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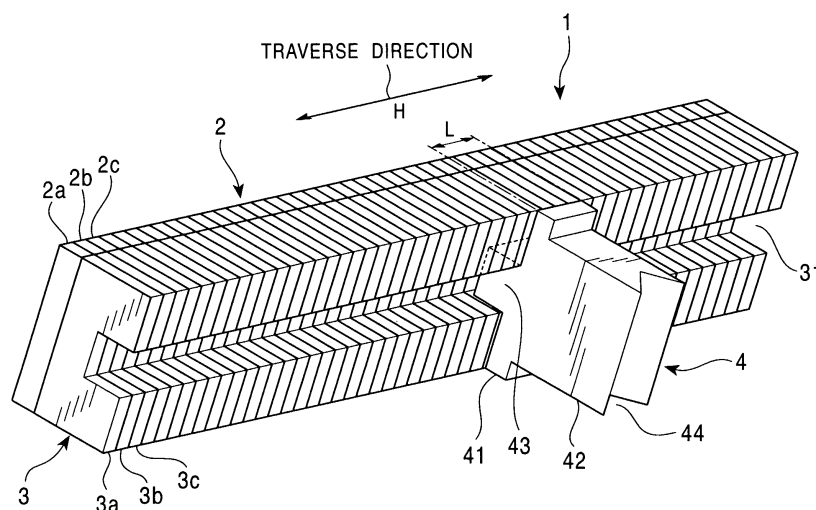
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(54) **Traverse device and traverse method**

(57) The first object of the present invention is to provide a traverse device (1) wherein a traverse guide (41) can be transferred at high speed by detecting the position or the speed of the traverse guide precisely. The second object of the present invention is to provide a traverse device capable of changing the turning position easily without using complicated mechanism and of accomplishing the speeding up of the traverse without carrying out the rotation of the electric motor in both forward and backward directions. According to the present invention, the traverse device (1) for traversing the yarn

guided by a traverse guide (41) comprises a plurality of piezoelectric elements (2a, 2b, 2c) arranged in the traverse direction over the entire traverse range where the yarn is to be traversed, an elastic body (3) deforming by the strain of the piezoelectric elements, and an alternately moving body (4) transferring in the traverse direction by the strain of the elastic body (3), provided in the elastic body (3) capable of transferring in the traverse direction, without being displaced from the elastic body substantially. The traverse guide (41) transfers in the traverse direction accompanying the transferring of the alternately moving body (4) (Fig. 1).

FIG. 1



Description

Field of the Invention

[0001] The present invention relates to a traverse device and a traverse method for traversing a yarn by the alternating motion of a traverse guide.

Background of the Invention

[0002] Conventionally, various types are known for the traverse device moving alternately in proximity to a winding package for alternately moving the running yarn in the axis direction of the winding package. For an example of such traverse device, as a first method for traversing the yarn by a spiral groove formed in the outer periphery of a cylindrical drum, there is a traverse device of groove drum method wherein a rotating drum of which a spiral groove is formed in the outer periphery contacts with the winding packaged, and the yarn engaging to the spiral groove is traversed in the axis direction while the rotating drum is rotated in one direction.

[0003] For the second method, there is a traverse device of traverse method adopting a cylindrical cam with a groove, including a cylindrical cam of which a spiral groove is formed in the outer periphery, wherein by rotating the cylindrical cam in one direction, a shoe engaging to the spiral groove is traversed in the axis direction. According to this device, the yarn is traversed by the traverse guide engaging to the yarn carrying out alternating motion along with a shoe.

[0004] According to the first method, the turning position of the yarn to be traversed is controlled by the spiraled form, and the turning position cannot be changed accompanying the proceeding of the winding. Therefore, there is a problem in that it cannot be corresponded easily to a taper end winding for decreasing the traverse range gradually accompanying the increase in the winding diameter.

[0005] Even according to the second method, since the turning position of the shoe running through the spiral groove cannot be changed, when forming a taper end package, a complicated mechanism for changing the relationship of the positions of the shoe and the traverse guide becomes necessary. Therefore, the size of the device was enlarged due to the mechanism being complicated and the enlarging in the size of the device lead to be an obstacle of the speeding up of the traverse. Furthermore, since the shoe carries out a high speed transferring under this method, the durability of the shoe was required to be considered.

[0006] Moreover, for the third method which differs from the first or the second method, a traverse device of forward-backward rotating method for moving alternately the alternating moving member (for example, endless belt) attached with a traverse guide by driving the electric motor (for example, stepping motor) in forward direction and backward direction, is known. Ac-

cording to this method, there is an advantage in that the turning position can be changed only by the control of the electric motor. However, there is a problem in that since the electric motor is rotated in both forward and backward, the speed of the yarn decreases considerably in proximity to the turning position, and a saddle bag (a phenomenon in which the section corresponding to the edge of the traverse rises to the outer periphery direction in the winding package) is subject to be generated. Furthermore, under this third method, there is a need to speed up or slow down the electric motor rapidly in proximity to the turning position. Thus, there is also a problem in that the speeding up of the traverse is difficult.

[0007] In addition, for the fourth method, a traverse device of the yarn which does not use aforementioned shoe, of the Unexamined Japanese Utility Model Patent Application Publication (Jikkai-Hei) No. 6-27820, can be given as an example. According to the publication, the traverse device supports a roller rotatable to a base unit of a traverse guide provided capable of moving alternately in the traverse direction, a plurality of pressuring members are arranged capable of emerging and submerging over the entire locus of the roller, and a driving means is provided for driving the traverse guide by pressurizing the roller by projecting the pressurizing members located in the rear side of the roller advancing direction accordingly. In other words, the traverse guide is fed by emerging and submerging a plurality of pins accordingly by the rotation of a plurality of cams provided in the axis of the same.

[0008] However, according to the traverse device of the fourth method, since the turning position of the traverse is fixed to the designated position, there is a problem in that it cannot be easily corresponded to the forming of a taper end package.

[0009] Moreover, according to the fifth method, a traverse device using a linear motor of such as an electromagnetic motor or an ultrasonic motor is proposed.

[0010] For the traverse device using the ultrasonic motor, the Unexamined Japanese Patent Application Publication (Tokkai-Hei) No. 7-165368 is known. Such traverse device comprises a traverse guide, a traverse bar with the traverse guide provided in a fixed condition, and two ultrasonic motors which support both ends of the traverse bar. The traverse bar is moved alternately in the axis direction by the ultrasonic motor, the traverse guide is alternately moved accordingly and the yarn is traversed.

[0011] However, concerning the traverse device publicized in the Unexamined Japanese Patent Application Publication (Tokkai-Hei) No. 7-165368, since the traverse bars to be moved alternately are provided outside the ultrasonic motor, the weight of the object (including both the traverse bar and the traverse guide) to be moved alternately is to be increased. Therefore, the traverse device of such method is not of the preferable structure for traversing the yarn at a high speed.

[0012] The first object of the present invention is to provide a traverse device and a traverse method wherein the traverse guide can transfer at a high speed by detecting the position or the speed of the traverse guide precisely.

[0013] The second object of the present invention is to provide a traverse device and a traverse method capable of changing easily the turning position without using any complicated mechanism (correspondence to the taper end package is easy), and of speeding up the traverse without rotating the electric motor in forward and backward directions.

Summary of the Invention

[0014] According to the present invention, the traverse device for traversing the yarn guided by the traverse guide comprises a plurality of piezoelectric elements arranged in the traverse direction over the entire traverse range where the yarn is to be traversed, an elastic body deforming by the strain of the piezoelectric element, and an alternately moving body transferring in the traverse direction by the strain of the elastic body, provided in the elastic body capable of transferring in the traverse direction, without being displaced from the elastic body substantially. The traverse device is characterized in that the traverse guide transfers in the traverse direction accompanying the transferring of the alternately moving body.

[0015] According to the present invention, the traverse device for traversing the yarn guided by the traverse guide comprises a plurality of piezoelectric elements arranged in the traverse direction over the entire traverse range where the yarn is to be traversed, an elastic body deforming by the strain of the piezoelectric element, and an alternately moving body transferring in the traverse direction by the deforming of the elastic body, provided in the elastic body capable of transferring in the traverse direction. Moreover, the traverse device is characterized in that the traverse guide transfers in the traverse direction within the width of the traverse direction of the elastic body accompanying the transferring of the alternately moving body.

[0016] According to the present invention, since the alternately moving body is not displaced from the elastic body substantially, or since the alternately moving body including the traverse guide is alternately transferring within the width of the traverse direction of the elastic body, the weight of the object (including both the alternately moving body and the traverse guide) to be transferred alternately due to the strain of the piezoelectric element (elastic body), can be reduced than the weight of that of the Unexamined Japanese Patent Application Publication (Tokkai-Hei) No. 7-165368. Therefore, the traverse guide can be transferred alternately at high speed. As a result, the winding speed of the yarn to the package can be improved.

[0017] Moreover, according to the traverse device us-

ing the electromagnetic motor, a magnetic body is used as a material of the object to be transferred alternately. However, according to the traverse device of the present invention, since ceramics or resin can be used for the material of the traverse guide and the alternately moving body, the weight of the object to be transferred alternately can be reduced. Therefore, comparing to the traverse device of which uses the electromagnetic motor, the winding speed of the yarn to a package can be improved. Furthermore, according to the traverse device of the present invention, since coil or magnets are not used, the magnetic position detector to be used for detecting the position of the traverse guide is not influenced greatly by the magnetic field. As a result, the position or the speed of the traverse guide can be detected precisely. In addition, since the position or the speed of the traverse guide can be detected precisely, the package forming of the packages of any shapes such as a taper end package, is facilitated.

[0018] Further, for the position detector, there is an optical position detector which is not influenced by the magnetic force. However, for the traverse device which is to be used within the textile machinery plants where the yarn wastes or the oil solution are scattered, the optical position detector is not preferable, and an electromagnetic position detector is used.

[0019] The traverse device according to the present invention is characterized in that the alternately moving body and the traverse guide are manufactured into one body by the same material. Since it is not necessary to provide the traverse guide fixed onto the alternately moving body after the traverse guide and the alternately moving body are manufactured separately, the manufacturing process is simple and the manufacturing costs can be suppressed.

[0020] The traverse device according to the present invention is characterized in that a groove extending in the traverse direction is formed in the elastic body over the entire traverse range. Since the groove formed in the elastic body serves as a guide to transfer the alternately moving body in the traverse direction, it is unnecessary to provide a member for guiding the alternately moving body in the traverse direction separately. As a result, the structure of the traverse device can be simplified and the unit price of a traverse device can be suppressed. Since the elastic body itself for transferring the alternately moving body is guiding the alternately moving body in the traverse direction, the alternately moving body can be transferred to the traverse device smoothly.

[0021] The traverse device according to the present invention is characterized in that the length in the traverse direction of the contacting section on the alternately moving body contacting to the elastic body corresponds to at least two cycles of the traveling wave generating from the strain of the elastic body. The alternately moving body can be prevented from falling off to the descent of the traveling wave generating by the strain of the elastic body. As a result, the alternating mo-

tion of the alternately moving body can be carried out smoothly.

[0022] The traverse device according to the present invention comprises a control unit for controlling the strain of the piezoelectric element. The control unit includes a memory which stores a program for carrying out a process to narrow the alternately moving range of the transferring body gradually, accompanying the increase in the winding diameter of the winding package by the winding of the yarn.

[0023] The traverse device according to the present invention is characterized in that the control unit comprises a memory which stores the program for carrying out a process to creep the reversing of the traverse guide to the inner side periodically.

