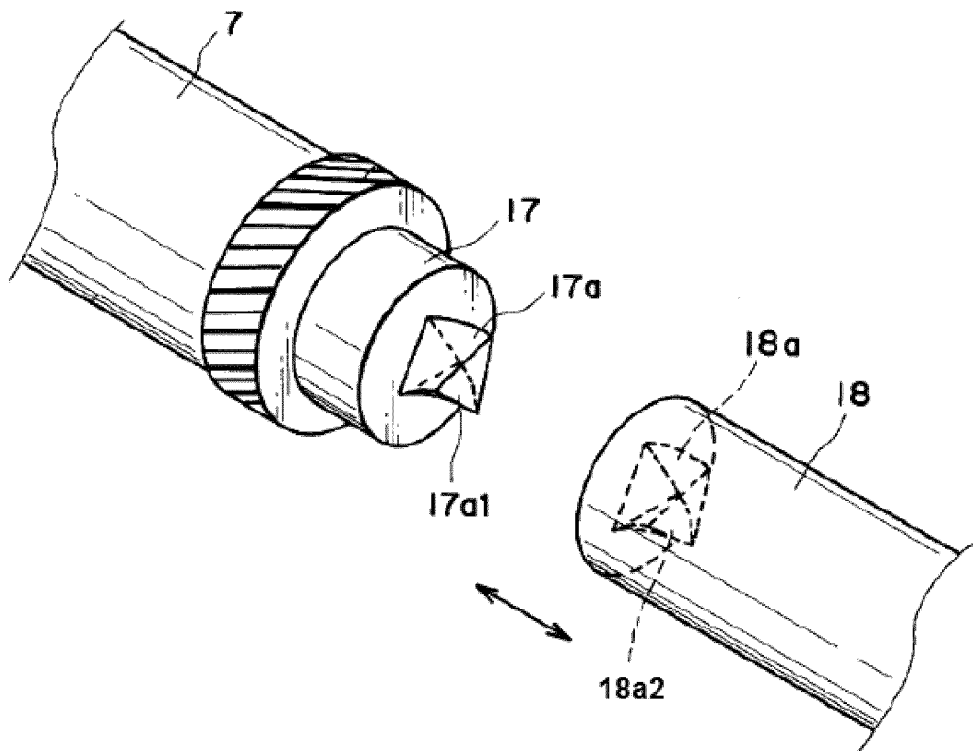


FIG. 2

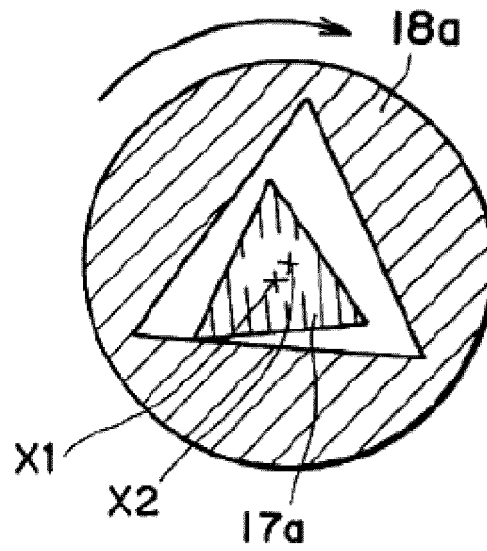


FIG. 3

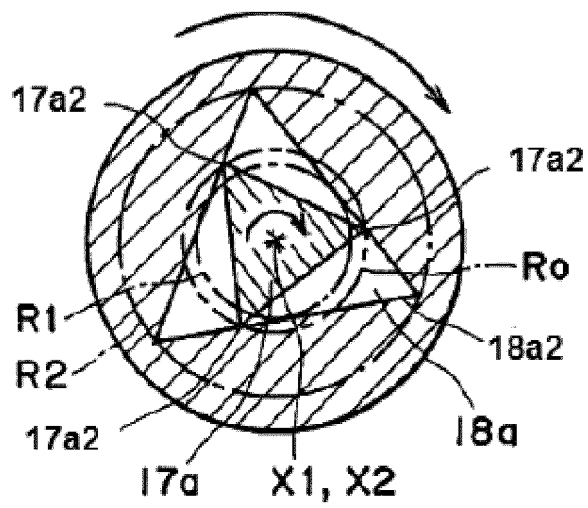


FIG. 4

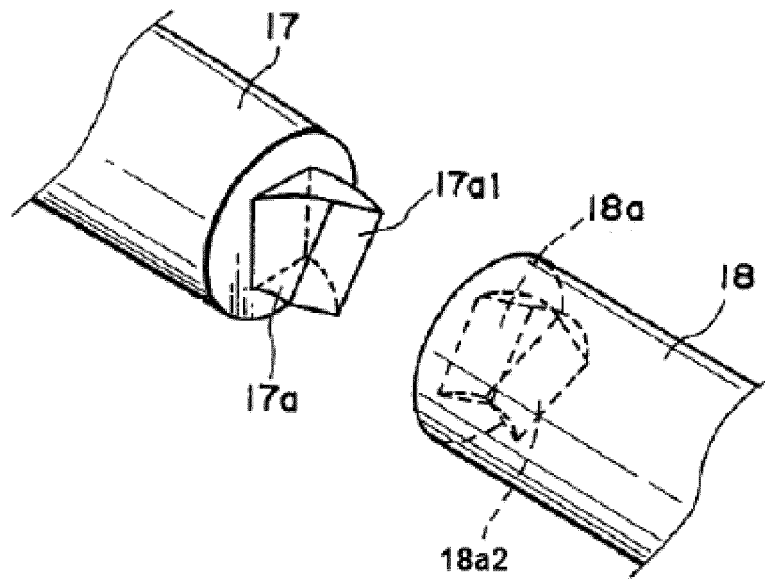


FIG. 5

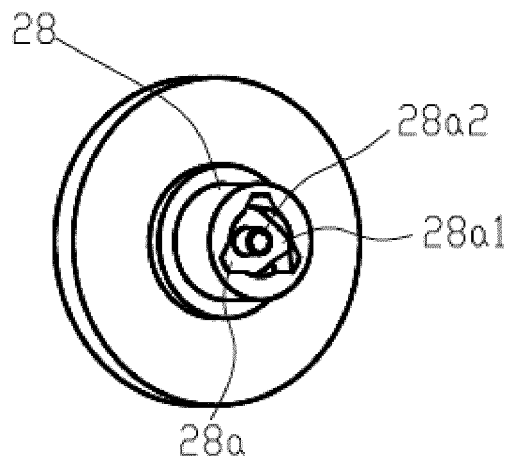


FIG. 6

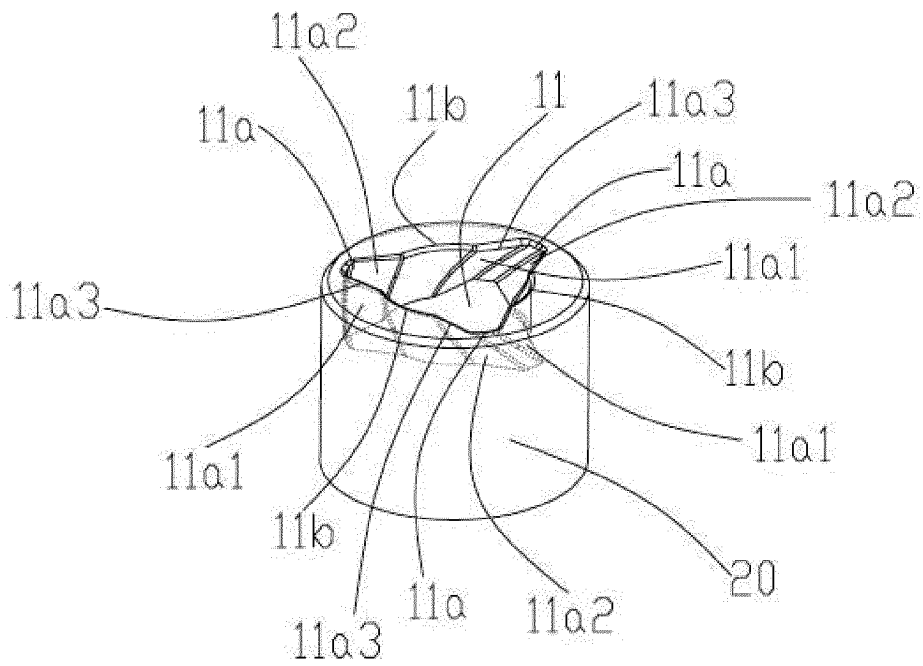
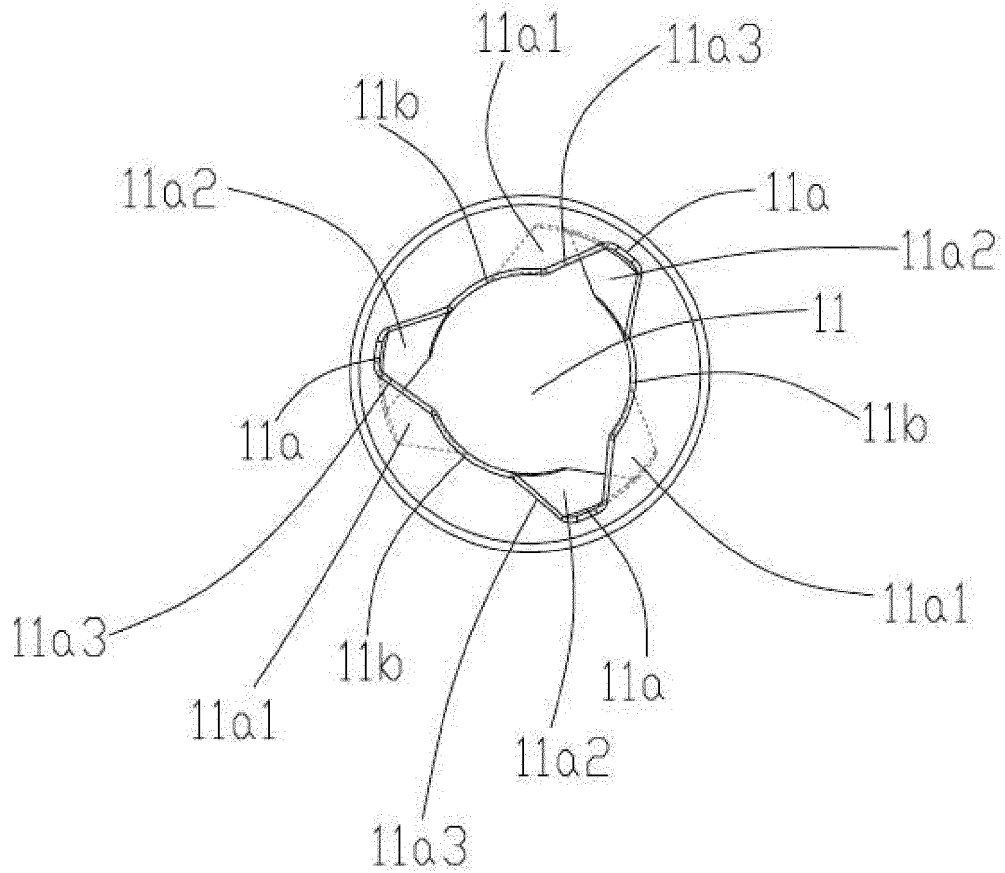


