



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
04.01.2012 Bulletin 2012/01

(51) Int Cl.:
D04B 15/34 (2006.01)

(21) Application number: **10193137.6**

(22) Date of filing: **30.11.2010**

(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
Designated Extension States:
BA ME

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(30) Priority: **30.06.2010 TW 099121451**

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(54) **Adjustable countercam device for a circular knitting machine**

(57) An adjustable countercam device for a circular knitting machine is adapted to be mounted on a sinker ring (10) to cooperate with a sinker cam (132) to define a camming path of sinkers (200). The device includes a primary counter-guide plate (21) having forward and backward marginal edges (2181, 2191) serving as an outside boundary of the camming path, and an auxiliary

counter-guide plate (22) having a body marginal edge (221) in alignment with the backward marginal edge (2191) in a pre-adjusted position, and disposed to restrain to make a radial displacement corresponding to the movement of the forward marginal edge (2181) so as to keep the body marginal edge (221) in line with the forward marginal edge (2181) in an adjusted position.

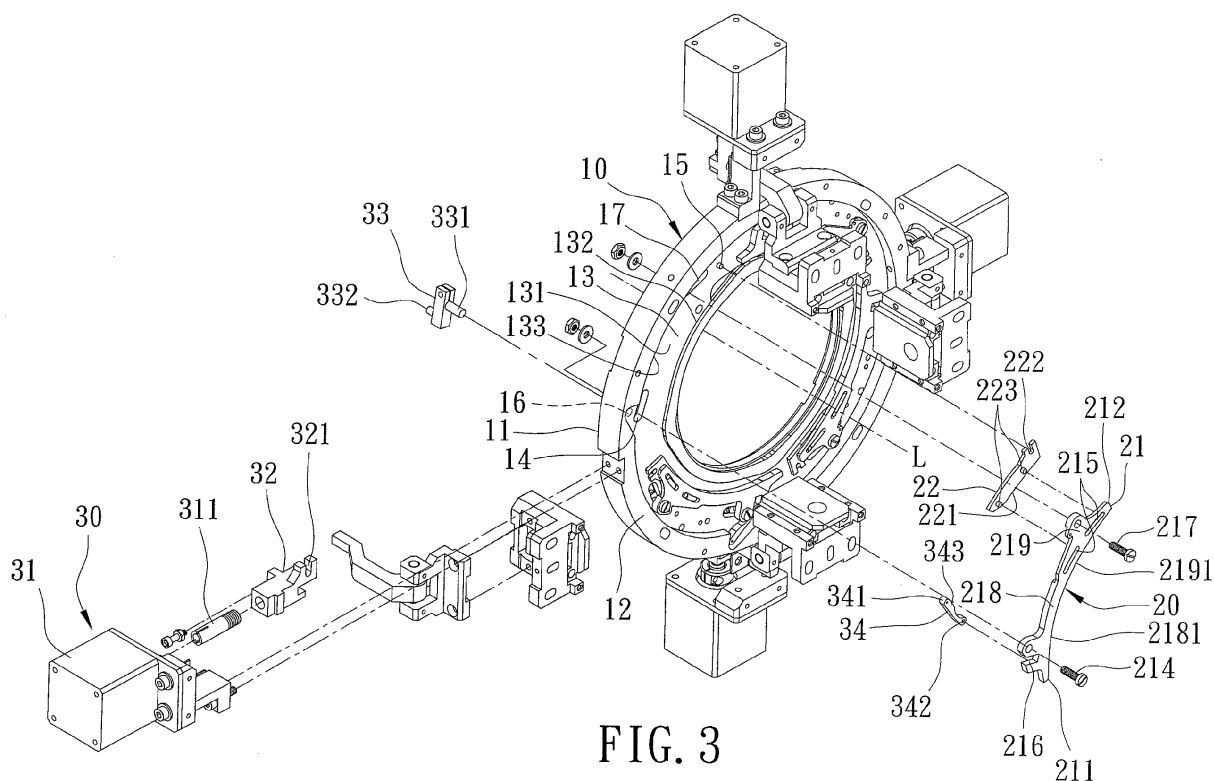


FIG. 3

Description

[0001] This invention relates to a circular knitting machine, more particularly to an adjustable countercam device for a circular knitting machine, such as a hosiery machine, to control the camming path of sinkers for making a reciprocating stroke in a knitting cycle.

[0002] A conventional circular knitting machine, such as that disclosed in EP 0 454 023 A2, generally includes a needle cylinder with a cylinder axis for accommodating a plurality of axially movable needles, a plate-like sinker support coaxially mounted on an upper end of the needle cylinder for accommodating a plurality of radially movable sinkers which can be actuated to make a reciprocating stroke in a knitting cycle, and a sinker ring mounted coaxially to the needle cylinder. The lower surface of the sinker ring is provided with a sinker cam extending around the needle cylinder, and a plurality of countercams facing the side of the sinker cam so that a camming path, in which the heels of the sinkers engage, is defined between the sinker cam and the countercams. The camming path extends around the needle cylinder and is shaped substantially in a known manner with portions which run incrementally closer to the cylinder axis and portions which run incrementally away therefrom in order to obtain a reciprocating motion of the sinkers along radial directions with respect to the needle cylinder when the needle cylinder is actuated with a rotary motion about the cylinder axis relative to the sinker ring. An annular actuation element is mounted on the upper face of the sinker ring and can be controllably actuated to adjust the radial positions of the countercams with respect to the needle cylinder so as to lead to variation in the stroke of the sinkers.

[0003] An object of the present invention is to provide an adjustable countercam device for a circular knitting machine which can adjust the outside boundary of the camming path with respect to the cylinder axis of a needle cylinder.

[0004] According to this invention, the adjustable countercam device is adapted to be mounted on a sinker ring of a circular knitting machine, and includes a plurality of countercam units and a plurality of drive units.

