United States Patent [19]

Uraya et al.

[11] **3,823,537**

[45] **July 16, 1974**

[54] **AUTOMATIC DOFFING PROCESS AND APPARATUS FOR TEXTILE MACHINES**

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[21] Appl. No.: **212,093**

[30] **Foreign Application Priority Data**

Dec. 28, 1970 Japan.....45-126936

[52] **U.S. Cl.**..... **57/52,** 57/34 TT, 57/156

[51] **Int. Cl.**..... **D01h 9/04,** D01h 9/16

[58] **Field of Search** ..... 57/52, 54, 156, 34 TT, 57/34 PW; 242/46.21

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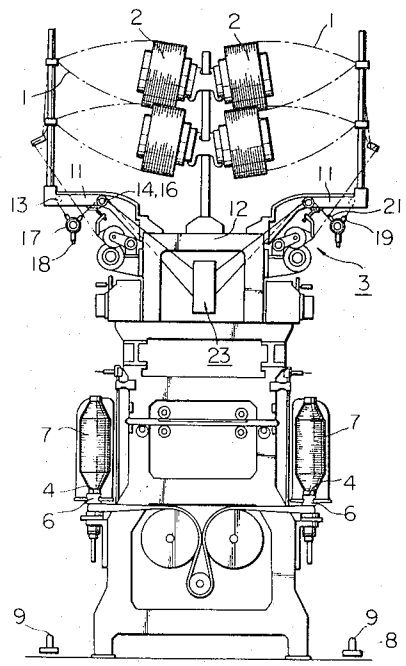
Primary Examiner—John W. Huckert
Assistant Examiner—Charles Gorenstein
Attorney, Agent, or Firm—Woodhams, Blanchard and Flynn

[57] **ABSTRACT**

On textile machines of the simultaneous doffing and-/or donning type, full bobbins on spindles are simultaneously replaced by bare bobbins at stand-by positions in front of the spindles by utilizing the movement of an elongated beam for transportation of bobbins via chucks hung thereto, which beam rests outside the range of movement of a travelling member such as an automatic yarn knotter during the non-working cycle, along preselected courses while positively guiding the bobbins by a pilot mechanism away from any contact with surrounding machine parts.

12 Claims, 56 Drawing Figures



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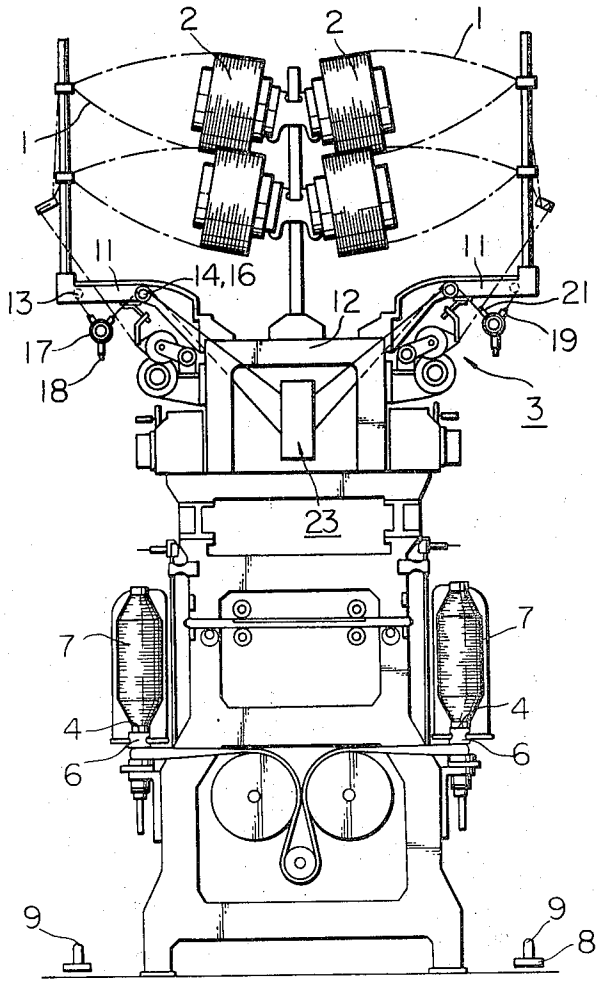

Fig. 2

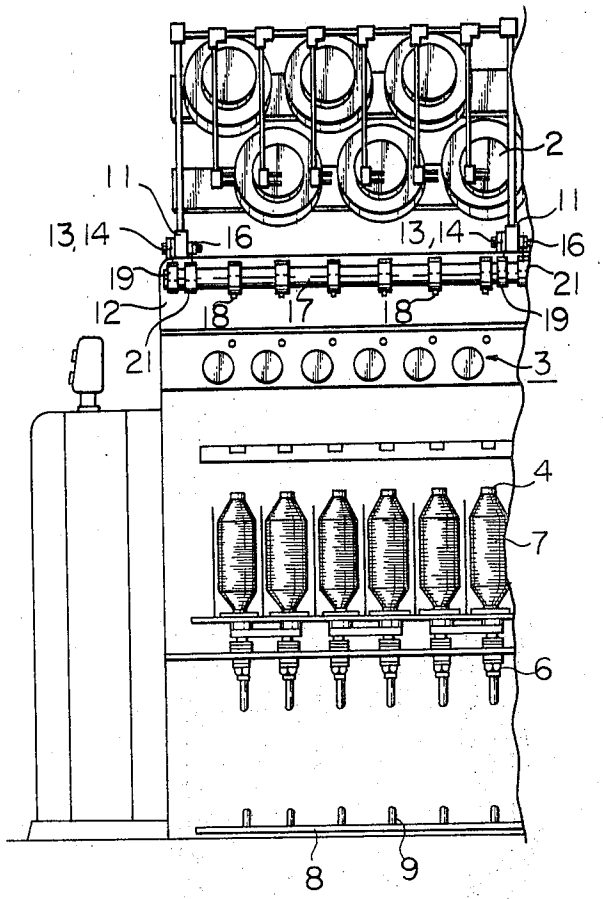

Fig. 3

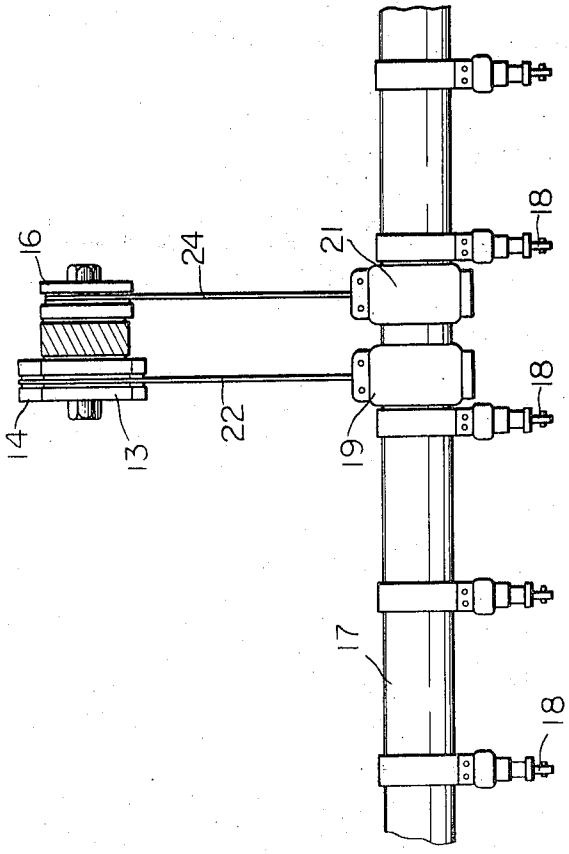

Fig. 4

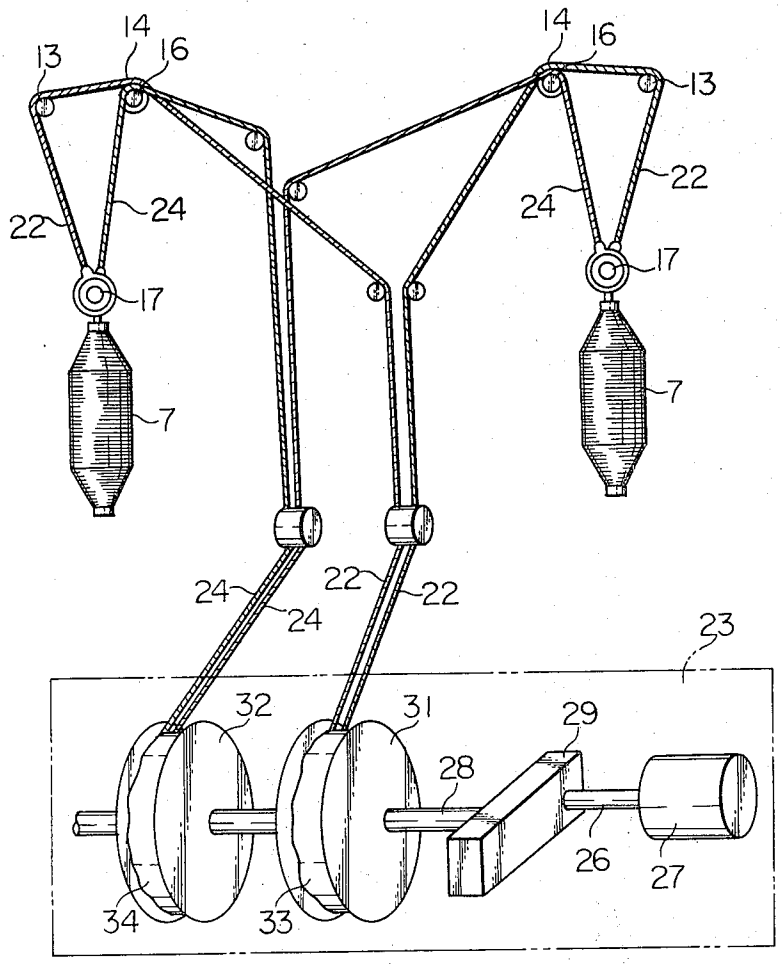
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Fig. 5A

