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(54) **Splicing method of core yarns, spliced portion of core yarn and automatic winder comprising core yarn splicing device**

(57) The present invention provides a method of splicing two core yarns so that inner layer fibers and outer layer fibers are substantially continuous at their spliced portion. The present invention also provides a spliced portion formed by this method and an automatic winder comprising a device that embodies this method. Compressed air is applied to two core yarns 1A, 1B to

untwist their outer layer fibers 11a, 11b. The core yarns 1A, 1B are then cut to form core yarn end surfaces 1a, 1b. The core yarn end surfaces 1a, 1b are then abutted against each other. Subsequently, an adhesive is applied to the abutted portion and then left set. Further, the inner layer fibers 10a, 10b and the outer layer fibers 11a, 11b are substantially continuous at the spliced portion of the core yarns (Fig. 1A).

FIG. 1A

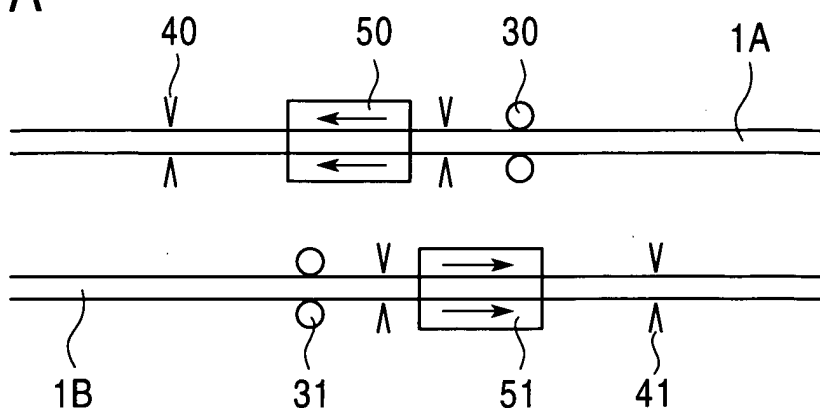


FIG. 1B

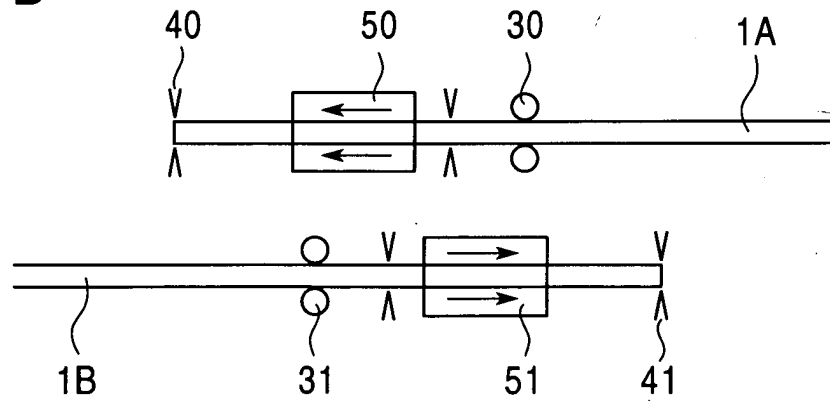
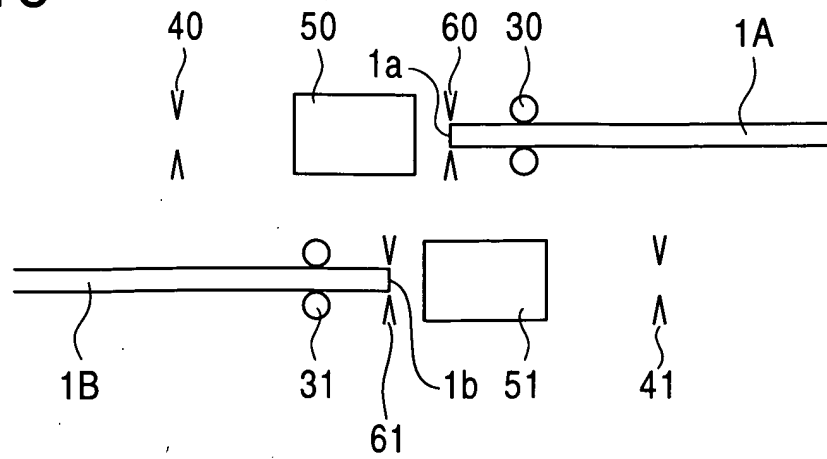


FIG. 1C



Description

Field of the Invention

[0001] The present invention relates to a splicing method of core yarns together, a spliced portion formed by this splicing method, and an automatic winder comprising a core yarn splicing device that embodies the splicing method.

Background of the Invention

[0002] A core yarn is composed of a stretchable yarn such as spandex (polyurethane fibers) as inner layer fibers and an anti-shrink yarn such as wool or cotton fibers, as outer layer fibers. The core yarn thus has both the stretchability of spandex and the texture of natural fibers. A description will be given of the yarn splicing method known to be practical.

[0003] First, a knot method comprises mechanically tying ends of two core yarns separated from each other by cutting. This method is applicable to even core yarns having strong tied portion and relatively large yarn numbers. However, the tie portion of the core yarns is a bump-shaped projection. Accordingly, when such yarns are used for woven or knitted fabrics, such bump-shaped projections must be pushed in toward the back side of a cloth.

[0004] Second, an air splicing method comprises using compressed air to untwist and disentangle the ends of separated two core yarns, superimposing the ends of the core yarns on each other, and then allowing the flow of compressed air to act on the superimposed portion to instantaneously splice the two core yarns together. According to this method, the resulting spliced portion is not a projection as in the knot method. However, the stretchable inner layer fibers are not spliced together, thus preventing the spliced portion from being stretchable. Further, the end of the core yarn may project out of the outer layer fibers, resulting in a yarn defect.

Summary of the Invention

[0005] The present invention thus provides a core yarn splicing method that can splice inner layer fibers and outer layer fibers together and can keep a spliced portion stretchable. The present invention also provides a spliced portion core yarns formed by this splicing method and an automatic winder comprising a splicing device that embodies this splicing method.

[0006] According to the present invention, there is provided a method of splicing core yarns composed of stretchable inner layer fibers and anti-shrink outer layer fibers characterized by comprising allowing a flow of compressed air to act or exerting external force of a rotating member such as a beater, on ends of the two core yarns obtained by cutting, in a direction in which the core yarns are stretched, to stretch the contracted outer layer

fibers to their original state, cutting the untwisted outer layer fibers, abutting the ends of the core yarns formed by the cutting, applying an adhesive to an abutted portion, and then setting the adhesive.

[0007] Preferably, this method is characterized in that the adhesive is optically set when irradiated with light. Alternatively, this method may be characterized in that the light is an ultraviolet ray or a laser beam.

[0008] According to the present invention, there is provided a spliced portion of core yarns characterized in that two core yarns each composed of stretchable inner layer fibers and anti-shrink outer layer fibers are provided, ends of the two core yarns are abutted together, an adhesive is applied to an abutted portion to splice the core yarns together so that at the spliced portion, the inner layer fibers and the outer layer fibers are substantially continuous.

[0009] According to the present invention, there is provided an automatic winder comprising a core yarn splicing device, the automatic winder being characterized by being provided with a core yarn splicing device that allows a flow of compressed air to act on ends of two core yarns obtained by cutting, in a direction in which the core yarns are stretched, to stretch the contracted outer layer fibers to their original state, cuts the untwisted outer layer fibers, abuts the ends of the core yarns formed by the cutting, applies an adhesive to an abutted portion, and then sets the adhesive for splicing.

[0010] According to a preferred embodiment, the automatic winder may be characterized in that the core yarn splicing device comprises pairs of clamp members each of which grips a corresponding one of two core yarns and is movable, a pair of first cutter members each used to form an end of the corresponding core yarn gripped by the clamp members, a pair of air nozzles each of which allows a flow of compressed air to act on the end of the corresponding core yarn, a pair of second cutter members each of which cuts, after the core yarns have been cut, the end of the corresponding core yarn so that the pairs of clamp members can be moved closer to each other to abut end surfaces of the core yarns against each other, resin supply means for applying an adhesive composed of a photo-setting resin, to an abutted portion, and light irradiation means for setting the applied photo-setting resin. Further, the automatic winder may be characterized in that the light irradiation means comprises a semiconductor laser.

Brief Description of the Drawings

[0011]

Figure 1 is a view illustrating a core yarn splicing method.

Figure 2 is a continued part of Figure 1 illustrating the core splicing method.

Figure 3 is a detailed view corresponding to Figure 1.

Figure 4 is a view illustrating a spliced portion of core yarns.