FIG. 7





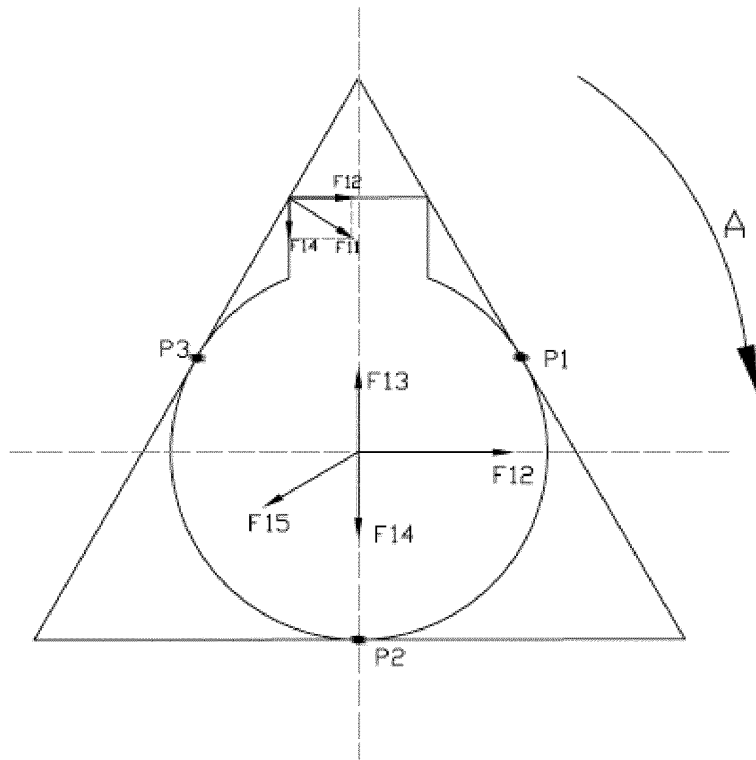


FIG. 10

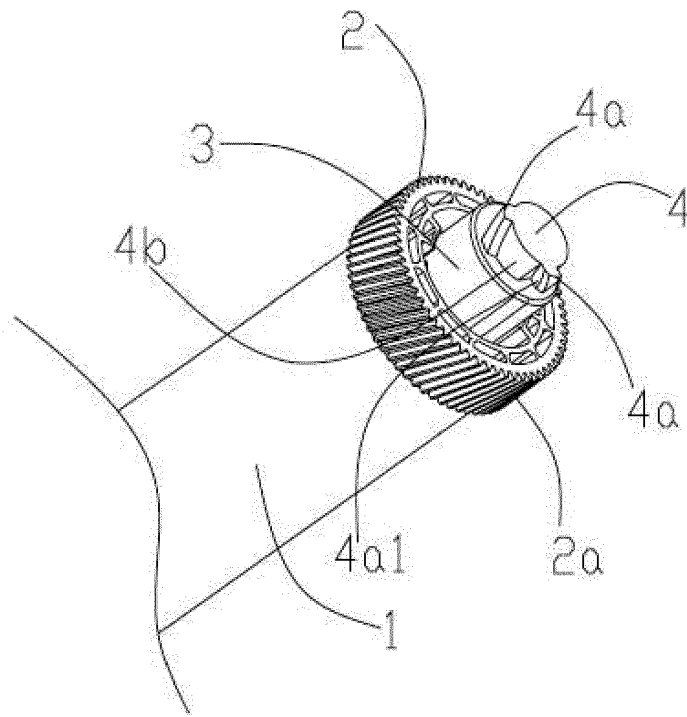


FIG. 11

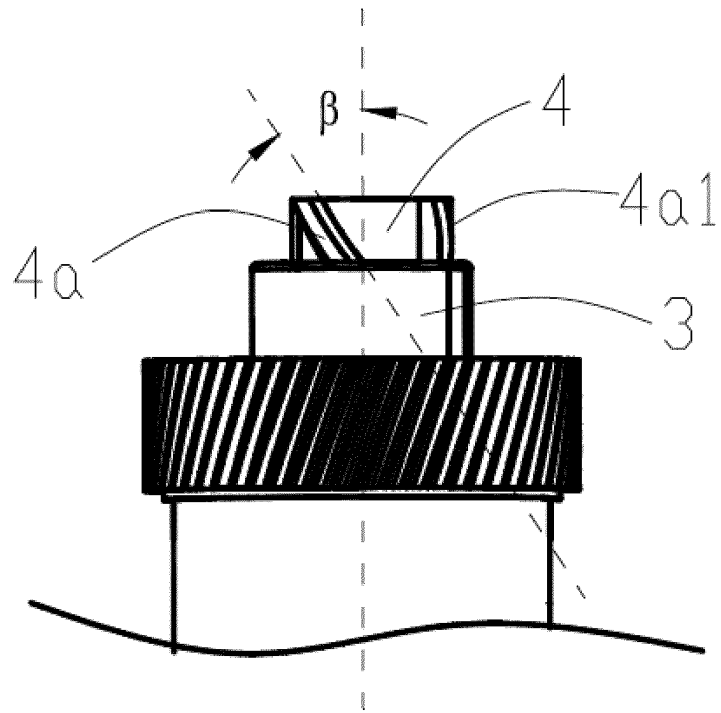


FIG. 12

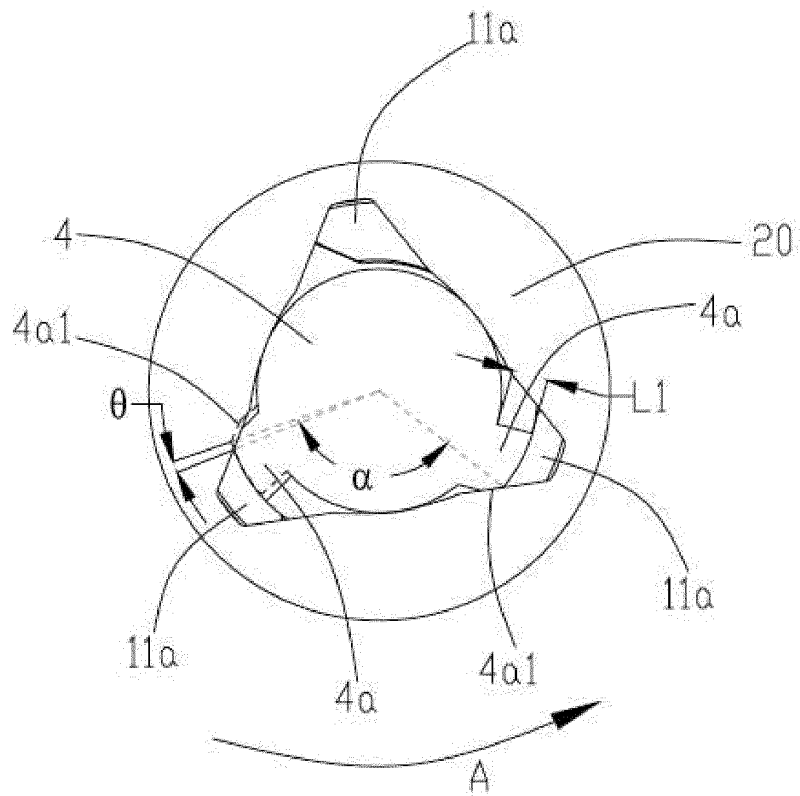


FIG. 13

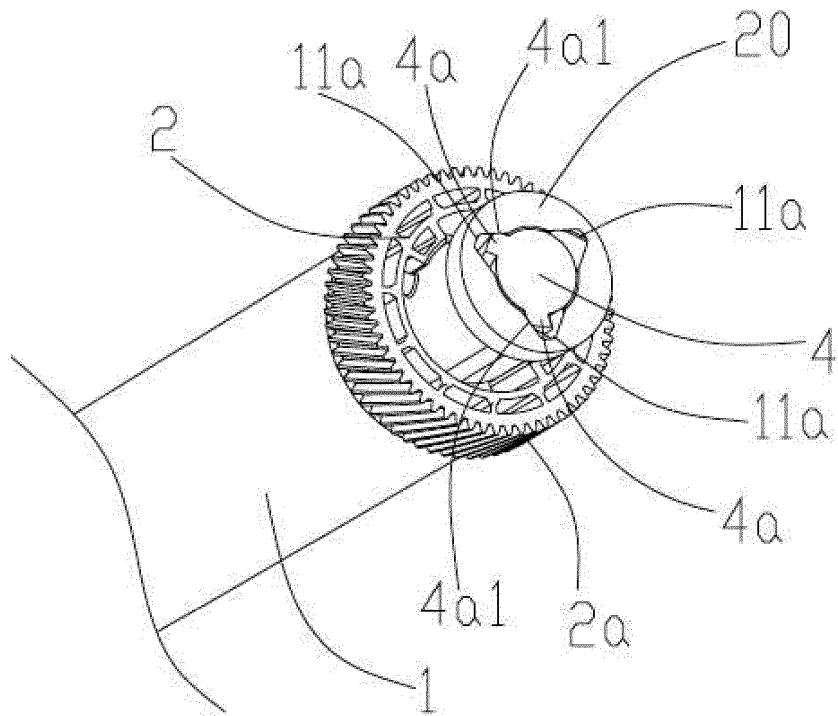


