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(54) FASTENING DEVICE AND TIE LINE ASSEMBLING METHOD

(57) The present invention provides a fastening device, comprising a housing, a reel, a knob, and a detent unit. The housing comprises a shell, a base, and a snap-fit portion. The shell comprises an accommodating space, the base is detachably connected to the shell, and the snap-fit portion is located in the shell. The reel is accommodated in the accommodating space and is used for winding a tie line. The knob comprises an insertion portion corresponding to the snap-fit portion. The detent unit is accommodated in the accommodating space. Thus, by means of the structural configuration of the fastening device, the assembling ease of the fastening device can be improved.

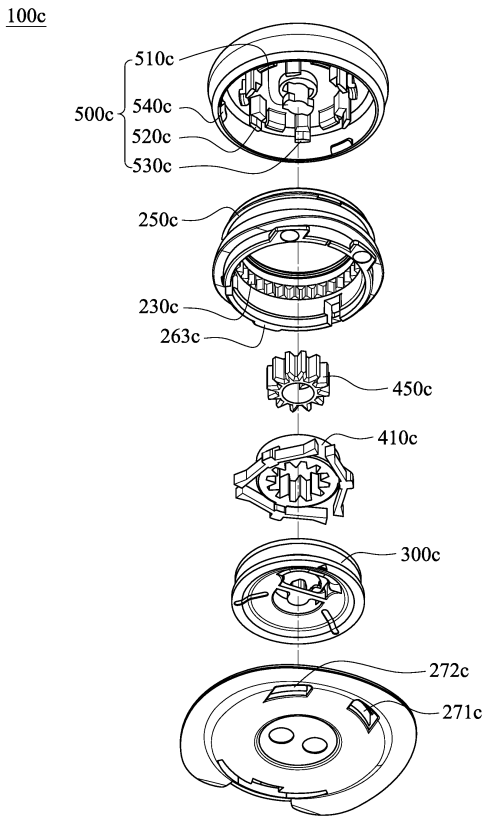

Fig. 3

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Description

Technical Field

[0001] The present disclosure relates to a fastening device and a lace assembling method. More particularly, the present disclosure relates to a fastening device and a lace assembling method for securing an article through releasing or tensioning a lace.

Description of Related Art

[0002] In daily life, cords, such as a lace or a thread, are usually used to tighten articles. The most common tightening method is to use the cord to reciprocately pass through holes on the article, such as eyelets of a shoe, and then tie a knot to secure the article. But in this kind of tightening method, the knot is loosened easily because of an external force. Not only does the knot need to be tied again, but also lots of inconveniences come owing to the insecurity of the articles.

[0003] In order to solve such problems, some practitioners developed a simple fastening mechanism including a case, a driving unit and a spring. The case includes holes configured for the lace to pass therethrough. Through the reaction force between the spring and the driving unit, the lace can be clamped between the driving unit and the case so as to be fastened. The length of the lace can be changed by pressing the spring to change the position of the driving unit. However, in such fastening mechanism, the restoring force of the spring is served as the securing force; thus, the lace is easily to be released owing to vibrations or an external force. In addition, the fastening mechanism has no space to receive the lace, and the exposure of the lace may bring danger.

[0004] Therefore, some practitioners developed another kind of buckle which can be rotated to tension the lace, and the lace can be received inside the buckle. Through the interference between components inside the buckle, the length of the lace as well as the tightness can be adjusted. However, the structure of the buckles is complex; as a result, the manufacturing cost is increased, and the buckle has assembly and repair difficulty. In addition, when the lace is broken and needs to be replaced, it is difficult to remove and assemble the lace, which is a problem has to be solved.

Disclosure of Invention

[0005] A fastening device is provided according to one embodiment of the present disclosure, which is applied for tensioning or releasing a lace, the fastening device includes a case, a spool, a knob and a locking unit. The case includes a housing, a base and a mounted portion, the housing includes a receiving space, the base is detachably connected to the housing, and the mounted portion is located on the housing. The spool is received in the receiving space and configured for the lace to be wound therearound. The knob includes an engaged portion for corresponding to the mounted portion. The locking unit is received in the receiving space. When the knob is rotated relative to the case in a tensioning direction, the spool is not affected by the locking unit, and the spool is allowed to rotate in the tensioning direction for tensioning the lace.

[0006] Therefore, through the configuration of the fastening device, the ease of assembling the fastening device can be increased.

[0007] According to examples of the aforementioned fastening device, when rotating the knob relative to the case in a releasing direction, the locking unit is switched from a first position to a second position along an axial direction, and when the locking unit is at the first position, the locking unit is coupled to the spool to prohibit the spool from rotating in the releasing direction; when the locking unit is at the second position, the spool is allowed to be rotated toward the releasing direction.

[0008] According to examples of the aforementioned fastening device, the locking unit can include an engaging disc and an inner gear, the engaging disc includes a central hole, the inner gear is movably located in the central hole, and, when the knob is rotated relative to the case in the releasing direction, the inner gear is switched from the first position to the second position.

[0009] According to examples of the aforementioned fastening device, the knob can include a screw post, the screw post protrudes downward to engage with a screw hole of the inner gear, when the knob is rotated relative to the case in the releasing direction, the screw hole is guided by the screw post, and the inner gear is allowed to be switched from the first position to the second position.

[0010] According to examples of the aforementioned fastening device, the spool can include a first opening, a second opening and at least one sloped surface, and a first end of the lace passes through the first opening toward the at least one sloped surface.

[0011] According to examples of the aforementioned fastening device, a number of the at least one sloped surface is one, the first end of the lace passes through the first opening toward the sloped surface, and a second end of the lace passes through the second opening toward the sloped surface.

[0012] According to examples of the aforementioned fastening device, which can further include a controlling set, the controlling set inserts the knob and is coupled to the locking unit, push or press the controlling set to release a coupling between the locking unit and the spool, and the spool is allowed to rotate freely.

[0013] According to examples of the aforementioned fastening device, the controlling set can include two clamping arms, and the two clamping arms are coupled to the locking unit.

[0014] According to examples of the aforementioned fastening device, the controlling set can include a restricting member, a screw and a bushing, the restricting mem-

ber inserts the knob, the bushing is restricted in the locking unit, and the screw passes through the bushing upward to screw into the restricting member.

[0015] According to examples of the aforementioned fastening device, the controlling set can include a controlling bar and a screw, the controlling bar inserts into the knob, and the screw is restricted in the locking unit and is fastened with the controlling bar.

[0016] According to examples of the aforementioned fastening device, the locking unit can include at least one pawl arm, the knob includes at least one protruding column, and as the knob is rotated in the releasing direction, the at least one protruding column displaces the at least one pawl arm.

[0017] According to examples of the aforementioned fastening device, which can further include a ratchet ring, the case includes a plurality of inner teeth, the ratchet ring is disposed at the case and includes a plurality of lower sloped teeth, a plurality of upper sloped teeth and a plurality of ratchet teeth, each of the lower sloped teeth and each of the upper sloped teeth are located at an outer surface of the ratchet ring, each of the lower sloped teeth is located below each of the upper sloped teeth to correspond to each of the inner teeth, and each of the ratchet teeth is located at an inner surface of the ratchet ring.

[0018] A lace assembling method is provided according to another embodiment of the present disclosure, which is applied for connecting a lace to a fastening device, the lace assembling method includes a fastening device providing step and a lace coupling step. In the fastening device providing step, the fastening device is provided, the fastening device include a case, a spool, a knob and a locking unit, the case includes a housing, a base and a mounted portion, the base is detachably connected to the housing, the mounted portion is located at the housing, the knob includes an engaged portion for corresponding the mounted portion, and the spool and the locking unit are disposed inside the housing. In the lace coupling step, a first end of the lace and a second end of the lace are exposed from the housing after passing through the housing and the spool, the first end and the second end are knotted, and the lace is allowed to be coupled to the spool.

[0019] According to examples of the aforementioned lace assembling method, the case further can include two side holes, the spool includes a first opening and at least one sloped surface, and the first end passes through one of the side holes and the first opening toward the at least one sloped surface.

[0020] According to examples of the aforementioned lace assembling method, a number of the sloped surface can be one, and after the first end passes through the one of the side holes and the first opening toward the sloped surface, the second end passes through another one of the side holes and a second opening toward the sloped surface.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 shows a three dimensional schematic view of a fastening device according to a 1st embodiment of the present disclosure;

Fig. 2 shows one exploded view of the fastening device of the 1st embodiment of Fig. 1;

Fig. 3 shows another exploded view of the fastening device of the 1st embodiment of Fig. 1;

Fig. 4 shows a partial top view of the fastening device of the 1st embodiment of Fig. 1;

Fig. 5 shows a cross-sectional view of the fastening device of the 1st embodiment of Fig. 4 taken along Line 5-5;

Fig. 6 shows a cross-sectional view of a fastening device according to a 2nd embodiment of the present disclosure;

Fig. 7 shows one exploded view of a fastening device according to a 3rd embodiment of the present disclosure;

Fig. 8 shows another exploded view of the fastening device of the 3rd embodiment of Fig. 7;

Fig. 9 shows a partial cross-sectional view of the fastening device of the 3rd embodiment of Fig. 7 coupled to a lace;

Fig. 10 shows one exploded view of a fastening device according to a 4th embodiment of the present disclosure;

Fig. 11 shows another exploded view of the fastening device of the 4th embodiment of Fig. 10;

Fig. 12 shows a cross-sectional view of the fastening device of the 4th embodiment of Fig. 10;

Fig. 13 shows one exploded view of a fastening device according to a 5th embodiment of the present disclosure;

Fig. 14 shows another exploded view of the fastening device of the 5th embodiment of Fig. 13;

Fig. 15 shows a cross-sectional view of the fastening device of the 5th embodiment of Fig. 13;

Fig. 16 shows an exploded view of a fastening device according to a 6th embodiment of the present dis-

closure;

Fig. 17 shows a cross-sectional view of the fastening device of the 6th embodiment of Fig. 16;

Fig. 18 shows one exploded view of a fastening device according to a 7th embodiment of the present disclosure;

Fig. 19 shows another exploded view of the fastening device of the 7th embodiment of Fig. 18;

Fig. 20 shows a cross-sectional view of the fastening device of the 7th embodiment of Fig. 18;

Fig. 21 shows an exploded view of a fastening device according to an 8th embodiment of the present disclosure;

Fig. 22 shows a cross-sectional view of the fastening device of the 8th embodiment of Fig. 21;

Fig. 23 shows one exploded view of a fastening device according to a 9th embodiment of the present disclosure;

Fig. 24 shows another exploded view of the fastening device of the 9th embodiment of Fig. 23;

Fig. 25 shows a cross-sectional view of the fastening device of the 9th embodiment of Fig. 23;

Fig. 26 shows a cross-sectional view of a fastening device according to a 10th embodiment of the present disclosure;

Fig. 27 shows a cross-sectional view of a fastening device according to an 11th embodiment of the present disclosure;

Fig. 28 shows a cross-sectional view of a fastening device according to a 12th embodiment of the present disclosure;

Fig. 29 shows one exploded view of a fastening device according to a 13th embodiment of the present disclosure;

Fig. 30 shows a partial top view of the fastening device of the 13th embodiment of Fig. 29 coupled to a lace;

Fig. 31 shows a cross-sectional view of a fastening device of the 13th embodiment of Fig. 29;

Fig. 32 shows a cross-sectional view of a fastening device according to a 14th embodiment of the present disclosure;

Fig. 33 shows a cross-sectional view of a fastening device according to a 15th embodiment of the present disclosure;

Fig. 34 shows an exploded view of a fastening device according to a 16th embodiment of the present disclosure;

Fig. 35 shows a cross-sectional view of the fastening device of the 16th embodiment of Fig. 34; and

Fig. 36 shows a block flow chart of a lace assembling method according to a 17th embodiment of the present disclosure.

DETAILED DESCRIPTION

[0022] The embodiment will be described with the drawings. For clarity, some practical details will be described below. However, it should be noted that the present disclosure should not be limited by the practical details. That is, in some embodiments, the practical details are unnecessary. In addition, for simplifying the drawings, some conventional structures and elements will be simply illustrated, and repeated elements may be represented by the same reference numerals.

[0023] In addition, the terms first, second, third, etc. are used herein to describe various elements or components, these elements or components should not be limited by these terms, and therefore a first element/ component discussed below could be termed a second element/ component. Moreover, a combination of these elements/ components/ mechanisms/ modules of the present closure is not a known, common, or conventional combination in the art, and it cannot be predicted whether a relation of the combination thereof can be easily done by a person having skill in the art by these elements/ components/ mechanisms/ modules.

[0024] Please refer to Fig. 1, Fig. 2, Fig. 3, Fig. 4 and Fig. 5, Fig. 1 shows a three dimensional schematic view of a fastening device 100c according to a 1st embodiment of the present disclosure, Fig. 2 shows one exploded view of the fastening device 100c of the 1st embodiment of Fig. 1, Fig. 3 shows another exploded view of the fastening device 100c of the 1 st embodiment of Fig. 1, Fig. 4 shows a partial top view of the fastening device 100c of the 1st embodiment of Fig. 1, Fig. 5 shows a cross-sectional view of the fastening device 100c of the 1 st embodiment of Fig. 4 taken along Line 5-5, and in Fig. 4 the knob 500c is omitted while the first biasing protrusions 520c and the second biasing protrusions 530c are shown in dashed lines. The fastening device 100c is applied for tensioning or releasing a lace (not shown in Fig. 1 to Fig. 5), and the fastening device 100c includes a case 200c, a spool 300c, a knob 500c and a locking unit 400c.

[0025] The case 200c includes a housing 260c, a base 270c and a mounted portion 250c. The housing 260c includes a receiving space 210c, the base 270c is de-

tachably connected to the housing 260c, and the mounted portion 250c is located on the housing 260c. The spool 300c is received in the receiving space 210c and configured for the lace to be wound therearound. The knob 500c includes an engaged portion 540c for corresponding to the mounted portion 250c. The locking unit 400c is received in the receiving space 210c.

[0026] Therefore, through the configuration of the fastening device 100c, the ease of assembling the fastening device 100c can be increased.

[0027] The housing 260c is ring-shaped and a receiving space 210c is formed therein, and the housing 260c can further include a plurality of inner teeth 230c, two side holes 220c and three tabs 261c, 262c, 263c. The inner teeth 230c face to the receiving space 210c, the two side holes 220c are communicated with the receiving space 210c, the mounted portion 250c protrudes outward from a body of the housing 260c and is ring-shaped, and the three tabs 261c, 262c, 263c are located below the mounted portion 250c and protrude radially and outward. The base 270c can further include three holes 271c, 272c, 273c respectively engaged with the three tabs 261c, 262c, 263c, and thus the base 270c and the housing 260c can be assembled. In addition, the base 270c can include a guiding groove 274c located above the hole 273c to guide the tab 263c, but the present disclosure is not limited thereto.

[0028] The knob 500c can include a protruding column 510c, three first biasing protrusions 520c and three second biasing protrusions 530c, the protruding column 510c, the three first biasing protrusions 520c and the three second biasing protrusions 530c all protrude downward from an inner top surface of the knob 500c, the protruding column 510c is located in the center, and the three first biasing protrusions 520c and the three second biasing protrusions 530c alternatively surround the protruding column 510c.

[0029] The locking unit 400c includes an engaging disc 410c and an inner gear 450c, the engaging disc 410c includes a central hole 412c and a plurality of transmission teeth 411c, the inner gear 450c is movably located within the central hole 412c and includes an inserting hole 452c and a plurality of outer teeth 451c, the inserting hole 452c is for receiving the protruding column 510c, and the outer teeth 451c correspond to engage with the transmission teeth 411c and engaging teeth 330c of the spool 300c.

[0030] The locking unit 400c can further include three first pawl arms 430c and three second pawl arms 440c extended outward from the engaging disc 410c, the three first pawl arms 430c and the three second pawl arms 440c all correspond to the inner teeth 230c, and as shown in Fig. 4, as the knob 500c is rotated in a first direction A3, each of the first biasing protrusions 520c displaces each of the first pawl arms 430c in the first direction A3 to allow the spool 300c to incrementally tension the lace; on the contrary, as the knob 500c is rotated in a second direction A4, each of the second biasing protrusions 530c displaces each of the second pawl arms 440c in the second direction A4 to allow the spool 300c to incrementally release the lace. In other embodiments, the fastening device can also be configured such that rotating the knob in the first direction can release the lace, and rotating the knob in the second direction can tension the lace, but the present disclosure is not limited thereto.

[0031] Please refer to Fig. 6, Fig. 6 shows a cross-sectional view of a fastening device 100d according to a 2nd embodiment of the present disclosure. The fastening device 100d includes a case 200d, a spool 300d, a locking unit (not labeled in Fig. 6) and a knob 500d. Precisely, the fastening device 100d consists of the case 200d, the spool 300d, the locking unit and the knob 500d, the structure of the fastening device 100d is similar to the structure of the fastening device 100c of the 1st embodiment in Fig. 1 to Fig. 5, the locking unit can also include an engaging disc 410d and an inner gear 450d, but the detail structures of the engaging disc 410d and the inner gear 450d are different therefrom, and the details will not be repeated.

[0032] Please refer to Fig. 7, Fig. 8 and Fig. 9, Fig. 7 shows one exploded view of a fastening device 100e according to a 3rd embodiment of the present disclosure, Fig. 8 shows another exploded view of the fastening device 100e of the 3rd embodiment of Fig. 7, and Fig. 9 shows a partial cross-sectional view of the fastening device 100e of the 3rd embodiment of Fig. 7 coupled to a lace T1, and in Fig. 9, the base 270e is omitted for clear illustration. The fastening device 100e can include a case 200e, a spool 300e, a locking unit 400e, a knob 500e, a ratchet ring 800e and a spring 700e.

[0033] The case 200e includes a base 270e and a housing 260e. The housing 260e includes two side holes 220e and three tabs 261e, 262e, 263e, the base 270e can further include a continuous wall 274e and three holes 271e, 272e, 273e, the three tabs 261e, 262e, 263e are configured to be respectively engaged with the three holes 271e, 272e, 273e, thereby allowing the base 270c being engaged with the housing 260e.

[0034] The spool 300e has a disc-shaped structure and includes a first opening 321e, a second opening (not shown), a sloped surface 316e and a bottom opening 315e, and the first opening 321e and the second opening are communicated with the bottom opening 315e. A first end and a second end of the lace T1 can respectively pass through the first opening 321e and the second opening to couple to the spool 300e, and therefore the lace T1 can be wound around a spool cylinder of the spool 300e. To be more specific, the first end of the lace T1 can be inserted from the first opening 321e toward the sloped surface 316e to pass through the bottom opening 315e and expose from the lower opening 240e, the second end of the lace T1 can be inserted from the second opening toward the sloped surface 316e to pass through the bottom opening 315e and expose from the lower opening 240e, which allows a user to tie a knot, and thus the lace T1 cannot be separated from the first opening

321e and the second opening, after which the base 270e can be assembled to the housing 260e.

[0035] The knob 500e can include a rotary cover 530e and an inner plate 510e, and the inner plate 510e is coupled to the rotary cover 530e. The locking unit 400e is coupled to the knob 500e and the spool 300e, the ratchet ring 800e is disposed in the housing 260e, and the spring 700e is disposed above the ratchet ring 800e and surrounds the inner plate 510e.

[0036] Specifically, the ratchet ring 800e includes a plurality of lower sloped teeth 810e, a plurality of upper sloped teeth 820e and a plurality of ratchet teeth 830e, the lower sloped teeth 810e and the upper sloped teeth 820e are located at an outer surface of the ratchet ring 800e, each of the lower sloped teeth 810e is located below each of the upper sloped teeth 820e to correspond to each of the inner teeth 230e, and each of the ratchet teeth 830e is located on an inner surface of the ratchet ring 800e.