[0024] According to the present invention, since a process (taper end winding process) can be carried out for narrowing the alternately moving range of the transferring body gradually, accompanying the increase in the winding diameter of the winding package by the winding of the yarn, by using such control program, a taper end package can be formed. Moreover, since the process (creeping process) can be carried out for creeping the reversing of the traverse guide to the inner side periodically, by using such control program, a package oscillation (control of the saddle bag) can be carried out.

[0025] The traverse device according to the present invention comprises a plurality of yarn feeding members, a plurality of piezoelectric actuators and a control means. The yarn feeding members are arranged in the traverse direction of the yarn, capable of advancing or receding between an acting position contacting with the yarn and a non-acting position, in the direction orthogonal to the traverse direction. The piezoelectric actuators drive each yarn feeding member to advance or recede individually between the acting position and the non-acting position. The control means switches the driving of each piezoelectric actuator under a predetermined procedure. Moreover, the present invention is characterized in that the traverse is carried out by delivering the yarn between the yarn feeding members by advancing the designated yarn feeding member to the acting position accordingly.

[0026] According to the present invention, the electric control can be carried out for supplying the electric power for driving to the piezoelectric actuators individually, following the designated procedure by the control means. The strain of the piezoelectric actuator is caused by supplying electric power to the piezoelectric actuator, and the yarn can be fed in the traverse direction at a high speed by advancing or receding the yarn feeding member by using this change. Moreover, by changing the timing to supply the electric power to the actuator, in other words, the timing of the advancing or receding of the yarn feeding member, it can be changed to a desired traverse width.

[0027] The traverse device according to the present invention comprises a switch unit for individually switch-

ing the supplying of the electric power for driving to each piezoelectric actuator, and is characterized in that the control means outputs the switching signal to the switch unit so that each piezoelectric actuator is to be driven under the designated procedure.

[0028] According to the present invention, the individual operation of the advancing, receding of the yarn feeding member can be carried out at a high speed just by the control means outputting the switch signal to the switch unit under the designated procedure.

[0029] The present invention is characterized in that the piezoelectric actuator is constructed of piezoelectric elements.

[0030] According to the present invention, by adopting piezoelectrics elements for the piezoelectric actuator, the digital ON/OFF control can be carried out at a high speed by the ON/OFF switching of the voltage applying to the piezoelectric elements.

[0031] The present invention is characterized in that the yarn feeding member comprises an inclining part, and when advancing from the non-acting position to the acting position, the yarn feeding member feeds the yarn in the traverse direction along the inclining part.

[0032] According to the present invention, the yarn can be fed toward the traverse direction just by feeding the yarn along the inclining part and advancing the yarn feeding member to the acting position.

[0033] The present invention is characterized in that the inclining parts are formed on the surface of the tip section of the yarn feeding member, and are inclining on both sides toward the edges of the traverse direction from the center section of the tip section of the yarn feeding member.

[0034] According to the present invention, from the fact that the inclining parts are inclining on both sides toward the traverse direction from the center of the tip section, since the inclining parts of differing inclining directions are formed, one of the inclining parts of one yarn feeding member can be used for the outward route of the traverse, and the other inclining part of the yarn feeding member can be used as the homeward route of the traverse. Therefore, it is not required to provide the yarn feeding members separately for the outward route and the homeward route for the traverse of the yarn.

[0035] The present invention is characterized in that the traverse can be carried out by delivering the yarn consequently to the adjacent yarn feeding member by advancing the yarn feeding member to the acting position independently, by switching the supplying of the electric power for driving by following the designated procedure to a plurality of piezoelectric actuators attached to a plurality of yarn feeding members respectively. The yarn feeding members are arranged in the traverse direction of the yarn and are capable of advancing or receding in the direction orthogonal to the traverse direction between the acting position contacting with the yarn and the non-acting position.

[0036] According to the present invention, the electric

control can be carried out for supplying the electric power for driving to the piezoelectric actuator individually, following the designated procedure by the control means. In addition, the piezoelectric actuator can be strained by the supplying of the electric power to the piezoelectric actuator, and the yarn feeding can be carried out at a high speed by advancing or receding the yarn feeding member following this strain. Moreover, by changing the timing for supplying the electric power to the piezoelectric actuator, in other words, the timing for advancing or receding the yarn feeding member, it can be changed to the desired traverse width.

[0037] The present invention is characterized in that the yarn is fed in the traverse direction along the inclining parts formed on the tip section of the yarn feeding member, and inclining on both sides toward the edges of the traverse direction from the center of the tip section.

[0038] According to the present invention, just by the operation to advance to the acting position, the yarn can be fed into the traverse direction, and since the inclining parts are inclining on both sides toward the edges of the traverse direction, the inclining parts of differing inclining directions are formed. As a result, one of the inclining parts of one yarn feeding member can be used for the outward route of the traverse, and the inclining part of the other yarn feeding member can be used for the homeward route of the traverse.

Brief Description of the Drawings

[0039]

Figure 1 is a perspective view showing the principal part of the traverse device according to the first embodiment of the present invention.

Figure 2 is a side view of the traverse device of which the principal part is shown in Figure 1.

Figure 3 is a block diagram showing the control block of the traverse device of which the principal part is shown in Figure 1.

Figure 4 is a view useful for explaining the relationship between the principal part of the traverse device shown in Figure 1, and the friction drum and the package.

Figure 5 is a view useful for explaining the measurement of the transferring body composing the principal part of the traverse device shown in Figure 1.

Figure 6 is a plain view showing the traverse device according to the second embodiment of the present invention.

Figure 7 is a side view showing the traverse device according to the second embodiment of the present invention.

Figure 8 is a view useful for explaining the alignment of the yarn feeding members shown in Figure 6.

Figure 9 is a diagram showing the yarn feeding operation of the yarn feeding members.

Figure 10 is a diagram showing the operation of the yarn feeding members between Figure 9B and Figure 9C.

Figure 11 is a diagram showing the other yarn feeding operation of the yarn feeding members.

Figure 12 is a diagram showing the operation of the yarn feeding members between Figure 11B and Figure 11C.

10 Detailed Description of Preferred Embodiments

[0040] The traverse device according to the first embodiment of the present invention will now be described in reference to Figure 1 through Figure 5.

15 **[0041]** A traverse device 1 is provided in the midst of the running of a yarn Y and traverses the yarn Y. The yarn Y to be traversed is wound to a winding package P rotating while contacting with a friction drum D rotated and driven (refer to Figure 4). Further, the traverse device 1 can be used for a yarn winder of such as a false twist processing machine, an automatic winder, a spinning machine, and a take-up winder. The yarn winder is constructed by providing in proximity in row arrangement, a plurality of winding spindles, and the traverse device 20 1 to be described in the following is provided per each winding spindle.

[0042] The principal part of the traverse device 1 comprises a piezoelectric ceramics 2, an elastic body 3, a transferring body 4, and a control unit 5 (refer to Figure 30 3). These members are held by a base material (not shown in the drawings) which attaches the traverse device 1 to the yarn winder or the like. The traverse device 1 is provided adjacent to the winding package P and the friction drum D.

35 **[0043]** The piezoelectric ceramics 2 is comprised of a plurality of piezoelectric ceramics 2a, 2b, 2c, etc. which are in the same shape to one another. A piezoelectric ceramics group is constructed by the plurality of piezoelectric ceramics 2a, 2b, 2c, etc. arranged in the traverse direction H (axis direction of the package P) of the yarn Y. In addition, the piezoelectric ceramics 2 is provided over at least the entire traverse range R of the traverse direction H which is required to traverse the yarn Y (refer to Figure 4). Accordingly, the transferring body 4 is capable of transferring alternately over the entire traverse range R of the traverse direction H which is required to traverse the yarn Y. When a voltage is applied, the piezoelectric ceramics 2a, 2b, 2c, etc. are to be strained in the direction orthogonal to the traverse direction H, as to be mentioned later on.

[0044] Further, the piezoelectric ceramics of several kinds of which the width differs in the traverse direction H can be arranged in the traverse direction H. In other words, according to the position of the traverse direction H, the width of the piezoelectric ceramics can be differentiated.

[0045] The elastic body 3 (elastic body group) is comprised of a plurality of elastic bodies 3a, 3b, 3c, etc. cor-

responding to the piezoelectric ceramics 2a, 2b, 2c, etc. accordingly. The elastic body 3 strains accompanying the strain of the piezoelectric ceramics 2, serves to transfer the transferring body 4 in the traverse direction H by the traveling wave generating from the strain, and is provided on one of the surfaces of the piezoelectric ceramics 2. In addition, a transferring body guide groove 31 extended in the traverse direction H of the yarn Y is provided on the elastic body 3. The transferring body guide groove 31 serves as a guide for guiding the transferring body 4 to transfer to the traverse direction H. Therefore, the transferring body guide groove 31 is formed over at least the entire traverse range R of the traverse direction H required to traverse the yarn Y.

[0046] The elastic body 3 has the structure to be provided on the surface of the piezoelectric ceramics 2 since when it is the structure to move the transferring body 4 by the strain of the piezoelectric ceramics 2 by contacting the transferring body 4 directly to the piezoelectric ceramics 2, there are cases in which the piezoelectric ceramics 2 and the transferring body 4 are to be rubbed against one another and damaged. Therefore, the structure of the present embodiment wherein the elastic body 3 is strained by the strain of the piezoelectric ceramics 2, and the alternately transferring body 4 is transferred by the traveling wave generating from the strain of the elastic body 3, has an advantage in that the transferring body 4 can be prevented from being damaged.

[0047] Further, it is not necessary to provide elastic bodies 3a, 3b, 3c corresponding to each piezoelectric ceramics 2a, 2b, 2c, etc. respectively. If the transferring body 4 can be transferred in the traverse direction H by the traveling wave generating on the surface of the elastic body 3 accompanying the strain of the piezoelectric ceramics 2, there is no restriction in particular for the relationship between the width of each piezoelectric ceramics 2a, 2b, 2c, etc. and the width of each elastic bodies 3a, 3b, 3c, etc. For example, one elastic body with the width of two times that of a piezoelectric ceramics can be provided to two piezoelectric ceramics, or two elastic bodies with the width of 1.5 times that of the width of a piezoelectric ceramics can be provided to three piezoelectric ceramics.

[0048] The transferring body 4 serves as a traverse guide for guiding the yarn Y and also serves as an alternately moving body transferring alternately in the traverse direction H by the traveling wave generating from the strain of the elastic body 3. Moreover, the transferring body 4 is formed into one body by same material, and the size equals to the measurement within the elastic body 3. In addition, for reducing the weight of the transferring body 4, it is preferable to use resin or ceramics for the material of the transferring body 4.

[0049] The transferring body 4 comprises an alternately moving body 41 of which one of the surfaces contacts to the elastic body 3, a yarn guide part 42 provided extending in the vertical direction to the other surface

opposing to one of the surfaces of an alternately moving body 41 and provided continuously from the other surface of the alternately moving body 41, and a guided protrusion 43 of rectangular parallelepiped shape protruding in the vertical direction to the one of the surfaces contacting with the elastic body 3 of the alternately moving body 41 and provided continuously from one of the surfaces of the alternately moving body 41. In addition, in the tip section of the yarn guide part 42, a yarn guide groove 44 where the yarn Y is engaged is provided.

[0050] As shown in Figure 5, the transferring body 4 is designed so that a length L in the traverse direction H of the contacting section on the alternately moving body 41 where the alternately moving body 41 and the elastic body 3 contacts against one another, is to be longer a little than a length LT in the traverse direction. Moreover, the length LT in the traverse direction corresponds to two cycles of the traveling wave generating from the strain of the elastic body 3. Accordingly, the alternately moving body 41 of the transferring body 4 can be prevented from falling into a descent 32 of the traveling wave generating from the strain of the elastic body 3. As a result, the transferring body 4 can be transferred alternately and smoothly in the traverse direction H.

