



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.04.2004 Bulletin 2004/17

(21) Application number: **03022869.6**

(22) Date of filing: **08.10.2003**

(51) Int Cl.7: **B65H 69/00**, B65H 61/00,
B65H 51/22, D02H 3/00,
D04B 15/66, D04B 15/38,
D04B 35/22

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(30) Priority: **15.10.2002 JP 2002300327**
31.10.2002 JP 2002317327
22.11.2002 JP 2002339566
08.11.2002 JP 2002325247

(71) Applicants:
• **MURATA KIKAI KABUSHIKI KAISHA**
Kyoto (JP)
• **Katayama Co., Ltd.**
Nishiwaki-shi, Hyogo (JP)

(72) Inventors:
• **Mima, Hiroshi**
Jyoyo-shi Kyoto (JP)
• **Naotaka, Sakamoto**
Kusatsu-shi Shiga (JP)
• **Katayama, Shozo**
Nishiwaki-shi Hyogo (JP)

(74) Representative:
Gritschneider, Martin, Dipl.-Phys. et al
Patentanwälte Abitz & Partner
Poschingerstrasse 6
81679 München (DE)

(54) **Yarn-processing system**

(57) To provide a take-up device which joins a plurality of yarns of different types having different colors or the like with respectively desired lengths while successively selecting these in accordance with a preliminarily designed pattern, and exerts superior functions from the viewpoint of availability factor when the yarn is wound into a package.

With respect to a single take-up package P placed in a take-up unit 15, a yarn-joining take-up device for different types of yarns is provided with a yarn-supplying unit 11 having supply yarns of a plurality of types, a yarn-joining unit 13 placed between the yarn-supplying unit and the take-up unit and a yarn-type selection unit 12

placed between the yarn-supplying unit and the yarn-joining unit, a yarn-joining device 19 is installed in the yarn-joining unit, and a yarn-type selection device 18 that selects the succeeding yarn on the yarn-supplying side to be joined to the leading yarn on the take-up package side is installed in the yarn-type selection unit; thus, the leading yarn, which is being connected to the yarn-type selection device, is guided to the yarn-joining device by the yarn-joining device and the yarn-type selection device, and the succeeding yarn is guided to the yarn-joining device by a succeeding-yarn guiding means to be yarn-joined therein.

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention relates to a yarn-processing system such as a yarn-joining take-up device for different types of yarns, in which a plurality of types of yarns having, for example, different colors are yarn-joined (including yarn knotting and yarn bonding processes) with respectively desired lengths, while being successively selected in accordance with a preliminarily designed pattern, and wound up to form packages.

Description of the Related Art

[0002] As conventionally known, in order to improve decorative varieties in response to an increasing number of types of fabrics, there have been demands for so-called fancy yarns (different types of yarns that are joined to form a single yarn with varieties in many kinds being imparted thereto in the length direction), and various processing systems have been developed and provided to manufacture such fancy yarns. In recent years, in the field of fabric industries, with respect to the weaving process, the trend for shifting from a large-lot supplying process to a small-lot supplying process in many kinds has become conspicuous, and with respect to yarns for warping, there have been strong demands for the above-mentioned fancy yarns. With respect to such a fancy yarn, a system has been proposed in which different types of yarns of a plurality of kinds are taken up by predetermined lengths while being selected so that a warping yarn to be used in a sample weaving machine is taken up on a package, for example, by using the following processes: 10 m of red yarn is taken up, the next blue yarn is joined to the preceding red yarn so that 30 m of the blue yarn is taken up, and the next white yarn is successively joined to the blue yarn so that 20 m of the white yarn is taken up (see Patent Application filed by the same applicant as the present invention on March 8, 2002: Japanese Patent Application No. 2002-63156).

[0003] The conventional yarn-joining processing system for different types of yarns has a structure, for example, shown in Fig. 8. In other words, the conventional yarn-joining processing system for different types of yarns of this type is basically provided with a yarn-joining device 9 that is placed between a yarn-supplying unit 1 having a plurality of types of yarns to be supplied and a take-up package 8 placed on a take-up unit 4, and a yarn-type selection device 2 which selects a yarn Y on the package side and types of yarns YA to YF on the yarn-supplying side to be joined thereto, and is placed between the yarn-supplying unit 1 and the yarn-joining device 9, so that the yarn Y on the package side and the types of yarns YA to YF are freely selected and the yarn

that has been subjected to the yarn-joining process is wound on a single take-up package 8.

[0004] More specifically, the above-mentioned conventional yarn-processing system includes a yarn selection unit 2 serving as the yarn-type selection device, and the yarn selection unit 2 reserves yarn ends drawn from the respective yarn-supplying packages, and selects a specific yarn end and selectively positions it at a yarn traveling station in accordance with instructions from a control unit 5, and, for example, a wheeling plate 6 that holds the respective yarn ends is rotated around a shaft 7 so that any one of the yarn ends YA to YF is positioned at a traveling station Y (see Patent Document 1).

[Patent Document 1] JP-B No. 1-56172 (Fig. 1)

[0005] The above-mentioned conventional yarn-processing system has an arrangement in which the take-up unit 4 is directly connected to the yarn-joining device 9; therefore, the other device units need to be stopped for each of the yarn-joining operations, resulting in inconvenience from the viewpoint of availability factor. Moreover, since the yarn-type selection device of this conventional yarn-processing system has a wheel system with the wheel plate 6, only one yarn of the yarn-supplying side yarns YA to YF to be joined is selected with respect to the yarn Y on the package side, and another problem is that a large space is required for the wheeling process.

SUMMARY OF THE INVENTION

[0006] The present invention has been devised to solve the above-mentioned conventional problems, and its objective is to provide processes in which different types of yarns of a plurality of kinds having, for example, different colors are joined with respectively desired lengths, while being successively selected in accordance with a preliminarily designed pattern so that the resulting yarn is wound into a package and a system in which the yarn that has been subjected to the yarn-joining process is directly supplied to a sample warper, and also to provide a yarn-processing system that is suitable for directly supplying the joined yarn to a knitting machine, and in particular, this yarn-processing system eliminates the necessity of stopping the other device units even during the yarn-joining operation, and consequently exerts a superior capability from the viewpoint of availability factor.

[0007] Moreover, a yarn-type selection device having another structure of the present invention makes it possible to selectively use a plurality of yarns on the supplying side to be joined to the yarn on the package side, and also to provide a yarn-processing system that effectively reduces the space of the yarn-type selection device itself.

[0008] In order to achieve the above-mentioned ob-

jectives, the present invention is provided with: a yarn-supplying unit having a plurality of kinds of yarns with respect to one take-up package placed in a take-up unit; a yarn-joining unit placed between the yarn-supplying unit and a take-up unit; and a yarn-type selection unit placed between the yarn-supplying unit and the yarn-joining unit; with a yarn-joining device being placed in the yarn-joining unit and a yarn-type selection device that selects a succeeding yarn on the yarn-supplying side to be yarn-joined to the leading yarn on the take-up package side being placed in the yarn-type selection unit, and in this arrangement, the yarn-joining device and the yarn-type selection device constitute a yarn-joining take-up device for different types of yarns in which the leading yarn is guided into the yarn-joining device with the leading yarn being connected to the yarn-type selection device so that the succeeding yarn is guided by a succeeding yarn directing means into the yarn-joining device so as to be subjected to a yarn-joining process.

[0009] Moreover, in this invention, the yarn-type selection device includes a plurality of yarn-selection guide members that are aligned so as to respectively rotate with respect to a common shaft, and thus constitutes a yarn-joining take-up device for different types of yarns which is capable of carrying out positioning processes in which the yarn-selection guide members are selectively operated and driven to a first position at which the selected yarn is guided to travel and a second position at which the yarn to be selected is held in a stand-by state.

[0010] Furthermore, in this invention, the succeeding yarn directing means in the yarn-type selection device includes first and second guiding mechanisms which hook the succeeding yarn to be selected that has been held by the yarn-selection guiding member that is in the stand-by state at the second position, and guides it into the yarn-joining device; thus, a yarn-joining take-up device for different types of yarns is formed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 shows a basic structural example of a yarn-joining take-up device for different types of yarns of the present invention; and Fig. 1A is a schematic plan view that shows the entire structure of the yarn-joining take-up device for different types of yarns, and Fig. 1B is a schematic side view thereof.

Figs. 2 and 3 relate to a specific structural example of a yarn-type selection device, and show operation modes thereof; and Fig. 2 is a schematic side view that shows a state in which a leading yarn Yb to be subjected to a yarn-joining process is traveling.

Fig. 3 is a schematic side view that shows a state in which a succeeding yarn Ya to be joined to a leading yarn Yb has been selected.

Fig. 4 is a schematic cross-sectional side view that shows a specific structural example of a length-measuring/storing device which measures the length of the yarn, and stores the yarn.

Figs. 5 to 7 are drawings that show a sequence of processes in which the leading yarn Yb to be joined and the succeeding yarn Ya to be joined thereto are set in a yarn-joining device through the yarn-type selection device; and Fig. 5 is a schematic perspective view in which the respective constituent members are indicated by solid lines in the traveling state of the leading yarn Yb to be joined, and a mode in which a yarn selection guide in the yarn-type selection device is then driven in arrow [Y1] direction and a mode in which a hook lever member is driven in arrow [Y2] direction are indicated by hypothetical lines.

Fig. 6 is a schematic perspective view in which: a state in which the yarn selection guide for the succeeding yarn Ya selected to be joined is driven in direction of arrow [Y3] so that a vertical portion is formed by the succeeding yarn Ya is illustrated by using solid lines, and a mode in which the hook lever member is then driven in arrow [Y4] direction with the vertical portion of the succeeding yarn Ya being hooked by the hook lever member is indicated by hypothetical lines.

Fig. 7 is a schematic perspective view in which a state prior to a process by which a succeeding yarn pushing lever member used for setting the succeeding yarn Ya to be joined in the yarn-joining device is driven in arrow [Y5] direction is indicated by solid lines.

Fig. 8 is a schematic plan view that shows a specific structural example of a conventional yarn-joining take-up device for different types of yarns.

Fig. 9 is a drawing that shows the entire structure of a second embodiment of the present invention together with a basic structural example of a sample warper; and Fig. 9A is a schematic plan view that shows the entire structure of the device, and Fig. 9B is a schematic side view thereof.

Fig. 10 is a drawing that shows the relationship between a warping drum and a warping beam in a sample warper; and Fig. 10A is a schematic plan view thereof, and Fig. 10B is a schematic cross-sectional view of the warping beam.

Fig. 11 is a drawing that shows a fabric-forming state by using a warping beam in the sample warper; and Fig. 11A is a schematic partial plan view that shows a cross-section of the warping beam, and Fig. 11B is a schematic perspective view thereof.

Fig. 12 is a schematic plan view that shows one example of a sample fabric-forming process in a conventional sample warper.

Fig. 13 is a schematic explanatory drawing that shows one embodiment of a knitting machine in accordance with the present invention.

Fig. 14 is a schematic drawing that shows a yarn selection device.

Fig. 15 shows a driving means for the yarn selection device.

Fig. 16 is a schematic explanatory drawing that shows a yarn-length measuring/storing device.

Fig. 17 shows fabrics formed by the knitting machine in accordance with the present invention; and Fig. 17 (a) shows an example of a fabric formed by a flat knitting machine, and Fig. 17 (b) shows an example of a fabric formed by a circular knitting machine.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] The following description will explain a specific structural example of the first embodiment of the present invention in detail. As shown in Fig. 1, the yarn processing system of the present invention is basically provided with a yarn supplying unit 11, a yarn-type selection unit 12, a yarn-joining unit 13, a length-measuring/storing unit 14 and a take-up unit 15 that are aligned into a one line, with a control unit 16 being added thereto.

[0013] The above-mentioned yarn-supplying unit 11 is provided with a yarn-supplying package creel 17 that properly sets a plurality of kinds of yarn-supplying package groups, and arranged so that n-kinds of yarn-supplying packages SPa, SPb, ... SPn including color yarn Ya having a color a, color yarn Yb having a color b, ..., color yarn Yn having a color n are placed so as to carry out yarn-feeding operations without intervening with each other. The color yarn Ya, color yarn Yb, ..., color yarn Yn, respectively fed from the yarn-supplying packages SPa, SPb, ... SPn, are respectively supplied to the yarn-type selection device 18 through a guide 21 and a tension device (not shown).

[0014] The color yarn Ya, color yarn Yb, ..., color yarn Yn, fed from these color yarn groups, are selected by a color-type selection device 18 placed in the color-type selection unit 12 so as to achieve a preliminarily designed pattern, yarn-joined by a yarn-joining device 19 placed in the yarn-joining unit 13, and measured in length and stored in a length-measuring/storing device 20 placed in the length-measuring/storing unit 14; thus, these yarns are formed into a joined yarn CY that is successively yarn-joined in a determined order with a length determined based upon the preliminarily designed pattern, and said yarn is further formed into, for example, a warping-yarn package P by a take-up device WA containing a traverse drum 22, placed in the take-up unit 15.

[0015] Here, the above-mentioned yarn-type selection unit 12 is provided with a yarn-type selection device 18 which reserves the end portions of the color yarn Ya, color yarn Yb, ... color yarn Yn that have been fed from the respective yarn-supplying packages SPa, SPb, ..., SPn, and brings at least one specific color yarn to a traveling station in accordance with instructions from the

control unit 16.

[0016] Based upon Figs. 1 to 3 as well as Figs. 5 to 7, the following description will discuss a specific structure of the above-mentioned yarn-type selection device 18 in detail. As shown in Fig. 1, the above-mentioned yarn-type selection device 18 includes a machine frame 23, and is provided with a guide 24 that individually guides the respective color yarns Ya, Yb, ..., Yn. A common shaft 25 is attached to the above-mentioned machine frame 23, and yarn selection guide members 26 which individually insert the respective color yarns to the common shaft 25 so as to allow the yarns to travel are also installed therein. Each of the above-mentioned yarn selection guide members 26 has a hook plate 27, and a tension spring 28 is placed between the hook plate 27 and the machine frame 23 so that the above-mentioned yarn selection guide member 26 is pressed toward a first position (selected color yarn travel guide position).

[0017] The above-mentioned yarn-type selection device 18 is provided with an external force applying means 29 which is used for shifting the respective yarn selection guide members 26 to a second position (selection stand-by position), and the yarn selection guide member 26, shifted to the second position by the action of the above-mentioned external force applying means 29, is engaged by a hook portion 27a of the hook plate 27 by the operation of a solenoid means 30 attached to the above-mentioned machine frame 23, and maintained in the second position.

[0018] Moreover, the above-mentioned yarn-type selection device 18 is provided with a yarn-end holding means 31 which catches and holds the yarn end portion of the color yarn to be guided by each of the yarn selection guide members 26 located at the second position (selection stand-by position). This yarn-end holding means 31 is constituted by a cross-blade rotary member 32 that is driven to rotate by a driving source M3 and a backing member 33 made of an elastic material such as urethane, and arranged so that the yarn end of the leading color yarn, cut by a yarn-joining device which will be described later, is caught and held.