[0037] The locking unit 400e is located within the ratchet ring 800e and includes an engaging disc 410e, an inner gear 450e, a plurality of coupling teeth 460e and three pawl arms 470e. The inner gear 450e is located within the engaging disc 410e, the inner gear 450e can move along the axial direction relative to the engaging disc 410e and includes a screw hole 451e. The coupling teeth 460e are located on the inner gear 450e and are detachably engaged with the engaging teeth 330e, and the three pawl arms 470e are disposed on the engaging disc 410e and correspond to the ratchet teeth 830e.

[0038] The knob 500e can further include a guiding block 520e which is located on an inner wall of the rotary cover 530e and corresponds to the upper sloped teeth 820e, the inner plate 510e can further include a screw post 511e and a coupling arm 512e, the screw post 511e is correspondingly engaged with the screw hole 451e, and the coupling arm 512e is selectively coupled to a coupling protrusion 411e of the engaging disc 410e.

[0039] With the configuration, when the rotary cover 530e is rotated in a tensioning direction, the pawl arm 470e is disengaged from the ratchet teeth 830e to allow the spool 300e to tension the lace T1. On the contrary, when the rotary cover 530e is not pressed and is rotated in a releasing direction, the inner gear 450e is lifted by the screw post 511e relative to the engaging disc 410e, the inner gear 450e and the engaging teeth 330e are separated, and the spool 300e is allowed to freely rotate in the releasing direction without restriction to release the lace T1. When the rotary cover 530e is pressed and rotated in the releasing direction simultaneously, the upper sloped tooth 820e is guided by the guiding block 520e, and the ratchet ring 800e is lifted to allow the lower sloped teeth 810e to disengage from the inner teeth 230e, which allows an incremental release of the lace T1.

[0040] In addition, the knob 500e can include an engaged portion 540e for corresponding to the mounted portion 250e of the case 200e, the details thereof are identical to the engaged portion 540c and mounted portion 250c of the 1st embodiment in Fig. 1 to Fig. 5, and will not be repeated.

[0041] Please refer to Fig. 10, Fig. 11 and Fig. 12, Fig. 10 shows one exploded view of a fastening device 100f according to a 4th embodiment of the present disclosure, Fig. 11 shows another exploded view of the fastening device 100f of the 4th embodiment of Fig. 10, and Fig. 12 shows a cross-sectional view of the fastening device 100f of the 4th embodiment of Fig. 10. The fastening device 100f includes a case 200f, a spool 300f, a knob 500f, a ratchet ring 800f and a spring 700f, and the case 200f includes a housing 260f and a base 270f.

[0042] When the knob 500f is rotated in the tensioning direction relative to the case 200f, the ratchet ring 800f is continually lifted to disengage from the inner teeth 230f, and the spool 300f can be rotated in the tensioning direction to tension a lace. When the knob 500f is pressed and rotated in the releasing direction relative to the case 200f simultaneously, the spool 300f is allowed to rotate in the releasing direction to incrementally release the lace. Hence, it is clear that the ratchet ring 800f in the 4th embodiment can function as a locking unit which can stop or release the spool 300f.

[0043] Please refer to Fig. 13, Fig. 14 and Fig. 15, Fig. 13 shows one exploded view of a fastening device 100g according to a 5th embodiment of the present disclosure, Fig. 14 shows another exploded view of the fastening device 100g of the 5th embodiment of Fig. 13, and Fig. 15 shows a cross-sectional view of the fastening device 100g of the 5th embodiment of Fig. 13. The fastening device 100g includes a case 200g, a spool 300g, a locking unit 400g, a knob 500g and a ratchet ring 800g, and the case 200g includes a housing 260g and a base 270g.

[0044] The locking unit 400g includes an engaging disc 410g and an inner gear 450g, the inner gear 450g is movably disposed within the engaging disc 410g. The knob 500g includes a plurality of top teeth 520g and a screw post 510g, the screw post 510g is engaged with a screw hole 451g of the inner gear 450g. The ratchet ring 800g includes three first arms 810g, three second arms 820g and a plurality of ratchet teeth 830g. The first arm 810g is correspondent to the inner teeth 230g on the housing 260g, and the second arm 820g is correspondent to both the inner teeth 230g and the top teeth 520g. The pawl arm 470g is selectively engaged with the ratchet teeth 830g.

[0045] When the knob 500g is forced in the tensioning direction, the second arm 820g is disengaged from the top teeth 520g, and the knob 500g is allowed to be rotated in the tensioning direction, and therefore the engaging disc 410g is driven by the knob 500g to cause the pawl arms 470g to disengage from the ratchet teeth 830g.

[0046] When the knob 500g is forced in the releasing direction, the inner gear 450g is lifted owing to the structure of the screw post 510g and the screw hole 451g, and can be separated from the spool 300g.

[0047] Please refer to Fig. 16 and Fig. 17, Fig. 16 shows an exploded view of a fastening device 100h ac-

cording to a 6th embodiment of the present disclosure, and Fig. 17 shows a cross-sectional view of the fastening device 100h of the 6th embodiment of Fig. 16. The fastening device 100h includes a case 200h, a spool 300h, a locking unit 400h, a controlling set 900h, a knob 500h and a spring 700h, and the case 200h includes a housing 260h and a base 270h.

[0048] The spool 300h is coupled to the knob 500h and includes a plurality of first pawl teeth 310h, and the spool 300h and the locking unit 400h are all located within the housing 260h.

[0049] The locking unit 400h is located below the spool 300h and includes a plurality of second pawl teeth 410h selectively engaged with the first pawl teeth 310h. The controlling set 900h is movably inserted in the knob 500h, and the spring 700h is abutted between a bottom surface of the housing 260h and the locking unit 400h.

[0050] When the controlling set 900h is in a fastening position, a flange 911h is located above a restricting portion 515h of the knob 500h, the spring 700h is not compressed, and at the time the second pawl teeth 410h are engaged with the first pawl teeth 310h in the releasing direction. When the controlling set 900h is pressed downward and switched to a releasing position, the flange 911h is located below the restricting portion 515h, the spring 700h is compressed, the locking unit 400h is separated from the spool 300h, and the second pawl teeth 410h are allowed to be fully disengaged from the first pawl teeth 310h.

[0051] Please refer to Fig. 18, Fig. 19 and Fig. 20, Fig. 18 shows one exploded view of a fastening device 100i according to a 7th embodiment of the present disclosure, Fig. 19 shows another exploded view of the fastening device 100i of the 7th embodiment of Fig. 18, and Fig. 20 shows a cross-sectional view of the fastening device 100i of the 7th embodiment of Fig. 18. The fastening device 100i includes a case 200i, a spool 300i, a locking unit 400i, a knob 500i, a controlling set 900i and a spring 700i, and the case 200i includes a housing 260i and a base 270i.

[0052] The controlling set 900i includes a controlling bar 910i and a screw 920i, the controlling bar 910i is inserted into the knob 500i, and the screw 920i is limited by the locking unit 400i and is screwed with the controlling bar 910i. The locking unit 400i can include a plurality of second teeth 410i and a plurality of first ratchet teeth 420i, the second teeth 410i are engaged with the first teeth 310i of the spool 300i, and the first ratchet teeth 420i are selectively engaged with the second ratchet teeth 261i on the housing 260i.

[0053] When the controlling set 900i is located in a fastening position, the flange 911i is located below the restricting portion of the knob 500i, the spring 700i is not compressed, at the time the locking unit 400i is at a lower position, and the spool 300i is allowed to rotate in the tensioning direction while rotation in the releasing direction is not allowed. When the controlling set 900i is pulled upward to be switched to a releasing position, the flange 911i is located above the restricting portion, the spring 700i is compressed, at the time the locking unit 400i is lifted, the first ratchet teeth 420i are disengaged from the second ratchet teeth 261i, and the spool 300i is allowed to be fully released.

[0054] Please refer to Fig. 21 and Fig. 22, Fig. 21 shows an exploded view of a fastening device 100j according to an 8th embodiment of the present disclosure, and Fig. 22 shows a cross-sectional view of the fastening device 100j of the 8th embodiment of Fig. 21. The fastening device 100j includes a case 200j, a spool 300j, a locking unit 400j, a controlling set 900j and a knob 500j, and the case 200j includes a housing 260j and a base 270j.

[0055] The controlling set 900j includes a controlling bar 910j and a screw 920j, and when the controlling set 900j is pulled upward, the locking unit 400j is lifted and fully separated from the inner teeth 230j.

[0056] Please refer to Fig. 23, Fig. 24 and Fig. 25, Fig. 23 shows one exploded view of a fastening device 100k according to a 9th embodiment of the present disclosure, Fig. 24 shows another exploded view of the fastening device 100k of the 9th embodiment of Fig. 23, and Fig. 25 shows a cross-sectional view of the fastening device 100k of the 9th embodiment of Fig. 23. The fastening device 100k includes a case 200k, a spool 300k, a locking unit 400k, a controlling set 900k and a knob 500k, and the case 200k includes a housing 260k and a base 270k.

[0057] The knob 500k can include two guiding protrusions 510k located at an outer top surface of the knob 500k. The controlling set 900k can insert the knob 500k and includes two tracking grooves 910k respectively corresponding to the two guiding protrusions 510k, each of the guiding protrusions 510k is spiral and has a high point and a lower point, and the shape of the tracking groove 910k corresponds the guiding protrusion 510k.

[0058] The case 200k includes housing pawl arms 280k located at the housing 260k, and the locking unit 400k includes a plurality of lateral teeth 410k corresponding to the housing pawl arms 280k. The controlling set 900k is coupled to the locking unit 400k by two clamping arms 920k. When the controlling set 900k is rotated relative to the knob 500k to switch to a higher position, the locking unit 400k is lifted such that the lace can be fully released.

[0059] Please refer to Fig. 26, and Fig. 26 shows a cross-sectional view of a fastening device 100l according to a 10th embodiment of the present disclosure. The fastening device 100l includes a case 200l, a spool 300l, a locking unit 400l, a controlling set 900l and a knob 500l.

[0060] The controlling set 900l can include a restricting member 910l, a screw 920l and a barrel 930l, the restricting member 910l inserts the knob 500l, the barrel 930l passes through the locking unit 400l upward and is restricted in the locking unit 400l, and the screw 920l passes through the restricting member 910l downward to screw into the barrel 930l. When the controlling set 900l is pulled upward, the locking unit 400l is lifted. In addition, the re-

stricting member 910l can include a flange, which is similar to the flange 911h of the 8th embodiment of Fig. 20, but the present disclosure is not limited thereto.

[0061] Please refer to Fig. 27, and Fig. 27 shows a cross-sectional view of a fastening device 100m according to an 11th embodiment of the present disclosure. The fastening device 100m is similar to the fastening device 100l of the 10th embodiment of Fig. 26 and includes a case 200m, a spool 300m, a locking unit 400m, a controlling set 900m and a knob 500m, but the controlling set 900m and the locking unit 400m are different from the controlling set 900l and the locking unit 400l.

[0062] To be more specific, the controlling set 900m can include a restricting member 910m, a screw 920m and a bushing 930m, the restricting member 910m inserts the knob 500m, the bushing 930 is restricted in the locking unit 400m, and the screw 920m passes through the bushing 930m upward to screw into the restricting member 910m. The locking unit 400m includes an engaging disc 410m and an inner gear 450m, and when the controlling set 900m is pulled upward, the inner gear 450m is lifted. In addition, the restricting member 910m can include a flange, which is similar to the flange 911h of the 8th embodiment of Fig. 20, but the present disclosure is not limited thereto.

[0063] Please refer to Fig. 28, and Fig. 28 shows a cross-sectional view of a fastening device 100n according to a 12th embodiment of the present disclosure. The fastening device 100n includes a case 200n, a spool 300n, a locking unit 400n and a knob 500n

[0064] The locking unit 400n includes an engaging disc 410n and an inner gear 450n, and the knob 500n includes a screw post 510n engaged with the inner gear 450n. When the knob 500n is rotated in the releasing direction, the inner gear 450n can be lifted to separate from the spool 300n.

[0065] Please refer to Fig. 29, Fig. 30 and Fig. 31, Fig. 29 shows one exploded view of a fastening device 100p according to a 13th embodiment of the present disclosure, Fig. 30 shows a partial top view of the fastening device 100p of the 13th embodiment of Fig. 29 coupled to a lace T1, and Fig. 31 shows a cross-sectional view of a fastening device 100p of the 13th embodiment of Fig. 29. The fastening device 100p includes a case 200p, a spool 300p, a locking unit 400p, a knob 500p and a controlling set 900p, and the case 200p includes a housing 260p and a base 270p.

[0066] The controlling set 900p includes two clamping arms 920p coupled to the locking unit 400p, and the locking unit 400p can be lifted by pulling the controlling set 900p upward.

[0067] The housing 260p can include three side holes 220p, and the spool 300p can include a first opening 321p, a second opening 322p and a third opening 323p. As coupling the lace T1, the first opening 321p, the second opening 322p and the third opening 323p can respectively correspond to the three side holes 220p, and the lace T1 is allowed to pass therethrough. Precisely, the first end of the lace T1 can pass through the first one of the side holes 220p and the first opening 321p, and goes out from the third opening 323p and the third one of the side holes 220p; the second end of the lace T1 can pass through the second one of the side holes 220p and the second opening 322p, goes out from the third opening 323p and the third one of the side holes 220p, and be tied to couple to the spool 300p.

[0068] Please refer to Fig. 32, and Fig. 32 shows a cross-sectional view of a fastening device 100q according to a 14th embodiment of the present disclosure. The fastening device 100q includes a case (not labeled in Fig. 32), a spool 300q, a locking unit 400q, a knob 500q and a controlling set 900q.

[0069] The fastening device 100q is similar to the fastening device 100m of the 11th embodiment of Fig. 27, but the locking unit 400q includes the pawl arms 470q to engage with the inner teeth 230q on the housing 260q, and the details will not be repeated.

[0070] Please refer to Fig. 33, and Fig. 33 shows a cross-sectional view of a fastening device 100r according to a 15th embodiment of the present disclosure. The fastening device 100r includes a case (not labeled in Fig. 33), a spool 300r, a locking unit 400r and a knob 500r. The fastening device 100r is similar to the fastening device 100n of the 12th embodiment of Fig. 28, but the locking unit 400r includes a plurality of pawl arms 470r to engage with the inner teeth 230r on the housing 260r, and the details will not be repeated.

[0071] Please refer to Fig. 34 and Fig. 35, Fig. 34 shows an exploded view of a fastening device 100s according to a 16th embodiment of the present disclosure, and Fig. 35 shows a cross-sectional view of the fastening device 100s of the 16th embodiment of Fig. 34. The fastening device 100s includes a case 200s, a spool 300s, a locking unit 400s and a knob 500s, and the case 200s include a housing 260s and a base 270s.

[0072] The locking unit 400s includes an engaging disc 410s and an inner gear 450s. The inner gear 450s is located in a central hole of the engaging disc 410s, and three guiding portions 430s extend radially and outward from the inner gear 450s. The knob 500s includes a spiral track 530s corresponding to the guiding portions 430s. Hence, as the knob 500s is rotated, the inner gear 450s can be lifted, thereby allowing the locking unit 400s to decouple from the spool 300s.

[0073] Based on the aforementioned embodiments, the locking unit can be a one-piece element or can be a two-piece element including the engaging disc and the inner gear, and one of the two elements can be lifted when the locking unit is a two-piece element. The pawl arm can be located on the locking unit while the teeth corresponding thereto are located on the housing, or the pawl arm can be located on the housing while the teeth corresponding thereto are located on the locking unit. The knob and the housing can be combined via engagement, after the knob is engaged with the housing, the housing, the locking unit, the knob and the spool are com-

bined and restricted, at this time the base can still be separated from the housing while the engagement between other elements is not affected, and the reason is that the base is only restricted by the housing.

[0074] Please refer to Fig. 36, also refer to Fig. 7 to Fig. 9, and Fig. 36 shows a block flow chart of a lace assembling method 100 according to a 17th embodiment of the present disclosure. A lace assembling method 100 is applied for connecting a lace T1 to a fastening device 100e, and the lace assembling method 100 includes a fastening device providing step S01 and a lace coupling step S02.

[0075] In the fastening device providing step S01, a fastening device 100e is provided, the fastening device 100e includes a case 200e, a spool 300e, a knob 500e and a locking unit 400e, the case 200e includes a housing 260e, a base 270e and a mounted portion 250e, the base 270e is detachably connected to the housing 260e, the mounted portion 250e is located at the housing 260e, the knob 500e includes an engaged portion 540e for corresponding to the mounted portion 250e, and the spool 300e and the locking unit 400e are disposed inside the housing 260e.

[0076] In the lace coupling step S02, a first end and a second end of the lace T1 are exposed from the housing 260e after passing through the housing 260e and the spool 300e, the first end and the second end are knotted, and the lace T1 is allowed to be coupled to the spool 300e.

[0077] The case 200e can further include two side holes 220e, the spool 300e includes a first opening 321e and at least one sloped surface 316e, and the first end of the lace T1 passes through one of the side holes 220e and the first opening 321e toward the at least one sloped surface 361e. As shown in Fig. 9, a number of the sloped surface 361e can be one, and after the first end of the lace T1 passes through the one of the side holes 220e and the first opening 321e toward the sloped surface 316e, the second end of the lace T1 passes through the other one of the side holes 220e and a second opening toward the sloped surface 316e.

[0078] Finally, after the lace T1 is coupled to the spool 300e, the base 270e can be connected to the housing 260e, thereby completing the assembling.

[0079] Although the present disclosure has been described as above, but the present disclosure is not limited thereto, any one skilled in the art, within the sprint and scope of the present disclosure, can take modifications and variations, and thus the protecting scope of the present discourse is defied by the scope of the following claims.

