

(12)

EUROPEAN PATENT APPLICATION

(43)

Date of publication:

10.04.2002 Bulletin 2002/15

(51)

Int Cl.7:

B65H 69/02

(21)

Application number:

01123262.6

(22)

Date of filing:

04.10.2001

(84) Designated Contracting States: AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR Designated Extension States: AL LT LV MK RO SI	(72) Inventor: Sakamoto, Naotaka Shiga (JP)
(30) Priority: 03.10.2000 JP 2000304050 24.04.2001 JP 2001125360	(74) Representative: Gritschneider, Martin, Dipl.-Phys. et al Patentanwälte Abitz & Partner Postfach 86 01 09 81628 München (DE)
(71) Applicant: Murata Kikai Kabushiki Kaisha Minami-ku, Kyoto-shi, Kyoto 601 (JP)	

(54)

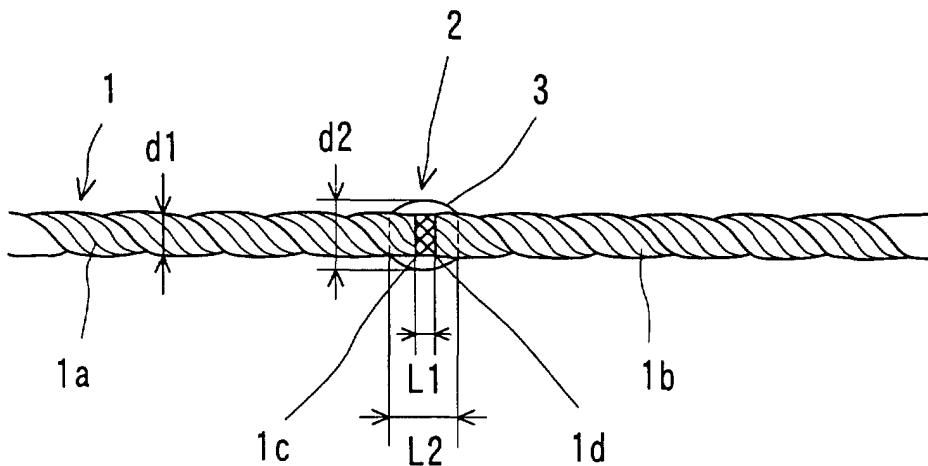
Yarn splicing method, the joint and auto winder equipped with yarn splicer

(57)

The yarn splicing method and the joint can secure the twist continuity of two yarn ends without reference to the yarn type, and makes the joint intensity superior and the dyeing property good. The adhesive (3)

is hardened in the state that the yarn ends (1a) and (1b) of spun yarn, which are made by twisting staple fibers, are butted and the adhesive (3) that has permeability to staple fibers are applied to the joint.

FIG. 1



Description

[Technical Field]

5 **[0001]** The present invention relates to a yarn splicing method and a structure of the joint formed by yarn splicing method, and an auto winder equipped with a yarn splicer that embodies the joint formed by yarn splicing method.

[Background Art]

10 **[0002]** The following splicing methods of the spun yarn are known as practical:

- (1) A knotting method that two yarn ends are tied mechanically.
- (2) An air splicer method that two yarn ends are laid in parallel and are twisted by the action of revolving airflow.

15 **[0003]** There are a fisherman's knot type and a weaver's knot type in the knotting methods, and the prescribed knot can be formed by use of the corresponding automatic yarn splicer. In these knotting methods, there is the advantage that the yarn joint has intensity and the relatively high number yarn count can be spliced. However, the joint is visible in the bunched state, so that the operation of pushing the bunched joint to the wrong side of cloth is needed when cloth or fabric is made.

20 **[0004]** The air splicer method is known for using an automatic yarn splicer, which two yarn ends are untwisted, laid in parallel and twisted by the action of revolving airflow. This air splicer method has an advantage of not producing protrusions in the joint, so that the joint is hardly visible when making cloth or fabric. However, it is inevitable that the range of the applicable yarn type becomes narrower compared with the knotting method and the joint becomes longer, for example 20 - 25 mm, so that the method has the problem in dyeing property that the color of the lengthened joint is likely to change when dyeing and the defect that the intensity of the joint is inclined to weak compared with parent yarn.

25 **[0005]** Moreover, a method of forming the joint is also proposed that the thermoplastic synthetic resin in a molten state is applied to the each yarn ends and solidified the joint, though the method is not put to practical use. However, as the molten synthetic resin starts to solidify at the time of applying to the doubled yarn ends, the joint gets thicker and it is hard to keep the size and the shape constant.

30 **[0006]** Next, the auto winder having the yarn splicer which realizes the above-mentioned yarn piecing method will be described. This auto winder eliminates the yarn defect part by cutting it in rewinding the yarn supplied from the yarn supply bobbin and the two yarn separated by cutting is pieced automatically, and this yarn splicer is developed from the knot type one to the air splicer. In this knot type, two separated yarn end parts by cutting knotted mechanically and there is a merit that the intensity of the yarn joint becomes high and the relatively large number yarn can be applied. However, as the yarn joint pieced by this knotted type sticks out to a bunched state, there is a disadvantage that protrusive part in the bunched state has to be pushed into the backside of the cloth in using in the fabric and knitting.

35 **[0007]** Moreover, as mentioned above, the air splicer is the device that the twist of the two separated yarn end parts is untwisted by the compressed air, and after that, the respective yarn end part is overlapped and two pieces of yarn can be pieced at once, twisted by the compressed air in addition. The disadvantage of the knotted type can be relieved as the joint is not protruded like the knotted type yarn piecing and the joint is not distinctive by providing the air splicer. However, this air splicer also has the disadvantage, and the joint part becomes longer (about 20-25mm) in the yarn piecing using air splicer and the color of the joint part may change in dyeing the pieced yarn, and the intensity of the joint part deteriorates compared with the unpieced part. Moreover, there is also the disadvantage that the range yarn type that this air splicer can be applied relatively becomes narrow structurally.

45

[Disclosure of the Invention]

50 **[0008]** Accordingly, it is an object of the present invention to solve these problems in the conventional art, and to provide a yarn splicer method and the joint that can secure the twist continuity of two yarn ends without reference to the yarn type and makes the joint intensity superior and the dyeing property good, and to provide a auto winder equipped with the yarn splicer by the photo-curing resin which realizes the yarn piecing method.

[0009] According to the yarn splicing method in the present invention for achieving the aforementioned object, two yarn ends are butted, and the adhesive is attached to the aforementioned butted part and the yarn is pieced by curing the aforementioned adhesive. In the above-mentioned composition, as yarn ends are connected by the adhesive in the state that they are not doubled but are butted, the joint can be made thinner than the one made by doubling or tying, and the yarns can be connected by the adhesive which permeates staple fibers in the state that the joint length is short. Moreover, by selecting the adhesive, the joint can be stronger and the elongation can be proper.

55 **[0010]** In the composition of the yarn splicing method of the present invention, the aforementioned adhesive is photo-

curing that the aforementioned adhesive is cured by the light radiation. In the above-mentioned composition, the yarn end is kept broke and is not untwisted and the twist of both yarn ends is substantially consecutive in the joint, so that the joint can be made thinner and shorter.

[0011] In the composition of the yarn splicing method of the present invention, the aforementioned light is the ultraviolet ray. In the above-mentioned composition, before ultraviolet irradiation, the adhesive permeates moderately to the joint part in the moderate viscosity and the joint can be hardened by the ultraviolet irradiation at once, so that the joint can be formed in short time.

[0012] In the composition of the yarn splicing method of the present invention, the aforementioned light is the laser beam. In the above-mentioned composition, the light can be radiated to the curing time is short and it is economical as the emission time is also short.

[0013] The spun yarn joint in the present invention comprises that the two yarn ends that are made by twisting staple fibers are not doubled but butted and the surface of the yarn ends which are butted and the both yarn ends are connected by the adhesive that has a permeability to staple fibers.

[0014] In the composition of the yarn splicing method of the present invention, the yarn is the spun yarn which is formed by applying the twist to the short fiber, and the aforementioned adhesive is cured in the state that the yarn ends of the spun yarn are butted and the adhesive which is the permeability to the short fiber is applied to the joint part. In the above-mentioned composition, the joint can be shorter and narrower.

[0015] In the composition of the yarn splicing method of the present invention, the aforementioned piecing two-yarn end is butted in the state of cutting, and the twist of both yarn ends is substantially connected in the joint. In the composition of the yarn piecing method, the yarn end is not untwisted in the cutting state, and the twist of both yarn ends is substantially connected in the yarn joint and the joint can be narrower and shorter.

[0016] In the yarn piecing method mentioned above, two yarn ends to piece are butted, and the maximum diameter of the joint surface and/or the both sides part is within 2.5 times of the yarn average diameter. Moreover, the length of the joint part by the aforementioned adhesive is within 10 times of the yarn average diameter, and the maximum diameter of the aforementioned joint is within 2.5 times of the yarn average diameter. In the above-mentioned composition, the joint is not distinctive, and the defect does not occur in making fabric and knitting.