Figure 5 is a view illustrating a splicing operation procedure executed by an automatic winder comprising a core yarn splicing device.

Figure 6 is a continued part of Figure 5 illustrating the splicing operation procedure.

Figure 7 is a continued part of Figure 6 illustrating the splicing operation procedure.

Figure 8 is a continued part of Figure 7 illustrating the splicing operation procedure.

Figure 9 is a view illustrating the splicing operation procedure executed by the core yarn splicing device.

Figure 10 is a continued part of Figure 9 illustrating the splicing operation procedure.

Figure 11 is a continued part of Figure 10 illustrating the splicing operation procedure.

Figure 12 is a continued part of Figure 11 illustrating the splicing operation procedure.

Figure 13 is a continued part of Figure 12 illustrating the splicing operation procedure.

Figure 14 is a continued part of Figure 13 illustrating the splicing operation procedure.

Figure 15 is a continued part of Figure 14 illustrating the splicing operation procedure.

Figure 16 is a view illustrating a second embodiment of a core yarn splicing device corresponding to Figure 15.

Detailed Description of the Preferred Embodiments

[0012] With reference to the accompanying drawings, detailed description will be given below of a core yarn splicing method, a spliced portion of core yarns formed by this splicing method, and an automatic winder comprising a splicing device that embodies this splicing method, according to the present invention.

[0013] First, the core yarn splicing method will be described with reference to the drawings. Figures 1 and 2 illustrate this splicing method. In Figure 1A, a pair of core yarns 1A, 1B are gripped by closable and movable clamps 30, 31. A pair of air nozzles 50, 51 are used to apply a flow of compressed air to the core yarns 1A, 1B in their axial direction (the direction in which yarn ends are stretched). At this time, the compressed air is allowed to flow toward first cutters 40, 41 (the direction of the arrows in the figure), described later. Subsequently, in Figure 1B, while the flow of compressed air is acting on the core yarns 1A, 1B, the first cutters 40, 41 are moved perpendicularly to the axial direction of the core yarns 1A, 1B to cut the core yarns 1A, 1B. Ends of the core yarns 1A, 1B are thus formed. Subsequently, in Figure 1C, the operation of the air nozzles 50, 51 is halted. At the same time, a pair of second cutters 60, 61 located close to the clamps 30, 31, respectively, are moved perpendicularly to the axial direction of the core yarns 1A, 1B to cut the core yarns 1A, 1B. Thus, core yarn end

surfaces 1a, 1b are formed in the core yarns 1A, 1B, respectively.

[0014] Furthermore, in Figure 2A, the core yarn end surfaces 1a, 1b are impregnated with an adhesive 2 composed of an ultraviolet setting resin. Subsequently, in Figure 2B, the clamps 30, 31 are moved to abut the core yarn end surfaces 1a, 1b against each other. Then, the adhesive 2 that has infiltrated through the core yarn end surfaces 1a, 1b becomes integral owing to surface tension. Subsequently, in Figure 2C, the core yarn end surfaces 1a, 1b abutted against each other are irradiated with an ultraviolet ray from an ultraviolet lamp 70. The adhesive 2 is thus set to form a spliced portion. After the spliced portion has been formed, the clamps 30, 31 are opened. Then, a driving device (not shown in the drawings) is used to feed the core yarns 1A, 1B.

[0015] Alternatively, the adhesive 2 may be applied to the abutted portion of the core yarn end surfaces 1a, 1b abutted against each other as shown in Figure 2B. Alternatively, the adhesive 2 may be applied to the core yarn end surfaces 1a, 1b during or immediately after cutting in unison with the operation of the second cutters 60, 61 as shown in Figure 1C.

[0016] If the adhesive 2 is made of a thermosetting resin, the thermosetting resin may be set by using, in place of the ultraviolet lamp 70, a halogen lamp that applies a heat ray or contacting a pair of hot plates with the abutted portion under pressure, the hot plates each having a semicircular groove is formed in its inner surface. On the other hand, if the adhesive 2 is made of a photosetting resin, it may be set by using a semiconductor laser in place of the ultraviolet lamp 70 and irradiating the abutted portion with a laser beam.

[0017] Furthermore, the splicing method will be described in detail with reference to Figure 3. Figure 3 corresponds to Figure 1 and is an enlarged view of the core yarn 1A. Figure 3A corresponds to Figure 1A. In this state, outer layer fibers 11a, an outer layer of inner layer fibers 10a, is wound around the inner layer fibers 11a at the intervals of a specified distance L1. Next, Figures 3B1 and 3B2 correspond to Figure 1B. Figure 3B1 shows a state observed before compressed air is applied. Figure 3B2 shows a state observed after the compressed air has been applied. As shown in Figure 3B1, by using the first cutter 40 to cut the core yarn 1A with no compressed air applied, the intervals at which the outer layer fibers 11a is wound around the inner layer fibers 10a decreases to a distance L2 in connection with the contraction of the inner layer fibers 10a. Furthermore, as shown in Figure 3B2, by applying compressed air in the direction of arrows in the figure (the direction in which the core yarn end is stretched), the winding interval of the outer layer fibers 11a returns to the distance L1, shown in Figure 3A. Next, Figure 3C corresponds to Figure 1C. The second cutter 60 is used to cut the core yarn 1A to clear the contraction of the outer layer fibers. Consequently, the core end surface 1a can be formed while the core yarn is in its original state, i.e. the state

in which the winding interval of the outer layer fibers 11a is the distance L1. In the above embodiment, the flow of compressed air is used as external force that untwists the outer later fibers. However, it is possible to use other mechanical means, e.g. a method of applying a brake

lining-like member to the yarn end surface and drawing the yarn end surface through this member or allowing a rotating member to act on the yarn end surface.

[0018] Now, with reference to Figure 4, description will be given of a spliced portion of core yarns formed by the previously described splicing method.

[0019] Figure 4 illustrates the spliced portion of core yarns. The spliced core yarns 1A, 1B are abutted against each other without superimposing the core yarn end surfaces 1a, 1b on each other. The core yarns 1A, 1B are tightly spliced together using the adhesive 2. Further, the core yarn end surfaces 1a, 1b are abutted against each other after cutting. Accordingly, the twists of the outer layer fibers 11a, 11b in the core yarns 1A, 1B, respectively, are substantially continuous.

[0020] Furthermore, with reference to Figures 5 to 16, description will be given of an automatic winder comprising a core yarn splicing device that embodies the previously described splicing method. Figures 5 to 8 are side views of the automatic winder. Figures 9 to 16 are front views of the core yarn splicing device provided in the automatic winder. These figures illustrate operations performed when two core yarns are spliced together.

[0021] The automatic winder shown in Fig. 5 comprises a core yarn splicing device (hereinafter referred to as a "splicing device") 101 arranged in the middle, a yarn supplying bobbin B arranged at the bottom, and a winding package P arranged at the top. A core yarn YP supplied by the yarn supplying bobbin B is wound around the winding package P being rotated. The core yarn YP supplied by the yarn supplying bobbin B passes through a guide G and is then subjected to an appropriate tension by a tenser T. The core yarn YP then passes around a traversing drum D being rotated. Thus, a predetermined amount of core yarn TP is wound around the winding package P. A detecting device F always detect the thickness of the passing core yarn YP so as to prevent a core yarn YP with a defective part from being wound around the winding package P.

[0022] Following Figure 5, in Figure 6, while the core yarn YP supplied by the yarn supplying bobbin B is being wound around the winding package P, the detecting device F detects a yarn defect in the passing core yarn YP by comparing the diameter of the core yarn YP with a preset value. Then, when the detecting device F detects a yarn defect, a cutter (not shown in the drawings) provided in the detecting device F cuts the core yarn YP. At the same time, the winding package P stops rotating, thus halting the winding operation.

[0023] Consequently, an upper yarn Y1 is wound around the package P, whereas a lower yarn Y2 is sucked into a yarn sucking port (yarn trap) W arranged above the guide G.

[0024] Following Figure 6, in Figure 7, in the state shown in Figure 6, an upper yarn suction arm S1 turns clockwise around an upper axis D1. On the other hand, a lower yarn suction arm S2 turns counterclockwise around a lower axis D2.

[0025] The suction arms S1 S2 are hollow inside and are connected to a suction duct KP. Then, when the suction duct KP sucks air, suction ports S1a, S2a in the suction arms S1 S2, respectively, suck and grip the upper yarn Y1 and the lower yarn Y2, respectively.

