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Remarks:
Amended claims in accordance with Rule 137(2) EPC.

(54) Electronic lock

(57) An electronic lock is disclosed, which incorporates electronic components to control lock and unlock operations. The electronic lock includes at least one flexible conductive element and at least one conductive tube provided in a first and second clutch for reducing electrical resistance and increasing electrical conductivity. Further, a coupling rod and two conductive members may be disposed through each conductive tube to interact with the flexible conductive element for providing a more secure construction. In addition, a front rotary plate and a rear rotary plate may be respectively provided on a contact end of the first and second clutch. The front rotary plate includes a front conductive ring, and the rear rotary plate includes rear conductive ring radially offset from the front conductive ring. When the first and second clutches engage with each other, the electrical contact achieved via the front and rear conductive rings is improved.

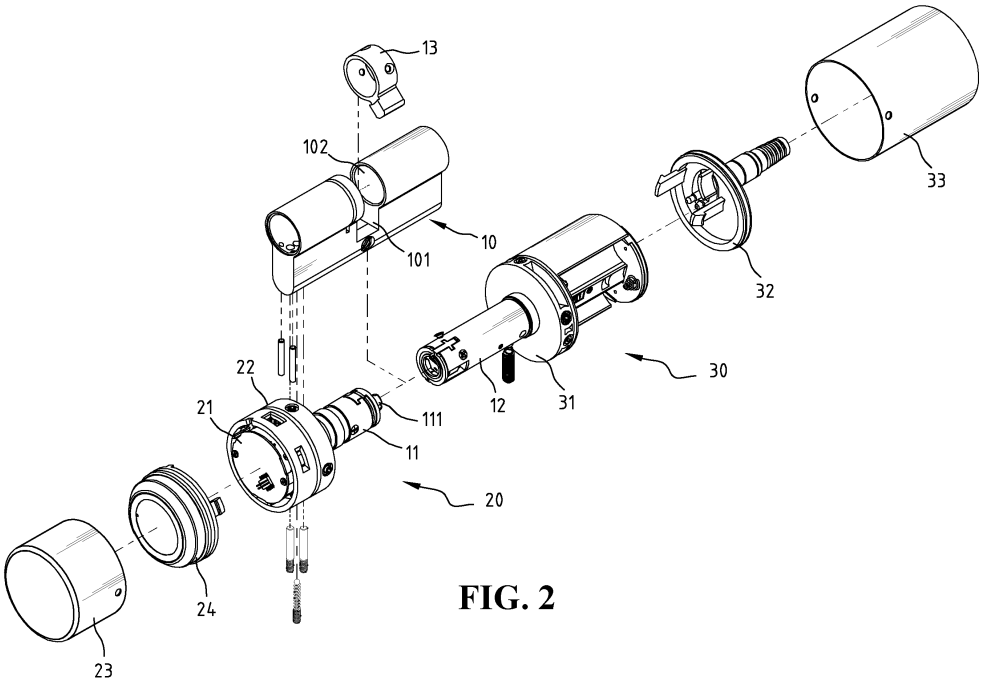

FIG. 2

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention generally relates to an electronic lock, and more particularly, to an electronic lock that uses electronic components to control lock and unlock operations of the lock.

2. The Prior Arts

[0002] As technical progress is made, the traditional mechanical lock provided on a building door is turned into a more sophisticated electronic lock that incorporates multiple electronic components operable to control lock and unlock movements of the lock. The addition of an electronic control makes the lock more secure against malicious attempts to break the lock. Some examples of conventional electronic locks are described in Taiwanese Patent Nos. M311736, M297994 and M294542, which are assigned to the same applicant of the present application. However, the electronic locks described in the aforementioned patents include some disadvantages that need improvements. More particularly, one problem of the conventional electronic lock is that the electrical connection to the power supply is usually achieved via component parts that have an excessively high electrical resistance owing to a reduced size of the component parts. As a result, the electrical current generated is substantially weak, which may cause a dysfunction of the lock control mechanism and consequently require cumbersome repair operations. One reason of the above problem is that the electrical connection is usually implemented through metallic wire or spring component parts that may have electrical properties modified by external factors, such as an electrical resistance that gradually increases owing to progressive oxidation. Because a resulting electrical current may be excessively weak, the actuation of the electronic lock cannot be controlled in an accurate manner, which leads to a malfunction of the lock.

SUMMARY OF THE INVENTION

[0003] The present application describes an electronic lock. One feature of the electronic lock includes the assembly of a pair of flexible conductive elements and a pair of conductive tubes. An inner radial region of the conductive tube is provided with a substantial conductive surface that is adapted to contact with an outer periphery of the flexible conductive element, which reduces substantially the electrical resistance and increases electrical conductivity. In addition, a coupling rod and two conductive members may be disposed through each conductive tube to interact with the flexible conductive element for providing a more secure construction. Further, a front rotary plate and a rear rotary plate may also be respectively provided on a contact end of the first and second clutch. The front rotary plate includes a front conductive ring, and the rear rotary plate includes rear conductive ring radially offset from the front conductive ring. When the first and second clutches engage each other, the electrical contact achieved via the front and rear conductive rings is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] So that the manner in which the above recited features of the present invention can be understood in detail, a more particular description of the invention, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only typical embodiments of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

[0005] FIG. 1 is a perspective view of an electronic lock according to an embodiment of the present invention;

[0006] FIG. 2 is an exploded view of an embodiment of the present invention;

[0007] FIG. 3A is an exploded view of a first clutch according to an embodiment of the present invention;

[0008] FIG. 3B is an exploded view of a first clutch according to another embodiment of the present invention;

[0009] FIG. 4 is an exploded view of a second clutch according to an embodiment of the present invention;

[0010] FIG. 5 is a side view of an electronic lock according to an embodiment of the present invention;

[0011] FIG. 6A is a cross-sectional view of an electronic lock according to an embodiment of the present invention;

[0012] FIG. 6B is a partial cross-sectional view of an electronic lock according to an embodiment of the present invention;

[0013] FIG. 7 is an exploded view of the first and second clutch according to an embodiment of the present invention;

[0014] FIG. 8 is a cross-sectional view of a front rotary plate and a rear rotary plate according to an embodiment of the present invention;

[0015] FIG. 9 is an exploded view of another embodiment of the present invention; and

[0016] FIG. 10 is a cross-sectional view of another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] An embodiment of an electronic lock is illustrated in the perspective view of FIGs. 1 and 2 and the exploded view of FIG. 3A. As shown, the embodiment comprises a lock barrel 10 having an end coupled to a signal

receiver 20 and another end coupled to a controller device 30. The lock barrel 10 has a hollow interior 102 defined longitudinally therein and a notch 101 defined in a central portion thereof for mounting a first clutch 11 and a second clutch 12. The first clutch 11 comprises a hollow tube having one end adapted to operatively engage with and disengage from the second clutch 12. A front rotary plate 112 is provided to an outer periphery of the first clutch 11. A cylindrical interior of the first clutch 11 includes a pair of conductive tubes 115, a pair of springs 116, and a pair of probe 117. Each conductive tube 115 is a precisely machined tube having a hollow interior adapted to receive one spring 116. Each spring 116 is made of an electrically conductive metallic material. The body of each spring 116 is mounted tightly against the inner sidewall of each conductive tube 115 so that increased electrical conductivity and reduced electrical resistance can be achieved when electric charges are transmitted through the spring 116 and the conductive tube 115. Each probe 117 is electrically conductive and is disposed at one end of one conductive tube 115 to establish electrical connection. Each probe 117 abuts against one spring 116. Through the resiliency of the spring, each probe 117 is urged in contact with the second clutch 12. When the second clutch 12 is in rotation, the electrical connection between the first clutch 11 and second clutch 12 can thereby be continuously maintained.

