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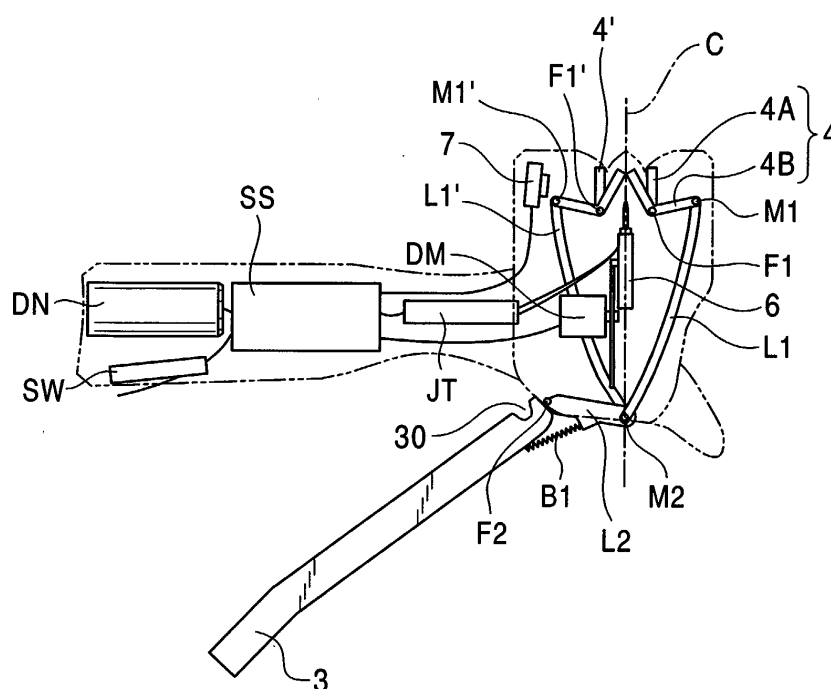
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(54) **Hand type yarn splicing device**

(57) The present invention provides a hand type yarn splicing device based on a resin joining method that provides a yarn joint having an appropriate length and strength as well as a highly applicable yarn. The hand type yarn splicing device includes clamp members 5, 5' that grip the yarn Y1 and the yarn Y2 to be spliced, cutter

members 4, 4' that cut one side of the gripped yarn to expose end surfaces of the yarn, a drive mechanism that moves the clamp members so that the exposed end surfaces of the yarn are abutted against each other, and adhesive supply means 6 for supplying an adhesive to the abutted end surfaces of the yarn (Fig. 2).

FIG. 2



Description

Field of the Invention

[0001] The present invention relates to a hand type yarn splicing device which allows two yarns to be spliced together and which is conveniently portable.

Background of the Invention

[0002] In order to remove a defective or weakened part from a yarn, a simplified manual yarn splicing device is used to cut the yarn into two yarns, remove the defective part or the like, and then splice the two yarns together. Alternatively, such a yarn splicing device is used to splice two yarns which are spontaneously cut during normal yarn processing steps. Various such yarn splicing devices are provided which are small and portable and which include a handle portion to allow the user to operate the device easily with one hand. Yarn splicing methods used for these devices include a knotting method and an air splicer method. With the knotting method, ends of two yarns which have been cut and separated are mechanically joined together. The knotting method is advantageous in that the knot obtained is very strong and in that it is applicable to yarns with relatively large yarn number count. However, the yarn joint obtained by the knotting method constitutes a lump-shaped projection. Thus, disadvantageously, when this yarn is used for textiles or knitting, the lump-shaped projection must be pushed into a cloth so as to project from its back side.

[0003] Further, with the air splicer method, ends of two separated yarns are untwisted by compressed air, placed on each other, and then twisted by compressed air, thus enabling the two yarns to be instantaneously spliced together. The air splicer method prevents a projection from being formed at the joint as in the case with splicing based on the knotting method. Further, the joint obtained is not substantially noticeable, so that the disadvantages of the knotting method are eliminated. However, splicing based on the air splicer method results in a longer joint. Furthermore, if the joined yarns are dyed, the joint may be discolored. Moreover, the joint may become weaker than the other parts of the yarns. It is also disadvantageous that the range of yarn types to which the air splicer method is applicable is relatively narrow because of the structure of the method. Further, with the air splicer method, it is necessary to provide an air splicer mechanism such as pipes through which compressed air is fed. Thus, disadvantageously, the equipment based on this method is heavy and is not sufficiently compact.

