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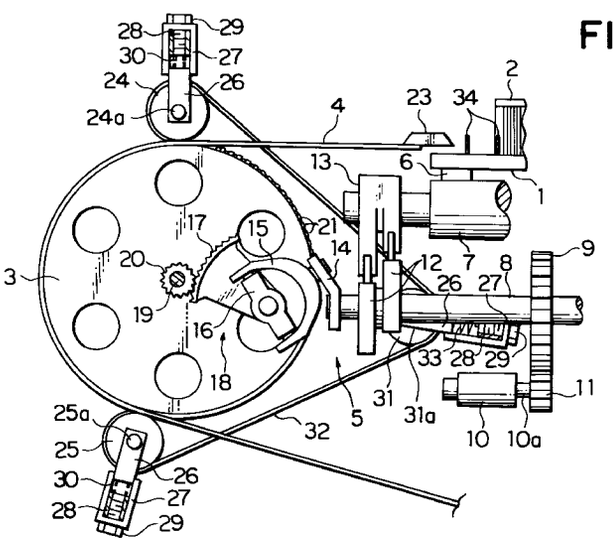
(54) Weft thread inserting apparatus in rapier loom

(57) In a weft thread inserting apparatus in a rapier loom, a rapier band 4 having a first end fixed to a rapier head 23 includes a row of engaging holes 22 defined in the lengthwise direction thereof. The rapier band 4 is wound around a rapier wheel 3 in the state that the engaging holes 22 are engaged with a row of engaging projections 21 defined to the circumference of the rapier wheel 3. Presser rollers 24, 25 are rotatably disposed at positions corresponding to the positions where the rapier band 4 leaves the rapier wheel 3 and an endless belt 32 is wound aroung the rapier wheel 3, the presser rollers 24, 25 and a tension roller 31 so that the endless belt 32 does not interfere with the rapier band 4. The outside diameter of the portion of the rapier wheel 3 around which the belt 32 is wound and the outside diameters of the presser rollers 24, 25 are set such that the reciprocating speed of the rapier band 4 coincides with the circumferential speeds of the presser rollers 24, 25. With this arrangement, a wide fabric can be handled without increasing the diameter of the rapier wheel, sliding friction can be avoided between the rapier band and the presser members to thereby improve the durability of the rapier band.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a weft thread inserting apparatus in a rapier loom, and more specifically, to a band type (flexible rapier) weft thread inserting apparatus using a flexibly deformable band with rigidity.

2. Description of the Related Art

This type of a weft thread inserting apparatus includes a rapier band having a rapier head fixed at an extreme end thereof and a rapier wheel around which the rapier band is wound. The rapier wheel is reciprocatingly rotated to cause the rapier head fixed to the rapier band to advance into a warp thread opening as well as to retract therefrom so as to insert weft threads. Then, a force for floating the rapier band from the circumference of the rapier wheel is applied to the rapier band by the action of a centrifugal force generated by the rotation of the rapier wheel.

As shown in FIG. 7, Japanese Patent Publication No. 60-40538 shows an apparatus including an example of the arrangement for reciprocating a rapier band. In the apparatus, a rapier band 61 having a rapier head 60 fixed at an extreme end thereof is wound around a rapier wheel 62 in the state that the base end portion thereof is fixed around the circumference of the rapier wheel 62. Two rollers 63, 64 are disposed above the rapier wheel 62 to prevent the rapier band 61 from floating from the circumference of the rapier wheel 62. A rope 65 is wound between the rapier wheel 62 and both the rollers 63, 64 to press the rapier band 61 against the surface of the rapier wheel 62 around which the repair band 61 is wound. As shown in FIG. 8. grooves 63a, 64a are formed in the circumference of both the rollers 63, 64 to guide the rope 65. The first roller 63 is disposed by being inclined with respect to a plane including the rapier wheel 62, whereas the second roller 64 is disposed in parallel with the above plane. The rope 65 is fixed to the rapier wheel 62 at both the ends thereof and wound to draw approximately a letter "8" shape so that it winds the entire circumference of the rapier wheel 62 as well as substantially one half the circumferences of both the rollers 63, 64. Both the rollers 63, 64 are urged by a spring (not shown) in a direction to apply pretension to the rope 65.

There are also apparatuses each arranged such that a row of engaging projections are disposed on the circumference of a rapier wheel in a circumferential direction and a row of engaging holes are defined in a rapier band in a lengthwise direction, as disclosed in Japanese Patent Application Laid-Open Nos. 53-111160 and 1-97235. The rapier band is wound around the rapier wheel in a turned-back state with the engaging projections being engaged with the engaging holes, the reciprocating rotation of a rapier wheel is transmitted to the rapier band through the engagement of the engaging projections with the engaging holes and a rapier head is reciprocated by the reciprocating rotation of the rapier wheel. In the apparatus disclosed in Japanese Patent Application Laid-Open No. 53-111160, presser rollers are rotatably disposed on the back surface side of the portion where the rapier band is wound and which corresponds to the positions at which the rapier band leaves the rapier wheel. In the apparatus disclosed in Japanese Patent Application Laid-Open No. 1-79235, presser members each composed of a porous synthetic material impregnated with grease or lubricant are fixedly disposed in place of the presser rollers.

To increase the stroke of a rapier head so as to cope with an increase of the width of a fabric in the apparatus disclosed in Japanese Patent Application Laid-Open No. 54-156858, a rapier band must be wound around a rapier wheel a plurality of times or the diameter of the rapier wheel must be increased. However, it is very difficult to wind the rapier band a plurality of times. Further, the increase of the diameter of the rapier wheel greatly increases an inertia moment, by which an increase of speed of a rapier loom is prevented as well as power consumption is increased.

In the apparatuses disclosed in Japanese Patent Application Laid-Open Nos. 53-111160 and 54-97235, the rapier band is wound around and engaged with only a part of the entire circumference of the rapier wheel. Therefore, the diameter of the rapier wheel can be reduced, which is advantageous to an increase of speed of the rapier loom. However, in the apparatus disclosed in Japanese Patent Application Laid-Open No. 53-111160 which is provided with the presser rollers for preventing the floating of the rapier band, the presser rollers come into contact with the rapier band through a line and further the length of the contact portion is less than the width of the rapier band and very short. Therefore, slip is liable to be caused between the presser rollers and the rapier band. Since the presser rollers press the rapier band in the state that it is free to rotate, the movement of the rapier band is against the inertia force of the rollers just after the moving direction of the rapier band is switched in particular, by which the slip is caused. Further, the rapier band is liable to be worn by sliding friction as well as a power loss is increased accordingly by an amount of the friction. In addition, since a large amount of heat is generated at the sliding portion of the rapier band, the rapier band composed of a resin is liable to be deteriorated and the life thereof is more shortened.

In the apparatus disclosed in Japanese Patent Application Laid-Open No. 1-97235, since the rapier band is slidingly guided by the presser members impregnated with grease or lubricant, there is a possibility that the grease or lubricant scatters and makes a fab-

ric dirty when the rapier band advances into a warp thread opening, although sliding wear is reduced.