[0051] The guided protrusion 43 is inserted to the transferring body guide groove 31 provided in the elastic body 3. Accordingly, the transferring body 4 is supported capable of alternating in the traverse direction H by the elastic body 3. In addition, to stabilize the alternating motion of the transferring body 4 in the traverse direction H, the transferring body 4 is designed so that a width W1 of the guided protrusion 43 is to be approximately equal to a width W2 of the transferring body guide groove 31. Moreover, for the alternately moving body 41 to contact against the elastic body 3 reliably, the transferring body 4 is designed so that a protruding height H1 of the guided protrusion 43 becomes lower than a depth D1 of the transferring body guide groove 31 (refer to Figure 2).

[0052] Further, the transferring body 4 can be prevented from falling off from the elastic body 3 by the yarn tension (the force for the yarn Y engaged to the yarn guide groove 44 to press the transferring body 4 against the elastic body 3). In addition, since the inserting and the releasing of the transferring body 4 are easy, there is an advantage in that the transferring body 4 can be exchanged easily.

[0053] To transfer the transferring body 4 by the traveling wave generated on the elastic body 3, a member to prevent the transferring body 4 from separating from the elastic body 3 becomes necessary. However, in the present embodiment, the yarn tension prevents the transferring body 4 from separating from the elastic body 3.

[0054] The control unit 5 comprises a plurality of outputting lines corresponding to each piezoelectric ceramics 2a, 2b, 2c, etc. Moreover, the control unit 5 controls

the applying of the voltage to each piezoelectric ceramics 2a, 2b, 2c, etc., and for example, the transferring/stopping, the transferring speed, and the transferring direction of the transferring body 4 can be controlled accordingly. Further, the transferring speed of the transferring body 4 basically relies on the timing of the applying of the voltage to each piezoelectric ceramics 2a, 2b, 2c, etc. and does not rely on the strained amount of each piezoelectric ceramics 2a, 2b, 2c, etc.

[0055] As shown in Figure 3, the control unit 5 comprises a memory 51, a linear encoder 52 as a position detector, a control processing unit 53, and a driving unit 54.

[0056] The memory 51 stores in advance the control program or the like corresponding to various processes which are carried out by the traverse device 1. For the examples of the control program, there are a program to carry out a process (creeping process) for creeping the traverse reversing position to the inner side periodically, and a program to carry out a process (taper end winding process) for narrowing gradually the alternating transferring range of the transferring body 4 accompanying the increase in the winding diameter. However, package oscillation can be carried out by using the control program of the former, and the taper end package can be formed by using the control program of the latter.

[0057] The linear encoder 52 is an electromagnetic encoder, detects the present position of the transferring body 4 continuously and outputs the detected result to the control processing unit 53.

[0058] The control processing unit 53 carries out various processes based on the detected result by the linear encoder 52, following the content of the control program stored in the memory 51. For the content of the processing, there are a determination of one or a plurality of piezoelectric ceramics which is to be applied with voltage from a plurality of piezoelectric ceramics 2a, 2b, 2c, etc., a determination of the timing and the time for applying the voltage to the determined piezoelectric ceramics, and the control of the driving unit 54 based on each determined results.

[0059] The driving of the driving unit 54 is controlled by the control processing unit 53, and the driving unit 54 applies voltage to each piezoelectric ceramics 2a, 2b, 2c, etc.. However, for making the alternating transferring of the transferring body 4 to be smooth by equalizing the size of the strain of each piezoelectric ceramics 2a, 2b, 2c, etc. (the size of the strain of each elastic bodies 3a, 3b, 3c, etc.) to that of one another, the driving unit 54 is constructed so that the volume of the voltage applied to the piezoelectric ceramics 2a, 2b, 2c, etc. becomes equal to one another.

[0060] Further, the driving unit 54 is not required to be constructed so that the size of the voltage to be supplied to each piezoelectric ceramics 2a, 2b, 2c, etc. is to be equal to one another.

[0061] The outline of the operation of the traverse device 1 will be described next. The control processing unit

53 reads out the control program corresponding to the work to be carried out herefrom from various control programs stored in the memory 51.

[0062] Then, following the content of the read control program, the control processing unit 53 first makes the linear encoder 52 to detect the position of the yarn guide part 41 of the transferring body 4, and based on the detected result of the linear encoder 52, chooses one or a plurality of piezoelectric ceramics from a plurality of piezoelectric ceramics 2a, 2b, 2c of which the voltage is to be applied, and also determines the timing and the time for applying voltage to the determined piezoelectric ceramics. In addition, the control processing unit 53 controls the driving of the driving unit 54 based on the determined result. According to the control, the voltage is to be applied to the chosen piezoelectric ceramics for a determined period of time under determined timing. Then, a strain generates to the piezoelectric ceramics with the voltage applied by the driving unit 54, a strain also generates to the elastic body 3 due to the strain of the piezoelectric ceramics, and a traveling wave generates on the surface of the elastic body 3. By the traveling wave generated on the surface of the elastic body 3, the transferring body 4 is transferred to the traverse direction H. As a result of the series of this process carried out repetitively, the transferring body 4 transfers alternately in the traverse direction H. Then, accompanying the alternate transferring of the transferring body 4 in the traverse direction H, the yarn Y is also traversed in the traverse direction H.

[0063] According to the traverse device 1 of the embodiment of the present invention mentioned above, since the transferring body 4 is made within a measurement of the elastic body 3, the weight of the transferring body 4 transferred alternately by the strain of the piezoelectric ceramics 2 (elastic body 3) is smaller than the weight of the object (including both the traverse bar and the traverse guide) to be transferred alternately in the traverse device using the conventional ultrasonic linear motor. As a result, the transferring body 4 can be transferred at a high speed. Therefore, the winding speed of the yarn Y to the package P can be improved.

[0064] Moreover, according to the embodiment, since ceramics or resin are used as the material of the transferring body 4 which serves as an alternately moving body and a traverse guide, comparing to the traverse device using the electromagnetic motor of which the material of the object to be transferred alternately is magnetic body, the weight of the object to be transferred alternately can be reduced and the winding speed of the yarn to a package can be improved. Moreover, unlike the traverse device using the electromagnetic motor, since coil and magnets are not used, the linear encoder 52 of electromagnetic type is not influenced greatly by the magnetic field. As a result, the position of the yarn guide part 41 of the transferring body 4 can be detected precisely.

[0065] Furthermore, since the transferring body 4

which serves as a traverse guide and an alternately moving body is manufactured into one body by the same material, it is not necessary to attach the traverse guide fixed onto the alternately moving body after manufacturing the traverse guide and the alternately moving body separately. As a result, the manufacturing process is simple and the manufacturing costs can be suppressed.

[0066] In addition, since the transferring body guide groove 31 for guiding the transferring body 4 is formed in the elastic body 3, a separate member for guiding the transferring body 4 to the traverse direction H becomes unnecessary. As a result, the structure of the traverse device 1 is simplified, and the unit price of a traverse device can be suppressed. Moreover, since the elastic body 3 itself for transferring the transferring body 4 functions as a guide to guide the transferring body 4 in the traverse direction H, the transferring body 4 can be transferred smoothly.

[0067] Furthermore, since the length L in the traverse direction H of the contacting section where the alternately moving body 41 of the transferring body 4 contacts with the elastic body 3 is set to be longer a little than the length LT corresponding to two cycles of the traveling wave generating from the strain of the elastic body 3, the transferring body 4 can be prevented from falling into the descent 32 of the traveling wave generating from the strain of the elastic body 3, and the alternate transferring of the transferring body 4 can be carried out smoothly.

[0068] In addition, since the transferring/stopping, the transferring direction, the transferring speed of the transferring body 4 can be controlled by the piezoelectric ceramics applied with voltage, and the timing and the time to apply voltage to the piezoelectric ceramics, by controlling these accordingly, package oscillation can be carried out by creeping the traverse reversing position of the transferring body 4 to the inner side periodically, and the taper end package can be made easily by narrowing the alternately transferring range of the transferring body 4 gradually accompanying the increase in the winding diameter. Moreover, since the transferring/stopping, the transferring direction, the transferring speed of the transferring body 4 can be controlled freely, the packages of various forms, not only the taper end package, can be formed easily. In addition, any control such as a ribbon oscillation can be carried out easily.

[0069] Furthermore, the feed back control is carried out by detecting the present position of the yarn guide part 42 of the transferring body 4 constantly, and based on the detected result, controlling the supplying of the voltage to the piezoelectric ceramics 2 for transferring the transferring body 4. Moreover, as in the manner stated above, the linear encoder 52 can detect the position of the yarn guide part 42 of the transferring body 4 precisely. As a result, the transferring body 4 can be transferred alternately in the traverse direction H by controlling the position and the speed of the transferring body 4 precisely.

[0070] As in the manner stated above, according to the present embodiment, the traverse device 1 comprising the piezoelectric ceramics group and the elastic body group, is provided per each winding package P, and since the transferring body 4 including the traverse guide transfers alternately within the width of the traverse direction H of the piezoelectric ceramics group and the elastic body group, in other words, since the traverse device 1 is provided to the proximity of each winding package P and each friction drum D respectively, the weight of the transferring body 4 which transfers alternately by the strain of the piezoelectric ceramics 2 (elastic body 3) can be reduced and the transferring body 4 can be transferred at a high speed. As a result, the winding speed of the yarn Y to the package P can be improved.

[0071] A preferable embodiment of the present invention has been described, however, the present invention is not to be limited to aforementioned embodiment, various designing changes are capable within the range according to the claims. For example, without manufacturing the transferring body 4 including a function as an alternately moving body and a traverse guide into one body with the same material, the alternately moving body and the traverse guide can be manufactured separately and the traverse guide can be attached to the alternately moving body. In such case, the manufacturing process is to become complicated, however, the weight of the object (including both the alternately moving body and the traverse guide) transferred by the motor can be reduced, and the winding speed of the yarn Y can be improved.

[0072] Moreover, according to the present embodiment, a piezoelectric ceramics is used as the piezoelectric elements, however, other elements such as piezoelectric elements can be used, and even when using the piezoelectric elements or the like, same effects can be achieved as when a piezoelectric ceramics is used.

[0073] Furthermore, according to the present embodiment, the transferring body 4 is designed so that the length L in the traverse direction H of the alternately moving body 41 of the transferring body 4 is to be longer a little than the length LT corresponding to two cycles of the traveling wave generating from the strain of the elastic body 3. However, the transferring body 4 can be designed so that the length L of the transferring body 4 is to be equal to or longer than the length LT corresponding to the two cycles. Also in such case, the transferring body 4 can be prevented from falling into the descent 32 of the traveling wave and the smooth transferring of the transferring body 4 can be not distracted. Moreover, if the transferring body 4 can transfer in the traverse direction H smoothly, the length L can be shorter than the length LT.

[0074] In addition, according to the present embodiment, the transferring body 4 is prevented from being displaced from the elastic body 3 by the yarn tension. However, to prevent the elastic body 3 from being dis-

placed from the transferring body 4 reliably, the traverse device can be constructed by providing a separate member to support the transferring body 4 to the elastic body 3.

[0075] Next, the second embodiment of the present invention will be described in reference to Figure 6 through Figure 12. However, unless it exceeds the purpose of the present invention, it is not to be limited to only the embodiment to be described in the followings.

[0076] A package P1 shown in Figure 6 and Figure 7 is a package formed by the yarn being wound by appropriate driving means D1 of such as a spindle drive or a drum drive, and 101 is a traverse device of the present invention. In the running path of a yarn Y1, the traverse device 101 is provided in the upstream side to the package P1.