[0004] It is thus an object of the present invention to solve these problems of the prior art to provide a hand type yarn splicing device based on a resin joining method which provides a yarn joint having an appropriate length and strength and which is very applicable.

Summary of the Invention

[0005] According to the present invention, a hand type yarn splicing device is characterized by comprising clamp members that grip a yarn to be spliced, a cutter member that cuts one side of the gripped yarn to expose end surfaces of the yarn, a drive mechanism that moves the clamp members so that the exposed end surfaces of the yarn are abutted against each other, and adhesive supply means for supplying an adhesive to the abutted end surfaces of the yarn.

[0006] Preferably, the adhesive is a photo-curing resin that is cured by light, and further comprises a light irradiating means that irradiates the abutted end surfaces of the yarn with light.

[0007] The hand type yarn splicing device further comprises a lever member which is used to operate the drive mechanism and which is operated to perform an operation of abutting the end surfaces of the yarn against each other.

[0008] According to a preferred embodiment, the photo-curing means is a semiconductor laser.

Brief Description of the Drawings

[0009]

Figure 1 is a view showing the appearance of a yarn splicing device according to the present invention.

Figure 2 is a side view of the internal structure of the yarn splicing device in which a mechanism associated with clamp members is omitted.

Figure 3 is a side view of the internal structure of the yarn splicing device.

Figure 4 is a schematic diagram illustrating how the yarn splicing device is operated.

Figure 5 is a schematic diagram illustrating how the yarn splicing device is operated and showing a continued part of the operation shown in Figure 4.

Figure 6 is a view showing the appearance of the yarn splicing device in the state of Figure 5.

Detailed Description of the Preferred Embodiments

[0010] An embodiment of the present invention will be described below in detail. However, the present invention is not limited to this embodiment, and other embodiments may be implemented unless they deviate from the spirits of the present invention.

[0011] First, the external structure of a hand type yarn splicing device (hereinafter referred to as a "yarn splicing device") according to the present invention will be described. Figure 1 shows the appearance of an embodiment of the yarn splicing device. Figure 1A is a side view and Figure 1B is a perspective view. The yarn splicing device comprises a main body portion 1 shaped like a frame into which four plates 1A, 1A', 1B, 1B' are combined, a handle portion 2 attached to the main body por-

tion 1, and a lever member 3 located below the handle portion 2. The two front plates 1A, 1A' are located so as to sandwich between themselves the side plate 1B to which the handle portion 2 is attached and the side plate 1B' located opposite the side plate 1B. The front plates 1A, 1A' are opposite to each other. Two yarn guiding grooves (hereinafter referred to as "grooves") 1a, 1b are formed at the top of the front plate 1A and are shaped like inverse triangles having acute bottoms.

[0012] Now, the internal structure of this yarn splicing device will be described with reference to Figure 2 and Figure 3. First, the description will be given with reference to Figure 2. To make the reader understand the internal structure of the yarn splicing device easily, Figure 2 shows a side view of the internal structure in which a mechanism associated with the clamp members is omitted. In this figure, the alternate long and two short dashes line indicates the contour of the yarn splicing device. Cutter members 4, 4' are located at the top of interior of the main body portion 1 to cut each of yarns Y1, Y2. The cutter members 4, 4' are composed of fixed blades 4A, 4A' and movable blades 4B, 4B', respectively. The movable blades 4B, 4B' are L-shaped and each have a cutter edge on its vertical side. Lower end portions of the fixed blades 4A, 4A' are fixedly supported by fixed shafts F1, F1', respectively, fixed to the front plates 1A, 1A', respectively. Bent portions of the movable blades 4B, 4B' are supported by the fixed shaft F1. Furthermore, movable shafts M1, M1' connect the ends of horizontal sides of the movable blades 4B, 4B' to the upper ends of link members L1, L1' respectively. The movable shafts M1, M1' are rotationally movable. Further, the lower ends of the link members L1, L1' are connected to one end of a link member L2 via a movable shaft M2 that is rotationally movable. The other end of the link member L2 and one end of the lever member 3 are supported by a fixed shaft F2 fixed to the front plates 1A, 1A'. The lever member 3 and the link member L2 are pulled together by a coil spring B1 provided below the link member L2 and normally assume a V shape.

