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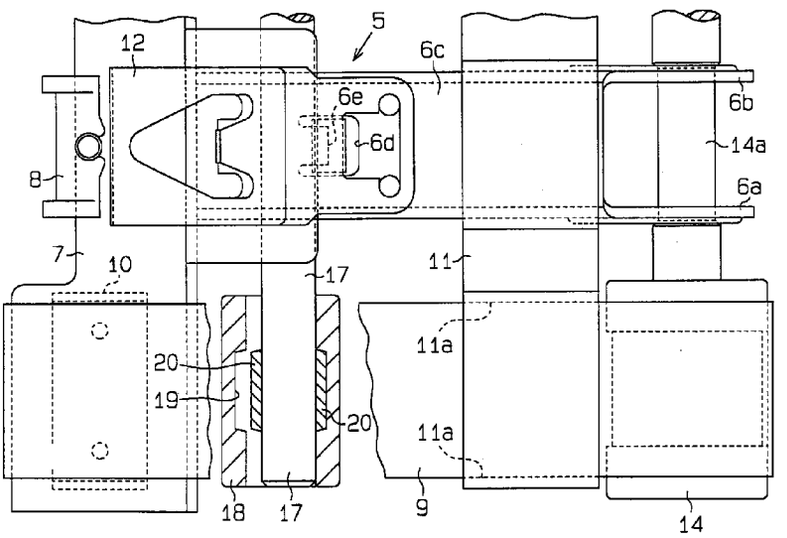
(54) Drafting apparatus in spinning machine

(57) The drafting apparatus in a spinning machine is provided with a top apron and a bottom apron, which are respectively wrapped around two pairs of drive rollers and tensors and are brought into contact with each other. An intermediate bottom roller engages the bottom apron. A weight roller engages the top apron to oppose the intermediate bottom roller and to press the top apron by its own weight toward the bottom apron. A cradle having a lateral face is located to support the top apron. A support shaft has a free end portion on which the weight roller is loosely fitted. The support shaft is cantilevered from the lateral face of the cradle. The weight roller is arranged to be removable in a direction away from the lateral face of the cradle. A restriction keeps the weight roller from shifting toward the free end of the support shaft.

Fig.1



EP 0 707 100 A2

Description

The present invention relates generally to a drafting apparatus in a spinning machine. More particularly, the present invention relates to an apron drafting system drafting apparatus which is particularly suitable for long fiber spinning.

Generally, a drafting apparatus in a spinning machine is used for drafting a rove into a thinner yarn and to uniformize the thickness of the yarn. There is known an apron drafting system drafting apparatus in which a pair of aprons consisting of endless rubber belts are each wrapped around a tensor and a drive roller. The tensors apply tension to the aprons, while the drive rollers rotate the aprons. A rove fed between the pair of aprons is drafted with the rotation of the aprons.

However, when the gauge between the tensor and the drive roller is extended for long fiber spinning in this apparatus, the force of nipping the rove between the aprons is insufficient at an intermediate part. In order to overcome such inconvenience, Japanese Patent Publication No. 28-5631 discloses a drafting apparatus in which a fluted roller is located at the middle of the lower apron to support the upper inner surface of the lower apron, while a weight roller is located at the middle of the upper apron to oppose the fluted roller and to contact the lower inner surface of the upper apron. In this publication, the constitution of the weight roller is not specifically disclosed.

A prior art drafting apparatus having such a weight roller at the middle of the apron is shown in Figs. 6 and 7. In an apron apparatus 32, located behind a front bottom roller 31a and a front top roller 31b, a top cradle 34 is located on a bottom apron 33. An intermediate bottom roller 35 is located at the middle of the bottom apron 33 to be in contact with it. The top cradle 34 comprises a pair of side walls 34a,34b and a top plate 34c connecting the side walls 34a,34b. A top apron 36 is wrapped around a top tensor 37 and a top roller 38.

The side walls 34a,34b contain supporting holes 39 in alignment with the intermediate bottom roller 35 respectively. The ends of a support shaft 40 carrying a cylindrical weight roller 41 around it are inserted in the supporting holes 39. A restricting piece 42 for restricting longitudinal movement of the support shaft 40 is pivotally supported by a pin 43 on the outer surfaces of the side wall 34a. The top apron 36 is designed to be pressed by the weight of the weight roller 41 to secure an appropriate fiber nipping state. The apron apparatus having such a weight roller 41 is attached to each spindle of the spinning machine.