[0019] In accordance with embodiments shown in Figs. 2 and 3, in Fig. 2, a yarn selection guide member 26b, located on the front side in the direction perpendicular to the drawing face, is selected and positioned at a first position (selected color yarn travel-guide position) that guides the leading color yarn Yb to a traveling state, and a yarn selection guide member 26a, located on the rear side in the direction perpendicular to the drawing face, is in a stand-by state at a second position (selection stand-by position) so that the end portion of the color yarn Ya, guided by said guide member 26a, is caught and held by the yarn-end holding means 31.

[0020] In this manner, the above-mentioned yarn-type selection device 18, which includes the yarn selection guide members 26 that are respectively aligned so as to freely rotate with respect to the common shaft 25, is

arranged so that the yarn selection guide members 26 are selectively driven to be positioned at the first position (selected color yarn travel-guide position) and the second position (selection stand-by position); thus, with respect to the succeeding yarn to be selected, not limited to one yarn, a plurality of yarns can be simultaneously selected so that a yarn-joining process with many variations can be carried out with the selected color yarns being aligned adjacent to each other.

[0021] Fig. 3 shows a mode in which with respect to the leading color yarn Yb, the color yarn Ya to be next joined is selected, and the yarn selection guide member 26b, located on the front side in the direction perpendicular to the drawing face, is driven in arrow [Y1] direction by the action of the above-mentioned external-force applying means 29 to the second position (selection stand-by position) so that the leading color yarn Yb is guided into the yarn-joining device.

[0022] On the other hand, upon release of the hook by the solenoid means 30, the yarn selection guide member 26a, located on the rear side in the direction perpendicular to the drawing face, is selectively driven to the first position by the pressing force of the tension spring 28. In this case, since the end portion of the color yarn Ya guided by the yarn selection guide member 26a is caught and held by the yarn-end holding means 31, the color yarn Ya is allowed to form a virtual portion Ya'.

[0023] Referring to Figs. 5 to 7, the following description will discuss the yarn-type selection mode of the above-mentioned yarn-type selection device 18 and a mode in which the leading color yarn Yb and the color yarn Ya next selected are guided into the yarn-joining device which will be described later. In this invention, the above-mentioned yarn-type selection device 18 is provided with a succeeding yarn guiding means 34 which hooks the vertical portion Ya' of the succeeding yarn Ya, and brings this into the yarn-joining device. This succeeding yarn guiding means 34 is constituted by a first guiding mechanism 35 and a second guiding mechanism 36. The first guiding mechanism 35 includes a hooking lever member 38 which is supported by a frame supporting shaft 37, and allowed to reciprocally rotate around the frame supporting shaft 37 in arrow directions [Y2] and [Y4]. The hooking lever member 38 is provided with a hook portion 39 that hooks the vertical portion Ya' of the succeeding yarn Ya on one of the ends 38a that is located on the opposite side with respect to the frame supporting shaft 37, with a cylinder action means 40 being connected to the other end 38b on the opposite side.

[0024] As shown in Fig. 7, the above-mentioned second guiding mechanism 36 is constituted by a pair of pushing lever members 42 and 43 that are attached to the rotary shaft 41 so that these are allowed to reciprocally rotate in arrow [Y5] direction and in the direction opposite to this direction by the action of an external force means 44; thus, when driven in arrow [Y5] direction, the succeeding color yarn Ya, directed to the hooked state by the first guiding mechanism 35, is di-

rected into the yarn-joining device. The pair of pushing levers 42 and 43 in the second guiding mechanism 36 are designed so that they are phase-shifted in the pivotal direction to be made in contact with the color yarn so as to push the color yarn Ya in a tilted state into a horizontal state with respect to the yarn-joining device.

[0025] The operation sequences of the yarn selection guide member 26 and the succeeding yarn guiding means 34 in the yarn-type selection device 18 are indicated by numbers of arrows [Y1] to [Y5] in Figs. 5 to 7, and in Fig. 5, the respective constituent members in the traveling state of the leading yarn Yb to be joined are indicated by solid lines and modes in which the yarn selection guide member 26b is driven in arrow [Y1] direction in the yarn-type selection device 18 and the first guiding mechanism 35 in the succeeding yarn guiding means 34 is driven in arrow [Y2] direction are indicated by hypothetical lines. In Fig. 6, a state in which the yarn selection guide member 26a for the succeeding yarn Ya selected to be yarn-joined is driven in [Y3] direction with the vertical portion Ya' of the succeeding yarn Ya has been formed is indicated by solid lines and a state in which the first guiding mechanism 35 is driven in arrow [Y4] direction with the vertical portion Ya' of the succeeding yarn Ya being hooked is indicated by hypothetical lines. In Fig. 7, a state prior to the actuation of the succeeding yarn pushing lever member in arrow [Y5] direction so as to set the succeeding yarn Ya to be joined in the yarn-joining device is indicated by solid lines. In accordance with these sequences, the leading color yarn Yb and the succeeding color yarn Ya to be joined to said color yarn Yb are set in the yarn-joining device 19 in a state capable of yarn-joining.

[0026] Next, the yarn-joining device 19 is placed in the yarn-joining unit 13 that is placed adjacent to the yarn-type selection unit 12. In this invention, the yarn-joining device 19 once forcefully cuts the leading color yarn Yb stored in a storing drum 57 which will be described later (in this stage, the above-mentioned color yarn Yb is in a connected state between the take-up package 23 and the yarn-supplying package SPb), and to the cut end of said leading color yarn Yb is yarn-joined the end of the succeeding color yarn Ya; thus, the device is constituted by at least a yarn-cutting mechanism and a yarn-joining mechanism.

[0027] With respect to this yarn-joining device 19, devices such as a Fisherman Knotter and a Weaver's Knotter that form knots may be applied; however, for example, a pneumatic yarn-joining device relating to the previously applied patent by the same applicant as the present invention (for example, device described in JP-A No. 61-16711) or a bonding-type yarn-joining device may be applied. The yarn-joining device applied to the present invention is basically arranged so that the leading yarn Yb stored in a storing drum 57 which will be described later (at this stage, the leading yarn Yb is of course continuous between the yarn-supplying package SPb and the package P on the take-up side) and

the succeeding yarn Ya selected by the yarn-type selection device 18 are individually received, and held, and in the respectively held states, the leading yarn Yb and the succeeding yarn Ya are cut, and the cut portions of the respective yarns are combined with each other to be yarn-joined by allowing these to entangle in the untwisted state, or the cut portions of the respective yarns are combined with each other and joined together through bonding.

[0028] In accordance with embodiments shown in Figs. 5 to 7, the yarn-joining device 19 is provided with two V-shaped guide plates GP1 and GP2, and each of the V-shaped guide plates has a first V-shaped guide groove G1 that guides and receives the leading yarn Yb and a second V-shaped guide groove G2 that guides and receives the succeeding yarn Ya. In the case of the knotter device, a first knotter bill NB1 that holds the leading yarn Yb and a second knotter bill NB2 that holds the succeeding yarn Ya are placed between the above-mentioned V-shaped guide plates GP1 and GP2. In accordance with this embodiment, the first the leading yarn Yb is guided and inserted along the first V-shaped guide groove G1, and held by the first knotter bill NB1, and the succeeding yarn Ya is guided and inserted along the second V-shaped guide groove G2, and held by the second knotter bill NB2; thus, a predetermined yarn knotting process is carried out.

[0029] Next, the following description will discuss the structure of the yarn length-measuring/storing unit that is placed between the yarn-joining unit 13 and the take-up unit 15. The yarn length-measuring/storing unit is provided with a yarn length-measuring/storing device 20 that measures the yarn length of the selected yarn to be wound, and temporarily stores the wound yarn. Fig. 4 shows one embodiment that specifically shows the yarn length-measuring/storing device 20. The yarn length-measuring/storing unit 20 in accordance with this embodiment is provided with a stationary machine part 45 and an independent rotation driving source M1 that is attached to an appropriate stationary structure (which may be the stationary machine part 45), and a rotary member 47, transmission-connected thereto by a power transmission mechanism 46 through the rotation driving operation of the rotation driving source M1, includes a rotation shaft portion 48 and a branch portion 49 that extends in a radial direction while intersecting the rotation shaft portion 48, and in the rotation shaft portion 48 and the branch portion 49, a yarn insertion travel hole 50 that allows yarn insertion and travel includes a rotary shaft.

[0030] The above-mentioned rotary member 47 is shaft-supported by a bearing 51 so as to rotate inside the stationary machine part 45, and provided with a balancer 52 for the branch portion 49 and an extended shaft portion 53. A cylinder-shaped yarn length-measuring/storing member 55 is attached to this extended shaft portion 53 through a bearing 54. For example, a magnetic force connecting means 56 is placed between the

yarn length-measuring/storing member 55 and the stationary machine part 45 so that the yarn length-measuring/storing member 55 is connected to the stationary machine part 45 by the magnetic force connecting means 56 through a magnetic force so as to be maintained in a stationary state even during rotation of the rotary member 47. Here, the yarn length-measuring/storing member 55 is provided with a storing drum unit 57 that tilts in a manner so as to narrow toward one end 55a, with a stopper flange 58 being attached to the narrowed tip end.

[0031] With respect to the yarn length-measuring/storing member 55 in the yarn length-measuring/storing device 20, a first position sensor 59 and a second position sensor 60 used for detecting the amount of wound yarn that is wound around the storing drum unit 57 are placed, and a yarn guide 61 for guiding the yarn to be drawn from the storing drum unit 57 is also installed.

[0032] In the yarn length-measuring/storing device 20 having the above-mentioned arrangement, during a drawing time of the yarn Y, when the branch portion 49, placed on one end of the rotary member 47, is allowed to rotate around the yarn length-measuring/storing member 55 by the rotary driving operation of the independent rotation driving source M1, the yarn Y, drawn from the branch portion 49 of the rotary member 47, is successively fed in arrow a direction along a taper face of the storing drum unit 57 in the yarn length-measuring/storing member 55, and temporarily stored before it is wound around the take-up package.

[0033] In said arrangement, the rotation driving source M1 is formed by, for example, a pulse motor, with the circumferential length of the storing drum unit 57 being preliminarily set by a unit of mm; thus, based upon the equation, one rotation of the pulse motor = circumferential length (mm) of the storing drum unit 57, the length of the succeeding yarn selected can be calculated based upon the number of revolutions of the pulse motor or the number of pulses so that the length of the succeeding yarn selected is measured within an error range of several millimeters. The above-mentioned rotation driving source M1 may be a stepping motor or a servomotor in place of the pulse motor.

[0034] With respect to first and second position sensors 59 and 60 that are set so as to detect the amount of yarn Y that has been fed to the storing drum unit 57 to be wound thereon in the yarn length-measuring/storing member 55 of the yarn length-measuring/storing device 20, the first position sensor 59 checks a station 57b that is apart from a yarn winding start position 57a by a distance α in the storing drum unit 57, that is, a station which is used for detecting a position of the yarn that has been stored in a manner so as not to cause lacking of yarn on the storing drum unit 57 while the next selected yarn is being joined, and for detecting whether or not any yarn exists at the station, and outputs the resulting detection signal to the control unit 16. The first position sensor 59 detects a state in which the yarn having a

length corresponding to the axis direction distance α remains on the storing drum unit 57 as a no-yarn state. The second position sensor 60 detects whether or not any yarn exists on a fully wound station 57c in the storing drum unit 57, and outputs the resulting detection signal to the control unit 16.

[0035] The following description will discuss yarn-joining and winding control processes in the above-mentioned device. In the present invention, first, the types of yarns to be wound, and lengths of said types of yarns are inputted to and set in the control unit 16 in addition to the order of the yarns to be wound. In this case, the length of the selected yarn is automatically converted to a number of pulses to be outputted to the pulse motor M1 or set as a number of pulses. Since the circumferential length of the storing drum unit 57 has been preliminarily known, the length of the yarn to be wound is set as a number of pulses based upon the number of pulses required for one rotation of the pulse motor M1 and the circumferential length. Therefore, the length of the yarn to be wound is set by a unit of mm.

[0036] In a normal winding operation, when the selected yarn has been wound around the storing drum unit 57 by the length that has been determined, the pulse motor M1 is stopped by an instruction from the control unit 16, while the next predetermined type of yarn is selected, and joined to the leading yarn. During said yarn-joining operation, a motor M2 on the take-up unit 15 side continues to rotate so that the yarn stored in the storing drum unit 57 is wound up by a package P. Upon completion of the yarn-joining process, the pulse motor M1 is again driven, and rotates by the number of pulses corresponding to the set length of the newly stored yarn. In this manner, the yarns of the predetermined types and lengths are wound up on packages P.

[0037] Normally, the storing speed (rotation speed of the motor M1) is greater than the winding speed (rotation speed of the winding-use motor M2); however, when the yarn-joining operations are frequently carried out, the stored yarn reduces, sometimes causing the reduction position sensor 59 to detect the no-yarn state. In this case, the winding-use motor M2 is temporarily stopped, and the yarn storing operation to the storing drum unit 57 is preferentially carried out. When the yarn has been wound around the storing drum unit 57 to allow the position sensor 59 to again detect the yarn-storing state, the winding-use motor M2 is again driven to rotate. Here, the winding-use motor M2 may be driven to rotate at a reduced speed without stopping so that the storing process may be carried out while continuing the winding process.

[0038] In contrast, in the case when the set length of the selected yarn is long, since the yarn-joining process is not carried out frequently, the amount of wound yarn on the storing drum 57 increases so that upon detection of the yarn-storing state by the position sensor 60 for detecting the maximum position, the motor M1 is stopped, and the winding process is preferentially car-

ried out by rotating only the winding-use motor M2. When the amount of yarn on the storing drum 57 reduces to allow the position sensor 60 for detecting the maximum position to detect the no-yarn state, the motor M1 is again driven to resume the storing process of yarn on the storing drum 57. In this case also, the speed of the winding-use motor M2 is increased without stopping the motor M1 to continue the rotation; thus, the amount of stored yarn on the storing drum 57 may be reduced by increasing the winding speed.

[0039] In the above-mentioned winding control, the detection signals indicating the yarn-storing state or the no-yarn state given by the first and second position sensors 59 and 60 are used to stop or drive the motors M1 and M2; however, since the types and lengths of yarns to be selected are preliminarily determined, the winding speed (rotation speed of the winding-use motor M2) may be set at a low speed in the case when one type of yarn the length of which is comparatively short is continuously fed, and the winding speed may be set at a high speed in the case when another type of yarn the length of which is comparatively long is continuously fed. Thus, it becomes possible to carry out an effective winding process without stopping/driving the motor.

[0040] The yarn-processing system of the present invention relates to a yarn-joining take-up technique for different types of yarns in which different types of yarns of a plurality of kinds having, for example, different colors are yarn-joined with respectively desired lengths, while being successively selected in accordance with a preliminarily designed pattern so that the resulting yarn is wound into a package, and this system is provided with a yarn-type selection unit placed between a yarn-supplying unit and a yarn-joining unit, and the yarn-type selection unit has a yarn-type selection device which selects a succeeding yarn on the yarn-supplying side to be yarn-joined to a leading yarn on the take-up package side; thus, the yarn-joining device and the yarn-type selection device function so that the leading yarn is guided into the yarn-joining device with the leading yarn being connected to the yarn-type selection device so that the succeeding yarn is guided by a succeeding yarn guiding means into the yarn-joining device so as to be subjected to a yarn-joining process. This arrangement makes it possible to quickly carry out yarn selection and yarn-joining processes, and also to eliminate the necessity of stopping the other device units during the yarn-joining processes; thus, it becomes possible to provide superior capability and effective functions from the viewpoint of availability factor.

