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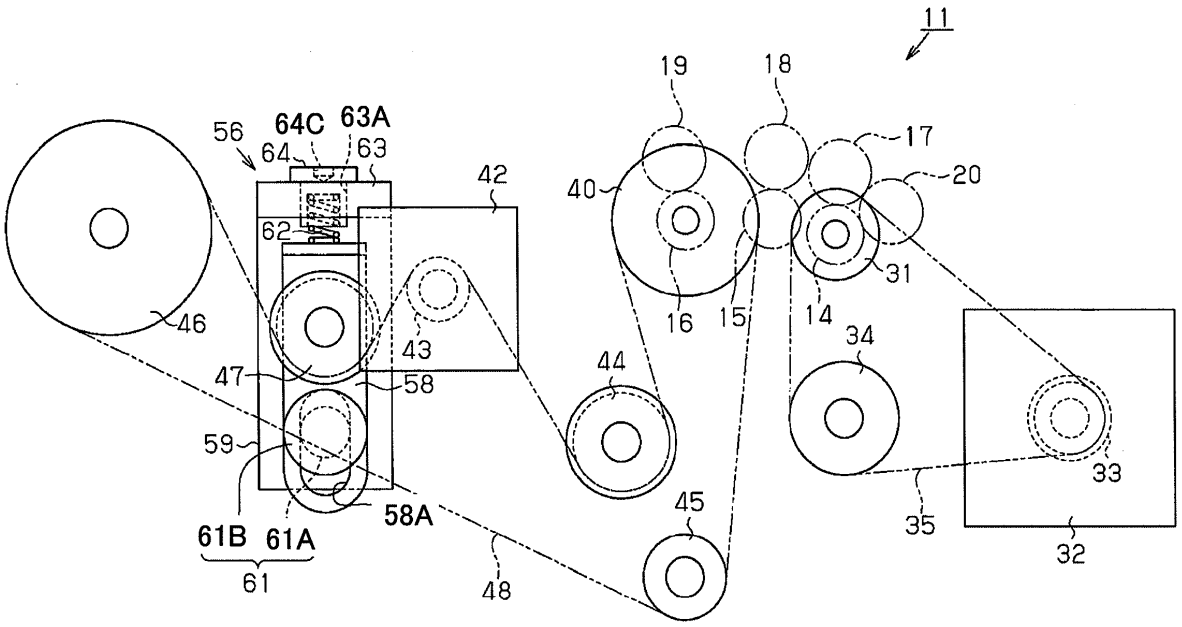
(54) Draft device in prespinning process

(57) A draft device in the prespinning process includes a bottom roller whose roller gauge is adjustable, a belt for driving the bottom roller, a tension pulley that can urge the belt downward, a support member for supporting the tension pulley, an urging member that can urge the support member downward so as to provide a desired tension to the belt through the tension pulley and an urging force releasing device for releasing an urging force of the urging member. The urging force releasing device is provided above the tension pulley so as to be operable above the tension pulley.

FIG. 1



EP 2 460 916 A2

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates generally to a draft device and, more particularly, to a draft device having belt-driven bottom rollers having adjustable roller gauge and used in the prespinning process in which a plurality of slivers is drafted by the draft device used in, e.g., a drawing frame and a comber, and combined into a strand of sliver.

[0002] In such draft device, the nip distance of the rollers (hereinafter referred to as "roller gauge") is adjusted depending on the type of fibers to be spun by a spinning machine. In a draft device whose bottom rollers are driven by a belt, the roller gauge is adjusted after the belt is loosened and subsequently the tension of the belt is adjusted to a desired value by a tension adjustment device. When the belt is lengthened over time, the tension of the belt is also adjusted by the tension adjustment device.

[0003] Published Japanese Translation H05-502271 of PCT International Publication discloses a draft device for drawing a sliver as shown in FIG 6. The draft device has drive pulleys 71, 72 that are driven by a flat belt 73 and a deflecting roller 74 provided between the drive pulleys 71 and 72 for changing the running direction P of the flat belt 73. Tension of the flat belt 73 is adjusted by another deflecting roller 76 having a tension lever 75 fixed thereto. The tension lever 75 is pivotally supported on a shaft 77. The deflecting roller 76 is urged through the tension lever 75 by a spring 78 whose length is set to a predetermined dimension so that the flat belt 73 is provided with an initial predetermined tension. The position of the deflecting roller 76 is fixed on the above condition by a clamp screw 79.

[0004] In reducing the tension of the flat belt 73 of the draft device of the above Publication, with the clamp screw 79 loosened, the tension lever 75 is tilted in the counterclockwise direction in FIG. 6 against the urging force of the spring 78 thereby to reduce the tension of the flat belt 73 and then the clamp screw 79 is tightened to fix the tension lever 75 in its tilted position. The tension lever 75 and the clamp screw 79 are located below the drive pulleys 71, 72 of the draft device. In a drawing frame and a comber having the above arrangement, the positions of the tension lever 75 and the clamp screw 79 are located below the frame to which the bracket supporting the bottom rollers of the draft device is adjustably mounted, with the result that it is troublesome to release the urging force of the spring 78 in changing the roller gauge. Additionally, the adjusted tension of the flat belt 73 may be varied depending on a work person performing the adjustment.

