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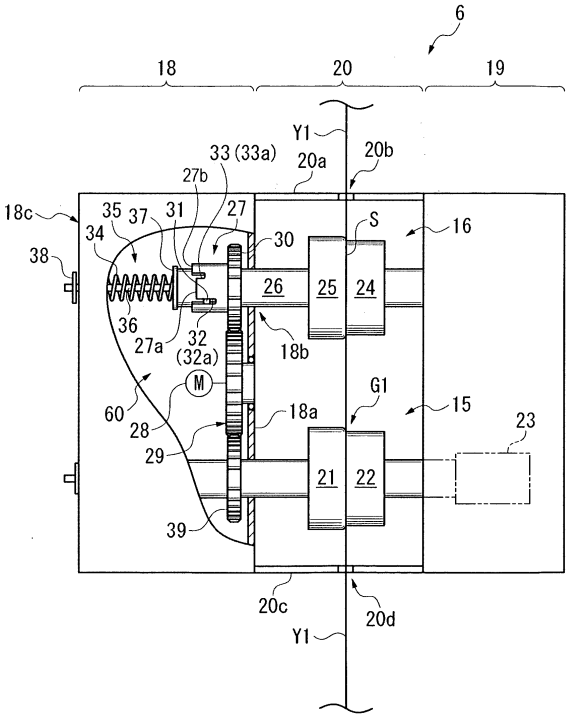
(54) Tension applying device

(57) A tension applying device has a fixed disc 24 and a movable disc 25 provided close to the fixed disc 24, and includes a plurality of tension applying portions 15, 16 that slide a traveling yarn Y1 between the fixed disc 24 and the movable disc 25 to apply tension to the yarn Y1. At least any one of the plurality of tension applying portions 15, 16, for example, the tension applying portion 16, includes a compression coil spring 34 on the movable disc 25 side and is configured such that action of the compression coil spring 34 biases said movable disc 25 toward said fixed disc 24. The tension applying device further includes a switching means 60 for switching the tension applying portion 16 between an operative state in which the tension applying portion 16 applies tension to the yarn Y1 and an inoperative state in which the tension applying portion 16 applies no tension to the yarn Y1 (Fig.2).

FIGURE 2



EP 1 975 105 A2

Description

Field of the Invention

[0001] The present invention relates to a tension applying device that applies a predetermined tension to a traveling yarn.

Description of Related Art

[0002] In general, in a winding unit of an automatic winder, a yarn unwound from a supplying package is subjected to a desired tension by a disc tenser and then wound into a winding package. The disc tensor comprises plural pairs of opposite discs and the number of pairs of discs contacted with the yarn is increased or reduced depending on the tension applied to the yarn. The number of the disc pairs is increased or reduced by, for example, mounting or removing the discs themselves, or where the paired opposite discs are configured to be moved closer to each other by the action of elastic bodies, mounting or removing the elastic bodies. Alternatively, where the paired opposite discs are configured to be moved closer to each other by the action of an air cylinder, the number of the disc pairs is increased or reduced by controlling the air cylinder such that the discs are moved forward or backward. Disc tensers of this kind are disclosed in, for example, the Unexamined Japanese Utility Model Application Publication (Jikkai-Hei) No. 7-33982 and the Unexamined Japanese Patent Application Publication (Tokkai-Hei) No. 10-297825.

[0003] The disc tensor according to the Unexamined Japanese Utility Model Application Publication (Jikkai-Hei) No. 7-33982 comprises disc right portions 5a, 6a that perform a rotating operation under the effect of a tenser motor M and disc left portions 5b, 6b that contact the disc right portions 5a, 6a to perform a rotating operation in conjunction with the disc right portions 5a, 6a.

[0004] The tenser motor M operates the disc right portions 5a, 6a such that the disc right portions 5a, 6a are swingable toward the disc left portions 5b, 6b (in a C direction in Figure 2) and the disc left portions 5b, 6b are thus pivotable around a shaft 16.

[0005] With the disc tensor according to the Unexamined Japanese Patent Application Publication (Tokkai-Hei) No. 10-297825, one of two discs, that is, a disc t2 is operated by a fluid cylinder 9 and cooperates with the other disc t2' in sandwiching a single yarn y between the discs t2, t2' to apply tension to the yarn y. The Unexamined Japanese Patent Application Publication (Tokkai-Hei) No. 10-297825 describes that the appropriate operation of the fluid cylinder 9 allows the selection between an operative position where tension is applied to the single yarn y and a standby position where no tension is applied to the single yarn y.

BRIEF SUMMARY OF THE INVENTION

[0006] However, in the Unexamined Japanese Utility Model Application Publication (Jikkai-Hei) No. 7-33982, the disc tenser is configured such that the tenser motor M causes swinging in the C direction to control the tension applied to the yarn. It is thus difficult to accurately control the tension. Furthermore, in the Unexamined Japanese Patent Application Publication (Tokkai-Hei) No. 10-297825, the configuration with the fluid cylinder transmits vibration of a compressor to the yarn. This makes it difficult to stably apply a fixed tension to the yarn. Additionally, the mounting and removal of the discs themselves and the mounting and removal of the elastic bodies require much time and effort and may result in loss of parts.

[0007] The present invention is made in view of these points. A main object of the present invention is to provide a tension applying device which can apply a fixed tension to the yarn and which enables switching to a state in which no tension is applied to the yarn.

[0008] Problems to be solved by the present invention have been described. Now, a description will be given of means for solving these problems and the effects of the means.

[0009] According to an aspect of the present invention, a tension applying device configured as follows is provided. That is, the tension applying device has a fixed portion and a movable portion provided close to the fixed portion, and comprises a plurality of tension applying portions that slide a traveling yarn between the fixed portion and the movable portion to apply tension to the yarn.

[0010] At least any one of the plurality of tension applying portions comprises an elastic body on the movable portion side and is configured such that action of the elastic body biases the movable portion toward the fixed portion. The tension applying device further comprises a switching means for switching the tension applying portion between an operative state in which the tension applying portion applies tension to the yarn and an inoperative state in which the tension applying portion applies no tension to the yarn. This configuration provides a tension applying device which can apply a fixed tension to the yarn by the action of the elastic body and which enables switching to the inoperative state.

[0011] Furthermore, the tension applying device is preferably configured as follows. That is, the tension applying portion comprising the switching means has a fixed disc as the fixed portion and a movable disc as the movable portion, and slides the traveling yarn on a mating surface between the fixed disc and the movable disc to apply tension to the yarn. The switching means moves the movable disc forward and backward along a normal direction of the mating surface with respect to the fixed disc. This configuration enables a reduction in the moving distance of the movable disc required for the switching, allowing the tension applying device to be compactly constructed.

[0012] Moreover, the above-described tension applying device is preferably configured as follows. That is, the switching means allows or regulates bias of the movable disc toward the fixed disc.

[0013] Moreover, the above-described tension applying device is preferably configured as described below. That is, the switching means is configured as follows. A rod with projection is projected from the movable disc toward an opposite side of the fixed disc side. The rod with projection is inserted into a cylinder subjected to regulation of movement in an axial direction. A bias allowing groove and a bias regulating groove are formed on the cylinder in different places in a circumferential direction; the bias allowing groove and the bias regulating groove have different lengths and extend from an end of the cylinder which is farther from the fixed disc side, toward the fixed disc side.

[0014] A projecting portion formed to be accommodatable in the bias allowing groove or the bias regulating groove is provided on an outer peripheral surface of the rod with projection. When the projecting portion is accommodated in the bias allowing groove, the movable disc can abut against the fixed disc. On the other hand, when the projecting portion is accommodated in the bias regulating groove, the projecting portion engages an end of the fixed disc side of the bias regulating groove to prevent the movable disc from abutting against the fixed disc. This configuration enables the operative state and the inoperative state to be switched simply by moving the movable disc in a direction in which the movable disc is separated from the fixed disc, against the force of the elastic body and rotating the movable disc. Then, in the inoperative state, the application of tension to the yarn is reliably avoided.

[0015] Moreover, the above-described tension applying device is preferably configured as described below. That is, the switching means is configured as follows. A rod with teeth is projected from the movable disc toward an opposite side of the fixed disc side. A bias transmitting rod is interposed between the rod with teeth and the elastic body. The rod with teeth is relatively non-rotatably inserted into a cylinder subjected to regulation of movement in the axial direction. A bias allowing groove and a bias regulating groove are formed on the cylinder in different places in a circumferential direction; the bias allowing groove and the bias regulating groove have different lengths and extend from an end of the cylinder which is farther from the fixed disc side, toward the fixed disc side. A projecting portion formed to be accommodatable in the bias allowing groove or the bias regulating groove is provided on the bias transmitting rod. When the projecting portion is accommodated in the bias allowing groove, a bias force applied to the bias transmitting rod by the elastic body is transmitted to the rod with teeth to allow the movable disc to be biased toward the fixed disc. On the other hand, when the projecting portion is accommodated in the bias regulating groove, the projecting portion engages the edge of the fixed disc side of the bias regulating groove to prevent the bias force applied to the bias transmitting rod by the elastic body from being transmitted to the rod with teeth. This regulates the bias of the movable disc toward the fixed disc. Moreover, an inclined surface is formed at an end of the rod with teeth which is farther from the fixed disc; the inclined surface engages the projecting portion of the bias transmitting rod to rotate the bias transmitting rod in a predetermined direction. This configuration enables the operative state and the inoperative state to be switched simply by moving the movable disc in the direction in which the movable disc is separated from the fixed disc, against the force of the elastic body.

[0016] Moreover, the above-described tension applying device is preferably configured as follows. That is, the elastic body is a compression coil spring and is configured such that a self elastic restoring force of the compression coil spring biases the movable disc toward the fixed disc. The switching means is configured as follows. The switching means includes the compression coil spring, a spring rod which is inserted into an insertion hole formed in a housing of the tension applying device and which is inserted into an inner peripheral side of the compression coil spring, a spring receiver which is secured to one end of the fixed disc side of the spring rod and which cooperates with the housing in sandwiching the compression coil spring between the spring receiver and the housing, a slip-out preventing member secured to the other end of the spring rod to prevent the spring rod from slipping out from the housing toward the fixed disc side, and an interposing member that is insertable between the housing and the slip-out preventing member. When the interposing member is not inserted between the housing and the slip-out preventing member, the compression coil spring is allowed to stretch freely. When the interposing member is inserted between the housing and the slip-out preventing member, free stretching of the compression coil spring is regulated. This configuration enables the operative state and the inoperative state to be switched simply by moving the movable disc in the direction in which the movable disc is separated from the fixed disc, against the force of the elastic body and inserting the interposing member between the housing and the slip-out preventing member.

[0017] Moreover, the above-described tension applying device is preferably configured as follows. That is, in the inoperative state, the movable disc is always separate from the fixed disc by at least a predetermined distance. This configuration reliably avoids the application of tension to the yarn in the inoperative state.

[0018] Other features, elements, processes, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of preferred embodiments of the present invention with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Figure 1 is a schematic diagram of a winding unit of an automatic winder according to a first embodiment of the present invention.

Figure 2 is a partly sectional elevation view of a disc tenser according to the first embodiment of the present invention.

Figure 3 is a diagram showing that a tension applying portion is switching from an operative state to an inoperative state.

Figure 4 is a diagram showing that the tension applying portion has switched to the inoperative state.

Figure 5 is a partly sectional elevation view of disc tenser according to a second embodiment of the present invention.

Figure 6 is a development showing a cooperative relationship between a rod with teeth and a bias transmitting rod and a rod driving cylinder.

Figure 7 is a development showing the cooperative relationship between the rod with teeth and the bias transmitting rod and the rod driving cylinder.

Figure 8 is a partly sectional elevation view of a disc tenser according to a third embodiment of the present invention.

Figure 9 is a diagram showing that the tension applying portion has switched to the inoperative state.

Figure 10 is a side view of the disc tenser as viewed in the direction of arrow A in Figure 8.

Figure 11 is a partly sectional view showing a coupling structure between the rod with teeth and the bias transmitting rod.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] A first embodiment of the present invention will be described below with reference to the drawings. Figure 1 is a schematic diagram of a winding unit of an automatic winder according to a first embodiment of the present invention.