[0018] As shown in FIG. 4, the first clutch 11 is coupled to the second clutch 12 through the hollow interior 102. The second clutch 12 includes a hollow tube body in which are disposed a motor fixing frame 121 and a leaf spring 122 for fixing a motor 123, an actuator 124 and a spring 126. The actuator 124 is securely fixed to a rotation axis of the motor 123. Further, the actuator 124 is connected to a rear clutch 127 via a torsion spring. An end of the second clutch 12 facing the first clutch 11 is coupled to a rear rotary plate 125. A surface of the rear rotary plate 125 corresponding to the first clutch 11 is electrically conductive. In addition, the rear rotary plate 125 has two conductive tubes 1254 mounted to two openings of the second clutch 12. The conductive tubes 1254 have the same functions as the conductive tubes 115 on the first clutch. Each conductive tube 1254 is a hollow conductive tube adapted to mount over one spring 126 and probe 1261. Once assembled in the conductive tube 1254, an outer radius of the spring 126 abuts against the inner surface of the conductive tube 1254 so as to increase electrical conductivity and reduce electrical resistance. A cam 13 is mounted at the notch 101 of the lock barrel 10 and around an outer surface of the second clutch 12.

[0019] The signal receiver 20 assembled at an end of the lock barrel 10 includes a front rotary portion 22 in which is disposed a signal receiving circuit 21 adapted to receive signals and alerts. The front rotary portion 22 includes a sleeve 23 disposed around an outer periphery thereof, and a front cover 24 at a front end thereof. An opposite end of the lock barrel 10 is mounted with a controller device 30 mainly comprised of a rear rotary portion 31 provided with a rear cover 32. The controller device 30 is adapted to control and supply power to the motor 123 and the front rotary portion 22. Further, an outer periphery of the rear rotary portion 31 is mounted with a sleeve 33. The assembly and functionality of the signal receiver 20, the controller device 30 and the lock barrel 10 may be similar to a conventional construction.

[0020] FIG. 3B is an exploded view of another embodiment of the present invention. Depending on the different configuration of the door leaf on which the electronic lock is mounted, the lock barrel 10 described above may need a more secure structural configuration, especially with respect to the component parts exposed outward such as the conductive tubes 115, the spring 116 and the probes 117. This embodiment incorporates an additional security device so that the overall structure is more secure. More particularly, one feature the embodiment includes the addition of a coupling rod 113 that extends perpendicular to the body of the first clutch 11 and passes through its interior where the conductive tubes 115, the springs 116 and the probes 117 are disposed. The coupling rod 113 is formed from two semi-circular bodies, each of which has two opposite end surfaces symmetrically provided with a slot. When the two semi-circular bodies are coupled to each other to form the coupling rod 113, two accommodating spaces are thereby defined to receive a conductive member 114 respectively. After the coupling rod 113 passes through the first clutch 11, the two accommodating spaces and the conductive members 114 divide the interior space of the first clutch 11 into two space volumes. In this embodiment, two sets of the conductive tubes 115, the springs 116 and the probes 117 are provided, thus each set being configured with a shorter length adapted to assemble in each of the two space volumes. More particularly, the two sets of the conductive tubes 115, the springs 116 and the probes 117 are respectively coupled to the conductive members 114 so as to form a flexibly electrical connection. The conductive member 114 may have a spherical shape, and its stiffness may be greater than that of the conductive tubes 115, the springs 116 and the probes 117. A safety separator element can thereby be advantageously provided.

[0021] With reference to FIG. 5 in conjunction with FIGs. 6A and 6B, in operation, the signal receiver 20 drives the controller device 30 to generate and control a power supply to drive the second clutch 12 moving toward the first clutch 11, thereby achieving the safety control mechanism for the overall structure. With the provided configuration of the conductive tubes 115, springs 116 and the probes 117, the electric current not only passes through the springs 116 and the probes 117, but also flows through the walls of the conductive tubes 115/1254 having higher electrical conductivity and lower electrical resistance. As a result, the relatively weak electric current can thereby be effectively transmitted to control the signal receiver 20 and the controller device 30 in a more efficient

manner. The problems of the prior arts induced by an inefficient electrical conductivity in the conventional structure can thereby be solved. It is worth noting that the conductive tubes 115 may also be replaced with multiple copper fingers or other electrically conductive materials abutting against an outer or inner surface of the springs 116. Moreover, if a more secure construction is required, the placement of the coupling rod 113 and the conductive members 114 can work as a safety separator element between the conductive tubes 115, the springs 116 and the probes 117 of relatively weaker constitution. When the structure is applied an external shock, the coupling rod 113 and the conductive members 114 with higher stiffness are able to actively interrupt the electrical connection between the two sets of conductive tubes 115, the springs 116 and the probes 117. A more safety can therefore be obtained.

[0022] Referring to FIG. 7, another embodiment of the present invention may also provide a modified design for the front rotary plate 112 and the rear rotary plate 125. As described previously, after the first clutch 11 and the second clutch 12 operatively engage with each other, the controller device 30 acts to supply power and output signals to the signal receiver 20 for operating the other structural parts. Power control hence can be used to provide higher security. However, the clutching action is performed via a rotary movement. To ensure that the electrical connection produce the greatest contact power, two rotary plates are used to establish electrical connection. More particularly, the opposing contact surfaces of the front rotary plate 112 and rear rotary plate 125 are configured as two annular surfaces. Moreover, each of the contact surfaces includes a through hole and conductive ring corresponding thereto. As shown, an embedded front conductive ring 1121 is provided to an outer periphery of the front rotary plate 112, and two through holes 1252 are defined on the contact locations of the rear rotary plate 125. The through holes are extension of the conductive tube 1254 for passage of the probes 1261. After the rotary engagement is effected, an end of each probe 1261 abuts against the front conductive ring 1121 to establish electrical connection. The rear rotary plate 125 also includes a rear conductive ring 1251 located radially inward from the positions of the through holes 1252. Further, two through holes 1252 are also provided on contact locations of the front rotary plate 112. The through holes 1252 on the front rotary plate 112 are extension of the conductive tubes 115 for passage of the probes 117. After the rotary engagement is effected, an end of each probe 117 abuts against the rear conductive ring 1251 to establish electrical connection. Referring to FIG. 8, through the contact realized between the front rotary plate 112 and rear rotary plate 125, power and electric signals can accurately control in a peripheral direction the engagement and disengagement movements during rotation.

[0023] FIGs. 9 and 10 illustrate another embodiment of the present invention. Because the applied control signals may have different characteristics, the electrical and signal connection between the first clutch 11 and second clutch 12 can also be realized through a single annular area engagement. More particularly, the front rotary plate 112 of the first clutch 11 can be mounted at the clutch end via a single conductive tube 115, single spring 116 and single probe 117. In addition, the rear rotary plate 125 of the second clutch 12 can include a single set of rear conductive ring 1251, spring 126 and probe 1261. The rear conductive ring 1251 includes an outward extension 1253 at end of the conductive tube 1254.

The outward extension 1253 is configured to overlap with an end of the conductive tube 1254 and in contact with the probe 1261 to establish electric and signal connection. When the first clutch 11 and second clutch 12 approaches each other, the rear conductive ring 1251 is abutted by the probe 117 to also establish electric and signal connection. Another possible function of operation control can thereby provided.

[0024] As described above, the construction provided herein thus not only can substantially reduce electrical resistance and increase the electrical conductivity, but is also able to provide improved electrical contact during an engagement operation of the clutches.

