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(54) **Selvage forming device for loom**

(57) Power transmission teeth (181) of a wheel (18) caused to make reciprocal rotation by an electric motor (17) are in mesh with power receiving holes (231) and (241) of a first band (23) and a second band (24). The position where the first band (23) is in mesh with the wheel (18) is regulated by a first position regulating member (19), and the position where the second band (24) is in mesh with the wheel (18) is regulated by a second position regulating member (20). The bands (23) and (24) are partially inserted into guide grooves (221) and (222) of a guide rail (22). The band (23) supports a first selvage heddle (11) through the intermediation of clasping arms (25) and (26), and the band (24) supports a second selvage heddle (12) through the intermediation of clasping arms (27) and (28).

FIG. 2A

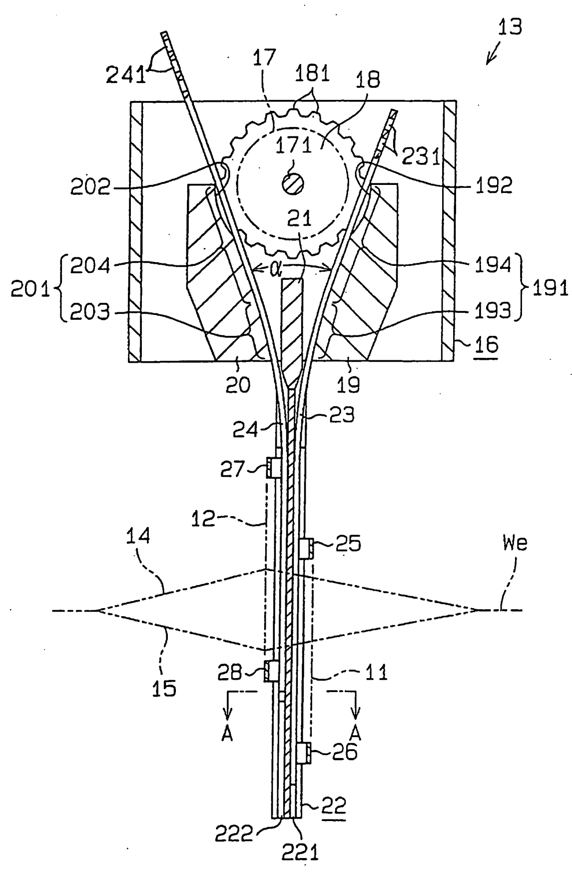


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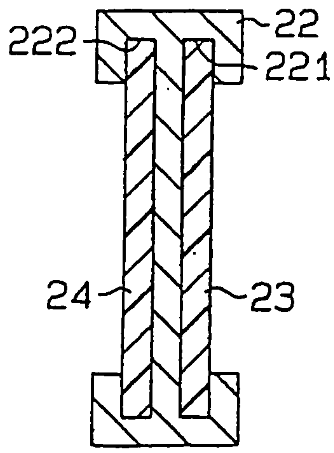
FIG. 2B



## Description

### BACKGROUND OF THE INVENTION

1. Field of the Invention

**[0001]** The present invention relates to a selvage forming device for a loom adapted to form a selvage based on the operation of a first selvage heddle and a second selvage heddle reciprocating in opposite directions.

2. Description of the Related Art

**[0002]** JP 10-503563 A, for example, discloses a selvage forming device adapted to form a selvage based on the operation of a first selvage heddle and a second selvage heddle that reciprocate in opposite directions. In the selvage forming device as disclosed in the above-mentioned publication, a two-dimensional crank mechanism is driven by an electric motor, and a pair of yarn guide elements are caused to make linear reciprocal motion through the driving of the two-dimensional crank mechanism. The two-dimensional crank mechanism is composed of a lever mounted to an output shaft of the electric motor and a pair of links connected to the ends of the lever. The pair of links are connected to the pair of yarn guide elements through one-to-one connection.

**[0003]** The larger the opening amount of a selvage, the more smoothly can weft picking be performed. When, in the device disclosed in JP 10-503563 A, an attempt is to be made to increase the maximum selvage opening amount, it is necessary to increase the rotational radius of the lever (that is, the distance from the rotation center axis of the lever to the position where the lever and the links are connected together). When the rotational radius of the lever is increased, the requisite torque for rotating the lever increases, resulting in an increase in the load on the electric motor. This makes it difficult to operate the electric motor at high speed, thereby constituting an obstruction to realizing a loom of higher speed.

### SUMMARY OF THE INVENTION

**[0004]** An object of the present invention is to provide a selvage forming device capable of enlarging the selvage opening amount without hindering an increase in loom operation speed.

**[0005]** To attain the above object, according to the present invention, there is provided a selvage forming device for a loom adapted to form a selvage based on operations of a first selvage heddle and a second selvage heddle reciprocating in opposite directions, the device including: a first band supporting the first selvage heddle and equipped with a plurality of power receiving holes arranged in a row, the first band being capable of deflection; a second band supporting the second selvage heddle and equipped with a plurality of power receiving holes arranged in a row, the second band being capable of deflection; and a wheel equipped with a plurality of power transmission teeth respectively brought into mesh-engagement with the power receiving holes of the first and second bands, in which the first band and the second band are opposed to each other in a deflected state, with the wheel therebetween, so as to bring the power receiving holes of the first and second bands into mesh-engagement with the power transmission teeth.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0006]** In the accompanying drawings:

Fig. 1 is a side sectional view of a first embodiment of the present invention;
Fig. 2a is a side sectional view as seen from the opposite side of Fig. 1, and Fig. 2b is a sectional view taken along the line A-A of Fig. 2a;
Fig. 3 is a front sectional view of the first embodiment of the present invention;
Fig. 4 is a rear sectional view of the same;
Fig. 5 is a front sectional view of the same;
Fig. 6 is a side sectional view of a third embodiment of the present invention;
Fig. 7 is a front sectional view of the same;
Figs. 8a and 8b are main-portion side sectional views of the third embodiment of the present invention; and
Figs. 9 and 10 are graphs showing positional changes in a selvage heddle.

### DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0007]** A selvage formation opening device according to a first embodiment of the present invention will now be described with reference to Figs. 1 through 4.

**[0008]** As shown in Figs. 1 and 2, a first selvage heddle 11 and a second selvage heddle 12 are moved vertically in opposite directions by a reciprocating drive mechanism 13. The movement paths for the first selvage heddle 11 and the second selvage heddle 12 are vertically extending reciprocation paths parallel to each other. Selvage yarn 14 passed through the first selvage heddle 11 and selvage yarn 15 passed through the second selvage heddle 12 form a selvage We with picked weft (not shown) therebetween.

**[0009]** As shown in Figs. 3 and 4, an electric motor 17 is attached to an inner wall 161 of a box 16 constituting the reciprocating drive mechanism 13. The upper and lower portions of the box 16 are open. An output shaft 171 of the electric motor 17 extends through the inner wall 161 and protrudes into the box 16. The axial direction of the output shaft 171 substantially'coincides with the weft picking direction. The protruding end portion of the output shaft 171 is rotatably supported by an outer wall 162 of the box 16. In the box 16, a wheel 18 is immovably mounted to the output shaft 171. In the outer periphery of the wheel 18, there are provided a plurality of power transmission teeth 181 (see Fig.2).

**[0010]** As shown in Figs. 1 and 2, immovably mounted to the inner surface of the outer wall 162 of the box 16 are a first position regulating member 19 and a second position regulating member 20. The first position regulating member 19 and the second position regulating member 20 are opposed to each other with the wheel 18 therebetween. A mounting member 21 is immovably mounted to the inner surface of the outer wall 162 of the box 16. The mounting member 21 is arranged between the first position regulating member 19 and the second position regulating member 20. The mounting member 21 is spaced apart from opposing surfaces 191 and 201 of the first position regulating member 19 and the second position regulating member 20.

**[0011]** The opposing surfaces 191 and 201 consist of guide curved surfaces 193 and 203 convex toward the wheel 18 and guide plane surfaces 194 and 204 smoothly continuous to the guide curved surfaces 193 and 203. The opposing surfaces 191 and 201 are convex toward the wheel 18 and opposed to each other. The guide plane surfaces 194 and 204 are opposed to each other with the wheel 18 therebetween so as to be diverged upwardly, and the guide curved surfaces 193 and 203 are opposed to each other with mounting member 21 therebetween so as to be diverged upwardly. The guide plane surfaces 194 and 204 form an angle $\alpha$. In this embodiment, the guide curved surfaces 193 and 203 are arcuate curved surfaces.