SUMMARY OF THE INVENTION

An object of the present invention made to solve the aforesaid conventional problems is to provide a weft thread inserting apparatus for a rapier loon capable of coping with an increase of the width of a fabric without increasing the diameter of a rapier wheel and improving the durability of a rapier band by avoiding sliding friction between the rapier band and presser members.

According to an aspect of the present invention for achieving the above object, there is provided a weft thread inserting apparatus in a rapier loom including a flexible rapier band having a first end fixed to a rapier head as well as a row of engaging holes defined thereto in the lengthwise direction thereof so that they can be engaged with a row of engaging projections defined to the circumference of a rapier wheel at predetermined pitches, the rapier band being wound around the rapier wheel in a turned-back state with the engaging projections engaged with the engaging holes, wherein the rapier head is inserted into a warp thread opening as well as retracted therefrom by the reciprocating rotation of the rapier wheel to thereby inserting weft threads into the warp thread opening. The weft thread inserting apparatus is arranged such that pressor rollers are rotatably disposed on the back surface side of the portion where the rapier band is wound and which corresponds to the positions at which the rapier band leaves the rapier wheel, an endless belt for transmitting the rotation of the rapier wheel to the presser rollers is wound between the rapier wheel, the presser rollers and a tension roller in the state that the belt cannot be engaged with the rapier band and the outside diameter of the portion of the rapier wheel 3 around which the belt is wound and the outside diameters of the presser rollers are set such that the reciprocating speed of the rapier band coincides with the circumferential speeds of the portions of the presser rollers in contact with the rapier band.

According to the above arrangement, the reciprocating power of the rapier wheel which is reciprocatingly rotated is transmitted to the rapier band through the engaging projections and the engaging holes. The rapier band is reciprocatingly moved by the transmission of the power so that the rapier head is advanced into and retracted from a warp thread opening to thereby insert weft threads into the warp opening.

Further, according to the above arrangement, the presser rollers press the back surface side of the portion where the rapier band is wound and which corresponds to the positions at which the rapier band leaves the rapier wheel. When the rapier wheel is rotated, the presser rollers are rotated through the belt such that the circumferential speeds of the portions of the presser rollers in contact with the rapier band coincide with the reciprocating speed of the rapier band. The presser rollers come into contact with the rapier band through a line likewise conventional apparatuses. Different from the conventional apparatuses, however, the presser rollers are not rotated by frictional resistance at the portion where the presser rollers are in contact with the rapier band but rotated through the belt wound between the rapier wheel, the presser rollers and the tension roller. Therefore, no slip is caused between the presser rollers and the rapier band so that the wear of the rapier band can be prevented.

It is preferable that the tension roller is disposed on the side of a sley with respect to the rapier wheel. With this disposition, the entire width of a loom is not increased even if the tension roller is provided.

Further, it is preferable that the belt is wound around the rapier wheel from the back surface side of the rapier band at the portion where the rapier band travels around the rapier wheel and the presser rollers are in contact with only the belt. Consequently, even if the outside diameters of the presser rollers are optionally changed regardless of the outside diameter of the rapier wheel, the moving speed of the belt coincides with the moving speed of the rapier band, no slip is caused between the rapier band and the rapier wheel and the wear of the rapier band can be prevented.

According to another aspect of the present invention, rollers are rotatably disposed on the back surface side of the portion where a rapier band is wound and which corresponds to the positions at which the rapier band leaves a rapier wheel and a belt is wound between the rapier wheel and both the rollers with a portion of the belt engaged with the back surface side of the circumferentially traveling portion of the rapier band as well as a portion thereof engaged with the rapier wheel.

With the above arrangement, the belt presses the rapier band against the rapier wheel at the portion where the rapier band travels around the rapier wheel. Since the belt is in contact with the rapier band on the entire circumferentially traveling portion thereof and moved at the same speed as that of the rapier band, no slip is caused between the belt and the rapier band and the wear of the rapier band is prevented.

Preferably, the belt is composed of a round elastic belt, a guide portion for guiding the belt is defined to the rapier wheel at a position whose phase is displaced in a width direction with respect to the winding portion of the rapier band and a winding portion is defined to each of the rollers to permit the belt to move in a width direction between the guide portion and the position corresponding to the winding position of the rapier band.

When the round elastic belt is used as the above belt as described above, the belt is reciprocatingly moved with a portion thereof securely pressed against the back surface of the rapier band on the circumferentially traveling portion thereof while guided by the guide portion of the rapier wheel and the guide grooves of the rollers.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially omitted front elevational view of a first embodiment;

FIG. 2 is a partially omitted side elevational view of the first embodiment;

FIG. 3 is a partially omitted front elevational view of a second embodiment;

FIG. 4 is a partially omitted perspective view of the second embodiment;

FIG. 5 is a partially omitted side elevational view of the second embodiment;

FIG. 6 is a partially omitted side elevational view showing a modified example;

FIG. 7 is a schematic side elevational view of a conventional example; and

FIG. 8 is an enlarged cross sectional view taken along the line A - A of FIG. 7.

DESCRIPTION OF PREFERRED EMBODIMENTS

(First Embodiment)

A first embodiment embodying the present invention will be described with reference to FIG. 1 and FIG. 2. FIG. 1 is a schematic front elevational view showing the weft insertion start end side of a weft thread inserting apparatus, wherein since a weft thread insertion finish end side disposed on the right side of the apparatus is symmetrically arranged with the weft thread insertion start end side, only the weft threads insertion start end side will be described without showing and describing the weft threads insertion finish end side.

As shown in FIG. 1, rapier wheels 3, rapier bands 4 and drive mechanisms for the rapier wheels 3 are symmetrically disposed on the right side and the left side across a reed 2 supported on a sley 1. The sley 1 is supported on a rocking shaft 7 through a sley sword 6. The sley 1 is rotated about the rocking shaft 7 together with it. A drive shaft 8 is rotatably disposed just below the rocking shaft 7. The drive shaft 8 is disposed in parallel with the rocking shaft 7 and a driven gear 9 is fixed to the drive shaft 8 so that it can be rotated together with the drive shaft 8. A servo motor 10 is disposed in the vicinity of the drive shaft 8. The servo motor 10 has an output shaft 10a to which a driving gear 11 is fixed so that it is rotated together with the output shaft 10a. The driving gear 11 is meshed with the driven gear 9 and the rotation of the servo motor 10 is transmitted to the drive shaft 8 through the driving gear 11 and the driven gear 9. Since the servo motor 10 rotates only in one direction, the drive shaft 8 also rotates only in one direction.

Double cams 12 are fixed to each end of the drive shaft 8 so that they can be rotated together with the drive shaft 8 and a double cam lever 13 is fixed to each end of the rocking shaft 7 so that it is rotated together with the rocking shaft 7. The double cans 12 and the double cam lever 13 constitute a positive cam mechanism so that the rotation in the one direction of the drive shaft 8 is converted into the reciprocating rotation of the rocking shaft 7 through the positive cam mechanism. The sley 1 is reciprocatingly rocked forward and backward by the reciprocating rotation of the rocking shaft 7 so that the reed 2 effects a reed beating operation.