REFERENCE NUMERAL

[0080]

100: lace assembling method

100c, 100d, 100e, 100f, 100g, 100h, 100i, 100j, 100k, 100l, 100m, 100n, 100p, 100q, 100r, 100s: fastening device

200c, 200d, 200e, 200f, 200g, 200h, 200i, 200j, 200k, 200l, 200m, 200n, 200p, 200s: case

210c: receiving space

220c, 220e, 220p: side hole

230c, 230e, 230f, 230g, 230j, 230q, 230r: inner tooth

240e: lower opening

250c, 250e: mounted portion

260c, 260e, 260f, 260g, 260h, 260i, 260j, 260k, 260p, 260q, 260r, 260s: housing

261c, 262c, 263c, 261e, 262e, 263e: tab

270c, 270e, 270f, 270g, 270h, 270i, 270j, 270k, 270p, 270s: base

271c, 272c, 273c, 271e, 272e, 273e: hole

274c: guiding groove

274e: continuous wall

280k: housing pawl arm

300c, 300d, 300e, 300f, 300g, 300h, 300i, 300j, 300k, 300l, 300m, 300n, 300p, 300q, 300r, 300s: spool

310h: first pawl tooth

310i: first tooth

315e: bottom opening

316e: sloped surface

321e, 321p: first opening

322p: second opening

323p: third opening

330c, 330e: engaging tooth

400c, 400e, 400g, 400h, 400i, 400j, 400k, 400l, 400m, 400n, 400p, 400q, 400r, 400s: locking unit

410c, 410d, 410e, 410g, 410m, 410n, 410s: engaging disc

410h, 261i: second pawl tooth

410i: second tooth

410k: lateral tooth

411c: transmission tooth

411e: coupling protrusion

412c: central hole

420i: first ratchet tooth

430c: first pawl arm

430s: guiding portion

440c: second pawl arm

450c, 450d, 450e, 450g, 450m, 450n, 450s: inner gear

451c: outer tooth

451e, 451g: screw hole

452c: inserting hole

460e: coupling tooth

470e, 470g, 470q, 470r: pawl arm

500c, 500d, 500e, 500f, 500g, 500h, 500i, 500j, 500k, 500l, 500m, 500n, 500p, 500q, 500r, 500s: knob

510c: protruding column

510e: inner plate

510g, 510n, 511e: screw post

510k: guiding protrusion

512e: coupling arm

515h: restricting portion

520c: first biasing protrusion

520e: guiding block

520g: top tooth

530c: second biasing protrusion

530e: rotary cover

530s: spiral track

540c, 540e: engaged portion

700e, 700f, 700h, 700i: spring

800e, 800f, 800g: ratchet ring

810e: lower sloped tooth

810g: first arm

820e: upper sloped tooth

820g: second arm

830e, 830g: ratchet tooth

900h, 900i, 900j, 900k, 900l, 900m, 900p, 900q: controlling set

910i, 910j: controlling bar

910k: tracking groove

910l, 910m: restricting member

911h, 911i: flange

920i, 920j, 920l, 920m: screw

920k, 920p: clamping arm

930l: barrel

930m: bushing

A3: first direction

A4: second direction

S01: fastening device providing step

S02: lace coupling step

T1: lace

Claims

1. A fastening device, which is applied for tensioning or releasing a lace, **characterized by**, the fastening device comprising:

a case, comprising:

a housing, comprising a receiving space;
a base, detachably connected to the hous-

ing; and
a mounted portion, located on the housing;

a spool, received in the receiving space and configured for the lace to be wound therearound;
a knob, comprising an engaged portion for corresponding to the mounted portion; and
a locking unit, received in the receiving space;
wherein, when the knob is rotated relative to the case in a tensioning direction, the spool is not affected by the locking unit, and the spool is allowed to rotate in the tensioning direction for tensioning the lace.

2. The fastening device of claim 1, wherein, when rotating the knob relative to the case in a releasing direction, the locking unit is switched from a first position to a second position along an axial direction, and when the locking unit is at the first position, the locking unit is coupled to the spool to prohibit the spool from rotating in the releasing direction; when the locking unit is at the second position, the spool is allowed to be rotated toward the releasing direction.

3. The fastening device of claim 2, wherein the locking unit comprises:

an engaging disc, comprising a central hole; and
an inner gear, movably located in the central hole;
wherein, when the knob is rotated relative to the case in the releasing direction, the inner gear is switched from the first position to the second position.

4. The fastening device of claim 3, wherein, the knob comprises a screw post, the screw post protrudes downward to engage with a screw hole of the inner gear, when the knob is rotated relative to the case in the releasing direction, the screw hole is guided by the screw post, and the inner gear is allowed to be switched from the first position to the second position.

5. The fastening device of claim 1, wherein, the spool comprises a first opening, a second opening and at least one sloped surface, and a first end of the lace passes through the first opening toward the at least one sloped surface.

6. The fastening device of claim 5, wherein, a number of the at least one sloped surface is one, the first end of the lace passes through the first opening toward the sloped surface, and a second end of the lace passes through the second opening toward the sloped surface.

7. The fastening device of claim 1, further comprising:

a controlling set, inserting the knob and being coupled to the locking unit;
wherein, push or press the controlling set to release a coupling between the locking unit and the spool, and the spool is allowed to rotate freely.

8. The fastening device of claim 7, wherein, the controlling set comprises two clamping arms, and the two clamping arms are coupled to the locking unit.

9. The fastening device of claim 7, wherein, the controlling set comprises a restricting member, a screw and a bushing, the restricting member inserts the knob, the bushing is restricted in the locking unit, and the screw passes through the bushing upward to screw into the restricting member.

10. The fastening device of claim 7, wherein, the controlling set comprises a controlling bar and a screw, the controlling bar inserts into the knob, and the screw is restricted in the locking unit and is fastened with the controlling bar.

11. The fastening device of claim 1, wherein, the locking unit comprises at least one pawl arm, the knob comprises at least one protruding column, and as the knob is rotated in the releasing direction, the at least one protruding column displaces the at least one pawl arm.

12. The fastening device of claim 1, further comprises a ratchet ring, the case comprises a plurality of inner teeth, the ratchet ring is disposed at the case and comprises a plurality of lower sloped teeth, a plurality of upper sloped teeth and a plurality of ratchet teeth, each of the lower sloped teeth and each of the upper sloped teeth are located at an outer surface of the ratchet ring, each of the lower sloped teeth is located below each of the upper sloped teeth to correspond to each of the inner teeth, and each of the ratchet teeth is located at an inner surface of the ratchet ring.

13. A lace assembling method, which is applied for connecting a lace to a fastening device, **characterized by**, the lace assembling method comprising:

a fastening device providing step, wherein the fastening device is provided, the fastening device comprises a case, a spool, a knob and a locking unit, the case comprises a housing, a base and a mounted portion, the base is detachably connected to the housing, the mounted portion is located at the housing, the knob comprises an engaged portion for corresponding the mounted portion, and the spool and the locking

unit are disposed inside the housing; and
a lace coupling step, wherein a first end of the lace and a second end of the lace are exposed from the housing after passing through the housing and the spool, the first end and the second end are knotted, and the lace is allowed to be coupled to the spool.

14. The lace assembling method of claim 13, wherein, the case further comprises two side holes, the spool comprises a first opening and at least one sloped surface, and the first end passes through one of the side holes and the first opening toward the at least one sloped surface.

15. The lace assembling method of claim 14, wherein, a number of the sloped surface is one, and after the first end passes through the one of the side holes and the first opening toward the sloped surface, the second end passes through another one of the side holes and a second opening toward the sloped surface.

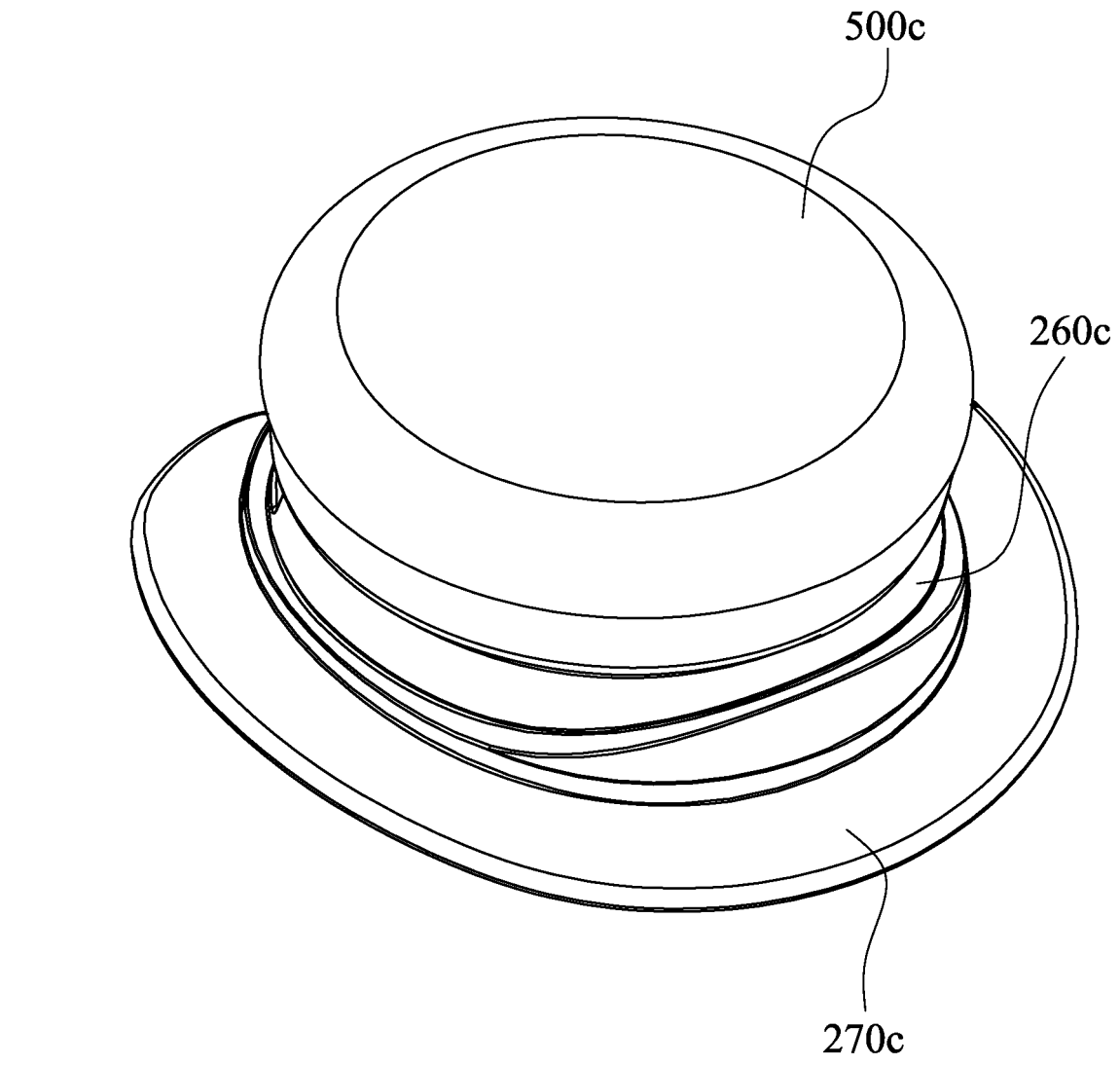
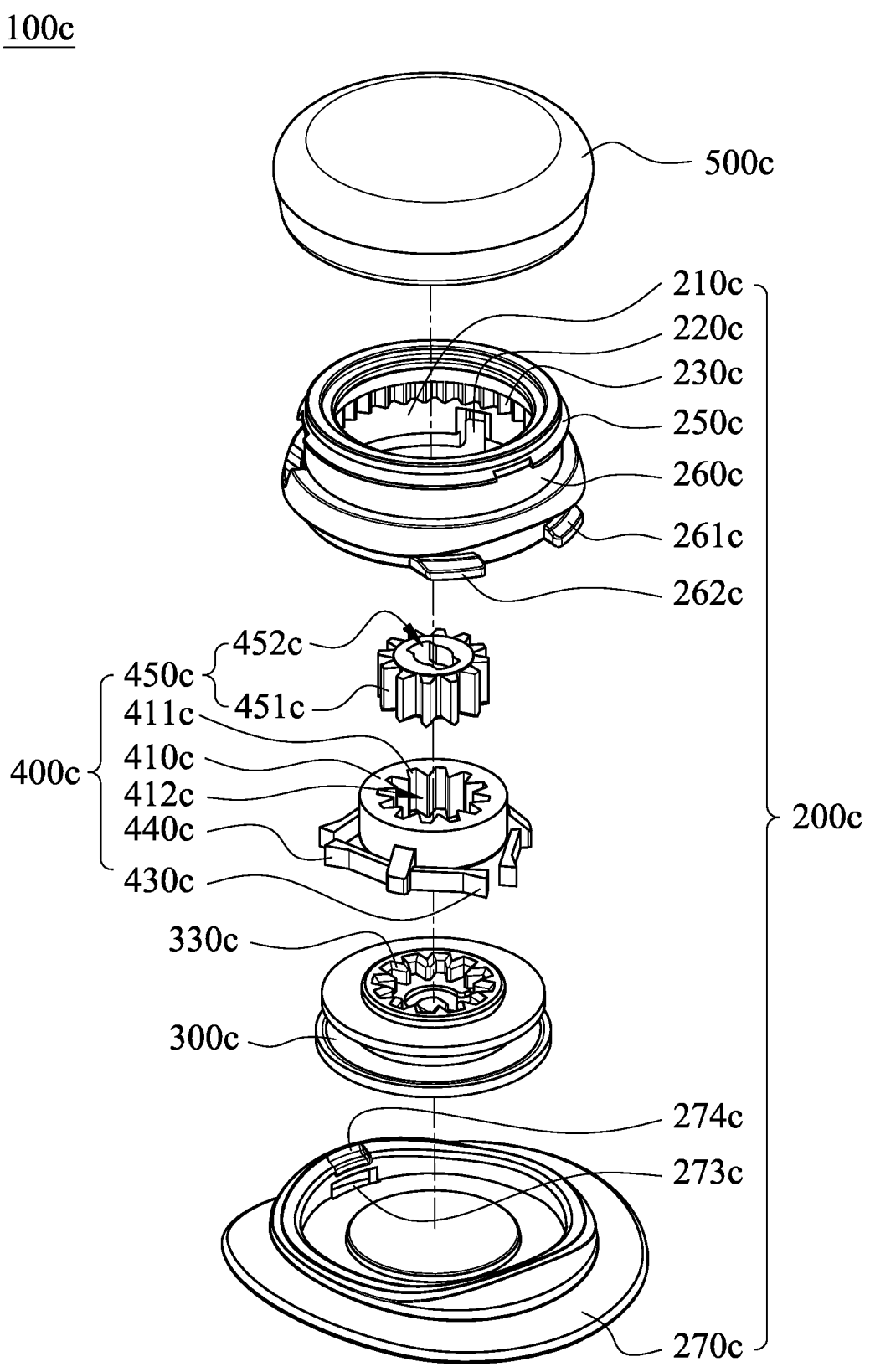


Fig. 1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262c
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Fig. 2

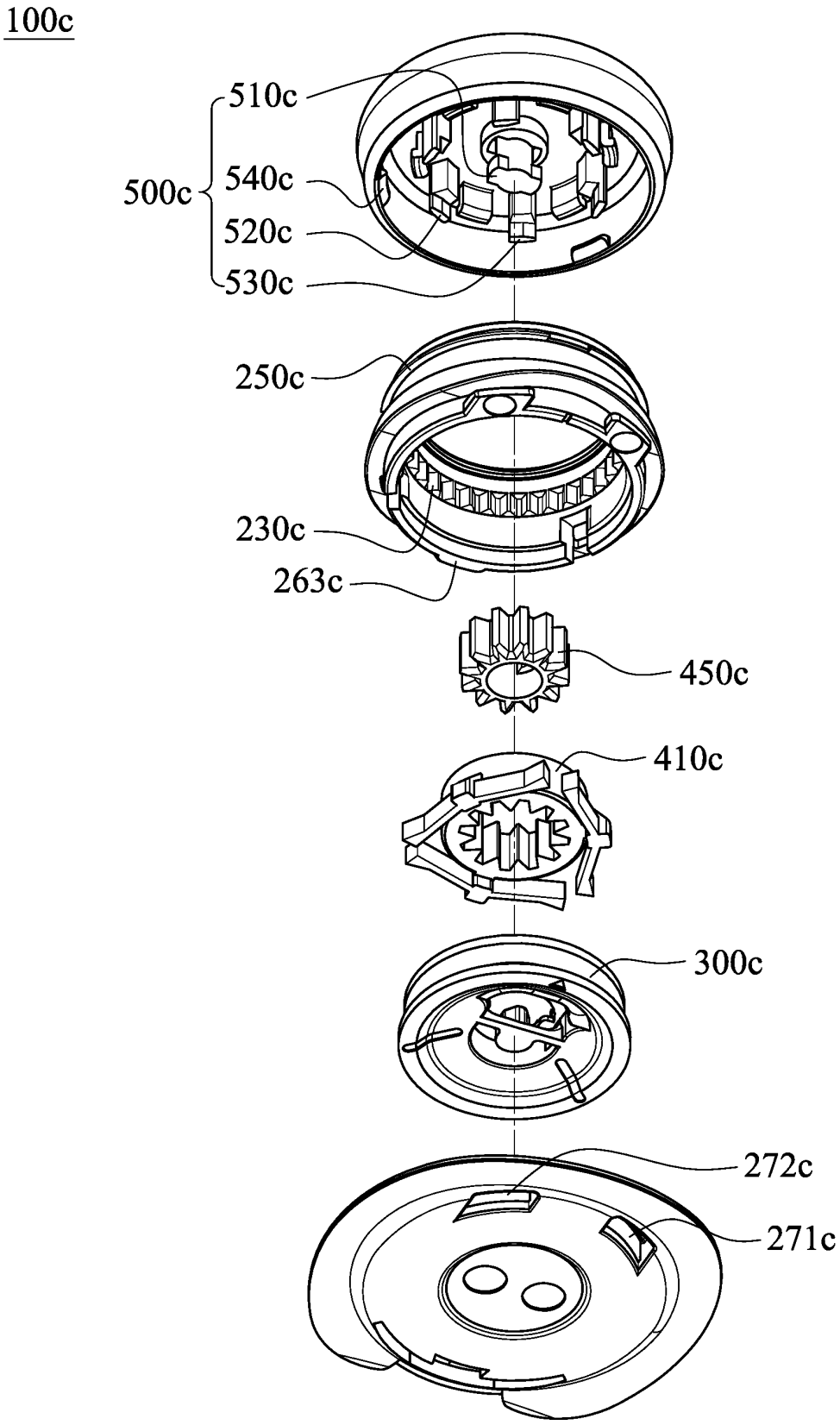
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Fig. 3