[0026] Following Figure 7, in Figure 6, with the suction arms S1 S2 gripping the upper yarn Y1 and the lower yarn Y1, respectively, the upper yarn suction arm S1 is rotated counterclockwise around the upper axis D1 and swung downward. On the other hand, the lower yarn suction arm S2 is rotated clockwise around the lower axis D2 and swung upward. The upper yarn Y1 and the lower yarn Y2 are thus guided to predetermined positions via a front surface of the splicing device 101.

[0027] Now, a description will be given of operations performed by the splicing device 101 to splice the upper yarn Y1 and the lower yarn Y2 together. Figure 9 shows the front surface of the splicing device 101. An upper yarn clamp member 110 and a lower yarn clamp member 111 are provided on a base 101A. The upper yarn clamp member 110 and the lower yarn clamp member 111 are composed of first clampers 110a, 111a and second clampers 110b, 111b, respectively. The first clampers 110a, 111a are normally separated from the second clampers 110b, 111b. The upper yarn suction arm S1 guides the upper yarn Y1 to between the first clasper 110a and the second clasper 110b of the upper yarn clamp member 110. The lower yarn suction arm S2 guides the upper yarn Y2 to between the first clasper 111a and the second clasper 111b of the lower yarn clamp member 111.

[0028] Following Figure 9, in Figure 10, with the upper yarn Y1 positioned between the first clasper 110a and the second clasper 110b of the upper yarn clamp member 110, and the lower yarn Y2 positioned between the first clasper 111a and the second clasper 111b of the lower yarn clamp member 111 (the state shown in Figure 9), the first clampers 110a, 111a are moved to abut their plate surfaces against plate surfaces of the second clampers 110b, 111b, located opposite the first clampers 110a, 111a, respectively. The upper yarn Y1 and the lower yarn Y2 are thus gripped.

[0029] Following Figure 10, in Figure 11, a first cutter member 220 for the upper yarn is positioned under the splicing device 101. On the other hand, a first cutter member 221 for the lower yarn is positioned above the splicing device 101. The first cutter member 220 for the upper yarn is composed of a fixed blade 220a and a movable blade 220b, and the first cutter member 221 for the lower yarn is composed of a fixed blade 221a and a movable blade 221b. Then, the movable blades 220b, 221b are moved to cause the first current member 220 for the upper yarn to cut the upper yarn Y1, while

causing the first cutter member 221 for the lower yarn to cut the lower yarn Y2. Further, an upper yarn air nozzle 230 is positioned between the upper yarn clamp member 110 and the first cutter member 220 for the upper yarn, and a lower yarn air nozzle 231 is positioned between the lower yarn clamp member 111 and the first cutter member 221 for the lower yarn. Simultaneously with the actuation of the first cutter members 220, 221, the air nozzles 230, 231 apply compressed air to the upper yarn Y1 and the lower yarn Y2, respectively. At this time, compressed air is directed toward the first cutter members 220, 221.

[0030] As shown in Figure 12, between the clamp members 110, 111, a second cutter member 120 for the upper yarn is positioned close to the upper yarn clamp member 110, and a second cutter member 121 for the lower yarn is positioned close to the lower yarn clamp member 111. The second cutter member 120 for the upper yarn is composed of a fixed blade 120a and a movable blade 120b, and the second cutter member 121 for the lower yarn is composed of a fixed blade 121a and a movable blade 121b. Then, the movable blades 120b, 121b are moved to cause the second cutter member 120 for the upper yarn to cut the upper yarn Y1, while causing the second cutter member 121 for the lower yarn to cut the lower yarn Y2. The suction arms S1, S2 suck parts of the upper yarn Y1 and lower yarn Y2 which are not gripped by the clamp members 110, 111, respectively, and parts of the yarns Y1, Y2 which have defective portions are discharged to the suction pipe KP.

[0031] Following Figure 12, in Figure 13, the clamp members 110, 111 gripping the upper yarn Y1 and the lower yarn Y2, respectively, are moved closer to each other to abut the cut end surface of the upper yarn Y1 against the cut end surface of the lower yarn Y2.

[0032] Following Figure 13, in Figure 14, with the end surfaces of the upper yarn Y1 and the lower yarn Y2 abutted against each other (the state shown in Figure 13), a supply port 131 of a resin supply means 130 approaches the abutted portion. Then, the resin supply means 130 applies a photosetting resin to the abutted portion through the supply port 131. The resin supply means 130 is a container shaped like a hypodermic syringe. It is composed of a main body 132, the supply port 131 and a cylinder 133. The main body 132 is attached to a pedestal CA that can be freely advanced and retracted. A photosetting resin is accommodated in the main body 132. Then, with the cut end surfaces of the upper yarn Y1 and the lower yarn Y1 abutted together, the pedestal CA is advanced. At the same time, shielding means 150 moves upward to open the supply port 131 of the resin supply means 130. The supply port 131 of the resin supply means 130 then approaches the abutted portion of the upper yarn Y1 and lower yarn Y2. Subsequently, the cylinder 133 is actuated to discharge a predetermined amount of photosetting resin to apply it to the abutted portion.

[0033] Following Figure 14, in Figure 15, with the photoset-

ting resin applied to the abutted portion of the upper yarn Y1 and lower yarn Y2 (the state shown in Figure 14), the photosetting resin is set by being irradiated with light from light irradiation means 140. The upper yarn Y1 and the lower yarn Y2 are thus spliced together. In this embodiment, the photosetting resin is an ultraviolet setting resin, and the light irradiation means 140 provides an ultraviolet ray. During irradiation, the pedestal CA is retracted to its original position. The supply port 131 thus moves away from the abutted portion of the upper yarn Y1 and lower yarn Y2. At the same time, the shielding means 150 returns to its original position. Its plate portion 151 thus shields the supply port 131. This prevents the photosetting resin in the supply port 131 from being set. This in turn prevents the supply port 131 from being blocked. Further, a heater (not shown in the drawings) provided close to the resin supply means 130 enables the adjustment of viscosity of the photosetting resin in the resin supply means 130. This provides a viscosity suitable for the yarn number of the core yarns to be spliced together.

[0034] Furthermore, in this embodiment, an upper yarn detecting means 160 is arranged close to the upper yarn clamp member 110. On the other hand, a lower yarn detecting means 161 is arranged close to the lower yarn clamp member 111. The detecting means 160, 161 operate in the state shown in Figure 10. The upper yarn detecting means 160 detects the upper yarn Y1, while the lower yarn detecting means 161 detects the lower yarn Y2. If the upper yarn detecting means 160 fails to detect the upper yarn Y1 or the lower yarn detecting means 161 fails to detect the lower yarn Y2, i.e. if the upper yarn clamp member 110 fails to grip the upper yarn Y1 or the lower yarn clamp member 111 fails to grip the lower yarn Y2, then the operations succeeding the one shown in Figure 11 are halted. This prevents the photosetting resin from being uselessly supplied or drooling from the supply port. Then, the operations succeeding the one shown in Figure 6 are performed again. These operations are repeated until a splicing process succeeds. After the splicing process has succeeded, i.e. after the upper yarn detecting means 160 and the lower yarn detecting means 161 have detected the upper yarn Y1 and the lower yarn Y2, respectively, and the operations ending with the one shown in Figure 15 have been performed, the winding package P is rotated again to wind up the core yarn YP from the yarn supplying bobbin B. This enables the core yarn YP without any defective parts to be always wound up.

[0035] Now, a second embodiment separate from the first embodiment will be described. A description of the same components as those in the first embodiment is omitted. Figure 16 shows a splicing device different from the first embodiment and corresponds to Figure 15 for the first embodiment. The light irradiation means 140 in the first embodiment sets a photosetting resin by irradiating it with light diffused by, for example, a halogen lamp. However, in the second embodiment, the light ir-

radiation means 140 is a semiconductor laser 140' with a lens installed on a semiconductor laser diode. The lens condenses light emitted by the semiconductor laser diode, to emit a laser beam 141. The laser beam 141 is allowed to impinge on the abutted portion of the upper yarn Y1 and lower yarn Y2 to set the photosetting resin. Further, the semiconductor laser 140' preferably has a wavelength, band of 400 nm to 420 nm. It is, for example, a blue or purple semiconductor laser manufactured by Nichia Chemical Co., Ltd.

[0036] In Figure 16, with the photosetting resin applied to the abutted portion of the yarns Y1, Y2 (the state shown in Figure 14), the laser beam 141 emitted by the semiconductor laser 140' is allowed to impinge on the abutted portion of the yarns Y1, Y2. The photosetting resin is thus set to splice the yarns Y1, Y2 together. The compact shape of the semiconductor laser 140' allows the entire splicing device 101 to be miniaturized. Further, the semiconductor laser 140' consumes only a small amount of power compared to the quantity of light it provides. It is thus economical.