[0005] The present invention is directed to providing a draft device which allows a work person to release the tension of the belt easily in roller gauge adjustment and also to adjust the tension of the belt properly and easily after having adjusted the roller gauge.

SUMMARY OF THE INVENTION

[0006] A draft device in the prespinning process includes a bottom roller whose roller gauge is adjustable, a belt for driving the bottom roller, a tension pulley that can urge the belt downward, a support member for supporting the tension pulley, an urging member that can urge the support member downward so as to provide a desired tension to the belt through the tension pulley and an urging force releasing device for releasing an urging force of the urging member. The urging force releasing device is provided above the tension pulley so as to be operable above the tension pulley.

[0007] Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] 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 objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

FIG. 1 is a schematic side view of a driving mechanism for a back bottom roller of a draft device according to an embodiment of the present invention;
FIG. 2 is a schematic side view showing the draft device and a coiler according to the embodiment of FIG. 1;
FIG. 3A is a cross-sectional view taken along the line A-A of FIG. 4 showing a tension adjustment device;
FIG. 3B is a partially enlarged cross-sectional view showing a cap and a spring of the tension adjustment device of FIG. 3A;
FIG. 4 is a schematic plan view of the driving mechanism for bottom rollers of the draft device according to the embodiment;
FIG. 5 is a cross-sectional view of a tension adjustment device according to an alternative embodiment of the present invention; and
FIG. 6 is a schematic side view of a tension adjustment device according to a prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] The following will describe a draft device according to the embodiment of the present invention with reference to FIGS. 1 through 4. As shown in FIG. 2, the draft device according to the embodiment is designated generally by numeral 11. A plurality of slivers supplied from a plurality of combing heads (not shown) or from a plurality of cans of a drawing frame (not shown) is drafted

in the draft device 11 and delivered to a coiler 13 through a gatherer 12. The draft device 11 is of a three-roller type having a front bottom roller 14, a middle bottom roller 15 and a back bottom roller 16. A front top roller 17, a middle top roller 18 and a back top roller 19 are provided at positions corresponding to the front bottom roller 14, the middle bottom roller 15 and the back bottom roller 16, respectively. The bottom rollers 14, 15, 16 and the top rollers 17, 18, 19 form three pairs of rollers, namely front, middle and back pairs of bottom and top rollers, respectively. A deflecting roller 20 is provided in front of the front bottom roller 14 with respect to the traveling direction of fleece F for changing the traveling direction of the fleece F delivered from the pair of front bottom and front top rollers 14, 17 to downward movement.

[0010] The coiler 13 includes a coiler trumpet 21, a pair of coiler calendar rollers 22 and a tube wheel 23. The sliver S traveling downward from the gatherer 12 is passed through the coiler trumpet 21 and the pair of coiler calendar rollers 22 to be pressed again thereby and delivered into a can 24 by the tube wheel 23.

[0011] The following will describe the driving mechanism for the bottom rollers of the draft device 11. As shown in FIG. 4, the front bottom roller 14 is rotatably supported between a pair of brackets 30 and a pulley 31 is fixedly mounted on one end of the front bottom roller 14 for rotation therewith. As shown in FIGS. 1 and 4, the pulley 31 is driven by a drive motor 32 through a belt 35 that is wound around the pulley 31, another pulley 34 provided below the pulley 31 and a drive pulley 33 that is fixed on output shaft of the drive motor 32 for rotation therewith.

[0012] As shown in FIG. 4, the middle bottom roller 15 is rotatably supported between a pair of brackets 36 and a pulley 37 is fixed on one end of the middle bottom roller 15 for rotation therewith. The pair of brackets 36 are mounted to the frame (not shown) by bolts 38 in such a way that the position of the brackets 36 are adjustable in the direction perpendicular to the axial direction of the middle bottom roller 15. The back bottom roller 16 is rotatably supported between a pair of brackets 39 and a pulley 40 is fixed on one end of the back bottom roller 16 for rotation therewith. The pair of brackets 39 are fixed to the frame (not shown) by bolts 41 at a position that is adjustable in the direction perpendicular to the axial direction of the back bottom roller 16.

[0013] As shown in FIGS. 1 and 4, the back bottom roller 16 is driven by a drive motor 42 through a belt 48 that is wound around four pulleys 40, 44, 45, 46, a tension pulley 47 and a drive pulley 43 that is fixed on the output shaft of the drive motor 42 for rotation therewith.

