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(54) Warp control apparatus for a loom

Kettfädensteuervorrichtung für Webmaschinen

Dispositif de commande des fils de chaîne pour métier à tisser

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- **PATENT ABSTRACTS OF JAPAN vol. 14, no. 149 (C-705)22 March 1990 & JP-A-2 019 534 (TAKEMURA SEISAKUSHO) 23 January 1990**

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Description

The present invention relates to a warp control apparatus for a loom, and more particularly to a warp control apparatus for a loom which is used when a pattern is formed on a fabric by controlling warps.

The general principle of a loom is as follows. In the case of a plain weave, warp yarns are passed through a heald and divided into two groups by an up-and-down movement of the heald to form a shed, into which a filling yarn is inserted by a shuttle. The filling yarn is then pressed to a cloth fell, followed by forming another shed of the warp yarns, into which the filling yarn is inserted, and thus the weaving proceeds. Shuttleless looms are also proposed in which no shuttle is used and a jet stream of air or water is used to insert a filling yarn into a shed. Looms are shifted from looms using treadles to dobby looms and further to jacquard looms, as the number of healds used therein increases. The jacquard looms have been proposed considering that more warp yarns are required to complete one pattern and therefore it becomes difficult to form a shed because of too many healds in the dobby looms, and constructed so as to be able to move the warp yarns up and down one by one, instead of using the healds. Of the jacquard looms, a loom is well known which is constructed so as to use a card perforated according to a pattern proposed by a jacquard machine to pull up only hooks corresponding to perforations of the card and pull up through harness cords only warp yarns linked to those hooks, thereby forming a shed between the pulled-up warp yarns and warp yarns remaining in their original positions. Recently, looms using electromagnets for the formation of the shed have been proposed.

As such prior-art embodiments, various machines such as one in which needles of the jacquard machine are moved in the transverse direction by excitation of solenoids have been proposed. Japanese Patent Unexamined Publication No. 59-199833/1984 proposes a heald control apparatus as shown in Fig. 9. In this apparatus, a heald rod retention device 50 is provided with a pair of solenoids 51, one of which forms a south pole and the other of which forms a north pole. When the solenoids 51 are excited to serve as electromagnets, an upper portion of a heald rod 52 is bent by magnetic attraction, and an aperture 53 thereof is brought into engagement with a hook portion 54 formed on the heald rod retention device 50, thereby retaining the heald rod 52 in a lifted state. On the other hand, when the solenoids 51 are not excited, the aperture 53 is not brought into engagement with the hook portion 54. Accordingly, an end portion of the reciprocating heald rod 52 can be selectively engaged for retention. In Fig. 9, the numeral 55 designates terminals, the numeral 56 designates lead wires, and the numeral 57 designates a pole piece.

On the other hand, as a heald control apparatus similarly using solenoids, a machine as shown in Fig. 10 is also proposed. Referring to Fig. 10, the numeral 61 designates solenoids, the numeral 62 designates a pulley, the numeral 63 designates a heald, the numeral 64 designates a knife, the numeral 65 designates a fixing stand, and the numeral 66 designates a hook portion. In this machine, the heald 63 is suspended from the pulley 62. When a rod remains in the hook portion 66 by the action of the solenoid 61, the heald 63 does not go down. On the other hand, in the reverse case, the heald 63 goes down. Namely, in this machine, the heald 63 is selected by the action of the solenoid 61 and the up-and-down movement of the pulley 62.

However, such a machine using the electromagnet has the problem that heat is significantly developed because the solenoid is used which has a coil wound many turns around a core, which results in increased power consumption. In particular, for a figured fabric (pattern fabric) requiring some thousands of warp yarns to complete one pattern, the heald rod retention devices corresponding thereto are necessary, and the solenoids corresponding thereto are of course arranged. The use of solenoids therefore introduces the problem of heat generation as described in Japanese Patent Unexamined Publication No. 59-199833/1984. Further, in order to selectively bring the end portion of the heald rod into engagement with the heald rod retention device of the heald control apparatus to retain it by utilizing electromagnetic attraction, it is necessary to give current both poles of the solenoid. When such an electromagnet is used, a long time is taken to attract the heald rod by means the electromagnet after the current is given thereto. Accordingly, this machine has a limitation on the accelerating of its response speed, arising from the functions of the electromagnet itself. Furthermore, in the apparatus using such an electromagnet, the solenoids each of which has the coil wound many turns around the core are used, which causes the apparatus to be increased in size and to require a large installation space.

The machine using the pulley is intended to accelerate the response speed by the use of the pulley. However, similarly this machine has a limitation on the accelerating of its response speed, arising from the functions of the electromagnet itself.

To obviate said drawbacks warp control apparatus using piezo-electric elements may be used. Such a control apparatus ist disclosed in JP-A-2 019 534 which is considered to represent the most relevant state of the art.

According to this invention a warp control apparatus for a loom having a control rod retention device for selective engagement and retention of an end portion of a reciprocating control rod comprises a finger provided with a hook portion or an aperture which can be selectively brought into engagement with the end portion of said control rod to retain it and a piezo-electric body having a piezo-electric element, the upper end portion of said piezo-electric body is movably supported on said control rod retention device by an adjustable offsetter and the lower end portion thereof is movably connected

to said finger, and an intermediate portion between the upper end portion of said piezo-electric body and the lower end portion thereof is fixed to a rotatable member rotatably mounted on said control rod retention device.

The present invention thus provides a piezo-electric warp control apparatus which eliminates the above-mentioned disadvantages of the prior-art machines, and which is high in response speed, little in heat generation, low in power consumption and can be miniaturized. Another advantage of the present invention is the provision of a warp control apparatus having a characteristic piezo-electric system.