FIG. 14

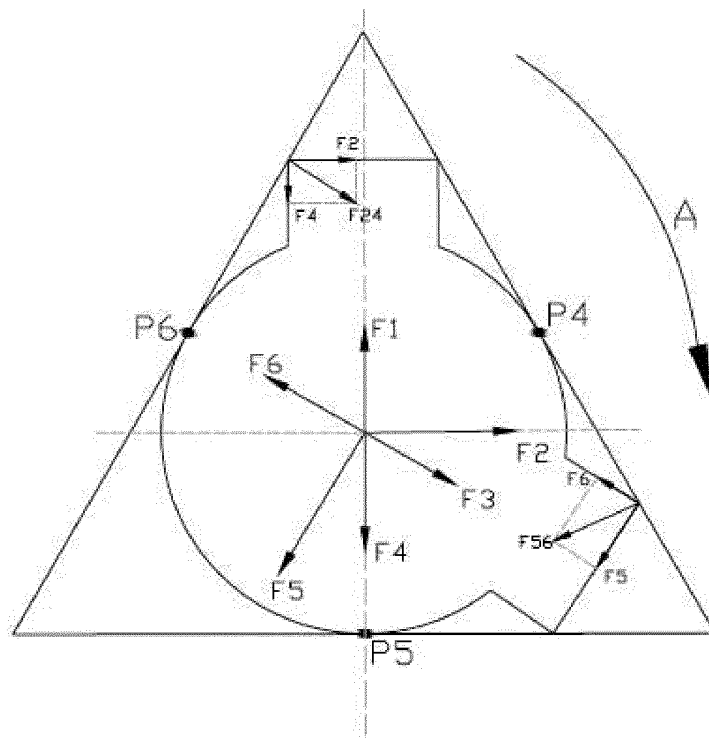


FIG. 15

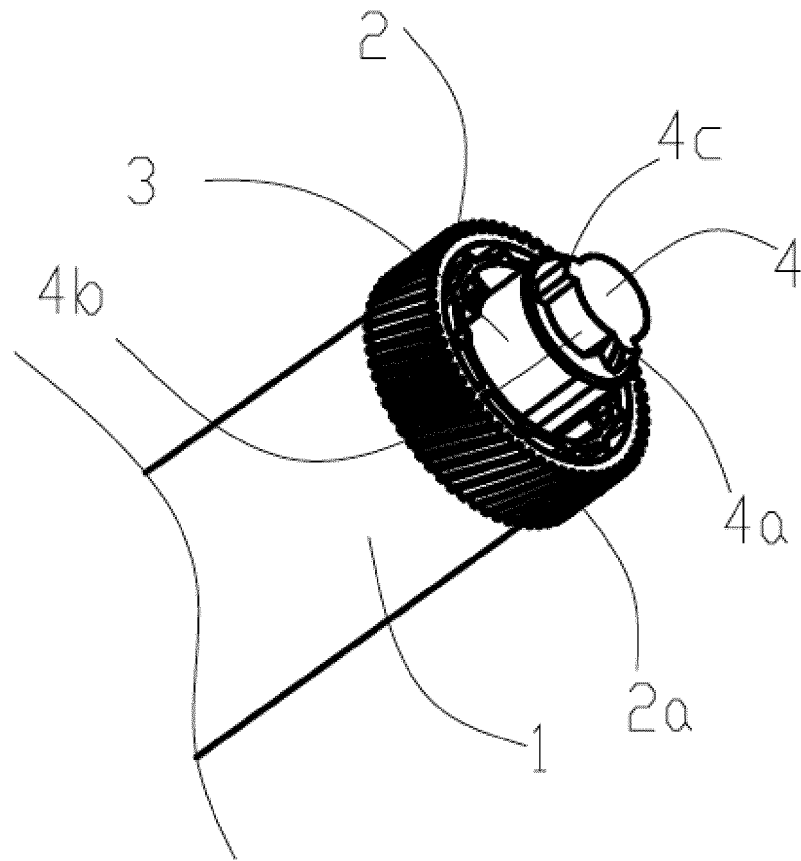


FIG. 16

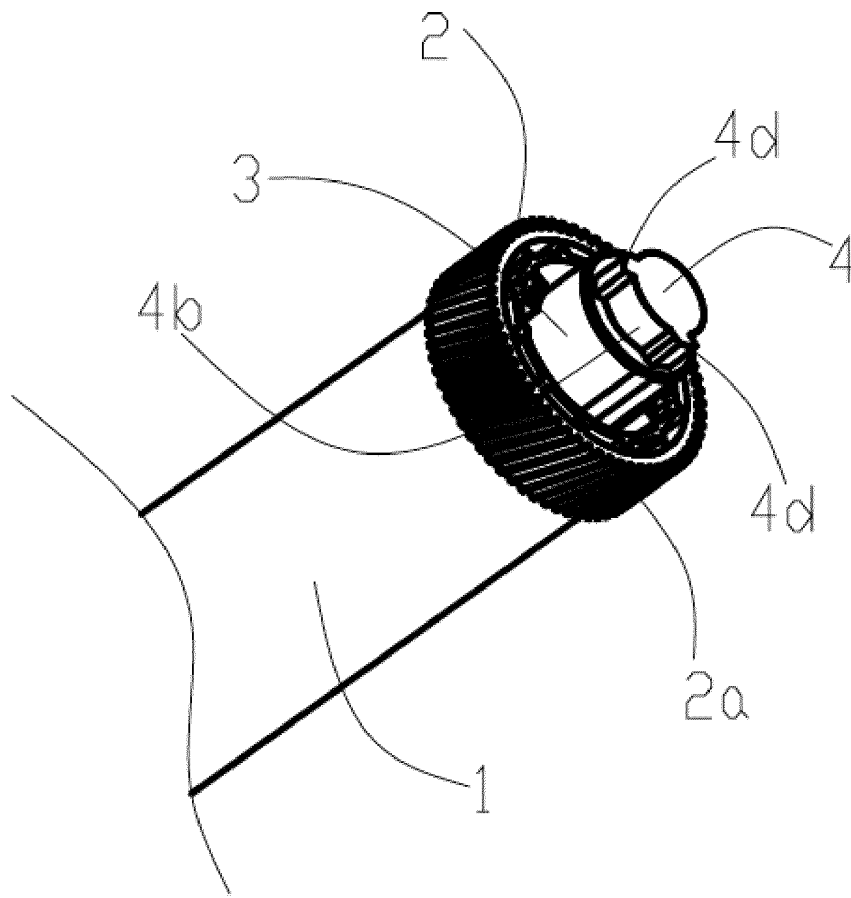


FIG. 17

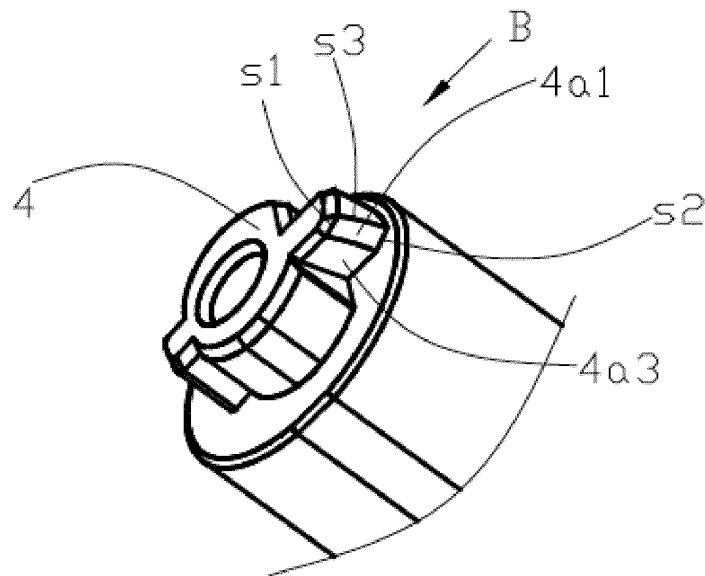


FIG. 18

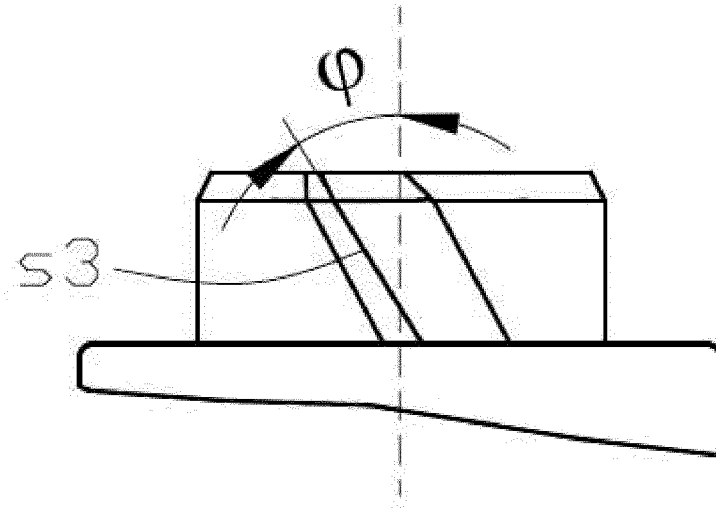


FIG. 19