[0017] In the composition of the auto winder of the present invention, the yarn splicer, wherein two yarn ends are butted and the adhesive is applied to the aforementioned joint part and the yarn is pieced by curing the aforementioned adhesive, is built-in. Moreover, the aforementioned yarn splicer is equipped with a pair of clamp members that two pieces of yarn respectively and is movable to come close each other, a pair of the cutter members cutting such that the end surface of the respective yarn that they grip are butted when the each of the respective clamp members comes close, the resin supply means applying photo-curing resin to the joint part and the light radiating means for curing the applied photo-curing resin.

[0018] In the above composition, the length of the joint part is short as two yarn cutting end surfaces are connected by putting and the yarn twist continuity can be secured after piecing, so that the color of the joint part including the vicinity does not change and the joint intensity can be higher than other part by selecting the type of photo-curing resin.

[0019] In the composition of the auto winder of the present invention, the shield means, which opens in supplying the photo-curing resin and shields after supplying the photo-curing resin, is provided in the supply inlet of the aforementioned resin supply means. In the above composition, the supply inlet does not close up as the curing of the photo-curing resin that is in the supply inlet of the resin supply means can be prevented even if the light radiating means radiates.

[0020] In the composition of the auto winder of the present invention, a pair of detecting means that detects the existence of the yarn that the aforementioned respective clamp member is detected is provided, and the aforementioned resin supply means applies the photo-curing resin based on the detecting result of the respective detecting means. The respective yarn cannot be butted when the respective clamp member fails to grip the yarn, as the respective clamp member is composed to grip two pieces of yarn respectively and butted the yarn cutting end surface of each yarn by the operation set in advance. Therefore, in the above composition, the unproductive supply of the photo-curing resin can be prevented by that the resin supply means does not supply the photo-curing resin when the respective clamp member fails to grip yarn.

[0021] In the composition of the auto winder of the present invention, the aforementioned light radiating means is composed of the semiconductor laser. In the above composition, the light can be radiated to the joint part in pinpoint and it is economical as the curing time is short and the emission time is also short, and the yarn splicer can be compact totally.

[Brief Description of the Drawings]

[0022]

Figure 1 shows a typical formation of single yarn joint.

Figure 2 shows a typical formation of doubled yarn joint.

Figure 3 is a process drawing, which shows a formation process of yarn joint

Figure 4 is a side view, which describes an operation of auto winder in an embodiment that is equipped with the yarn splicer in the present invention.

Figure 5 is a side view, which describes the next operation of auto winder that is equipped with the yarn splicer in the present invention, following Figure 4.

Figure 6 is a side view, which describes the next operation of auto winder that is equipped with the yarn splicer in the present invention, following Figure 5.

Figure 7 is a side view, which describes the next operation of auto winder that is equipped with the yarn splicer of the present invention, following Figure 6.

Figure 8 is a front view of yarn splicer in the present invention, which describes an operation in an embodiment.

Figure 9 is a front view of yarn splicer in the present invention, which describes the next operation of Figure 8.

Figure 10 is a front view of yarn splicer in the present invention, which describes the next operation of Figure 9.

Figure 11 is a front view of yarn splicer in the present invention, which describes the next operation of Figure 10.

Figure 12 is a front view of yarn splicer in the present invention, which describes the next operation of Figure 11.

Figure 13 is a front view of yarn splicer in the present invention, which describes the next operation of Figure 12.

Figure 14 is a front view of yarn splicer, describing the operating status in the second embodiment of the present invention, following Figure 12.

Figure 15 is a perspective view of Figure 14.

Figure 16 is a side view of Figure 15.

[Best Mode for Embodying the Invention]

[0023] Embodiments of the present invention will be described below with reference to the drawings. Figure 1 is a typical drawing, showing the example of the single yarn joint, and Figure 2 is a typical drawing, showing the example of the doubled yarn joint.

[0024] In Figure 1, one yarn end 1a and the other yarn end 1b of the parent yarn 1 are butted without doubling or overlapping, and formed the joint part 2 by using the adhesive 3. One yarn end 1a and the other yarn end 1b have the surfaces 1c, 1d, which are broken perpendicular to the centerline of yarn by a cutter. The interval L1 between the joint surfaces 1c and 1d becomes narrower to the extent that the accuracy of truing up the yarn ends after the cut by the automatic yarn splicer is permitted, for example within 0.2 mm. The adhesive 3 permeates through staple fibers from the surfaces 1c, 1d of the yarn ends butted to the both sides at almost equal distance, and the joint part 2 is formed by the adhesive 3, which permeates in the interval L1.

[0025] One yarn end 1a and the other yarn end 1b are butted in the cut state, and the twists of one yarn end 1a and the other yarn end 1b are in the state of substantially consecutive. The adhesive 3 permeates through staple fibers in the both-side parts of this yarn end 1a and the other yarn end 1b, and as the interval L1 is permeated by the adhesive 3, the both yarn ends 1a, 1b are connected firmly by use of the adhesive 3 even if the length L of the joint part 2 is short.

[0026] This joint part and the joint 2 are applied to single yarn, hard twisted yarn and the yarn made by innovative spinning machine and the like. If the viscosity of the adhesive 3 is proper when applied to yarn, the length of the joint part 2 can be within 10 times of the average diameter d1 of the parent yarn 1: within 2 mm in an absolute value, preferably within 7 times or within 1.5 mm in an absolute value, without reference to the yarn count. Moreover, the ratio of the maximum diameter d2 to the average diameter d1 of the parent yarn 1 can be 2.5, preferably within 2 times. The joint part 2 is formed compactly like this, so that the joint part 2 of the yarn is indistinctive when making cloth or fabric.

[0027] Figure 2 shows the joint part 12 in case that the doubled yarn that two pieces of single yarn are twisted again becomes the parent yarn 11. One yarn end 11a of the parent yarn 11 and the other yarn end 11b of the parent yarn 11 are cut with keeping the state of doubled yarn, and the joint surfaces 11c, 11d are placed face to face. In this state, the joint part 12 is formed by filling the interval L11 by use of the adhesive 13 and permeating the adhesive 13 to the length L12.

[0028] This joint part, namely the joint 12, is applied to doubled yarn and wool and the like. If the viscosity of the adhesive 3 is proper when applied to yarn, the length of the joint part 12 can be within 10 times of the average diameter d11 of the parent yarn 11, or preferably within 7 times, without reference to yarn count. Moreover, the ratio of the maximum diameter d12 of the joint part 12 to the average diameter d11 of the parent yarn 11 can be 2.5, preferably within 2 times. The joint part 12 is formed compactly and equally like this, so that the dispersion of the joint strength

becomes small.

[0029] Various kinds of adhesive can be used as the adhesive 3 and 13, which is used in the joint parts 2, 12 in Figure 1 and 2. The conditions are as follows:

(1) Having permeability to the yarn 1, 11, enough to get into the twisted staple fibers composing the yarn 1, 11 before hardening, and having ductility enough to bend the yarn 1, 11 after hardening.

(2) The hardening process is conducted in short time, preferable within one second, and having fluidity before the hardening process.

(3) Preferably, having the similar character to the spun yarn in order to harden responding to the cottonseed oil or the poly-oil solution, not the acid or the oil from the human body.

[0030] The adhesive made by the ultraviolet ray curing resin applies at least the above-mentioned conditions 1 and 2. By selecting the resin composition, the adhesive can go for the above condition 3 to some extent. Before irradiating the ultraviolet ray, the adhesive has liquidity and permeates staple fibers, and keeps the condition stably that the adhesive is filled with the interval between L1 and L11 and permeates the length L2, L12, by the surface tension. By irradiating the ultraviolet ray in this state, the adhesive is hardened at once, within one second. After hardening, it has ductility to some extent as the resin. Moreover, the thermosetting resin is also available such as to have liquidity before hardening and to harden at once within one second by radiating the heat ray of the halogen lamp and the like.

[0031] The forming process of the joint parts 2, 12 in Figures 1 and 2 will be described using Figure 3. In Figure 3A, the movable clamp 30, 30, which can open and close, holds each of a pair of yarn to connect, and the yarn ends 1a and 1b are formed in each of a pair of yarn by moving the cutter 31, 31 to the direction and perpendicular to the yarn.

[0032] In Figure 3B, by using the clamp 30, 30, the yarn ends 1a and 1b are moved to the position that the adhesive is applied, and the joint surface 1c of the yarn end 1a and the joint surface 1d of the yarn end 1b are impregnated with the ultraviolet ray resin from the tip to the prescribed width.

[0033] In Figure 3C, the clamp 30, 30 moves the yarn end 1a and 1b to the joint position, and the joint surface 1c of the yarn end 1a and the joint surface 1d of the yarn end 1b are put together. The adhesive of the yarn ends 1a and 1b are united by the surface tension.