[0025] While the foregoing is directed to embodiments of the present invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

Claims

1. An electronic lock, comprising:

a signal receiver adapted to transmit and receive a control signal, and emit an alert signal;
a controller device configured to exchange a signal with the signal receiver to control an operation sequence of the electronic lock, wherein the controller device includes a power supply adapted to electrically connect with other component parts of the electronic lock;
an electronic lock barrel including a first clutch, a second clutch and a driving element, wherein each of the first and second clutch includes at least one flexible conductive element and one conductive tube, the flexible conductive element is arranged in the conductive tube, the flexible conductive element includes a conductive flexible member and a conductive end, the driving element is configured to drive the operation of the first and second clutches, the first and second clutch respectively includes a first contact end and a second contact end, and the first contact end and the second contact end are configured to enter in contact with the flexible conductive element to establish electrical connection

when the first and second clutches engage to each other.

2. The electronic lock according to claim 1, wherein a coupling rod is disposed through an adequate location of the first and/or second clutch, the coupling rod is formed from two rod bodies on which are provided with two accommodating slots, each accommodating slot includes a conductive material, the two coupling rod bodies and the conductive material are respectively coupled to a corresponding flexible conductive element and conductive tube for establishing electrical connection.

3. The electronic lock according to claim 2, wherein the conductive material in each accommodating slot is electrically conductive and has a higher stiffness than the flexible conductive element and the conductive tube for providing a safety separation function.

4. The electronic lock according to claim 1, wherein the conductive flexible member of the flexible conductive element includes a spring.

5. The electronic lock according to claim 1, wherein the conductive end of the flexible conductive element mainly includes a probe adapted to be coupled to one end of the conductive flexible member and the conductive tube.

6. The electronic lock according to claim 1, wherein the conductive tube is formed from multiple copper fingers and abuts against an outer surface or an inner surface of the spring.

7. The electronic lock according to claim 1, wherein the front rotary plate includes a front conductive ring and at least one first through hole adapted to connect with the conductive end of the first clutch.

8. The electronic lock according to claim 1, wherein the rear rotary plate includes a rear conductive ring and at least one second through hole adapted to connect with the conductive end of the second clutch.

9. The electronic lock according to claim 1, wherein the driving element is one of a motor and an electromagnetic valve for driving forward and rearward movements.

10. The electronic lock according to claim 7, wherein the front conductive ring is adapted to separably contact with the second through hole, and the rear conductive ring is adapted to separably contact with the first through hole.

11. The electronic lock according to claim 8, wherein the front conductive ring is adapted to separably contact with the second through hole, and the rear conductive ring is adapted to separably contact with the first through hole.

12. The electronic lock according to claim 1, wherein the first contact end includes a front rotary plate and the second contact end includes a rear rotary plate.

Amended claims in accordance with Rule 137(2) EPC.

1. An electronic lock, comprising:

a signal receiver (20) adapted to transmit and receive a control signal, and emit an alert signal;
a controller device (30) configured to exchange a signal with the signal receiver to control an operation sequence of the electronic lock, wherein the controller device includes a power supply adapted to electrically connect with other component parts of the electronic lock;
an electronic lock barrel including a first clutch (11), a second clutch (12) and a driving element (123), the driving element being configured to drive the operation of the first and second clutches, the first and second clutches respectively including a first contact end (112) and a second contact end (125),

characterized in that each of the first and second clutches includes at least one flexible conductive element (116, 117) and one conductive support element (115), the flexible conductive element is arranged adjacent to the conductive support element and the conductive support element has a substantial conductive surface in electrical contact with the flexible conductive element,
in that the flexible conductive element includes a conductive flexible member (116) and a conductive end (117),
and **in that** the first contact end (112) and the second contact end (125) are configured to enter in contact with the flexible conductive element (116) to establish electrical connection when the first and second clutches engage each other.

2. The electronic lock according to claim 1, wherein a coupling rod (113) is disposed through a chosen location of the first (11) and/or second (12) clutch, the coupling rod is formed from two rod bodies on which are provided with two accommodating slots, each accommodating slot includes a conductive material, the two coupling rod bodies and the conductive material are respectively coupled to a corresponding flexible conductive element (116, 117) and conductive support element (115) for establishing electrical connection.

3. The electronic lock according to claim 2, wherein the conductive material in each accommodating slot is electrically conductive and has a higher stiffness than the flexible conductive element (116) and the conductive support element (115) for providing a safety separation function.

4. The electronic lock according to claim 1, wherein the conductive flexible member of the flexible conductive element includes a spring (116).

5. The electronic lock according to claim 1, wherein the conductive end of the flexible conductive element mainly includes a probe (117) adapted to be coupled to one end of the conductive flexible member (116) and the conductive support element (115).

6. The electronic lock according to claim 1, wherein the conductive support element (115) is formed from multiple copper fingers and abuts against an outer surface or an inner surface of the conductive flexible member (116).

7. The electronic lock according to claim 1, wherein the first contact end includes a front rotary plate (112) and the second contact end includes a rear rotary plate (125).

8. The electronic lock according to claim 7, wherein the front rotary plate (112) includes a front conductive ring (1121) and at least one first through hole adapted to connect with the conductive end of the first clutch (11).

9. The electronic lock according to claim 7, wherein the rear rotary plate (125) includes a rear conductive ring (1251) and at least one second through hole (1252) adapted to connect with the conductive end of the second clutch (12).

10. The electronic lock according to claim 1, wherein the driving element is one of a motor (123) and an electromagnetic valve for driving forward and rearward movements.

11. The electronic lock according to claim 8 and claim 9, wherein the front conductive ring (1121) is adapted to separably contact with the second through hole (1252), and the rear conductive ring (1251) is adapted to separably contact with the first through hole.