[0005] Each of the countercam units includes a primary counter-guide plate, a first guiding unit, a second guiding unit, an auxiliary counter-guide plate, a third guiding unit, and an adjusting actuator. The primary counter-guide plate is elongated lengthwise to terminate at leading and trailing ends, and includes forward and backward segments which are respectively proximate to the leading and trailing ends, and which respectively have forward and backward marginal edges that extend in a circumferential direction of the sinker ring, and that respectively define forward and backward ones of an outside boundary of a camming path for sinkers. The first guiding unit is disposed to guide the forward segment to move along a first guideway relative to the sinker ring from a pre-adjusted position, where the forward marginal edge is

radially spaced apart from the sinker cam by a first distance **D1**, to an adjusted position, where the forward marginal edge is radially spaced apart from the sinker cam by a second distance **D2** that is greater than the first distance **D1** by Δd . The second guiding unit is disposed to guide the backward segment to move along a second guideway relative to the sinker ring to make a combined displacement which is a vector-sum of a circumferential displacement component and a radial displacement component when the forward segment is moved from the pre-adjusted position to the adjusted position. The auxiliary counter-guide plate is disposed on the backward segment of the primary counter-guide plate, and has a body marginal edge in alignment with the backward marginal edge in the pre-adjusted position. The auxiliary counter-guide plate is restrained to make a radial displacement corresponding to the Δd relative to the sinker ring. The third guiding unit is disposed to guide the auxiliary counter-guide plate to retrieve the circumferential displacement component relative to the backward segment so as to keep the body marginal edge in line with the forward marginal edge when the backward segment is guided by the second guiding unit to make the combined displacement. The adjusting actuator includes a pivoted end pivotally mounted on the sinker ring, and an actuating arm extending radially from the pivoted end to terminate at an actuating end that is configured to be loosely engaged with the leading end of the primary counter-guide plate such that the actuating arm is turnable so as to angularly move the actuating end to thereby displace the forward segment from the pre-adjusted position to the adjusted position.

[0006] Each of the drive units includes a motor actuated to make the angular movement of the actuating end of the respective countercam unit.

[0007] Other features and advantages of the present invention will become apparent in the following detailed description of the preferred embodiment of the invention, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective top view of the preferred embodiment of an adjustable countercam device incorporated with a sinker ring according to this invention; Fig. 2 is a perspective bottom view of the preferred embodiment mounted on the sinker ring;

Fig. 3 is an exploded perspective view of the preferred embodiment incorporated with the sinker ring; Fig. 4 is a fragmentary top plan view of an adjusting actuator and a drive unit of the preferred embodiment; and

Figs. 5 to 7 are fragmentary bottom plan views of the preferred embodiment, illustrating its operation.

[0008] Referring to Figs. 1 to 5, the preferred embodiment of an adjustable countercam device according to the present invention is shown to be mounted on a sinker ring 10 of a circular knitting machine, such as a hosiery machine. The circular knitting machine includes a needle

cylinder 300 with a cylinder axis (L), and a plurality of sinkers 200 radially movable relative to the needle cylinder 300 to be actuated to make a reciprocating stroke in a knitting cycle, and each having a heel portion 201 which is guided to move along a camming path extending to surround the cylinder axis (L). The sinker ring 10 is disposed coaxially relative to the needle cylinder 300, and has top and bottom faces 11, 12, and an annular recess 13 formed in the bottom face 12 and defined by a base face 131, an inner annular face 132 and an outer annular face 133. The inner annular face 132 is formed to serve as a sinker cam 132 which defines an inside boundary of the camming path. The adjustable countercam device is shown to comprise a plurality of countercam units 20 and a plurality of drive units 30.

[0009] Each of the countercam units 20 includes a primary counter-guide plate 21, a first guiding unit 214, a second guiding unit 217, an auxiliary counter-guide plate 22, a third guiding unit 215, 223, and an adjusting actuator 34.

[0010] The primary counter-guide plate 21 is elongated lengthwise to terminate at leading and trailing ends 211, 212, and includes forward and backward segments 218, 219 which are respectively proximate to the leading and trailing ends 211, 212, and which respectively have forward and backward marginal edges 2181, 2191 that extend in a circumferential direction, and that respectively define forward and backward ones of an outside boundary of the camming path. The leading end 211 has an actuated slot 216 extending radially.

[0011] The bottom face 12 of the sinker ring 10 has a plurality of first elongate grooves 14 each extending through the top face 11 and formed proximate to the forward segment 218 to serve as a first guideway 14, and a plurality of second elongate grooves 17 each extending through the top face 11 and formed proximate to the backward segment 219 to serve as a second guideway 17.

[0012] The first guiding unit 214 is in the form of a key 214, such as a screw bolt, which extends through the forward segment 218 and the first elongate groove 14 and which is threadedly engaged with a screw nut to mount the key 214 on the forward segment 218 and to permit the key 214 to be slidable along the first elongate groove 14 from a pre-adjusted position, as shown in Fig. 5, where the forward marginal edge 2181 is radially spaced apart from the sinker cam 132 by a first distance **D1**, to an adjusted position, as shown in Fig. 7, where the forward marginal edge 218 is radially spaced apart from the sinker cam 132 by a second distance **D2** that is greater than the first distance **D1** by Δd .

[0013] The second guiding unit 217 is in the form of a key 217, such as a screw bolt, which extends through the backward segment 219 and the second elongate groove 17 and which is threadedly engaged with a screw nut to mount the key 217 on the backward segment 219 and to permit the key 217 to be slidable along the second elongate groove 17 so as to make a combined displacement which is a vector-sum of a circumferential displacement component and a radial displacement component

when the forward segment 218 is moved from the pre-adjusted position to the adjusted position.

[0014] The auxiliary counter-guide plate 22 is disposed on the backward segment 219 of the primary counter-guide plate 21, and has a body marginal edge 221 which extends in the circumferential direction, and which is brought in alignment with the backward marginal edge 2191 in the pre-adjusted position (see Fig. 5), and a restrained slot 222 extending radially to terminate at proximate and distal slot ends 2221, 2222 which are distant from each other by the Δd . A restraining pin 15 is disposed on the base face 131 of the sinker ring 10 and is slidably engaged with the restrained slot 222 so as to permit the auxiliary counter-guide plate 22 to be restrained to make a radial displacement corresponding to the Δd relative to the sinker ring 10.