**[0012]** A guide rail 22 is immovably mounted to the mounting member 21 so as to extend vertically downwards. As shown in Fig. 2(b), a pair of guide grooves 221 and 222 are formed back to back in the guide rail 22. The guide grooves 221 and 222 are arranged adjacent to each other so as to extend parallel to the reciprocating movement paths of the first selvage heddle 11 and the second selvage heddle 12. The guide groove 221 is exposed on the front side of the loom (In Figs. 1 and 2, the right-hand side corresponds to the front side of the loom, and the left-hand side corresponds to the rear side of the loom), and the guide groove 222 is exposed on the rear side of the loom.

**[0013]** A part of a first band 23 which is capable of deflection is slidably inserted into the guide groove 221, and a part of a second band 24 which is capable of deflection is slidably inserted into the guide groove 222. That is, the portions of the first band 23 and the second band 24 in the guide grooves 221 and 222 are adjacent to each other so as to reciprocate parallel to the reciprocating paths of the first selvage heddle 11 and the second selvage heddle 12. The first band 23 and the second band 24 are formed of fiber-reinforced plastic reinforced by carbon fiber.

**[0014]** The first band 23 extends, while deflected, upwardly through the gap between the mounting member 21 and the opposing surface 191 of the first position regulating member 19. The second band 24 extends, while deflected, upwardly through the gap between the mounting member 21 and the opposing surface 201 of the second position regulating member 20. Further, the first band 23 extends upwardly between the wheel 18 and the opposing surface 191 of the first position regulating member 19, and the second band 24 extends upwardly between the wheel 18 and the opposing surface 201 of the second position regulating member 20.

**[0015]** A plurality of power receiving holes 231 and 241 are provided in rows in the first band 23 and the second band 24. The power receiving holes 231 and 241 are in mesh with the power transmission teeth 181. That is, the first band 23 and the second band 24 are opposed to each other in a deflected state, with the wheel 18 therebetween, so as to keep the power receiving holes 231 and 241 of the first band 23 and the second band 24 in mesh with the power transmission teeth 181.

**[0016]** At the position where the power transmission holes 231 of the first band 23 and the power transmission teeth 181 are in mesh with each other, there is formed a clearance groove 192 in the opposing surface 191 (the guide plane surface 194) of the first position regulating member 19. At the position where the power transmission holes 241 of the second band 24 and the power transmission teeth 181 are in mesh with each other, there is formed a clearance groove 202 in the opposing surface 201 (the guide plane surface 204) of the second position regulating member 20. The power transmission teeth 181 in mesh with the power receiving holes 231 of the first band 23 are in the clearance groove 192, and the power transmission teeth 181 in mesh with the power receiving holes 241 of the second band 24 are in the clearance groove 202, whereby there is no fear of the first position regulating member 19 and the second position regulating member 20 interfering with the power transmission teeth 181.

**[0017]** In the following, the positions where the power receiving holes 231 and 241 are in mesh with the power transmission teeth 181 will also be referred to as the in-mesh positions of the bands 23 and 24 and the wheel 18.

**[0018]** A pair of clasping arms 25 and 26 are immovably mounted to the first band 23, and a pair of clasping arms 27 and 28 are immovably mounted to the second band 24. The first selvage heddle 11 is clasp-supported by the pair of clasping arms 25 and 26 as connecting members, and the second selvage heddle 12 is clasp-supported by the pair of clasping arms 27 and 28 as connecting members. That is, the first band 23 supports the first selvage heddle 11, and the second band 24 supports the second selvage heddle 12.

**[0019]** Next, the operation of the first embodiment will be described.

**[0020]** The output shaft 171 of the electric motor 17 makes reciprocal rotation, causing the wheel 18 to make reciprocal rotation. The reciprocal rotation of the wheel 18 is transmitted to the first band 23 and the second band 24 through the meshing engagement of the power transmission teeth 181 with the power receiving holes 231 and 241, whereby the first band 23 and the second band 24 move vertically in the guide grooves 221 and 222 in opposite directions. The first band 2 3 reciprocates while in slide contact with the opposing surface 191 as a guide surface (the guide curved surface 193 and the guide plane surface 194), and the second band 24 reciprocates while in slide contact with the opposing surface 201 as a guide surface (the guide curved surface 203 and the guide plane surface 204). That is, the first position regulating member 19 is in contact with the first band 23 so as to regulate the in-mesh position of the first band 23 and the wheel 18, and the second position regulating member 20 is in contact with the second band 24 so as to regulate the in-mesh position of the second band 24 and the wheel 18.

**[0021]** When the first band 23 and the second band 24 move vertically in the guide grooves 221 and 222 in opposite directions, the first selvage heddle 11 and the second selvage heddle 12 are moved vertically in opposite directions. Thus, the selvage yarn 14 (see Fig. 1) passed through the first selvage heddle 11 and the selvage yarn 15 (see Fig. 1) passed through the second selvage heddle 12 form the selvage We (see Fig. 1) with the picked weft (not shown) therebetween.

**[0022]** The guide rail 22 constitutes a third position regulating member having the pair of guide grooves 221 and 222 guiding parallel to each other. The first position regulating member 19, the second position regulating member 20, and the guide rail 22 constitute a guide means for guiding the first band 23 and the second band 24. This guide means brings the first band 23 and the second band 24 closer to each other as the first band 23 and the second band 24 are departed away from the in-mesh positions of the power transmission teeth 181 and the power receiving holes 231 and 241. Next, the guide means guides the first and second bands 23 and 24 such that a part of the first band 23 and a part of the second band 24 extend parallel to each other.

**[0023]** The first embodiment provides the following advantages:

(1-1) When the wheel 18 is caused to make reciprocal rotation, the first band 23 and the second band 24 reciprocate in a deflected state in opposite directions, and the first selvage heddle 11 and the second selvage heddle 12 reciprocate in opposite directions. The maximum selvage yarn opening amount can be appropriately increased by increasing the one-way rotating amount of the wheel 18 caused to make reciprocal rotation. The term "one-way rotating amount of the wheel 18" refers to the requisite rotating amount of the wheel 18 for causing the selvage heddles 11 and 12 to move one going or returning stroke. The requisite torque for rotating the wheel 18 can be reduced by reducing the radius of the wheel 18. Further, the bands 23 and 24 capable of deflection and in mesh with the wheel 18 can be reduced in weight by reducing their thickness. The adoption of lightweight bands 23 and 24 is effective in reducing the requisite torque for rotating the wheel 18.

(1-2) In the state in which the power transmission teeth 181 of the wheel 18 are in the clearance grooves 192 and 202, the power transmission teeth 181 are in mesh with the power receiving holes 231 and 241 of the bands 23 and 24. In this state, there is no fear of the power transmission teeth 181 being detached from the power receiving holes 231 and 241. The first position regulating member 19 equipped with the clearance groove 192 makes the meshing engagement between the first band 23 and the wheel 18 reliable, and the second position regulating member 20 equipped with the clearance groove 202 makes the meshing engagement between the second band 24 and the wheel 18 reliable.

(1-3) The first band 23 and the second band 24 are brought closer to each other as they are departed from the positions where they are in mesh with the wheel 18 toward the selvage heddles 11 and 12, and then they are guided so as to extend parallel to each other. The deflected portions of the first and second bands 23 and 24 are brought into sliding contact with the guide curve surfaces 193 and 203, and the portions of the first and second bands 23 and 24 in sliding contact with the guide plane surfaces 194 and 204 at angle $\alpha$ are linear. That is, the first and second bands 23 and 24 undergo deflection in the paths from the positions where they are in mesh with the wheel 18 to the guide grooves 221 and 222.

The configuration of the deflected portions of the first and second bands 23 and 24 from the positions where they are in mesh with the wheel 18 to the guide grooves 221 and 222 can be adjusted to a proper configuration through appropriate selection of the angle $\alpha$. Here, the proper configuration refers to a deflected configuration to diminish the sliding resistance between the position regulating members 19 and 20 and the bands 23 and 24 and the sliding resistance between the guide rail 22 and the bands 23 and 24.

(1-4) The configuration of the deflected portions of the first and second bands 23 and 24 from the positions where they are in mesh with the wheel 18 to the guide grooves 221 and 222 can be modified to some degree by changing the radius of curvature of the guide curved surfaces 193 and 203 that are arcuate surfaces. The guide curved surfaces 193 and 203 contribute to adjusting to a proper configuration of the deflected portions of the first and second bands 23 and 24 from the positions where they are in mesh with the wheel 18 to the guide grooves 221 and 222. Arcuate surfaces that are easy to machine are suitable as the guide curved surfaces 193 and 203.

(1-5) The configuration of the portions of the bands 23 and 24 upwardly diverging from the positions where they are in mesh with the wheel 18 is linear. This linear configuration is effective in diminishing the sliding resistance between the position regulating members 19 and 20 and the bands 23 and 24 and the sliding contact between the guide rail 22 and the bands 23 and 24.