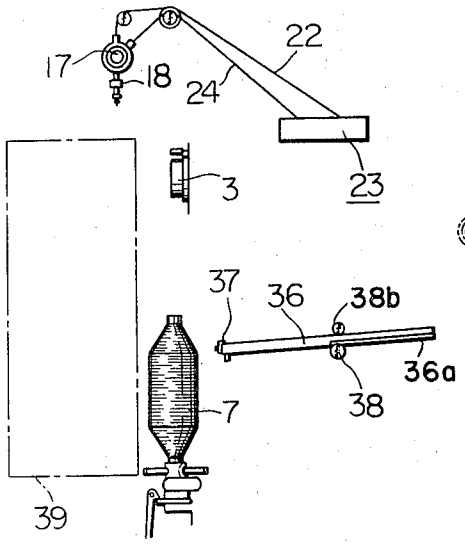
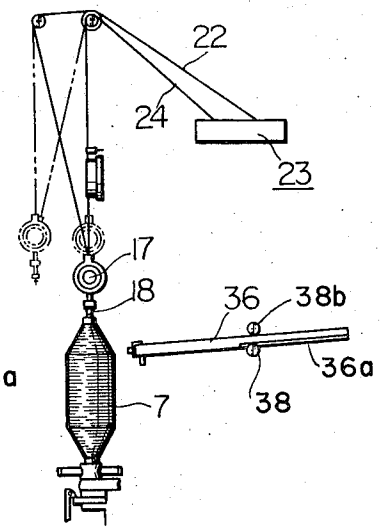


Fig. 5B



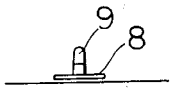
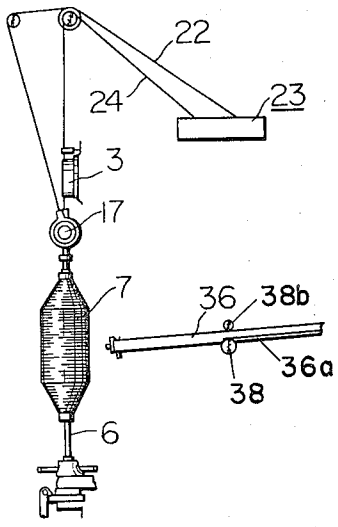


Fig. 5C



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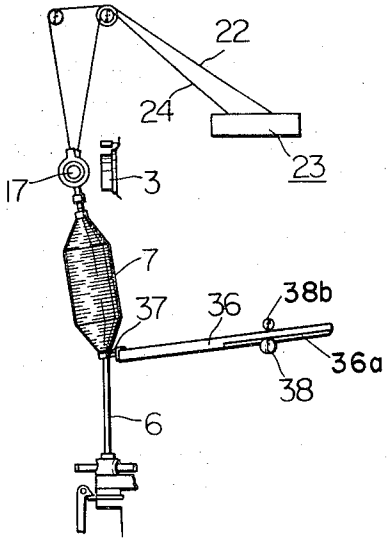

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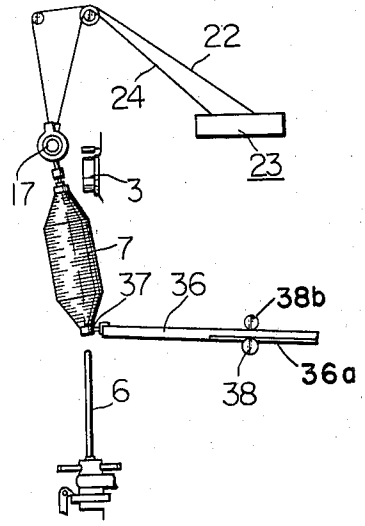

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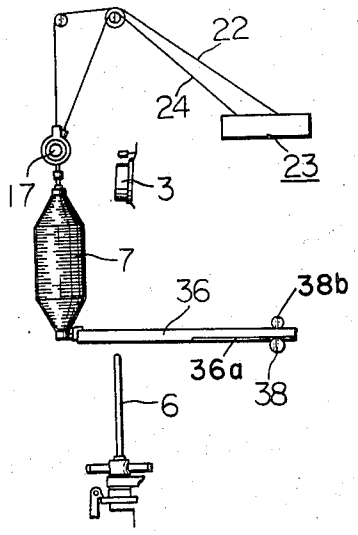

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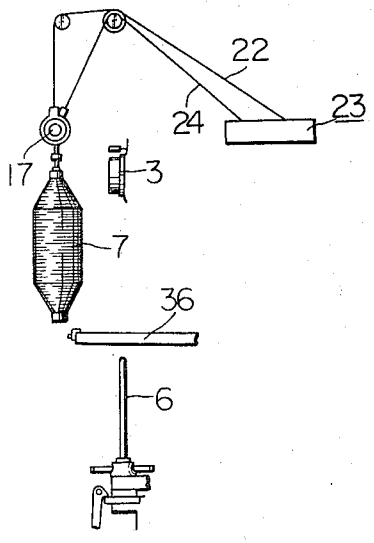

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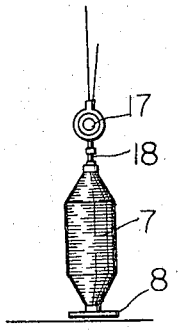

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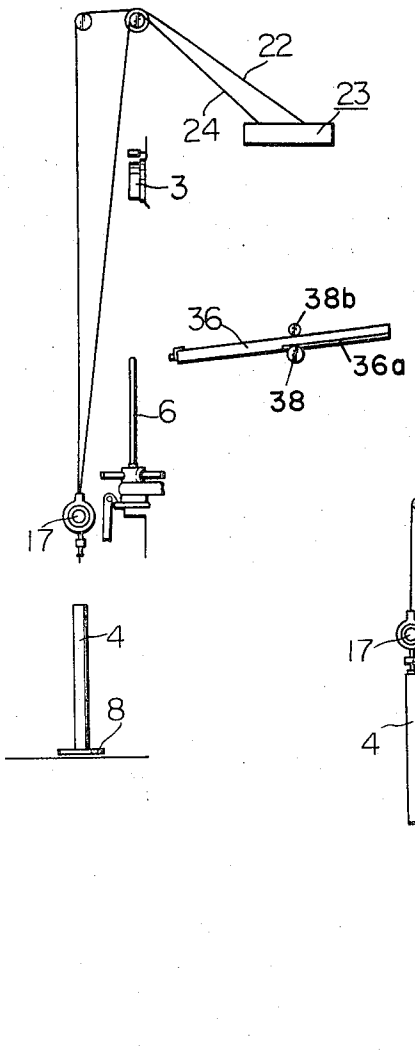

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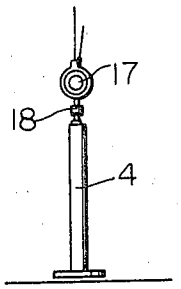

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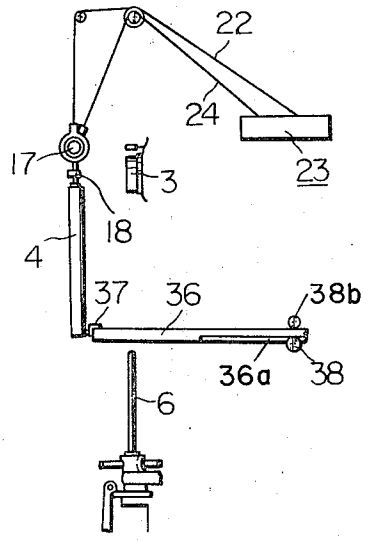

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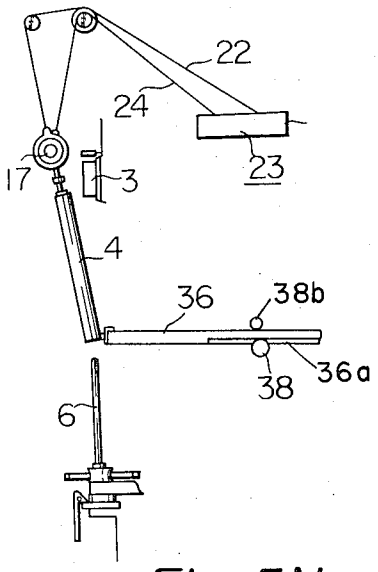

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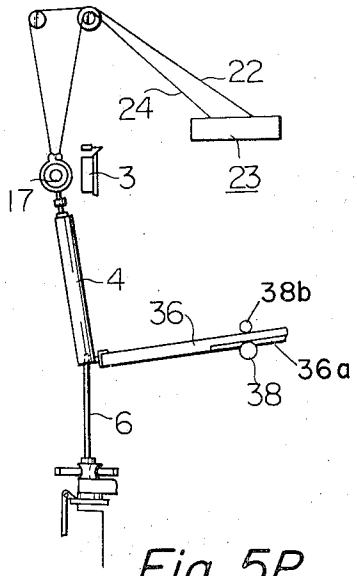