[0037] Furthermore, since the photosetting means 140 in the first embodiment diffuses light, the splicing process fails if the photosetting resin sticks to the yarns Y1, Y2 and clamp members 110, 111. However, in the second embodiment, since the abutted portion is irradiated with the laser beam 141 in a pinpointing manner. Consequently, even if the photosetting resin sticks to the yarns Y1, Y2 and clamp members 110, 111, the yarns Y1, Y2 and clamp members 110, 111 are not exposed to the laser beam 141. Consequently, the yarns Y1, Y2 and clamp members 110, 111 are prevented from sticking to one another. This makes the splicing operation always successful.

[0038] Moreover, the pinpointing irradiation allows the photosetting resin to be set more appropriately than in the first embodiment.

[0039] Another advantage of the semiconductor laser 140' is that the photosetting resin is instantaneously set to increase operation speed, thus lengthening the lifetime of the light irradiation means 140.

[0040] Further, in this embodiment, the spliced portion of the yarns Y1, Y2 is irradiated with light from the semiconductor laser 140' in a pinpointing manner. This eliminates the need for the shielding means as in the case with the first embodiment. Therefore, the device as a whole can be simplified.

[0041] As described above, according to the present invention, when the two core yarns are spliced together using the adhesion method, the inner layer fibers and the outer layer fibers can be spliced together. Consequently, the resulting spliced portion is stretchable and the two core yarns can be spliced together while maintaining their characteristics.

[0042] Furthermore, the adhesion method serves to prevent the projection of the spliced portion and to make the spliced portion short and small. Therefore, when the yarn is dyed, its discolored portion is short and unno-

ticeable.

Claims

1. A method of splicing core yarns composed of stretchable inner layer fibers and anti-shrink outer layer fibers **characterized by** comprising exerting external force on ends of the two core yarns with the outer layer fibers contracted by the cutting owing to stretchability of the inner layer fibers, in a direction in which the core yarns are stretched, to stretch said contracted outer layer fibers to their original state, cutting the untwisted outer layer fibers, abutting the ends of the core yarns formed by the cutting, applying an adhesive to an abutted portion, and then setting the adhesive.
2. A method of splicing core yarns composed of stretchable inner layer fibers and anti-shrink outer layer fibers **characterized by** comprising allowing a flow of compressed air to act on ends of the two core yarns with the outer layer fibers contracted by the cutting owing to stretchability of the inner layer fibers, in a direction in which the core yarns are stretched, to stretch said contracted outer layer fibers to their original state, cutting the untwisted outer layer fibers, abutting the ends of the core yarns formed by the cutting, applying an adhesive to an abutted portion, and then setting the adhesive.
3. A method of splicing core yarns together according to Claim 1 or Claim 2, **characterized in that** said adhesive is optically set when irradiated with light.
4. A method of splicing core yarns together according to Claim 3, **characterized in that** said light is an ultraviolet ray.
5. A method of splicing core yarns together according to Claim 3, **characterized in that** said light is a laser beam.
6. A spliced portion of core yarn **characterized in that** two core yarns each composed of stretchable inner layer fibers and anti-shrink outer layer fibers are provided, ends of the two core yarns are abutted together, an adhesive is applied to an abutted portion to splice the core yarns together so that at the spliced portion, said inner layer fibers and said outer layer fibers are substantially continuous.
7. An automatic winder comprising a core yarn splicing device, the automatic winder being **characterized by** being provided with a core yarn splicing device that exerts external force on ends of two core yarns, which are composed of stretchable inner layer fibers and anti-shrink outer layer fibers, with the

outer layer fibers contracted by the cutting owing to stretchability of the inner layer fibers, in a direction in which the core yarns are stretched, to stretch said contracted outer layer fibers to their original state, cuts the untwisted outer layer fibers, abuts the ends of the core yarns formed by the cutting, applies an adhesive to an abutted portion, and then sets the adhesive for splicing. 5

8. An automatic winder according to Claim 7, **characterized in that** said core yarn splicing device comprises pairs of clamp members each of which grips a corresponding one of two core yarns and is movable, a pair of first cutter members each used to form an end of the corresponding core yarn gripped by the clamp members, a pair of air nozzles each of which allows a flow of compressed air to act on the end of said corresponding core yarn, a pair of second cutter members each of which cuts, after the core yarns have been cut, the end of said corresponding core yarn so that the pairs of clamp members can be moved closer to each other to abut end surfaces of said core yarns against each other, resin supply means for applying an adhesive composed of a photo-setting resin, to an abutted portion, and light irradiation means for setting the applied photo-setting resin. 10 15 20 25
9. An automatic winder according to Claim 8, **characterized in that** said light irradiation means comprises a semiconductor laser. 30