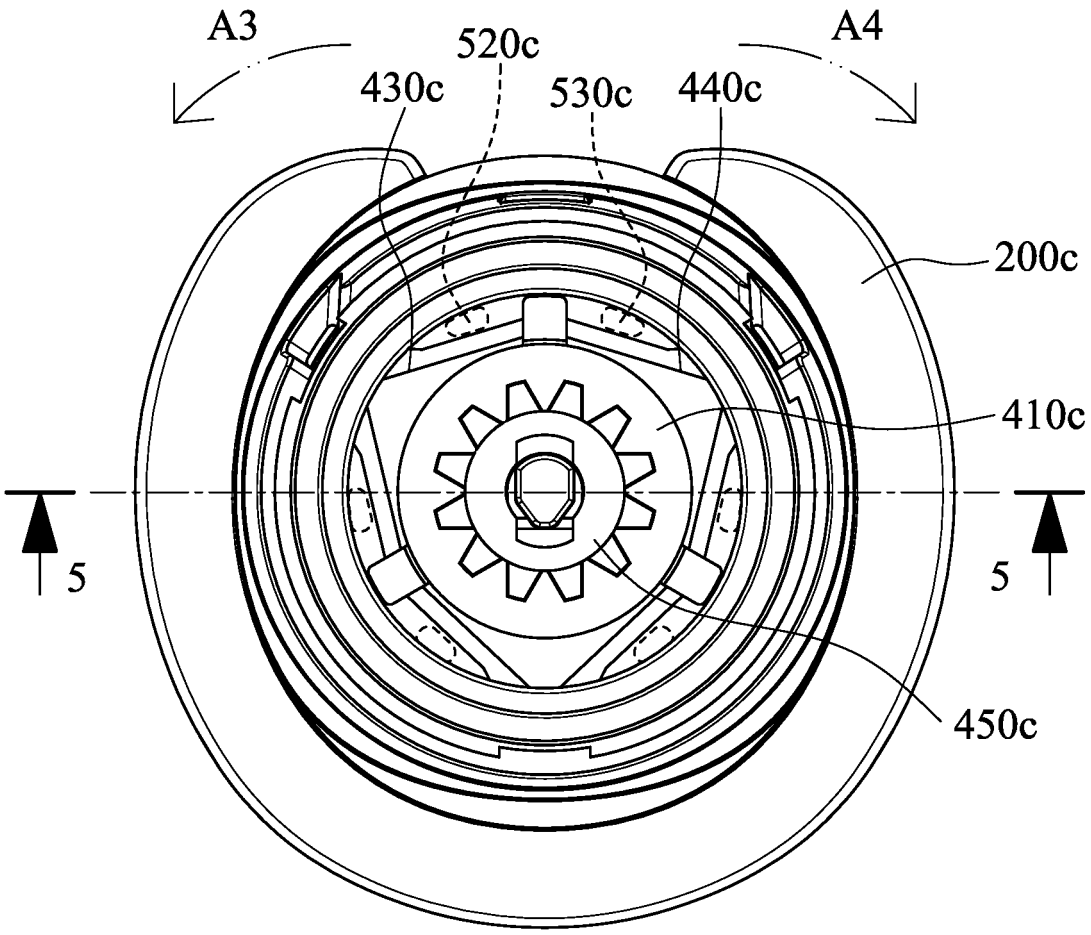

Fig. 4

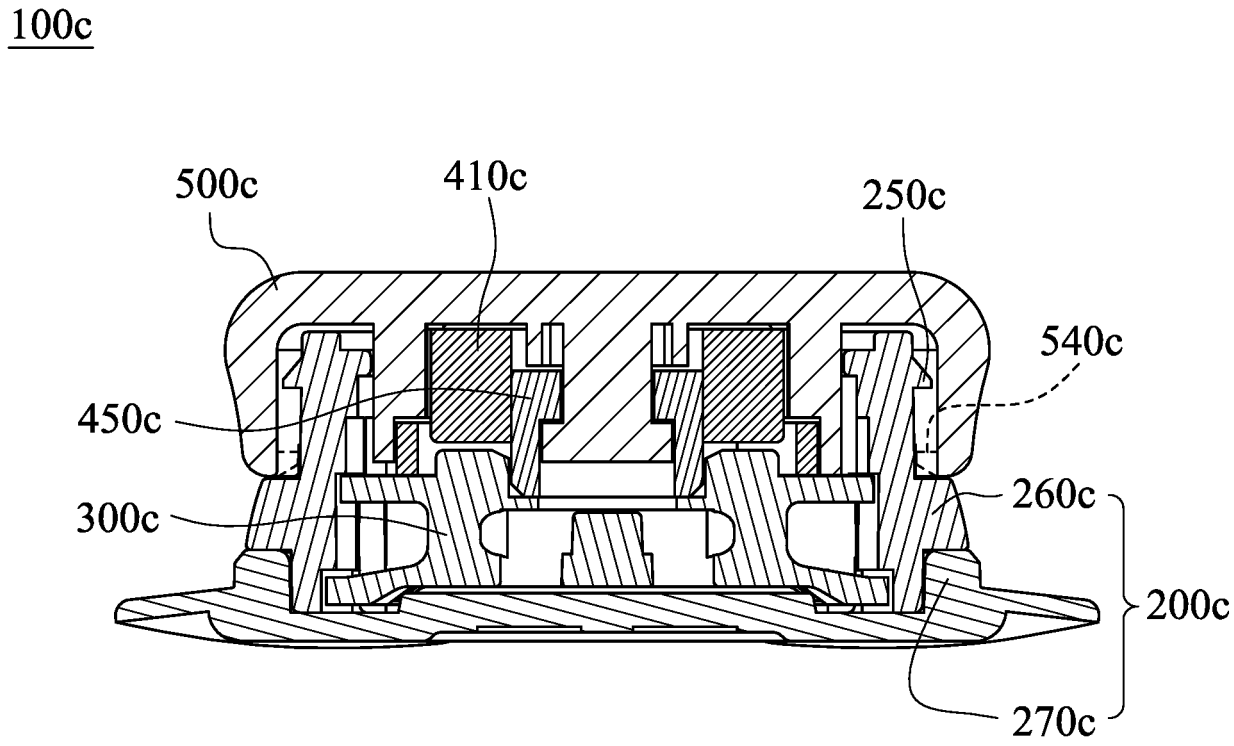

Fig. 5

100d

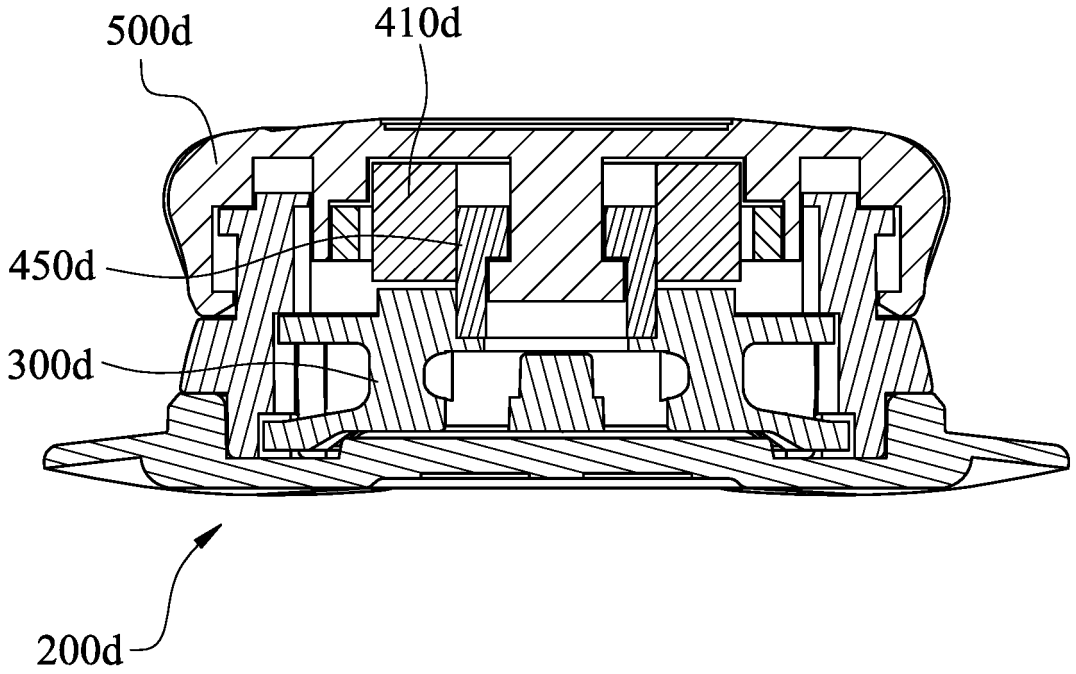

Fig. 6

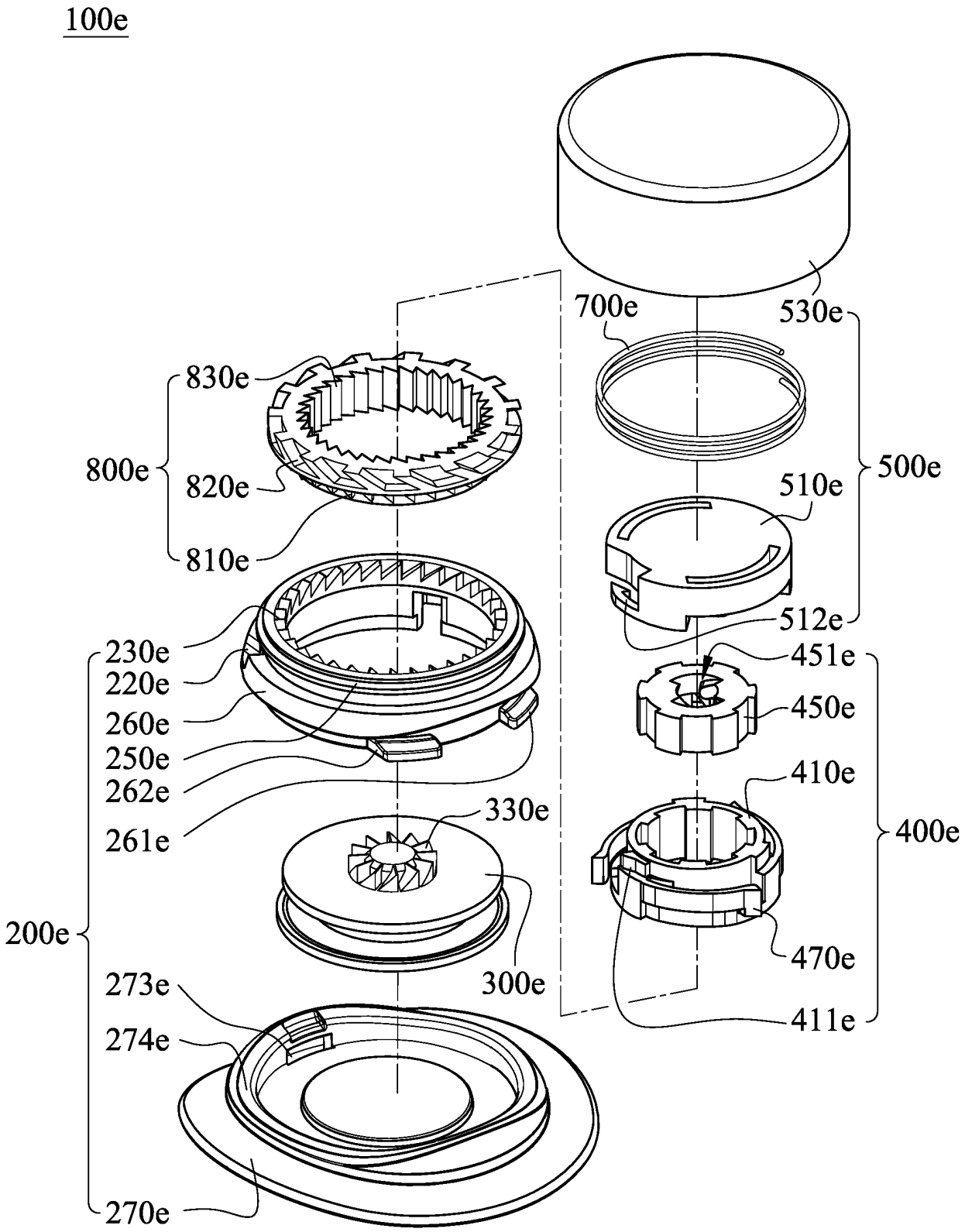
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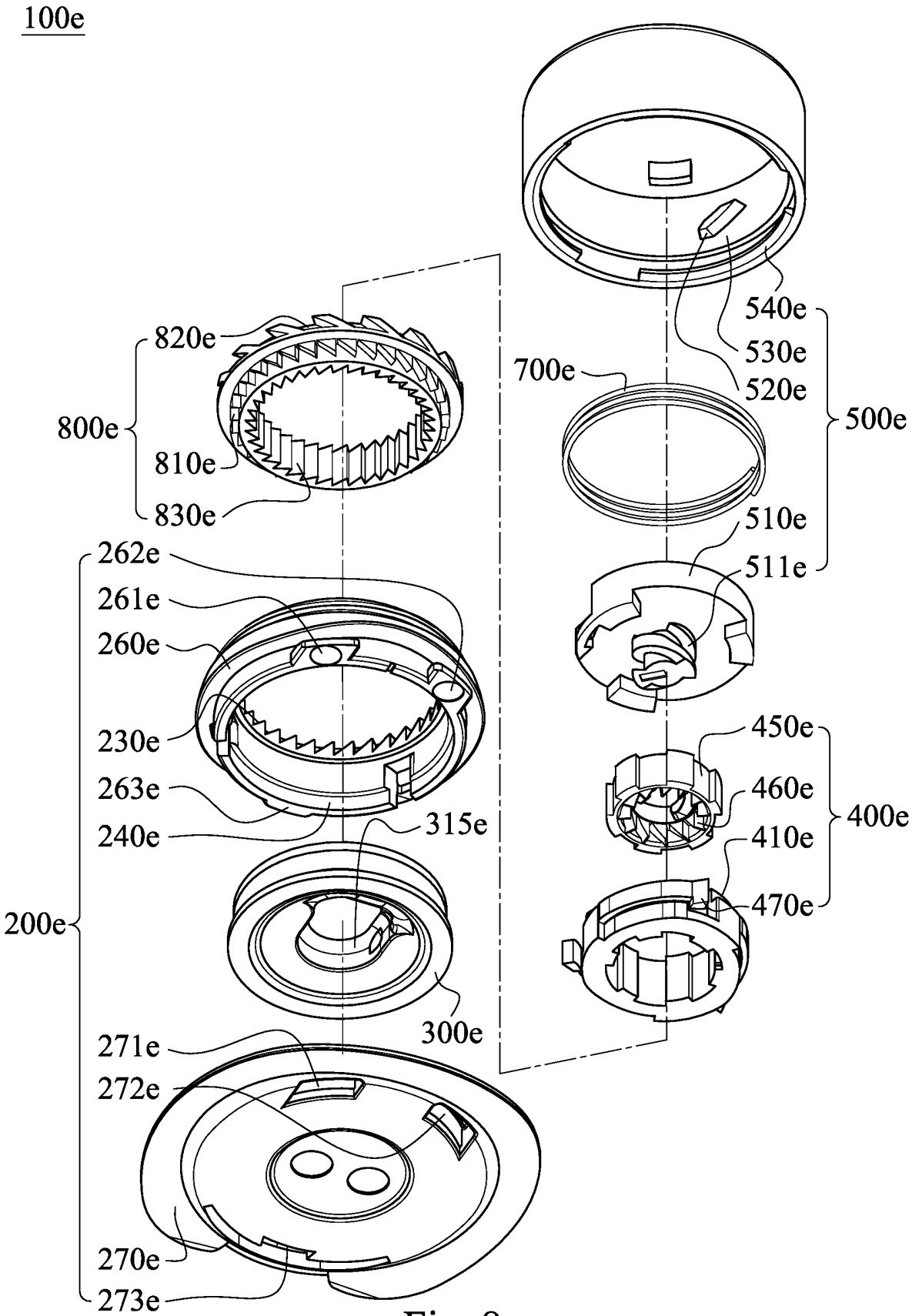
Fig. 7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263e
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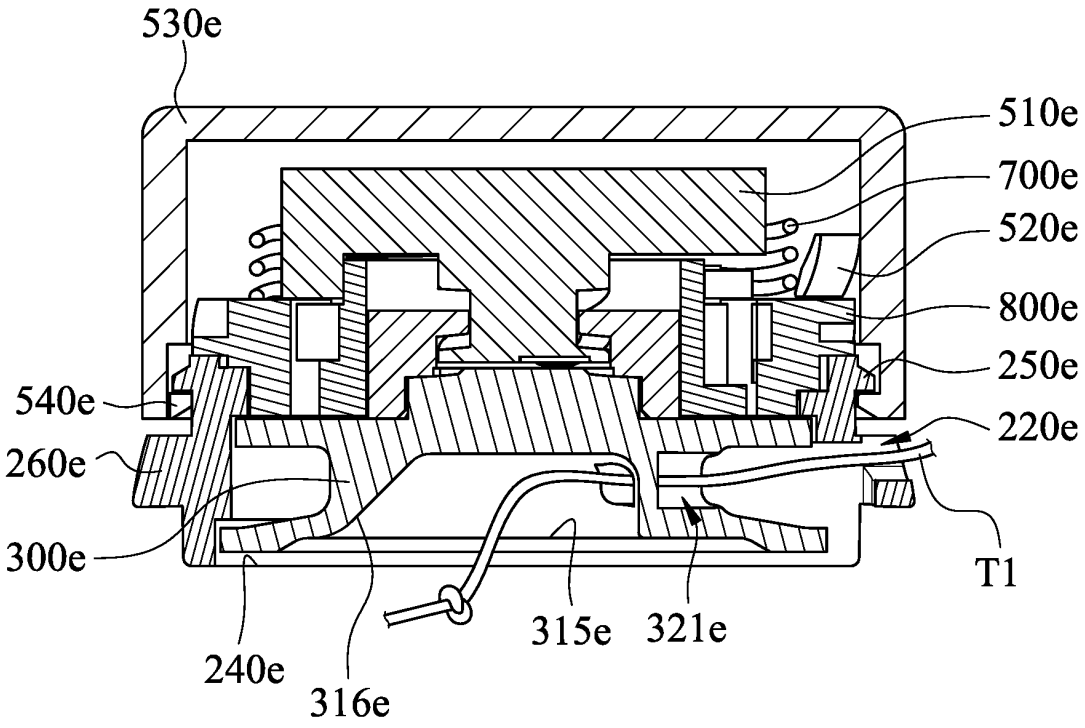
273e

Fig. 8

100e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T1
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316e
315e
321e