An inclined shaft crank 14 is fixed to each end of the drive shaft 8. A fork-shaped intermediate link 15 is rotatably connected to the inclined shaft crank 14 and a support shaft 16 is rotatably supported by the intermediate link 15. A segment gear 17 is rotatably supported at an intermediate portion of the support shaft 16. The inclined shaft crank 14, intermediate link 5, support shaft 16 and segment gear 17 constitute a three-dimensional crank mechanism 18.

The rapier wheel 3 is disposed on the side of the three-dimensional crank mechanism 18 so that it can be rotated together with a support shaft 19. The support shaft 19 is horizontally disposed intersecting perpendicularly to the drive shaft 8. A driven gear 20 is fixed to the support shaft 19 so that it can be rotated together with the support shaft 19. The segment gear 17 is meshed with the driven gear 20 and the rotation in the one direction of the drive shaft 8 is converted into the reciprocating rotation of the rapier wheel 3 through the three-dimensional crank mechanism 18 and driven gear 20. That is, the rapier wheel 3 is reciprocatingly rotated by the action of the servo motor 10.

Train-shaped engaging projections 21 are defined on the circumference of the rapier wheel 3 at predetermined pitches. The rapier band 4 is composed of a flexible material with rigidity and has train-shaped engaging holes 22 (shown in FIG. 2) defined along the lengthwise direction of thereof, the engaging holes 2 capable of being engaged with the engaging projections. The rapier band 4 is wound around the rapier wheel 3 in a turned-back state with the engaging projection being engaged with the engaging holes. A delivery rapier head 23 is fixed to the first end of the rapier band 4. The engaging projections 21 are spaced apart from the engaging holes 22 at suitable intervals so that the projections 21 are smoothly engaged with the holes 22.

Presser rollers 24, 25 are rotatably disposed on the back surface side of the portion where the rapier band 4 is wound and which corresponds to the positions at which the rapier band 4 leaves the rapier wheel 3. The presser rollers 24, 25 have shafts 24a, 25a which are rotatably supported by support brackets 26. Each of the support brackets 26 has a base end portion slidably inserted into a fixedly disposed support frame 27. A hollow-nut-type slider 28 is slidably and unrotatably accommodated in the support frame 27. An adjustment screw 29 passes through and is threaded with the base end portion of the support frame 27. The adjustment screw 29 is threaded with the slider at the extreme end thereof. A compressed spring 30 is interposed between the slider 28 and the support bracket 26. The presser rollers 24, 25 are pressed against the rapier wheel 3 by the spring force of the compressed spring 30 so that the

presser rollers 24, 25 press the rapier band 4 against the rapier wheel 3.

The position of the slider 28 in the support frame 27 can be changed by changing the threading position of the adjustment screw 29 with the support frame 27. The spring force of the compressed spring 30 is changed by the change of the position, by which the pressing force of the presser rollers 24, 25 against the rapier band 4 is adjusted and changed.

As shown in FIG. 2. grooves 24b, 25b are defined to the presser rollers 24, 25 at the positions thereof corresponding to the engaging projections 21 to permit the engaging projections 21 to pass therethrough. A tension roller 31 is disposed on the sley 1 side with respect to the rapier wheel 3. An endless belt 32 is wound between the rapier wheel 3, presser rollers 24, 25 and tension roller 31 in the state that it cannot be engaged with the rapier band 4. In the first embodiment, the belt 32 is composed of a flat belt. The belt 32 transmits the rotation of the rapier wheel 3 to the presser rollers 24, 25. The outside diameter of the portion of the rapier wheel 3 around which the belt 32 is wound and the outside diameters of the presser rollers 24, 25 are set so that the reciprocating speed of the rapier band 4 coincide with the circumferential speeds of the portions of the pressor rollers 24, 25 where the presser rollers 24, 25 are in contact with the rapier band 4.

For example, when the portion of the rapier wheel 3 around which the rapier band 4 is wound and the portion of the rapier wheel 3 around which the belt 32 is wound are formed to the same outside diameter, the outside diameters of the portions the presser rollers 24, 25 around which the belt 32 is wound are different from the outside diameters thereof in contact with the rapier band 4. When the radius of the rapier wheel 3 is represented by R, the thickness of the rapier band 4 is represented by t, the radii of the portions of the presser rollers 24, 25 in contact with the rapier band 4 are represented by r_1 and the radii of the portions of the presser rollers 24, 25 around which the belt 32 is wound are represented by r_2, the following formula is given.

$$(R + t) : r_1 = R : r_2$$

That is, the following formula results from above formula.

$$r_2 = r_1 - r_1 t/(R + t)$$

That is, the outside diameters of the portions of the presser rollers 24, 25 around which the belt 32 is wound are smaller than the outside diameters of the portions thereof in contact with the rapier band 4.

On the other hand, when the presser rollers 24, 25 have the same outside diameter, the outside diameter of the portion of the rapier wheel 3 around which the rapier band 4 is wound is different from the outside diameter of the portion thereof around which the rapier wheel 32 is wound. When the radius of the presser rollers 24, 25 is represented by r, the radius of the portion of the rapier wheel 3 around which the rapier band 4 is wound is represented by R_1 , the radius of the portion of the rapier wheel 3 around which the rapier wheel 32 is wound is represented by R_2, the following formula is given.

$$(R_1 + t) : r = R_2 : r$$

That is, the following formula results from above formula.

$$R_2 = (R_1 + t)$$

Thus, the radius of the potion of the rapier wheel 3 around which the belt 32 is wound is larger than the radius of the portion thereof around which the rapier band 4 is wound by the thickness of the rapier band 4.

The shaft 31a of the tension roller 31 is supported by substantially the same arrangement as that of the shafts 24a, 25a of the presser rollers 24, 25 except that a tension spring 33 is provided in place of the compressed spring 30. That is, the tension spring 33 is stretched between the slider 28 and the support bracket 26. When the position at which the adjustment screw 29 is threaded with the support frame 27 is changed, the position of the slider 28 in the support frame 27 is changed, by which the tensile force of the belt 32 is changed.

Next, operation of the weft thread inserting apparatus arranged as described above will be described below.

The drive shaft 8 is rotated in the one direction through the driving gear 11 and the driven gear 9 when the servo motor 10 is driven. The rotation of the drive shaft 8 is converted into the reciprocating rotation of the rocking shaft 7 through the double cams 12 and the double cam lever 13. The sley 1 is reciprocatingly rocked forward and backward by the reciprocating rotation of the rocking shaft 7 so that the reed 2 effects a reed beating operation.

The rotation of the drive shaft 8 is converted into the reciprocating rotation of the rapier wheel 3 through the three-dimensional crank mechanism 18 and the driven gear 20. The reciprocating rotation of the rapier wheel 3 is transmitted to the rapier band 4 through the engagement of the engaging projections 21 with the engaging holes 22 to thereby reciprocatingly move the rapier band 4. The rapier head 23 is caused to advance into and retract from the warp thread opening by the reciprocating movement of the rapier band 4. The right and left rapier wheels 3 are rotated in an opposite direction each other. Therefore, both the rapier heads 23 advance into the warp thread opening in synchronism with each other, meet at the center of the width direction of a fabric and then retracts from the warp thread opening. Weft threads (not shown) transported into the warp thread opening by the delivery rapier head 23 is delivered to the receiving rapier head. Then, when the receiving

rapier head retracts from the warp thread opening, the weft threads are inserted into the warp thread opening.