(1-6) Generally speaking, the selvage heddles 11 and 12 are arranged in a space formed by removing the heddle frame for opening formation in warp for forming woven cloth which is on the front side of the loom, or are arranged at the rearmost side of the heddle frames. In the case in which the selvage heddles 11 and 12 are arranged in front of the heddle frame, the larger the distance between the arrangement position of the clasping arms 25 and 26 and the arrangement position of the clasping arms 27 and 28 in the longitudinal direction of the loom, the farther away toward the rear side of the loom is the position of the rearmost selvage heddle frame. Thus, the vertical stroke amount of the rearmost selvage heddle frame increases, which is disadvantageous in driving the selvage heddles. Further, when the selvage heddles 11 and 12 are arranged at the rearmost of the heddle frames, it is necessary to enlarge the opening amount of the selvage heddles 11 and 12, which disadvantageously requires a motor of large torque.

The fiber reinforced plastic bands 23 and 24 reinforced by carbon fiber undergo deflection, whereby it is possible to diminish the distance between the portions of the bands 23 and 24 parallel to each other (i.e., the portions thereof in the guide grooves 221 and 222 of the guide rail 22). Thus, it is possible to diminish the distance between the arrangement position of the clasping arms 25 and 26 and the arrangement position of the clasping arms 27 and 28 in the longitudinal direction of the loom. This contributes to diminishing the stroke amount of the rearmost selvage heddle frame.

(1-7) The first band 23 is in sliding contact with the first position regulating member 19 formed of metal and the guide rail 22 formed of metal, and the second band 24 is in sliding contact with the second position regulating member 20 formed of metal and the guide rail 22 formed of metal. The sliding resistance between the fiber reinforced plastic reinforced by carbon fiber and metal is small. The fiber reinforced plastic reinforced by carbon fiber is suitable as the material of the bands 23 and 24 capable of deflection.

(1-8) The electric motor 17 capable of being adapted to various selvage textures independently of the loom driving motor (not shown) is suitable as the drive source for causing the wheel 18 to make reciprocal rotation.

**[0024]** Next, a second embodiment of the present invention shown in Fig. 5 will be described. The components that are the same as those of the first embodiment are indicated by the same reference numerals.

**[0025]** In a reciprocating drive mechanism 13A according to the second embodiment, the electric motor 17 is attached to the box 16 through the intermediation of an auxiliary plate 32. A driving gear 29 is immovably mounted to the output shaft 171 of the electric motor 17. Rotatably supported by the inner wall 161 and the outer wall 162 of the box 16 is a support shaft 30, to which the wheel 18 and a driven gear 31 are immovably mounted. The driving gear 29 is in mesh with the driven gear 31, and the reciprocal rotation of the output shaft 171 is transmitted to the support shaft 30 through the meshing engagement between the driving gear 29 and the driven gear 31, whereby the support shaft 30 and the wheel 18 integrally make reciprocal rotation. Otherwise, this embodiment is of the same construction as the first embodiment.

**[0026]** By appropriately selecting the gear ratio between the driving gear 29 and the driven gear 31, it is possible to form a speed increasing mechanism, a speed reduction mechanism, etc. This construction is advantageous in that the speed increasing ratio, the speed reduction ratio, etc. can be selected according to the torque characteristics of the electric motor 17.

**[0027]** Next, a third embodiment of the present invention shown in Fig. 6 to Fig.10 will be described. The components that are the same as those of the first embodiment and second embodiment are indicated by the same reference numerals.

**[0028]** As shown in Fig. 6, the first selvage heddle 11 and the second selvage heddle 12 are caused to move in opposite directions by a reciprocating drive mechanism 33. As shown in Fig. 7, in a box 34 constituting the reciprocating drive mechanism 33, a base frame 35 is supported so as to be rotatable through support shafts 36 and 37. The axial direction of the support shafts 36 and 37 corresponds to the weft picking direction.

**[0029]** As shown in Figs. 8(a) and 8(b), a connection shaft 38 is rotatably supported in the base frame 35. The axis of the connection shaft 38 is perpendicular to the axis of the support shafts 36 and 37. A T-shaped connection member 39 is fixed to the connection shaft 38, and another connection shaft 40 is fixed to the connection member 39. The axis of the connection shaft 38 and the axis of the connection shaft 40 are perpendicular to each other.

**[0030]** An electric motor 41 is attached to the upper surface of an upper wall 341 of the box 34. An output shaft 411 of the electric motor 41 extends through the upper wall 341 to protrude into the box 34, and an angle member 42 is immovably mounted to the forward end portion of the output shaft 411. The connection shaft 40 is rotatably connected to the angle member 42. When the output shaft 411 rotates, the connection shaft 40 revolves around the axis of the output shaft 411. When the connection shaft 40 revolves around the axis of the output shaft 411, the connection shaft 38 swings around the axis of the support shafts 36 and 37. The swinging of the connection shaft 38 is transmitted to the support shafts 36 and 37 through the base frame 35, and the support shafts 36 and 37 make reciprocal rotation. The angle member 42, the connection shaft 40, the connection member 39, the connection shaft 38, the base frame 35, and the support shafts 36 and 37 constitute a three-dimensional crank mechanism 43. The support shaft 37 constitutes the reciprocal output shaft of the three-dimensional crank mechanism 43.

**[0031]** As shown in Fig. 7, the support shaft 37 extends through a front wall 342 of the box 34 to protrude into the exterior of the box 34, and a driving gear 44 is immovably mounted to the protruding end portion of the support shaft 37. A cover 45 is immovably mounted to the front wall 342 of the box 34, and a support shaft 46 is rotatably supported by a front wall 451 of the cover 45 and the front wall 342 of the box 34. The driven gear 31 and the wheel 18 are immovably mounted to the support shaft 46, and the driving gear 44 is in mesh with the driven gear 31. The number of teeth of the driving gear 44 is larger than the number of teeth of the driven gear 31. Otherwise, this embodiment is of the same construction as the first and second embodiments.

**[0032]** Next, the operation of the third embodiment will be described.

**[0033]** The output shaft 411 of the electric motor 41 rotates in one direction, and this rotation in one direction of the output shaft 411 is converted into a reciprocating rotational motion by the three-dimensional crank mechanism 43. That is, the support shaft 37 constituting the three-dimensional crank mechanism 43 makes reciprocal rotation. When the support shaft 37 makes reciprocal rotation, the driving gear 44 integrally makes reciprocal rotation, and the rotation of the driving gear 44 is transmitted to the driven gear 31, whereby the support shaft 46 makes reciprocal rotation in a direction opposite to the rotating direction of the driving gear 44 at a rotating speed higher than the rotating speed of the support shaft 37. When the support shaft 46 makes reciprocal rotation, the wheel 18 integrally makes reciprocal rotation, and the first band 23 and the second band 24 reciprocate in opposite directions.

**[0034]** When the three-dimensional crank mechanism 43 is in the position as shown in Fig. 8(a), the first band 23 is in the uppermost movement position as indicated by the chain line, and the second band 24 is in the lowermost movement position indicated by the chain line. When the three-dimensional crank mechanism 43 is in the position as shown in Fig. 8 (b) , the second band 24 is in the uppermost movement position as indicated by the chain line, and the first band 23 is in the lowermost movement position indicated by the chain line.

**[0035]** The third embodiment provides the following advantages:

(3-1) Curve E1 in the graph of Fig. 9 indicates the changes in the position of the first selvage heddle 11 when the three-dimension crank mechanism 43 is used and the rpm of the electric motor 41 is fixed. In the graph of Fig. 9, the horizontal axis θ indicates the loom rotation angle, and the vertical axis indicates height position. In Fig. 9, the line drawn as the horizontal axis θ coincides with the height position of the warp line of the loom. The changes in the position of the second selvage heddle 12 when the three-dimensional crank mechanism 43 is used can be expressed by curve E2 which is akin to a curve as obtained vertically reversing curve E1 around the horizontal axis θ.

In the graph of Fig. 9, curve D1 indicates the changes in the position of the first selvage heddle 11 when a conventional two-dimensional crank mechanism is used and when the RPM of the electric motor is fixed. The changes in the position of the second selvage heddle 12 when the two-dimensional crank mechanism is used can be expressed by curve D2 which is akin to a curve as obtained vertically reversing curve D1 around the horizontal axis θ.

In the example shown in Fig. 9, a 1/1 selvage texture is formed. That is, the first selvage heddle 11 and the second selvage heddle 12 are vertically interchanged in their positions for each rotation of the loom.