In order to spin out a yarn having minimal unevenness, it is necessary to adjust the apron contact pressure to a proper level depending on the spinning condition and to replace the weight roller 41 with another having an appropriate weight depending on the spinning conditions. Since the support shaft 40 carrying the weight roller 41 around it is supported between the pair of side walls 34a and 34b in the prior art apparatus, when the weight roller 41 is to be replaced, the top roller 38 is first removed from the top cradle 34, and then the top apron 36 is removed from the top roller 38. Next, the restricting piece 42 is pivoted to expose the supporting hole 39 to withdraw the support shaft 40 out of the hole 39, and then the weight roller 41 is removed. Another weight roller 41 to be used is installed in the top cradle 34 in the reversed order. That is, inevitably, the top apron 36 must be removed from the top roller 38 when the weight roller 41 is to be replaced, and the replacement of the roller 38 requires troublesome procedures.

In addition, since the weight roller 41 is fitted loose on the support shaft 40 supported between the side walls 34a and 34b, floccules readily collect in the clearances defined between the inner surfaces of the side walls 34a,34b and the end faces of the weight roller 41 or tangle around the circumference of the support shaft 40. If such floccules collected or tangled are left as such, they grow to hinder rotation of the weight roller 41 and prevent the aprons from running stably. Accordingly, removal of the deposited floccules is required, and the weight roller 41 must be detached from the support shaft 40 for carrying out the removal operation. Thus, troublesome procedures of mounting and detaching the weight roller 41 to and from the top cradle 34 are required as in the case of replacing the weight roller 41.

The present invention was accomplished in view of the problems described above, and it is an object of the invention to provide a drafting apparatus that facilitates detaching and mounting of the weight roller located at the middle of the top apron without removing the top apron from the top roller.

In order to attain the above object, the drafting apparatus of the present invention is provided with a top apron and a bottom apron, which are respectively wrapped around two pairs of drive rollers and tensors and are brought into contact with each other. An intermediate bottom roller engages the bottom apron. A weight roller engages the top apron to oppose the intermediate bottom roller and to press the top apron by its own weight toward the bottom apron. A cradle having a lateral face supports the top apron. A support shaft has a free end portion on which the weight roller is loosely fitted. The support shaft is cantilevered from the lateral face of the cradle. The weight roller is disposed to be removable in a direction away from the lateral face of the cradle. A restricting section restricts the weight roller from shifting toward the free end of the support shaft.

The features of the present invention that are believed to be novel are set forth with particularity in the appended claims. The invention, together with the objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments taken in conjunction with the accompanying drawings in which:

Fig. 1 is a partially cut-away plan view of the drafting apparatus according to a first embodiment of the invention;

Fig. 2 is a side view showing how a weight roller is supported;

Figs. 3A and 3B are partially cut-away cross-sectional views of the drafting apparatus according to a second embodiment of the invention;

Fig. 4 is a partially cut-away cross-sectional view of the drafting apparatus according to a third embodiment of the invention;

Fig. 5 is a partial side view showing a variation of the drafting apparatus;

Fig. 6 is a partially cut-away side view of a prior art drafting apparatus; and

Fig. 7 is a cross-sectional view of the prior art drafting apparatus shown in Fig. 6.

A first embodiment of the present invention in a double-spindle type drafting apparatus will be described below referring to Figs. 1 and 2. A bottom apron 1 is wrapped around a bottom roller 2 serving as a drive roller, a bottom tensor bar 3 and an intermediate bottom roller 4 located between the roller 2 and the tensor bar 3. The bottom tensor bar 3 is secured at a predetermined position such that each end portion may protrude beyond each side edge of the bottom apron 1.

A top cradle 5, which is made of a metal, comprises a pair of side walls 6a,6b and a top plate 6c connecting these side walls 6a,6b. A top tensor 7 common to two spindles of the spinning machine is secured at the middle on the top plate 6c at a front position. The right and left side portions of the top tensor 7 are adapted to oppose the two spindles respectively. Since these side portions are substantially symmetrical, the central portion and the left side portion are shown in Fig. 1 and the right side portion is omitted.

A resin piece 8 for adjusting the tensor gauge is fitted at the front center of the top tensor 7. Guide pieces 10 (only one guide piece is shown) for restricting crosswise shifting of the top apron 9 are secured on the lower surface of the top tensor 7 at each side portion.

An opening 6d is defined in the top plate 6c of the top cradle 5 adjacent to the rear end portion of the top tensor 7, and an engaging section 6e is formed on the top plate 6c to bend downward from the front edge of the opening 6d. A leaf spring 12 for urging the top tensor 7 downward is fitted on the top plate 6c and is partly retained by the engaging section 6e. The leaf spring 12 is bent to have a hair pin-like shape in side view, and the front loop is abutted against the upper surface of the top tensor 7. A guide piece 11 having a pair of guiding sections 11a is fixed on the rear upper surface of the top plate 6c so as to restrict lateral shifting of the top apron 9.