Since the belt 32 is wound around substantially one half the circumference of the rapier wheel 3 as well as caused to come into contact the rapier wheel 3 under pressure by the tension roller 31 with a proper press force, no slip is caused between the belt 32 and the rapier wheel 3. Since the belt 32 is also wound around more than one half the circumferences of the presser rollers 24, 25 as well as a proper tensile force is applied to the belt 32, no slip is caused between the belt 32 and the presser rollers 24, 25.

The presser rollers 24, 25 are rotated by the belt 32 so that the circumferential speeds of the portions thereof around which the belt 32 is wound are the same as the moving speed of the belt 32, that is, the circumferential speed of the portion of the rapier wheel 3 around which the belt 32 is wound. The portions of the presser rollers 24, 25 in contact with the rapier band 4 is rotated at a circumferential speed which is the same as the moving speed of the rapier band 4. Therefore, the presser rollers 24, 25 press the rapier band 4 against the rapier wheel 3 side in the state that no slip is caused between the presser rollers 24, 25 and the rapier band 4 to thereby regulate the separation of the rapier band 4 from the rapier wheel 3.

When a freely rotating roller is pressed against the rapier band 4, the movement of the rapier band 4 is against the inertia moment of the roller just after the direction in which the rapier band 4 moves is switched. As a result, slip is caused between the roller and the rapier band 4 and the rapier band 4 is liable to be worn. As described above, however, the presser rollers 24, 25 are positively rotated in synchronism with the rapier wheel 3 through the belt 32 which is driven by the rapier wheel 3. Therefore, the movement of the rapier band 4 is not against the inertia force of the presser rollers 24, 25 even just after the moving direction of the rapier band 4 is switched. As a result, since sliding friction is avoided between the presser rollers 24, 25 and the rapier band 4, the rapier band 4 is not worn by the sliding friction. Further, power consumption can be reduced and the durability of the rapier band can be improved.

Since the proper intervals are set between the engaging projections 21 and the engaging holes 22, when the moving direction of the 4 is reversed, the engaging projections 21 collide against the walls of the engaging holes 22. However, since the rapier band 4 is pressed against the rapier wheel 3 side by the presser rollers 24, 25 at both the ends of the circumferentially traveling portion thereof, the impact of the collision is reduced.

Further, since the tension roller 31 is disposed on the sley 1 side with respect to the rapier wheel 3 in this embodiment, the width of a loom is not increased as a whole even if the tension roller 31 is provided. In addition, since the tensile force of the belt 32 can be easily adjusted by changing the position of the tension roller 31, the tension force can be easily changed to a proper tension force corresponding to the r.p.m. of the loom.

Note, train-shaped guide plates 34 may be disposed on the sley 1 in the lengthwise direction thereof to guide the rapier band 4, as shown in FIG. 1. The guide plates 34 are engaged with both the ends of the rapier band 4 in the width direction thereof to guide the rapier band 4. The provision of the guide plates 34 can reduce a failure ratio of the delivery of the weft threads effected between the delivery rapier head 23 and the receiving rapier head.

(Second Embodiment)

Next, a second embodiment will be described with reference to FIG. 3 to FIG. 5. The second embodiment is different from the first embodiment in that a rapier band 4 is pressed against a rapier wheel 3 by a belt 37 wound between a pair of rollers 35, 36 and the rapier wheel 3 instead of being directly pressed by the aforesaid presser rollers 24, 25. The same numerals as used in the first embodiment are used to denote the same parts in the second embodiment and the detailed description of the parts is omitted.

As shown in FIG. 4 and FIG. 5, a guide groove 38 as a guide portion is formed to the rapier wheel 3 to guide the belt 37, the guide groove 38 being located at a position whose phase is dislocated in a width direction with respect to the portion of the rapier wheel 3 around which the rapier band 4 is wound (backside in the second embodiment). The guide groove is formed to a width in which only the belt 37 can be accommodated.

As shown in FIG. 3, the rollers 35, 36 are rotatably disposed on the back surface side of the portion where the papier band 4 is wound and which corresponds to the positions at which the rapier band 4 leaves the rapier wheel 3. The shafts 35a, 36a of the rollers 35, 36 are rotatably supported by the same arrangement as that of the shaft 31a of the first embodiment and the rollers 35, 36 are disposed at positions where they cannot come into contact with the rapier band 4.

As shown in FIG. 4 and FIG. 5, each of the rollers 35, 36 has a winding portion 39 formed thereto which permits the belt 37 to move between a winding portion located on the guide groove 38 side with respect to the engaging holes 4a of the rapier band 4 wound around the rapier wheel 3 and a position corresponding to the guide groove 38. The winding portion 39 has a width in which two belts 37 can be disposed side by side with enough room. The belt 37 is composed of a round elastic belt. The belt 37 is wound around the rapier wheel 3 and both the rollers 35, 36 in a letter "8" shape in the state that the belt 37 is engaged with the backside surface of the rapier band 4 on the circumferntially rotating portion of the rapier band 4 as well as engaged with the guide groove 38 on the opposite side thereof. That is, the belt 37 is wound around the rollers 35, 36 at a winding angle of 360, respectively.

When the radii of the rollers 35, 36 are represented by r, the thickness of the belt 37 is represented by t, the radius of the portion of the rapier wheel 3 around which the rapier band 4 is wound is represented by R_1 , the radius of the portion of the rapier wheel 3 around which the belt 37 is wound is represented by R_2, they are set to satisfy the following relationship.

$$(R_1 + t) : r = R_2 : r$$

That is, the radius of the rapier wheel 3 around which the belt 37 is wound, i.e. the radius of the guide groove 38 is larger than the radius of the portion thereof around which the rapier band 4 is wound by the thickness of the rapier band 4.

The rapier wheel 3 is reciprocatingly rotated likewise the first embodiment and the rapier band 4 is also reciprocatingly moved in synchronism with the rapier wheel 3 by the engagement of engaging projections 21 with engaging holes 22. Since the following relationship

$$(R_1 + t) : r = R_2 : r$$

is satisfied, the circumferential speeds of the rollers 35, 36, the moving speed of the rapier band 4, the circumferential speed of the portion of the rapier wheel 3 around which the belt 37 is wound and the circumferential speed of the backside surface of the rapier band 4 around which the belt 37 is wound are equal to each other. Therefore, the belt 37 reciprocatingly moves without causing slip by being guided by the guide groove 38 and the winding portion 39 in the state that it is pressed against the circumferentially traveling portions of the respective rollers 35, 26 and rapier band 4 and the guide groove 38. Consequently, since sliding friction is avoided between the rapier band 4 and the belt 37, the rapier band 4 is not worn by the sliding friction. Further, power consumption can be reduced and the durability of the rapier band can be improved.