[0041] The following description will discuss second embodiment in which the above-mentioned yarn-processing unit is prepared as a sample warper.

[0042] In the case when warping yarns for a plurality of sample fabrics are prepared by using such a sample warper, conventionally, warping yarn beams for use in the respective samples need to be made individually. In other words, as shown in Fig. 12, after warping yarns

Yb the number ([1] to [N]) of which is set so as to correspond to the width of a fabric to be formed have been wound on a warping drum D1 with a predetermined length for each of sample patterns, the yarns on the warping drum D1 are re-wound on warping yarn beams V1 while being released (the warping yarn beam V1 is constituted by N-number of warping yarns Yb, with each warping yarn being aligned in the axis direction and wound thereon). In the same manner, a beam V2 of warping yarn Ya to be used for another sample pattern is formed, and a beam V3 of warping yarn Yc for still another sample pattern is further formed (see Patent Document 2).

[Patent Document 2] JP-A No. 11-293536 (Figs. 1 and 2)

[0043] After a plurality of warping yarn beams for use in the respective samples have been formed, the respective warping yarn beams are set in a weaving machine to weave a desired sample fabric. In this case, each warping yarn beam is set for each sample, with the result that much time is required for preparation jobs such as a drawing process of yarns from the beams, a beam insertion process and a connecting process for yarns. In the case of a sample weaving process, the preparation time required for warping-yarn beam exchanges and connections of warping yarns sometimes becomes longer than the process time of a weaving machine required for weaving a texture of one pattern.

[0044] The present invention has been devised to solve the above-mentioned conventional problems, and its objective is to provide a sample warper which prepares warping yarns for a plurality of sample patterns as a single warping-yarn beam without the necessity of preparing a specific warping-yarn beam for each of the sample patterns so that the single warping-yarn beam is used for continuously weaving the sample patterns; thus, it becomes possible to greatly reduce preparation time required for setting respective warping-yarn beams in a weaving machine for the respective sample patterns.

[0045] In order to achieve the above-mentioned objective, specifically, a sample warper of the present invention is provided with a yarn-supplying unit provided with a plurality of types of yarns to be supplied with respect to a single warping drum, and a yarn-joining unit having a yarn-joining device placed between a yarn-supplying package placed on the yarn-supplying unit and the warping drum, and in this arrangement, the plurality of types of yarns are successively selected in accordance with a preliminarily designed pattern, and yarn-joined, and the joined yarn is subjected to a warping process on a warping-yarn beam so that said warping-yarn beam is supplied to a weaving machine so as to form a fabric.

[0046] Moreover, the present invention provides a sample warper in which a yarn length-measuring/storing unit, which measures the length of the selected yarn and

stores the yarn, is installed between the yarn-joining unit and the warping drum.

[0047] Furthermore, the present invention provides a sample warper in which a yarn-joining device is installed between a warping drum having a yarn length-measuring means and the yarn-supplying package so that based upon a yarn length measuring signal from the yarn length-measuring means of the warping drum, the yarn-joining device is operated.

[0048] Based upon specific embodiments shown in attached drawings, the following description will discuss the sample warper in accordance with the present invention in detail.

[0049] First, based upon Figs. 9, 10 and 11, the warping system in the sample warper of the present invention is explained in detail. In the present invention, first, a group of packages of n-kinds of yarn-supplying packages (SPa, SPb, SPc, ... SPn) including color yarn Ya having a color a, color yarn Yb having a color b, color yarn Yc having a color c ..., color yarn Yn having a color n are prepared in a yarn-supplying unit 11. The color yarns Ya to Yn, fed from the group of yarn-supplying packages, are respectively selected by the yarn-type selection device 18 so as to achieve a preliminarily designed pattern, and successively yarn-joined by the yarn-joining device 19 in a predetermined order with predetermined lengths in accordance with the preliminarily designed pattern, and wound on a warping drum D through a take-up device WA placed in a take-up unit 15.

[0050] Referring to Fig. 10, the following description will discuss a structural example which weaves three sample patterns in the present invention. In this case, as shown in Fig. 10A, three types of color yarns Yb, Ya, Yc are formed into a yarn-joined continuous warping yarn CY while being yarn-joined at joined portions j with respectively preset length dimensions, and [1] to [N] number of these warping yarns are wound on warping drums D so that these are fed as shown in Fig. 10A to form a single warping-yarn beam V in a mode shown in Fig. 10B.

[0051] Here, in the above-mentioned warping-yarn beam V has an arrangement in which with respect to the weaving width dimension W in the sample weaving sheet CS to be woven, yarn-joined warping yarns [1] to [N] the number of which corresponds to the number of warping yarns in the weaving width direction are wound up in a manner as shown in cross-sectional views of Fig. 10B and Fig. 11A. For example, in accordance with a specific embodiment shown in Fig. 10A, the respective yarn-joined warping yarns [1] to [N], indicated by the first warping yarn [1] to the N-numbered warping yarn [N], are joined in the order of color yarn Yb having a length dimension L3 in the weaving direction, color yarn Ya having a length dimension L2 in the weaving direction and color yarn Yc having a length dimension L1 in the weaving direction, and the warping-yarn beam V is constituted by N-number of yarn-joined continuous warping yarns CY that have been yarn-joined as de-

scribed above, and wound up.

[0052] Next, referring to Figs. 2 to 9, the following description will discuss a specific structural example of a yarn-joining take-up device for different types of yarns that is applied to a sample warper in accordance with the present invention. As shown in Fig. 9, the yarn-joining take-up device for different types of yarns to which the present invention is applied is basically provided with a yarn supplying unit 11, a yarn-type selection unit 12, a yarn-joining unit 13, a yarn length-measuring/storing unit 14 and a take-up unit 15 that are aligned into a one line, with a control unit 16 being added thereto.

[0053] The above-mentioned yarn-supplying unit 11 is provided with a yarn-supplying package creel 17 that properly sets a plurality of kinds of yarn-supplying package groups, and arranged so that n-kinds of yarn-supplying packages SPa, SPb, ... SPn including color yarn Ya having a color a, color yarn Yb having a color b, ..., color yarn Yn having a color n are placed so as to carry out yarn-feeding operations without intervening with each other. The color yarn Ya, color yarn Yb, ..., color yarn Yn, respectively fed from the yarn-supplying packages SPa, SPb, ... SPn, are respectively supplied to the yarn-type selection device 18 through a guide 21 and a tension device (not shown).

[0054] The color yarn Ya, color yarn Yb, ..., color yarn Yn, fed from these color yarn groups, are selected by a color-type selection device 18 placed in the color-type selection unit 12 so as to achieve a preliminarily designed pattern, yarn-joined by a yarn-joining device 19 placed in the yarn-joining unit 13, and measured in yarn length and stored in a yarn length-measuring/storing device 20 placed in the yarn length-measuring/storing unit 14; thus, these yarns are formed into a joined yarn CY that is successively yarn-joined in a predetermined order with a length determined based upon the preliminarily designed pattern, and this is further formed into, for example, a warping-yarn beam V, for example, as shown in Fig. 11A, by a take-up device WA containing a warping drum D, placed in the take-up unit 15.

[0055] Here, the above-mentioned yarn-type selection unit 12 is provided with a yarn-type selection device 18 which reserves the end portions of the color yarn Ya, color yarn Yb, ... color yarn Yn that have been fed from the respective yarn-supplying packages SPa, SPb, ..., SPn, and brings at least one specific color yarn to a travel station in accordance with instructions from the control unit 16.

[0056] With respect to specific structures of the above-mentioned yarn-type selection device 18, yarn-joining device 19 and yarn length-measuring/storing device 20, these are the same as those explained in detail by reference to Figs. 2 to 7.

[0057] In accordance with another structural example of the present invention, a yarn length-measuring means 70 may be placed in the warping drum D, and the above-mentioned yarn-joining device 19 may be placed between the above-mentioned yarn-supplying

package and warping drum. In this case, the yarn length-measuring means 70 is provided with an independent rotation driving source M4, and includes a rotary member 71 that is allowed to rotate by the rotation driving operation of the rotation driving source M4. A yarn insertion traveling hole through which the yarn is inserted and allowed to travel is formed in the rotary member 71 so that the yarn fed from the rotary member 71 is wound on the above-mentioned warping drum D.

[0058] In the yarn length-measuring means 70 having the above-mentioned arrangement, during a drawing time of the yarn Y, when the rotary member 71 is allowed to rotate around the warping drum D by the rotary driving operation of the independent rotation driving source M4, the yarn Y, drawn from the rotary member 71, is wound on the peripheral face of the warping drum D. In this arrangement, the rotation driving source M4 is formed by, for example, a pulse motor, with the circumferential length of the warping drum D being preliminarily set by a unit of mm; thus, based upon the equation, one rotation of the pulse motor = circumferential length (mm) of the warping drum D, the length of the selected yarn can be calculated based upon the number of revolutions of the pulse motor or the number of pulses so that the length of the selected yarn is measured within an error range of several millimeters. The above-mentioned rotation driving source M4 may be a stepping motor or a servomotor in place of the pulse motor.

[0059] Referring to Fig. 9, the following description will discuss control operations of the sample warper of the present invention. In the present invention, first, information relating to a sample fabric to be woven, such as the types of yarns for respective sample patterns and lengths of the types of yarns are inputted to and set in the control unit 16 in addition to the order of the yarns to be woven. In this case, the length of the yarn selected in the order to be woven as the sample pattern is automatically converted to a number of pulses to be outputted to the pulse motor M1 (or the pulse motor M4 in another embodiment) or set as a number of pulses. Since the circumferential length of the storing drum unit 57 has been preliminarily known, the length of the yarn to be wound is set as a number of pulses based upon the number of pulses required for one rotation of the pulse motor M1 and the circumferential length. Therefore, the length of the yarn to be wound is set by a unit of mm.

[0060] In a normal winding operation, when the selected yarn has been wound around the storing drum unit 57 (or warping drum D) by the length that has been determined, the pulse motor M1 (or pulse motor M4) is stopped by an instruction from the control unit 16, while the next predetermined type of yarn is selected, and joined to the leading yarn. During this yarn-joining operation, the yarn stored in the storing drum unit 57 is wound on the warping drum D. Upon completion of the yarn-joining process, the pulse motor M1 is again driven, and rotates by the number of pulses corresponding to the set length of the newly stored yarn. In this manner,

the predetermined types and lengths of yarns are wound on the warping drum D.

[0061] Normally, in this yarn length-measuring/storing device, the storing speed (rotation speed of the motor M1) is greater than the winding speed of the warping drum D; however, when the yarn-joining operations are frequently carried out, the stored yarn reduces, sometimes causing the reduction position sensor 59 to detect the no-yarn state. In this case, the winding operation onto the warping drum D is temporarily stopped, and the yarn storing operation to the storing drum unit 57 is preferentially carried out. When the yarn has been wound around the storing drum unit 57 to allow the position sensor 59 to again detect the yarn-storing state, the winding operation onto the warping drum D is resumed.

[0062] In contrast, in the case when the set length of the selected yarn is long, since the yarn-joining process is not carried out frequently, the amount of wound yarn on the storing drum 57 increases so that upon detection of the yarn-storing state by the position sensor 60 for detecting the maximum position, the motor M1 is stopped, and the winding process onto the warping drum D is preferentially carried out. When the amount of yarn on the storing drum 57 reduces to allow the position sensor 60 for detecting the maximum position to detect the no-yarn state, the motor M1 is again driven to resume the storing process of yarn on the storing drum 57. In this case also, the winding speed onto the warping drum D may be increased without stopping the motor M1; thus, the amount of stored yarn on the storing drum 57 may be reduced.

[0063] The above-mentioned embodiment shows a case in which, as shown in Fig. 9, a yarn-supplying unit 11, a yarn selection unit 12, a yarn-joining unit 13, a yarn length-measuring/storing unit 14 and a warping drum D are directly connected and aligned into one row; however, a plurality of sets, each including devices from the yarn-supplying unit 11 to the yarn length-measuring/storing unit 14, may be placed with respect to a single warping drum D so that the yarn-supplying units may prepare various sample patterns of different types as a single warping beam.

[0064] In accordance with the sample warper in accordance with the present invention, without the necessity of preparing a warping yarn beam for each of sample patterns, a warping yarn of a plurality of sample patterns is prepared as a single warping-yarn beam, and a plurality of sample patterns can be continuously woven by using the single warping-yarn beam; thus, this method functions effectively in that preparation time required for setting warping-yarn beams for the respective sample patterns is greatly reduced.

[0065] In accordance with the sample warper of the present invention, since a yarn-joining device for different types of yarns which carries out a yarn-joining process on a plurality of types of yarns having, for example, different colors with respectively desired lengths, while successively selecting the corresponding yarn in ac-

cordance with a preliminarily designed pattern, and a yarn length-measuring/storing device are installed so that the yarn length of a desired yarn type is freely set, and yarn-selection and yarn-joining processes are quickly carried out, and it is possible to eliminate the necessity of stopping the other device units during the yarn-joining operation; thus, it becomes possible to provide superior functions in that an excellent capability is exerted from the viewpoint of availability factor.

[0066] Moreover, in accordance with the sample warper of the present invention, a yarn length-measuring means is installed in a warping drum so that it becomes possible to simplify the device and also to provide superior functions in that the length of a yarn for each sample pattern is measured more appropriately.

[0067] The following description will discuss third embodiment in which the above-mentioned yarn-processing unit is prepared as a knitting machine.

[0068] Conventionally, a flat knitting machine which is provided with a yarn-length measuring means used for carrying out a knitting process from a plurality of color-yarn packages has been known (for example, see Patent Document 3).

[0069] Moreover, a flat knitting machine, which is provided with a yarn-supplying support member that is allowed to freely shift with respect to its height positions and lateral positions so as to carrying out a knitting process while selectively changing orientations of color yarns inside a knitting needle hook, which are combined so as to develop a pattern, to suitable orientations that properly fit to a color yarn appearing on the surface side and a color yarn appearing on the back side in accordance with the pattern, has also been known (for example, see Patent Document 4).

[0070] Furthermore, a knitting machine, which serves as a yarn processing system that is provided with a plurality of color-yarn packages, and has a yarn selection unit, a yarn-joining unit and a yarn storing unit, and generally controls all the operations of these devices and the knitting machine so that a desired yarn is selected from the yarn-supplying packages, and supplied to the knitting machine in desired synchronized timing so as not to stop the knitting machine, has also been known (for example, see Patent Document 5).

[Patent Document 3]

JP-A No. 8-209504 (pages 2 to 6, Fig. 1)

[Patent Document 4]

JP-A No. 9-49154 (pages 2 to 6, Fig. 1)

[Patent Document 5]

JP-A No. 9-176942 (pages 2 to 5, Fig. 1)

[0071] However, in the case of a (flat) knitting machine

simply having a yarn-length measuring means and a (flat) knitting machine having a yarn-supplying support member that is freely shiftable, the kinds of color yarns to be used are limited to only few kinds, and with respect to the color yarn length, at least a length corresponding to a traverse of a carriage that reciprocally moves is required, and the knitting process is not carried out on color yarns that are shorter than this length.