[0021] In the present embodiment, the automatic winder is composed of a plurality of winding units 1, 1, ... arranged in a line, and one of the winding units 1, 1, ... is shown in Figure 1. Each of the winding units 1 winds a spun yarn Y unwound from a supplying bobbin B, around a winding bobbin Bf while traversing the spun yarn Y, to form a package P of a predetermined shape.

[0022] The winding unit 1 comprising a cradle 2 that grips the winding bobbin Bf and a traversing drum 3 that traverses the spun yarn Y. The cradle 2 is swingable in a direction in which the cradle 2 moves closer to or away from the traversing drum 3. Thus, the package P, formed by winding the spun yarn Y around the winding bobbin Bf, is contacted with or separated from the traversing drum 3. The cradle 2 also has a lift-up mechanism 2a attached thereto and which lifts the cradle 2 when the yarn breaks to separate the package P from the traversing drum 3, and a package brake mechanism 2b also attached thereto and which stops rotation of the package P gripped by the cradle 2, simultaneously with the lift-up of the cradle 2.

[0023] A spiral traversing groove 3a is formed on a peripheral surface of the traversing drum 3 to traverse the spun yarn Y. Furthermore, the winding unit 1 has a unwinding auxiliary device 4, a yarn feeler 5, a disc tenser 6 (tension applying device), a disc splicer 7 (yarn splicing device), and a yarn clearer 8 arranged in a yarn traveling path between the supplying bobbin B and the traversing drum 3 in this order from the supplying bobbin B side.

[0024] The unwinding auxiliary device 4 lowers a cylinder covering a core tube simultaneously with the unwinding of the yann Y from the supplying bobbin B, to assist the unwinding of the yarn from the supplying bobbin B. The yarn feeler 5 detects the presence or absence of the spun yarn Y between the unwinding auxiliary device 4 and the disc tenser 6. The disc tenser 6 applies a predetermined tension to the traveling spun yarn Y.

[0025] When the yarn is cut owing to a detected yarn defect or the yarn breaks during unwinding, the disc splicer 7 splices a lower yarn Y1 as a supplying bobbin B side spun yarn and an upper yarn Y2 as a package P side spun yarn. The yarn clearer 8 detects a defect in the spun yarn Y. A signal from the clearer 8 corresponding to the thickness of the spun yarn Y is processed by an appropriate analyzer to detect a yarn defect such as slab. Furthermore, the clearer 8 has a yarn cutting cutter 8a used when a yarn defect is detected.

[0026] A lower yarn capturing and guiding means 11 is provided below the disc splicer 7, and an upper yarn capturing and guiding means 12 is provided above the disc splicer 7, respectively; the lower yarn capturing and guiding means 11 captures and guides the lower yarn Y1 of the supplying bobbin B side, and the upper yarn capturing and guiding means 12 captures and guides the upper yarn Y2 of the package P side. With this configuration, when the yarn is cut or breaks, a suction mouth 11a of the lower yarn capturing and guiding means 11 captures the lower yarn Y1 at a position shown in Figure 1, and the suction mouth 11a then turns around a shaft 11b from below to above to guide the lower yarn Y1 to the disc splicer 7. At the same time, a suction mouth 12a of the upper yarn capturing and guiding means 12 turns around a shaft 12b at a position shown in Figure 1 from below to above to capture the upper yarn Y2 from the reversing package P. Moreover, the suction mouth 12a turns around the shaft 12b from above to below to guide the upper yarn Y2 to the disc splicer 7.

[0027] Now, the configuration of the above-described disc tensor 6 will be described in detail. Figure 2 is a partly sectional elevation view of the disc tensor 6 according to a first embodiment of the present invention.

[0028] As shown in Figure 2, the disc tensor 6 comprises tension applying portions 15, 16 that apply tension

to the traveling yarn Y1. The tension applying portion 15 and the tension applying portion 16 are rotatably supported in a housing of the disc tensor 6 in a horizontal state so as to lie in this order along a traveling direction of the yarn Y1 shown by a thick arrow, and rotating shafts of the tension applying portions 15, 16 are parallel to each other. The housing is composed of a first box member 18 and a second box member 19 arranged in this order (from the left of Figure 2) along an extending direction of the tension applying portions 15, 16. A yarn traveling space 20 is formed between the first box member 18 and the second box member 19 so that the yarn Y1 travels in the yarn traveling space 20. An insertion hole 20b in which the yarn Y1 is inserted is formed in an upper flange 20a which constitutes a part of the housing and which defines an upper part (a downstream side of the yarn Y1) of the yarn traveling space 20. Similarly, an insertion hole 20d in which the yarn Y1 is inserted is formed in a lower flange 20c which constitutes a part of the housing and which defines a lower part (an upstream side of the yarn Y1) of the yarn traveling space 20.

[0029] A description will be given of the structure of one of the above-described tension applying portions 15, 16 which is disposed on the upstream side of the yarn Y1, that is, the tension applying portion 15. The tension applying portion 15 has a fixed disc 21 (fixed portion) and a movable disc 22 (movable portion) provided close to the fixed disc 21. Furthermore, the tension applying portion 15 slides the traveling yarn Y1 between the fixed disc 21 and the movable disc 22 to apply tension to the yarn Y1. The fixed disc 21 is rotatably supported so as to be subjected to regulation of movement in an axial direction with respect to the first box member 18. On the other hand, the movable disc 22 is rotatably supported so as to be allowed to move in the axial direction with respect to the second box member 19. The latter movable disc 22 is connected to a solenoid 23 schematically shown by an alternate long and two short dashes line in Figure 2. The solenoid 23 operates and moves the movable disc 22 in the axial direction to adjust the gap G1 between the fixed disc 21 and the movable disc 22. The tension applied to the yarn Y1 by the tension applying portion 15 is determined by the size of the gap G1.

[0030] Now, a description will be given of the structure of one of the above-described tension applying portions 15, 16 which is disposed on the downstream side of the yarn Y1, that is, the tension applying portion 16. The tension applying portion 16 has a fixed disc 24 (fixed portion) and a movable disc 25 (movable portion) provided close to the fixed disc 24. Furthermore, the tension applying portion 16 slides the traveling yarn Y1 between the fixed disc 24 and the movable disc 25 to apply tension to the yarn Y1. The fixed disc 24 is rotatably supported so as to be subjected to regulation of movement in the axial direction with respect to the second box member 19. On the other hand, the movable disc 25 is rotatably supported so as to be allowed to move in the axial direction with respect to the first box member 18 (that is, the movable disc 25 is movable forward and backward along a normal direction of a mating surface S between the fixed disc 24 and the movable disc 25).

[0031] The structure of the movable disc 25-side of the tension applying portion 16 will be specifically described.

[0032] That is, a rod with projection 26 extending to the interior of the first box member 18 is projected from the movable disc 25 toward the opposite side of the fixed disc 24 side. The rod with projection 26 is supported by being inserted into a rod support hole 18b formed in a disc side wall 18a of the first box member 18 and a rod driving cylinder 27 (cylinder) rotatably supported so as to be subjected to regulation of movement in the axial direction. The rod driving cylinder 27 transmits the power of a first power transmitting gear 29 rotationally driven by a schematically shown electric motor 28, to the rod with projection 26. A second power transmitting gear 30 that meshes with the first power transmitting gear 29 is formed around an outer peripheral surface of the rod driving cylinder 27. Moreover, a bias allowing groove 32 and a bias regulating groove 33 are engraved on the outer peripheral surface of the rod driving cylinder 27 in different places in a circumferential direction; the bias allowing groove 32 and the bias regulating groove 33 have different lengths and extend from an end 27b of the rod driving cylinder 27 which is farther from the fixed disc 24 side, toward the fixed disc 24 side. A projecting portion 31 formed to be accommodatable in the bias allowing groove 32 or the bias regulating groove 33 is provided on the outer peripheral surface of the rod with projection 26. The bias allowing groove 32 and the bias regulating groove 33 extend from a base end (the end located farther from the fixed disc 24 side; this also applies to the description below) of the rod driving cylinder 27 as a start point toward a leading end (an end located closer to the movable disc 25; this also applies to the description below) of the rod driving cylinder 27. The extending length of the bias allowing groove 32 is greater than that of the bias regulating groove 33. In the present embodiment, as viewed in the axial direction of the rod driving cylinder 27, the angle between the bias allowing groove 32 and the bias regulating groove 33 is about 90 degrees. Moreover, a base end portion 27a as a portion of the rod driving cylinder 27 which is sandwiched between the bias allowing groove 32 and the bias regulating groove 33 is formed by uniform cutting in the circumferential direction. In short, the base end portion 27a of the rod driving cylinder 27 is shaped generally like the letter U by means of cutting, as viewed in a radial direction. The projecting portion 31 is accommodated in the bias allowing groove 32 or the bias regulating groove 33 so as to be prevented from moving relatively in the circumferential direction. This regulates the relative rotation between the rod driving cylinder 27 and the rod with projection 26. When the projecting portion 31 is accommodated in the bias allowing groove 32, the movable disc 25 can abut against the fixed disc 24. On the other hand, when the projecting portion 31 is accommodated in the bias regulating groove 33,

the projecting portion 31 engages an edge 33a of the fixed disc 24 side of the bias regulating groove 33 to prevent the movable disc 25 from abutting against the fixed disc 24.

[0033] An elastic portion 35 including a compression coil spring 34 (elastic body) is interposed between the rod with projection 26 inserted into an inner peripheral side of the rod driving cylinder 27 and an outer wall 18c of the first box member 18. The elastic portion 35 is composed of the compression coil spring 34, a spring rod 36 inserted into an insertion hole (not shown in the drawings) formed in the outer wall 18c (the housing of the disc tenser 6) and inserted into an inner peripheral side of the compression coil spring 34, a spring receiver 37 secured to one end of the fixed disc 24 side of the spring rod 36 and cooperating with the outer wall 18c in sandwiching the compression coil spring 34 between the spring receiver 37 and the outer wall 18c, and a slip-out preventing member 38 secured to the other end of the spring rod 36 to prevent the spring rod 36 from slipping out from the outer wall 18c toward the fixed disc 24 side. In a state shown in Figure 2 (the state in which the tension applying portion 16 of the disc tenser 6 applies tension to the yarn Y1), the compression coil spring 34 is sandwiched between the base end side of the outer wall 18c and the leading end side of the spring receiver 37, and thus compressed in the axial direction. The spring rod 36 extends through the outer wall 18c of the first box member 18 to the exterior of the first box member 18.

[0034] The slip-out preventing member 38 is secured to the part of the spring rod 36 which extends to the exterior to prevent the elastic portion 35 from slipping out toward the leading end. The spring receiver 37 abuts slidably against the base end of the rod with projection 26. In the above-described configuration, the tension applying portion 16 comprises the compression coil spring 34 on the movable disc 25 side. In this configuration, the self elastic restoring force (action) of the compression coil spring 34 causes the movable disc 25 to be biased toward the fixed disc 24. That is, the compressed compression coil spring 34 biases the rod with projection 26 toward the fixed disc 24 side via the spring receiver 37. The movable disc 25, formed at the leading end of the rod with projection 26, is biased toward the fixed disc 24. Tension is thus applied to the yarn Y1 sliding between the movable disc 25 and the fixed disc 24.

[0035] Now, a description will be given of a switching mechanism 60 (switching means) that switches the tension applying portion 16 between the operative state in which the tension applying portion 16 applies tension to the yarn Y1 and the inoperative state in which the tension applying portion 16 applies no tension to the yarn Y1. See Figures 3 and 4. Figure 3 shows that the tension applying portion is switching from the operative state to the inoperative state. Figure 4 shows that the tension applying portion has been switched to the inoperative state. The switching mechanism 60 mainly comprises the rod with projection 26, the rod driving mechanism 27, the projecting portion 31, the bias allowing groove 32, and the bias regulating groove 33, described above.