[0015] The third guiding unit 215, 223 includes two elongated slots 215 disposed in the backward segment 219 of the primary counter-guide plate 21 and extending in the circumferential direction, and two pins 223 disposed on the auxiliary counter-guide plate 22 and slidably engaged in the elongated slots 215, respectively.

[0016] Referring to Figs. 4 and 5, the adjusting actuator 34 includes a pivoted end 341 pivotally mounted on the sinker ring 10 about a pivot axis parallel to the cylinder axis (L), and an actuating arm 343 extending radially from the pivoted end 341 to terminate at an actuating end 342 that is configured to be loosely engaged with the actuated slot 216.

[0017] Each of the drive units 30 includes a transmitting member 33, a driving member 32, and a motor 31.

[0018] The transmitting member 33 has a journalled end 331 which is rotatably mounted in a pivot hole 16 formed in the sinker ring 10 and which is securely connected to and rotatable with the pivoted end 341 of the adjusting actuator 34 about the pivot axis, and a driven end 332 which is offset from the pivot axis so as to be swingable about the journalled end 331.

[0019] The driving member 32 has a driving end 321 which is loosely engaged with the driven end 332 such that movement of the driving end 321 in a direction transverse to the pivot axis results in swinging of the driven end 332.

[0020] The motor 31 may be a servomotor, and has an output shaft 311 threadedly engaged with the driving member 32 such that rotation of the output shaft 311 results in the movement of the driving member 32 in the transverse direction.

[0021] Referring to Figs. 4 to 7, when the motor 31 is actuated to move the driving member 32 in the transverse direction and to thereby rotate the journalled end 331 of the transmitting member 33 about the pivot axis, the actuating arm 343 is turned to angularly move the actuating end 342 so as to displace the forward segment 218 of the primary counter-guide plate 21 along the first elongate groove 14, and displace the backward segment 219

along the second elongate groove 17 from the pre-adjusted position to the adjusted position. With the engagement between the restrained slot 222 and the restraining pin 15, and with the provision of the third guiding unit 215, 223, the auxiliary counter-guide plate 22 is restrained and is guided to retrieve the circumferential displacement component relative to the backward segment 219 of the primary counter-guide plate 21 while making the radial movement so as to permit relative movement of the restraining pin 15 from the distal slot end 2222 to the proximate slot end 2221. Consequently, the body marginal edge 221 of the auxiliary counter-guide plate 22 is kept in line with the forward marginal edge 2181.

[0022] As illustrated, by actuation of the motor 31 of each of the drive units 30, the primary counter-guide plate 21 is displaced to vary the distance between the forward marginal edge 2181 and the sinker cam 132 so as to adjust the strokes of the sinkers 200, while the auxiliary counter-guide plate 22 is moved radially to keep the body marginal edge 221 in line with the forward marginal edge 2181, thereby maintaining the continuity of the outside boundary of the camming path (which is defined by the forward marginal edge 2181 and one of the backward marginal edge 2191 and the body marginal edge 221) which is disposed to be spaced apart from the sinker cam 132 by the same radial length. Thus, by control of the motor 31 which may be a servomotor, the adjustment of the countercam device is precise for manufacturing socks of high quality.

Claims

1. An adjustable countercam device for a circular knitting machine, the circular knitting machine including a needle cylinder (300) with a cylinder axis (L), a plurality of sinkers (200) radially movable relative to the needle cylinder (300) to be actuated to make a reciprocating stroke in a knitting cycle, and each having a heel portion (201) which is guided to move along a camming path extending to surround the cylinder axis (L), a sinker ring (10) disposed coaxially relative to the needle cylinder, and a sinker cam (132) which suspends from the sinker ring (10) to surround the needle cylinder (300), and which defines an inside boundary of the camming path, **characterized by** said adjustable countercam device comprising:

a primary counter-guide plate (21) elongated lengthwise to terminate at leading and trailing ends (211, 212), and including forward and backward segments (218, 219) which are respectively proximate to said leading and trailing ends (211, 212), and which respectively have forward and backward marginal edges (2181, 2191) that extend in a circumferential direction, and that respectively define forward and backward ones of an outside boundary of the cam-

ming path;

a first guiding unit (214) disposed to guide said forward segment (218) to move along a first guideway (14) relative to the sinker ring (10) from a pre-adjusted position, where said forward marginal edge (2181) is radially spaced apart from the sinker cam (132) by a first distance **D1**, to an adjusted position, where said forward marginal edge (2181) is radially spaced apart from the sinker cam (132) by a second distance **D2** that is greater than the first distance **D1** by Δd ; a second guiding unit (217) disposed to guide said backward segment (219) to move along a second guideway (17) relative to the sinker ring (10) to make a combined displacement which is a vector-sum of a circumferential displacement component and a radial displacement component when said forward segment (218) is moved from the pre-adjusted position to the adjusted position;

an auxiliary counter-guide plate (22) which is disposed on said backward segment (219) of said primary counter-guide plate (21), which has a body marginal edge (221) that extends in the circumferential direction, and that is brought in alignment with said backward marginal edge (2191) in the pre-adjusted position, and which is restrained to make a radial displacement corresponding to said Δd relative to the sinker ring (10);

a third guiding unit (215, 223) disposed to guide said auxiliary counter-guide plate (22) to retrieve the circumferential displacement component relative to said backward segment (219) so as to keep said body marginal edge (221) in line with said forward marginal edge (2181) when said backward segment (219) is guided by said second guiding unit (217) to make the combined displacement; and

an adjusting actuator (34) including a pivoted end (341) which is pivotally mounted on the sinker ring (10) about a pivot axis, and an actuating arm (343) which extends radially from said pivoted end (341) to terminate at an actuating end (342) that is configured to be loosely engaged with said leading end (211) such that said actuating arm (343) is turnable so as to angularly move said actuating end (342) to thereby displace said forward segment (218) from the pre-adjusted position to the adjusted position.