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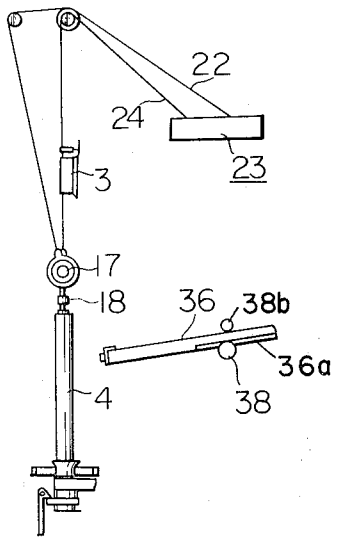

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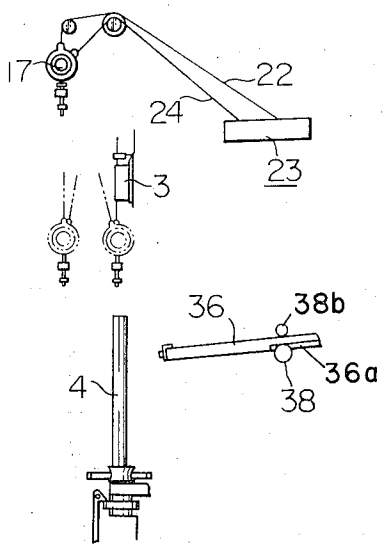

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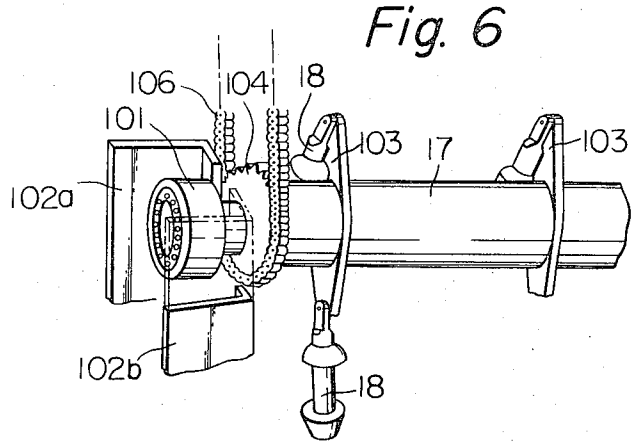

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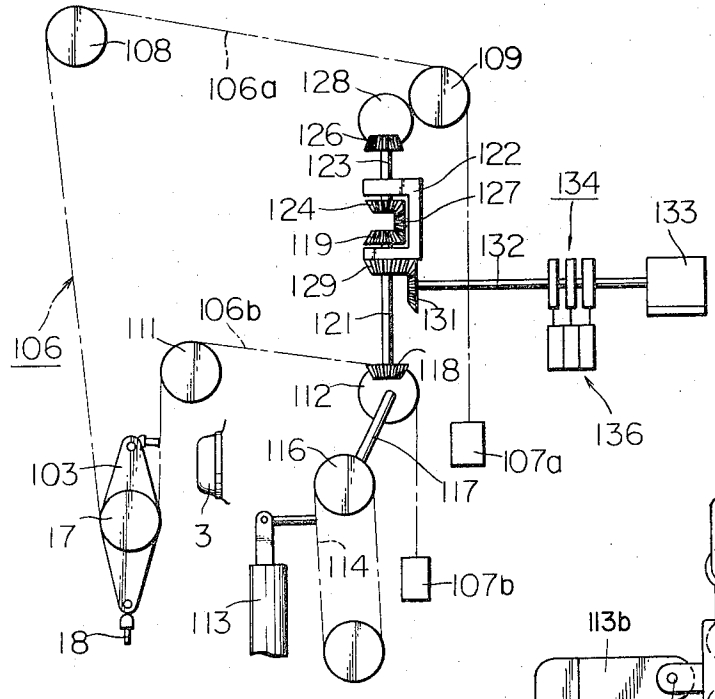
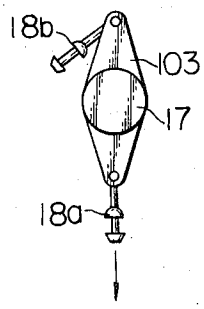


FIG. 7B

Fig. 8A



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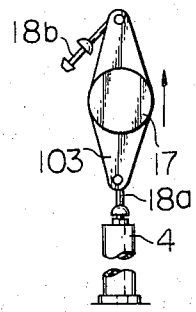

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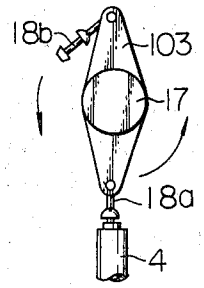

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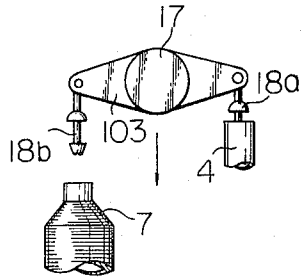

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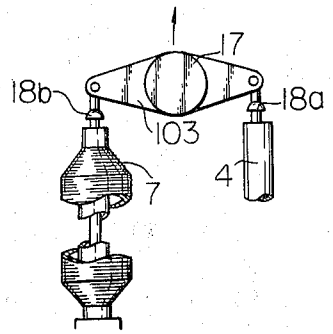

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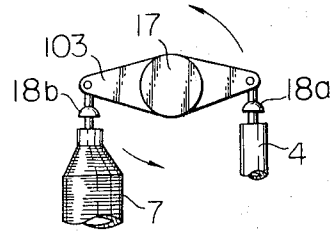

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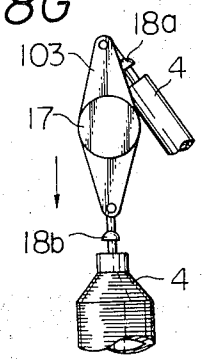

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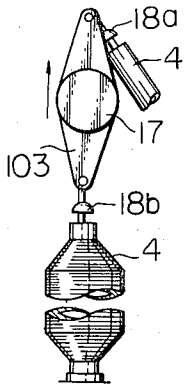

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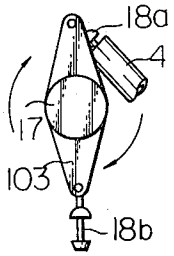

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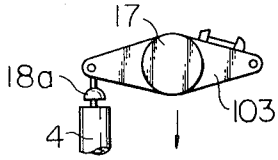

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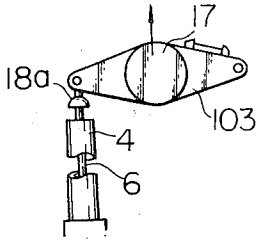

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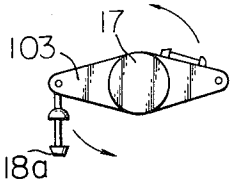

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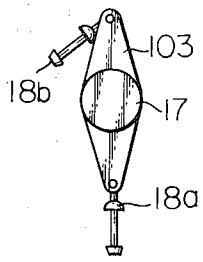

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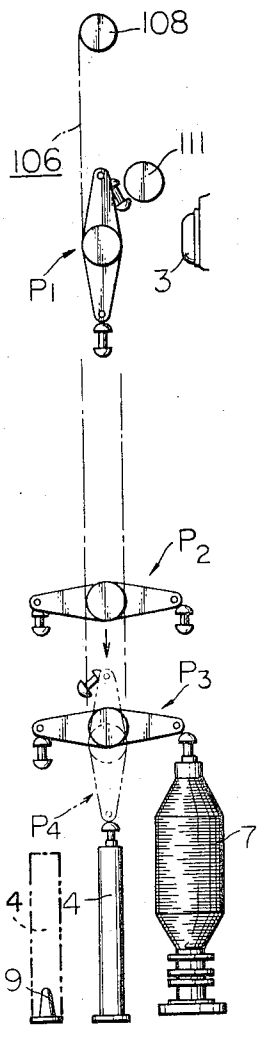

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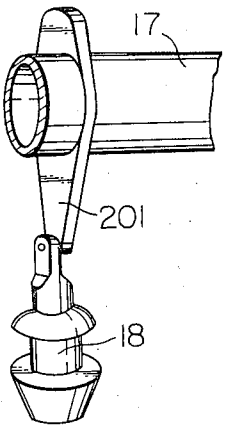

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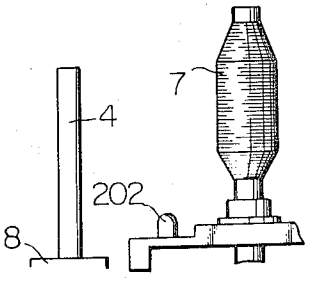

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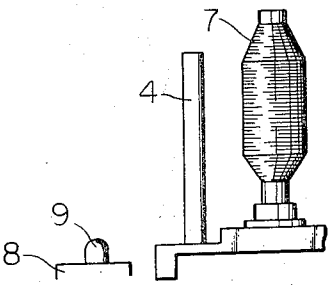

