

Nov. 17, 1970

ZENZABURO TSUKUMO ET AL
AUTOMATIC YARN PIECING APPARATUS FOR RING
SPINNING FRAME OR THE LIKE

3,540,200

Filed Feb. 20, 1968

16 Sheets-Sheet 1

Fig. 1

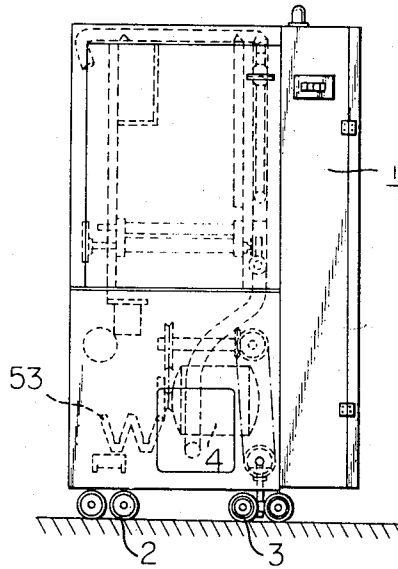


Fig. 2A

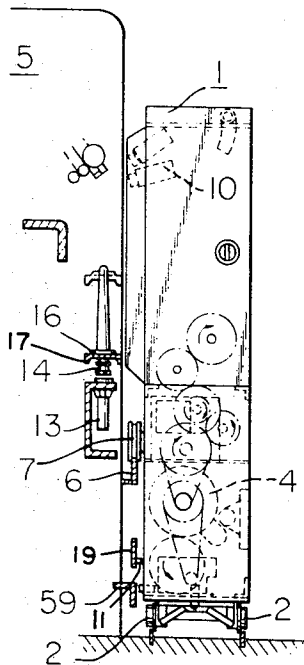
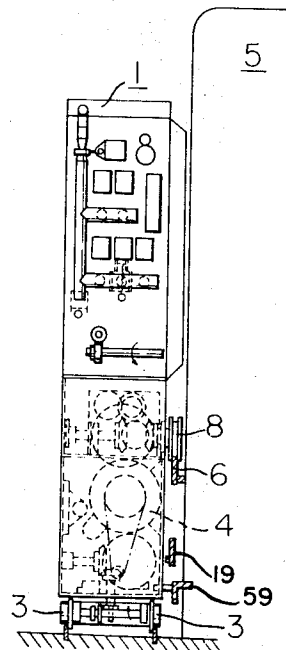


Fig. 2B



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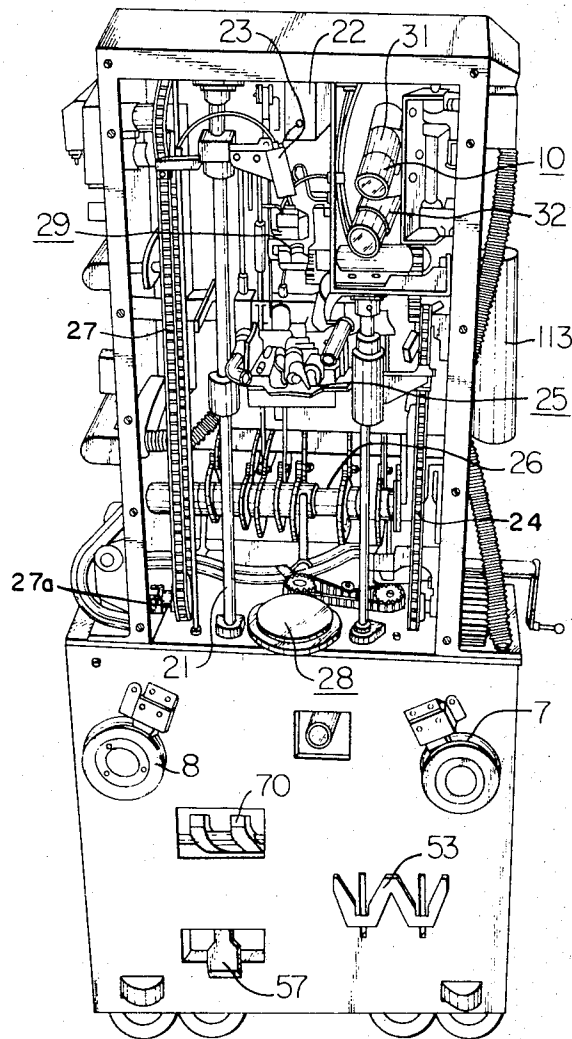
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Fig. 3



INVENTOR

BY

ATTORNEY

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Fig. 4

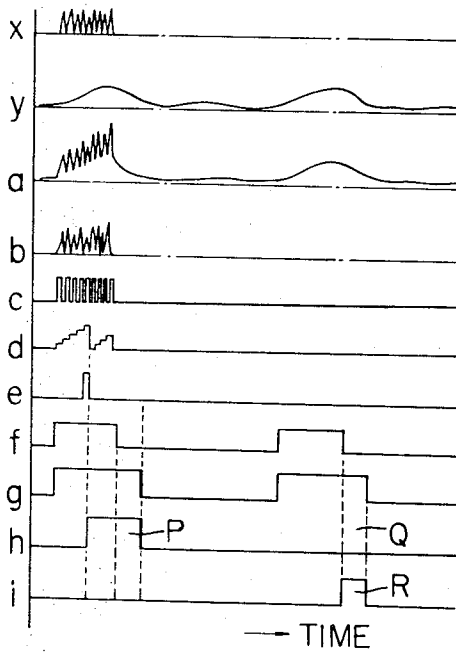
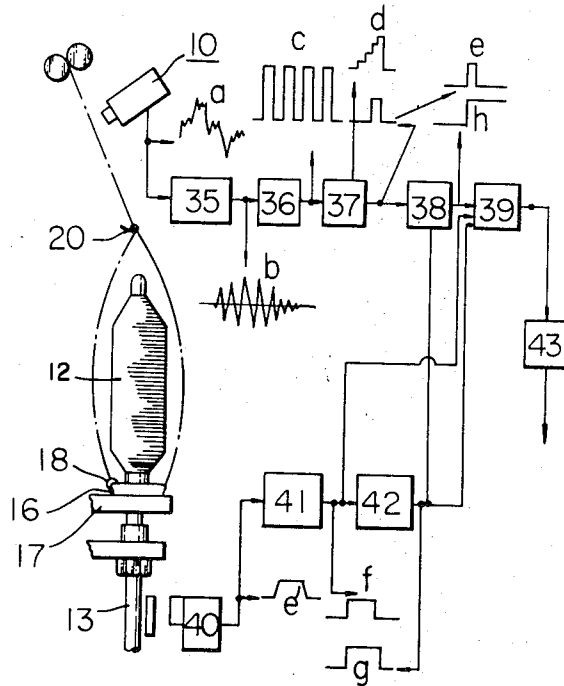


Fig. 5

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Fig. 6A

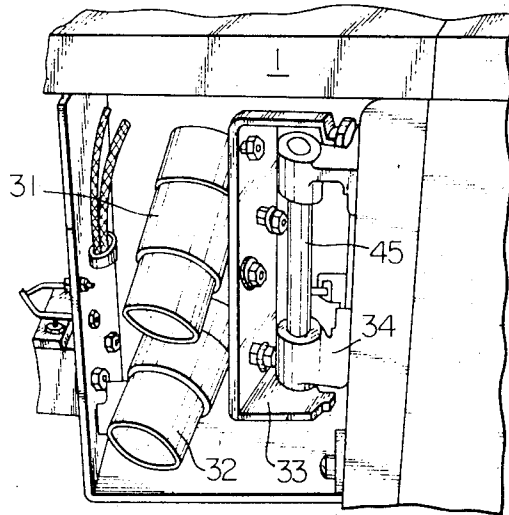
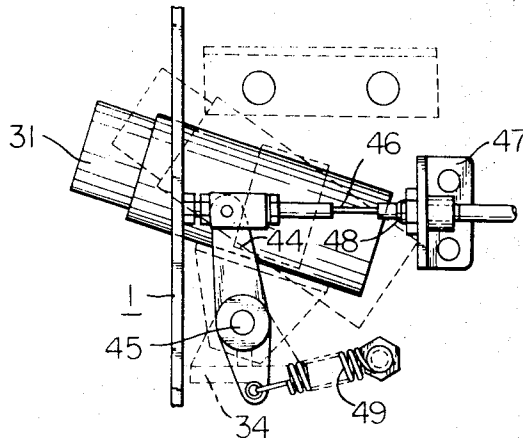


Fig. 6B



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Fig. 7

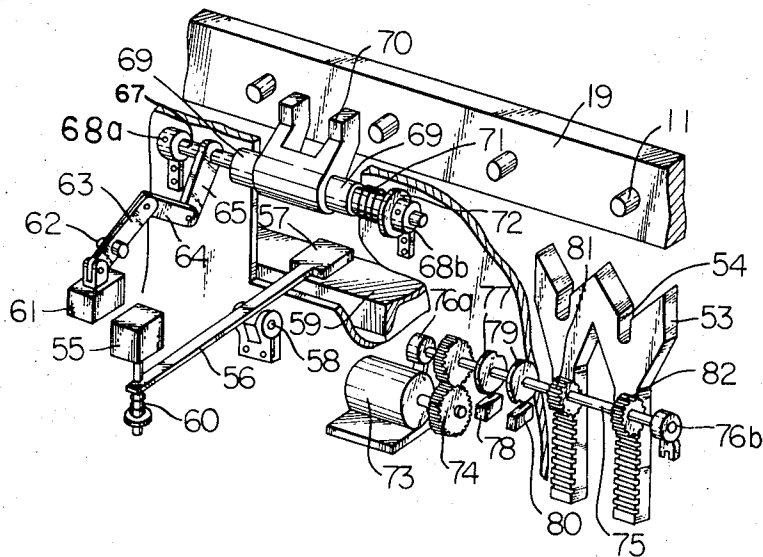
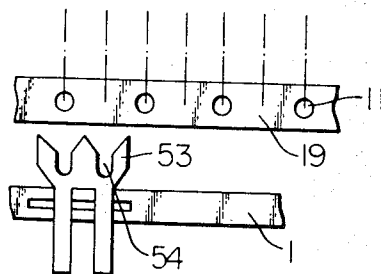


Fig. 8



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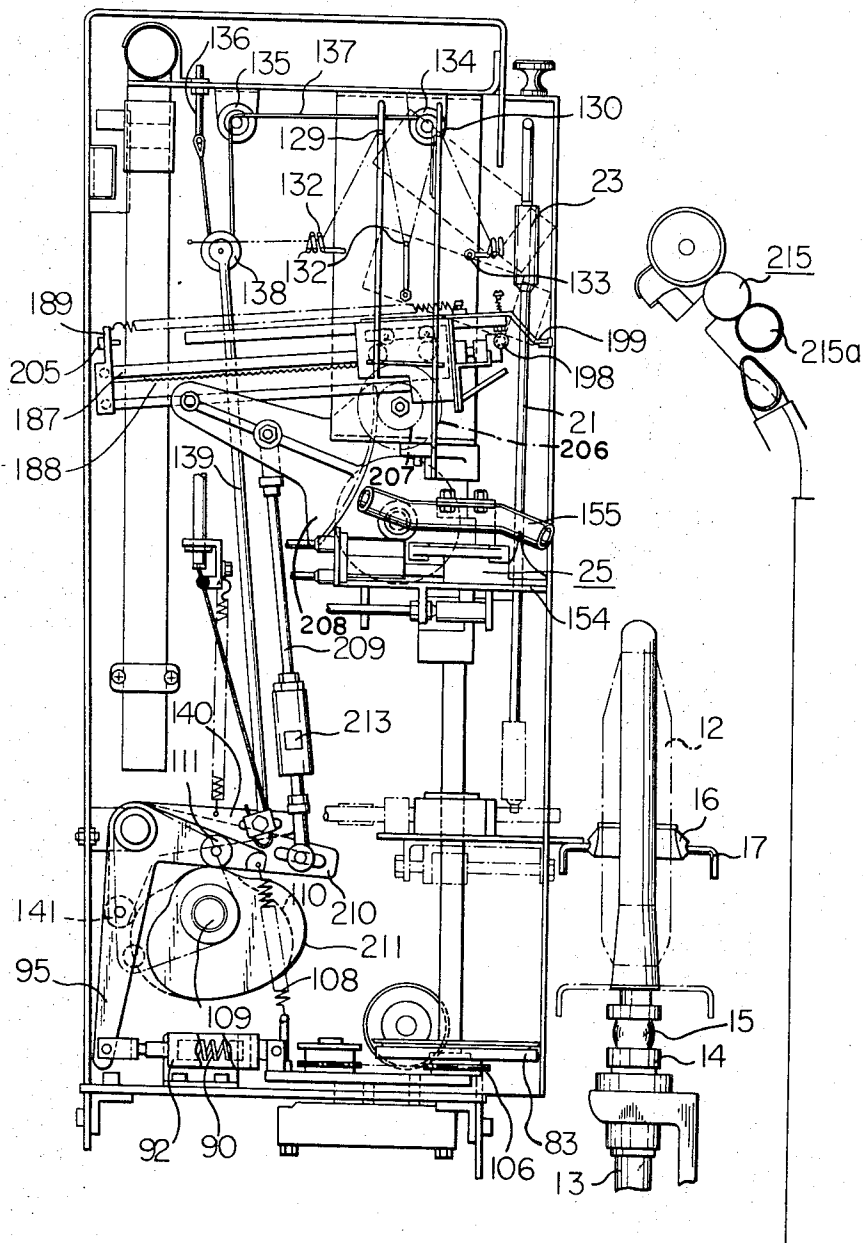
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Fig. 9