[0013] Further, an adhesive used to splice two yarns together is a photo-curing resin (hereinafter referred to as a "resin") cured when irradiated with light energy. The main body portion 1 comprises adhesive supply means 6 arranged in its central portion to supply the resin, a power motor DM also arranged in the central portion to move the adhesive supply means up and down, and light irradiating means 7 arranged at the top to cure the resin. Furthermore, the handle 2 contains a resin housing tank JT in which the resin is housed, a control device SS that controls the power motor DM and the photo irradiating means 7, a battery DN used to drive these components, and a switch SW used to turn on and off the flow of a current from the battery DN.

[0014] Figure 3 is similar to Figure 2 except that the mechanism associated with the clamp members is added to the yarn splicing device, i.e. a side view of the entire internal structure of the yarn splicing device. Clamp

members 5, 5' are located at the top of interior of the main body portion 1, and are composed of first clampers 5A, 5A' and second clampers 5B, 5B', respectively. The second clampers 5B, 5B' are L-shaped, and their bent portions and the first clampers 5A, 5A' are supported by fixed shafts F3, F3', respectively, fixed to the front plates 1A, 1A', respectively. Springs B2, B2' provided around the fixed shafts F3, F3', respectively, elastically urge the first clampers 5A, 5A' and the second clampers 5B, 5B', respectively, so that these clampers are normally abutted against each other. Further, movable shafts M3, M3' connect the ends of horizontal sides of the second clampers 5B, 5B' to the upper ends of link members L3, L3', respectively, and the movable shafts M3, M3' are rotationally movable.

[0015] An arm member 8 is located below the main body portion 1 so as to extend in a horizontal direction, in order to drive the clamp members 5, 5', and a movable shaft M4 connects an intermediate portion of the arm member 8 to the lower ends of the link members L3, L3', and the movable shaft M4 is rotationally movable. Furthermore, one end of the arm member 8 is supported by a fixed shaft F4 fixed to projecting portions 10A, 10A' provided below the front plates 1A, 1A', respectively. The other end of the arm member 8 and the lower end of a link member L4 are connected to a movable shaft M5 that is rotationally movable. The upper end of the link member L4 is provided with a projecting portion L40 projecting to the lever member 3. The projecting portion L40 is adapted to be fitted into a concave portion 30 formed in the upper side of one end of the lever member 3. However, the projecting portion L40 is normally not fitted into the concave portion 30 as shown in Figure 3.

[0016] A stopper ST is provided below the clamp member 5 and is normally elastically urged upward by coil springs B3, B3' provided below the stopper ST.

[0017] A concave portion ST1 is formed in the upper side of the stopper ST. A projecting portion 50A provided at the lower end of the first clasper 5A is adapted to be fitted into the concave portion ST1. However, the projecting portion 50A is normally not fitted into the concave portion ST1 as shown in Figure 3.

[0018] Each of the pairs of cutter members 4, 4', link members L1, L1', clamp members 5, 5' and link members L3, L3' are disposed symmetrically with respect to a vertical center line C located midway between the grooves 1a, 1b because these components are used to grip the yarn Y1 and the yarn Y2, and to cut the yarns Y1, Y2.

[0019] Now, description will be given of how the yarn splicing device is used.

[0020] When a defective portion is found in the yarn, the yarn is cut into two yarns Y1, Y2. Then, the first clampers 5A, 5A' are manually moved to open the clamp members 5, 5'. Subsequently, the yarn Y1 is placed on the grooves 1a, 1a', arranged opposite each other, so as to extend over the tips of the grooves 1a, 1a'. On the other hand, the yarn Y2 is placed on the grooves 1b, 1b'

arranged opposite each other, so as to extend over the tips of the grooves 1b, 1b'. Accordingly, the yarns Y1, Y2 are located parallel with each other. In this state, the operator's hand, holding the clamp members 5, 5' open, is released from the clamp members 5, 5' to allow the spring B2 to elastically urge the clamp members 5, 5', and then, the clamp members 5, 5' grip the yarns Y1, Y2. Then, the handle portion 2 and the lever member 3 are held and gripped to move the lever member 3 closer to the handle portion 2. In unison with this movement, the cutter members 4, 4' and clamp members 5, 5' in the main body portion 1 are operated to abut end surfaces of the yarns Y1, Y2 against each other. Then, the resin is applied to the abutted portion, which is then cured to splice the yarns Y1, Y2 together.