A particular embodiment of a device in accordance with this invention will now be described with reference to the accompanying drawings, in which:-

Fig. 1 is a perspective view showing a principal part of an embodiment of the present invention;
Fig. 2 is a cross sectional view showing a control rod retention device of an embodiment of the present invention;
Fig. 3(A) is a vertical sectional view taken along the center line of a principal part of the control rod retention device shown in Fig. 2;
Fig. 3(B) is a cross sectional view showing a piezo-electric body;
Fig. 4 is a perspective view showing a cylindrical member of an embodiment of the present invention;
Fig. 5 is a cross sectional view showing a rotatable member of an embodiment of the present invention;
Fig. 6 is a cross sectional view showing a rod having a slit portion of an embodiment of the present invention;
Figs. 7(A), 7(B) and 7(C) are each side elevation views for illustrating behavior of an embodiment of the present invention;
Fig. 8 is a side elevation view for illustrating an embodiment of the present invention;
Fig. 9 is a cross sectional view for illustrating a prior-art embodiment; and
Fig. 10 is a partially sectional side elevation view for illustrating another prior-art embodiment.

Fig. 1 is a perspective view showing a principal part of embodiment of the present invention for illustrating engagement for retention of a control rod retention device with a control rod, Fig. 2 is a cross sectional view showing part of the control rod retention device, Fig. 3 (A) is a vertical sectional view taken along the center line of a principal part of the device shown in Fig. 2, and Fig. 3(B) is a cross sectional view showing a piezo-electric body. A cylindrical member 3 is attached to an upper end portion of the piezo-electric body 2 of the control rod retention device 1. Fig. 4 is a perspective view showing an example of the cylindrical member 3. As is shown in Fig. 4, the cylindrical member 3 is axially provided with a slot 30A, into which one end portion of the piezo-electric body 2 is inserted and fixed.

As is shown in Figs. 2 and 3, the cylindrical member 3 is retained in a groove 7 of an offsetter 6 secured to an offset plate 4 by means of bolts 5, and rotatable in the groove 7. The upper end portion of the piezo-electric body 2 is therefore movable as indicated by the arrows in Fig. 3. In Fig. 2, the numeral 8 designates a washer. Though not shown in the drawings, bolt holes are formed in the offset plate 4. By adjusting positions at which the bolts 5 are fastened, a position of the offsetter 6, in its turn a position of the upper end portion of the piezo-electric body 2 is adjusted, whereby the upper end portion of the piezo-electric body 2 can be adjusted to a suitable position.

As is shown in Figs. 2 and 3, a lower end portion of the piezo-electric body 2 is also fitted with a cylindrical member 8 similar to the above-mentioned cylindrical member 3, and the cylindrical member 8 is inserted for connection in an open end portion 90 of an upper end portion of a finger 9. As is shown in Fig. 3, the cylindrical member 8 is movable in the open end portion 90 of the finger 9.

The finger 9 is provided with a hole formed in the transverse direction of the finger on the side opposite to the open end portion 90. As is shown in Figs. 2 and 3, a pin 10 is inserted into the hole of the finger 9, thereby fixing the finger 9 to a frame 11. A face plate 12 is attached to a lower end of the frame 11 by means of a bolt 13. As is shown in Fig. 3, the strip-like finger 9 is connected to the rectangular piezo-electric body 2 in alignment (in the same direction). A lower end portion of the finger 9 is provided with a hook portion 91 which can be selectively brought into engagement with an end portion (upper end portion) of a control rod to retain it. Though not shown in the drawing, the lower end portion of the finger 9 may be provided with an aperture which can be selectively brought into engagement with the upper end portion of the control rod to retain it, in the place of the hook portion 91. The finger 9 is formed as short as possible in order to lighten it to expedite its operation. For a purpose similar to that described above, the finger 9 Is preferably provided with a through hole 92 as is shown in Figs. 2 and 3. When the finger 9 follows the bending movement of piezo-electric body 2 and the hook portion 91 thereof comes into engagement with an aperture 140 opened at the end portion (upper end portion) of the control rod 14 as is shown in Fig. 1, the control rod 14 is left lifted upward to prevent the control rod 14 from moving downward. On the other hand, when the hook portion 91 does not come into engagement with the aperture 140 opened at the upper end portion of the control rod 14, the control rod 14 is retained as it is. In the embodiment shown in Fig. 1, the aperture 140 is formed at the end portion (upper end portion) of the control rod 14. However, a hook portion may be formed instead of the aperture, and these may be used in combination. The lower end portion of the finger 9 is protruded from an opening opened at the face plate 12, as is shown in Fig. 2. The opening is formed so as to have such a size that

the finger 9 can perform the above-mentioned movement therethrough. A side wall surface of the opening of the face plate 12 serves as a stopper for the finger 9. The finger 9 is formed of, for example, a metal, similarly with a plate of the piezo-electric body 2 described below. The finger 9 is formed so as to be a long narrow strip-like thin plate having a thickness of, for example, about 1 mm, but is not required to be uniform in thickness. The lower end portion thereof may be formed thicker in a tapered shape in order to cushion the impact produced by collision with the control rod 14. The response speed of the finger 9 is increased with a decrease in thickness thereof. The finger 9 may be formed in a tapered shape from one end portion thereof to the other end portion thereof, whereby the finger 9 can be reduced in weight and more improved in response speed.

An intermediate portion between the one end portion (upper end portion) and the other end portion (lower end portion) is maintained by a rotatable member 16 rotatably mounted on a bracket 15. Fig. 5 is a cross sectional view showing an example of the rotatable member 16 used in this embodiment. The rotatable member 16 is provided with a through slot 160 having a size of such a degree that the piezo-electric body 2 can be inserted therein, as is shown in Fig. 5. The piezo-electric body 2 is inserted into the through slot 160 of the rotatable member 16, thereby fixing the piezo-electric body 2 to the rotatable member 16. Both ends of the rotatable member 16 are rotatably supported by means of screws inserted into holes formed in the bracket 15. The piezo-electric body 2 is securely fixed to an inner surface of the through slot 160 of the rotatable member 16 by molding or an adhesive. The rotatable member 16 is movable with the operation of the piezo-electric body 2 not to disturb the bending movement of the piezo-electric body 2. It is important where is the intermediate portion between the upper end portion and the lower end portion of the piezo-electric body 2 fixed to the rotatable member 16. The position at which the intermediate portion is fixed to the rotatable member 16 serves as a fulcrum of the bending movement of the piezo-electric body 2. As this position approaches the finger 9, the finger 9 is increased in speed, decreased in amplitude, increased in torque, and reduced in voltage. However, when this position approaches the finger 9 too near, the torque is reduced. On the other hand, when this position goes away from the finger 9, reverse phenomena take place. For example, the amplitude is increased and the torque is decreased. It is therefore necessary to select a suitable position, and such a construction that the position can be suitably selected is preferred. In the above-mentioned embodiment, the position is selected at an approximately intermediate portion between the upper end portion and the lower end portion of the piezo-electric body 2.