2. The adjustable countercam device according to Claim 1, **characterized in that** said first and second guideways (14, 17) are respectively in form of first and second elongate grooves (14, 17) formed in the sinker ring (10), said first and second guiding units (214, 217) being in form of keys (214, 217) which are respectively mounted on said forward and back-

ward segments (218, 219) and which are slidable along said first and second elongate grooves (14, 17), respectively, so as to guide movement of said forward segment (218) between the pre-adjusted and adjusted positions, and movement of said backward segment (219) to make the combined displacement.

3. The adjustable countercam device according to Claim 2, **characterized in that** said auxiliary counter-guide plate (22) has a restrained slot (222) extending radially to terminate at proximate and distal slot ends (2221, 2222) which are distant from each other by said Δd , and a restraining pin (15) disposed on the sinker ring (10) and slidably engaging said restrained slot (222) so as to permit said auxiliary counter-guide plate (22) to make the radial displacement. 10 15
4. The adjustable countercam device according to Claim 3, **characterized in that** said third guiding unit (215, 223) includes an elongated slot (215) disposed in one of said backward segment (219) of said primary counter-guide plate (21) and said auxiliary counter-guide plate (22) and extending in the circumferential direction, and a pin (223) disposed on the other one of said backward segment (219) and said auxiliary counter-guide plate (22) and slidably engaged in said elongated slot (215) so as to permit said auxiliary counter-guide plate (22) to retrieve the circumferential displacement component. 20 25 30
5. The adjustable countercam device according to Claim 4, **characterized in that** said leading end (211) has an actuated slot (216) extending radially to allow displacement of said actuating end (342) of said adjusting actuator (34) therein when said actuating arm (343) is turned. 35
6. The adjustable countercam device according to Claim 5, further **characterized by** a drive unit (30) including
 - a transmitting member (33) having a journalled end (331) which is connected to and rotatable with said pivoted end (341) of said adjusting actuator (34) about the pivot axis, and a driven end (332) which is offset from the pivot axis so as to be swingable about said journalled end (331), 40 45
 - a driving member (32) having a driving end (321) which is loosely engaged with said driven end (332) such that movement of said driving end (321) in a direction transverse to the pivot axis results in swinging of said driven end (332), and 50
 - a motor (31) having an output shaft (311) coupled to said driving member (32) to actuate movement of said driving member (32) in the transverse direction. 55
7. The adjustable countercam device according to

Claim 6, **characterized in that** said output shaft (311) is threadedly engaged with said driving member (32) such that rotation of said output shaft (311) results in the movement of said driving member (32) in the transverse direction.