[0072] Moreover, such an arrangement in which a desired yarn is selected from the yarn-supplying packages, and supplied to the knitting machine in desired synchronized timing so as not to stop the knitting machine makes it possible to use a number of color yarns and also to freely change the length of the color yarn; however, the yarn length is not determined by taking a picture pattern after a predetermined knitting process into consideration.

[0073] The objective of the present invention is to provide a knitting machine which can continuously knit various color yarns and types of yarns having yarn lengths corresponding to a picture pattern after the knitting process.

[0074] In order to achieve the above-mentioned objective, the invention according to claim 11 relates to a knitting machine having a yarn-supplying device which is provided with: a selection device which selects at least one yarn from a plurality of packages having different colors and a plurality of packages having different types of yarns, a yarn-joining device that joins the selected yarn, and a yarn-length measuring/storing device that simultaneously carries out a measuring process of the yarn and a storing process thereof.

[0075] In accordance with the invention of claim 11 having the above-mentioned arrangement, it is possible to continuously supply knitting yarns having an alignment of color yarns and lengths thereof that accurately represent a picture pattern after the knitting process.

[0076] The invention according to claim 12 relates to the yarn-length measuring/storing device which is provided with a storing drum that is driven to rotate by a pulse motor or a servomotor capable of angle control, and carries out the yarn-length measuring process by controlling the number of revolutions of the motor.

[0077] In accordance with the invention of claim 12 having the above-mentioned arrangement, it is possible to accurately control the color yarn length up to a minute unit by controlling the number of revolutions of the pulse motor and the like; thus, it becomes possible to manufacture a knit fabric having a minute knit pattern.

[0078] The invention according to claim 13 is characterized by an arrangement in which the yarn length to be measured corresponds to a yarn length of each of the various color yarns and yarns of various types that are determined by taking a picture pattern after the knitting process into consideration.

[0079] In accordance with the invention of claim 13 having the above-mentioned arrangement, it becomes possible to continuously manufacture a knit fabric that

accurately represents a desired picture pattern.

[0080] Referring to Figs. 13 to 17, the following description will discuss embodiments of a knitting machine in accordance with the present invention.

[0081] Fig. 13 is a schematic explanatory drawing that shows one embodiment of a knitting machine of the present invention. Fig. 14 is a schematic drawing showing a yarn selection device. Fig. 15 shows a driving means for a yarn selection device. Fig. 16 is a schematic explanatory drawing that shows a yarn-length measuring/storing device. Fig. 17 shows a knit fabric that has been knitted by a knitting machine in accordance with the present invention, Fig. 17(a) shows an example of a knit fabric that has been knitted by a flat knitting machine, and Fig. 17 (b) shows an example of a knit fabric that has been knitted by a round knitting machine.

[0082] Referring to Fig. 13, a knitting machine according to the present invention is explained. The knitting machine 101 is constituted by a knitting machine main body 102 and a yarn-supplying device 103 placed therein. Said yarn-supplying device 103 draws yarns Y1, Y2 and Y3 respectively from packages P1, P2, P3... attached to a creel 110, allows these to pass through a tension applying member 111, and supplies the yarns to the knitting machine main body 2 through a yarn-joining device 112, a yarn-length measuring/storing device 130 and a second tension applying member 113.

[0083] The packages P1, P2, P3... are packages that respectively have yarns having different colors and types, and supplies the yarns continuously to the yarn-length measuring/storing device 130 with the yarns being continuously yarn-joined by the yarn-joining device 112. Moreover, the kinds and the number of the packages required for manufacturing a desired knit fabric are attached to the creel 110, and not limited to three shown in the drawing, six or twelve of these may be attached, without limitation in the number.

[0084] The yarn selection device 120 is provided with respective yarn guides 121a, 121b and 121c (see Fig. 15) that are attached to the respective packages P1, P2 and P3, and as will be described later, these guides are controlled to freely shift toward a yarn guide position (corresponding to 121A in the drawing) used for guiding the yarn Y to the yarn-joining device 12 and a guide position (corresponding to 121B in the drawing) used for guiding the yarn Y to a suction member 116.

[0085] The yarn-joining device 112 carries out cutting and joining processes of the yarn Y, and the yarn selected by the yarn selection device 120 is guided toward the yarn-joining device 112 by a guide 126 shown in Fig. 14 and subjected to a yarn-joining process. With respect to the yarn-joining device 112, a splicer device that carries out a yarn-joining process by using a vortex air flow may be used or a knoter device that carries out a yarn knotting process may be used. As to whether the splicer device or the knoter device is used, selection is properly made depending on the type of yarn to be used and required yarn-joining mode.

[0086] Referring to Figs. 14 and 15, the following description will discuss the yarn selection device 120 in detail. With respect to the yarn guide 121, a yarn guide 121a for guiding the yarn Y1, a yarn guide 121b for guiding the yarn Y2, a yarn guide 121c, ... for guiding the yarn Y3, ... and so on are respectively installed, and a rocking member 128 is rocked around a fulcrum 128a as the center of rotation by a cylinder 127 so that a raising rod 128b, placed on the other end of the rocking member 128, comes into contact with a rear guide plate 122B of the yarn guide 121 to rock the yarn guide 121 so as to freely shift the yarn Y to the yarn-joining device 112 (corresponding to 121B).

[0087] The yarn guide 121 has a boss portion 122, and is allowed to freely rotate around a rotation axis 122A. A rear guide plate 122B that is extended backward is attached to the boss portion 122, and a spring member 123, attached to the rear guide plate 122B, is used to press the yarn guide 121 toward a yarn guide position (corresponding to 121A in the figure) at which the yarn Y is guided to the yarn-joining device 112.

[0088] The yarn Y, sucked onto the suction member 116, is sandwiched by a yarn holding roller 117 and a yarn holding plate 118. The yarn holding roller 117 is a roller member coated with an elastic member such as urethane on its circumferential surface, and the yarn holding plate 118 is made in contact with and separated from the yarn holding roller 117 by a cylinder 119.

[0089] When the yarn guide 121 is rocked during selection of the yarn, the yarn holding plate 118 is separated from the yarn holding roller 117 so that the suction member 116 is allowed to suck the yarn Y. When the corresponding yarn is selected and the corresponding yarn guide 121 is positioned at 121A, the yarn holding plate 118 is made in contact with the yarn holding roller 117 by the cylinder 119 so that the yarn Y sucked onto the suction member 116 is held.

[0090] A notched section is formed in the rear end of the rear guide plate 122B so as to be engaged with an engaging member 124, and when the yarn guide 121 is pressed to the position (corresponding to 121B in the drawing) used for guiding the yarn Y to the suction member 116 by the cylinder 127 through a raising rod 128b, the cylinder 125 makes the engaging member 124 engaged with the notched section at the rear end of the rear guide plate 122B so that the position of the yarn guide 121 is secured to the position of 121B in the drawing. The engaging member 124 is driven by the cylinder 125 so as to freely rotate around a fulcrum 124A as the center of rotation.

[0091] With respect to a switching method of the yarn, first, the cylinder 127 is slightly extended to raise the rear guide plate 122B so as to be released from its engaged state with the engaging member 124. Next, only the cylinder 125 corresponding to the yarn type to be selected is driven so that the engaging member 124 is shifted; thus, the engaging member 124 is set in such a state that it is not made in contact with the rear guide

plate 122B regardless of the position thereof. Thereafter, the cylinder 127 is shrunk to set the yarn guide 121 in such a position that only the engaging member 124 is not engaged with the rear guide plate 122B; thus, the yarn guide 121 corresponding to the selected yarn type is shifted to a yarn guide station (corresponding to 121A in the drawing) used for guiding the yarn Y to the yarn-joining device 112, and stopped at the guide position corresponding to 121B.

[0092] The yarn that is allowed to pass through the selected yarn guide 121 has its one end held by the suction member 116, and forms a yarn YA indicated by a broken line. This yarn YA is guided toward the yarn-joining device 112 by the guide 126 that is pivoted in the direction of arrow in the drawing so that it is yarn-joined to the yarn Y that has been wound on the yarn-length measuring/storing device 130, and subjected to a winding process.

[0093] In this case, with respect to the types of yarns, not limited to one type, two types of yarns (for example, yarns Y1 and Y2) may be simultaneously selected and yarn-joined.

[0094] Referring to Fig. 16, the following description will discuss the yarn-length measuring/storing device 130. When the yarn-length measuring/storing device 130 is driven to start a winding process, the yarn Y having a predetermined length is stored in a storing drum 133. A rotary shaft 132 having a yarn passage 132b formed along the center axis inside a device main body 131 is driven to rotate by a pulse motor 137 (or a servomotor capable of angle control). A pulley 134 attached to the rotary shaft 132 is driven to rotate through a pulley 136 and a driving belt 135 attached to the pulse motor 137 so that the rotary shaft 132 is rotated and a winding tube 132a branched from the rotary shaft 132 is allowed to pivot around the storing drum 133.

[0095] When the winding tube 132a is driven to rotate around the storing drum 133, the yarn Y passing through the yarn passage 132b that is formed in a manner so as to penetrate the winding tube 132a from the center axis of the rotary shaft 132 is wound on the storing drum 133 that is formed in a tapered shape the diameter of which is slightly narrowed in the advancing direction of the yarn, and stored thereon. The yarn Y drawn from the winding tube 132a is wound around the outer diameter portion of the tapered portion of the storing drum 133 so that it is allowed to shift forward along the slightly narrowed diameter while sliding the taper portion. When the yarn Y is wound around the storing drum 133 with the winding tube 132a rotating, the above-mentioned yarn-sliding function is exerted continuously, the yarn Y is stored along the virtually entire length of the outer diameter portion of the tapered portion of the storing drum in a helically aligned state.

[0096] The controlling operation of the yarn length to be selected is carried out by controlling the rotation angle of the pulse motor 137 (or servomotor capable of angle control or the like) using a control device, not

shown. Therefore, the length controlling operation with a fine dimension (not more than 1 cm) is available. In cooperation with the rotation angle (corresponding to the yarn length determined by taking a pattern after the knitting process into consideration) of the pulse motor 137 that is rotated in accordance with a control program determined by taking a picture pattern after the knitting process into consideration, the winding tube 132a is rotated by a predetermined angle so that the length of the yarn that is wound on the storing drum 133 and stored thereon is accurately controlled to the yarn length to form the pattern after the knitting process. The presence of the yarn Y stored on the storing drum 133 is detected by a detection sensor such as a photoelectric sensor, and in the present embodiment, a leading-portion detection sensor 139a and a rear-portion detection sensor 139b are placed.

[0097] When, after the start of the winding process of the yarn Y onto the storing drum 133, the leading-portion detection sensor 139a detects the yarn Y, the rotation driving process of the winding tube 132a is temporarily stopped. In a state in which the winding process of the yarn Y onto the storing drum 133 is stopped to suspend the storing process, when the knitting operation is continued, the yarn gradually decreases from the storing drum 133 and is consumed so that the rear end detection sensor 139b no longer detects the yarn Y; therefore, the pulse motor 137 is re-driven to resume the winding process by the length-measuring/storing device 130. When the winding process is resumed, the yarn Y is wound on the storing drum 133 while advancing forward along the slightly narrowed diameter in a sliding manner on the taper shaped outer diameter portion so that the yarn is again stored over the entire length of the storing unit, with the leading-portion detection sensor 139a being allowed to detect the yarn Y.

[0098] The speed at which the yarn Y is being stored by rotating the winding tube 132a is set at a speed higher than the knitting speed. This arrangement is made from the viewpoint of absorbing an error between the knitting speed and the storing speed and of taking the periods of time of yarn selection and yarn-joining into consideration; thus, by storing the yarn faster than the knitting speed, it becomes possible to continue the knitting operation even during the selection of a new yarn and yarn-joining process after the yarn storage.

[0099] Fig. 17 shows examples of knit fabrics; and Fig. 17(a) shows a knit fabric knitted by a flat knitting machine and Fig. 17(b) shows a knit fabric knitted by a round knitting machine. In Fig. 17(a), a fabric basically knitted by yarn Y1 contains various types of color yarns, Y2, Y3 and Y4, that are knitted therein with predetermined lengths in a predetermined order, with a short pattern indicated by Y5 being arranged therein. Fig. 17(b) shows an arrangement in which a fabric knitted by a basic yarn Y6 contains a color yarn Y7 knitted therein with a predetermined length at predetermined positions.

[0100] As described above, the present invention can

be commonly applied to various knitting machines such as flat knitting machines and round knitting machines, and has an arrangement in which the yarn-length measuring/storing device 130, which is driven to rotate by a pulse motor or the line with the rotation angle being controlled, is allowed to wind the knitting yarn up while various color yarns are yarn-joined; therefore, it is possible to provide a knitting machine 1 which can knit even a short pattern using various color yarns as described in the present embodiment.

[0101] In accordance with the present invention, at least one yarn is selected from a plurality of packages having different colors and a plurality of packages having different types of yarns, and the yarn is continuously knitted while being yarn-joined, and the yarn length of each of various types of color yarns with various yarn types is determined by taking a pattern after the knitting process into consideration; thus, it becomes possible to knit a desired pattern, to readily manufacture a fabric in accordance with each of various orders, and consequently to provide a knitting machine capable of responding to demands for various types of products in small amounts.

[0102] Moreover, even in the case of a recently developed three-dimensional knitting process for the entire clothe, by using a flat knitting machine provided with the yarn-supplying device of the present invention, various color yarns are combined with each other so that it becomes possible to easily manufacture fashionable, unique knitted products.

[0103] In accordance with the invention of claim 11, it is possible to continuously supply knitting yarns having an alignment of color yarns and lengths thereof that accurately represent a picture pattern after the knitting process.

[0104] In accordance with the invention of claim 12, it is possible to accurately control the color yarn length up to a minute unit by controlling the number of revolutions of the pulse motor and the like; thus, it becomes possible to manufacture a knit fabric having a minute knit pattern.

[0105] In accordance with the invention of claim 13, it becomes possible to continuously manufacture a knit fabric that accurately represents a desired picture pattern.

Claims

1. A yarn-processing system comprising:

a yarn-supplying unit having a plurality of kinds of yarns with respect to a yarn-processing unit;
a yarn-joining unit placed between the yarn-supplying unit and the yarn-processing unit;
a yarn-type selection unit which selects a yarn of the yarn-supplying unit side to be joined with the yarn of yarn-processing unit side, and is placed between the yarn-supplying unit and the

yarn-joining unit; and
 a yarn length-measuring/storing unit which measures the length of the selected yarn and stores the yarn, and is placed between the yarn-joining unit and the yarn-processing unit.

2. The yarn-processing system according to claim 1, further comprising:

a control unit which controls respective operations of the yarn-type selection unit, the yarn-joining unit, the yarn length-measuring/storing unit and the yarn-processing unit in a separated manner so that, while the yarn stored in the yarn length-measuring/storing unit is being processed in the yarn-processing unit, another type of yarn on the yarn-supplying unit side to be next processed is selected, yarn-joined, yarn length-measured and stored.

3. The yarn-processing system according to claim 1 or claim 2, wherein: the yarn length-measuring/storing unit has a storing member that is made of a yarn storing drum on the outer surface of which a yarn is wound, a driving source used for rotating a spindle for winding the yarn on the drum is constituted by a pulse motor, and the length of the selected yarn is measured by the number of revolutions and/or rotation angle of the pulse motor.