[0014] Like the back bottom roller 16, the middle bottom roller 15 is driven by a drive motor 49 through a belt 50. As shown in FIG. 4, the drive motors 42 and 49 are disposed symmetrically with respect to an imaginary line extending across the front, middle and back bottom rollers 14, 15, 16 at the longitudinal center thereof as seen in FIG. 4. The middle bottom roller 15 is driven by the drive motor 49 through the belt 50 that is wound around four pulleys 37, 52, 53 (one pulley is hidden behind the pulleys 52, 53 in the drawing), a tension pulley 55 and a drive pulley 51 that is fixed on the output shaft of the drive motor 49 for rotation therewith. For the sake of convenience of illustration, the driving mechanism for the middle bottom roller 15 is omitted in FIG. 1.

[0015] The belts 35, 48, 50 are made of toothed belt and the drive pulleys 33, 43, 51 and other pulleys (e.g. pulleys 40, 45, 46) are made of toothed pulley. All the pulleys are engaged with and wound around by the toothed belts.

[0016] The following will describe the tension adjustment devices 56, 57 for the belts 48, 50, respectively. Since the tension adjustment devices 56 and 57 are substantially identical, the following description will be focused on the tension adjustment device 56 for the belt 48. As shown in FIGS. 1, 3A and 4, the tension adjustment device 56 includes a housing 59, a support member 58, a tension pulley 47 and a cylindrical guide 61 having a small-diameter portion 61A and a large-diameter portion 61 B. The tension pulley 47 is rotatably supported by the support member 58 that is supported by the housing 59 in such a way that the support member 58 is movable in vertical direction relative to the housing 59. As shown in FIGS. 1 and 3A, the support member 58 is formed in L-shape and has formed therethrough in lower part thereof an elongated hole 58A extending in vertical direction. The guide 61 is fixed to the housing 59 by a bolt 60 (shown in FIGS. 3A and 4) and the guide 61 is engaged at the small-diameter portion 61A thereof with the elongated hole 58A. The guide 61 is in contact at the large-diameter portion 61 B thereof with the surface of the support member 58 on the tension pulley 47 side thereof and the support member 58 is guided vertically in a manner that the small-diameter portion 61A of the guide 61 slides in the elongated hole 58A.

[0017] A spring such as a coil spring 62 as the urging member of the present invention is fixed at the lower end thereof to the upper surface of the support member 58 for urging the support member 58 downward. The tension adjustment device 56 further includes a support part 63 that is formed to project horizontally from the upper potion of the housing 59 and has formed therethrough a screw hole 63A at a position corresponding to the coil spring 62. A cap 64 is screwed into the support part 63 so that the external thread 64B of the cap 64 is engaged with the screw hole 63A of the support part 63. The cap 64 is formed therein with a recess 64A receiving therein the upper portion of the coil spring 62. In the embodiment, contact of the head of the cap 64 with the upper surface of the support part 63 serves to prevent the cap 64 from being screwed in further. The cap 64 has formed in the upper surface of the head thereof a recess 64C that is engageable with the tip of a screwdriver. The cap 64 functions as the urging force releasing device of the present invention for releasing the urging force of the coil spring 62.

[0018] The following will describe the operation of the above draft device 11. In the draft device 11, the front bottom roller 14, the middle bottom roller 15 and the back bottom roller 16 are driven by the drive motors 32, 49, 42, respectively, at such speeds that provide the desired draft ratio. A plurality of slivers S is drafted into a plurality of fleece F at the desired draft ratio and delivered from the paired front rollers. Subsequently, the plurality of fleece F are passed through the gatherer 12 and the coiler trumpet 21, collected into a strand of sliver S, pressed again through the paired coiler calendar rollers 22 of the coiler 13 and delivered into a can 24 through the tube wheel 23.

[0019] The middle bottom roller 15 and the back bottom roller 16, whose roller gauges are adjustable, are driven through the belts 48, 50 provided with a desired tension by the tension pulleys 47, 55 that are urged downward, respectively. The tension pulleys 47, 55 provide the tension to the belts 48, 50 by the coil springs 62 urging the support members 58 of the tension pulleys 47, 55 downward, respectively.

[0020] In adjusting the roller gauge, the work person releases the urging force of the tension pulleys 47, 55 on the belts 48, 50, respectively, by removing the cap 64 from the support part 63. Then, the positions of the back bottom roller 16 and the middle bottom roller 15 are adjusted by changing the fixing positions of the brackets 39, 36 so as to adjust the roller gauge to a target value. The work person may remove the cap 64 by putting the tip of the screwdriver in the recess 64C of the cap 64 and turning the screwdriver. The work person can operate the urging force releasing device easily for releasing the urging force of the coil spring 62 because the cap 64 as the urging force releasing device is located above the tension pulleys 47, 55.

[0021] After the roller gauge has been adjusted, the work person screws the cap 64 into the screw hole 63A of the support part 63 until the external thread 64B of the cap 64 is prevented from being screwed into the screw hole 63A further, in other words, until the head of the cap 64 comes in contact with the upper surface of the support part 63. In this state of the cap 64, the tension adjustment devices 56, 57 are set to a state in which the coil springs 62 urge the tension pulleys 47, 55 through the support members 58 so as to provide the desired tension to the belts 48, 50, respectively.