[0077] A traverse device 101 comprises yarn feeding members 102 provided in a plurality of row arrangements in the traverse direction of the yarn Y1, a piezoelectric element 103 constructing the piezoelectric actuator attached to a yarn feeding member 102, a voltage applying change-over switch unit 141 as a switch unit, a voltage applying control unit 104 including a voltage apply switching control means 142 as a control means, and a power source 105 which is the supplying source of the electric power (voltage) for driving, to be supplied to the piezoelectric element 103.

[0078] For example, as shown in the upper part of Figure 8, concerning the form of the yarn feeding members 102, tip sections 121a through 121f are formed in approximately the center position of the surface of the tip section (the surface of the side contacting with the yarn Y1) in the similar manner as the yarn feeding members 102a through 102f arranged along the traverse direction (left-right direction of Figure 8), and inclining parts 123a through 123f, 124a through 124f are formed inclining in a straight line toward the edges of the traverse direction from both sides of the tip sections 121a through 121f. The inclining directions of the inclining parts 123a through 123f, 124a through 124f are different of one another, and for example, are formed so that to be symmetrical with the center line passing through the tip sections 121a, 121b as the axis of symmetry (same for the yarn feeding members 102c through 102f). In such case, the inclining parts 123a through 123f, 124a through 124f are formed in a straight line, but it can be in an arc-like form. Moreover, 125a through 125f, 126a through 126f are side walls of the yarn feeding members 102a through 102f.

[0079] Furthermore, as shown in the upper part of Figure 8, the alignment of each yarn feeding members 102 is as follows. For example, the tip section 121a of one yarn feeding member 102a is located in the tip section 121b side of the yarn feeding member 102b in the traverse direction (in Figure 8, to the left-right direction of the page), in other words, in the left side in the traverse direction to the side wall 125b of the adjacent yarn feeding member 102b. In the same manner, the tip

section 121b of the yarn feeding member 102b is located in the tip section 121c side of the yarn feeding member 102c in the traverse direction, in other words, in the left side to the side wall 125c of the adjacent yarn feeding member 121c, and all the yarn feeding members 102a through 102f are provided under this positioning. In addition, for example, the tip section 121b of one yarn feeding member 102b is located in the tip section 121a side of the yarn feeding member 102a in the traverse direction, in other words, in the right side of the traverse direction to the side wall 126a of the adjacent yarn feeding member 102a. As in the same manner, the tip section 121c of the yarn feeding member 102c is located in the tip section 121b side of the yarn feeding member 102b in the traverse direction, in other words, to the right side of the side wall 126b of the adjacent yarn feeding member 102b. All yarn feeding members 102a through 102f are provided under this positioning. In other words, as shown in the drawing, for examples, the distance in the traverse direction between the tip section 121a of the yarn feeding member 102a and the tip section 121b of the yarn feeding member 102b which are adjacent to one another, is provided to be shorter than the half of the width in the traverse direction of the yarn feeding member 102a (102b) (the distance between the tip section 121a and the side wall 126a, or the distance between the tips section 121b and the side wall 125b, of the traverse direction). This alignment is the same between the yarn feeding member 102b and the yarn feeding member 102c, the yarn feeding member 102c and the yarn feeding member 102d, the yarn feeding member 102d and the yarn feeding member 102e, and the yarn feeding member 102e and the yarn feeding member 102f.

[0080] Moreover, as shown in the lower drawing in Figure 8 which shows the upper drawing of Figure 8 above the X-X arrows, for each yarn feeding members 102a through 102f to not contact against one another, the yarn feeding member 102a through the yarn feeding member 102c and the yarn feeding member 102d through the yarn feeding member 102f are provided in a staircase pattern, and the yarn feeding member 102a and the yarn feeding member 102d, the yarn feeding member 102b and the yarn feeding member 102e, the yarn feeding member 102c and the yarn feeding member 102f are provided adjacent to one another in the traverse direction respectively. Such area between the yarn feeding member 102a through the yarn feeding member 102f is to be the smallest unit of the alignment pattern, and the alignment pattern are arranged in a plurality along the traverse direction, and form the traverse device 101 shown in Figure 6.

[0081] However, the present invention is not to be limited to such alignment, the yarn feeding members are to be provided not contacting against one another.

[0082] Moreover, the yarn path control guides 107a, 107b are provided in parallel along the tip sections of the yarn feeding members 102a through 102f, and the

yarn Y1 is arranged to pass through between the yarn path control guides 107a, 107b. Accordingly, the yarn Y1 can be prevented from being displaced from the traverse device 101 reliably. However, according to the tension of the yarn Y1 and the yarn path (alignment of the traverse device 101), the yarn path control guides 107a, 107b can be made unnecessary.

[0083] The yarn feeding member 102 shown in Figure 6 is capable of transferring alternately in that to advance and recede in the direction orthogonal to the traverse direction. Such transferring is made practicable by the piezoelectric element 103 which is the piezoelectric actuator attached to each yarn feeding member 102. The piezoelectric element 103 is an element straining by the electric power for driving (voltage) being supplied (applied) from the outside. According to the present embodiment, the piezoelectric element 103 is strained by applying voltage via the voltage applying change-over switch unit 141 from the power source 105, and the strain leads to the alternate transferring of the yarn feeding members 102.

[0084] The voltage applying change-over switch unit 141 is capable of switching short-circuit, releasing between the power source 105 and the piezoelectric element 103, and is also capable of applying voltage separately to the piezoelectric elements 103 attached to the yarn feeding members 102 of which are required to be advanced to the acting position. Therefore, the digital ON/OFF switching control of the voltage applying to the piezoelectric elements 103 by the voltage applying change-over switch unit 141 becomes practicable. Moreover, the switching control of the voltage applying change-over switch unit 141 is carried out by the voltage applying change-over control means 142 outputting the switch signal.

[0085] The traverse by the operation of the yarn feeding members 102 will now be described in reference to Figure 9 and Figure 10.

[0086] In Figure 9, the operation of the yarn feeding members 102 of Figure 6 is made so that at least one of the yarn feeding members 102 advance, and when the yarn feeding member 102 recedes, the adjacent yarn feeding member 102 is made to be advanced accordingly. For example, as shown in Figure 9A, when the yarn feeding member 102A is advancing (the position where the yarn feeding member 102A advances and contacts with the yarn Y1 is to be referred to as acting position, and the position of other yarn feeding members 102B through 102E is referred to be non-acting position hereafter), the yarn feeding member 102A acts by the yarn Y1 and the side wall 126A contacting with one another. Next, as shown in Figure 9B, the yarn feeding member 102A recedes to the non-acting position and the yarn feeding member 102B adjacent to the left side of the yarn feeding member 102A advances to the acting position. When the yarn Y1 is delivered to the side wall 126B of the yarn feeding member 102B, the yarn Y1 is to be traversed by being fed to the left side of Figure 9.

[0087] Moreover, in Figure 9B, since the yarn feeding member 102E, not only the yarn feeding member 102B, is advancing, the transferring in the left direction of Figure 9 is to be controlled by the yarn Y1 contacting on the side wall 125E of the yarn feeding member 102E. Accordingly, turning is to be carried out in the left side of the traverse, and the position of the yarn Y1 shown in Figure 9B is to become the turning point of the traverse. The turning in the right side of the traverse becomes practicable by operating the operation in the left side of the traverse to be symmetrical with the center of the traverse as the axis. Therefore, by selecting the yarn feeding member 102 which operates as the yarn feeding member 102E following the designated procedure, the turning point of the traverse can be changed.

[0088] Next, the procedure of the yarn feeding operation by the yarn feeding members 102 will be described further in detail by referring to Figure 10.

[0089] For the example of the cases to carry out traverse to the right side of Figure 9 from the turning of the traverse of the yarn Y1 shown in Figure 9B, as shown in Figure 10A, the yarn feeding member 102B starts the receding to the non-acting position and the yarn feeding member 102D advances to the acting position. At the time being, the yarn Y1 transfers along the inclining part 123D on the yarn feeding member 102D. The yarn Y1 is to be along the inclining part 123D, and when the yarn feeding member 102D advances to the acting position, a component of the force to feed the yarn Y1 toward the traverse direction (in this case, to right side of Figure 10) generates and as shown in Figure 10B, the yarn Y1 transfers to the right side. The yarn feeding member 102E is to recede to the non-acting position at the point of time when the contact with the yarn Y1 is released. Next, as shown in Figure 10C, when the yarn feeding member 102D advances furthermore, and the yarn feeding member 102B recedes to the non-acting position completely, the yarn Y1 is transferred further to the right direction and contacts to the side wall 125D, and as shown in Figure 9C, the yarn Y1 is delivered toward the inclining part 123C of the adjacent yarn feeding member 102C. The operation mentioned above is to be repeated also in the yarn feeding member 102C and as shown in Figure 9D, the yarn Y1 is to be transferred to the right direction even more.

[0090] As shown in Figure 8, the inclining part 123a and the inclining part 124a are formed symmetrical to one another with the line passing through the tip section 121a and orthogonal to the traverse direction as the axis of symmetry, since the inclining part 123a is to be used for the yarn feeding in the right direction of Figure 8 and the inclining part 124a is to be used for the yarn feeding in the left direction of Figure 8. In other words, there is an object to reduce the number of the yarn feeding members 102 by using one yarn feeding member 102 for both the outward route and homeward route of the traverse. Furthermore, the object is to equalize the pitch of the yarn feeding to both the right and the left direction (it is

to be same for the inclining parts 123b through 123f and the inclining parts 124b through 124f of the yarn feeding members 102b through 102f).

[0091] Moreover, for example, for carrying out the delivery of the yarn Y1 reliably, the tip section 121a of one yarn feeding member 102a is provided in the inclining part 121b side in the traverse direction, in other words, in the left side in the traverse direction to the side wall 125b of the yarn feeding member 102b. When assuming that the tip section 121a of the yarn feeding member 102a is located in the right side to the side wall 125b of the yarn feeding member 102b, the yarn Y1 is sandwiched between the inclining part 124a and the inclining part 123b and the yarn feeding is to be interrupted. Furthermore, for example, it is of the same reason for the tip section 121b of one yarn feeding member 102b located in the tip section 121a side of the yarn feeding member 102a in the traverse direction, in other words, in the right side in the traverse direction, to the side wall 126a of the adjacent yarn feeding member 102a.

[0092] As shown in Figure 6, when making the tip section form of the package P1 to be a taper end by reducing the traverse range gradually accompanying the progress in winding, the operation of the yarn feeding members 102A through 102E shown in Figure 9 and Figure 10, are to be switched to shift to the right side of the page, in other words, to the inner side of the traverse range accordingly. Furthermore, by carrying out the switching of the voltage applying change-over switch unit 141 by the output of the switch signal of the voltage apply switching control means 142 shown in Figure 6 at a high speed, the speed of the traverse can be improved.

[0093] Moreover, for the way to take timing to reduce the traverse range, for example, a rotating speed detector 106 can be provided at the center of the winding package P1, the change in the rotating speed of the center section of the package P1 accompanying the progress in the winding can be detected, and based on the detected result, the voltage apply switching control means 142 shown in Figure 6 can output the switch signal to the voltage applying change-over switch unit 141. Moreover, concerning the turn of the yarn Y1, for example, when the turn is to be carried out by the yarn feeding member 102E (refer to Figure 9 and Figure 10), by making the adjacent yarn feeding members 102D, 102C, etc. to carry out the operation of the yarn feeding member 102E from time to time, a desired creeping (package oscillation) can be carried out for controlling the saddle bag phenomenon easily generating at the tip section of the traverse.