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FIG. 1A

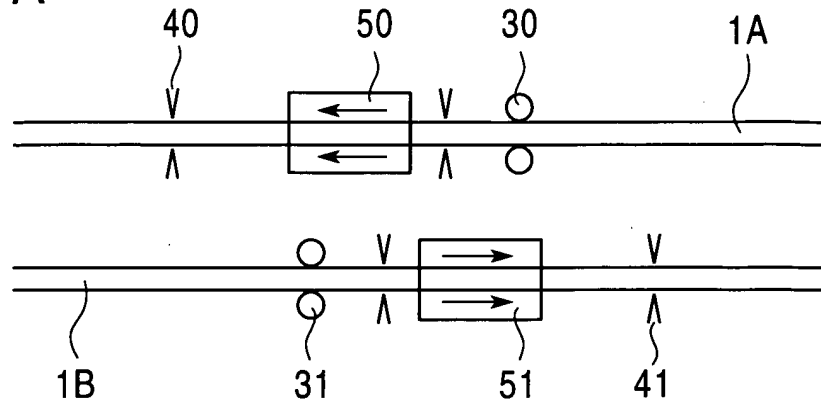


FIG. 1B

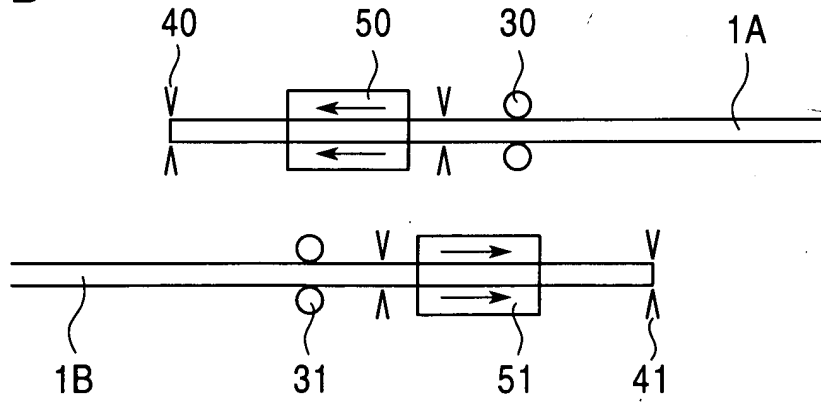


FIG. 1C

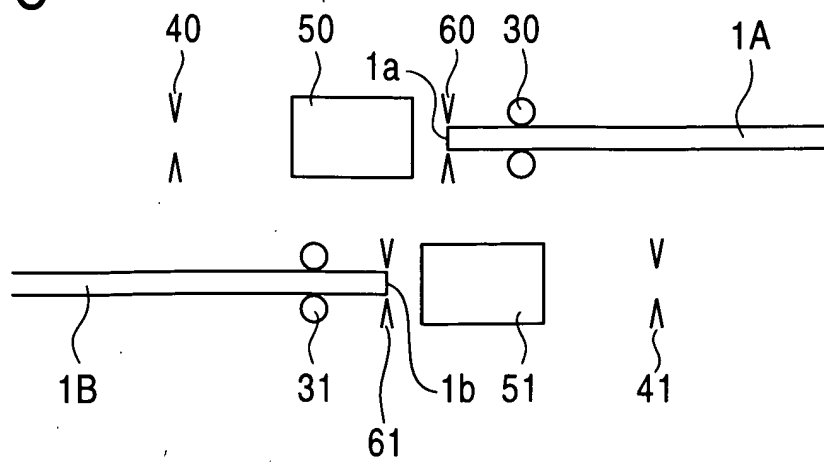


FIG. 2A

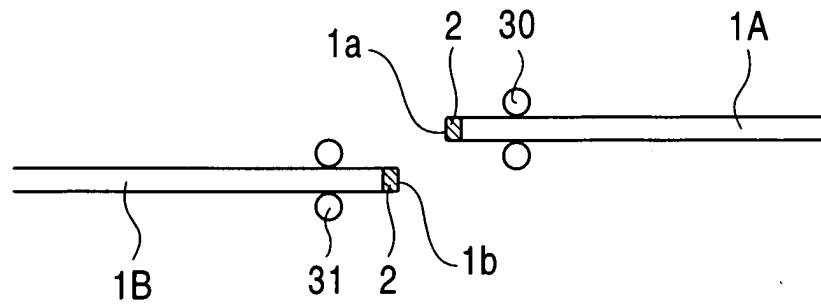


FIG. 2B

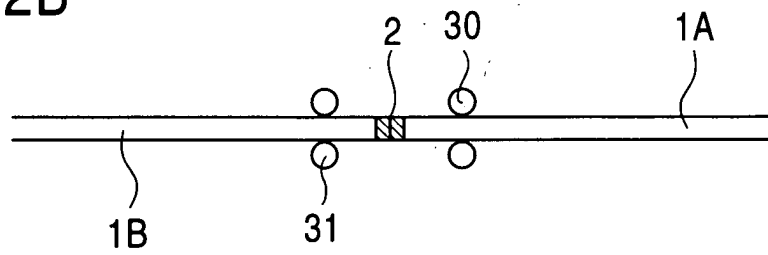