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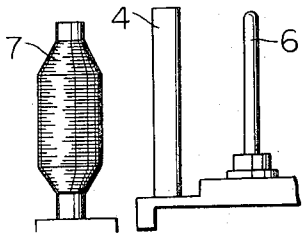
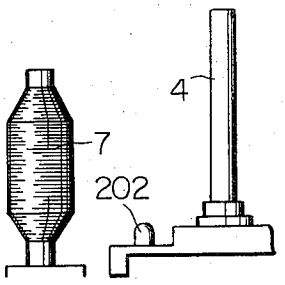


Fig. 11D



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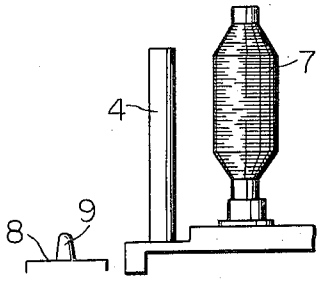

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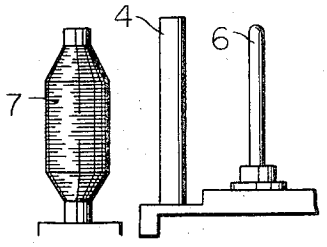

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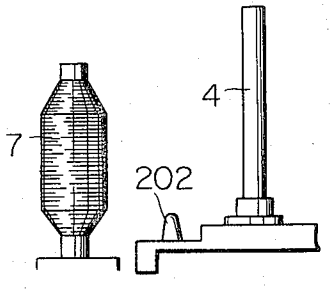

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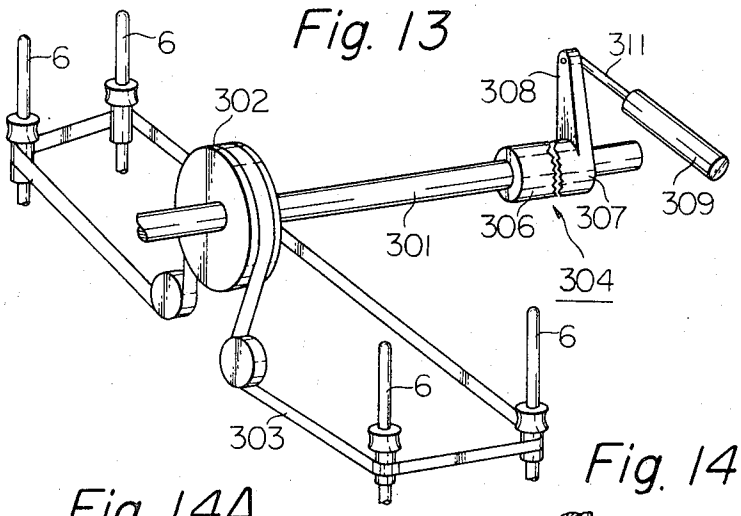
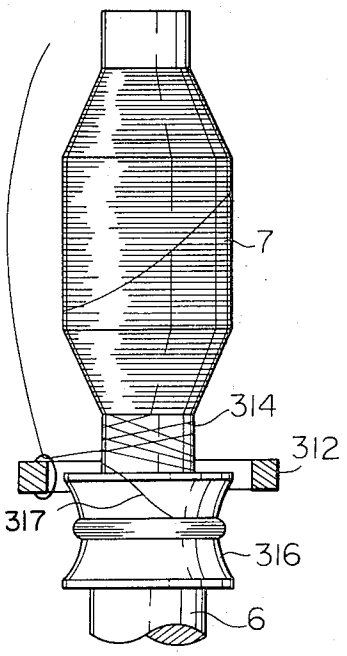


Fig. 14A



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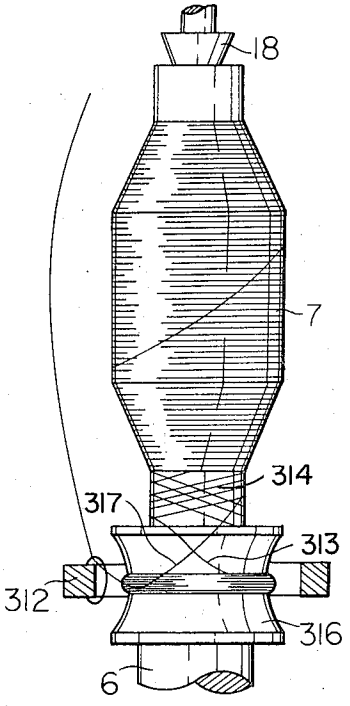

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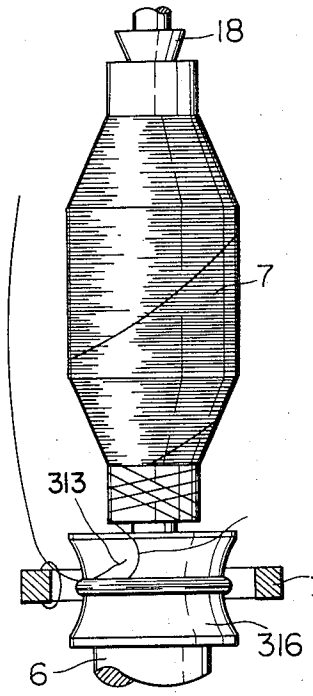

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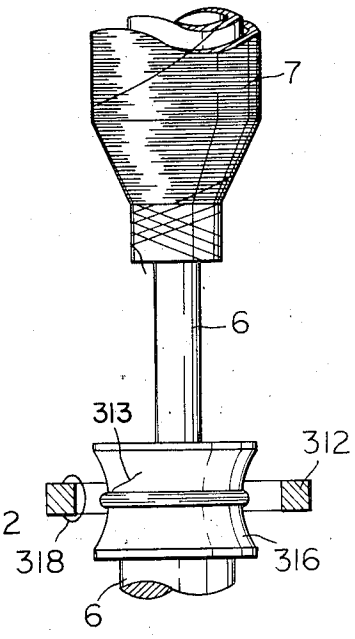


Fig. 15A

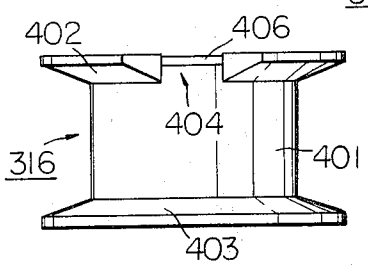
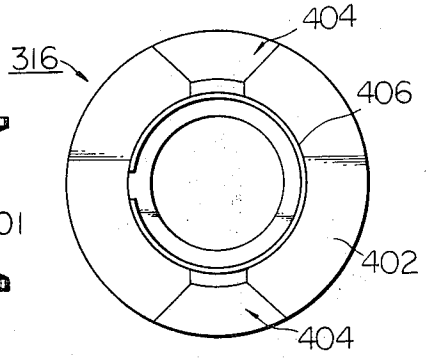


Fig. 15B



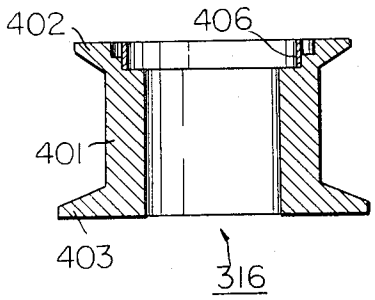


Fig. 15C

Fig. 16

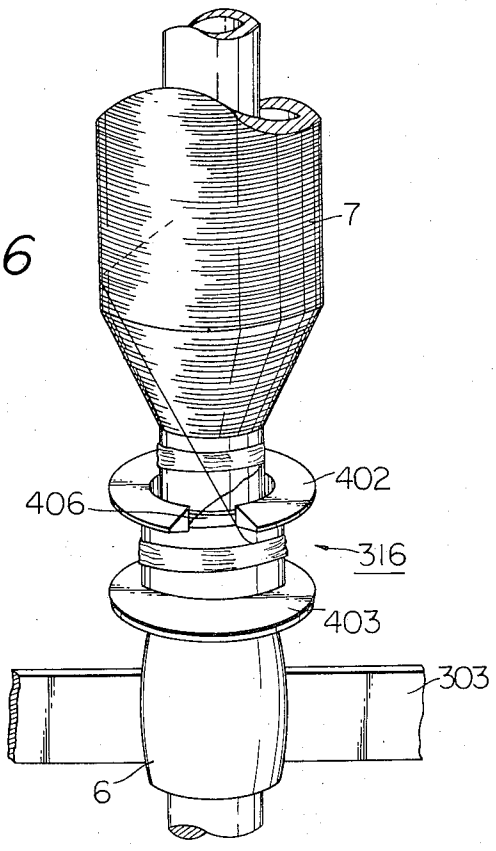
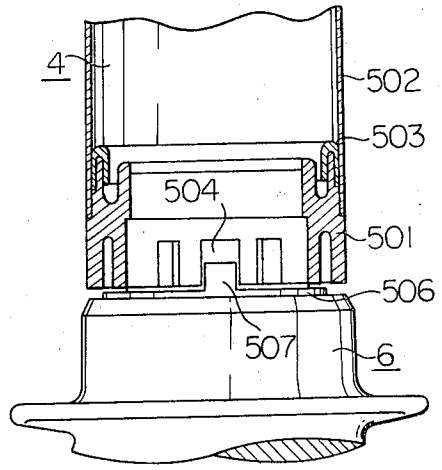