[0034] In Figure 3C, the joint 2 is formed by irradiating the ultraviolet ray from the ultraviolet lamp 32 with keeping the yarn ends 1a and 1b put together and hardening the adhesive. After forming the joint 2, the clamp 30, 30 are released, and the yarn is got off by the drive unit that is not shown in the drawings.

[0035] By the way, the yarn ends 1a and 1b can be connected by applying the adhesive between the surfaces of the yarn ends in the state of the surfaces putting face to face. Moreover, the adhesive can be applied to the yarn ends during or soon after the cut of the yarn in conjunction with the work of the cutter 31 in Figure 3A.

[0036] Furthermore, in case of applying the thermosetting resin, the thermosetting resin can be hardened by using halogen lamp that radiates heat ray instead of the ultraviolet lamp 32, or pressing a pair of hot plate that the semicircular groove is formed in the inner surface.

[0037] The joints 2, 12 in Figures 1 and 2, which are formed by the aforementioned processes, have the following characteristics:

(1) A joint can be bonded strongly and formed shortly and smaller even if the amount of the adhesive that is supplied to the joint part is small, as the adhesive is permeated through staple fibers of the yarn ends in the joint part.

(2) Any yarn can be connected without considering the types, as the yarn are connected by the adhesive in the state of the yarn ends putting face to face after cutting and the yarn ends can connect unless broken and spread.

(3) Hardening can be finished in shorter time and the joint can be formed speedy, by the component of the adhesive combined properly.

(4) The joint flexibility after hardening can be about equal to the one of the parent yarn, by the component of the adhesive combined properly.

[0038] Sixteen joints are formed by putting the commercial ultraviolet ray curing resin (produced by Loctite, product no. 363) to the spun yarn whose yarn count is 40. (Yarn Type: Cotton)

[0039] The joint length L2 in Figure 1 is 1.4 mm and the yarn average diameter d1 is 0.2 mm, so that the ratio of the joint length to the yarn diameter is 7 times. Moreover, the joint maximum diameter d2 is 0.4 mm and the ratio of the joint thickness to the yarn diameter is 2 times. The length of the joint discontinuity part is short as long as 1.4 mm, and the ratio of the length is within 1/10 compared with the one by the air splicer method, so that the influence on gloss or texture can be disregarded when making cloth or fabric.

[0040] The physical properties of the strength etc. of the 16 yarns having the joints formed like this and the 16 parent

yarns are measured. Table 1 shows the results. As shown in Table 1, the joint physical property is not so much difference as the parent yarn.

Table 1

	Strength (g)			Dispersion Degree CV%	Elongation (%)	CV%
	Average	Minimum	Maximum			
Parent Yarn	200.1	182.5	227.5	6.05	4.07	9.02
P-splice (present invention)	193.8	175.6	222.50	6.21	4.01	6.77
Yarn: Cotton Ne40						

[0041] Hereafter, the detailed embodiments of the present invention will be described.

[0042] In Figure 4, this is the auto winder equipped with the yarn splicer 101, which has the supply bobbin B down below and the winding package P upward, and the yarn YP supplied from the supply bobbin B is wound to the rotating winding package P. The yarn YP supplied from the supply bobbin B is burdened the proper tension by the tensor T through the guide G, and is wound in the prescribed thickness to the winding package P by way of the rotating traverse drum D. The yarn defect detector F is always detecting the thickness of the passing yarn YP.

[0043] In Figure 5, following Figure 4, when the winding package P winds the yarn YP from the supply bobbin B, the detector F detects the yarn defect of the yarn YP passing by comparing the information on the yarn thickness set in advance. Moreover, when the detector F detects the yarn defect, the cutter (not shown in the drawings) cuts the yarn YP, the rotation of the winding package P is stopped and the winding from the supply bobbin B is once cancelled. Consequently, the upper yarn Y1 goes into the state of winding the package, and the lower yarn Y2 goes into the state of being sucked by the yarn trap W in the upper side of the guide G. In Figure 6 following Figure 5, in the state of Figure 5, the suction arm S1 for the upper yarn revolves clockwise around the arm shaft D1, and the suction arm S2 for the lower yarn revolves in a counter-clockwise direction around the lower shaft D2. There are the air holes inside of each of the suction arms S1, S2, and the arms are connected to the air suction duct KP. Moreover, the tips S1a and S2a of the respective suction arms S1 and S2 are suction inlets by the air suction duct KP and the suction arm S1 for the upper yarn intakes and grips the upper yarn Y1, and likewise, the suction arm S2 for the lower yarn intakes and grips the lower yarn Y2.

[0044] In Figure 7 following Figure 6, in the state that the respective suction arms S1, S2 grip each of the yarns Y1, Y2, the suction arm S1 for the upper yarn is turned down by rotating in a counter-clockwise direction around the arm shaft D1, and the suction arm S2 for the lower yarn is turned up by rotating clockwise around the lower shaft D2. That is why the upper yarn Y1 and the lower yarn Y2 are guided to the prescribed position through the front side 1a of the yarn splicer 101.

[0045] Consecutively, the situation will be described that the upper yarn Y1 and the lower yarn Y2 are spliced by the yarn splicer. Figure 8 shows the front side 101a of the yarn splicer 101, which is equipped with the clamp member 110 for the upper yarn on the upper side of the machine 101A and the clamp member 111 for the lower yarn on the lower side of it, and the respective clamp members 110, 111 comprise the first clampers 110a, 111a and the second clampers 110b, 111b. They are normally separate, and as shown in Figure 7, the upper yarn Y1 is guided to the space between the clampers 110a and 110b of the clamp member 110 for the upper yarn and the lower yarn Y2 is also guided to the space between the clampers 111a and 111b of the clamp member 111 for the lower yarn, by the respective suction arms S1, S2, and this status is sustained. Moreover, the yarns Y1, Y2 are put on a pair of the basis blocks B1, B2 whose height is as same as to the machine block 101A, and the upper yarn Y1 is put on the basis block B1 for the upper yarn and the lower yarn Y2 is put on the basis block B2 for the lower yarn.

[0046] In Figure 9 following Figure 8, in the state that the respective yarns Y1, Y2 are positioned among the respective clampers 110a, 110b, 111a and 111b of the respective clamp members 110, 111, the respective yarns Y1, Y2 positioned among them are gripped by that the respective first clamp members 110a, 111a are moved and that the plate surface which the clasper has abuts against the plate surface of the confronted respective second clampers 110b, 111b. Likewise, in this case, as the respective yarns Y1, Y2 are on the respective basis blocks B1, B2, the height of the respective yarns Y1, Y2 are as same as the height to the machine block 101A.

[0047] As shown in Figure 10, a pair of cutter members 120, 121 is positioned adjacent to the respective clamp members 110, 111 between the respective clamp members 110 and 111. Moreover, the cutter member 120 for the upper yarn is positioned close to the clamp member 110 for the upper yarn and the cutter member 121 for the lower yarn is positioned close to the clamp member 111 for the lower yarn. The respective cutter members 120, 121, composing the stationary knives 120a, 121a and the movable knives 120b, 121b, are constituted such that the cutter

member 120 for the upper yarn cuts the upper yarn Y1 and the cutter member 121 for the lower yarn cuts the lower yarn Y2 by moving the movable knives 120a, 121a. Furthermore, in Figure 10 following Figure 9, in the state that the respective clamp members 110, 111 grip the respective yarns Y1, Y2, the respective yarns Y1, Y2 are cut by moving the respective movable knives 120b, 121b.

[0048] In Figure 11 following Figure 10, in the state that the respective clamp members 110, 111 grip the cut upper yarn Y1 and the cut lower yarn Y2, the respective clamp members 110, 111 move to the direction that they become close each other, and the cut end surfaces of the upper yarn Y1 and the lower yarn Y2 are butted. In this case, as the respective yarns Y1, Y2 are placed on the respective basis blocks B1, B2, the cut surfaces of the respective yarns Y1 and Y2 are butted correctly if it is constituted such that the respective clamp members 110, 111 move left and right, and the longitudinal directions of the respective yarns Y1, Y2 become same. Moreover, as the cut yarn of the upper yarn Y1 that is the lower part than the cutter member 110 for the upper yarn and the cut yarn of the lower yarn Y2 that is the upper part than the cutter member 111 for the lower yarn are not gripped by the respective clamp members 110, 111, the cut yarns are suck to the respective suction arms S1, S2 and the yarns having the defects are discarded to the suction KP.