The piezo-electric body 2 used in the present invention comprises a plate 200 and a pair of piezo-electric elements (piezo-electric sheets) 210 attached to the plate 200, as is shown in Fig. 3(B). For the above-mentioned piezo-electric body 2, cavity (space) portions may be formed on the plate 200 to bond the piezo-electric elements 210 therein. Such formation of the cavity portions reduces the weight of the plate 200, which results in easy bending of the plate 200. Accordingly, when the voltage (pulse) is applied to the piezo-electric elements 210, the plate 200 can be bent at a low voltage. The piezo-electric elements 210 can be bonded to the plate 200, for example, by the use of an adhesive such as an epoxy adhesive. It is necessary to bond the two piezo-electric elements to the plate, arranging each positive electrode and each negative electrode thereof in the same direction. Any kind of piezo-electric element may be used as the piezo-electric element 210, as long as it has an inverse piezo-electric effect. However, ceramic piezo-electric elements formed of barium titanate or the like are preferably used, because the piezo-electric elements having stable qualities can be commercially provided in a large amount. The thinner the piezo-electric elements 210 are, the higher the electric field can be elevated. It is therefore preferred to use the piezo-electric elements having a thickness of about 100 to about 200 μm and formed in a shape elongated in the longitudinal direction of the plate 200. Paste for electrodes is baked on both faces of the piezo-electric element 210, and lead wires 230 are connected to the electrodes 220, respectively (see Fig. 7(A). The other ends of these lead wires 230 are provided with a connector 240. The above-mentioned plate 200 is formed of, for example, a metal.

In the example described above, the two piezo-electric elements 210 are bonded to the plate 200. However, a pair of piezo-electric elements may be directly bonded to each other without using a plate.

As is shown in Fig. 2, a connecting substrate 18 is joined to the offset plate 4 through an insulating plate 17, and connectors 19 and 20 are connected to the connecting substrate 18. The connector 19 is connected to the connector 240 elongated from the above-mentioned piezo-electric body 2, and a controller (not shown in the drawing) is connected to the connector 20. Pulses are applied from the controller to each piezo-electric element 210. The controller is a device for memorizing a pattern knitting procedure and applying pulses to a plurality of piezo-electric elements on the basis of the memorized pattern knitting procedure. A controller for an electromagnetic heald apparatus can be employed as such a device. Since the structure thereof is well known in the art, a further detailed description will be omitted. The piezo-electric body 2 is bent around the intermediate fulcrum provided with the rotatable member 16 on the basis of the pulses thus applied from the controller, and the finger 9 moves based on the pattern knitting procedure memorized in the controller.

Figs. 7(A) to 7(C) show further details of the operation of the control rod retention device and the control rod shown in Fig. 1. Fig. 7(A) shows a state in which the

hook portion 91 of the finger 9 is in meshing engagement with the aperture 140 of the control rod 14, Fig. 7(B) is a cross sectional view of Fig. 7(A), and Fig. 7(C) shows a state in which the engagement is released.

A lower end portion of the control rod 14 is provided with a hook portion 141, and the hook portion 141 is connected to a heald 63, though not shown in the drawings.

A large number of control rod retention devices 1 are arranged as is shown in Fig. 8. Each of the control rod retention devices 1 controls each of the control rods 14.

The control rod retention device 1 used in the warp control apparatus of the present invention is actuated by the piezo-electric system. When the voltage (pulse) is applied to the piezo-electric elements 210 of the piezo-electric body 2, the piezo-electric body 2 executes the bending movement. Since the finger 9 is connected to the piezo-electric body 2, the finger 9 is moved following the bending movement of the piezo-electric body 2. The finger 9 is provided with the hook portion 91 or the aperture, so that the finger 9 is brought into engagement with the control rod 14 similarly provided with the aperture 140 or the hook portion. When the voltage (pulse) is not applied to the piezo-electric elements of the piezo-electric body, the finger 9 is not brought into engagement with the control rod 14 to keep them apart. In this manner, the finger 9 can be selectively brought into engagement with the control rod 14 to retain it. The control rod is operatively associated with the heald to control the heald, thereby controlling the warp yarn.

Thus, according to the heald apparatus using the piezo-electric system, high cycle pulses can be applied to the piezo-electric elements thereof because of their high response speed, and the heald operation can be carried out at a rotation speed at least twice that of the conventional apparatus using electromagnets.

Further, the piezo-electric body 2 used in the present invention is made up of the thin plate 200 and the piezo-electric elements 210. The size of the apparatus itself can therefore be more reduced, compared with the conventional apparatus having solenoids utilizing electromagnets.

Furthermore, the conventional apparatus utilizing electromagnets is very low in power consumption efficiency. The power is almost dissipated as heat, and the power consumption becomes large. In contrast, the heald apparatus of the present invention according to the piezo-electric system scarcely produces heat, and is markedly reduced in power consumption.