As can be seen from comparison of curves E1 and E2 and curves D1 and D2, the ranges on the dead point sides in the reciprocating linear movement of the selvage heddle 11 and 12 (the so-called stagnation ranges), in which the positional change is small, is larger in the case in which the three-dimensional crank mechanism 43 is used than in the case in which the two-dimensional crank mechanism is used. In the example shown, the range of loom rotation corresponding to the height position range between the uppermost position H1 of the selvage heddles 11 and 12 and a height position H2 thereof close to the uppermost position H1 is a stagnation range. Similarly, the range of loom rotation corresponding to the height position range between the lowermost position L1 of the selvage heddles 11 and 12 and a height position L2 thereof close to the lowermost position L1 is a stagnation range. That is, in the example shown, the stagnation ranges of the selvage heddles 11 and 12 when the three-dimensional crank mechanism 43 is used can be expressed as (Te1+Te2) and (Te3+Te4), and the stagnation ranges of the selvage heddles 11 and 12 when the two-dimensional crank mechanism is used can be expressed as (Td1+Td2) and

(Td3+Td4).

That is, a selvage (warp) opening state with an opening amount close to the maximum opening amount can be maintained longer in the case in which the three-dimensional crank mechanism 43 is used than in the case in which the two-dimensional crank mechanism is used.

(3-2) In the device as disclosed in JP 10-503563 A, the two-dimensional crank mechanism is driven through reciprocal rotation of the electric motor. However, when the electric motor is to be caused to make reciprocal rotation in a short cycle, it is rather difficult to increase the rotating speed of the electric motor. This difficulty leads to an obstruction to an increase in loom operation speed. In this embodiment, in which the three-dimensional crank mechanism 43 is driven by the electric motor 41, it is only necessary to continuously rotate the electric motor 41 solely in one direction, thus making it possible to increase the rotating speed of the electric motor 41. The adoption of the three-dimensional crank mechanism 43, which allows an increase in the rotating speed of the electric motor 41, is advantageous in achieving an increase in loom operation speed.

(3-3) In the present invention, which uses the three-dimensional crank mechanism 43, it is possible, when forming a 1/1 selvage texture, to enlarge the stagnation ranges of the selvage heddles 11 and 12 without increasing or decreasing the speed of the electric motor 41, so that it is possible to adopt an electric motor 41 of low torque. This helps to achieve a reduction in the cost of the electric motor 41.

In the graph of Fig. 10, curve E3 indicates the positional changes of the first selvage heddle 11 when the three-dimensional crank mechanism 43 is used. In the graph of Fig. 10, the horizontal axis $\theta$ indicates the loom rotating angle, and the vertical axis indicates height position. In Fig. 10, the line drawn as the horizontal axis $\theta$ coincides with the height position of the warp line of the loom. The positional changes of the second selvage heddle 12 when the three-dimensional crank mechanism 43 is used can be expressed by curve E4 which is akin to a curve as obtained by vertically reversing curve E3 around the horizontal axis $\theta$.

In the graph of Fig. 10, curve D3 indicates the positional changes of the first selvage heddle 11 when the conventional two-dimensional crank mechanism is used. The positional changes of the second selvage heddle 12 when the two-dimensional crank mechanism is used can be expressed by curve D4 which is akin to a curve as obtained by vertically reversing curve D3 around the horizontal axis $\theta$.

In the example shown in Fig. 10, a 2/2 selvage texture is formed. That is, the first selvage heddle 11 and the second selvage heddle 12 are vertically interchanged in their positions for each two rotations of the loom.

As indicated by curves D3 and D4, in the formation of a 2/2 selvage texture by using the two-dimensional crank mechanism, reciprocal rotation of the electric motor requires stopping of the electric motor and an abrupt increase and decrease in the speed thereof. As indicated by curves E3 and E4, in the formation of a 2/2 selvage texture by using the three-dimensional crank mechanism 43, there is no need to cause the electric motor 41 to make reciprocal rotation, so that no abrupt increase or decrease in the speed of the electric motor 41 is required. Further, low torque suffices when stopping and starting the electric motor 41.

Further, by using the electric motor 41 as the drive source for the three-dimensional crank mechanism 43, it is also possible to form a complicated texture, such as a 1/3 selvage texture, without having to abruptly increase or decrease the speed of the electric motor 41. In the formation of a 1/3 selvage texture, the first selvage heddle 11 and the second selvage heddle 12 are vertically interchanged in their positions after three rotations of the loom after vertical interchange; thereafter, they undergo vertical interchange after one rotation of the loom.

Thus, the electric motor 41, which is applicable to the formation of various selvage textures independently of the loom drive motor (not shown), is suitable as the drive source for the three-dimensional crank mechanism 43.

(3-4) The larger the reciprocation angle $\beta$ (see Fig. 8(a)) of the support shaft 46, the larger the maximum opening amount of the opening formed by the selvages 14 and 15, which is advantageous in performing weft picking. In the three-dimensional crank mechanism 43, it is difficult to enlarge the reciprocation angle $\gamma$ (see Fig. 8(a)) of the support shafts 36 and 37 making reciprocal rotation. A speed increasing mechanism composed of the driving gear 44 and the driven gear 31 transmits the output from the three-dimensional crank mechanism 43 to the wheel 18 after increasing the output in speed. That is, the speed increasing mechanism composed of the driving gear 44 and the driven gear 31 makes the reciprocation angle $\beta$ of the support shaft 46 larger than the reciprocation angle $\gamma$. This speed increasing mechanism proves effective in increasing the maximum opening amount when the three-dimensional crank mechanism 43 is adopted.

**[0036]** In the present invention, the following modified embodiments are also possible.

(1) In the above-described embodiments, the guide curved surfaces 193 and 203 may be curved surfaces other than arcuate surfaces.

(2) In the above-described embodiments, the guide curved surfaces 193 and 203 may be omitted.
(3) It is also possible to use rollers as the first position regulating member 19 and the second position regulating member 20. In this case, it is expedient to arrange the rollers such that they press toward the wheel 18 the portions of the bands 23 and 24 at the positions where they are in mesh with the wheel 18. However, it is also possible to bring the rollers into contact with the portions of the bands 23 and 24 in the ranges between the in-mesh positions and the guide rail 22.
(4) It is also possible to band-shaped metal plates capable of deflection as the first band 23 and the second band 24.
(5) It is also possible to integrate the first band 23 and the second band 24 so as to connect them together around the upper side of the wheel 18.
(6) In the third embodiment, it is also possible to use a two-dimensional crank mechanism instead of the three-dimensional crank mechanism.
(7) In the third embodiment, the box 34 may be formed as an oil tank and to put lubricant oil in the box 34, thereby lubricating the three-dimensional crank mechanism 43. In this case, since the electric motor 41 is on top of the box 34, the box 34 can be easily formed so as to prevent intrusion of lubricant oil into the electric motor 41.

**[0037]** As described in detail above, the present invention can advantageously provide a selvage forming device capable of enlarging the selvage opening amount without hindering an increase in loom operation speed.

## Claims

**1.** A selvage forming device for a loom adapted to form a selvage based on operations of a first selvage heddle and a second selvage heddle reciprocating in opposite directions, **characterized in that** the selvage forming device comprises:

a first band supporting the first selvage heddle and equipped with a plurality of power receiving holes arranged in a row, the first band being capable of deflection;
a second band supporting the second selvage heddle and equipped with a plurality of power receiving holes arranged in a row, the second band being capable of deflection; and
a wheel equipped with a plurality of power transmission teeth respectively brought into mesh-engagement with the power receiving holes of the first and second bands,

wherein the first band and the second band are opposed to each other in a deflected state, with the wheel therebetween, so as to bring the power receiving holes of the first and second bands into mesh-engagement with the power transmission teeth.

**2.** A selvage forming device for a loom according to Claim 1, further comprising a guide means for guiding the first and second bands such that the first band and the second band are brought closer to each other as the first band and the second band are departed away from positions where the power transmission teeth and the power receiving teeth are in mesh with each other, and then a portion of the first band and a portion of the second band extend so as to be adjacent and parallel to each other.

**3.** A selvage forming device for a loom according to Claim 2,
wherein the guide means is equipped with a first position regulating member coming into contact with the first band so as to regulate a position where the first band and the wheel are in mesh with each other, a second position regulating member coming into contact with the second band so as to regulate the position where the second band and the wheel are in mesh with each other, and a third position regulating member having a pair of guide grooves adapted to guide the first and second bands such that the first and second bands extend parallel to each other, wherein connection members are immovably mounted to portions of the first and second bands in the pair of guide grooves, and wherein the first selvage heddle is mounted to one of the connection members, and the second selvage heddle is mounted to the other of the connection members.

**4.** A selvage forming device for a loom according to Claim 3,
wherein the first position regulating member has a guide surface in contact with the first band, and wherein the second position regulating member has a guide surface in contact with the second band, with the guide surfaces being opposed to each other so as to be convex toward the wheel.