[0022] When the belt 48 or 50 is lengthened due to the temporal change, the belt 48 or 50 needs to be replaced by a new one. Alternatively, the coil spring 62 of the tension adjustment device 56 or 57 needs to be changed to a spring that provide the desired tension to the lengthened belt 48 or 50 through the support member 58 and the tension pulley 47 or 55. The tension adjustment device 56 or 57 of the present embodiment allows the coil spring 62 to be replaced by a new one having a spring constant that provides the lengthened belt 48 or 50 with the same urging force as that before the belt 48 or 50 was lengthened. The tension adjustment device 56 of the present embodiment also allows the cap 64 to be replaced by a new one that is formed with a recess, such as 64A, having a depth that permits the cap when screwed into contact with the upper surface of the support part 63 to provide the desired tension to the lengthened belt 48 or 50.

[0023] The draft device 11 according to the embodiment of the present invention offers the following advantageous effects.

(1) In the draft device 11, the middle bottom roller 15 and the back bottom roller 16 whose roller gauges are adjustable are driven by the belts 50 and 48, respectively. The tension adjustment devices 56, 57 of the draft device 11 include the tension pulleys 47, 55 urging the belts 48, 50 downward, and the urging member (or the coil spring 62) urging downward the support members 58 so that the tension pulleys 47, 55 supported by the support member 58 urge and provide the belts 50, 48 with the desired tension. The tension adjustment devices 56, 57 further include the urging force releasing devices (or the caps 64) that are located at a position above the tension pulleys 55, 47, respectively, and release the urging force of the urging member (or the coil spring 62). Therefore, in adjusting the roller gauges of the middle bottom roller 15 and the back bottom roller 16, the operations for releasing the tension of the belts 50, 48 and for providing the desired tension to the belts 50, 48 after the adjustment of the roller gauges can be accomplished without any difficulty.

(2) The spring (or the coil spring 62) serves as the urging member of the present invention. A hydraulic damper may be used as the urging member. However, the use of the spring is advantageous over the hydraulic damper in that the urging member can be made compact.

(3) The coil spring 62 forms a part of the tension adjustment devices 56, 57 for providing the desired tension to the belts 48, 50, respectively, when the coil spring 62 is urged by the cap 64 engaged with the upper end of the coil spring 62. The cap 64 is fixed to the support part 63 projecting from the housing 59 in a manner that the external thread 64B of the cap 64 is engaged with the screw hole 63A of the support part 63 and contact of the head of the cap 84 with the upper surface of the support part 63 prevents the cap 84 from being screwed in further when the desired tension generated by the coil spring 62 is provided to the belt 48 or 50. When the cap 64 is removed from the housing 59, the urging force of the coil spring 62 providing the tension to the belt 48 or 50 is released. When the cap 64 is screwed again into the screw hole 63A of the support part 63 until the head of the cap 64 contacts with the upper surface of the support part 63, the cap 64 is

prevented from being screwed further into the screw hole 63A, and then the coil spring 62 urges the support member 58 thereby to provide the desired tension to the belt 48 or 50. Thus, the embodiment of the present invention allows any work person to adjust the tension of the belt 48 or 50.

(4) In case when the belt 48 or 50 is lengthened due to the temporal change, the tension adjustment of the lengthened belt may be made by replacing the coil spring 62 or the cap 64 instead of replacing the belt 48 or 50. Therefore, the cost for part replacement can be made lower as compared with a case of replacing the belt by a new one.

[0024] The present invention is not limited to the above embodiment, but may be practiced in various ways as exemplified below.