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Fig. 12A

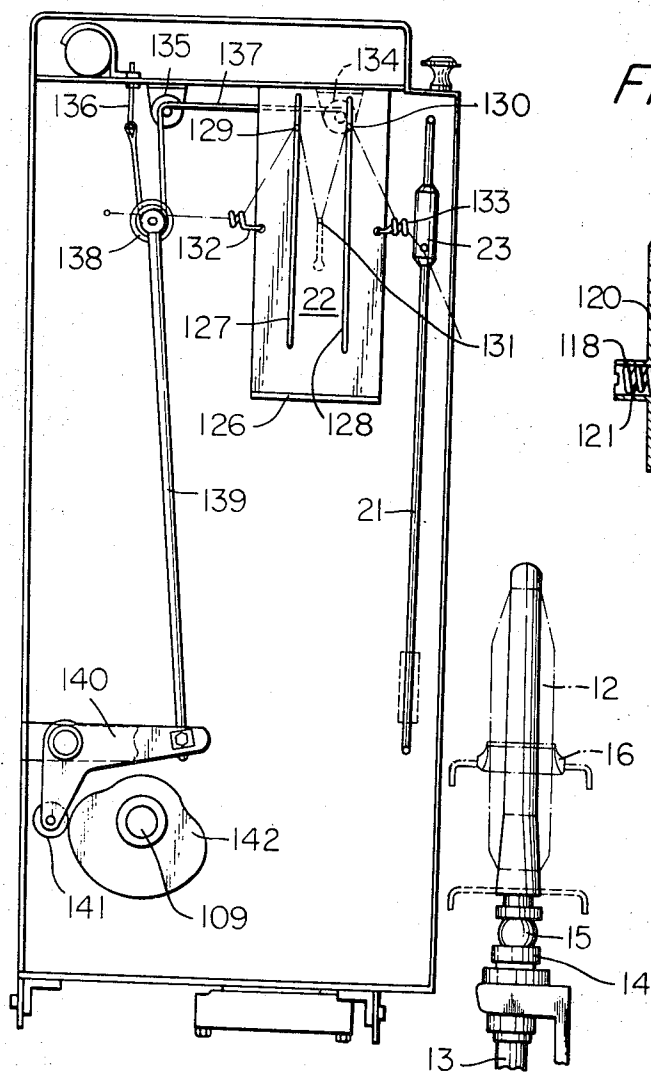
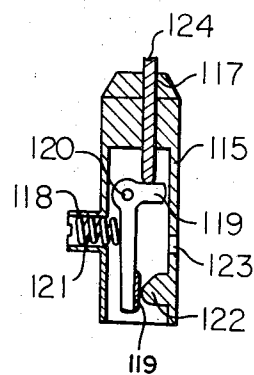


Fig. 11



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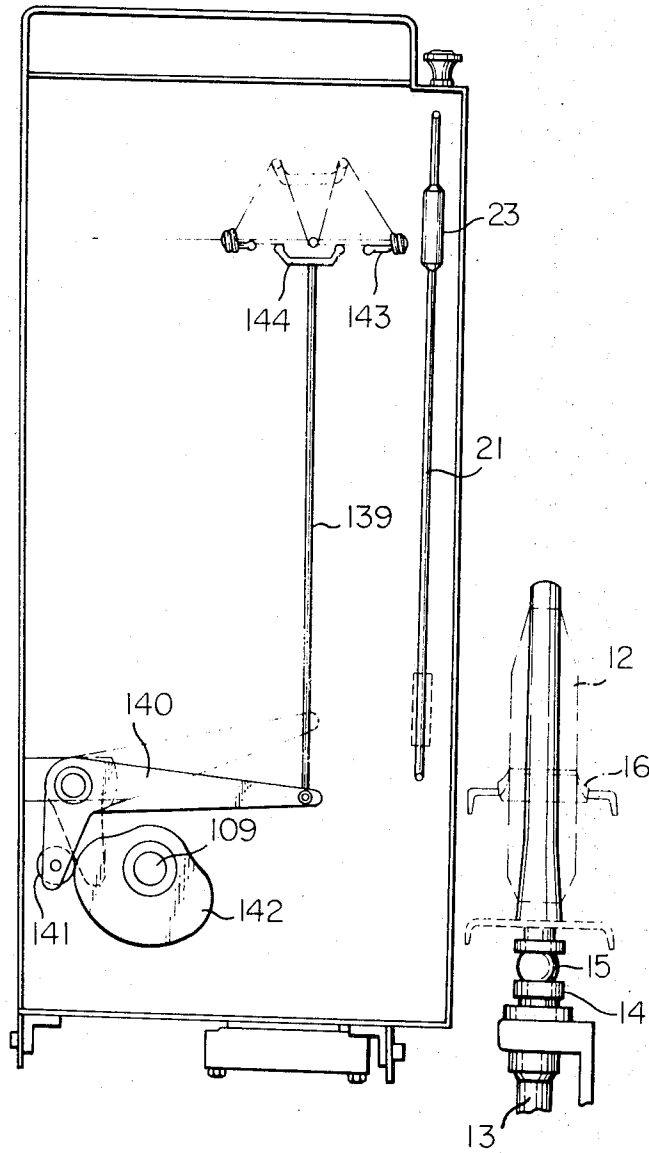
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Fig. 12B



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Fig. 13

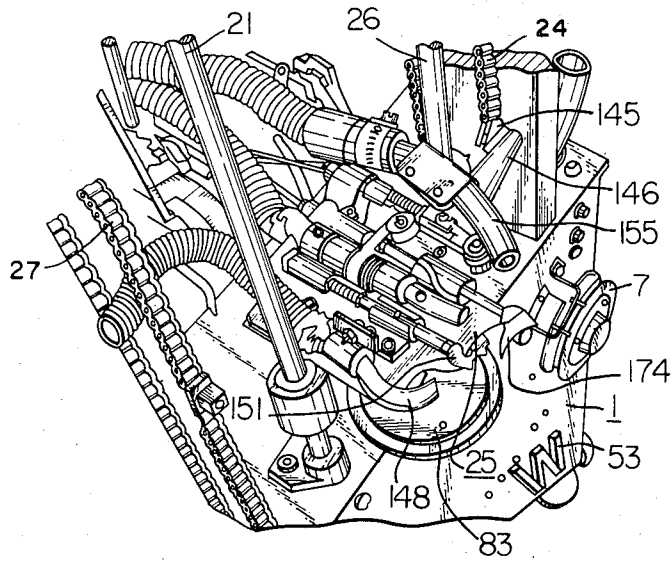
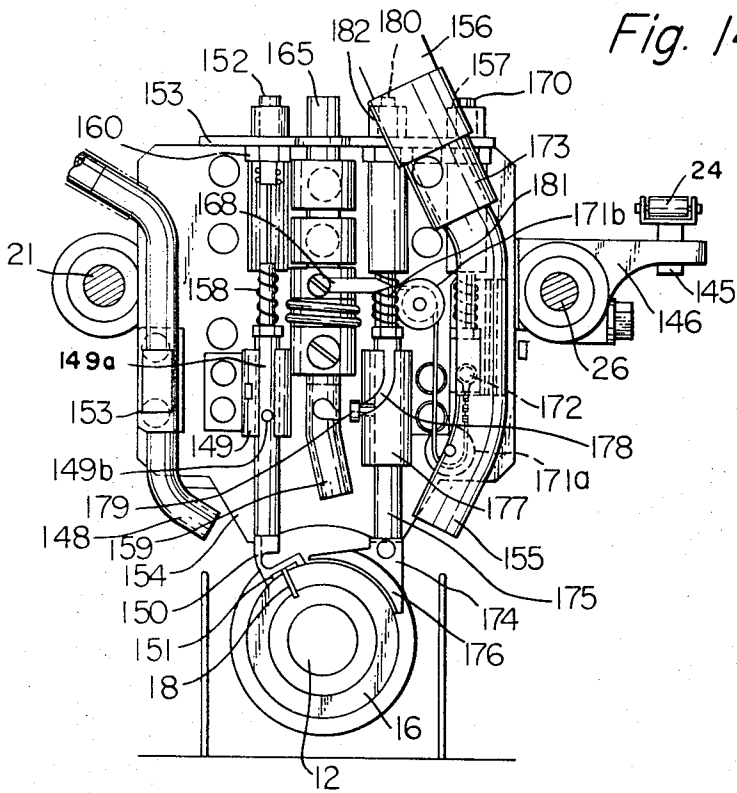


Fig. 14



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Fig. 15

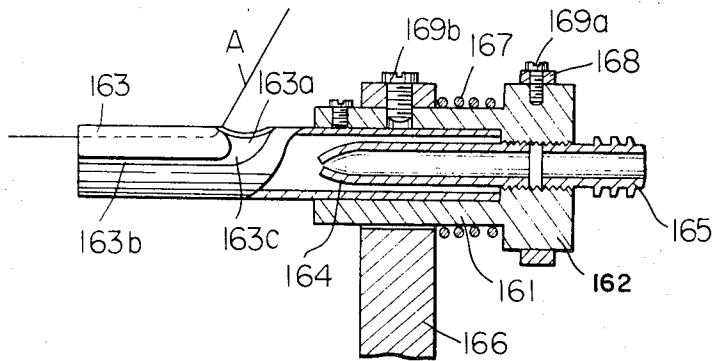
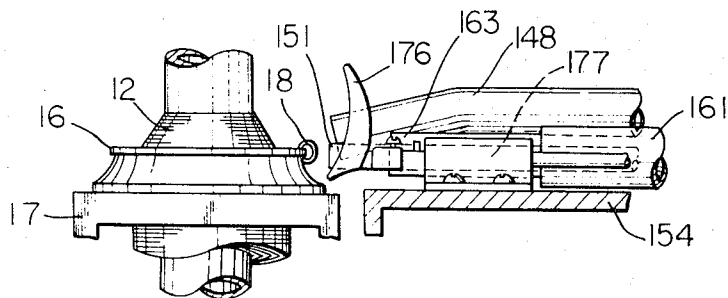