**5.** A selvage forming device for a loom according to Claim 4,
wherein each of the guide surfaces includes a guide plane surface and a guide curved surface, and wherein the first and second bands are held between the guide plane surfaces and the wheel while in contact with the guide plane surfaces.

**6.** A selvage forming device for a loom according to Claim 5,
wherein the guide curved surfaces are arcuate surfaces.

**7.** A selvage forming device for a loom according to any one of Claims 1 through 6, wherein the wheel is driven by an electric motor.

**8.** A selvage forming device for a loom according to Claim 7, further comprising a reciprocating drive mechanism for causing the wheel to make reciprocal rotation by converting rotation of the electric motor in one direction into a reciprocating movement.

**9.** A selvage forming device for a loom according to Claim 8,
wherein the reciprocating drive mechanism comprises a crank mechanism.

**10.** A selvage forming device for a loom according to Claim 9, wherein the crank mechanism is a three-dimensional crank mechanism.

**11.** A selvage forming device for a loom according to Claim 10, further comprising a speed increasing mechanism for increasing a speed of an output from the three-dimensional crank mechanism before transmitting the output to the wheel.

**12.** A selvage forming device for a loom according to any one of Claims 1 through 11, wherein the first band and the second band are formed of a fiber reinforced plastic reinforced by carbon fiber.

FIG. 1

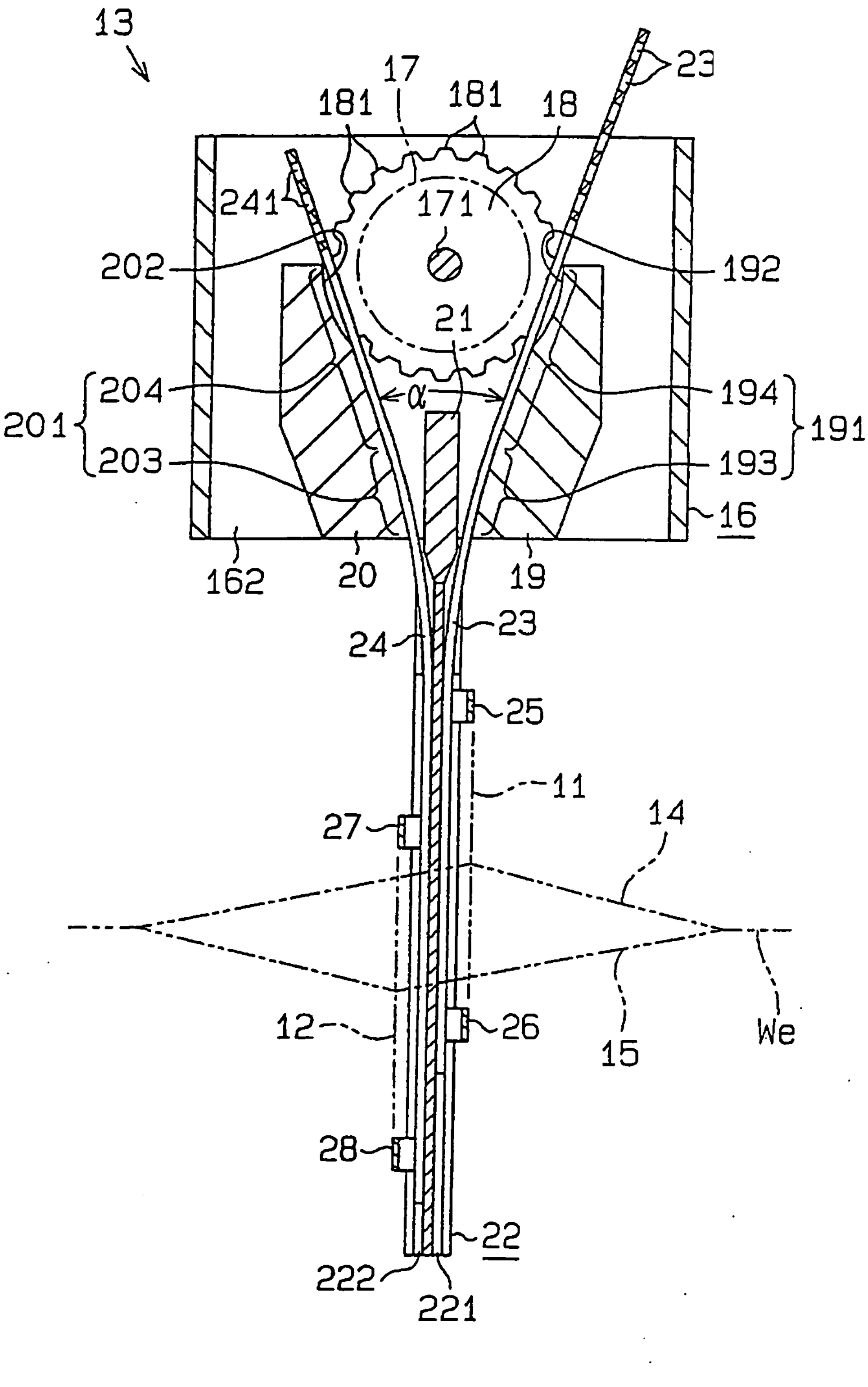

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FIG. 2A

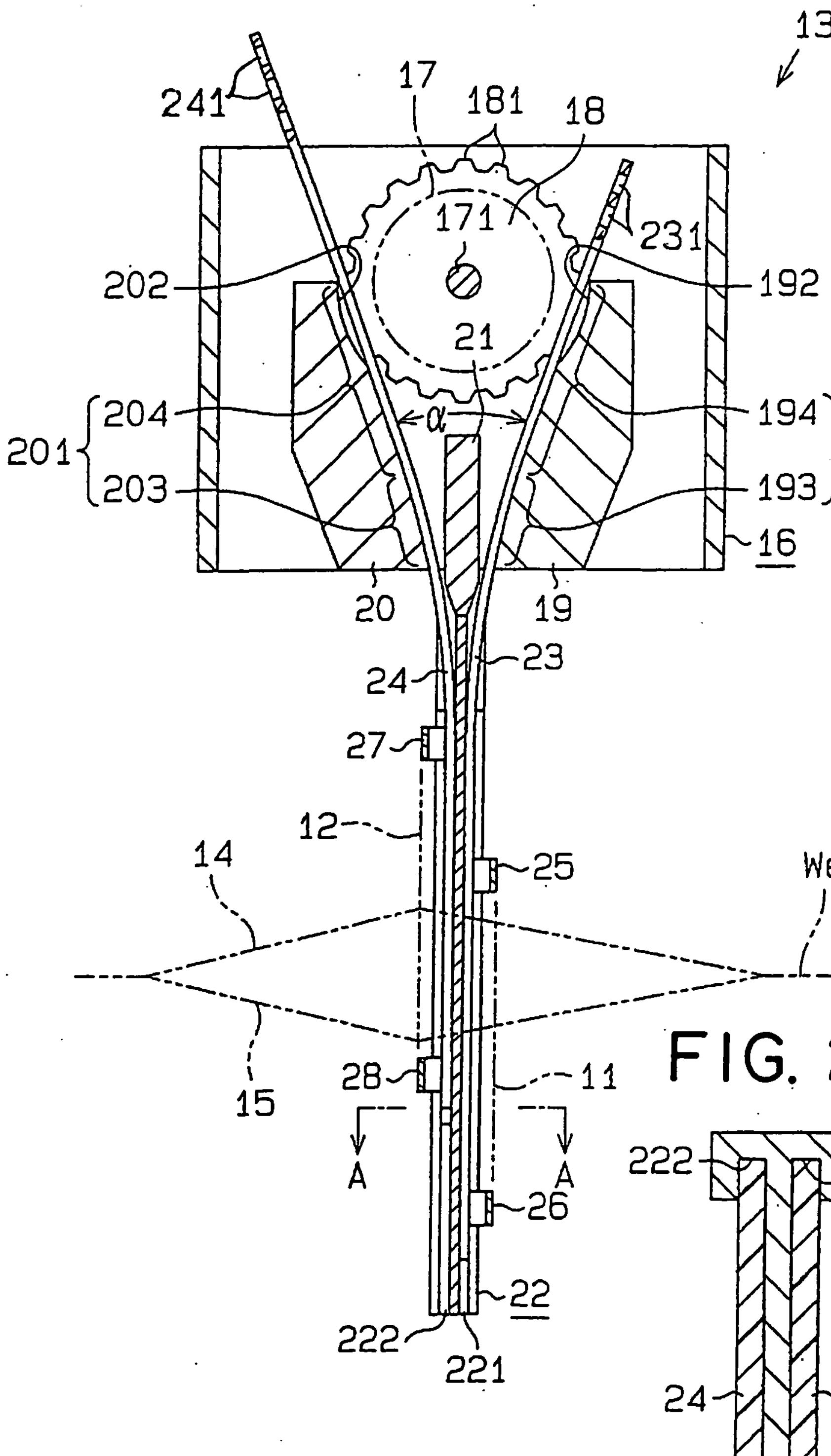
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FIG. 2B