[0094] Apart from aforementioned operation, as shown in Figure 11, only two yarn feeding members 102 recede to the non-acting position, and as shown in Figure 11A for example, the yarn path is controlled so that the yarn Y1 is to be sandwiched between the side wall 126A of the yarn feeding member 102A and the side wall 126D of the yarn feeding member 102D, and by the

yarn feeding members 102C, 102D (Figure 11B) receding from the acting position accordingly, the yarn Y1 can be fed to the left direction of Figure 11. In this case, since the yarn path is controlled from both sides by the yarn Y1 being sandwiched between the side wall 126A of the yarn feeding member 102A and the side wall 125D of the yarn feeding member 102D, and between the side wall 126B of the yarn feeding member 102B and the side wall 125E of the yarn feeding member 102E, the staggering of the yarn Y1 can be suppressed reliably.

[0095] Next, the procedure of the yarn feeding operation by the yarn feeding members 102 will be described further in detail in reference to Figure 12.

[0096] First, the turning of the yarn Y1 is to be carried in Figure 11B, and for example, when carrying out the traverse to the right side of Figure 11 from the turning of the traverse of the yarn Y1 to Figure 11C, as shown in Figure 12A, the yarn feeding member 102B starts receding to the non-acting position, and the yarn feeding member 102D starts advancing to the acting position. At the time being, the yarn Y1 transfers along the inclining part 123D of the yarn feeding member 102D. When the yarn feeding member 102D advances to the acting position by the yarn Y1 passing along the inclining part 123D, a component of the force to feed in the yarn Y1 toward the traverse direction (in this case, to the right side of Figure 12) generates, and the yarn Y1 transfers to the right side as shown in Figure 12B by being delivered to the inclining part 124B of the yarn feeding member 102B of which started the receding operation to the non-acting position. The yarn feeding member 102E is left located at the acting position, and unmoved. Next, as shown in Figure 12C, the yarn feeding member 102C is to be left at the receding position, and after advancing the yarn feeding member 102D furthermore, when the yarn feeding member 102B recedes to the non-acting position completely, the yarn Y1 transfers further to the right direction and then contacts with the side wall 125D. Moreover, as shown in Figure 11C, the yarn Y1 is to be sandwiched between the side wall 125D and the side wall 126A of the yarn feeding member 102A. By repeating such operation in the yarn feeding members 102C, 102B, 102A, as shown in Figure 11D, the yarn Y1 is to be transferred further to the right direction.

[0097] As in the manner stated above, by providing a plurality of yarn feeding members 102 arranged in the traverse direction of the yarn Y1 and capable of advancing and receding between the acting position and non-acting position, the piezoelectric elements 103 which advance and recede each yarn feeding member 102 individually between the acting position and the non-acting position, and a voltage applying control unit 104 for generating the strain by applying voltage to the designated piezoelectric elements 103, a taper end package P1 can be formed by the high speed traverse since the traverse can be carried out by only the switching of the supplying of the electric power for driving. Particularly, as in the same manner with the present embodiment,

by feeding the yarn Y1 with the yarn feeding member 102 contacting directly with the yarn Y1, a member transferring along the traverse direction becomes unnecessary, and accordingly, the speed of the traverse can be improved.

[0098] Moreover, according to the present embodiment, as shown in Figure 8, the inclining parts 123, 124 are formed in the yarn feeding members 102, however, one with inclining part formed for traversing the yarn Y1 to the right direction, and one with the inclining part formed for the traversing to the left direction, can be provided separately. Furthermore, the yarn feeding member 102 can be not worked directly on the yarn Y1, however, the yarn can be fed by the yarn guide and the yarn guide can be pressed with a member like the yarn feeding member 102.

[0099] Moreover, according to the second embodiment of the present invention, the piezoelectric element 103 was used for the actuator, however, ultrasonic transducer accompanying ultrasonic vibration by the electric signal can be used.

[0100] According to the present invention, since the alternately moving body is not displaced from the elastic body substantially, and since the alternately moving body including the traverse guide are transferring alternately within the width of the traverse direction of the elastic body, the weight of the object (including both the alternately moving body and the traverse guide) to be transferred alternately by the strain of the piezoelectric elements (elastic body) can be reduced than that of the invention publicized in the aforementioned Unexamined Japanese Patent Application Publication No. (Tokkai-Hei) 7-165368. Therefore, the traverse guide can be transferred alternately at a high speed. As a result, the speed to wind the yarn to a package can be improved.

[0101] Moreover, according to the traverse device using the electromagnetic motor, a magnetic body is used for the material of the object to be transferred alternately. On the other hand, according to the traverse device of the present invention, since ceramics or resin can be used for the material of the traverse guide and the alternately moving body, the weight of the object to be transferred alternately can be reduced, and comparing to the traverse device using the electromagnetic motor, the winding speed of the yarn to the package can be improved.

[0102] Furthermore, according to the traverse device of the present invention, since coil or magnet are not used, the electromagnetic position detector to be used for the detection of the position of the traverse guide is not influenced by the magnetic field, and the position and the speed of the traverse guide can be detected precisely. In addition, as a result of the precise detection of the position or the speed of the traverse guide, the package of any form, such as a taper end package, can be formed easily.

[0103] Moreover, since the traverse guide is not required to be attached fixed onto the alternately moving

body after manufacturing the traverse guide and the alternately moving body separately, the manufacturing process becomes simple and the manufacturing cost can be suppressed.

[0104] Furthermore, since the groove formed in the elastic body serves as a guide for transferring the alternately moving body to the traverse direction, it is unnecessary to provide a member for guiding the alternately moving body to the traverse direction separately. As a result, the structure of the traverse device can be simplified and the unit price of a traverse device can be suppressed. Since the elastic body itself which transfers the alternately moving body is guiding the alternately moving body to the traverse direction, the alternately moving body can be transferred to the traverse direction smoothly.

[0105] In addition, the alternately moving body can be prevented from falling off to the descent of the traveling wave generating from the strain of the elastic body, and the alternate motion of the alternately moving body can be carried out smoothly.

[0106] Moreover, since a process (taper end winding process) for narrowing the alternating motion range of the transferring body gradually can be carried out accompanying the increase in the winding diameter of the winding package by the winding of the yarn, by using this control program, a taper end package can be formed easily.

[0107] In addition, since a process (creeping process) for creeping the reversing of the traverse guide to the inner side periodically, by using this control program can be carried out, package oscillation (control of saddle bag) can be carried out easily.

[0108] Furthermore, the traverse device of the present invention comprises a plurality of yarn feeding members, a plurality of piezoelectric actuators, and a control means. A plurality of yarn feeding members are arranged in the traverse direction of the yarn, and are capable of advancing and receding in the direction orthogonal to the traverse direction between the acting position contacting with the yarn and non-acting position. A plurality of piezoelectric actuators advances or recedes each yarn feeding member between the acting position and the non-acting position independently of one another. The control means switches the driving of each piezoelectric actuator under a designated procedure. Moreover, the traverse is carried out by delivering the yarn between the yarn feeding members by advancing the designated yarn feeding member to the acting position accordingly. Therefore, the taper end package can be formed by the high speed traverse.

[0109] Furthermore, according to the present invention, a switch unit for switching separately the supplying of the electric power for driving to each piezoelectric actuator is provided, and the control means outputs the switch signal to the switch unit so that each piezoelectric actuator is driven under designated procedure. As a result, the individual advancing and receding operations

of the yarn feeding member can be sped up.

[0110] Moreover, the piezoelectric actuator can carry out the digital ON/OFF control at high speed by being constructed with piezoelectric elements.

[0111] In addition, the yarn feeding member comprises an inclining part, and when the yarn feeding member advances from the non-acting position to the acting position, by feeding the yarn to the traverse direction along the inclining part, the yarn can be fed in toward the traverse direction under a simple operation. Moreover, by feeding the yarn directly by the yarn feeding member, a member to transfer along the traverse direction becomes unnecessary and the speed of the traverse can be improved.

[0112] Furthermore, the inclining part is formed on the surface of the tip section of the yarn feeding member and is inclining on both sides toward the edges of the traverse direction from the center of the tip section. As a result, the yarn feeding member for the outward route of the traverse of the yarn and the yarn feeding member for the homeward route of the traverse of the yarn are not required to be provided separately, and the number of yarn feeding members can be reduced.

[0113] In addition, according to the present invention, by switching the supplying of the electric power for driving by following the designated procedure, to a plurality of piezoelectric actuators attached respectively to a plurality of yarn feeding members arranged in the traverse direction of the yarn, and capable of advancing and receding in the direction orthogonal to the traverse direction between the acting position contacting with the yarn and the non-acting position, the traverse can be carried out by delivering the yarn accordingly to the adjacent yarn feeding member while advancing the yarn feeding member individually to the acting position. As a result, the taper end package can be formed by the high speed traverse.

[0114] Furthermore, the inclining parts are formed on the surface of the tip section of the yarn feeding member and are inclining on both sides toward the edges of the traverse direction from the center of the tip section. By feeding the yarn in the traverse direction along the inclining part, the traverse can be carried out with even fewer numbers of yarn feeding members. Moreover, by feeding the yarn directly to the yarn feeding member, a member transferring along the traverse direction becomes unnecessary, and the speed of the traverse can be improved.

Claims

1. A traverse device for traversing yarn guided by a traverse guide comprising:

a plurality of piezoelectric elements arranged in a traverse direction over the entire traverse range where the yarn is traversed;

an elastic body transforming by the strain of the piezoelectric elements; and
an alternately moving body provided on the elastic body, transferable in the traverse direction and not to fall out from the elastic body substantially, and transferring in the traverse direction by the strain of the elastic body;

wherein the traverse guide transfers in the traverse direction accompanying the transferring of the alternately moving body.

2. A traverse device for traversing yarn guided by a traverse guide comprising:

a plurality of piezoelectric elements arranged in the traverse direction over the entire traverse range where the yarn is traversed;
an elastic body transforming by the strain of the piezoelectric elements; and
an alternately moving body provided on the elastic body, transferable in the traverse direction and not to fall out from the elastic body substantially, and transferring in the traverse direction by the strain of the elastic body;

wherein the traverse guide transfers in the traverse direction within the width of the traverse direction of the elastic body accompanying the transferring of the alternately moving body.

3. A traverse device according to claim 1 or claim 2 wherein the alternately moving body and the traverse guide are manufactured by the same material into one body.
4. A traverse device according to any one of claim 1 through claim 3 wherein a groove extending in the traverse direction in the entire range of the traverse range is formed on the elastic body.
5. A traverse device according to any one of claim 1 through claim 4 wherein a length in the traverse direction of the contacting section on the alternately moving body contacting to the elastic body corresponds to at least two cycles of the traveling wave generating from the strain of the elastic body.
6. A traverse device according to any one of claim 1 through claim 5 comprising:

a control unit for controlling the strain of the piezoelectric element, and including a memory storing a program to carry out a process to narrow the alternately moving range of the transferring body gradually accompanying the increase in the winding diameter of the winding package by the winding of the yarn.

7. A traverse device according to claim 6 wherein the control unit comprises a memory storing the program for carrying out a process to creep the reversing of the traverse guide to the inner side periodically. 5
8. A traverse device comprising:
- a plurality of yarn feeding members arranged in the traverse direction of the yarn, and capable of advancing and receding in the direction orthogonal to the traverse direction between the acting position contacting with the yarn and non-acting position; 10
 - a plurality of piezoelectric actuators for advancing and receding each yarn feeding member between the acting position and the non-acting position independently of one another; and 15
 - a control means for switching the driving of each piezoelectric actuator under a designated procedure; 20
- wherein the traverse is carried out by delivering the yarn between the yarn feeding members by advancing the designated yarn feeding member to the acting position accordingly. 25
9. A traverse device according to claim 8 comprising:
- a switch unit for switching separately the supplying of the electric power for driving to each piezoelectric actuator; 30
- wherein the control means outputs a switch signal to the switch unit so that each piezoelectric actuator is driven under the designated procedure. 35
10. A traverse device according to claim 8 or claim 9 wherein the piezoelectric actuator is formed of piezoelectric elements. 40
11. A traverse device according to any one of claim 8 through claim 10 wherein the yarn feeding member comprises an inclining part, and when the yarn feeding member advances from the non-acting position to the acting position, the yarn is fed to the traverse direction along the inclining part. 45
12. A traverse device according to claim 11 wherein the inclining parts are formed on a surface of a tip section of the yarn feeding member and are inclining on both sides toward the edges of the traverse direction from the center of the tip section. 50
13. A traverse method for carrying out a traverse by delivering the yarn accordingly to the adjacent yarn feeding member by advancing the yarn feeding member separately to the acting position, by switch-

ing the supplying of the electric power for driving following the designated procedure, to a plurality of piezoelectric actuators attached respectively to each of a plurality of yarn feeding members arranged in the traverse direction of the yarn, and capable of advancing and receding in the direction orthogonal to the traverse direction between the acting position in contact with the yarn and the non-acting position.

