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(54) RESIDUAL BOBBIN THREAD REMOVING DEVICE AND THE SEWING MACHINE

(57) The residual bobbin thread removing device of the present invention is applied to a sewing machine and has a movable arm, a cutter and a suction mechanism. The movable arm is connected to the cutter, and can be driven to make the cutter enter a winding space of the bobbin through the movable arm. Accordingly the cutter can cut off the bobbin thread inside the winding space, and the suction mechanism perform removal operation for the bobbin thread cut by the cutter, which makes the bobbin show the initial state of without wound bobbin thread. By doing so, after the rotary hook is removed from the sewing machine during the sewing operation, the movable arm, the cutter and the suction mechanism can jointly remove the bobbin thread remaining on the bobbin, thereby shortening the working time of removing the bobbin to improve the working efficiency of the sewing machine.

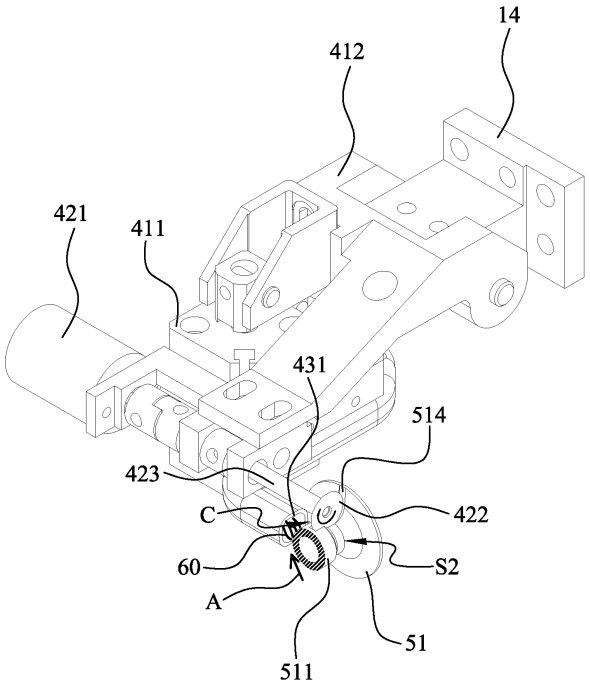

FIG. 15B

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Description

FIELD OF THE DISCLOSURE

[0001] The present invention relates to a cleanup device for a bobbin of sewing machine, and more in particular, to a residual bobbin thread removing device capable of completely separating residual bobbin thread from a bobbin.

BACKGROUND

[0002] When using a sewing machine of lockstitch principle, whether it is a full-rotary rotary hook or a semi-rotary swing hook, there is a bobbin that can wind the bobbin thread. Besides, most sewing machines that using lockstitch principle have a bobbin case for accommodating a bobbin.

[0003] However, in order to increase the rotation speed of the sewing machine, the capacity of the bobbin to accommodate the bobbin thread cannot be too much, but on the other hand, the length of the bobbin thread is relatively limited, so that the bobbin must be changed frequently to avoid the bottom thread running out; besides, when the bobbin thread is replaced, not only the sewing machine must stop the sewing work, but even the operator must manually replacing the bobbin thread, result in the production efficiency is hard to increase.

[0004] In order to overcome the aforementioned shortcomings, there has been an automatic bobbin replacing device in the sewing machine industry. When the bobbin thread wound around the bobbin is detected to run out, the automatic bobbin replacing device will simultaneously detach the bobbin case and the bobbin from the rotary hook. Accordingly, both the bobbin case and the bobbin are separated from the hook, and then another set of the bobbin case and the bobbin full with wound bobbin thread are assembled at the same time to the rotary hook to achieve the function of automatically changing the bobbin.

[0005] In addition, since the bobbin that is about to run out of the bobbin thread will have a part of the bobbin thread remaining therein, and though the automatic bobbin changing device can separate the bobbin which is about to run out of the bobbin thread from the rotary hook, the automatic bobbin changing device cannot assist the operator in removing the bobbin thread remaining in the bobbin, which makes the operator take extra time to remove the bobbin thread remaining in the bobbin before manually rewinding the bobbin thread around the bobbin.

SUMMARY

[0006] The main purpose of the present invention is to automatically remove the bobbin thread wound around the bobbin to shorten the working time of clearing the bobbin, and relatively reduce the time for the operator to prepare the bobbin.

[0007] To achieve the above purpose, the present invention relates to a residual bobbin thread removing device. In one preferred embodiment, the residual bobbin thread removing device is mounted to a sewing machine and comprises a thread cutting mechanism, a movable mechanism and a suction mechanism, wherein the sewing machine has a sewing machine body and a bobbin replacing device, and the sewing machine body has a rotary hook, and wherein the bobbin replacing device is assembled to the sewing machine body and can selectively make the bobbin assembled to or detached from the rotary hook.

[0008] In the present embodiment, the thread cutting mechanism comprises a cutter, and the cutter can cut off the bobbin thread inside a winding space. The movable mechanism has a movable arm capable of changing position, and the movable arm can drive the cutter move into the winding space, which makes the cutter to be at a cutting position to cut off the bobbin thread inside of the winding space, wherein the suction mechanism can generate a suction airflow in the winding space to remove the bobbin thread cut off by the cutter, which makes the bobbin to be in an initial state where the bobbin thread is not wound around.

[0009] In the present embodiment, the thread cutting mechanism further includes a cutting driving source capable of driving the cutter to rotate, wherein the cutting driving source is connected to the movable arm, and moves synchronously during the process that the movable arm drives the cutter to move to the cutting position, and furthermore the cutting driving source is assembled with a cutting transmission member connected to the cutter, wherein the cutting transmission member is arranged with a blowing hole, and the blowing airflow is from the blowing hole.

[0010] The bobbin is arranged with a through space formed by recessing the surface contour of the bobbin, wherein the through space communicates with the winding space, and accommodates a part of the cutter when the cutter is located at the cutting position. In one preferred embodiment, the bobbin has two spaced stop plates and a spool member between the two stop plates, wherein the two stop plates and the spool member jointly form the winding space, and wherein one of the two stop plates and the spool member both are recessed to respectively form a stop groove and a spool groove, such that the stop groove communicates with the spool groove, and thus the stop groove and the spool groove form the through space jointly.

[0011] In addition, the residual bobbin thread removing device further comprises an alignment mechanism, wherein the alignment mechanism is connected between the bobbin and a transmission member, and when the bobbin is assembled to the transmission member, the alignment mechanism aligns the through space with the cutter positioned at the cutting position, so that the cutter can enter the through space.

[0012] Moreover, the alignment mechanism compris-

es a guide module and a position module, and the guide module shorten the distance between the bobbin and the transmission member, which makes the through space be close to the cutter located at the cutting position, wherein the position module limits the relative angular position between the bobbin and the transmission member when the through space is close to the cutter located at the cutting position through the guide module, so that the bobbin cannot rotate relatively to the transmission member.

[0013] The invention is characterized in the movable arm of the movable mechanism that drives the cutter to move into the winding space, so that the cutter cuts off the bobbin thread located inside the winding space, and the bobbin thread is cut off by the cutter for being separated from the bobbin, and besides the suction mechanism can generate suction airflow in the winding space to remove the bobbin thread cut by the cutter. By doing so, the residual bobbin thread removing device of the present invention can remove the bobbin thread remaining in the bobbin without the operator having to reconfirm whether the bobbin has residual bobbin thread, and thus the residual bobbin thread removing device of the present invention can not only shorten the working time for cleaning the bobbin, but also reduce the working time of preparing the bobbin by the operator.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Accompanying drawings are for providing further understanding of embodiments of the disclosure. The drawings form a part of the disclosure and are for illustrating the principle of the embodiments of the disclosure along with the literal description. Apparently, the drawings in the description below are merely some embodiments of the disclosure, a person skilled in the art can obtain other drawings according to these drawings without creative efforts. In the figures:

FIG. 1 is a schematic illustrating perspective view of the automatic bobbin winding sewing machine of the present invention according to a first preferred embodiment;

FIG. 2 is a schematic illustrating exploded perspective view of the automatic bobbin winding sewing machine of the present invention according to a first preferred embodiment;

FIG. 3A is a schematic illustrating exploded perspective view of the bobbin module;

FIG. 3B is a schematic illustrating the bobbin module according to another embodiment;

FIG. 4 is a schematic illustrating exploded perspective view of the replacement of bobbin in FIG. 2;

FIG. 5 is a schematic illustrating exploded perspective view of the bobbin thread introduction device in FIG. 2;

FIG. 6 is a schematic illustrating exploded perspective view of the bobbin module motion mechanism in FIG. 5;

FIG. 7 is a schematic illustrating sectional view of the bobbin module motion mechanism;

FIG. 8 is a schematic illustrating bobbin case mounted on the third transmission member;

FIG. 9 is a schematic illustrating exploded perspective view of the bobbin thread clamping mechanism in FIG. 5;

FIG. 10 is a schematic illustrating exploded perspective view of the thread releasing mechanism in FIG. 5;

FIG. 11 is a schematic illustrating exploded perspective view of the bobbin thread control mechanism in FIG. 5;

FIG. 12 is a schematic illustrating exploded perspective view of the residual bobbin thread removing device in FIG. 2;

FIG. 13 is a schematic illustrating the bobbin mounted to the first transmission member;

FIG. 14A is a schematic illustrating the rotary hook and the bobbin module motion mechanism separately assembled to the bobbin module;

FIG. 14B is a schematic illustrating the movable frame moving in the direction of close to the rotary hook;

FIG. 14C is a schematic illustrating the first jaw assembly clamping the first bobbin module;

FIG. 14D is a schematic illustrating the second jaw assembly clamping the second bobbin module;

FIG. 14E is a schematic illustrating the movable frame moving in the direction of away from the rotary hook;

FIG. 14F is a schematic illustrating the movable frame rotating clockwise;

FIG. 14G is a schematic illustrating the movable frame again close to the rotary hook;

FIG. 14H is a schematic illustrating the second jaw assembly loosening the second bobbin module;

FIG. 14I is a schematic illustrating the first jaw assembly located right in front of the bobbin module motion mechanism;

FIG. 14J is a schematic illustrating the positioning protrusion entering the positioning groove;

FIG. 14K is a schematic illustrating the latch clip clamping the annular groove entering the positioning groove;

FIG. 14L is a schematic illustrating the bobbin of the first bobbin module coupled to the first transmission member through a alignment mechanism;

FIG. 15A is a schematic illustrating the separation state between the bobbin case and the bobbin;

FIG. 15B is a schematic illustrating the cutter at the cutting position;

FIG. 15C is a schematic illustrating the suction mechanism according to the form in another embodiment;

FIG. 15D is a schematic illustrating local sectional view of FIG. 15C;

FIG. 16A is a schematic illustrating the bobbin wound

with the bobbin thread;

FIG. 16B is a schematic illustrating the bobbin thread control mechanism controlling the position of the bobbin thread;

FIG. 16C is a schematic illustrating the clamp module moving to the position of clamping position;

FIG. 16D is a schematic illustrating the clamp module clamping the bobbin thread;

FIG. 16E is a schematic illustrating the clamp module moving to the first preparatory position;

FIG. 16F is a schematic illustrating the thread releasing mechanism clamping the bobbin thread;

FIG. 16G is a schematic illustrating the clamp module moving to the first guiding position;

FIG. 16H is a schematic illustrating the cutter cutting off the bobbin thread;

FIG. 17A is a schematic illustrating the assembling state between the bobbin case and the bobbin;

FIG. 17B is a schematic illustrating the wound bobbin thread introduced into the thread guiding slot;

FIG. 17C is a schematic illustrating the clamp module moving to the second preparatory position;

FIG. 17D is a schematic illustrating the first jaw transmission member in contact with the roller;

FIG. 17E is a schematic illustrating the clamp module moving to the second guiding position;

FIG. 17F is a schematic illustrating the wound bobbin thread introduced into thread hole;

FIG. 18 is a schematic illustrating the bobbin module motion mechanism according to a second preferred embodiment; and

FIG. 19 is a schematic illustrating the bobbin module motion mechanism according to a third preferred embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0015] In order to understand the above objectives, features and advantages of the present disclosure more clearly, the present disclosure is described in detail below with references to the accompanying drawings and specific embodiments.

[0016] Please refer to FIGS. 1 and 2. In one first preferred embodiment, the automatic bobbin winding sewing machine of the present invention is used in conjunction with a bobbin module 50 (as shown in FIG. 3) and comprises a sewing machine body 10, a bobbin replacing device 20, a bobbin thread introduction device 30 and a residual bobbin thread removing device 40. Please refer to FIG. 3, the bobbin module 50 comprises a bobbin 51 capable of winding bobbin thread 60 (as shown in FIG. 14A) and a bobbin case 52 that can be mounted to the bobbin 51; the bobbin 51 has a spool member 511 and two stop plates 512; the partial section of the spool member 511 is set as a first winding portion 511a, and the remaining section of the spool member 511 is set as a second winding portion 511b having an outer diameter larger than that of the first winding portion 511a, wherein the two stop plates 512 are spaced and formed respectively at the first winding portion 511a and the second winding portion 511b, so that the spool member 511 is positioned between the two stop plates 512; further, the spool member 511 and the two stop plates 512 jointly form a winding space 513 therein capable of accommodating the bobbin thread 60 (as shown in FIG. 14A). As shown in the figure, the spool member 511 is recessed to form a spool groove 511c communicating with the winding space 513, and one of the stop plates 512 is recessed to form a limiting groove 512a communicating with the winding space 513; the spool groove 511c communicates with the limiting groove 512a, so that the spool groove 511c and the limiting groove 512a together form a through space 514 formed by indentation along the surface contour of the bobbin 51. However, that the spool member 511 of the bobbin 51 has the first winding portion 511a and the second winding portion 511b is for convenience of description. As shown in FIG. 3B, a limiting flange 511d extends outwardly from the spool member 511, and the limiting flange 511d is near to the stop plate 512 where the limiting groove 512a forms thereon.

[0017] As shown in FIG. 3A, the bobbin case 52 has a housing 521 being of a hollow structure; a bobbin shaft 522 with a hollow structure is arranged inside the housing 521. A closed end 523 and an open end 524 are respectively formed at opposite ends of the housing 521; an accommodating space 525 for accommodating the bobbin 51 is formed between the inner edge of the housing 521 and the outer edge of the bobbin shaft 522. A thread guiding hole 526 forms through the housing 521 and communicates with the accommodating space 525; a thread guiding slot 527 communicating with the accommodating space 525 is formed by recessing the housing 521 from the open end 524 toward the closed end 523. In the present embodiment, the housing 521 is assembled with a clamping elastic piece 528 that allows the bobbin thread 60 (as shown in FIG. 17B) to be guided from the thread guiding slot 527 to the thread guiding hole 526, and a hook arm 529 is formed by extending outward from the housing 521; wherein, one side of the clamping elastic piece 528 is provided with a guiding opening 528a, and outer edge of the hook arm 529 is recessed to form a thread hole 529a. In addition, a thread blocking piece 530 assembled on the closed end 523 of the housing 521 can restrict the bobbin thread 60 (as shown in FIG. 17B) to the thread hole 529a, and the thread blocking piece 530 has an elastically deformable elastic arm 530a near the thread hole 529a, and the elastic arm 530a is located on one side of the hook arm 529 to prevent the bobbin thread 60 from leaving the thread hole 529a.

[0018] Please refer to FIG. 2 again. The sewing machine body 10 has a base 11 (the figure only shows a particular part of the base 11), and the base 11 has a horizontally disposed lower shaft (not shown in the figure), and the lower shaft can drive a rotary hook 12 installed inside the base 11 to rotate; wherein, a working

table 13 is disposed above the base 11, and the base 11 connects with a fixing frame 14, and the base 11 has a thread gripper 15 attached to the fixing frame 14.

[0019] Please refer to FIGS. 2 and 4. The bobbin replacing device 20 is located in front of the rotary hook 12 and has a bobbin module moving assembly 21, a movable frame 22, a first jaw assembly 23 and a second jaw assembly 24, and a rotary hook 12. The bobbin module moving assembly 21 is configured to drive the movable frame 22 to selectively move close to or away from the bobbin module rotating assembly 25, and has a movement driving source 211 capable of generating moving power and a transmission rod 212 assembled to the movement driving source 211. In the present embodiment, the movement driving source 211 is connected to the movable frame 22, and the transmission rod 212 is fixed to the fixing frame 14 of the sewing machine body 10, so that when the movement driving source 211 generates moving power, the movement driving source 211 moves integrally along the transmission rod 212 in the axial direction. Therefore, the movable frame 22 can make the movement to be close to or away from the rotary hook 12.

[0020] The movable frame 22 has a first connecting end 221 and a second connecting end 222 away from the first connecting end 221. An assembling portion connected to the movement driving source 211 is arranged between the first connecting end 221 and the second connecting end 222; wherein, the first jaw assembly 23 has a first jaw connection base 231 formed by two symmetric plate pieces; the first jaw connection base 231 is assembled with a immovable first fixed jaw 232, and a first pivoting portion 231a is disposed on a side away from the first fixed jaw 232; the first fixed jaw 232 is fixedly coupled to the first connecting end 221, and the first pivoting portion 231a is pivotally connected to a first movable jaw 233 that can swing; furthermore, the first movable jaw 233 has a first clamping portion 233a (as shown in FIG. 14C), and a first jaw driver 234 coupled to the movable frame 22 is assembled to an end of the first movable jaw 233 away from the first clamping portion 233a; wherein, the first jaw driver 234 can drive the first movable jaw 233 to swing back and forth such that the first clamping portion 233a can selectively move closed to or away from the first fixed jaw 232.

[0021] The second jaw assembly 24 is coupled to the second connecting end 222 of the movable frame 22, and comprises a second jaw connection base 241 having the same structure as the first jaw connection base 231, a second fixed jaw 242 having the same structure as the first fixed jaw 232, a second movable jaw 243 having the same structure as the first movable jaw 233 (as shown in FIG. 14D) and a second jaw driver 244 having the same structure as the first jaw driver 234. Besides, the second jaw connection base 241, the second fixed jaw 242, the second movable jaw 243 and the second jaw driver 244 are connected to each other in the same manner as the first jaw assembly 23. Therefore, structure description of the second jaw assembly 24 is omitted later.

[0022] The bobbin module rotating assembly 25 has a rotation driving source 251 and a transmission module 252. The rotation driving source 251 can generate rotation power and is fixed to the fixing frame 14 of the sewing machine body 10; the transmission module 252 is located between the rotation driving source 251 and the transmission rod 212 of the bobbin module moving assembly 21; the transmission module 252 has a first transmission gear 252a assembled to the rotation driving source 251 and a second transmission gear 252b engaged with the first transmission gear 252a; wherein, the second transmission gear is 252a assembled to the transmission rod 212 in a coaxial manner, whereby when the rotation driving source 251 can generate the rotation power, the first and second transmission gears 252a, 252b can drive the movable frame 22 to rotate around the transmission rod 212 as the axis center. Besides, since the movement driving source 211 of the bobbin module moving assembly 21, the first and second jaw assemblies 23, 24 are all connected to the movable frame 22, the first and second jaw assemblies 23, 24 rotate synchronously when the movable frame 22 rotates.

[0023] Please refer to FIGS. 2 and 5. The bobbin thread introduction device 30 is assembled to the fixing frame 14 of the sewing machine body 10, and has a bobbin module motion mechanism 31, a bobbin thread clamping mechanism 32, a thread releasing mechanism 33 and a bobbin thread control mechanism 34. Please refer to FIGS. 2 through 7. The bobbin module motion mechanism 31 comprises a first motion module 311, a second motion module 312, a third motion module 313 and a synchronization module 314. As shown in the figure, the first motion module 311 has a first driving source 3111 and a first transmission member 3112; the first driving source 3111 is assembled to the fixing frame 14 of the sewing machine body 10, and can generate rotation power to drive the first transmission member 3112 to perform a rotary motion. The first transmission member 3112 is coaxially disposed along a motion axis L parallel to the first transmission member 3112, and one end of the first transmission member 3112 forms a connection plate 3112a; wherein, the first transmission member 3112 is mounted with a blade 3112b below the connection plate 3112a. The blade 3112b is composed of an elastic material and has a edge portion 3112c (as shown in FIG. 10) below the connection plate 3112a as well as a connecting portion 3112d (as shown in FIG. 10) on the rear side of the connection plate 3112a. In the present embodiment, the motion axis L is overlapped with the axis of the first transmission member 3112, and the first driving source 3111 is connected to the first transmission member 3112 via a first interlocking module 3113, wherein the first interlocking module 3113 has a first driving belt pulley 3113a assembled to the first driving source 3111 and a first driven belt pulley 3113b assembled to the first transmission member 3112, and the first driving

belt pulley 3113a is assembled with a first belt 3113c connected to the first driven belt pulley 3113b.

[0024] The second motion module 312 has a second driving source 3121 capable of generating rotation power and a second transmission member 3122 spaced apart from the first transmission member 3112. The second driving source 3121 is assembled to the fixing frame 14 of the sewing machine body 10, and is connected to the second transmission member 3122 through a second interlocking module 3123, such that the second driving source 3121 can drive the second transmission member 3122 to perform a rotary motion through the second interlocking module 3123; the second transmission member 3122 is coaxially disposed to the first transmission member 3112 such that the axis of the second transmission member 3122 overlaps the motion axis L. As shown in the figure, the second interlocking module 3123 has a second driving belt pulley 3123a assembled to the second driving source 3121 and a second driven belt pulley 3123b assembled to the second transmission member 3122, and the second driving belt pulley 3123a is connected to the second driven belt pulley 3123b via a second belt 3123c.

[0025] **The** third motion module 313 has a third driving source 3131 capable of generating moving power and a third transmission member 3132 coaxially disposed on the motion axis L. The third driving source 3131 is mounted with a third interlocking module 3133, and drives the third interlocking module 3133 to move away from or into contact with the third transmission member 3132; the two ends of the third transmission member 3132 respectively pass through the first transmission member 3112 and the second transmission member 3122; that the third transmission member 3132 is movable relative to the first and second transmission members 3112, 3122 makes third transmission member 3132 movably assembled to the first and second transmission members 3112, 3122. In the present embodiment, when the third driving source 3131 releases the third interlocking module 3133 to move away from the third transmission member 3132, a pressing block 3132a connected to the third transmission member 3132 together with the second transmission member 3122 press a resetting member 3134 located between the second transmission member 3122 and the third transmission member 3132; such that, the resetting member 3134, like a spring is pressed, makes restoring force 3134a acting on the pressing block 3132a, and the magnitude of the restoring force 3134a is smaller than the moving power of the third driving source 3131. Through it, when the third driving source 3131 generates moving power to drive the third interlocking module 3133 to push against the third transmission member 3132, the third driving source 3131 overcomes the restoring force 3134a of the resetting member 3134 to push the third transmission member 3132 to move linearly along the motion axis L, which makes the third transmission member 3132 be away from the third driving source 3131.

[0026] The synchronization module 314 is located between the second transmission member 3122 and the third transmission member 3132, and can make the second transmission member 3122 and the third transmission member 3132 rotate simultaneously. As shown in figure, the synchronization module 314 has a synchronization groove 3141 formed on the second transmission member 3122 and a synchronization protruding pillar 3142 formed on the third transmission member 3132. The synchronization groove 3141 shows an elongate shape; the synchronization protruding pillar 3142 passes through the synchronization groove 3141, and can move axially in the synchronization groove 3141 while the third transmission member 3132 is moving.

[0027] Please refer to FIG. 8. The bobbin case 52 of the bobbin module 50 is mounted on the third transmission member 3132 of the third motion module 313, and a limiting assembly 315 is disposed between the bobbin case 52 and the third transmission member 3132. The limiting assembly 315 has an anti-displacement unit 3151 capable of restricting the bobbin case 52 from having the axial movement relative to the third transmission member 3132 and an anti-rotation unit 3152 capable of restricting the bobbin case 52 from rotating relative to the third transmission member 3132. As shown in the figure, the anti-displacement unit 3151 is provided with an annular groove 3151a, a latch clip 3151b and a latch 3151c. The annular groove 3151a is formed on a partial portion of the third transmission member 3132 sticking out of the first transmission member 3112, and the latch clip 3151b and the latch 3151c are pivotally connected to each other. Also, both the latch clip 3151b and the latch 3151c are mounted to the closed end 523 of the bobbin case 52. In this embodiment, both the latch clip 3151b and the latch 3151c belong to components of the bobbin case 52, wherein when the bobbin case 52 is mounted on the third transmission member 3132, the third transmission member 3132 passes through the bobbin shaft 522 of the bobbin case 52, so that a partial section of the third transmission member 3132 protrudes outwardly from the closed end 523 of the bobbin case 52. In turn, the latch 3151c can be snapped fit into the annular groove 3151a to restrict the bobbin case 52 from having the axial movement.

[0028] As shown in the figure, the anti-rotation unit 3152 has a positioning protrusion 3152a and a positioning groove 3152b. The positioning protrusion 3152a is formed on the third transmission member 3132 of the third motion module 313, and is spaced apart from the annular groove 3151a of the anti-displacement unit 3151; the positioning groove 3152b is formed on the bobbin shaft 522 of the bobbin case 52; wherein, when the bobbin case 52 is mounted on the third transmission member 3132, the third transmission member 3132 passes through the bobbin shaft 522 of the bobbin case 52; such that the positioning protrusion 3152a moves into the positioning groove 3152b to restrict the bobbin case 52 from rotating.

[0029] Please refer to FIG. 9. The bobbin thread clamp-

ing mechanism 32 has a first moving module 321, a second moving module 322 and a clamp module 323. The first moving module 321 has a first movable jaw driving source 3211 capable of making a single-stage moving travel and a first jaw transmission member 3212 connected to the first movable jaw driving source 3211; the first movable jaw driving source 3211 and first jaw transmission member 3212 are commonly connected with an avoidance unit 324; the avoidance unit 324 makes both the first movable jaw driving source 3211 and the first jaw transmission member 3212 move relatively to the second moving module 322. By doing so, when the first movable jaw driving source 3211 drives the first jaw transmission member 3212 to move, the first movable jaw driving source 3211 and the first jaw transmission member 3212 both can move relative to the second moving module 322 through the avoidance unit 324.

[0030] In the present embodiment, the avoidance unit 324 has a swinging plate 3241 assembled to the first movable jaw driving source 3211, an assembling plate 3242 assembled to the second moving module 322, and a roller 3243 assembled to the fixing frame 14, so that the swinging plate 3241 can swing relative to the assembling plate 3242. The assembling plate 3242 is recessed to form a low-centered curved guide rail 3242a, and the curved guide rail 3242a is in contact with a guide wheel 3244 connected to the first jaw transmission member 3212; wherein, a holding member 3245 is arranged between the swinging plate 3241 and the assembling plate 3242. The swinging plate 3241 and the assembling plate 3242 collectively press the holding member 3245 to generate holding force 3245a acting on the swinging plate 3241; so that, the swinging plate 3241 can swing relative to the assembling plate 3242 by the holding force 3245a, and thus the guide wheel 3244 moves toward the curved guide rail 3242a, which makes the guide wheel 3244 be continuously in contact the curved guide rail 3242a through the holding force 3245a of the holding member 3245.

[0031] As shown in the figure, the second moving module 322 has a second movable jaw driving source 3221 capable of making two-stages moving travel and a second jaw transmission member 3222 connected to the second movable jaw driving source 3221. The second movable jaw driving source 3221 is assembled to the fixing frame 14 of the sewing machine body 10, and the second jaw transmission member 3222 is connected to the assembling plate 3242 of the second moving module 322. By doing so, when the second movable jaw driving source 3221 drives the second jaw transmission member 3222 to move, the first moving module 321 as a whole is driven by the second jaw transmission member 3222 to move. Furthermore, the clamp module 323 has a movable clamp 3231 pivotally coupled to the first jaw transmission member 3212 and a fixed clamp 3232 fixed to the first jaw transmission member 3212. The movable clamp 3231 is driven by a clamp driving source 3233 mounted on the first jaw transmission member 3212 to bring the end of the movable clamp 3231 selectively to be close to or away from the end of the fixed clamp 3232 (as shown in FIG. 16A).

[0032] As shown in FIG. 9, the end of the movable clamp 3231 has a clamping groove 3231a, and the end of the fixed clamp 3232 has a clamping block 3232a having a smaller volume than the clamping groove 3231a. As shown in the figure, when the clamp driving source 3233 drives the movable clamp 3231 to swing, the movable clamp 3231 moves close to the fixed clamp 3232, such that the clamping block 3232a moves into the clamping groove 3231a, and the clamping block 3232a and the clamping groove 3231a are in a close contact state. In the present embodiment, the movable clamp 3231 is provided with a stop pin 3231b in the middle of the clamping groove 3231a, and clamping block 3232a of the fixed clamp 3232 is recessed to form a pin hole 3232b. When the clamping block 3232a and the clamping groove 3231a are in a close contact state, the stop pin 3231b will enter the pin hole 3232b.

[0033] Please refer to FIGS. 5 and 10. The thread releasing mechanism 33 has a release lever 331 and a release driving source 332. The release lever 331 has a pivot connection 3311 pivotally coupled to the fixing frame 14, and two ends of the pivoting portion 3311 respectively form a pushing portion 3312 spaced apart from the connection plate 3112a and an action portion 3313 connected to the release driving source 332. A clamping space 3314 (shown in FIG. 7) is disposed between the edge portion 3112c of the blade 3112b and the connection plate 3112a. Wherein, the release driving source 332 can generate power to drive the action portion 3313 to move, which makes release lever 331 swing about pivot connection 3311; such that, the pushing portion 3312 can selectively move closer to or away from the rear side of the connection plate 3112a, and the pushing portion 3312 pushes against the lower end of the connecting portion 3112d of the blade 3112b. Therefore, the edge portion 3112c is away from the connection plate 3112a to allow the clamping space 3314 to show an open state in which the bobbin thread 60 enters. Furthermore, please refer to FIGS. 5 and 11. The bobbin thread control mechanism 34 is located between the bobbin module motion mechanism 31 and the thread gripper 15 and has an adjustment member 341 and an adjustment driving source 342. The adjustment member 341 has a pivoting shaft 3411 pivotally connected to the fixing frame 14, and one end of the pivoting shaft 3411 has an adjustment plate 3412 and a connecting post 3413; wherein a through hole 3412a forms through a partial area of the adjustment plate 3412, and the connecting post 3413 is connected to the adjustment driving source 342, and wherein the adjustment driving source 342 can generate the power to drive adjustment member 341 to swing about pivoting shaft 3411.