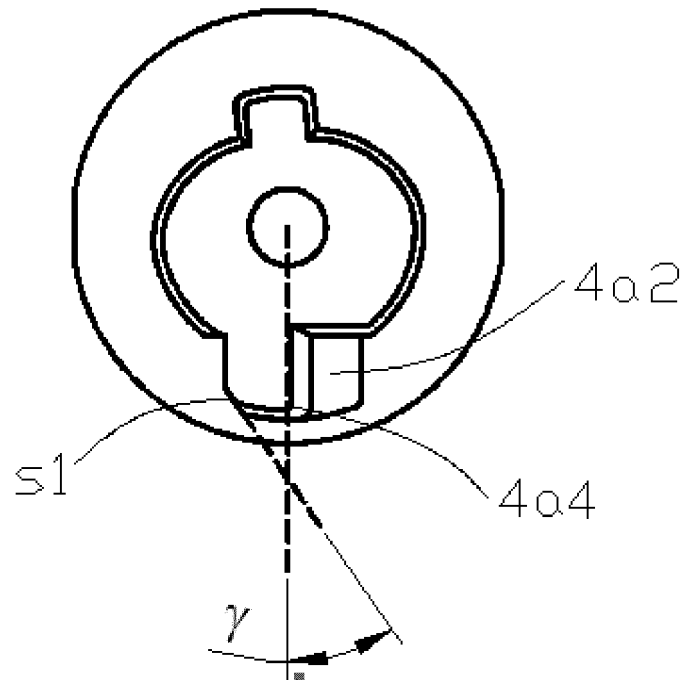


FIG. 20

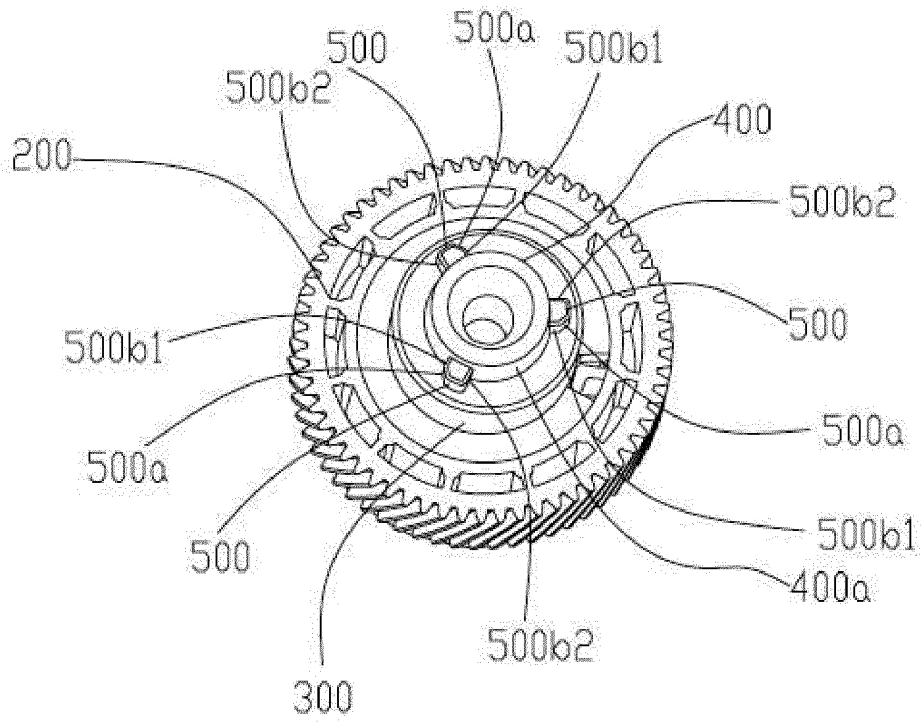


FIG. 21

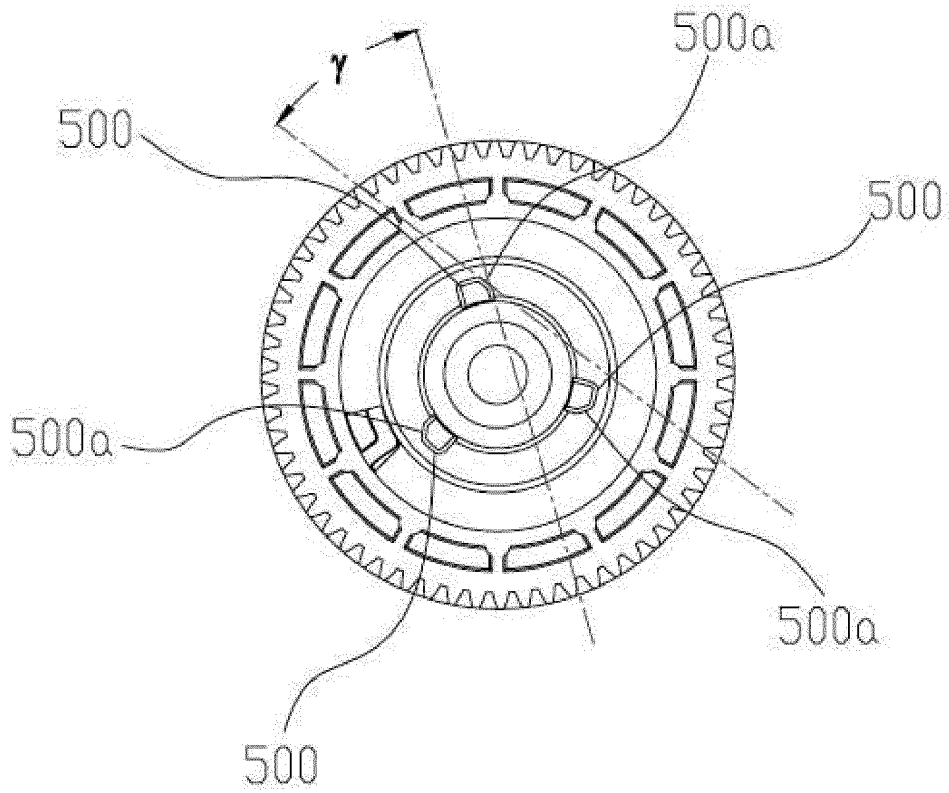


FIG. 22

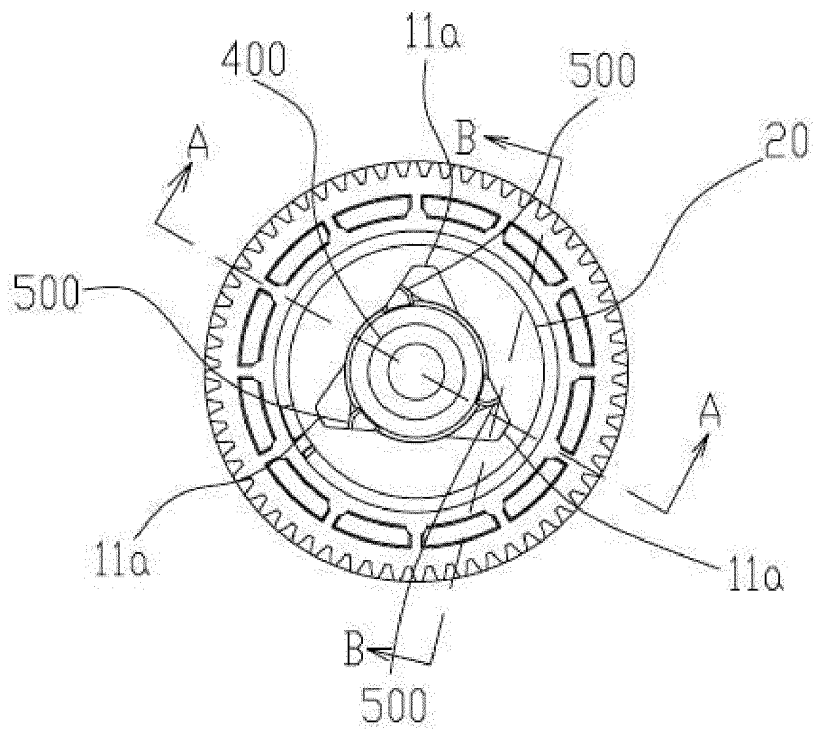


FIG. 23

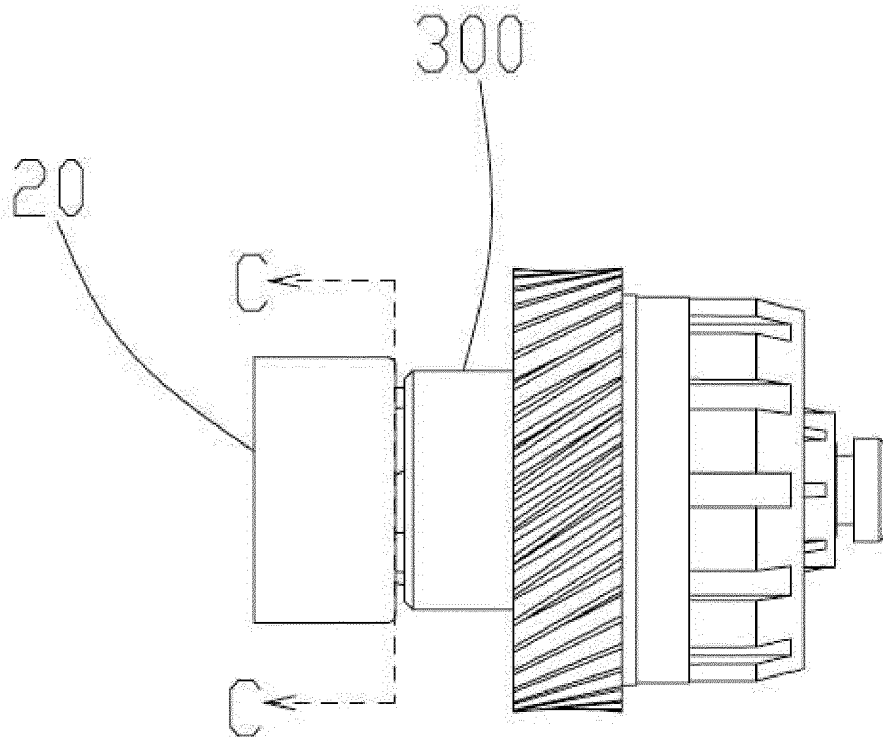


FIG. 24(a)