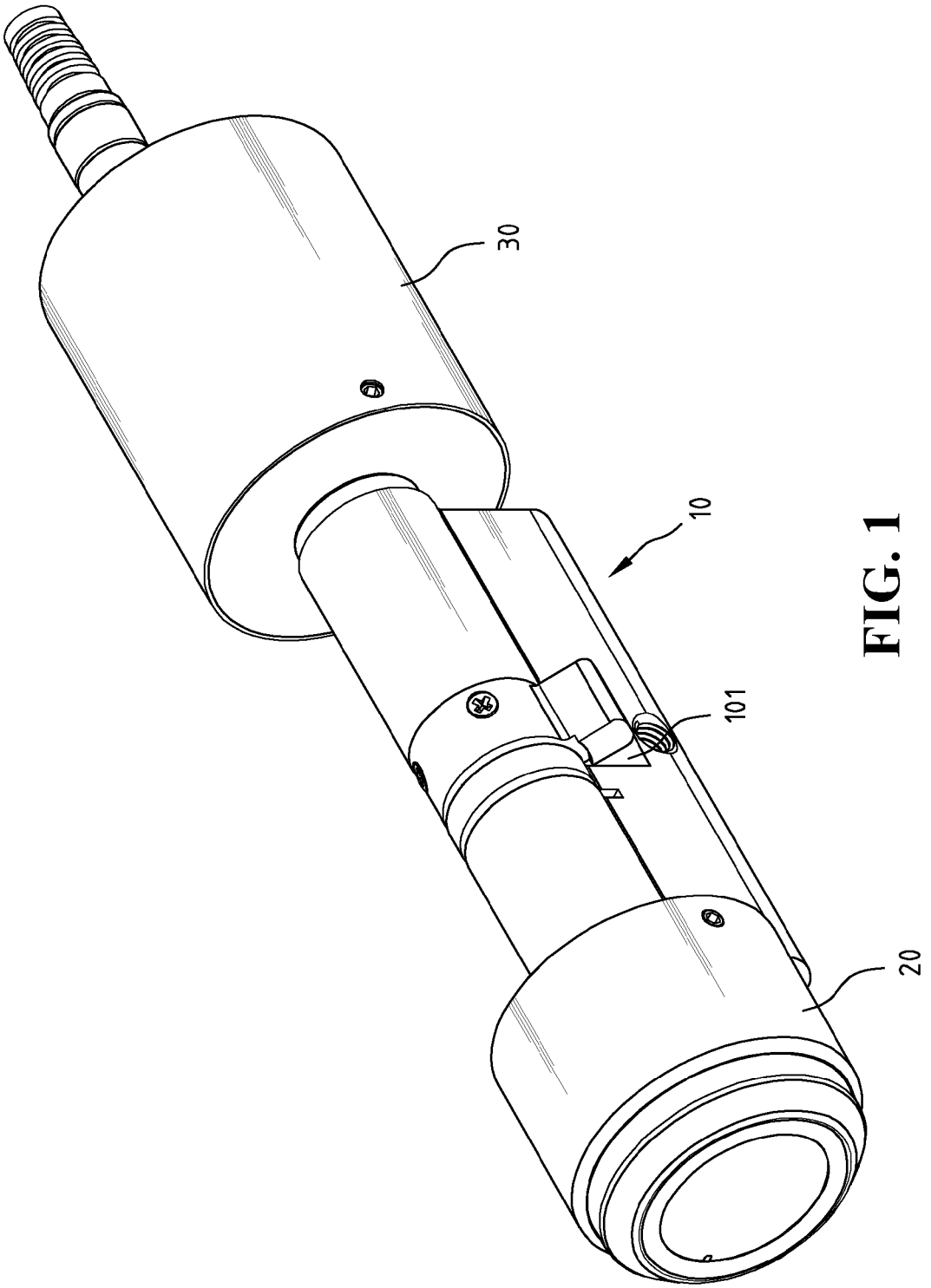

FIG. 1

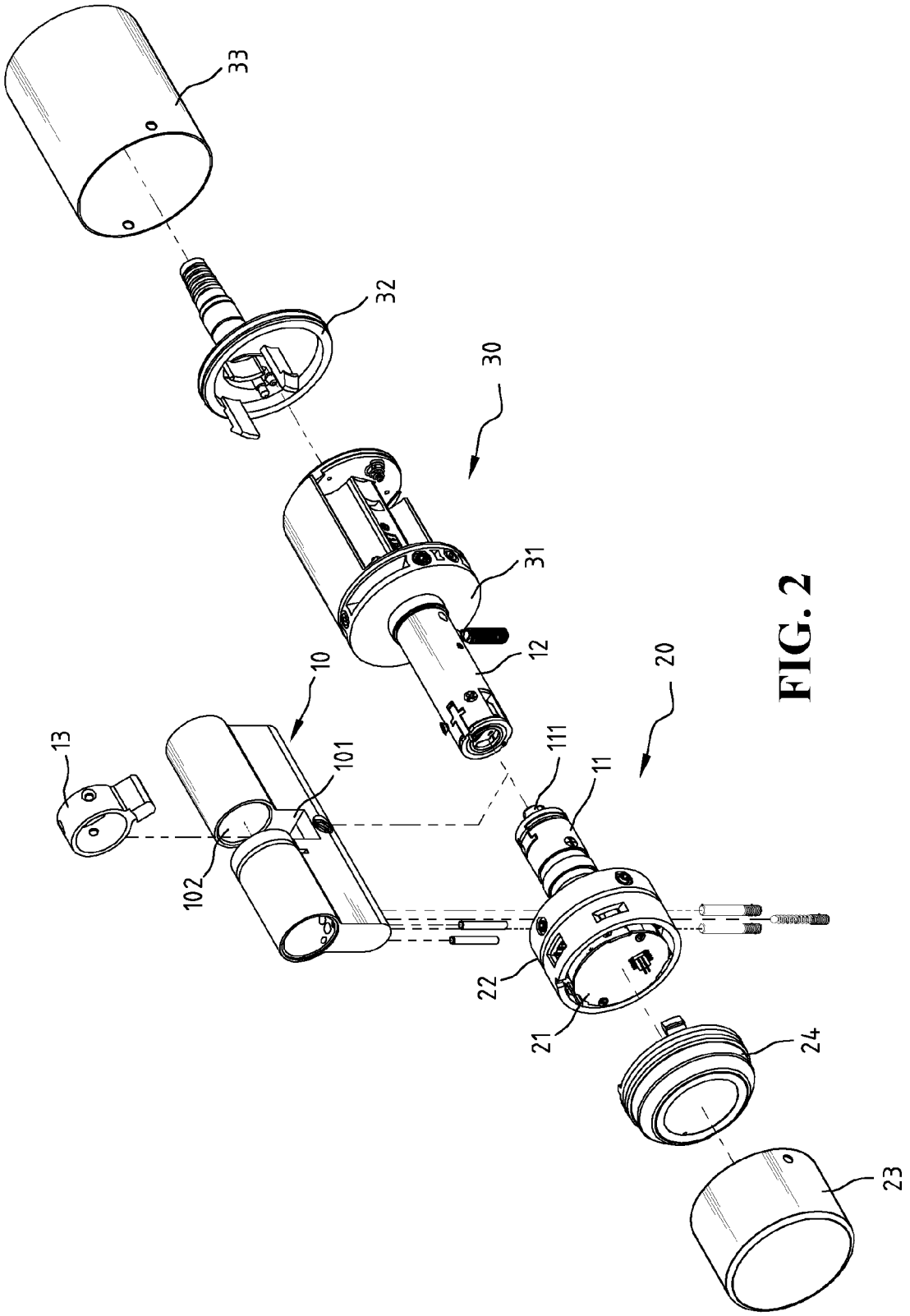

FIG. 2

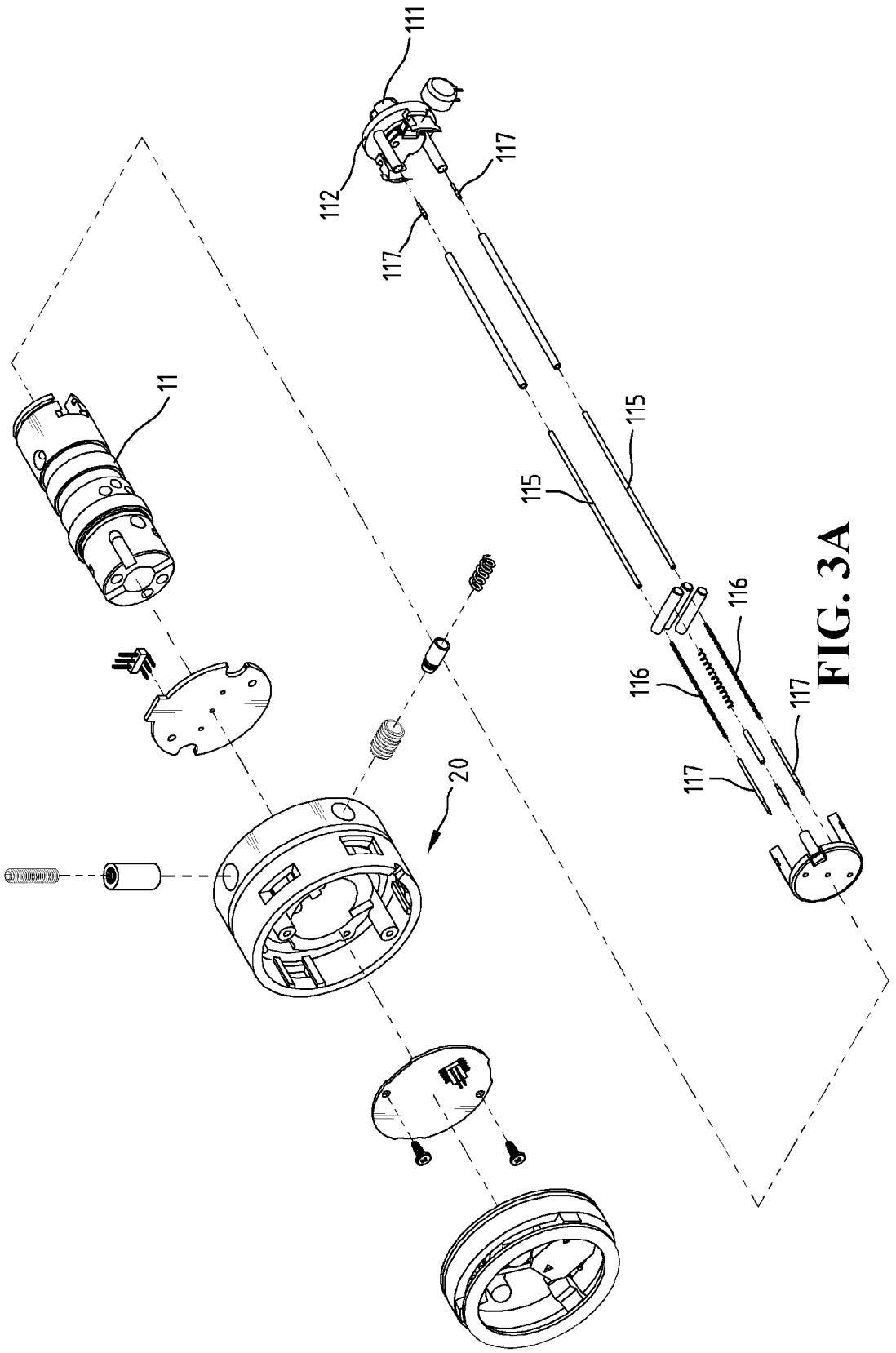