On the other hand, for the piezo-electric body 2 used in the present invention, the upper end portion thereof is movably supported in a groove 7 of the offsetter 6, the lower end portion thereof is movably connected to the finger 9, and the intermediate portion between the upper end portion and the lower end portion of the piezo-electric body 2 is inserted in the rotatable member 16 rotatably mounted on the retention device. Thus, the upper end portion and the lower end portion of the piezo-electric body 2 are movable following the bending movement of the piezo-electric body 2 so as not to disturb the bending movement. Also with respect to the intermediate portion between the upper end portion and the lower end portion of the piezo-electric body 2, the rotatable member 16 is rotated so as not to disturb the bending movement. Further, the intermediate portion of the piezo-electric body 2 is supported by the rotatable member 16 so as to have the intermediate fulcrum. Accordingly, the speed of the heald operation can be more improved, the lifetime of the piezo-electric body can be prolonged, and the applied voltage can be more reduced.

Furthermore, in the present invention, the finger 9 is connected to the rectangular piezo-electric body 2 in alignment (in the same direction). In this respect, it is considered to attach the finger 9 perpendicularly to the piezo-electric body 2 made up of the plate and the piezo-electric elements. In this case, however, the width of the piezo-electric body 2 becomes wide, which results in enlargement of the apparatus in size. The heald rod retention devices 1 are arranged in large numbers, as is described in Japanese Patent Unexamined Publication No. 59-199833/1984, so that it is important to miniaturize the devices. In the above-mentioned apparatus, it is also considered to attach the upper end portion of the finger 9 to the surface of the piezo-electric element 210 bonded to the plate 200. In this case, however, the finger 9 is overlapped on the piezo-electric body 2 comprising the plate 200 and the piezo-electric elements bonded thereto, which also results in enlargement of the apparatus in size. Moreover, if the finger 9 is attached to the surface of the piezo-electric element 210 in this manner, the load of the finger 9 is easily applied to the piezo-electric element 210, and when the voltage is applied to the piezo-electric element 210 to execute the bending movement, the bending movement is disturbed. This also produces the danger of destroying the piezo-electric element 210 at the position to which the finger 9 is attached, when the apparatus is used for a long period of time.

In the course of the study for the piezo-electric body 2 which can easily execute the bending movement, the present inventor accidentally pressed the surface of the piezo-electric element 210, and discovered that the operation speed of the finger 9 was significantly improved and the torque of a tip of the finger 9 was increased thereby. Based on such information, the piezo-electric body 2 was made to execute the bending movement as easily as possible, and the operation speed of the finger 9 could be significantly improved by inserting the intermediate portion between the upper end portion and the lower end portion of the piezo-electric body 2 into the rotatable member 16 rotatably mounted on the bracket 15 to form the intermediate fulcrum.

A rod 3B having a slit portion 30B as shown in Fig. 6 may be used in the place of the cylindrical member 3A. The cylindrical member 8 may be replaced in a similar manner. In the embodiment described above, the in-

termediate portion between the upper end portion and the lower end portion of the piezo-electric body 2 is supported by the rotatable member 16 rotatably mounted on the bracket 15 so as to have the intermediate fulcrum. However, the intermediate portion between the upper end portion and the lower end portion of the piezo-electric body 2 may be securely fitted to an upper surface and/or a lower surface of the rotatable member 16.

Claims

1. A warp control apparatus for a loom having a control rod retention device (11, 15) for selective engagement and retention of an end portion of a reciprocating control rod (14), whereby said control rod retention device comprises a substantially vertical finger (9) provided with a hook portion (91) or an aperture which can be selectively brought into engagement with the end portion of said control rod (14) to retain it and a piezo-electric body (2) having a piezo-electric element, the lower end portion (8) of said piezo-electric body (2) is movably connected to said finger (9), characterised in that the upper end portion (3A) of said piezo-electric body (2) is movably supported on said control rod retention device by an adjustable offsetter (6) and an intermediate portion between the upper end portion (3A) of said piezo-electric body (2) and the lower end portion (8) thereof is fixed to a rotatable member (16) rotatably mounted on said control rod retention device (15).

2. A warp control apparatus for a loom according to claim 1, in which a cylindrical member (3A) is attached to the one end portion of said piezo-electric body (2) and recessed in a groove of an offsetter (6) to movably support the one end portion of said piezo-electric body (2) on said control rod retention device (4).

3. A warp control apparatus for a loom according to claim 2, in which a cylindrical member (8) is attached to the other end portion of said piezo-electric body (2) and inserted into an end portion (90) opposite to the hook portion (91) or the aperture of said finger (9) to movably connect the other end portion of said piezo-electric body (2) to said finger (9).

Patentansprüche

1. Kettfadensteuervorrichtung für eine Webmaschine, mit einer mit einem Einhakelement arbeitenden Einlesevorrichtung (11,15) für ein wahlweises Eingreifen und Zurückhalten eines Endteiles eines hin- und hergehenden Einhakelementes (14), wobei die mit Einhakelement arbeitende Einlesevorrichtung einen im wesentlichen vertikalen Finger (9) aufweist, der mit einem Hakenteil (91) oder mit einer Durchbrechung versehen ist, der bzw. die wahlweise in Eingriff mit dem Endteil des Einhakelementes (14) bringbar ist um es zurückzuhalten, und mit einem piezo-elektrischen Körper (2), der mit einem piezo-elektrischen Element versehen ist, wobei der untere Endabschnitt (8) des piezo-elektrischen Körpers (2) mit dem Finger (9) beweglich verbunden ist, dadurch gekennzeichnet, dass der obere Endabschnitt (3A) des piezo-elektrischen Körpers (2) mittels einer einstellbaren Versetzeinrichtung (6) an der Einlesevorrichtung beweglich angeordnet ist, und dass ein zwischen dem oberen Endabschnitt (3A) und dem unteren Endabschnitt (8) des piezo-elektrischen Körpers (2) liegender Zwischenabschnitt in einem drehbaren Element (16) befestigt ist, das drehbar in der Einlesevorrichtung (15) gelagert ist.

2. Kettfadensteuervorrichtung nach Anspruch 1, dadurch gekennzeichnet, dass sich am einen Endabschnitt des piezo-elektrischen Körpers (2) ein zylindrisches Organ (3A) befindet, das in einer Rinne der Versetzeinrichtung (6) eingelassen ist, um diesen einen Endabschnitt des piezo-elektrischen Körpers (2) an der Einlesevorrichtung (4) beweglich zu halten.