[0034] Please refer to FIG. 12. The residual bobbin thread removing device 40 is located at one side of the bobbin module rotating assembly 25 of the bobbin mod-

ule, and has a movable mechanism 41, a thread cutting mechanism 42 and a suction mechanism 43. The movable mechanism 41 has a movable driving source 411 assembled to the fixing frame 14 and a movable arm 412 pivotally connected to the fixing frame 14. The movable driving source is connected to the movable arm 412, and can drive the movable arm 412 to move and swing. The thread cutting mechanism 42 has a cutting driving source 421 assembled to the movable arm 412 and a cutter 422 which can be driven by the cutting driving source 421. The cutting driving source 421 is assembled with a cutting transmission member 423, wherein cutting driving source 421 can drive the cutter 422 to rotate through the cutting transmission member 423, and the cutter 422 is located above the bobbin module motion mechanism 31. As shown in the figure, the suction mechanism 43 is coupled to the movable arm 412 and has a suction port 431, and the suction mechanism 43 can generates a suction airflow A (as shown in FIG. 15B).

[0035] Please refer to FIG. 13. The bobbin 51 of the bobbin module 50 is mounted on the first transmission member 3112 of the first motion module 311, and an alignment mechanism 44 is disposed between the bobbin 51 and the first transmission member 3112. The alignment mechanism 44 can restrict the through space 514 of the bobbin 51 to be directly above the bobbin 51 when the bobbin 51 is assembled to the first transmission member 3112, which makes the through space 514 close to the cutter 422 of the thread cutting mechanism 42. As shown in the figure, the alignment mechanism 44 has a guiding module 441 and a positioning module 442. The guiding module 441 is configured as two magnets 4411. The positioning module 441 is configured as a bump 4421 and a positioning groove 4422, which can be engaged with each other. As shown in the figure, the two magnets 4411 are respectively assembled to the bobbin 51 and the first transmission member 3112. Further, the bump 4421 is formed on the first transmission member 3112, and the positioning groove 4422 is formed on the bobbin 51. Wherein, when the bobbin 51 is assembled to the first transmission member 3112, the bobbin 51 may be in a freely rotatable state. Subsequently, the first transmission member 3112 drives the bobbin 51 to rotate, so that the two magnets 4411 are magnetically attracted to each other to shorten the relative distance of the bobbin 51 and the first transmission member 3112, and the bump 4421 is further engaged with the positioning groove 4422 to limit the relative angular position between the bobbin 51 and the first transmission member 3112; so that, the bobbin 51 cannot rotate relative to the first transmission member 3112, and when the first transmission member 3112 stops rotating and is angularly positioned, the through space 514 can be located directly above the bobbin 51 to correspond to the cutter 422.

[0036] Please refer to FIG. 14. In a specific application, the rotary hook 12 of the sewing machine body 10 and the bobbin module motion mechanism 31 of the bobbin thread introduction device 30 are respectively assembled with a bobbin module 50 wound by bobbin thread 60; such that, the bobbin module 50 of the rotary hook 12 is set as a first bobbin module 501, and the bobbin module 50 assembled to the bobbin module motion mechanism 31 is set as a second bobbin module 502; furthermore, arranged on the sewing machine body 10, the bobbin thread 60 is assembled to the thread gripper 15 of the sewing machine body 10; the bobbin thread 60 arranged in the sewing machine body 10 passes through the through hole 3412a of the bobbin thread control mechanism 34, so that a partial section of the bobbin thread 60 arranged in the sewing machine body 10 can be positioned inside the clamping space 3314 of the thread releasing mechanism 33, thereby making the blade the edge portion 3112c of the blade 3112b and the connection plate 3112a of the first transmission member 3112 collectively clamp the bobbin thread 60 arranged in the sewing machine body 10.

[0037] Please refer to FIG. 14B. When the sewing machine body 10 performs the sewing operation to make the bottom thread 60 quantity of the first bobbin module 501 nearly run out, the movement driving source 211 of the bobbin module moving assembly 21 generates moving power; so that, the bobbin module moving assembly 21 as a whole along the transmission rod 212 moves close to the rotary hook 12, and further the movable frame 22 drives the first and second jaw assemblies 23, 24 to respectively approach the rotary hook 12 of the sewing machine body 10 and the bobbin module motion mechanism 31 of the bobbin thread introduction device 30.

[0038] Please refer to FIGS. 14C and 14D. When the first and second jaw assemblies 23, 24 are respectively approach the rotary hook 12 of the sewing machine body 10 and the bobbin module motion mechanism 31 of the bobbin thread introduction device 30, the first fixed jaw 232 of the first jaw assembly 23 is in contact with the bobbin case 52 of the first bobbin module 501, while the second fixed jaw 242 of the second jaw assembly 24 is in contact with the bobbin case 52 of the second bobbin module 502. Subsequently, the first jaw driver 234 drives the first movable jaw 233 to swing, so that the first clamping portion 233a of the first movable jaw 233 moves close to the first fixed jaw 232, and further the first clamping portion 233a is fastened to the latch clip 3151b arranged on the first bobbin module 501. By doing do, the first movable jaw 233 and the first fixed jaw 232 collectively clamp the first bobbin module 501; meanwhile, the second jaw driver 244 drives the second movable jaw 243 to swing, so that the second clamping portion 243a of the second movable jaw 243 moves close to the second fixed jaw 242, and further the second clamping portion 243a is fastened to the latch clip 3151b arranged on the second bobbin module 502. By doing do, the second movable jaw 243 and the second fixed jaw 242 collectively clamp the second bobbin module 502.

[0039] Please refer to FIGS. 14E and 14F. When the first jaw assembly 23 and the second jaw assembly 24 respectively clamp the first bobbin module 501 and the

second bobbin module 502, the movement driving source 211 of the bobbin module moving assembly 21 generates moving power; such that, the bobbin module moving assembly 21 as a whole moves along the transmission rod 212 to be away from the rotary hook 12, and further the first jaw assembly 23 drives the first bobbin module 501 to move away from the rotary hook 12 of the sewing machine body 10, and meanwhile the second jaw assembly 24 drives the second bobbin module 502 to move away from the bobbin module motion mechanism 31 of the bobbin thread introduction device 30. By doing so, the first jaw assembly 23 can separate the first bobbin module 501 from the rotary hook 12 through the bobbin module moving assembly 21, and also the second jaw assembly 24 separates the second bobbin module 502 from the bobbin module motion mechanism 31 through the bobbin module moving assembly 21.

[0040] Subsequently, the rotation driving source 251 of the bobbin module rotating assembly 25 can generate rotational power, so that the first transmission gear 252a of the transmission module 252 and the second transmission gear 252b of the transmission module 252 drive the transmission rod 212 of the bobbin module moving assembly 21 to rotate, which makes the transmission rod 212 drive the movable frame 22 to rotate clockwise in the direction of the arrow in the figure, so that the second bobbin module 502 is positioned directly in front of the rotary hook 12.

[0041] Please refer to FIGS. 14G and 14H. Again, the movement driving source 211 of the bobbin module moving assembly 21 generates the moving power, so that the movement driving source 211 drives the movable frame 22, along the transmission rod 212, to approach the rotary hook 12 of the sewing machine body 10, and the second bobbin module 502 is mounted on the rotary hook 12; then, the second jaw driver 244 of the second jaw assembly 24 drives the second clamping portion 243a of the second movable jaw 243 to move away from the latch clip 3151b, so that the second bobbin module 502 is indeed assembled to the rotary hook 12; now, the first jaw assembly 23 still clamps the first bobbin module 501.

[0042] Please refer to FIGS. 14I, 14J and 14K. When the second bobbin module 502 is assembled to the rotary hook 12, the movable frame 22 of the bobbin replacing device 20 is driven by the bobbin module moving assembly 21 and the bobbin module rotating assembly 25 to bring the first jaw assembly 23 close to the bobbin module motion mechanism 31 of the bobbin thread introduction device 30, which makes the first bobbin module 501 mounted to the bobbin module motion mechanism 31; wherein, when the first bobbin module 501 can be mounted to the bobbin module motion mechanism 31, the third transmission member 3132 of the third motion module 313 passes through the bobbin shaft 522 of the first bobbin module 501, such that the positioning protrusion 3152a of the limiting assembly 315 enters positioning groove 3152b of the limiting assembly 315 to restrict the bobbin case 52 of the first bobbin module 501 from rotating about the motion axis L.

[0043] As shown in the figure, when the positioning protrusions 3152a of the limiting assembly 315 are fitted into the positioning grooves 3152b of the limiting component 315, the first jaw driver 234 of the first jaw assembly 23 drives the first clamping portion 233a of the first movable jaw 233 to move away from the latch clip 3151b disposed in the first bobbin module 501; the latch clip 3151b disposed in the first bobbin module 501 rebounds to make the latch 3151c snapped fit into the annular groove 3151a of the limiting assembly 315 to restrict bobbin case 52 of the second bobbin module 502 having movement along the motion axis L.

[0044] Afterward, the movement driving source 211 of the bobbin module moving assembly 21 generates moving power to drive the movable frame 22 to move away from the rotary hook 12, and now, the first jaw assembly 23 and the second jaw assembly 24 respectively do not hold the bobbin module 501 and the second module 502, which makes both the first jaw assembly 23 and the second jaw assembly 24 wait for the next action of holding the bobbin module 50.

[0045] Please refer to FIG. 14L. When the first bobbin module 501 can be mounted to the bobbin module motion mechanism 31, the bobbin 51 of the first bobbin module 501 is close to the connection plate 3112a of the first transmission member 3112. At this time, the bobbin 51 may be in a freely rotatable state. Then, the first transmission member 3112 drives the bobbin 51 to rotate clockwise, so that the guiding module 441 of the two magnets 4411 are magnetically attracted to each other to allow the bobbin 51 of the first bobbin module 501 to rotates about the motion axis L; besides, the bump 4421 of the alignment mechanism 44 is engaged with the positioning groove 4422 of the alignment mechanism 44 to limit the relative angular position between the bobbin 51 of the first bobbin module 501 and the first transmission member 3112; and when the first transmission member 3112 rotates for several turns and then stopped to being angularly positioned, the through space 514 of the first bobbin module 501 can be directly located above the spool member 511; besides, when the first transmission member 3112 rotates, the bobbin 51 of the first bobbin module 50 can rotate via the first transmission member 3112, and the partial bobbin thread 60 between the housing 521 and the clamping elastic piece 528 as well as the partial bobbin thread 60 exposed outside the thread guiding hole 526 can be wound back into the bobbin case 52 by the rotating bobbin 51, which is for subsequent thread cutting action. In the present embodiment, the bobbin 51 has two through spaces 514; the two through spaces 514 are spaced by 180°; and both the alignment mechanism 44 and the through space 514 are formed symmetrically by 180°. Therefore, the bobbin 51 has two angles for positioning.

[0046] Please refer to FIG. 15A. After the first jaw assembly 23 and the second jaw assembly 24 both do not

clamp the bobbin module 50, the residual bobbin thread 60 in first bobbin module 501 begins being removed. First, the third driving source 3131 of the third motion module 313 drives the third transmission member 3132 of the third motion module 313 to move along the motion axis L, which makes the synchronization protruding pillar 3142 of the synchronization module 314 move toward the end portion of the synchronization groove 3141; such that, the moving third transmission member 3132 can drive the bobbin case 52 of the first bobbin module 501 to be axially separated from the bobbin 51 of the first bobbin module 501, which makes the bobbin case 52 of the first bobbin module 501 and the bobbin 51 of first bobbin module 501 show a separated state S1, where they are separated from each other.

[0047] Please refer to FIG. 15B. Subsequently, the cutting driving source 421 of the thread cutting mechanism 42 drives the cutter 422 of the thread cutting mechanism 42 to rotate, and the suction mechanism 43 starts to operate for generating the suction airflow A. Then, the movable driving source 411 of the movable mechanism 41 drives the movable arm 412 of the movable mechanism 41 to swing, which makes cutting driving source 421, the cutter 422, and the suction mechanism 43 simultaneously swing downward, thereby making the rotating cutter 422 move to a cutting position C to cut off the residual bobbin thread 60 inside the winding space 513. When the bobbin thread 60 inside the winding space 513 is cut off by the cutter 422, the suction port 431 of the suction mechanism 43 would be located on the side of the bobbin 51, which makes the suction airflow A of the suction mechanism 43 remove the bobbin thread 60 cut off by the cutter 422. As shown in the figure, since the alignment mechanism 44 can restrict the through space 514 of the first bobbin module 501 to directly above the spool member 511, the through space 514 can be aligned with the cutter 422 located at the cutting position C through the alignment mechanism 44 when the cutter 422 is at the cutting position C; such that, the cutter 422 not only can enter the through space 514 to ensure that the cutter 422 can truly cut off the bobbin thread 60, but also surely not interfere with the spool member 511. And then, the movable driving source 411 of the movable mechanism 41 drives the movable arm 412 of the movable mechanism 41 to swing upward, so that the cutting driving source 421, the cutter 422 and the suction mechanism 43, three are away from the bobbin 51; wherein, when the cutter 422 just leaves the through space 514 of the bobbin 51, the first transmission member 3112 of the first motion module 311 can drive the bobbin 51 to rotate to enhance the effect of suctioning the residual bobbin thread 60 by suction mechanism 43; accordingly, the bobbin 51 of the first bobbin module 501 shows an initial state S2 of not being wound with the bobbin thread 60, that is, the work of removing the bobbin thread 60 is completed.

[0048] Please refer to FIG. 15C. The movable arm 412 of the suction mechanism 43 assembled to the movable mechanism 41 is only for convenience of explanation, that is, the suction mechanism 43 can be assembled to the fixing frame 14 of the sewing machine body 10; accordingly, when the movable arm 412 swings, the suction mechanism 43 does not swing as the movable arm 412. As shown in the figure, the suction port 431 of the suction mechanism 43 is located below the bobbin 51, and the appearance of the suction port 431 shows a funnel, whereby when the cutter 422 is at the cutting position C to cut off the bobbin thread 60, the suction mechanism 43 can receive the bobbin thread 60 that naturally falls after cut off by the cutter 422, and thus the bobbin thread 60 is taken away from the bobbin 51 by the suction airflow A.

[0049] Please refer to FIG. 15D. In one preferred embodiment, the cutting transmission member 423 of the thread cutting mechanism 42 is connected to an air pressure source (not shown in the figure) capable of generating airflow, wherein the cutting transmission member 423 is provided with a plurality of air blowing holes 423a close to the cutter 422. Accordingly, when the cutter 422 is at the cutting position C to cut off the bobbin thread 60, the air pressure source generates blown airflow B flowing out of the air blowing holes 423a to prevent the cut bobbin thread 60 from being wound around the cutting transmission member 423.

[0050] Please refer to FIG. 16A. After the bobbin thread 60 is removed, the work of winding bobbin thread 60 starts. First, the first driving source 3111 of the first motion module 311 generates rotational power to drive the first driving belt pulley 3113a of the first interlocking module 3113 to rotate, which makes the first belt 3113c of the first interlocking module 3113 drive the first transmission member 3112 to rotate about the motion axis L through the first driven belt pulley 3113b of the first interlocking module 3113, so that the bobbin thread 60 inside the clamping space 3314 starts to rotate with the first transmission member 3112, and accordingly the bobbin 51 of the first bobbin module 501 synchronously rotates to bring the bobbin thread 60 into the winding space 513 of the bobbin 51.

[0051] In the early phase, the bobbin 51 of the first bobbin module 501 is wound with the bobbin thread 60. Since the outer diameter of the first winding portion 511a of the first bobbin module 501 is smaller than the outer diameter of the second winding portion 511b of the first bobbin module 501, the bobbin thread 60 first is wound around the first winding portion 511a of the bobbin 51 to ensure that the bobbin thread 60 first covers the through space 514 of the first bobbin module 501; accordingly, the residual bobbin thread 60 on the bobbin 51 of the first bobbin module 51 after sewing operation also remains in the first winding portion 511a, and thus the cutter 422 of the thread cutting mechanism 42 at the cutting position C can truly cut off bobbin thread 60. In one preferred embodiment, in order to further ensure that the bobbin thread 60 is first wound around the first winding portion 511a at the early phase of the winding operation, the adjustment driving source 342 of the bobbin thread con-

trol mechanism 34 drives the adjustment member 341 of the bobbin thread control mechanism 34 to swing, which makes the through hole 3412a of the adjustment member 341 restrict the bobbin thread 60 more to the connection plate 3112a. When the bobbin thread 60 is wound around the first winding portion 511a for up to a certain number of turns (for example, 10 turns or 20 turns), the adjustment driving source 342 then drive the adjustment member 341 to make through hole 3412a not restrict the bobbin thread 60 from shifting, and accordingly the bobbin thread 60 is evenly wound around the spool member 511 of the bobbin 51. Besides, when the bobbin thread 60 is wound around the first winding portion 511a for up to a certain number of turns (for example, 10 turns or 20 turns), the release driving source 332 of the thread releasing mechanism 33 also drives the release lever 331 of the thread releasing mechanism 33 to swing, so that the pushing portion 3312 of the release lever 331 pushes against the lower end of the connecting portion 3112d of the blade 3112b (as shown in FIG. 16F) to release the bobbin thread 60, which makes the end of the bobbin thread 60 inside the clamping space 3314 loose and wound into the winding space 513 at the same time. Immediately, the release driving source 332 drives the pushing portion 3312 to move away from the connection plate 3112a, such that the blade 3112b through its own elastic force makes the edge portion 3112c be in contact with the connection plate 3112a; subsequently, when the bobbin 51 of the first bobbin module 501 is wound with the bobbin thread 60 for up to a preset number of turns, inside of the winding space 513 of the first bobbin module 501 has been fully wound with the bobbin thread 60, and at this time, the first driving source 3111 of the first motion module 311 stops rotating.

[0052] Please refer to FIG. 16B. After stop winding the bobbin thread 60, since the relative position relationship between the bobbin thread 60 and the clamp module 323 cannot be determined, the adjustment driving source 342 of the bobbin thread control mechanism 34 needs to drive the adjustment member 341 of the bobbin thread control mechanism 34 to swing about the pivoting shaft 3411, which makes the adjustment plate 3412 of the adjustment member 341 be in contact against the bobbin thread 60 located between the thread gripper 15 and the bobbin 51, and accordingly the through hole 3412a of the adjustment plate 3412 restricts the bobbin thread 60 located between the thread gripper 15 and the bobbin 51 to be close to the clamp module 323. Through this, it next ensures that the clamp module 323 clamps bobbin thread 60 located between the thread gripper 15 and the bobbin 51. In order to achieve the foregoing effect, another implementation procedure is that adjustment driving source 342 drives the adjustment member 341 to swing before stopping the winding the bobbin thread 60, which makes the adjustment plate 3412 be in contact against the bobbin thread 60 between the thread gripper 15 and the bobbin 51; Accordingly, the bobbin thread 60 positioned between the wire gripper 15 and the bobbin 51 is restricted to be close to the clamp module 323, which makes the bobbin thread 60 finally wound around the bobbin 51 can be on the moving path of the clamp module 323.

[0053] Please refer to FIG. 16C. The first movable jaw driving source 3211 of the first moving module 321 drives the first jaw transmission member 3212 of the first moving module 321 to extend outward, and the clamp module 323 of the bobbin thread clamping mechanism 32 is driven by the first jaw transmission member 3212 to move to a clamping position P2 from a first preparatory position P1 (as shown in FIG. 16A) along a first path D1 (as shown in FIG. 16D) intersecting the motion axis L, which makes the bobbin thread 60 between the bobbin 51 and the thread gripper 15 be positioned between the movable clamp 3231 and the fixed clamp 3232. In the present embodiment, during the movement of the clamp module 323 from the first preparatory position P1 to the clamping position P2, the guide wheel 3244 of the avoidance unit 324 is continuously in contact with the curved guide rail 3242a of the assembling plate 3242 through the holding force 3245a of the holding member 3245; such that, when the guide wheel 3244 moves from one end of the curved guide rail 3242a to the other end of the curved guide rail 3242a, the swinging plate 3241 of the avoidance unit 324 drives the first moving module 321 and the clamp module 323 to swing in a counterclockwise path, which further changes the relative position between three portions (the first moving jaw driving source 3211, the first jaw transmission member 3212 and the clamp module 323) and the first bobbin module 501 to make the clamp module 323 avoid the bobbin 51 of the first bobbin module 501. Through this, when moving along the first path D1 to the clamping position P2, the clamp module 323 is not in contact with the bobbin 51 of the first bobbin module 501 through the avoidance unit 324. Please refer to FIG. 16D. When the clamp module 323 of the bobbin thread clamping mechanism 32 is at the clamping position P2, the stop pin 3231b of the movable clamp 3231 may be in contact against the bobbin thread 60 between the bobbin 51 and the thread gripper 15. Through it, when the bobbin thread 60 is in a loose state, the stop pin 3231b can restrict a local length of the bobbin thread 60 to between the movable clamp 3231 and the fixed clamp 3232, thereby ensuring the relative position relationship between the bobbin thread 60 and the clamp module 323 when the clamp module 323 clamp the bobbin thread 60. Subsequently, the clamp driving source 3233 of the clamp module 323 drives the movable clamp 3231 of the clamp module 323 to swing, which makes the movable clamp 3231 move close to the fixed clamp 3232 of the clamp module 323, and thus makes the movable clamp 3231 and the fixed clamp 3232 at a position near the adjustment member 341 clamp the bobbin thread 60 that is located between the bobbin 51 and the thread gripper 15. At this time, the clamping block 3232a of the fixed clamp 3231 moves into the clamping groove 3231a, so that the clamping groove 3231a and the clamping block 3232a are in a close contact state, which makes the clamping groove

3231a and the clamping block 3232a clamp bobbin thread 60 to prevent the bobbin thread 60 from being separated from the clamp module 323, and makes the clamping groove 3231a and the clamping block 3232a together clamp a local length of the bobbin thread 60. Here, the bobbin thread 60 is divided into wound bobbin thread 61 between the bobbin 51 and the clamp module 323, as well as the remaining portion of the bobbin thread 60 set as source bobbin thread 62 assembled to the thread gripper 15.

[0054] Please refer to FIGS. 16E and 16F. The first movable jaw driving source 3211 of the first moving module 321 drives the first jaw transmission member 3212 of the first moving module 321 to move backward, and the clamp module 323 of the bobbin thread clamping mechanism 32 is driven by the first jaw transmission member 3212 to back to the first preparatory position P1 from the clamping position P2 along the first path D1, which makes the source bobbin thread 62 pass under the bobbin 51 of the first bobbin module 501. At this time, the release driving source 332 of the thread releasing mechanism 33 drives the release lever 331 of the thread releasing mechanism 33 to swing, which makes the pushing portion 3312 of the release lever 331 pushes against the lower end of the connecting portion 3112d of the blade 3112b, and thus the edge portion 3112c of the blade 3112b is away from the connection plate 3112a to allow the clamping space 3314 to show an open state in which the bobbin thread 60 enters. Subsequently, the first driving source 3111 of the first motion module 311 drives the first transmission member 3112 to rotate clockwise through the first interlocking module 3113, which makes the source bobbin thread 62 passes through the interior of the clamping space 3314. And then, the release driving source 332 drives the release lever 331 to swing, which makes the pushing portion 3312 of the release lever 331 be away from the lower end of the connecting portion 3112d of the blade 3112b; accordingly the blade 3112b through its own elastic force makes the edge portion 3112c of the blade 3112b and the connection plate 3112a together clamp the source bobbin thread 62 (as shown in FIG. 16F) to wait for the next action of winding the bobbin thread 60. Afterward, the second movable jaw driving source 3221 of the second moving module 322 drives the second jaw transmission member 3222 of the clamp module 323 to make a first-stage moving travel, so that both the first moving module 323 and the clamp module 323 are driven to move by the second jaw transmission member 3222, and thus the clamp module 323 moves from the first preparatory position P1, along a second path D2 intersecting the first path D1, to a first guiding position P3; and when the clamp module 323 is at the first guiding position P3, the source bobbin thread 62 would touch the edge portion 3112c of the blade 3112b. Subsequently, as shown in FIGS. 16G and 16H, the first driving source 3111 of the first moving module 311 through the first interlocking module 3113 drives the first transmission member 3112 to rotate counterclockwise about the motion axis L, which makes the blade 3112b is driven by the first transmission member 3112 to cut off the source bobbin thread 62. At this time, the end of the source bobbin thread 62 is clamped by the blade 3112b, while the end of the wound bobbin thread 61 is clamped by the clamp module 323. In the above FIGS. 16A to 16H, that the bobbin case 52 is axially separated away from bobbin 51 is for convenience of explanation. In fact, the relative distance between the bobbin case 52 and the bobbin 51 should be substantially shown as the separated state S1 of FIG. 15A. And in FIG. 16G, in order to clearly show the angular state of the blade 3112b, the bobbin 51 is moved out of the connection plate 3112a.

[0055] In the above-mentioned steps of FIGS. 16A to 16E, in order to prevent the clamp module 323 from moving along the first path D1, the clamp module 323 would interfere with the connection plate 3112a and the blade 3112b; the first motion module 311 can drive the connection plate 3112a and the blade 3112b to rotate, which makes the blade 3112b rotate to an angle to avoid the clamp module 323, but not limited to the angle shown in the figure.

[0056] Please refer to FIG. 17A. After cutting off bobbin thread 60 is completed, the wound bobbin thread 61 starts to be installed on the bobbin case 52 of the first bobbin module 501. First, the third driving source 3131 of the third motion module 313 drives the third interlocking module 3133 move away from the third transmission member 3132; the restoring force 3134a of the resetting member 3134 acts on the pressing block 3132a, which makes the third transmission member 3132 move toward the third driving source 3131, and thus the moving third transmission member 3132 can make the bobbin case 52 of the first bobbin module 501 assembled to the bobbin 51 of the first bobbin module 501; accordingly, both the bobbin case 52 of the first bobbin module 501 and the bobbin 51 of the first bobbin module 501 are transformed from the separated state S1 into an assembled state S3 of being assembled to each other. At this time, the wound bobbin thread 61 is in contact with the open end 524 of the bobbin case 52, making the wound bobbin thread 61 be in a tensioned state.

[0057] Please refer to FIG. 17B. When the wound bobbin thread 60 is in contact with the open end 524 of the bobbin case 52, the second driving source 3121 of the second motion module 312 generates rotational power to drive the second driving belt pulley 3123a of the second interlocking module 3123 to rotate, which makes the second belt 3123c of the second interlocking module 3123 drive the second transmission member 3122 to rotate about the motion axis L via the second driven belt pulley 3123b of the second interlocking module 3123; when the second transmission member 3122 rotates, the synchronization protruding pillar 3142 of the synchronization module 314 cannot be moved by the limitation of the synchronization groove 3141, so that the second transmission member 3122 through the synchronization module 314 drives the third transmission member 3132 of the

third motion module 313 to rotate, and thus the bobbin case 52 of the first bobbin module 501 rotates synchronously. As shown in the figure, the second driving source 3121 first drives the bobbin case 52 of the first bobbin module 501 to rotate clockwise through the second transmission member 3122, and then the second driving source 3121 drives the bobbin case 52 of the first bobbin module 501 to rotate counterclockwise; accordingly, the rotating bobbin case 52 can guide the wound bobbin thread 61 into the thread guiding slot 527 of the bobbin case 52, which makes a local length of the wound bobbin thread 61 located between the housing 521 of the bobbin case 52 and the clamping elastic piece 528 of the bobbin case 52.

[0058] Please refer to FIG. 17C. Next, the second movable jaw driving source 3221 of the second moving module 322 drives the second jaw transmission member 3222 of the clamp module 323 to make a second stage moving travel, which makes both the first moving module 321 and the clamp module 323 are driven by the second transmission member 3222 to move in a direction away from the connection plate 3112a, so that the clamp module 323 moves from the first guiding position P3 to a second preparatory position P4 along a third path D3 parallel to the second path D2. As shown in FIG. 17D, during the movement process of the clamp module 323 toward the second preparatory position P4, the first jaw transmission member 3212 of the first moving module 321 touches the roller 3243 of the avoidance unit 324, which makes the swing plate 3241 of the avoidance unit 324 swing, thereby the guide wheel 3244 of the avoidance unit 324 is separated from the curved guide rail 3242a. Through it, the clamp module 323 of the bobbin thread clamping mechanism 32 pulls the wound bobbin thread 61, which makes the wound bobbin thread 61 introduced into the guiding opening 528a of the clamping elastic piece 528, and thus the clamping elastic piece 528 can guide the wound bobbin thread 61 to the thread guiding hole 526 from the thread guiding slot 527.

[0059] Please refer to FIG. 17E. When the clamp module 323 is located at the second preparatory position P4, the first movable jaw driving source 3211 of the first moving module 321 again drives the first jaw transmission member 3212 of the first moving module 321 to extend outward, so that the first jaw transmission member 3212 drives the clamp module 323 to move from the second preparatory position P4 to a second guiding position P5 along a fourth path D4 parallel to the first path D1; wherein, during the movement process of the clamp module 323 toward the second guiding position P5, the wound bobbin thread 61 first touches the hook arm 529 of the bobbin case 52, and then the wound bobbin thread 61 pushes against the elastic arm 530a of the thread blocking piece 530, which makes the elastic arm 530a deform, such that the wound bobbin thread 61 is guided into the thread hole 529a of the hook arm 529. Through it, the operation of mounting the wound bobbin thread 61 to the bobbin case 52 is completed; wherein when the wound bobbin thread 61 is located inside the thread hole 529a, the elastic arm 530a is overlapped with the thread hole 529a because of not being pushed by the wound bobbin thread 61, which makes the wound bobbin thread 61 blocked by the elastic arm 530a to avoid being separated from the thread hole 519a.