Fig. 9

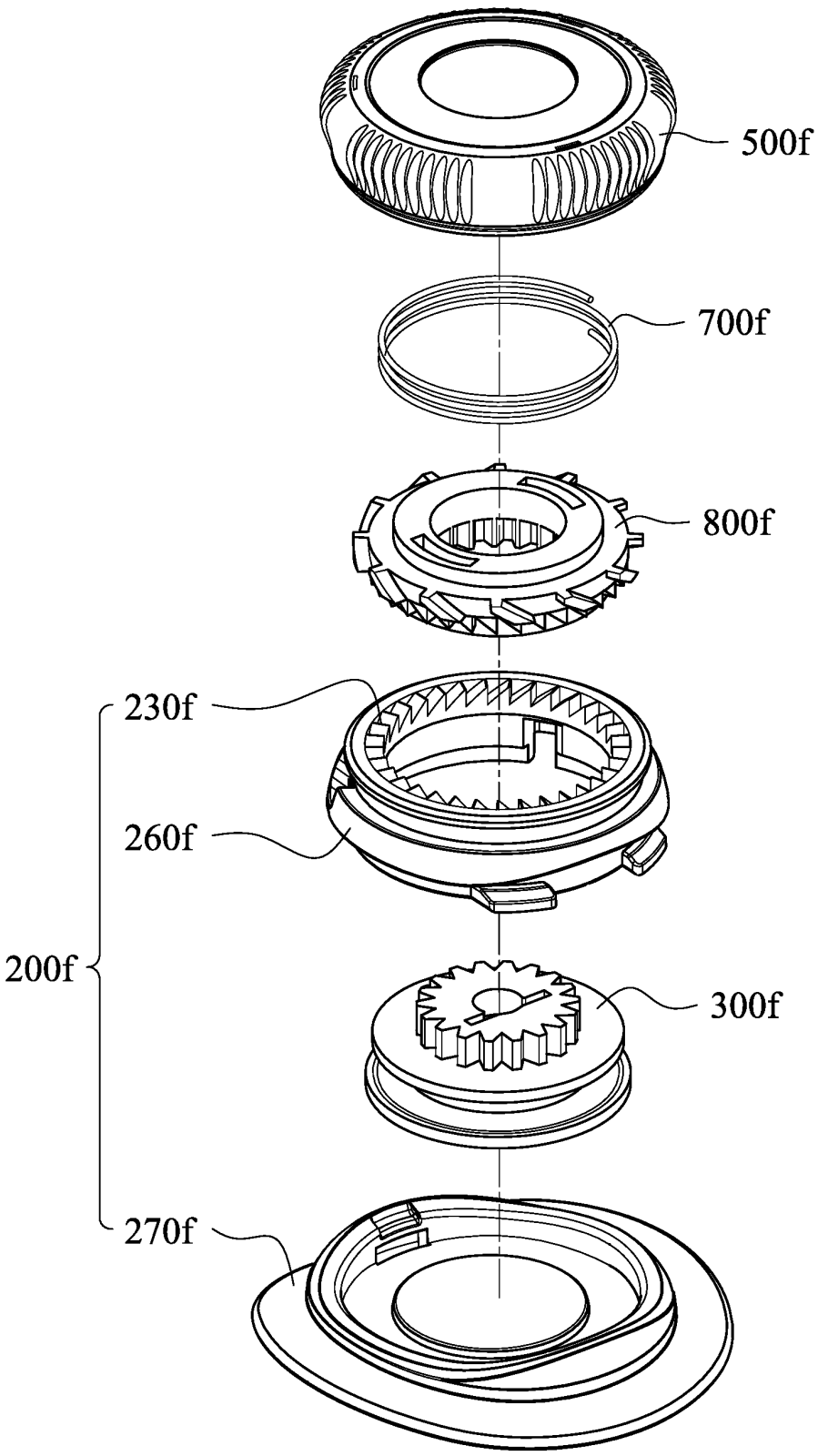

Fig. 10

100f

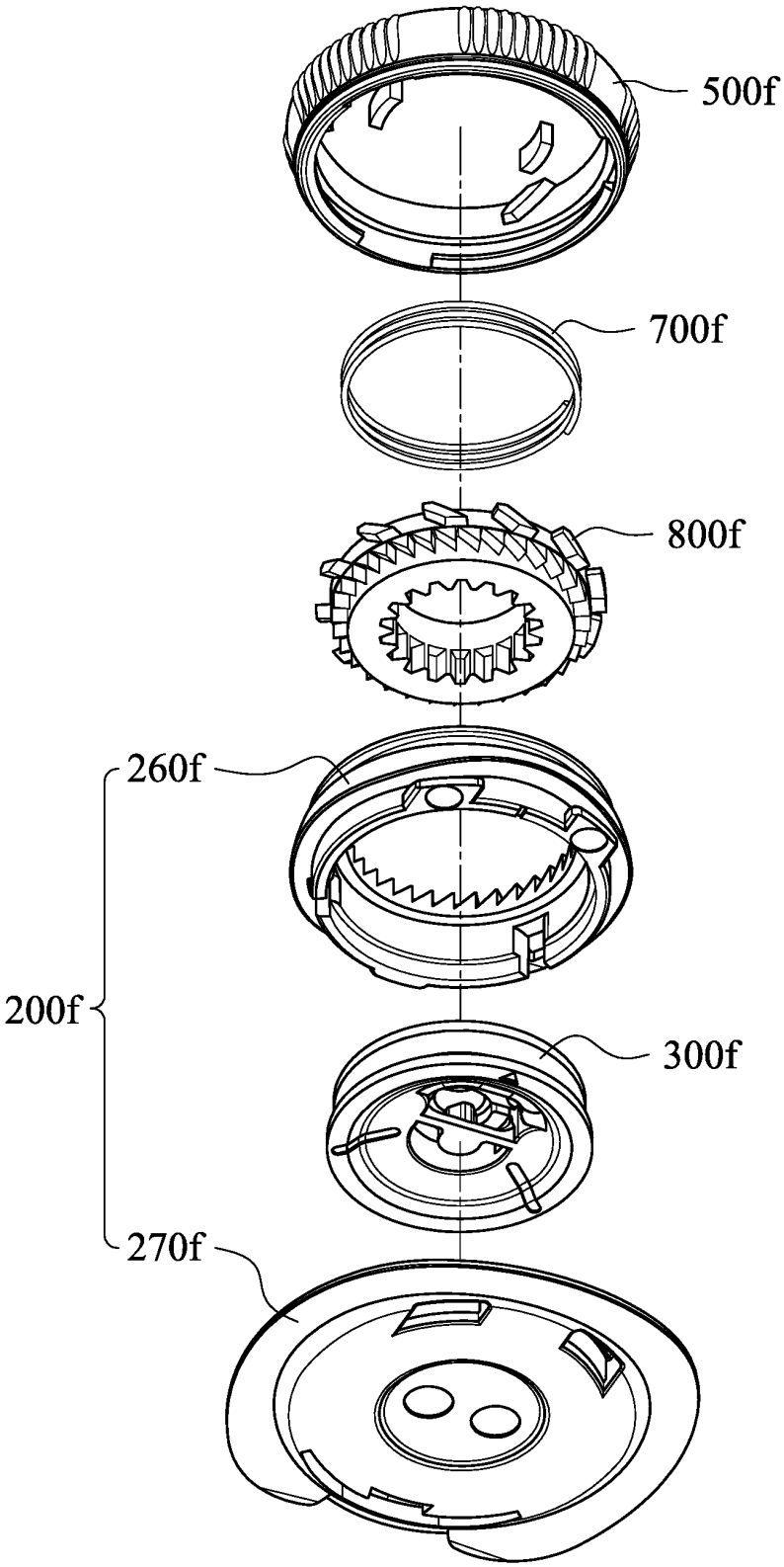

Fig. 11

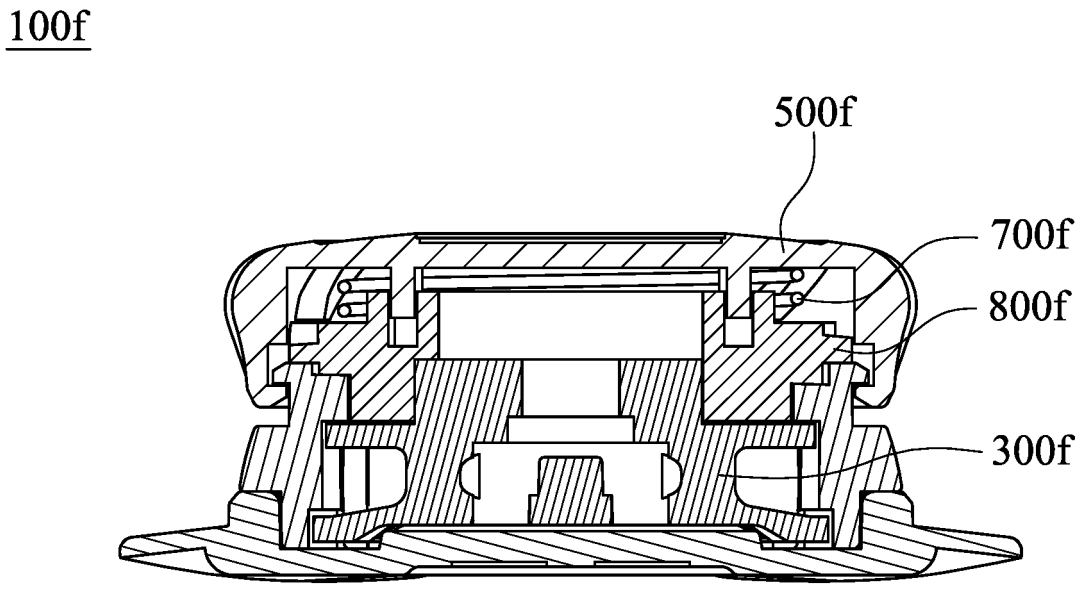

Fig. 12

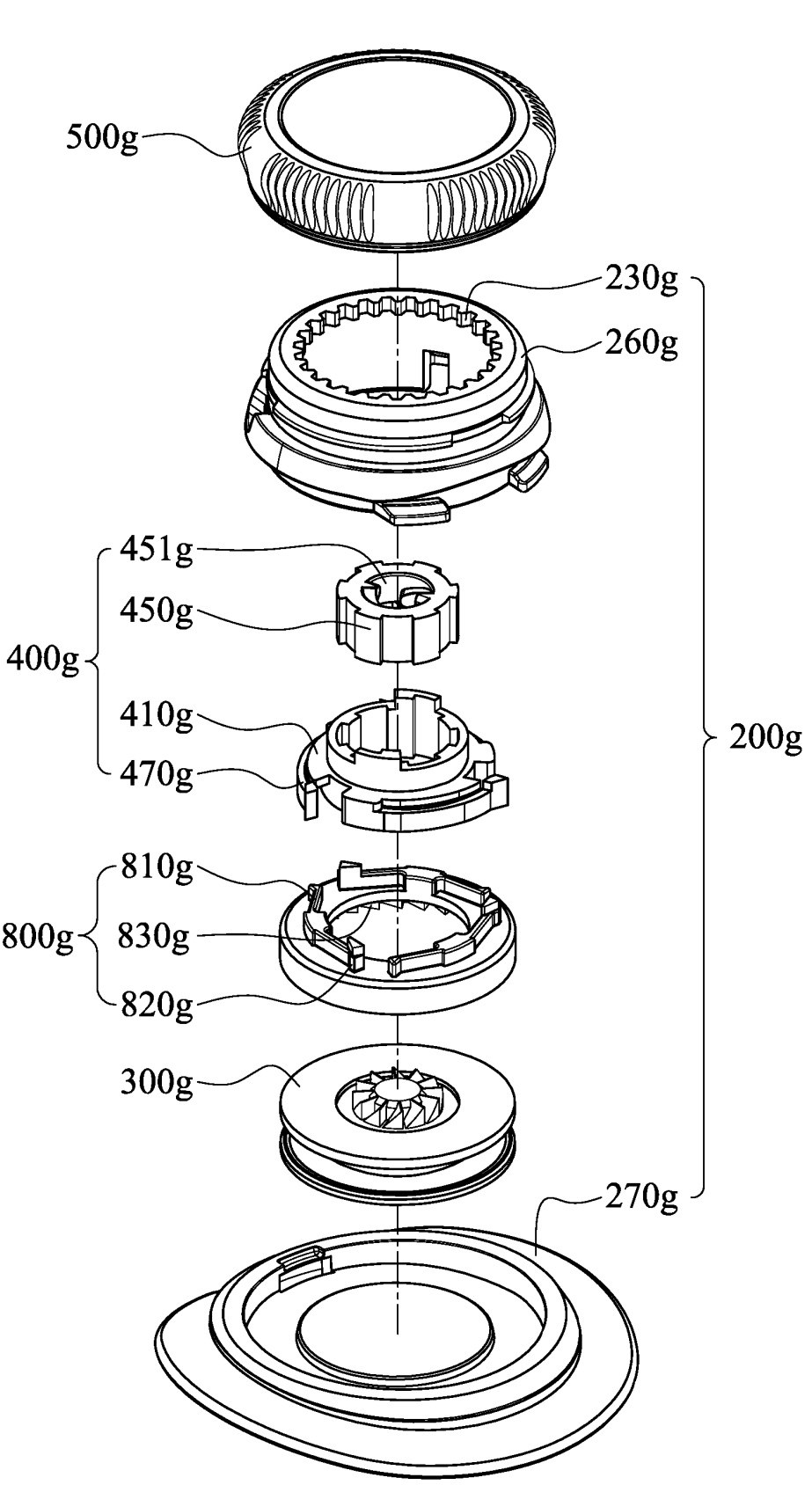
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Fig. 13

