

SPEED CHANGE GEARBOX OF A SPEED-ADJUSTABLE CLOTH-ROLLING MACHINE WITH A SAFETY DEVICE

BACKGROUND OF THE INVENTION

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1. Field of the Invention

The present invention relates to a speed change gearbox of a cloth-rolling machine and, more particularly, to an apparatus which can easily adjust the speed of the cloth spool to distribute the tightness of the cloth well. Moreover, it's easy to control the engagement of the toothed wheel for facilitating the speed change. Meanwhile, when the output of the cloth from the circular knitting machine is uncommonly slow to influence the cloth-pulling, the present invention is able to slow down the cloth-pulling action for fear that the knitting needles is broken due to the rapid accumulation of the cloth. In addition, a warning sound will be given for informing the operators to perform the trouble-shooting.

2. Description of the Prior Art

The cloth knitted by the conventional circular knitting machine has to be suitably pulled by a cloth-rolling machine so that the cloth can be rolled up in different tightness and weight. Consequently, the rotation speed and the strength stability of the cloth-rolling machine in pulling cloth play an important roll for the quality of finished product. Thus, the rotation speed of the cloth-pulling roller is adjustable in accordance with the quality and the different tightness of cloth material in order to produce cloth of different density required.

However, in the conventional speed change gearbox of a cloth-rolling machine,

an infinitely variable speed change apparatus by means of belt transmission or changing the transmission gear with different tooth number are used to achieve the speed change effect. However, a slippery effect often happens to the belt transmission in transmitting cloth-pulling power of the heavy loading, and this will cause an uneven tightness in pulling the cloth so that the knitting needles are seriously worn out and the service life thereof is much influenced. A better power transmission will be achieved by changing the engaged toothed wheels. However, it's troublesome and inconvenient to change different transmission gears, and the required rotation speed won't be attained until a correct calibration by replacing for many times.

10 The improved prior arts own an excellent using effect. However, the gradually more and more precise knitting technique, no matter in knitting patterns, layers, density, etc., will influence the cloth-output speed. The less speed change and the speed reduction of these prior arts can't meet the requirement of the modern and complicate cloth patterns or figures. Moreover, the gearbox and the pivoting shaft are arranged in eccentric manner, and the eccentric rotation will cause uneven cloth-pulling at the right and left sides. These are their disadvantages.

The conventional gearbox makes use of a main transmission shaft to drive a left stepped gear set which will thereafter drives another front stepped gear set. Then, the telescopic pivot shaft of the front stepped gear set drives a right transmission gear.

20 The engaged gear ratio of the right transmission gear can be chosen by means of the turn-control hand wheel and the toothed-bar pull rod so that the different reduction rotation ratio between the front stepped gear set and the right engaged stepped gear set is produced. However, the four stepped gear sets of the speed change gearbox are complicate in configuration. When the engaged gear speed is changed, the average speed ratio of every macro-adjustable step can't be obtained. The speed of the neighbored macro-adjustable steps is changed, the front and rear micro-adjustable steps of the single macro-adjustable step gear set in combination with the micro-

adjustable steps of the two neighbored front and rear macro-adjustable steps gear set will create the repetition of the multiple micro-adjustable steps. Therefore, it will be found after the gear shift that the continuous speed change of the two neighbored macro-adjustable steps is not performed in accordance with the average speed. The most serious situation is that the knitted cloth is heavy and its strip clearance doesn't meet the requirement after knitted for a great section. This will cause a great cloth loss. Moreover, the transmission gear shaft can be telescopic so that it is much more difficult to precisely control the speed change ratio in using. In addition, the torque strength of the transmission gear shaft is insufficient so that it's easy to cause the teeth collapse or another troubles. Furthermore, the disassembly and the maintenance are not easy, and its production cost is high. These are the disadvantages thereof.

In order to reach the automatic gear shift of the above-mentioned gearbox, a clutch is an indispensable part. The separation and the connection between the conventional clutch gear set and the stepped gear set are shown in Fig. 1. The power inside of the gearbox 91 is transmitted by the drive shaft 911 to the clutch gear set which is fixed on a rotatable guide post 912. The gearbox 91 is fitted with a stepped gear set 92 at the center thereof which is extended outwards with a cloth-pulling power shaft 913. A pivot shaft 931 above the gearbox 91 is pivotally disposed at one end of a clutch slide plate 93 which includes a long hole 932 at the center thereof in order for a moving rod 941 to bring an eccentric wheel 94 into rotation therein. The other end side of the clutch slide plate 93 is provided with a bevel guide rail 915 slopingly extending in the direction of the center. The bevel guide rail 915 can be received at the top side of the guide post 912.