Since the belt 37 presses the rapier band 4 against the rapier wheel 3 side on the entire circumferentially traveling portion thereof, an effect for preventing the floating of the rapier band 4 from the rapier wheel 3 is improved more than the first embodiment. As a result, more eased is an impact due to the collision of the engaging projections 21 against the walls of the engaging holes 22 which is caused when the moving direction of the rapier band 4 is reversed.

Since the belt 37 is composed of the round elastic belt, even if the belt 47 which is wound between the rapier wheel 3 and both the rollers 35, 36 in the letter "8" shape is twisted, the area of the belt 37 in contact with the rapier wheel 3, the rapier band 4 and both the rollers 35, 36 is not reduced, different from the case of a flat belt. Therefore, the belt 37 is smoothly moved. Further, even if the radius of the portion of the guide groove 38 defined to the rapier wheel 3 is not accurately increased by the thickness of the rapier band 4 as compared with the radius of the portion of the rapier wheel 3 around which the rapier band 4 is wound, since the error of the thickness is absorbed by the expansion/contraction of the belt 37, the belt 37 smoothly moves without causing slip between the belt 37 and the rapier band 4.

It is to be noted that the present invention is not limited to the above embodiments but may be embodied, for example, as described below.

(1) In the arrangement that the belt 32 is wound between the presser rollers 24, 25 and the tension roller 31, the tension roller 31 may be disposed on the side opposite to the weft thread inserting side with respect to the rapier wheel 3 and the rapier band 4 may be pressed by the belt 32. In the arrangement that the extreme ends of the engaging projections 21 project from the engaging holes 22 likewise the aforesaid embodiments, guide grooves 24c, 25c for guiding the belt 32 are defined to the presser rollers 24, 25, as shown in FIG. 6.

In this case, the belt 32 is wound between the presser rollers 24, 25 and the tension roller 31 in the state that the rapier band 4 is pressed against the rapier wheel 3 side on the circumferentially traveling portion thereof. Since the belt 32 is pressed against the rapier band 4 on the entire circumferentially traveling portion thereof, the belt 32 reciprocatingly moves together with the rapier band 4 without causing slip between the belt 32 and the rapier band 4. Consequently, since sliding friction is avoided between the rapier band 4 and the belt 32, the rapier band 4 is not worn by the sliding friction. Further, power consumption can be reduced and the durability of the rapier band can be improved.

Since the belt 32 presses the rapier band 4 against the rapier wheel 3 side on the entire circumferentially traveling portion thereof, an effect for preventing the floating of the rapier band 4 from the rapier wheel 3 is more improved than the first embodiment. In addition, since it suffices for the rapier wheel 3 only to have a width necessary to wind the rapier band 4, the weight of the rapier wheel 3 is reduced accordingly. Thus, inertia force is reduced to further decrease power consumption.

In addition, there nay be employed such an arrangement that two pieces of the belts 32 are used and the both sides of the rapier band 4 are pressed by the belts 32 across the engaging holes 22.

(2) The thickness of the rapier band may be larger than the height of the engaging projections. In this case, when the rapier band 4 is pressed against the rapier wheel 3 side by the belt 32 as described in the item (1), the width of the belt 32 can be increased to the same size as that of the rapier band 4, so that the effect for preventing the floating of the rapier band 4 by the belt 32 is improved. Further, the grooves 24b, 25b need not be defined to the presser rollers 24, 25 in the case of the first embodiment.

(3) When the presser rollers 24, 25 and the rollers 35, 36 are supported, they may be fixedly disposed at a predetermined position without being elastically supported through the compressed spring 30 or the tension spring 33.

(4) In the arrangement that the presser rollers 24, 25 are rotated by the belt 32 in synchronism with the rapier wheel 3 similarly to the first embodiment, the tension roller 31 may be disposed on the side opposite to the weft thread inserting side with respect to the rapier wheel 3.

(5) The rapier wheel 3 may be disposed above the weft thread inserting path of the rapier head 23. In this case, a mechanism for transmitting the rotational force to the rocking shaft 7 is different from that of the above embodiments.

(6) A multiplicity of train-shaped regulating projections may be disposed in a circumferential direction at predetermined intervals as a guide portion in place of the guide groove 38.

(7) The belt 32 is not limited to the flat belt but may be a V-belt or a round belt. Further, the belt 37 is not limited to the round belt but may be a flat belt or the like.

(8) A mechanism other than the three-dimensional crank mechanism 18 may be employed as the drive mechanism for reciprocatingly rotating the rapier wheel 3. For example, such a known arrangement may be employed that a rack is reciprocatingly moved by a crank fixed to a shaft rotated in synchronism with the crank shaft of a loom and the reciprocating movement of the rack is transmitted to the driven gear 20 through an idle gear.

Inventions other than those according to claims which can be achieved from the above respective embodiments and modified examples will be described below together with their advantages.

(1) In the invention according to claim 1, a flat belt is used as the belt. In this case, the area of the belt in contact with the rapier wheel and the rollers is increased, so that the slip of the belt is avoided even if the rapier wheel and the presser rollers have small diameters.

(2) In the inventions according to claim 1 and claim 2, the thickness of the rapier band is made larger than the height of the engaging projections. In this case, the rapier band can be pressed by the presser rollers even at the portion where the engaging holes are defined as a train, so that the effect of preventing the floating of the rapier band achieved by the presser rollers is improved. Further, a groove for preventing the contact of each of the presser rollers with the engaging projections need not be defined to the circumference of each of the presser rollers, so that the manufacture of the presser rollers is simplified.

(3) In the invention of claim 3, the thickness of the rapier band is made larger than the height of the engaging projections. In this case, the rapier band can be pressed by the presser rollers even at the portion where the engaging holes are defined as a train, so that the effect of preventing the floating of the rapier band achieved by the belt is improved.

As described above in detail, according to the inventions of claim 1 to claim 5, an increase of the width of a fabric can be coped with without increasing the diameter of the rapier wheel and moreover slip between the rapier band and the presser members can be prevented. Therefore, the floating of the rapier band is prevented as well as the rapier band is not worn by friction, so that the durability of the rapier band can be improved.

According to the inventions of claim 2, claim 4 and claim 5, the aforesaid advantages can be obtained without increasing the size of a loom.

According to the inventions of claim 3 to claim 5, since the belt presses the rapier band against the rapier wheel side on the entire circumference on the back side thereof, the floating of the rapier band is further prevented.

According to the inventions of claim 4 and claim 5, since the tension roller is not needed, the apparatus is r made compact as compared with the inventions of claim 1 to claim 3.

According to the invention of claim 5, since the belt is composed of the round belt, even if the belt wound in the letter "8" shape is twisted, the area of the belt in contact with the rapier wheel, the rapier band and both the rollers is not reduced, different from the case of the flat belt, so that the belt is more smoothly moved.