Guide slits 13 opening downward are defined at the rear end portions of the side walls 6a,6b of the top cradle 5 respectively. A support shaft 14a is inserted to the guide slits 13 and supported therein, and a pair of top rollers 14 (only one roller is shown) are supported at the ends of the support shaft 14a to be rotatable integrally with the shaft 14a. The top apron 9 is wrapped around the top tensor 7 and the top roller 14. A known weighting arm 15 (partly shown in broken lines in Fig. 2) supports a top front roller (not shown) and a top back roller (not shown). A supporting arm 16 protrudes downward from the weighting arm 15 to rotatably support the support shaft 14a at its middle. In other words, the top cradle 5 is supported via the support shaft 14a on the weighting arm 15.

A support shaft 17 is located in the top cradle 5 such that it opposes the intermediate bottom roller 4. The support shaft 17 penetrates the side walls 6a,6b and is secured to the walls 6a,6b. A pair of weight rollers 18 (only one roller is shown) is loosely fitted to each end of the support shaft 17, and a portion of the outer surface of each weight roller 18 contacts the inner surface of the top apron 9. Accordingly, the support shaft 17 carrying the weight rollers 18 is cantilevered on the top cradle 5.

An annular recess 19 serving as an engaging section is defined on the inner surface of the weight roller 18. The engagement recess 19 has a trapezoidal cross section. A plurality of protrusions or engaging sections 20 serving as restricting sections are formed on the circumference of the support shaft 17 to engage with the outer extremity of the engagement recess 19. The minimum inner diameter of the weight roller 18, i.e. the diameter of the weight roller 18 excluding the engagement recess 19, is designed to be greater than the maximum outer width dimension of the support shaft 17, i.e., the total width of the shaft including the protrusions 20. Accordingly, the protrusions 20 do not interfere with the weight roller 18 when the roller 18 is fitted onto the support shaft 17.

Next, the operation of the drafting apparatus will be described. When the weighting arm 15 is located at a pressing position (as shown in Fig. 2) where the arm 15 presses the front top roller (not shown) and the back top roller (not shown) toward the bottom roller (not shown), the lower surface of the weighting arm 15 engages with the leaf spring 12 to weakly urge the top tensor 7 toward the bottom apron 1. The gauge between the top tensor 7 and the bottom tensor bar 3 is determined when the tensor gauge adjusting piece 8 is abutted against the upper surface of the bottom tensor bar 3. The top apron 9 is brought into contact with the bottom apron 1 by the pressure of the top roller 14 toward the bottom roller 2, the weight of the weight roller 18 and the tension of the top apron 9. The bottom apron 1 is rotated with the rotation of the bottom roller 2, while the top apron 9, which is brought into contact with the bottom apron 1, is rotated synchronously with the bottom apron 1 to transport a fiber bundle (not shown) in cooperation with the bottom apron 1.

The portions of the aprons 1,9 which are brought into contact with each other between the bottom roller 2 and the bottom tensor bar 3, i.e., the portions of the aprons

1,9 at which the fiber bundle is nipped and transported, have regions of relatively weak contacting forces. That is, if the distance between the bottom tensor bar 3 and the bottom roller 2 is relatively long, the contacting forces between the aprons 1,9 are relatively weak at the middle to exert a weak pressing force against the fiber bundle. However, according to this invention, the intermediate bottom roller 4 is located such that a contacting force is applied near the middle of the bottom apron 1. Meanwhile, with respect to the top apron 9, the weight roller 18 disposed to oppose the intermediate bottom roller 4 and to press the top apron 9 toward the bottom apron 1, so that a relatively strong force is applied to the fiber bundle.

While the weight roller 18 is removably and loosely fitted around the support shaft 17, the roller 18 is rotated while the engagement recess 19 is engaged with the protrusions 20, so that the weight roller 18 is restricted from shifting in the axial direction of the support shaft 17. Accordingly, the weight roller 18 cannot slip off the support shaft 17 during operation of the drafting apparatus, even if no supporting and restriction device is present at the ends of the weight roller 18. Further, the top apron 9 is driven while guided by the guide piece 10. The guiding section 11a restricts the aprons from shifting laterally.

When the weight roller 18 is to be replaced in accordance with a change in the spinning conditions, the pressure applied by the weighting arm 15 is first released. Next, the weight roller 18 is held by an operator facing the free end of the support shaft 17 and is manipulated to be concentric with the support shaft 17 to disengage the protrusions 20 from the engagement recess 19. In this state, the weight roller 18 is pulled toward the free end side of the support shaft 17 to detach the weight roller 18 from the support shaft 17. Since the minimum inner diameter of the weight roller 18 is bigger than the maximum outer width of the support shaft 7, the weight roller 18 can be detached easily. Next, a substitute weight roller 18 is fitted onto the support shaft 17 from the free end until the engagement recess 19 is aligned with the protrusions 20 to complete the replacement procedures.

Meanwhile, when floccules collected between the support shaft 17 and the weight roller 18 are to be removed, the weight roller 18 is detached from the support shaft 17 in the same manner as described above. After the floccules tangled around the support shaft 17 and collected within the weight roller 18 are removed, the same weight roller 18 may be re-fitted onto the support shaft 17.