The speed change is performed in the manner that the gearbox 91 completely stops its operation to pull the moving rod 941 to enable the clutch slide plate 93 to rotate counterclockwise. Therefore, the top of the guide post 912 is rotated by the bevel guide rail 915 of the clutch slide plate 93 while the clutch gear set is disengaged

from the stepped gear set 92. Then, the clutch gear set is adjusted to be shifted to another preset position (the top of the guide post 912 also slides at another position inside of the bevel guide rail 915). The moving rod 941 restores itself back to the original position to enable the guide post 912 to rotate so that the clutch gear set also
 5 restores itself to be engaged with another toothed wheel of the stepped gear set 92.

Though the above-mentioned is able to simplify the speed change operation of the gearbox, it's much difficult to change the engagement position of the clutch gear set with the stepped gear set 92 because the clutch slide plate 93 moves in a rotation manner, the bevel guide rail 915 extends itself in a sloping way and the clutch gear set
 10 is restricted by the guide post 912. A correct engagement will be achieved only after a repeated correction of angle.

Furthermore, the circular knitting machine is situated at rapid knitting movement for a long time. It is unavoidable that the cloth output is in trouble due to the wear-out of the knitting needles or another defects. When the cloth output is slow, an
 15 uncommon pulling force will be created by the cloth-rolling machine. Generally, a protection apparatus is provided for prevention of a more serious defect of another device due to the uncommon pulling force. A common device to protect against the uncommon pulling force, as shown in Fig. 2, makes use of a cloth-pulling power shaft 913 as power output. The cloth-pulling power shaft 913 is neighbored connected to a
 20 coupled sleeve 9141 of the cloth-pulling transmission shaft 914 by means of a coupled sleeve 9131. A safety pin 916 is interposed between the coupled sleeves 9131, 9141 for connecting the both in series. A plurality of cloth-pulling roller 82 on a turning support 8 is driven by the cloth-pulling transmission shaft 914 for completing the cloth-pulling and cloth-rolling action. If the cloth output is slow or in trouble
 25 during the knitting process of the circular knitting machine, the cloth-pulling roller 82 is unable to smoothly pull out the cloth. Thus, the cloth-pulling transmission shaft 914 produces a tremendous application force so that a great torque upon the safety pin 916

is created between the cloth-pulling power shaft 913 and the cloth-pulling transmission shaft 914. When the torque is large enough to break down the safety pin 916, the torque transmission between the cloth-pulling power shaft 913 and the cloth-pulling transmission shaft 914 will then be interrupted. Accordingly, a continuous
 5 cloth rolling stops in case of the uncommon (or slow) cloth output of the circular knitting machine, and poor quality of too loose density of the cloth can be avoided. However, the circular knitting machine is still in operation while the cloth is not pulled down so that the knitting needles are wound by cords. At last, hundred of knitting needles would broken to cause a huge loss.

10 Taiwan Pat. No. 326816 discloses another prior art, as shown in Fig. 3, named "energy-breaking safety apparatus for a speed change of a cloth-rolling machine". A toothed wheel 96 coupled with the cloth-pulling transmission shaft 914 and a locating screw sleeve 961 are disposed at an outer cone 952 of a tapered clutch 95. The tapered frictional force between the outer cone 952 and the inner cone 951 of the
 15 tapered clutch 95 can be adjusted by means of an adjustable screw sleeve 971, a bearing 972 and a compression spring 97. When the power is transmitted to the toothed wheel 96 of the energy-breaking element, it will be outputted by the tapered clutch 95 to the cloth-pulling roller 82. Accordingly, The tapered frictional force between the outer cone 952 and the inner cone 951 of the tapered clutch 95 can be
 20 adjusted by means of an adjustable screw sleeve 971, a bearing 972 and a compression spring 97.

Consequently, when the cloth-rolling machine is blocked due to an uncommon situation while the turning support 8 continuously in rotation, the power will be transmitted to the energy-breaking element. Moreover, when the resistance of the
 25 cloth-pulling roller 82 is larger than the tapered frictional force of the tapered clutch 95 provided by the compression spring 97, a relative motion will be created between the outer cone 952 and the inner cone 951 of the tapered clutch 95. Thus, the

transmission power will be consumed by the moving frictional force. Therefore, transmission elements won't be instantly damaged.