3. Kettfadensteuervorrichtung nach Anspruch 2, dadurch gekennzeichnet, dass sich am anderen Endabschnitt des piezo-elektrischen Körpers (2) ein zylindrischer Teil (8) befindet, der in einem Endteil (90) eingesetzt ist, der dem Hakenteil (91) oder der Durchbrechung des Fingers (9) abgewandt liegt, um den anderen Endabschnitt des piezo-elektrischen Körpers (2) beweglich mit dem Finger (9) zu verbinden.

Revendications

1. Appareil de commande de chaîne pour un métier à tisser présentant un dispositif (11, 15) de retenue de barre de commande, pour venir en prise avec, et retenir sélectivement une partie d'extrémité d'une barre de commande (14) se déplaçant en va-et-vient, dans lequel ledit dispositif de retenue de barre de commande comprend un doigt (9) essentiellement vertical doté d'une partie en crochet (91) ou d'une ouverture qui peut être amenée sélectivement en prise avec la partie d'extrémité de ladite barre de commande (14) pour la retenir, et un corps piézoélectrique (2) présentant un élément piézoélectrique, la partie (8) d'extrémité inférieure dudit corps piézoélectrique (2) étant reliée de manière mobile audit doigt (9), caractérisé en ce qu'une partie (3A) d'extrémité supérieure dudit corps piézoélectrique (2) est soutenue de manière mobile sur le

dispositif de retenue de barre de commande par un élément de décalage (6) ajustable, et une partie intermédiaire entre la partie (3A) d'extrémité supérieure dudit corps piézoélectrique (2) et la partie (8) d'extrémité inférieure de celui-ci est fixée sur un élément rotatif (6) monté à rotation sur ledit dispositif (15) de retenue de barre de commande.

2. Appareil de commande de chaîne pour un métier à tisser selon la revendication 1, dans lequel un élément cylindrique (3A) est attaché à une partie d'extrémité dudit corps piézoélectrique (2) et est reçu dans une rainure d'un élément de décalage (6), en vue de soutenir de manière mobile la partie d'extrémité dudit corps piézoélectrique (2) sur ledit dispositif (4) de retenue de barre de commande.

3. Appareil de commande de chaîne pour un métier à tisser selon la revendication 2, dans lequel un élément cylindrique (8) est attaché à l'autre partie d'extrémité dudit corps piézoélectrique (2) et est inséré dans une partie d'extrémité (90) située à l'opposé de la partie en crochet (91) ou à l'ouverture dudit doigt (9), pour relier de manière mobile l'autre partie d'extrémité dudit corps piézoélectrique (2) audit doigt (9).