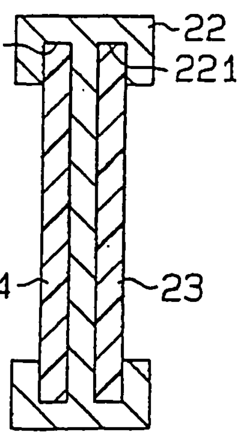
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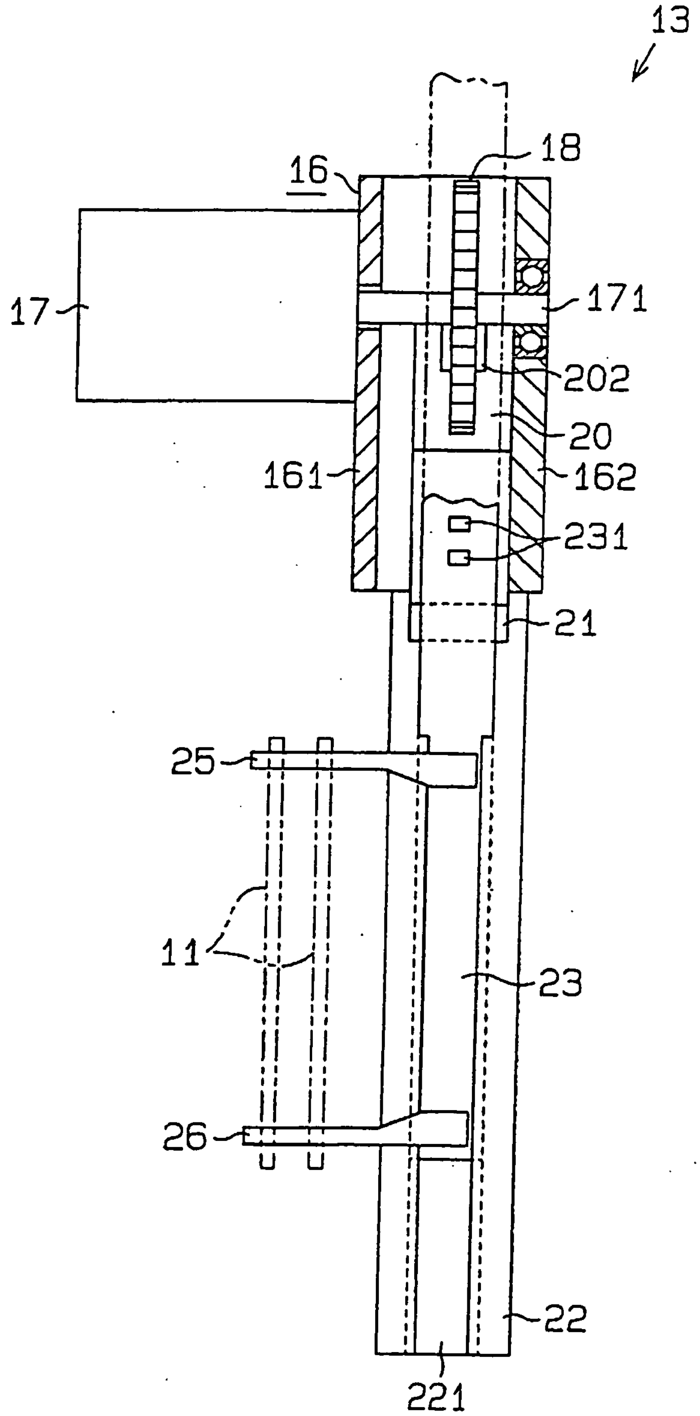
FIG. 3



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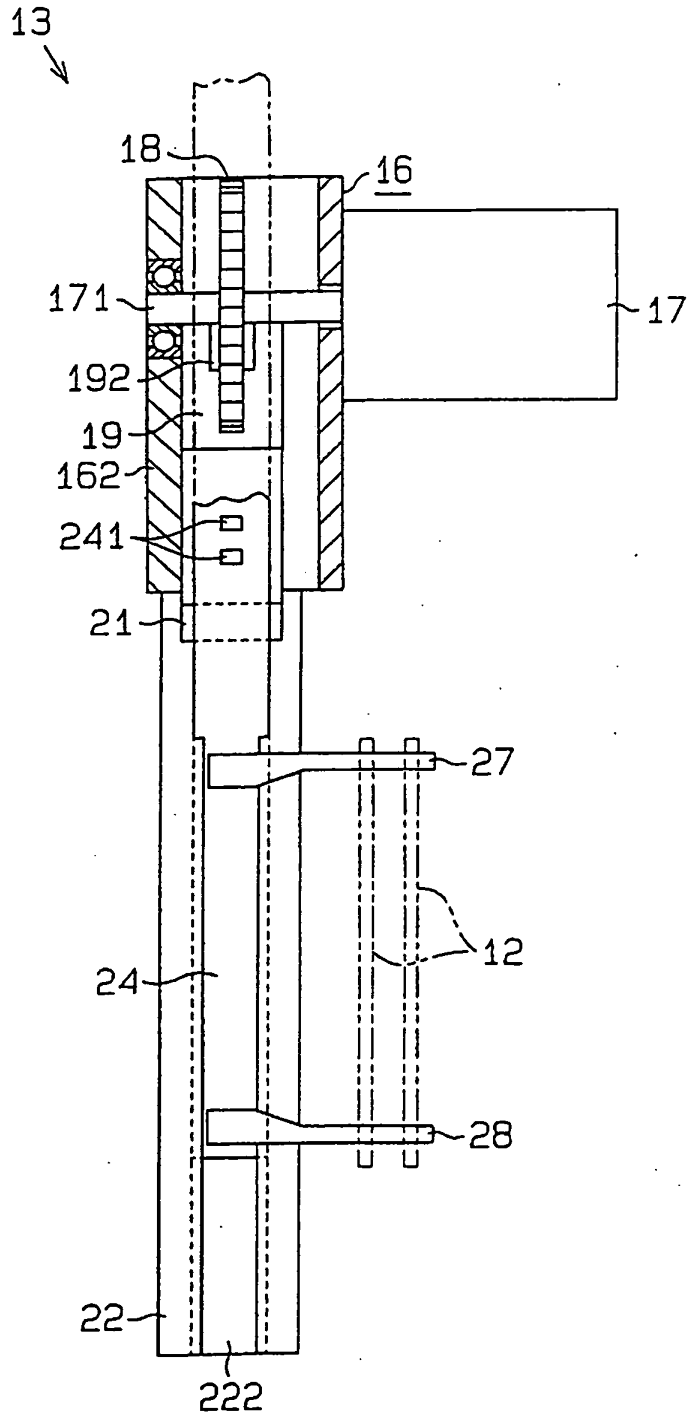