[0021] Now, with reference to Figure 4 to Figure 6, description will be given of how the internal structure of the yarn splicing device operates. First, description will be given with reference to Figure 4. Figure 4 is a schematic diagram showing how a part of the internal structure of the yarn splicing device operates, wherein the structure associated with the clamp members is omitted.

[0022] The lever member 3 is operated to operate the internal structure so that it changes from the state shown in Figure 4A to the state shown in Figure 4B. The dotted line shown in Figure 4B represents the state shown in Figure 4A. As shown in Figure 4A, the yarn Y1 and the yarn Y2 gripped by the clamp members 5, 5' (not shown in the drawing) and fixed in place respectively, are located in the open portions of the open cutters 4, 4', respectively. Then, as shown in Figure 4B, the lever member 3 is moved upward around the fixed shaft F2. In this case, since the lever member 3 and the link member L2 are pulled together by the coil spring B1, the link member L2 moves downward around the fixed shaft F2 in unison with the rotational movement of the lever member 3, and the movable shaft M2 is also rotationally moved around the fixed shaft F2. Accordingly, the links L1, L1' are pulled downward to rotationally move the movable shafts M1, M1' downward, which are located at the upper ends of the link members L1, L1', respectively. Thus, the vertical sides of the movable blades 4B, 4B' are moved around the fixed shafts F1, F1', respectively, so as to overlap the fixed blades 4A, 4A', respectively. Consequently, the yarn Y1 and the yarn Y2 are cut.

[0023] Now, description will be given with reference to Figure 5, showing a continued part of the operation shown in Figure 4. Figure 5 is also a schematic diagram showing how the above part of the internal structure of the yarn splicing device operates, wherein the structure associated with the cutter members is omitted. Figure 5A corresponds to Figure 4B.

[0024] The lever member 3 is operated to operate the internal structure so that it changes from the state shown in Figure 5A to the state shown in Figure 5B. Further, the dotted line shown in Figure 5B shows the state shown in Figure 5A.

[0025] As shown in Figure 5A, the clamp members 5, 5' grip the yarn Y1 and the yarn Y2 cut by the cutter members 4, 4', respectively, and furthermore, the projecting portion L40 provided at the upper end of the link member L4 is fitted in the concave portion 30 in the lever member 3. Even if the lever 3 is further moved upward with the fixed blade 4A and the movable blade 4B placed on each other, the link member L2 remains fixed in place, while only the lever 3 is moved, because the movable blade 4b cannot be moved further. The lever member 3 and the link member L2 are simply pulled by the coil spring B1, so that the lever member 3 can be moved further though the link member L2 remains fixed in place.

[0026] As shown in Figure 5B, the lever member 3 is moved further upward around the fixed shaft F2 to rotationally move the projecting portion L40 around the fixed shaft F2, the projecting portion L40 being provided at the upper end of the link member L4, which has been fitted in the concave portion 30 in the lever member 3. In unison with this rotational movement, the movable shaft M5 and the movable shaft M4 are rotationally moved upward around the fixed shaft F4, the movable shaft M5 being connected to the link member L4 and the arm member 8, the movable shaft M4 being connected to the link members L3 and L3' and the arm member 8. In unison with the rotational movement of the movable shaft M5 and the movable shaft M4, the link members L3, L3' are moved upward to rotationally move the movable shafts M3, M3', located at their upper ends, upward around the fixed shaft F4. Thus, the clamp members 5, 5' are moved around the fixed shafts F3, F3' so as to move closer to each other. Then, since the stopper ST is elastically urged upward by the coil springs B3, B3' (not shown in the drawing) as described above, the projecting portion 50A, provided at the lower end of the first clasper 5A, is moved rightward as shown in Figure 5B. The projecting portion 50A is thus fitted into the concave portion ST1 in the stopper ST to fix the entire internal mechanism in place.

[0027] Now, description will be given with reference to Figure 6. Figure 6 corresponds to Figure 5B. Figure 6A is a plan view and Figure 6B is a partial sectional view.