FIG. 1

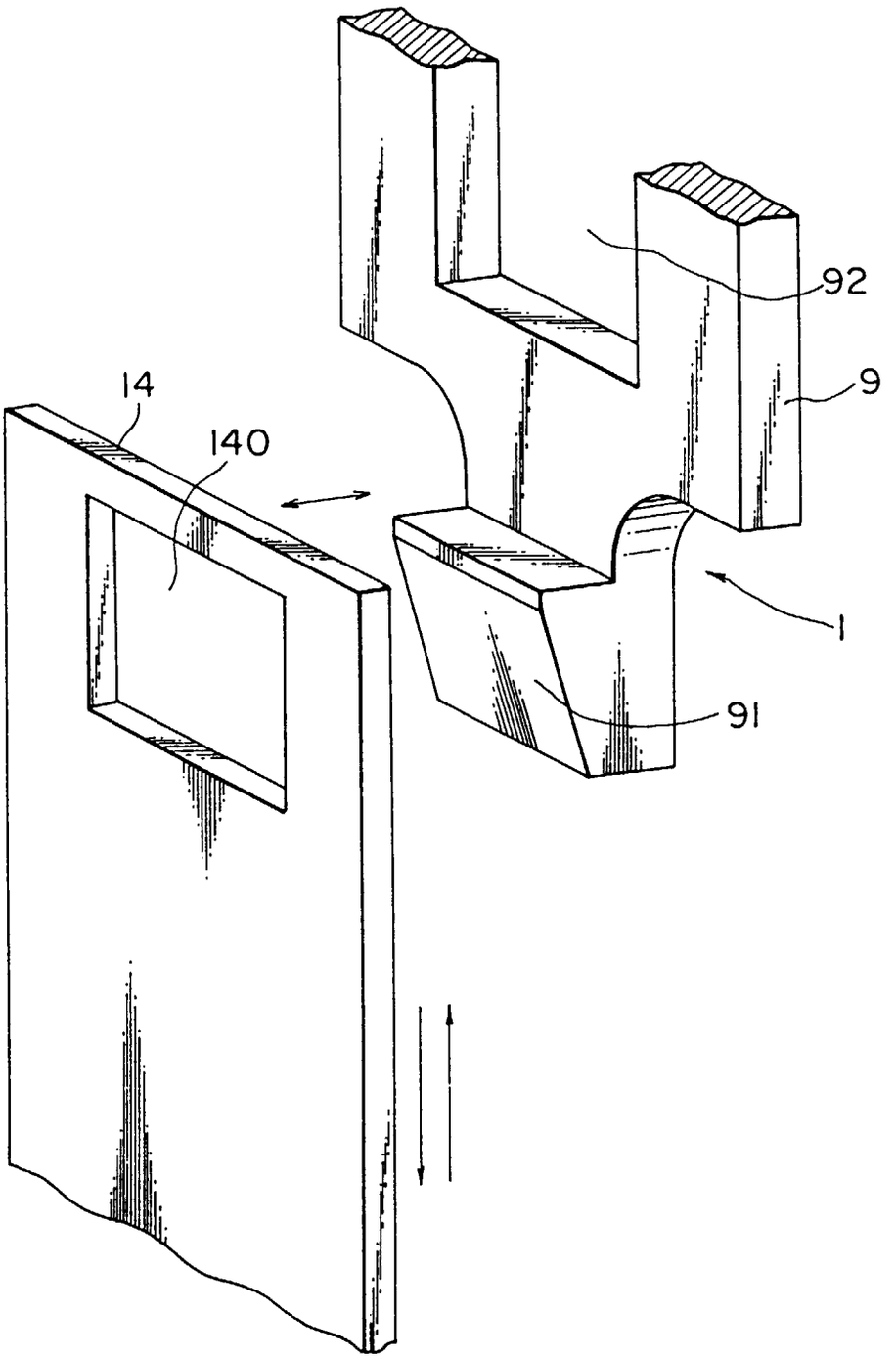

FIG. 2

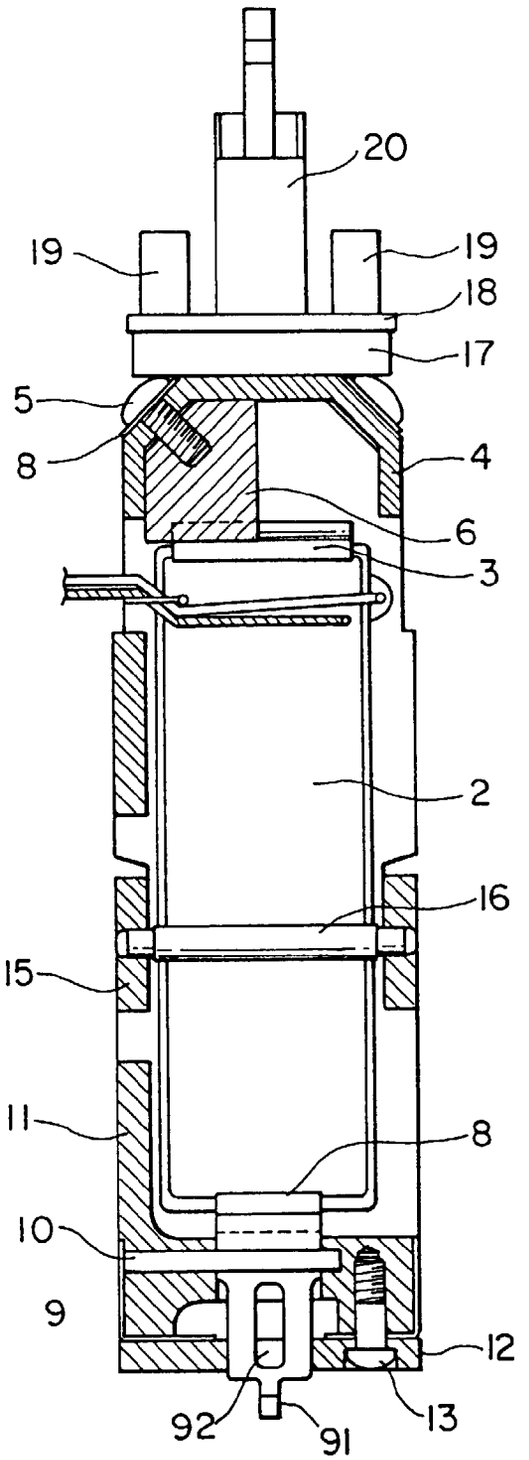

FIG.3(A)

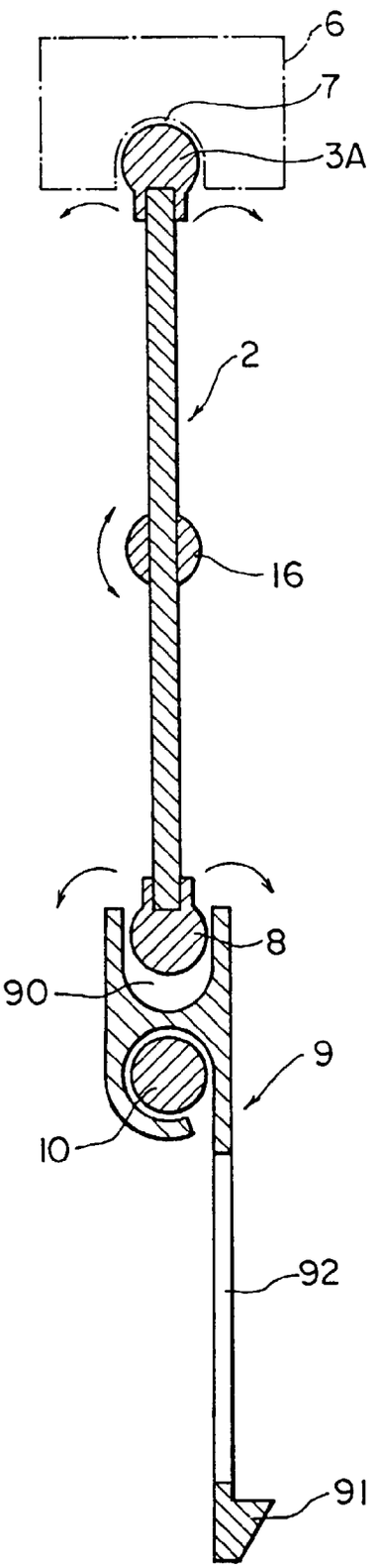

FIG.3(B)