FIG. 3A

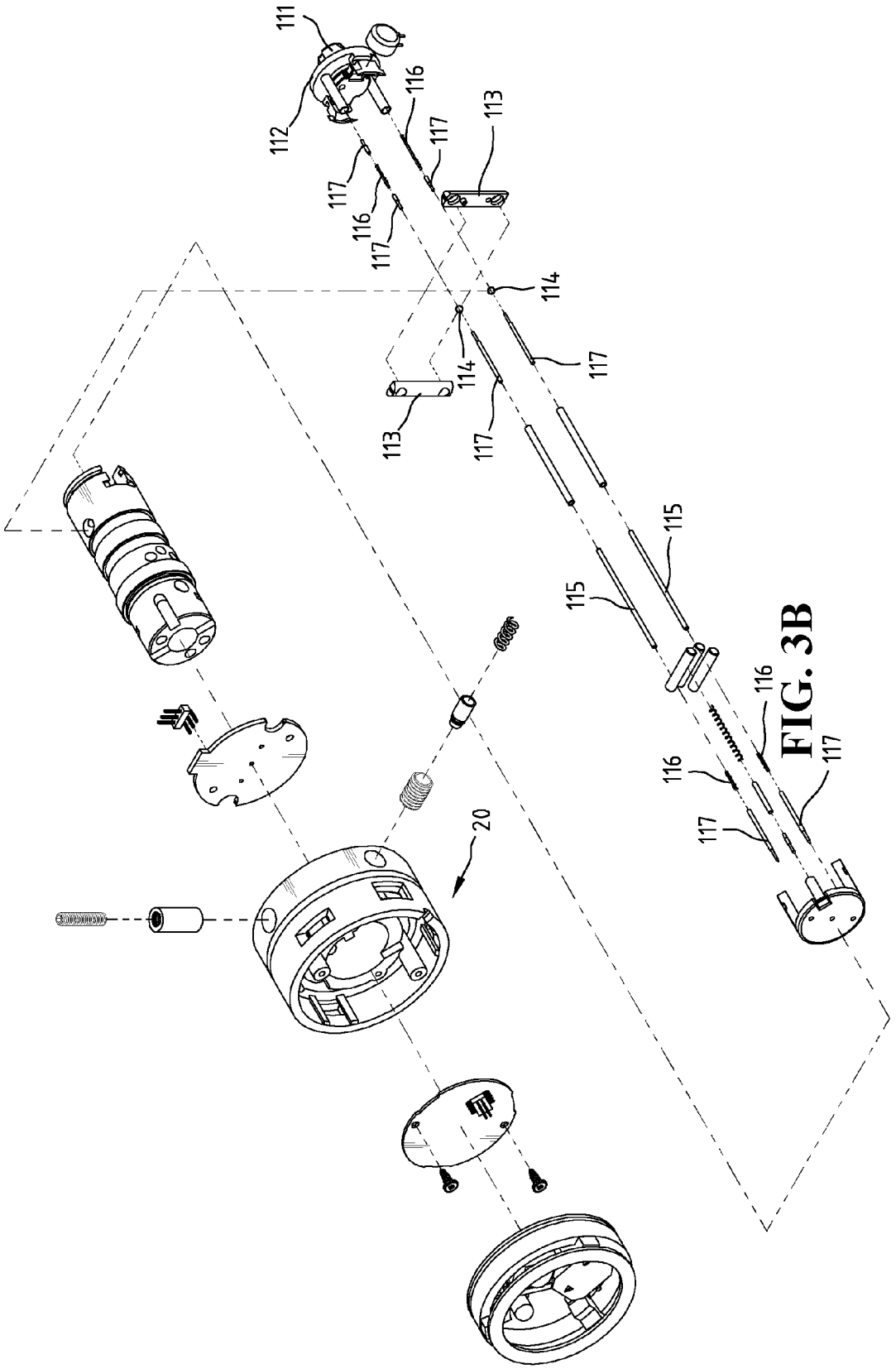
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FIG. 3B

