Nov. 3, 1964 YUKIO URANO ET AL 3,154,909

APPARATUS FOR AUTOMATICALLY EXCHANGING BOBBINS IN SPINNING MACHINES

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9 Sheets-Sheet 1

Fig. 1

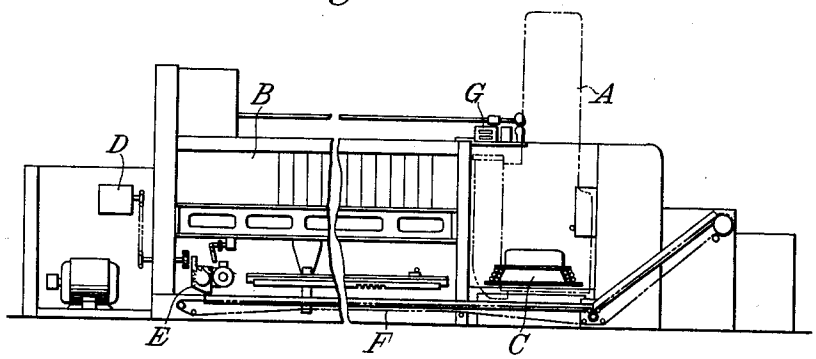


Fig. 2

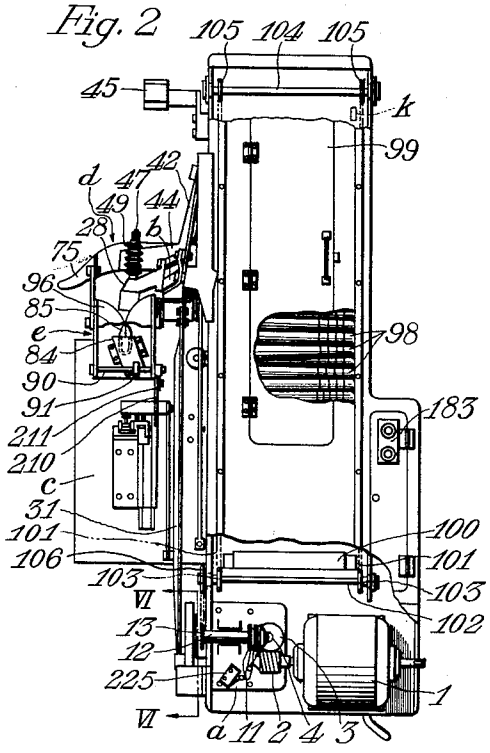
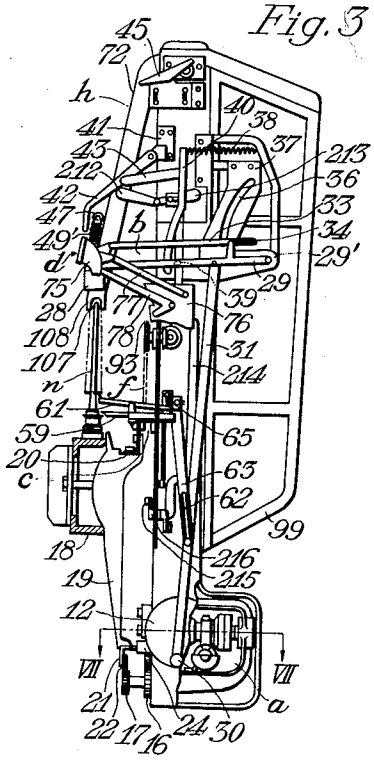


Fig. 3



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APPARATUS FOR AUTOMATICALLY EXCHANGING BOBBINS IN SPINNING MACHINES

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Fig. 4

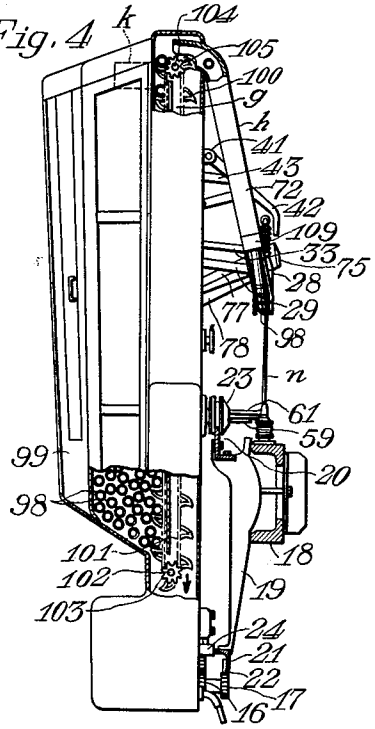


Fig. 5

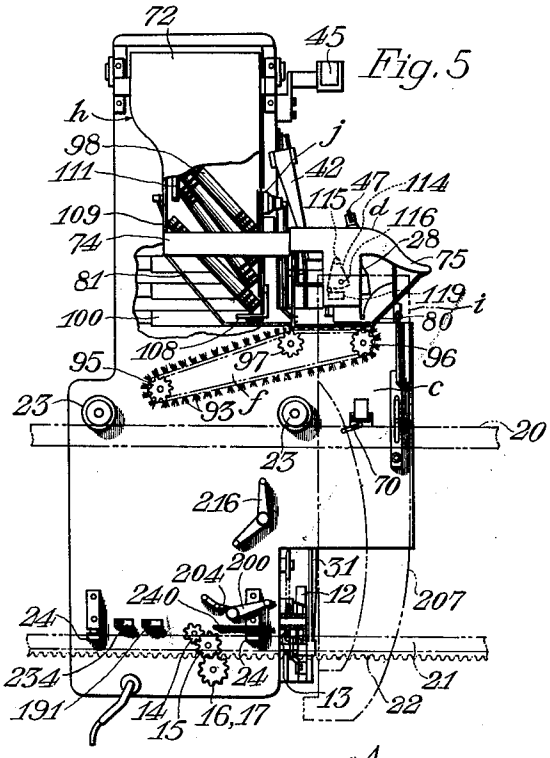


Fig. 6

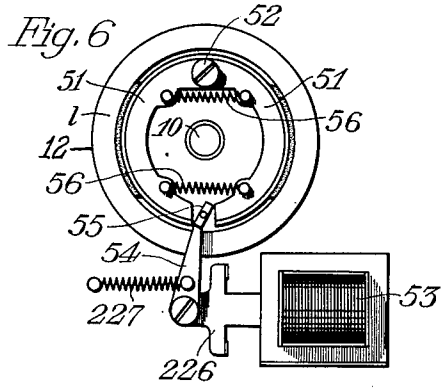
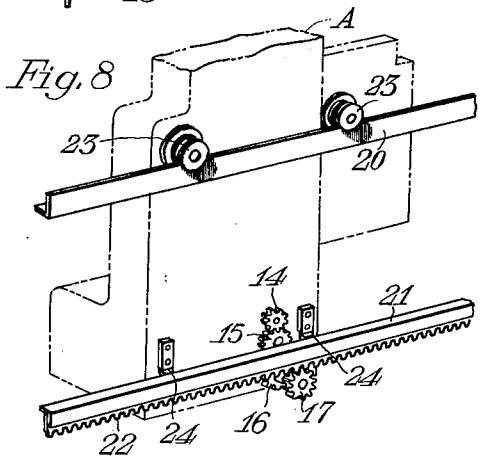