[0028] When the clamp members 5, 5' are moved closer to each other as described above, the cut end surfaces of the yarn Y1 and the yarn Y2 are abutted against each other (so as not to overlap each other) as shown in Figure 6A. In this state, the lever member 3 abuts against the bottom surface of the handle portion 2 to turn on the switch SW, provided on the bottom surface of the handle portion 2. Thus, the control device SS controls the operations of the adhesive supply means 6, the light irradiating means 7, the power motor DM, and the resin housing tank JT. The adhesive supply means 6 is located below an abutted portion Y10 of the yarn Y1 and the yarn Y2, and a bar RB provided with a rack is attached to the adhesive supply means 6, and a

gear HG attached to the power motor DM meshes with the rack of the bar RB. When the switch SW is turned on, the power motor DM is actuated to rotate the gear HG counterclockwise to move the bar RB upward, which is meshed with the gear HG. Then, a resin supply port (hereinafter referred to as a "supply port") 6A in the adhesive supply means 6 moves closer to the abutted portion Y10, and the power motor DM is stopped. In this state, the adhesive supply means 6 discharges a predetermined amount of resin through the supply port 6A to apply it to the abutted portion Y10. Subsequently, the power motor DM is actuated to rotate the gear HG clockwise to move the bar RB downward, which is meshed with the gear HG. Accordingly, the adhesive supply means 6 returns to its original position. Then, the light irradiating means 7 irradiates the abutted portion Y10 with light to cure the resin applied to this portion. As a result, the yarn Y1 and the yarn Y2 are spliced together.

[0029] With the yarns Y1 and the yarn Y2 spliced together, the clamp members 5, 5' are opened to separate the yarns Y1, Y2 from the clamp members 5, 5' to complete the splicing process. Subsequently, the stopper St is manually moved downward to release the means for fixing the internal structure in place. Then, the tensile force of the coil spring B1 causes the lever member 3 to return to its original state.

[0030] This resin is preferably an ultraviolet curing resin. Before curing, the ultraviolet curing resin can infiltrate through twisted short fibers constituting the yarn owing to its permeability. It also has a sufficient elongation percentage to follow bending of the yarn after curing. Furthermore, the ultraviolet curing resin allows a curing process to be completed within a time as short as one second, and maintains fluidity before the curing process. The light irradiating means preferably irradiates the resin with ultraviolet rays, which are suitable for the resin. The light irradiating means 7 may be a halogen lamp or another equipment which emits light so as to be diffused but is preferably a semiconductor laser having a lens installed in a semiconductor diode, which requires less power consumption. When the light irradiating means 7 has a reduced size, the entire yarn splicing device can be miniaturized and is thus portable. Furthermore, the reduced power consumption enables the size of the battery to be reduced, thus reducing the size of the entire device. This semiconductor laser uses a lens to condense light emitted by the semiconductor diode, to emit a laser beam. The semiconductor laser thus irradiates the abutted portion Y10 with the laser beam in a pinpoint manner to instantaneously cure the resin applied to this portion. The semiconductor laser preferably generates blue or purple light having a frequency range from 400 to 420 nm and is manufactured, for example, by NICHIA CHEMICAL CORPORATION (NICHIA KAGAKU KABUSHIKI KAISHA). The battery used for this semiconductor laser consumes less power, i.e. 6 or 9 V. Consequently, the semiconductor laser generally has a reduced size and is economical.

[0031] As described above, according to the yarn splicing device of the present invention, the end surfaces of the two yarns being separated are abutted against each other and spliced together using the resin. Accordingly, the resulting joint is short. Further, it is not necessary to untwist the ends of the yarns as in the conventional example, thus preventing the joint from being discolored. Furthermore, selection of the type of the resin allows the strength of the joint to be increased compared to the other parts of the yarns. Further, the joint is not shaped like a knot as in the case with the knotting method. Accordingly, the joint does not create any problems, thus allowing the spliced yarn to be used for textiles or for knitting. Moreover, since the separated yarns are joined together using the resin, larger ranges of yarn types and yarn number count are advantageously applicable than in the prior art. Furthermore, the present yarn splicing device is lighter and more compact than the conventional ones based on the air splicer method. Therefore, the present yarn splicing device can be handled conveniently and are portable.

Claims

1. A hand type yarn splicing device **characterized by** comprising clamp members that grip a yarn to be spliced, a cutter member that cuts one side of the gripped yarn to expose end surfaces of the yarn, a drive mechanism that moves the clamp members so that the exposed end surfaces of the yarn are abutted against each other, and adhesive supply means for supplying an adhesive to the abutted end surfaces of the yarn.
2. A hand type yarn splicing device according to Claim 1, **characterized in that** the adhesive is a photocuring resin that is cured by light, and further comprises a light irradiating means that irradiates the abutted end surfaces of the yarn with light.
3. A hand type yarn splicing device according to Claim 1 or Claim 2, **characterized by** further comprising a lever member which is used to operate the drive mechanism and which is operated to perform an operation of abutting the end surfaces of the yarn against each other.
4. A hand type yarn splicing device according to Claim 2 or Claim 3, **characterized in that** the photocuring means is a semiconductor laser.