14. A traverse method according to claim 13 wherein the inclining parts are formed on the surface of the tip section of the yarn feeding member and are inclining on both sides toward the edges of the traverse direction from the center of the tip section, and the yarn is fed in the traverse direction along the inclining parts.

FIG. 1

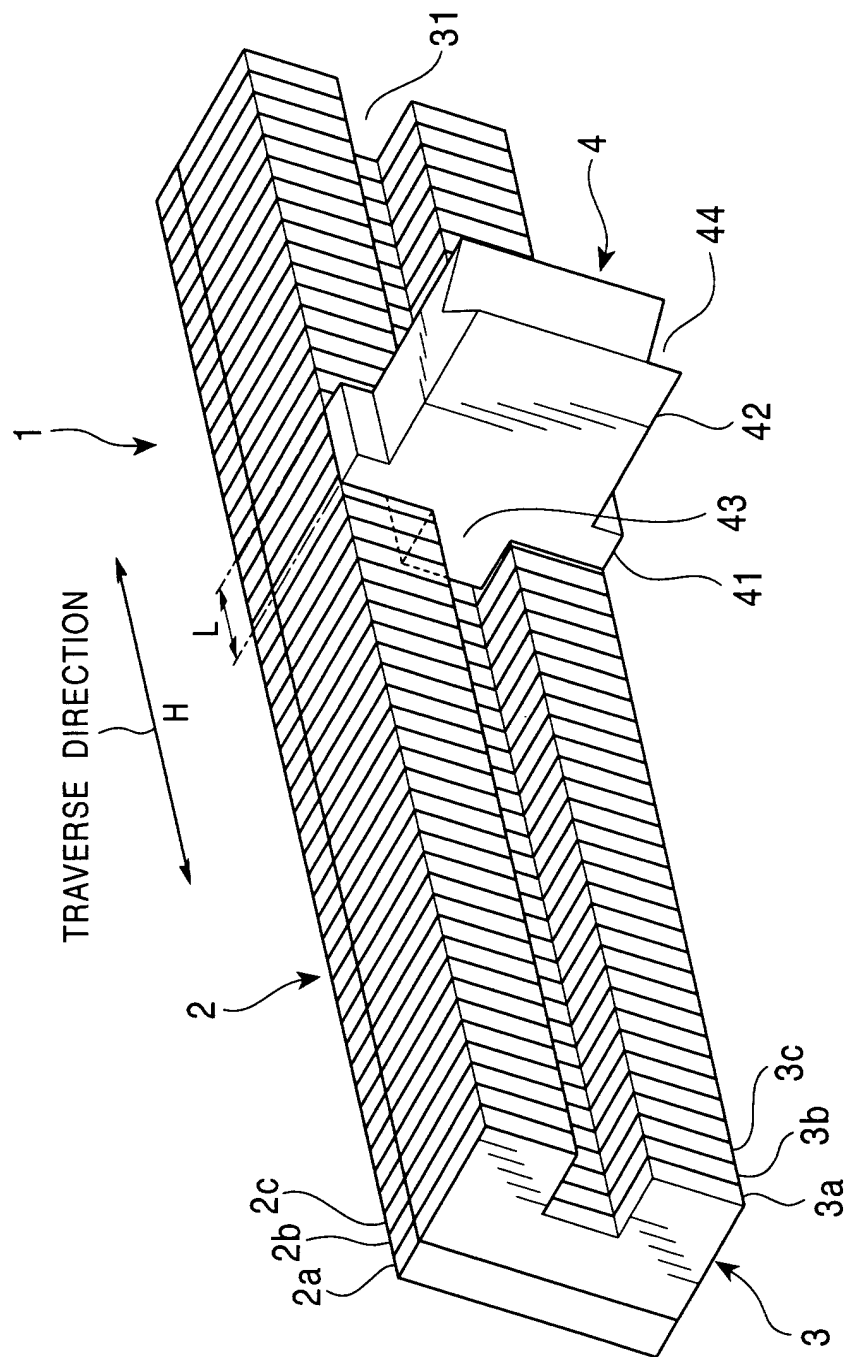


FIG. 2

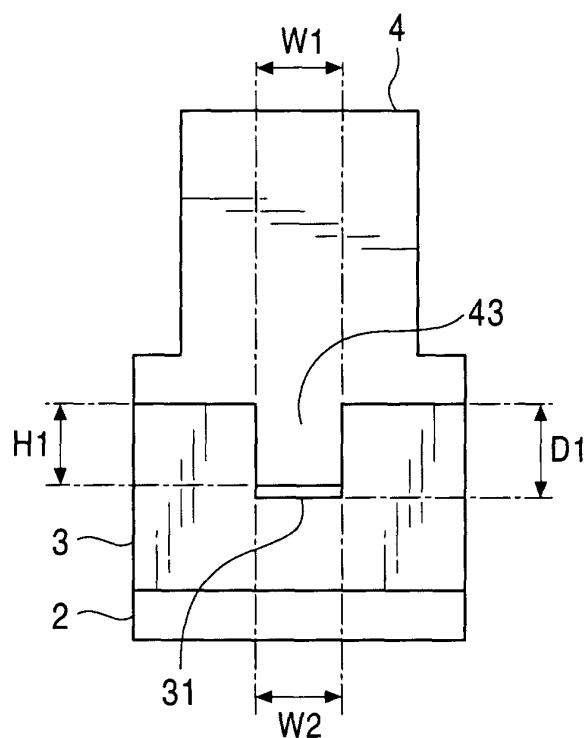


FIG. 3

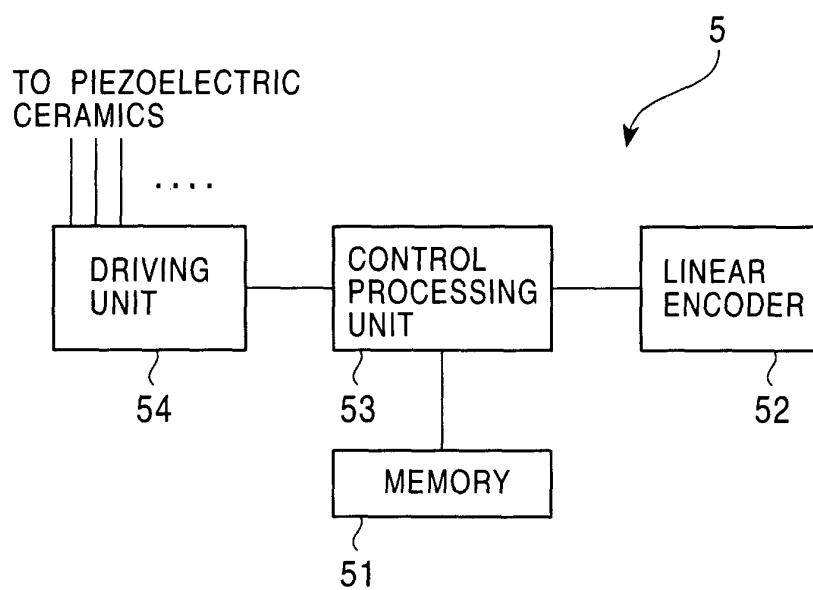