However, in the above-mentioned prior arts, the circular knitting machine can stop the rotation of the cloth-pulling rollers 82 of cloth-pulling machine in case of uncommon cloth output to avoid the improper pull and the reactive force of a continuous constant-speed cloth-pulling, causing the poor quality of too loose cloth and the damage of the gearbox. In fact, the malfunction situations and reasons are various during the knitting process of the circular knitting machine. Moreover, the unsmooth or blocking situations for cloth output are not the same to the previous. If only the cloth-pulling action is stopped instead of removal of the original defects, the circular knitting machine would continuously knit the poor cloth and the cloth output continues to accumulate above the cloth-pulling rollers 82, easily causing the knitting needles to be broken for a huge loss.

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SUMMARY OF THE INVENTION

It is a primary object of the present invention to provide a speed change gearbox of a cloth-rolling machine with a safety device which includes a speed change gearbox in which a macro-adjusting gear set, a micro-adjusting gear set, a stepped gear set, a clutch transmission set and a plurality of transmission shafts are installed. When the power is transmitted to a cloth-rolling transmission shaft, the macro-adjusting gear set and the micro-adjusting gear set pivotally mounted on the cloth-rolling transmission shaft are driven by the transmission gear. Meanwhile, a gear with different tooth amount ratio will be chosen to indirectly transmit the power to the clutch transmission set. The clutch slide plate is used to control its engagement with any toothed wheel of the stepped gear set so that the power transmission is achieved

while an increasing or a decreasing speed shift is chosen. Accordingly, the required power is transmitted through a safety device to the cloth-pulling transmission shaft to complete the shifting applied to the circular knitting machine. Thus, the cloth weight and strip distance can be stabilized for avoidance of an uncommon cloth-pulling.

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BRIEF DESCRIPTION OF THE DRAWINGS

The accomplishment of this and other objects of the invention will become apparent from the following description and its accompanying drawings of which:

10 Fig. 1 is a perspective view of a conventional gearbox and a speed change clutch thereof;

Fig. 2 is a schematic drawing of a conventional cloth-rolling machine showing the protection against the uncommon cloth-pulling;

15 Fig. 3 is a schematic drawing of another conventional cloth-rolling machine showing the protection against the uncommon cloth-pulling;

Fig. 4 is a perspective view of a gearbox and a turning support of the present invention;

Fig. 5 is a perspective exploded view of partial elements of the speed change gearbox of the present invention;

20 Fig. 6 is a perspective view of the assembled speed change gearbox of the present invention;

Fig. 7 is a plan view of the assembled speed change gearbox of the present invention;

Figs. 8A and 8B are schematic drawings of a macro-adjusting gear set of the

present invention showing the operation action;

Figs. 9A and 9B are schematic drawings of a micro-adjusting gear set of the present invention showing the operation action;

Fig. 10 is a perspective exploded view of a clutch slide plate and a clutch
5 transmission set of the present invention;

Fig. 11 is a perspective assembly view of the clutch slide plate and the clutch transmission set of the present invention;

Fig. 12 is a first schematic drawing of the clutch slide plate showing the operation action;

10 Fig. 13 is a second schematic drawing of the clutch slide plate of present invention showing the operation action thereof;

Fig. 14 a perspective view of another embodiment of the clutch slide plate of the present invention;

Fig. 15 a perspective exploded view of a safety device of the present invention;
15 and

Fig. 16 a sectional view of the assembled safety device of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

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Fig. 4 shows a perspective view of a gearbox and a turning support of the present invention. It's apparent that the speed change gearbox 1 is pivotally disposed by means of two turning bars 81 and two turning frame 8. A bottom supporting base 121 is extended with a main shaft used as turning support point. A cloth-pulling

transmission shaft 17 and a cloth-rolling power shaft 11 are respectively installed at two sides of the speed change gearbox 1. The transmission elements (e.g. transmission chain or belt, not shown) inside of the turning frame 8 drive a number of cloth-pulling rollers 82 by means of the cloth-pulling transmission shaft 17 while a
 5 cloth-rolling roller 83 behind is driven by the cloth-rolling power shaft 11.