4. The yarn-processing system according to claim 1, comprising:

a yarn-supplying unit having a plurality of kinds of yarns with respect to a yarn-processing unit; a yarn-joining unit placed between the yarn-supplying unit and the yarn-processing unit; a yarn-type selection unit placed between the yarn-supplying unit and the yarn-joining unit, with a yarn-joining device being placed in the yarn-joining unit and a yarn-type selection device that selects a succeeding yarn on the yarn-supplying side to be yarn-joined to the leading yarn on the yarn-processing unit side being placed in the yarn-type selection unit,

wherein the yarn-joining device and the yarn-type selection device are arranged in such a manner that the leading yarn is guided into the yarn-joining device with the leading yarn being connected to the yarn-type selection device so that the succeeding yarn is guided by a succeeding yarn guiding means into the yarn-joining device so as to be subjected to a yarn-joining process.

5. The yarn-processing system according to claim 5, wherein the yarn-type selection device includes a plurality of yarn-selection guide members that are

aligned so as to respectively rotate with respect to a common shaft so as to carry out positioning processes in which the yarn-selection guide members are selectively operated and driven to a first position at which the selected yarn is guided to travel and a second position at which the yarn to be selected is held in a stand-by state.

6. The yarn-processing system according to claim 4 or claim 5, wherein the succeeding yarn guiding means in the yarn-type selection device includes first and second guiding mechanisms which hook the succeeding yarn to be selected that has been held by the yarn-selection guiding member that is in the stand-by state at the second position, and guide the succeeding yarn into the yarn-joining device.

7. The yarn-processing system according to any one of claims 1 to 6, comprising:

a yarn-supplying unit having a plurality of kinds of yarns with respect to one take-up package placed in the take-up unit;
 a yarn-joining unit placed between the yarn-supplying unit and the take-up unit;
 a yarn-type selection unit that selects a yarn on the yarn-supplying side to be yarn-joined to the leading yarn on the take-up package side, and is placed between the yarn-supplying unit and the yarn-joining unit; and
 a yarn length-measuring/storing unit which measures the length of the selected yarn, and stores the yarn, and is placed between the yarn-joining unit and the take-up package.

8. The yarn-processing system according to any one of claims 1 to 6, which has a sample warper as the yarn-processing unit, comprising:

a yarn-supplying unit having a plurality of types of yarns to be supplied with respect to a single warping drum; and
 a yarn-joining unit having a yarn-joining device placed between a yarn-supplying package placed on the yarn-supplying unit and the warping drum,

wherein: the plurality of types of yarns are successively selected in accordance with a preliminarily designed pattern, and yarn-joined, and the joined yarn is subjected to a warping process on a warping-yarn beam so that said warping-yarn beam is supplied to a weaving machine so as to form a fabric.

9. The yarn-processing system according to claim 8, further comprising:

a yarn length-measuring/storing unit which measures the length of the selected yarn, and stores the yarn, and is placed between the yarn-joining unit and the warping drum.

5

10. The yarn-processing system according to claim 8, wherein: a yarn-joining device is installed between a warping drum having a yarn length-measuring means and the yarn-supplying package so that based upon a yarn length measuring signal from the yarn length-measuring means of the warping drum, the yarn-joining device is operated.

10

11. The yarn-processing system according to any one of claims 1 to 6, which has a knitting machine as the yarn-processing unit, comprising:

15

a yarn-supplying unit having a plurality of kinds of supplying yarns; and

a yarn-joining unit having a yarn-joining device and a yarn-length measuring/storing unit that are placed between a yarn-supplying package placed in the yarn-supplying unit and the knitting machine.

20

25

12. The yarn-processing system according to claim 11, wherein the yarn-length measuring/storing device comprises a storing drum that is driven to rotate by a pulse motor or a servomotor capable of angle control, and carries out the yarn-length measuring process by controlling the number of revolutions of the motor.

30

13. The yarn-processing system according to claim 11 or claim 12, wherein the yarn length to be measured is a yarn length of each of the various color yarns and yarns of various types that are determined by taking a picture pattern after the knitting process into consideration.