As described above, since the weight roller 18 can be mounted and detached to and from the support shaft 17 with the top apron 9 remaining wrapped around the top tensor 7 and the top roller 14, replacement of the weight roller 18 and removal of floccules can be carried out more easily.

Further, in this embodiment, the weight roller 18 can be detached very easily from the support shaft 17 by bringing the weight roller 18 into a substantially concentric relationship with the support shaft 17 and pulling it toward the nearest free end of the shaft 17. Since the engaging section for restricting axial shifting of the weight roller 18 is simply the annular engagement recess 19, it can be formed easily.

Moreover, a pair of top tensors 7, a pair of top rollers 14, a pair of weight rollers 18, and a pair of top aprons 9 are located in the top cradle 5 common to two spindles. Accordingly, the procedures of incorporating the drafting apparatus into the spinning machine can be halved compared with the prior art apparatus where a cradle is attached to each spindle.

Next, a second embodiment of the invention will be described referring to Figs. 3A and 3B. The constitution of this embodiment is the same as in the first embodiment, except that the constitution of the restricting section for restricting shifting of the weight roller 18 in the axial direction of the support shaft 17 is different. The parts or members similar to those in the first embodiment are affixed with the same reference numbers respectively, and detailed description of them are omitted. Only the differences will be described below.

The support shaft 17 comprises a small diameter portion 17a locating on the free end and a large diameter portion 17b having an outer diameter bigger than the inner diameter of the weight roller 18. The small diameter end portion 17a supports the weight roller 18. The inside of the weight roller 18 is cylindrical and has no engagement recess. The support shaft 17 has no engaging protrusions.

The weight roller 18 is fitted loosely around the small diameter portion 17a, and a resin cap 21 serving as an engaging member is fitted to the free end of the small diameter portion 17a such that it can be fitted on or pulled off easily. In the state where the cap 21 is fitted on the small diameter portion 17a, clearances are present between the end faces of the weight roller 18 and the opposing faces of the large diameter portion 17b and of the cap 21, respectively. The weight roller 18 is rotated with the running of the top apron 9. Axial shifting of the roller 18 is restricted by the large diameter portion 17b and the cap 21.

When the weight roller 18 is to be detached from the support shaft 17, the cap 21 is first removed. The operator then holds the weight roller 18 and pulls it toward the nearest end of the support shaft 17. When a weight roller 18 is to he mounted, it is fitted onto the support shaft 17 from the free end, and then the cap 21 is fitted on the small diameter portion 17a. Accordingly, the weight roller 18 can be mounted or detached easily as in the first embodiment.

Alternatively, a pin 22 may be removably fitted to the free end portion of the small diameter portion 17a as the engaging member in place of the cap 21, as shown in Fig. 3B. Since the weight roller 18 has a simple cylindrical shape in both cases, no special machining is required, and the weight roller 18 can be formed more easily than in the first embodiment.

Next, a third embodiment of the invention will be described referring to Fig. 4. What is different in the third embodiment from the foregoing embodiments is that the support shaft 17 is fitted to the top cradle 5 such that it may be easily removable from the top cradle 5. A resin block 23 is fixed to it. The block 23 contains a shaft receiving hole 24 and a spring retaining hole 25 communicating to the hole 24. A coil spring 27 having a ball 26 being fixed to the inner end is retained in the hole 25 such that substantially a half of the ball 26 protrudes into the shaft receiving hole 24. The support shaft 17 has an engagement groove 28 formed circumferentially at the proximal end portion and a large diameter restricting section 29 formed at the distal end.

In this embodiment, the support shaft 17 is slidably fitted in the shaft receiving hole 24. The support shaft 17 is positioned upon engagement of the ball 26 with the engagement groove 28 when the shaft 17 is slide-fitted in the hole 24. In this state, the distance between the restricting section 29 and the outer surface of the block 23 on the top cradle 5 is slightly longer than the weight roller 18. The weight roller 18 is abutted against the restricting section 29 to limit it from shifting toward the free end side of the support shaft 17, and is rotated with the running of the top apron 9.

When the weight roller 18 is to be replaced, an operator holds the restricting section 29 of the support shaft 17 and pulls toward the free end, and the ball 26 slips off the engagement groove 28 against the urging force of the coil spring 27 to allow the weight roller 18 to be detached from the top cradle 5 together with the support shaft 17. Then, the support shaft 18 carrying a substitute weight roller 18 is fitted in the shaft receiving hole 24 to complete replacement of the weight roller 18. Accordingly, the weight roller 18 need not be subjected to special machining and can be mounted or detached easily again in this embodiment.