100g

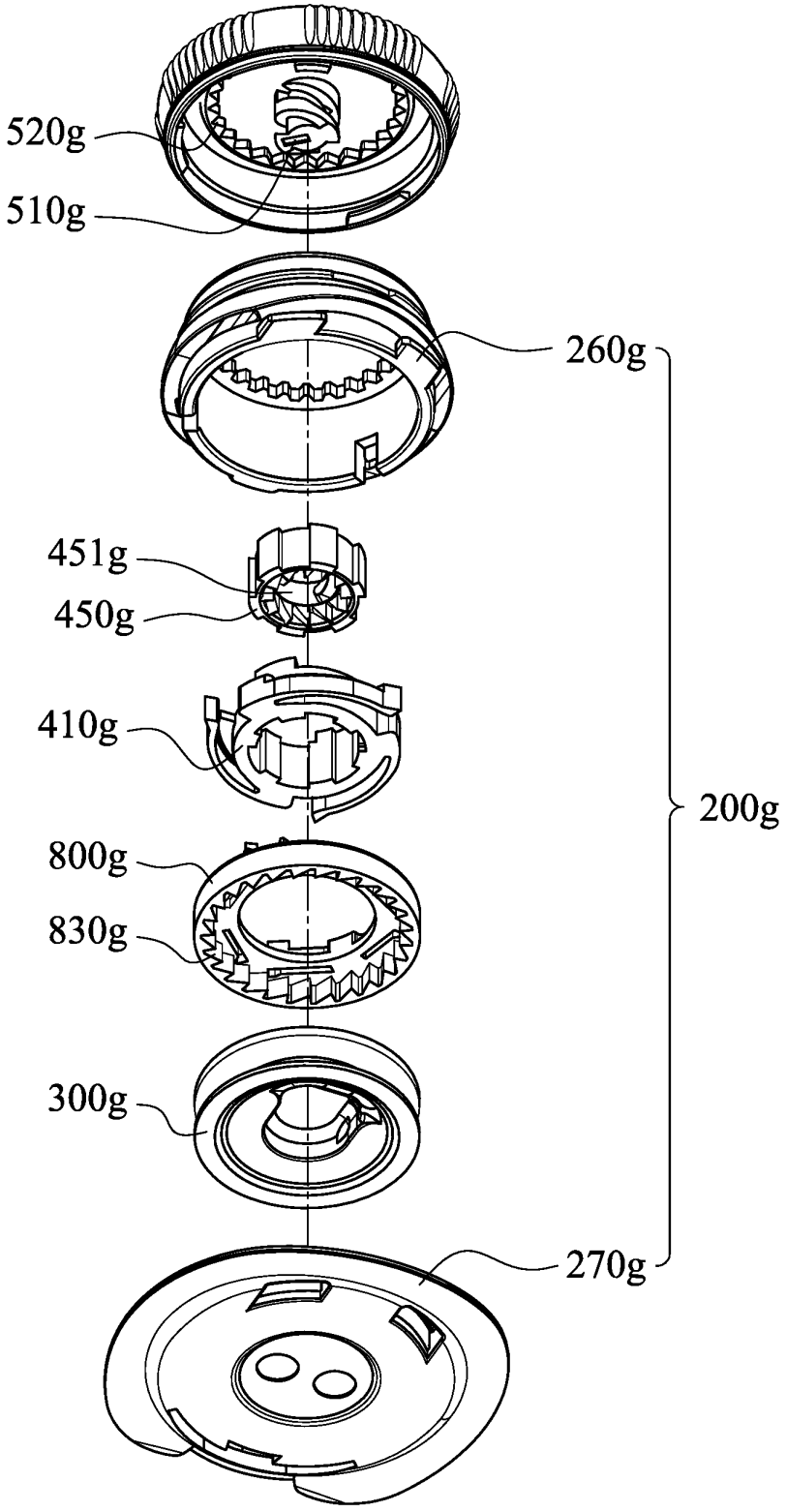

Fig. 14

100g

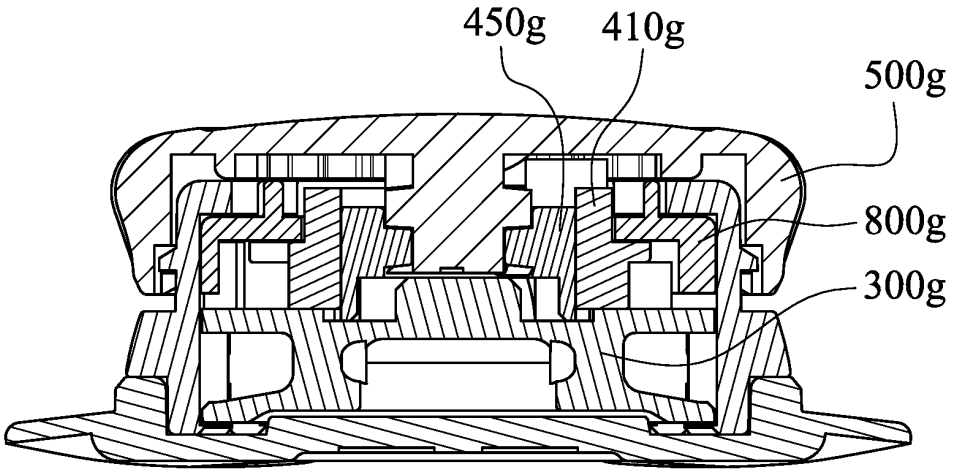

Fig. 15

100h

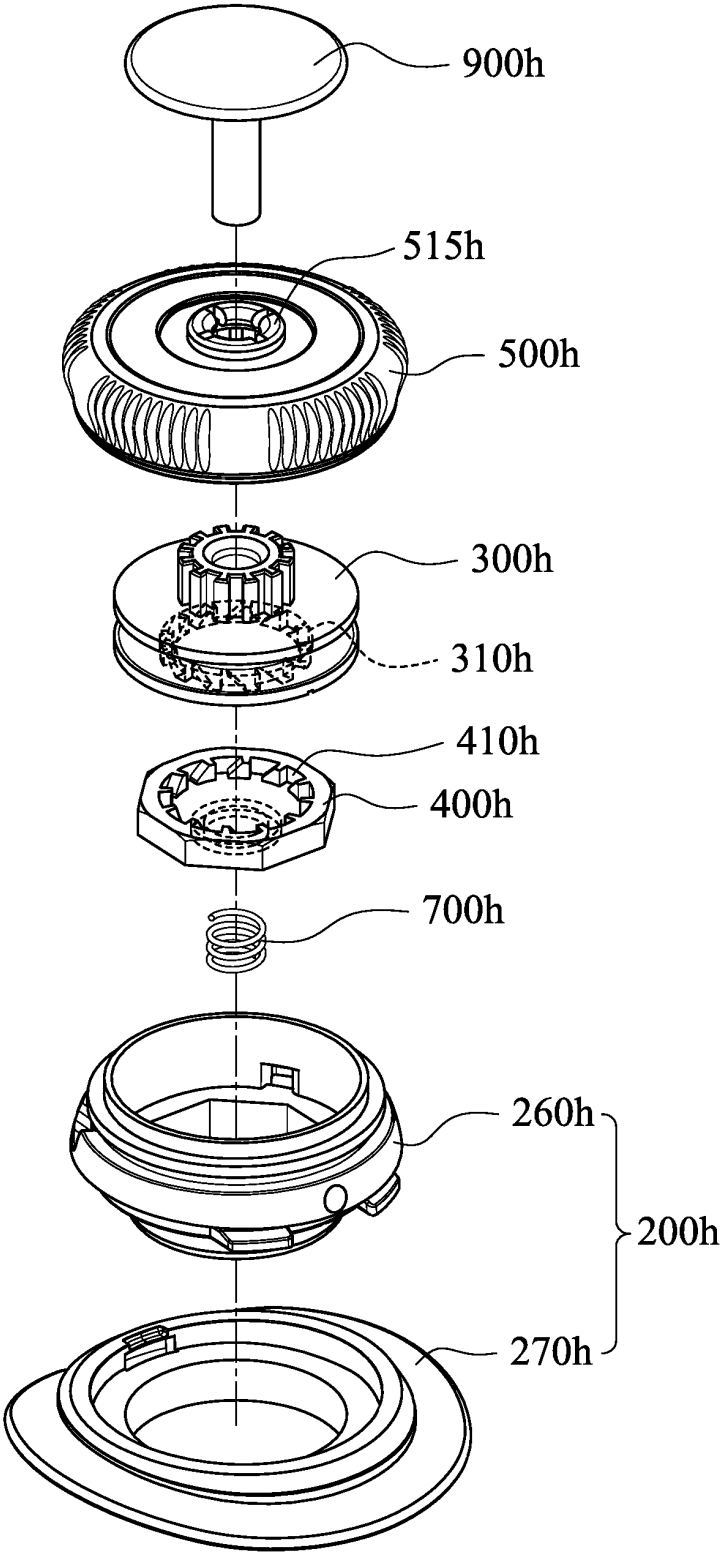

Fig. 16

100h

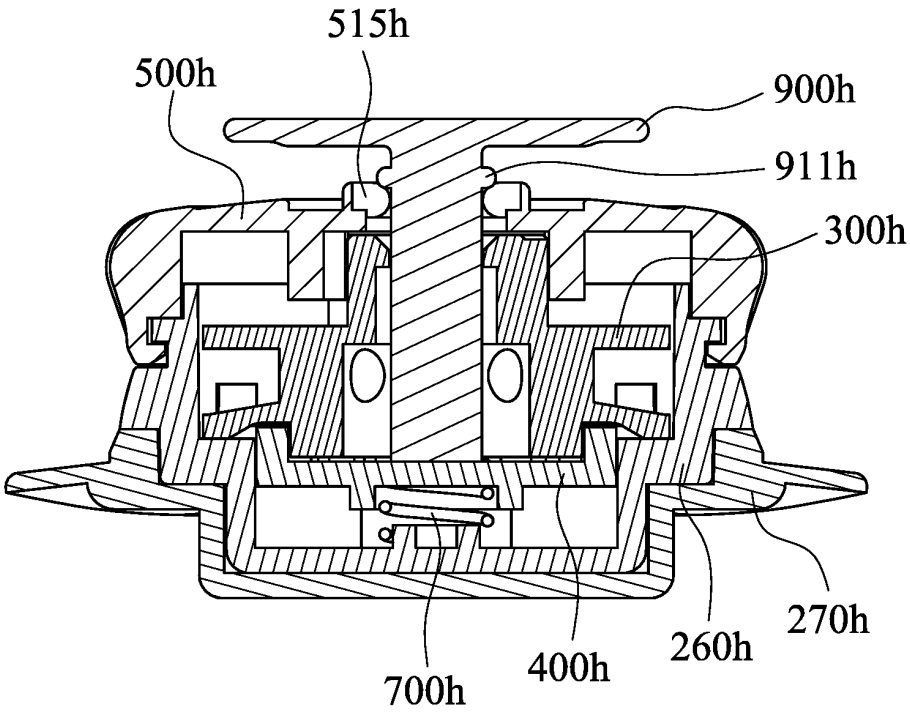

Fig. 17

100i

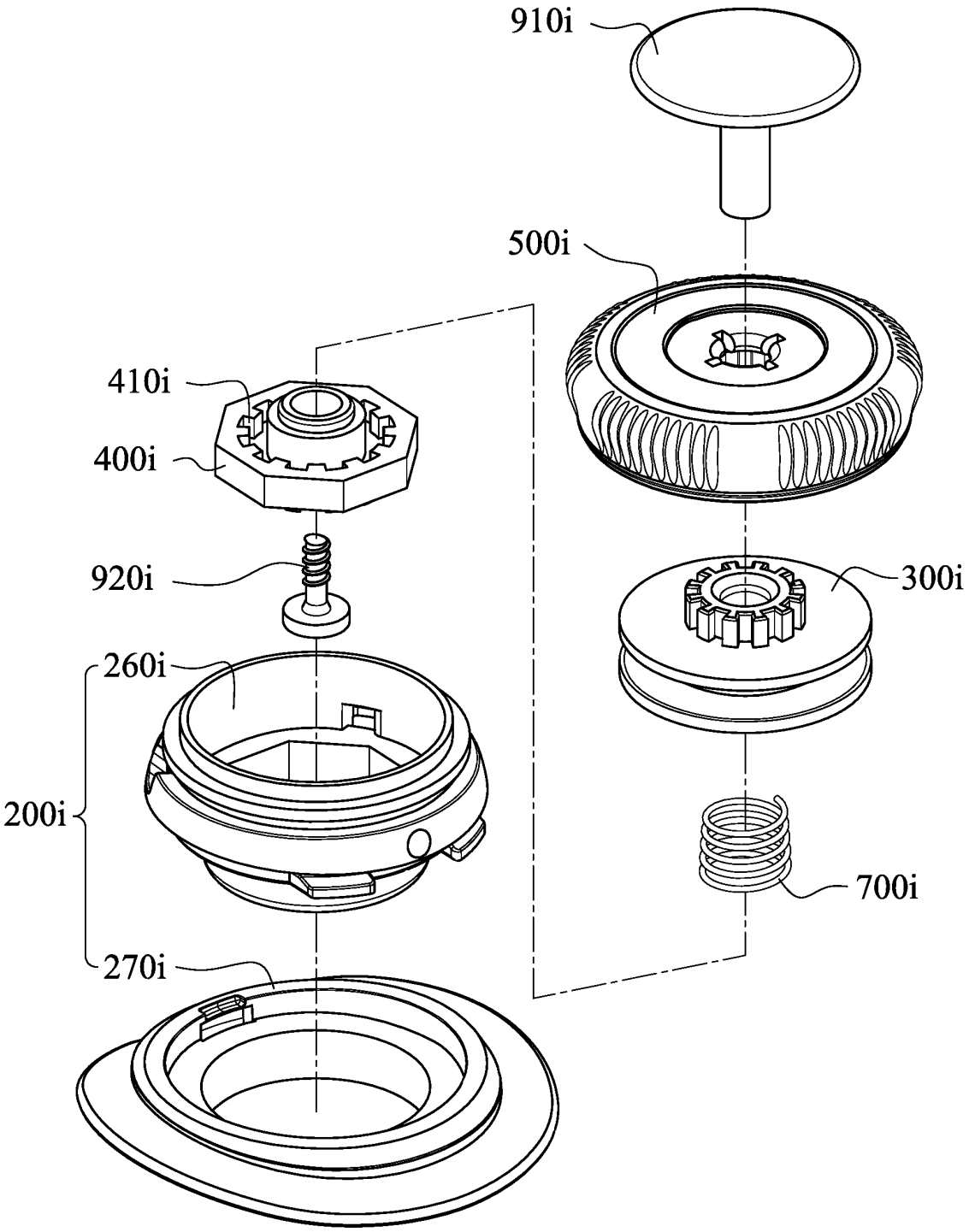

Fig. 18

100i

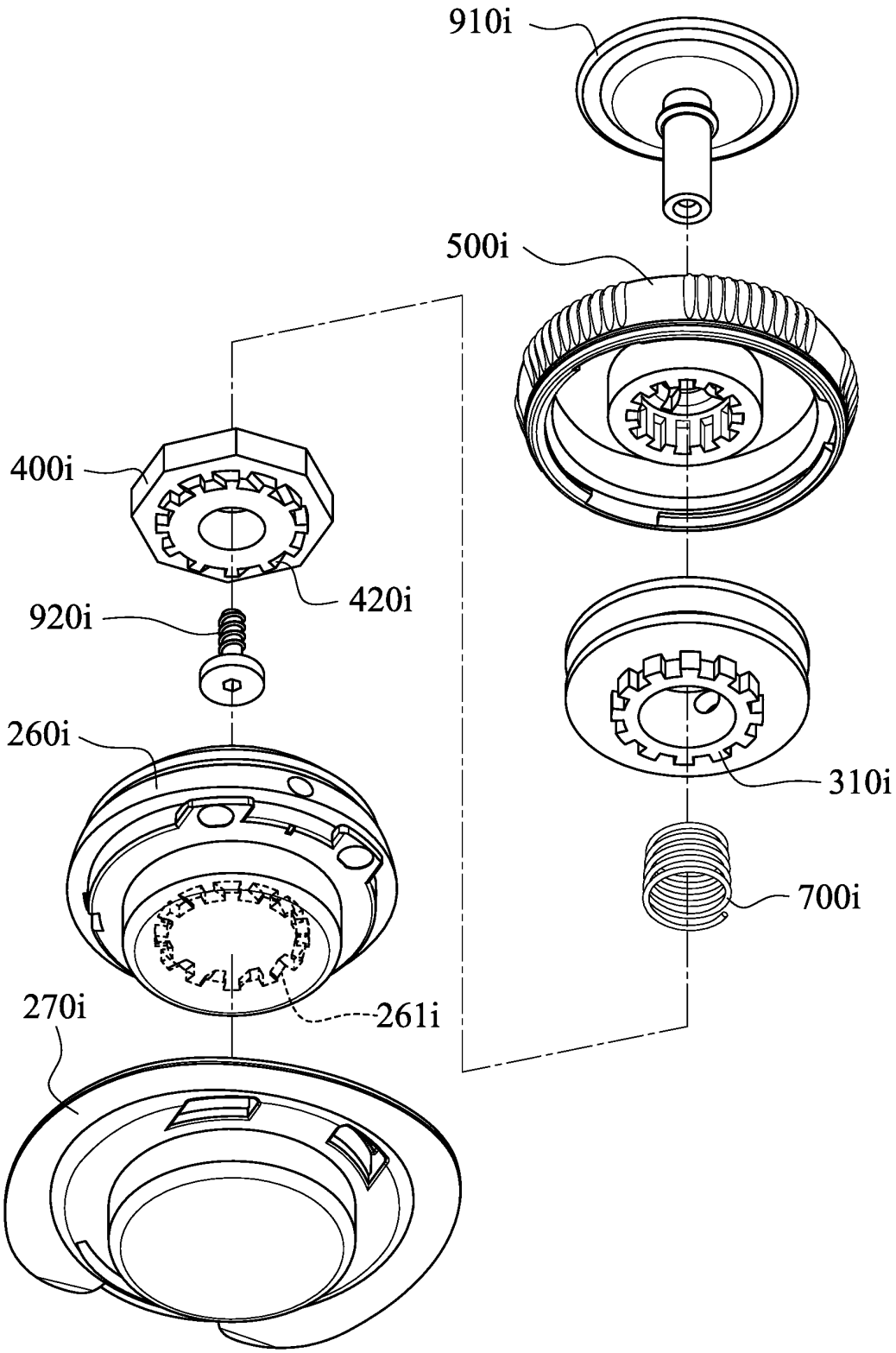

Fig. 19

100i

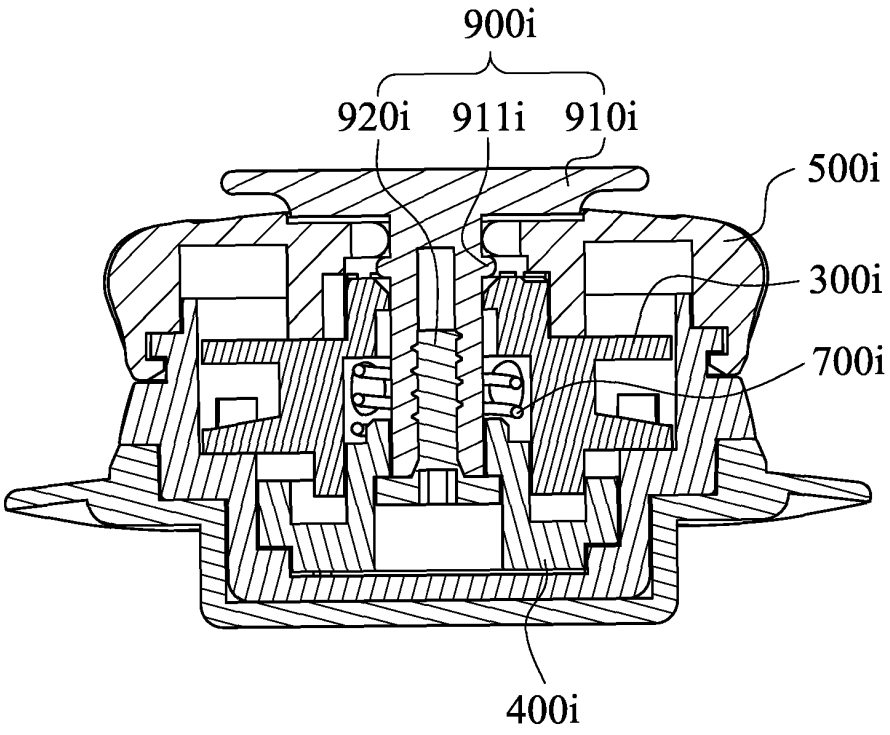

Fig. 20

100j

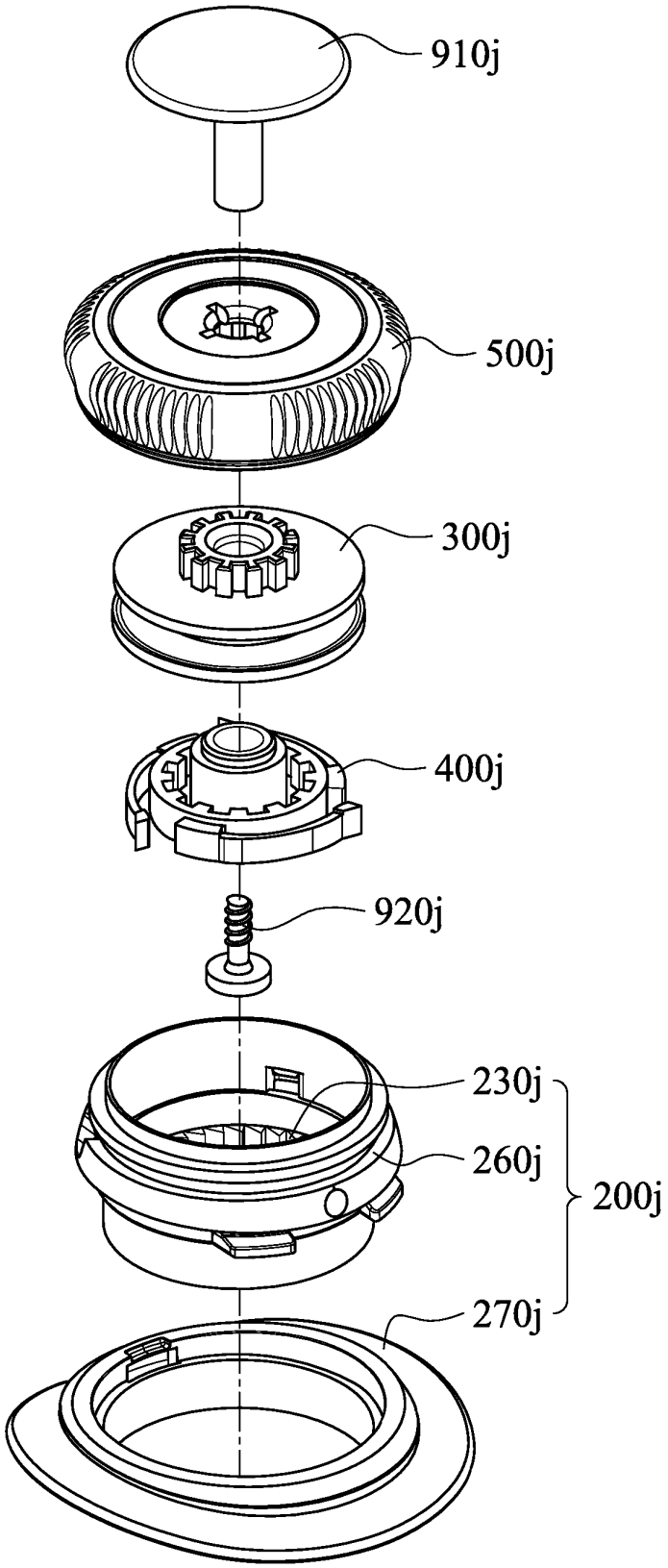

Fig. 21

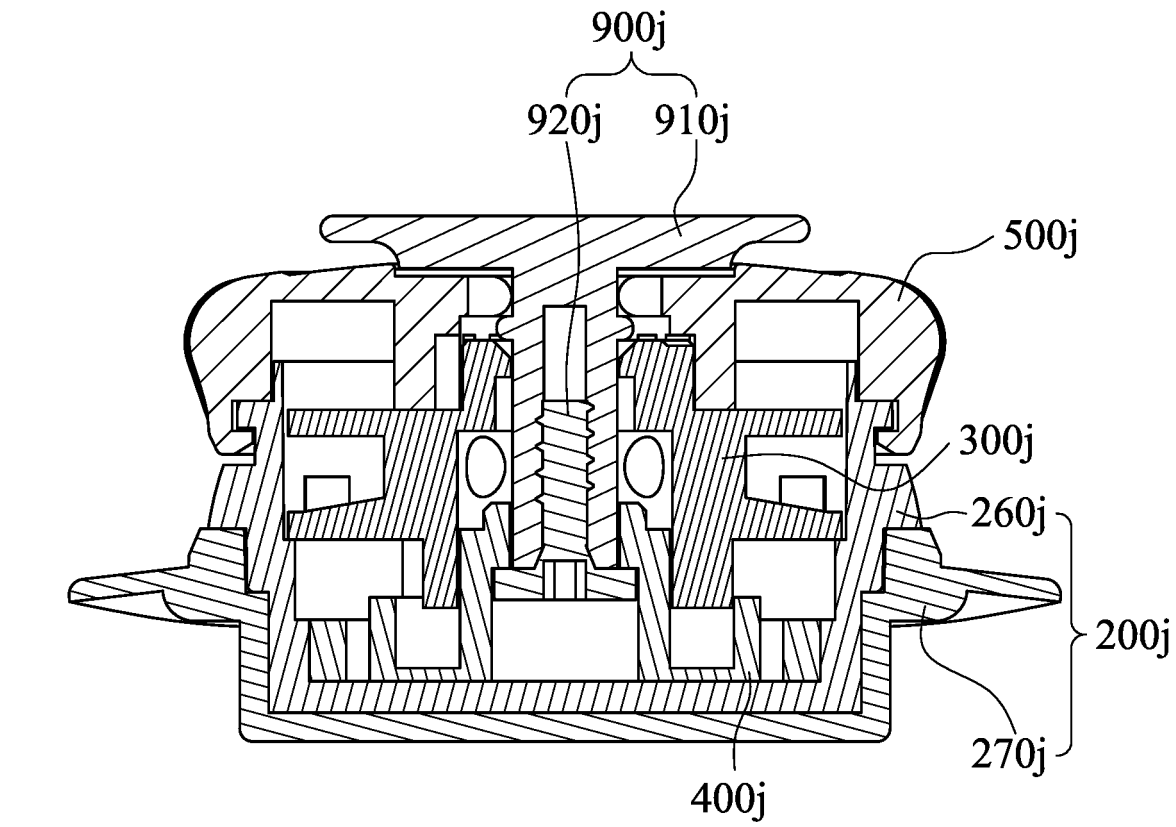

Fig. 22

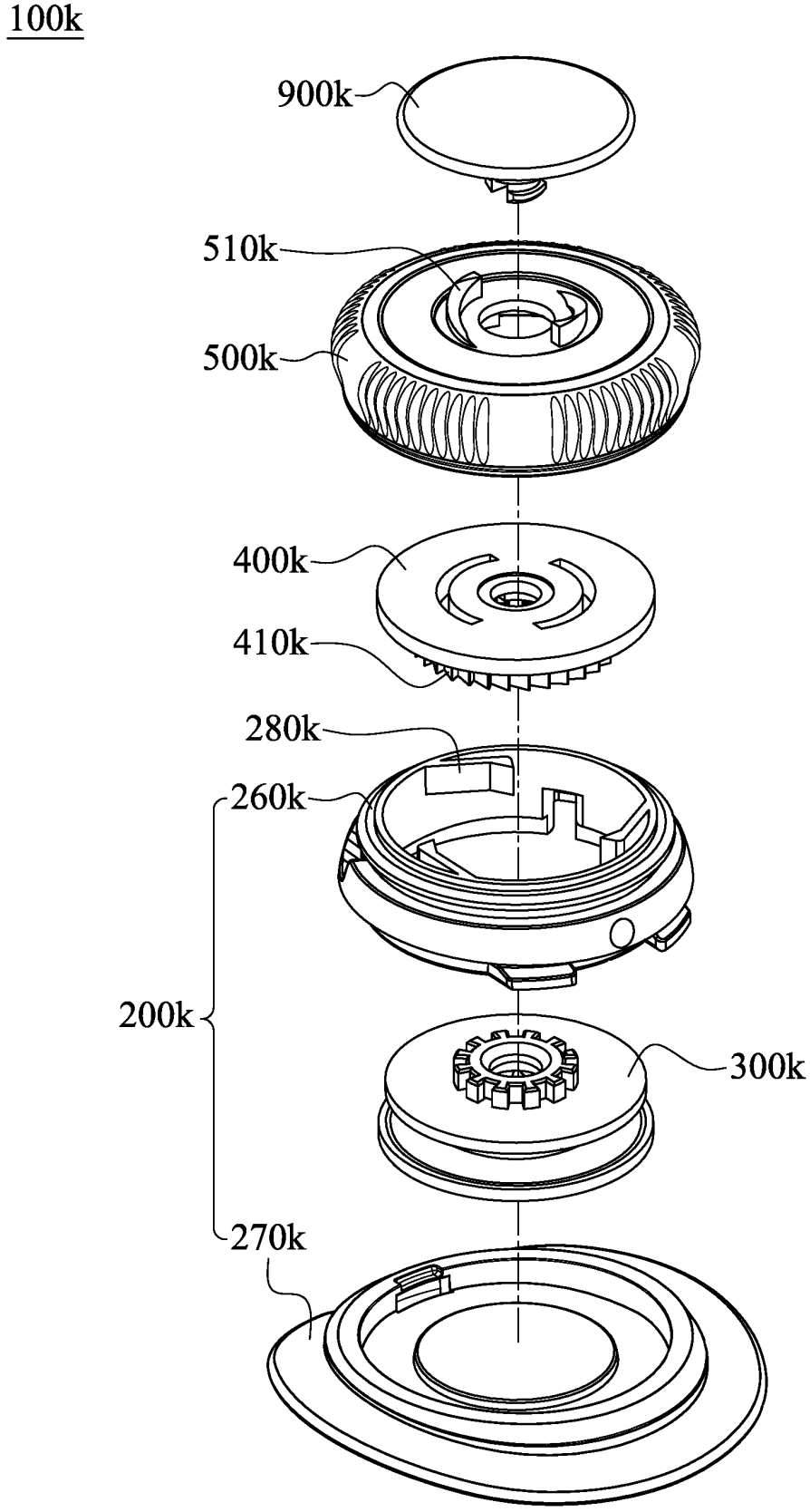

Fig. 23

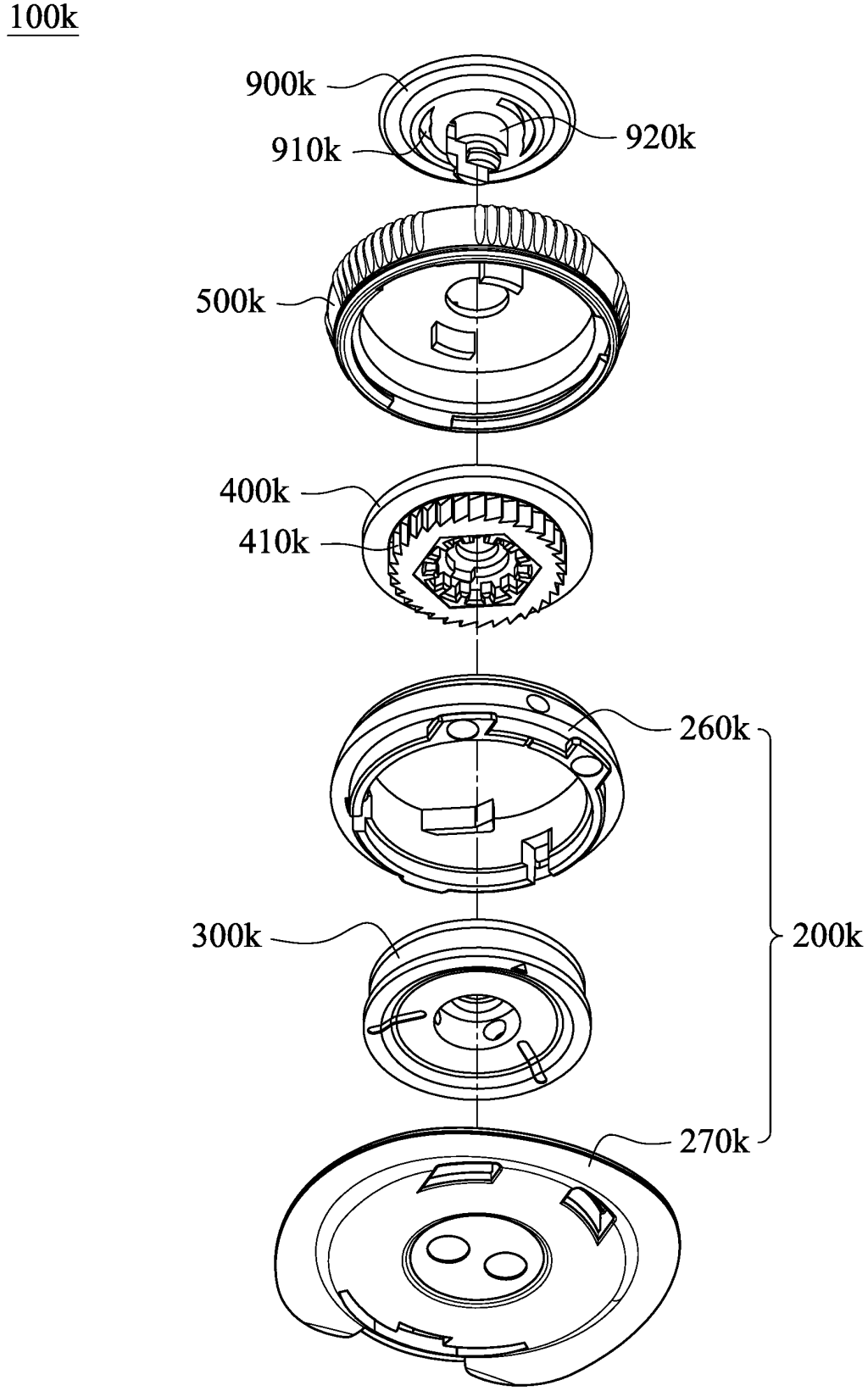

Fig. 24

100k

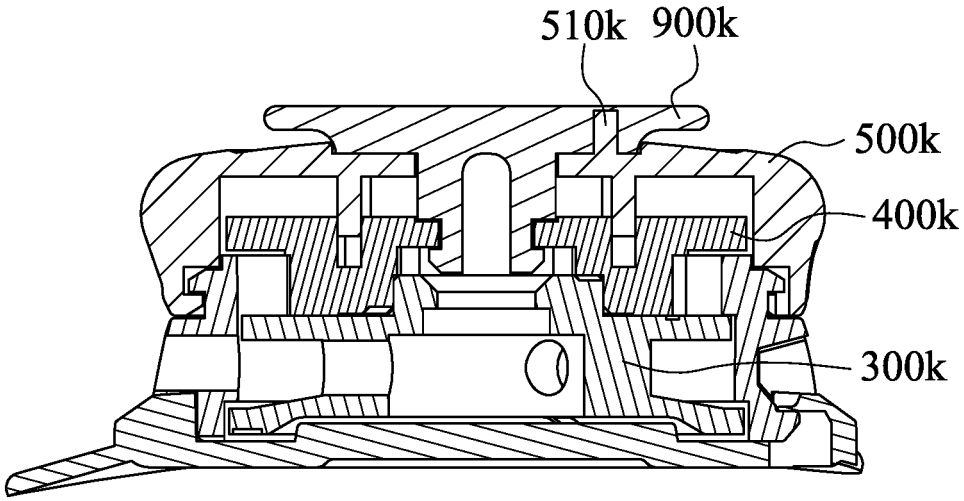

Fig. 25

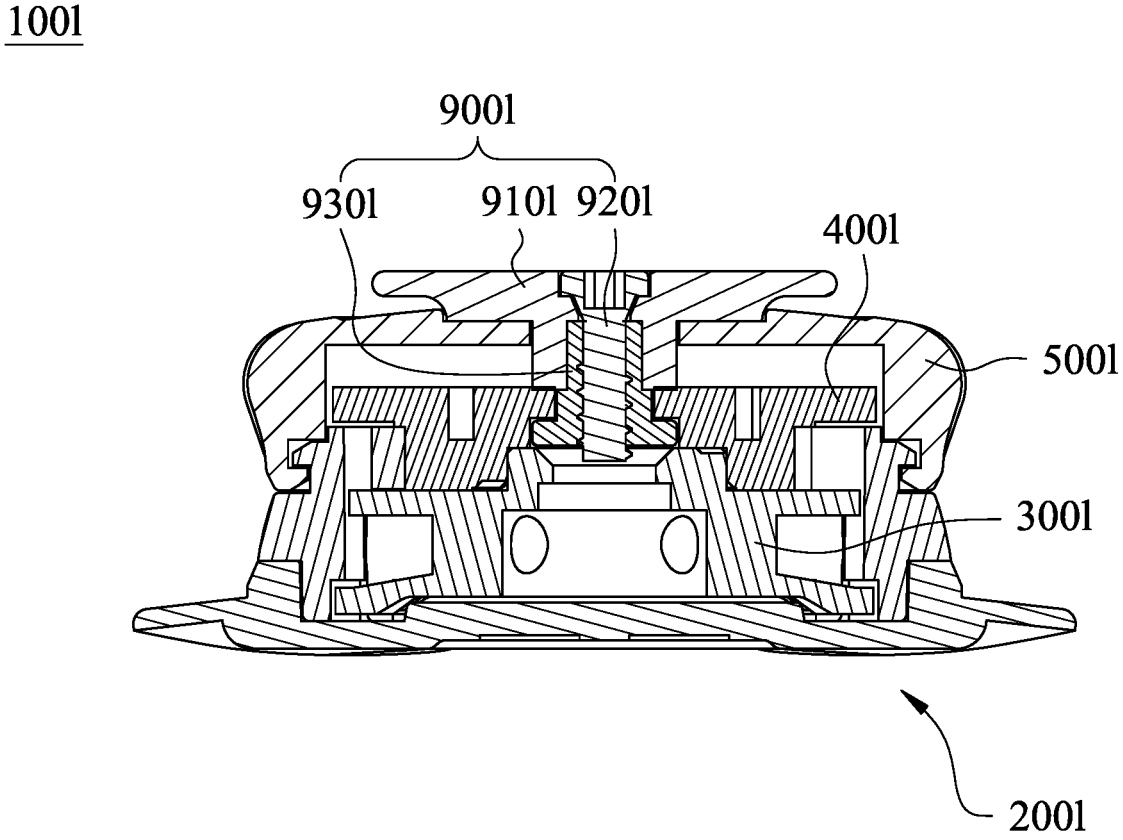

Fig. 26

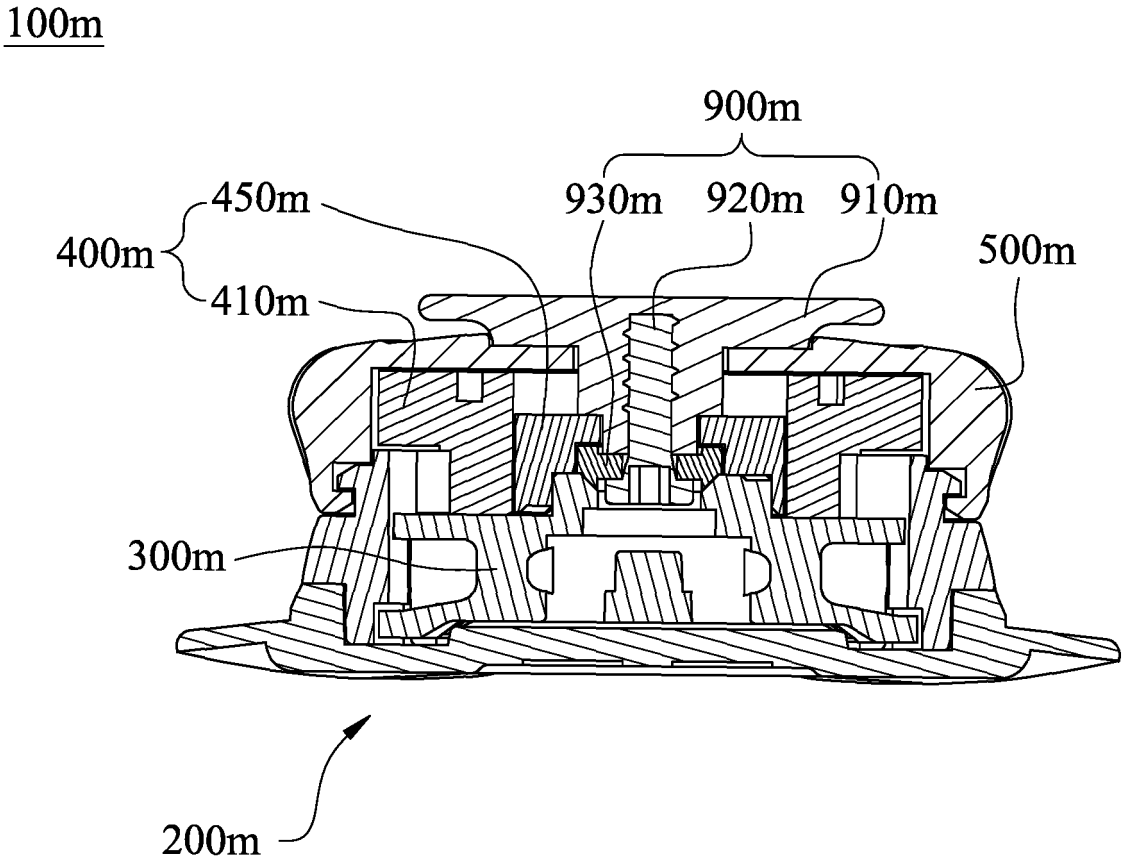

Fig. 27

100n

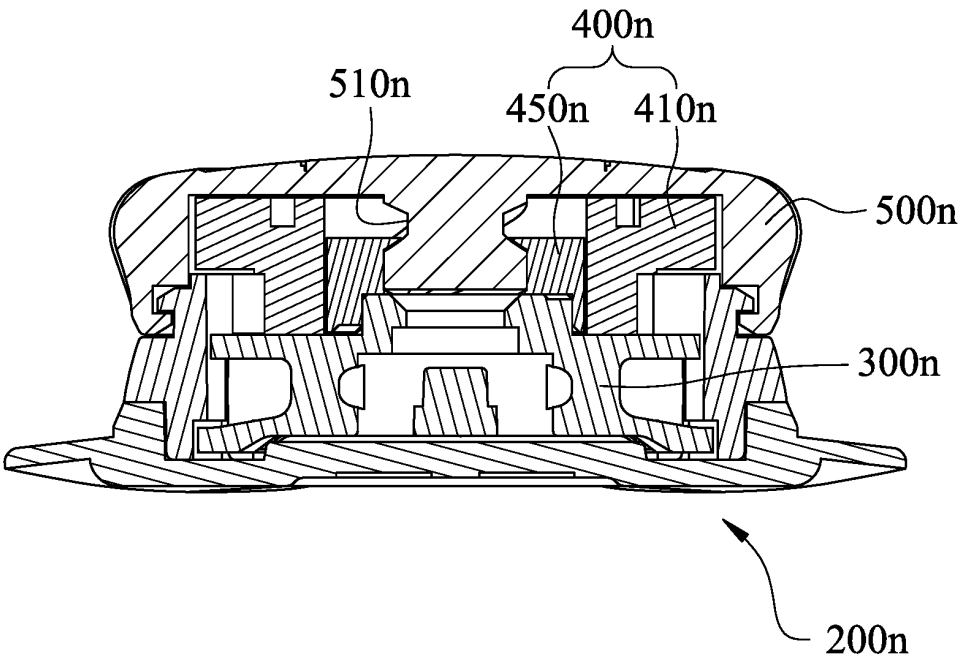

Fig. 28

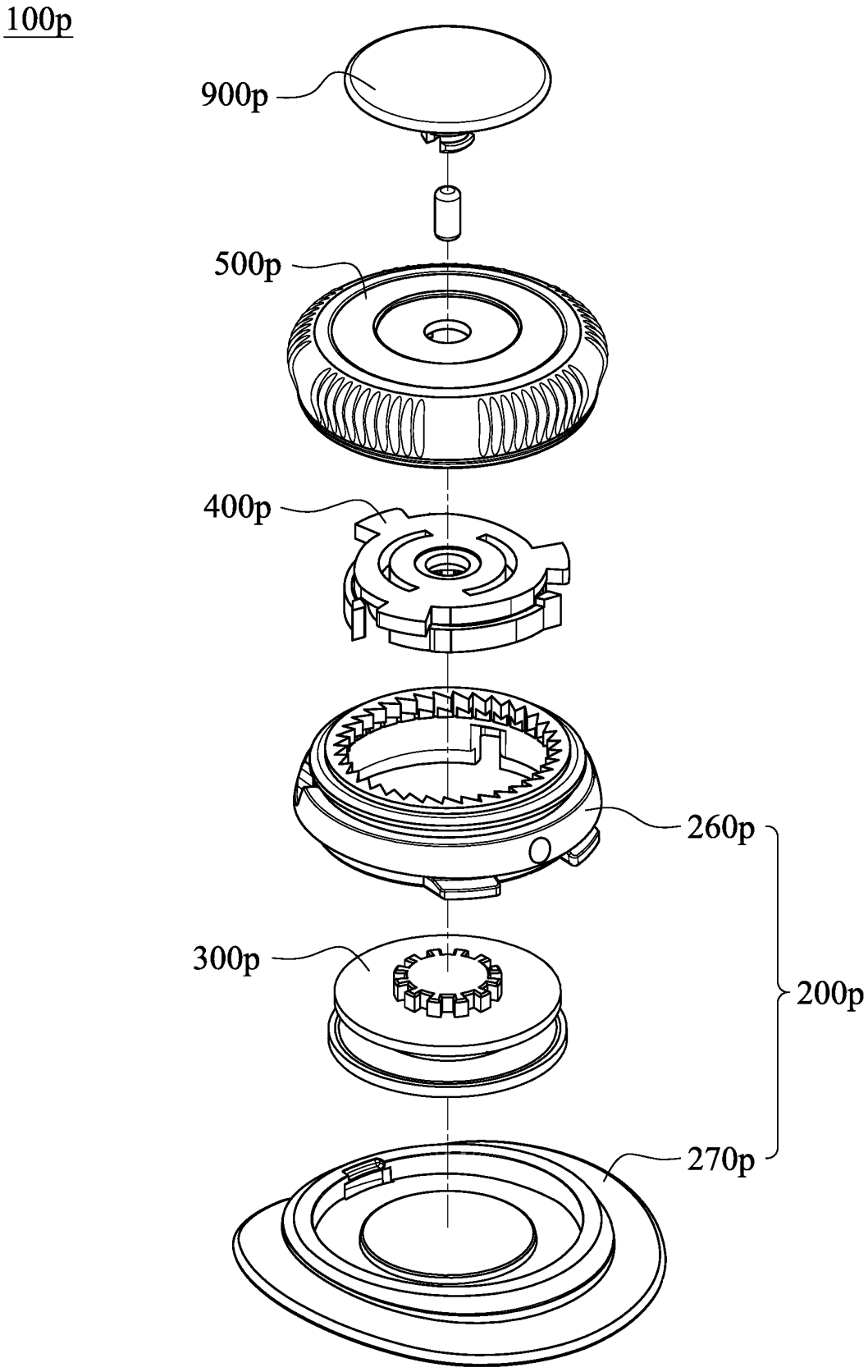

Fig. 29

100p

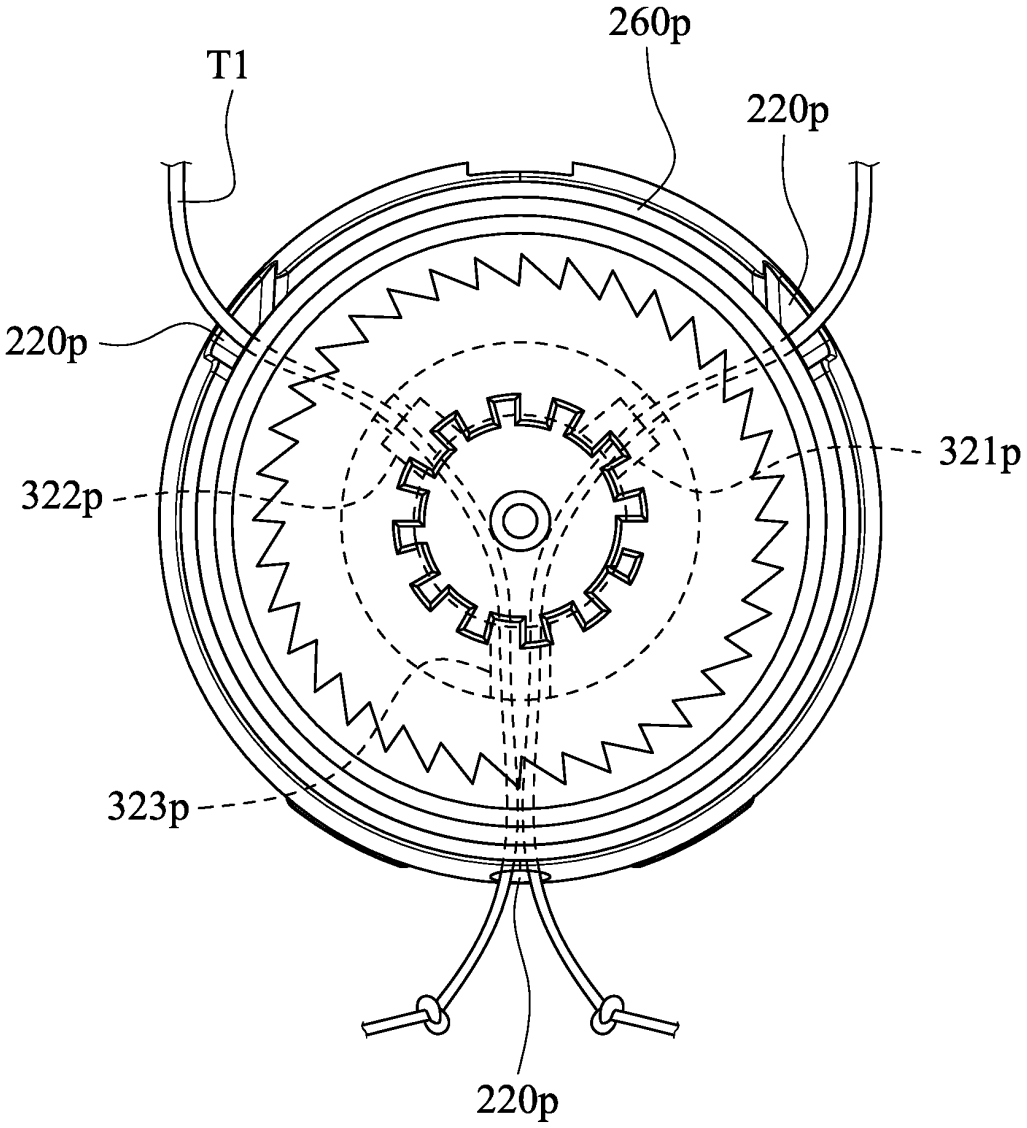

Fig. 30

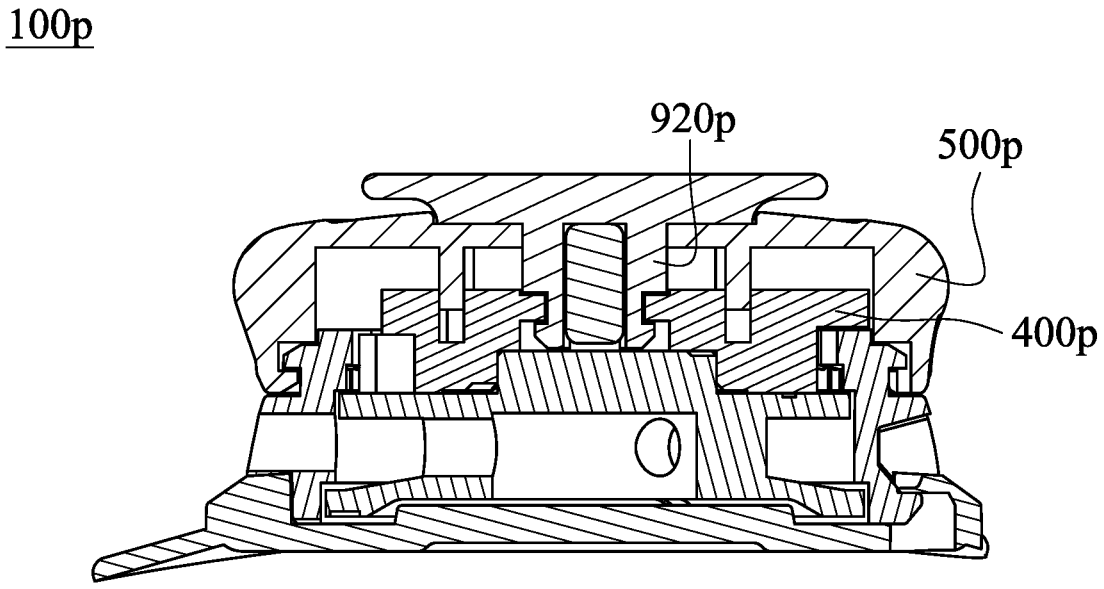

Fig. 31

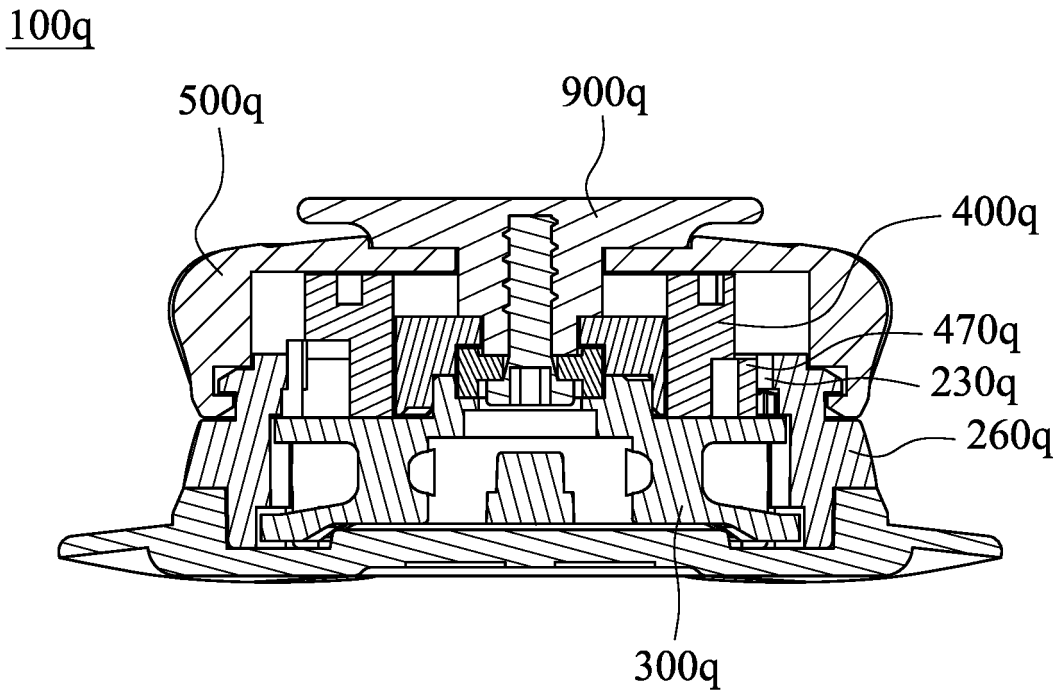

Fig. 32

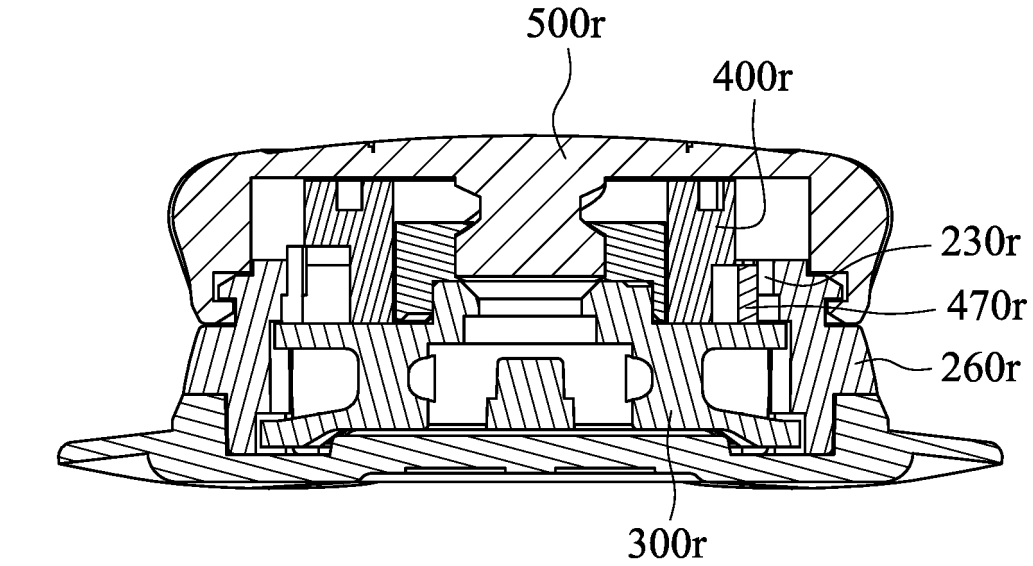

Fig. 33