FIG. 2C

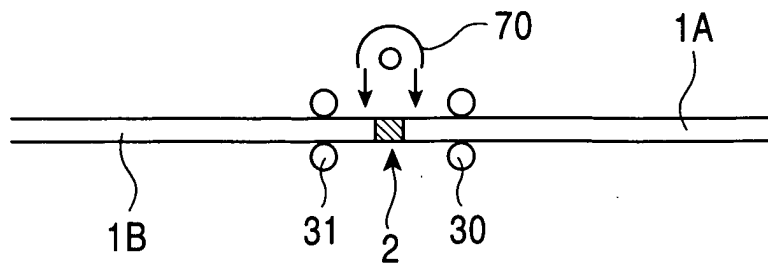


FIG. 3A

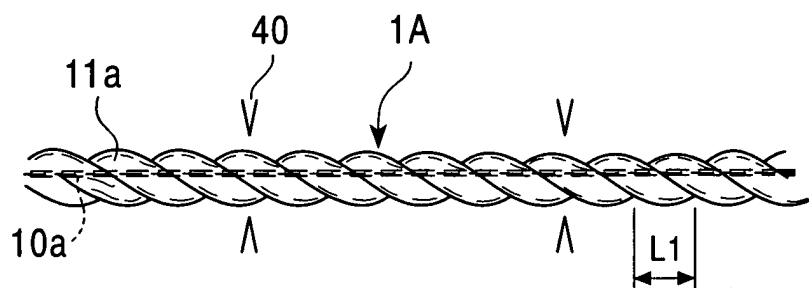


FIG. 3B1

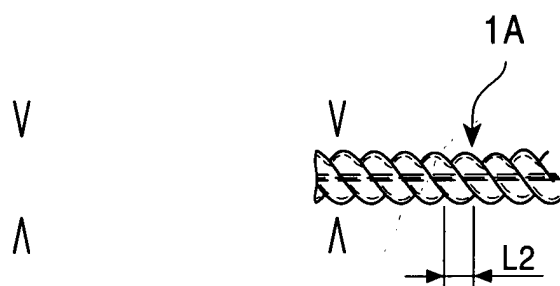


FIG. 3B2

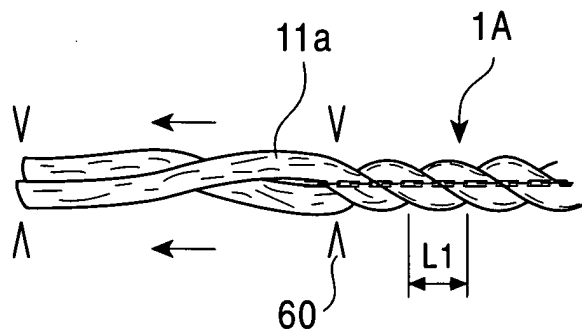


FIG. 3C

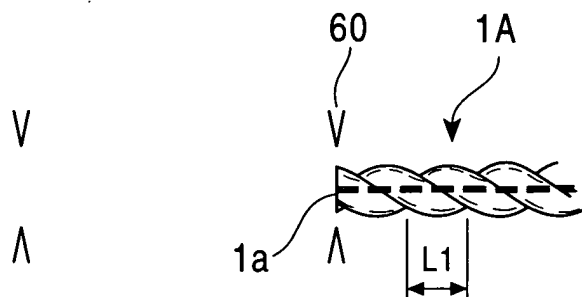


FIG. 4