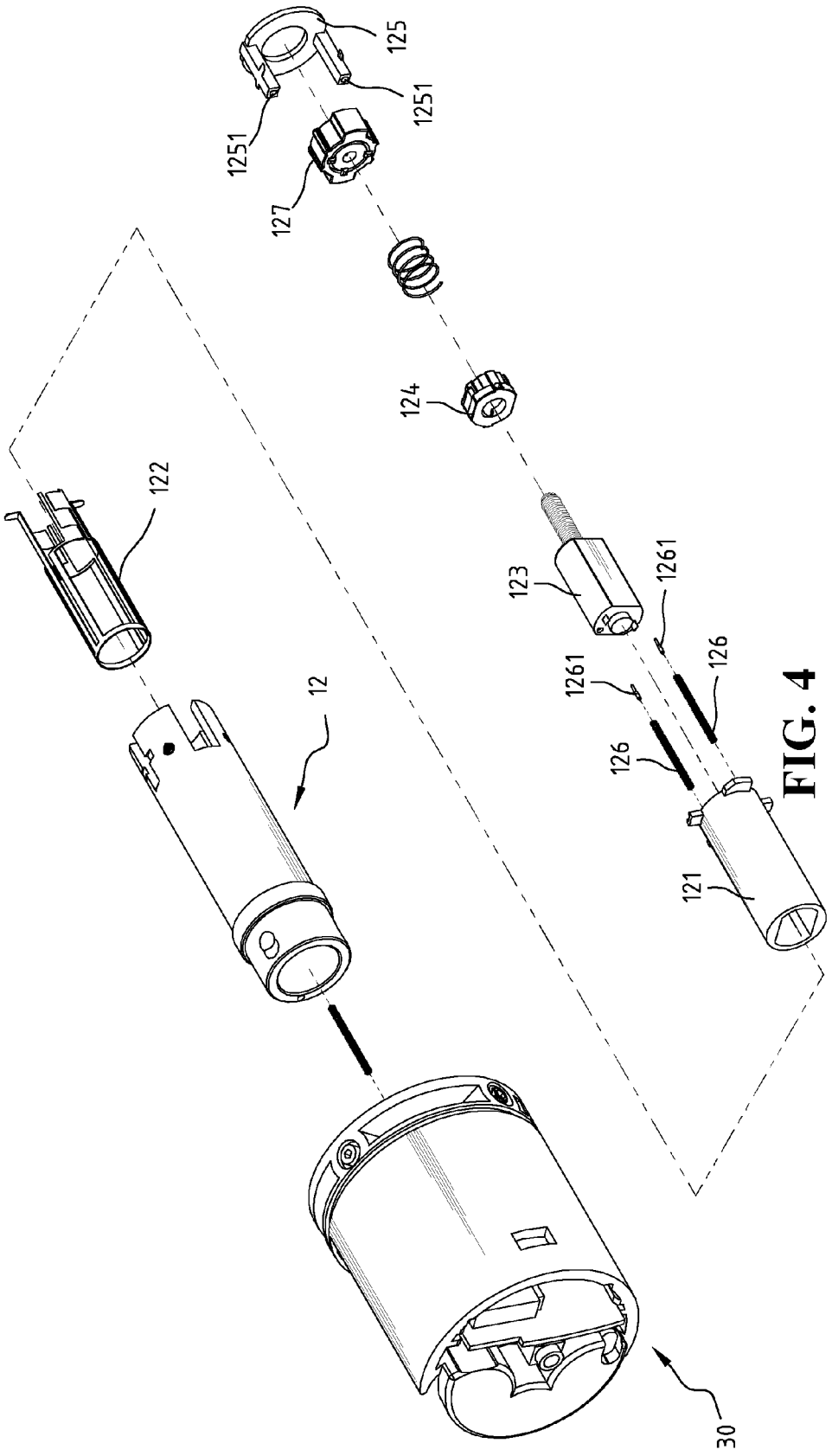

FIG. 4

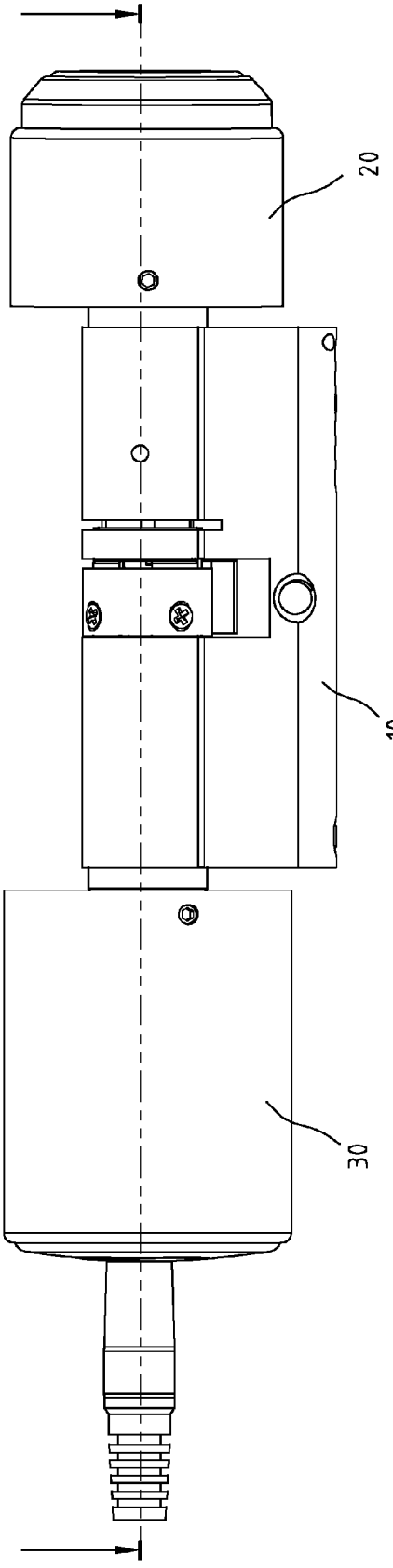

FIG. 5

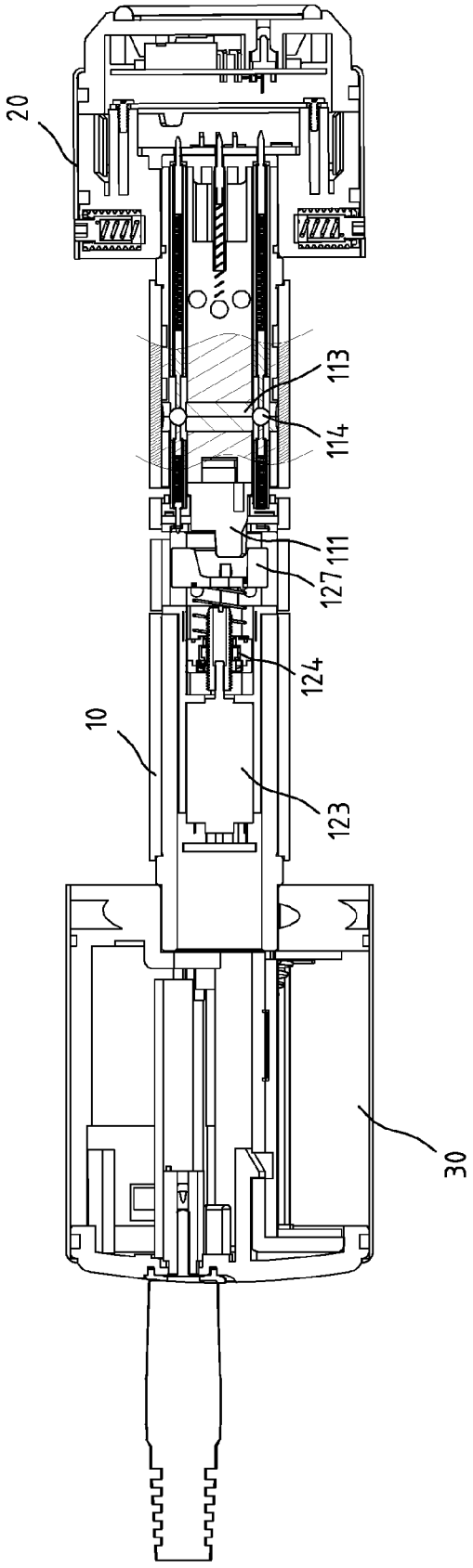

FIG. 6A

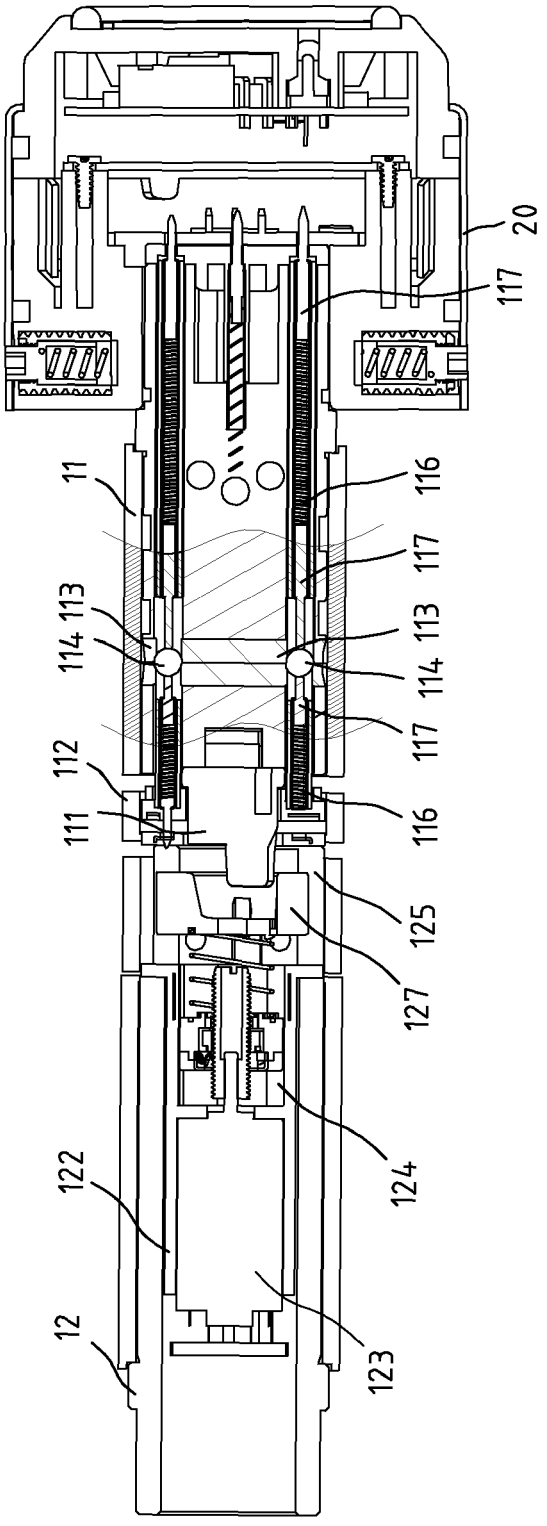
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FIG. 6B