[0036] Figure 2 shows the operative state of the tension applying portion 16. In the operative state, the projecting portion 31 is accommodated in the bias allowing groove 32, which is formed to be long in the axial direction. The distance from the mating surface S between the fixed disc 24 and the movable disc 25 to the projecting portion 31 is greater than that from the mating surface S between the fixed disc 24 and the movable disc 25 to an edge 32a of the fixed disc 24 side of the bias allowing groove 32. Consequently, the movable disc 25 can abut against the fixed disc 24, and the projecting portion 31 is prevented from abutting against the edge 32a of the fixed disc 24 side of the bias allowing groove 32. As a result, the bias force applied to the rod with projection 26 by the compressed compression coil spring 34 is transmitted to the fixed disc 24. That is, the bias force is allowed to act on the movable disc 25, which is thus biased toward the fixed disc 24. This applies tension to the yarn Y1 sliding between the movable disc 25 and the fixed disc 24.

[0037] To switch the tension applying portion 16 from the operative state shown in Figure 2 to the inoperative state shown in Figure 4, first, the movable disc 25 is gripped and pushed in by a predetermined amount in a direction in which the movable disc 25 is separated from the fixed disc 24, against the elastic force of the compression coil spring 34, as shown in Figure 3. Then, the projecting portion 31 slips out from the bias allowing groove 32, having an opening on the base end side, toward the base end. This allows the rod with projection 26 and the rod driving cylinder 27 to rotate relatively (in Figure 2, the projecting portion 31 in this condition is shown by a dashed line). Second, the gripped movable disc 25 is rotated in a direction shown by a thick line in Figure 2 so as to position the projecting portion 31 on an extension of the bias regulating groove 33 in a direction in which the bias regulating groove 33 is engraved. At this time, since the base end portion 27a is formed by uniform cutting in the circumferential direction, the movable disc 25 (the rod with projection 26) rotates smoothly with respect to the rod driving cylinder 27. Moreover, it is easy to get a feeling that the projecting portion 31 abuts against an edge of the bias regulating groove 33. Third, the operation of pushing in the movable disc 25 in the direction in which the movable disc 24 is separated from the fixed disc 24 is stopped. Then, as shown in Figure 4, the action of the compression coil spring 34 in a compressed state moves the rod 26 with the projection toward the fixed disc 24 side. In conjunction with this, the projecting portion 31 enters the bias regulating groove 33. Then, the projecting portion 31 engages the edge 33a of the fixed disc 24 side of the bias regulating groove 33 before the movable disc 25 abuts against the fixed disc 24 (that is, before the gap G2 between the movable disc 25 and the fixed disc 24 disappears). The bias of the movable disc 25 toward the fixed disc 24 is regulated by

the engagement between the projecting portion 31 and the edge 33a of the fixed disc 24 side of the bias regulating groove 33 in the axial direction. Thus, even after the movable disc 25 is ungripped, the gap G2 between the fixed disc 24 and the movable disc 25 is maintained. Therefore, the tension applying portion 16 is bought into the inoperative state in which the tension applying portion 16 does not (cannot) apply any tension to the yarn Y1.

[0038] With reference to Figures 2 to 4, a description has been given of the structure and operation of the switching mechanism 60. which switches the tension applying portion 16 from the operative state to the inoperative state. To switch the tension applying portion 16 from the inoperative state to the operative state, the movable disc 25 is gripped and pushed in the direction in which the movable disc 25 is separated from the fixed disc 24 as shown in Figure 4, and the movable disc 25 is rotated in a direction opposite to that shown by a thick line in Figure 3. Subsequently, the movable disc 25 may be ungripped.

[0039] In the present embodiment, the movable disc 25 and the fixed disc 24 are rotated in the same direction at the same rotation speed by a mechanism (not shown in the drawings). Similarly, the movable disc 22 and the fixed disc 21 are rotated in the same direction at the same rotation speed by a mechanism (not shown in the drawings). The power of the first power transmitting gear 29, rotationally driven by the electric motor 28, is transmitted to the movable disc 25 via the second power transmitting gear 30. This power is further transmitted to the fixed disc 21 via a third power transmitting gear 39 formed on an outer periphery of the fixed disc 21. Furthermore, when the rod with projection 26 (movable disc 25) rotates, a base end surface of the rod with projection 26 and the spring receiver 37 slide.

[0040] As described above, in the first embodiment, the disc tenser 6 is configured as follows. That is, the disc tenser 6 has the fixed disc 24 (21) and the movable disc 25 (22) provided close to the fixed disc 24 (21), to slide the traveling yarn Y1 between the fixed disc 24 (21) and the movable disc 25 (22). The plurality of tension applying portions 15, 16 are provided which apply tension to the yarn Y1. At least any one tension applying portions 16 of the plurality of tension applying portions 15, 16 comprises the compression coil spring 34 on the movable disc 25 side. The disc tenser 6 is configured such that the self elastic restoring force of the compression coil spring 34 bias the movable disc 25 toward the fixed disc 24. Moreover, the disc tenser 6 comprises the switching mechanism 60, which switches the tension applying portion 16 between the operative state in which the tension applying portion 16 applies tension to the yarn Y1 and the inoperative state in which the tension applying portion 16 applies no tension to the yarn Y1. This configuration provides the disc tensor 6 including the tension applying portion 16 which can apply a fixed tension to the yarn Y1 by the action of the compression coil spring 34 and which enables switching to the inoperative state.

[0041] The disc tensor 6 is further configured as follows. That is, the tension applying portion 16, comprising the switching mechanism 60, has the fixed disc 24 and the movable disc 25. The tension applying portion 16 slides the yarn Y1 on the mating surface S between the fixed disc 24 and the movable disc 25 to apply tension to the yarn Y1. The switching mechanism 60 moves the movable disc 25 forward and backward along the normal direction of the mating surface S with respect to the fixed disc 24. This configuration enables a reduction in the moving distance of the movable disc 25 required for the switching, allowing the disc tensor 6 to be compactly constructed.

[0042] The disc tensor 6 is further configured as follows. That is, the switching mechanism 60 allows or regulates the bias of the movable disc 25 toward the fixed disc 24.

[0043] The disc tensor 6 is further configured as described below. That is, the switching means 60 is configured as follows. The rod with projection 26 is projected from the movable disc 25 toward the opposite side of the fixed disc 24 side. The rod with projection 26 is inserted into the rod driving cylinder 27, subjected to regulation of movement in the axial direction. The bias allowing groove 32 and the bias regulating groove 33 are formed in the different places in the circumferential direction; the bias allowing groove 32 and the bias regulating groove 33 have the different lengths and extend from the end 27b of the rod driving cylinder 27 which is farther from the fixed disc 24 side, toward the fixed disc 24 side. The projecting portion 31 formed to be accommodatable in the bias allowing groove 32 or the bias regulating groove 33 is provided on the outer peripheral surface of the rod with projection 26. When the projecting portion 31 is accommodated in the bias allowing groove 32, the movable disc 25 can abut against the fixed disc 24. On the other hand, when the projecting portion 31 is accommodated in the bias regulating groove 33, the projecting portion 31 engages the edge 33a of the fixed disc 24 side of the bias regulating groove 33 to prevent the movable disc 25 from abutting against the fixed disc 24. This configuration enables the operative state and the inoperative state to be switched simply by moving the movable disc 25 in the direction in which the movable disc 25 is separated from the fixed disc 24, against the force of the compression coil spring 34 and rotating the movable disc 25. Furthermore, in the inoperative state, the application of tension to the yarn Y1 is reliably avoided.

[0044] The first embodiment of the present invention has been described. The first embodiment can be varied as described below.

[0045] That is, although in the first embodiment, the spring receiver 37 abuts slidably against the base end of the rod with projection 26, the present invention is not limited to this. The spring receiver 37 may be bonded to the base end of the rod with projection 26 or molded integrally with the rod with projection 26.

[0046] Now, a second embodiment of the present in-

vention will be described. Figure 5 is a partly sectional elevation view of a disc tenser according to the second embodiment of the present invention. Differences between the present embodiment and the first embodiment will be mainly described.

[0047] In the present embodiment, a rod with teeth 40 is projected from the movable disc 25 toward the opposite end of the fixed disc 24. A bias transmitting rod 41 is interposed between the rod with teeth 40 and the compression coil spring 34, and the rod with teeth 40 is relatively non-rotatably inserted into a rod driving cylinder 42 subjected to regulation of movement in the axial direction. The relatively non-rotatable condition between the rod driving cylinder 42 and the rod with teeth 40 is achieved by a linear groove (not shown in the drawings) engraved on an inner peripheral surface of the rod driving cylinder 42 and extending in the axial direction, and a projection projected from an outer peripheral surface of the rod with teeth 40 and accommodated in the linear groove. The second power transmitting gear 30 is formed on an outer peripheral surface of the rod driving cylinder 42 as is the case with the rod driving cylinder 27, shown in Figure 2. Furthermore, as is the case with the first embodiment, the spring receiver 37 abuts slidably against the base end of the bias transmitting rod 41.

[0048] Although not shown in Figure 5, bias allowing grooves and bias regulating grooves are alternately formed on the rod driving cylinder 42 in the circumferential direction; each of the bias allowing grooves and each of the bias regulating grooves have different lengths and extend from an end 42b of the rod driving cylinder 42 which is farther from the fixed disc 24 side, toward the fixed disc 24 side. In the present embodiment, the bias allowing groove and the bias regulating groove are engraved on the inner peripheral surface of the rod driving cylinder 42. The bias allowing groove and the bias regulating groove will be described below with reference to Figure 6. Figure 6 is a development showing the cooperative relationship between the rod with teeth 40 and the bias transmitting rod 41 and the rod driving cylinder 27.

[0049] As shown in Figure 6, the bias allowing grooves 43, 43, ... and the bias regulating grooves 44, 44, ... are alternately formed on the inner peripheral surface of the rod driving cylinder 42 in the circumferential direction; each of the bias allowing grooves 43 and each of the bias regulating grooves 44 have different lengths and extend from the end 42b that is farther from the fixed disc 24 side, toward the fixed disc 24 side. Each of the bias allowing grooves 43, 43, ... has an axial length that is at least double that of each of the bias regulating grooves 44, 44, ..., and is formed as a parallel groove parallel to the axial direction. Each of the bias regulating grooves 44, 44, ... is shaped generally like a right triangle such that one side surfaces of the groove 44, 44, ... are parallel to the axial direction, while other side surfaces 44a, 44a, ... of the groove 44, 44 are inclined, in the circumferential direction, at 45 degrees to the axial direction.

[0050] The bias transmitting rod 41 has projecting portions 45, 45, ... formed to be accommodatable in the bias allowing grooves 43, 43, ... or the bias regulating grooves 44, 44, ... The projections 45, 45, ... extend parallel to the axial direction from an end 41b of the fixed disc 24 side of the bias transmitting rod 41 toward the fixed disc 24 side. In Figure 6 shows that the projecting portions 45, 45, ... are accommodated in the bias allowing grooves 43, 43, ... Inclined surfaces 45a, 45a, ... that are parallel to the other side surfaces 44a, 44a, ... are formed at leading ends of the projecting potions 45, 45, ...

[0051] An end of the rod with teeth 40 which is farther from the fixed disc 24 side is formed zigzag along the circumferential direction and includes inclined surfaces 40a, 40a, ... that are parallel to the inclined surfaces 45a, 45a, ...

[0052] When the projecting portions 45, 45, ... of the bias transmitting rod 41 are accommodated in the bias allowing grooves 43, 43, ..., a bias force applied to the bias transmitting rod 41 by the compression coil spring 34 is transmitted to the rod with teeth 40 via the inclined surfaces 45a, 45a, ... and the inclined surfaces 40a, 40a, ... This allows the movable disc 25 to be biased toward the fixed disc 24 (see Figure 6A). On the other hand, when the projecting portions 45, 45, ... of the bias transmitting rod 41 are accommodated in the bias regulating grooves 44, 44, ..., the projecting portions 45, 45, ... engage the other side surfaces 44a, 44a, ... (edges) of the fixed disc 24 side of the bias regulating grooves 44, 44, ... to prevent the bias force applied to the bias transmitting rod 41 by the compression coil spring 34 from being transmitted to the rod with teeth 40. This regulates the bias of the movable disc 25 toward the fixed disc 24 (see Figure 7B).