Fig. 8



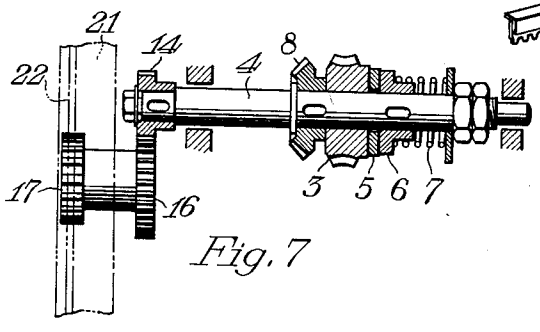


Fig. 7

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APPARATUS FOR AUTOMATICALLY EXCHANGING BOBBINS IN SPINNING MACHINES

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Fig. 9

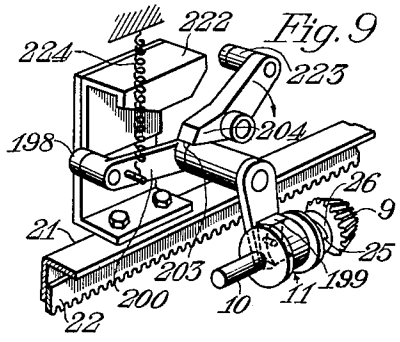


Fig. 10

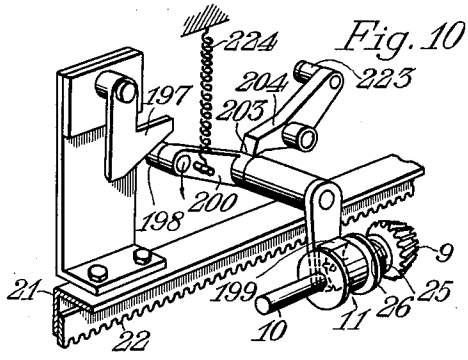


Fig. 11

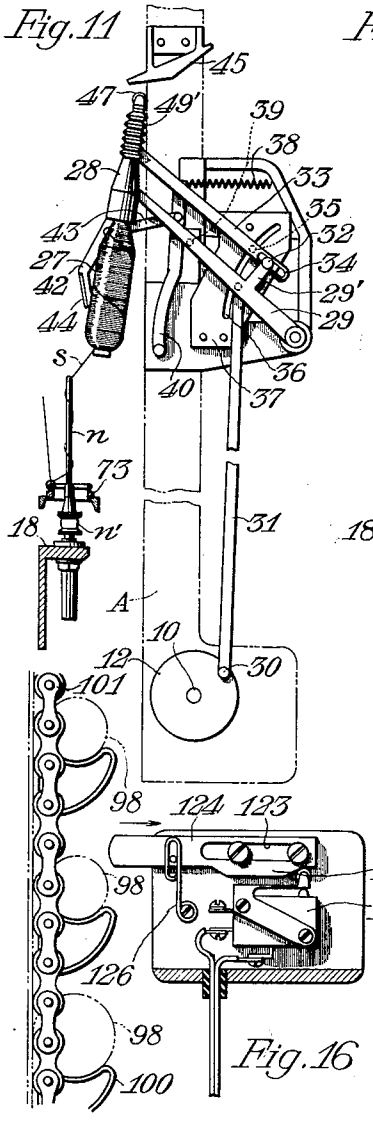


Fig. 12

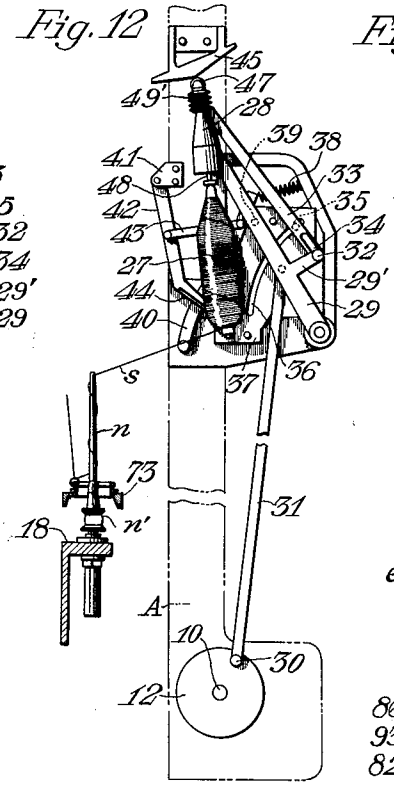


Fig. 13

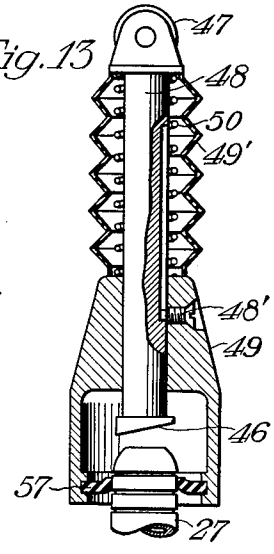


Fig. 19

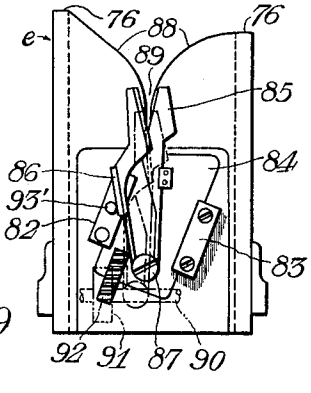


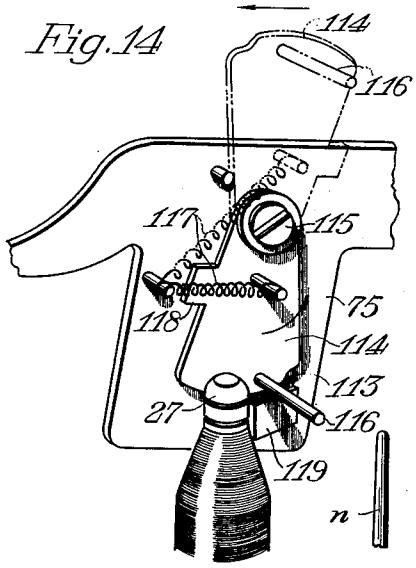
Fig. 16

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APPARATUS FOR AUTOMATICALLY EXCHANGING BOBBINS IN SPINNING MACHINES

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Fig. 14



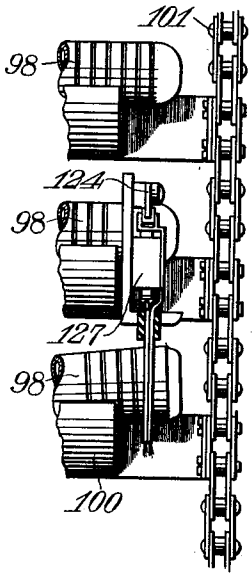


Fig. 15

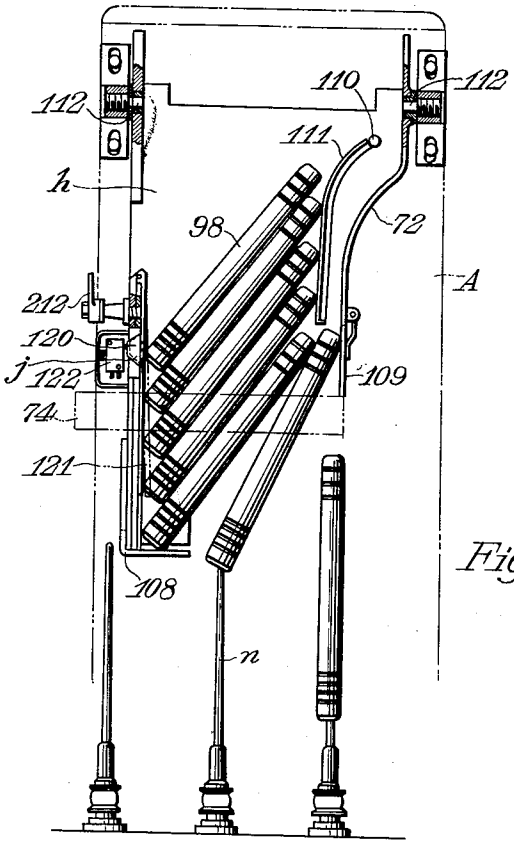
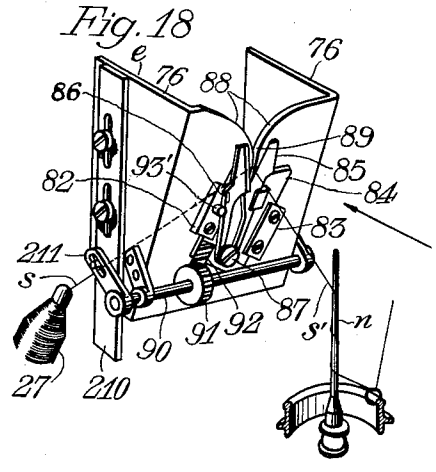


Fig. 17

Fig. 18



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APPARATUS FOR AUTOMATICALLY EXCHANGING BOBBINS IN SPINNING MACHINES

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Fig. 20

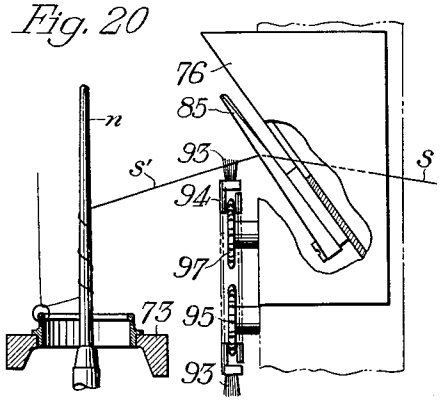


Fig. 21

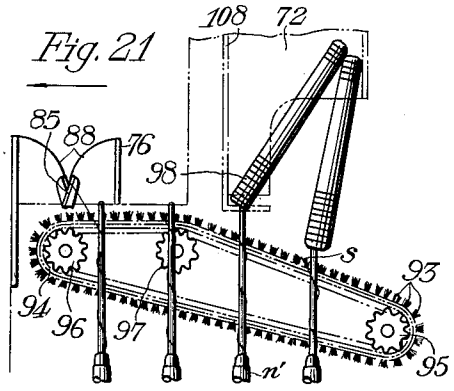


Fig. 22

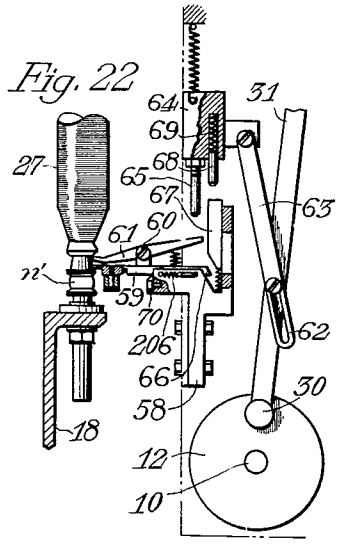
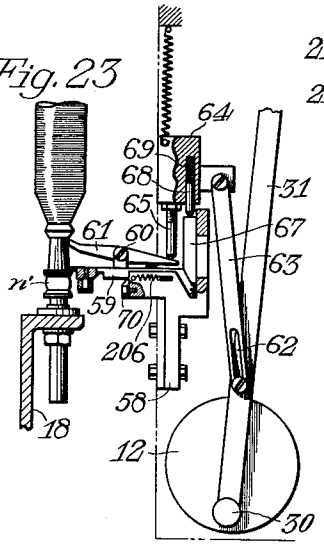


Fig. 23



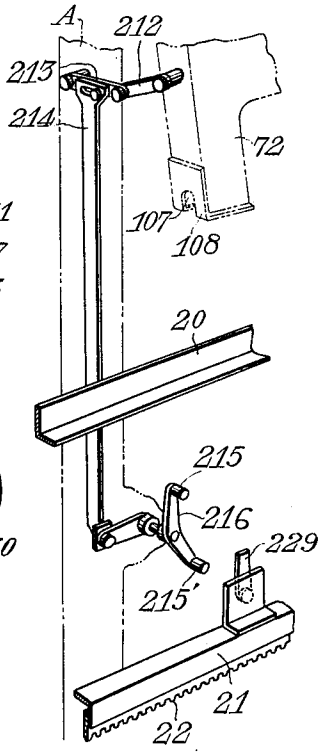


Fig. 26

Fig. 24

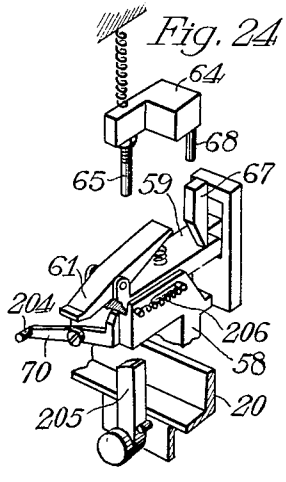
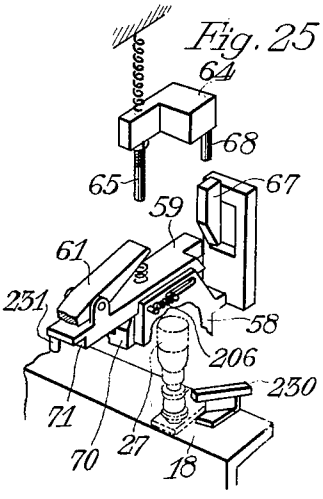


Fig. 25



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APPARATUS FOR AUTOMATICALLY EXCHANGING BOBBINS IN SPINNING MACHINES

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Fig. 27

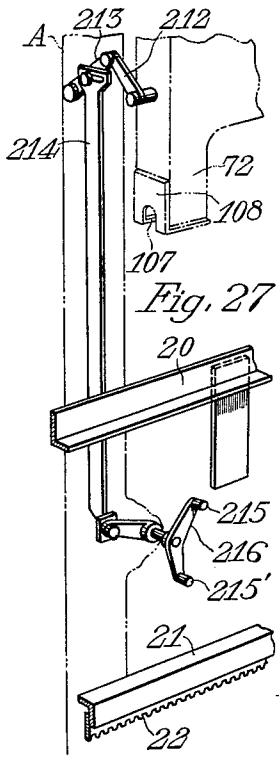


Fig. 28

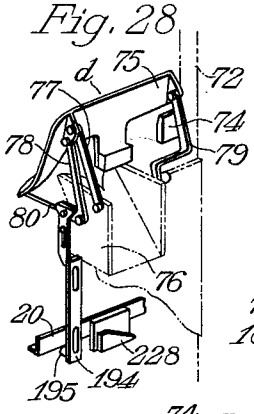


Fig. 29

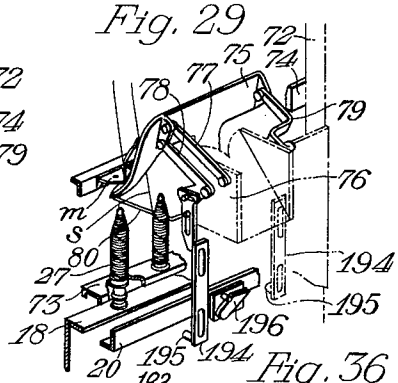


Fig. 30

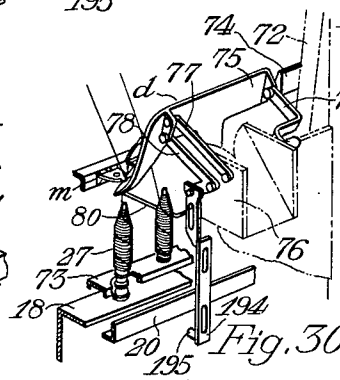


Fig. 36

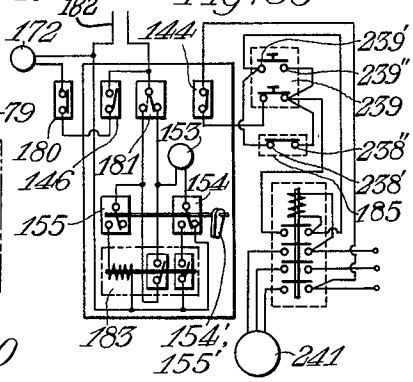


Fig. 31

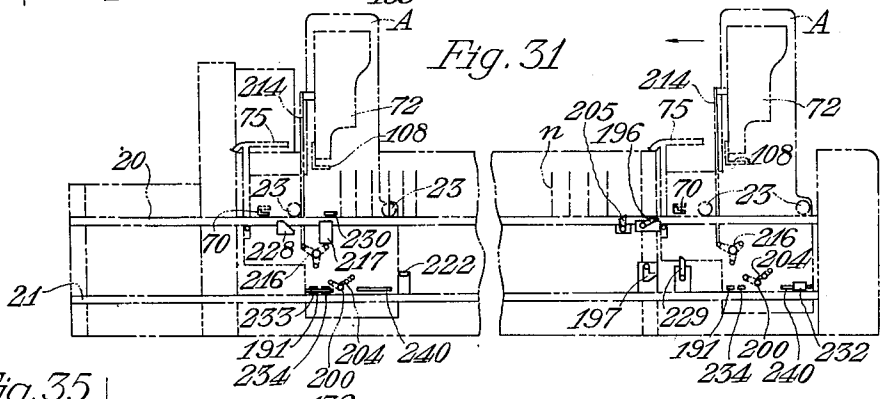


Fig. 35

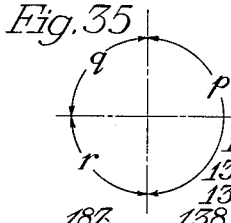


Fig. 32

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APPARATUS FOR AUTOMATICALLY EXCHANGING BOBBINS IN SPINNING MACHINES

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Fig. 33

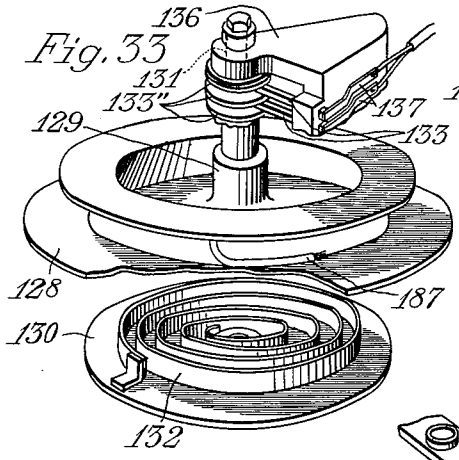


Fig 34

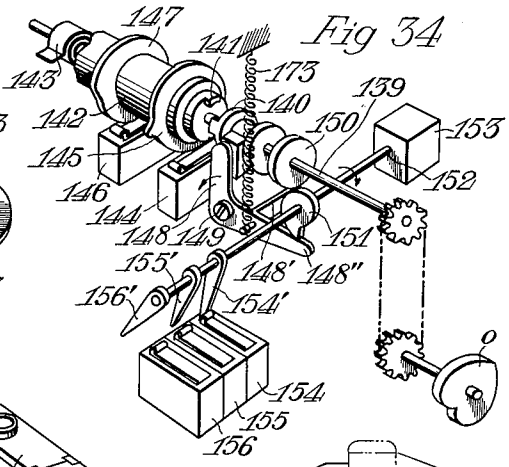
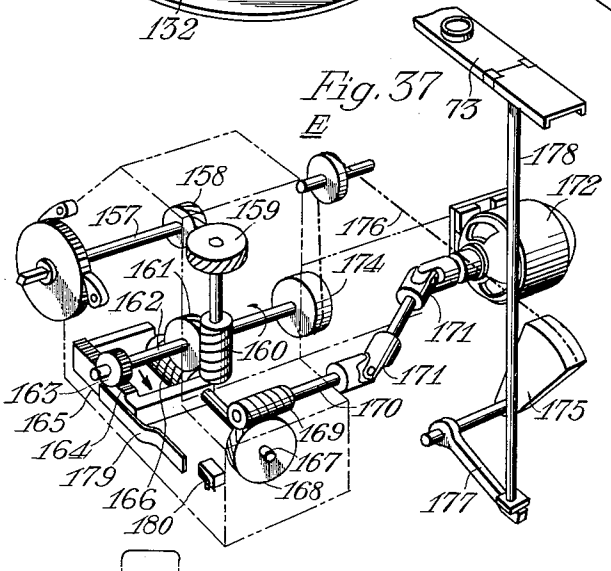