FIG. 1A

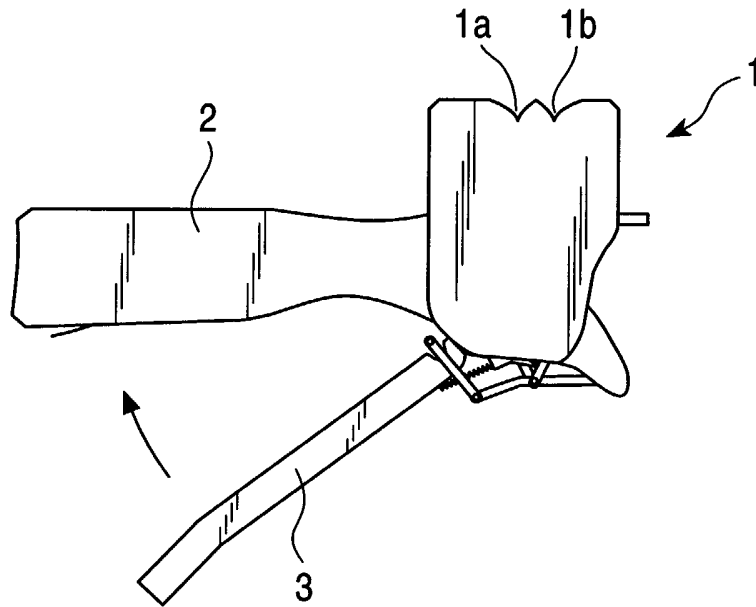


FIG. 1B

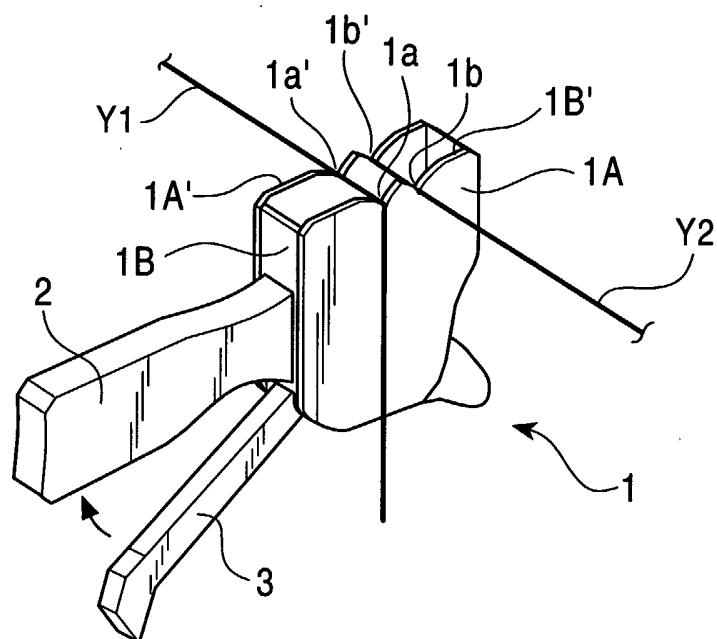


FIG. 2

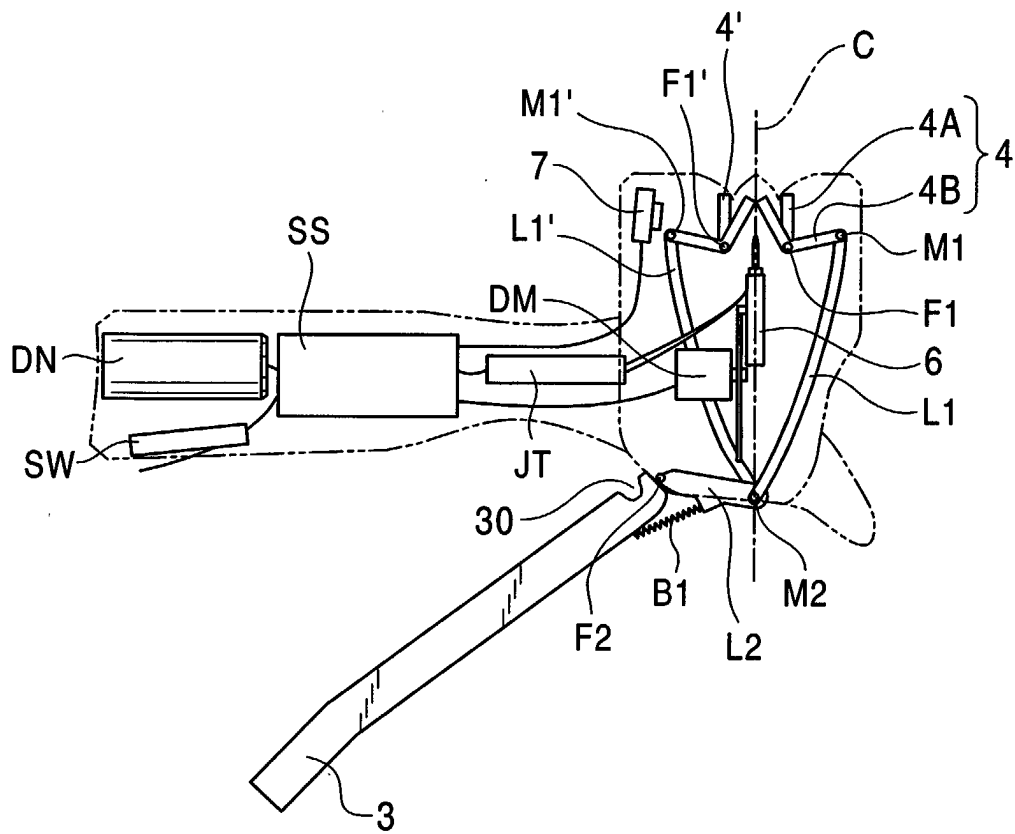