Referring to Figs. 5, 6 and 7, the speed change gearbox 1 in accordance with the present invention includes a macro-adjusting gear set 2, a micro-adjusting gear set 3, a clutch transmission set 4, a clutch slide plate 5, a stepped gear set 6 and a safety device 7. A fixed bevel gear 12 extending from the bottom supporting base 121 serves
 10 as supporting central point for turning. Two sides of the speed change gearbox 1 are respectively connected with a cloth-pulling power shaft 16 and a cloth-rolling power shaft 11. The cloth-rolling power shaft 11 contains a drive gear 112 at the center thereof. One end of the cloth-rolling power shaft 11 is engaged with the fixed bevel gear 12 by means of a moving bevel gear 111. Therefore, a relative motion is created
 15 between the moving bevel gear 111 and the fixed bevel gear 12 when the turning frame 8 is driven to rotate by the circular knitting machine. Accordingly, the cloth-rolling power shaft 11 is brought in rotation. The macro-adjusting gear set 2 and the micro-adjusting gear set 3 are respectively mounted on a first transmission shaft 13 beside the cloth-rolling power shaft 11. The stepped gear set 6 is mounted on the
 20 cloth-pulling power shaft 16 at the opposite side of the speed change gearbox 1.

When the turning frame 8 turns to bring the moving bevel gear 111 and the fixed bevel gear 12 in a relative motion, the cloth-rolling power shaft 11 will be therefore rotated. The drive gear 112 for driving a neighbored first pivoting gear 21 of the first transmission shaft 13 is fixed at the center of the cloth-rolling power shaft 11.
 25 Thereafter, a second pivoting gear 24 on the cloth-rolling power shaft 11 is engaged with the first pivoting gear 21 and is driven thereby. Another pivoting gears 22, 25, 23, 26 are driven in this manner. The pivoting gears 21, 24, 22, 25, 23, 26 serve as idle

gear on the cloth-rolling power shaft 11 and the first transmission shaft 13 for transmission. The pivoting gear 26 is engaged with a first transmission gear 141 fixed on the second transmission shaft 14 at the opposite side of the cloth-rolling power shaft 11. A second transmission gear 142 is fixed at the other end of the second transmission shaft 14 and is engaged with the idle pivoting gear 32 (or 34) on the cloth-rolling power shaft 11. Therefore, the pivoting gear 32 is engaged with the pivoting gear 31 (or 33). A third transmission gear 131 is fixed at one end of the first transmission shaft 13, and another third pivoting gear 161 idling on the cloth-pulling power shaft 15 is engaged with the third transmission gear 131 and is driven thereby. Accordingly, a fourth transmission gear 151 of a driving shaft 15 is engaged with the third pivoting gear 161 to bring the driving shaft 15 in rotation. Consequently, the clutch transmission set 4 fixed on the driving shaft 15 is in a powered state, and can be engaged with any toothed wheel of the stepped gear set 6 to transmit the power to the cloth-pulling power shaft 16.

As shown in Figs. 8A, 8B, 9A and 9B, when the power is transmitted by the cloth-rolling power shaft 11 to the drive gear 112 which is engaged with the first pivoting gear 21 on the first transmission shaft 13, this power can be transmitted to the second pivoting gear 24 and then to the other pivoting gears 22, 25, 23, 26. If the turning hand wheel 1411 drives the moving clamping piece 1413 by means of the connecting rod 1412 to rotate the first transmission gear 141 slid on the second transmission shaft 14 to engage with the pivoting gear 26, as shown in Fig. 8A, it's A-step rotation speed. The rotation speed ratio is 1:1, that is, the rotation speed ratio between the cloth-rolling power shaft 11 and the second transmission shaft 14 is 1:1. If the first transmission gear 141, as shown in Fig. 8B, is moved to engaged with the drive gear 112 for D-step rotation speed, the increasing (or decreasing) rotation speed is 1:8. As shown in Figs. 9A and 9B, if the turning hand wheel 1421 drives the moving clamping piece 1413 by means of the connecting rod 1412 to rotate the second

transmission gear 142 slid on the second transmission shaft 14 to change the engagement position with the pivoting gear 31 (or 33) by means of the pivoting gear 32 (or 34), the rotation speed can also be changed. In addition, the power will be transmitted by the first transmission shaft 13 to the right side of the speed change gearbox 1. Meanwhile, the fourth transmission gear 151 on the cloth-pulling power shaft 16 will be driven by the third transmission gear 131. Again, the fourth transmission gear 151 on the driving shaft 15 is driven as well. A toothed bar 42 can be moved by means of turning the turning hand wheel 421 through a toothed wheel 422 to shift the clutch transmission set 4. Accordingly, the engagement position of the clutch transmission set 4 with the stepped gear set 6 can be changed for a further adjustment of the rotation speed.