[0060] Please refer to FIG. 17F. The wound bobbin thread 61 is guided to the inside of the thread hole 529a of the hook arm 529, and the clamp driving source 3233 of the clamp module 323 drives the movable clamp 3231 of the clamp module 323 to swing; so that, the movable clamp 3231 is away from the fixed clamp 3232 of the clamp module 323, and thus the clamp module 323 releases the end of the wound bobbin thread 61. Finally, the clamp module 323 moves back to the first preparatory position P1 from the second guiding position P5 through the first moving module 321 and the second moving module 322, which makes the clamp module 323 wait to mount the bobbin thread 60 to the bobbin case 52.

[0061] Please refer to FIG. 18F. In second preferred embodiment, the difference from the first preferred embodiment is the manner of assembly among the first motion module 311, the second motion module 312, the third motion module 313, and the synchronization module 314. As shown in the figure, the second transmission member 3122 of the second motion module 312 is movably disposed through the first transmission member 3112 of the first motion module 311, the second interlocking module 3123 of the second motion module 312 is configured as a single hollow shaft, and the third transmission member 3132 is movably assembled to the outer circumference of the second interlocking module 3123 and assembled to the second transmission member 3122 through the synchronization protruding pillar 3142 of the synchronization module 314; wherein, the first transmission member 3112 and the third transmission member 3132 are respectively located on opposite sides of the second transmission member 3122. Further, the third interlocking module 3133 of the third movement module 313 is arranged with an interlocking rack 3133a that can drive the axial displacement of the third transmission member 3132, and an interlocking gear 3133b assembled to the third driving source 3131; the interlocking rack 3133a is engaged with the interlocking gear 3133b. Wherein, the synchronization groove 3141 of the synchronization module 314 is formed in the second interlocking module 3123, which makes the synchronization groove 3141 an elongated form, and thus the synchronization protruding pillar 3142 is simultaneously disposed through the third transmission member 3132, the second interlocking module 3123, and the second transmission member 3122.

[0062] In the present embodiment, when the second driving source 3121 of the second motion module 312 generates rotational power, the second driving source 3121 drives the second transmission component 3122 to rotate relative to the first transmission component 3112. At this time, the synchronization protruding pillar

3142 of the synchronization module 314 would not be affected by the first transmission member 3112 to rotate, and the synchronization groove 3141 of the synchronization module 314 synchronously rotates with the second transmission member 3122. Furthermore, the third driving source 3131 of the third motion module 313 generates rotational power, and the interlocking gear 3133b of the third interlocking module 3133 drives the interlocking rack 3133a of the third interlocking module 3133 to move; accordingly the third transmission member 3132 moves along the motion axis L. And when the third transmission member 3132 moves, the synchronization protruding pillar 3142 of the synchronization module 314 moves along the synchronization groove 3141 of the synchronization module 314, which makes the third transmission member 3132 drive the entire second transmission module 3122 to move axially through the synchronization module 314.

[0063] Please refer to FIG. 19. In third preferred embodiment, the difference from the second preferred embodiment is that the bobbin module motion mechanism 31 has no synchronization module 314 and the third transmission member 3132 of the third motion module 313; the second driving source 3121 configured as a plate member and assembled to the second motion module 312 makes the third transmission member 3132 not coaxially disposed on the movement axis L; wherein, when the third driving source 3131 of the third motion module 313 drives the third transmission member 3132 to move along the axis direction of the motion axis L, the second motion module 312 as a whole (including the second driving source 3121, the second transmission member 3122 and the second interlocking module 3123) simultaneously moves along the motion axis L, so that the bobbin case 52 moves to be separated from the bobbin 51. In the present embodiment, the third transmission member 3132 may be directly connected to the third driving source 3131. However, the third transmission member 3132 may also be connected to the third driving source 3131 via the third interlocking module 3133.

[0064] However, that the third transmission member 3132 is assembled to the second driving source 3121 is for convenience of description, that is, the third transmission member 3132 can be assembled to the first driving source 3111 of the first motion module 311, and thus the entire first motion module 311 (including the first driving source 3111, the first transmission member 3112 and the first interlocking module 3113) can simultaneously move along the motion axis L when the third transmission member 3132 moves along the motion axis L through the third driving source 3131, which makes the bobbin 51 move to be separated from the bobbin case 52.

[0065] In addition, in this embodiment, before the bobbin thread 60 is wound around the bobbin 51, the clamp module 323 of the bobbin thread clamping mechanism 32 can temporarily clamp the source bobbin thread 62, and then, the release driving source 332 of the thread releasing mechanism 33 drives the release lever 331 of the thread releasing mechanism 33 to swing, which makes the pushing portion 3312 of the release lever 331 push against the lower end of the connecting portion 3112d of the blade 3112b, and thus the edge portion 3112c of the blade 3112b is further away from the connection plate 3112a to allow the clamping space 3314 to be in an open state. Next, the clamp module 323 is driven by the first moving module 321 and the second moving module 322 to make the source bobbin thread 62 be temporarily separated from the clamping space 3314. Through it, in the process of removing the bottom thread 60, since the source bottom thread 62 is temporarily separated from the clamping space 3314, an excess of bobbin thread 60 can prevent from being draw out from the thread gripper 15 during the rotation of the first transmission member 3112. Subsequently, after removal of bobbin thread 60 is completed, the first and second moving modules 321, 322 drive the clamp module 323 to move, which makes the source bobbin thread 62 return to the interior of the clamping space 3314. And then, the release driving source 332 drives the release lever 331 to swing, which makes the pushing portion 3312 of the release lever 331 be away from the lower end of the connecting portion 3112d of the blade 3112b, and thus the blade 3112b through its own elastic force to make the edge portion 3112c of the blade 3112b and the connecting plate 3112a collectively clamp the source bobbin thread 62.

[0066] The above-mentioned embodiments are used for conveniently describing the present invention, not further to limit it. For the person skilled in the art of the disclosure, without departing from the concept of the disclosure, simple modifications or changes can be made according to the claims and description of the present invention and should be included in the protection scope of the disclosure.

Claims

1. A residual bobbin thread removing device, used in conjunction with a bobbin arranged with a winding space, and comprising:

   a thread cutting mechanism having a cutter, the cutter capable of cutting off the bobbin thread inside the winding space; and

   a movable mechanism having a movable arm capable of changing position, wherein the movable arm can drive the cutter move into the winding space, so that the cutter be at a cutting position to cut off the bobbin thread inside of the winding space.

2. The residual bobbin thread removing device according to claim 1, wherein the thread cutting mechanism further comprises a suction mechanism, and the suction mechanism can generate suction airflow in the winding space to remove the bobbin thread cut off

by the cutter, so that the bobbin be in an initial state without being wound around by the bobbin thread.

3. The residual bobbin thread removing device according to claim 1, wherein the thread cutting mechanism further includes a cutting driving source capable of driving the cutter to rotate, and wherein the cutting driving source is connected to the movable arm, and both of the movable arm and the cutting driving source move synchronously during the movable arm drives the cutter to move to the cutting position.

4. The residual bobbin thread removing device according to claim 3, wherein the cutting driving source is assembled with a cutting transmission member connected to the cutter, and wherein the cutting transmission member is arranged with a blowing hole, and a blowing airflow can flow out the blowing hole.

5. The residual bobbin thread removing device according to claim 1, wherein the bobbin is arranged with a through space formed by indentation along the surface contour of the bobbin, wherein the through space communicates with the winding space, and accommodates a part of the cutter when the cutter is located at the cutting position.

6. The residual bobbin thread removing device according to claim 5, wherein the bobbin has two spaced stop plates and a spool member between the two stop plates, wherein the two stop plates and the spool member jointly form the winding space, and wherein one of the two stop plates and the spool member both are recessed to respectively form a limiting groove and a spool groove, such that the limiting groove communicate with the spool groove, and thus the limiting groove and the spool groove together form the through space.

7. The residual bobbin thread removing device according to claim 5, wherein the residual bobbin thread removing device further includes a alignment mechanism, wherein the alignment mechanism is connected between the bobbin and a transmission member, and when the bobbin is assembled to the transmission member, the alignment mechanism can align the through space with the cutter located at the cutting position, so that the cutter can enter the through space.

8. The residual bobbin thread removing device according to claim 7, wherein the alignment mechanism comprises a guiding module, and the guiding module can change the relative position between the bobbin and the transmission member, which makes the through space be close to the cutter located at the cutting position.

9. The residual bobbin thread removing device according to claim 8, wherein the alignment mechanism further comprises a positioning module, and the positioning module can limit the relative position between the bobbin and the transmission member when the through space is close to the cutter located at the cutting position through the guiding module, so that the bobbin cannot make displacement relative to the transmission member

10. The residual bobbin thread removing device according to claim 1, wherein the bobbin assembled to a bobbin case for being can be driven to rotate, and the bobbin case has a clamping elastic piece, and wherein the bobbin thread between the bobbin case and the clamping elastic piece can be wound back into the bobbin case by the rotating bobbin.

11. A sewing machine, comprising a residual bobbin thread removing device of any of claims 1 to 10, used in conjunction with a bobbin arranged with a winding space, and comprising:

a sewing machine body, having a rotary hook; and

a bobbin replacing device, assembled to the sewing machine body and capable of selectively making the bobbin assembled to or detached from the rotary hook.

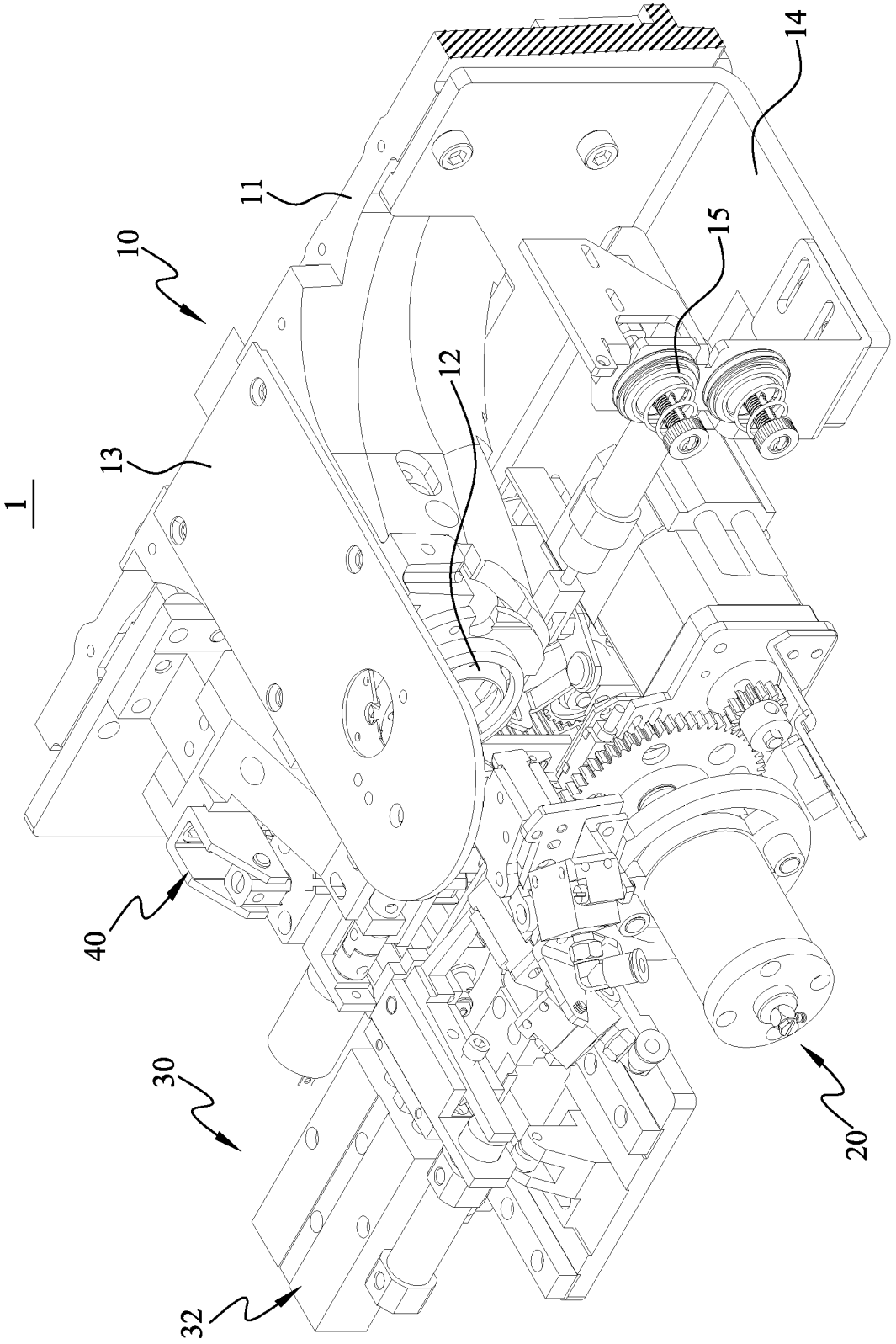
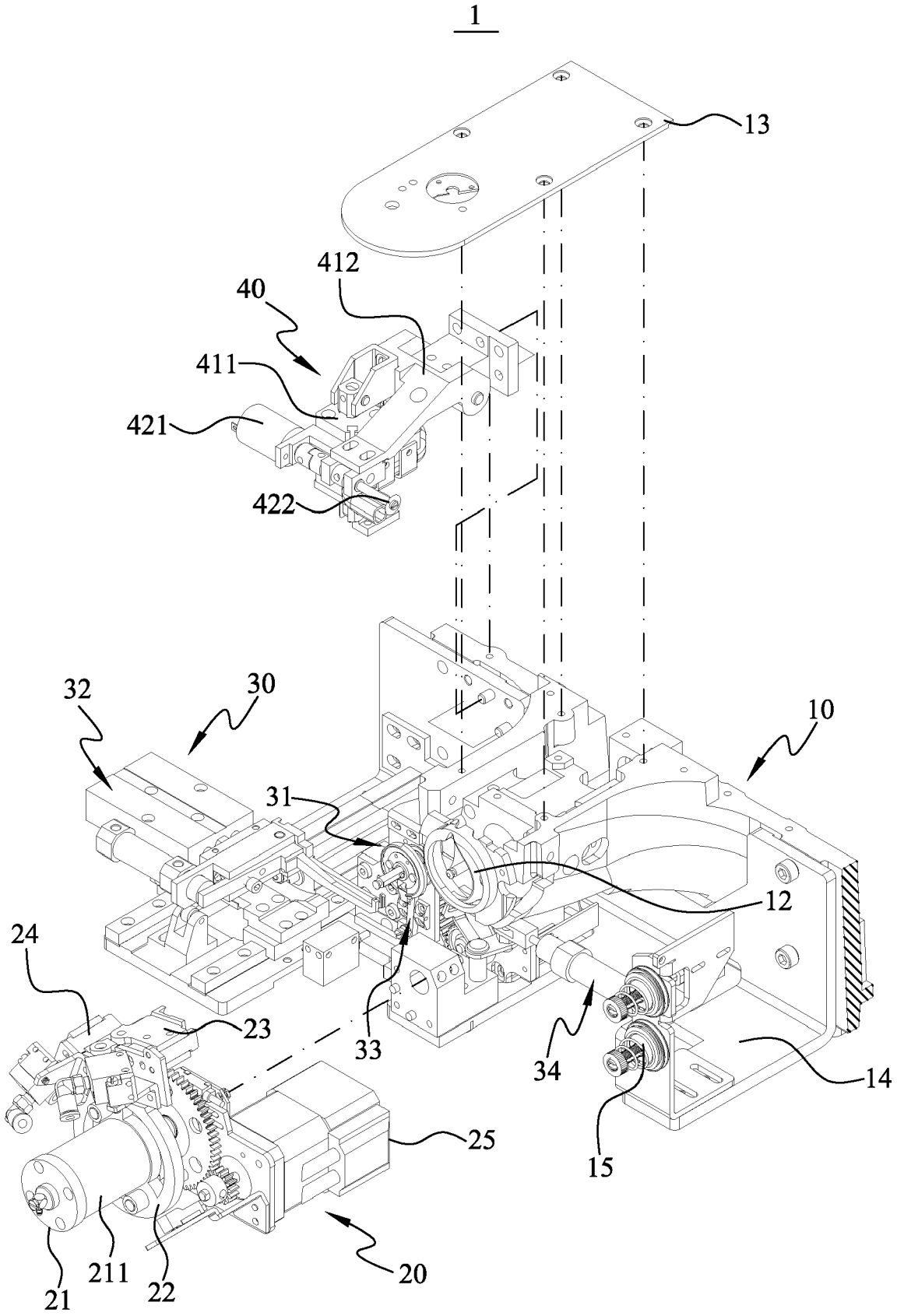


FIG. 1


1
13
412
40
411
421
422
32
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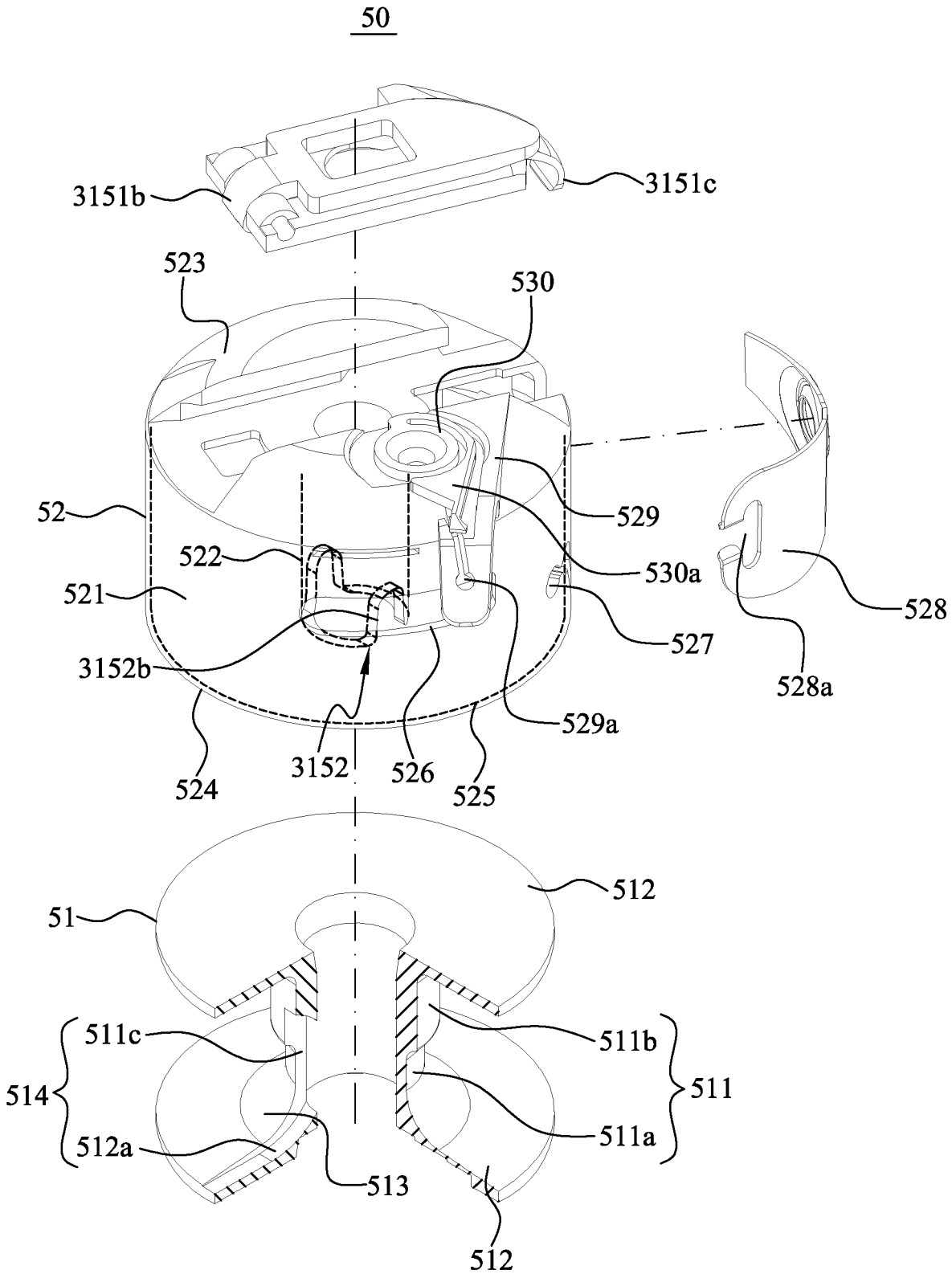
31
12
24
23
33
34
14
25
15
211
22
21
20

FIG. 2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3151c
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530
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529
522
530a
521
528
527
3152b
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511b
514
511
512a
511a
513
512

FIG. 3A

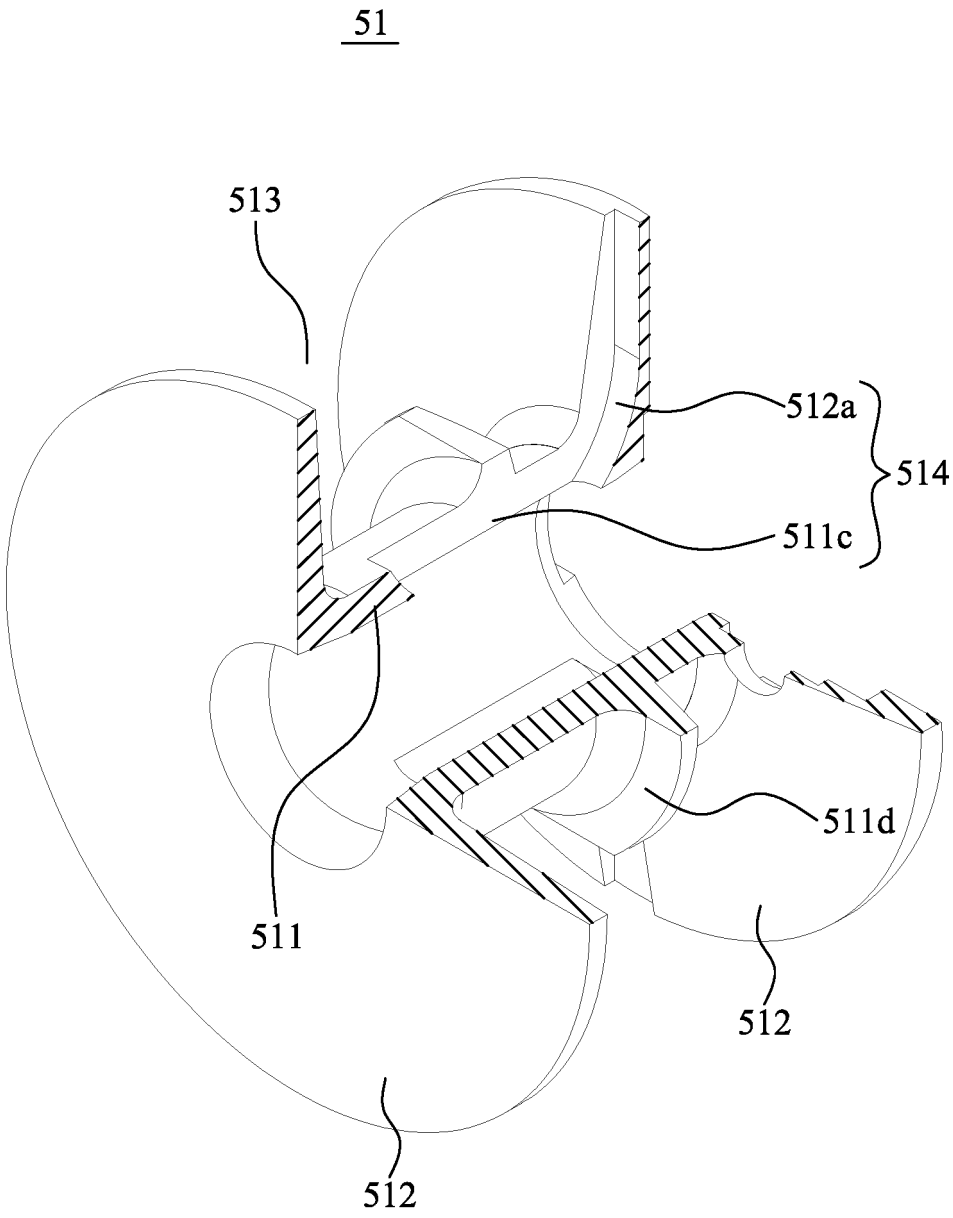
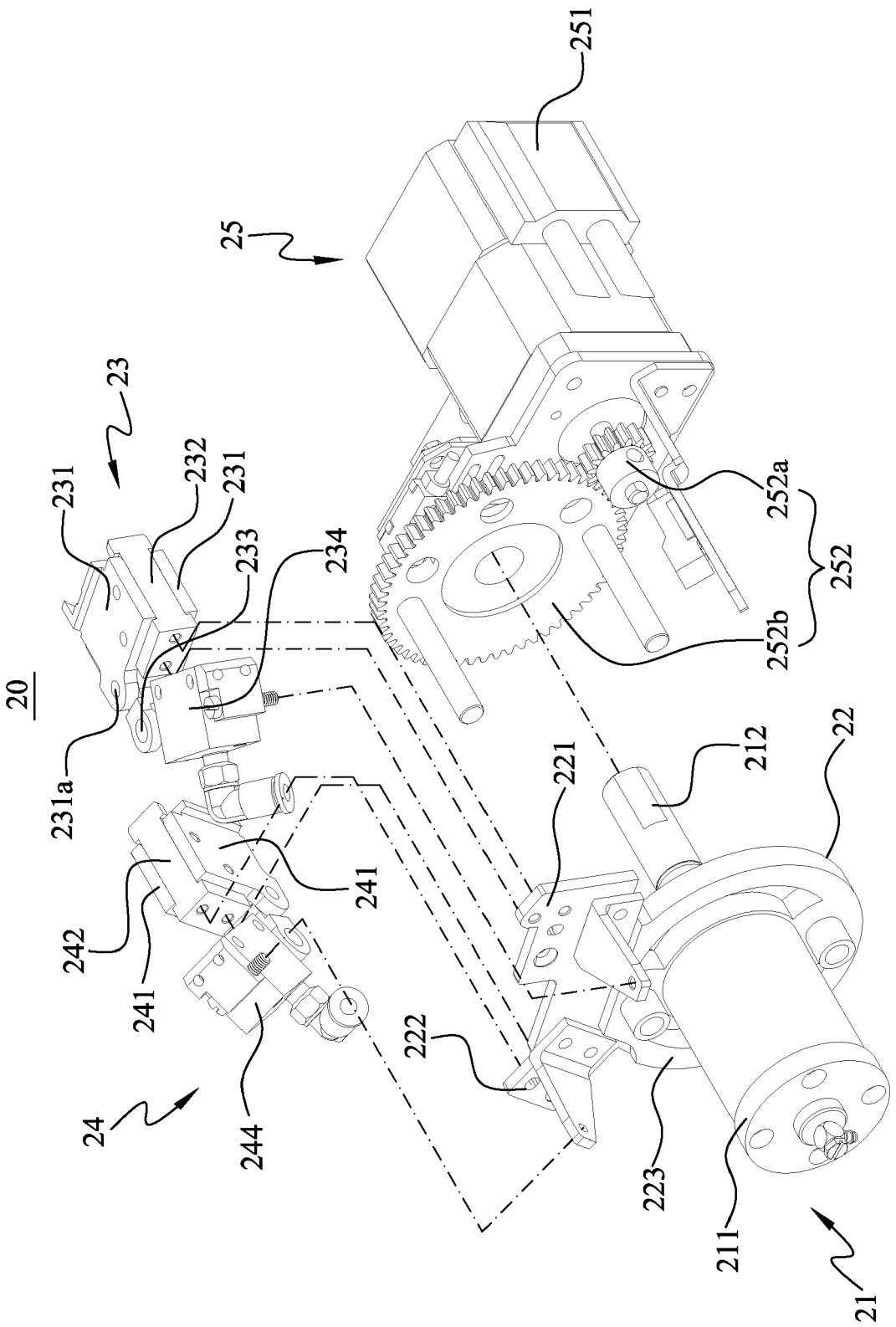


FIG. 3B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211
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212
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231a
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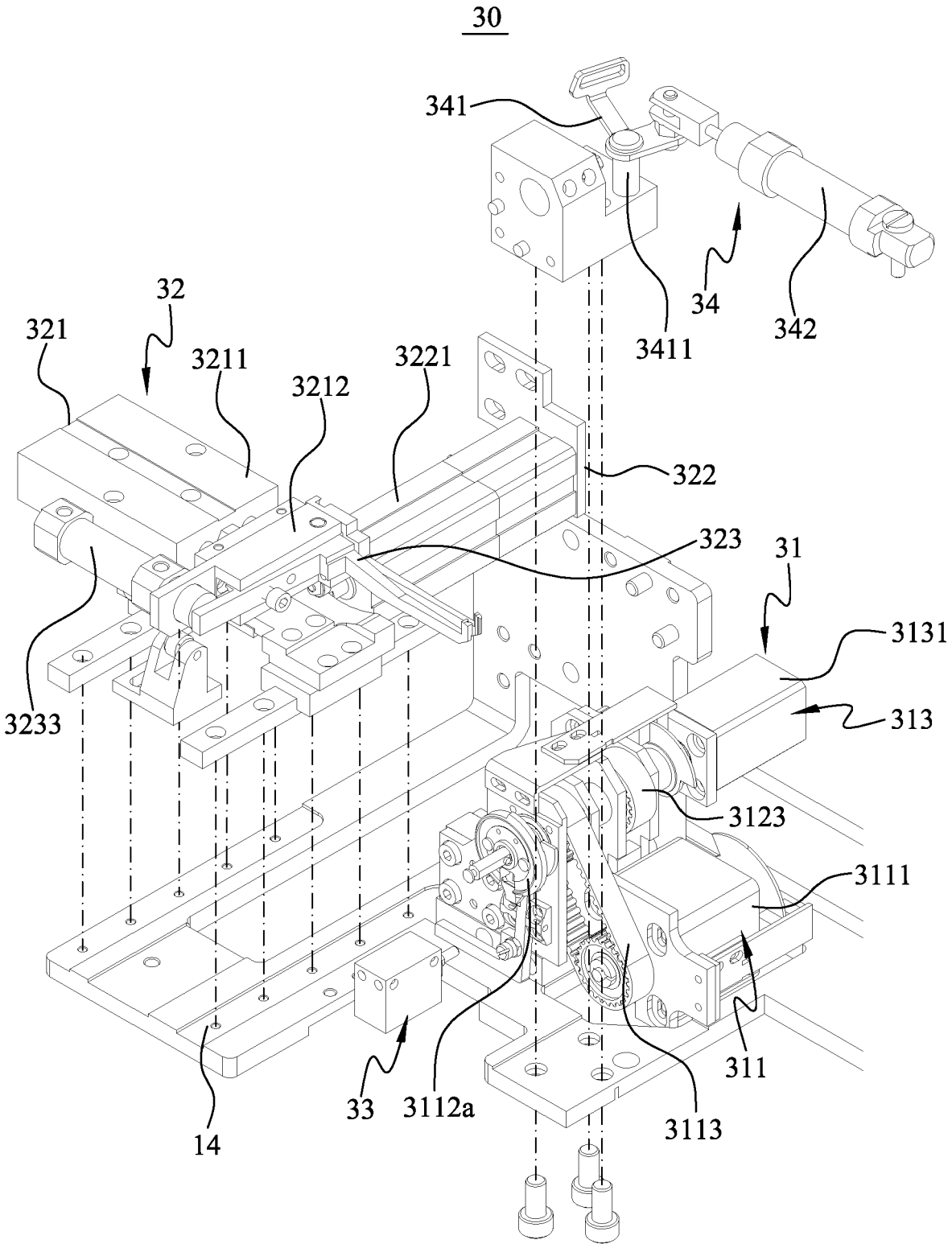
252
252a
252b