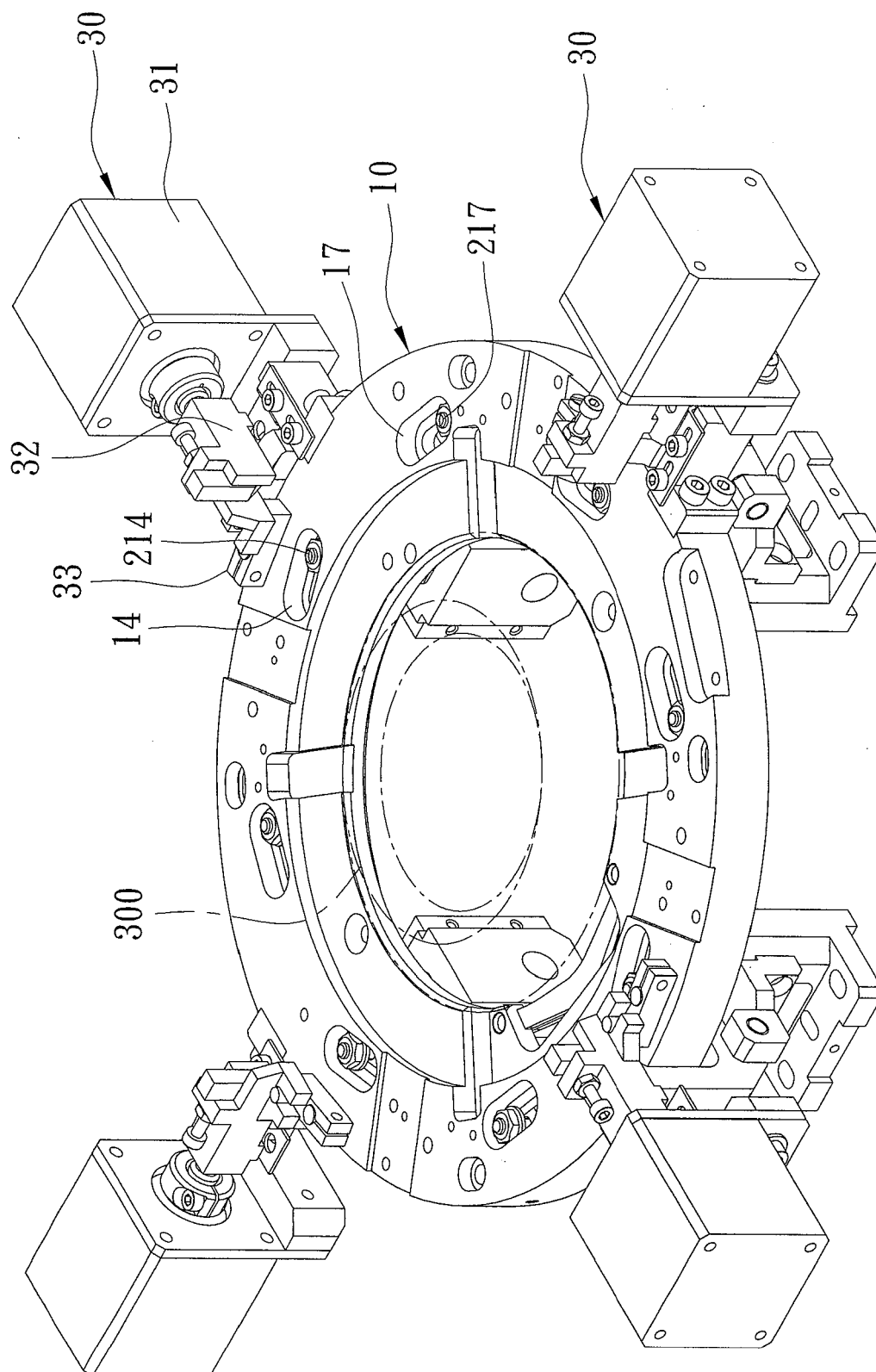


FIG. 1

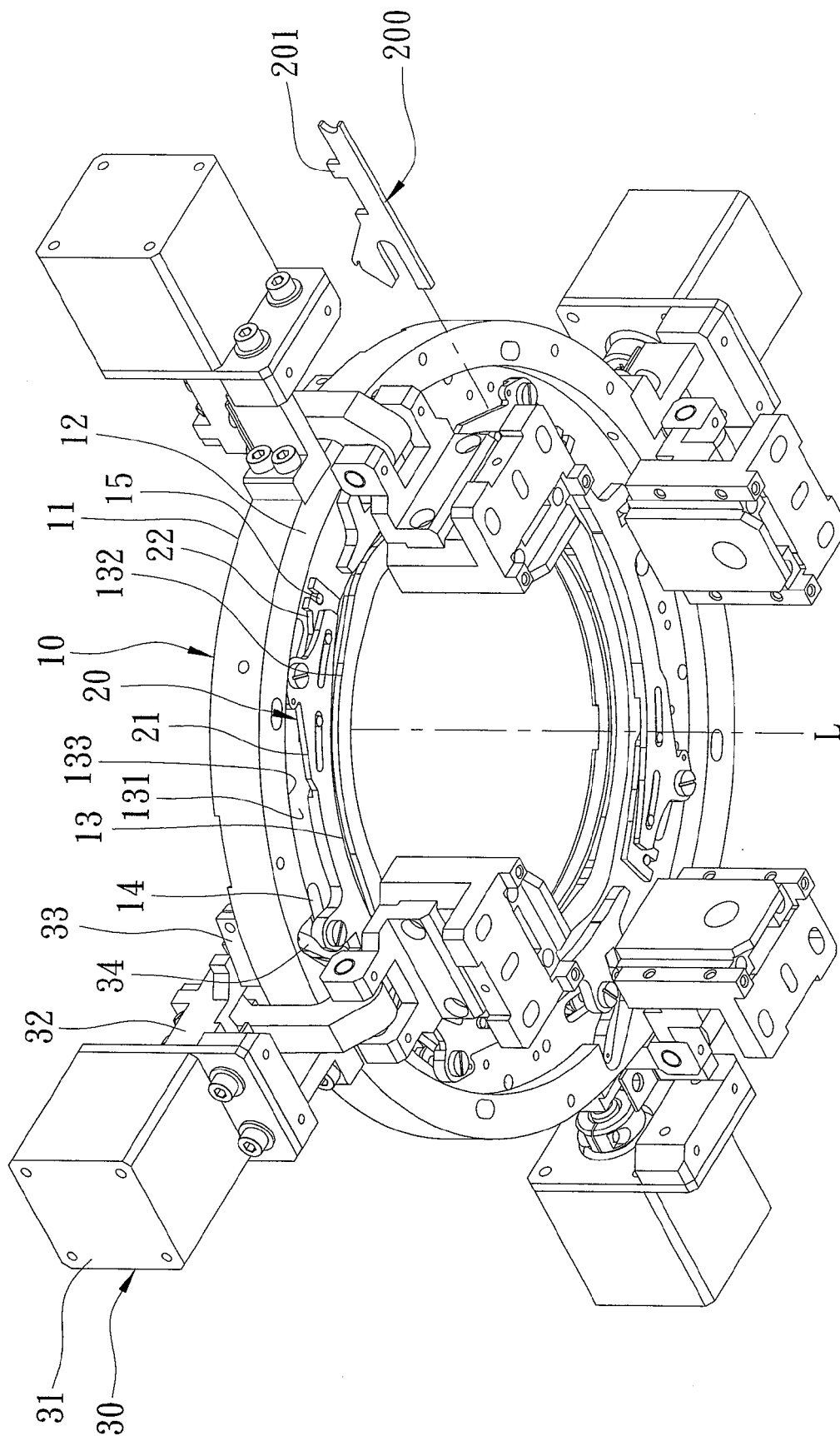


FIG. 2

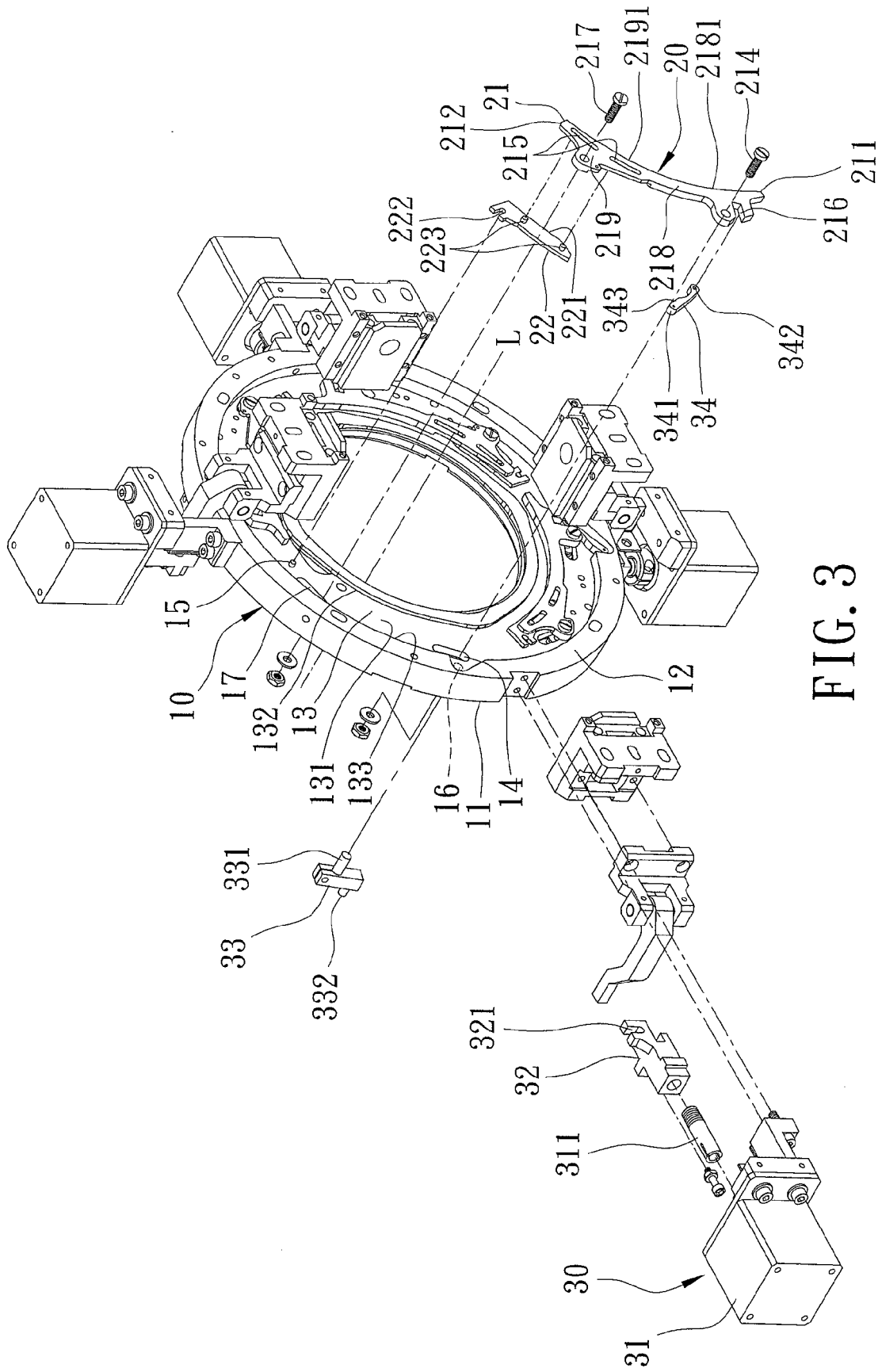


FIG. 3