Fig. 17A



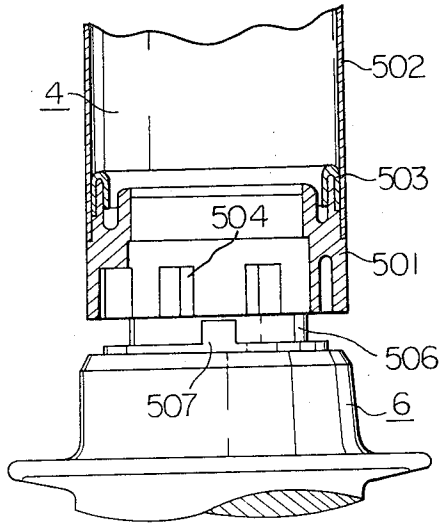
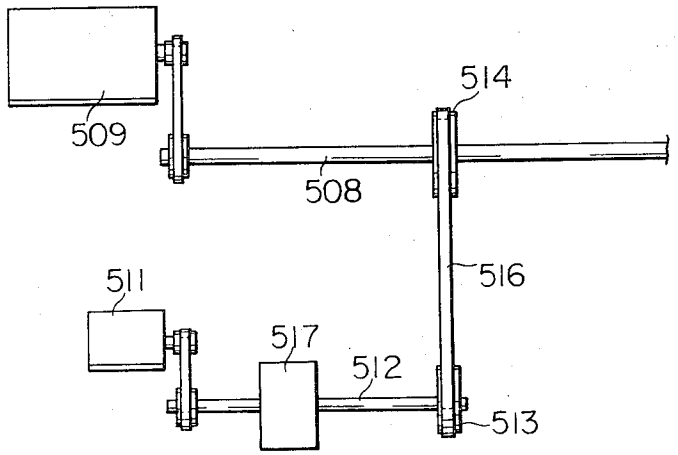


Fig. 17B

Fig. 18



AUTOMATIC DOFFING PROCESS AND APPARATUS FOR TEXTILE MACHINES

The present invention relates to an improved automatic doffing process and apparatus on textile machines, more particularly relates to a process for automatically and simultaneously replacing full bobbins with bare bobbins by transporting and piloting them along a preselected course in a predetermined manner and an apparatus for carrying out such process on textile machines of the simultaneous doffing and/or donning type.

As is well-known the conventional doffing systems are roughly classified into two typical types. In one system, a travelling type doffer moves along the front side of a textile machine while carrying out doffing and/or donning of bobbins from unit to unit. When this system is employed in a process wherein synthetic filamentary yarns are processed, the relatively heavy mass of a unit full bobbin causes increased loading of the travelling doffer as the doffing proceeds from unit to unit. Such increase in the load undoubtedly requires a heavy construction of the doffer and of its related parts. In addition to this, the limited space on the travelling doffer does not leave room for the doffed full bobbins to be stored therein without making contact with each other. In other words, the full bobbins doffed on the travelling doffer must be subjected to a mutual surface contact which tends to cause accidental damage of the filamentary yarn in the surface layers of the full bobbin.

In the other system, full bobbins of all yarn processing units are doffed and, when necessary, bare bobbins are donned to all yarn processing units simultaneously. This system may be one solution to the problem of the heavy loading and yarn damage in the above-mentioned system of the travelling doffer type. However, generally, the mechanism of this system requires the provision of complicated mechanical members on the front side of the machine in the vicinity of the yarn processing units. However, it is usually required that some free space should be left in front of the machine in the vicinity of the units so that travelling members such as an automatic yarn knotter can travel along the machine without any hindrance by the other machine parts. Provision of the above-mentioned additional complicated mechanical members often establishes such hindrance to the free travelling and operation of the travelling members.

The principal object of the present invention is to provide a process and apparatus for carrying out simultaneous doffing and/or donning operation on textile machines without establishing any hindrance to the free passage and operation of the travelling members such as an automatic yarn knotter of travelling type.

The other object of the present invention is to provide a process and apparatus for carrying out simultaneous doffing and/or donning operation on textile machines without any damage to the yarns on the full bobbins.

In order to attain the above-mentioned objectives according to the present invention, full bobbins on spindles are simultaneously replaced by bare bobbins at stand-by positions in front of the spindles. This transportation of the bobbins is effected by movement of at least a beam which extends along the machine and carries a plurality of chucks, one for each unit, for catching the bobbins. The beam rests outside the range of

movement of the travelling members such as the automatic yarn knotter during the non-working cycle but it moves along a preselected course during transportation of bobbins while positively guiding the bobbins, by a pilot mechanism, away from any contact with surrounding machine parts.

Further features and merits of the present invention will be made more clear from the following description, reference being made to the accompanying drawings, wherein;

FIG. 1 is a schematic entire side view of a draw-twister provided with the first embodiment of the doffing apparatus of the present invention,

FIG. 2 is a front view of a part of the apparatus shown in FIG. 1,

FIG. 3 is an enlarged front view of the beam and the related parts of the apparatus shown in FIG. 1,

FIG. 4 is an explanatory perspective view for showing the structure of the control assembly used in the apparatus shown in FIG. 1,

FIGS. 5A to 5P are schematic side views showing the doffing and donning operation of the apparatus shown in FIG. 1,

FIG. 6 is an enlarged perspective part view of the second embodiment of the apparatus of the present invention,

FIG. 7A is a schematic side view showing the principal mechanical structure of the apparatus shown in FIG. 6,

FIG. 7B is a more detailed schematic side view of the principal mechanism shown in FIG. 7A,

FIGS. 8A to 8M and 9 are schematic side views for showing the doffing and donning operation of the apparatus shown in FIGS. 6 and 7,

FIG. 10 is an enlarged perspective part view of a third embodiment of the apparatus of the present invention,

FIGS. 11A to 11D and 12A to 12C are schematic side views of two types of doffing and donning operations of the apparatus shown in FIG. 10,

FIG. 13 is a perspective part view of a third embodiment of the apparatus of the present invention,

FIGS. 14A to 14D are schematic side views for showing the doffing operation using the apparatus shown in FIG. 13,

FIGS. 15A to 15C are drawings showing a fourth embodiment of the apparatus of the present invention,

FIG. 16 is a perspective part view of the doffing operation using the apparatus shown in FIGS. 15A to 15C,

FIGS. 17A and 17B are sectional side views of a fifth embodiment of the apparatus of the present invention,

FIG. 18 is a schematic explanatory view of the arrangement for driving the apparatus shown in FIGS. 17A and 17B.

Although the beam extends almost over the entire length of the machine in the following embodiments, there may be provided multiple beams in axial alignment each beam covering a certain number of yarn processing units.

An embodiment of the doffing apparatus of the present invention mounted on a draw-twister for synthetic fibers is shonw in FIGS. 1 and 2, wherein yarns 1 issuing from respective supply packages 2 are subjected to a drawing operation during their travel through drawing arrangements 3 and, after being twisted, wound on

bobbins **4** on respective spindles **6** so as to form take-up packages **7.**

On both front sides of the twister, there is provided an endless belt **8.** The belts **8** travel endlessly passing through a given supply mechanism of bare bobbins (not shown) and a given storing mechanism of fully wound take-up packages. Upright pegs **9** are fixed on the faces of the belt **8** spaced at equal distances along the belt length. Spacing between neighbouring pegs **9** is the same as the spacing between neighbouring spindles **6.**

Creel brackets **11** extend outwardly from the machine framework **12** and are spaced from each other at suitably selected distances. Near the front end of the creel bracket **11,** front rope guide rollers **13** are disposed in vertical alignment with the row of upright pegs **9** on the belts **8.** Inwardly spaced from the front guide roller **13,** first back rope guide rollers **14** are disposed on the brackets **11** in horizontal alignment with the front guide rollers **13** and in vertical alignment with the row of spindles **6.** In axial alignment with the first back guide rollers **14,** second back rope guide rollers **16** are mounted onto the brackets **11.** All the above-mentioned rollers are mounted for free rotation.

On each side of the framework **12,** an elongated beam **17** runs parallel to the framework **12** front face over the entire length of the twister. The beam **17** is provided with chucks **18** for hanging bobbins, which are disposed thereto at locations corresponding to the spindles **6** of the respective twisting units. The chuck **18** is so designed that it engages or disengages with the bobbin to be hung thereby when it is pressed towards the head of the bobbin. This arrangement is clearly shown in FIG. **3.** The well known "Whitehead" bobbin hanger disclosed in the U.S. Pat. Nos. 3,065,926 and 3,286,949, and the "Kitamura" bobbin hanger disclosed in the U.S. Pat. No. 3,512,731 can be preferably utilized. Therefore, a pair of pawls (not shown) of the chuck **18** are engaged or disengaged with a shoulder portion of an axial bore of the bobbin in a very similar manner to the action of the above-mentioned bobbin hangers.