FIG. 4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341
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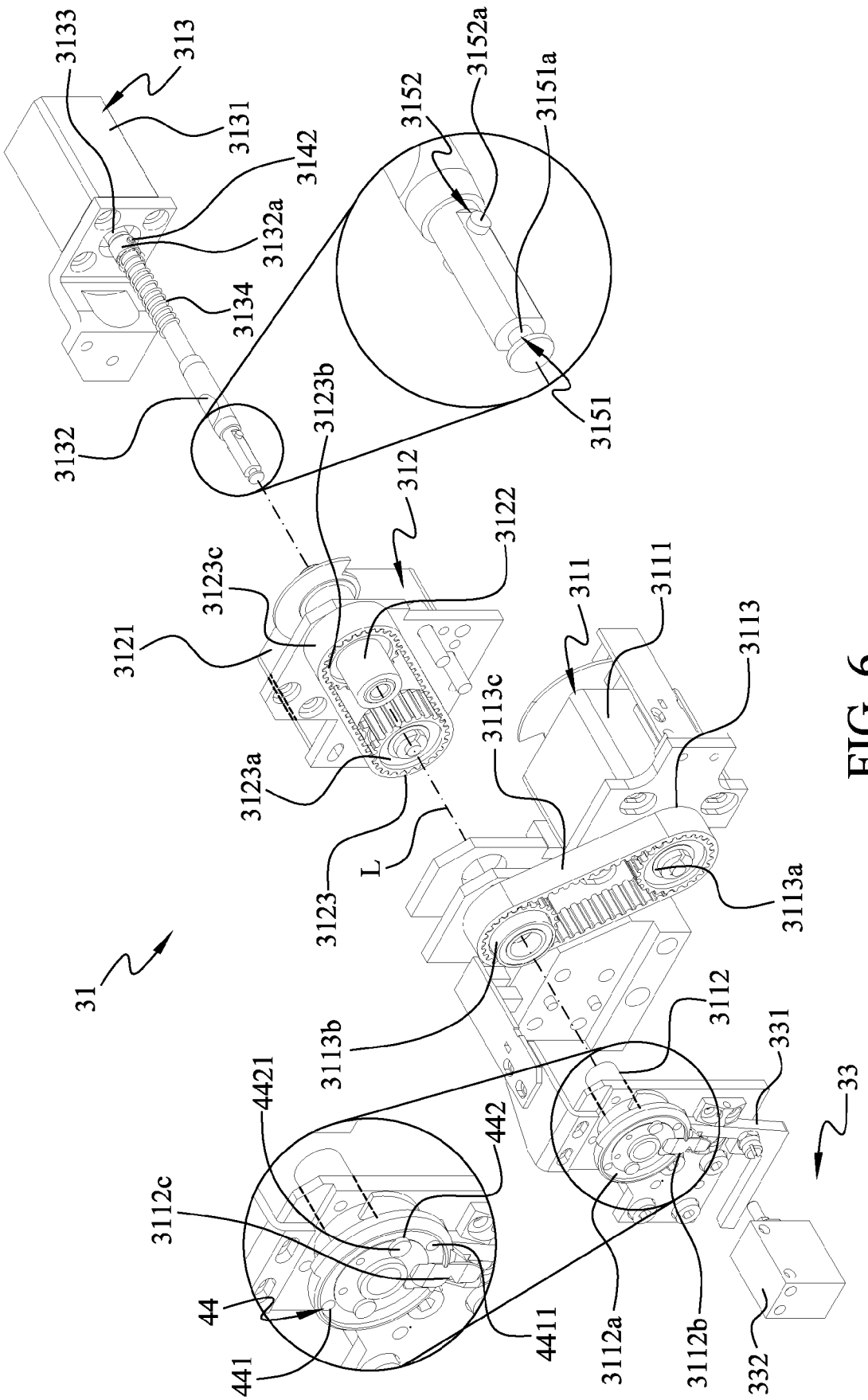
321
3211
3212
3221
322
323
31
3131
313
3233
3123
3111
311
3113
33
3112a
14
34
342
3411

FIG. 5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313
3131
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3132a
3134
3132
3123b
3152
3152a
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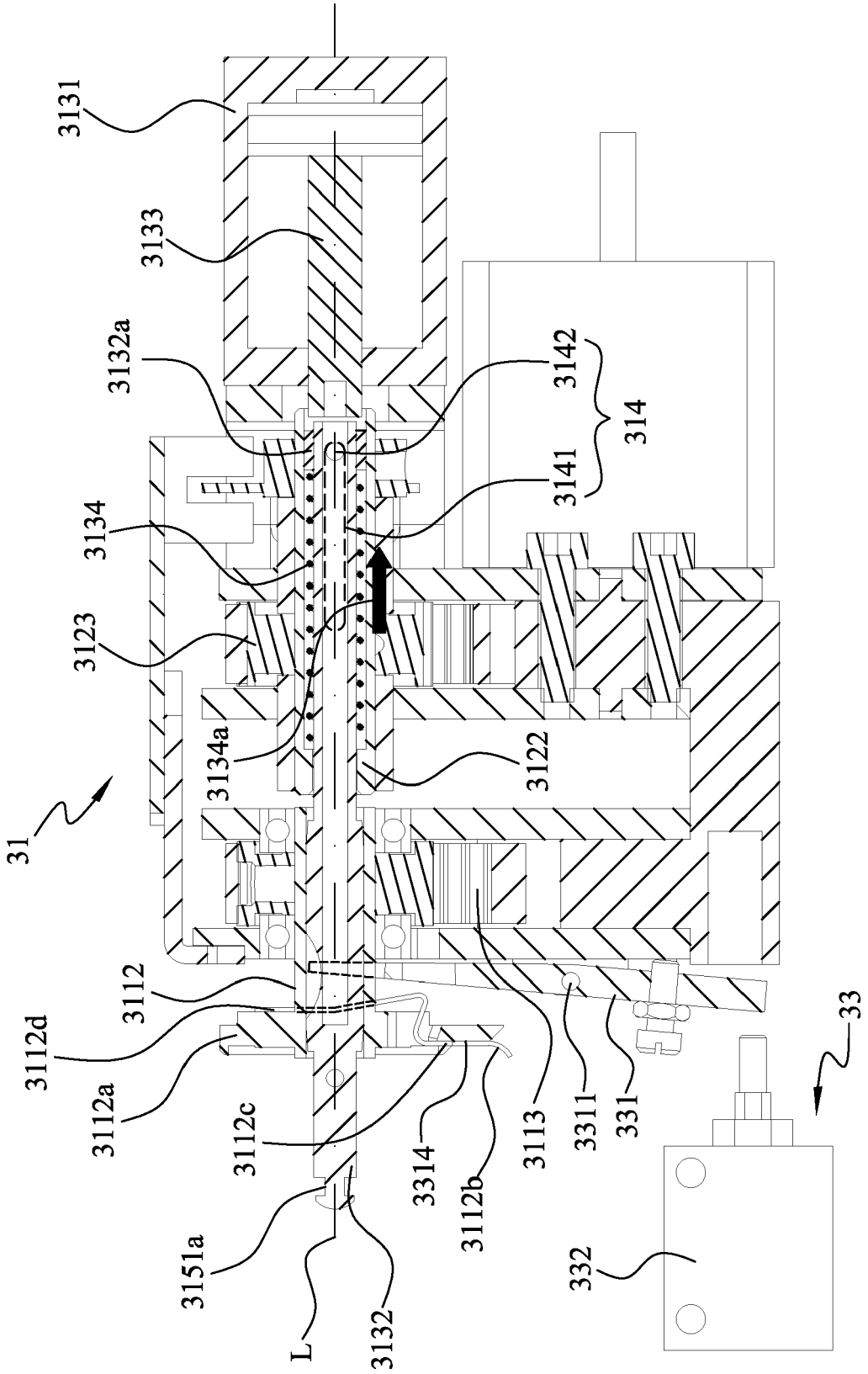
3151
312
3122
3123c
3121
311
3111
3113
3123a
3113c
3123
L
3113a
31
3113b
3112
331
33
4421
442
3112c
44
4411
3112a
3112b
441
332

FIG. 6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3133
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3142
314
3141
3134
3123
3134a
3122
31
3112
3112d
3112a
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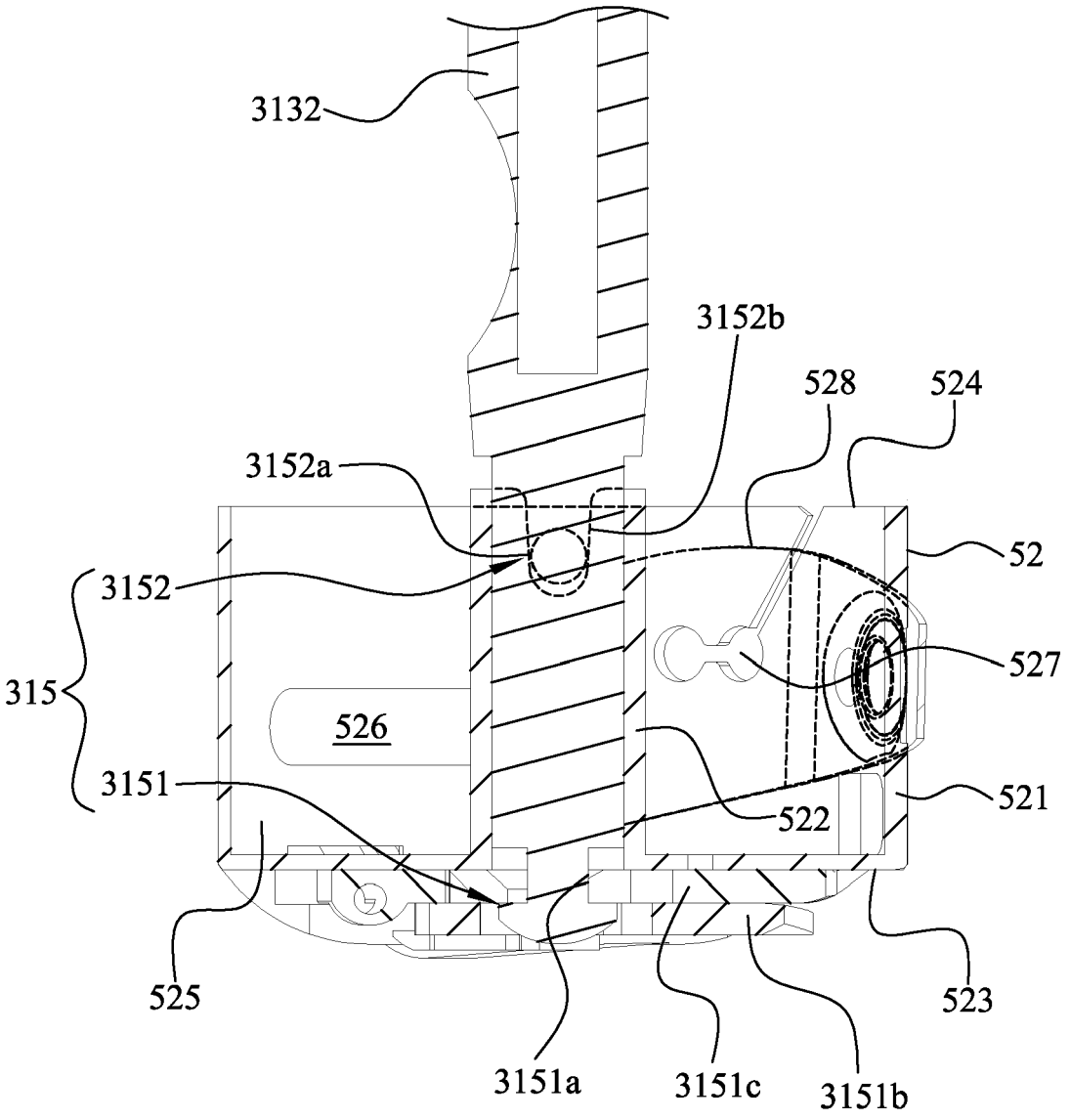
3112b
3113
3311
331
33
3151a
L
3132
332

FIG. 7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3152b
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3152a
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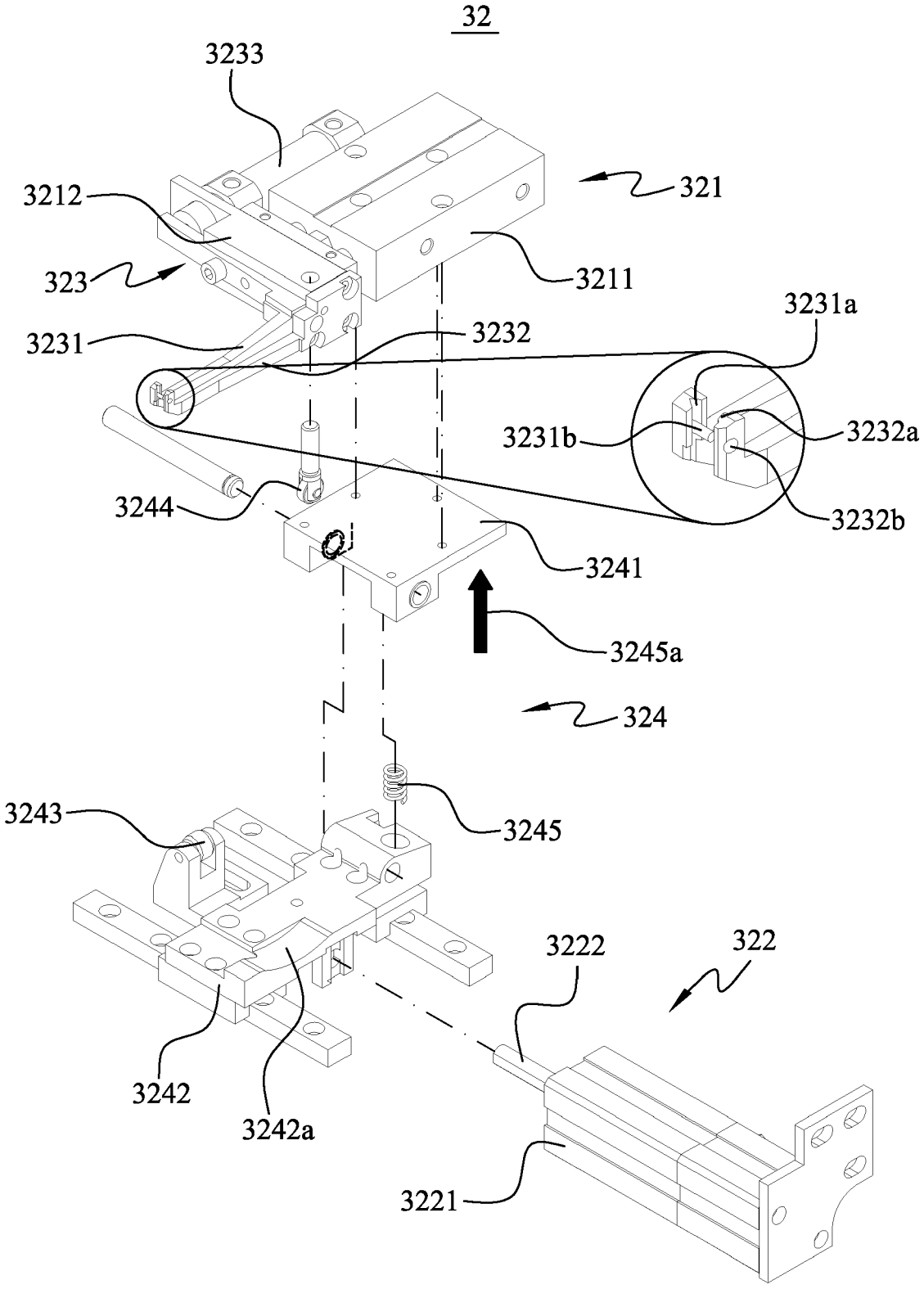
3152
315
527
526
3151
521
522
525
523
3151a
3151c
3151b

FIG. 8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3233
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3231
3232
3231a
3231b
3232a
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3241
3245a
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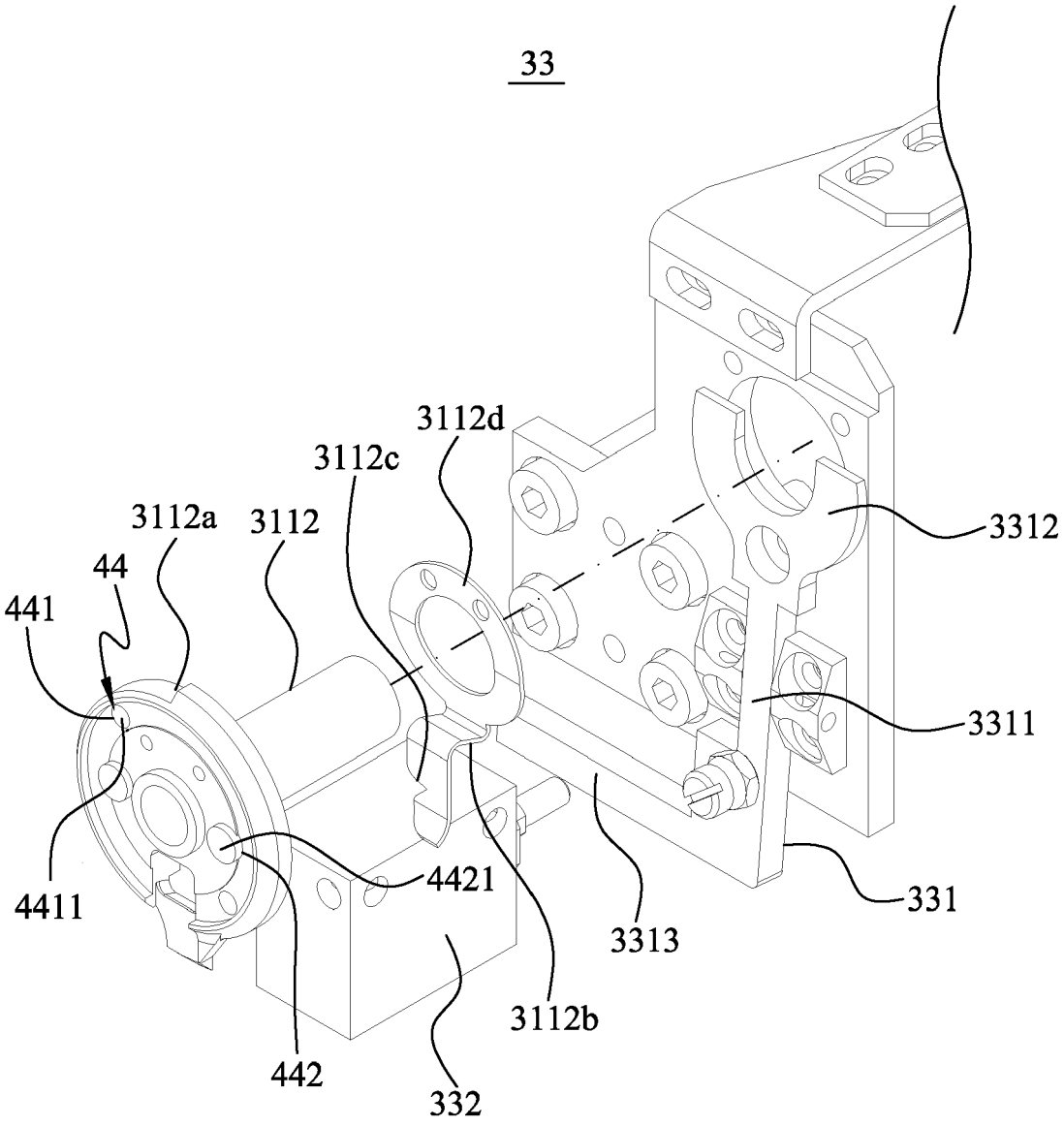
3243
3245
3222
322
3242
3242a
3221

FIG. 9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3112d
3112c
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3112
44
441
3312
3311
4411
4421
3313
331
3112b
442
332

FIG. 10

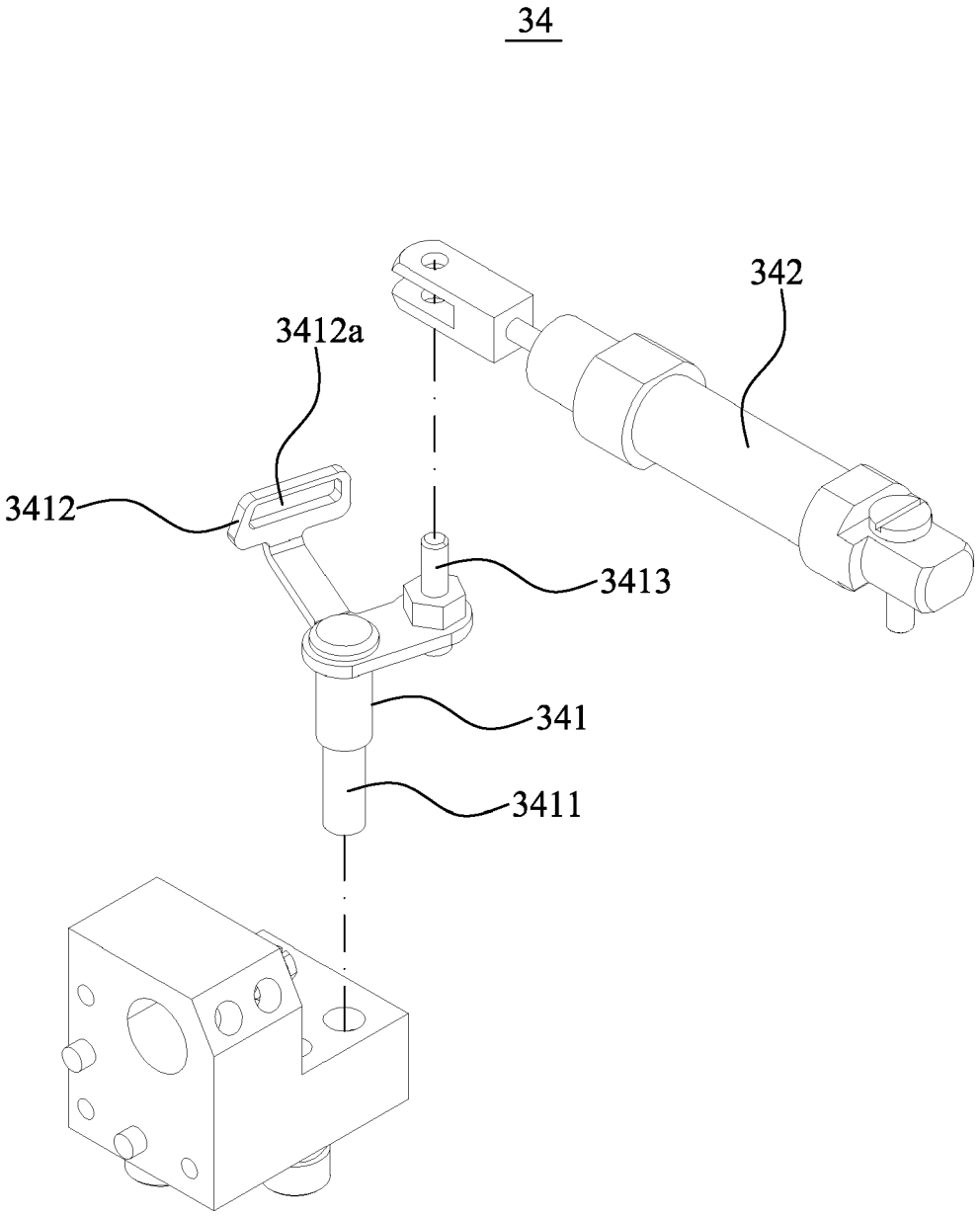


FIG. 11

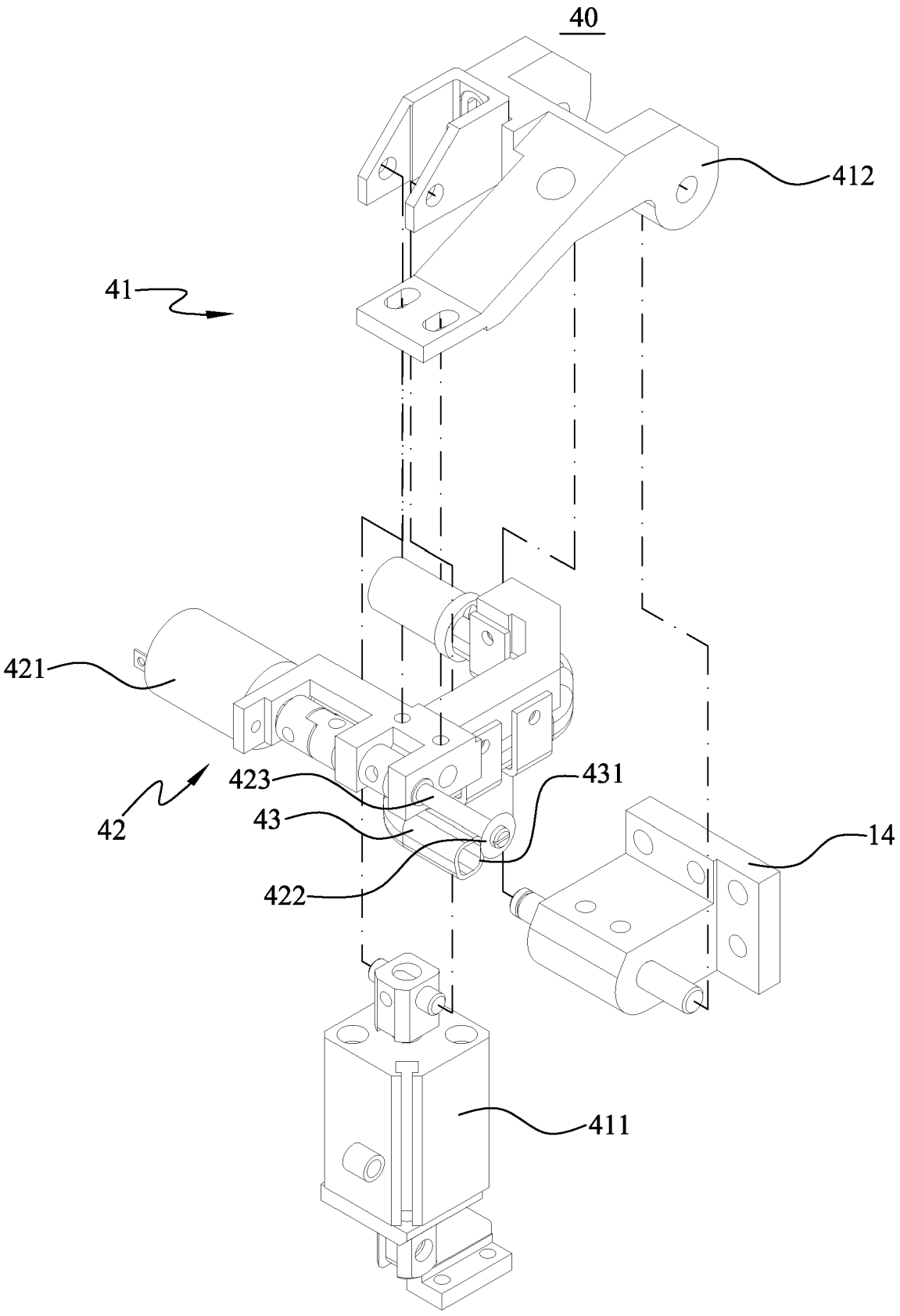
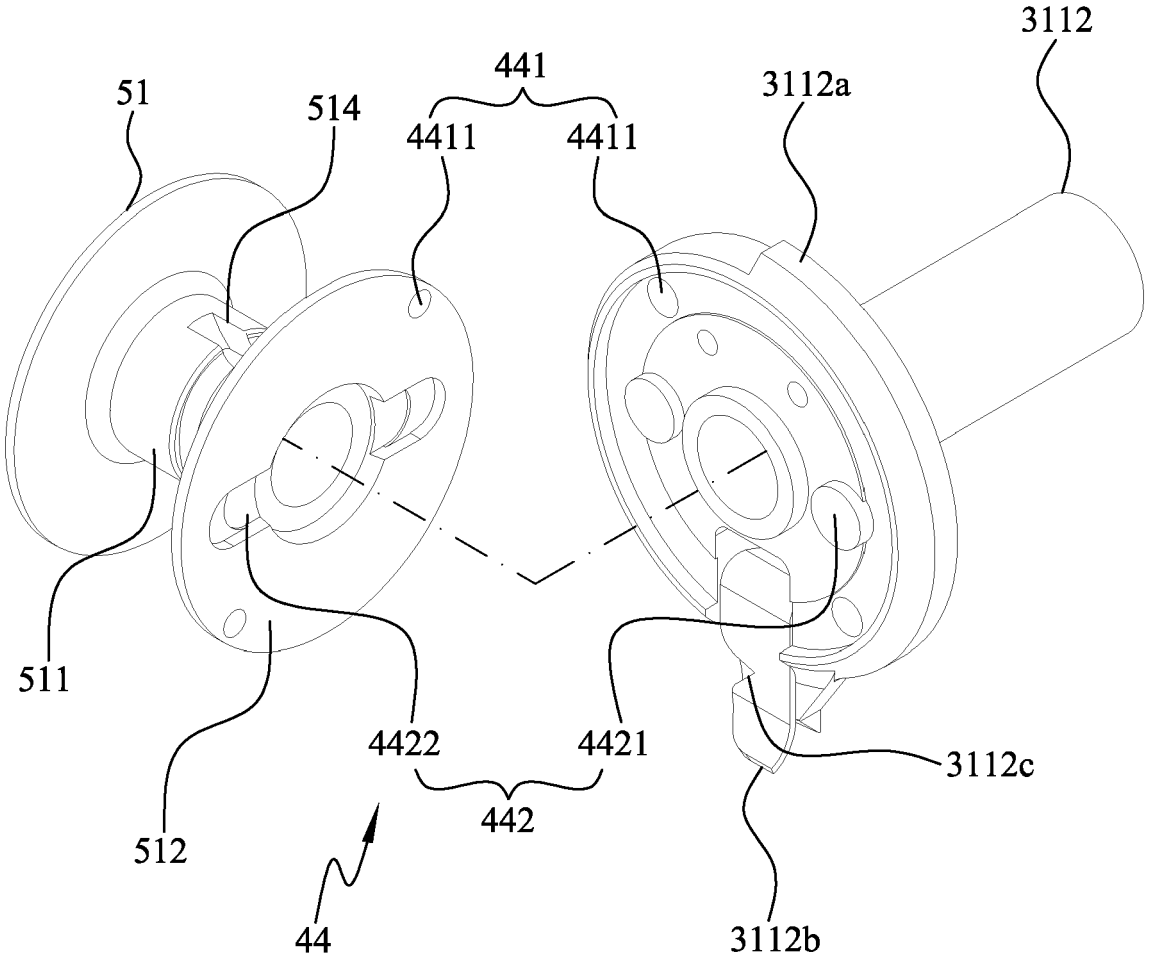