Fig. 16



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Fig. 17A

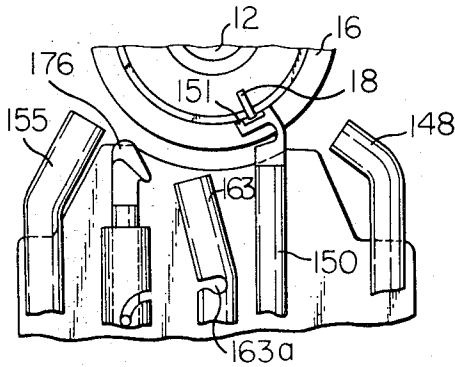


Fig. 17B

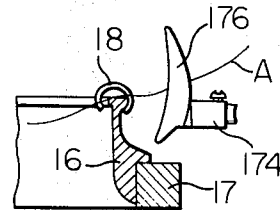


Fig. 17C

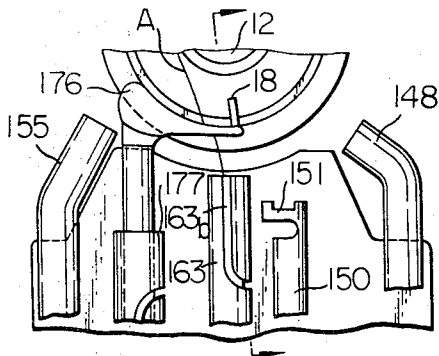


Fig. 17D

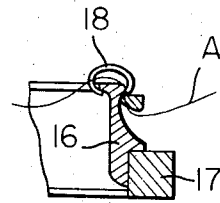


Fig. 17E

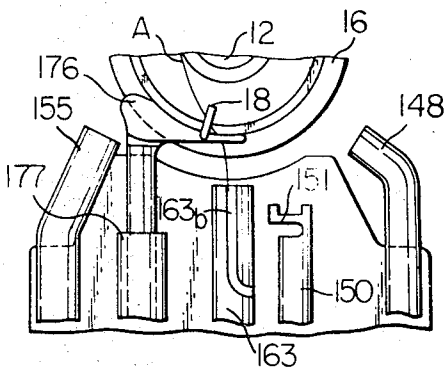
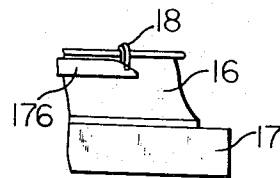


Fig. 17F



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Fig. 18A

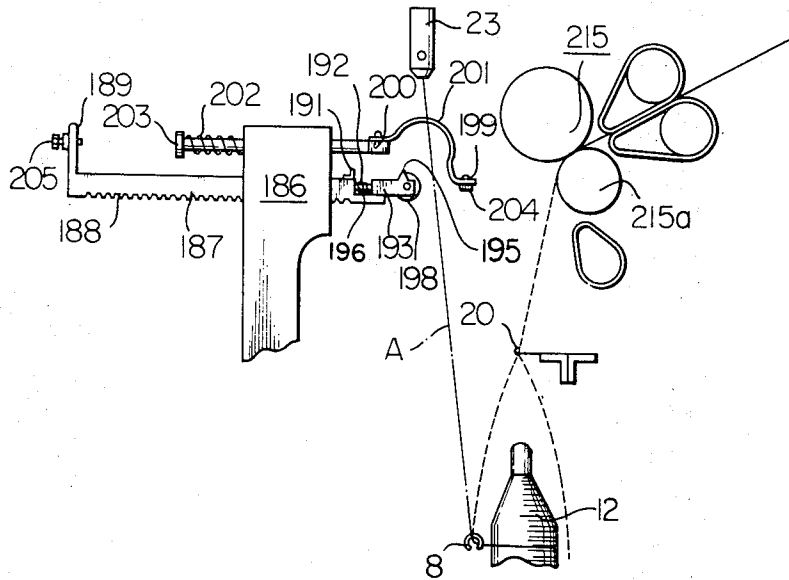


Fig. 18B

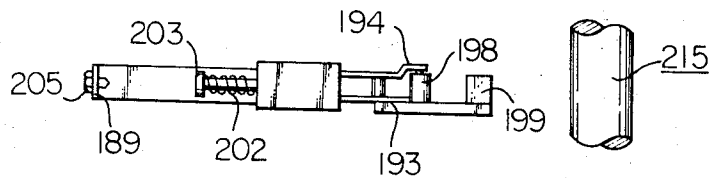
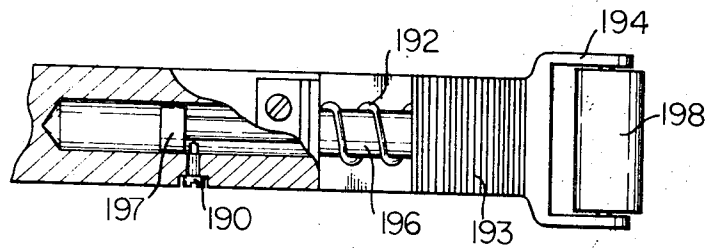


Fig. 18C



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Fig. 19A

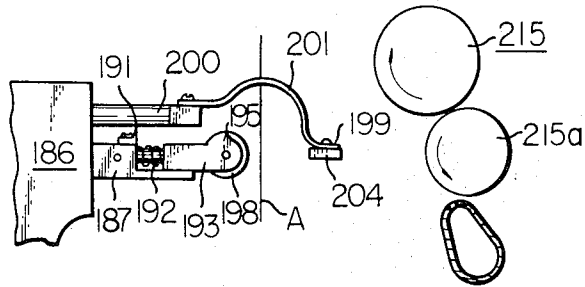


Fig. 19B

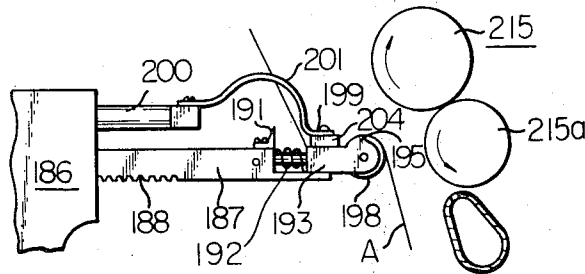


Fig. 19C

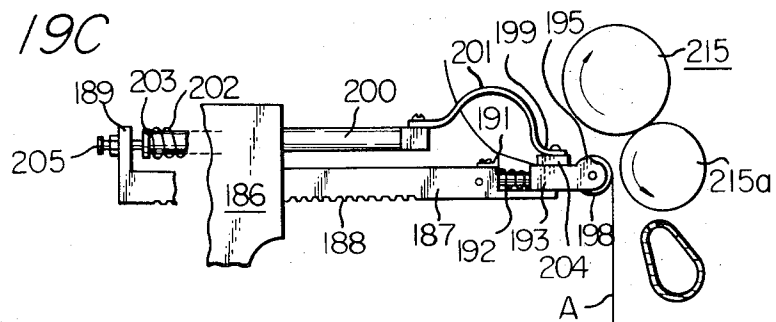
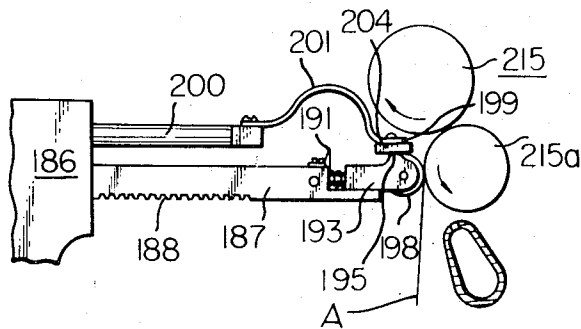


Fig. 19D



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Fig. 20

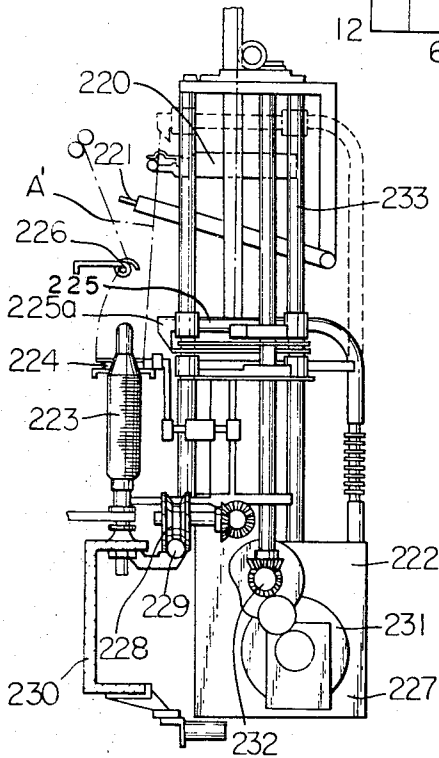
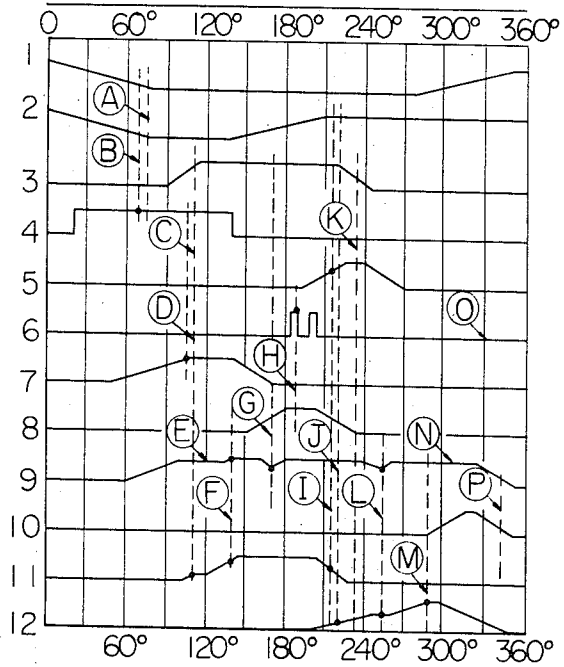


Fig. 21

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AUTOMATIC YARN PIECING APPARATUS FOR RING SPINNING FRAME OR THE LIKE

Zenzaburo Tsukumo, Nishinomiya-shi, Takeki Sato, Takarazuka-shi, Kanehiro Ito, Amagun, Aichi-ken, and Noboru Ohashi, Akashi-shi, Japan, assignors to Toyo Boseki Kabushiki Kaisha, Osaka, Japan, and Howa Kogyo Kabushiki Kaisha, Aichi-ken, Japan, both companies of Japan

Filed Feb. 20, 1968, Ser. No. 706,876

Claims priority, application Japan, Aug. 17, 1967, 42/53,061

Int. Cl. D01h 15/00

U.S. Cl. 57—34

12 Claims

ABSTRACT OF THE DISCLOSURE

An automatic yarn piecing apparatus is provided with a detector for sensing a yarn breakage during winding of a supply yarn around a winding bobbin and a yarn piecing mechanism. The yarn piecing mechanism carries a supplementary yarn supply cop and when a yarn breakage is detected, one end of the supplementary yarn is wound around the winding bobbin at which the breakage occurred. The yarn piecing mechanism includes means for then parting the supplementary yarn into two sections, each having a jagged end, and means for pressing together one of the jagged ends with a portion of the original supply yarn which was broken to effectively join the supplementary yarn with the supply yarn.

The present invention relates to an improved apparatus for automatically piecing broken yarns on spinning machines.

The conventional yarn piecing apparatus developed up to now can be classified into two types, that is, one is an apparatus characterized by means for extracting the broken end of yarn from a bobbin and means for piecing the extracted yarn directly with a drafted roving or sliver issuing from the producing roller of the corresponding spinning unit of the ring spinning frame, while the other is an apparatus characterized by a piecing mechanism comprising means for taking a supplementary yarn from a supply cop supported by the apparatus when an absence of one of the threads moving toward bobbins supported by the spindles of a ring spinning frame is detected and means for winding the supplementary yarn taken from the supply cop about a bobbin whose yarn is broken and means for cutting a yarn connection between the supplementary yarn and piecing the end portion of the supplementary yarn and the bobbin with a fleece delivered from a producing roller of a corresponding spinning unit just after threading the supplementary yarn wound about the bobbin through a traveller riding on a ring of the spinning unit.

Although many improvements on the above-mentioned apparatus have been introduced, it is said that these apparatus are not available for our practical purpose at the present situation.

The principal object of the present invention is to provide an improved automatic yarn piecing apparatus having many practical characters, such as easy operative functions without any troubles.

The other object of the present invention is to provide a compact yarn piecing apparatus fit for all types of spinning mills without reinstallation of the spinning frames.

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Other objects and features of the invention will more fully appear from the following description and the accompanying drawings and will be particularly pointed out in the claims.