Although only three embodiments of the present invention have been described herein, it should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms without departing from the spirit or scope of the invention. Particularly, the present invention may be embodied, for example, in the following manners:

(1) The protrusions 20 to be engaged with the engagement recess 19 in the first embodiment may be replaced with an annular protrusion. Otherwise, a ridge may be formed as an engaging section on the inner surface of the weight roller 18, while an annular recess serving as an engaging section may be formed on the support shaft 17. While the ridge need not be annular, an annular ridge can be machined easily.

(2) As shown in Fig. 5, a plurality of shaft receiving holes 30 may be formed on the side walls 6a,6b of the top cradle 5 respectively, so that the position of the support shaft 17 to be fitted to the top cradle 5 can be changed. In this case, an optimum position of the support shaft 17 can be selected to adjust the contact pressure of the top apron 9 to a proper level.

(3) The drafting apparatus may be a single-spindle type. In this case, a first side wall of the two walls constituting the top cradle is allowed to have a notch or a slit, which permits passage of the weight roller 18 such that it opposes the support shaft carrying the weight roller 18 around it. Meanwhile, a second side wall is given a boss, which supports the support shaft such that it may oppose the notch or slit. The support shaft is cantilevered at the boss.

(4) The weight roller 18 need not be brought into contact with both the upper inner surface and the lower inner surface of the top apron 9, but may be constituted such that it is brought into contact only with the lower inner surface of the top apron 9.

(5) The leaf spring 12 and the piece 8 may be omitted. In the modification shown in Fig. 3A, the shaft 17a and the cap 21 may be threaded to engage with each other. The cap 21 may be fixed on the shaft by use of a nut that engages with the shaft. In the modification shown in Fig. 4, the shaft receiving hole 24 and the shaft 17 may be threaded to engage with each other.

It should be noted here that the expression "shaft is cantilevered" used herein means not only the state where the shaft is supported at one end such that the other end has a free end but also the state where the shaft is supported at a middle such that each end of the shaft may assume a free end.

Therefore, the present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein, but may be modified within the scope of the appended claims.

The drafting apparatus in a spinning machine is provided with a top apron and a bottom apron, which are respectively wrapped around two pairs of drive rollers and tensors and are brought into contact with each other. An intermediate bottom roller engages the bottom apron. A weight roller engages the top apron to oppose the intermediate bottom roller and to press the top apron by its own weight toward the bottom apron. A cradle having a lateral face is located to support the top apron. A support shaft has a free end portion on which the weight roller is loosely fitted. The support shaft is cantilevered from the lateral face of the cradle. The weight roller is arranged to be removable in a direction away from the lateral face of the cradle. A restriction keeps the weight roller from shifting toward the free end of the support shaft.

Claims

1. A drafting apparatus in a spinning machine having a bottom apron (1) and a top apron (9) respectively wrapped around two pairs of drive rollers (2, 14) and tensors (3,7), said bottom and top aprons (1, 9) being brought into contact with each other, an intermediate bottom roller (4) engaging the bottom apron (1), and a weight roller (18) engaging the top apron (9) to oppose the intermediate bottom roller (4) and to press the top apron (9) toward the bottom apron (1) by its own weight, said drafting apparatus being characterized by:

   a cradle (5) for supporting the top apron (9) and having a lateral face;

   a support shaft (17) having a free end on which the weight roller (18) is loosely fitted, said support shaft (17) being cantilevered from the lateral face of the cradle (5);

   said weight roller (18) being removable in a direction away from the lateral face of the cradle (5); and

   a restricting section (20, 21, 22, 29) for restricting the weight roller (18) from shifting toward the free end of the support shaft (17).

2. An apparatus according to Claim 1, wherein said weight roller is tube-shaped and has an engaging section (19) on its inner surface, said support shaft having a circular cross section and a retaining section (20) formed on the outer periphery of the support shaft, wherein said retaining section (20)is capable of engaging with the engaging section (19), said retaining section (20) constituting the restricting section, and said weight roller (18) having a minimum inner diameter larger than a maximum width of the support shaft (17).

3. An apparatus according to Claim 2, wherein said engaging section includes a ring-shaped recess (19) and said retaining section includes a protrusion (20).

4. An apparatus according to Claim 1, wherein said free end of the support shaft protrudes from the weight roller (18), wherein said restricting section comprises an engaging member (21, 22) detachably connected to the free end of the support shaft (17), and wherein said engaging member is adapted to abut against an end surface of the weight roller (18).

5. An apparatus according to Claim 4, wherein said engaging member is a cap made of resin adapted to attach to the support shaft (17).

6. An apparatus according to Claim 1, wherein said support shaft (17) is detachably coupled to the cradle (5) and wherein said restricting section is provided on the free end of the support shaft to restrict the axial movement of the weight roller (18).

7. An apparatus according to any one of Claims 1 to 6, wherein said drafting apparatus has the cradle (5) common to two spindle of the spinning machine and wherein a set of said tensor (7), top apron (9) and weight roller (18) is symmetrically located at both sides of the cradle (5).