[0049] In Figure 12 following Figure 11, in the state that the cut end surfaces of the respective yarns Y1, Y2 are butted, the feed opening 31 of the resin supply means 30 approaches the part that two pieces of the yarn are butted and the photo-curing resin is applied from the feed opening 31. This resin supply means, comprising the container in the shape of injector, consists of the main body 132, the feed opening 131 and the cylinder 133. Moreover, the main body 132 is attached to the movable pedestal CA, and the photo-curing resin is placed in the inner part of the main body 132. Furthermore, in the state that the cut end surfaces of the upper yarn Y1 and the lower yarn Y2 are placed face to face, the pedestal CA is advanced and the after-mentioned shield means 150 is moved upward at the same time, and the feed opening 131 of the resin supply means 130 is opened. Furthermore, it is composed that the feed opening 131 of the resin supply means 130 comes close to the joint part of the respective yarns Y1, Y2 and activates the cylinder 133, and the photo-curing resin is applied to the part which the yarns are butted by discharging the prescribed amount of the photo-curing resin inside of the main body 132.

[0050] In Figure 13 following Figure 12, the photo-curing resin, applied to the part that the cut end surfaces of the upper yarn Y1 and the lower yarn Y2 are butted, is hardened by using the light radiating means 140. This light radiating means 140 gives off light for hardening the photo-curing resin, and in this embodiment, the photo-curing resin means the ultraviolet ray curing resin, and the light radiating means 140 gives off the ultraviolet light. When this light radiating means 140 gives off light, the pedestal CA is replaced and the feed opening 131 of the resin supply means 130 is apart from the part that the respective yarns Y1, Y2 are butted. At the same time, the shield means 150 is also replaced and the plate part 151 of the shield means 150 shields the feed opening 131. Thereby, it is composed that the photo-curing resin that exists in the feed opening 131 of the resin supply means 130 is prevented from the light from the light radiating means 140 and the feed opening 131 is not shielded. This light radiating means 140 is composed to give off light like photoflash, and the number of flash is set in advance according to the photo-curing resin types. Thereby, the electric power consumption for radiating by the light radiating means 140 can be minimized. Moreover, by installing a heater (not shown in the drawing) near the resin supply means 130, the viscosity of the photo-curing resin inside of the resin supply means can be controlled by using the heater when the ambient temperature is low. That is why the viscosity suitable for the yarn count that is going to splice can be provided.

[0051] Besides, a pair of the detectors 160, 161 is provided in the vicinity of the respective clamp members 110, 111, and the respective detectors 160, 161 are set to activate when the respective clasper 110a, 110b, 111a and 111b of the respective clamp members 110, 111 in Figure 9 abut against the detectors 160, 161. The detector 160 for the upper yarn is positioned near the clamp member 110 for the upper yarn, and the detector 161 for the lower yarn is positioned near the clamp member 111 for the lower yarn. Moreover, it is composed that the detector 160 for the upper yarn detects the upper yarn Y1 and the detector 161 for the lower yarn detects the lower yarn Y2. As the upper yarn Y1 and the lower yarn Y2 cannot be connected in case that the respective detectors 160, 161 do not detect the respective yarns Y1, Y2, in other words, in case that both the clamp members 110 and 111 fail to grip the respective yarn Y1, Y2, the next operation after the step of Figure 11 is set to be cancelled, and prevents from the unnecessary supply or the dripping of the photo-curing resin. Moreover, the operation after the step of Figure 5 is set to repeat again and again till the splicing is completed. Furthermore, when the yarn splicing is completed, in other words, when both the detectors 160, 161 detect the respective yarns Y1, Y2 and the operation to the step of Figure 13 is completed, the winding package P rotates again for winding the yarn YP from the supply bobbin B, and can wind up the yarn YP that does not have the defects. In the above-mentioned embodiment, though using the spun yarn to splice, the man-made fiber like the filament yarn can be certainly applicable.

[0052] Next, the second embodiment will be described, aparting from the above mentioned first embodiment. Moreover, the same explanation as the one of the first embodiment will be abbreviated. Figure 14-16 show the yarn splicer which is different from the first embodiment, and Figure 14 is corresponded to Figure 13. The light radiating means 140 of the first embodiment cures the photo-curing resin by generating the diffusing light like halogen lamp for example,

however in the second embodiment, this light radiating means 140, that is a semiconductor laser 140' installing the lens to the semiconductor diode, generates a laser 141 by collecting the semiconductor diode generating light by the lens, and the laser 141 is applied to two yarn end joint part and the photo-curing resin applied the part is cured. Moreover, the wavelength band of this semiconductor laser 140' is preferably from 400 to 420 nm, for example the blue or violet colored semiconductor laser by Nichian Corporation.

[0053] Figure 14-16 show the state that the photo-curing resin is applied to the part that the cut end surface of the upper yarn Y1 and the lower Y2 are butted, and the photo-curing resin can be cured by that the laser 141 is radiated from the semiconductor laser 140' and the laser 141 are applied to the joint part. This semiconductor laser 140' has the compact shape, so that the yarn piecing device can be miniaturized and the power consumption is lower than the amount of light and it is economical. Moreover, the light is diffused in the light curing means 140 in the first embodiment and the yarn Y1 and Y2 are stuck to the clamps 110 and 111 and the yarn Y1 and Y2 fails to be pieced when the photo-curing resin is attached to the yarn Y1 and Y2 and the clamps 110 and 111, however in the second embodiment, the laser 141 does not radiate the resin attachment part of the yarn Y1 and Y2 and the clamps 110 and 111 as the laser 141 is radiated to the joint part of the yarn Y1 and Y2 in pinpoint even if the photo-curing resin is attached to the yarn Y1 and Y2 and the clamps 110 and 111, so that they are not clung to each other and the piecing of the yarn Y1 and Y2 does not fail. Furthermore, there is the advantage that the curing ability is higher and the operating speed is faster as the photo-curing resin hardens at once and the lifetime of the light radiating means 140 becomes longer, compared with the first embodiment. Moreover, as the shield means 150 is provided such as not to close up the supply inlet 131 of the resin supply means 130 by the light generated from the light radiating means 140, the semiconductor laser 140' in the second embodiment that the light can be radiated in pinpoint does not need to provide the shield means 150 and the composition can be simpler totally.

[Industrial Applicability]

[0054] As described above, according to the yarn piecing method and the joint of the present invention, the joints can be formed regardless of the yarn types, and the hard twisted yarn and the doubled yarn can also be connected though they were thought to be hard to splice. Moreover, the defects are not developed when making cloth or fabric, as the joints are formed shorter and smaller and the discoloring part is small and invisible when dyeing. Furthermore, the adhesive can be hardened in shorter time and the yarn splicer can also be speeded up, by selecting the adhesive properly.

[0055] According to the auto winder equipped with the yarn splicer in the present invention, the joint part is short as the two divided yarn end surfaces are butted and connected by use of the photo-curing resin. Moreover, as the yarn ends are not untwisted like the conventional art, they can be connected without changing the color of the joint part. Furthermore, the intensity of the joint part can be higher than the one of the other part by selecting the kind of the photo-curing resin, and the spliced yarn can be used for making cloth or fabric with the joint part invisible, as the joint part is smaller than the one made by using the conventional knotter-type machine. Furthermore, there is an advantage that many kinds of yarn and the wide range of the yarn count can be applicable compared to the conventional machine as the broken yarn is connected by the resin.

Claims

1. The yarn splicing method for splicing together two yarn ends which comprises: butting said two yarn ends, applying an adhesive to the butted portion of said two yarn ends, and hardening said adhesive.
2. The yarn splicing method according to Claim 1, wherein said adhesive has the property of photo curing, so that the adhesive is hardened by radiating light.
3. The yarn splicing method according to Claim 2, wherein said radiating light is the ultraviolet.
4. The yarn splicing method according to Claim 2, wherein said radiating light is the laser beam.
5. The yarn splicing method for splicing together two yarn ends, in the case where said yarn is the spun yarn which is formed by twisting the staple fibers, the method comprising:

butting said two spun yarn ends, applying an adhesive that has a permeability to staple fibers to the butted portion of said two spun yarn ends, and hardening said adhesive.

6. The yarn splicing method according to Claim 5, wherein said two spun yarn ends which is going to splice are butted in the state of cutting, and the twist of both yarn ends are substantially consecutive in the joint.

7. The yarn joint formed by yarn splicing method, **characterized in that** the two yarn ends which are bound to splice are butted, and the surface which two yarn ends are butted and / or both sides of the surface is / are bonded by the adhesive.

8. The yarn joint according to Claim 7, wherein the length of the joint by said adhesive is within 10 times of the average diameter of the yarn, and the maximum diameter of the joint part is within 2.5 times of the average diameter.

9. An auto winder, **characterized in** being equipped with the yarn splicer that two yarn ends are butted and spliced by applying the adhesive to the joint part and hardening the adhesive.

10. The auto winder shown in Claim 9, equipped with the yarn splicer comprising:

a pair of movable clamp members such that two yarns are held respectively and close to each other;
a pair of cutter members which cut yarn so that the end face of each yarn which is held by the each clamp member is butted as the members come close;
the resin supplying means that the joint which two yarns are butted is applied the photo-curing resin; and,
the light-radiate means for hardening the photo-curing resin which is applied.