- A hydraulic damper 65 may be used as the urging member of the tension adjustment device, as shown in FIG. 5. The hydraulic damper 65 is connected with a transfer valve 69. The transfer valve 69 is selectively connectable through a conduit 67A to an oil tank 66 supplying hydraulic oil to the hydraulic damper 65 at a predetermined pressure and also to a drain tank 68 through a conduit 67B. When the hydraulic damper 65 is connected to the oil tank 66 through the conduit 67A, the tension adjustment device 56 hydraulically urges the support member 58 to a position where the support member 58 provides the desired tension to the belt 48 through the tension pulley 47. When the hydraulic damper 65 is connected to the drain tank 68 through the conduit 67B, on the other hand, the hydraulic urging force of the tension adjustment device 56 is released. In this case, when the position of the back bottom roller 16 is changed for adjusting the roller gauge, the positional adjustment of the back bottom roller 16 can be accomplished without any difficulty because of the absence of the tension to the belt. The transfer valve 69 may be of a hand-operated type having an operation lever 69A, as shown in FIG. 5. The transfer valve 69 is disposed at such a position that a work person can operate the operation lever 69A of the transfer valve 69 at a position that is above the tension pulley 47. The hand-operated valve includes a detent mechanism (not shown) for keeping the hydraulic damper 65 connected to either the oil tank 66 or the drain tank 68. The tension adjustment device 57 for the middle roller belt 50 may have the same structure as the tension adjustment device 56 shown in FIG. 5. Additionally, in the case when the belt 48 or 50 is lengthened due to the temporal change, the hydraulic damper 65 connected to the oil tank 66 through the conduit 67A can urge the support member 58 to a position where the lengthened belt 48 or 50 is provided with the desired tension.
- The transfer valve 69 may be provided by an electromagnetic valve. In this case, the operating switch of the electromagnetic valve is disposed so that a work person can operate the operating switch at a position that is above the tension pulley 47.
- The coil spring 62 as the urging member may be replaced by a leaf spring. In this case, the leaf spring is fixed at the lower end thereof to the support part 63 and engaged at the upper end thereof with the cap 64. When the cap 64 is screwed into the screw hole 63A until the cap 64 is brought into contact with the upper surface of the support member 58, the belt is provided with the desired tension by the leaf spring.
- When the coil spring is used for the urging member, the lower end of the coil spring may not be fixed to the support member 58 and only the upper end of the coil spring may be fixed to the cap 64. In this case, when the cap 64 is removed, the coil spring is removed together with the cap 64.
- The cap 64 need not be formed with the thread on the entire length of its small diameter portion. Specifically, no external thread may be formed on part of the cap 64 adjacent to the tip end thereof and such part is formed with a reduced diameter. In this case, the number of times of turning the cap 64 until the cap 64 contacts with the upper surface of the support part 63 is reduced.
- The shape of the recess 64C of the cap 64 need not be slotted, but the cap 64 may be formed with a Phillips head or a hexagon socket head.
- The structure for fixing the cap 64 to the support part 63 is not limited to the structure in which the cap 64 is screwed into the screw hole 63A. For example, the cap 64 may dispense with the external thread 64B and the recess 64C. Instead of the screw hole 63A, the support part 63 may have formed therethrough a hole through which the cap 64 is passed. For holding the cap 64, a retainer may be provided that is movable between the retaining position for holding the cap 64 and the releasing position for releasing the cap 64. When the retainer is moved to the releasing position, the cap 64 can be removed from the hole of the support part 63. When the retainer is moved to the retaining position, the retainer holds the cap 64 at a position where the support member 58 is urged through the coil spring 62 and the tension pulleys 55, 47 provide the desired tension to the belts 50, 48, respectively..
- The draft device according to the present invention is not limited to the three-roller type, but may be of either four-roller type, five-roller type or two-roller type that is composed of the front roller and the back

roller.

- The draft device 11 may dispense with the deflecting roller 20 that is provided in front of the front bottom roller 14.

- The draft device 11 used in the prespinning process is not limited to a drawing frame and a comber, but it may be applied to a spinning machine performing a process of drafting a plurality of slivers into a strand of sliver, e.g., a sliver-wrap machine or a ribbon-wrap machine.

- The prespinning process may be a process in which a wide fiber bundle (or a web) is drafted into a sliver, such as carding.

- Instead of the structure in which the urging force of the coil spring 62 is completely released when the cap 64 is removed, the cap 64 may not be removed when the urging force is completely released. In this case, the urging force is released in a manner that the coil spring 62 extends to its free length before the cap 64 is completely loosened. Alternatively, when the cap 64 is completely loosened, the coil spring 62 extends to a predetermined length and, accordingly, provides small tension that allows a work person to adjust the roller gauge without any difficulty. In the present invention, this case is included in the operation of releasing the urging force of the urging member. In this case, the cap 64 needs not be removed and, therefore, loss of the cap 64 will not take place and the trouble of reinstalling the cap 64 for providing the urging force again can be saved.

[0025] A draft device in the prespinning process includes a bottom roller whose roller gauge is adjustable, a belt for driving the bottom roller, a tension pulley that can urge the belt downward, a support member for supporting the tension pulley, an urging member that can urge the support member downward so as to provide a desired tension to the belt through the tension pulley and an urging force releasing device for releasing an urging force of the urging member. The urging force releasing device is provided above the tension pulley so as to be operable above the tension pulley.

Claims

1. A draft device (11) in prespinning process comprising:

   a bottom roller (15, 16) whose roller gauge is adjustable;
   a belt (48, 50) for driving the bottom roller (15, 16);
   a tension pulley (47, 55) that can urge the belt (48, 50) downward;
   a support member (58) for supporting the tension pulley (47, 55);
   an urging member (62, 65) that can urge the support member (58) downward so as to provide a desired tension to the belt (48, 50) through the tension pulley (47, 55); and
   an urging force releasing device (64) for releasing an urging force of the urging member (62, 65), **characterized in that** the urging force releasing device is provided above the tension pulley (47, 55) so as to be operable above the tension pulley (47, 55).

2. The draft device (11) according to claim 1, **characterized in that** the urging member (62) is a spring (62).

3. The draft device (11) according to claim 2, **characterized in that** the draft device further comprising:

   a tension adjustment device (56, 57) adjusting a tension of the belt (48, 50) through the spring (62), wherein the tension adjustment device including:

      a housing (59, 63) having a screw hole (63A); and
      a cap (64) engaged with upper end of the spring (62) and having an external thread (64B), wherein the external thread (64B) of the cap (64) is screwed into the screw hole (63A) of the housing (59), wherein the tension adjustment device (56, 57) can prevent the external thread (64B) of the cap (64) from being screwed into the screw hole (63A) further with the belt (48, 50) provided with the desired tension by the urging force of the spring (62).