A pair of supporter rings **19** and **21** are freely inserted over the beam **17,** the position of the front ring **19** corresponding to that of the front guide roller **13** and to that of the first back guide roller **14** whereas the position of the back ring **21** corresponds to that of the second back guide roller **16.** One end of a front rope **22** is fixed to the front ring **19** and the other end thereof is connected to a rope control assembly **23** shown in FIG. **1** via the corresponding front guide roller **13** and first back guide roller **14.** In the same way, one end of a back rope **24** is fixed to the back ring **21** and the other end thereof is connected to the rope control assembly **23** via the corresponding second back guide roller **16.**

Detailed construction of the rope control assembly **23** and its related parts is shown in FIG. **4,** wherein the assembly **23** includes a drive shaft **26** connected to a given drive source **27,** which is actuated for rotation by a suitable electric signal input thereto, and a cam shaft **28** connected to the drive shaft **26** via a suitable reduction gear mechanism **29.** It is well known that, when the winding operation of the packages on the bobbins on the spindle rail has been completed, an electric actuator such as a relay is energized, and a doffing and donning mechanism is actuated by the output signal of the electric actuator, as described in the U.S. Pat. No. 3,382,659. In this invention, a similar electric actuator as in U.S. Pat. No. 3,382,659 can be utilized. It is further well known that a step motor is useful to turn a shaft of a control mechanism under a definite condition by a pertinent pulse signal, and the pulse motor such as the step motor shown in the U.S. Pat. No. 3,452,263, is very useful to attain the above-mentioned function. Further, it is well known art that a pertinent pulse signal can be issued from a pulse generator which is actuated according to an output signal of the above-mentioned electric actuator. Therefore, in the present invention, the shaft **26** (FIG. **4**) can be turned precisely 360° according to the turning motion of the motor **27,** if the above-mentioned pulse motor is utilized as the motor **27,** and the other well known component elements such as an electric actuator, and pulse generator are used in combination.

The cam shaft **28** carries a front rope cam **31** and a back rope cam **32** which are fixedly mounted thereon in a spaced axial alignment. Both cams **31** and **32** are, as shown in FIG. **4,** constructed as drum-like members provided with peripheral cam faces **33** and **34,** respectively. The ends of the front and back ropes **22** and **24** are fixed to the peripheries of the cams **31** and **32,** respectively, whereby the ropes are wound or unwound from the respective cams as they are rotated in opposite directions.

In addition to the above-mentioned arrangement, each unit is accompanied with a pilot stick **36** disposed in the vicinity of the spindle **6** (see FIG. **5A**). The free end of the stick **36** directed towards the spindle **6** is provided with a magnet **37** and the other end thereof is connected to an operator gear **38** which is controlled by a suitable electric system (not shown). Gear **38** engages a rack portion **36***a* on the stick **36,** and a guide roller **38***a* is positioned opposite the gear **38.**

Operation of the doffing apparatus of the present invention having the above-explained construction will hereinafter be explained in detail, reference being made to FIGS. **5A** to **5P.** For a clear and simple understanding, only one draw-twisting unit is illustrated in the drawings.

In the disposition shown in FIG. **5A,** the take-up package **7** has become full and the twister has stopped running. At this stage, the beam **17** is kept outside the range of travel of the automatic yarn breakage detector **39** and the pilot stick **36** is maintained inside the framework **12** so as to permit free travel of the detector **39.** The endless belt **8** remains stationary, with the pegs **9** in position.

Next, the rope control assembly **23** so functions that the beam **17** lowers towards the full package **7** and, upon arrival of the chuck **18** at the head of the package **7,** the beam **17** urges the chuck **18** further downwards under its own weight into engagement with the package **7** (see FIG. **5B**).

After establishment of this chuck-package engagement, the control assembly **23** winds up the ropes **22** and **24** so that the package **7** is hung up from the spindle **6** as shown in FIG. **5C.**

Further, the control assembly **23** carries on winding up the ropes **22** and **24** while controlling the winding-up length of the ropes in such a manner that the beam **17** does not abut against the drawing arrangement **3** during the lifting (see FIG. **5D**). At the very moment when the bobbin carrying the package **7** leaves the top

of the spindle 6, the pilot stick 36 advances towards the lower end of the bobbin carrying the package 7 (hereinafter referred to as the full bobbin 7) being operated by the operator cam 38 and the magnet 37 contacts the lower end of the full bobbin so as to hold it by magnetic attraction.

In the disposition shown in FIG. 5E, the full bobbin 7 completely leaves the spindle 6, its lower end being held by the pilot stick 36.

In this disposition, the control assembly 23 unwinds the back rope 24 and the pilot stick 36 advances forwards so that the full bobbin 7 is held by only the front rope 22 in a vertical condition in vertical alignment with the corresponding peg 9 on the belt 8 as shown in FIG. 5F.

Following this, the control assembly 23 winds up the front rope 22 so that the full bobbin 7 is released from magnetic engagement with the pilot stick 36 (see FIG. 5G) and the pilot stick 36 resumes its initial disposition shown in FIG. 5A.

Next, the control assembly 24 unwinds both ropes 22 and 24 so that the full bobbin 7 is inserted over the corresponding peg 9 on the belt 8 as shown in FIG. 5H and, by further lowering of the beam 17, the chuck 18 is disengaged from the full bobbin 7 due to a knocking action caused by the self weight of the beam 17.

After completion of this disengagement, the control assembly 23 winds up the ropes so as to lift the beam 17 to a level outside the range of travel of the bare bobbin 4 on the belt 8. The belt 8 then travels so as to place the bare bobbin 4 in the position shown in FIG. 5I. In this disposition the bare bobbin 4 is situated directly under a chuck 18 of the beam 17.

Next, the control assembly 23 lowers the beam 17 to put the chuck 18 into engagement with the bare bobbin 4 in that position (see FIG. 5J) and, then, the control assembly 23 lifts the beam 17 together with the bobbin 4 to a prescribed level. Concurrently, the operator cam 38 pushes the pilot stick 36 towards the lower end of the bare bobbin 4 so that the magnet 37 comes into magnetic engagement with the bobbin lower end as shown in FIG. 5K.

In the stage shown in FIG. 5L, the control assembly 23 lowers the beam 17 while controlling the unwinding length of the ropes. This lowering movement of the beam 17 with the bobbin 4 is guided towards the spindle 6 by the pilot stick 36 so that the bobbin 4 does not abut the drawing arrangement 3.

At the time when the lower end of the bobbin 4 is inserted over the top of the spindle 6 as shown in FIG. 5M, the operator cam 38 causes the pilot stick 36 to leave the bare bobbin 4.

In the disposition shown in FIG. 5N, the bare bobbin 4 is fully mounted on the spindle 6 and the chuck 18 is released from engagement with the bobbin 4 by a knocking action caused by the self weight of the beam 17.

After complete disengagement, the control assembly 23 lifts the beam 17 to the original disposition shown in FIG. 5P.

As is clear from the foregoing detailed analysis of the operational sequence, the doffing system of the present invention may be summarized as follows.

a. The full bobbin 7 on the spindle 6 held by the beam 17 via the chuck 18.

b. The full bobbin 7 unmounted from the spindle 6 is transferred onto the endless belt 8 along a prescribed course obviating the abutment with the drawing arrangement 3.

c. The full bobbin 7 so placed on the belt 8 is released from being held by the beam 17.

d. The full bobbin 7 on the belt 8 is replaced by the bare bobbin 4.

e. The bare bobbin 4 is held by the beam 17 via the chuck 18.

f. The bare bobbin 4 so held is transferred to the spindle 6 along a prescribed course obviating the abutment with the drawing arrangement 3.

g. The bare bobbin 4 so mounted onto the spindle 6 is released from being held by the beam 17.

In the case of the foregoing embodiment, the beam is fixed against axial turning and movement of the bobbins relative to the beam during the doffing operation is caused by the magnetic engagement of the bobbin with the pilot stick. A modification of the first embodiment is shown in FIGS. 6 and 7, wherein the beam is mounted in an axially turnable arrangement.

The beam 17 extends substantially over the entire length of the draw-twister in an arrangement the same as that in the first embodiment. As shown in FIG. 6, the beam 17 is provided with bearings 101 mounted thereon at selected locations along the length thereof. The bearings 101 are received in guide grooves defined by pairs of vertical guide bars 102*a* and 102*b* spaced apart and facing each other. Being guided in this way, displacement of the beam 17 in the horizontal direction is limited. At locations corresponding to the respective draw-twisting units, hanger arms 103 are fixedly mounted on the beam 17. The hanger arm 103 is provided with a pair of chucks 18 disposed on both free ends thereof. At selected locations along the length of the beam 17, sprockets 104 are fixedly mounted onto the beam 17 in a meshing engagement with chains 106.

Via the chains 106, the beam 17 is connected to a chain control assembly, whose construction is shown in detail in FIG. 7. As shown in the drawing, one end of chain 106 carries a weight 107*a* and the other end thereof carries another weight 107*b*. A chain portion 106*a* (hereinafter referred to as the front chain portion) connected to the weight 107*a* passes over a front guide sprocket 108 and a front driving sprocket 109 and a chain portion 106*b* (hereinafter referred to as the back chain portion) connected to the weight 107*b* passes over a back guide sprocket 111 and a back driving sprocket 112.

A cylindrical fluid piston 113 is provided so as to drive the back driving sprocket 112 via chain 114 and a sprocket 116 which is fixedly mounted on a shaft 117 in common with the back driving sprocket 112. That is, a piston rod 113*a* of the cylindrical fluid piston 113 is provided with an L shaped top portion 113*b*, and the L shaped top portion is connected to a connector 114*a*, which is an element of the chain 114, by way of a pin 114*b*. Consequently, the chain 114 is displaced according to the motion of the piston rod 113*a*. (FIG. 7B) This piston 113 is controlled by a conventional shifter valve (not shown). This shifter valve is actuated by a micro-switch (not shown) which is operated by a suitably shaped programming cam (not shown). This programming cam carries out rotation over a preset angle upon receipt of a signal announcing that the take-up package 7 is full.