Fig. 37



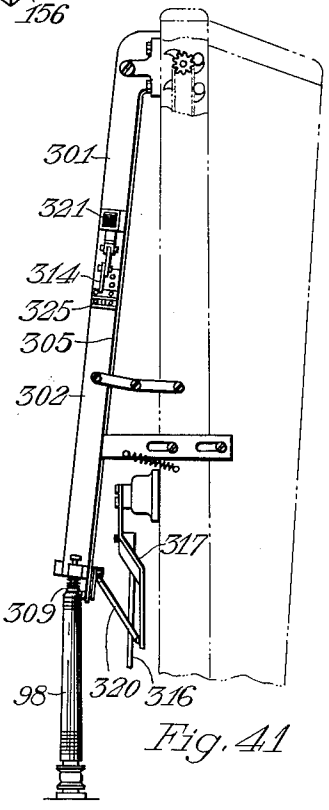
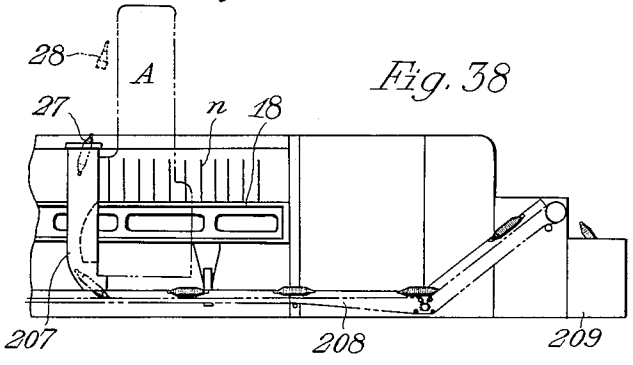


Fig. 41

Fig. 38

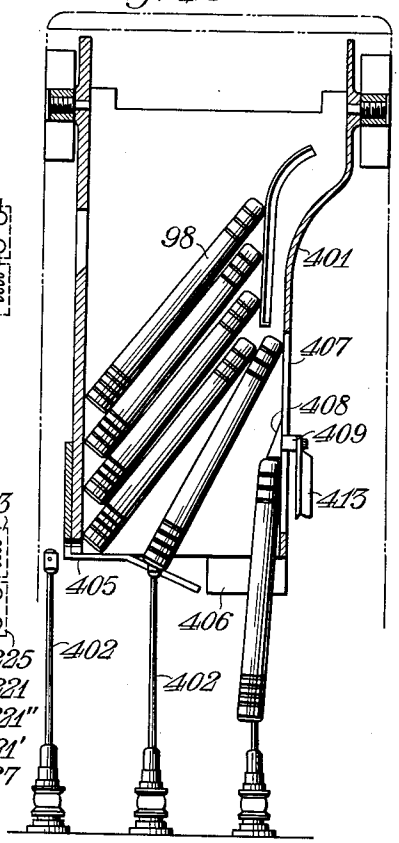


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APPARATUS FOR AUTOMATICALLY EXCHANGING BOBBINS IN SPINNING MACHINES

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Fig. 43



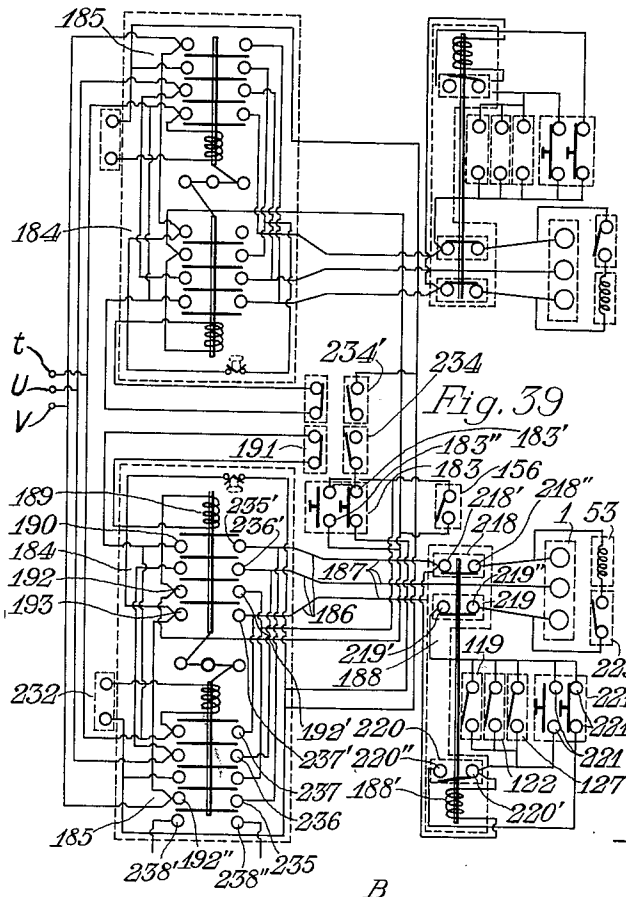


Fig. 39

Fig. 48

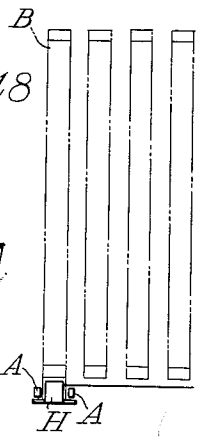
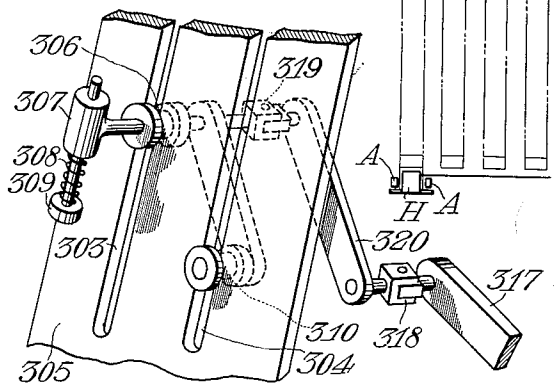


Fig. 42



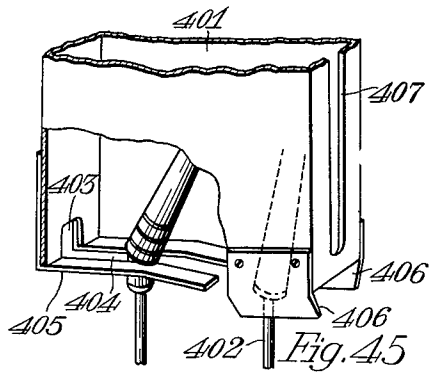


Fig. 45

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APPARATUS FOR AUTOMATICALLY EXCHANGING BOBBINS IN SPINNING MACHINES

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Fig. 40

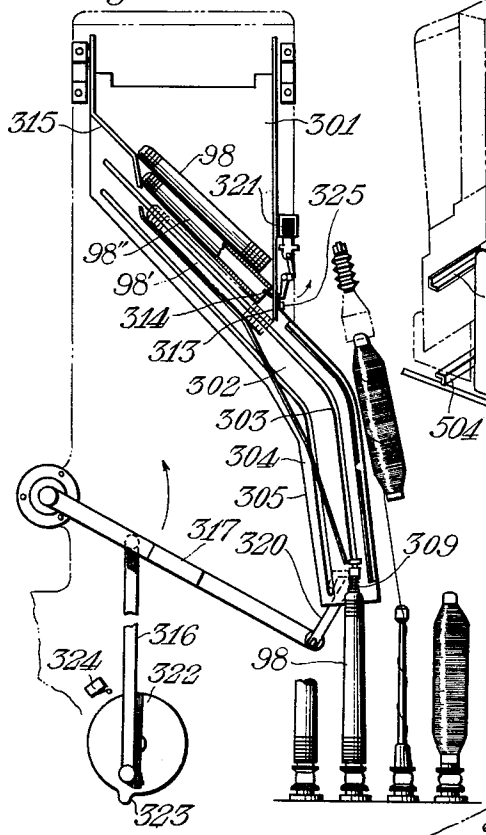


Fig. 46

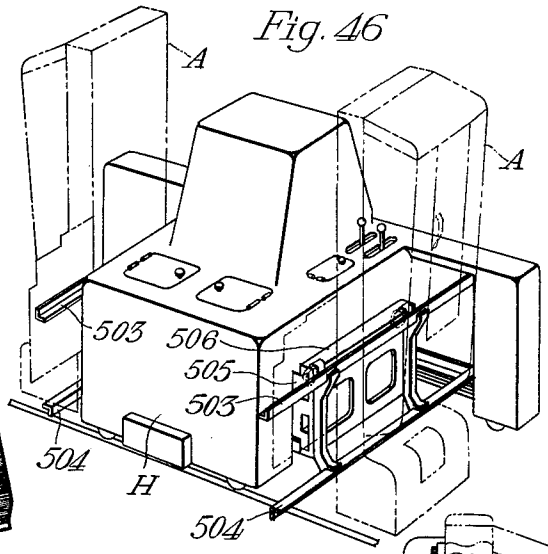


Fig. 44

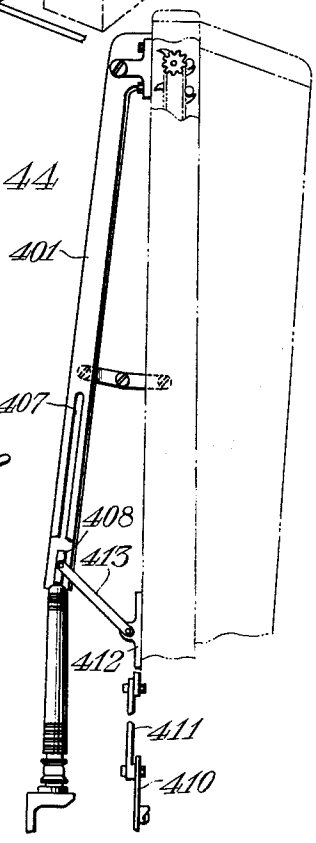
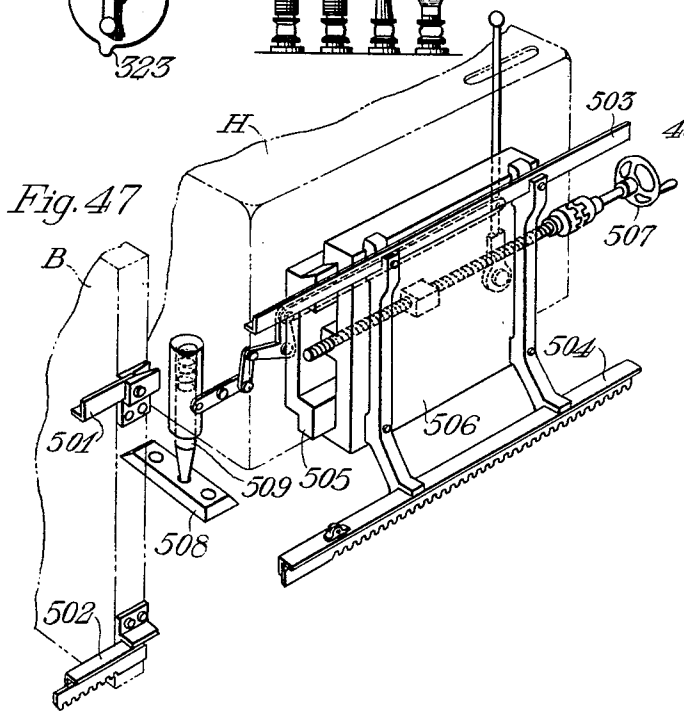


Fig. 47



United States Patent Office 3,154,909 Patented Nov. 3, 1964

3,154,909

APPARATUS FOR AUTOMATICALLY EXCHANGING BOBBINS IN SPINNING MACHINES

Yukio Urano, Nishinomiya-shi, Shinichi Hamahata, Nishishigino, Joto-ku, Osaka-shi, Tamotsu Yosano, Suita-shi, and Teruo Fujihara, Ikuno-ku, Osaka-shi, Japan, assignors to Kanegafuchi Boseki Kabushiki Kaisha, Tokyo, Japan, a corporation of Japan, and Kanegafuchi Kikai Kogyo Kabushiki Kaisha, Hyogo-ken, Japan, a corporation of Japan

Filed May 23, 1960, Ser. No. 31,198
Claims priority, application Japan, Sept. 26, 1959, 34/30,784; Oct. 17, 1959, 34/33,019, 34/33,020; Feb. 5, 1960, 35/5,410
7 Claims. (Cl. 57—52)

This invention relates to an apparatus for automatically exchanging bobbins in spinning machines such as a fine spinning machine and twister, characterized in that while cutting off the electric power source of the spinning machine through control means coupled with a full cop auto-counter which shows that the cops are full, apparatus for automatically lowering the ring rail is started to lower the ring rail to the starting position. Thereafter a pair of automatic bobbin changers are driven from one end of the spinning machine to the other end along the front thereof, whereby the cops are doffed one after another and bobbins are inserted on the spindles from which the full cops have been just doffed. By the time said automatic bobbin changers return to their starting position after completing the changing of the bobbins on all the spindles, the operation of the spinning machine is resumed, the cops doffed having been carried away by a full cop conveyor to a suitable place.