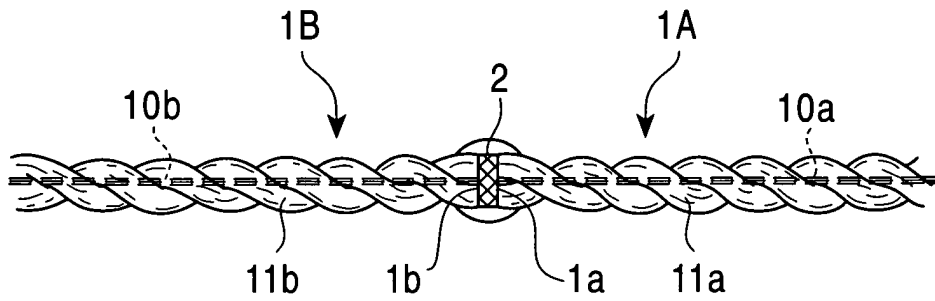


FIG. 5

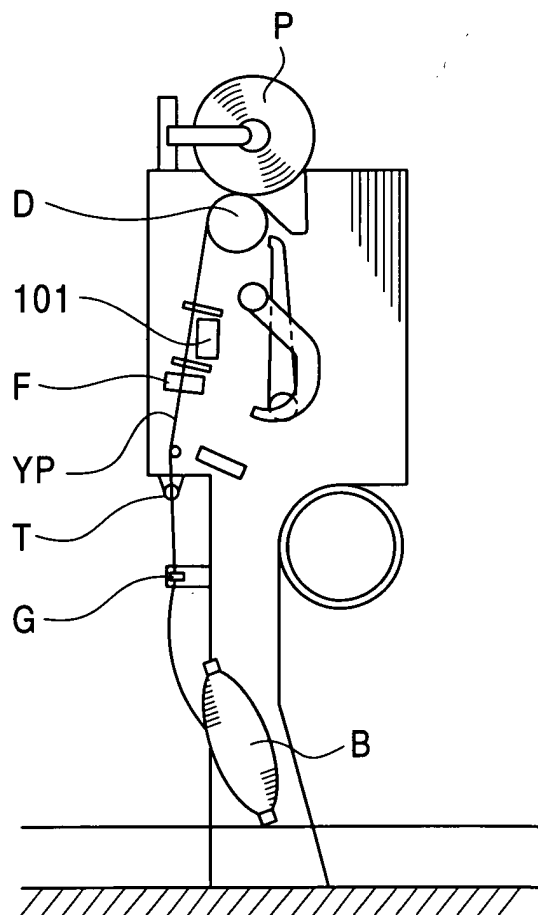


FIG. 6

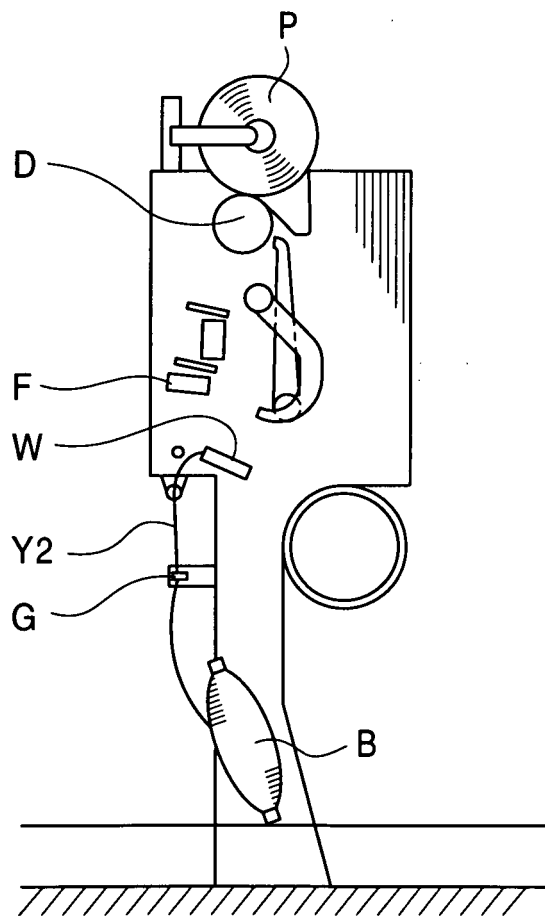


FIG. 7

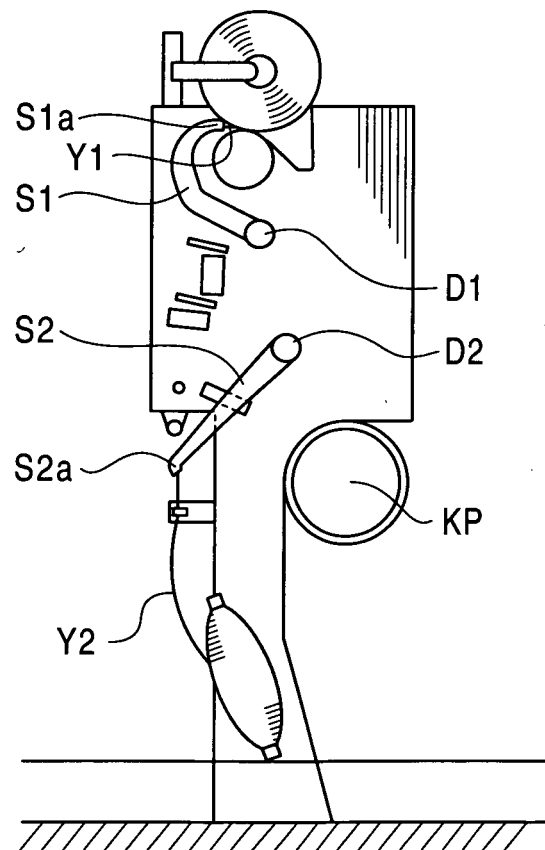


FIG. 8

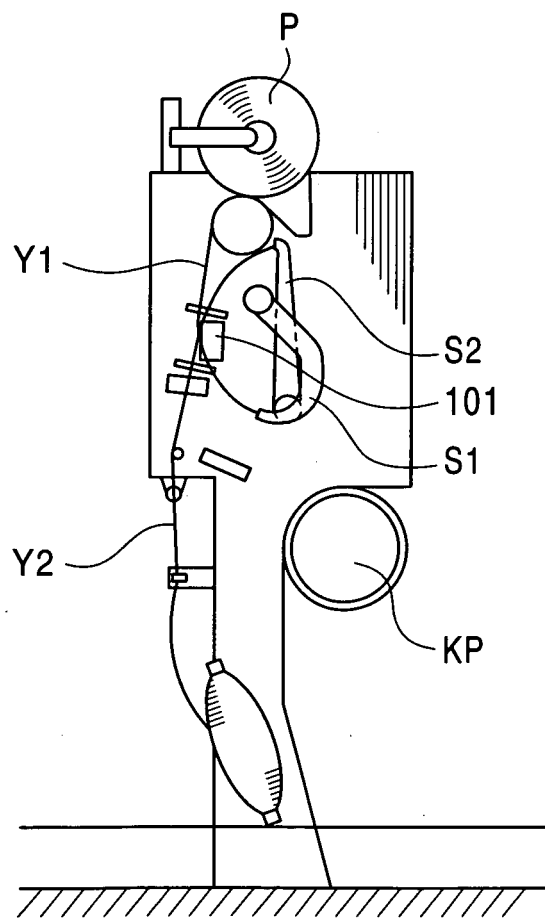


FIG. 9

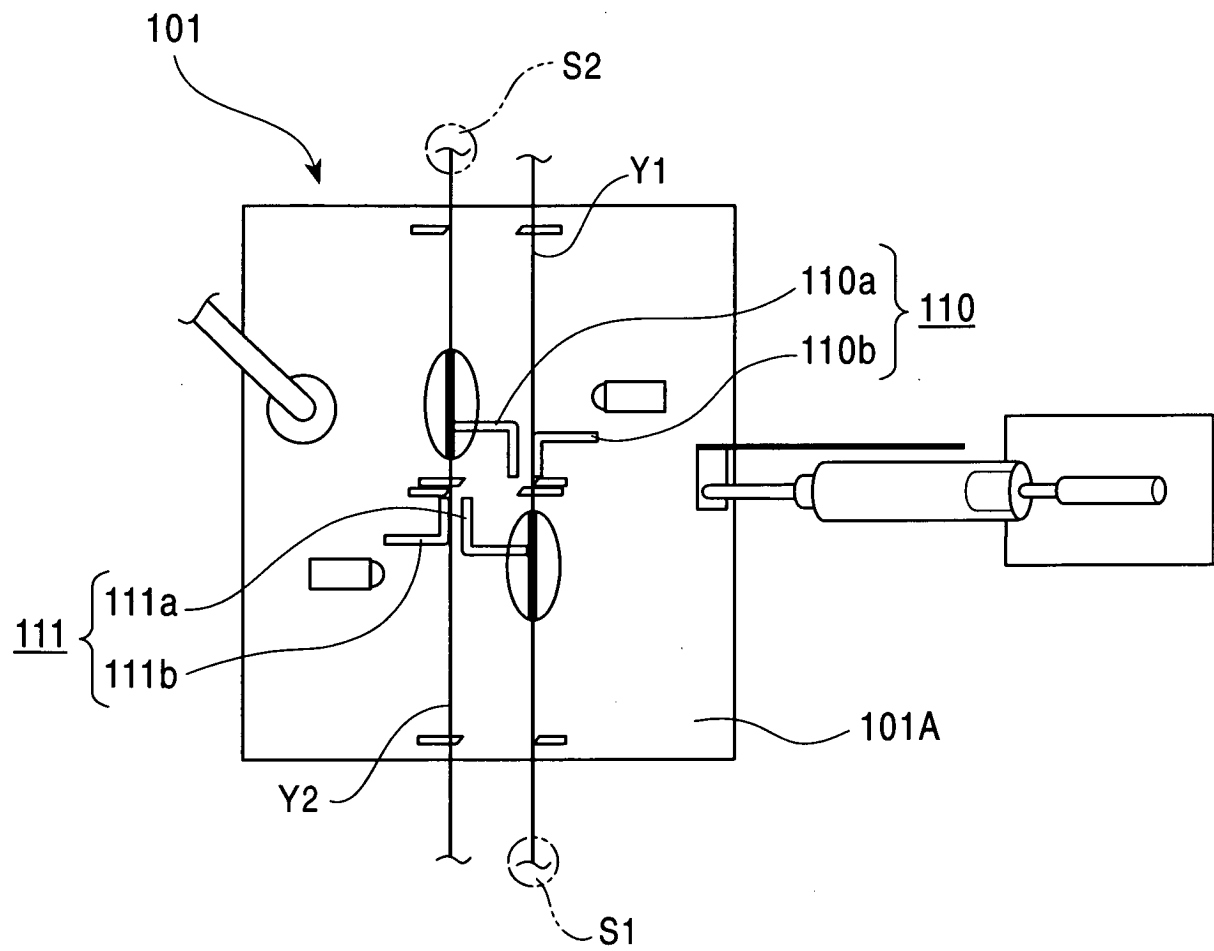


FIG. 10