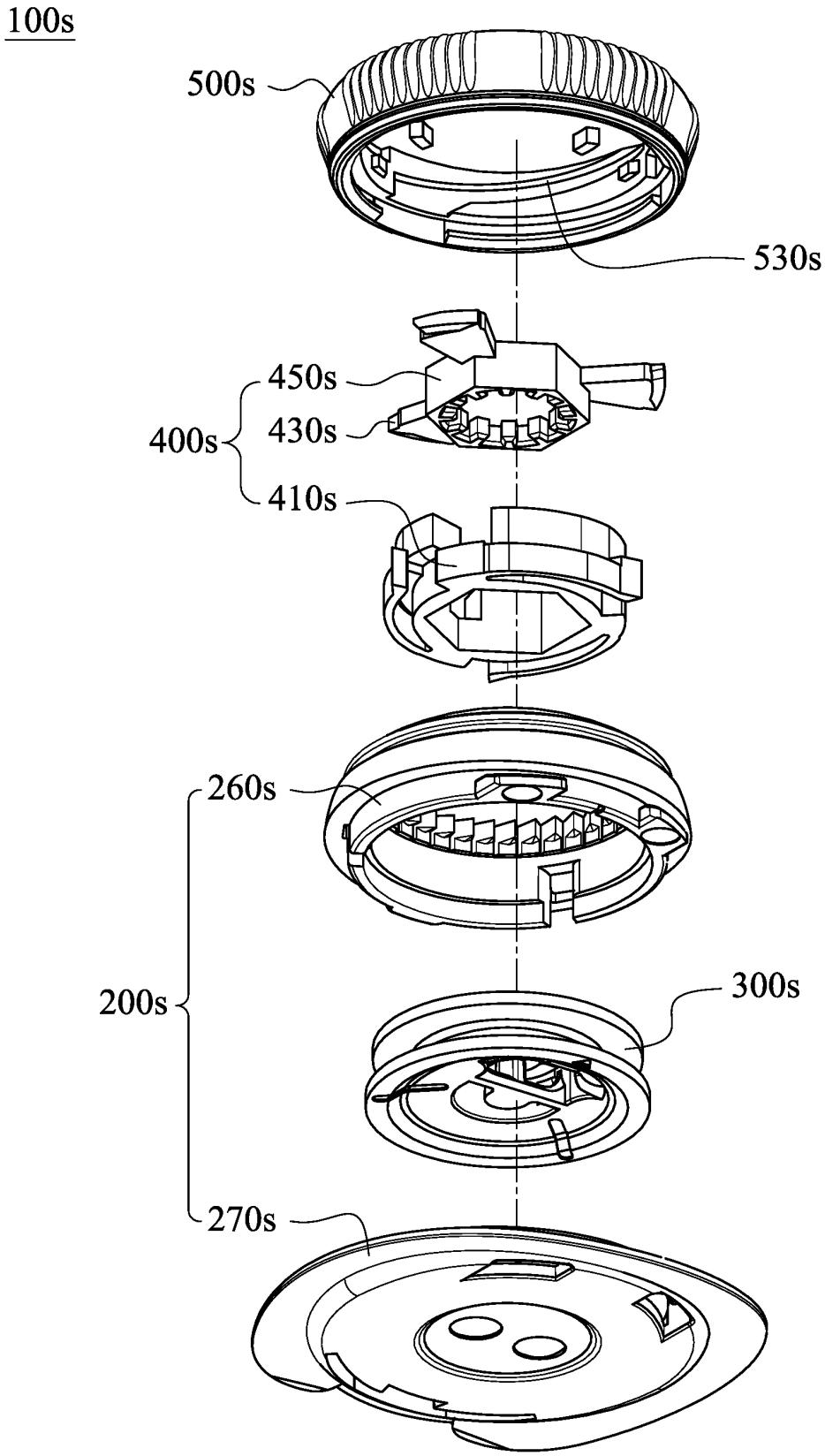

Fig. 34

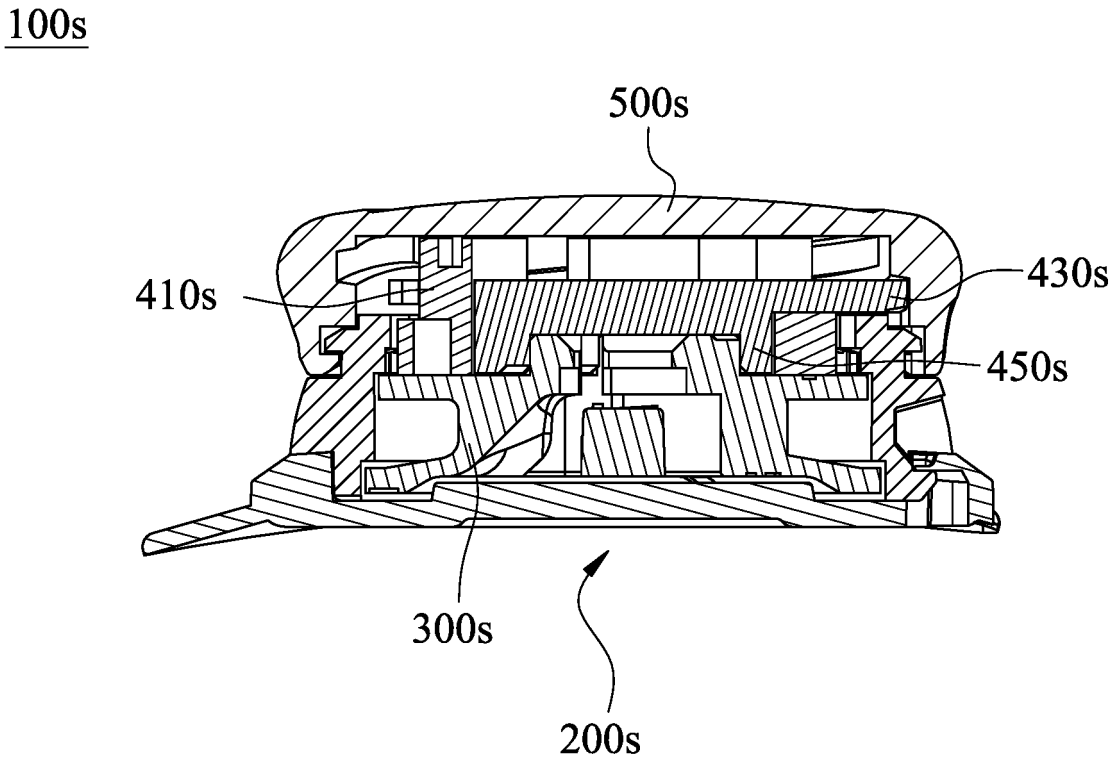

Fig. 35

100

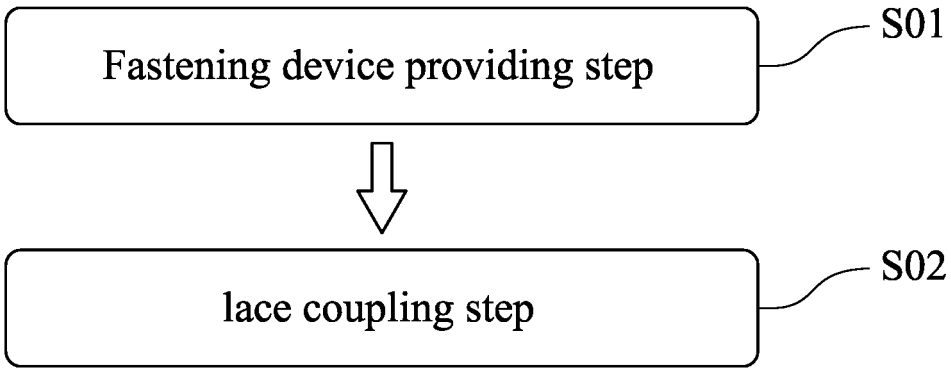
Fastening device providing step
S01
lace coupling step
S02

Fig. 36

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/107457

A. CLASSIFICATION OF SUBJECT MATTER

A43C 11/16(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A43C

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)

CNPAT, CNKI, WPI, EPODOC: 绳, 线, 丝, 卷, 盘, 绕, 缠, 钮, 旋, 转, 轴向, 控制, 螺孔, 螺柱, 螺纹, spool, wall, continuous, lace, coil, roll, wrap, rotat+, control+, screw.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	US 2021127794 A1 (CHEN, Chin Chu) 06 May 2021 (2021-05-06) description, paragraphs 73-85, and figures 10-30	1-15
PX	US 2021127795 A1 (CHEN, Chin Chu) 06 May 2021 (2021-05-06) entire document	1-15
X	CN 110049694 A (BOA TECHNOLOGY INC.) 23 July 2019 (2019-07-23) description, paragraphs 48-84, and figures 1-9	1-11, 13-15
A	CN 111115388 A (CHEN, Jinzhu) 08 May 2020 (2020-05-08) entire document	1-15
A	CN 111846339 A (CHEN, Jinzhu) 30 October 2020 (2020-10-30) entire document	1-15
A	DE 202011101828 U1 (CHEN, Jinzhu) 06 October 2011 (2011-10-06) entire document	1-15

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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"E" earlier application or patent but published on or after the international filing date
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"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
"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
"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
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 September 2021	**20 October 2021**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2021/107457

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
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		US 2018160775 A1	14 June 2018
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		US 10842230 B2	24 November 2020
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		WO 2020087975 A1	07 May 2020
CN 111846339 A	30 October 2020	None	
DE 202011101828 U1	06 October 2011	None	

Form PCT/ISA/210 (patent family annex) (January 2015)