FIG. 1 is a back side view of an automatic yarn piecing apparatus according to the invention,

FIGS. 2A and 2B are left and right hand side views respectively of the apparatus shown in FIG. 1,

FIG. 3 is a perspective view showing the front side of the apparatus shown in FIG. 1,

FIG. 4 is a block diagram showing the function of a detector for detecting the absence of spinning yarn, according to the invention,

FIG. 5 illustrates various waveforms of elements of the detector shown in FIG. 4,

FIG. 6A is a perspective view of a detector according to the invention,

FIG. 6B is a plan view of a mechanism to provide a swinging motion of the detector shown in FIG. 5,

FIGS. 7 and 8 are a perspective view of mechanism for stopping the apparatus at its correct working position according to the invention, and an elevation of a portion of the mechanism, respectively,

FIG. 9 is a skeleton sketch, showing the main portion of the apparatus shown in FIG. 1,

FIG. 10A is a perspective view of a braking mechanism for controlling a rotating speed of a spindle of a ring spinning frame, according to the invention,

FIG. 10B is a perspective view of another embodiment of the braking mechanism of the apparatus according to the invention,

FIG. 11 is a sectional side view of a nipper of the yarn piecing apparatus of the invention,

FIG. 12A is a skeleton sketch, showing mainly the mechanism for reserving the supplementary yarn disposed in the apparatus shown in FIG. 1. FIG. 12B is a skeleton sketch of another embodiment of the mechanism for reserving the supply yarn according to the invention,

FIG. 13 is a perspective view of a winding mechanism for winding a supplementary yarn about a bobbin which is supported by a spindle of a ring spinning frame, according to the invention,

FIG. 14 is a plan view of the winding mechanism shown in FIG. 13,

FIG. 15 is an elevational view, partly in section of a guide member of the supplementary yarn, which is one of the elements of the winding mechanism shown in FIG. 13,

FIG. 16 is an explanatory drawing showing the relative positions of the winding mechanism shown in FIG. 13 and a ring with a traveller of a spinning unit,

FIGS. 17A, 17B, 17C, 17D, 17E and 17F are plan views showing the operation of the winding mechanism shown in FIG. 13,

FIGS. 18A and 18B are a side and plan views of an embodiment of yarn piecing mechanism according to the invention,

FIG. 18C is an enlarged plan view of a portion of the yarn piecing mechanism partly in section, shown in FIG. 18B,

FIGS. 19A, 19B, 19C and 19D are side views showing the operation of the yarn piecing mechanism according to the invention,

FIG. 20 is a programming diagram showing the relative relation of the time function with respect to the cam-profile of programming cams for controlling the motion

of the members of the automatic yarn piecing apparatus shown in FIG. 1,

FIG. 21 is a skeleton sketch, side elevation of the apparatus showing the main portion thereof, according to the invention.

GENERAL MECHANISM OF YARN PIECING APPARATUS OF THE INVENTION AND ITS OPERATION

The apparatus of the invention is characterized by a novel means for piecing yarn or strands of fibers with the drafted roving or sliver issuing from the producing roller where the yarn is broken and the breakage of the yarn is detected. The novel means for piecing yarn with the drafted roving or sliver according to the invention can be applied to both of the above-mentioned types of automatic yarn piecing apparatus. The apparatus of the invention is further characterized by means for threading yarn through a traveller.

One of the typical embodiments of the automatic yarn piecing machine according to the invention, which is applied to the latter type is hereinafter illustrated.

A typical apparatus according to the invention comprises a carriage adapted for moving in front of and along spindles of one or more ring spinning frames; a detector for detecting absence of spinning yarns of the respective spinning units of ring spinning frames; means for stopping the carriage at a correct working position of the apparatus when the detector detects a yarn breakage; means for reserving a supplementary yarn supplied from a supply cop supported by the apparatus, winding mechanism for winding the reserved supplementary yarn around a bobbin supported by a spindle wherein a spinning yarn is broken; means for threading the supplementary yarn through a traveller riding on a ring of the spindle after completion of winding the supplementary yarn around the bobbin; means for piecing one end of a parted supplementary yarn which is connected to the bobbin with a fleece issuing from a pair of front rollers of the spinning unit wherein the spinning yarn is broken just after parting the supplementary yarn between the supply cop and a nipper which grips the end portion of the reserved supplementary yarn connected to the bobbin; and a programming cam mechanism for regulating motions of the above-mentioned members of the apparatus.

Referring to FIGS. 1, 2A, 2B 3 and 4, an embodiment of the automatic yarn piecing apparatus according to the invention is encased in a carriage 1 provided with a pair of front wheels 2 and a pair of drive wheels 3 which drives the carriage 1 when the apparatus is carried outside of the operative position of ring spinning frames, for example, the carriage 1 is carried from a ring spinning frame 5 to the adjacent ring spinning frame by means of the operation of the drive wheels 3. The drive wheels 3 are driven by a suitable means such as an electric motor 4 and its power transmission mechanism. As shown in the drawing, a drive wheel 8 and guide wheel 7 are disposed to the carriage 1 so that these wheels are engaged with a guide rail 6 secured to the ring spinning frame 5 during the working operation of the apparatus 1 for guiding it along the spindle rail of the ring spinning frame 5. Other well-known driving mechanisms, such as a trolley system may be applied for carrying the apparatus.

The automatic yarn piecing apparatus is carried along the guide rail 6 of the ring spinning frame 5 and, when a detector 10 detects a yarn breakage, the detector 10 actuates the electric circuit of the motor 4 so as to stop the motor 4 and a brake 57 disposed on the carriage 1 is actuated by the output of the detector 10 so that the brake 57 comes in contact with a brake rail 59 which is disposed adjacent to the spinning frame 5 in a parallel condition with the guide rail 6, thereby the carriage 1 is carried only by its inertia and then stops. Just after the brake 57 has been applied, means for correcting the working position of the carriage

1 engages with one of the setting pins 11 secured to the spinning frame 5 with an equal interval corresponding to a spindle gauge of the frame 5, thereby the carriage 1 is stopped at the correct working position. The above-mentioned interval between the pins 11 may be chosen as a multiple of the space of the spindle distance. Next, a nipper 23 gripping a leading end portion of yarn reserved by a supplementary yarn reserve mechanism 22 (FIG. 3) is carried downward along a vertical shifting guide 21 by a motion of a shifting mechanism provided with a chain 24 of the shifting mechanism while a mechanism 25 for leading and guiding the end portion of the supply yarn (hereinafter referred to as a winding mechanism) is carried downward along a vertically shifting guide 21 by means of a guiding motion of a chain 27 of the shifting mechanism as shown in FIG. 3. The winding mechanism 25 stops its downward motion when it contacts with a ring rail 17 of the spinning frame 5. And the nipper 23 also stops its downward motion when it contacts with a stopper secured to the mechanism 25. These positions wherein the nipper 23 and the winding mechanism 25 are stopped are at positions which are hereinafter referred to as the operating positions, respectively. While the nipper 23 and the winding mechanism 25 are being carried downwards, a spindle braking mechanism 28 stops the rotation of the spindle or decreases the rotation speed of the spindle by its braking action to against a spindle braking pulley 14 secured under a spindle wharve 15 of the spindle wherein the yarn is broken. The nipper 23 and the winding mechanism 25 are always pulled downwards by a spring or counter balance (not shown) and are supported by the respective carrying members secured to the chains 24, 27 of the respective shifting mechanism so as to restrict the free movement in the downward direction. When the nipper 23 and the winding mechanism 25 arrive at their operative positions and are stopped by the above-mentioned mechanism, the leading end portion of the supplementary yarn is transferred from the nipper 23 to a supporting member of the winding mechanism 25, then a friction pulley of the spindle braking mechanism 28 is positively driven at a low speed for controlling the spindle speed while ejecting the end portion of yarn, which is supported by the supporting member of the winding mechanism 25, by jet air stream blown in the tangential direction of a ring from a nozzle disposed to the carriage 1, whereby the end portion of the supply yarn is wound around a cop 12 supported by the spindle, and just after the winding motion of the supplementary yarn around the cop 12, a traveller 18 is slid on the ring 16 by the action of jet air blown from the other nozzle disposed to the carriage 1, next the traveller 18 is stopped at a predetermined position by a stopper disposed to the winding mechanism 25. When a yarn guide member of the winding mechanism 25 leads the supplementary yarn extending from the nipper 23 to the cop 12 so that the supplementary yarn contacts with the flange of the ring 16, the traveller is ridden on the yarn guide member by the action of jet air blow, thereby the supplementary yarn is threaded through the space between the ring 16 and the traveller. Next, the nipper 23 is carried upwards along the vertical shifting guide 21 while permitting the free passing of the supplementary yarn, and returns to its original position. While the nipper 23 is being carried upwards, a tail end portion of the supplementary yarn is positioned at the operative position of a yarn piecing mechanism 29. Next the yarn piecing mechanism 29 leads the tail end portion of the supplementary yarn to an approach position to the nip point of the front rollers of the spinning unit of the spinning frame 5 and then the tail end portion of the supplementary yarn is parted by a parting means of the yarn piece in mechanism 29 in such a way that the tail end portion of the supplementary yarn is transferred to the yarn piecing mechanism 29 so as to grip the tail end portion of the supplementary yarn temporarily. When a parted portion of the supplementary

yarn connected to the cop is carried to the bottom front roller and contacted with a fleece issuing from the front rollers by means of the yarn piecing mechanism, the parted portion of the supplementary yarn is pieced with the fleece. Thereafter the yarn piecing mechanism 29 recedes from the operative position and returns to its original position, while the winding mechanism 25 is also carried upwards and returned to its original position. When the supplementary between the nipper 23 and the yarn piecing mechanism 29 is parted, the nipper 23 grips firmly the supplementary yarn which is supplied from the supply cop through the supplementary yarn reserve mechanism 22. Consequently, when the next piecing motion of the apparatus starts, a leading end portion of the supplementary yarn is projected from the nipper 23. Further the spindle is released from the engagement with the spindle braking mechanism 28 at a time just before the completion of the yarn piecing motion of the apparatus. The above-mentioned yarn piecing operation is carried out without troubles in other words carried out satisfactorily. Then the detector 10 works again to confirm the completion of the yarn piecing motion of the apparatus. Next, the apparatus is carried along the guide rail 6 until the detector 10 detects an occurrence of a broken yarn. It is also possible to operate the detector 10 in such a way that the miss operations of the above-mentioned yarn piecing operation of the apparatus, the apparatus is operated again or the trouble is informed by a suitable device such as an alarm so as to call the attention of the operator.

MEANS FOR DETECTING A YARN BREAKAGE

Generally, it is well known that a large number of flies are stuck to machine parts of the spinning frame. Consequently, in case the detection of a reflection from a spinning yarn of a spinning unit is applied for detecting a yarn breakage, it is quite possible to detect a reflection from a fly, thereby perfect detection by the detector is disturbed very much.

According to the present invention, a novel method for detecting the absence of the spinning yarn is applied to prevent the above-mentioned miss-detection, that is, vibration of a spinning yarn passing through a yarn passage between a nip point of front rollers and a snail wire of a spinning unit is particularly considered and a modified detecting method by sensing a reflection in a wave form is applied to distinguish spinning yarn in a normal spinning condition from a yarn breakage.

Referring to FIGS. 3, 4, 5, 6A and 6B, an embodiment of the detector 10 of the invention comprises a projector 31, a light receiver 32 for receiving a reflected light from a yarn, an element of a photo-electric transducer (not shown) which transforms the output of the receiver 32 into an electric output, a filter and amplifier 35 which detects only a component signal of the element of the photo-electric transducer having a predetermined frequency, a shaper 36 for shaping the output of the filter and amplifier 35, a counter 37 for counting the pulse of the shaper 36, a detecting head 40 for detecting a position of corresponding spindle 13, another shaper 41 for shaping the output of the detecting head 40 into a signal of a square wave form, an off delay timer 42 to make an output signal which is maintained longer for a predetermined period than the duration of the square wave output of the shaper 41, a memory 38 for keeping the output signal of the counter 37 while the output signal of the off delay timer 42 is maintained, a gate circuit 39 to which the output of the shaper 41 and memory 38 and off delay timer 42 are put in, and a relay 43 which is actuated by the output of the gate circuit 39 and actuates the yarn piecing mechanism of the apparatus. Further, a swing mechanism for swinging the projector 31 together with the light receiver 32 is provided. The operative character of the detector 10 is illustrated by the drawings of FIGS.