FIG. 3

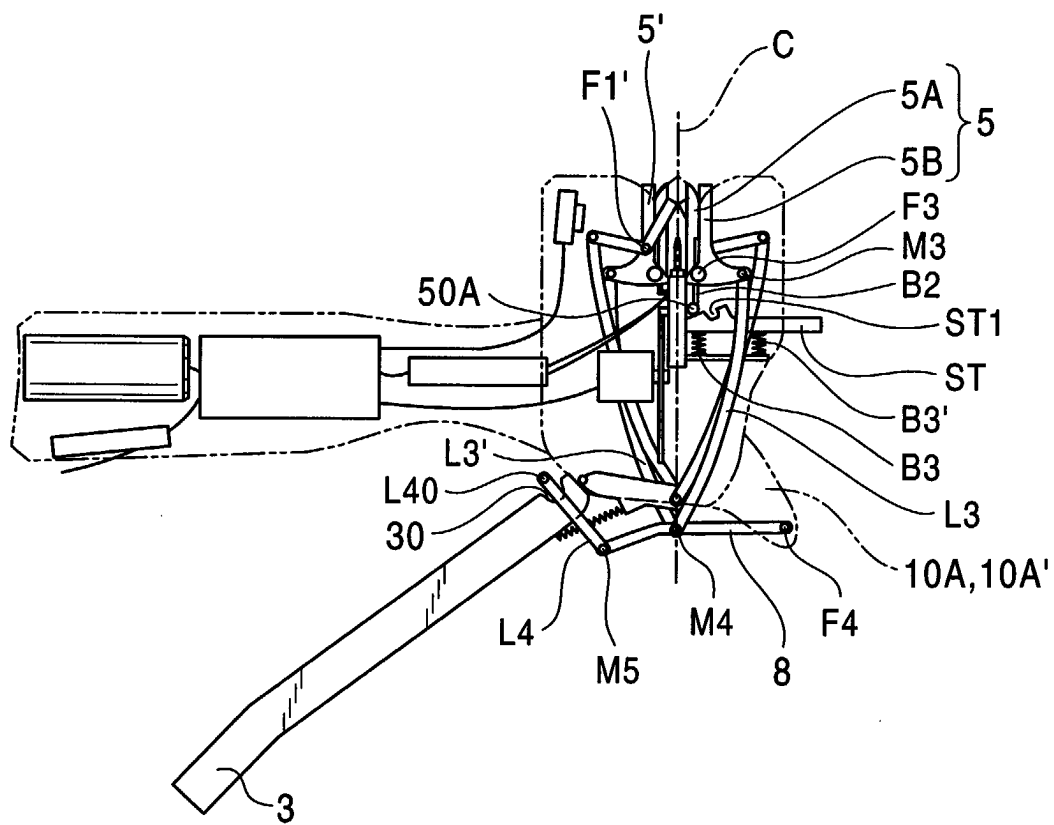


FIG. 4A

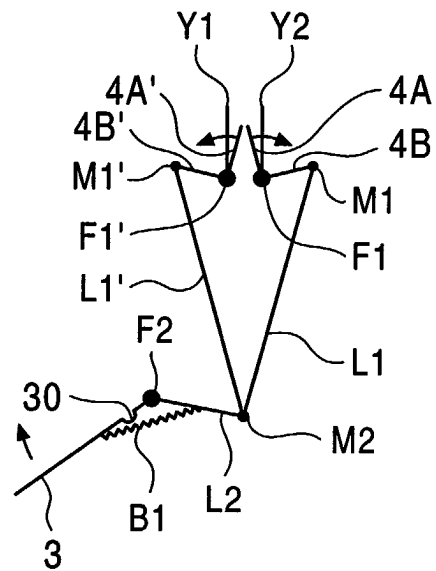


FIG. 4B

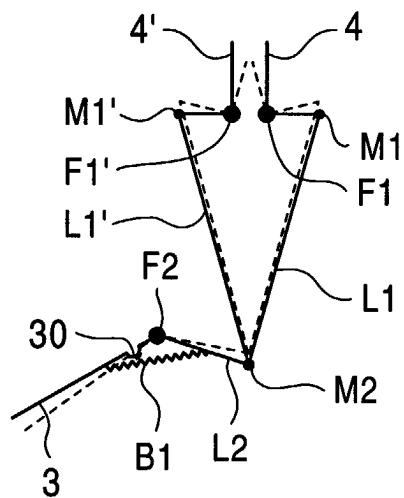


FIG. 5A