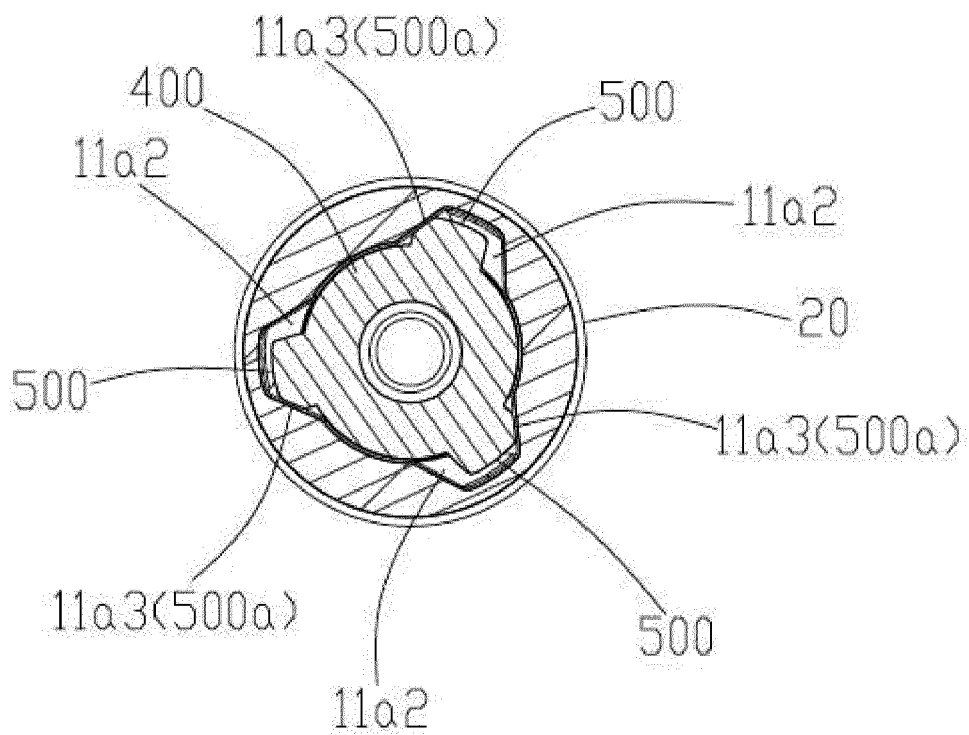


FIG. 24(b)