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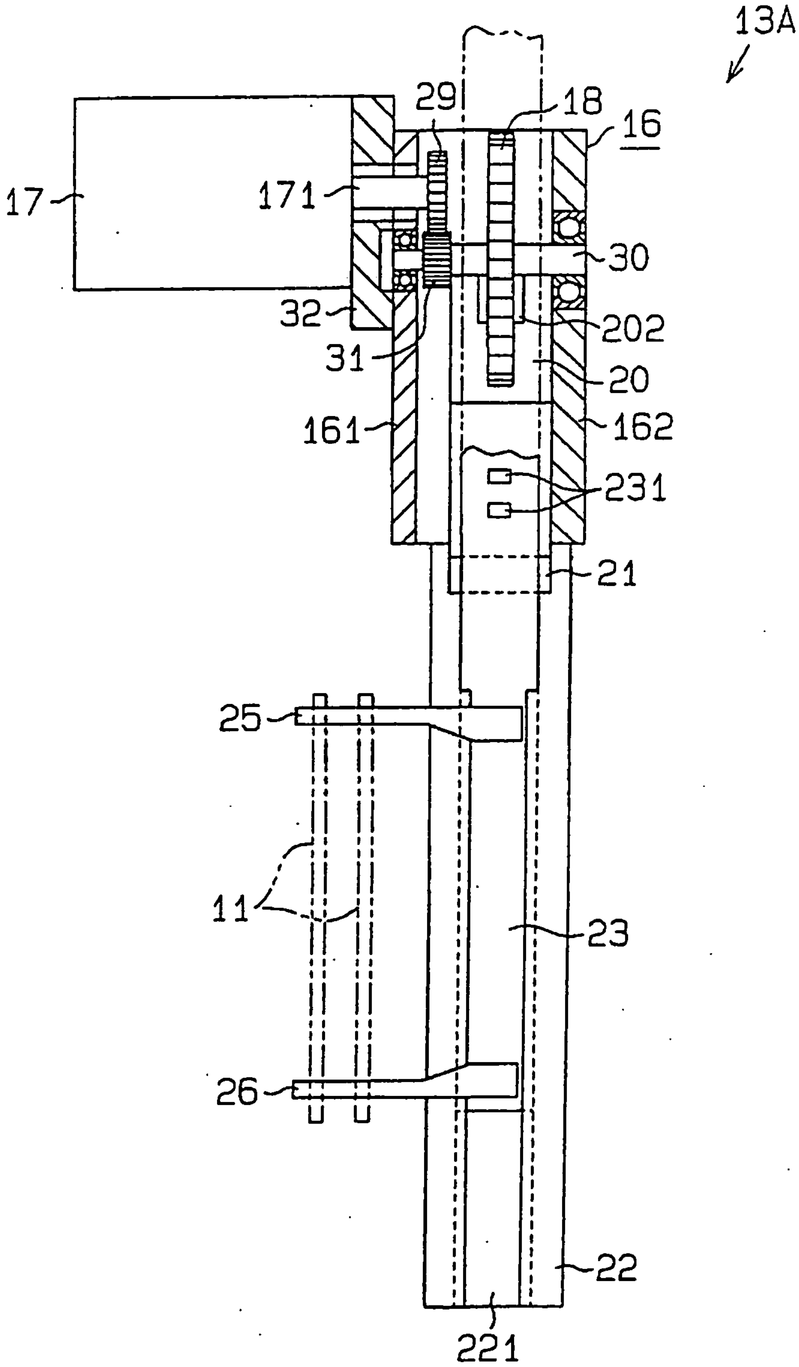

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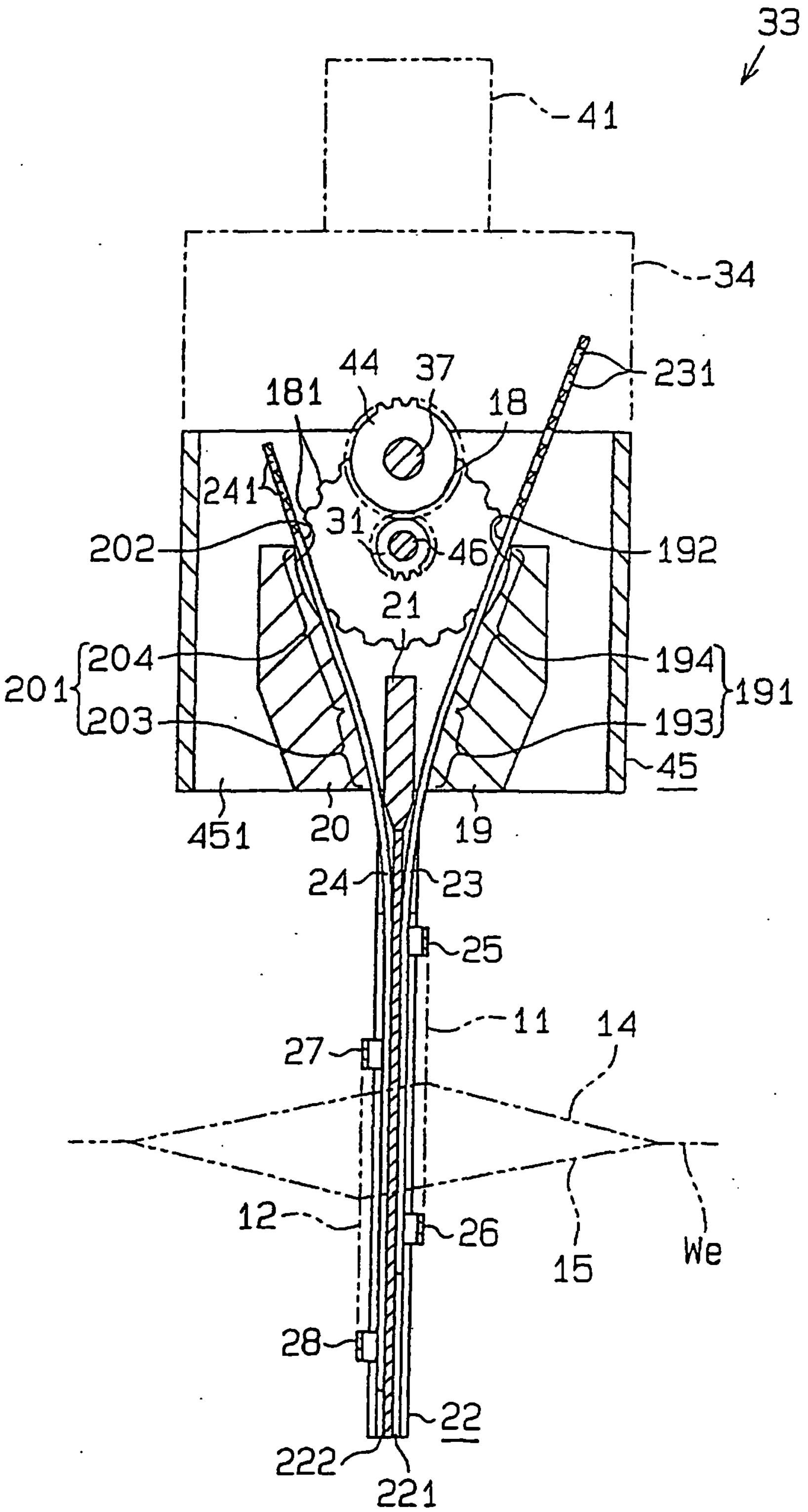
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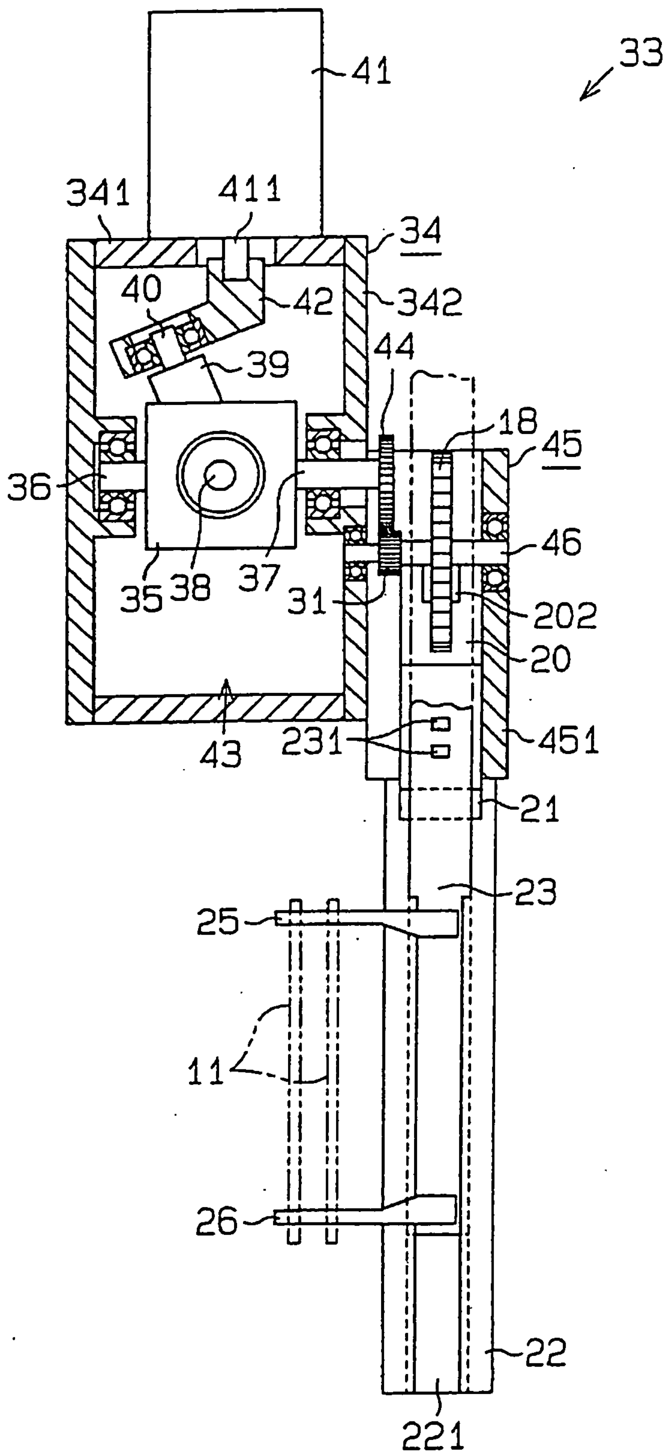
FIG. 7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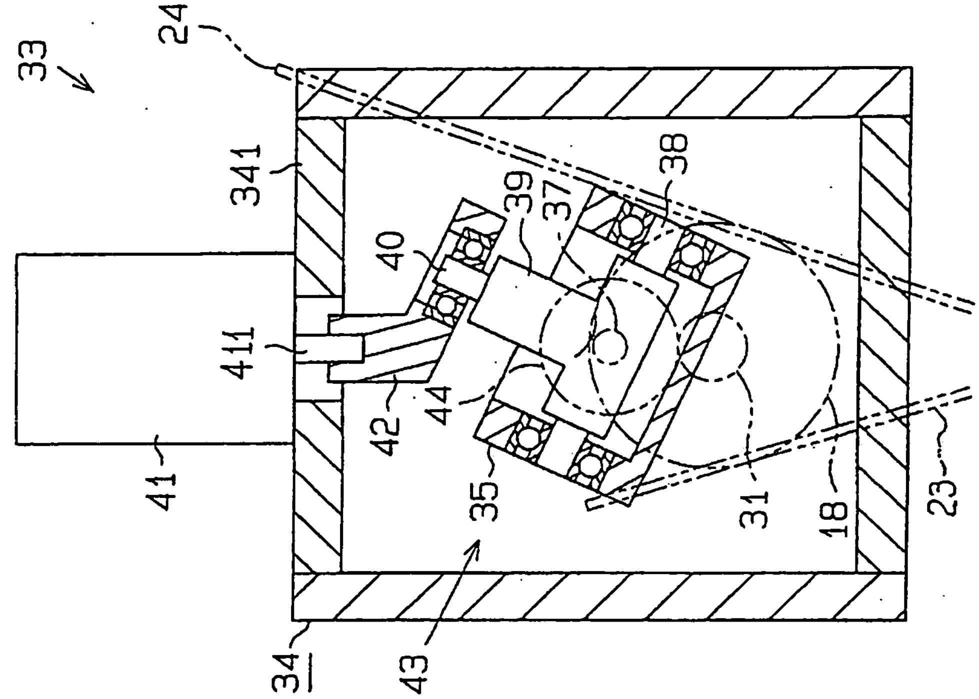
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FIG. 8B