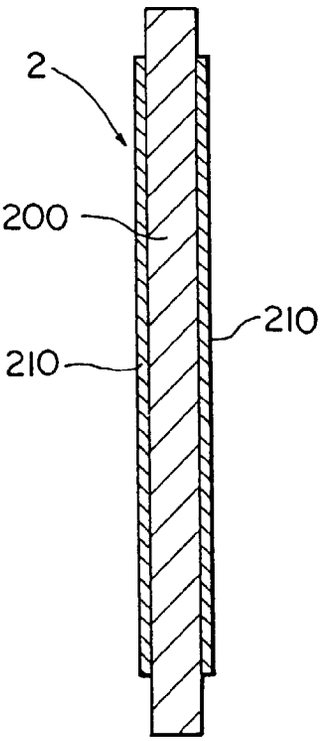

FIG.4

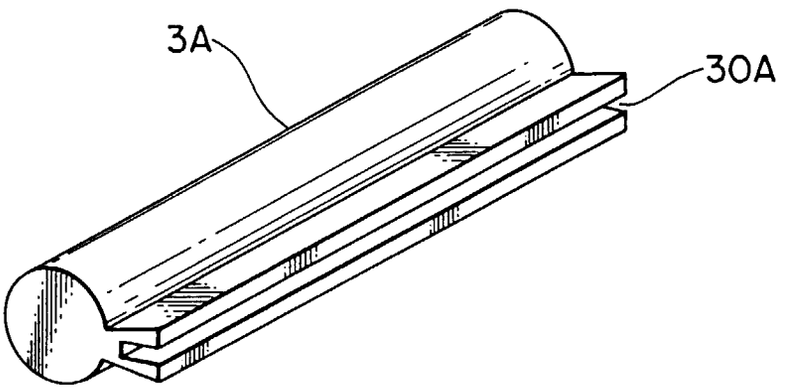

FIG.5

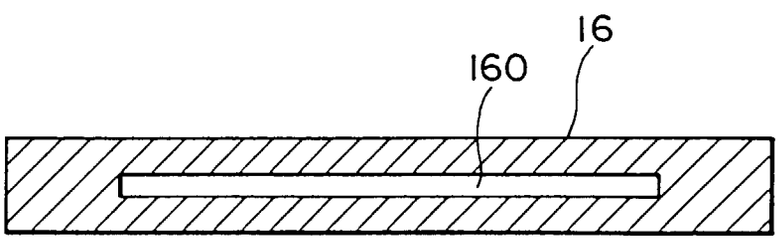

FIG. 6

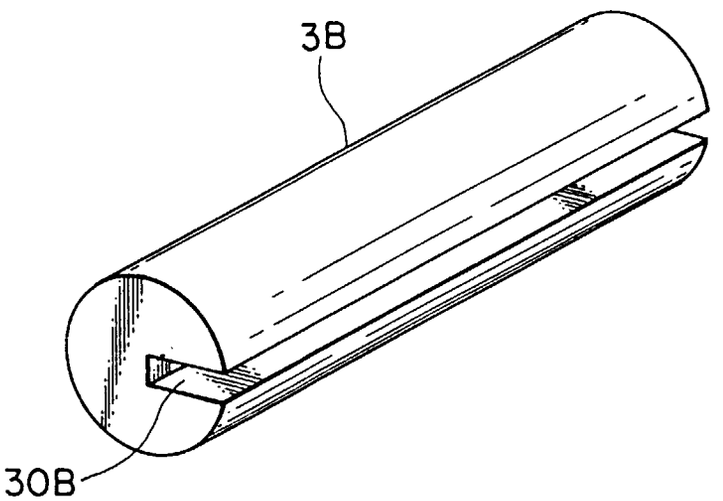

FIG. 7(A)

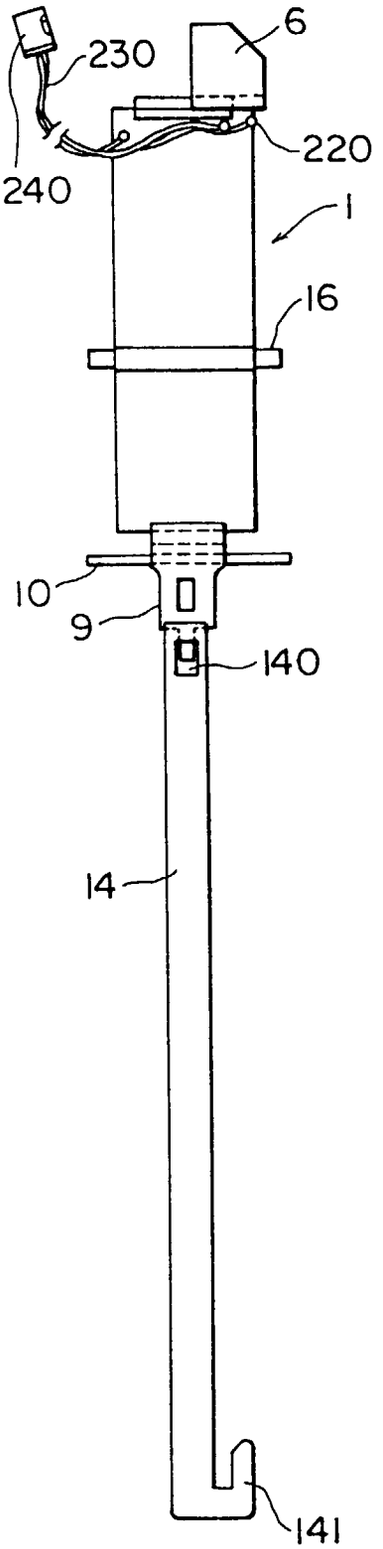

FIG. 7(B)

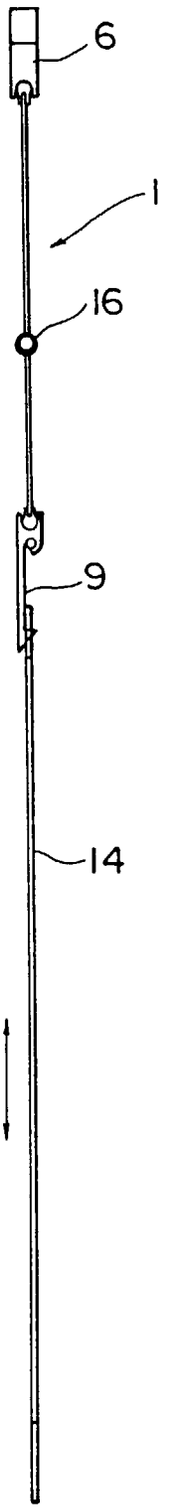

FIG. 7(C)