Referring to Figs. 10, 11, 12 and 13, the clutch transmission set 4 is pivotally mounted on the driving shaft 15 by means of two clamping pieces 41. A connecting rod 412 between two clamping pieces 41 makes a synchronic motion therewith. A lower gear 43 and an upper gear 431 are engaged with each other between two clamping pieces 41 which can be formed in a body and are provided with a groove for receiving the lower gear 43 and the upper gear 431 respectively. The lower gear 43 is fixed on the driving shaft 15 and is engaged with the upper gear 431 pivotally interposed between two clamping pieces 41 so that an engaged transmission with the stepped gear set 6 is achieved. A hook 423 at one end of the toothed bar 42 is inserted between two clamping pieces 41 while the other end thereof is engaged with the toothed wheel 422 coupled with the turning hand wheel 421. The clutch transmission set 4 is movable on the driving shaft 15 through the toothed bar 42 by means of the turning hand wheel 421. The middle section of the clutch slide plate 5 is provided with an oblique main guide groove 51 having at least a guide slot 52 beside the main guide groove 51. The clutch slide plate 5 is (or not) inserted through guide slot 52. Besides, an elongated hollow hole 53 is disposed on the surface of the clutch slide

plate 5, and a through hole 531 is disposed therein. The through hole 531 serves as sliding guide groove. After penetrating through the through hole 531 of the elongated hollow hole 53, one end of an eccentric wheel axle 541 of an eccentric wheel 54 is inserted into the speed change gearbox 1. The top of the eccentric wheel axle 541 is fitted with a cover 55 having a vertical screw hole 552 at the top thereof and a horizontal screw hole 556 at one side thereof. A sunk screw 555 can be driven into the vertical screw hole 552 to contact with a resilient element 554 for supporting against a locating body 553. The horizontal screw hole 556 is used for inserting a locating pin 557 fixed on the eccentric wheel axle 541. The speed change gearbox 1 includes a gearbox cover 18 having a through hole 181 and a plurality of grooves 182 for receiving the eccentric wheel axle 541 and the locating body 553. Accordingly, the pivoted cover 55 is created, and the cover 55 is provided with a moving rod 551 for turning the eccentric wheel 54.

The clutch slide plate 5 included at least a guide slot 52 and a through hole 531 which parallel to each other. A locating post 19 is arranged in a corresponding manner so that the locating post 19 can be riveted in the opposite direction on the bottom side of the clutch slide plate 5 while a guide groove is installed at the corresponding position of the speed change gearbox 1 to create the same effect.

The clutch slide plate 5 is fixed on the speed change gearbox 1 in order that the locating post 19 and the eccentric wheel axle 541 are respectively inserted into the guide slot 52 and the through hole 531 in position or for being pivotally mounted on the speed change gearbox 1. Meanwhile, the guide post 411 of the clamping piece 41 is connected to the main guide groove 51. The eccentric wheel 54 is turned inside of the elongated hollow hole 53 by means of the moving rod 551 for supporting against the clutch slide plate 5 to make an eccentric motion. The clutch slide plate 5 is slid downwards by means of the locating post 19 and the eccentric wheel axle 541. At this time, the elongated hollow hole 53 drives the guide post 411 to bring the clutch

transmission set 4 in motion so that the clutch transmission set 4 and the stepped gear set 6 are separated from each other. Thereafter, the toothed bar 42 is controlled by the turning hand wheel 421 to enable the clutch transmission set 4 to make a reciprocate motion on the driving shaft 15. When the clutch transmission set 4 is moved to a selected position of the stepped gear set 6, the moving rod 551 has to be moved to enable the clutch slide plate 5 to slide upwards. Then, the guide post 411 on the clamping piece 41 is moved in the main guide groove 51 to drive the clutch transmission set 4 to engage with another toothed wheel of the stepped gear set 6. Accordingly, a various kinds of speed can be changed and adjusted.