4. The draft device (11) according to claim 3, **characterized in that** the tension adjustment device (56, 57) further including:

   a guide (61) that is cylindrically-shaped, fixed to the housing (59) and has a small-diameter portion (61A) and a large-diameter portion (61 B), wherein the support member (58) having:

      an elongated hole (58A) extending in vertical direction, wherein the guide (61) is engaged at the small-diameter portion (61A) with the elongated hole (58A) so that the support member (58) is guided vertically.

5. The draft device (11) according to any one of claims 3 through 4, **characterized in that** the cap (64)

forms the urging force releasing device (64) and further including:

a head, wherein the external thread (64B) of the cap (64) is prevented from being screwed in further when the head comes in contact with upper surface of the housing (59).

6. The draft device (11) according to claim 5, **characterized in that** the urging force releasing device (64) is formed to be no longer removed from the draft device (11) when the urging force releasing device (64) releases the urging force of the urging member (62).

7. The draft device (11) according to claim 1, **characterized in that** the urging member (65) is a hydraulic damper (65).

8. The draft device (11) according to claim 7, **characterized in that** the draft device (11) further comprising:

an oil tank (66) supplying hydraulic oil at a predetermined pressure;
a drain tank (68) recovering the hydraulic oil; and
a transfer valve (69) through which the hydraulic dumper (65) is connected to either the oil tank (66) or the drain tank (68).

9. The draft device (11) according to claim 2, **characterized in that** the draft device further comprising:

a tension adjustment device (56, 57) adjusting a tension of the belt (48, 50) through the spring (62), wherein the tension adjustment device including:

a housing (59, 63) having a hole (63A);
a cap (64) engaged with upper end of the spring (62), wherein the cap (64) is passed through the hole (63A) of the housing (59), and
a retainer that is movable between a retaining position for holding the cap (64) and a releasing position for releasing the cap (64), wherein the retainer holds the cap (64) at a position where the belt (48, 50) is provided with the desired tension by the urging force of the spring (62) when the retainer is in the retaining position.