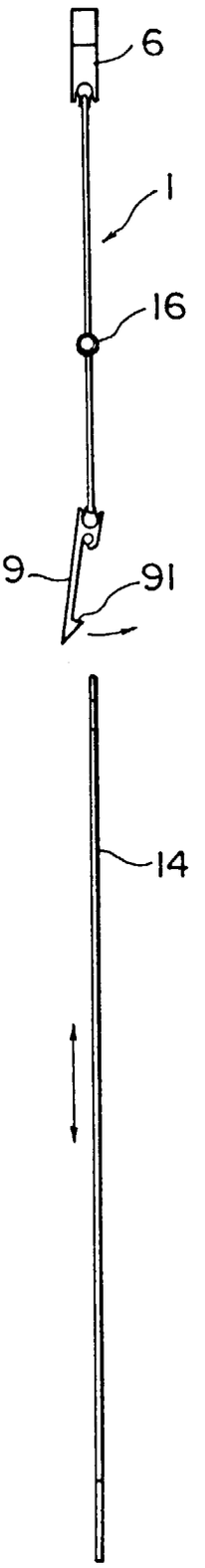

FIG. 8

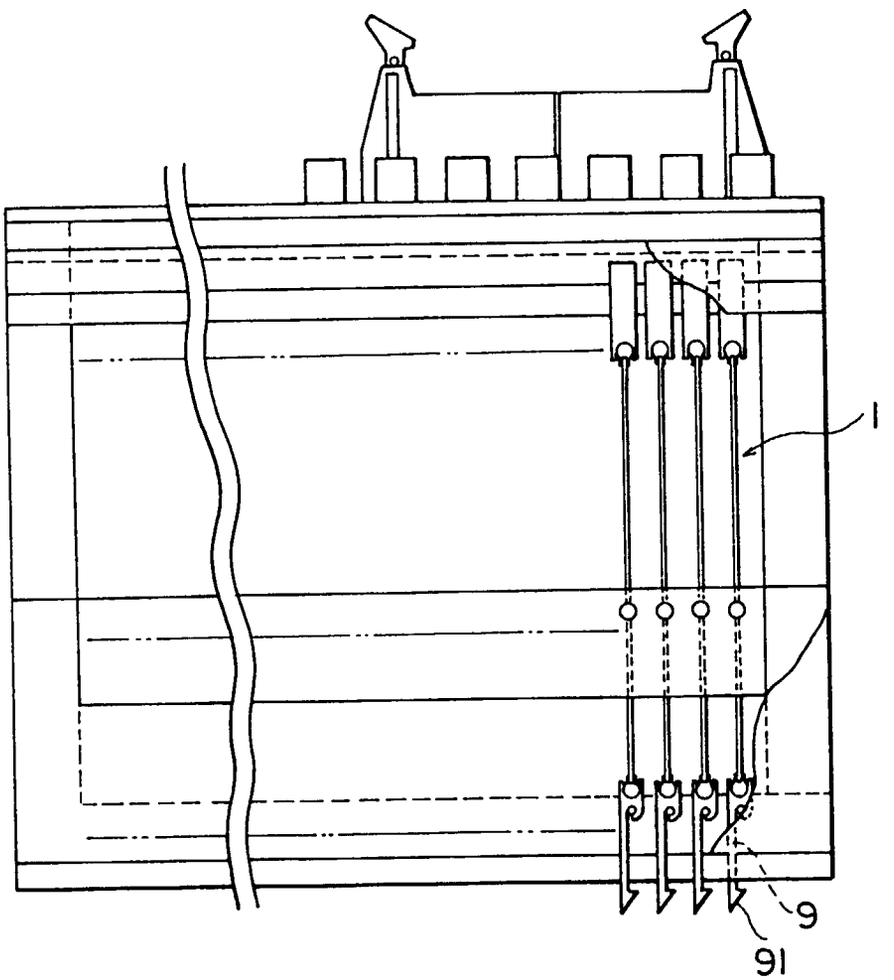

FIG.9

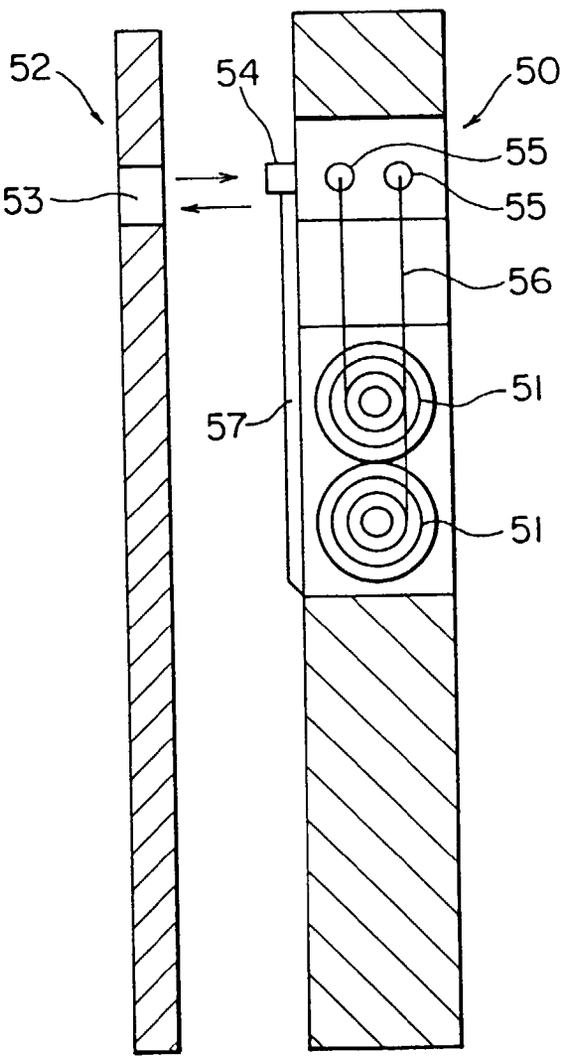

FIG. 10