A pair of bevel gears **118** and **119** are fixedly mounted on a shaft **121,** which is rotatably carried by a carrier block **122,** one bevel gear **118** meshing with the back drive sprocket **112.** The carrier block **122** further rotatably carries a shaft **123,** upon which a pair of bevel gears **124** and **126** are fixedly mounted. Inside the carrier block **122,** bevel gears **119** and **124** are connected for co-rotation by an intermediate gear **127,** the transmission ratio being 1 : 1. The bevel gear **126** is related to the front drive gear **109** via an intermediate gear **128** for reversal of rotation.

The carrier block **122** is accompanied by a bevel gear **129** which is in a meshing engagement with a bevel gear **131** fixedly mounted on a drive shaft **132** of a drive motor **133.** By the rotation of the carrier block **122** actuated by the drive motor **133,** the ratio of the rotation between the front driving sprocket **109** and the back driving sprocket **112** can be adjusted such that the beam **17** and the hanger arm **103** operate in accordance with the preset doffing schedule. Several programming cams **134** are fixedly mounted on the drive shaft **132** in an arrangement operable upon corresponding micro-switches **136** so as to decide the magnitude of rotation of the drive motor **133.** Other mechanical parts of conventional construction are omitted in the illustration except the drawing arrangement **3.**

The operational sequence of the doffing apparatus of the present invention having the above-explained construction will hereinafter be explained in detail, reference being made to FIGS. **8A** to **8M.**

When full wind of the take-up package **7** is sensed, the piston **113** is actuated as already explained causing rotation of the front and the back driving sprockets **109** and **112** so as to drive the chain portions **106***a* and **106***b* forwards and the beam **17** lowers accordingly (see FIG. **7**).

At this stage of the operation, the drive motor **133** has not yet started its rotation. Therefore, both chain portions **106***a* and **106***b* are driven at equal speeds and beam **17** does not turn on its axis, i.e., the hanger arm **103** does not turn about the axis of the beam **17.** Maintaining this disposition, beam **17** with arm **103** further lowers towards the bare bobbin **4** resting on the belt **8** (FIG. **8A**).

After one of the chucks **18***a* has completely caught bobbin **4,** beam **17** starts to lift as shown in FIG. **8B.**

When beam **17** comes to a prescribed level, it stops lifting and turns about its axis (FIG. **8C**). In order to effectuate this turning motion of the beam **17,** the drive motor **133** in FIG. **7** rotates. By this rotation of the drive motor **133,** the carrier block **122** starts to turn about the axis of the bevel gear **129** together with the latter so that a difference in rotation is caused between the front and the back driving sprockets **109** and **112.** In the case of the illustrated embodiment, the beam **17** turns clockwise and, accordingly, the chain portion **106***a* is taken up backwardly (rightwardly) by the sprocket **109** while the chain portion **106***b* issues forwardly (leftwardly) by the sprocket **112** in FIG. **7.**

Beam **17** ceases its turning when arm **103** assumes a horizontal disposition as shown in FIG. **8D** and, in this disposition, the other chuck **18***b* comes to a position right over the full bobbin **7.** While keeping this horizontal disposition of arm **103,** beam **17** starts to lower towards the full bobbin **7** mounted on the spindle **6.**

After chuck **18***b* has caught full bobbin **7** by the lowering of beam **17,** beam **17** changes its movement from downward to upward so as to take off full bobbin **7** from spindle **6** as shown in FIG. **8E.**

When beam **17** arrives at a preset level, it ceases its upward movement and starts the clockwise turning on its axis as shown in FIG. **8F.** This clockwise turning of the beam **17** is effectuated in the same manner as the clockwise turning shown in FIG. **8C.**

This turning goes on until hanger arm **106** assumes the vertical disposition shown in FIG. **8G** with full bobbin **7** hanging in a vertical alignment with the peg **9** on belt **8.** While keeping this vertical disposition of arm **103,** beam **17** lowers towards peg **9.** After full bobbin **7** fully rests on peg **9,** chuck **18***b* is released from engagement with full bobbin **7** by the downward knocking action caused by the self weight of beam **17** and beam **17** changes its direction of movement from downward to upward while carrying bare bobbin **4** by chuck **18***a* as shown in FIG. **8H.**

Upon arrival at a preset level, beam **17** ceases its lifting movement and turns counter clockwise on its axis by 270° as shown in FIG. **8I.** By this turning, bare bobbin **4** caught by chuck **18***a* is placed in vertical alignment with spindle **6** and beam **17** starts to lower towards spindle **6** (see FIG. **8J**).

After bare bobbin **4** fully rests on spindle **6,** chuck **18***a* is released from engagement with bobbin **4** due to the knocking action caused by the self weight of beam **17** and beam **17** shifts its direction of movement from downward to upward as shown in FIG. **8K.**

Upon arrival at a preset level, beam **17** turns clockwise on its axis while carrying on its lifting as shown in FIG. **8L** and finally assumes the disposition shown in FIG. **8M,** which is the same as that shown in FIG. **8A.**

The positional relationship between the respective stage dispositions and the main machine parts will be understood from the rough sketch in FIG. **9.**

In the dispositions shown in FIGS. **8A,** and **8M,** beam **17** is in the position P_1. In the dispositions shown in FIGS. **8C, 8J,** and **8L,** beam **17** is in the position P_2. In the dispositions shown in FIGS. **8E, 8F, 8G** and **8K,** the beam is in the position P_3. In the disposition shown in FIGS. **8B** and **8H,** beam **17** is in the position P_4.

A modification of the embodiment shown in FIGS. **6** and **7** is given in FIG. **10,** wherein the hanger arm **201** extends in only one direction radially with respect to the axis of the beam **17** and, at its free end, is provided with one chuck **18.** The mechanism for causing the vertical and axial turning movement of the beam **4** is essentially the same as that shown in FIGS. **6** and **7.**

One operational sequence on this embodiment is shown in FIGS. **11A** to **11D.**

At the time when the take-up package has become full, the bare bobbin **4** rests on the peg **9** on the belt **8** and an auxiliary peg **202** located just in front of the spindle **6** remains empty (see FIG. **11A**). Firstly, bare bobbin **4** is taken off peg **9** and mounted on auxiliary peg **202** as shown in FIG. **11B.** Next, the full bobbin **7** is taken off from spindle **6** and mounted on peg **9** on belt **8** as shown in FIG. **11C.** Finally, bare bobbin **4** is taken off from auxiliary peg **202** and mounted on spindle **6** as shown in FIG. **11D** in condition ready for the subsequent starting of the normal yarn take-up operation. This operational sequence may be advantageously employed in the situation where bare bobbins **4** are automatically mounted on the pegs **9** on a given separate

bobbin supply device and are transported to positions by the programmed travel of the belt 8.

Another operational sequence is shown in FIGS. 12A to 12C wherein, at the time of full package, bare bobbin 4 rests on auxiliary peg 202 and peg 9 stands empty as shown in FIG. 12A. Firstly, full bobbin 7 is taken off spindle 6 and is mounted on peg 9 on belt 8. Next, bare bobbin 4 is taken off auxiliary peg 202 and is mounted on spindle 6 in a condition ready for the subsequent starting of the normal yarn take-up operation. This operational sequence may be advantageously employed in the situation where the operator has sufficient time for manual mounting of the bare bobbins 4 onto the auxiliary pegs 202.

In order to carry out the above-described automatic doffing operation according to the present invention, the yarn from the full bobbin needs to be smoothly transferred to the bare bobbin at the time of the full bobbins doffing and bare bobbins mounting. More desirably, this transfer of the yarns should be carried out automatically. Several embodiments of the mechanism for carrying out such automatic yarn transfer will be hereinafter explained in detail.

The first embodiment for this effect is shown in FIG. 13, wherein a drive shaft 301 is mounted in the main body of the draw-twister, running almost the entire length of the latter. Several drive pulleys 302 are fixedly mounted on the drive shaft 301 at preselected locations, each pully 302 being responsible for the driving of four sets of spindles 6 in the case of the example shown via an endless drive belt 303. At a selected location along the shaft 301, a clutch 304 including a driven disc 306 and a driver disc 307 are disposed. The driver disc 307 has a radially extending arm 308 which, at its outer end, is linked to a cylindrical fluid piston 309 via a piston rod 311. The clutch 304 is so designed that it opens during normal draw-twisting operation and closes at the time of the doffing operation. The piston 309 is actuated upon reception of a suitable signal announcing the commencement of the doffing operation. The discs 306 and 307 are disengaged from each other when the clutch 304 is open whereas they are engaged with each other when the clutch 304 is closed.

The operation of the above-mentioned mechanism will now be explained in detail with reference to FIGS. 14A to 14D.

In the disposition shown in FIG. 14A, the normal yarn taking-up motion is completed and the full bobbin 7 stands still on the spindle 6. The ring rail 312 is positioned at the level of the bottom end of the bobbin. Prior to this disposition, the leading part 313 of the yarn connected to the supply package 2 is wound several times around the bottom part of the bobbin over the bottom bunch 314, and, subsequently, wound several times around the waste spool ring 316 of the spindle 6.