11. The auto winder according to Claim 10, **characterized in** being equipped with the shield means which makes the feed opening open when incoming of the photo-curing resin and close after supplying the photo-curing resin.

12. The auto winder according to Claim 10 or 11, **characterized in** being equipped with a detector that detects the yarn held by the clamp members, and applying the photo-curing resin by the resin supplying means based on the detection result of the detector.

13. The auto winder according to any one of Claims 10 to 12, **characterized in** being equipped with a detector that detects the yarn held by the clamp members, and applying the photo-curing resin by the resin supplying means based on the detection result of the detector.

FIG. 1

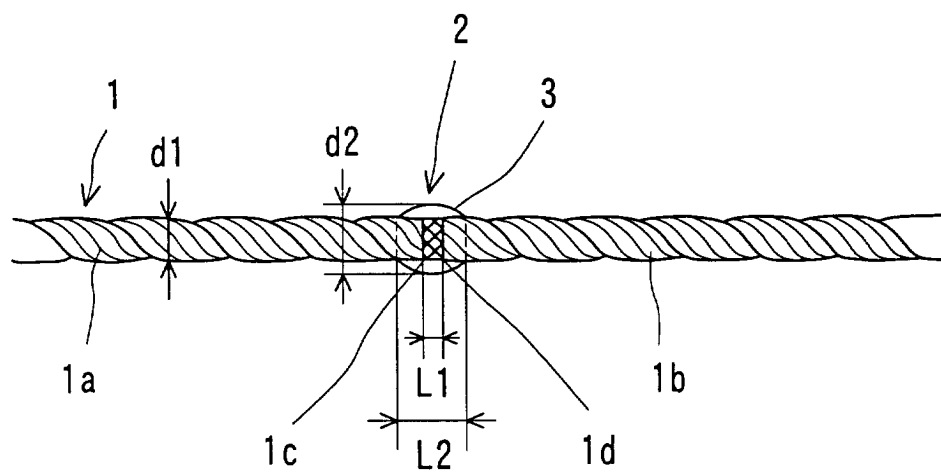


FIG. 2

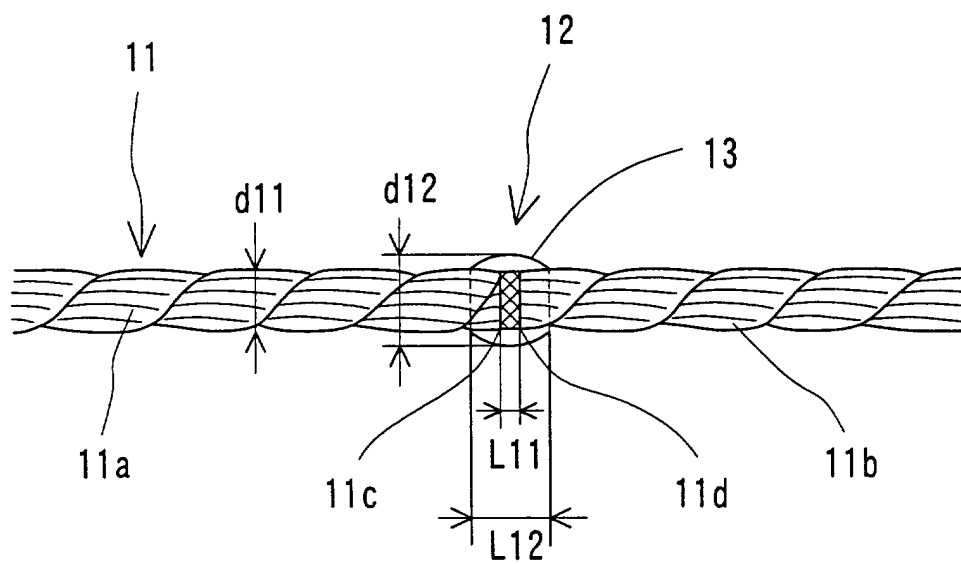


FIG. 3

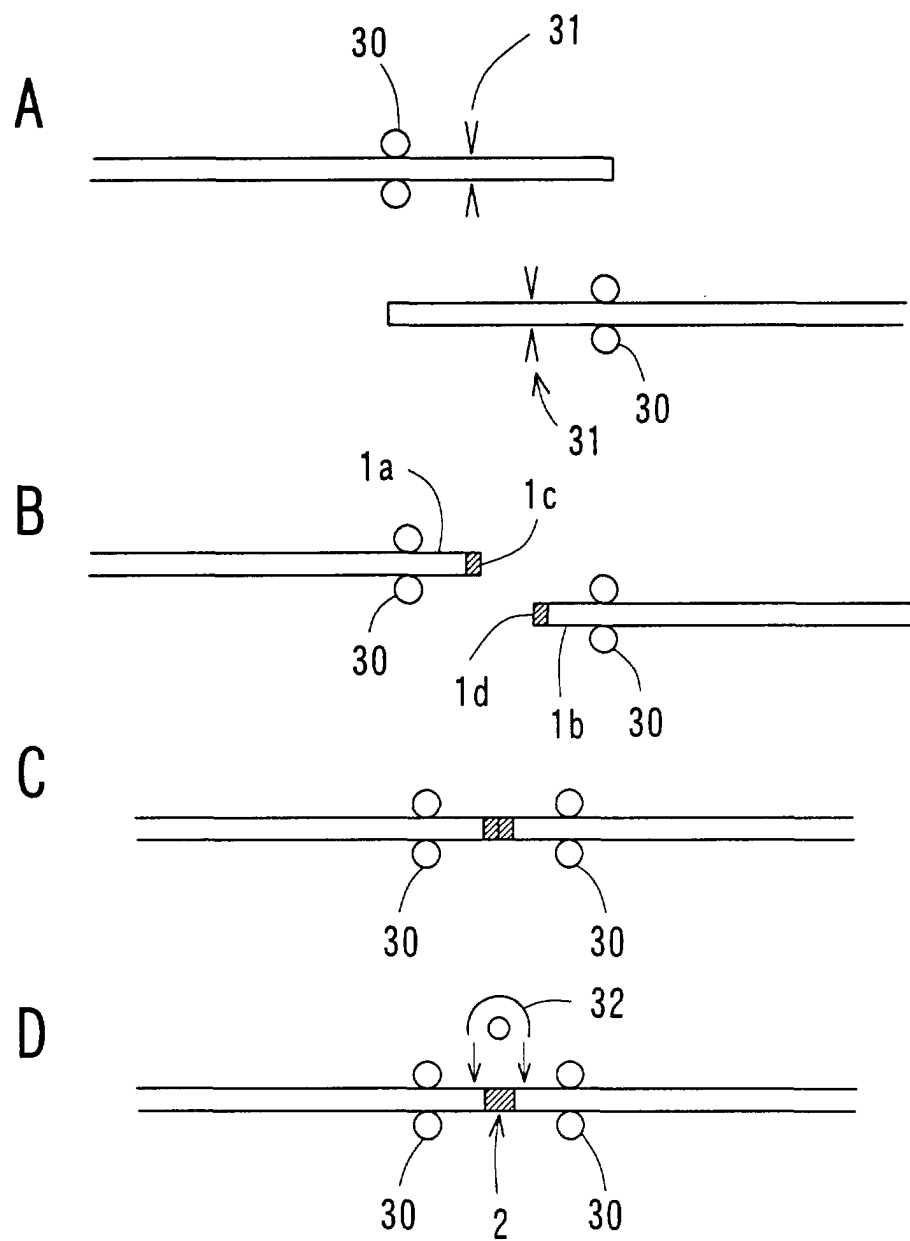


FIG. 4

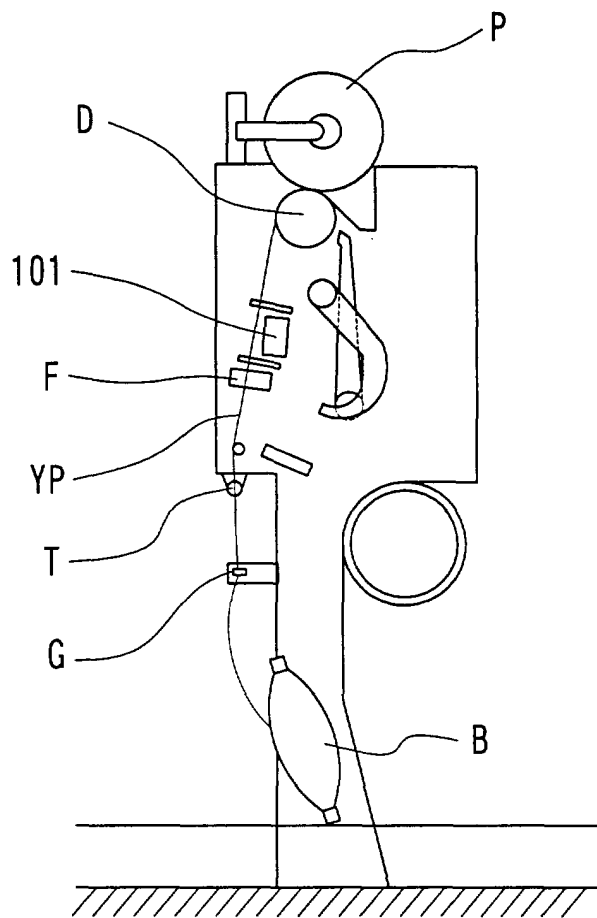


FIG. 5

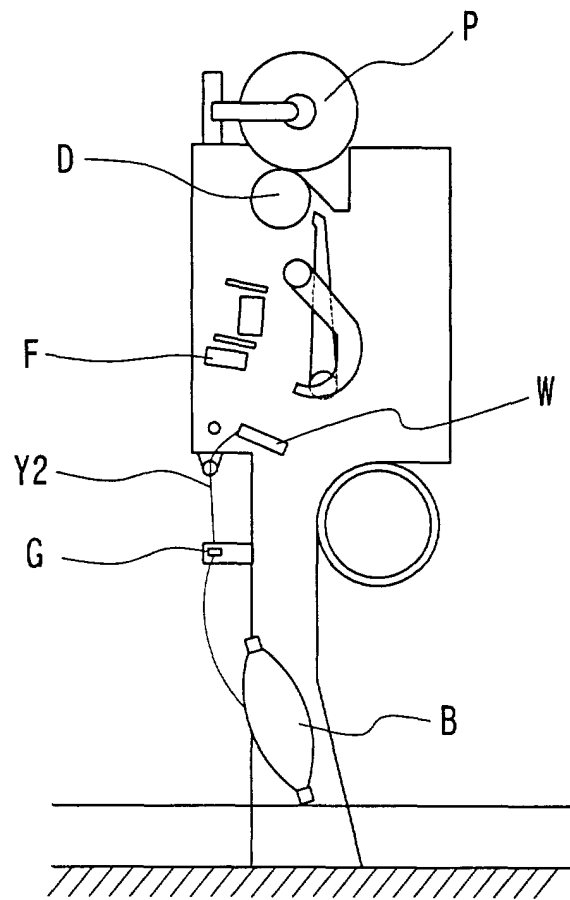


FIG. 6

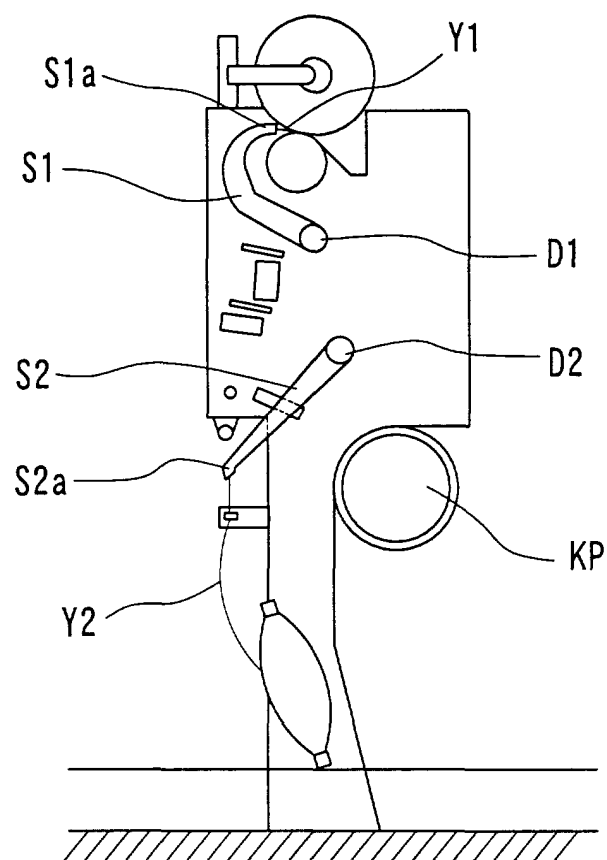


FIG. 7

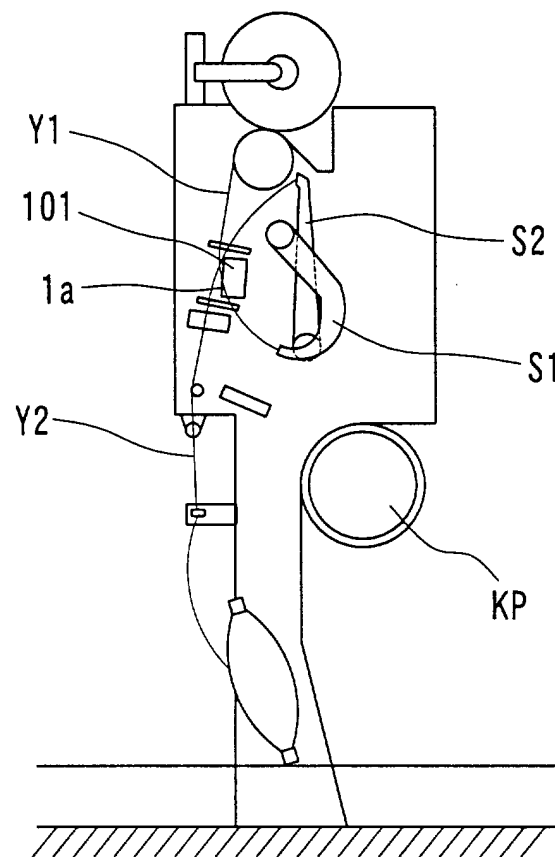


FIG. 8

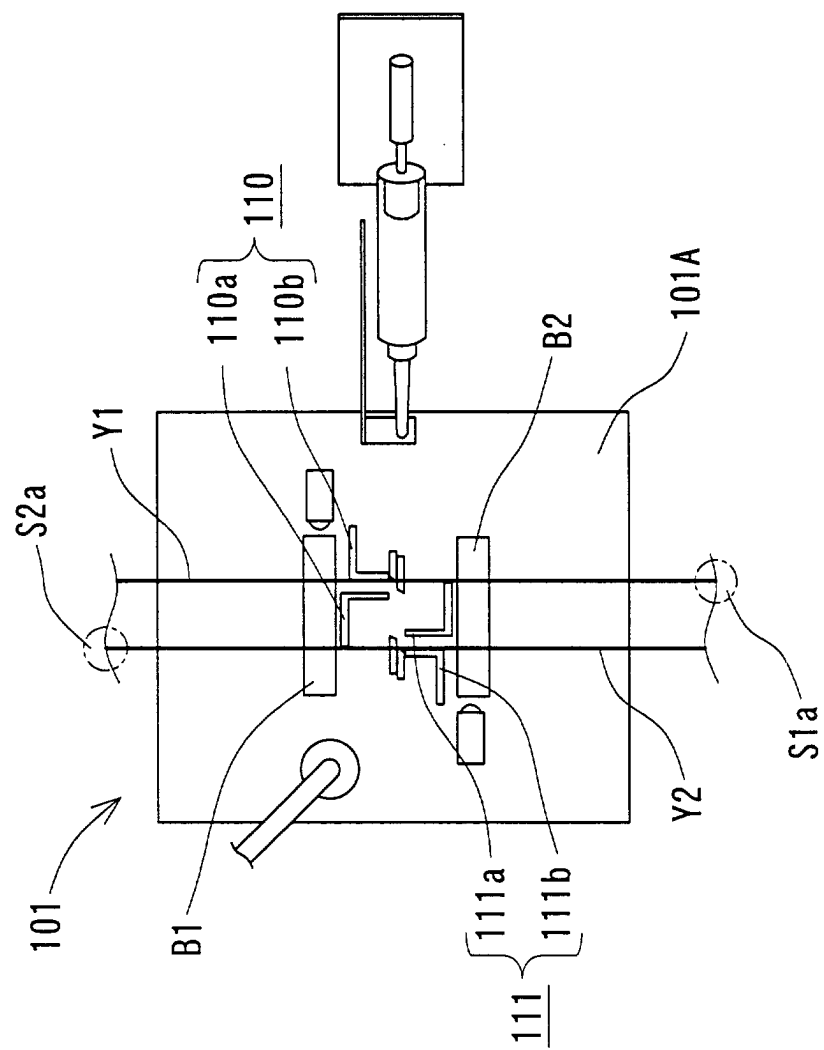