An object of the invention is to provide means to carry out all the necessary operations from the switching off of the spinning machine by the action of the full cop auto counter to re-starting of the machine after the bobbin changing is completed automatically thereby realizing the long-wished-for idea of the spinning industry, namely, operation of spinning machines without manual handling.

Another object of the invention is to increase the production rate by greatly shortening the idle period of the spinning machine during the bobbin exchanging operation.

Still another object of the invention is to provide means to accomplish the above objects without re-constructing the spinning machines themselves, but by adding a few parts including rails to the conventional spinning machines.

Another object of the invention is to provide means to resume the operation of the spinning machine at the time of the automatic bobbin changer's return, by automatically pushing backward a bobbin feed hopper thereby withdrawing said hopper and lappet lifting guides to a position which will not interfere with the operation of the spinning machine.

A further object of the present invention is to provide means to make disposing of cops convenient, by either collecting the cops doffed into a cop-collecting box mounted on one end of the spinning machine successively by means of a full cop conveyor, or carrying said cops to cop moisture absorbing apparatus wherein the succeeding treatment to the cops is given.

Another object of the invention is to provide means for stopping automatically the advance of the automatic bobbin changer, feeling out the failure of normal operation such as misdoffing or tumbling-down of the bobbin.

Another object of the invention is to make it possible to apply means for feeding a bobbin other than feeding the same by dropping, such as positive feeding

means of bobbin to button-cap type spindle or combined means of the above depending on the weight of bobbin or type of spindle.

Another object of the invention is to lessen the cost of equipment by providing a pair of automatic bobbin changers for each spinning machine, or instead, loading the automatic bobbin changer on a travelling car and transferring the same to the one end of a spinning machine which requires bobbin changing, and thereafter starting said automatic bobbin changer to the other end of said spinning machine from the travelling car, thereby enabling the plurality of spinning machines to cooperatively use one pair of automatic bobbin changers.

A further object of the present invention is to provide means, in the case of a plurality of spinning machines co-operatively using one pair of automatic bobbin changers, for continuing the bobbin changing operation smoothly even if said plurality of spinning machines have different spindle pitch. This is done by providing several pinions for driving on the axis thereof to engage with the rack provided on the rail.

Further objects of the invention will be understood by the following description.

The present invention is accomplished by using an apparatus comprising an automatically reversing type full cop auto-counter (hereinafter referred to as merely "auto-counter") to indicate that the bobbins in the spinning machine are fully wound; control means coupled with said auto-counter to switch off the electric motor, start the apparatus for lowering the ring rail, and make a pair of automatic bobbin changers (hereinafter referred to as AD apparatus) advance; apparatus for automatically lowering the ring rail from its top position to its lowest position; a pair of AD apparatus which travel from one end of a spinning machine to the other end along the front thereof, to accomplish continuous doffing of cops from the spindles and feeding of bobbins to the empty spindles; electric remote controls to drive said AD apparatus; and a full cop conveyor to carry away doffed cops to a suitable place.

Namely, when all the bobbins in the spinning machine are fully-wound, that fact is indicated by the auto-counter. Then the auto-counter starting control means, and thereby the electric motor of the spinning machine, is switched off at an appropriate position of a heart cam mounted on the spinning machine, followed by the lowering of the ring rail to its initial position as the apparatus for lowering the ring rail is started. After the stopping of the spinning machine, a pair of AD apparatus advance from one end of said machine. Before the same pass from their initial position to the front position of the first spindle, the above listed means for bobbin changing operation are automatically set to be ready for action. In the ensuing bobbin changing operation, firstly by means for doffing a full cop which has a link mechanism adapted to catch the cop by the top part thereof, and which can freely choose doffing locus, the cop is doffed vertically, and the yarn end is wound onto a spindle a suitable number of times. As the yarn between the doffed cop and the spindle is cut, simultaneously the yarn end connected with the spindle is held in front of the doffed cop until the bobbin is fed to said spindle, maintaining the same tension as the main body of the apparatus advances. By the repetition of the above steps in described order, all the cops are exchanged with bobbins by the time the main body of the apparatus reaches the other end of the spinning machine. At the time of return of said body, all the devices are automatically withdrawn or pushed aside, so that the main body of the apparatus may return while the spinning machine has already resumed its operation. Thus as the pair of AD apparatus which reached the other end of the spinning machine is automatically re-

turned to their initial position by remote control mechanism, the spinning machine is re-started while the doffed cops are carried away to a suitable place by a full cop conveyor. The AD apparatus which have completed one cycle of automatic operation by going and coming are then stopped at their initial awaiting positions until all the bobbins become fully wound again, at which time they repeat the above-described actions.

Further, if said AD apparatus were provided at each spinning machine and rested at one end thereof until all the bobbins become fully wound again, the period between one cycle of operation and the next would be considerably long. Therefore, the AD apparatus is made movable and available for a plurality of spinning machines in the present invention by loading the same on a travelling car. Thus the AD apparatus may be better utilized and the cost for equipping the same may be lessened. Namely, the AD apparatus is transferred to one end of a spinning machine which needs bobbin changing by means of the travelling car, and therefrom starts to travel toward the other end of the spinning machine and return to be loaded on said travelling car after completing the bobbin changing.

The nature of the invention will be better understood by referring to the following description, taken in connection with the accompanying drawings.

FIG. 1 is a diagrammatic plan view showing the apparatus of the invention mounted on a spinning machine.

FIG. 2 is a partially cut-away front view of the AD apparatus for the right side use as seen from the gear-end side of the spinning machine starting from the outer end.

FIG. 3 is a partially cut-away side view of FIG. 2 seen from the advancing side.

FIG. 4 is a partially cut-away side view of FIG. 2 seen from the returning side.

FIG. 5 is a partially cut-away back view.

FIG. 6 is an enlarged cut-away view taken along line VI—VI of FIG. 2.

FIG. 7 is an enlarged cut-away view taken along line VII—VII of FIG. 3.

FIG. 8 is a perspective view showing the essential part of the driving means.

FIG. 9 is a perspective view showing the driving mechanism of means for doffing the full cop.

FIG. 10 is a perspective view showing a driving mechanism of means for feeding the bobbin.

FIG. 11 and FIG. 12 are each side views showing different manners of operation of means for doffing a full cop.

FIG. 13 is an enlarged cut-away view of a catcher.

FIG. 14 is a perspective view of means for feeling the failure of doffing.

FIG. 15 is a side view of means for feeling the wrong alignment of bobbins mounted on the means for feeding the bobbin.

FIG. 16 is the front veiw of FIG. 15.

FIG. 17 is a partially cut-away front view showing means for feeling tumbling-down of the bobbin mounted on means for capping the bobbin.

FIG. 18 is a perspective view of means for cutting yarn.

FIG. 19 is a front view of FIG. 18 seen from the direction of the arrow in said FIG. 18.

FIG. 20 is a side view of means for holding the cut-off yarn end on the side of the spindle line.

FIG. 21 is the front view of FIG. 20.

FIG. 22 and FIG. 23 are each partially cut-away side views showing different manners of operation of means for kicking a full cop.

FIGS. 24 and 25 are each perspective views showing different manners of operation of shifting mechanism in said means for kicking a full cop.

FIGS. 26 and 27 are each perspective views showing the respective positions of a swingable mechanism in operation in the means for capping a bobbin.

FIGS. 28, 29 and 30 are each perspective views showing the manner of operation of means for lifting a lappet.

FIG. 31 is a plan view showing automatic reversing apparatus as mounted on the main body.

FIG. 32 is a cut-away view of electric remote control means.

FIG. 33 is a perspective cut-away view of the essential part of said remote control means.

FIG. 34 is a perspective view of control means.

FIG. 35 is a diagrammatic view showing the function of said control means on the electric motor shaft.

FIG. 36 shows the electric circuit thereof.

FIG. 37 is a perspective view of apparatus for lowering the ring rail.

FIG. 38 is a front view showing the full cop conveyor.

FIG. 39 shows the electric circuit of an automatic bobbin changer.

FIG. 40 is a partially cut-away front view showing another embodiment of means for capping a bobbin.

FIG. 41 is the side view of the above.

FIG. 42 is a part perspective view of driving mechanism for the above.

FIG. 43 is a cut-away front view showing still another embodiment of means for capping a bobbin.

FIG. 44 is the side view of FIG. 43.

FIG. 45 is a partially cut-away perspective view showing the lower part of a bobbin feed hopper in the means for capping bobbins.

FIG. 46 is a perspective view showing the whole of a travelling car carrying a pair of automatic bobbin changers for the purpose of using a pair of said automatic bobbin changers for the plurality of spinning machines.

FIG. 47 is a perspective view showing the combining means of said travelling car with a spinning machine.

FIG. 48 is a diagrammatic view for the purpose of explanation showing the use of the travelling car.

In the following description to explain the manner of the invention, in order that the same may be more easily understood, a case wherein a pair of AD apparatus are mounted on a single spinning machine shall first be explained in detail.

In FIG. 1, illustrating the whole plan view of the apparatus, A is a pair of automatic bobbin changers in a starting position at both sides of the outer end of spinning machine B, C is an electric remote control means, D is controls, E is an apparatus for lowering the ring rail, F is a full cop conveyor and G is the auto-counter.

In FIGS. 2 to 5, showing the whole of the AD apparatus A, *a* is means for driving the main body, *b* is means for doffing a full cop, *c* is means for kicking a full cop, *d* is means for lifting a lappet, *e* is means for cutting yarn, *f* is means for holding the cut-off yarn end connected with a spindle, *g* is means for feeding a bobbin, *h* is means for capping a bobbin, *i* is means for feeling the failure of doffing, *j* is means for feeling the tumbling-down of a bobbin, *k* is means for feeling the wrong alignment of a bobbin in the means for feeding a bobbin *g*.

The AD apparatus is driven by motor 1 provided at the lower part thereof through a power transmission system such as a worm 2 fixed on the shaft of said motor 1. Worm wheel 3 engages with said worm 2 and is loosely mounted on said worm wheel shaft 4. Friction washer 5 is attached on said shaft 4 facing friction ring 6 which is fitted to shaft 4 by a sliding key mechanism and pressed to the worm wheel 3 by a spring 7, thereby driving shaft 4. Further, a bevel gear 8 mounted on said shaft 4 engages with another bevel gear 9 loosely mounted on a clutch shaft 10. This drives a crank disk 12 to drive means for doffing a full cop *b* and a chain wheel 13 to drive means for feeding a bobbin *g*, both being fixed on said clutch shaft 10, through clutch mechanism also provided on shaft 10. Still further the travel of the main body is effected by transmission of power to a pinion

17 through a gear 14 fixed at one end of the shaft 4, an idle gear 15 in engagement therewith, and another gear 16 which is combined into one body with said pinion 17. These mechanisms are shown in FIGS. 2, 3, 5, 7, 8, 9 and 10. At the back of the AD apparatus, two sets of rollers 23 and 24 are rotatably mounted to travel the apparatus on upper and lower rails 20 and 21 respectively. These rails are long enough to cover the whole length of the spinning machine and are fixed to said machine through a spindle rail 18 and a bracket 19. Moreover the lower pair of rollers 24 are provided with a rack 22 which engages with pinion 17. Clutch mechanism 11 consists of bevel gear 9, one single-toothed clutch 25 provided on the boss of said bevel gear 9, and a corresponding clutch 26 fitted to the clutch shaft 10 by a sliding key mechanism.