The rotation speed of the driving shaft 15 is adjustable by means of the engagement of the lower gear 43 with a certain toothed wheel of the stepped gear set 6. After the speed is properly reduced, it is transmitted by the cloth-pulling power shaft 16 to the rotation speed of the cloth-pulling transmission shaft 17. The increasing (or decreasing) rotation speed ratio of the macro-adjusting gear set 2 and the micro-adjusting gear set 3, as shown in Figs. 8A and 9A, can be lie between 1:1 through 1:8. As shown in Figs. 8B and 9B, the engaged rotation speed ratio difference between the macro-adjusting gear set 2, the micro-adjusting gear set 3 and the stepped gear set 6 can be lie in 1:16. The more toothed wheels of the stepped gear set 6 and the greater tooth number difference there is, the greater speed change transmitted by the cloth-rolling power shaft 11 there is. Especially, the differential tooth number ratio of the micro-adjusting gear set 3 is just the half of that of the macro-adjusting gear set 2 and the stepped gear set 6. That is, the differential ratio of the engagement rotation speed of the macro-adjusting gear set 2 with the micro-adjusting gear set 3 is in a manner of selective speed, supplementing the rotation speed of different half selective speed section. Accordingly, the insufficiency of the rotation speed ratio between the macro-adjusting gear set 2 and the stepped gear set 6 is supplemented. In addition, An uneven repetition of the certain step of the speed change adjustment can

be avoided.

As shown in Fig. 14, the elongated hollow hole 53 of the clutch slide plate 5 is a through hole. Two slots 522 and 52 are disposed in parallel. When assembled, a locating post 191 together with the locating post 19 is respectively inserted into the slots 522 and 52. The eccentric wheel 54 is rotated in the elongated hollow hole 53 by means of two locating posts 191, 19 and the slots 522 and 52. Accordingly, a identical sliding effect of the eccentric wheel 54 is created.

Referring to Figs. 15 and 16, the safety device 7 includes a transmission shaft sleeve 71, an output shaft sleeve 72 and a safety pin 73. The center of the output shaft sleeve 72 is fitted with a shaft hole 721 for inserting the cloth-pulling power shaft 16 which is fixed by a key 162 in the shaft hole 721. The output shaft sleeve 72 contains a plurality of locating grooves 722 and a through hole 723 around the rim thereof. A screw hole 724 is laterally disposed on the outer rim of the output shaft sleeve 72 for turning a sunk screw 7241 to press against the key 162. Again, the center of the transmission shaft sleeve 71 contains a shaft hole 711 for inserting the cloth-pulling transmission shaft 17 which is fixed by a key 171 in the shaft hole 711. A through hole 713 and a screw hole 712 are disposed in parallel at the outer side of the shaft hole 711. A sunk screw 7121 can be driven into rear side of the screw hole 712. A locating element 715 is pressed against by the sunk screw 7121 through a resilient element 714 while the sunk screw 7121 projects forwards. A screw hole 716 is laterally disposed on the outer rim of the transmission shaft sleeve 71 for turning a sunk screw 7161 to press against the key 171. Accordingly, the transmission shaft sleeve 71 and the output shaft sleeve 72 correspond to each other and are connected by means of a safety pin 73 (or a screw together with a nut 731) to penetrate through the through holes 713, 723. Consequently, the cloth-pulling power shaft 16 and the cloth-pulling transmission shaft 17 can synchronically transmit the power. At this time, the locating element 715 inside of the screw hole 712 of the transmission shaft

sleeve 71 pressed by a resilient element 714 is just locked in the locating groove 722 on the output shaft sleeve 72.

A tremendous torque between the cloth-pulling power shaft 16 and the cloth-pulling transmission shaft 17 is produced in case of an uncommon cloth-rolling and a great resistance. If the safety pin 73 is broken, the power is transmitted by the frictional force between the transmission shaft sleeve 71 and the output shaft sleeve 72, wherein the resilient element 714 presses against the locating element 715 to enable it to be locked in the locating groove 722. (The pressing force against the resilient element 714 can be changed by the sunk screw 7121 while the pressing force of the locating element 715 is also changed.) Accordingly, a sliding frictional state is formed between the cloth-pulling power shaft 16 and the cloth-pulling transmission shaft 17. This can protect the internal gear of the speed change gearbox 1 from defects due to an overloaded torque. Meanwhile, the cloth-pulling rollers 82 stops to pull cloth so that the damage of the elements of the circular knitting machine can be avoided. At this time, a relative rotation between the transmission shaft sleeve 71 and the output shaft sleeve 72 is created while the locating element 715 also rotates in the locating grooves 722. In addition, a regular striking sound is produced in changing the engagement with the locating grooves 722 so that people can be warned to perform the trouble-shooting.