[0053] Now, a description will be given of a switching mechanism 61 (switching means) that switches the tension applying portion 16 between the operative state in which the tension applying portion 16 applies tension to the yarn Y1 and the inoperative state in which the tension applying portion 16 applies no tension to the yarn Y1. See Figures 6 and 7. Figure 6A shows the tension applying portion in the operative state. Figures 6B and 7A show that the tension applying portion is switching from the operative state to the inoperative state. Figure 7B shows that the tension applying portion has been switched to the inoperative state.

[0054] Figure 6A shows the operative state of the tension applying portion 16. In the operative state, the projecting portions 45, 45, ... are accommodated in the bias allowing grooves 43, 43, ..., which are formed to be long in the axial direction. The distance from the mating surface S between the fixed disc 24 and the movable disc 25 to the projecting portions 45, 45, ... is greater than that from the mating surface S between the fixed disc 24 and the movable disc 25 to the other side surfaces 44a, 44a, ... of the fixed disc 24 side side of the bias allowing grooves 43, 43, ... Consequently, the movable disc 25 can abut against the fixed disc 24, and the projecting

portions 45, 45, ... are prevented from abutting against the other side surfaces 44a, 44a, ... of the fixed disc 24 side of the bias allowing grooves 43, 43, ... As a result, the bias force applied to the bias transmitting rod 41 by the compressed compression coil spring 34 is transmitted to the fixed disc 24 via the inclined surfaces 45a, 45a, ... and the inclined surfaces 40a, 40a, ... That is, the bias force is allowed to act on movable disc 25, which is thus biased toward the fixed disc 24. This applies tension to the yarn Y1 sliding between the movable disc 25 and the fixed disc 24.

[0055] To switch the tension applying portion 16 from the operative state shown in Figure 6A to the inoperative state shown in Figure 7B, first, the movable disc 25 is gripped and pushed in by a predetermined amount in a direction (shown by a dashed arrow) in which the movable disc 25 is separated from the fixed disc 24, against the elastic force of the compression coil spring 34, as shown in Figure 6B. Then, the projecting portions 45, 45, ... slip out from the bias allowing grooves 43, 43, ..., each having an opening on the base end side, toward the base end (as shown by a thick arrow). This allows the bias transmitting rod 41 and the rod driving cylinder 42 to rotate relatively. Second, as shown in Figure 7A, the gripped movable disc 25 is pushed in by a predetermined amount in the direction (shown by a dashed arrow) in which the movable disc 25 is further separated from the fixed disc 24. Then, the inclined surfaces 45a, 45a, ... of the projecting portions 45, 45, ... of the bias transmitting rod 41 engage the inclined surfaces 40a, 40a, ... of the rod with teeth 40 to slide along the inclined surfaces 40a, 40a, ... The bas transmitting rod 41 also rotates by a predetermined rotation angle (as shown by a thick arrow). At this time, as viewed in the axial direction, the inclined surfaces 45a, 45a, ... partly overlap the other surfaces 44a, 44a, ... Third, as shown in Figure 7B, the operation of pushing in the movable disc 25 in the direction in which the movable disc 24 is separated from the fixed disc 24 is stopped. Then, the action of the compression coil spring 34 in the compressed state biases the rod with teeth 40 toward the fixed disc 24 side. The bias transmitting rod 41 moves toward the fixed disc 24 side to cause the inclined surfaces 45a, 45a, ... to abut against the other side surfaces 44a, 44a, ... The inclined surfaces 45a, 45a, slide on the other side surfaces 44a, 44a, ... to further rotate the bias transmitting rod 41 by a predetermined rotation angle (as shown by a thick arrow). That is, the projecting portions 45, 45, ... enter the bias regulating grooves 44, 44, ... Regardless of whether or not the movable disc 25 abuts against the fixed disc 24, the projecting portions 45, 45, ... engage the bias regulating grooves 44, 44, .. The bias of the movable disc 25 toward the fixed disc 24 is regulated by the engagement between the projecting portions 45, 45, ... and the other side surfaces 44a, 44a, ... (edges) of the fixed disc 24 side of the bias regulating grooves 44, 44, ... Thus, the tension applying portion 16 is brought into the inoperative state in which the tension applying portion 16 applies no tension to the yarn Y1.

[0056] With reference to Figures 6 and 7, description has been given of the structure and operation of the switching mechanism 61, which switches the tension applying portion 16 from the operative state to the inoperative state. To switch the tension applying portion 16 from the inoperative state to the operative state, the movable disc 25 is gripped and pushed in the direction in which the movable disc 25 is separated from the fixed disc 24 as shown in Figure 7B, and the movable disc 25 is then ungripped.

[0057] As described above, in the second embodiment, the disc tenser 6 is configured as described below. That is, the switching means 61 is configured as follows. The rod with teeth 40 is projected from the movable disc 25 toward the opposite side of the fixed disc 24 side. The bias transmitting rod 41 is interposed between the rod with teeth 40 and the compression coil spring 34. The rod with teeth 40 is relatively non-rotatably inserted into the rod driving cylinder 42 subjected to regulation of movement in the axial direction. The bias allowing grooves 43, 43, ... and the bias regulating grooves 44, 44, ... are formed in the different places in the circumferential direction; the bias allowing grooves 43, 43, ... and the bias regulating grooves 44, 44, ... have the different lengths and extend from the end 42b of the rod driving cylinder 42 which is farther from the fixed disc 24 side, toward the fixed disc 24 side.

[0058] The projecting portions 45, 45, ... formed to be accommodatable in the bias allowing grooves 43, 43, ... or the bias regulating grooves 44, 44, ... are provided on the bias transmitting rod 41. When the projecting portions 45, 45, ... are accommodated in the bias allowing grooves 43, 43, ..., a bias force applied to the bias transmitting rod 41 by the compression coil spring 34 is transmitted to the rod with teeth 40 to allow the movable disc 25 to be biased toward the fixed disc 24. On the other hand, when the projecting portions 45, 45, ... are accommodated in the bias regulating grooves 44, 44, ..., the projecting portions 45, 45, ... engage the other side surfaces 44a, 44a, ... of the bias regulating grooves 44, 44, ... to prevent the bias force applied to the bias transmitting rod 41 by the compression coil spring 34 from being transmitted to the rod with teeth 40. This regulates the bias of the movable disc 25 toward the fixed disc 24. Moreover, the inclined surfaces 40a, 40a, ... are formed at the end of the rod with teeth 40 which is farther from the fixed disc 24; the inclined surfaces 40a, 40a, ... engage the projecting portions 45, 45, ... of the bias transmitting rod 41 to rotate the bias transmitting rod 41 in a predetermined direction. This configuration enables the operative state and the inoperative state to be switched simply by moving the movable disc 25 in the direction in which the movable disc 25 is separated from the fixed disc 24, against the force of the compression coil spring 34.

[0059] The second embodiment of the present invention has been described. The second embodiment can

be varied as described below.

[0060] That is, although in the second embodiment, the spring receiver 37 abuts slidably against the base end of the bias transmitting rod 41, the present invention is not limited to this. The spring receiver 37 may be bonded to the base end of the bias transmitting rod 41 or molded integrally with the bias transmitting rod 41.

[0061] Furthermore, in the inoperative state shown in Figure 7B, the rod with teeth 40 is freely movable forward and backward. Furthermore, the movable disc 25 is formally allowed to abut against the fixed disc 24. At this time, since the bias of the movable disc 25 toward the fixed disc 24 is regulated, the tension applying portion 16 applies no tension to the yarn Y1. However, the above-described second embodiment may be configured as follows. That is, the switching mechanism 61 is configured such that the movable disc 25 is always separated from the fixed disc 24 by at least a predetermined distance in the inoperative state shown in Figure 7B. This configuration reliably avoids applying tension to the yarn Y1 in the inoperative state. This configuration is as shown in, for example, Figure 11. Figure 11 is a partly sectional view showing a coupling structure between the rod with teeth 40 and the bias transmitting rod 41. That is, a locking hole 70 is formed at an axis of the leading end surface of the bias transmitting rod 41; the locking hole 70 extends toward the opposite side of the fixed disc 24 side and has a diameter increasing toward the inside of the bias transmitting rod 41. A locking projection 71 is projected from an axis of the base end surface of the rod with teeth 40; the locking projection 71 extends toward the opposite side of the fixed disc 24 side and has an increased diameter portion 71a at the tip thereof.

[0062] The increased diameter portion 71a of the locking projection 71 is accommodated in the locking hole 70. With this configuration, in the inoperative state shown in Figure 7B, when the rod with teeth 40 advances in a leading end direction, the locking hole 70 engages the increased diameter portion 71a of the locking projection 71 to enable the advancement to be stopped before the movable disc 25 abuts against the fixed disc 24. This makes it possible to provide a configuration in which the movable disc 25 is always separated from the fixed disc 24 by a predetermined distance.

[0063] Now, a third embodiment of the present invention will be described. Figure 8 is a partly sectional elevation view of a disc tensor according to the third embodiment of the present invention. Differences between the present embodiment and the above-described first embodiment will be mainly described below.

[0064] In the first embodiment, the bias allowing groove 32 and the bias regulating groove 33 are engraved on the rod driving cylinder 27. However, in the present embodiment, only the bias allowing groove 32 is engraved on the rod driving cylinder 27. Furthermore, the projecting portion 31, projected from the outer peripheral surface of the rod with projection 26, is always accommodated in the bias allowing groove 32.

[0065] Now, a description will be given of a switching mechanism 62 (switching means) that switches the tension applying portion 16 between the operative state in which the tension applying portion 16 applies tension to the yarn Y1 and the inoperative state in which the tension applying portion 16 applies no tension to the yarn Y1. See Figures 8, 9, and 10. Figure 9 shows that the tension applying portion has been switched to the inoperative state. Figure 10 is a side view of the tension applying portion as viewed in the direction of arrow A in Figure 8. The switching mechanism 62 is mainly composed of the compression coil spring 34, spring rod 36, spring receiver 37, and slip-out preventing member 38, described above, as well as an interposing member 50.

[0066] The interposing member 50 is insertable between the outer wall 18c (housing) and the slip-out preventing member 38. As shown in Figure 10, the interposing member 50 is composed of a linear portion 51 extending from a shaft 50a and a circular arc portion 52 extending from the linear portion 51 like a circular arc. The interposing member 50 is provided on the outer wall 18c so as to be pivotable around the shaft 50a.

[0067] When the interposing member 50 is not inserted between the outer wall 18c and the slid-out preventing member 38 as shown in Figure 8, the compression coil spring 34 is allowed to stretch freely. On the other hand, when the interposing member 50 is inserted between the outer wall 18c and the slid-out preventing member 38 as shown in Figure 9, the free stretching of the compression coil spring 34 is regulated.

[0068] Figure 8 shows the operative state of the tension applying portion 16. In the operative state, the projecting portion 31 is accommodated in the bias allowing groove 32, which is formed to be long in the axial direction. The distance from the mating surface S between the fixed disc 24 and the movable disc 25 to the projecting portion 31 is greater than that from the mating surface S between the fixed disc 24 and the movable disc 25 to the edge 32a of the fixed disc 24 side of the bias allowing groove 32. Consequently, the movable disc 25 can abut against the fixed disc 24, and the projecting portion 31 is prevented from abutting against the edge 32a of the fixed disc 24 side of the bias allowing groove 32. As a result, the bias force applied to the rod with projection 26 by the compressed compression coil spring 34 is transmitted to the fixed disc 24. That is, the bias force is allowed to act on the movable disc 25, which is thus biased toward the fixed disc 24. This applies tension to the yarn Y1 sliding between the movable disc 25 and the fixed disc 24.