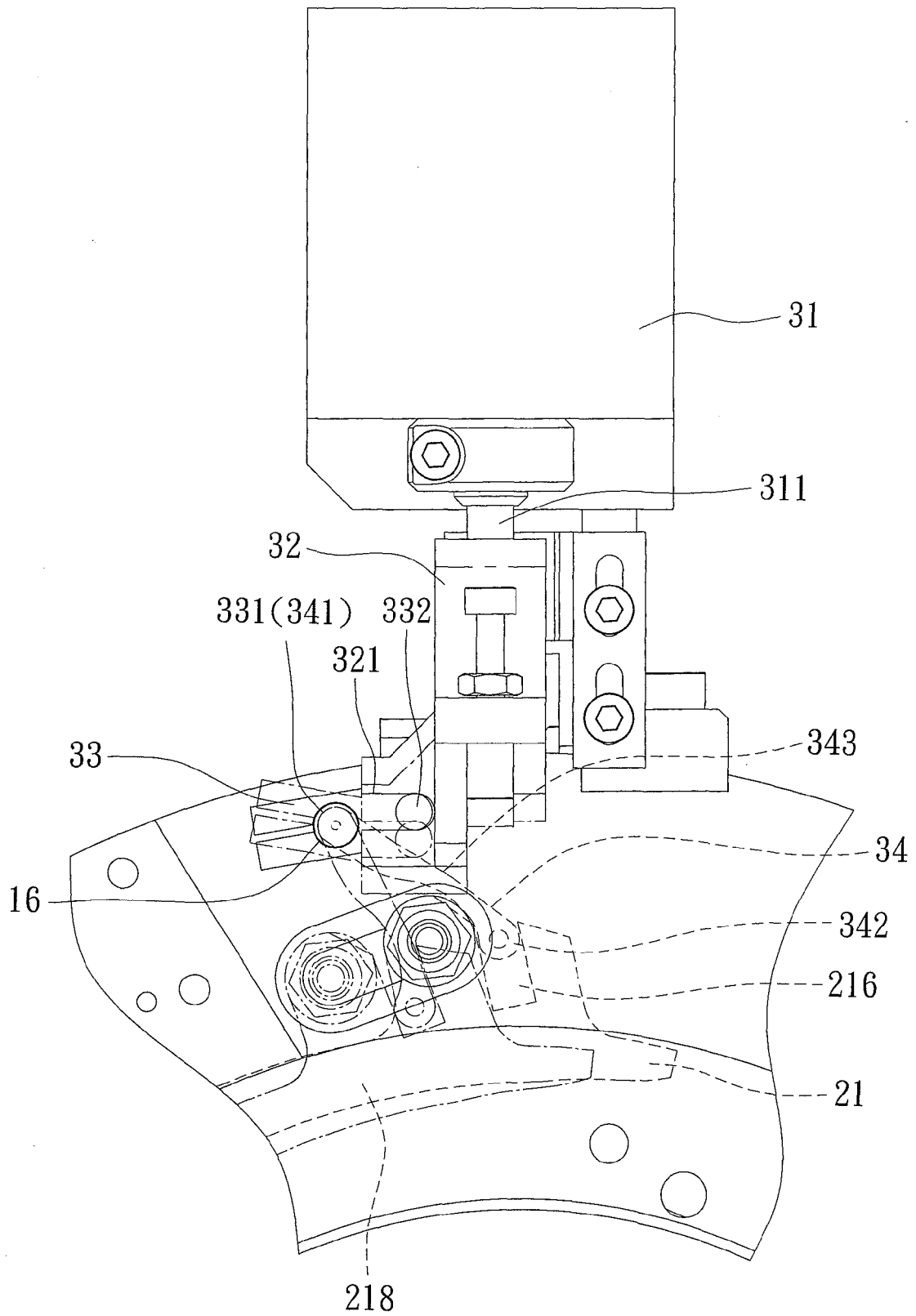


FIG. 4

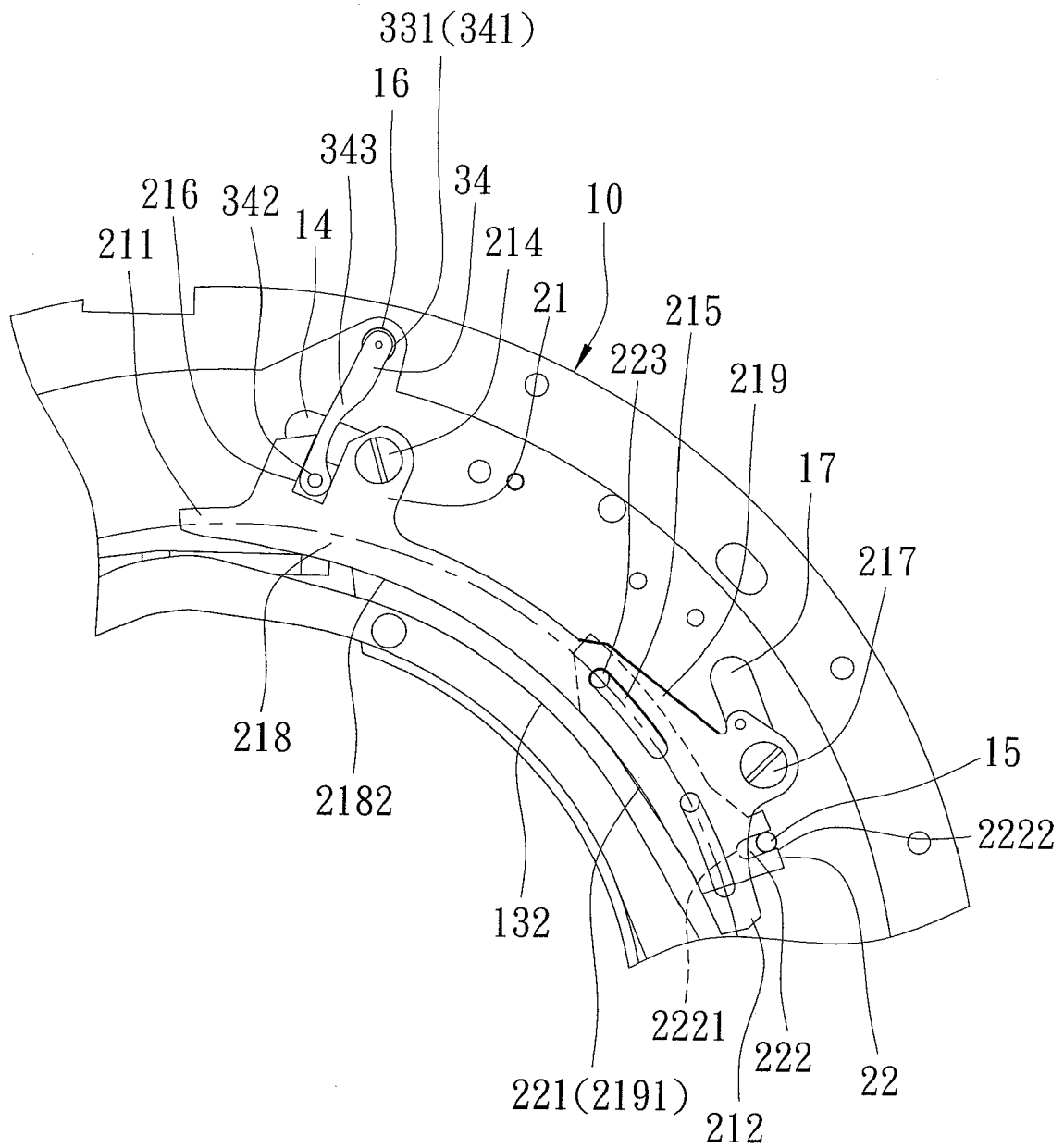


FIG. 5

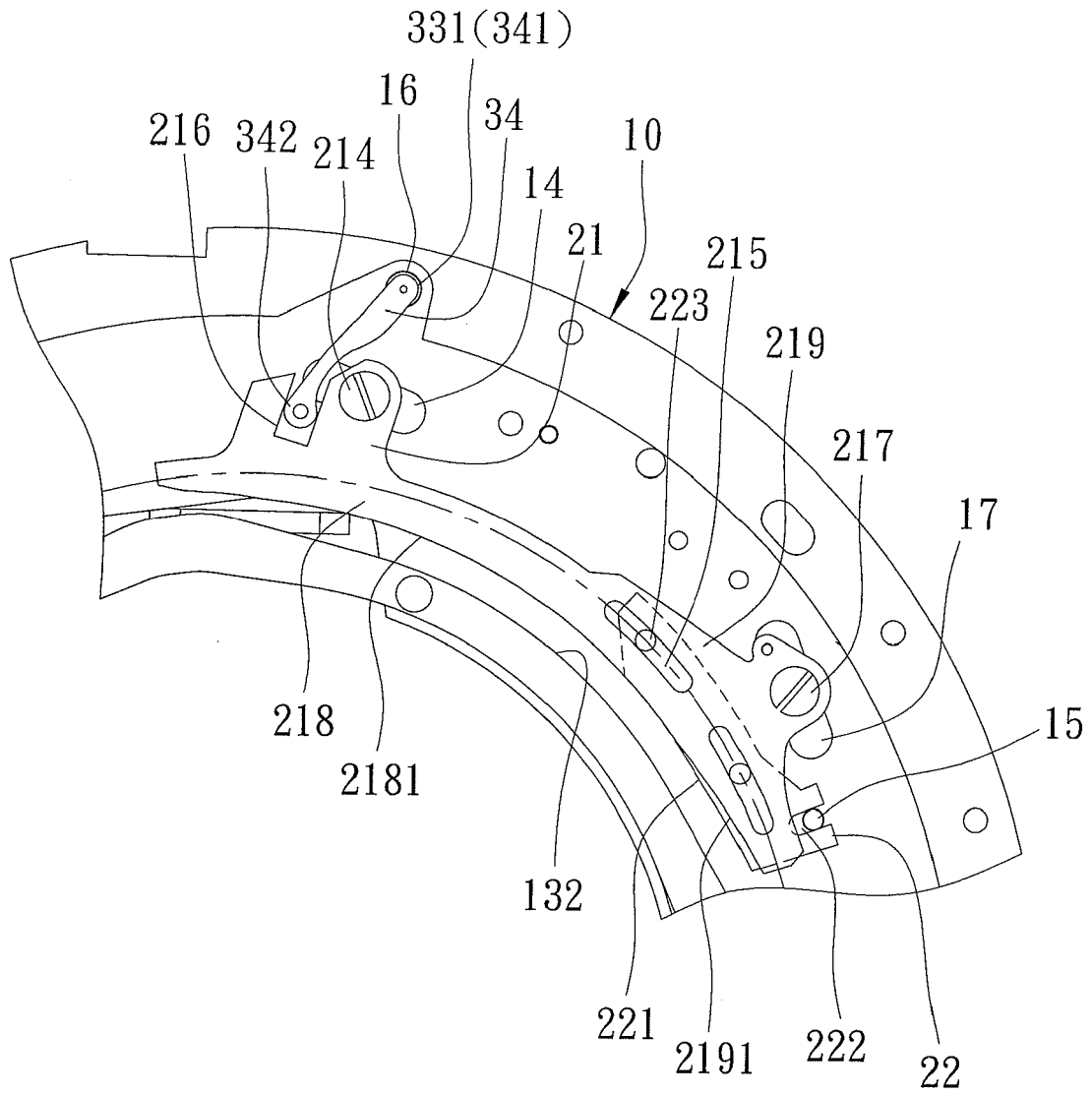


FIG. 6