The means for doffing a full cop *b* comprises, as shown in FIGS. 3, 11, 12 and 13, a catcher 28 to catch the head of cop 27; reversed T lever 29 connected with the catcher 28 at one end and rotatably pivoted to the main body A at the other end; a connecting lever 31 connected with said reversed T lever 29 at its upper end and rotatably connected with pin 30 mounted on the crank disc 12 at its lower end; an auxiliary lever 33 connected with the catcher at one end and loosely mounted on the nose 29′ of the reversed T lever 29 by means of a pin 32 on the nose 29′ loosely fitting in the slot 34 of the lever 33, allowing free shifting of said auxiliary lever; a cam plate 37 having a grooved cam 36 to which a roller 35 provided on said auxiliary lever is loosely fitted; an oscillating lever 40 rotatably jointed to the side of the apparatus at one end, and pressed to the roller 39 mounted on the reversed T lever 29 by means of a spring 38 at its other end; an oscillating arm 42 having a cop pick-off plate 44 at one end, movably supported by a supporting member 41 at the other end and connected to said oscillating lever 40 by a connecting rod 43; and a guide 45 adjustably mounted on the upper part of the apparatus so as to press down the head of catcher 28 when it is lifted to its top position.

The construction of catcher 28 is as shown in FIG. 13. Namely, a push-out rod 48 having a sloping surface at the bottom and a roller 47 provided on the upper part thereof is slidably fitted in a pipe 49 which is covered with a flexible rubber-cover 49′, and a spring 50 is provided between the upper surface of said pipe 49 and the upper part of the push-out rod 48. At the lower end of said pipe 49, an elastic cop gripping ring 57 is provided to hold the head of cop 27.

Furthermore in order to bind the catcher 28 at its top position after the cop doffing operation is completed as to all the spindles, means for braking the main body 1 is provided as shown in FIG. 6. This means comprises a pair of semi-circular brake shoes 51 fitted in the depression of the crank disc 12 so as to be rotatable around a pin 52 planted on the main body; a lever 54 driven by a solenoid 53, of which one end 55 is positioned opposite to said pin 52; and a spring 56 fixed on the pair of brake shoes respectively at each end.

The means for kicking a full cop *c* is illustrated in FIGS. 3, 22 and 23, and comprises a guide 58 fixed on the back of the main body; a slide plate 59 slidably fitted on the upper surface of the guide 58; a kicker 61 rotatably pivoted on the slide plate by means of a pin 60; a connecting lever 63 having a slot 62 at one end connecting a slide piece 64 and another connecting lever 31 of the crank disc 12; a slide piece 64 which is so positioned that the push rod 65 provided thereon comes above the tail of the kicker 61; a wedge 67 mounted on the back of the guide 58 to engage with the slope 66 formed at the end of the slide plate 59; and a buffer 68 corresponding to the wedge 67 containing a spring 69 provided on the slide piece. While the main body is stopped, a hook 70 rotatably mounted on the guide 58 is engaged with the notch 71 in the slide plate 59 as shown in FIGS. 24 and 25, binding the kicker 61 at the withdrawn position.

The means for lifting lappet *d* comprises, referring to FIGS. 2, 3, 5, and 28 to 30, the first lappet lifting guide 75 connected with the cop guide 76 of the means for cutting yarn *e* by levers 77, 78, and 79; the second lappet lifting guide 74 coupled therewith, which is mounted on the back of the bobbin feed hopper 72 of the means for capping bobbin *h* in a position slightly higher than the horizontal level of the lappet *m* when the ring rail 73 is at its initial position; said first and second lappet lifting guides 75 and 74 each being provided with a thread guide 80 and 81 respectively. These lappet lifting guides 75 and 74 are withdrawn so as not to interfere with the operation of the spinning machine while the main body is not working, as shown in FIG. 28.

The means for cutting yarn *e*, referring to FIGS. 2, 18 and 19, comprises a pair of guides 82 and 83 fixed on the front of the cop guide 76; a slide plate 84 slidably fitted with the guides; a pair of scissors 85 having a projection 86 on the outer part thereof, with the inner part being fixed on the slide plate 84, and the curved part, fixed by a pin 87 planted on the slide plate 84; and a roller 93′ provided on the guide 82 to be pressed to the projection 86. The function of the scissors is accomplished by sliding of the slide plate 84 at a suitable angle to always place the cutting point of the scissors at the center of the slit 89 formed by the curved portions 88 of the cop guide 76. This sliding in return is accomplished by the rotation of pinion axis 90 having a pinion 91, which is engaged with the rack 92 provided on the slide plate 84.

The means for holding the cut-off yarn end *f*, referring to FIGS. 5, 20 and 21, comprises an endless chain 94 planted with a brush 93 on the periphery thereof, hung between two chain wheels 95 and 96 so as to be driven toward the opposite direction from the advance of the main body through a suitable driving means; and another chain wheel 97 which is positioned so as to form a horizontal part of the endless chain 94 slightly below the cutting point of the scissors 85 in the means for cutting the yarn end *e*.

The means for feeding bobbin *g* comprises, as shown in FIGS. 2 and 4, a bobbin hopper 99 capable of containing many bobbins 98 mounted on the front of the main body; a pair of endless chains 101 positioned at the back of said hopper 99, being provided with many carriers disposed at a regular interval and designed to carry each one bobbin, said pair of endless chains 101 being hung over a set of lower chain wheels 103 fixed on the lower shaft 102 and a set of upper chain wheels 105 fixed on the upper shaft 104; and a chain wheel 13 to drive the chains with carriers 100 in the direction indicated by the arrow in FIG. 4 through a chain wheel 106 fixed on one end of the lower shaft 102.

The means for capping a bobbin *h* is illustrated in FIGS. 3, 4, 5 and 17, wherein a bobbin feed hopper 72 having an entrance end at the position corresponding to the top position of a bobbin 98 carried on a carrier 100 is swingably supported on the main body by a pivot 112, said bobbin hopper 72 being provided with a bobbin supporter 108 having a notch 107 to pass the head of a spindle *n* at the lower end thereof, and a swingable supporter 109 at the opopsite side thereto. Further a nose 110 and a guide 111 are also provided in the bobbin hopper so that the dropped-in bobbins 98 from the entrance end may be held obliquely in order with their heads closely aligned with their bottoms down.

The means for feeling misdoffing *i* comprises a plate 114 of which the bottom is curved and provided with a notch 113; a microswitch 119 placed under the plate 114, connected with a circuit which is normally open, said plate 114 being rotatably pivoted by a pin 115 on the front of the first lappet lifting guide 114, and having a feeling rod to come between the head of spindle *n* and the head of the cop 27 while the main body is in opera-

tion planted therein, and moreover always being pressed to a stopper 118 fixed on the first lappet lifting guide 75 by the compressive force of a spring 117 as shown in FIG. 14.

The means for feeling the tumbling-down of bobbin *j* as shown in FIG. 17 comprises a feeling member 121 with a nose 120 swingably pivoted on the inner surface of the bobbin supported 108 mounted on the bobbin feed hopper 72, and a microswitch 122 positioned correspondingly to the nose 120, which is connected with a circuit normally in an opened state.

The means for feeling the wrong alignment of bobbin *k* as shown in FIGS. 15 and 16 comprises a feeling member 124 having a slot 123 and a nose 125 at the bottom thereof, and a microswitch 127 in a normally open circuit positioned correspondingly to the nose 125. Said feeling member 124 is mounted on the right hand of the bobbin hopper 99 shown in FIG. 2 so as to be slidable back and forth against the chains with carriers 101, and is advanced by a spring 126 so that the front of the feeling member 124 is always maintained at the midpoint of the lateral portion of a bobbin 98.

The automatic bobbin changer, i.e. AD apparatus comprises all the means described hereinabove.

Now the remote controls C to drive the AD apparatus, referring to FIGS. 32 and 33, comprises a cord spool 128 having a ⊐ shaped section; a boss 129 combined into one body with the cord spool 128 and loosely fitted in a vertical axle 131 vertically fixed on an eddy spring supporter 130; an eddy spring 132 fixed to the lower end of the boss 129 and the eddy spring supporter 130 respectively; a bracket 136 fixed on the upper end of the vertical axle 131, having three carbon brushes 133 for a three phase electric source and four carbon brushes 134 and 135 for the electric circuit to drive the AD apparatus, each slidably held thereon; and electrodes 133′, 134′ and 135′ each corresponding to the carbon brushes 133, 134 and 135 respectively fixed on the boss 129 through insulators 133″, 134″ and 135″, said carbon brushes 133, 134 and 135 being pressed to the electrodes 133′, 134′ and 135′ with a constant force by a contact piece 137 of which one end is fixed to the bracket 136, and the lead wires from each of the electrodes being connected with a terminal 138.

Controls D is shown in FIGS. 34 and 35, which comprises a shaft 139 which rotates at the same rotation ratio with a heart cam O of the spinning machine, and on which a clutch 140 is fitted in by a sliding key mechanism and a ring 142 having a corresponding clutch 141 is also loosely mounted; an eddy spring 143 fixed between the shaft 139 and a fixed bearing; a cam 145 corresponding to a microswitch 144 to cut off the electric source of the spinning machine and another cam 147 corresponding to a microswitch 146 to start the automatic ring rail lowering apparatus both adjustably fixed on the periphery of the ring 142; an L-shaped clutch shifter 148 engaged at one end with the depression of the clutch 140 with the other end roughly V shaped, and pivoted by a pivot 149, one arm of said V shape 148′ having a corresponding cam 150 fixed thereon and the other arm 148″ having a shaft 152 mounted thereon on which a corresponding cam 151 is fixed; the shaft 152 driven by a small synchronous motor 153, having at one end contact pieces 154′, 155′ and 156′ each corresponding to the microswitches 154 and 155 to cut off the rotation of the motor 153 by a single rotation, and a microswitch 156 to start the AD apparatus.

Ring rail lowering apparatus E is as shown in FIG. 37, comprising a spiral gear 158 fixed on one end of the shaper wheel shaft 157 of the spinning machine; another spiral gear 159 in engagement with the gear 158; a worm 160 fixed on the shaft of the gear 159; a worm wheel 161 in engagement with the worm 160 fixed on a shaft 162; a pinion 163 fixed on the other end of the shaft 162 in engagement with rack 164 provided on ⊏ shaped slide member 165; the slide member 165 having a worm 166 therebetween in engagement with the worm wheel 161 and fitted in a shaft 167 by sliding key mechanism; a worm wheel 168 fixed on the one end of the shaft 167; and a motor 172 connected with the rest through a universal joint 171 mounted on one end of a shaft 170 of a worm 169 in engagement with the worm wheel 168.

Now the manner of operation of the present invention shall be explained. When the autocounter G shows that the bobbins are fully wound in the spinning machine, the microswitch 181 (in FIG. 36) provided in the autocounter G connected with the same circuit with the small synchronous motor 153 in the controls D shown in FIG. 34, is closed. Then the motor 153 is rotated in a clockwise direction. The one arm 148″ of the V shaped clutch shifter 148 is freed by the rotation of the cam 151, resulting in the rotation of the clutch shifter 148 to the direction indicated by the arrow around the pivot 149, drawn by the spring 173, thereby pressing the clutch 140 in engagement therewith to the corresponding clutch 141. At that time the shaft 139, being rotated at the same rotation ratio with the heart cam O of the spinning machine, the clutches 140 and 141 come into engagement at a certain position of the heart cam, and drive the ring 142. Thus by the motion of cams 145 and 147, through the microswitch 144 the motor 1 for the main body is switched off, and through the microswitch 146 the ring rail lowering apparatus is started by the motor 172 when the heart cam O is at an appropriate position. The period for one rotation of the motor 153 is set in advance, as shown in the diagram of FIG. 35, so that the same is the total sum of one revolution of the heart cam *p*, and the time from switch-off to stop of the spinning machine *q* and proper spare time *r*.

The revolution of the motor 172 drives the shaft 167 through the worm 169 and the worm wheel 168 as shown in FIG. 37, resulting in the sliding of the worm 166 mounted on the shaft 167 in the direction indicated by the arrow, while rotating. This sliding induces the sliding of the slide member 165 in the same direction, thereby rotating the shaft 162 in the direction of the arrow through the engagement of the pinion 163 with the rack 164, winding up the chain 176 for lifting and lowering the ring rail 73, hung between the drum 174 fixed on the shaft 162 and the sector 175, thereby lowering the ring rail 73 through the rocking arm 177 and a poker rod 178. When the ring rail is lowered to its initial position, the electric source of the motor 172 is switched off by opening of the microswitch 180 by a contact piece 179 provided on the ⊏ shaped slide member 165. During lowering of the ring rail, worm wheel 161 does not rotate, since the sliding of the worm 166 is caused by the engagement of the worm wheel 161 and another worm 160.

As the work of the microswitches 144 and 146 are completed, the shaft 139 goes back to its original position by the repulsive force of the eddy spring 143, rotating the cam 150 to press one arm 148′ of V-shaped clutch shifter 148 which then frees the clutch 140. At the same time a contact piece 156 on the shaft 152 which starts from the position where both contact pieces 154′ and 155′ have freed the microswitches 154 and 155, closes the microswitch 156 to start the AD apparatus. This is followed by the opening of microswitches 154 and 155 for cutting off the electricity to the small synchronous motor 153 by the contact pieces 154′ and 155′, thus stopping said motor 153.