Many changes and modifications in the above-described embodiments of the invention can, of course, be carried out without departing from the scope thereof. Accordingly, to promote the progress in science and the useful arts, the invention is disclosed and is intended to be limited only by the scope of the appended claims.

5 What Is Claimed Is:

1. A speed change gearbox of a cloth-rolling machine with a safety device at least comprising:

a gearbox whose bottom side is supported by a bottom supporting base on the ground, said bottom supporting base having a fixed bevel gear extending to the turning center of said gearbox, said gearbox being connected to a turning frame, at least a locating post projecting at the top side of the rim of said gearbox, a cloth-pulling power shaft and a cloth-rolling power shaft being disposed at two sides of said gearbox, said cloth-rolling power shaft contains a drive gear at the center thereof, one end of said cloth-rolling power shaft being engaged with a fixed bevel gear by means of a moving bevel gear, said cloth-rolling power shaft having a first and a second transmission shafts at two sides thereof so that a relative motion is created between the moving bevel gear and the fixed bevel gear when said turning frame is rotated by a circular knitting machine;

a macro-adjusting gear set having a plurality of pivoting gears idled on said cloth-rolling power shaft and said first transmission shaft at one side thereof, each of said pivoting gears being reciprocately connected and engaged with one another, a second transmission shaft being disposed at the other side of said cloth-rolling power shaft, two transmission gears synchronically turned and making an axial reciprocate sliding movement, one of said transmission gears being engaged with pivoting gears respectively for receiving the power transmitted by said cloth-rolling power shaft and



said first transmission shaft;

a micro-adjusting gear set having a plurality of pivoting gears idled on said cloth-rolling power shaft and said first transmission shaft at one side thereof, a corresponding transmission gear being fixed on the first transmission shaft and
 5 engaged with pivoting gears, one transmission gear synchronically turned to make an axial reciprocate sliding movement being engaged with one of the pivoting gears so that the power is transmitted from the second transmission shaft through the cloth-rolling power shaft to the first transmission shaft;

a stepped gear set disposed at the center of said cloth-pulling power shaft inside
 10 of said gearbox, a driving shaft extending in parallel and being disposed at one side of said stepped gear set, one end of said cloth-pulling power shaft having an idling pivoting gear respectively engaged with two transmission gears of said transmission shaft and said driving shaft so that the power of said first transmission shaft can be transmitted to said driving shaft;

15 a clutch transmission set pivotally mounted on said driving shaft by means of two clamping pieces, a connecting rod between two clamping pieces making a synchronic motion therewith, a lower gear and an upper gear being engaged with each other between two clamping pieces which are provided with a groove for receiving said lower gear and said upper gear respectively, said lower gear being fixed on said
 20 driving shaft and engaged with said upper gear pivotally interposed between two clamping pieces so that an engaged transmission with said stepped gear set is achieved, a hook at one end of a toothed bar being inserted between two clamping pieces while the other end thereof is engaged with said toothed wheel coupled with a turning hand wheel, said clutch transmission set being movable on said driving shaft
 25 through said toothed bar by means of said turning hand wheel;

a clutch slide plate whose middle section is provided with an oblique main guide



groove for receiving a guide post at the top of said clamping pieces, having at least a guide slot beside said main guide groove for receiving a corresponding guide post on the gearbox, an elongated hollow hole being disposed on the surface of the clutch slide plate, a through hole being disposed inside of said elongated hollow hole for
 5 receiving an eccentric wheel axle of an eccentric wheel to be pivotally located on said gearbox, the top of said eccentric wheel being extended with a moving rod for moving said eccentric wheel, said clutch slide plate being moved when said eccentric wheel is turned, said clutch slide plate making a sliding movement by means of the sliding guide of said locating post and said eccentric wheel so that said upper gear of said
 10 clutch transmission set is able to change the engagement situation with said stepped gear set 6, the driving shaft being also transporting power to said stepped gear set in case the engagement between said upper gear and said stepped gear set;

a safety device having a transmission shaft sleeve, a output shaft sleeve and a safety pin, said transmission shaft sleeve and said output shaft sleeve being
 15 neighbored to each other and respectively fixed on said cloth-rolling power shaft and said cloth-pulling power shaft of said gearbox, a plurality of locating grooves and a through hole being disposed on the neighbored connection surface while a through hole and a screw hole are provided on the other surface, the inside of said screw hole having a resilient element to support against a locating element, said safety pin
 20 penetrating through said through hole of said transmission shaft sleeve and said output shaft sleeve so that the power output shaft and cloth-pulling transmission shaft are able to be coupled for synchronically transmitting power while said locating element supported against by said resilient element inside of said screw hole of said transmission shaft sleeve is just locked in the locating groove of said output shaft
 25 sleeve so that a regular collision sound in case that the safety pin is broken is created by means that said locating element is pivoted in each of said locating grooves.