FIG. 12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441
51
514
4411
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3112a
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4422
4421
3112c
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512
44
3112b

FIG. 13

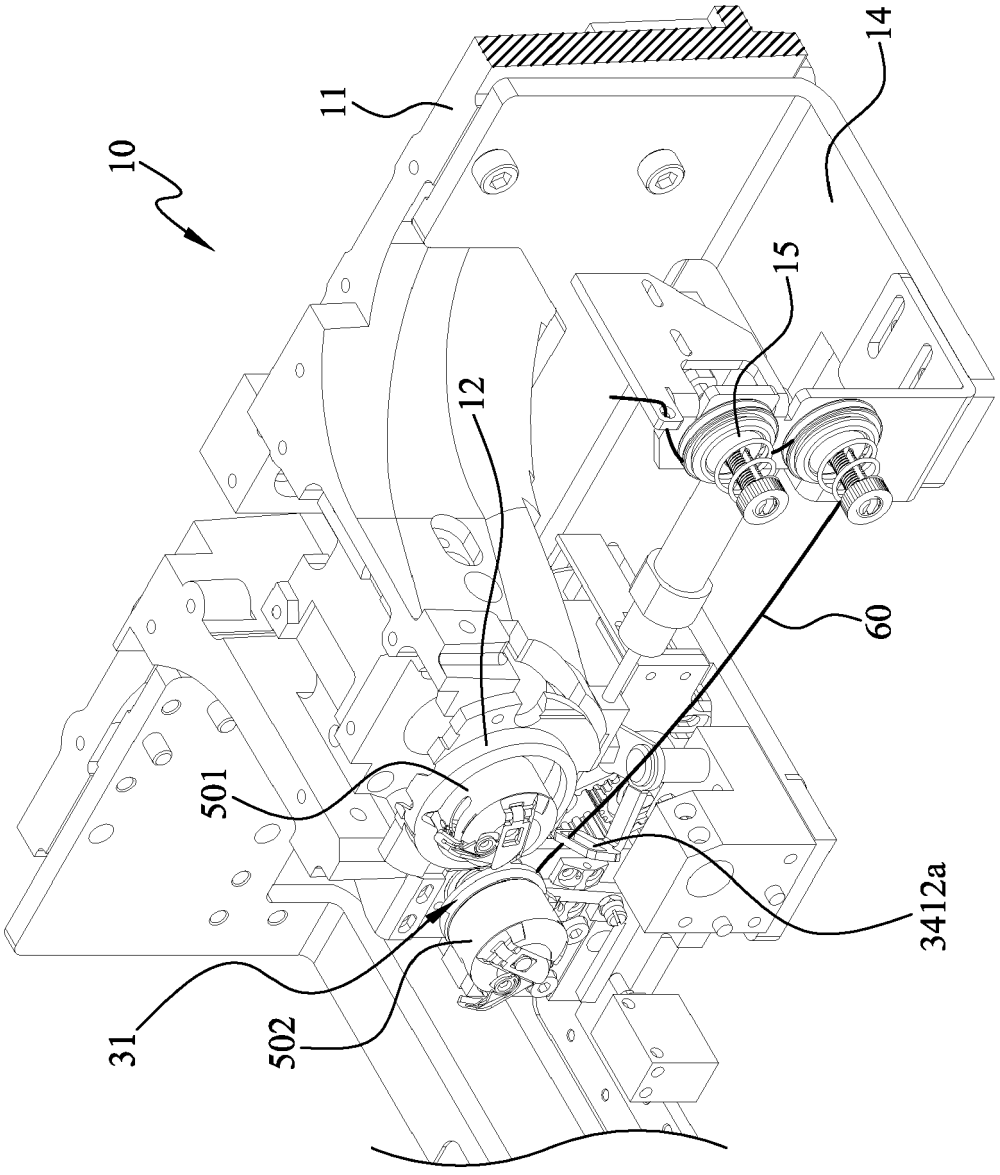
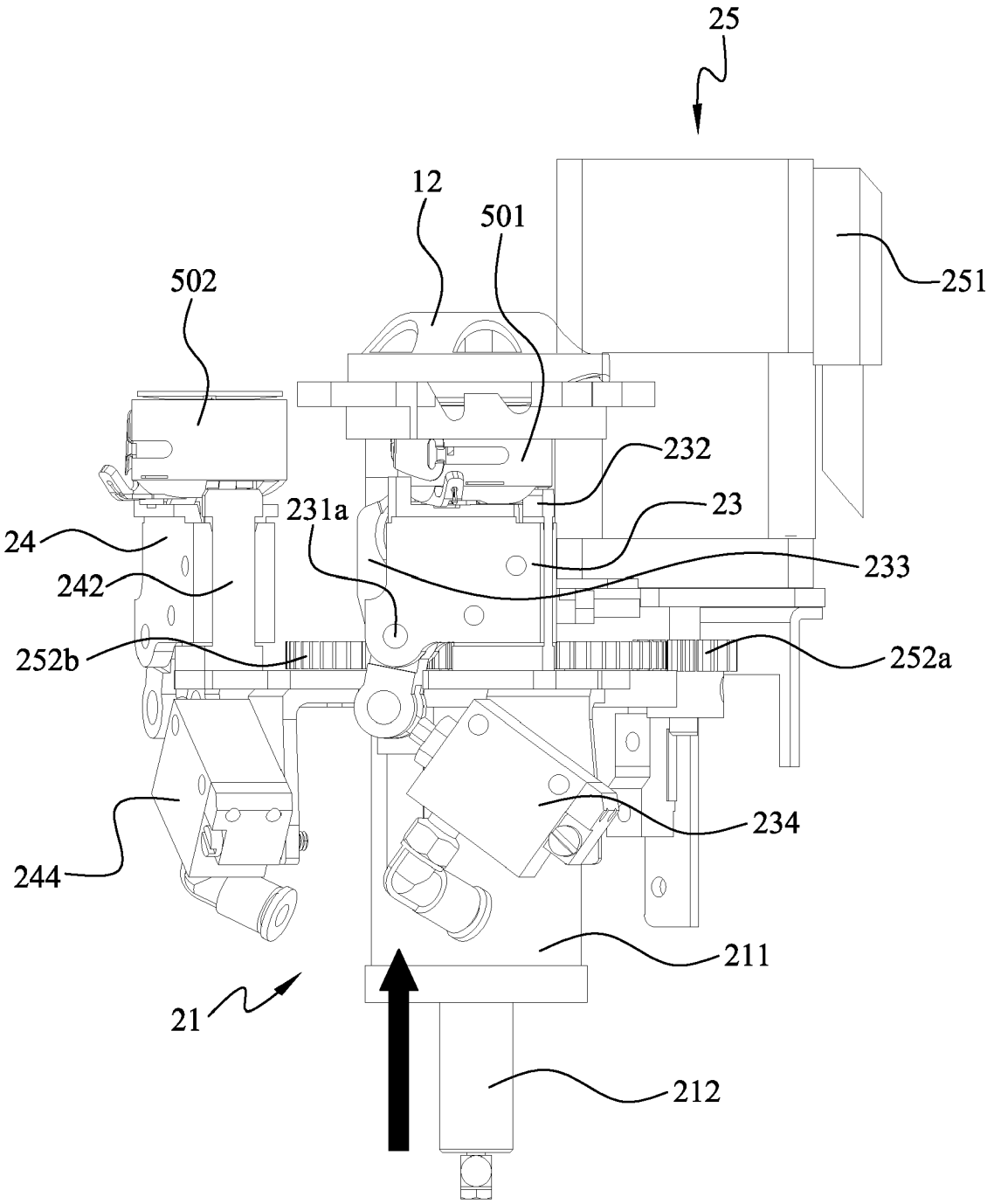


FIG. 14A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502
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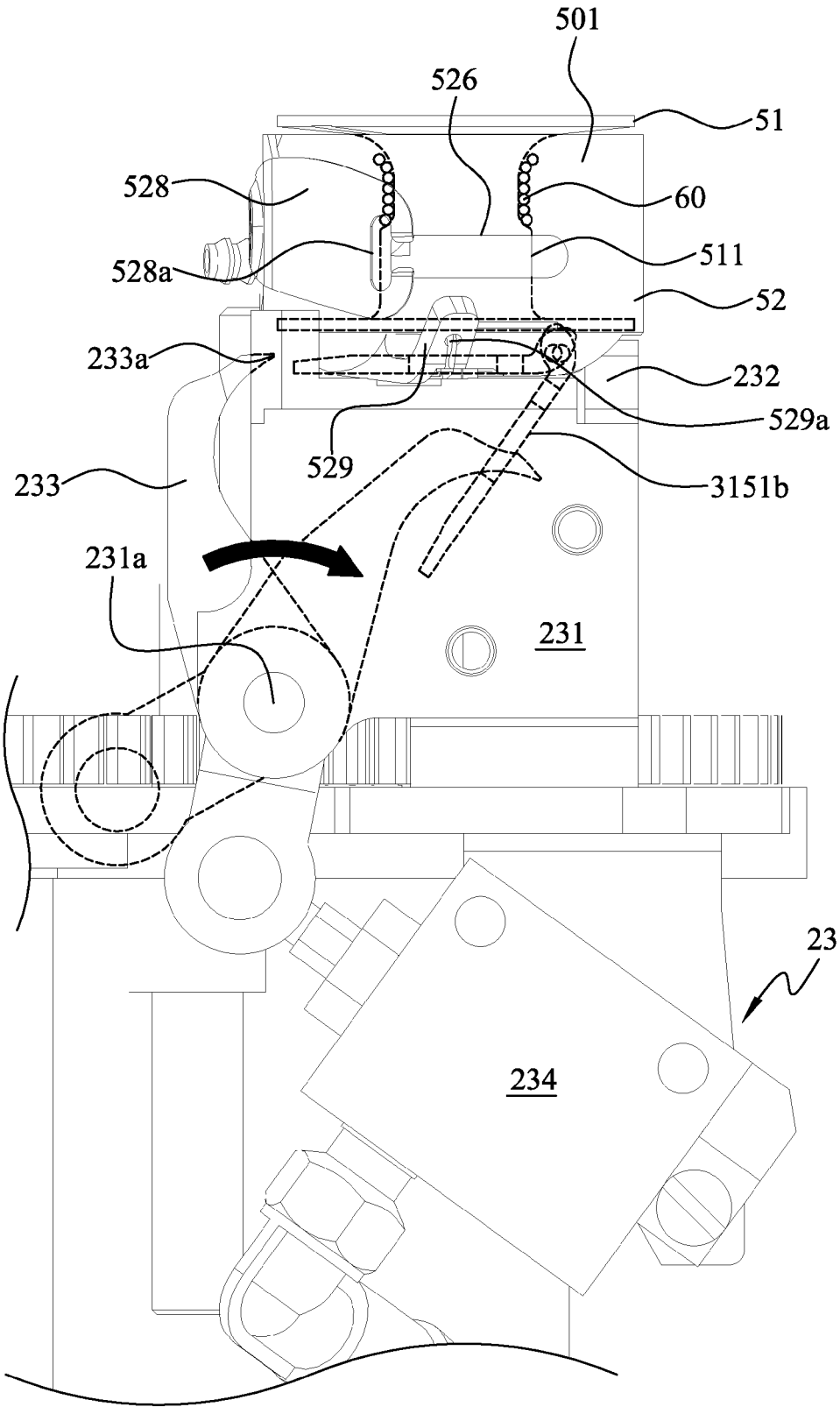
232
231a
23
24
233
242
252b
252a
234
244
211
21
212

FIG. 14B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526
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528
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52
233a
232
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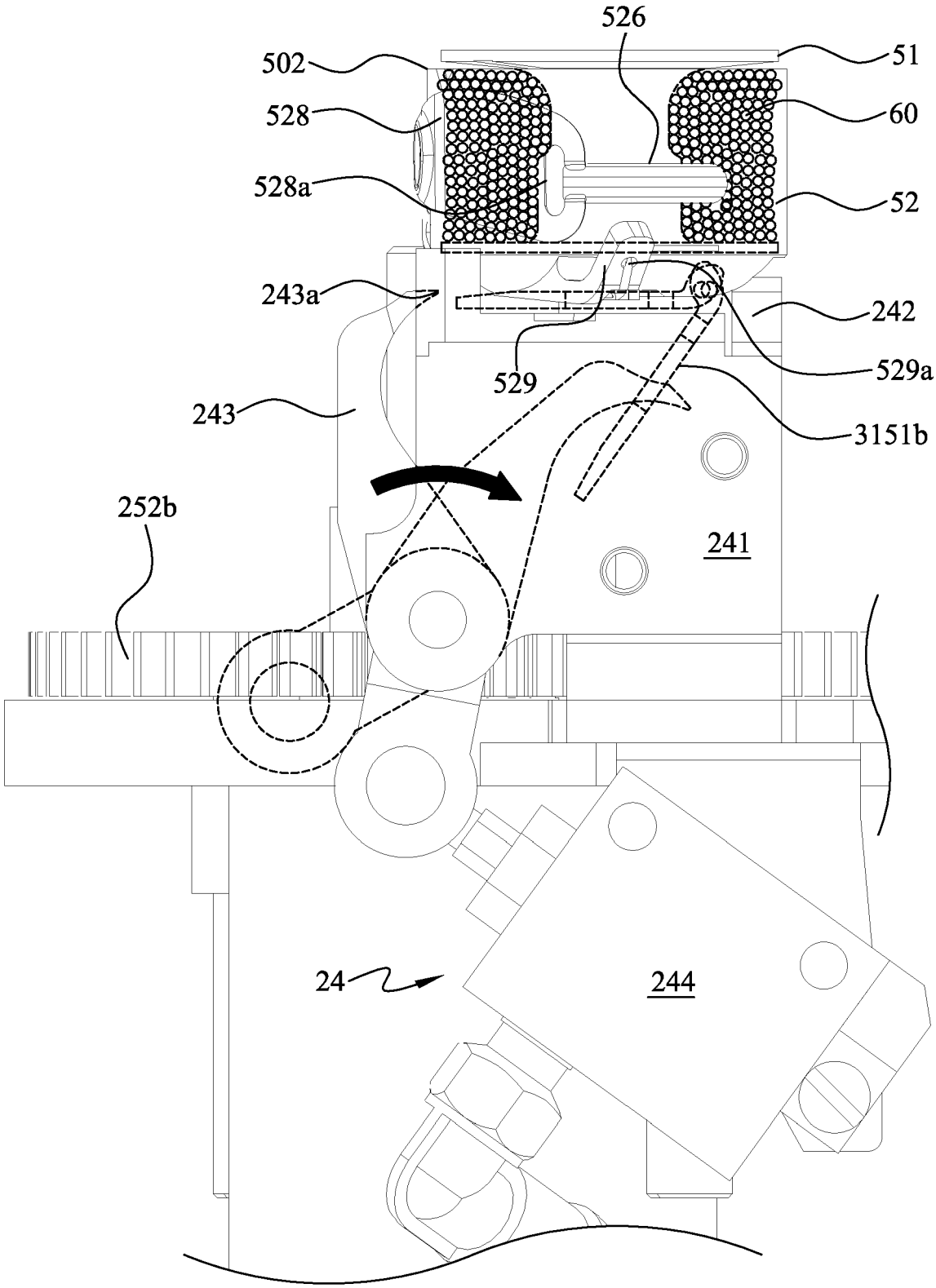
529
233
3151b
231a
231
23
234

FIG. 14C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24
244

FIG. 14D

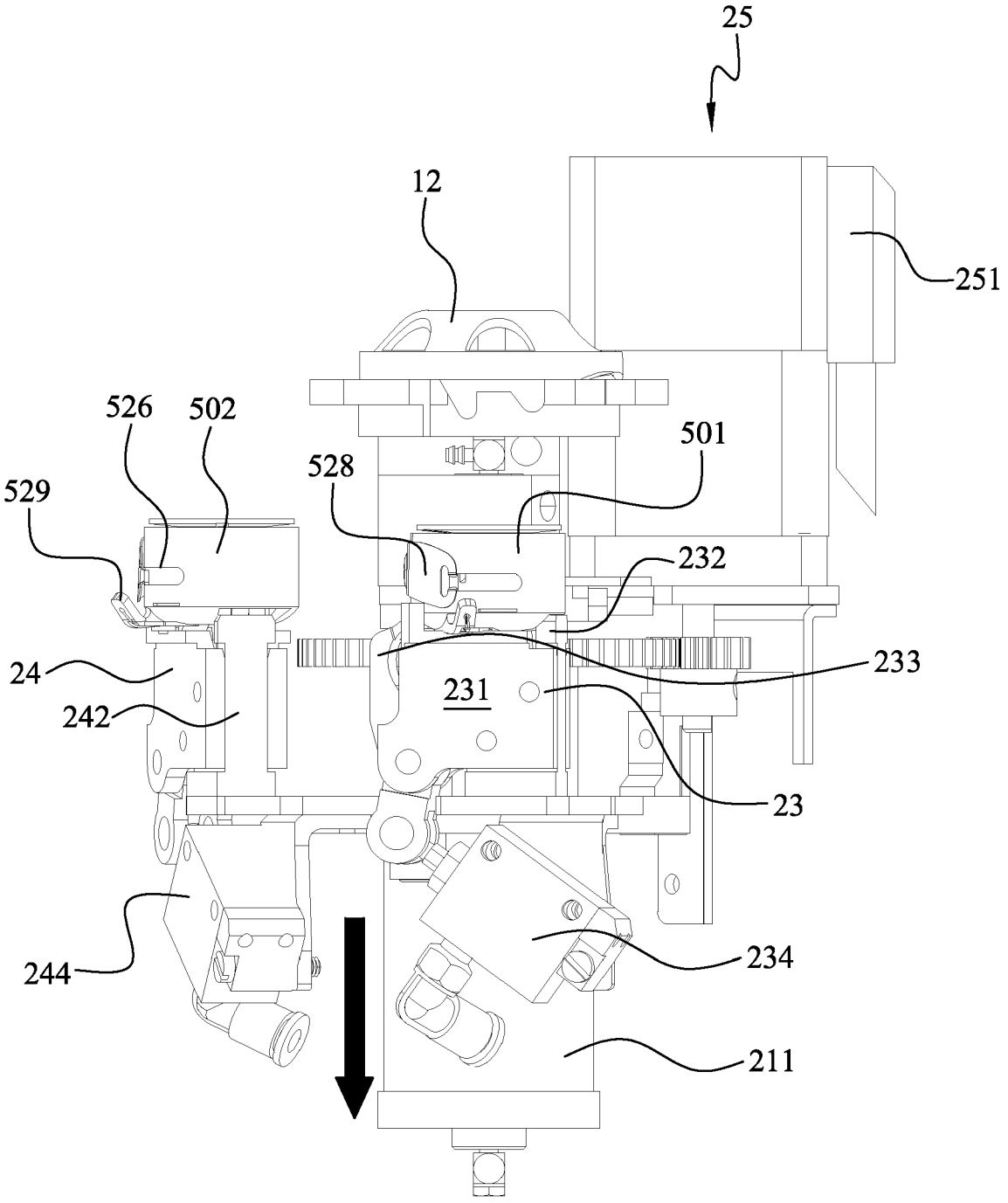


FIG. 14E

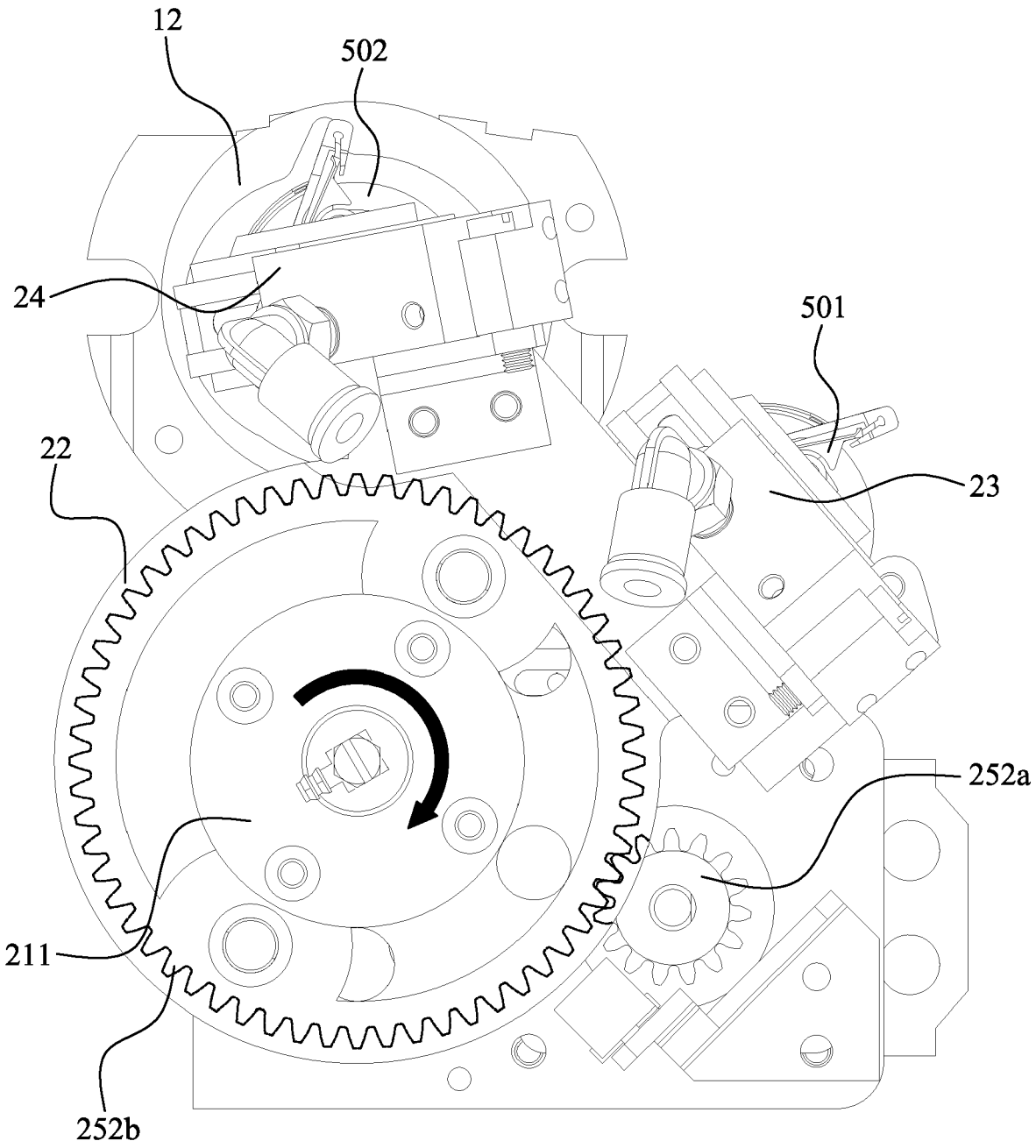
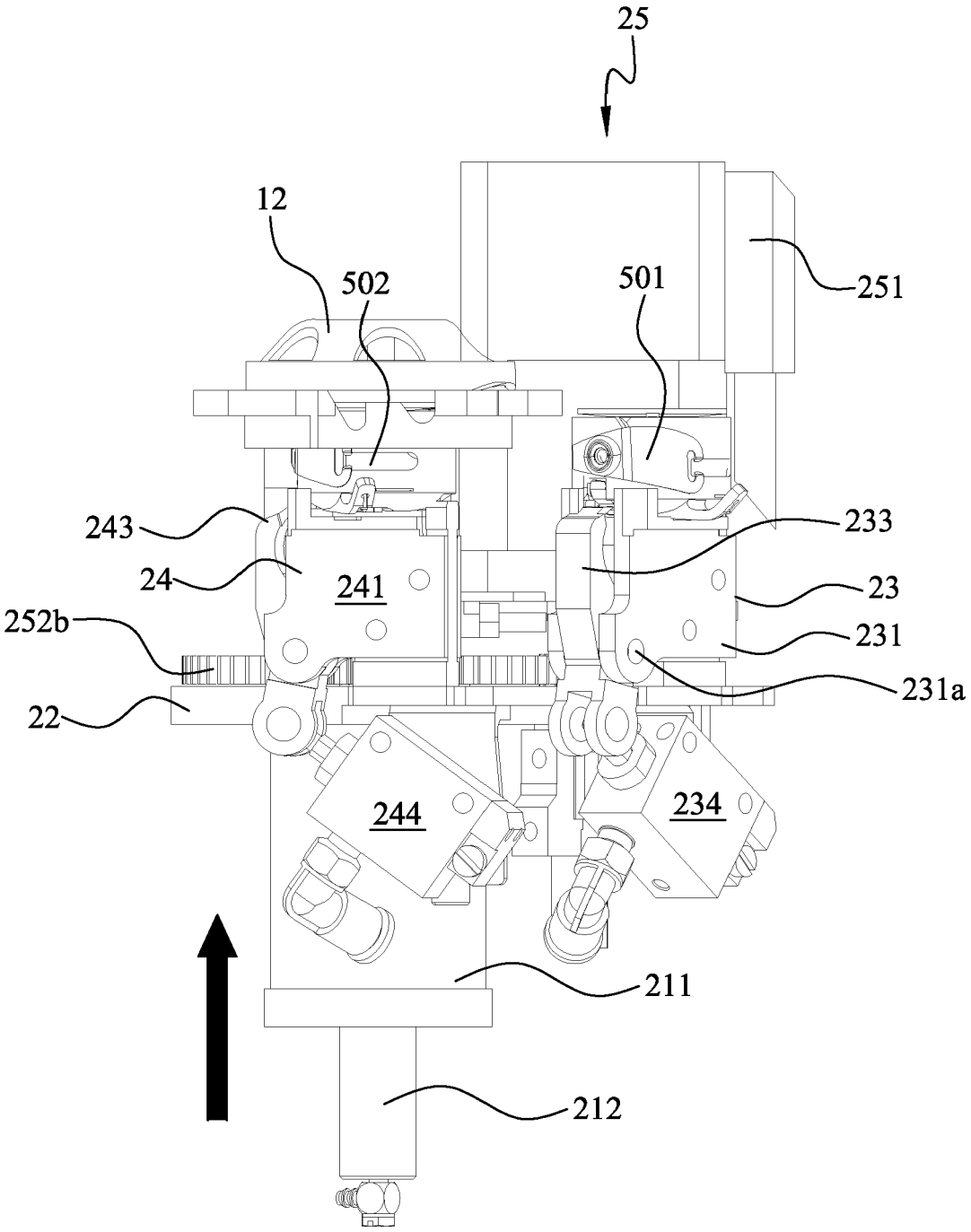