In a weft thread inserting apparatus in a rapier loom, a rapier band 4 having a first end fixed to a rapier head 23 includes a row of engaging holes 22 defined in the lengthwise direction thereof. The rapier band 4 is wound around a rapier wheel 3 in the state that the engaging holes 22 are engaged with a row of engaging projections 21 defined to the circumference of the rapier wheel 3. Presser rollers 24, 25 are rotatably disposed at positions corresponding to the positions where the rapier band 4 leaves the rapier wheel 3 and an endless belt 32 is wound aroung the rapier wheel 3, the presser rollers 24, 25 and a tension roller 31 so that the endless belt 32 does not interfere with the rapier band 4. The outside diameter of the portion of the rapier wheel 3 around which the belt 32 is wound and the outside diameters of the presser rollers 24, 25 are set such that the reciprocating speed of the rapier band 4 coincides with the circumferential speeds of the presser rollers 24, 25. With this arrangement, a wide fabric can be handled without increasing the diameter of the rapier wheel, sliding friction can be avoided between the rapier band and the presser members to thereby improve the durability of the rapier band.

Claims

1. A weft thread inserting apparatus in a rapier loom including a rapier wheel (3) having a row of engaging projections (21) provided on the circumference thereof at a predetermined pitch, and a flexible rapier band (4) having a rapier head (23) fixedly attached to a first end thereof and a row of engaging holes (22) provided therein along the lengthwise direction thereof, said rapier band (4) being wound around said rapier wheel (3) in a turned-back state with said engaging holes (22) receiving therein said engaging projections (23), wherein said rapier head (23) is inserted into and retracted from a warp thread opening upon the reciprocating rotation of said rapier wheel (3) to thereby inserting weft threads into the warp thread opening, said inserting apparatus being characterized in that:

   pressor rollers (24, 25) are rotatably disposed at positions on the outer surface side of a portion of said rapier band (4) where the inner surface of said wound rapier band (4) is in contact with said rapier wheel (3), said positions corresponding to positions at which said wound rapier band (4) leaves said rapier wheel (3);

   an endless belt (32) for transmitting the rotation of said rapier wheel (3) to said presser rollers (24, 25) is wound around said rapier wheel (3), said presser rollers (24, 25) and a tension roller (31) so that said belt (32) does not interfere with said rapier band (4); and

   a outside diameter of the portion of said rapier wheel (3) around which said belt (32) is wound and outside diameters of said presser rollers (24, 25) are set such that the reciprocating speed of said rapier band (4) coincides with the circumferental speeds of portions of said presser rollers (24, 25) in contact with said rapier band (4).

2. A weft thread inserting apparatus according to claim 1, characterized in that said tension roller (31) is disposed on the side of a sley (1) with respect to said rapier wheel (3).

3. A weft thread inserting apparatus in a rapier loom including a rapier wheel (3) having a row of engaging projections (21) provided on the circumference thereof at a predetermined pitch, and a flexible rapier band (4) having a rapier head (23) fixedly attached to a first end thereof and a row of engaging holes (22) provided therein along the lengthwise direction thereof, said rapier band (4) being wound around said rapier wheel (3) in a turned-back state with said engaging holes (22) receiving therein said engaging projections (21), wherein said rapier head (23) is inserted into and retracted from a warp thread opening upon the reciprocating rotation of said rapier wheel (3) to thereby inserting weft threads into the warp thread opening, said inserting apparatus being characterized in that:

   pressor rollers (24, 25) are rotatably disposed at positions on the outer surface side of a portion of said rapier band (4) where the inner surface of said wound rapier band (4) is in contact with said rapier wheel (3), said positions corresponding to positions at which said wound rapier band (4) leaves said rapier wheel (3);

   an endless belt (32) for transmitting the rotation of said rapier wheel (3) to said presser rollers (24, 25) is wound around said rapier wheel (3), said presser rollers (24, 25) and a tension roller (31), said tension roller (31) being disposed on the side opposite to a sley (1) with respect to said rapier wheel (3) so that said belt (32) is in contact with the outer surface of said portion of said rapier band (4); and

   a outside diameter of the portion of said rapier wheel (3) around which said belt (32) is wound and outside diameters of said presser rollers (24, 25) are set such that the reciprocating speed of said rapier band (4) coincides with the circumferental speeds of portions of said presser rollers (24, 25) in contact with said rapier band (4).

4. A weft thread inserting apparatus in a rapier loom including a rapier wheel (3) having a row of engaging projections (21) provided on the circumference thereof at a predetermined pitch, and a flexible rapier band (4) having a rapier head (23) fixedly attached to a first end thereof and a row of engaging holes (22) provided therein along the lengthwise direction thereof, said rapier band (4) being wound around said rapier wheel (3) in a turned-back state with said engaging holes (22) receiving therein said engaging projections (23), wherein said rapier head (23) is inserted into and retracted from a warp thread opening upon the reciprocating rotation of said rapier wheel (3) to thereby inserting weft threads into the warp thread opening, said inserting apparatus being characterized in that:

   rollers (35, 36) are rotatably disposed at positions on the outer surface side of a portion of said said rapier band (4) where the inner surface of said rapier band (4) is in contact with said rapier wheel (3), said positions corresponding to positions at which said rapier band (4) leaves said rapier wheel (3); and

   a belt (37) is wound around said rapier wheel (3) and said rollers (35, 36) so that a portion of said belt (37) is engaged with the outer surface of the portion of said rapier band (4) and a portion thereof is engaged with said rapier wheel (3).

5. A weft thread inserting apparatus according to claim 4, characterized in that said belt (37) is composed of a round elastic belt, a guide portion (38) for guiding said belt (37) is formed in said rapier wheel (3) at a position which is displaced in the

direction of a width of said rapier band (4) from the portion of said rapier band (4), and a winding portion (39) is defined to each of said rollers (35, 36) to permit said belt (37) to move in the width direction between said guide portion (38) and a position corresponding to the winding position of said belt (37) onto said rapier band (4).

6. A weft thread inserting apparatus according to any of claims 1 to 3, characterized in that said respective presser rollers (24, 25) have peripheral surfaces in which guide means (24c, 25c) for guiding said belt (32) are formed in the circumferential direction and said engaging projections (21) are adapted to project through said engaging holes (22).

7. A weft thread inserting apparatus according to claim 6, characterized in that said guide means are composed of guide grooves (24c, 25c) formed in said presser rollers (24, 25) in the circumferential directions thereof.

8. A weft thread inserting apparatus according to any of claims 1 to 3 and claim 7, characterized in that said belt (32) is wound around said presser rollers (24, 25) and said tension roller (31) so that the portion of said rapier band (4) wound around said rapier wheel (3) is pressed against said rapier wheel (3).

9. A weft thread inserting apparatus according to any of claims 1 to 7, characterized in that said rapier band (4) has a thickness larger than the height of said engaging projections (21).

10. A weft thread inserting apparatus according to any of claims 1 to 4 and 6 to 9, characterized in that said belt (32) is composed of a flat belt.