[0069] To switch the tension applying portion 16 from the operative state shown in Figure 8 to the inoperative state shown in Figure 9, first, the movable disc 25 is gripped and pushed in by a predetermined amount in a direction in which the movable disc 25 is separated from the fixed disc 24, against the elastic force of the compression coil spring 34. Then, a predetermined amount of gap is formed between the slip-out preventing member

38 and the outer wall 18c. Second, in this condition, the interposing member 50 is caused to pivot in a direction shown by a thick arrow as shown in Figure 10 and is inserted between the outer wall 18c and the slip-out preventing member 38. At this time, the circular arc center of circular arc portion 52 is preferably aligned with the axis of the spring rod 36. Third, the operation of pushing in the movable disc 25 in the direction in which the movable disc 24 is separated from the fixed disc 24 is stopped. Then, as shown in Figure 9, the action of the compression coil spring 34 in the compressed state moves the sprint receiver 37 and the spring rod 36 forward toward the fixed disc 24 side. The slip-out preventing member 38 coupled to the spring rod 36 thus abuts against the interposing member 50. The abutment between the slip-out preventing member 38 and the interposing member 50 regulates the further stretching of the compression coil spring 34.

[0070] With reference to Figures 8 to 10, a description has been given of the structure and operation of the switching mechanism 62, which switches the tension applying portion 16 from the operative state to the inoperative state. To switch the tension applying portion 16 from the inoperative state to the operative state, the movable disc 25 is gripped and pushed in the direction in which the movable disc 25 is separated from the fixed disc 24 as shown in Figure 9, and the interposing member 50 is caused to rotate in the direction opposite to that shown by the thick arrow in Figure 10. Subsequently, the movable disc 25 is ungripped. This substantially allows the compression coil spring 34 to stretch freely.

[0071] As described above, in the third embodiment, the disc tensor 6 is configured as follows. That is, the disc tensor 6 is configured such that the compression coil spring 34 is used as the elastic body and such that the self elastic restoring force of the compression coil spring 34 biases the movable disc 25 toward the fixed disc 24. The switching means 62 is configured as follows. The switching means 62 includes the compression coil spring 34, the spring rod 36 which is inserted into the insertion hole formed in the outer wall 18c and which is inserted into the inner peripheral side of the compression coil spring 34, the spring receiver 37 which is secured to one end of the fixed disc 24 side of the spring rod 36 and which cooperates with the outer wall 18c in sandwiching the compression coil spring 34 between the spring receiver 37 and the outer wall 18c, the slip-out preventing member 38 secured to the other end of the spring rod 36 to prevent the spring rod 36 from slipping out from the outer wall 18c toward the fixed disc 24 side, and the interposing member 50 that is insertable between the outer wall I 18c and the slip-out preventing member 38. When the interposing member 50 is not inserted between the outer wall 18c and the slip-out preventing member 38, the compression coil spring 34 is allowed to stretch freely. When the interposing member 50 is inserted between the outer wall 18c and the slip-out preventing member 38, the free stretching of the compression coil spring 34 is regulated. This configuration enables the operative state and the inoperative state to be switched simply by moving the movable disc 25 in the direction in which the movable disc 25 is separated from the fixed disc 24, against the force of the compression coil spring 34 and inserting the interposing member 50 between the outer wall 18c and the slip-out preventing member 38.

[0072] The third embodiment of the present invention has been described. The third embodiment can be varied as described below.

[0073] That is, although in the third embodiment, the spring receiver 37 abuts slidably against the base end of the rod with projection 26, the present invention is not limited to this. The spring receiver 37 may be bonded to the base end of the rod with projection 26 or molded integrally with the rod with projection 26.

[0074] In the inoperative state shown in Figure 9, the rod with projection 26 is freely movable forward and backward. Furthermore, the movable disc 25 is formally allowed to abut against the fixed disc 24. At this time, since the bias of the movable disc 25 toward the fixed disc 24 is regulated, substantially no tension is applied to the yarn Y1. However, the above-described third embodiment may be configured as follows. That is, the switching mechanism 62 is configured such that the movable disc 25 is always separated from the fixed disc 24 by at least a predetermined distance in the inoperative state shown in Figure 9. This configuration reliably avoids applying tension to the yarn Y1 in the inoperative state. This configuration is as shown in, for example, Figure 11. That is, in this configuration, the locking hole 70 is formed at the axis of the base end surface of the rod with projection 26, and the locking projection 71 is projected from the leading end surface (the surface located closer to the fixed disc 24 side) of the spring receiver 37.

[0075] While the present invention has been described with respect to preferred embodiments thereof, it will be apparent to those skilled in the art that the disclosed invention may be modified in numerous ways and may assume many embodiments other than those specifically set out and described above. Accordingly, it is intented by the appended claims to cover all modifications of the present invention that fall within the true spirit and scope of the invention.

Claims

1. A tension applying device (6) having a fixed portion (21) and a movable portion (22) provided close to said fixed portion (21), and comprising a tension applying portion (16) that slides a traveling yarn between said fixed portion (21) and said movable portion (22) to apply tension to the yarn, said tension applying device being **characterized in that** a plurality of said tension applying portions (16) are provided and at least any one of the plurality of said tension applying portions (16) comprises an elastic body (34) on said movable portion (22) side and is

configured such that action of said elastic body (34) biases said movable portion (22) toward said fixed portion (21), and **in that** said tension applying device further comprises a switching means (60) for switching said tension applying portion (16) between an operative state in which said tension applying portion applies tension to the yarn and an inoperative state in which said tension applying portion applies no tension to the yarn.

2. A tension applying device (6) according to Claim 1, **characterized in that** said tension applying portion (16) comprising said switching means (60) has a fixed disc (21) as said fixed portion (21) and a movable disc (22) as said movable portion (22), and slides said traveling yarn on a mating surface between said fixed disc (21) and said movable disc (22) to apply tension to the yarn, and said switching means (60) moves said movable disc (22) forward and backward along a normal direction of said mating surface with respect to said fixed disc (21).

3. A tension applying device (6) according to Claim 2, **characterized in that** said switching means (60) allows or regulates bias of said movable disc (22) toward said fixed disc (21).

4. A tension applying device (6) according to Claim 3, **characterized in that** said switching means (60) comprises a rod with projection (26) projected from said movable disc (22) toward an opposite side of said fixed disc (21) side, said rod with projection (26) being inserted into a cylinder subjected to regulation of movement in an axial direction, a bias allowing groove (32) and a bias regulating groove (33) formed on said cylinder in different places in a circumferential direction, said bias allowing groove (32) and said bias regulating groove (33) having different lengths and extending from an end of said cylinder which is farther from said fixed disc (21) side, toward said fixed disc (21) side, and a projecting portion (31) formed to be accommodatable in said bias allowing groove (32) or said bias regulating groove (33) and provided on an outer peripheral surface of said rod with projection (26) so that when said projecting portion (31) is accommodated in said bias allowing groove (32), said movable disc (22) can abut against said fixed disc (21), whereas when said projecting portion (31) is accommodated in said bias regulating groove (33), said projecting portion (31) engages an edge of said fixed disc (21) side of said bias regulating groove (33) to prevent said movable disc (22) from abutting against said fixed disc (21).

5. A tension applying device (6) according to Claim 3, **characterized in that** said switching means (60) comprises a rod with teeth (40) projected from said movable disc (22) toward an opposite side of said fixed disc (21) side, a bias transmitting rod (41) interposed between said rod with teeth (40) and said elastic body (34), said rod with teeth (40) being relatively non-rotatably inserted into a cylinder subjected to regulation of movement in the axial direction, said bias allowing groove (32) and said bias regulating groove (33) formed on said cylinder in different places in a circumferential direction, said bias allowing groove (32) and said bias regulating groove (33) having different lengths and extending from an end of said cylinder which is farther from said fixed disc (21) side, toward said fixed disc (21) side, said projecting portion (31) formed to be accommodatable in said bias allowing groove (32) or said bias regulating groove (33) is provided on said bias transmitting rod (41) so that when said projecting portion (31) is accommodated in said bias allowing groove (32), a bias force applied to said bias transmitting rod (41) by said elastic body (34) is transmitted to said rod with teeth (40) to allow said movable disc (22) to be biased toward said fixed disc (21), whereas when said projecting portion (31) is accommodated in said bias regulating groove (33), said projecting portion (31) engages said bias regulating groove (33) to prevent the bias force applied to said bias transmitting rod (41) by said elastic body (34) from being transmitted to said rod with teeth (40), regulating the bias of said movable disc (22) toward said fixed disc (21), and an inclined surface (40a) formed at an end of said rod with teeth (40) which is farther from said fixed disc (21), said inclined surface (40a) engaging said projecting portion (31) of said bias transmitting rod (41) to rotate said bias transmitting rod (41) in a predetermined direction.

6. A tension applying device (6) according to Claim 3, **characterized in that** said elastic body (34) is said compression coil spring (34) and is configured such that a self elastic restoring force of said compression coil spring (34) biases said movable disc (22) toward said fixed disc (21), **in that** said switching means (60) includes said compression coil spring (34), a spring rod (36) which is inserted into an insertion hole formed in a housing (18) of said tension applying device (6) and which is inserted into an inner peripheral side of said compression coil spring (34), a spring receiver (37) which is secured to one end of said fixed disc (21) side of said spring rod (36) and which cooperates with said housing (18) in sandwiching said compression coil spring (34) between said spring receiver (37) and said housing (18), a slip-out preventing member (38) secured to the other end of said spring rod (36) to prevent said spring rod (36) from slipping out from said housing (18) toward said fixed disc (21) side, and an interposing member (50) that is insertable between said housing (18) and said slip-out preventing member (38), and **in that** when said interposing member (50) is inserted be-

tween said housing (18) and said slip-out preventing member (38), free stretching of said compression coil spring (34) is regulated.

7. A tension applying device (6) according to Claim 5 or Claim 6, **characterized in that** said switching means (60) is configured such that in said inoperative state, said movable disc (22) is always separate from said fixed disc (21) by at least a predetermined distance.