This stopping was accomplished as shown in FIG. 36, in the following order. The microswitch 181 in the autocounter automatically returning to its starting position as shown by the dotted line, the electric current from the source 182 passes microswitch 155 to the exciting coil of the push button switch 183, closing the microswitch therein to close the circuit to reach the small synchronous motor 153. This results in the rotation of said

motor until the contact pieces 154' and 155' free the corresponding microswitch 154 and 155, switching off the microswitches 154 and 155. Thus all the contact pieces 154', 155' and 156' return to their starting positions, stopping the small synchronous motor 153 until the next occasion when all the bobbins in the spinning machines are fully wound.

By the closing of the microswitch 156 in the controls D, the AD apparatus starts advancing. The electric circuit for the operation of the AD apparatus is shown in FIG. 39. Namely, on the spinning machine the push button switch 183, and respective advancing and reversing magnet switches 184 and 185 connected with the electric motor of the main body 1 for each of the pair of AD apparatus in corresponding positions, are provided. Three phase electric sources *t*, *u*, *v*, as shown in FIG. 39, are each connected to the first phase of each of the magnet switches, and the lead wires 136 from the second phase of the three phase electric source are each connected with the contact piece 137 in the remote controls C shown in FIG. 32, thus transmitting the electricity to the carbon brushes 133, the electrode 133', the terminal 138, and to the cord 137 wound on the cord spool 128, of which one end is connected with the electric motor 1 through a three phase microswitch relay. Further, the lead wire from the electric source terminal 190 for the exciting coil 189 of the advancing switch 184 is connected with the fourth terminal 192 through the microswitch 191 of the normally closed circuit and the exciting coil 189, and further from said terminal 192, connected in parallel with the terminal 183'' provided in the normally open circuit connected with the push button switch 183 and with the microswitch 156 for startiing the AD apparatus in control means D. Its secondary wire is then connected with a terminal 193 of a different phase from that of the terminal 190 through the off-switch 183' of the push-button switch 183. And the lead wire from a corresponding terminal 192' to the primary terminal 192 is connected with the off-switch 183'. Consequently, if the microswitch 156 is closed, the electric current passes from the primary circuit of the magnet switch 184 to the secondary circuit thereof, by the work of the exicting coil 189. The current from the three phase electric source will not be cut off when the microswitch 156 is opened, the electric source of the exciting coil 189 being maintained by the terminals 192 and 192'.

Thus the electric motor 1 for the AD apparatus is started by the above mechanism in the controls D, driving the pinion 17 in engagement with the rack 22 on the lower rail 21 through the worm 2, worm wheel 3, friction ring 6, worm wheel shaft 4, gear 14, an idle gear 15, and the gear 16, as shown in FIGS. 2, 7 and 8, resulting in the advance of the pair of AD apparatus from both sides of the spinning machine.

During this advance, the cord 137 of FIG. 32 connecting the remote controls and the main body is unwound as the main body advances, while compressing the eddy spring 132.

Before the first lappet lifting guide 75 in the means for lifting lappet *d* shown in FIG. 28 reaches the lappet *m* of the first spindle of FIG. 29, said guide 75 is pushed out to the position of FIG. 29 from the withdrawn position of FIG. 28. This action is accomplished by driving the roller 195 provided at the lower end of the vertical rod 194 which in turn is coupled with the lever 78, from the position shown by the dotted line along the bottom of the dog 196 mounted on the upper rail 20; thereby pulling down the rod 78 and pushing out the first lappet lifting guide 75, enabling the same to lift the lappets at a suitable angle so as not to interfere with cop-catching action of the catcher 28. At the same time the thread guide 80 provided on the first lappet lifting guide 75 pushes away the thread *s* of the cop 27 coming from the front roller of the spinning machine which is not shown, through the wire on the lappet *m*, so that the thread *s* may not interfere with the operation of the catcher 28, and also may have a suitable slack at the time of feeding the bobbin 98.

As the main body further advances, referring now to FIG. 12, the distance from the top position of the catcher 28 in the means for doffing a full cop *b* to the first spindle *n* which is not shown becomes that of the spindle pitch. As shown in FIG. 10, through the clutch mechanism 11 which is provided between the means for driving the main body and the driving mechanism for the means for doffing a full cop *b* and the means for feeding a bobbin *g*, the lever 200 is set in motion, being in engagement with the clutch piece 199 of the clutch mechanism. Said lever 200 has a roller 198 which is in contact with the downward slope at the bottom of a L-shaped dog 197 mounted rotatably above the lower rail 21, and through the rotation of said roller 198 in the direction of the arrow due to the slope in the dog 197, is rotated to bring the clutch 26 and the clutch 25 on the bevel gear 9 in engagement.

At the same time the notch 203 of the lever 200 comes into engagement with a corresponding hook 204, binding the lever 200 at its rotated position. Simultaneously, the solenoid 53 is energized through the microswitch 225 which operates in relation with the clutch mechanism 11, and is switched off when the clutches thereon come in engagement, to adsorb the corresponding sticking member 226, thereby freeing the means for braking the main body 1. The electric source of said solenoid 53 is, as shown in FIG. 39, connected in parallel with the output terminal 218'' and the output terminal 219'' of the microswitches 218 and 219 in the three phase microswitch relay 188. Further the driving mechanism herein is so constructed that both the clutches 25 and 26 have a single tooth, the connection of the pinion 17 with the bevel gear 9 having the clutch 25 allows no slipping and that one revolution of the bevel gear 8 causes the advance of the main body by one pitch of the spindle by the pinion 17, while bevel gear 9 completes one revolution. Consequently, even if the clutches 25 and 26 are disengaged during the advance of the main body, the relationship between the up and down movement of the catcher 28 and spindle *n* is always constant.

By the engagement of the clutches 25 and 26, the driving power is transmitted to the clutch shaft 10 shown in FIG. 10 from the electric motor 1, therefrom to the crank disc 12 on the shaft 10 which is the driving source of the means for doffing full cop *b* so as to cause one revolution of the disc 12 during the advance of the main body by one pitch of the spindle as described hereinabove. This is further transmitted to the chain wheel 13 which is the driving source of the means for feeding a bobbin *g* at such a rotation ratio that at each advance of the main body by one pitch of the spindle one of the bobbins 98 carried on the carries 100 may be dropped into the feed hopper 72 of the means for capping bobbin *h* as shown in FIG. 4.

On the other hand, before the slide plate 59 of the means for kicking a full cop *c* shown in FIG. 22 reaches the first spindle *n*, the hook 70 frees its binding effect on the slide plate 59 as shown in FIG. 24, being rotated in a clockwise direction by the passing of the roller 204 mounted on the tail of said hook 70 along the upward slope of the dog 205 provided on the back of the upper rail 20. This allows the slide plate 59 to push forward so that the front of the plate 59 is slightly withdrawn from the outer periphery of the spindle warp *n'*, by the drawing force of the spring 206. This position is so determined in advance that the center of the kicker 61 comes to the midpoint of the warp *n'* when the catcher 28 is lowered to its lowest position to catch the head of the cop 27 as the main body advances.

Meanwhile the rotation of the crank disc 12 causes up-and-down movement of the reversed T lever 29 through the connecting lever 31 as shown in FIG. 12, resulting in the lowering of the catcher 28 from its initial top posi-

tion to catch the head of the cop 27 on the spindle by the cop gripping ring 57 provided in said catcher as shown in FIG. 13. At the same time as shown in FIG. 22, connecting lever 63 draws down the slide piece 64, of which push rod 65 then in turn pushes down the tail of the kicker 61 which is at the midpoint of said warp *n'*. Thus the kicker 61 kicks up the bottom of the cop with its front, loosening the fitting of the spindle and the cop. On the other hand, before the lowering of the push-rod 65, the buffer 68 is also lowered to put the wedge 67 in engagement with the slope 66 of the slide plate 59, preventing the backward motion of the plate 59 to maintain the desired position of the cop. The catcher 28 is thereby enabled to doff the cop, being maintained at certain posture by the auxiliary lever 33, roller 35, and the grooved cam 36 is relation to the lifting motion of the reversed T lever 29, without colliding with projections such as the roller part of the spinning machine which is not shown, and moreover with out unduly forcing the spindle. Then with the proper time delay in lowering the ring rail 73 by ring rail lowering apparatus E and cutting off the electricity to the electric motor of the spinning machine before the advance of the AD apparatus, when the ring rail 73 reaches its initial position for winding, the yarn end is wound onto the end of the cop by the idle operation of the spinning machine due to inertia, thereby the yarn end is left on the spindle winding the same by several times when the cop 27 is doffed from the spindle as shown in FIG. 12. Also as shown in FIGS. 12 and 13, the quick pushing motion to the right side exerted on the bottom of the cop by the cop pick-off plate 44 provided on the oscillating arm 42 during the lifting motion of the catcher gives stability to the cop gripped in the catcher 28 by the head, and prevents the coming off of the yarn wound onto the spindle.

In order to carry out this full cop doffing operation during the advance of the main body at its regular speed, the reversed T lever 29 and the auxiliary lever 33 holding the catcher 28 control the motion of the catcher, so that the one stroke of the catcher is always delayed by one half a spindle pitch toward the direction of the advance of the main body as shown in FIG. 2. Thus when the full cop 27 is doffed, this time delay is offset by the advancing speed of the main body, enabling the vertical doffing of the cop.

A little before the catcher 28 gripping the cop 27 reaches the top position, the roller 47 is touched by the guide 45 as shown in FIG. 12, causing the dropping of the cop along the sloping surface 46 by the projection of the push-out rod 48 against the force of the spring 50 shown in FIG. 13.

As the yarn end connected with the spindle from the dropped cop 27 slides into the slit 89 formed by the curved portion 88 of the cop guide 76 in the means for cutting yarn *e* shown in FIGS. 2 and 18, the rod 210 coupled with the slide piece 64 in the means for kicking full cop *c* goes down with the going down of the catcher 28, downwardly rotating the oscillating lever 211 which is connected with said rod 210. Said lever 211 being fixed on the pinion axis 90 at one end, the motion is transmitted to the scissors 85 through the pinion 91, rack 92, and the slide plate 84, sliding said scissors 85 downwardly so that the projection 86 on the outer part thereof presses the pin 87, and the yarn is cut.

After cutting the yarn, the scissors 85 returns to its starting position when the cop-doffing apparatus is lifted. Further, the slit 89 of the cop guide 76 is located opposite to the direction of advance of the main body by a suitable distance when the catcher 28 is at its lowest position, rendering the sliding of the yarn into the slit easier.

After the yarn is cut, the yarn end S' connected with the spindle is caught by the brush 93 on the endless chain 94 of the means for holding the cut-off yarn end, as shown in FIGS. 20 and 21, and thereby held with certainly from the time of cutting the yarn until an empty bobbin is fed to the spindle.

While the cop 27 which is dropped from catcher 28 falls on a belt conveyor 208 provided on the front of the spinning machine, which advances with the main body to any desired direction, through a cop chute 207 provided on the main body as shown in FIG. 38.

In order to render the falling of the cop to the belt conveyor 208 through the cop chute 207 easier, the lower part of the cop chute is smoothly curved toward the direction of advance of the conveyor 208. As soon as the cop is carried away by the conveyor to the end of the spinning machine, the same is further sent to the upward direction to be collected in a cop box 209 provided at the end of the belt conveyor 208.

Thus, as the main body advances while carrying out the cop doffing operation, before the bobbin supporter 108 in the feed hopper 72 of the means for capping the bobbin *h* reaches the first spindle *n*, a short lever 212 rotatably mounted on the advancing side of the feed hopper 72 and another short lever 213 rotatably mounted on the main body become coupled as shown in FIG. 27, said lever 213 being coupled with a long lever 214 on which a V shaped lever 216 having rollers 215 and 215' on each end respectively is pivoted. By the contacting of this roller 215 with a dog 217 fixed on the upper rail 20, the V shaped lever 216 is rotated in a counter-clockwise direction, thereby the long lever 214 is pulled down, causing the rotation of the short levers 212 and 213 beyond their dead points. Then as shown in FIG. 17, the feed hopper 72 is pushed out from the pivot 112 so that the center of the notch 107 in the bobbin supporter 108 comes to the central position of the spindle. Simultaneously the second lappet lifting guide 74 on the feed hopper 72 is also pushed out, to get ready to held the lappet *m* at the position as has been lifted by the first lappet lifting guide 75 until the bobbin capping operation is completed. When the main body further advances, among the suitable number of bobbins 98 which have been obliquely aligned in the feed hopper 72 with their larger-hole parts down, the one which has been at the lowest position (refer to FIG. 5) is caught by the head of the first spindle *n*, freed from the bobbin supporter 108 to gradually take a vertical position, and finally dropped and fitted on the spindle by its own weight. Now during this dropping motion of the bobbin, the head of the bobbin being in an empty space provided below the guide 111 which holds the heads of the bobbins aligned above the dropping bobbin, the idle rotation of the dropping bobbin is not transmitted to the other bobbins, thereby rendering the smooth dropping and fitting of the bobbin possible, with small resistance to the head part thereof.