FIG. 1

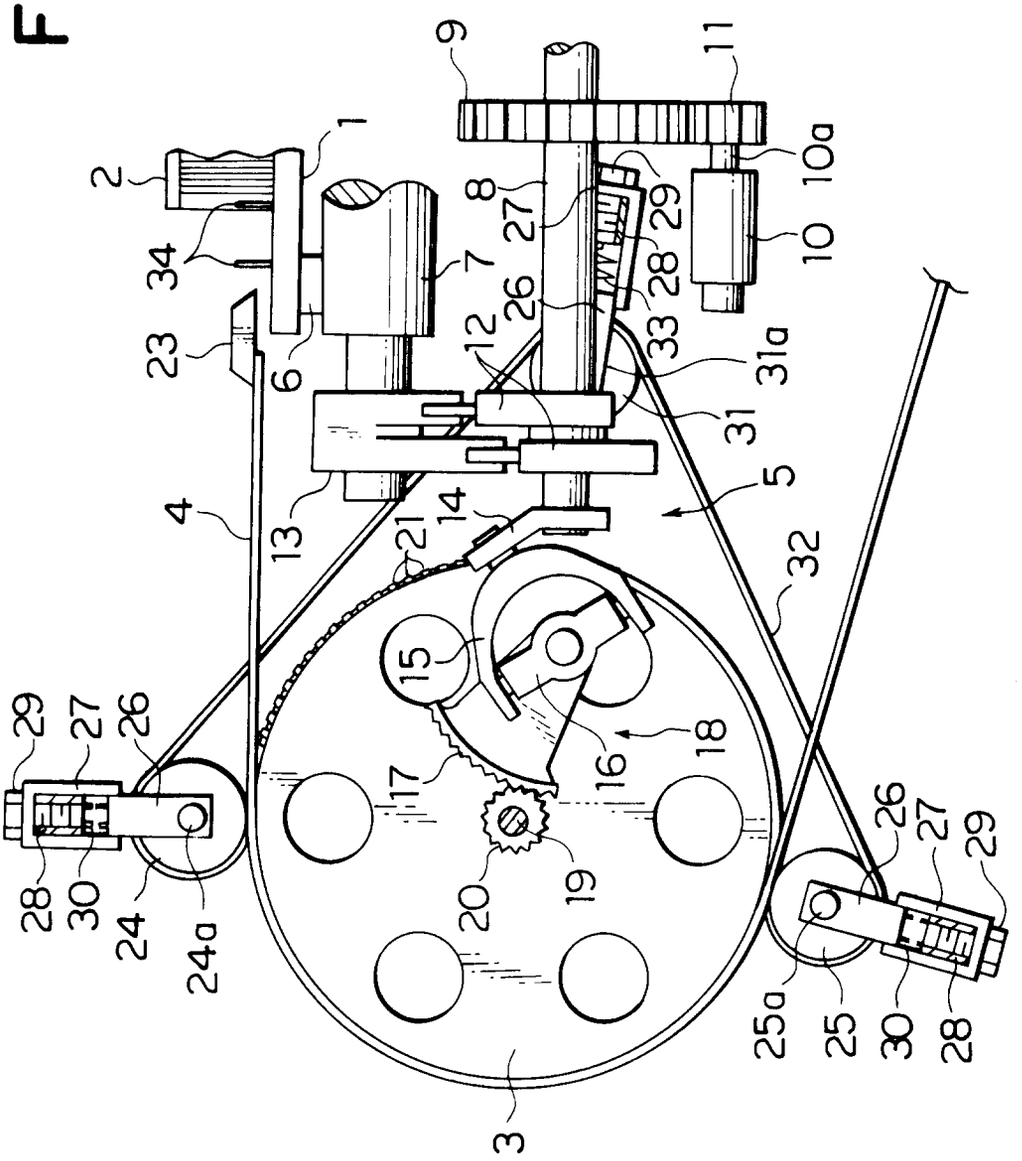
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FIG. 2

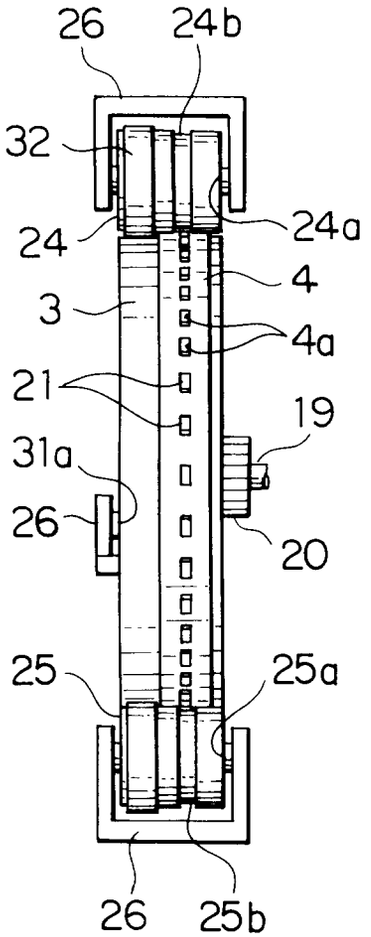

FIG. 3

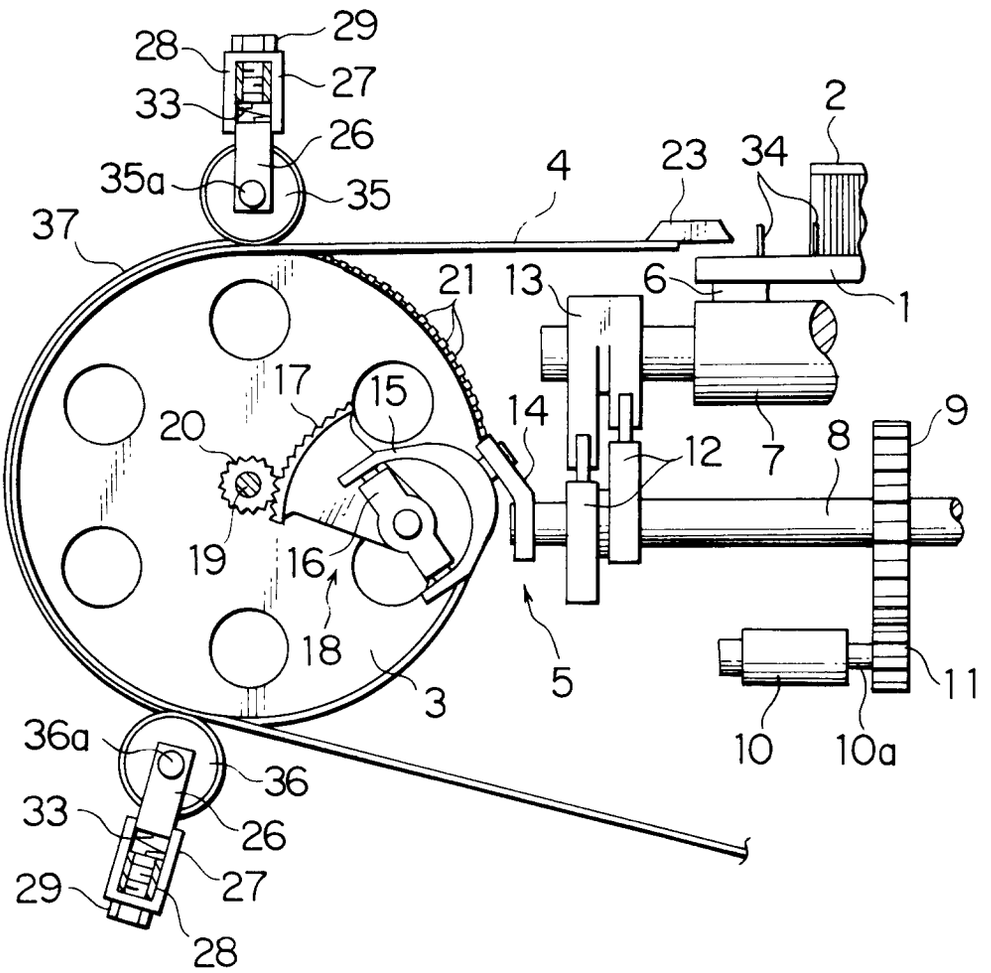
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FIG. 4