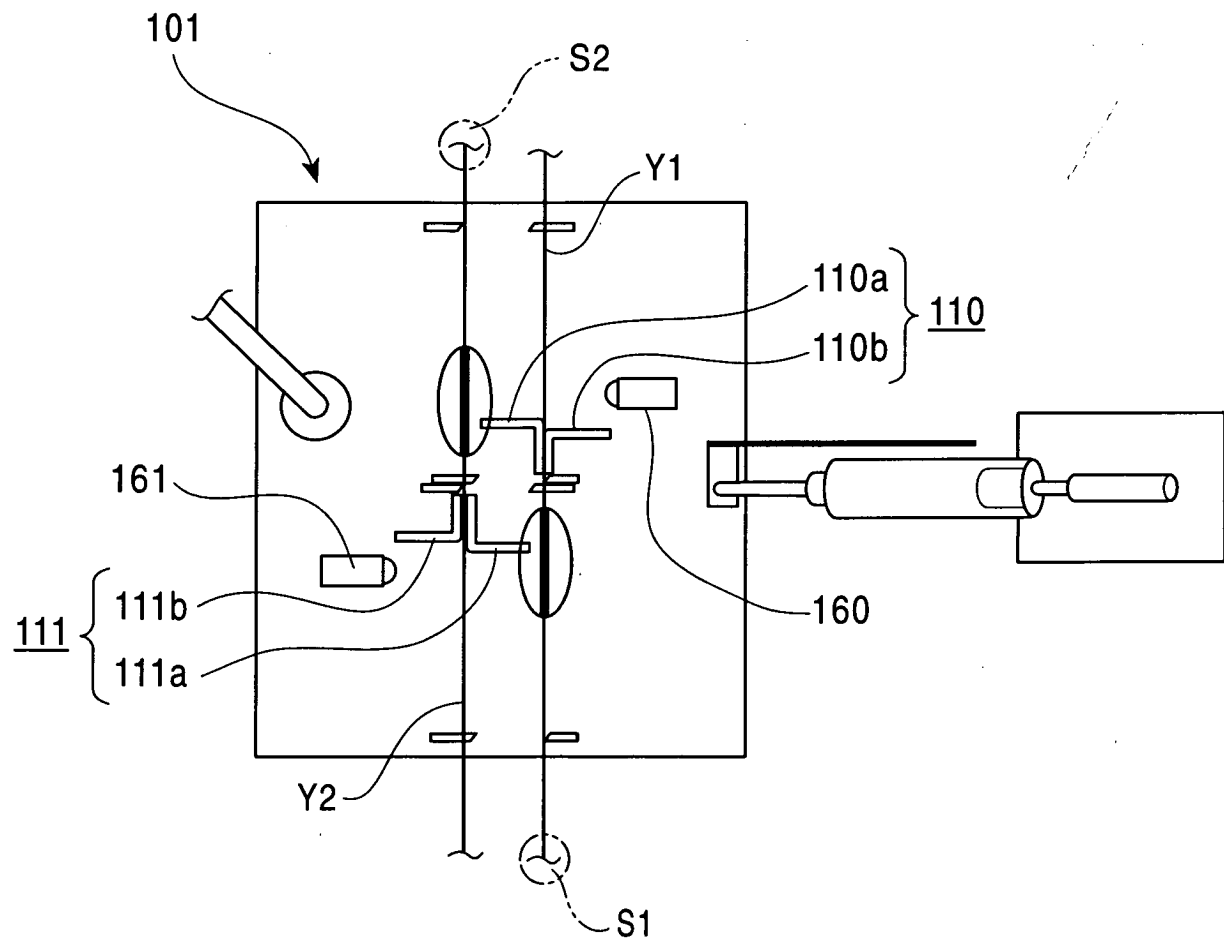


FIG. 11

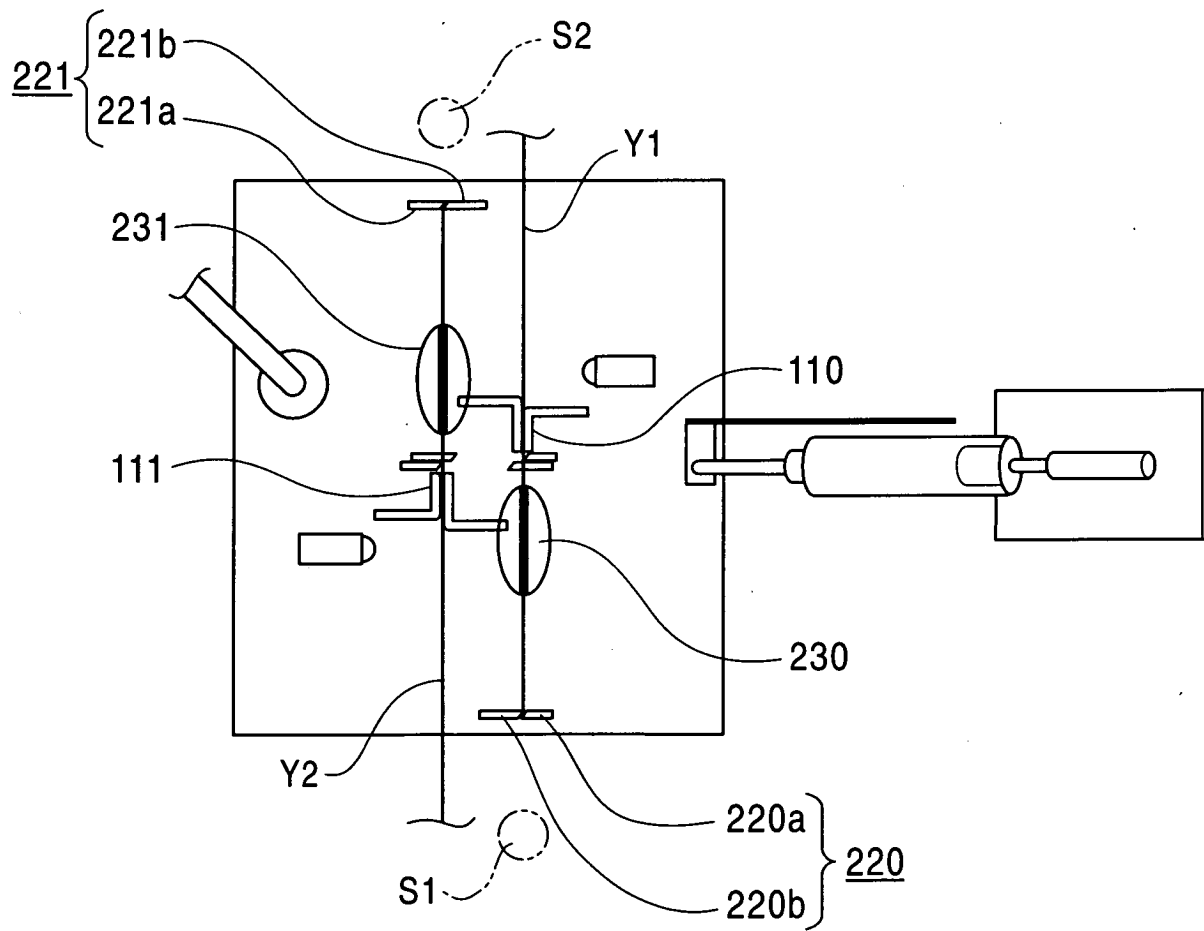


FIG. 12

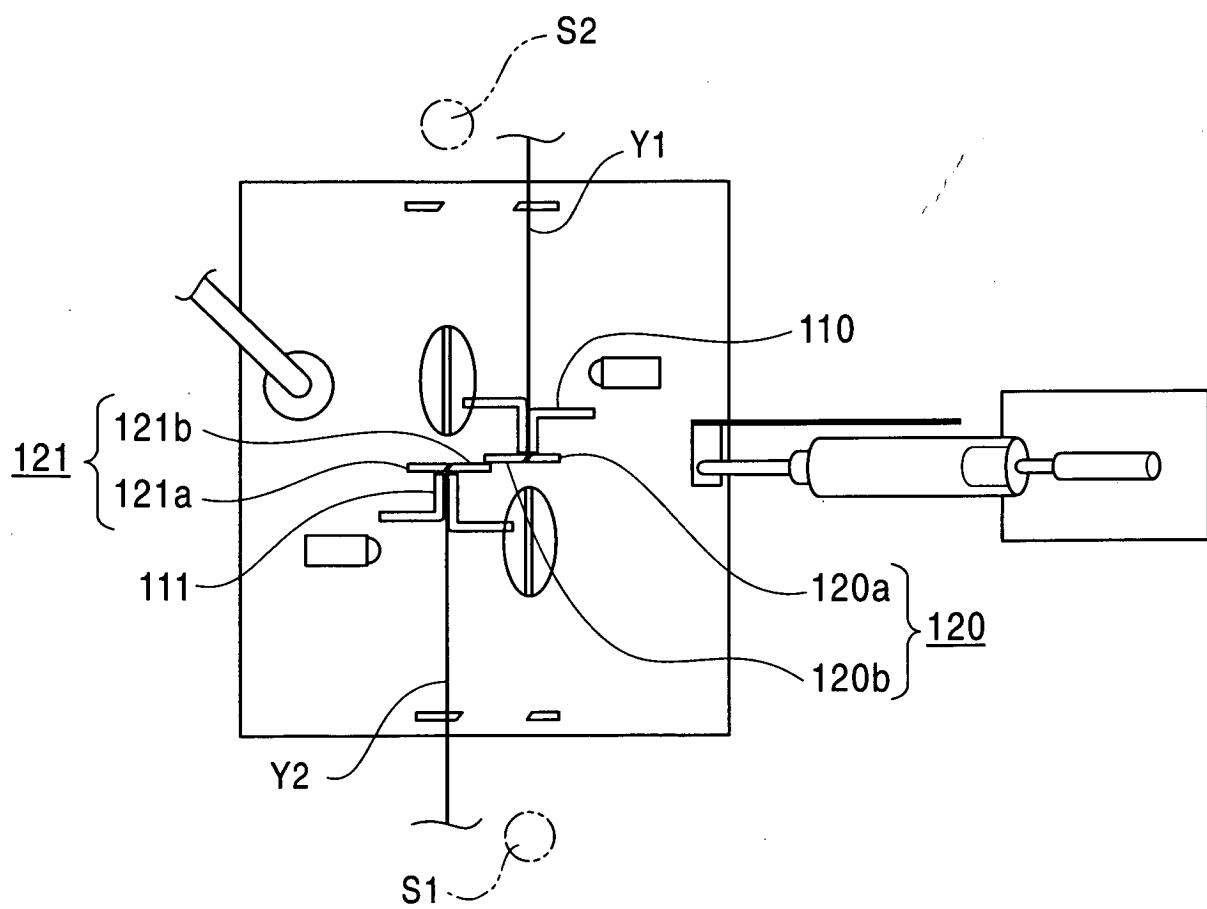


FIG. 13

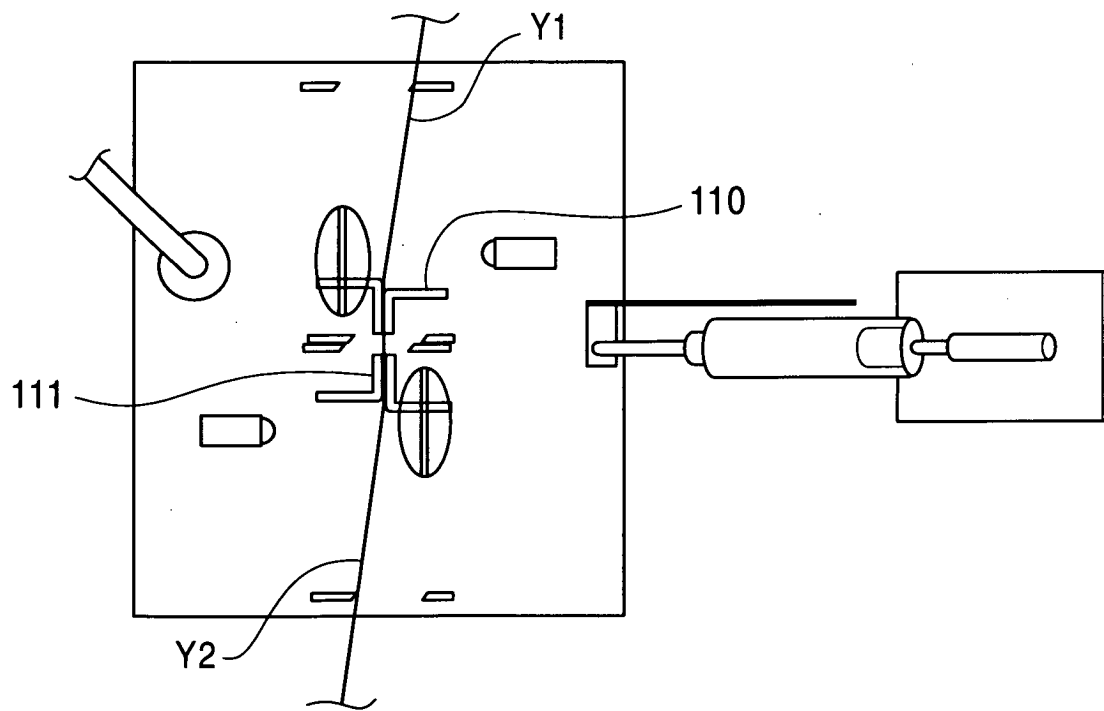


FIG. 14

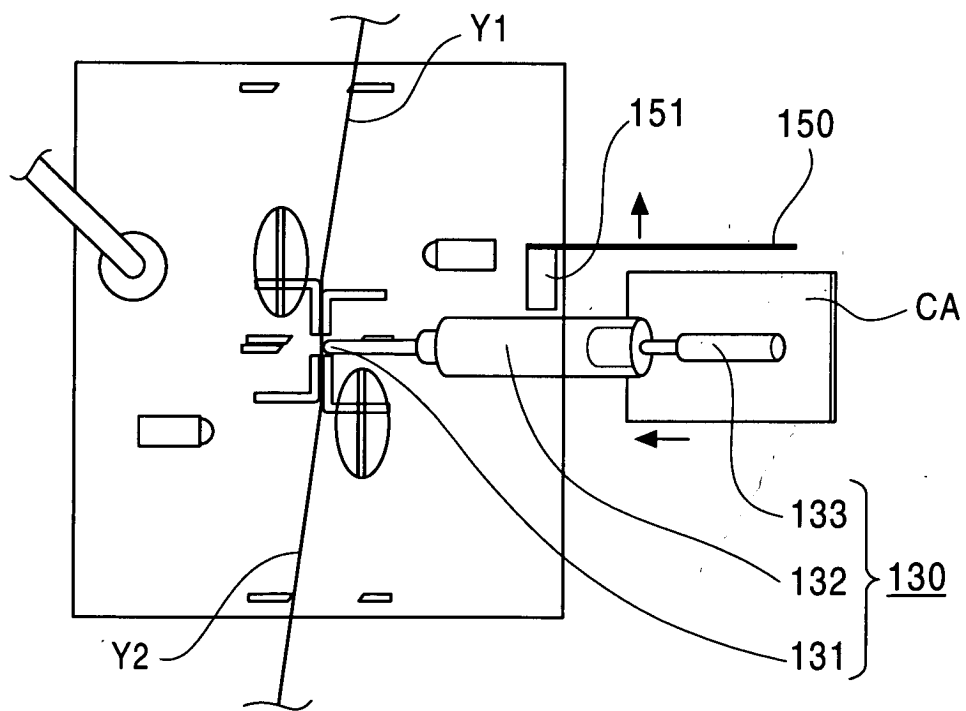


FIG. 15

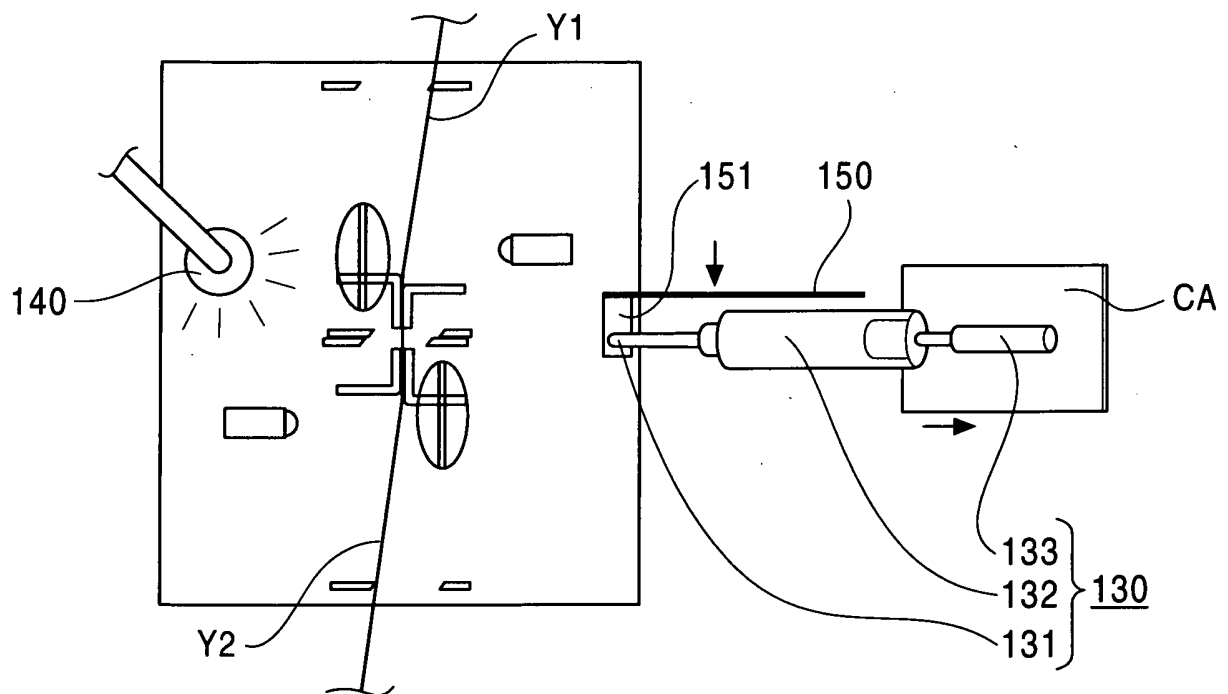


FIG. 16