FIG. 4

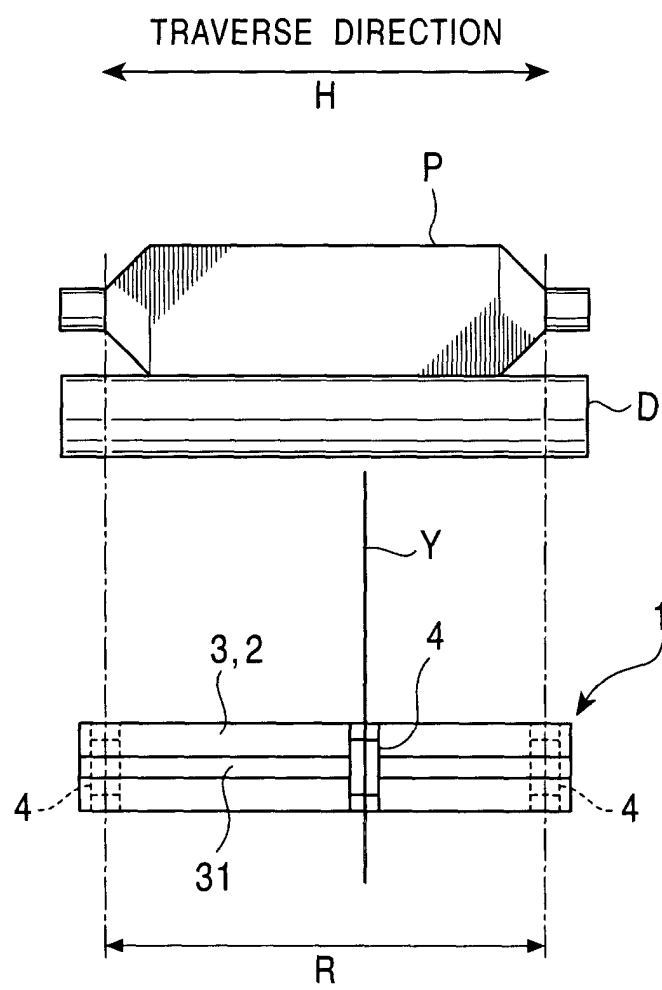


FIG. 5

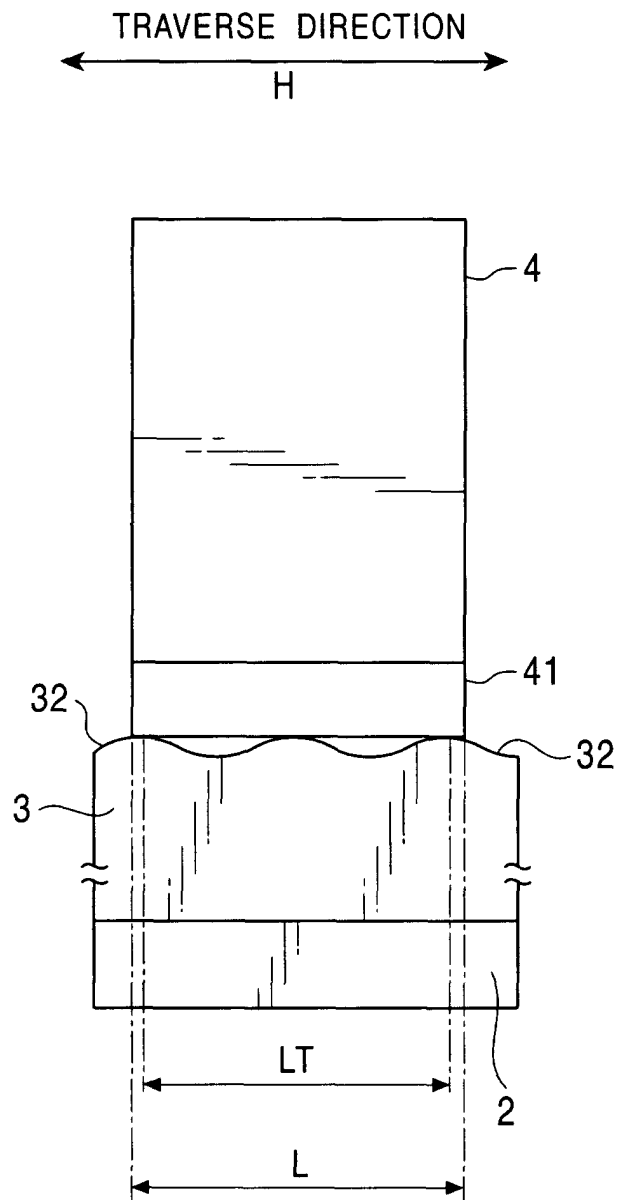


FIG. 6

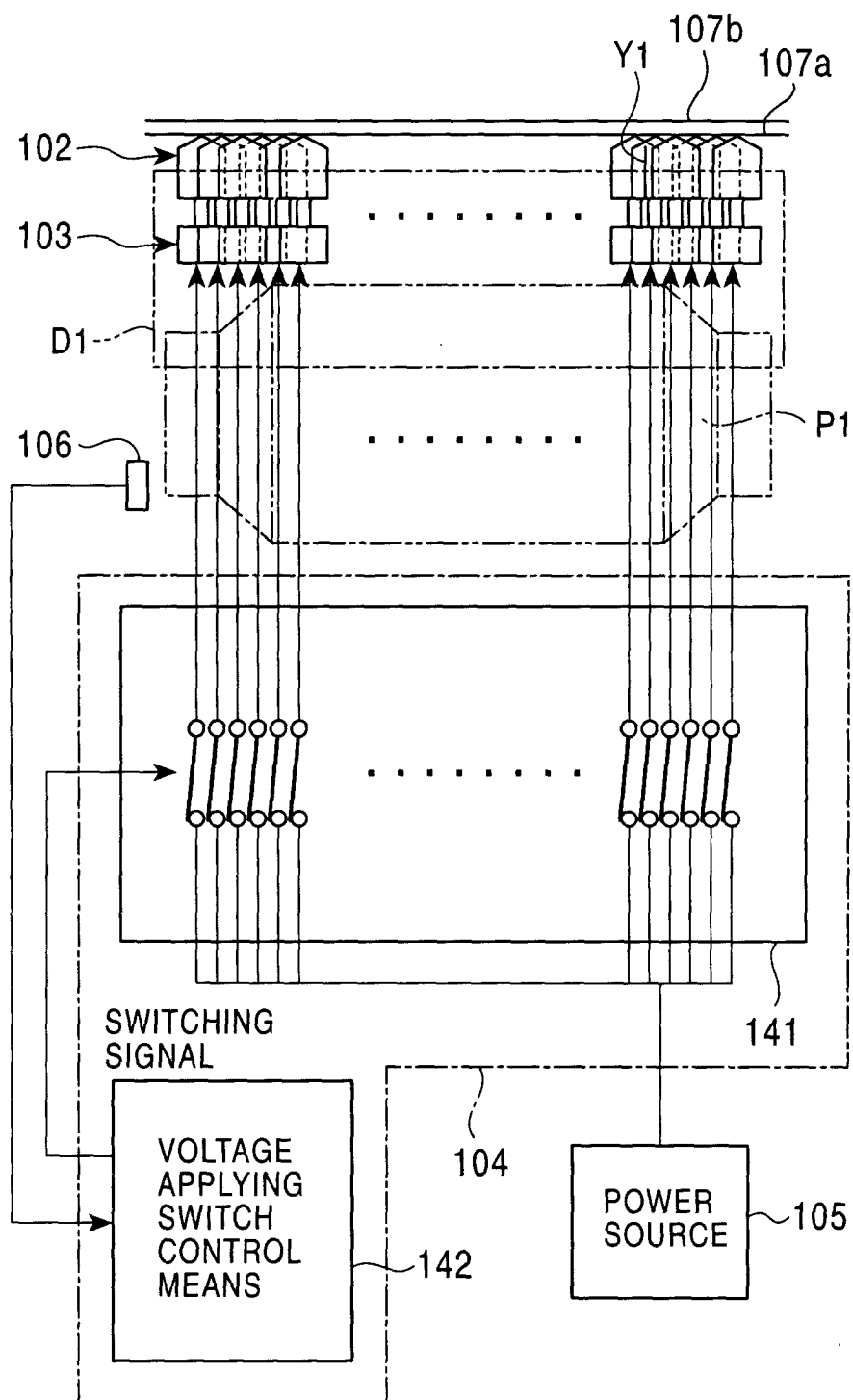


FIG. 7

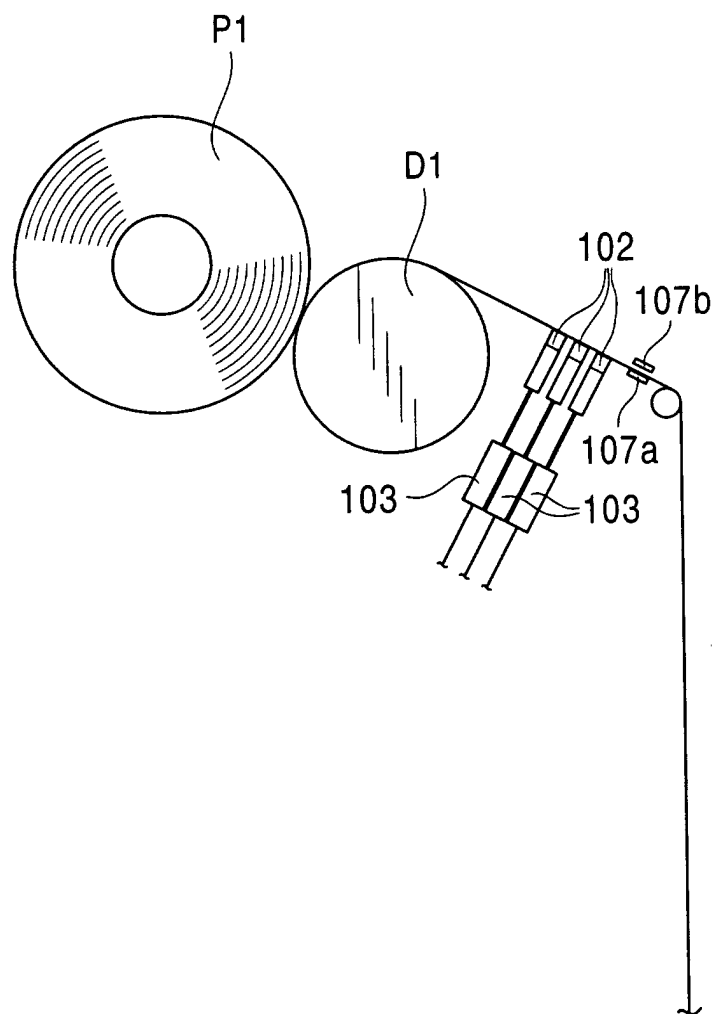


FIG. 8

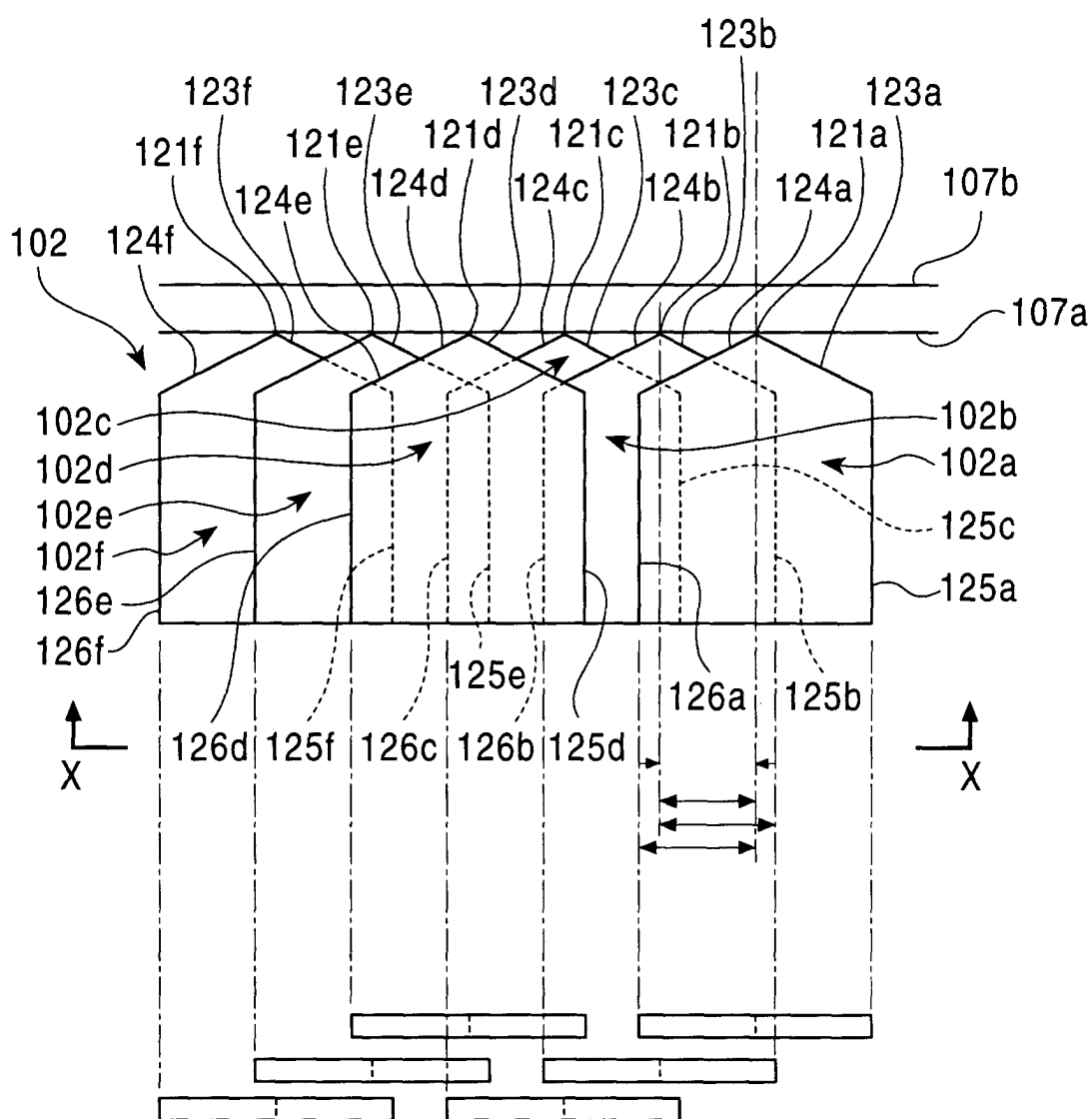


FIG. 9A

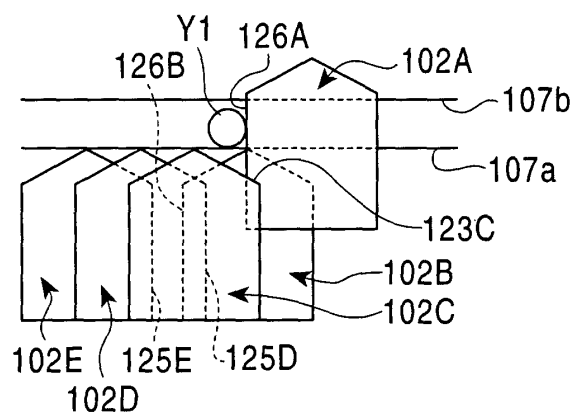


FIG. 9B

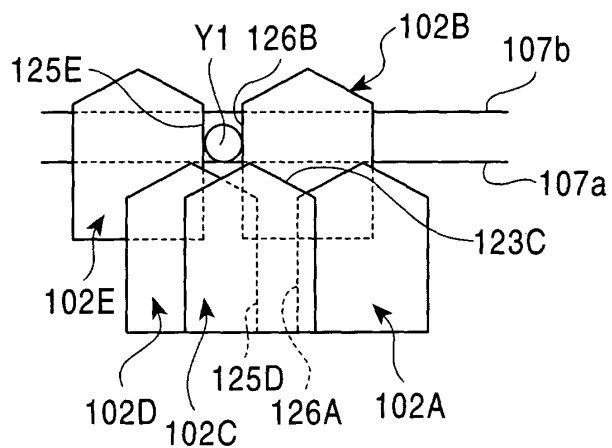


FIG. 9C

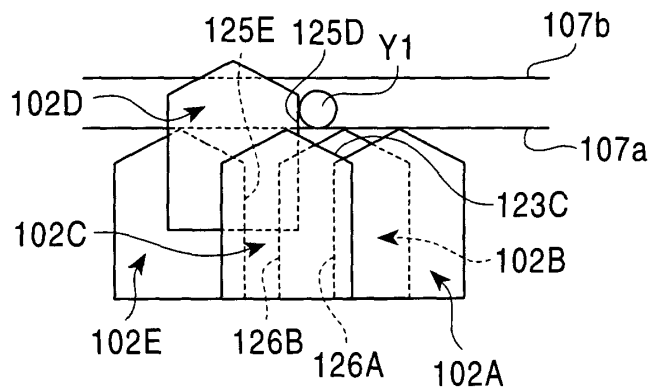


FIG. 9D

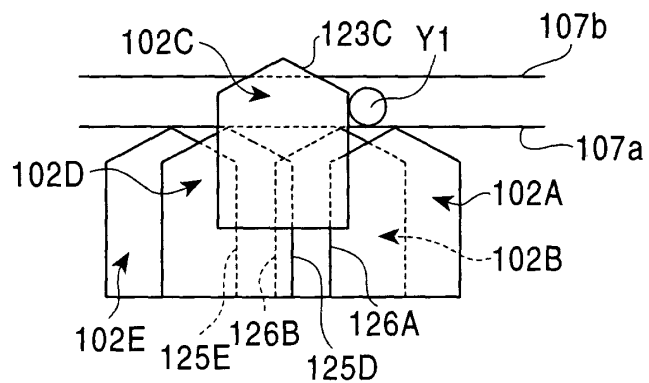


FIG. 10A