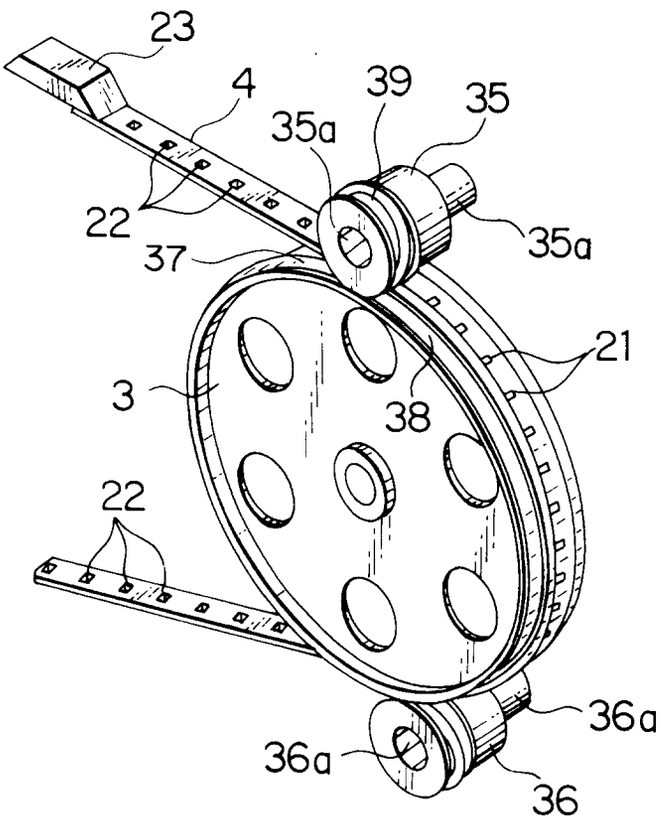

FIG. 5

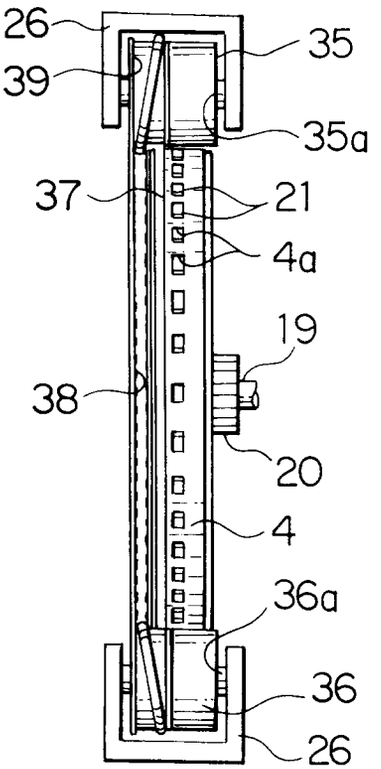

FIG. 6

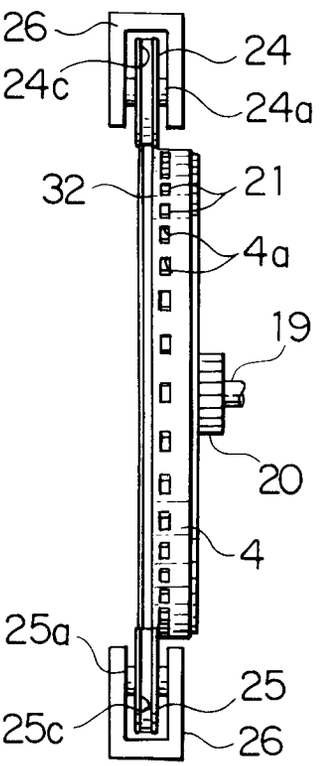

FIG. 7

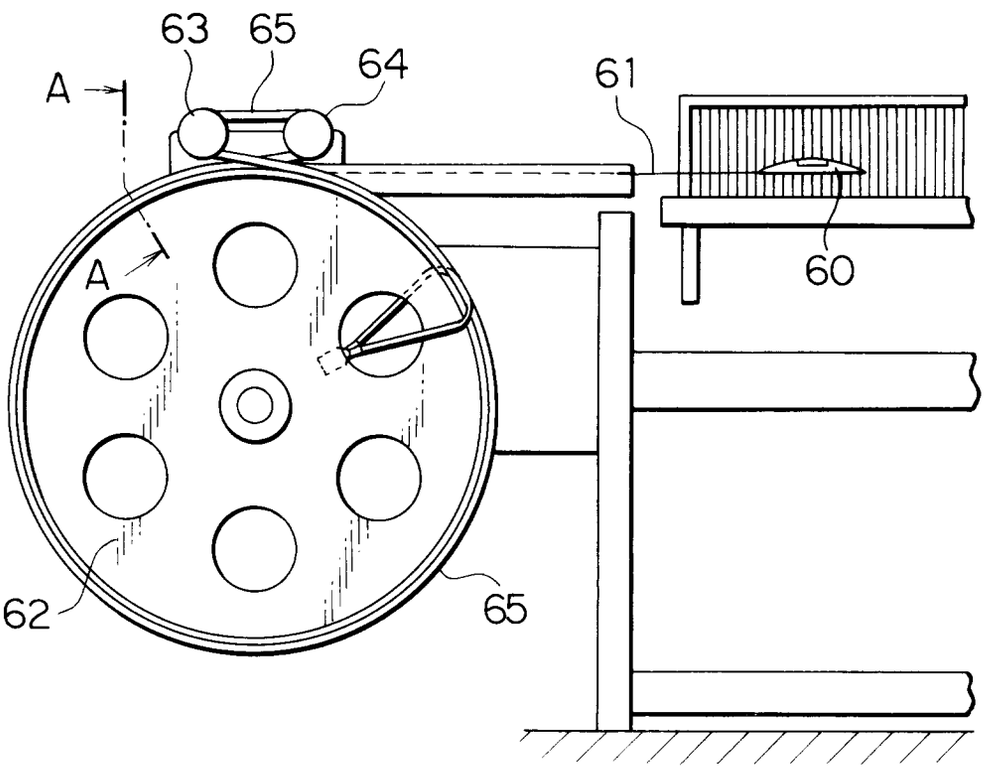

FIG. 8