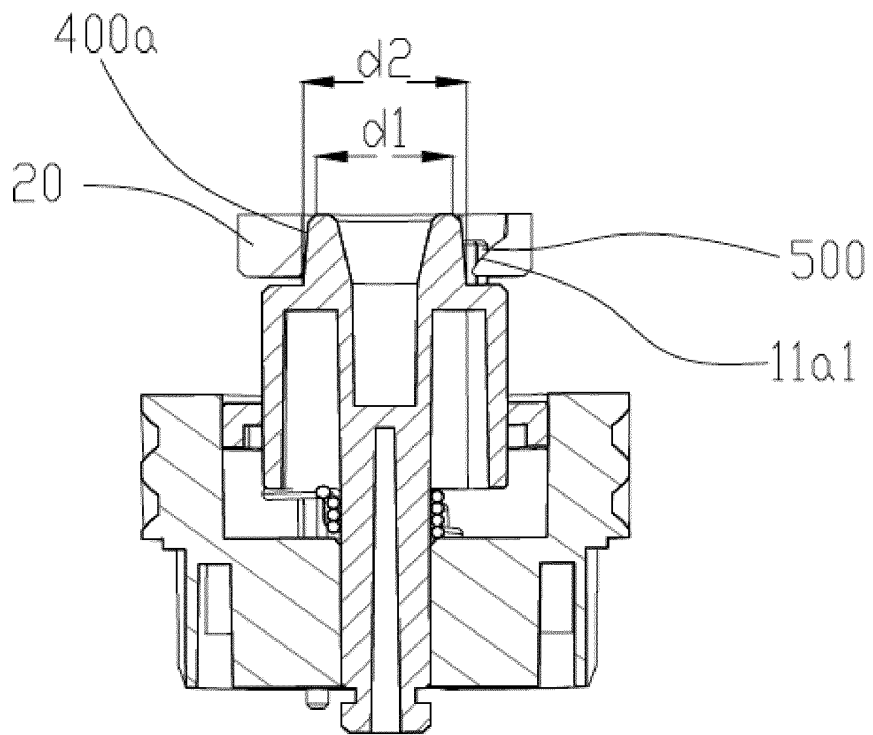


FIG. 25

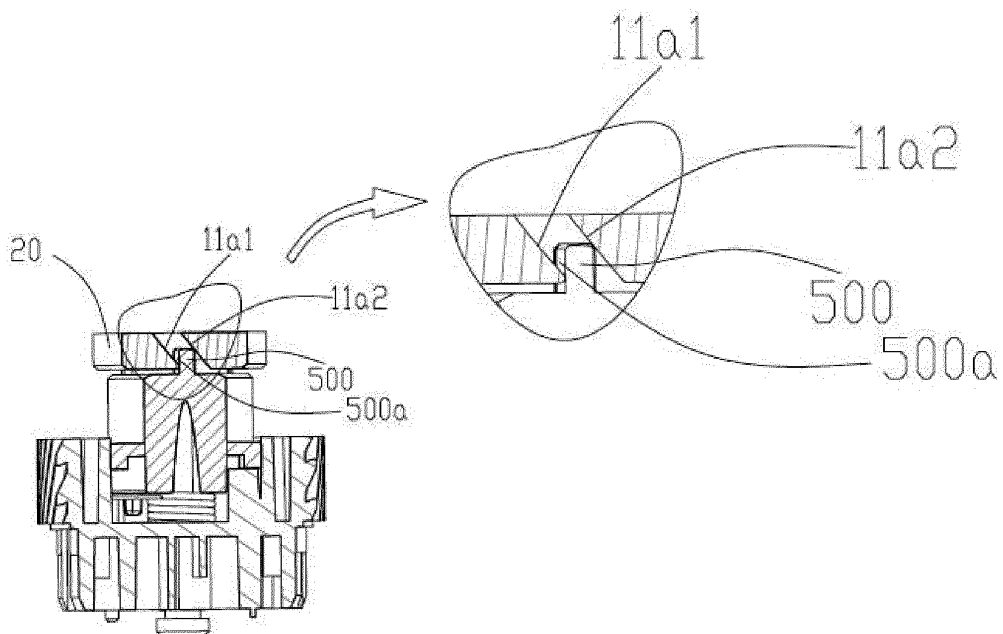


FIG. 26

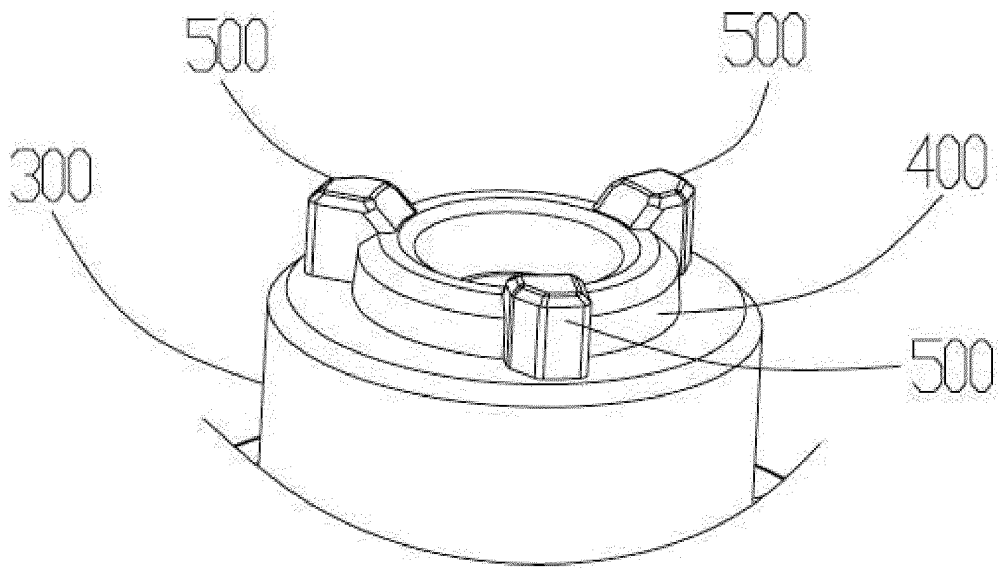


FIG. 27

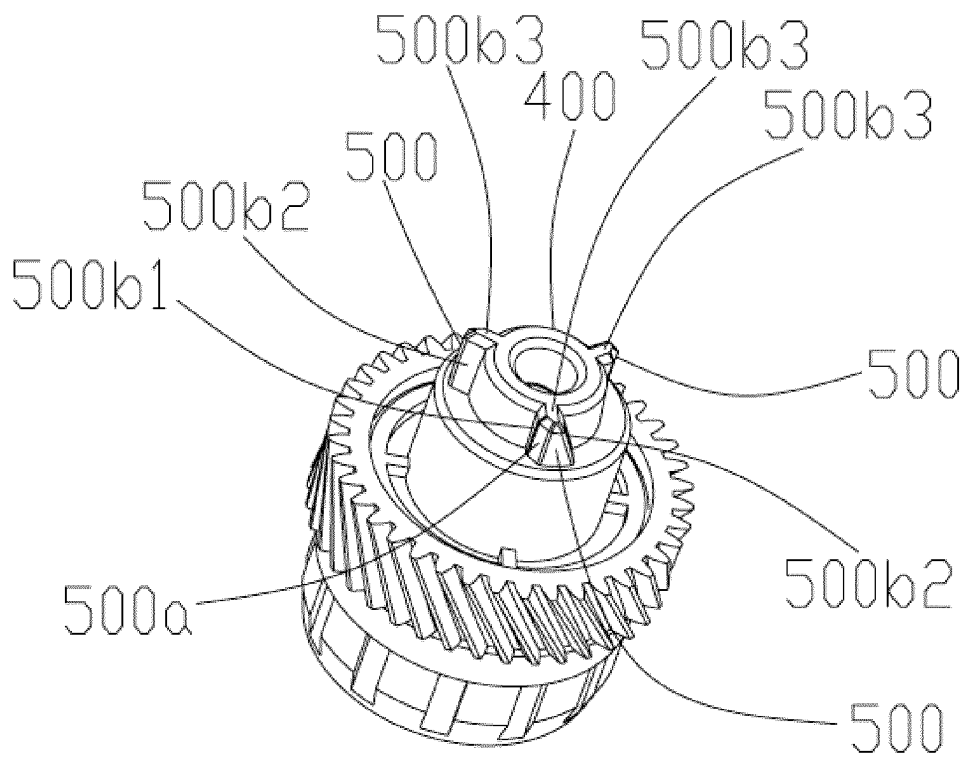


FIG. 28

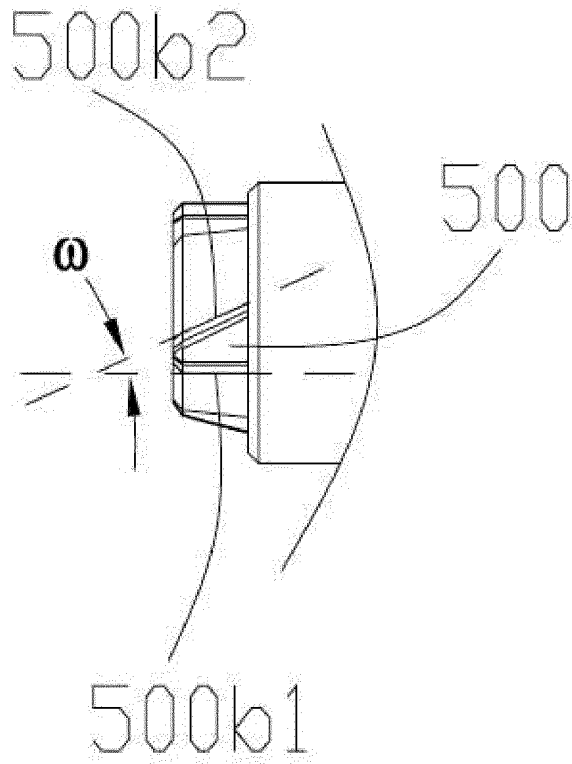


FIG. 29

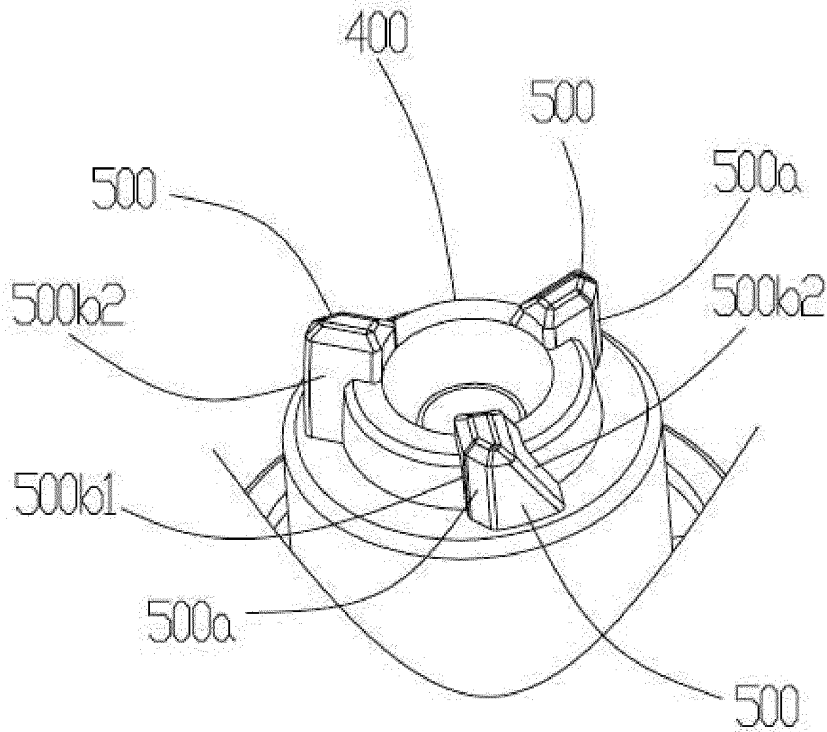


FIG. 30

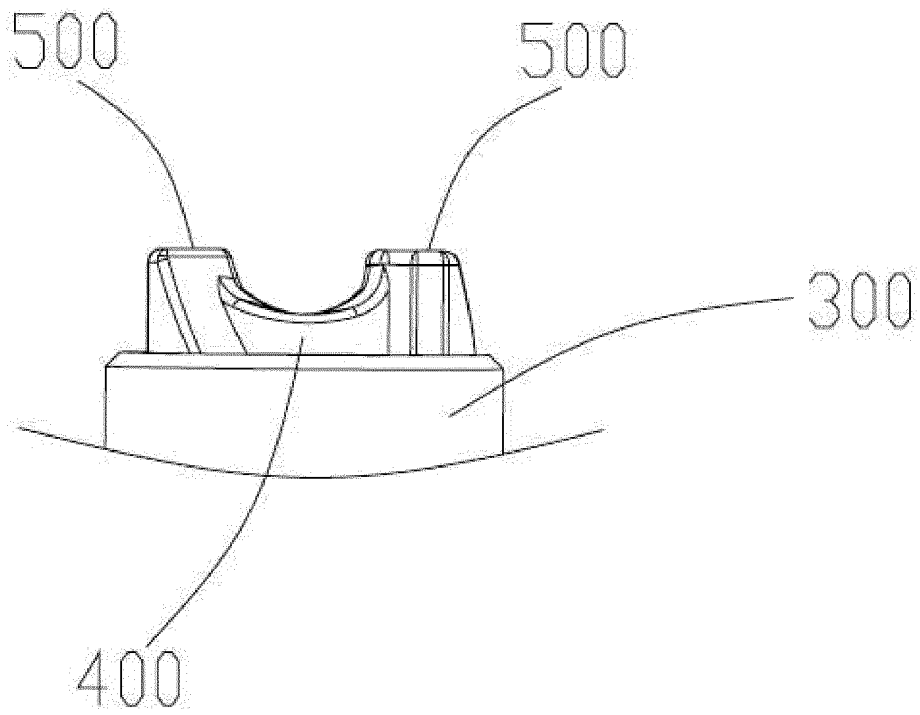


FIG. 31

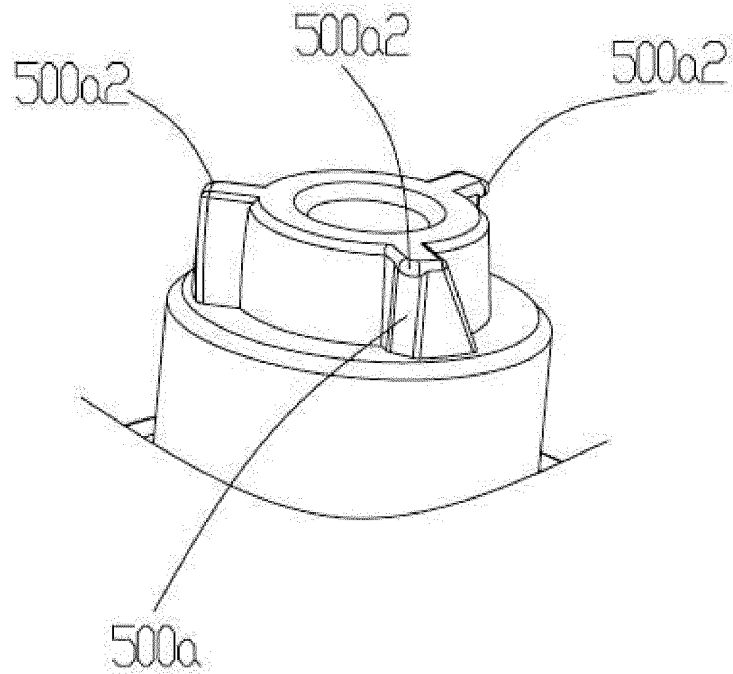


FIG. 32

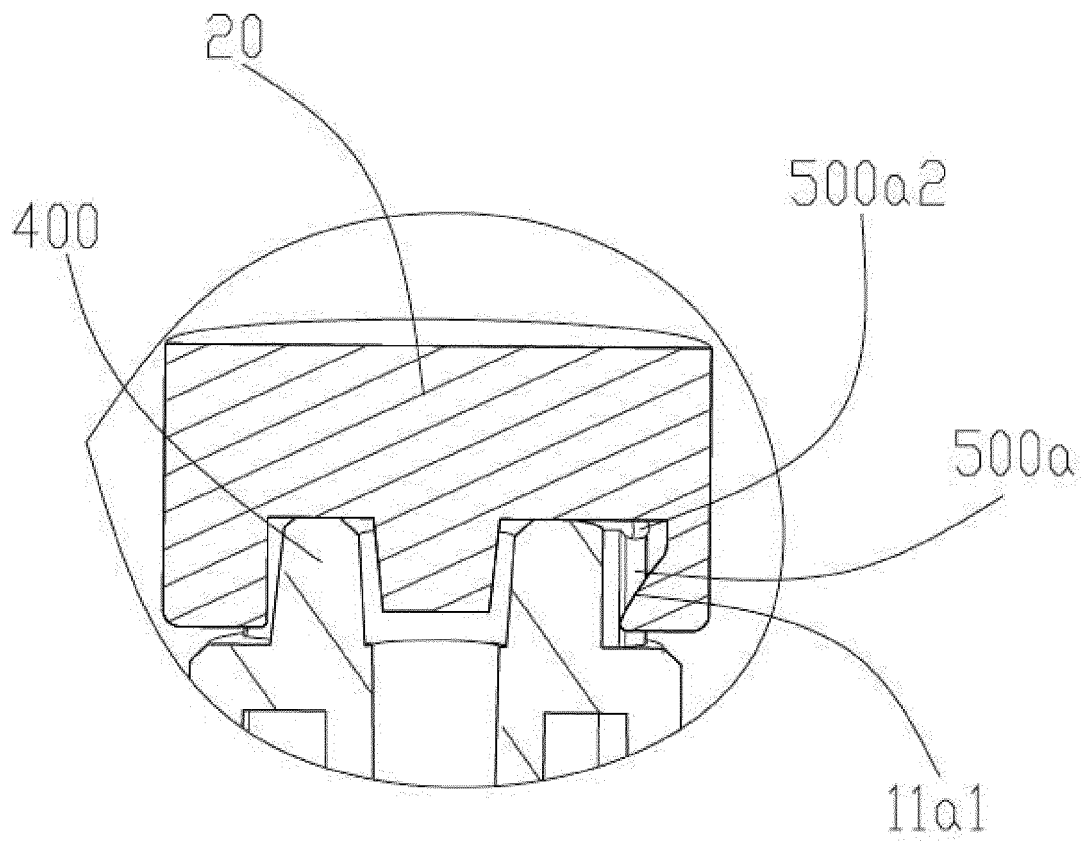


FIG. 33

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/086505

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>		
G03G 15/00 (2006.01) i		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols)		
IPC: G03G 15, G03G 21		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
CPRSABS, VEN: platform, drum S driv+ S (head or end), projection or protrusion or convex or prominence or prominence or protuberance or salience or gear		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 102866609 A (ZHUHAI SEINE TECHNOLOGY CO., LTD.), 09 January 2013 (09.01.2013), claims	1-6