FIG. 1

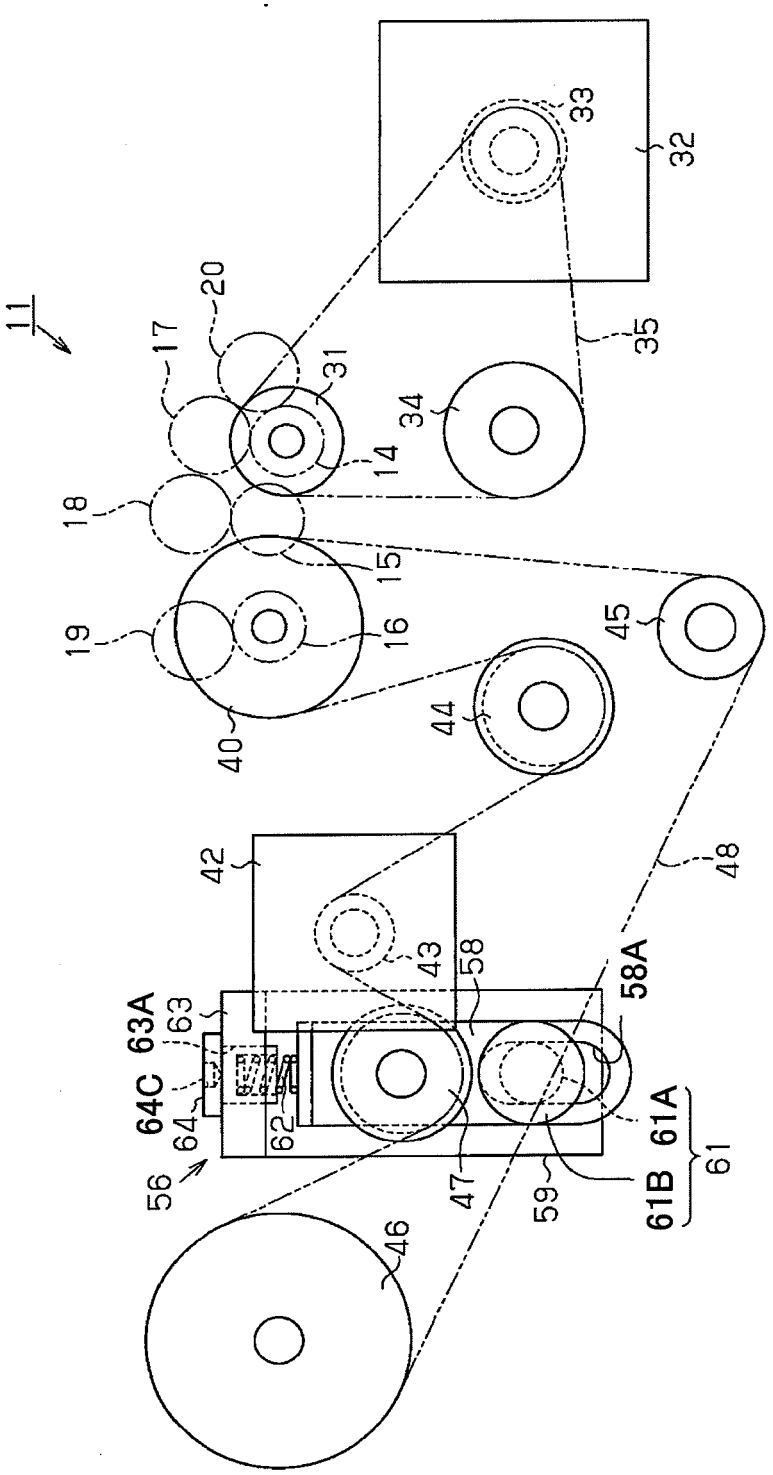

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FIG. 2

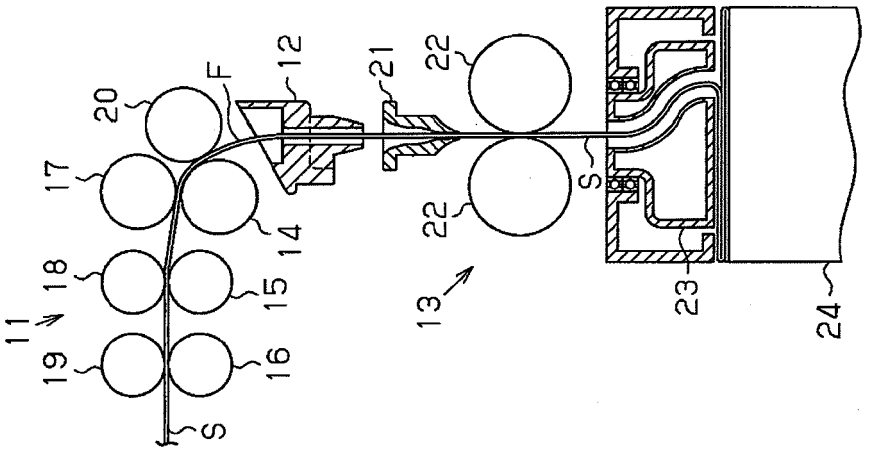

FIG. 3B

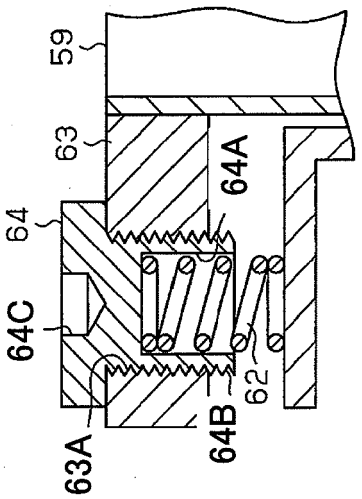

FIG. 3A

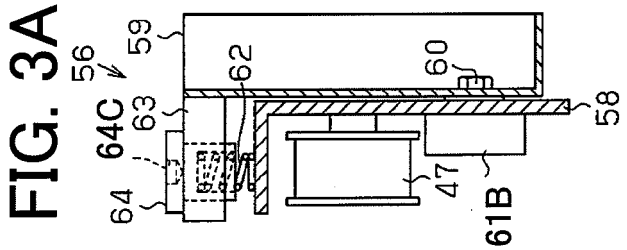

FIG. 4