FIG. 14F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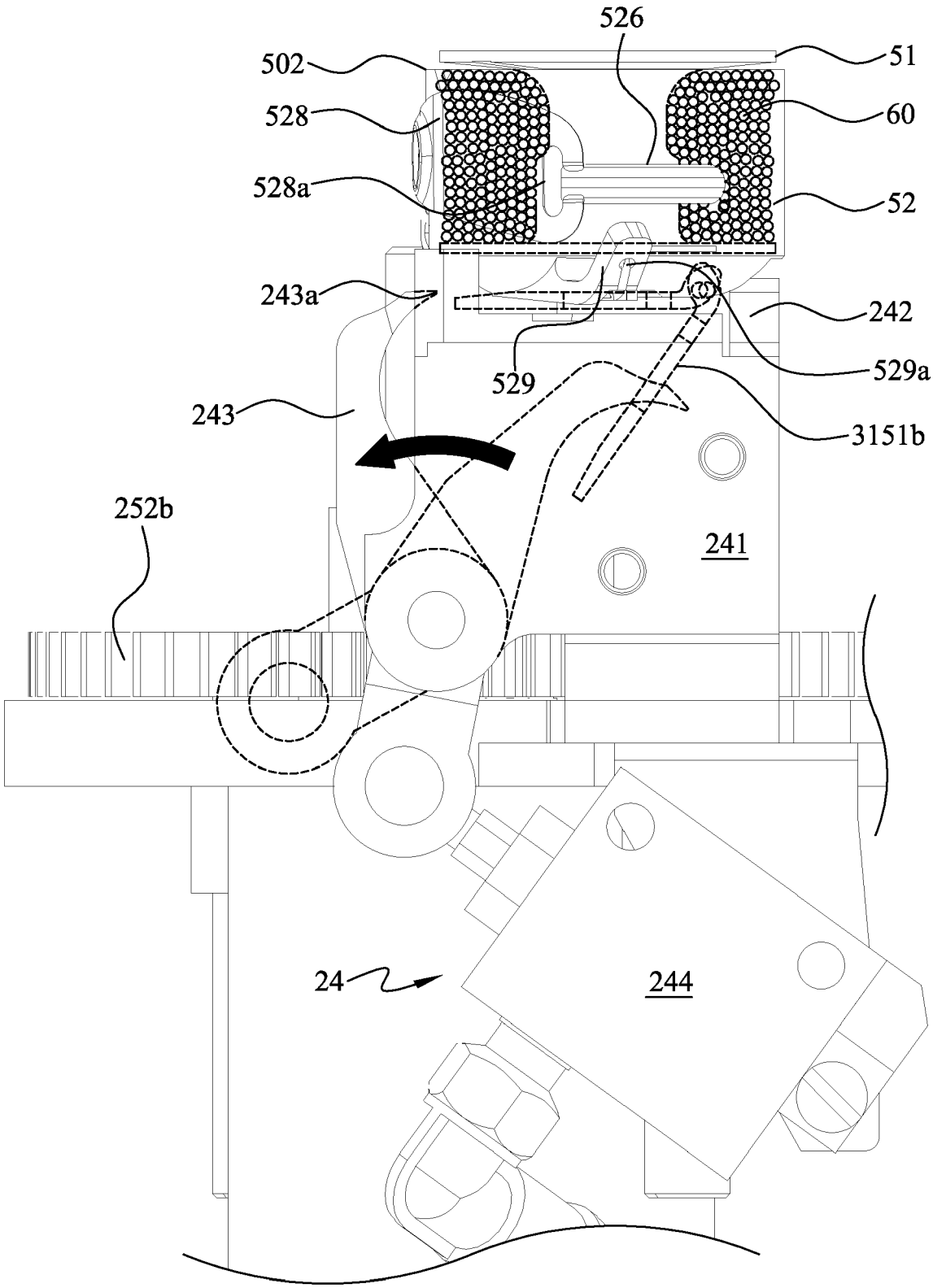
211
212

FIG. 14G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52
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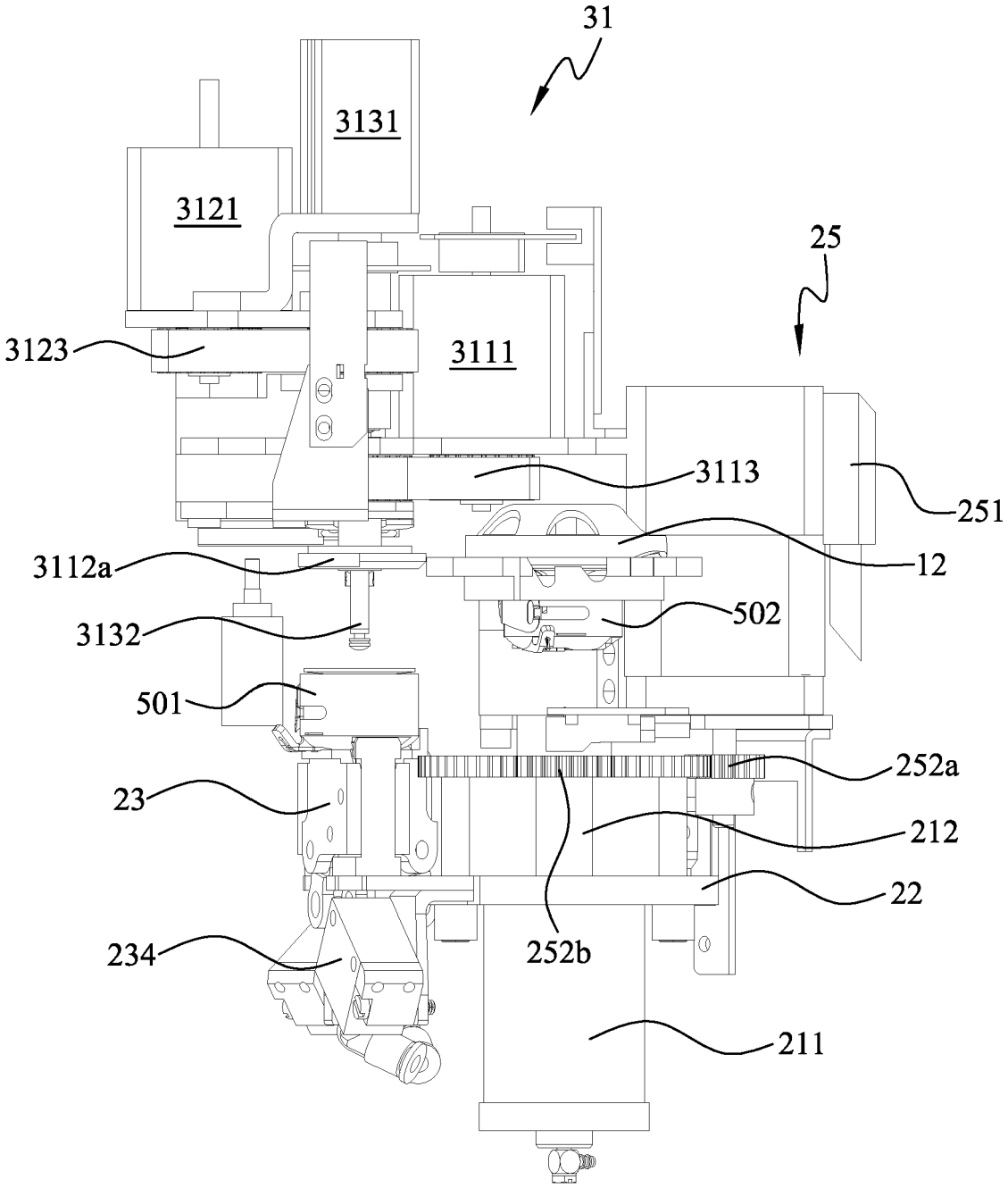
529
529a
243
3151b
252b
241
24
244

FIG. 14H


31
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3121
25
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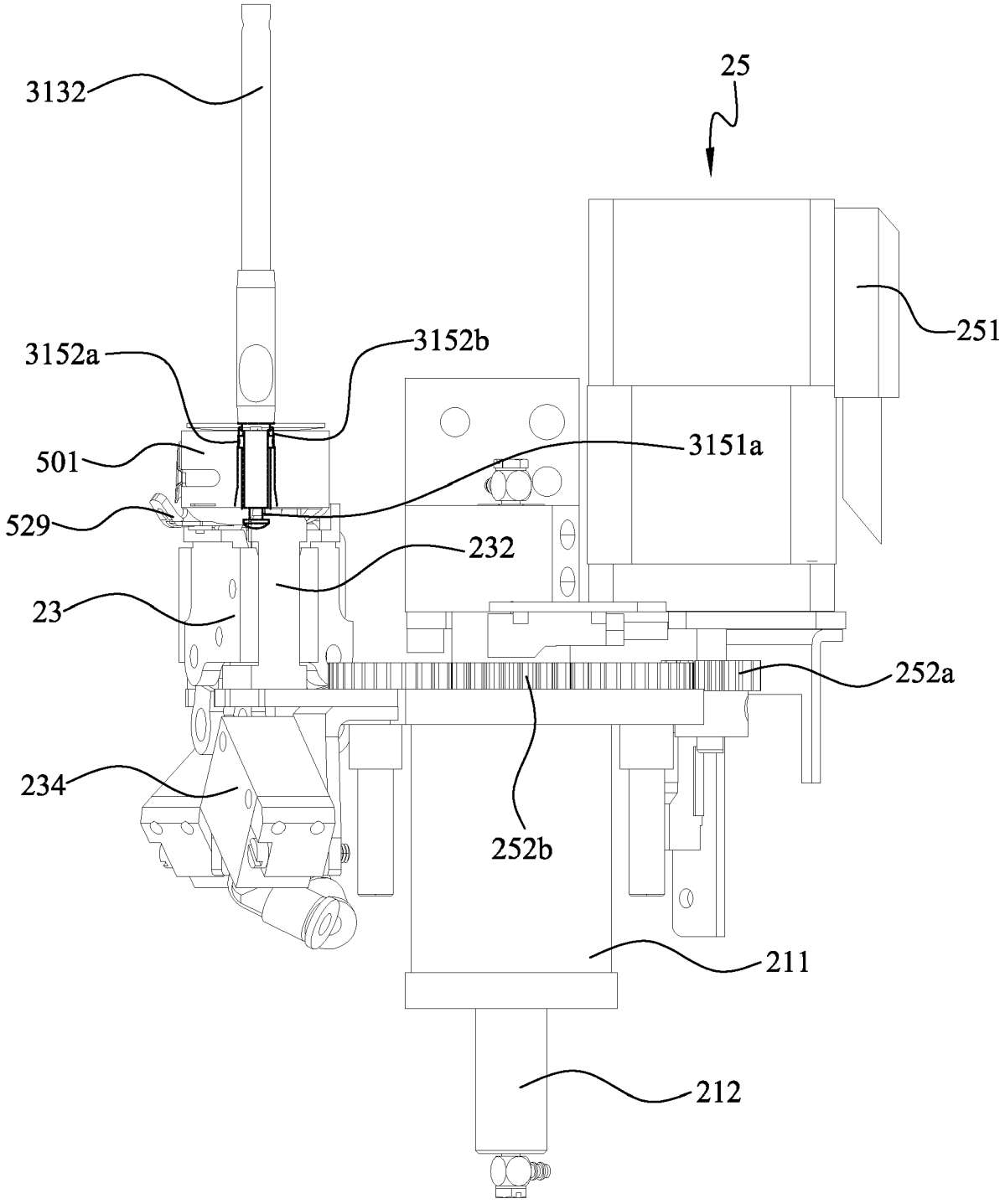
12
3112a
502
3132
501
252a
23
212
22
234
252b
211

FIG. 14I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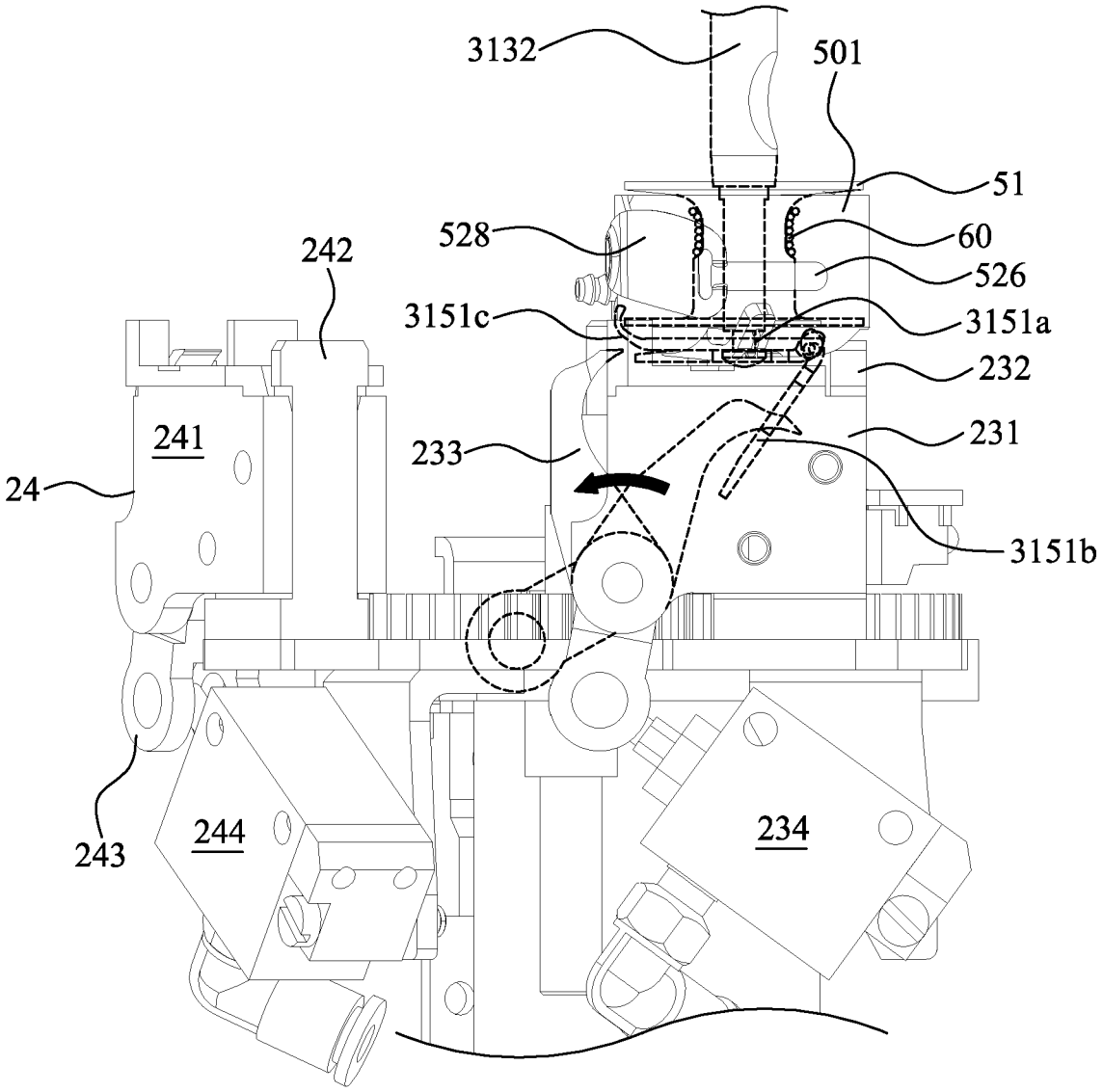
529
232
23
252a
234
252b
211
212

FIG. 14J


3132
501
51
528
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3151c
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231
24
3151b
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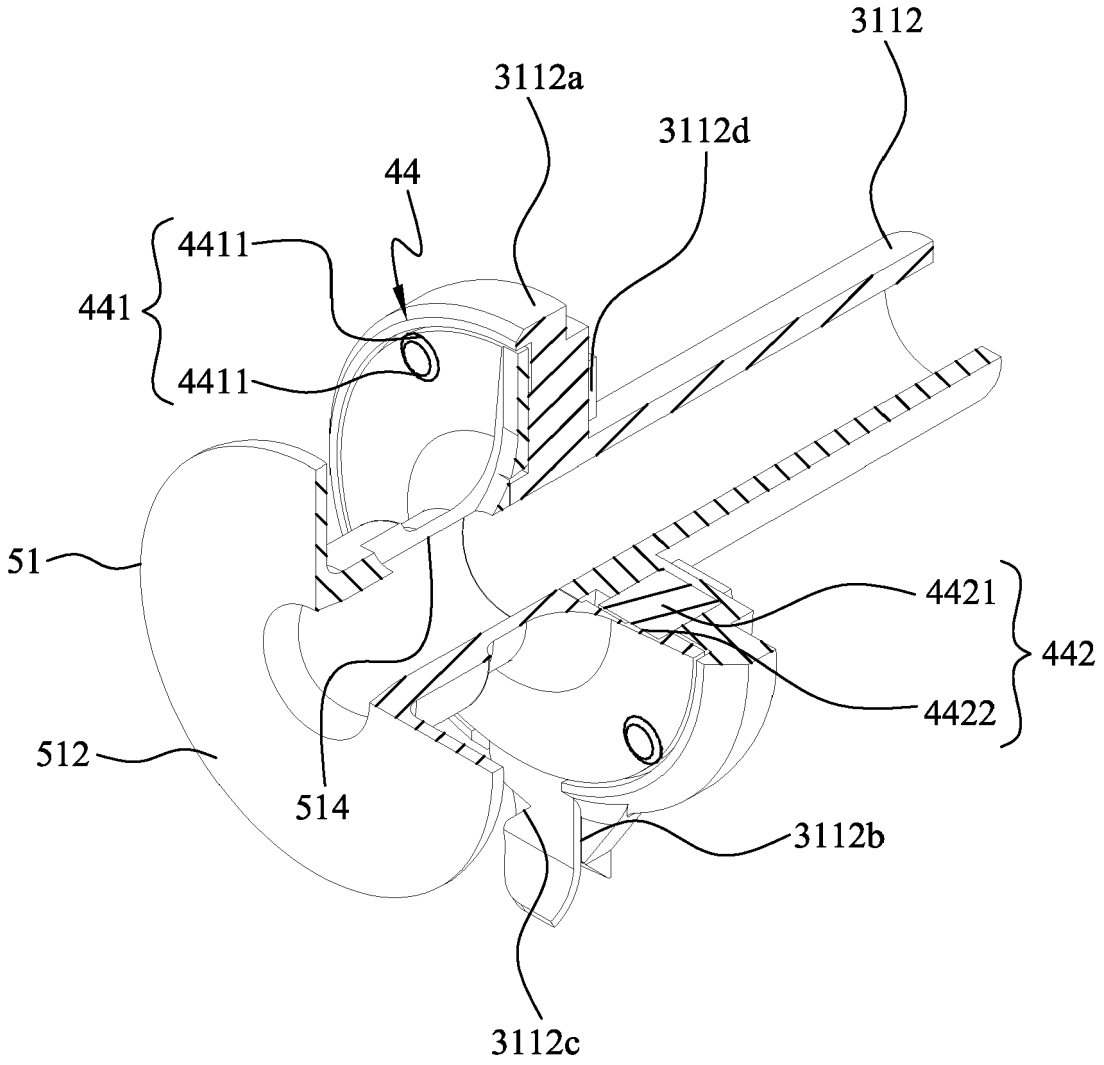
234
243

FIG. 14K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4421
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4422
512
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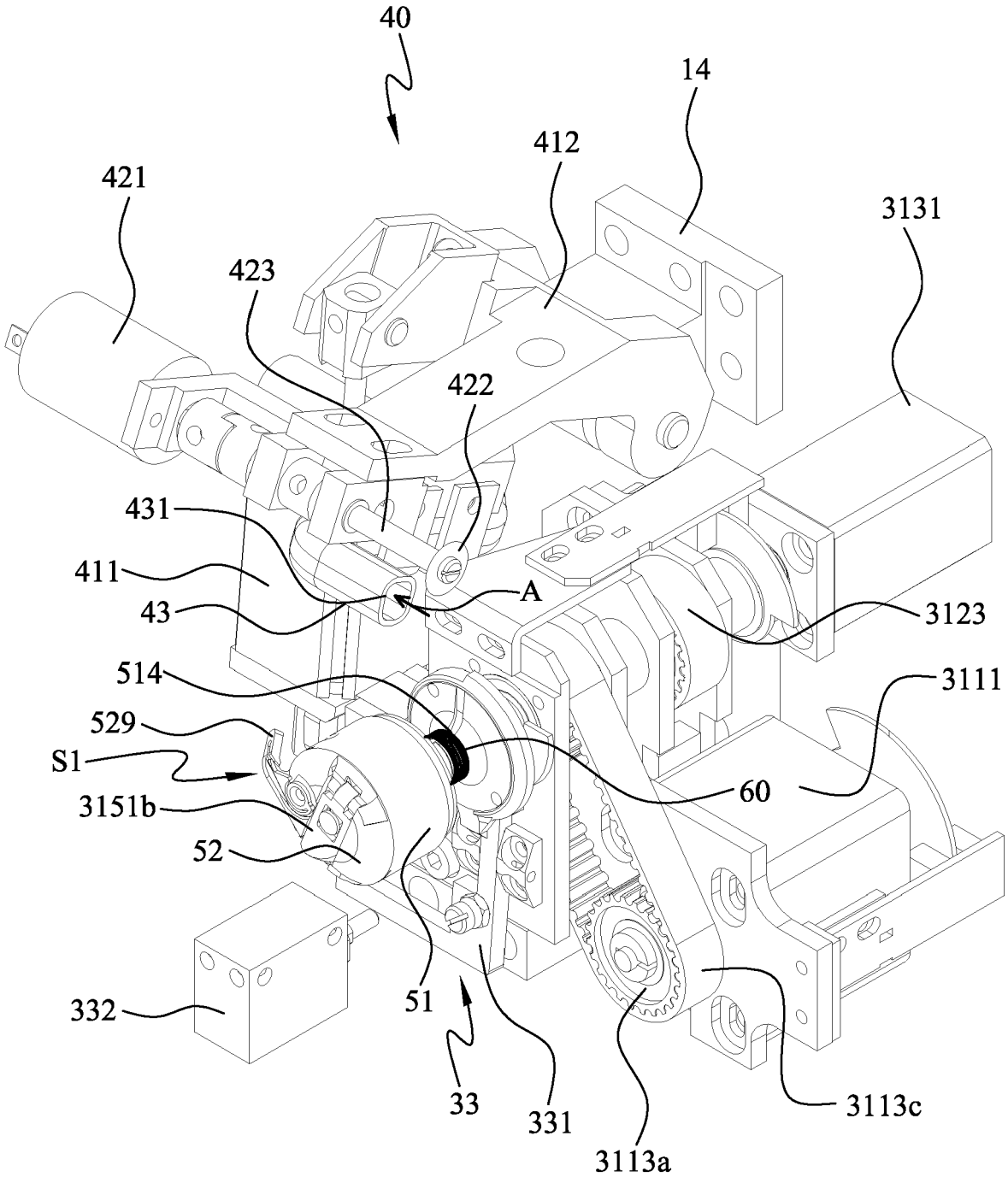
3112b
3112c

FIG. 14L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411
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S1
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51
33
331
3113a
3113c

FIG. 15A

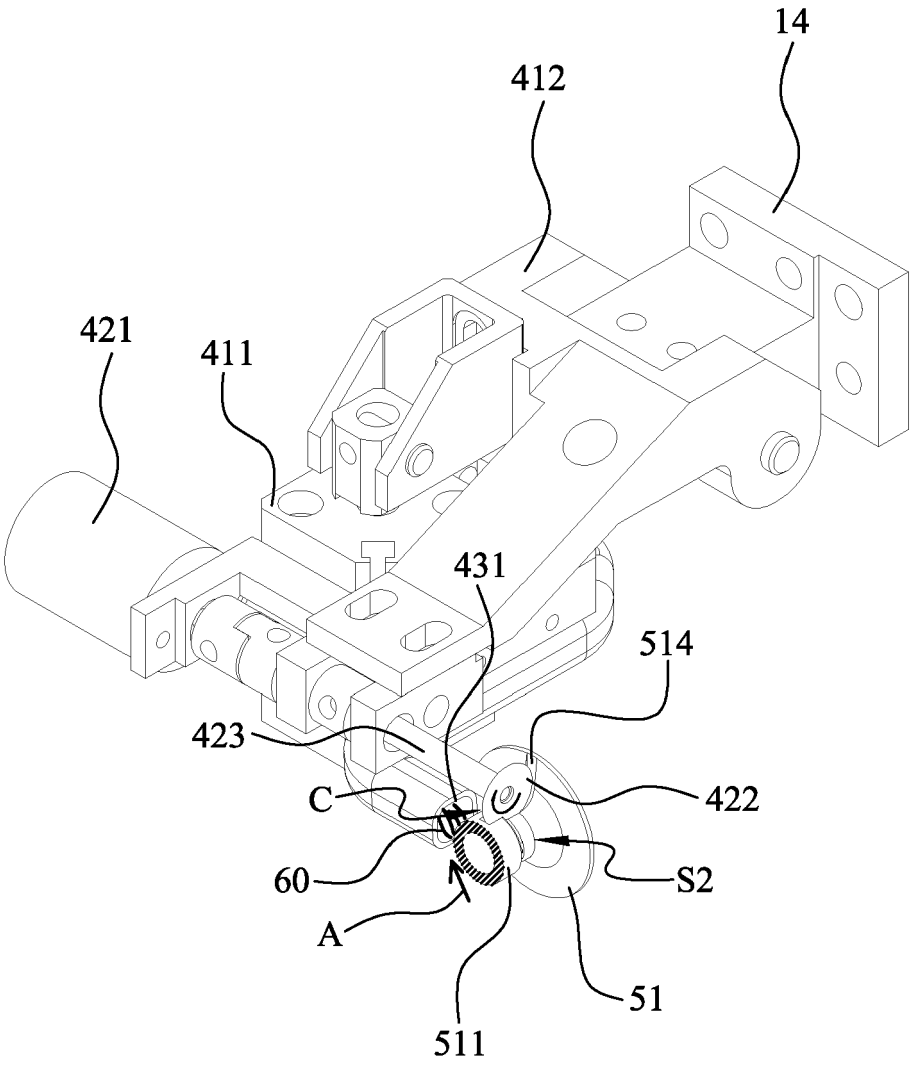


FIG. 15B

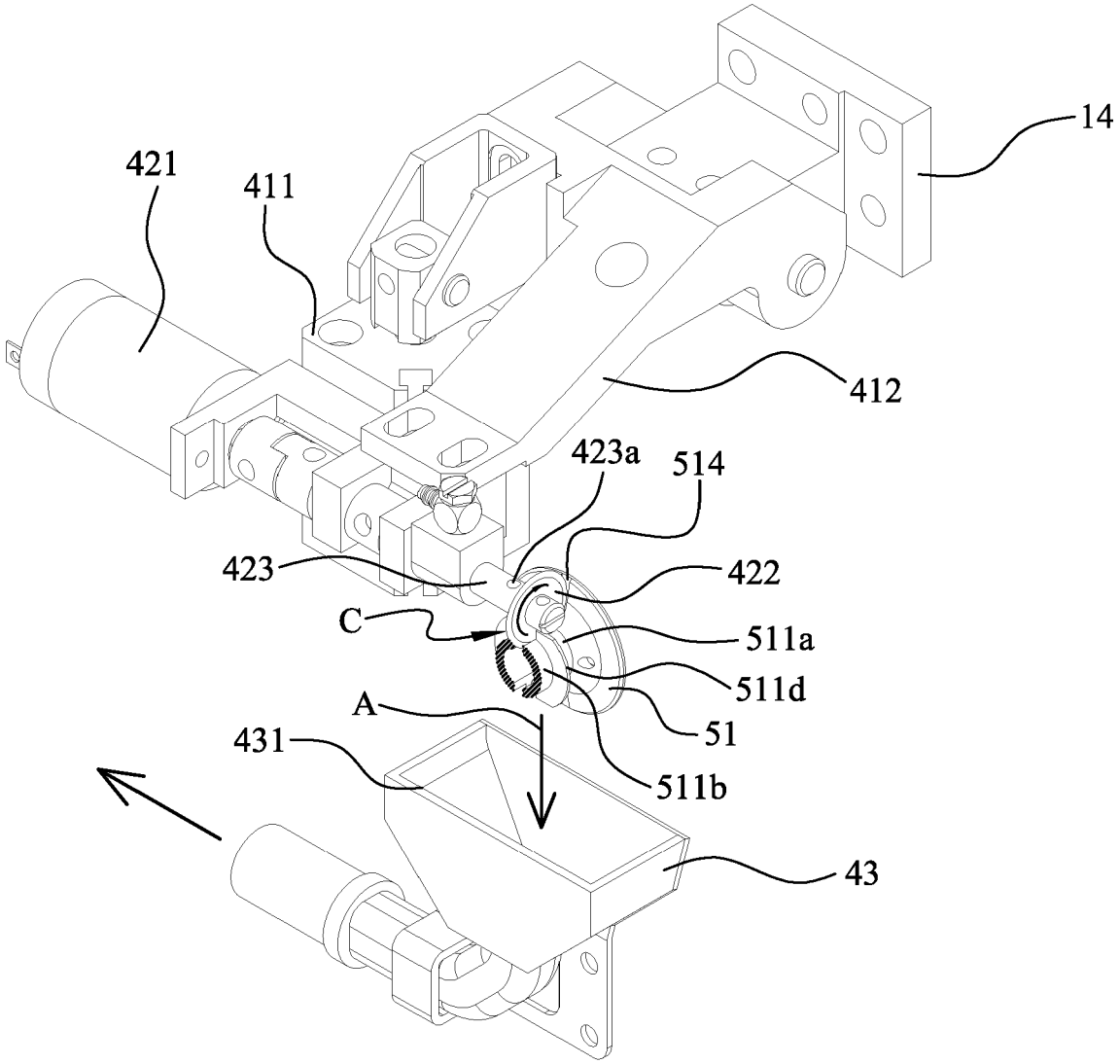


FIG. 15C

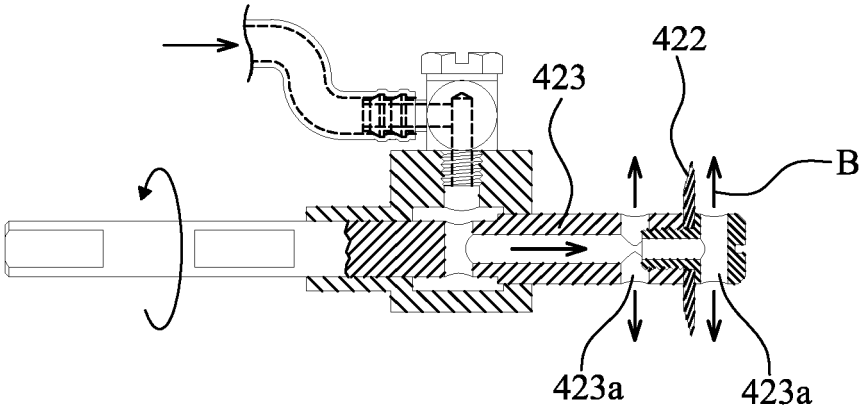
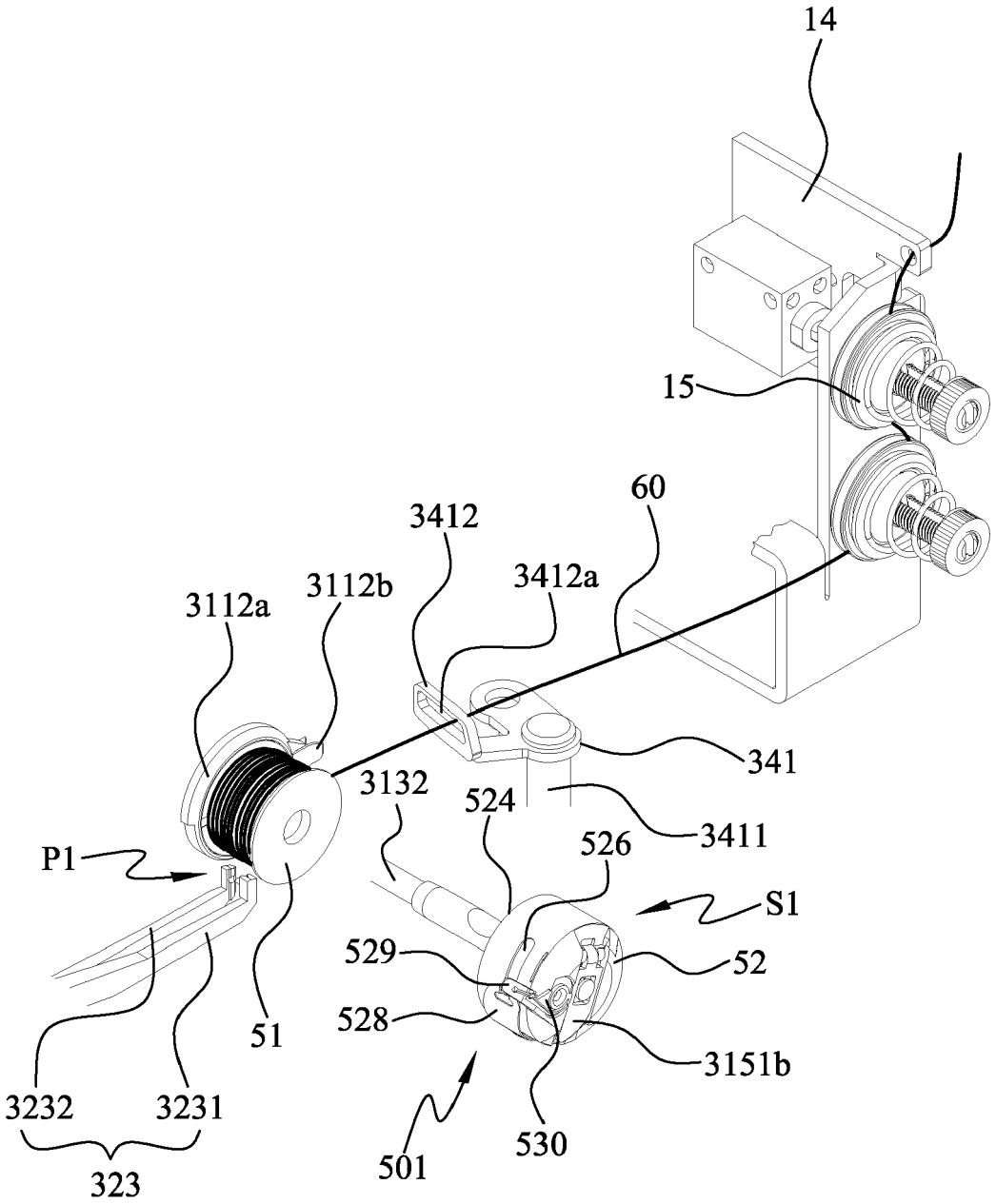