2. A speed change gearbox as claimed in claim 1, wherein the differential ratio of said macro-adjusting gear set and said micro-adjusting gear set are adjustable to each other for supplementing different half speed adjustment step.

5 3. A speed change gearbox as claimed in claim 1, wherein said macro-adjusting gear set, said micro-adjusting gear set and said clutch transmission set are well-distributed at two sides of said fixed bevel gear in said gearbox for an excellent weight balance of two sides of said fixed bevel gear so that the cloth-rolling machine turns more smoothly.

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4. A speed change gearbox as claimed in claim 1, wherein said locating post of said gearbox is installable at the lower side of said clutch slide plate while said gearbox is provided with guide grooves at corresponding position.

15 5. A speed change gearbox as claimed in claim 1, wherein said elongated hollow hole of said clutch slide plate is constructed as elongated hole for serving as another guide groove.

20 6. A speed change gearbox as claimed in claim 1, wherein said locating post of said gearbox and said guide grooves of said clutch slide plate are many in amount and are disposed in pairs.

25 7. A speed change gearbox as claimed in claim 1 or 4, wherein said guide grooves on said clutch slide plate or said gearbox are constructed as elongated through hole.



8. A speed change gearbox as claimed in claim 1 or 4, wherein said guide grooves on said clutch slide plate or said gearbox are constructed as elongated groove (not penetrated).

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9. A speed change gearbox as claimed in claim 1, wherein said eccentric wheel axle includes a cover at the top thereof, and a locating pin penetrates through said cover for being fixed on said eccentric wheel axle.

10 10. A speed change gearbox as claimed in claim 9, wherein said cover contains a vertical screw hole at the top thereof and a horizontal screw hole at one side thereof, and wherein a sunk screw can be driven into said vertical screw hole to contact with a resilient element for supporting against a locating body, and wherein the horizontal screw hole is used for inserting a locating pin fixed on said eccentric wheel axle, and
15 wherein said gearbox includes a gearbox cover having a through hole and a plurality of grooves for receiving said eccentric wheel axle and the locating body so that a pivoted cover is created.

11. A speed change gearbox as claimed in claim 10, wherein said resilient
20 element is constructed as spring.

12. A speed change gearbox as claimed in claim 10, wherein said locating body is constructed as steel ball.

25 13. A speed change gearbox as claimed in claim 1, wherein a key is inserted



between said power output shaft and said output shaft sleeve and between said cloth-pulling transmission shaft and transmission shaft sleeve for fixing in a pressing manner.

5 14. A speed change gearbox as claimed in claim 1, wherein a screw hole is laterally disposed at outer rim of said output shaft sleeve and transmission shaft sleeve for driving a sunk screw to press against a key disposed between said power output shaft and output shaft sleeve.

10 15. A speed change gearbox as claimed in claim 1, wherein a sunk screw is driven at the screw hole rear side, and wherein the force of said resilient element to press against said locating element is adjustable by turning said sunk screw.

15 16. A speed change gearbox as claimed in claim 1, wherein said safety pin is fixed by a screw joining a nut.

20 17. A speed change gearbox as claimed in claim 1, wherein said locating element pressed by said resilient element inside of said screw hole of said transmission shaft sleeve is constructed as a ball.

18. A speed change gearbox as claimed in claim 1, wherein said locating element pressed by said resilient element inside of said screw hole of said transmission shaft sleeve is constructed as projecting curved post from an end.



19. A speed change gearbox as claimed in claim 1, wherein a plural of grooves are constructed round.

20. A speed change gearbox as claimed in claim 1, wherein a plural of grooves
5 are round-hole sleeve are constructed in a radial manner.

21. A speed change gearbox as claimed in claim 20, wherein the whole of said grooves and the other side thereof are arranged in a manner of ring-shaped projecting teeth.

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22. A speed change gearbox as claimed in claim 20, wherein the whole of said grooves and the other side thereof are arranged in a manner of ring-shaped waves.