FIGURE 1

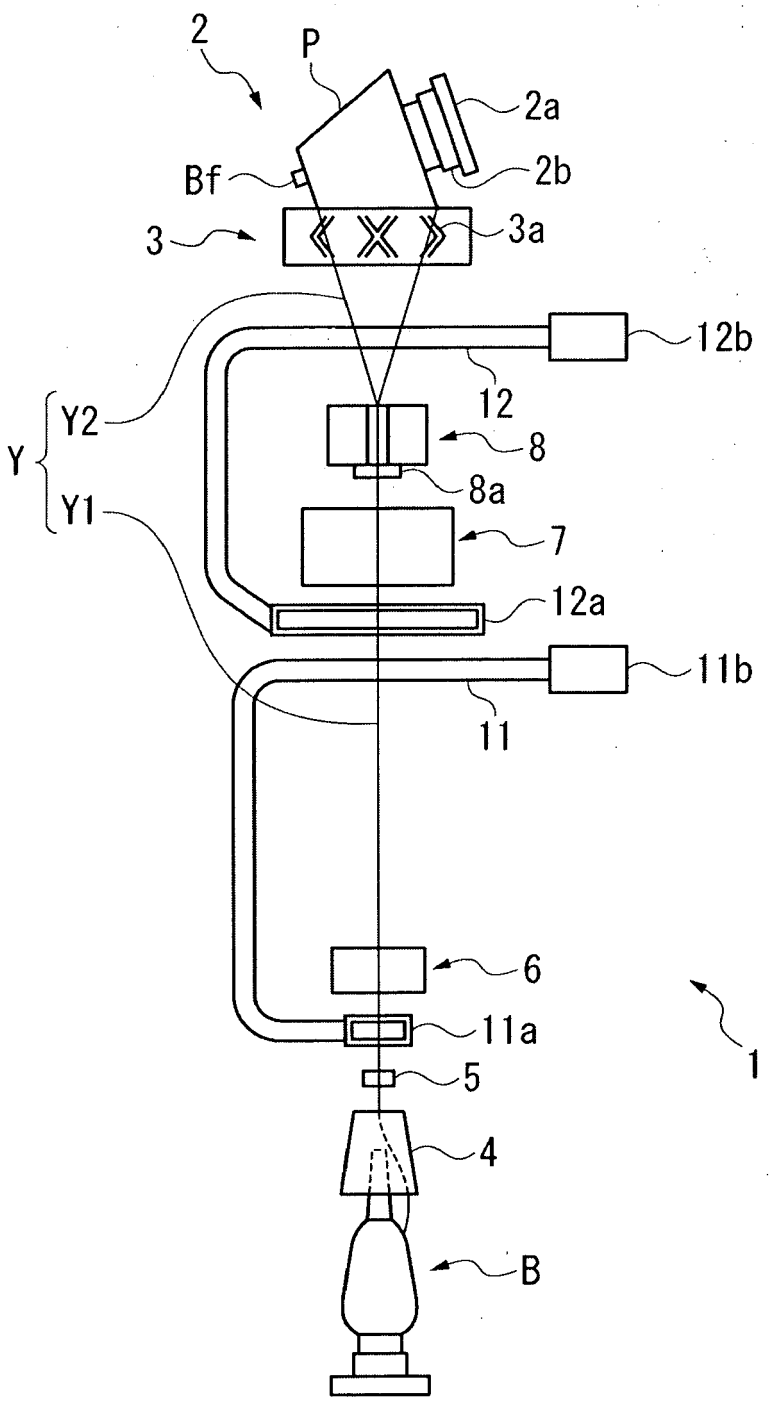


FIGURE 2

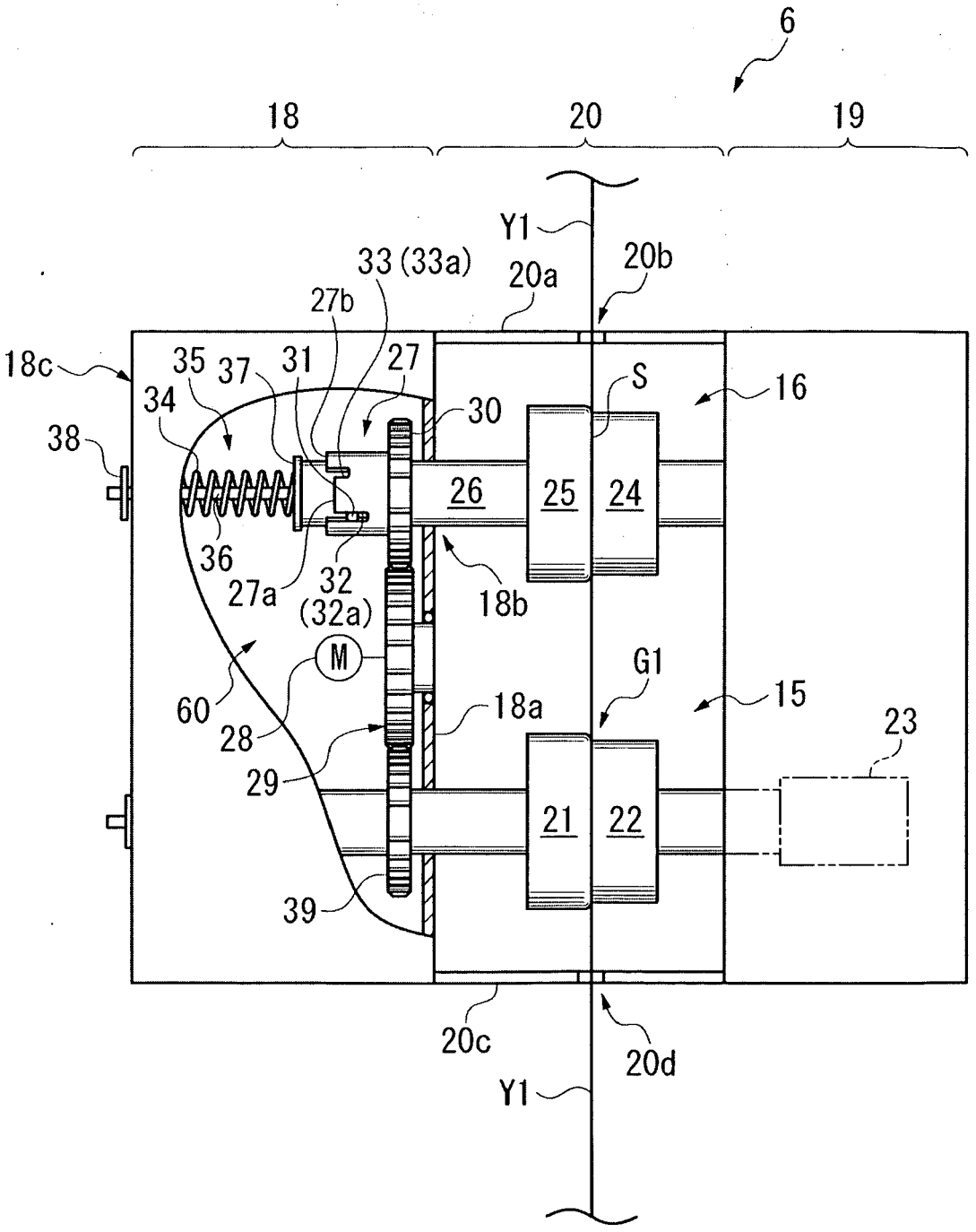

6
18
20
19
Y1
33 (33a)
20a
20b
27b
18c
35
37
31
27
S
16
34
30
38
26
25
24
36
27a
32
(32a)
18b
M
G1
60
18a
15
23
28
29
21
22
39
20c
20d
Y1