FIG. 9

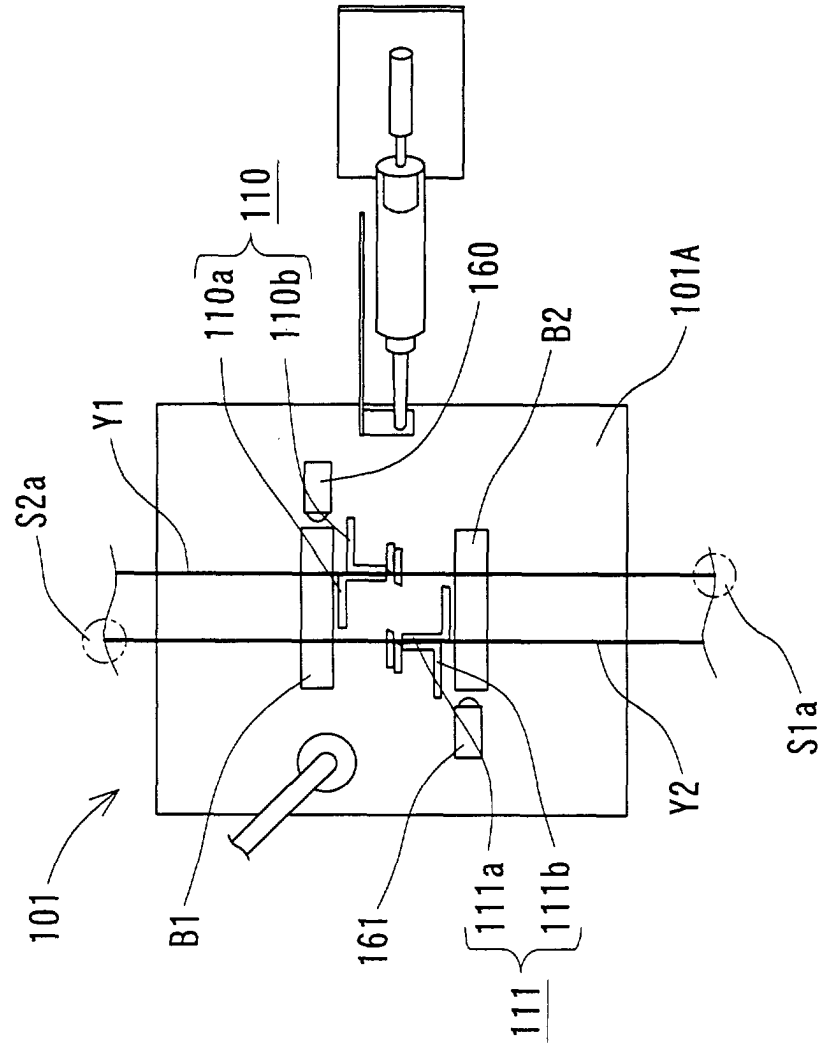


FIG. 10

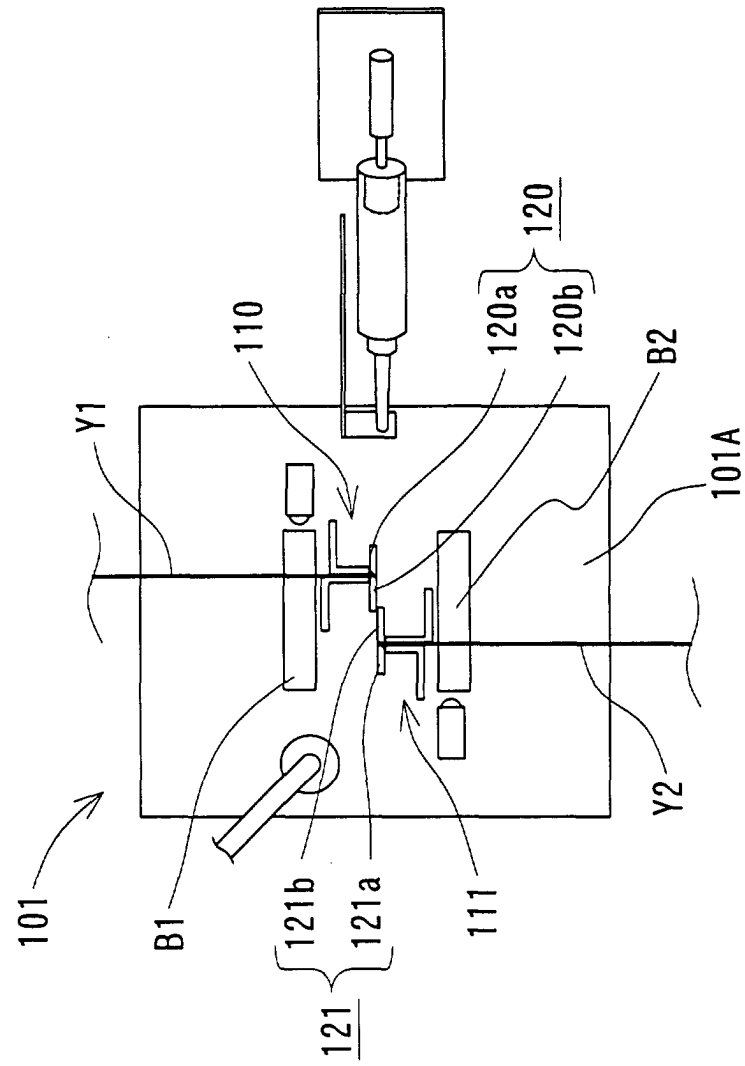


FIG. 11

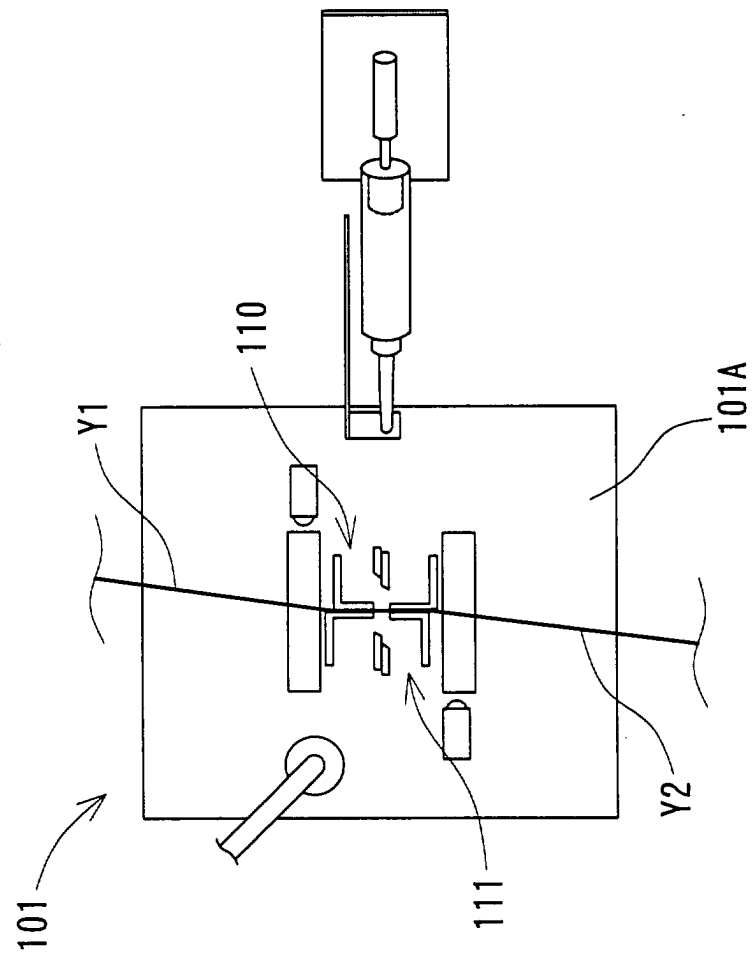


FIG. 12

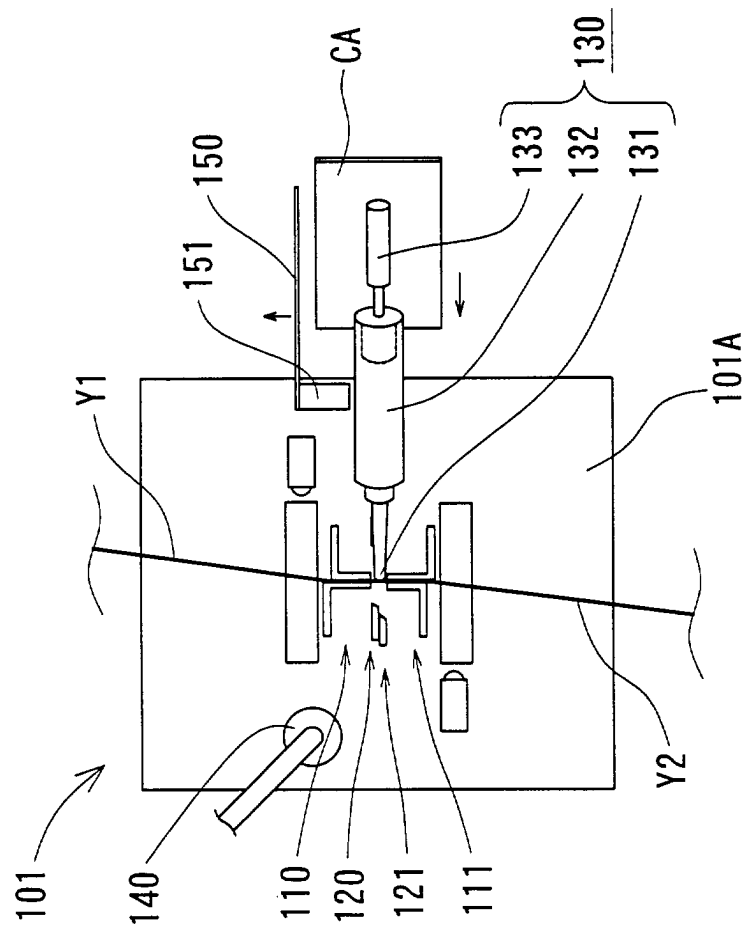


FIG. 13

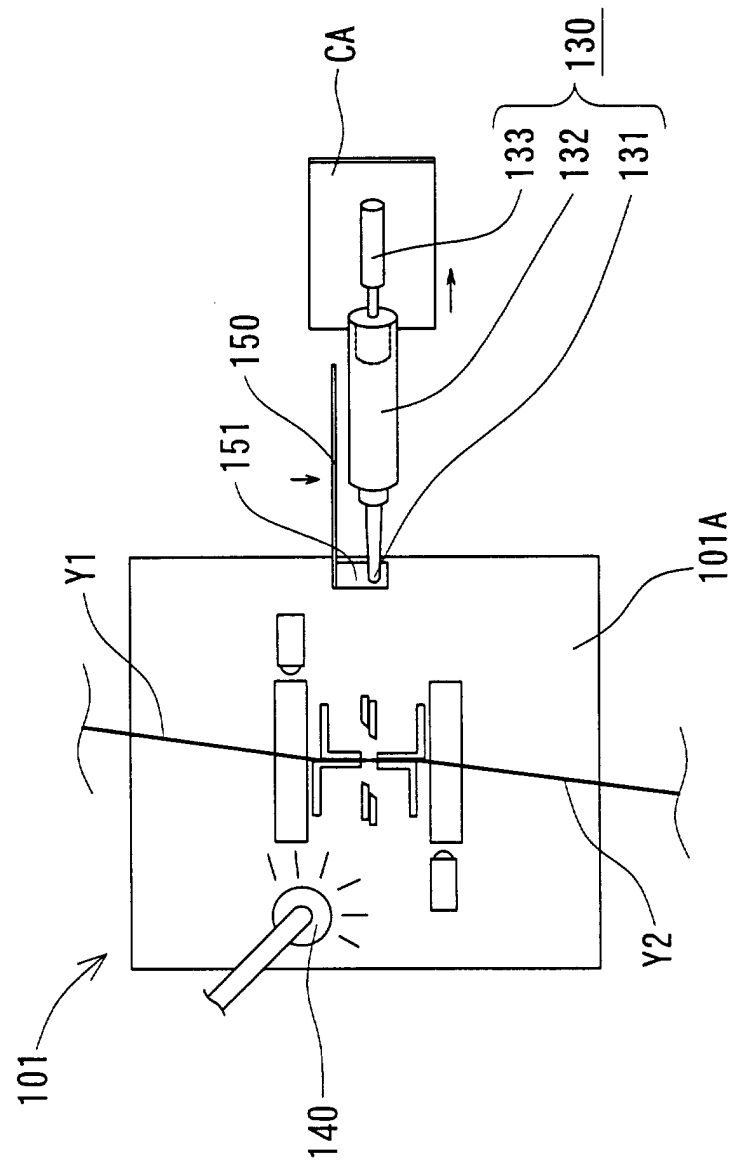


FIG. 14

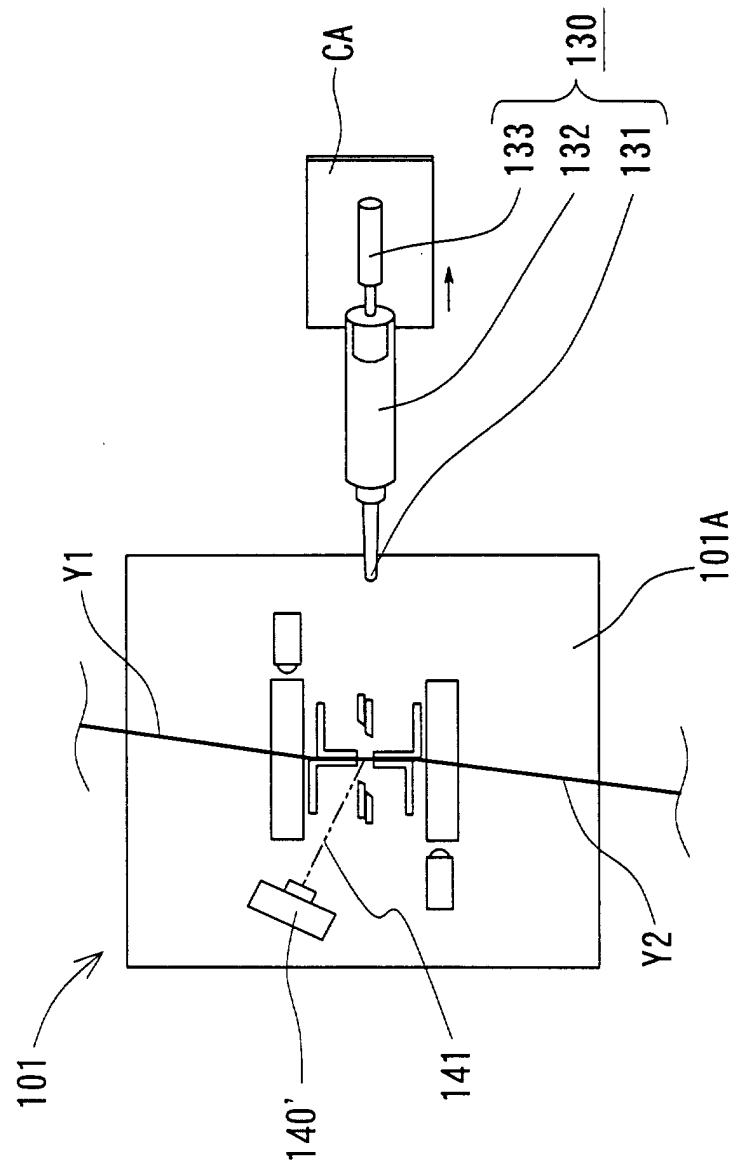


FIG. 15

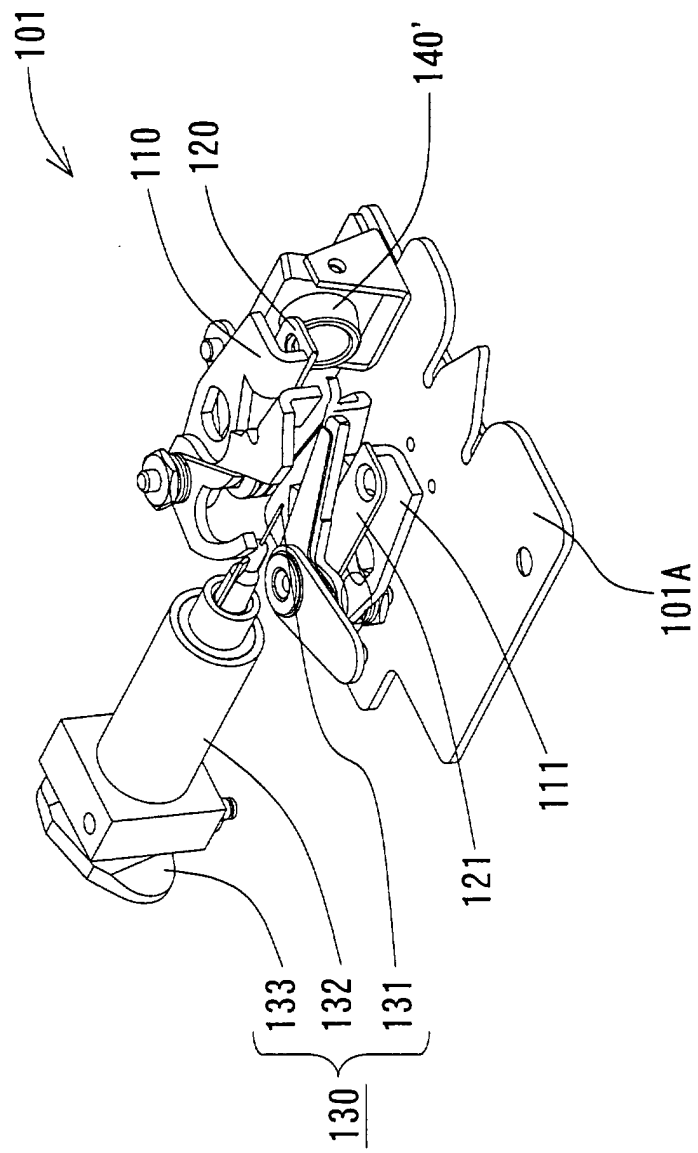


FIG. 16