8. An apparatus according to Claim 6, wherein said cradle (5) has a plurality of holes (20) into which the support shaft (17) is selectively inserted.

9. An apparatus according to Claim 1 further comprising a spring which urges one tensor (7) towards the other tensor (3).

10. An apparatus according to Claim 1 further comprising means for adjusting a distance between the tensors (3, 7).

Fig.1

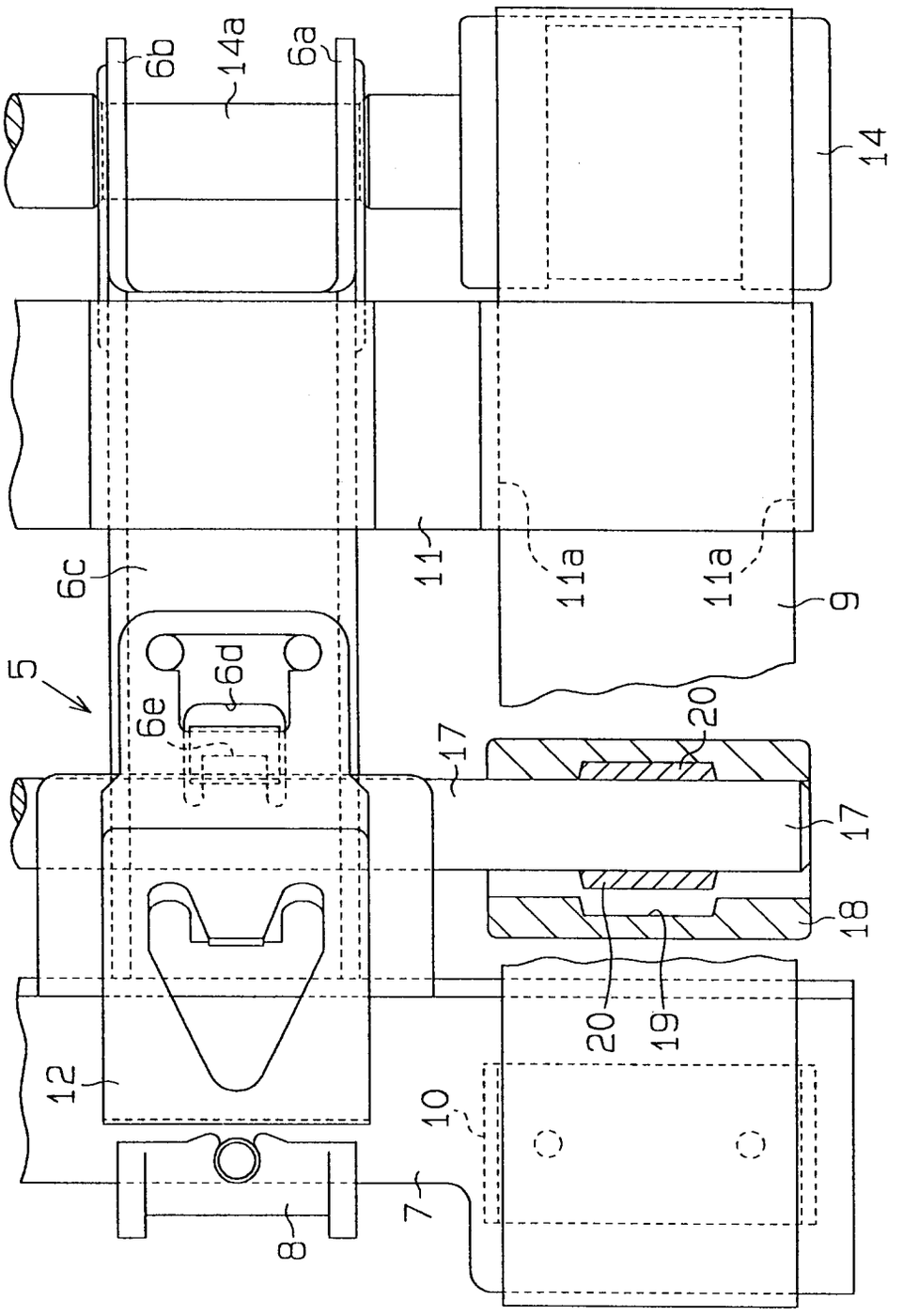


Fig.2

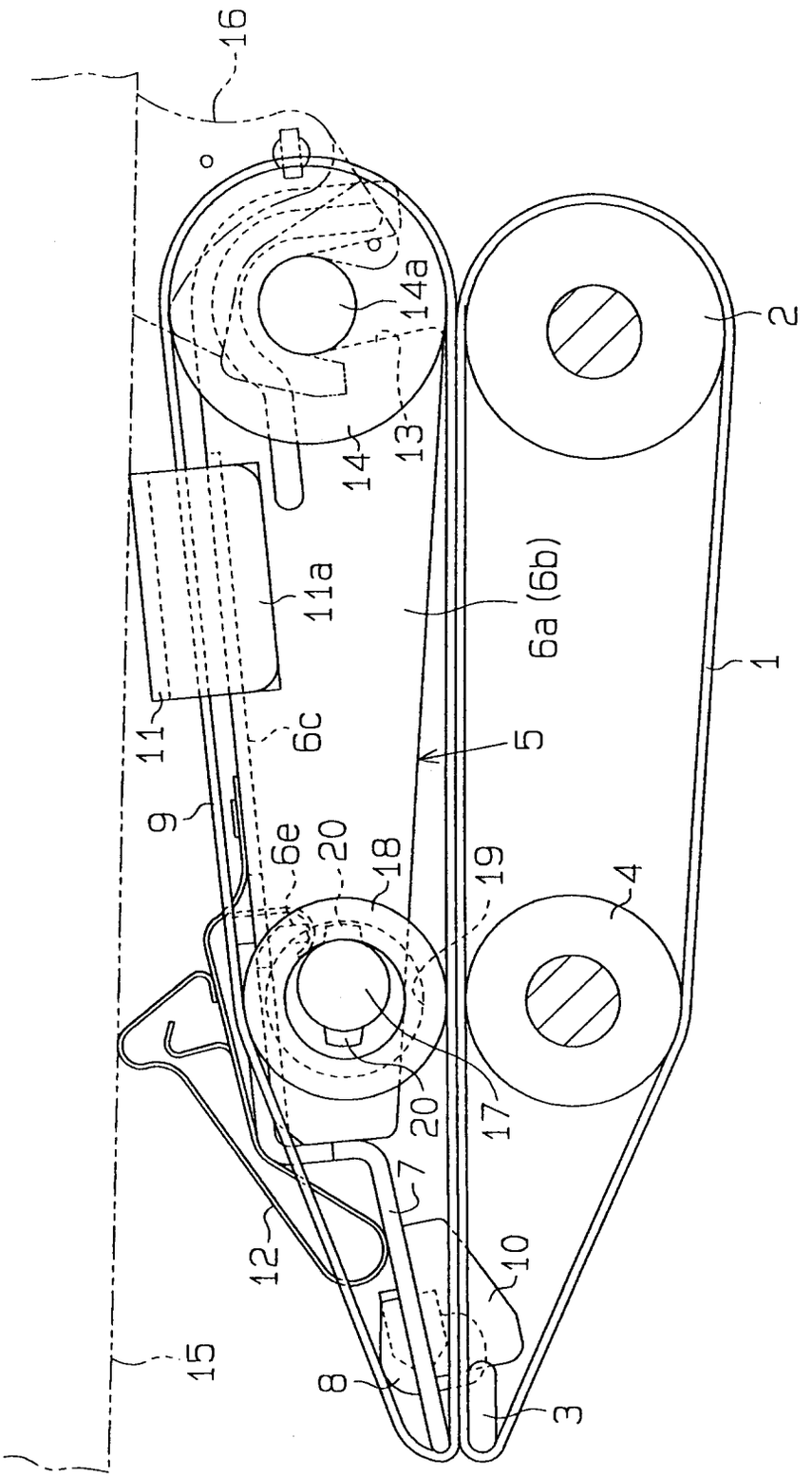


Fig.3A

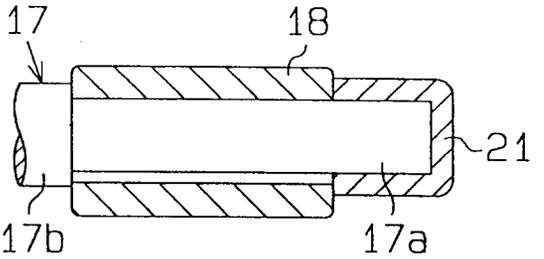


Fig.3B

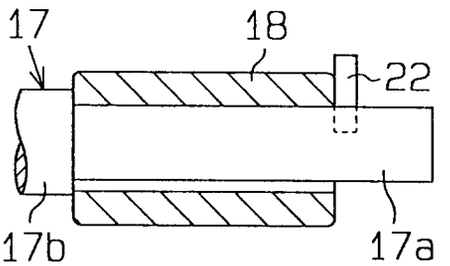