35

40

45

50

55

FIG. 1

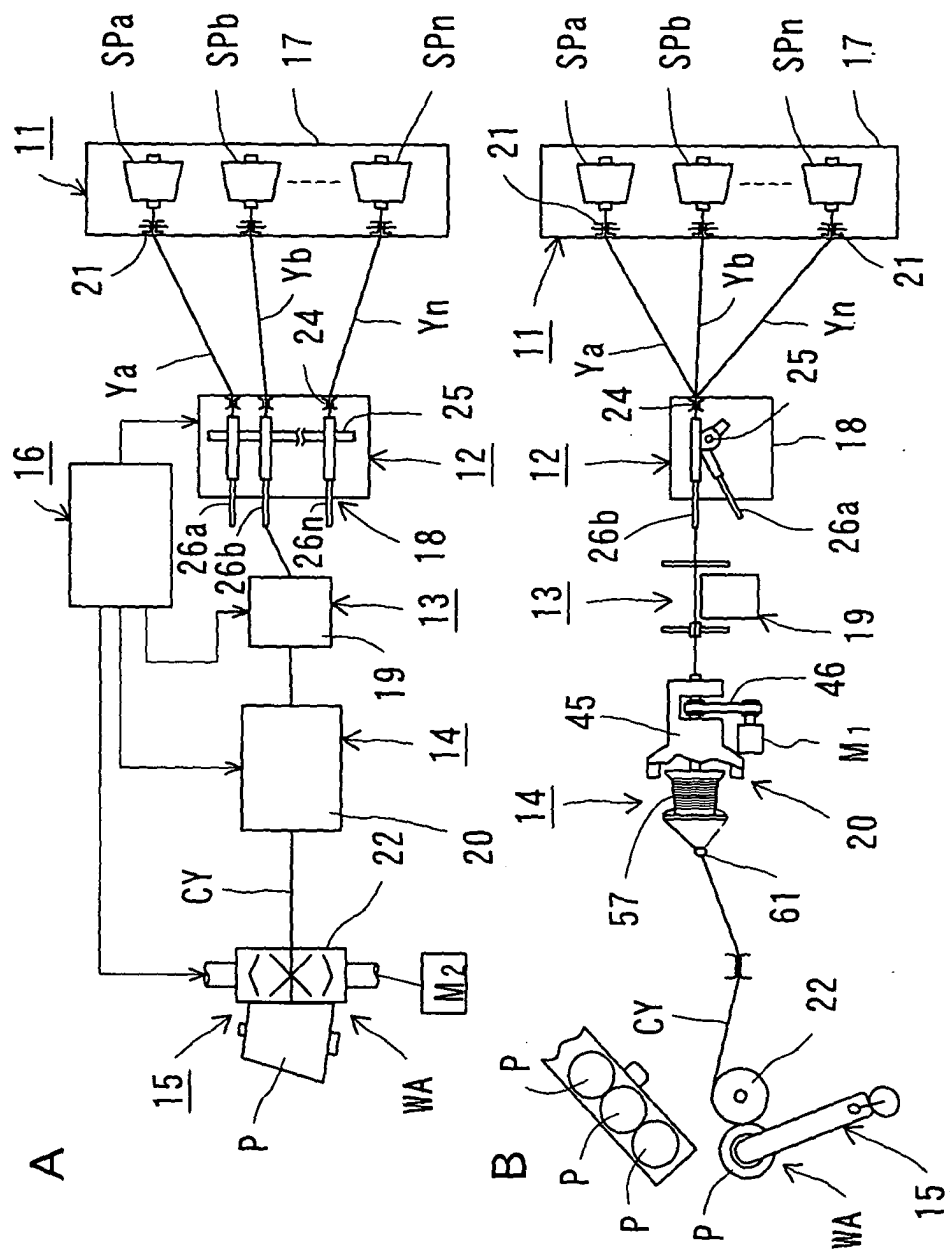


FIG. 2

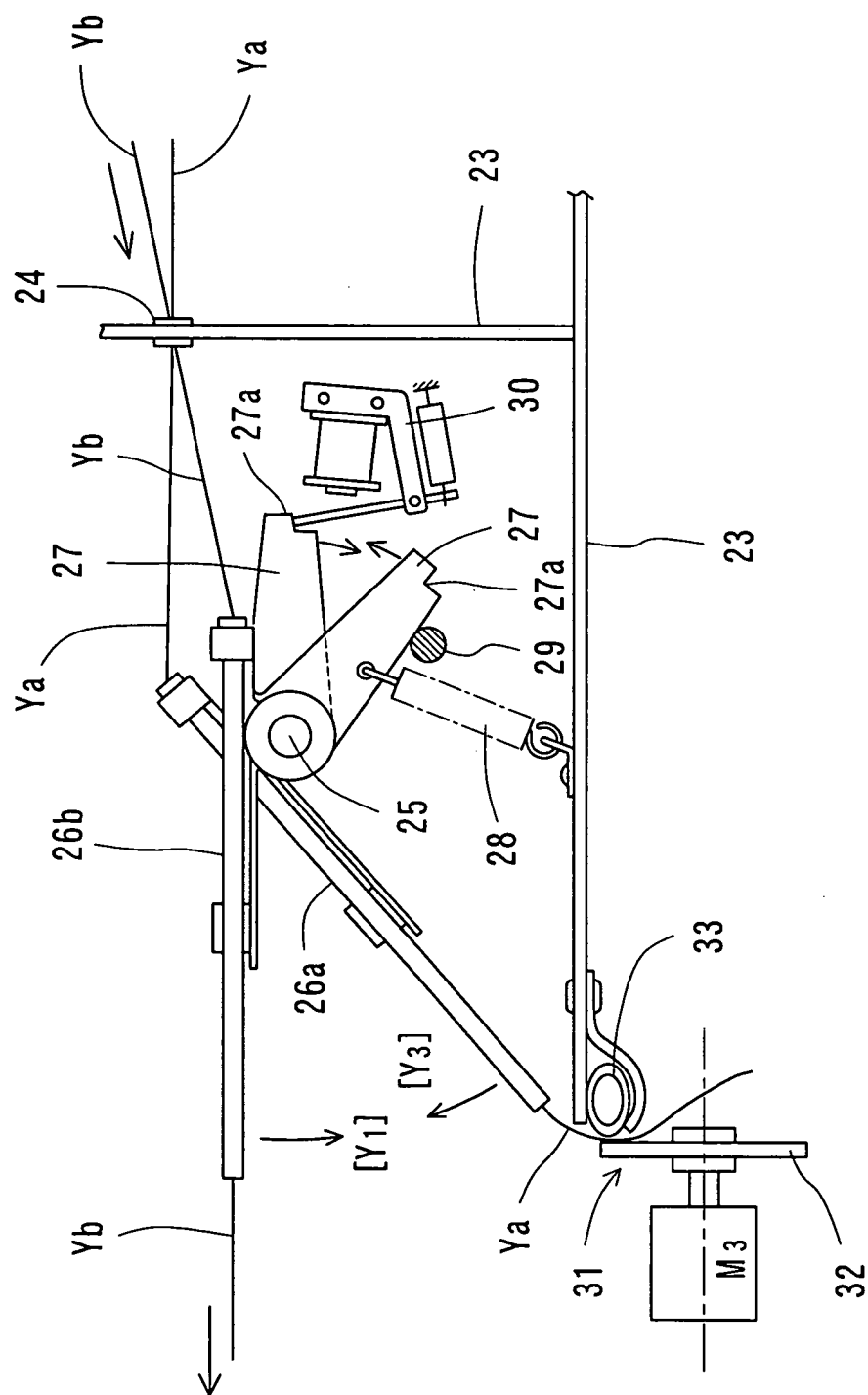


FIG. 3

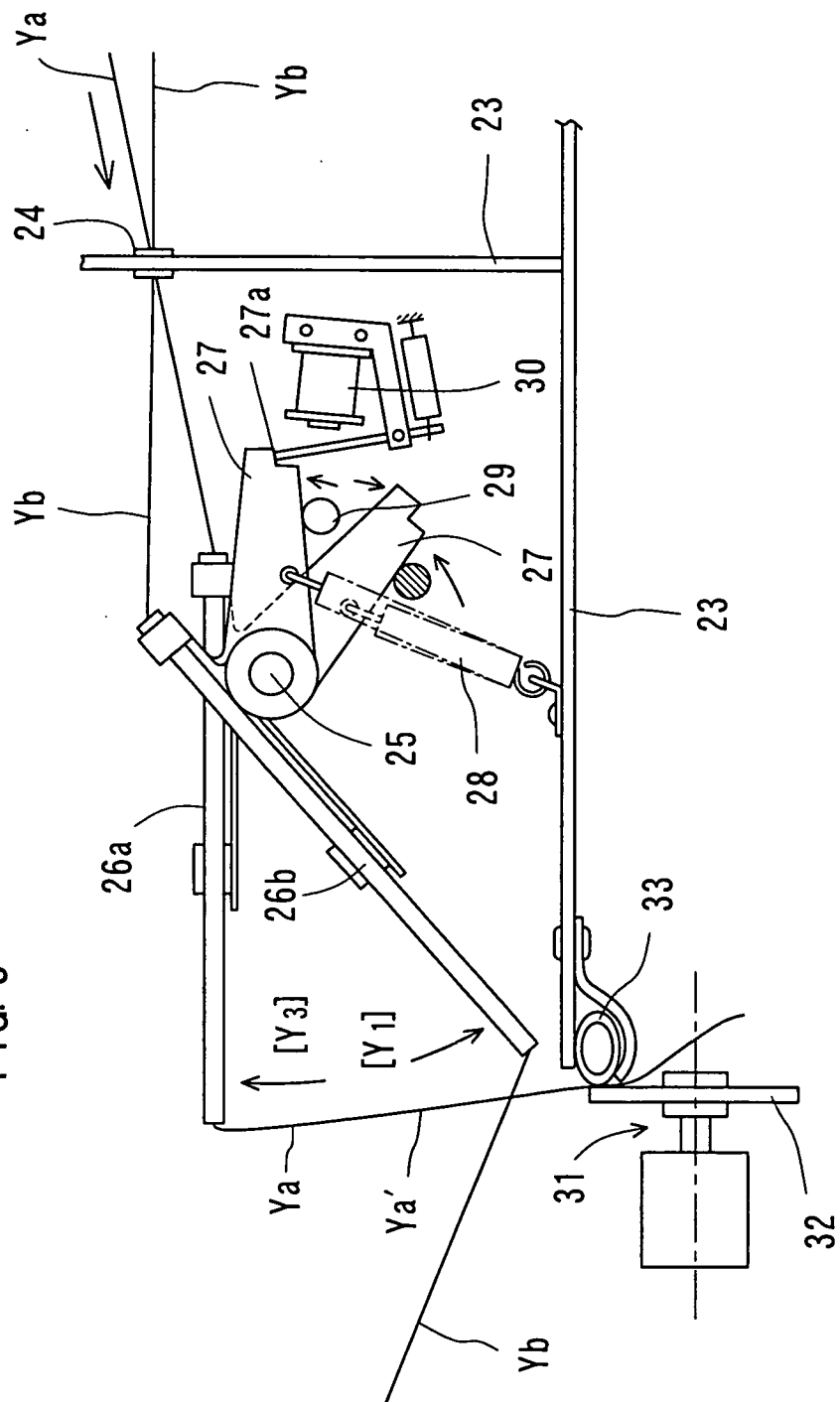


FIG. 4

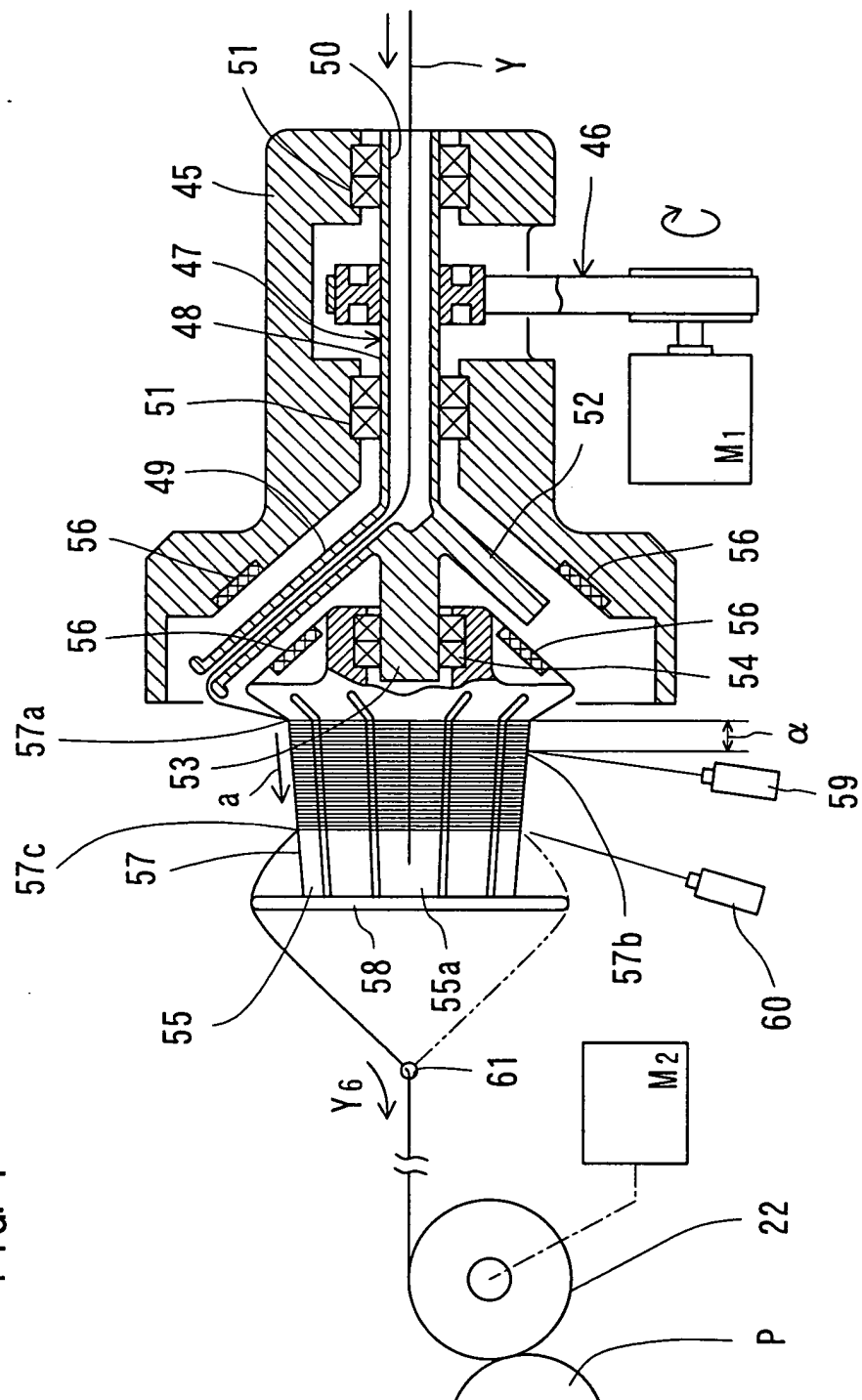


FIG. 5

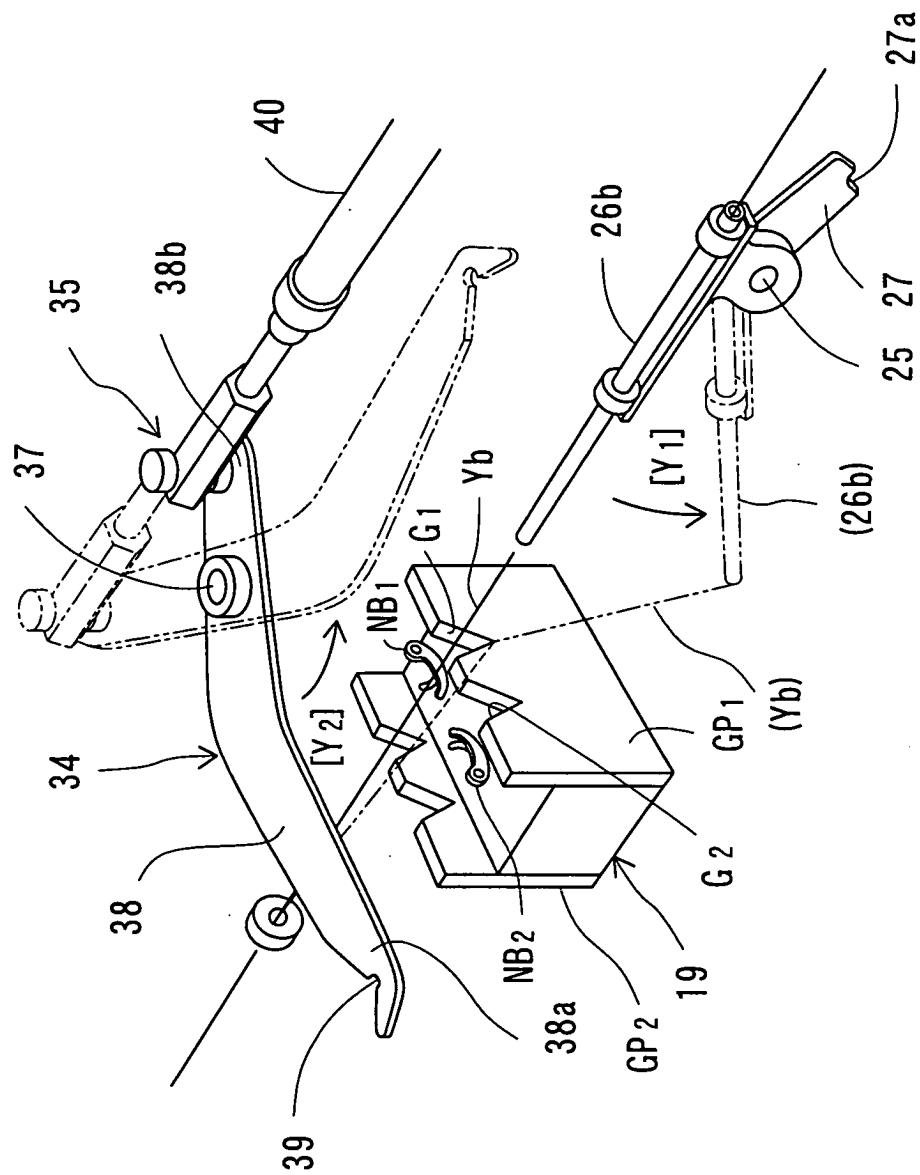


FIG. 6