FIGURE 3

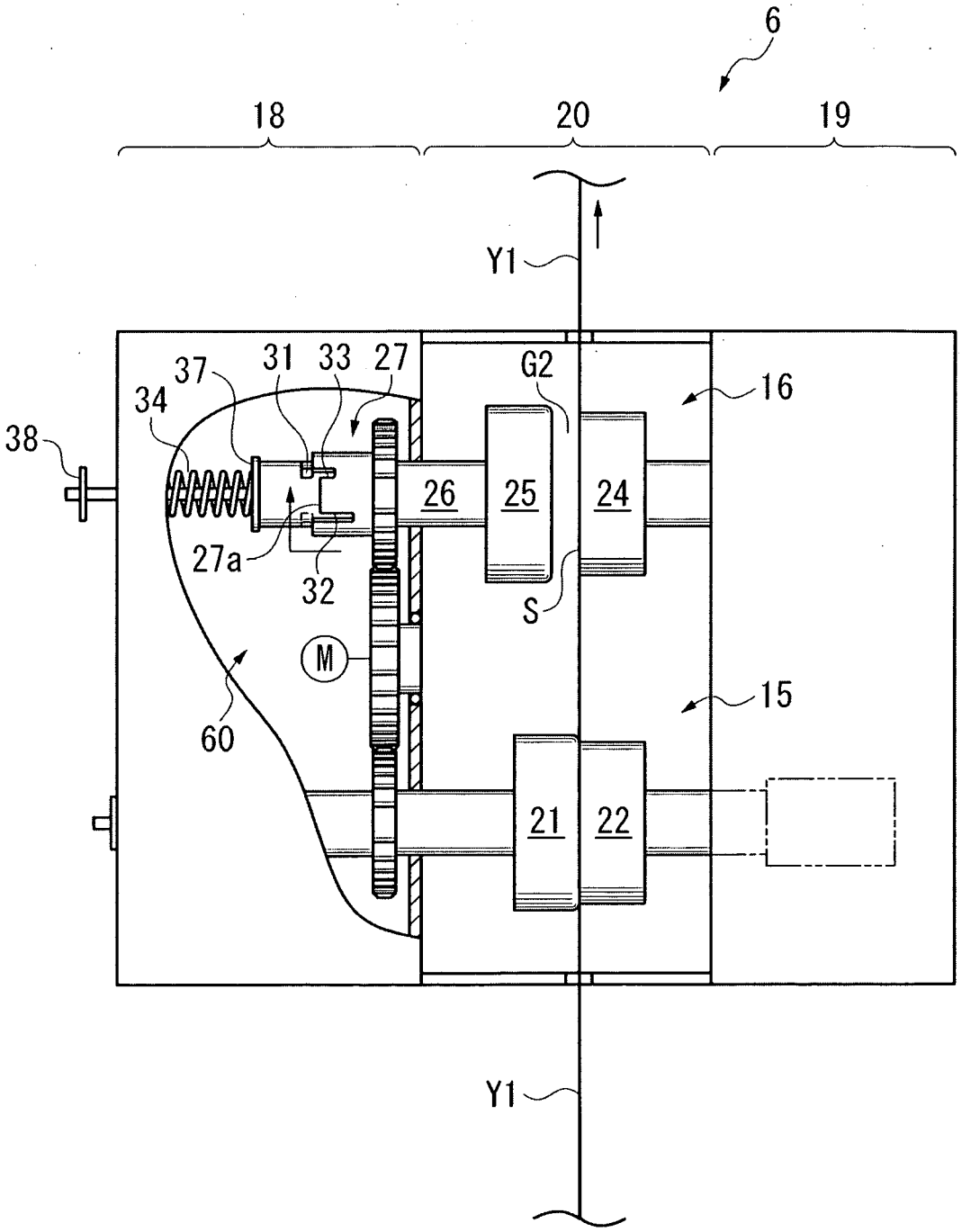


FIGURE 4

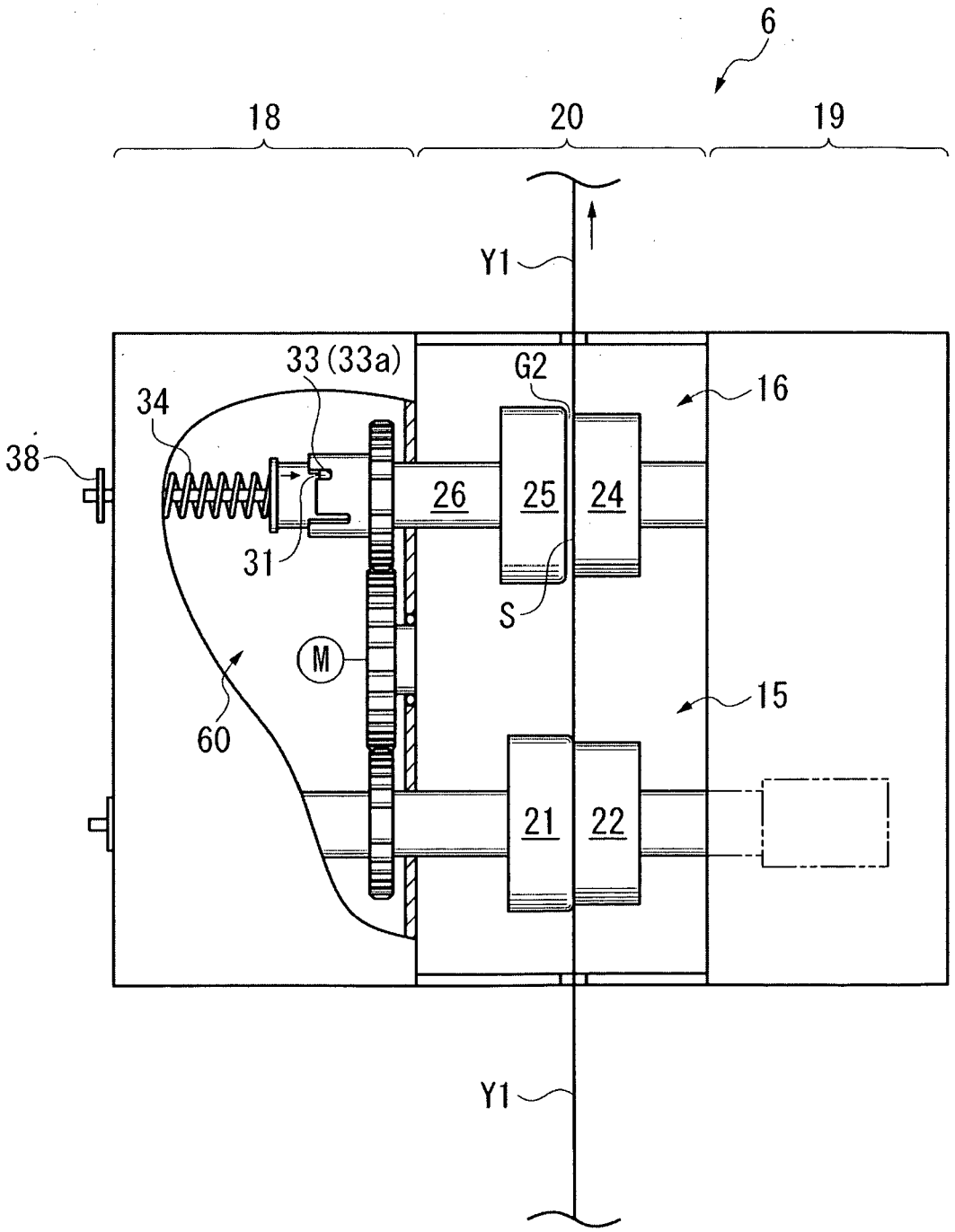
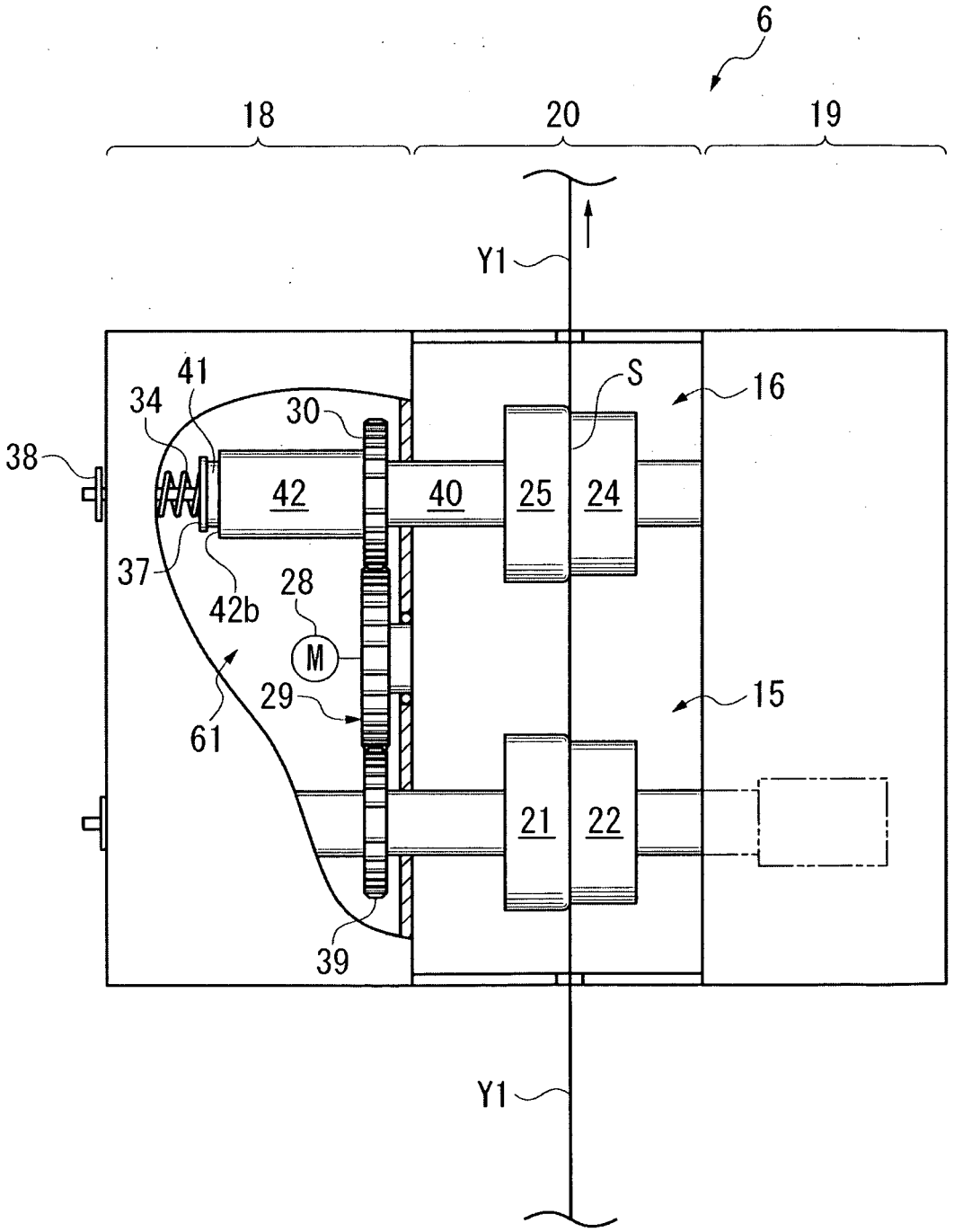


FIGURE 5


6
18
20
19
Y1
41
34
30
S
16
38
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40
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24
37
42b
28
M
29
15
61
21
22
39
Y1