FIG. 15D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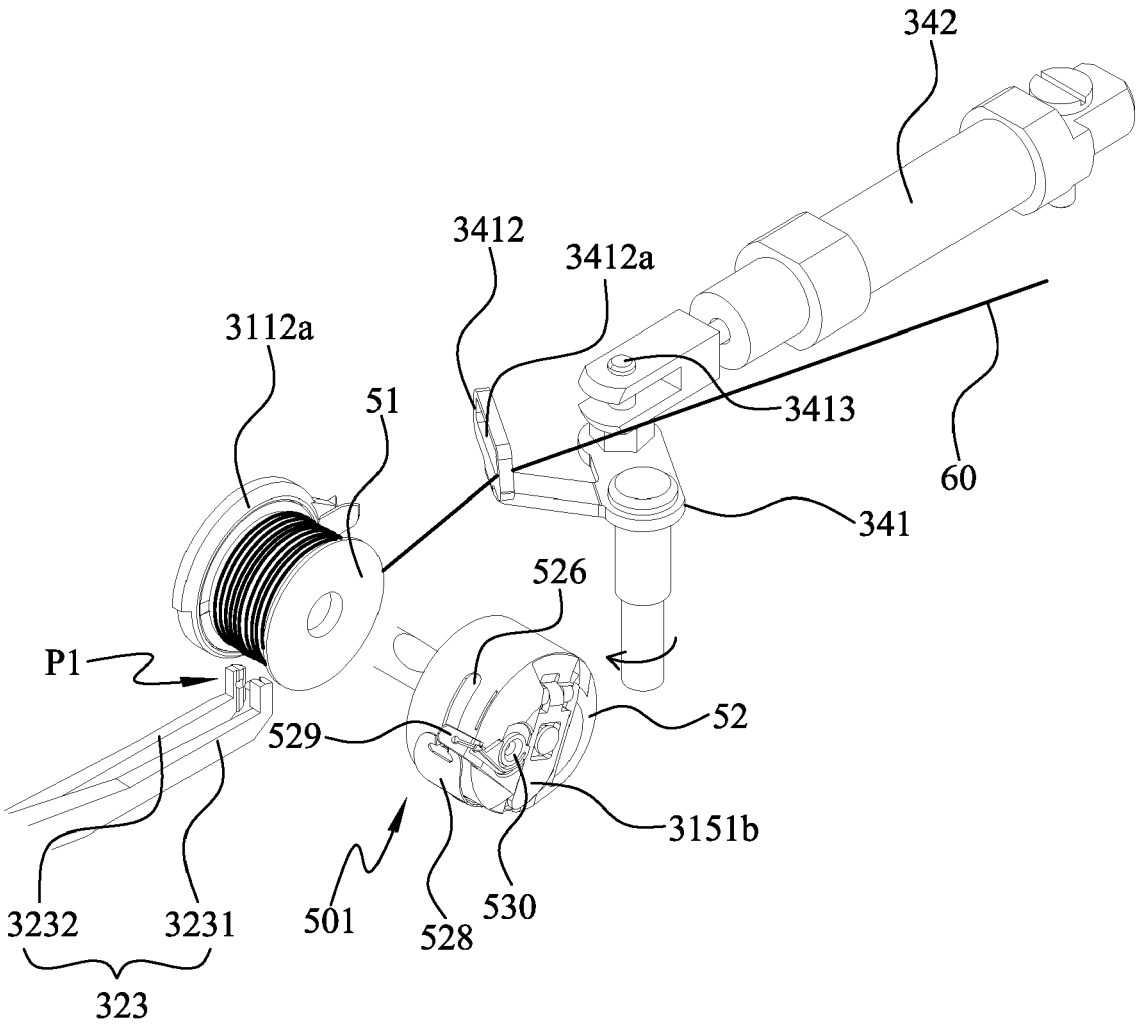
51
3151b
3232
3231
530
501
323

FIG. 16A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529
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3232
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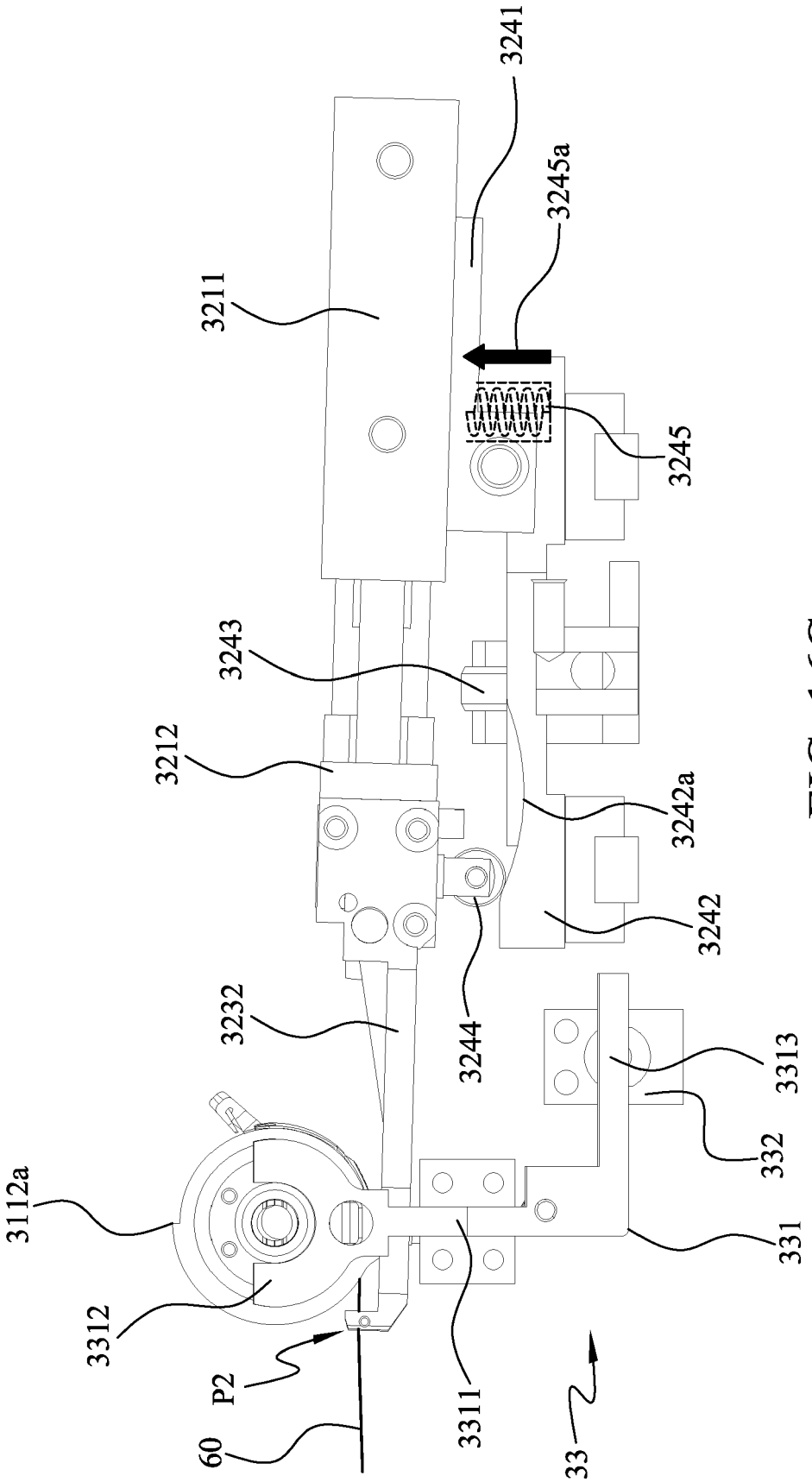
501
528
530
323

FIG. 16B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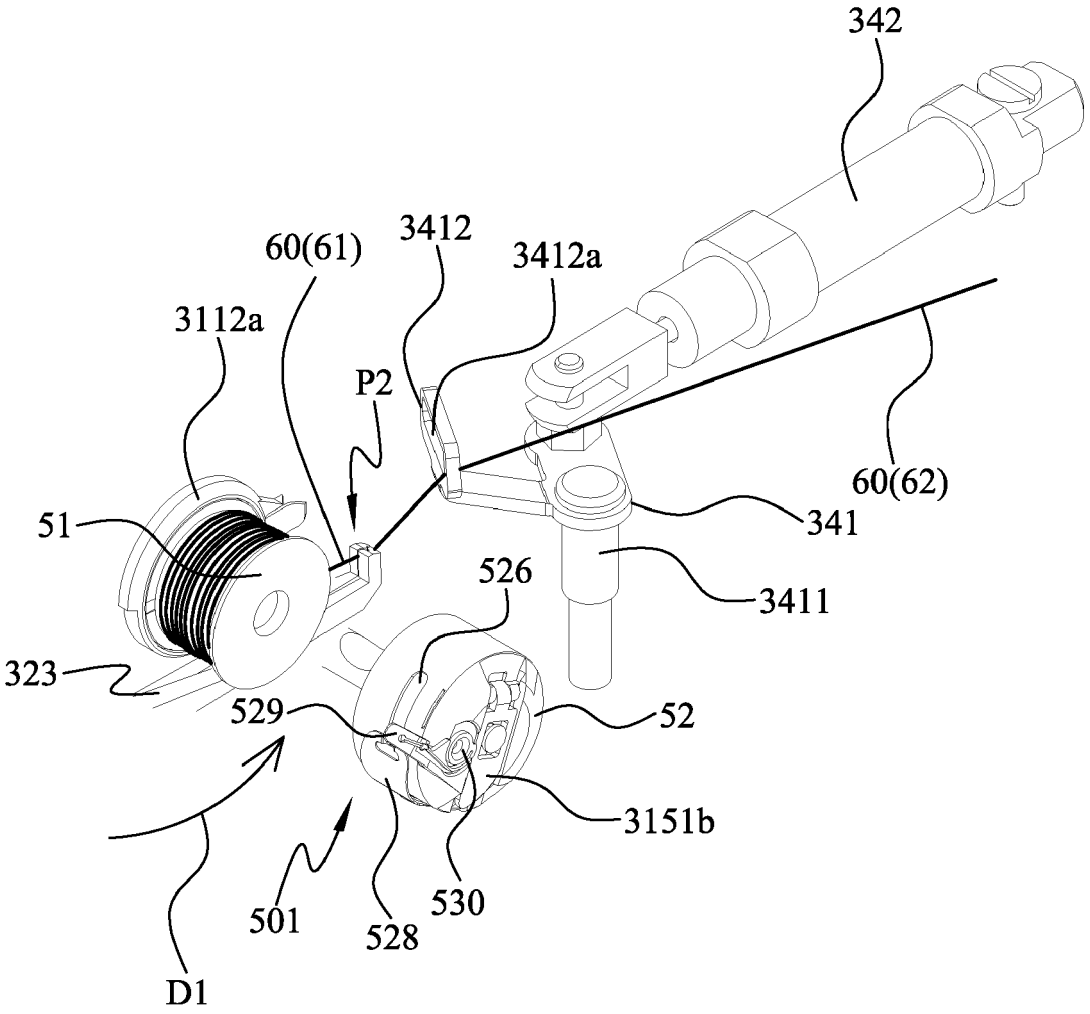
3312
P2
3311
60
33

FIG. 16C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60(62)
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341
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323
529
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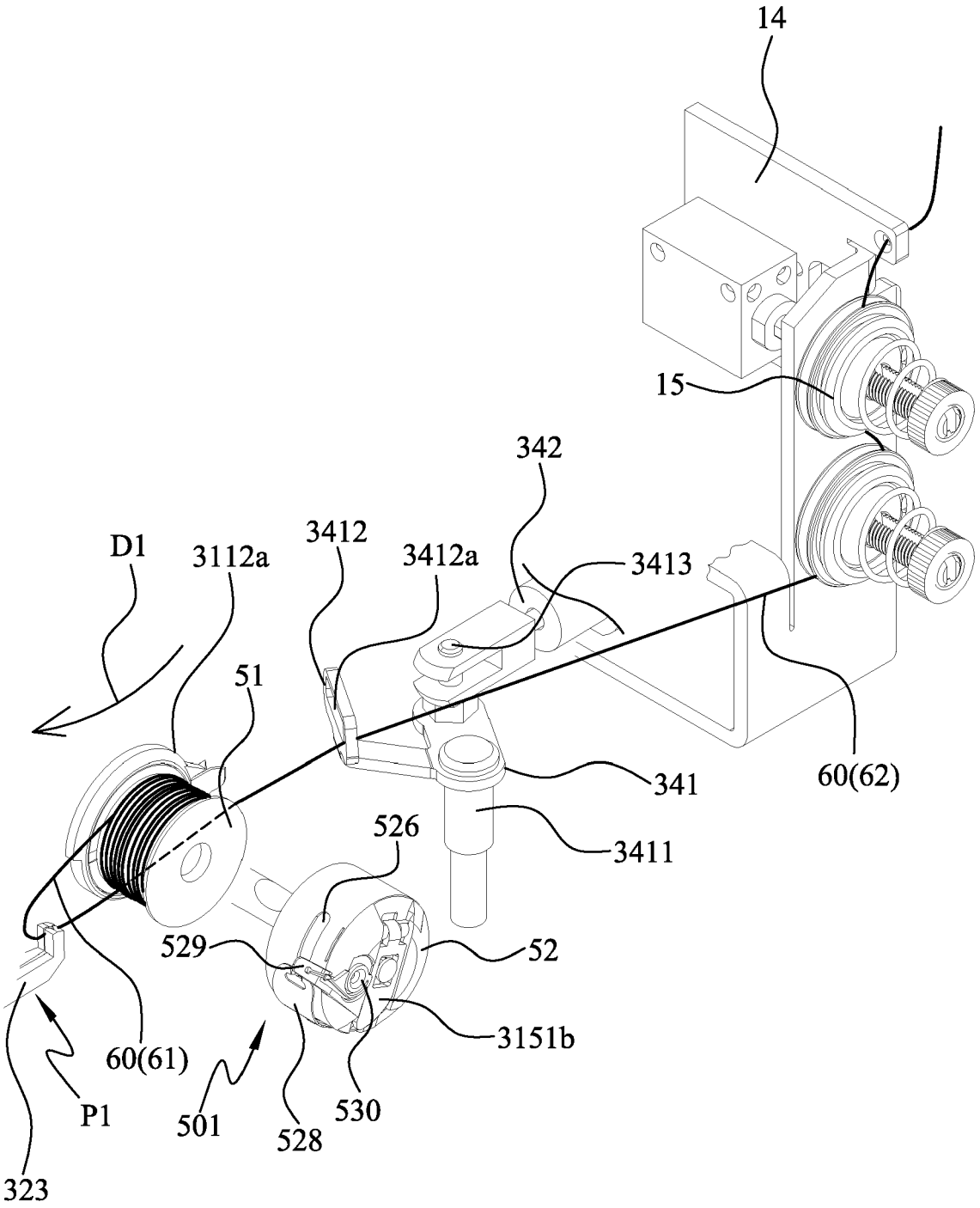
3151b
501
528
530
D1

FIG. 16D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60(62)
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60(61)
P1
501
528
530
323

FIG. 16E

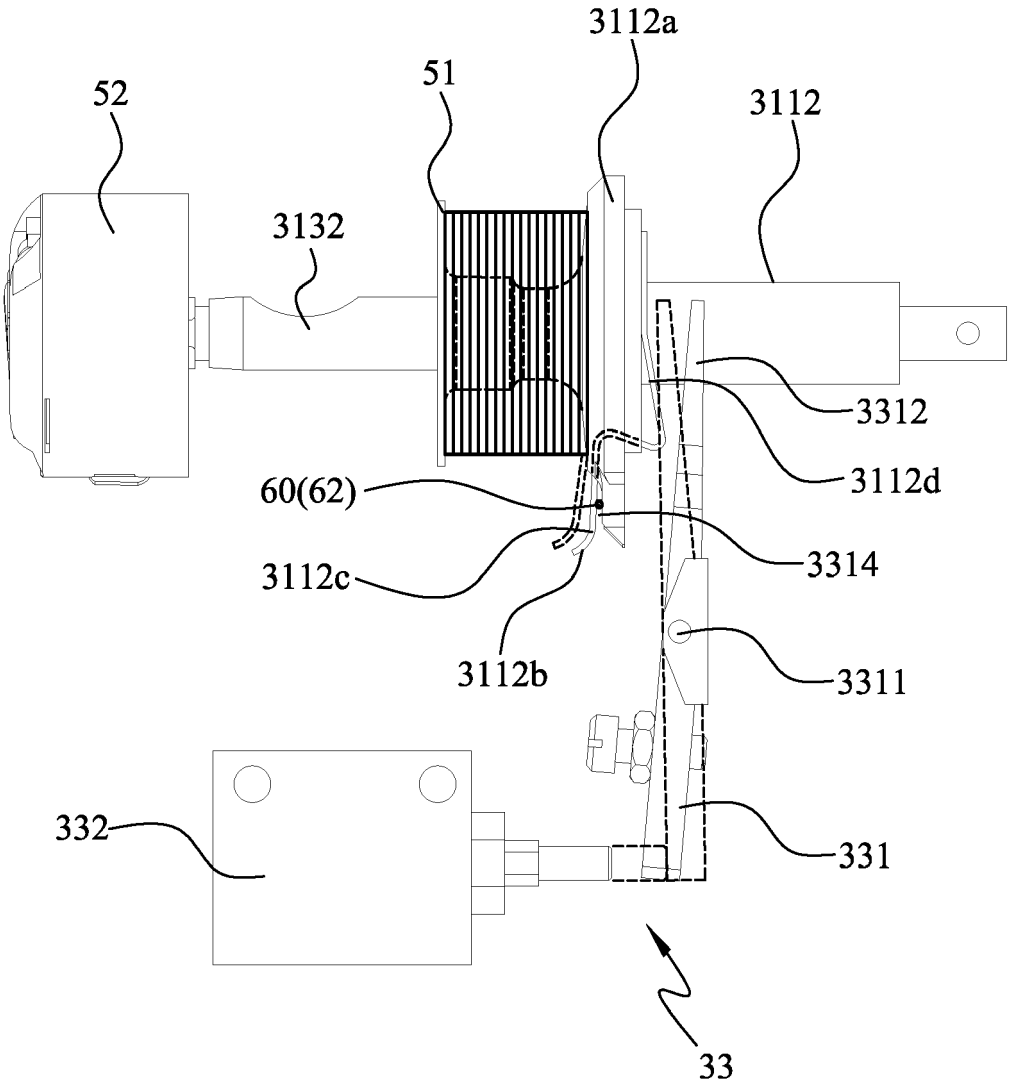
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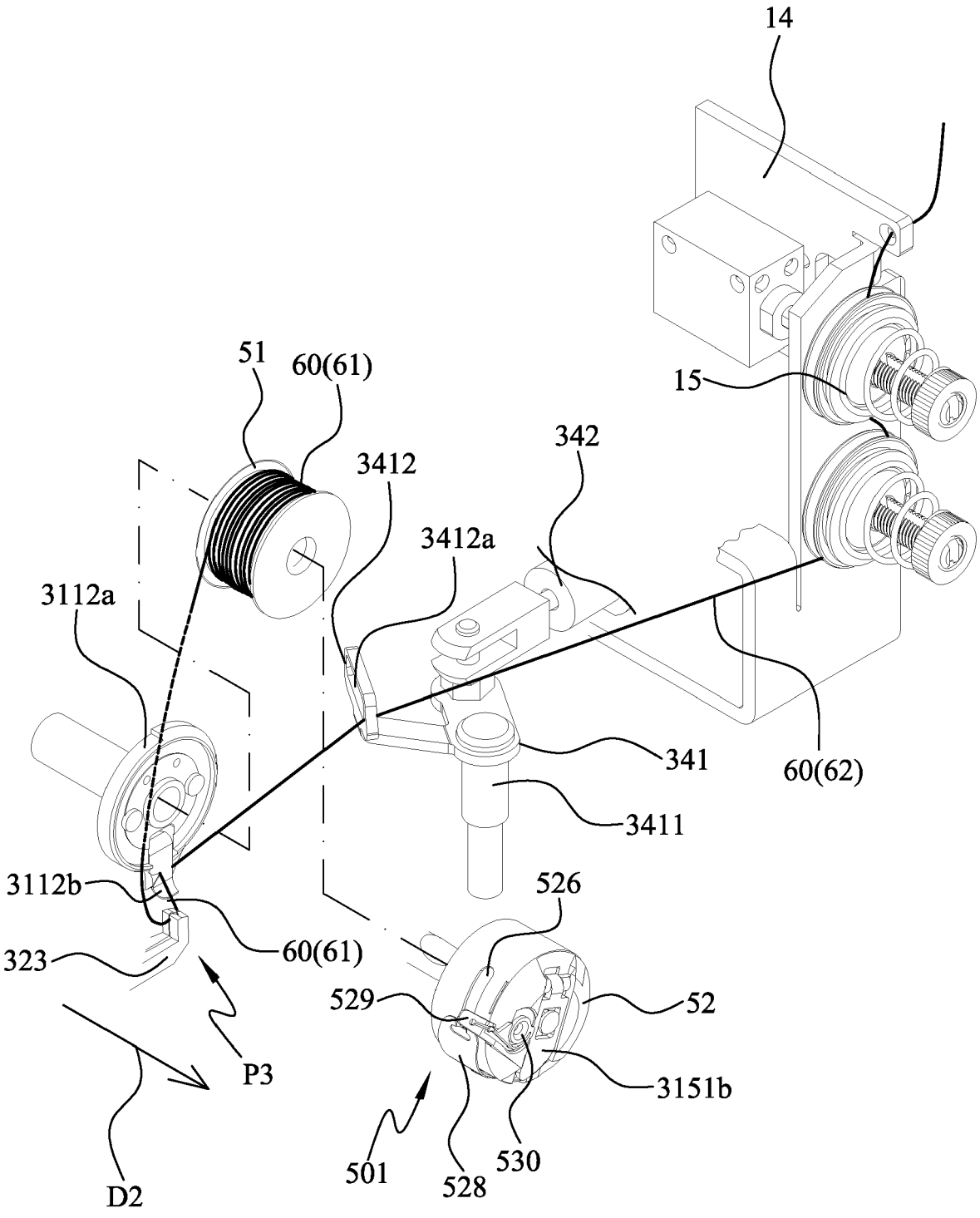
FIG. 16F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60(61)
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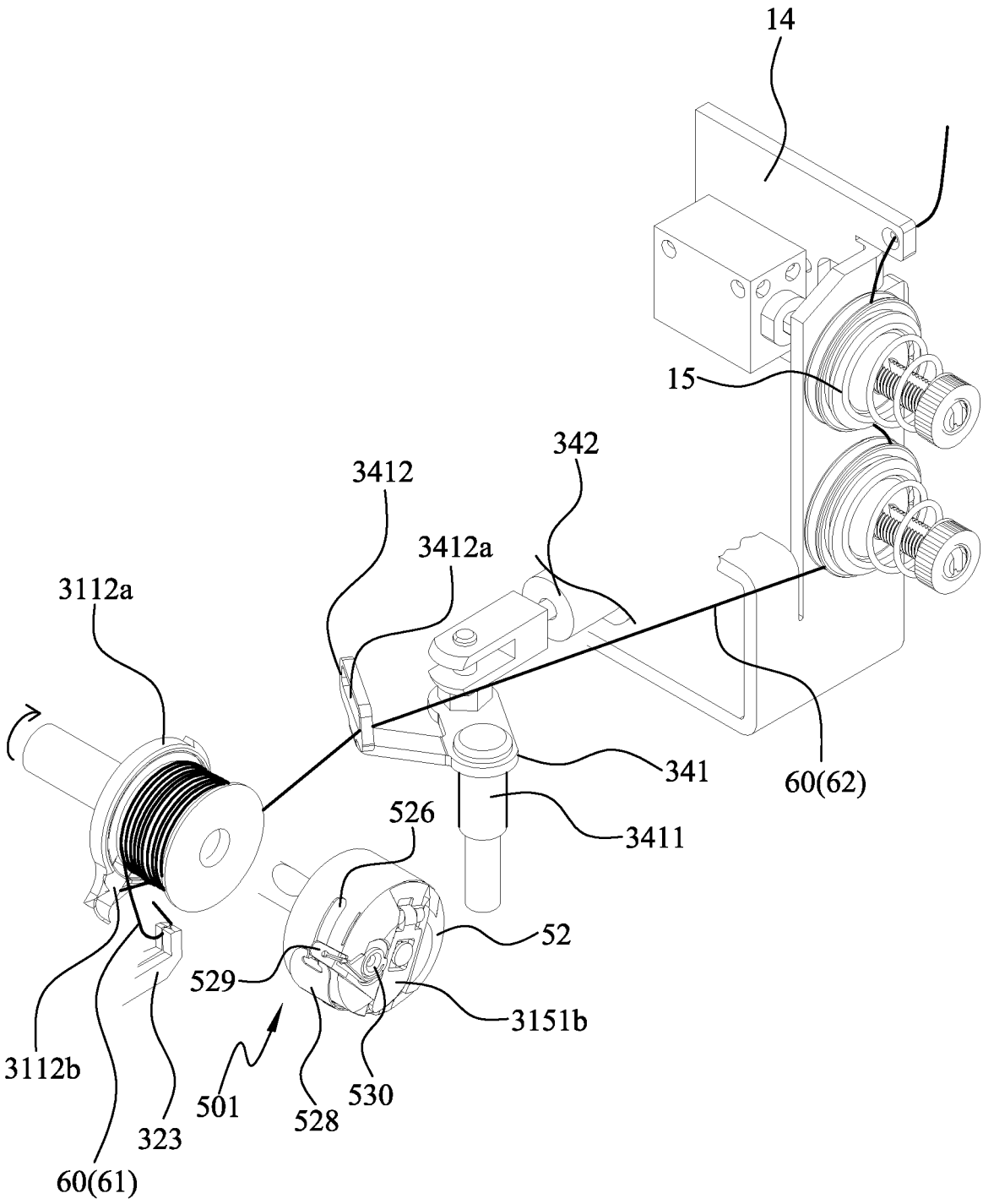
P3
3151b
D2
501
528
530