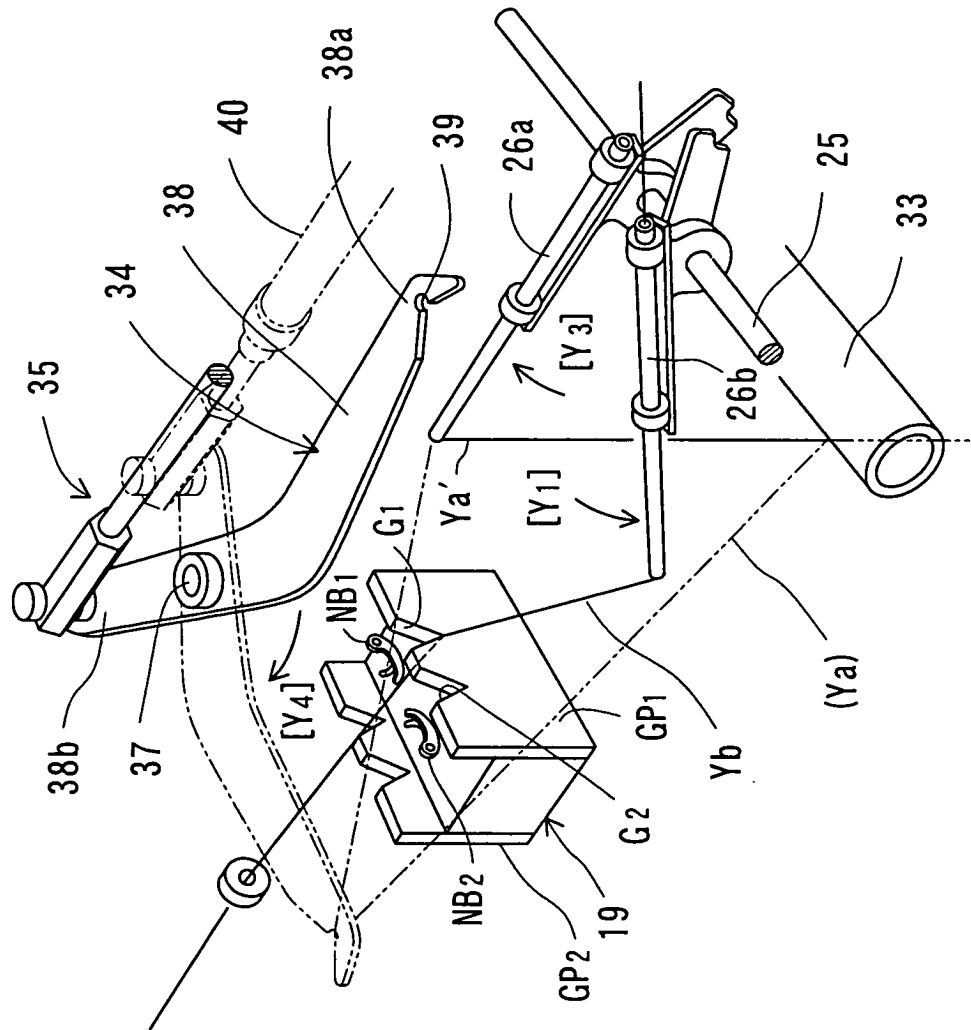


FIG. 7

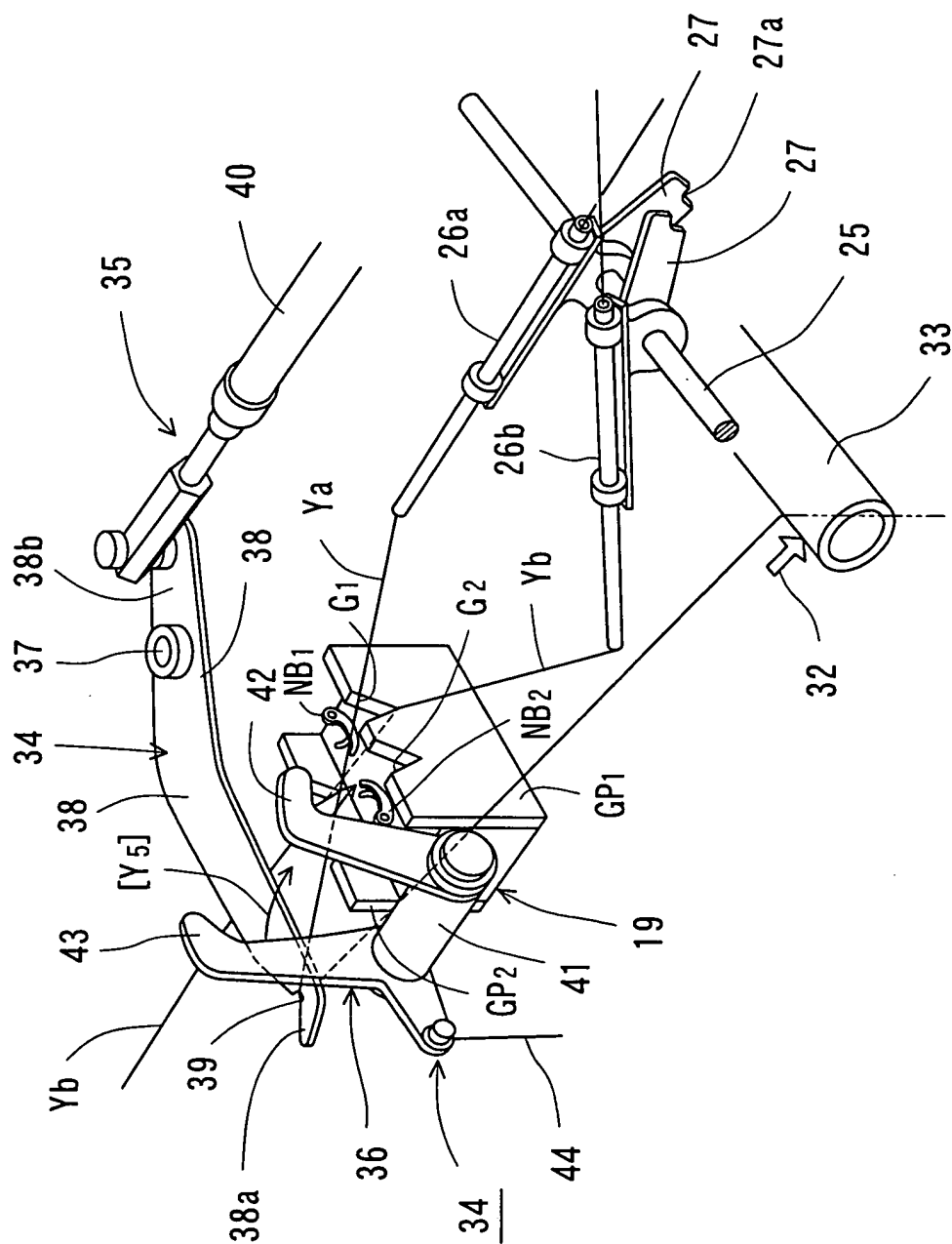


FIG. 8

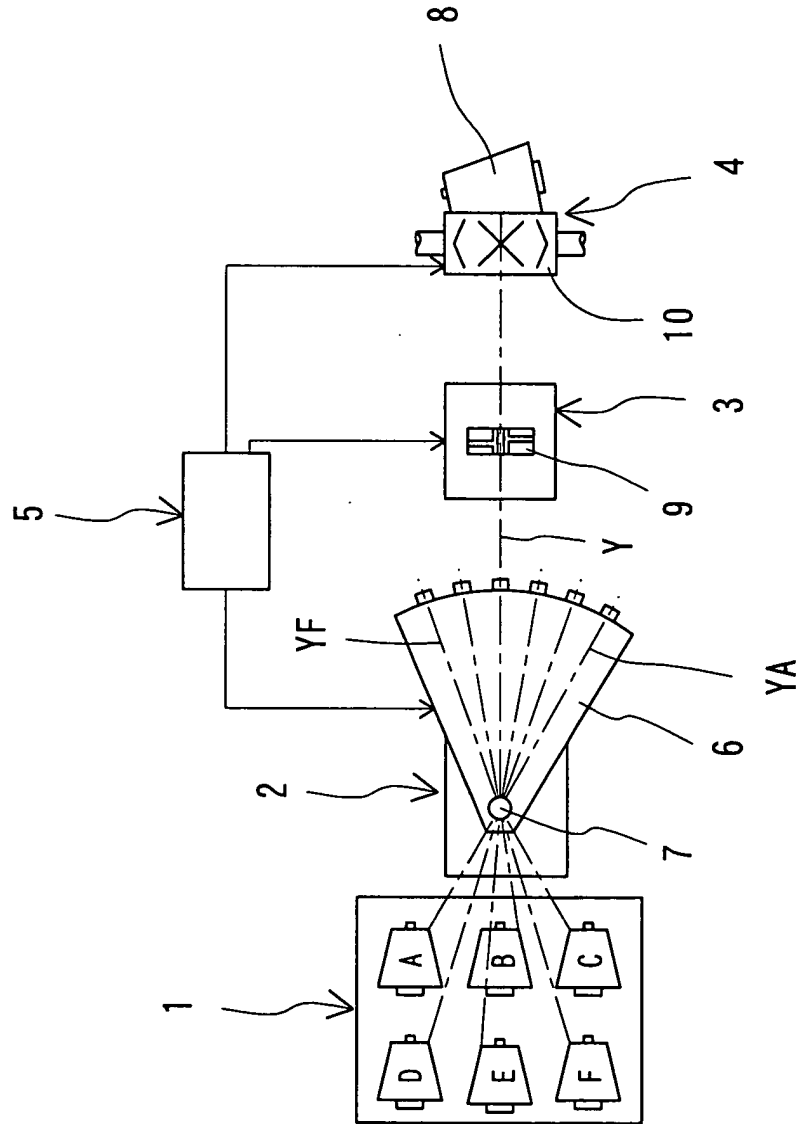


FIG. 9

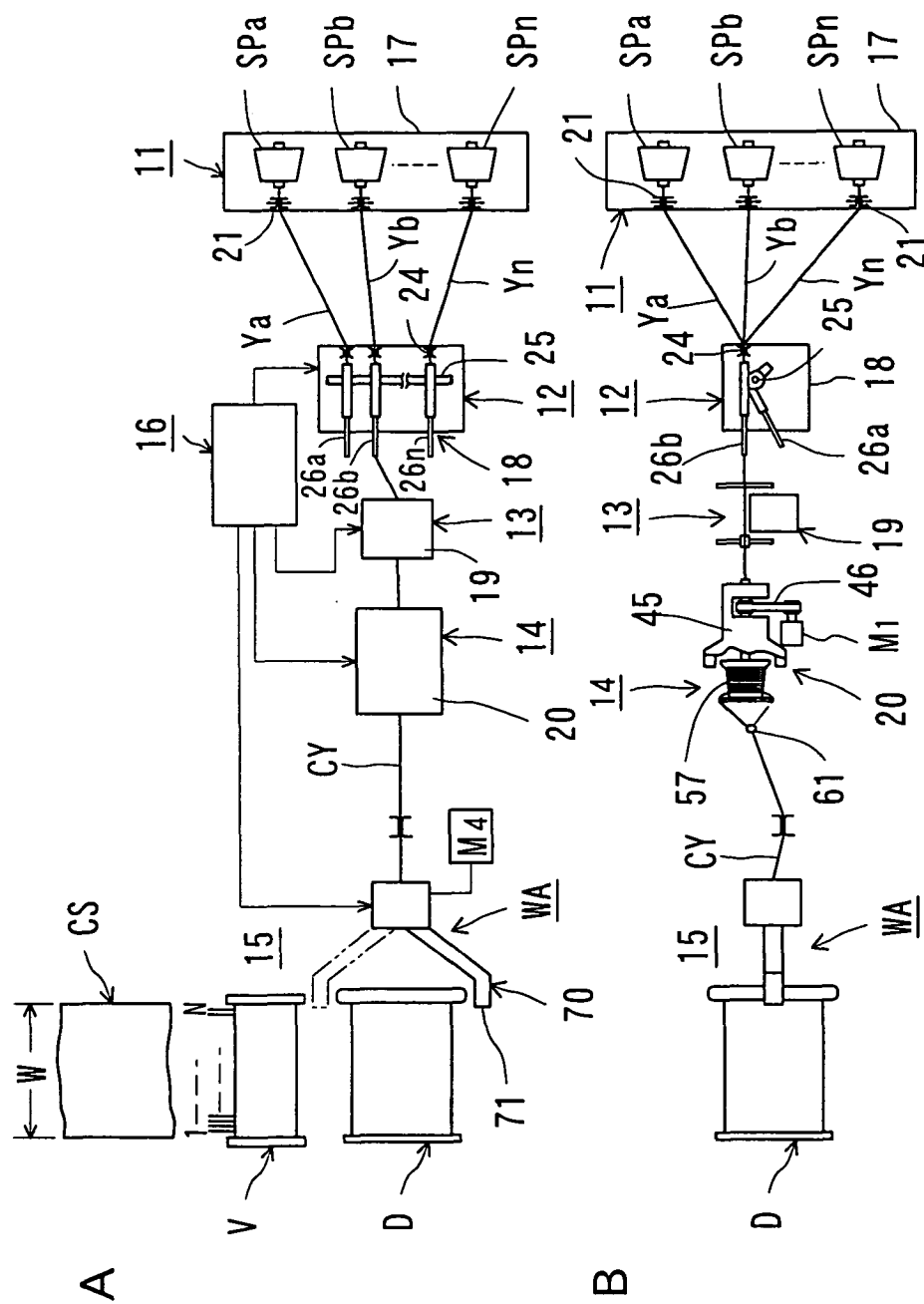


FIG. 10

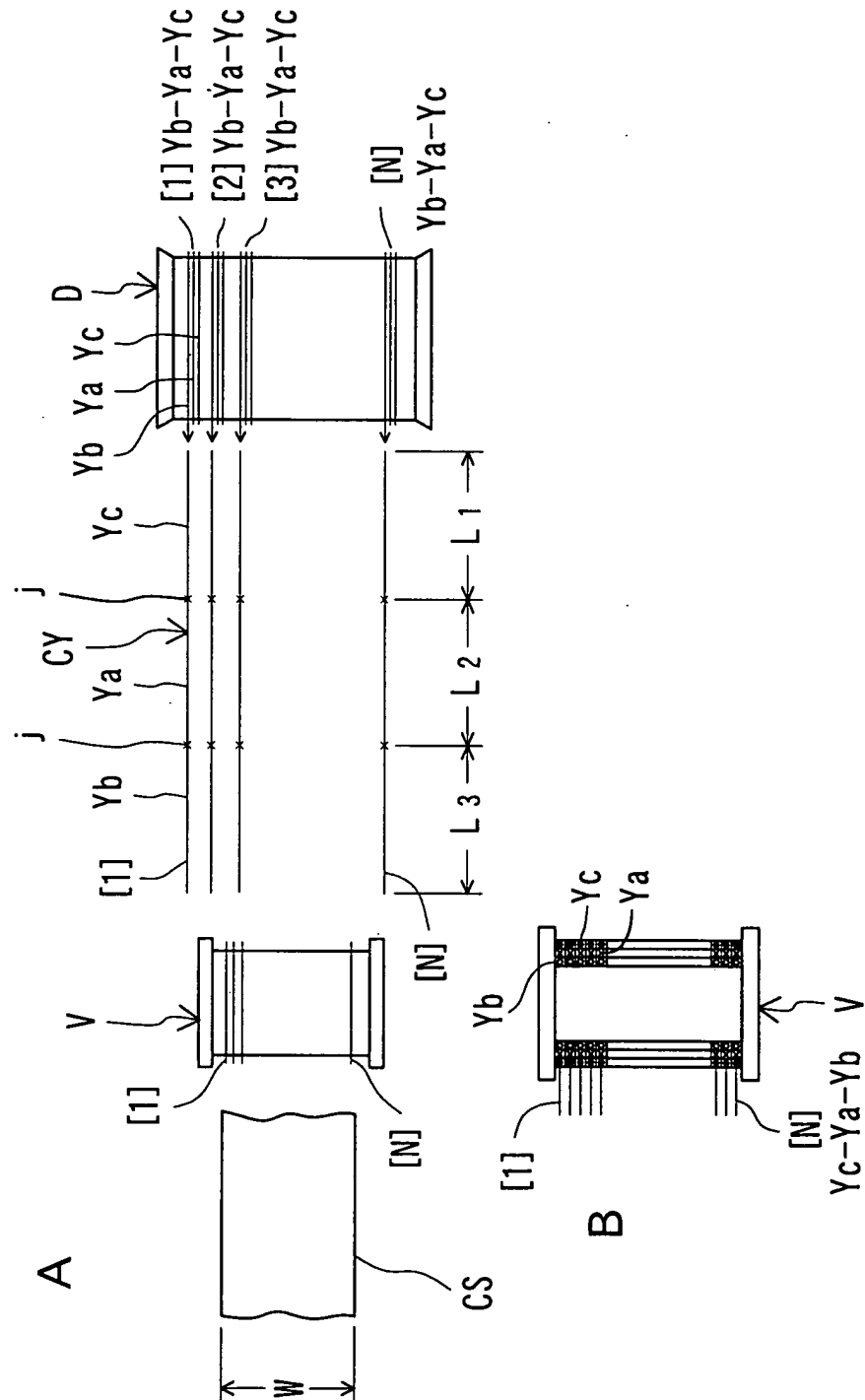


FIG. 11

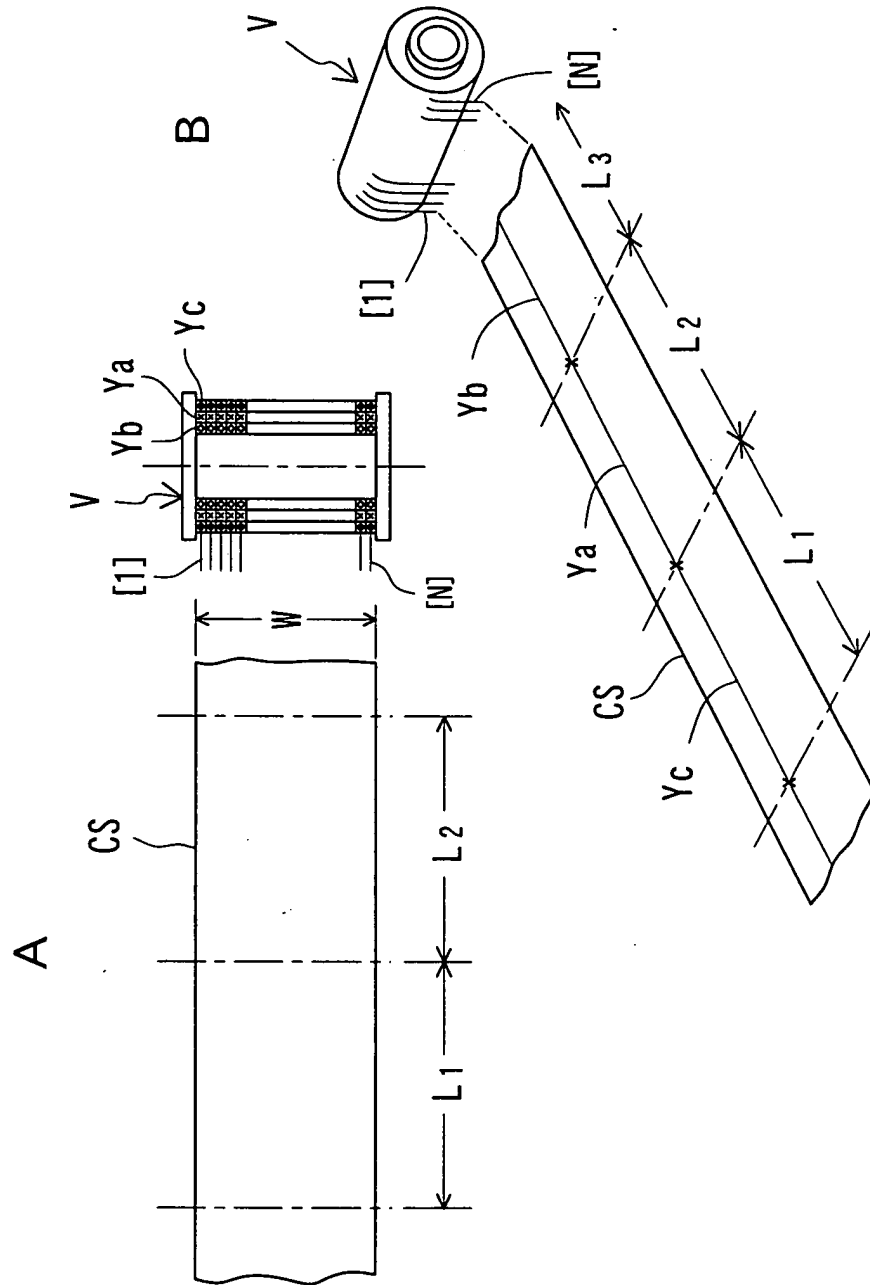


FIG. 12