PX	CN 102866608 A (ZHUHAI SEINE TECHNOLOGY CO., LTD.), 09 January 2013 (09.01.2013), description, paragraphs 81-90, and figures 47-60	1-6
PX	CN 202394037 U (JIANGXI YIBO E-TECH CO., LTD.), 22 August 2012 (22.08.2012), claims, and figures 2-6	1-6
X	CN 201110946 Y (PRINT-RITE TECHNOLOGY DEVELOPMENT CO., LTD. OF ZHUHAI), 03 September 2008 (03.09.2008), description, pages 4-5, and figure 6	1-6
A	US 2009074453 A1 (CANON KK), 19 March 2009 (19.03.2009), the whole document	1-6
A	JP 2003186348 A (CANON KK), 04 July 2003 (04.07.2003), the whole document	1-6
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family	
"O" document referring to an oral disclosure, use, exhibition or other means		
"P" document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search 01 April 2013 (01.04.2013)	Date of mailing of the international search report <b>25 April 2013 (25.04.2013)</b>	
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer <b>XING, Jinhui</b> Telephone No.: (86-10) <b>62085572</b>	

Form PCT/ISA/210 (second sheet) (July 2009)

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
**PCT/CN2012/086505**

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 102866609 A	09.01.2013	None	
CN 102866608 A	09.01.2013	None	
CN 202394037 U	22.08.2012	None	
CN 201110946 Y	03.09.2008	None	
US 2009074453 A1	19.03.2009	US 7660545 B2	09.02.2010
		CN 1096629 C	18.12.2002
		AU 726711 B2	16.11.2000
		CN 1164052 A	05.11.1997
		KR 100355723 B1	09.10.2002
		US 6128454 A	03.10.2000
		KR 100355724 B1	19.10.2002
		US 2009290908 A1	26.11.2009
		EP 0735432 A1	02.10.1996
		US 5903803 A	11.05.1999
		US 6349188 B1	19.02.2002
		US 7920806 B2	05.04.2011
		AU 5032396 A	24.10.1996
		DE 69611116 D1	11.01.2001
		CA 2172593 C	27.11.2001
		CN 1210633 C	13.07.2005
		US 7630661 B2	08.12.2009
		US 2011211863 A1	01.09.2011
		US 6128454 C1	03.01.2012
		CA 2172593 A1	28.09.1996
		EP 0735432 B1	06.12.2000
		US 2009074452 A1	19.03.2009
		US 5903803 C1	13.09.2011
		JP 8270642 A	15.10.1996
		AU 8081798 A	15.10.1998
		KR 100258609 B1	15.06.2000
		JP 8328449 A	13.12.1996
		TW 420784 B	01.02.2001
		CN 1428669 A	09.07.2003
JP 2003186348 A	04.07.2003	JP 3880391 B2	14.70.2007