FIG. 16G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3411
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323
60(61)

FIG. 16H

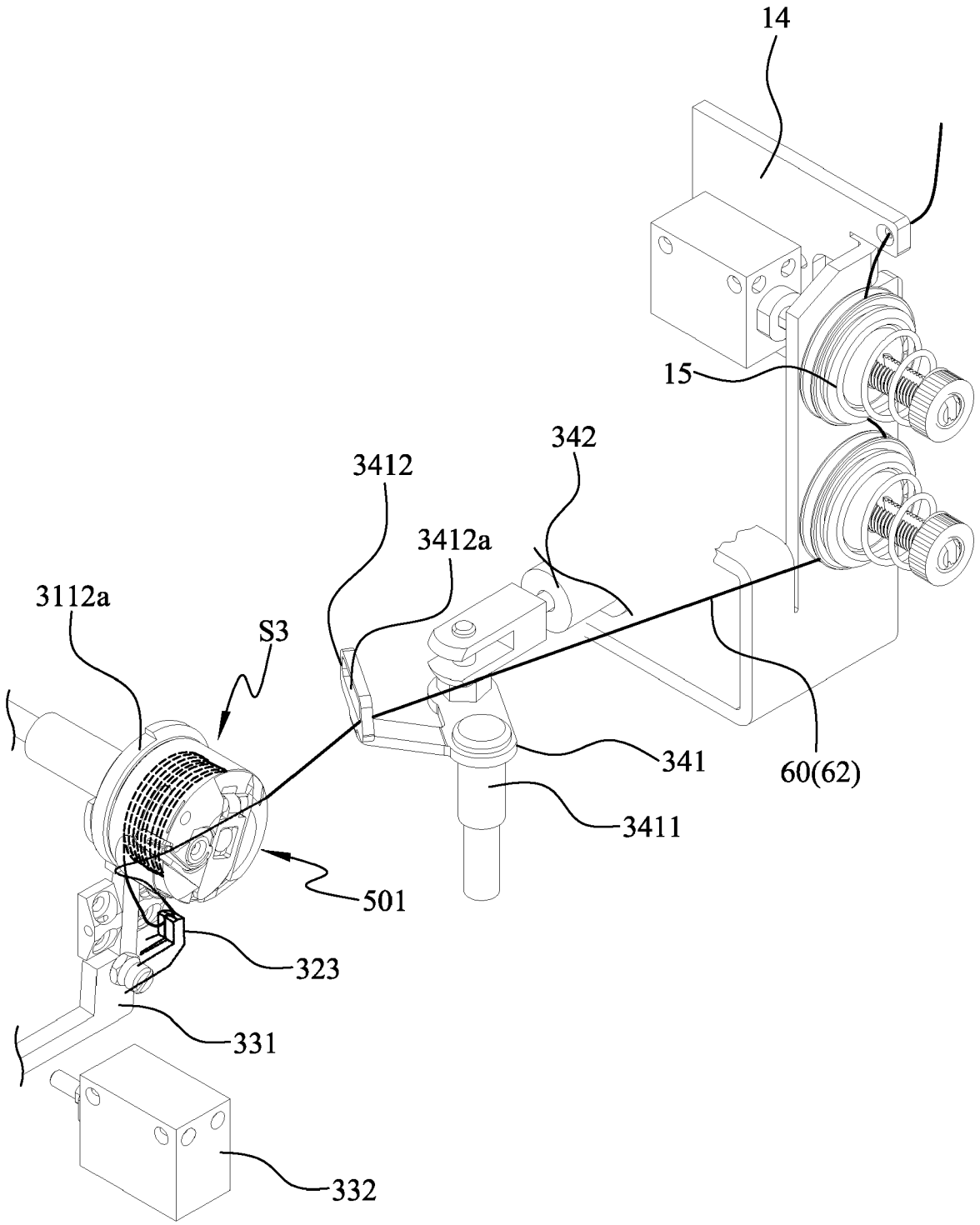
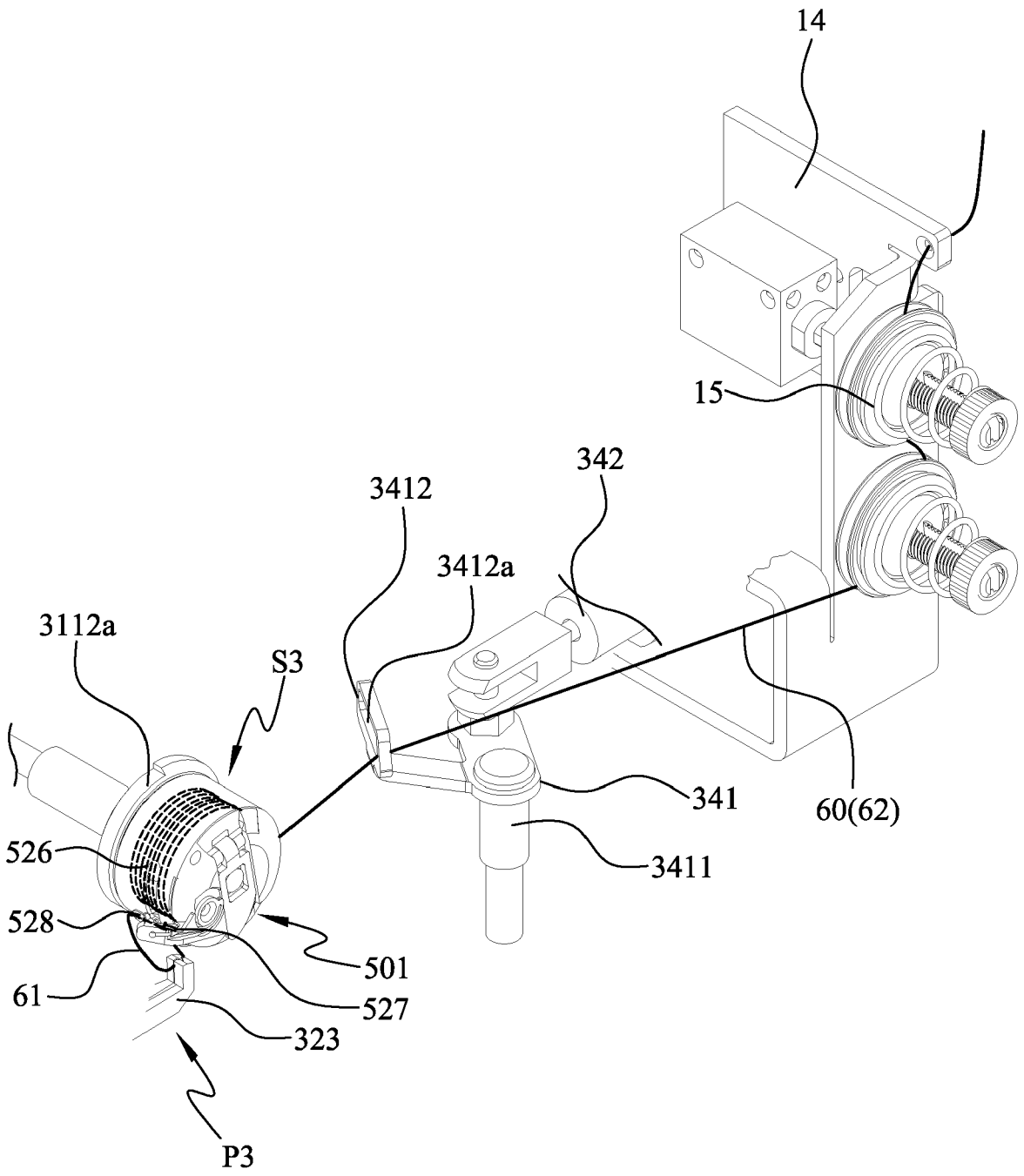


FIG. 17A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60(62)
3411
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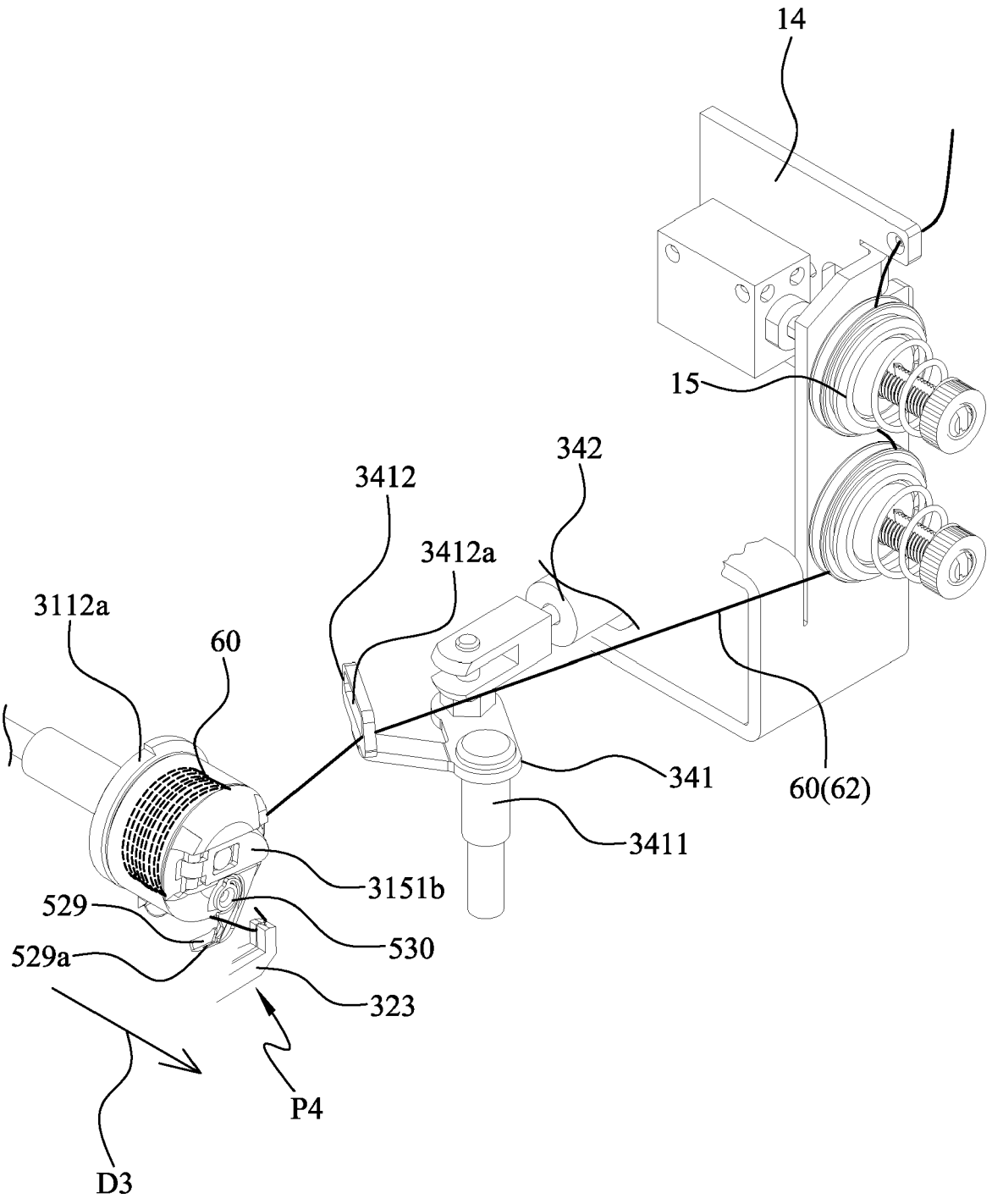
323
P3

FIG. 17B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60(62)
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3151b
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529a
323
P4
D3

FIG. 17C

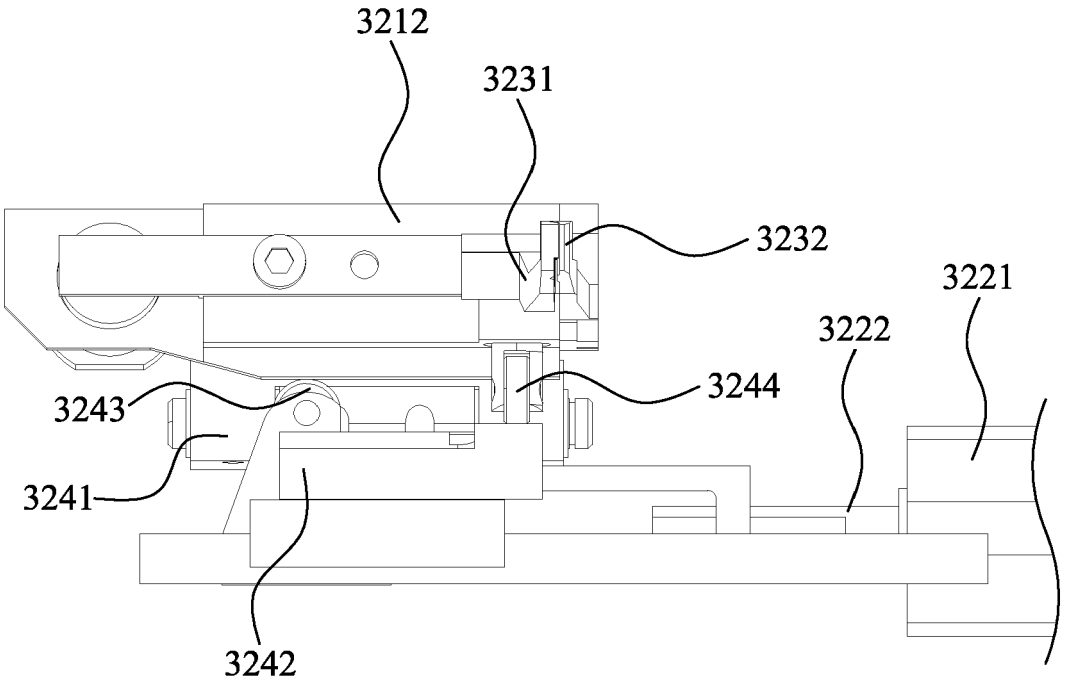
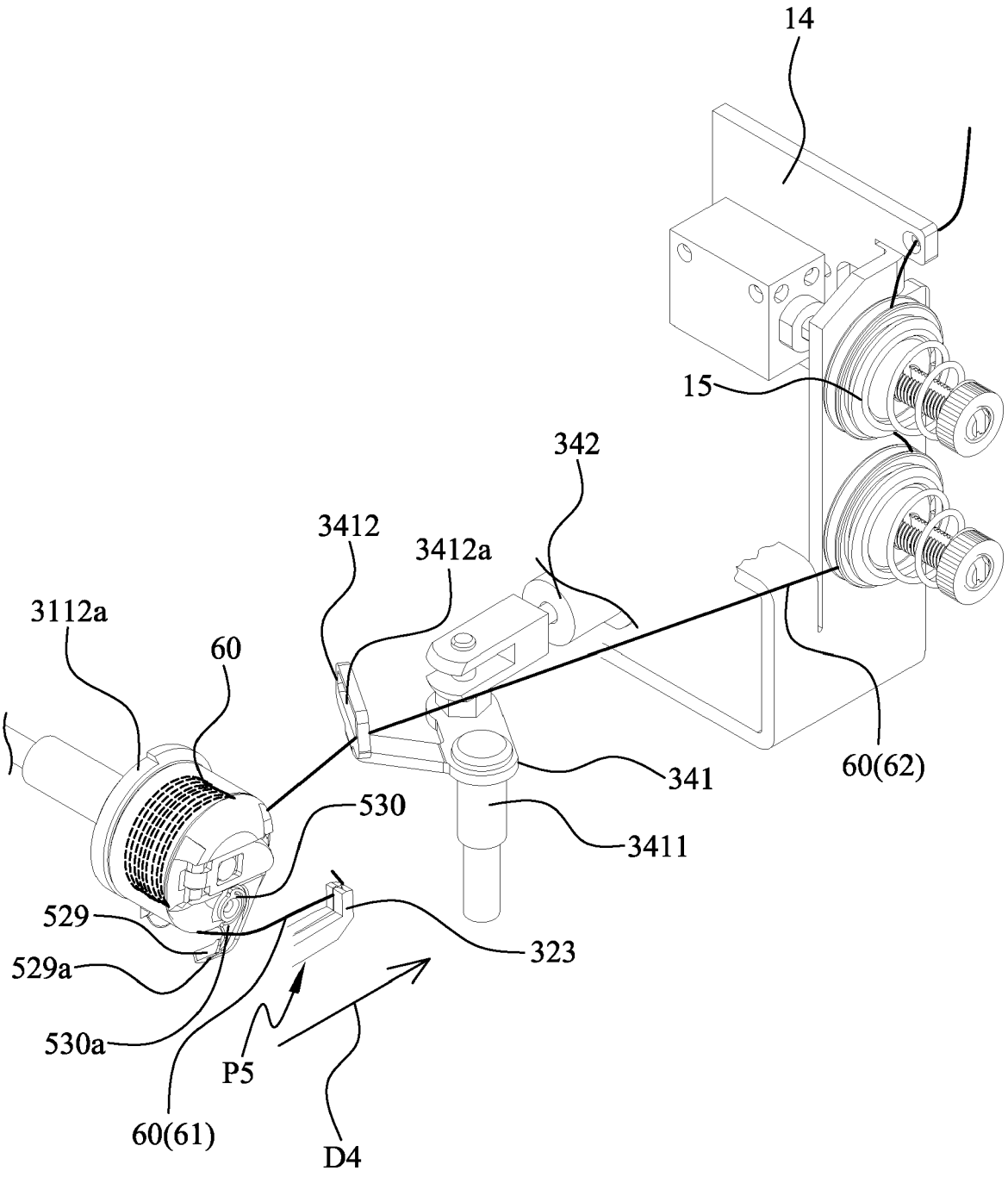


FIG. 17D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60(62)
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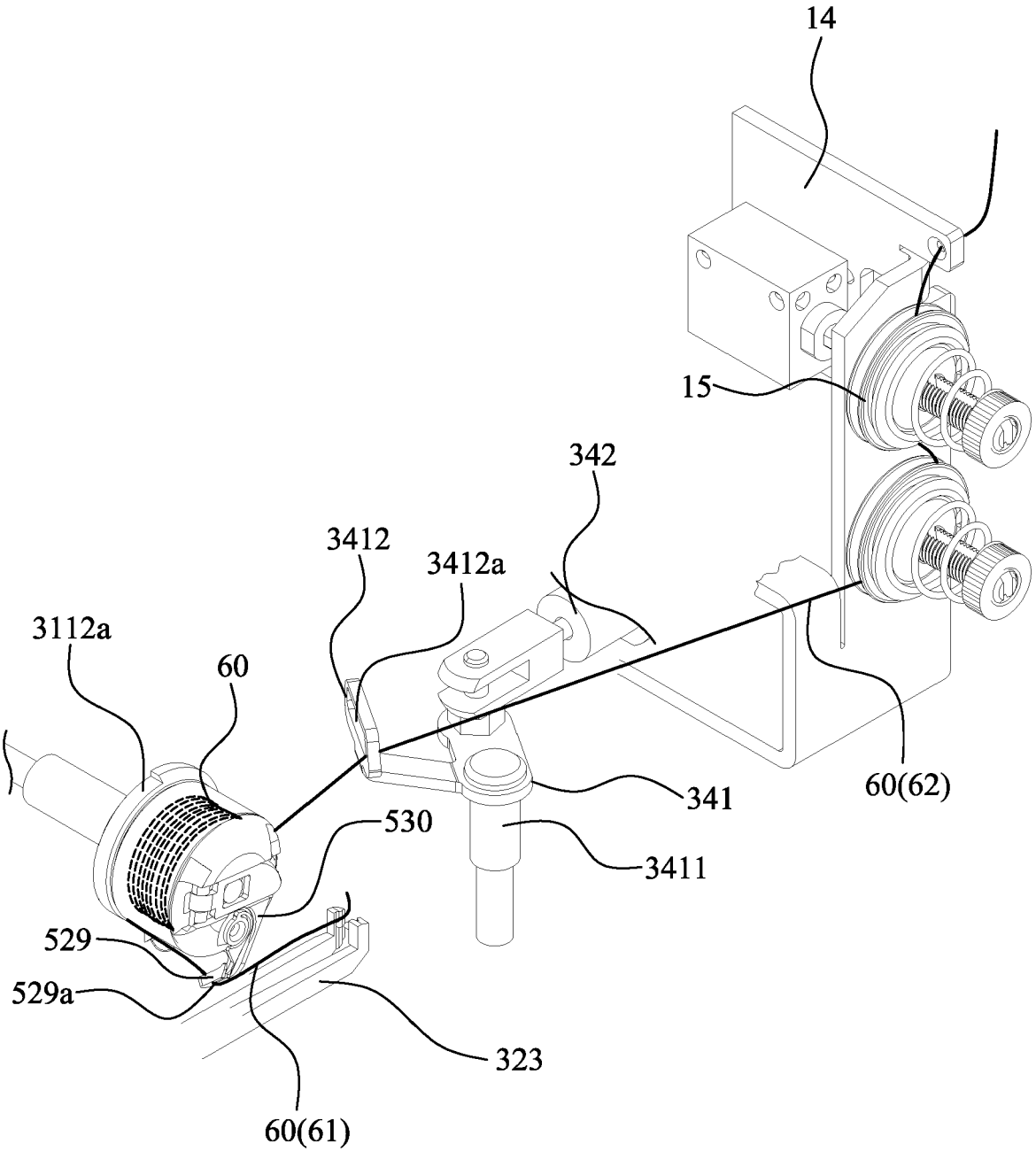
P5
60(61)
D4

FIG. 17E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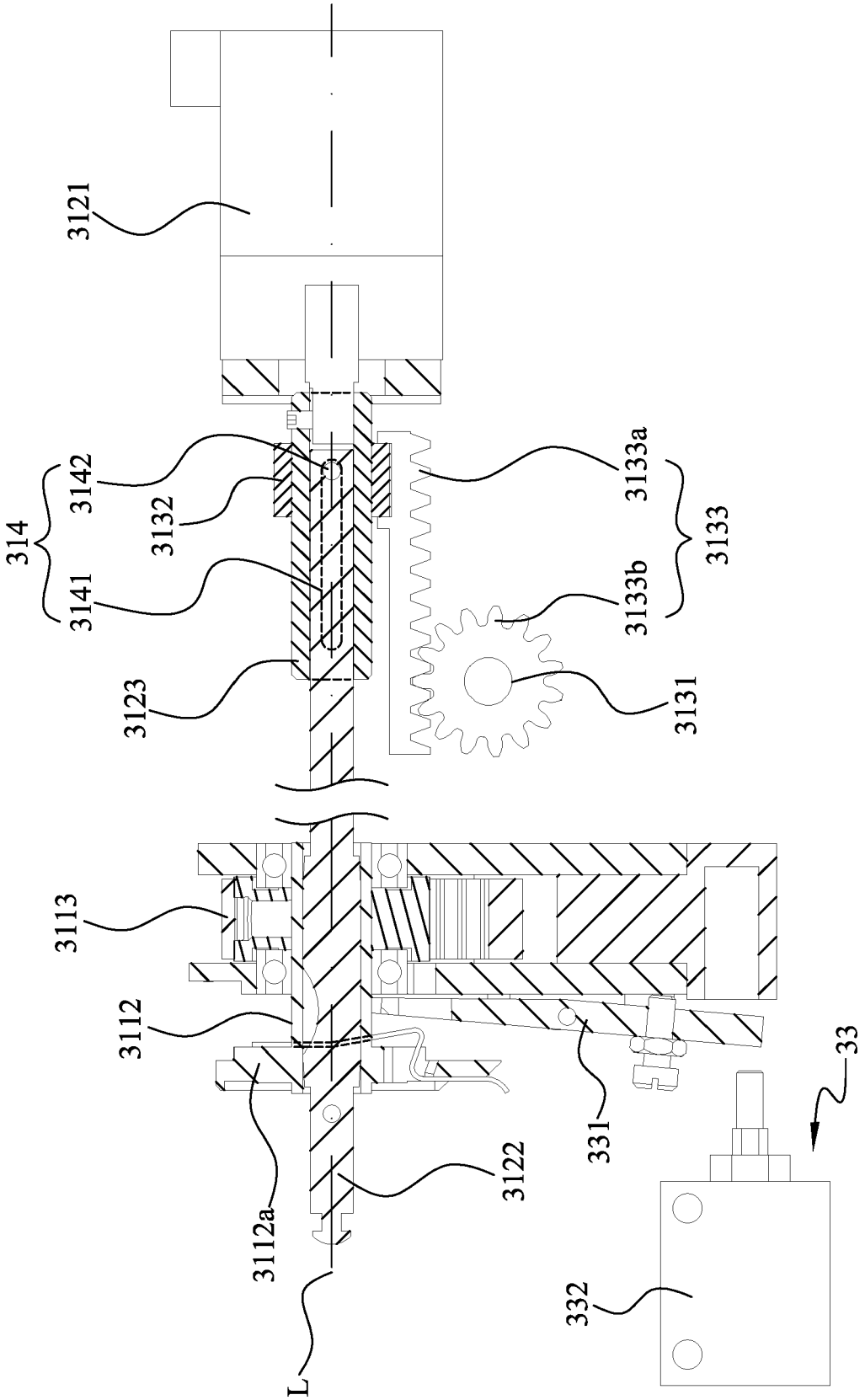
60(61)

FIG. 17F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L

FIG. 18

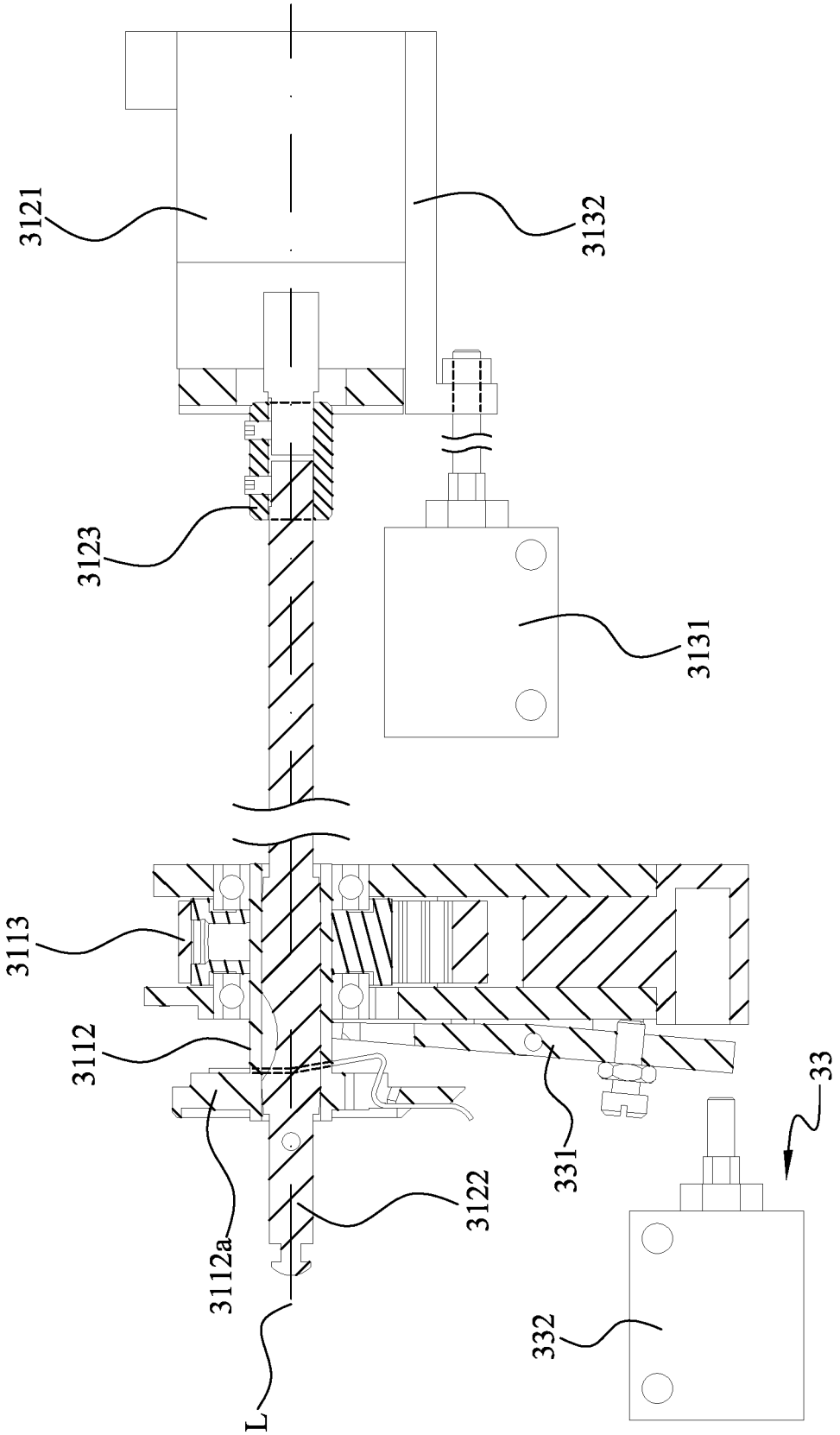

FIG. 19

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EUROPEAN SEARCH REPORT

Application Number
EP 19 21 9695

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 109 662 A (INGER SIEGFRIED [DE]) 5 May 1992 (1992-05-05)	1-3	INV. D05B59/00
A	* column 5, line 39 - column 6, line 3; figures 4, 5 *	4-11	D05B59/04 D05B65/00 D05B65/06
A	US 6 053 119 A (OKUBO TSUTOMU [JP] ET AL) 25 April 2000 (2000-04-25) * column 8, line 13 - line 24; figure 3 *	1-11	B65H73/00
A	US 5 694 874 A (NAKAMURA MASAO [JP] ET AL) 9 December 1997 (1997-12-09) * column 9, line 52 - column 10, line 14; figures 41, 42 *	1-11	
A	DE 27 43 668 A1 (FAEHNRICH KURT) 5 April 1979 (1979-04-05) * the whole document *	1,5,6	

TECHNICAL FIELDS SEARCHED (IPC)

D05B
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 August 2020	Braun, Stefanie

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06-08-2020

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