As shown in FIG. 21, the yarn end connected with spindle *n'* held by the brush 93 of the endless chain 94 is freed from the brush by the dropping of the bobbin, and at the same time the part of the yarn which has been remaining at the bottom of the spindle is held between the inner part of the bottom of the bobbin and the warp *n'*. The necessary slack of the yarn at the time of capping the bobbin being, as aforementioned, provided by the curving of the yarn *s* at the time of cop doffing by the thread guide 80, further said curving being maintained by the thread guide 80 and the horizontal part of the adjacent thread guide 81 until the yarn is freed from the guide 81 simultaneously with the capping of the bobbin, the unnecessary tension on the yarn is avoided, and the breakage of yarn which tends to occur at the time of re-starting of the spinning machine is prevented.

The feeding of the bobbins into the feed hopper 72 of the means for capping bobbin *h* is carried out as shown in FIG. 4, wherein the many bobbins 98 contained in the bobbin hopper 99 with their larger-hole parts down are carried away therefrom one by one on the carrier 100 provided on the chain 101 with the progress of said chain 101, and at the upper turning point dropped into the

feed hopper 72. As a bobbin is dropped, its head is touched by the nose 110 (refer to FIG. 17) in the feed hopper 72, thereby aligned with the other bobbins in order with their larger-hole parts down, awaiting to be fed to the spindle one by one.

As so far explained, the preparatory operations of the AD apparatus, namely the projection of the first lappet lifting guide, that of the slide plate of the cop-kicker, and that of the feed hopper having the second lappet lifting guide are carried out while the bobbin exchanging operation has been carried out as to only a few of the spindles at the end part of the spinning machine, and as for the rest of the spindles, only the necessary operations for bobbin changing are repeated at each spindle.

The safety devices in the AD apparatus consists of the means for feeling misdoffing, the means for feeling the wrong alignment of a bobbin, and the means for feeling the tumbling-down of a bobbin, which quickly respond to failure of doffing at the time of doffing the cops, wrong alignment of bobbins in the bobbin hopper 99, and the tumbling down of several bobbins from the feed hopper 72 at the time of capping bobbins, respectively, and stop the advance of the main body.

If a cop is missed during the cop-doffing operation, the feeling rod 116 in the means for feeling the failure of doffing *i* as shown in FIGS. 5 and 14 touches the top of the remaining cop, and rotates in the direction of the arrow as the main body advances, causing the closing of the circuit by switching on the microswitch 119 by the lower part of the plate 114.

When several bobbins are tumbled down from the feed hopper 72, the feeling member 121 provided in the means for feeling the tumbling down of bobbin *j* swings as indicated by the dotted line due to the loss of pressure exerted by the bobbins, thus closing the circuit connected with the microswitch 122.

Further when a bobbin is inserted with reversed state in the feed hopper 99, as shown in FIGS. 15 and 16, the larger-hole part of the bobbin touches the feeling member 124 and slides in the direction of the arrow, closing the circuit connected with the microswitch 127.

The main body is stopped by switching of any of the microswitches 119, 122 and 127.

The electric circuit for the safety devices consisting of the above three feeling means is as shown in FIG. 39. Namely, among the cords 187 reaching the main body from the remote controls C, two phases are passed through the microswitches 218 and 219 of the 3 phase microswitch relay, the remaining one phase being connected directly with the electric motor of the main body 1. From the in-put terminal 218' of the microswitch 218, the cord 187 are connected with the terminal 220' of the another microswitch 220 of the 3 phase microswitch relay through the exciting coil 188' of said 3 phase microswitch relay 188, and between this and the in-put terminal 219' of the microswitch 219 in the relay 188, the three microswitches for each of the feeling means, 119, 122 and 127, and open side switch 221' of the push button switch 221 on the main body are each connected in parallel. Further the lead wire from the terminal 220'' of the microswitch 220 is connected with in-put terminal 219' of the microswitch 219 in the relay 188 through the closed side switch 221'' of the push button switch 221 of the main body.

Thus by the closing of the microswitches 119, 122 and 127 in each of the feeling means, the exciting coil 188' in the relay 188 is excited, thereby opening the microswitches 218 and 219 in said relay 188 to cut off the electricity to the motor 1. At that time the electric circuit for the aforementioned means for braking the main body 1 is also cut off, starting the braking operation. Moreover by exciting the exciting coil 188', the microswitch 220 in the relay being simultaneously closed to secure the electric source of the exciting coil 188', the motor 1 of the main body will not start unless the push-button switch 221'' of the main body is opened, even if the microswitches 119, 122 and 127 of each feeling means are opened.

At the time when doffing of the cop from the last spindle is completed and the catcher 28 reaches its top position, as shown in FIG. 9, the bottom of the dog 222 on the lower rail 21 touches the roller 223 which is provided at the end of hook 204 which in turn is in engagement with the notch 203 of the lever 200, thereby rotating the hook in the direction of the arrow, freeing its restriction on the lever 200.

The free lever 200 is then, by the drawing force of the spring 224, rotated in the direction of the arrow, disengaging the single-toothed clutch 26 from the clutch 25. This cuts off the rotation of the clutch shaft 10 which is the driving source of the rotation of the motor 1, and the means for doffing full cop and feeding bobbin, and also cuts off the electricity to the solenoid 53 by the functioning of the microswitch 225 which is coupled with the clutch mechanism 11 and opens with the disengagement of the clutches 26 and 25. Then by the drawing force of the spring 227, the means for braking the main body 1 is set in operation, controlling the idle rotation of the crank disc 12 to bind the catcher 28 at its top position.

When the tail of the first lappet lifting guide 75 passed over the last lappet *m*, then as shown in FIG. 28, the slope of the dog 228 on the upper rail 20 and the roller 195 mounted on the rod 194 become contacted, pushing up the rod so that the first lappet lifting guide 75 regains its initial waiting state. Further as the main body advances until the last spindle is capped with a bobbin as shown in FIG. 26, the dog 229 on the lower rail 21 and the roller 215' on the V shaped lever 216 coupled with the long lever 214 become contacted, pushing up said lever 214 to return the feed hopper 72 to its original position as well as the second lappet lifting guide 74 mounted thereon, as shown in FIG. 27. Again, during the time from the passing of the slide plate 59 in the means for kicking the full cop *c* before the warp *n'* of the last spindle until the stopping of the main body, the dog 230 on the spindle rail 18 and the roller 231 on the plate 59 become contacted at a proper position as shown in FIG. 25, thereby returning the plate to the original position shown in FIG. 24. The hook 70 maintains the plate at this withdrawn position.

After all the operations aforementioned are completed, the microswitch 191 provided on the lower part of the main body for stopping the advance of the main body is touched by the contact piece 233 on the lower rail 21 as shown in FIGS. 5 and 31 and opened, cutting off the electricity to the motor 1. The ensuing idle motion of the main body causes the turning on of the microswitch 234. Contact piece 233 is also provided on the lower part of the main body next to the microswitch 191 for stopping microswitch 234.

The electric power transmission in this case is as shown in FIGS. 39 and 32. The two lead wires from the terminals 190 and 192 in the magnet-switch 184 for advancing the AD apparatus are each connected with the contact piece 137 in the remote controls C. The lead wires are connected to the microswitch 191 for stopping the AD apparatus, through the carbon brush 134, electrodes 134', terminal 138 and the cord 187 wound up onto the cord spool 128. One end of the cord spool 128 is connected with said terminal 138. The secondary three phase electric sources 235, 236 and 237 of the reversing magnet-switch 185 are each connected with the secondary terminals 235', 236' and 237' of the magnet-switch 184 on the advancing side. An electric circuit for securing the electric source as connected with the magnet-switch 184 on the advancing side is also provided for the magnet-switch 185 on the reversing side. A microswitch 232 for stopping the return trip of the AD apparatus is

also provided on the lower rail at the advancing side of the AD apparatus. Between the off-switch 183' of push button switch 183 and the fourth terminal of the primary coil, lead wires from aforementioned microswitches 234 and 234' for automatic return of the pair of AD apparatus, provided on the main bodies, are connected. Thus, when the microswitch 191 for stopping the advance of the main body is opened, the magnet-switch 184 on the advancing side in opened, cutting electricity off to the electric motor 1 in the AD apparatus, and when both the microswitches 234 and 234' are closed, the magnet-switch 185 for returning provided in the motor for each of the AD apparatus is closed simultaneously, supplying the electric source in a reversed phase to the motor. This starts the reversed rotation of said motor. In either of the electric circuits connected with the magnet switch 185 in each of the pair of AD apparatus, a fifth terminal 238 is provided. The terminals 238' and 238'' are connected with the starting side terminals 239' and 239'' of the push button switch 239 in the motor for the spinning machine shown in FIG. 36. The motor for the spinning machine 241 is re-started when AD apparatus is returned. In this occasion, even if either one of the AD apparatus goes before the other, pressing and closing the microswitch for returning, unless the other AD apparatus which comes after also presses and closes its microswitch for returning, neither of the AD apparatus are able to come back, subsequently preventing the re-starting of the spinning machine. When the AD apparatus reach their original awaiting position for advance, the microswitch 232 for stopping the return of the AD apparatus provided on the lower rail 21 is touched by the contact piece 240 shown in FIG. 5 and opened as shown in FIG. 31, opening the reversing magnet switch 185, thereby shutting off the electric source of the main body and stopping the same. At the time of this return trip, the eddy spring 132 shown in FIG. 32 utilizes the rotating power saved at the time of unwinding the cord while the AD apparatus was advancing, and makes the cord spool 128 wind up said cord 187 without causing slack therein as the main body returns.

FIGS. 40 to 42 show other embodiment of a bobbin capping apparatus. Namely while in the previous embodiment the bobbins are dropped on the spindle by their own weight and fitted on the set position, it is preferable in such cases as bobbins' having a light weight, for instance being made of paper, or the spindles being of button cap type spindles, that the bobbin capping is accomplished by a positive means in the following embodiment, wherein the bobbins are pushed to fit in the spindles with certainty.

In FIGS. 40, 41 and 42, a bobbin feed hopper 301 is swingably mounted on the back of a bobbin feeding apparatus which sends off the many bobbins contained in the bobbin feed hopper on the AD apparatus A one by one by the carrier. Said bobbin feed hopper 301 has its upper entrance for bobbins connected with the upper part of said bobbin feeding apparatus, with its lower end being made in a chute form 302 which approximately corresponds with the capping locus of the bobbins 98. The middle part thereof is so constructed that the bobbin 98 may be aligned in order with a suitable obliqueness. The chute 302 is horn shaped, its bobbin discharge end having an equal diameter with that of the larger-hole part (bottom) of the bobbins, and its bottom plate 305 having a groove 303 which corresponds to the locus of the smaller-hole part (top) of the bobbin passing through said chute 302 to be fitted on a spindle, and an adjacent groove 304. A roller 306 is loosely fitted in said groove 303 as shown in FIG. 42, the shaft 307 of the roller 306 having a buffering push-out piece 309 swingably mounted on the one end thereof through a spring 308, and a short lever 311 fixed on the other end thereof. The short lever 311 in turn is pivoted to a roller 310 which loosely fits in the groove 304. Further, a bobbin supporter 313 is swingably mounted on the lower side wall of the bobbin feed hopper 301 where the larger-hole part of the bobbins are located, in order to prevent the falling of the bobbin 98' in the chute 302 by its own weight, and a hook 314 which fits in the larger-hole of the bobbin 98'' which is right above the bobbin 98' is provided. When this hook 314 comes into engagement with the bobbin 98'', the side wall 315 is bent so that the top of the bobbin is supported and prevented from falling down. One end of a connecting lever 316 pivoted on a disc 322 fixed on the driving source of the main body is connected with an oscillating lever 317 which is rotatably pivoted on the main body. One end of this lever 317 and the shaft 307 of the roller 306 are then coupled by a short lever 320 through universal joints 318 and 319, thereby one cycle of the reciprocating motion of the push-out piece 309 in the chute 302 is accomplished during the advance of the main body by one pitch of the spindle, by the one reciprocating stroke of the oscillating lever 317. Thus the advance of the main body and the swinging of the oscillating lever 317 are so adjusted in advance that when the bottom of the bobbin dropped from the chute 302 reaches the level of the top of the spindle, the center of the bobbin comes to the center of the spindle.