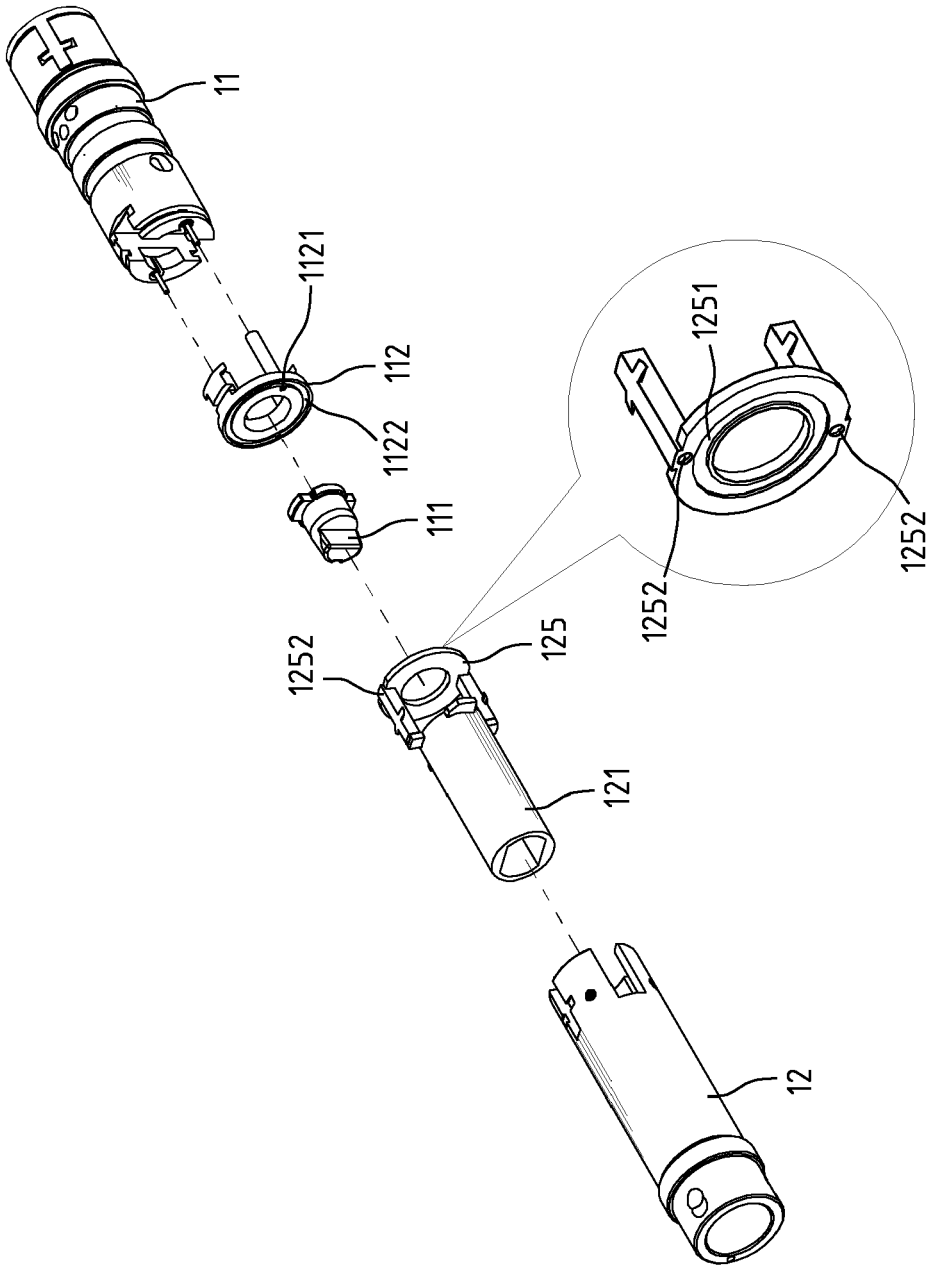

FIG. 7

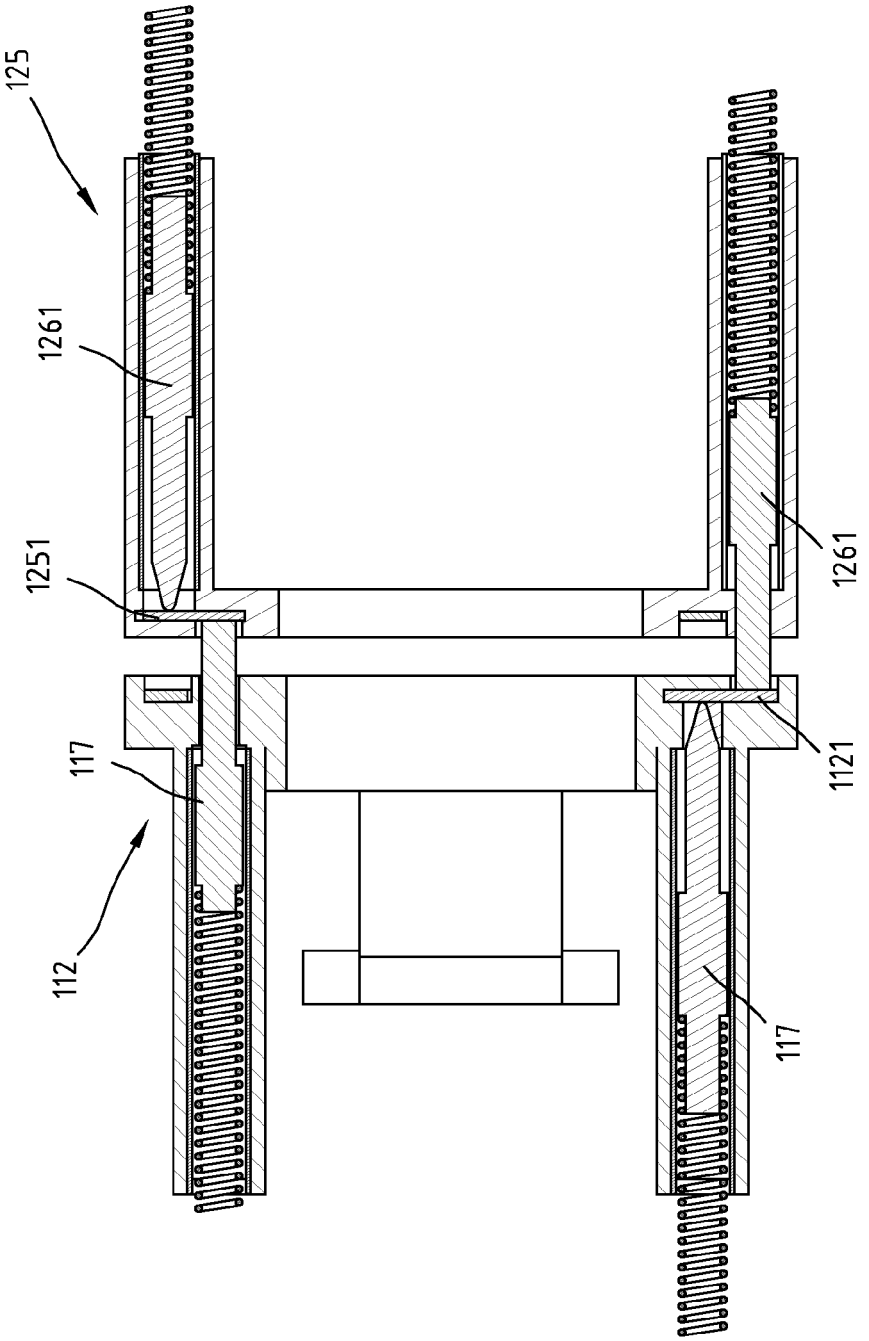

FIG. 8

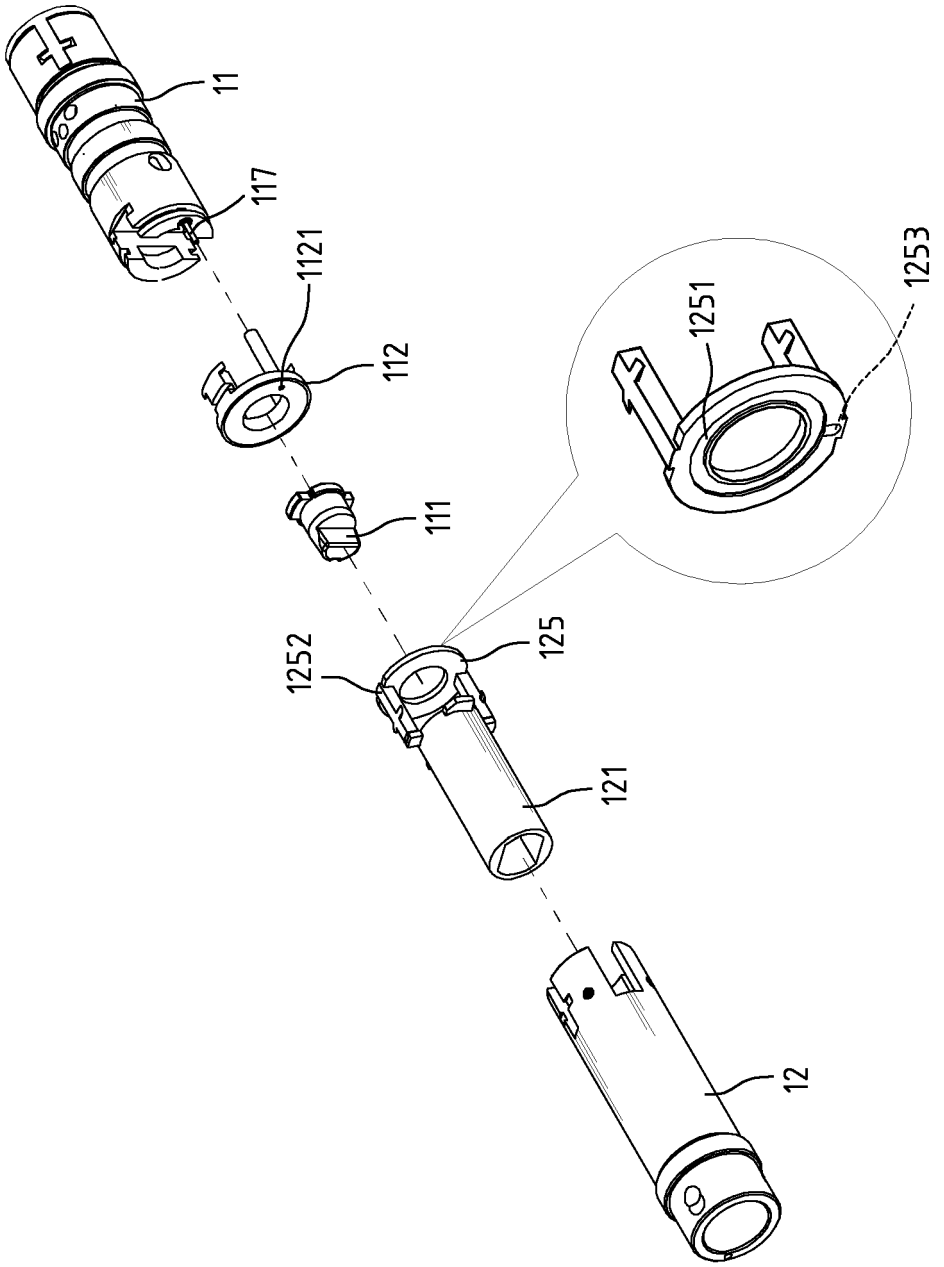

FIG. 9

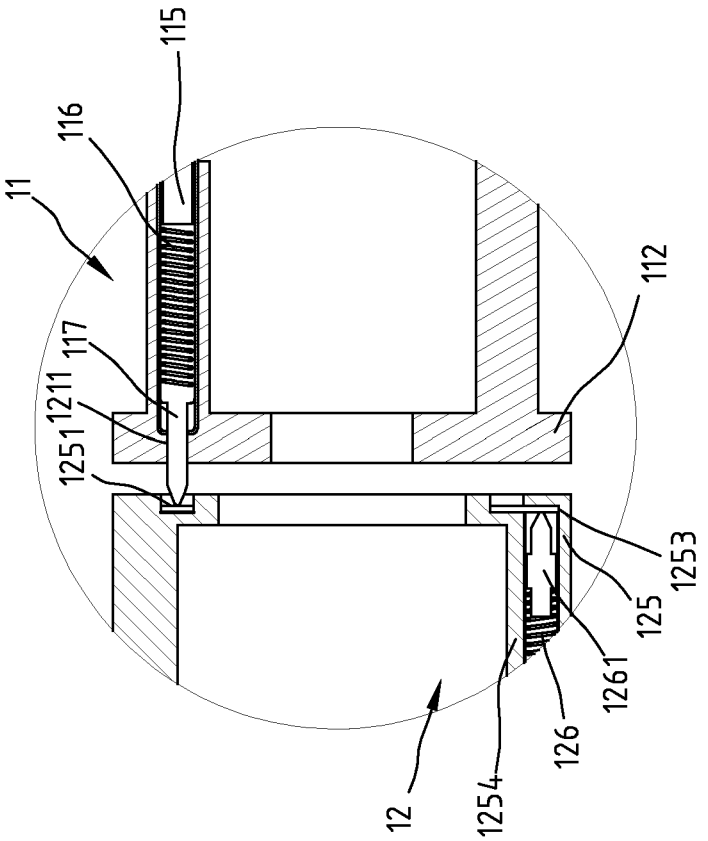

FIG. 10

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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 08 10 5427

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	EP 1 707 712 A (WFE TECHNOLOGY CORP) 4 October 2006 (2006-10-04) * paragraph [0008] - paragraph [0035]; figures 1-10 *	1	
A	EP 0 995 864 A (UHLMANN GUENTER) 26 April 2000 (2000-04-26) * paragraph [0063] - paragraph [0066]; figures 1-3b *	1	
A	DE 10 2004 063126 B3 (HEWI HEINRICH WILKE GMBH) 1 June 2006 (2006-06-01) * paragraph [0036]; figure 5 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

E05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	24 March 2009	Perez Mendez, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 10 5427

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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24-03-2009

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