4 and 5. When the detecting head 40 detects the existence of the spindle, the output signal *f* is given and the signal *g* is provided by the off delay timer 42 at the same time. On the other hand, in case there is no yarn breakage, the light from the projector 31 is reflected by the spinning yarn of the normal spinning condition, and the reflected light caused by the spinning yarn in a vibration form is detected by the receiver 32 so that the reflected light received by the receiver 32 is in a compound form with some reflected lights from several parts of the ring spinning frame or flies. Then the reflected light received by the receiver 32 is changed into an electric signal *a* by the element of the photo-electric transducer. It is considered that the output signal *a* is composed of signal *x* corresponding to a reflection from a spinning yarn passing through a passage between the front rollers and a snail wire 20 of a spinning unit and the other signal *y* corresponding to a reflection from several parts of the spinning frame or flies. Therefore, it is necessary to only detect the signal *x* by an action of the filter and amplifier 35. The output signal *b* corresponding to the signal *x* can be obtained by the filter and amplifier 35. The output signal *b* is further changed to a corresponding pulse signal *c* by the shaper 36, and the pulse signal *c* is counted as a signal *d* by the counter 37. In case the signal *d* becomes a predetermined value, a pulse signal *e* is obtained and the pulse signal *e* is memorized by the memory 38 during the duration of a signal *g* of the off delay timer 42. This signal is represented by *h*. As mentioned above, the disturbance caused by the reflection of some flies, can be eliminated. On the contrary, in case the pulse signal *e* is not obtained, in other words, in case the spinning yarn is broken, no signal is memorized by the memory 38. In FIG. 5, the abscissa of all diagrams represent "time," while the ordinates represent the magnitude of the respective signals. In the diagram of a signal *h* of the memory 38, a portion designated by P shows the signal *h* when the spinning of the yarn is operating without troubles, while a portion designated by Q shows the signal *h* when a yarn breakage is detected. As already illustrated, the signals *f*, *g* and *h* are put into the gate circuit 39. And the output signal of the gate circuit 39 is finally detected by the balancing condition between the signals *g* and *h*, that is, the output signal *i* of the gate circuit 39 does not exist in case the signal *h* is at the condition of P, while the signal *i* exists at the condition of Q of the signal *h*. When the signal *i* exists, a pulse signal R is obtained, therefore, when the pulse signal R is obtained in other words, when a spinning yarn is broken, the relay 43 is excited by the signal R.

Even if the yarn piecing operation of the apparatus has been operated after detecting a yarn breakage, it is not certain whether the yarn piecing operation has been performed completely or not, consequently, the confirmation of the operation may preferably be required for practical use of the yarn piecing apparatus in the mill. For the above-mentioned purpose, means for confirmation of the piecing yarn operation may be added to this embodiment of the invention. Referring to FIGS. 6A and 6B, the projector 31 and the receiver 32 are secured to the same bracket 33 with an angle such that the projector 31 illuminates the spinning yarn between the front rollers and the snail wire 20, while the receiver 31 receives the reflected light from the yarn. The bracket 33 is secured to a vertical shaft 45 rotatably supported by a bracket 34 secured to the frame of the yarn piecing apparatus. Further, a horizontal arm 44 is secured to the vertical shaft 45, one end portion of the horizontal arm 44 is connected with the front end portion of a flexible wire 46 which is operated by a programming cam (not shown), another end of the horizontal arm 44 is connected with a helical spring 49 secured at its end to the frame of the yarn piecing apparatus. A guide tube 48 of the flexible wire 46 is supported by a bracket 47 secured to the frame of the apparatus. After completion of the yarn piecing operation,

the flexible wire 46 is pulled toward the right in FIG. 6B by an action of the programming cam, consequently, the horizontal arm 44 is turned clockwise while resisting to the force of the spring 49, thereby the projector 31 and the receiver 32 are turned to the position shown by the dotted line so as to face the detecting position of the spinning unit where the piecing operation has just been finished, thereby, the detecting operation is carried out again on the spinning unit to confirm the completion of the yarn piecing operation.

The position of the projector 31 shown by the solid line shows its normal working position.

The detecting operation mentioned above is carried out on each spinning unit while the yarn piecing apparatus moves along a working front of the ring spinning frame 5. In a modified embodiment of the detector according to the present invention, when a miss operation of the above-mentioned yarn piecing operation is detected by the confirmation operation which is already described, the miss operation is counted. However, the operation of the apparatus is continued until the counted number of the miss operation becomes a predetermined value and when the counted value becomes the predetermined one, the apparatus is stopped automatically by a suitable means and the trouble is noticed by operators by a suitable means such as an alarm.

MEANS FOR STOPPING THE APPARATUS AT ITS CORRECT WORKING POSITION

Referring to FIGS. 2A, 2B, 3, 7 and 8 means for stopping the apparatus at its correct working position (hereinafter referred to as a stop means) firstly brakes the movement of the carriage 1 when a yarn-breakage is detected by the detector 10, and an engaging arm 70 is projected forwards simultaneously thereby the carriage 1 is stopped at a position adjacent to its working position, next a correcting device provided with an engaging member 53 is operated in such a way that the engaging member 53 engages with the setting pins 11 so as to stop the carriage 1 at the correct working position of the apparatus.

As shown in FIG. 2, the apparatus is carried along an upper rail 19 disposed to the frame 5 and the brake rail 59 disposed under the upper rail 19, and a plurality of setting pins 11 for correcting the stop position of the carriage 1 are disposed to the upper rail 19 in such a way that the pins 11 are arranged at an equal interval which corresponds to several times greater than a spindle distance. For example, in the embodiment shown in FIG. 8, the pins 11 are arranged at the positions corresponding to alternate spindles. The brake rail 59 works to support the apparatus. Generally, the upper rail 19 can be attached to the spindle rail of the ring spinning frame 5 or is replaced with the guide rail 6. The engaging member 53 is provided with a plurality of engaging grooves 54 opened upwardly. The lateral space between the adjacent grooves 54 coincides with the spindle distance so as to engage one of the grooves 54 with one pin 11 when the engaging member 53 is shifted upwardly. To obtain easy engagement of the engaging grooves 54 with the pin 11, the top portion of the engaging groove 54 is wider than its lower portion. When the pins 11 are disposed to the upper rail 19 as shown in FIG. 7, the engaging member must be provided with two engaging grooves 54, and if the lateral space between the adjacent pins 11 corresponds to a distance three times larger than the spindle distance, the engaging member 53 must be provided with three engaging grooves 54. The engaging member 53 is maintained at its lowermost position while carrying the carriage 1, and is shifted upwards when the carriage 1 is stopped so as to engage a groove 54 with one of pin 11 for stopping the carriage 1 at the correct working position of the apparatus.

In FIG. 7, a braking device and an embodiment stop means are shown. The braking device comprises an electromagnet 55, a lever 56 and the brake 57. The electromagnet 55 is actuated by an output of the detector 10

when the detector 10 detects yarn breakage. A lever 56 is turnably mounted on a shaft 58 and one end of the lever 56 is connected to the electromagnet through a helical spring 60, while the other end forms the brake 57 which rides upon a brake rail 59. Consequently, when the electric magnet 55 is actuated and the end of the lever 56 is pulled upwards, the lever 56 is turned in such a way that the brake 57 contacts with the brake rail 59 strongly so as to brake the motion of the apparatus. Further an electromagnet 61 is actuated simultaneously or just after the actuation of the electromagnet 55. The electromagnet 61 is actuated by a signal from the above mentioned stop means, and turns a shaft 67 through a lever 63 pivoted to a fixed shaft 62 and connecting rods 64 and 65. The shaft 67 is rotatably supported by a pair of cannon brackets 68a, 68b in such a way that the shaft 69 does not move in the lateral direction. To obtain the above-mentioned feature, a stopper 69 is secured to the shaft 67, the engaged portion of the shaft 67 with an engaging arm 70 is provided with the configuration of a spline shaft and a compression spring 71 is mounted on one end portion of the shaft 67 so as to form a shock absorber. A washer 72 is mounted on the end of the shaft 67. The engaging arm 70 is supported at its receded position in the carriage 1 during the movement of the carriage 1 so as to disengage from pins 11, on the contrary, when the electromagnet 61 is actuated, the top portion of the engaging arm 70 is moved forward and engaged with the pin 11, the electromagnet 55 is also actuated simultaneously so as to break the movement of the apparatus by the action of the brake 57, thereby the carriage 1 is stopped at the engaged position of the engaging arm 70 with the pin 11. However, the above-mentioned stopped position of the carriage 1 is not always the correct operating position. In the present embodiment, when the carriage 1 is stopped as mentioned above, the working elements of the electromagnets 55 and 61 are returned to their waiting position, and the carriage 1 is released from the condition of engagement between the brake 57 and the brake rail 59. Next, the correcting device for correcting the stopped position of the carriage 1 is actuated. In the correcting device a wheel 74 is secured to a shaft of a motor 73, and is meshed with a wheel of a shaft 75. The shaft 75 is supported by cannon brackets 76a, 76b, and cams 77, 79 for operating limit switches 78 and 80 and pinions 81, 82 are secured to the shaft 75. The cams 77, 79 are engaged with the respective limit switches 78 and 80 so as to stop the engaging member 53 at its upper or lower most positions. The motor 73 is actuated by a limit switch (not shown) after stopping the carriage 1, thereby the engaging member 53 moves upwards by the engagement of the rack portions of it with the pinions 81, 82 of the shaft 75. By this upward motion of the engaging member 53, one of the grooves 54 engages with the pin 11, thereby the stop position of the carriage 1 is corrected to the correct operating position. And the engagement of the engaging member 53 with the pin 11 is maintained at the correct operating position of the carriage 1 till the yarn piecing operation is completed. After the completion of the yarn piecing operations, the motor 73 rotates in the reverse direction thereby the engaging member 53 moves downwards so as to release the engagement of the engaging member 53 with the pin 11, and next the carriage 1 moves again. Instead of using a single motor as described above, a pair of driving motors, which rotate in reverse direction, may be used for shifting the engaging member 53.

SPINDLE SPEED CONTROL MECHANISM

Referring to FIGS. 2, 3, 9 and 10A, the rotation of the spindle can be controlled by a positive engagement of the spindle brake pulley 14 secured coaxially to a portion right under a spindle wharve 15 of the respective spindles 13 with a friction pulley 83 of a spindle speed control mechanism 28 for controlling the rotation of the spindle. Consequently the rotation speed of the spindle 13 can

be controlled so as to conform to the motion of the elements of the automatic yarn piecing apparatus, in other words, the spindle 13 can be stopped or rotated at a braked condition to conform to the motion of the elements of the apparatus. The friction pulley 83 is secured to the upper end portion of a vertical shaft 85 rotatably mounted on a top end portion of a sliding plate 87 slidably engaged with a pair of guides 88 secured to a base plate 86 of the control mechanism 28. At the rear end portion of the sliding plate 87, the bottom end of an L shaped lever 95 rotatably supported by a horizontal shaft 93 is connected with an arm 92 which is connected with the sliding plate 87 through a connecting bracket 89a, connecting rod 91 and connecting bracket 89b. A roll 111 rotatably supported by one end of the L shaped lever 95 is always contacted with a programming cam 110 (FIG. 9) by a spring 108. A sprocket wheel 106 (FIG. 9) is secured to a shaft portion projected downward beyond the sliding plate 87, that is, the sprocket wheel 106 is secured to a bottom end portion of the vertical shaft 85. As shown in the drawing, a small motor 97 is mounted on the base plate 86, a horizontal supporting plate 99 is turnably mounted on a motor shaft 98, further a sprocket wheel 101 is secured to a top end portion of the motor shaft 98. A vertical shaft 103 is disposed to an end of the horizontal supporting plate 99, a sprocket wheel 102 is secured to the top end portion of the vertical shaft 103 and the other sprocket wheel (not shown) is secured to the bottom end portion of the vertical shaft 103 in such a way that the horizontal supporting plate 99 is positioned at an intervened portion of the vertical shaft 103 between the above-mentioned two sprocket wheels. The sprocket wheel 102 is driven by the sprocket wheel 101 through a driving chain 100, and the sprocket wheel 106 is driven by a sprocket wheel under the supporting plate 98 through a driving chain 105.