Fig.4

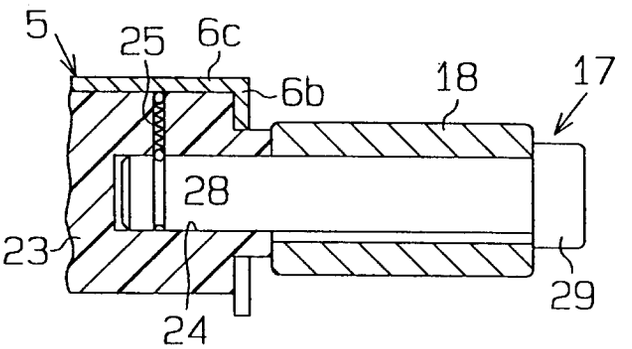


Fig.5

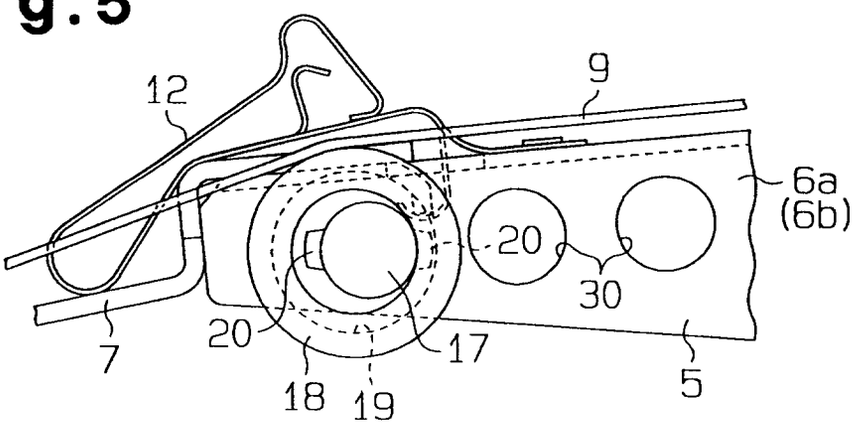


Fig.6

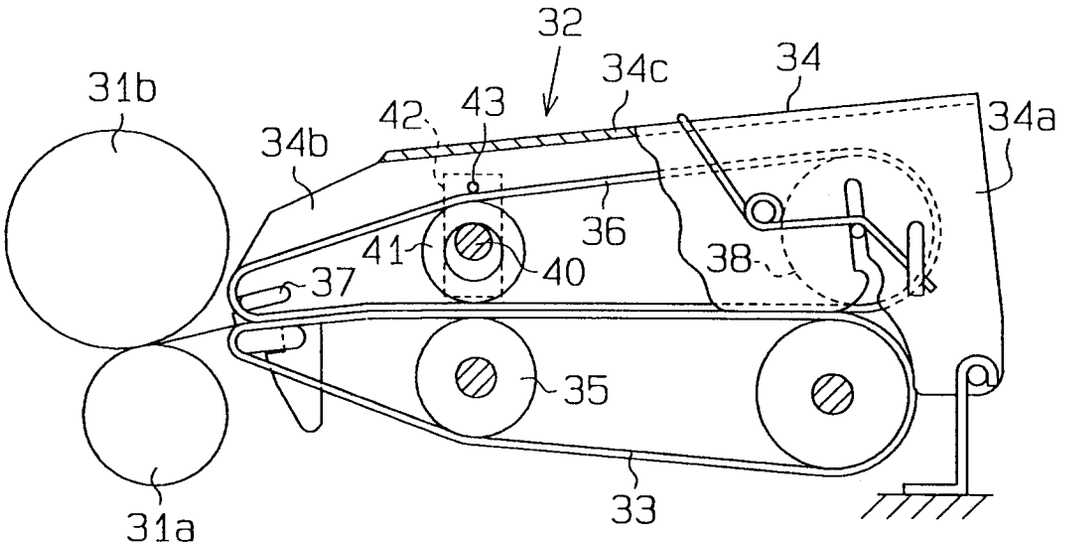

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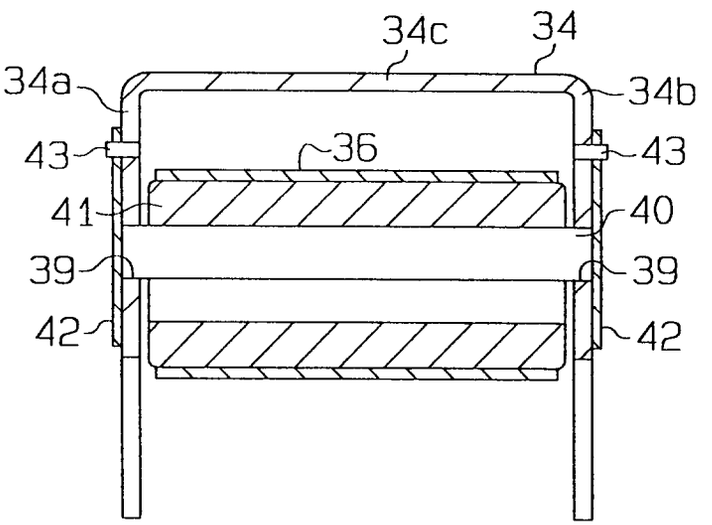
Fig.7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