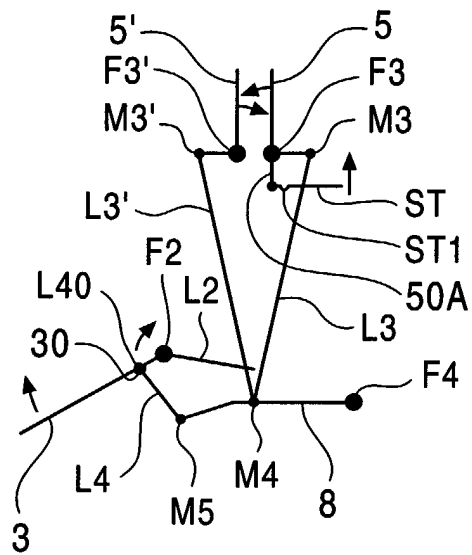


FIG. 5B

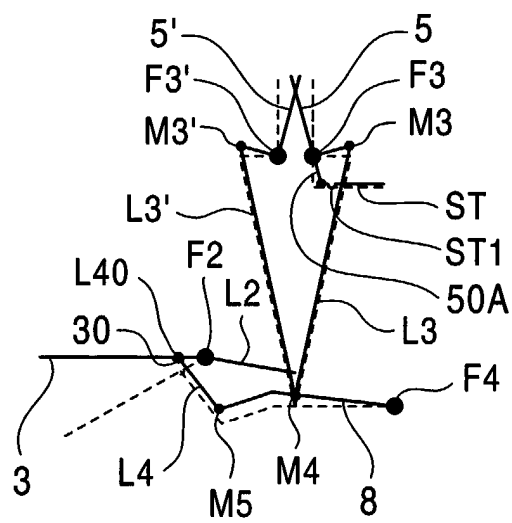


FIG. 6A

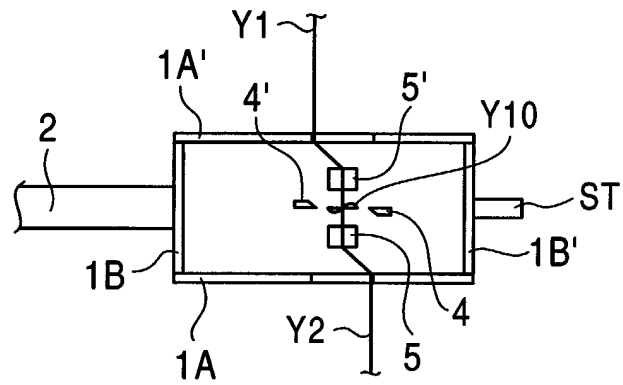


FIG. 6B