The control of the rotation of the spindle is performed in the following manner. The top end portion of the L shaped lever 95 is turned around the shaft 93 by a rotation of the programming cam 110 (FIG. 9) secured to a programming cam shaft 109 of the programming mechanism through the roll 111, that is, the L shaped lever 95 is turned around the horizontal shaft 93 in a counter-clockwise direction in FIG. 10A. Consequently, by the above-mentioned connection of the elements, the sliding plate 87 is moved forward beyond the carriage 1 so as to contact the friction pulley 83 with the brake pulley 14 of the spindle 13. To provide an effective braking action of the friction pulley 83 with the brake pulley 14, an elastic connecting member 92 containing a helical spring 90 (FIG. 9) may be used instead of using the connecting bracket 89a, 89b, further the outer contacting portion of the friction pulley 83 is covered by an elastic material such as soft rubber or other braking material suitable for the purpose. When the friction pulley 83 is kept in the stopped condition, the spindle wharve 15 slips to a spindle tape 13a rotating at a high speed, thereby the spindle brake pulley 14 is positively stopped, while the friction pulley 83 rotates at the contacting condition with the spindle brake pulley 14, therefore the rotation of the spindle brake pulley 14 is controlled by the rotation of the friction pulley 83. The positive driving of the friction pulley 83 is performed in the following manner. The motor 97 is driven by an electric signal from the programming mechanism, the rotation of the motor shaft 98 is transmitted to the friction pulley 83 through a power transmission mechanism comprising the sprocket wheel 101, driving chain 100, the sprocket wheel 102, the vertical shaft 103, the sprocket wheel (not shown) secured to a bottom end portion of the vertical shaft 103, the driving chain 105, the sprocket wheel 106 (FIG. 9), and the vertical shaft 85. The position of the friction pulley 83 is changed by the forward and rearward sliding motion of the sliding plate 87, however, the rotation of the motor shaft 98 is positively transmitted to the friction pulley 83

by the above-mentioned power transmission mechanism. To compensate the slack of the driving chain 105 caused by the forward and rearward motion of the sliding plate 87, the horizontal supporting plate 99 is always pulled in the counter-clockwise direction in FIG. 10A, by the action of a tension spring 107 which its one end is connected to the base plate 86 and the other end is connected to the horizontal supporting plate 99.

In FIG. 10B, another embodiment of the controlling mechanism in which the sliding mechanism of the sliding plate 87 has been modified is shown. As shown in FIG. 10B, a solenoid 96 which is actuated by an electric signal of the programming mechanism can be used instead of the programming cam 110 of the above-mentioned embodiment shown in FIG. 10A. As described above, the control mechanism for controlling the rotation speed of the spindle is operated positively with a correct and precise timing by the programming mechanism disposed to the apparatus.

20 SUPPLEMENTARY YARN RESERVE MECHANISM AND NIPPER

Referring to FIGS. 3, 9, 11, 12A and 12B in the present embodiment, a same yarn as the spinning yarn is used as a supplementary yarn. A copy of the supplementary yarn is supported in a magazine 113 shown in FIG. 3. And a leading end of the supplementary yarn is gripped by a grip of the nipper 23 in such a way that the supplementary yarn passes through an aperture made on a side frame of the carriage 1 and the reserve mechanism 22. The upward or downward motion of the nipper 23 is limited by the shifting guide 21. A shifting mechanism comprises the chain 24 which is supported by a drive sprocket wheel 27a and a driven sprocket wheel (not shown), by the downward motion of a projected piece secured to a portion of the chain 27 the nipper 23 is shifted in the downward direction, and a base plate of the winding mechanism 25 disturbs further downward motion of the nipper 23. It is preferable to provide an adjustable projected member disposed under the nipper 23 so as to keep a predetermined distance between the nipper 23 and the winding mechanism 25, when the nipper 23 and the winding mechanism 25 are positioned at their working position. Further, when the chain 27 is driven upwards, the projected piece pushes the nipper 23 till the driving of the chain 27 is stopped. As mentioned above, the chain 27 is driven in both directions for a predetermined distance, and the uppermost position of the nipper 23 is always fixed, while the position of the nipper 23 follows the winding mechanism 25 when the nipper 23 and the winding mechanism 25 are going in the downward direction.

Referring to FIG. 11, an embodiment of the nipper 23 comprises an outer shell 115 wherein one end portion thereof is open and an aperture 117 is disposed to the other end portion thereof. A flexible wire 124 passes through the aperture 117. An L shaped lever 116 is turnably mounted on a shaft 120 disposed inside of the shell, one end of the L shaped lever 116 is always contacted with the flexible wire 124, and the other end of the L shaped lever 116 is formed as grip piece 119. A coil spring 121 presses the grip of the L shaped lever 116 and is disposed in a supporting member 118. An aperture 123 which permits the passing of the supplementary yarn and another projection 122 forming a grip are disposed to the inside wall of the shell 115. Therefore, the supplementary yarn can be gripped by the grip piece 119 of the L shaped lever 116 and the projected piece 122 when the L shaped lever 116 turns counterclockwise (in FIG. 11) and contacts with the projected piece 122. As mentioned above, the turning motion of the L shaped lever 116 is operated by the forward or rearward motion of the flexible wire 124 caused by the motion of the programming cam (not shown). The relative motion of the nipper 23 and the flexible wire 124 is predetermined as follows, that is, the nipper 23 nips the

supplementary yarn in such a way that one end portion of the yarn is projecting from the lower end of the nipper 23 while the nipper is moving downward and the grip of the nipper 23 is closed, on the contrary the grip of the nipper 23 is released during its upward motion, thereby the supplementary yarn can be passed through the nipper 23 freely, and when the nipper is stopped at its uppermost position, the grip of the nipper 23 is closed again. Other mechanisms of the nipper having the same function as mentioned above can be used for the apparatus.

The supply yarn reserve mechanism 22 of the embodiment works as hereinafter illustrated, that is, the mechanism 22 reserves a certain length of the supplementary yarn so as to supply the yarn having a predetermined length to the winding mechanism 25 so that a satisfactory winding operation of the supplementary yarn around the cop 12 can be carried out. Generally, it is required to apply a supplementary means for feeding the supply yarn rapidly to the rotating cop 12 supported by the spindle 13 or to apply a certain cohesive agent such as water to the supplementary yarn so that the cop 12 can take. Further, it is necessary to decrease the tension of the supplementary yarn to prevent yarn breakage when the supplementary yarn is taken hastily. In the present embodiment, a jet air system is applied for the winding of the supplementary yarn around the cop 12, that is, the jet air supplied from the winding mechanism 25 develops air current blowing the cop 12, consequently, it can be understood that, when a leading end portion of the supplementary yarn is led to the zone of the turning air current, supplementary yarn is caught by the rotating cop 12 instantaneously, and a certain length of the supplementary yarn is wound hastily around the rotating cop 12. As the reserved supplementary yarn is fed to the cop 12 through the nipper 23, the tension of the yarn A is maintained low during the winding operation. The supplementary yarn reserve mechanism 22 comprises a plurality of yarn guides wherein at least one yarn guide can be shifted by its shifting mechanism. For example, in case two yarn guides can be shifted in the vertical direction while the other yarn guide is fixed at its position, W- or M-shaped passage of the supplementary yarn can be formed in such a way that the two yarn guides are positioned at two positions corresponding to the two outside apexes of the letter M or W while the other yarn guide is fixed at the position corresponding to the middle apex of the letter M or W, on the contrary, when the two guides are shifted to the same level of the fixed guide, the shape of the yarn passage becomes a straight one. In the above mentioned cases, further, a pair of fixed yarn guides are positioned, at two predetermined positions corresponding to two end portions of the letter M or W. Consequently, when the two yarn guides change their positions from the condition of straight yarn passage to M- or W-shaped yarn passage, an excess yarn which corresponds to the difference between the length of the M-shaped passage and the straight passage is reserved by the yarn guides, and when the two yarn guides are shifted to the condition of the straight yarn passage, the excess yarn reserved as mentioned above can be supported in a released condition by the yarn reserve mechanism 22. Referring to FIGS. 9 and 12A, a bracket 126 is secured to the frame of the apparatus and three yarn guides 131, 132 and 133 are secured to the bracket 126 in such a way that the guides 131, 132 and 133 are aligned in a straight line as shown in FIG. 12A. A pair of movable yarn guides 129 and 130 are slideably supported at their sliding portions by the respective guide grooves 127 and 128 in such a way that the yarn guides 129 and 130 can be shifted in a vertical direction along the guide grooves 127 and 128 respectively. The yarn guides 129 and 130 are mounted on a supporting member (not shown) which is always pulled downward so as to keep the positions of the yarn guides 129 and 130 at the same level of the other three guides 131, 132, and 133, by a spring (not shown). An L shaped lever 140 is provided with a roll 141 which always contacts with a programming cam 142 secured to the programming cam

shaft 109. A connecting rod 139 is connected at its bottom end with one end of the L shaped lever 140, and a guide pulley 138 is rotatably supported by the top end of the connecting rod 139. A pair of guide pulleys 134 and 135 are rotatably supported to the apparatus and one end of a tape 137 is connected to the supporting member of the movable yarn guides 129 and 130 and the other end of the tape 137 is secured to the apparatus through a supporting rod 136 secured to the apparatus in such a way that the tape 137 passed over the guide pulley 134, 135 and 138 as shown in FIG. 12A. The tape 137 is always maintained in a tensioned condition by means of a spring. When the connecting rod 139 is shifted in the upward direction by the action of the programming cam 142, the tape 137 is loosened. Consequently, the movable yarn guides 129 and 130 are shifted downwards till the yarn guides 129 and 130 are positioned at the same level of the fixed yarn guides 131, 132, 133. At the positions of the yarn guides shown in FIG. 12A, the passage of the supplementary yarn is formed as zigzag line, therefore, when the yarn guides 129 and 130 are shifted to the uppermost positions shown in FIG. 12A from the lowermost positions while the end of the supplementary yarn is firmly gripped by the nipper 23, the supplementary yarn having a length corresponding to the zigzag line shown in FIG. 12A is taken up from a supply cop and reserved by the above mentioned reserve mechanism 22. And then the movable yarn guides 129 and 130 are shifted to their lowermost positions, the excess yarn corresponding to the difference between the length of the zigzag line and the straight line of the yarn passage is maintained at its released condition, consequently the excess yarn can be supplied to the winding mechanism 25 in a free condition. Other types of reserve mechanism, such as that shown in FIG. 12B, can be used for the purpose, that is, in FIG. 12B, a plurality of fixed guides 143 are formed as one member while the movable yarn 144 guides are connected to the connected rod 139 directly and the bracket 126 is omitted.

WINDING MECHANISM

The winding mechanism 25 of the embodiment comprises a yarn catch and discharge member which receives a leading end of the supplementary yarn from the nipper 22 of the reserve mechanism 23 and carry the leading end of the supplementary yarn to the rotating cop 12, an air jet nozzle which assists in the catching of the end of the leading supplementary yarn by the rotating cop 12 and actuates the sliding motion of the traveller 18 on the ring spinning flange 5, a stopper to stop the traveller 18 at a predetermined position, a presser to press the supplementary yarn between the cap 12 and the nipper 23 to the outside portion of flange of the ring 16, and an air jet nozzle to shift the traveller 18 over the supplementary yarn A pressed to the outside portion of the flange of the ring 16. The above-described elements are shown in the drawings of FIGS. 13, 14, 15, 16, 17A, 17B, 17C, 17D, 17E and 17F. As shown in the drawings, a base plate 154 of the winding mechanism 25 is secured to a pair of brackets 146 which are slideably supported by the respective shifting guide 21 and 26 vertically mounted on the apparatus, and the above mentioned elements are mounted on the base plate 154. The position of the base plate 154 is controlled by a projection 145 secured to the chain 24 (FIG. 3) through a stopper disposed to the bracket 146. The control method of the base plate 154 may be understood as being similar as that of the nipper 23. Consequently, when the projection 145 of the chain 24 is shifted downwards, the winding mechanism 25 is shifted downwards, thereby the forward end portion of the winding mechanism 25, whose frame is permitted to shift downwards till the forward end portion of the winding mechanism 25 contacts with the ring rail 17, thereafter the projection 145 is shifted only in the downward direction till the projection 145 comes to its predetermined lowermost position, next the driving of the chain 24 is stopped. Consequently, the base plate 154 follows the upward and

downward motion of the ring rail 17 and the above-mentioned elements of the winding mechanism 25 can maintain their correct working positions.