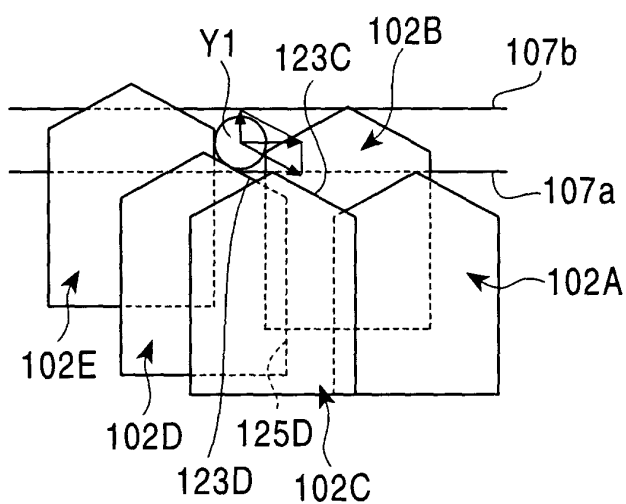


FIG. 10B

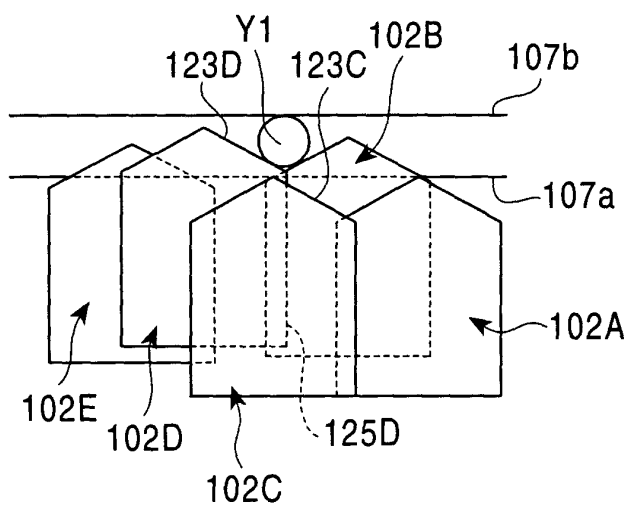


FIG. 10C

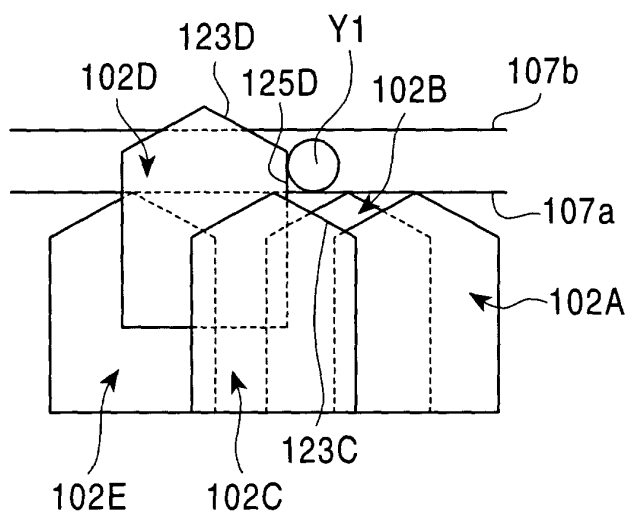


FIG. 11A

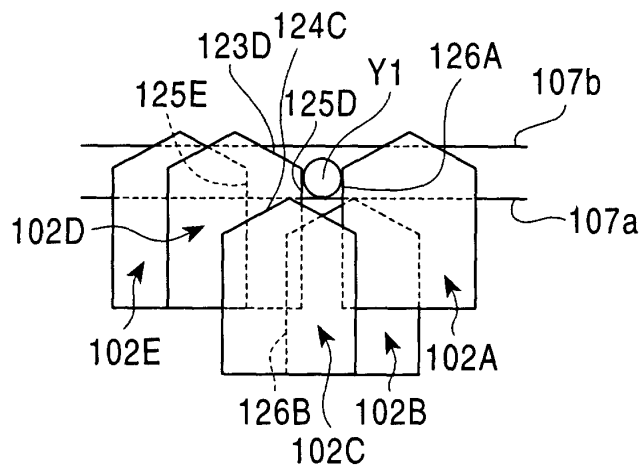


FIG. 11B

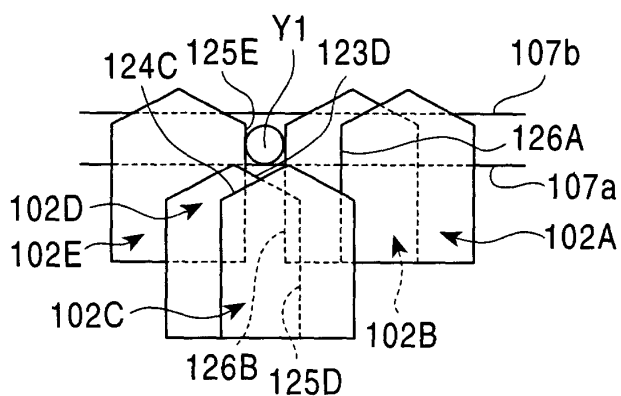


FIG. 11C

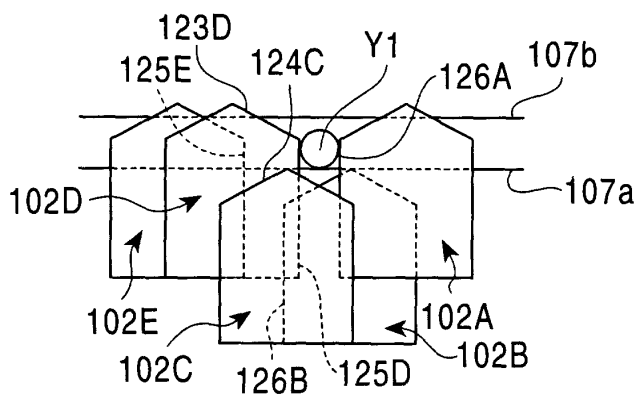


FIG. 11D

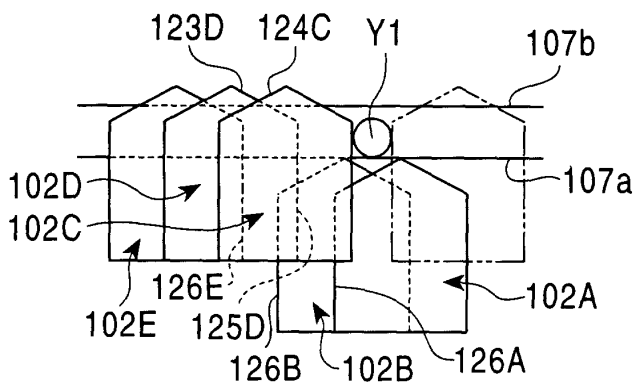


FIG. 12A

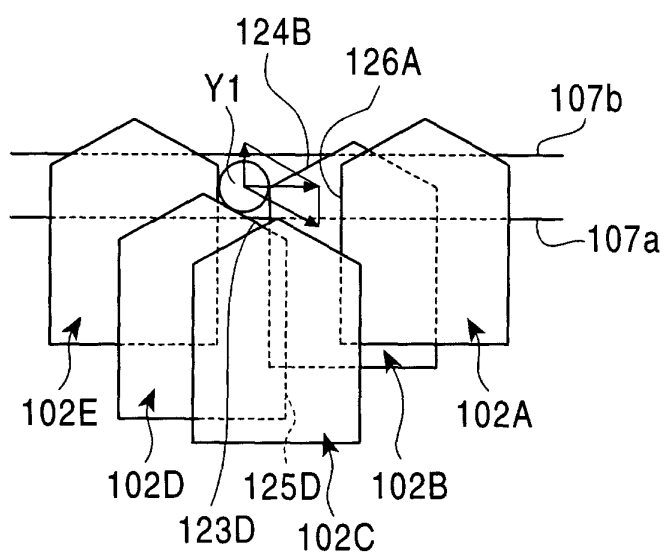


FIG. 12B

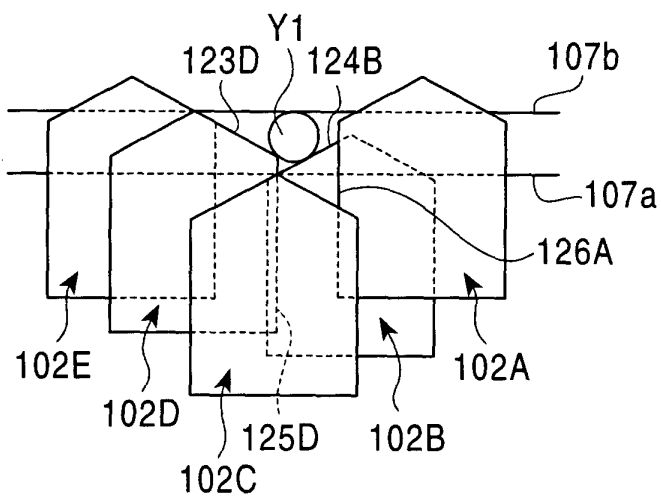


FIG. 12C