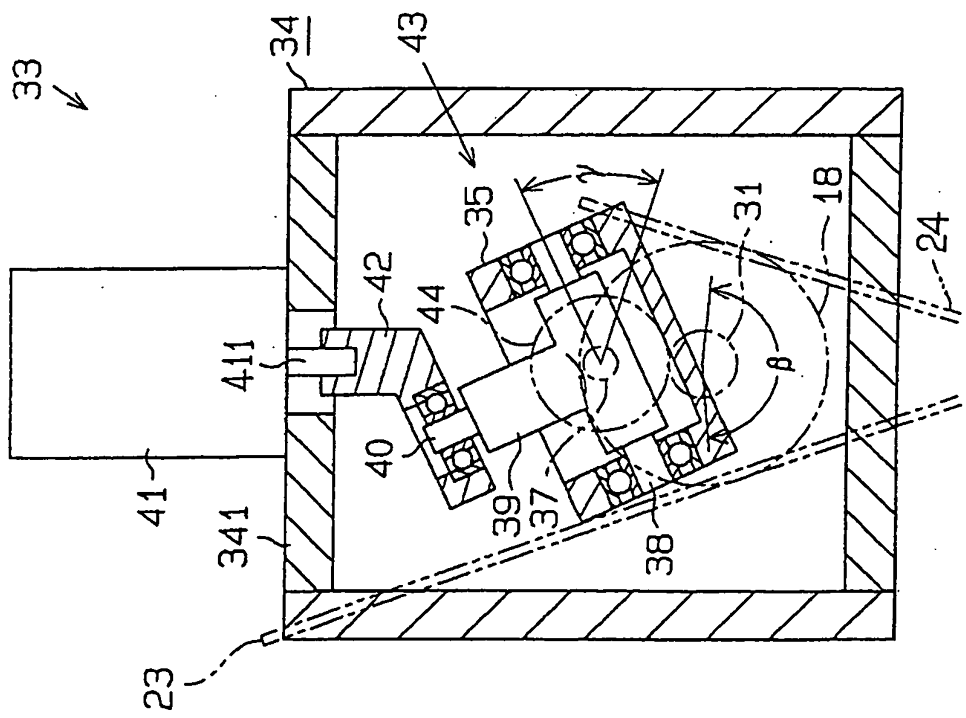
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FIG. 8A

FIG. 9

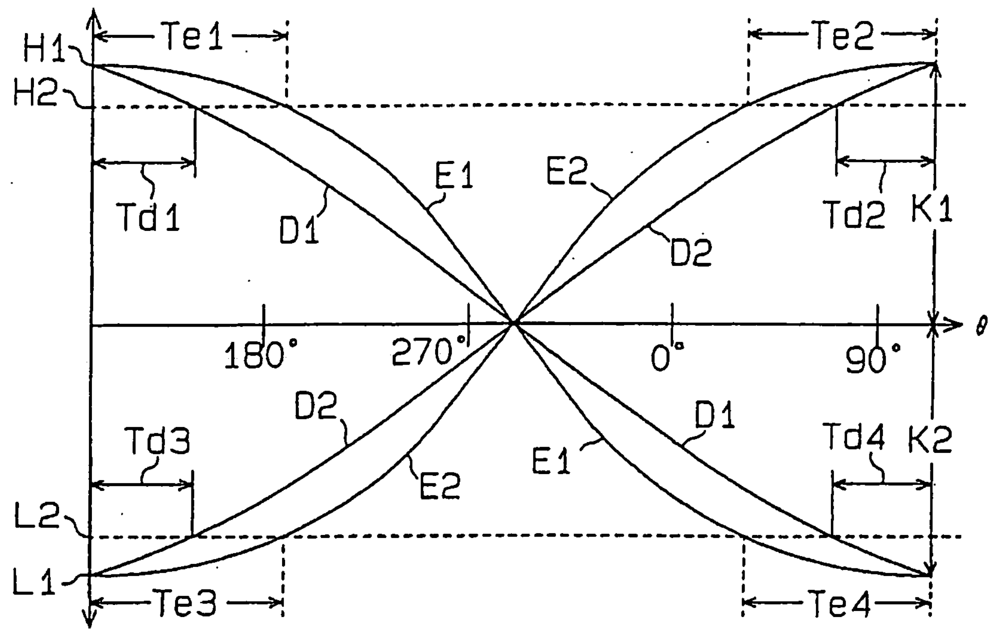
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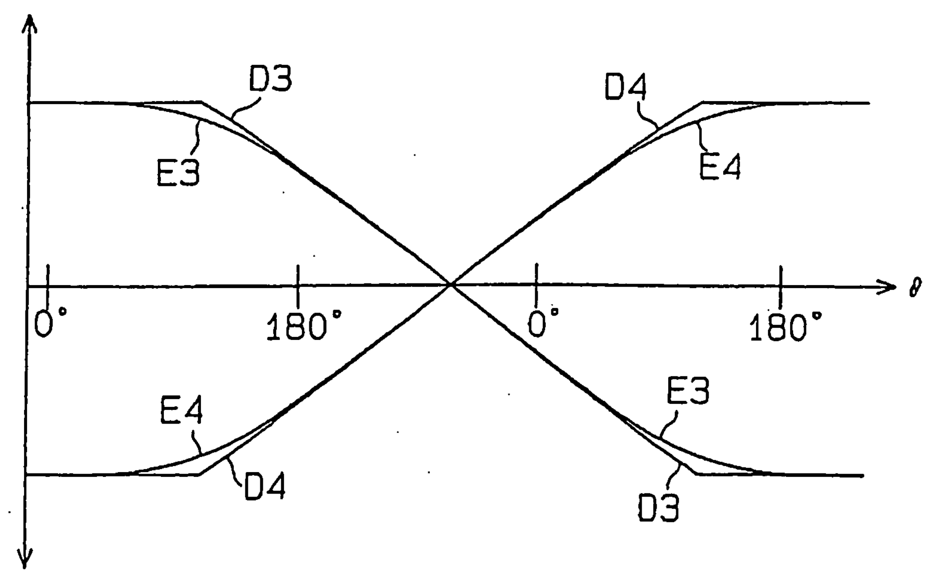
FIG. 10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European Patent Office

# EUROPEAN SEARCH REPORT

Application Number
EP 04 00 8109

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| | | | D03C |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| MUNICH | 17 May 2004 | Louter, P |

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X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

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17-05-2004

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