The winding operation of the mechanism 25 is hereinafter described. To permit easy understanding, the winding operation of the mechanism 25 is explained in accordance with the order of the operation of the elements. A jet air nozzle 155 is connected to a compression air source (not shown) disposed in the apparatus, by way of a magnet valve and a flexible air conduit 156. The nozzle 155 is supported by a supporting bracket 157 in such a way that the blowing direction of the nozzle 155 is directed in a tangential direction to the inside surface of the ring 16 with an angle of 15 to 20° facing the ring surface. The blowing of the nozzle 155 is controlled by opening or closing of the magnet valve which is actuated by the programming mechanism of the apparatus. The jet air blown from the nozzle 155 turns the current of air along the inside surface of the ring 16 and is discharged at an under side portion of the ring 16. By the above-mentioned turning current of air and turning current caused by the rotation of the cop 12, the end portion of the supplementary yarn is led to the cop 12, thereby the leading end portion of the yarn is naturally taken by the rotating cop 12. The above-mentioned turning current is so strong that the leading end portion of the supplementary yarn can be taken by the cop 12 even though the rotation of the cop 12 is stopped. The traveller 18 is carried along the ring flange with the turning current. A traveller stopper 150 is slidably mounted to a bracket 149 secured to the base plate 154 and its turning is prevented by a groove 149a of the bracket 149 and a pin 149b disposed to the stopper 150. A supporting member 153 for supporting flexible wires is disposed to the rear end portion of the base plate 154. The guide member 160 guides a flexible wire 152 connected with the traveller stopper 150. The stopper 150 is always pushed forward by a coil spring 158 and its forward motion is controlled by the action of a programming cam. The forward end 151 of the stopper 150 is preferably made of an elastic material and its contact surface against the ring flange is provided with a recess so as to catch the traveller 18 when the forward end 151 is deformed when it contacts with the flange of the ring 16.

Next the winding operation of the mechanism 25 is explained. Referring to FIG. 15, a yarn catch and a discharge member (hereinafter referred to as a catch member 159) is composed of a cylindrical member 163 provided with a slit 163b disposed along its axis and an aperture opens forward. A jet nozzle 164 is coaxially disposed inside the cylindrical member 163. The jet nozzle 164 is connected with a jet air source (not shown) by way of a connecting conduit 165 a conduit and a magnet valve (not shown). A yarn receiving mouth 163a is disposed to the upper side of the opened end portion of the cylindrical member 163 and the yarn receiving mouth 163a is connected with the slit 163b through a curved groove 163c so as to form a passage for the supplementary yarn (hereinafter designated as yarn A). Consequently, after receiving the supplementary yarn A by the yarn receiving mouth 163a, the supplementary yarn A caught by the catch member 159 is released from the cylindrical member 163, when the supplementary yarn A is taken up by the rotating cop 12, or when the cylindrical member 163 is turned so as to transfer the slit 163b in the upward position, or the supplementary yarn A is positively led to the slit 163b, or the curved groove 163c is deformed by a certain means. The embodiment of the winding mechanism 25 shown in the drawings corresponds to a case that the cylindrical member 163 is turned. The cylindrical member 163 is rigidly supported by a block 161 which is rotatably supported by a bracket 166. To restrict the turning motion of the block 161 and the sliding motion in the axial direction, a set screw 169b secured to the bracket 166 is engaged with a grooved portion of the block. A rear end por-

tion 162 of the block 161 is formed as a projected portion which is connected with an end portion of a belt 168 by a set screw 169a. The cylindrical member 163 is turned by the motion of the belt 168. A coil spring 167 is mounted at an intervened position between the bracket 166 and the rear end portion 162 so as to normally keep the yarn receiving mouth 163a at the upper position shown in FIG. 15. The belt 168 is connected with a sliding rod 172 through a pair of guide pulleys 171a and 171b, and the sliding rod 172 is slidably supported by a guide member 173 and is actuated by the motion of a flexible wire 170. Consequently, when the flexible wire 170 is shifted forward so as to push the sliding rod 172, the belt 168 is loosened, and the cylindrical member 163 of the catch member 159 is turned by the action of the coil spring 167 in such a way that the slit 163b comes to the upper position. The cylindrical member 163 is directed toward the tangential direction of the inside surface of the ring 16 which is similar to that of the jet nozzle 155, so as to release the supplementary yarn A toward the rotating cop 12 to obtain satisfactory taking action of the supplementary yarn A by the rotating cop 12. When the jet air is ejected from the jet nozzle 164, a suction stream is formed in the cylindrical member 163, consequently, when the nipper 23 which faces the yarn-receiving mouth 163a releases the end portion of the supplementary yarn A, the supplementary yarn A is led to the cylindrical member 163 through the receiving mouth 163a and is fed toward the rotating cop 12 from the forward aperture of the cylindrical member 163. By the above-mentioned motion, the supplementary yarn A reserved by the reserve mechanism 22 is hastily carried toward the cop 12, and wound around the cop 12 simultaneously. In the above-mentioned embodiment, the jet nozzle 155 actuates the running of the traveller 18, but this the jet nozzle 155 can be omitted if the cylindrical member 163 is positioned slightly higher than the above-mentioned embodiment and disposed in such a way that the jet air from the member 163 is directed toward the inside surface of the ring 16 so as to develop a turning current around the cop 12 and actuate the running of the traveller 18, instead of two jet nozzles 148 and 155 being applied to wind the supplementary yarn A at a position as close as possible to the upper surface of the ring flange, in the present embodiment.

At the time of the above-mentioned winding of the supplementary yarn A around the cop 12, the rotation of the spindle 13 is stopped or braked by the action of the braking mechanism described by FIG. 10A so as to rotate at a very slow speed.

Referring to FIGS. 14 and 16, a presser 174 is composed of a rod portion 175 and a triangular shaped end portion 176 secured to the rod 175 in such a way that the end portion 176 can be slightly moved toward the rod 175. The triangular shaped end portion 176 is provided with a curved side surface which can be fitted to the under side surface of the flange of the ring 16. The rod portion 175 is slidably supported by a slide bracket 177 which is provided with a groove 178 disposed in such a way that the groove 178 forms a quarter turned groove as shown in FIG. 14. A pin 179 secured to the rod 175 engages with the groove 178. Consequently, when the rod 175 is shifted forward, the rod 175 is turned a quarter turn, and when the rod 175 is shifted rearwards, the rod 175 returns to its original position. The forward or rearward motion of the rod 175 is operated by a flexible wire 180 and a coil spring 181. The flexible wire 180 is supported by a guide member 182 disposed to the mechanism 25. The jet nozzle 148 for running the traveller 18 is supported by a supporting member 153 and is connected with a conduit of the supply source by way of a magnet valve (not shown). The operation of the winding mechanism 25 is explained in detail as follows. Referring to FIGS. 17A, 17B, 17C, 17D, 17E and 17F, the traveller stopper 150 catches the traveller 18 after ejecting the jet

air from the jet air nozzle 155 so as to run the traveller 18 (FIG. 17A) next the supplementary yarn A is ejected from the cylindrical member 163, and the supplementary yarn A is wound around the cop 12 in such a way that the yarn A passes over the flange of the ring 16 (FIG. 17B), and when the presser 174 is shifted forward, the rod portion 175 is turned a quarter turn so that the curved surface of the presser 174 presses the supplementary yarn A to the lower surface of the flange of the ring 16 as shown in FIGS. 17C and 17D. It is preferable to stop the rotation of the spindle by the above-mentioned braking mechanism, however in case the spindle 13 is driven at a very low speed, the outer surface of the presser 174 may be provided with a small groove (not shown) which permits the passage of the supplementary yarn A. Next the traveller stopper 150 is retracted from its working position, then the jet air nozzle 148 ejects jet air, thereby the traveller 18 is actuated. As the top end portion 176 of the presser 174 is provided with an inclined shape and smooth upper surface as shown in FIG. 16F, the traveller 18 can be easily ridden upon the presser 174. When the traveller 18 riding upon the presser 174 runs further, the supplementary yarn A is threaded through the traveller 18 and then the traveller 18 is stopped by the supplementary yarn A as shown in FIG. 17E.

Next the presser 174 is retracted to its normal position and the cylindrical member 163 is turned so as to release the supported supplementary yarn A by which the winding operation of the winding mechanism 25 is completed.

After the completion of the winding operation of the supplementary yarn A around the cop 12, the most important point is how to piece the end of the supplementary yarn A with the drafted roving or sliver issuing from the delivery roller of the ring spinning frame to attain the main purpose of the present invention.

Generally, according to the present invention, one end of the yarn connected to the cop 12 is led to the bottom front roller of the spinning unit by carrying with a nipper provided with a nipper roller rotatably mounted on the forward end portion of a supporting rod while pushing it forward by a spring, next releasing it from the nipper by a relative displacement of the nipper roller from the nipper when the nipper roller is pushed to the bottom front roller and rotated, thereby the end of the supplementary yarn A is pierced with the drafted roving or sliver issuing from the delivery roller.

YARN PIECING MECHANISM

Referring to FIGS. 9, 18A, 18B, 18C, 19A, 19B, 19C and 19D, an embodiment of the yarn piecing mechanism of the apparatus, comprises a shift lever 187 supported by a bracket 186 secured to the apparatus, a cradle 193 slidably supported by the shift lever 187 in such a way that the cradle 193 is always pushed toward front side of the apparatus by a helical spring 192 mounted on its rear end portion, a nipper roller 198 rotatably supported by the cradle 193, a nipper rod 200 slidably supported by the bracket 186 in a parallel condition with the shift lever 187 in such a way that the nipper rod 200 is positioned at the upper position of the shift lever 187, a spring 202 mounted on the rear expanded portion 203 of the nipper rod 200 projected to the rear side of the bracket 186 so as to always push the rod 200 in the rearward direction, a nipper piece 199 connected with the forward end portion of the nipper rod 200 projected from the front side of the bracket 186 through a curved plate 201 in such a way that the nipper piece 199 is positioned at advanced position of the passage of the nipper roller 198 with the exception of the period of yarn piecing operation. An elastic member 204 having sufficient coefficient of friction is disposed under its nipper piece 199. The shift lever 187 is provided with a rack 188 at the under side portion and a projection 189 at its rear end and an adjusting set screw 205 is disposed to the projection 189 as shown in the drawings. The forward and rearward shifting motion

against a pair of front rollers 215 of the spinning frame 5 of the shift lever 187 is operated by a shifting mechanism comprising a pinion 206 meshed with the rack 188, a pinion 207 secured to a shaft of the pinion 206 supported by the apparatus, a fan shaped wheel 208 meshed with the pinion 207 and rotatably supported by the apparatus, a connecting rod 209 pivotably connected at its top end portion with the fan-shaped wheel 208 and its bottom end portion with an L shaped lever 210 which is actuated by a programming cam 211. The connecting rod 209 is composed of a pair of solid rod portions and a shock absorber 213 containing a certain shock absorber 213 such as a coil spring. By the action of the shock absorber 213, the contact of the nipper roller 198 with a bottom front roller 215a of the spinning unit is made firmly to provide a satisfactory yarn piecing operation without any trouble. The nipper roller 198 is rotatably supported by a pair of forward arms 194 of the cradle 193 in such a way that the upper portion of the nipper roller 198 is projected upward from the arms 194, however an upper projection 195 of the arms 194 is projected from a level of the nipper roller 198. The upper surface of the cradle 193 is provided with a so-called roughened surface and forms a grip together with the nipper piece 199 when it engages with the nipper piece 199. The rear end portion of the cradle 193 is formed as a rod 196 which is slidably inserted into a horizontal guide aperture of the shift lever 187, and the helical spring 192 is mounted on the rod 196. At the rear end of the rod 196, a set screw 190 is secured in such a way that the setscrew 190 is engaged with an inside stepped portion 197 of the rod 196 so as to restrict the forward position of the nipper roller 198. Therefore, after touching the nipper roller 198 with the bottom front roller 215a, the nipper roller 198 can be contacted with the bottom front roller 215a with a certain pushing force by the compression of the helical spring 192 caused by the further forward motion of the shift lever 187.