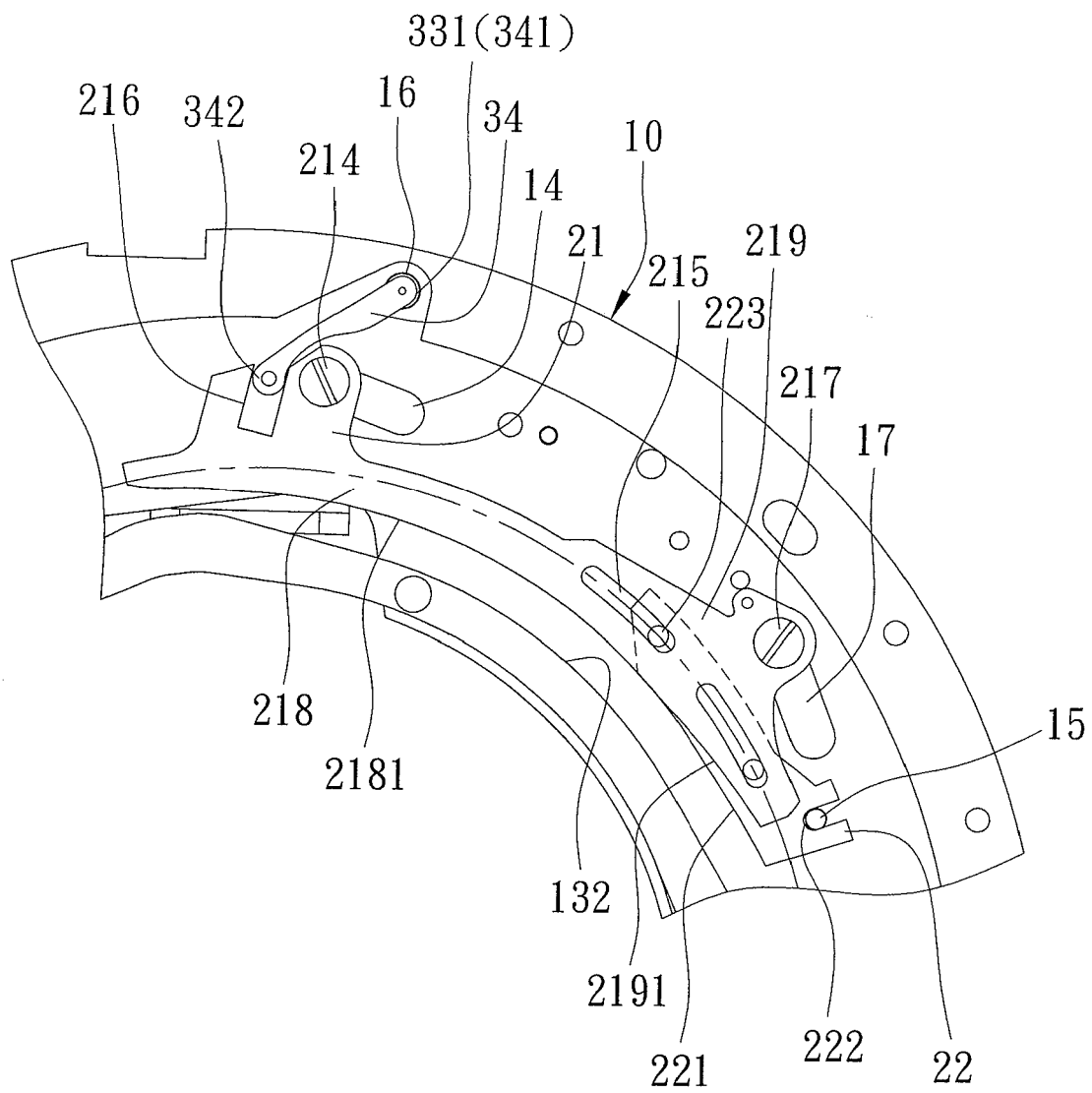


FIG. 7



EUROPEAN SEARCH REPORT

Application Number
EP 10 19 3137

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 18 November 2011	Examiner Zirkler, Stefanie
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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