FIGURE 6A

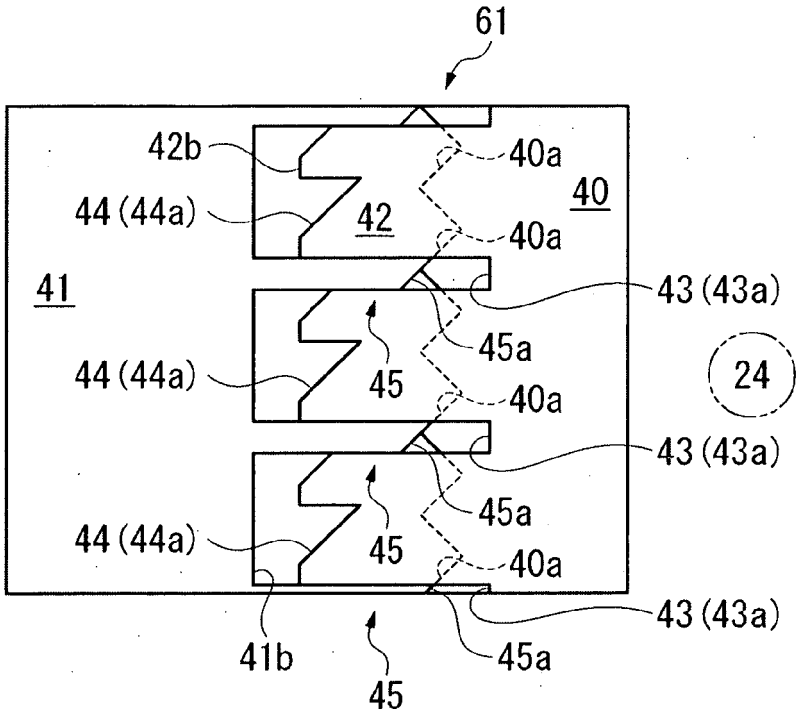


FIGURE 6B

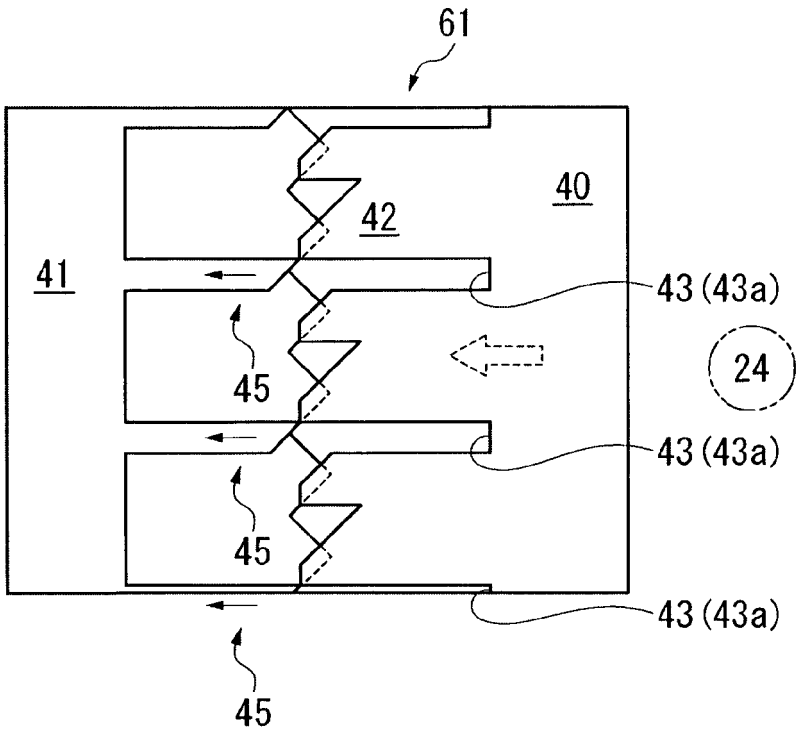


FIGURE 7A

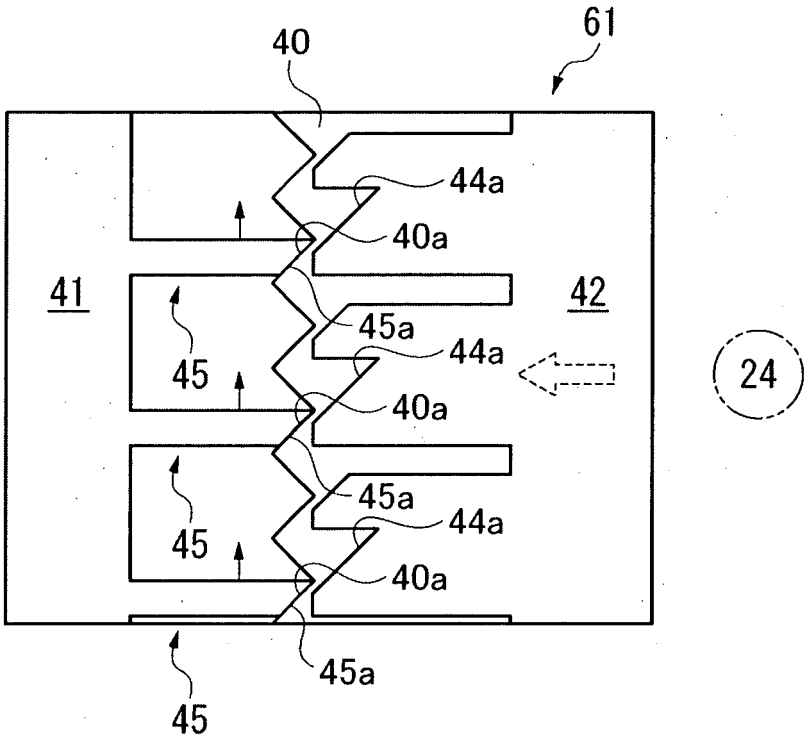


FIGURE 7B

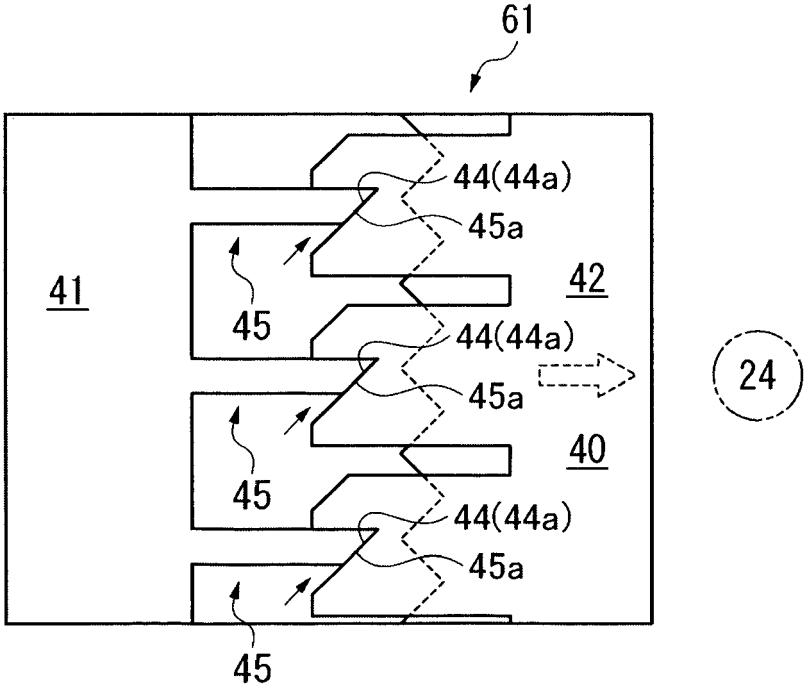


FIGURE 8

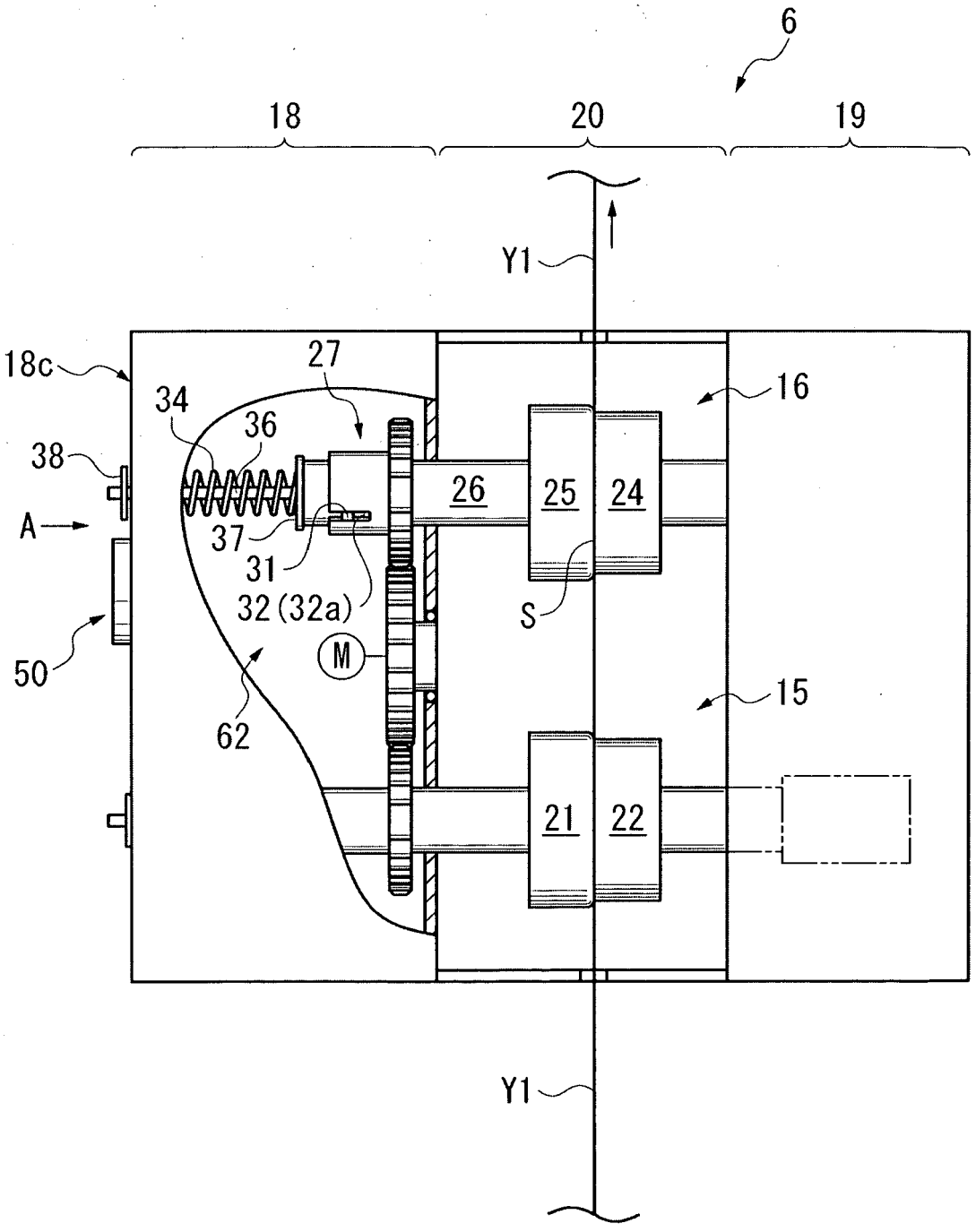

6
18
20
19
Y1
18c
27
34
36
38
A
37
31
32 (32a)
M
50
62
16
26
25
24
S
15
21
22
Y1

FIGURE 9

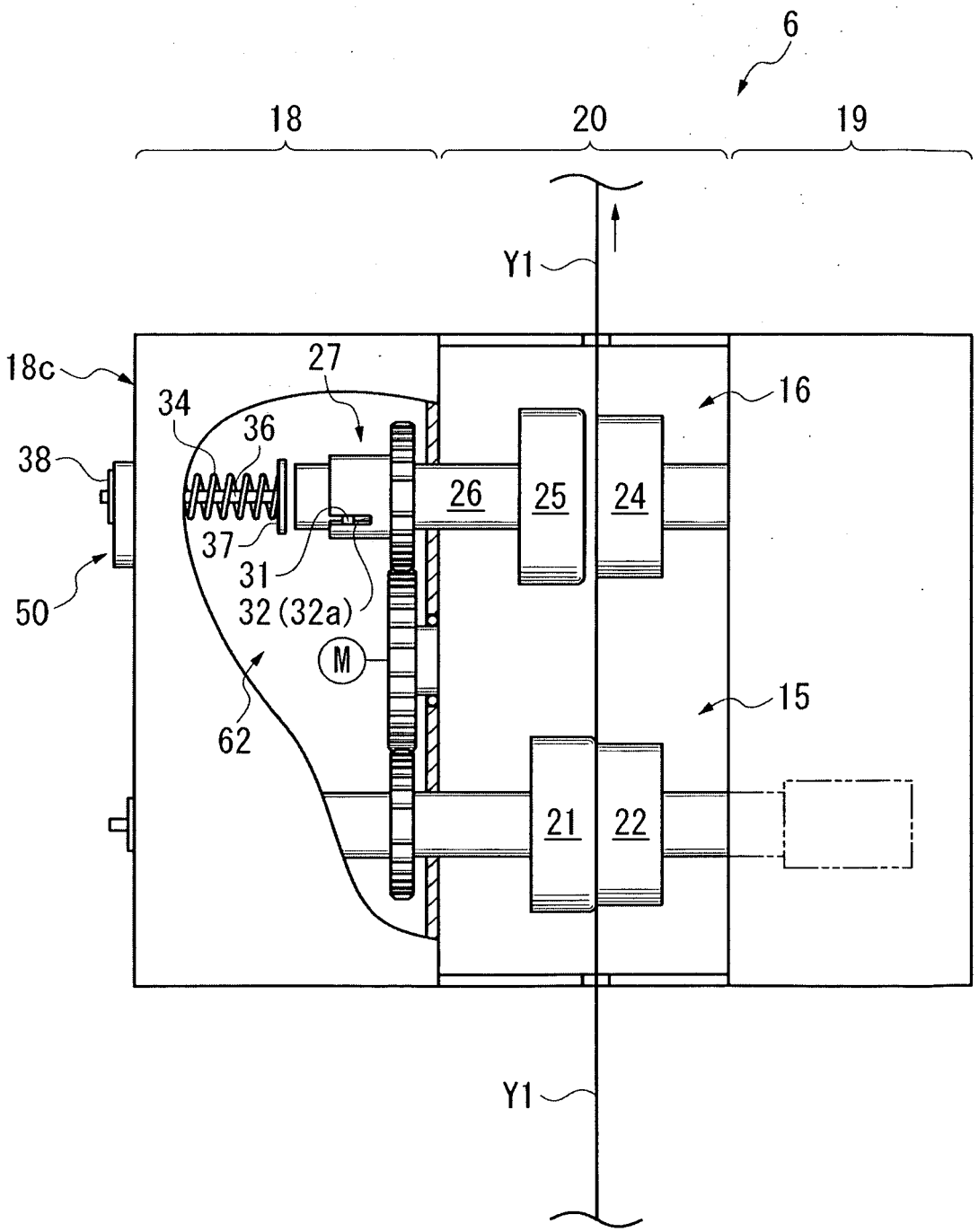

6
18
20
19
Y1
18c
27
34
36
38
16
26
25
24
37
31
32 (32a)
50
M
15
62
21
22
Y1

FIGURE 10

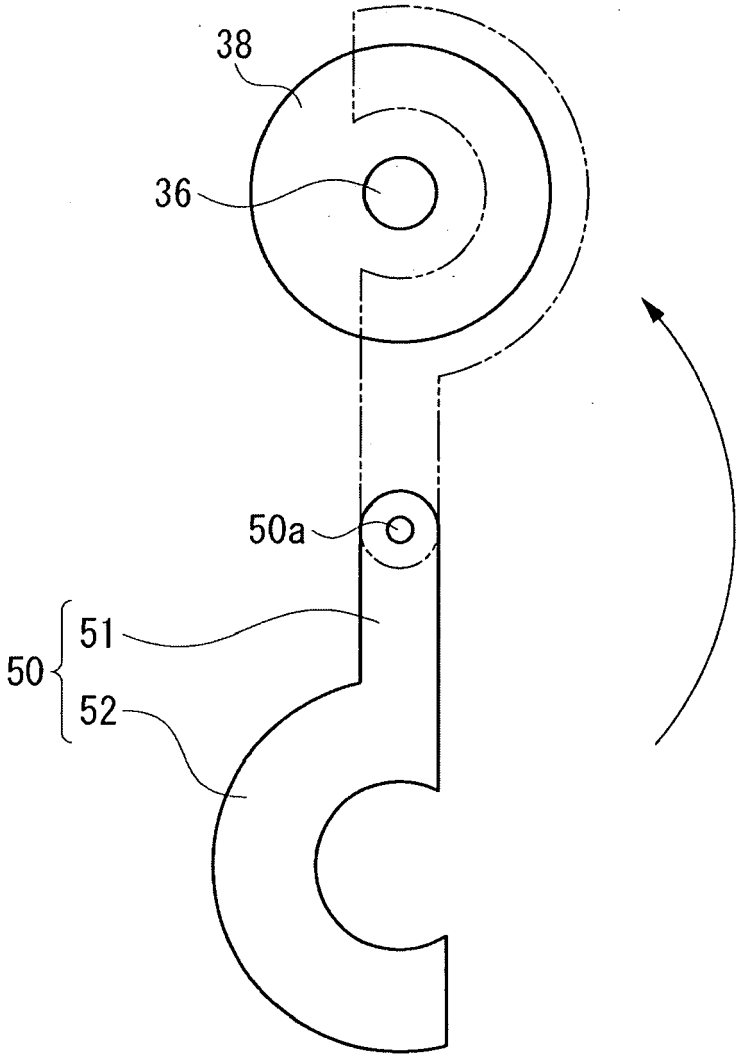
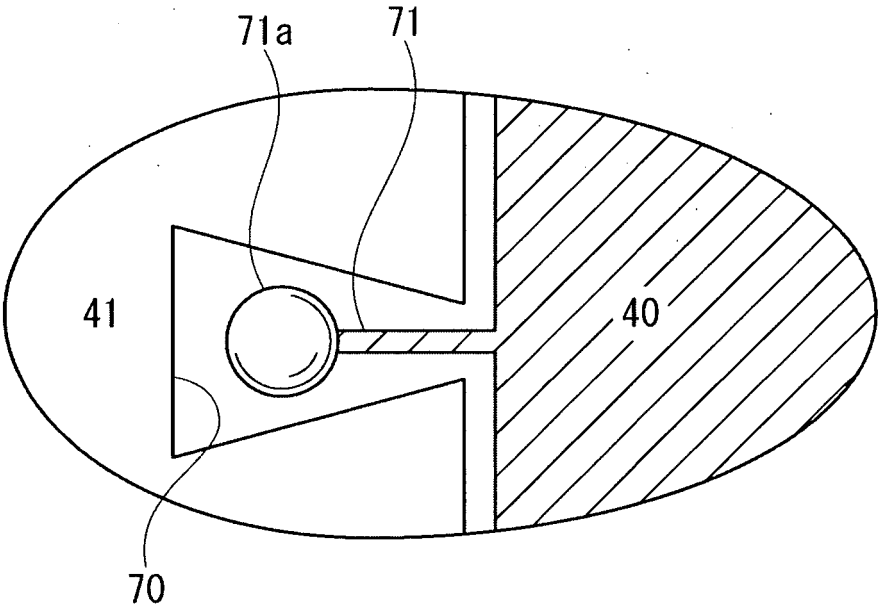


FIGURE 11



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 7033982 A **[0002] [0003] [0006]**
- JP 10297825 A **[0002] [0005] [0005] [0006]**