The above-mentioned nipper 23 carries the supplementary yarn A, which is connected to the cop 12, to a position between the nipper roller 198 and the nipper piece 199. The above-mentioned relative position of the elements of the yarn piecing mechanism is shown in FIG. 19A. Next, by the motion of the programming cam 211, the shift lever 187 is shifted towards the bottom front roller 215a. This movement is hereinafter referred to as "forward movement of the shift lever 187." And movements of other elements related to the forward movement of the shift lever 187 are hereinafter referred to as "forward movement of the respective elements. During the forward movement of the shift lever 187, the supplementary yarn A is engaged with the nipper roller 198 at first, and the curved plate 201 is pushed upward by the further forward movement of the nipper roller 198, thereby the supplementary yarn A is turned over the nipper roller 198, and then a portion of the yarn A is gripped firmly by a grip composed of the upper surface of the cradle 193 and the nipper piece 199 in accordance with the further forward motion of the nipper roller 198. The above-mentioned relative condition of the supplementary yarn A and the elements is shown in FIG. 19B. At the moment of gripping the supplementary yarn A is gripped, the adjusting screw 205 of the shift lever 187 touches the expand portion 203 of the nipper rod 200, therefore the nipper rod 200 is shifted forward by further shift motion of the shifting lever 187 in the forward direction. Therefore, as shown in FIG. 19C, the cradle 193 is closed with the front bottom roller 215a while gripping the supplementary yarn A. A knife edge 191 is adjustably secured to the shifting lever 187 as shown in the drawings. Consequently, when a sufficient tension is imparted to the supplementary yarn A between a first gripping means or nipper 23 and a second gripping means composed of the nipper plate 199 and the cradle 193, the yarn A is parted. The yarn A is broken or parted by the tension caused

by the forward shifting motion of the grip. The knife edge 191 is useful to part the yarn A at a constant position. The parted end of the yarn A has a different configuration from the cut end portion of a yarn sharply cut by a knife or scissors, that is, the parted end of the yarn A looks like the end of broken yarn broken or parted by applying excess tension, therefore, the yarn piecing operation can be operated satisfactorily without producing a slub. After the yarn A has been parted as mentioned above, the parted end of the supplementary yarn A is carried forward by the grip by the forward motion of the shift lever 187. And finally, the nipper roller 198 touches the bottom front roller 215a, and the cradle 193 is receded relative to the nipper piece 199 due to the compression of the spring 193 in accordance with the shift lever 187 during further forward motion of the shift lever 187. As the nipper rod 200 is kept at a stationary position, the small upper projection 195 pushes the nipper piece 199 in the upward direction, thereby the parted end of the supplementary yarn A gripped by the grip is released and turned positively to the front bottom roller 215a by the frictional rotation of the nipper roller 198 and the broken end of the supplementary yarn A is joined with a fleece delivered from the front rollers 215. Before the above-mentioned releasing of the parted end of the supplementary yarn A, the spindle braking mechanism 27 release the braked condition of the spindle so as to rotate the spindle 13 at the normal condition and to provide the supplementary yarn A with twist, consequently, the yarn piecing operation of the present embodiment can be operated in a steady condition without trouble. Further, it is possible to change the length of the parted end of the supply yarn by means of changing the set position of the knife edge 191, thereby the size of the connected portion of the yarn can be adjusted to obtain the desired size of connected portion of the yarn in accordance with kind of yarn.

PROGRAMMING CAM MECHANISM

The above-mentioned relative motions of the elements of the apparatus 1 are controlled by the programming cam mechanism 26 (FIG. 3) comprising, a cam No. 1 for controlling the motion of the shifting mechanism for carrying the winding mechanism 25 for leading and guiding the end portion of the supplementary yarn to a close position to the ring 16 and to the normal waiting position of the winding mechanism 25 after completion of the yarn piecing operation, a cam No. 2 for shifting the nipper 23 downwards and upwards, a cam No. 3 for operating the L shaped lever 116 disposed inside the nipper 23, a cam No. 4 for opening and closing the valve for controlling the working period of the jet nozzle 164, a cam No. 5 for pulling or pushing the flexible wire 170 so as to turn the cylindrical member 163 a quarter turn, a cam No. 6 for opening or closing a valve disposed to a conduit used for supplying jet air to the jet air nozzle 148 so as to run the traveller 18 upon the ring 16, a cam No. 7 for pulling or pushing the flexible wire 152 to control the forward or rearward motion of the traveller stopper 150, a cam No. 8 for pulling or pushing the flexible wire 180 so as to control the presser 174, a cam No. 9 for controlling the forward or rearward motion of the friction pulley 83 of the spindle braking mechanism, a cam No. 10 for controlling the swing motion of the projector 31 and receiver 32 of the detector 10, a cam No. 11 for controlling the upward or downward motion of the yarn guide 129, 130 of the reserve mechanism, and a cam No. 12 for controlling the forward or rearward motion of the nipper roller 198, are rigidly mounted on the same cam shaft. When a yarn breakage is detected by the detector 10, the carriage is stopped at the correct operating position as already illustrated, next the cam shaft 109 is rotated, the elements of the apparatus are actuated by the control action of the respective cams so as to join the parted end of the supplementary yarn A connected to the cop 12 with a fleece delivered from the front rollers 215.

The diagram of FIG. 20 represent the relative relation motion of the respective programming cams by showing their spread out profiles. In FIG. 20, the numerals shown along the ordinate corresponds to the above-mentioned cams designated by number, respectively. Further, letters A represents the time when the mechanism 25 arrives at its working position with respect to the ring rail 17 and starts to move together with the ring rail 17, letter B represents the time when the traveller 18 starts to run upon the ring 16, letter C represents the time when the supplementary yarn A is sucked into the receiving mouth 163a of the cylindrical member 163 from the nipper 23, letter D represents the time when the running of the traveller 18 has been stopped by the traveller stopper 150, letter E represents the time when the brake mechanism 27 actuates to brake the rotation of the spindle 13 so as to rotate the spindle 13 at its half braked condition, letter F represents the time when the supplementary yarn is ejected from the cylindrical member 163 so as to wind around the cop 12, letter G represents the time when the winding position of the supplementary yarn around the cop 12 is regulated by the winding motion of the cop 12, letter H represents the time when the supplementary yarn between the cop 12 and the cylindrical member 163 is threaded in the traveller 18, letter I represents the time when the grip of the nipper 23 is opened while the nipper 23 is shifted upwards, letter J represents the time when the cradle 193 of the yarn piecing mechanism 29 and the nipper piece 199 grips the supplementary yarn between the nipper 23 and the traveller 18, letter K represents the time when the supplementary yarn between the nipper 23 and the grip composed of the cradle 193 and the nipper piece 199 is caused to be broken by the knife edge 191 disposed to the shift lever 187, letter L represents the time when the supplementary yarn between the nipper roller 198 and the traveller 18 is threaded in the snail wire 20, letter M represents the time when the yarn piecing of the parted end of the supplementary yarn is carried out with a fleece issuing from the front rollers 215 by the frictional rotation of the nipper roller 198 caused by the frictional contact with the front front bottom roller 215a, letter N represents the period of maintaining the rotation of the spindle 13 at its half braked condition which is controlled by the action of the braking mechanism 27, letter O represents the time when the confirming action by the detector 10 is actuated to confirm the completion of the piecing operation of the apparatus.

As it can be clearly understood by the above-mentioned illustration, a yarn piecing operation similar to that of the manual operation can be obtained by the yarn piecing apparatus according to the present invention. The above-mentioned yarn piecing mechanism can be applied to other types of yarn piecing apparatus, that is, for the apparatus characterized by means for extracting the broken end of yarn from a cop of a spinning unit, and means for piecing the extracted yarn directly with a fleece issuing from a front roller of the spinning unit of the ring spinning frame. For example, the yarn piecing mechanism illustrated in the first embodiment of the invention can be applied to an apparatus shown in British Patent No. 908,507, which may be understood as the yarn piercing apparatus characterized by means for extracting the broken end of yarn from a cop, means for piecing the extracted yarn directly with a fleece issuing from the producing roller of the corresponding spinning unit of the ring spinning frame.

Referring to FIG. 21, an apparatus of the type shown in the above-mentioned British patent in which a nose-piece is replaced by a yarn piecing mechanism 220 according to the present invention is shown. The apparatus of FIG. 21 comprises a carriage 222 adapted to move in front of and along the spinning spindles of one or more ring spinning frames and including a detector which upon detecting the absence of one of the yarn moving towards the spinning cops 223 so as to stop the carriage 222 and

starts a yarn piecing mechanism 220, an extractor 225 for extracting a broken end of yarn from the cop 223 and means for threading the extracted end of yarn through a traveller ridden on a ring 224, means for raising the extractor 225 together with the broken yarn end and means for threading the same into a snail wire 226 in such a way that the extractor 225 raises along guide pillars 233. The carriage 222 is provided with a housing 227, and grooved wheels 228 which ride on a horizontal bar 229 secured to the ring spinning frame 230, and the grooved wheels 228 are driven by an electric motor 31 disposed in the housing 227 by way of a power transmission mechanism in the housing 227. The yarn piecing mechanism 220 is actuated and controlled its motion by a programming cam secured to a cam shaft 232 by the same manner as shown in the first embodiment of the invention. The extracted yarn A' from the cop 223 by sucking air into a suction tube of the extractor 225 is carried upward in such a way that the suction tube 225a is shifted beyond the yarn piecing mechanism 220, and stopped at the position corresponding to the nipper 23 shown in FIG. 18A. Thereby a similar yarn piecing operation as the first embodiment of the invention can be performed.

While the invention has been described in conjunction with certain embodiments thereof it is to be understood that various modification and changes may be made without departing from the spirit and scope of the invention.

We claim:

1. An apparatus for joining together a first and second strand of fibers comprising: first advancing means for advancing a first strand of fibers to a joining zone; second advancing means for advancing a second strand of fibers to said joining zone; tensioning means including said first advancing means for tensioning said first strand of fibers until it parts into two sections each having a jagged end; and pressing means including said second advancing means for pressing together one of the jagged strand ends with said second strand with sufficient force to join them together.

2. An apparatus according to claim 1, wherein said first advancing means includes first gripping means for gripping said first strand of fibers therebetween; and wherein said tensioning means includes said first gripping means and a second gripping means movable relative to said first gripping means for gripping said first strand of fibers therebetween.

3. An apparatus according to claim 1, wherein said pressing means includes a first surface constituting part of said second advancing means and a second surface spaced-apart from said first surface to accommodate said one of the jagged strand ends and said second strand therebetween, and urging means for urging said second surface into nipping contact with said first surface.

4. An apparatus according to claim 1, including control means for automatically rendering said pressing means effective subsequent to the parting of said first strand of fibers by said tensioning means.

5. An apparatus according to claim 1, wherein said first advancing means includes first gripping means for gripping said first strand of fibers therebetween; said tensioning means includes said first gripping means and a second gripping means movable relative to said first gripping means for gripping said first strand of fibers therebetween; said pressing means includes a first surface constituting part of said second advancing means and a second surface spaced-apart from said first surface to accommodate said one of the jagged strand ends and said second strand therebetween, and urging means for urging said second surface into nipping contact with said first surface; and control means for automatically rendering said pressing means effective subsequent to the parting of said first strand of fibers by said tensioning means.

6. An apparatus according to claim 5, wherein said second advancing means comprises at least one rotatably

mounted roller having said first surface as a peripheral surface thereof; and said pressing means includes another rotatably mounted roller having said second surface as a peripheral surface thereof.

7. An apparatus according to claim 6, further including means including said second gripping means for positively feeding said one of the jagged strand ends to said pressing means.

8. An apparatus for piecing a supply strand of fibers separated into two parts during supply thereof to a winding machine having a winding bobbin comprising: winding means for winding one end of a supplementary strand of fibers around a winding bobbin; advancing means for advancing a portion of said supplementary strand of fibers to a joining zone; additional advancing means for advancing a supply strand of fibers to said joining zone; tensioning means including said advancing means for tensioning said advanced portion of said supplementary strand of fibers until it parts into two sections each having a jagged end; and pressing means including said additional advancing means for pressing together one of the jagged ends with said supply strand of fibers with sufficient force to join them together; whereby said supply strand of fibers is pieced to said winding bobbin by means of a linking portion of said supplementary strand of fibers.

9. An apparatus according to claim 8, wherein said advancing means includes first gripping means for gripping said supplementary strand of fibers therebetween; wherein said tensioning means includes said first gripping means and a second gripping means movable relative to said first gripping means for gripping said supplementary strand of fibers therebetween; wherein said pressing means includes a first surface constituting part of said additional advancing means and a second surface spaced-apart from said first surface to accommodate said one of the jagged ends and said supply strand therebetween, and urging means for urging said second surface into nipping contact with said first surface; and control means for automatically rendering said pressing means effective subsequently to the parting of said advanced supplementary strand of fibers by said tensioning means.

10. An apparatus according to claim 9, wherein said second advancing means comprises at least one rotatably mounted roller having said first surface as a peripheral surface thereof; and said pressing means includes another rotatably mounted roller having said second surface as a peripheral surface thereof.

11. An apparatus according to claim 10, further including speed control means for automatically slowing down the rotational speed of said winding bobbin during the joining together of said advanced supplementary strand with said supply strand.

12. An apparatus according to claim 8, wherein said winding machine includes a ring and a traveller movable on said ring; and wherein said winding means comprises fluid means for fluidally effecting initial winding of said one end of said supplementary strand of fibers around said winding bobbin, and means operative after said one end of said supplementary strand of fibers is wound around said winding bobbin for threading said supplementary strand of fibers through said traveller.

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