As shown in FIG. 40, when the main body advances ½ pitch of the spindle from the position where the push-out piece 309 is at the lowest point and the bobbin is capped on the spindle, the oscillating lever 317 is rotated upwardly, pushing up the push-out piece 309 along the groove 303. At this time the bobbin 98' being not in the chute 302, and the bobbin 98'' being held by the hook 314 and the side wall 315, the push-out piece 309 reaches the top position without colliding with the bobbins obliqued aligned in the feed hopper 301. While said push-out piece 309 passes slightly under the smaller-hole part of the bobbin 98'' on its way up, by turning the microswitch 324 on by the nose 323 on the disc 322, the hook 314 is disengaged from the bobbin 98'', passing the current through the solenoid 321 which is connected with the hook 314, thereby causing the rotation of the hook 314 in the direction of the arrow, freeing the bobbin 98''. The bobbin 98'' subsequently falls into the chute 302, coming to a stop maintained by the supporter 313 at the bottom thereof. During the subsequent advance of the main body by ½ pitch of the spindle, the push-out piece 309 going down from the top position to the lowest position by the downward rotation of the oscillating lever 317, the pointed end of the push-out piece 309 pushes down the top of the bobbin in the chute 302, positively pushing down the bobbin against the force of a leaf spring 325 provided on the back of the supporter 313, while maintaining the bobbin by frictional force of the side wall on the grooved side 303 and the pushing force of the push-out piece 309. Before the bobbin reaches the lowest position, the same is fitted on the spindle also by the cooperation of the spring 308. During this fitting operation, the direction of the force exerted on the pushout piece 309 is adjusted a suitable distance between the two grooves 303 and 304 and the rotation of the short lever 311. Although the bobbin changes its oblique posture to that of a vertical, said force is not changed and is always in conformity with the direction of the axis of the bobbin. Again in order to prevent the shifting of the push-out piece 309 from the top of the bobbin, due to the advance of the main body during the time when the bottom of the bobbin reaches the top of the spindle until the fitting of the two, the groove 303 to guide the push-out piece 309 is designed in advance to offset the advancing speed of the main body. By repeating the above strokes in order, the bobbins are continuously capped on the spindles from which full cops had been doffed one by one.

In FIGS. 43 to 45, still another embodiment of a bobbin capping apparatus is shown. In this embodiment, the bobbin is guided to take the vertical posture fittable to the spindle, dropped thereon by its own weight, and

thereafter positively fitted to the spindle. Thus, this is a combined type bobbin capping apparatus of the aforementioned two, suitable for button-cap type spindle or similar types thereto wherein the diameter of the top of the spindle is almost equal to that of the bottom hole of a bobbin, or for the case wherein a light-weight bobbin such as one made of paper is used. The construction thereof is as shown in FIGS. 43, 44 and 45. The construction comprises an L shaped supporter 405 having a notch 403 through which the head of a spindle 402 may pass, mounted on the lower part of the bobbin feed hopper 401 on the advancing side of the main body. The bottom 404 of the L shaped supporter 405 is curved downward from the midpoint thereof. Further a groove which opens on said notch 403 is provided together with a pair of bobbin grippers 406 made of an elastic composition rubber such as rubber, which are mounted on the opposite ends of the bottom 404. Also, a longitudinal groove 407 is provided. A sliding piece 409 with a triangular push-out piece 408 is loosely fitted in said groove 407. A disc 410, to which rotation is transmitted, causes one reciprocating motion of the slide piece 409 during the advance of the main body by one pitch of the spindle, through the rods 411, 412, and 413.

The bobbins 98 fed to the bobbin hopper 401 are, as shown in FIG. 43, aligned obliquely with their bottoms down, and the lowest bobbin 98' is carried away by the head of a spindle, gradually taking a vertical position along the surface of the bottom 404 of the L shaped supporter 405. The bobbin which departed from the front of the bottom 404 is then engaged with the bobbin grippers 406, maintained at a posture to be fitted to the spindle by the vertical external force. At the same time, by the rotation of the disc 410 in the main body, the triangular push-out piece 408 is lowered from its top position through the rods 411, 412 and 413, pushing the head of the bobbin to fit the same onto the spindle. Said triangular push-out piece returns to its top position from the previous lowest position during the advance of the main body by ½ pitch of the spindle from the time when the bobbin is fitted onto the spindle. Thus by the going-down of the triangular push-out piece 408, the bobbins engaged with the grippers 406 are positively fitted onto the spindle one by one.

FIGS. 46 to 48 illustrate an embodiment of a case when a pair of AD apparatus are loaded on a travelling car, thereby transferred to the spinning machine which needs bobbing changing, and thereafter started to accomplish their normal function.

IN FIGS. 46 to 48, H is the travelling car which travels on one side of the spinning machines disposed along a lateral line carrying a pair of AD apparatus. A pair of short rails 503 and 504 of the travelling car H corresponding to the rails 501 and 502 for the travel of AD apparatus provided on the spinning machine are each fixed on the slide plates 506 slidably mounted on the fixing pieces 505, said short rails 503 and 504 being made to slide in parallel with the travelling rails 501 and 502 by rotation of a handle 507. Also, a fitting lever 509 which may detachably engage with stopper 508 provided on the end of each spinning machine is provided slidably in the longitudinal direction on the travelling car. Said fitting lever 509 is maintained at a withdrawn position while the travelling car is in motion, and freed when the car has passed before a spinning machine next to which the spinning machine which needs bobbin changing is placed, thereby becoming engaged with the stopper 508 of the spinning machine, and stopping the car H at a set position.

After the car H carrying a pair of AD apparatus is set on the spinning machine which needs bobbin changing, the short rails 503 and 504 thereof are connected with the rails 501 and 502 on the spinning machine, and the AD apparatus are started from the travelling car H, to return thereto after the changing of all the bobbins on the spindles are completed. After the AD apparatus are returned and stopped, again by the operation of the handle 507 the short rails 503 and 504 are disconnected from the rails 501 and 502 of the spinning machine, and the fitting lever 509 is disengaged from the stopper 508, freeing the travelling car H to travel to the other spinning machine which needs bobbin changing, where the operations above described are repeated.

By the present embodiment, it being possible that all the necessary actions for changing bobbins of one spinning machine are completed within 20 minutes, one pair of AD apparatus can easily serve up to 15 spinning machines with an average time required for the empty bobbins in one spinning machine to become fully wound is about 5 hours. Thus the equipping cost of the AD apparatus is greatly lessened. while the operation of the same is easy with simple construction thereof.

Although in the above embodiment the explanation is made as to the case wherein the travel of the travelling car is accomplished by manual handling, it is very easy to make the same automatic.

Also, in the foregoing embodiment, the doffed cops are carried to the cop box provided on one end of a spinning machine by means of a belt conveyor. However it should of course be understood that the cops may be carried to other apparatus such as cop-moisture absorbing apparatus which is a next step. Further, instead of the exclusive-use type wherein one pair of AD apparatus are available for a sole spinning machine, the movable type may be employed wherein the pair of AD apparatus are made movable by being loaded on a travelling car to serve the use of plurality of the spinning machines. It is also possible to enlarge the scope of utility of this machine by employing a vertical bobbin capping apparatus which fits the bobbins onto the spindles with vertical posture as explained, when button-cap type spindles, or similar type such as rather long spindles, so called long-lift spindles, are employed in the spinning machines.

When the pair of AD apparatus are used as the movable type, the same can be used for spinning machines having different spindle pitches, by providing several pinions of different sizes for driving the main body on the pinion axis thereof, and determining the position of the rack in each of the spinning machines as will correspond with the particular pinion to come in engagement with the rack. Moreover, the apparatus of the present invention may also be used for spinning machines having slightly different spindle lift without substantial change in their construction, i.e., by making a few pertinent parts adjustable.

Thus the present invention has proved very important and useful, having brought in an outstanding improvement in the techniques of the spinning industry.

We claim:

1. An apparatus for automatically exchanging bobbins on a spinning machine, said spinning machine having a ring rail, a plurality of spindles each removably carrying a bobbin having a head, a plurality of spinning means for spinning yarn, each of said spinning means being associated with one of said bobbins, and means for guiding said yarn onto said bobbins whereby empty bobbins are wound with yarn until they are full, said apparatus comprising auto-counter means for indicating when said bobbins are full, means responsive to said auto-counter means for stopping the operation of said spinning machine, means for lowering said ring rail, doffing means for removing each of the full bobbins from said spindles, automatic bobbin exchanger means for replacing each of the doffed full bobbins with an empty bobbin, means to restart said spinning machine when said empty bobbins are replaced, and conveying means for carrying said full bobbins away from the spinning machine, said doffing means comprising a catcher having a top and a bottom and having means in said bottom for gripping the head of

one of said bobbins, a reversed T-shaped lever having a crossbar with two ends and an integral arm intermediate said ends extending perpendicularly from said crossbar, one end of said crossbar being pivotally connected to said catcher adjacent its bottom, the other end of said crossbar being pivotally connected to said apparatus, a connecting lever having two ends, a crank disc having a periphery, one end of said connecting lever being pivotally connected to said crossbar, the other end of said connecting lever being pivotally connected to the periphery of said crank disc, means for rotating said crank disc, an auxiliary lever having two ends, one end of said auxiliary lever being slidingly connected to the end of said integral arm remote from said crossbar, the other end of said auxiliary lever being pivotally connected to said catcher adjacent its top, a cam plate having a camming groove therein, a cam roller rotatably connected to said auxiliary lever intermediate its ends, said cam roller being maintained in cam-following engagement with said camming groove, a stop roller rotatably connected to said crossbar intermediate its ends, a first oscillating lever having two ends, one end of said first oscillating lever being pivotally connected to said apparatus, said first oscillating lever being elastically biased in rolling relationship with said stop roller, a second oscillating lever having two ends, one end of said second oscillating lever being pivotally connected to said apparatus, the other end of said second oscillating lever having a pick-off plate fixed thereto, a connecting rod having two ends, one end of said connecting rod being pivotally connected to said first oscillating lever and the other end of said connecting rod being pivotally connected to said second oscillating lever, whereby said pick-off plate is maintained in contact with a full bobbin held by said catcher and as said crank disc is rotated said full bobbin is moved up and away from its spindle, and means for releasing said full bobbin from said catcher.

2. An apparatus in accordance with claim 1, wherein said catcher comprises a pipe having a bottom and a top, the gripping means being a gripping ring of an elastic material fitted in the bottom of said pipe, a push-out rod maintained in a lifted position by a spring in the top of said catcher, and wherein said means for releasing said full bobbin from said catcher comprises a guide fixed to said apparatus, said guide having a slanted surface thereon, and a roller in pressing relationship with said push-out rod at the top of said catcher, said roller engaging said slanted surface and thereby pressing said push-out rod against the force of said spring toward the bottom of said pipe to push the head of said bobbin out of gripping relationship with said gripping ring.

3. An apparatus in acordance with claim 1, wherein means are provided for braking said apparatus in order to hold said catcher in its uppermost position when the doffing of all of said full bobbins is completed.

4. An apparatus in acordance with claim 3, wherein said means for braking said apparatus comprises a depression in said crank disc, a pin fixed to said spinning machine, a pair of semi-circular brake shoes rotatably mounted in said depression around said pin, a lever having two ends, one end of said lever being positioned opposite said pin, a solenoid, the other end of said lever being driven by said solenoid, and a spring means fixed to each end of said pair of brake shoes.

5. An apparatus for automatically exchanging bobbins on a spinning machine, said spinning machine having a ring rail, a ring rail lowering apparatus, a heart-shaped cam, an electric power source and a control means, said control means comprising a clutch shaft operatively connected to, and driven at the same speed as, said heart-shaped cam, a first clutch plate slidingly supported on said clutch shaft, a ring having asecond clutch plate fixed thereto loosely mounted on said clutch shaft, a fixed bearing, an eddy spring having two ends, one end of said eddy spring fixed to said clutch shaft, the other end of said eddy spring fixed to said fixed bearing, a first microswitch operatively connected to said electric power source for said spinning machine, a second microswitch operatively connected to said ring rail lowering apparatus, first and second cams fixed to said clutch shaft in operative relationship with said first and second microswitches respectively, and means to press said first and second clutch plates into engaging relationship.

6. An apparatus in accordance with claim 5, wherein said means for pressing said first and second clutch plates into engaging relationship comprises an L-shaped clutch shifter having two ends, said clutch shifter being pivotally mounted intermediate its ends, one end of said clutch shifter being fitted to said first clutch plate, the other end of said clutch shifter being V-shaped and having two arms, a third cam fixed to said clutch shaft in operative engagement with one of said arms, a synchronous motor, a motor shaft driven by said synchronous motor, a fourth cam fixed to said motor shaft in operative engagement with the other of said arms.

7. A means for automatically exchanging bobbins on a spinning machine, said spinning machine having a ring rail and a ring rail lowering apparatus, said ring rail lowering apparatus comprising a motor, a microswitch operatively connected to said motor for starting and stopping said motor, a rack, means connecting said rack to said motor for causing sliding movement of said rack, a contact piece on said rack in operative relationship with said microswitch, a shaft having two ends, a pinion on one end of said shaft, said pinion being rotated by said sliding movement of said rack, a drum fixed to the other end of said shaft, a sector, a chain hung between said drum and said sector, said chain having two ends, one end of said chain being fixed to said drum whereby said chain is wound on said drum when said shaft is rotated, and the other end of said chain being fixed to said sector whereby said sector is oscillated when said chain is wound on said drum, and means responsive to oscillation of said sector for raising and lowering said ring rail.

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