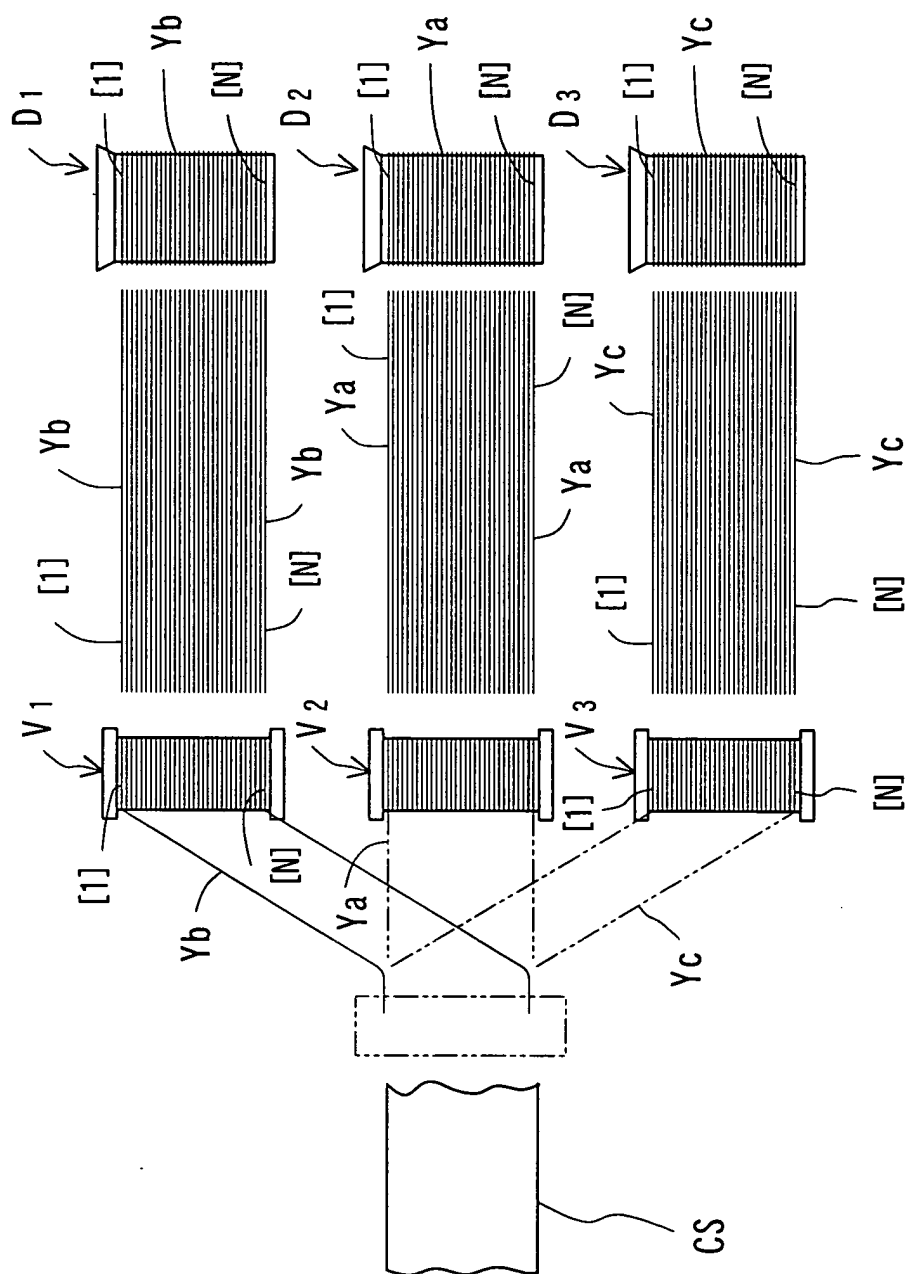


FIG. 13

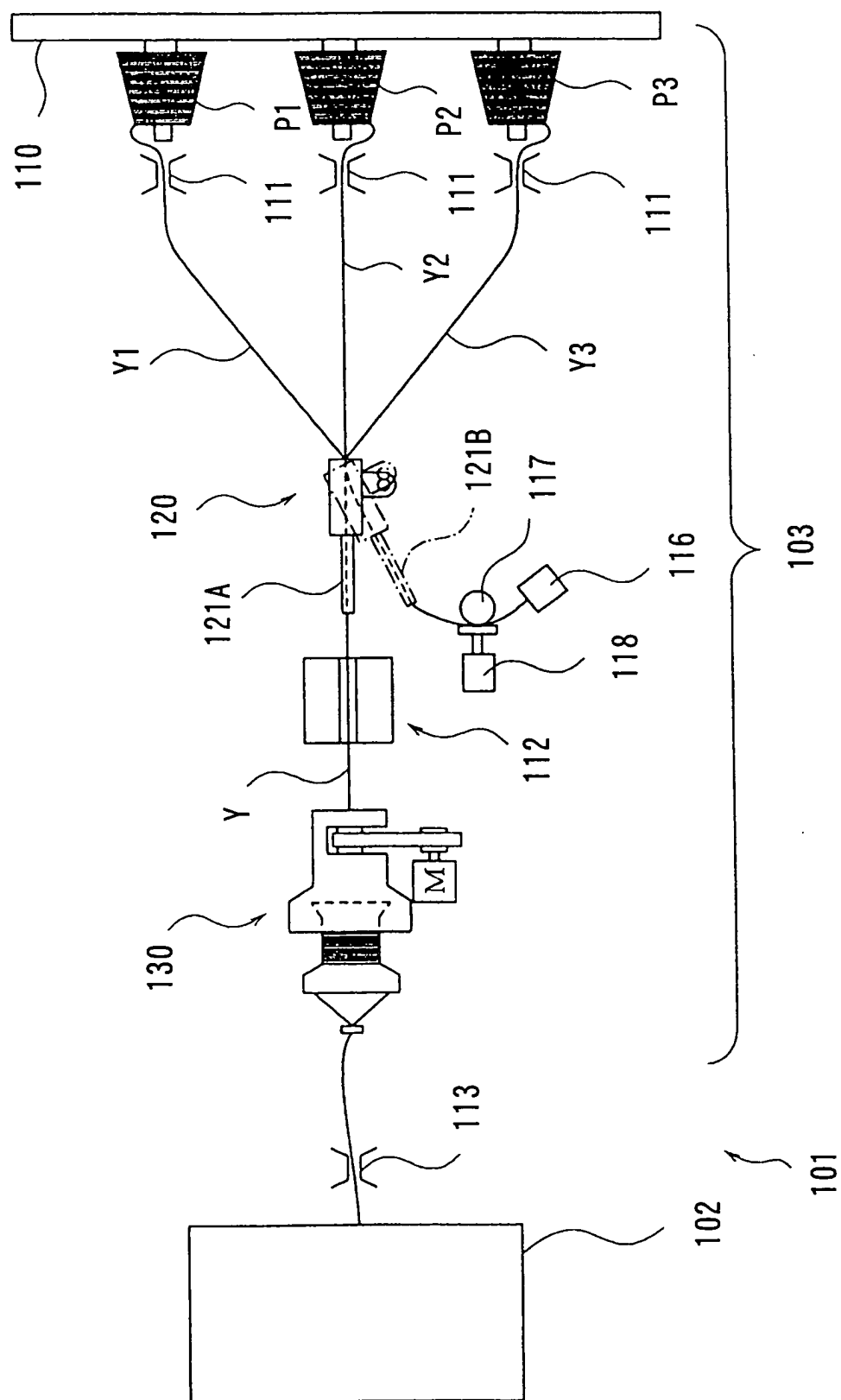


FIG. 14

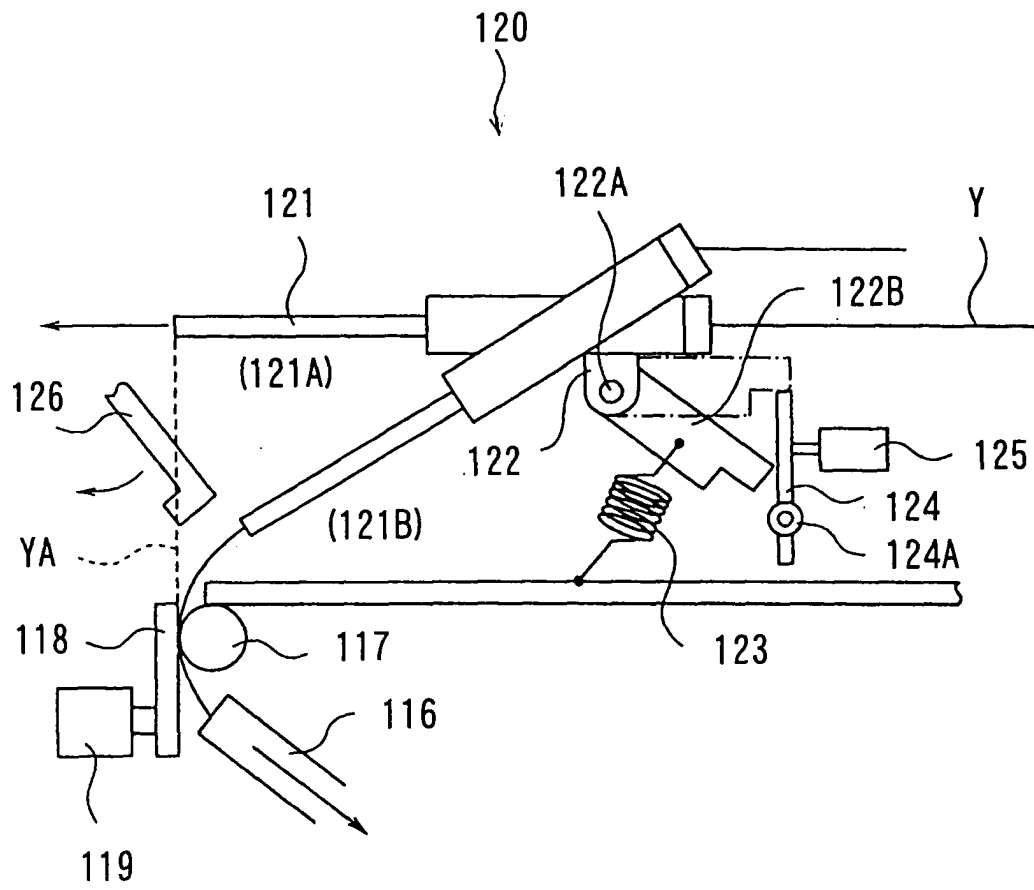


FIG. 15

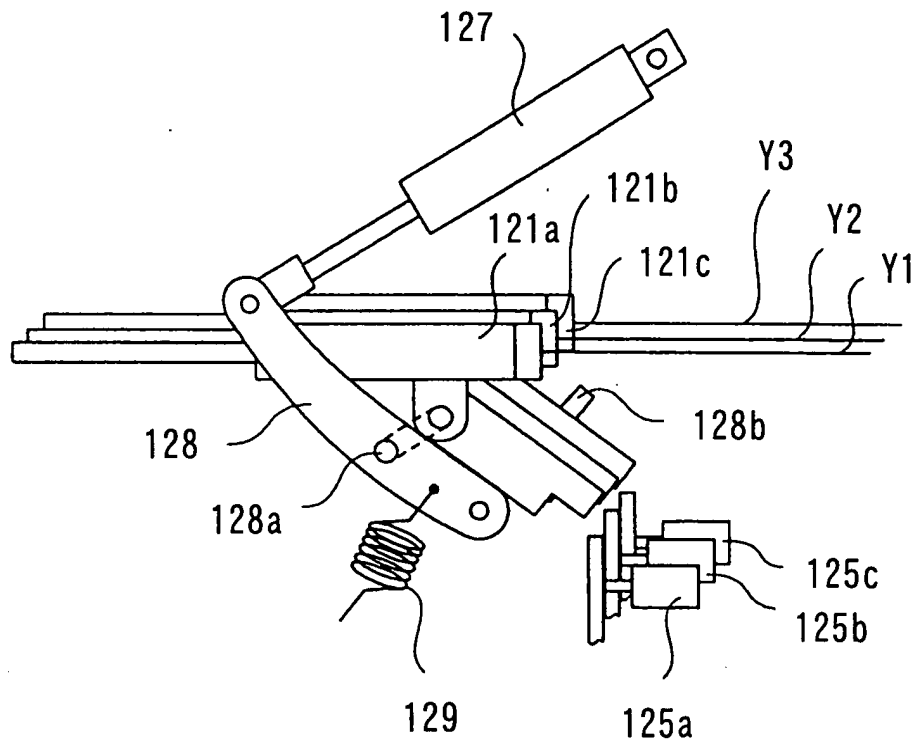


FIG. 16

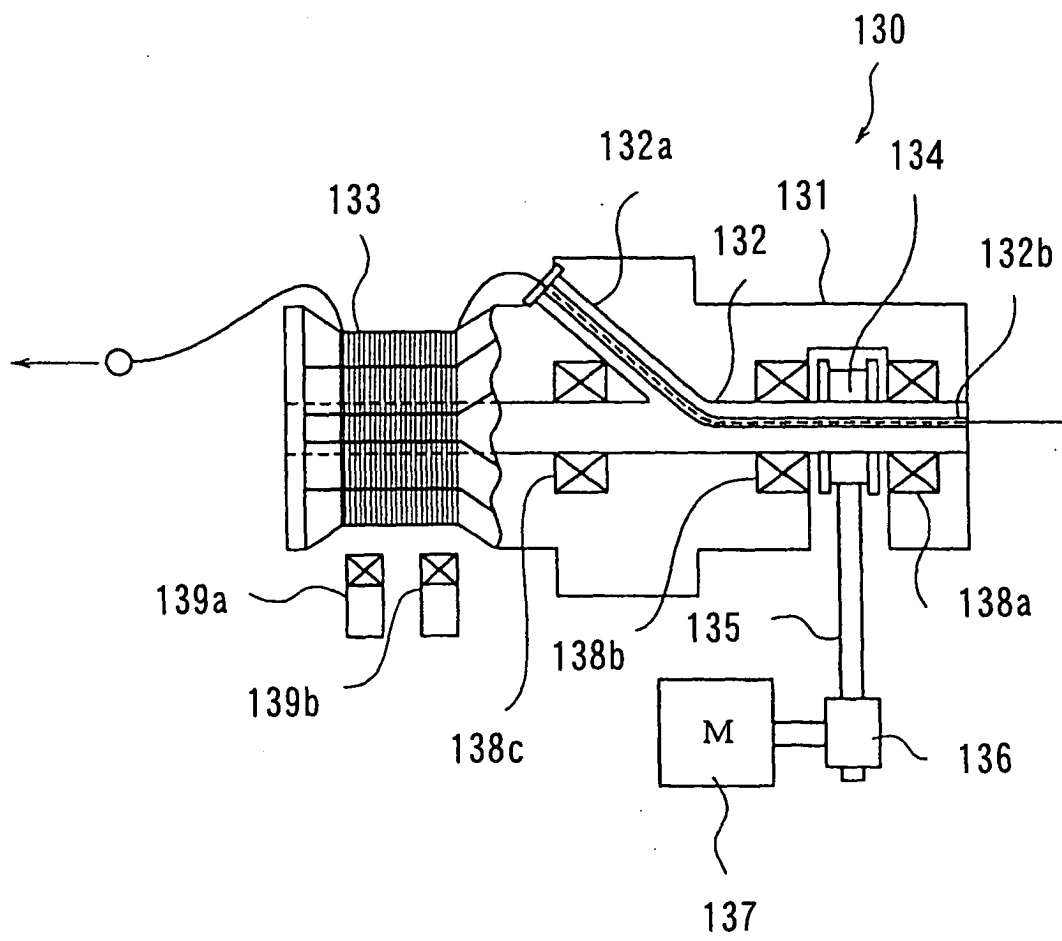
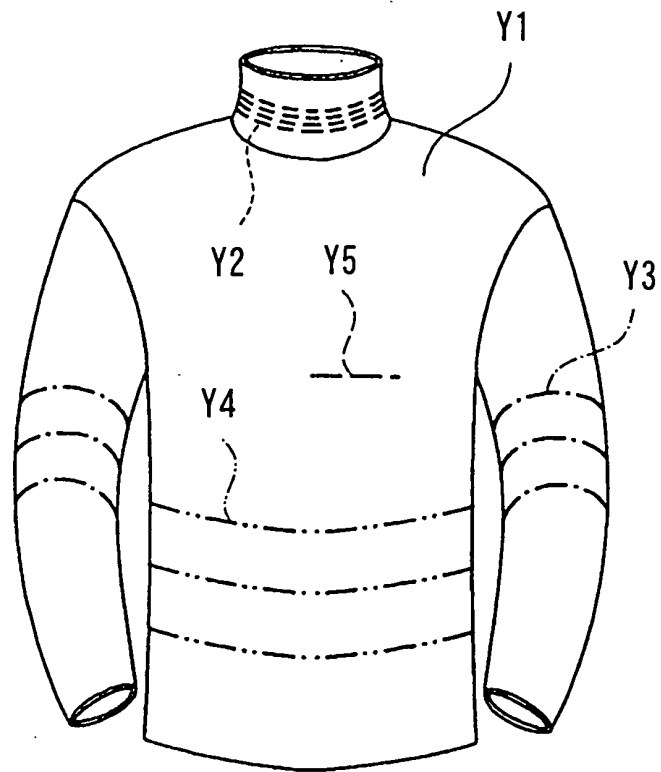


FIG. 17

A



B