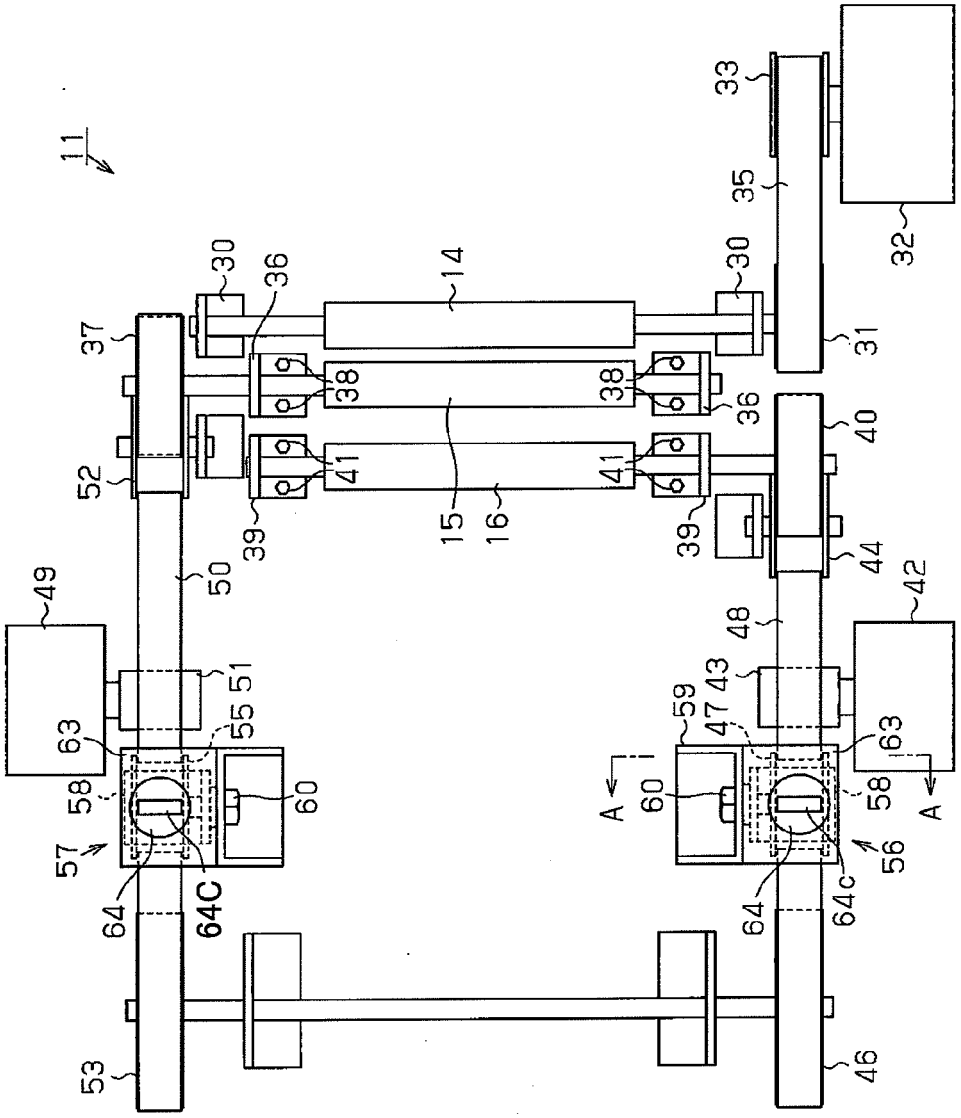
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FIG. 5

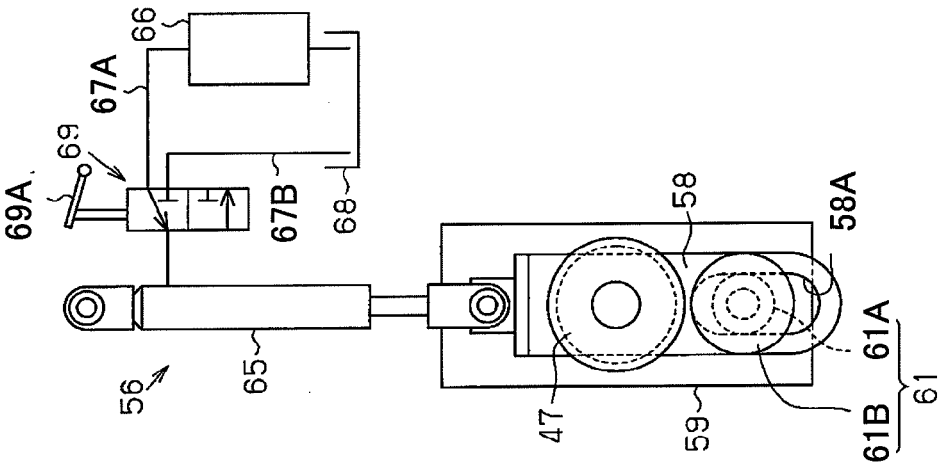
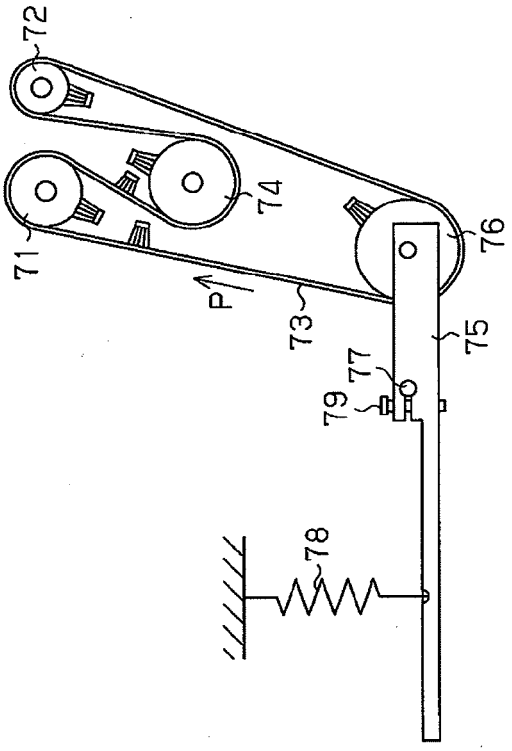


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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