In this condition, the leading part 313 and the trailing part 317 of the yarn connected to the bottom bunch 314 cross each other in the region between the bobbin and the ring 316 as shown in FIG. 14B. At this moment, the chuck 18 comes into engagement with the top end of the full bobbin 7 so as to lift it. By this lifting, the full bobbin 7 is rendered free from the rotation of the spindle 6. Then the clutch 304 in FIG. 13 closes and the piston rod 311 advances outwards from the fluid piston 309 so that the spindle 6 is turned about one turn in a direction opposite to the direction of rotation in the normal draw-twisting operation. This limited reverse turning of the spindle 6 is effected by way of elements 301, 302 and 303. Further, the full bobbin 7 remain stationary being hung by the chuck 18 whereas the ring 316 turns together with the spindle 6. By this limited reverse turning of the ring 316, the leading part 313 extending between the ring 316 and the bobbin is pulled to break as shown in FIG. 14C. Conversely, this limited reverse turning of the ring 316 induces corresponding unwinding of the trailing part 317 and the latter becomes slack. This unwinding of the trailing part 317 is limited by the presence of the leading part 313 which has previously been wound several times on and around the bottom bunch 314 and the trailing part 317 is pulled to break also. After both parts 313 and 317 are broken, the piston rod 311 in FIG. 13 recedes into the piston 309 so as to resume the initial disposition and the clutch 304 opens. In this disposition, the yarn from the supply package 2 connects to the yarn winding on the waste spool ring 316 via the traveller as shown in FIG. 14D. The full bobbin 7 is taken off from the spindle 6 and the bare bobbin 4 is inserted on the spindle 6 as already explained in detail. Upon commencement of the normal spindle rotation, the yarn winds about the bare bobbin.

In the case of the above-explained process, both parts 313 and 317 are broken during the advancement of the piston rod 311 from the piston 309. However, it is also employable that the leading part 313 is broken when the rod 311 comes out from the piston 309 whereas the trailing part 317 is broken when the rod 311 recedes into the piston 309.

In order to explain the above-mentioned yarn breakage by pulling, a modification of the waste spool ring 316 is shown in FIGS. 15A to 15C, wherein the waste spool ring 316 includes a cylindrical stem 401 and a pair of upper and lower flanges 402 and 403. The upper flanges 402 are provided with a cut-off 404. Near the upper face of the stem 401, an annular cutter blade 406 is disposed with its cutting edge exposed to the cut-off 404 in an upwardly directed arrangement.

When the waste spool ring 316 of this construction is used, the crossing yarn parts 313 and 317 are spontaneously introduced into the cut-off 404 as shown in FIG. 16 and are cut by the cutter blade 406 when the waste spool ring 316 turns with the spindle as already explained.

The mechanism shown in FIG. 13 is usable not only for the breaking of the yarn parts shown in FIGS. 14A to 14D but also for a smooth coupling of the spindle with the bobbin mounted thereon. The latter can be effectuated by imparting suitable signals to the fluid piston 309 in accordance with a preset programme. That is, the spindle 6 is turned through a preset angular distance at a preselected time.

In order to carry out the doffing operation according to the system of the present invention, it is desirable that, at the time of the mounting of the bare bobbin to the spindle, the bare bobbin should be correctly, sufficiently and stably inserted over the spindle. Otherwise, the bobbin tends to jump out of control during the draw twisting operation, whereby the yarn is badly wound up on the bobbin or, in the worst case, the yarn is broken accidentally during the winding.

In the conventional manner of mounting a bobbin on a spindle, the bobbin is pressed downward after being inserted over the spindle. Such pressing type mounting

is employable without any special difficulty in the case of ordinary doffing on the cotton spinning machine, wherein the weight of the full bobbin amounts to about 0.6 kg. If this mounting technique is applied to the doffing on the draw-twister, especially on the draw-twister for synthetic fibers wherein the weight of the full bobbin amounts to 2 to 3 kg, sufficient and stable mounting can not be assured. In order to ensure sufficient and stable mounting, it is necessary to press the bare bobbin down very strongly. This naturally causes difficulty in the bobbin taking-off operation.

In order to fulfill the two mutually conflicting requirements, it is necessary to substitute a new wedging type mounting for the conventional pressing type mounting. In the case of the wedging type mounting, the bottom end of the bobbin is placed under a wedge engagement with the spindle. An embodiment of such wedge type engagement on the apparatus of the present invention will hereinafter be explained in detail.

Referring to FIGS. **17A** and **17B**, the bobbin **4** includes, at its bottom end, a tubular end core **501** inserted into the bobbin main tube **502** via an end core ring **503.** The end core **501** is provided with several bottom recesses **504,** which are formed with 60° center angles with respect to the axis of the end core **501** in the case of the structure shown. The sleeve **506** of the spindle **6** is provided with several spindle knobs **507** protruding upwards. In the disposition shown in FIG. **17A**, the knobs **507** are received within the recesses **504,** i.e., the bobbin **4** is in a wedge engagement with the spindle **6.** In the disposition shown in FIG. **17B**, the knobs **507** are out of the recesses **504,** i.e., the bobbin **4** is free from the wedge engagement with the spindle **6.**

One example of the driving mechanism of the spindles of the above-explained wedge type engagement is shown in FIG. **18,** wherein a drive shaft **508** for driving the spindle **6** is driven for rotation by a main drive motor **509.** Separately from this, rotation of a brake motor **511** is also transmitted to the shaft **508** via shaft **512,** a pulley **513** mounted on the shaft **512,** a pulley **514** mounted on the shaft **508** and a transmission belt **516** for connecting the pulleys **513** and **514.** The shaft **512** is further provided with a one-way clutch **517** which transmits rotation from the motor **511** to the shaft **508** only.

The wedge type engagement of the bobbin with the spindle is carried out in the following sequence according to the present invention.

After removal of the full bobbin, the bare bobbin **4** is inserted over the spindle **6** as the chuck **18** of the beam **17** (see FIG. **5N** for example) lowers. This disposition is shown in FIG. **17B**. The chuck **18** further lowers so as to press down bobbin **4** and, at this moment, the motor **511** starts its rotation. By this rotation of the motor **511,** the spindle **6** is turned axially. The bobbin **4** does not completely follow this rotation and the knobs **507** come into engagement with the recesses **504** of the end core **501.** After establishment of this wedge type engagement, the bobbin **4** becomes co-rotational with the spindle **6.**

What is claimed is:

1. An improved automatic process for simultaneously doffing all full packaged bobbins from spindles of a textile machine and carrying said bobbins to an unloading station provided with pegs for holding bobbins, by way of chucks being capable of alternately engaging or disengaging with a shoulder of an axial bore of each bobbin and carried by at least a movable beam extending along said machine, comprising the steps of:

displacing said chucks to positions axially above corresponding spindles when a doffing operation is required;

displacing said chucks downward to said spindles holding full packaged bobbins;

inserting each of said chucks into said bore of full packaged bobbins mounted on corresponding spindles;

displacing said chucks upward whereby said chucks engage with said shoulder of corresponding full packaged bobbins;

rotating said spindles through a prescribed angle in the direction of the normal winding after said full bobbins have been caught by said chucks;

displacing each of said chucks to a position axially above corresponding pegs mounted on said unloading station;

displacing said chucks toward said unloading station and mounting said full packaged bobbins on corresponding pegs;

disengaging said chucks from said bobbins by a small displacement of each of said chucks into said bore of each bobbin; and then

displacing said chucks to a rest station thereof, all of said displacing motions of said chucks being carried out simultaneously with a predetermined program while guiding them positively away from any contact with surrounding machine parts.

2. An improved automatic doffing process according to claim **1,** wherein said guiding is carried out by turning said bobbins under control about the axis of said beam.

3. An improved automatic process for simultaneously doffing full packaged bobbins from spindles of textile machine according to claim **1,** further comprising a donning operation for automatically supplying fresh bobbins from a given standby station in front of said spindles onto spindles wherefrom said full packaged bobbins have been doffed, said donning operation being carried out by;

displacing said chucks to positions axially above corresponding bare bobbins waiting at said given standby positions;

displacing said chucks downward to said bare bobbins;

inserting each of said chucks into said bore of bare bobbins positioned at said standby positions;

displacing said chucks upward whereby said chucks engage with said shoulder of corresponding bare bobbins,

displacing each of said chucks to a position axially above corresponding spindles wherefrom said full packaged bobbins have been doffed;

displacing said chuck toward corresponding spindles and mounting said bare bobbins on said corresponding spindles;

disengaging said chucks from said bare bobbins by a small displacement of each of said chucks into said bore of each bare bobbin; and then

displacing said chucks to a rest station thereof;

all of said displacing motions of said chucks being carried out simultaneously with a predetermined program while guiding them positively away from any contact with surrounding machine parts.

4. An improved automatic doffing process according to claim 3, wherein said guiding is carried out by turning said bobbins under control about the axis of said beam.

5. An improved automatic apparatus for simultaneously doffing all full packaged bobbins from spindles of a textile machine and carrying said bobbins by way of chucks capable of alternately engaging and disengaging with a shoulder of an axial bore of each bobbin, comprising a movable beam extending along said machine and turnably holding said chucks, flexible element means for displacing said beam in a direction perpendicular to the longitudinal axis thereof between a rest position and a plurality of dispositions including a position for inserting said chucks into a bore of corresponding full packaged bobbins held by spindles respectively, said flexible element means including a pair of flexible elements connected to said beam for suspending same, pilot means for piloting said chucks positively away from any contact with surrounding machine parts, and control means connected to said pair of flexible elements for controlling displacing motion of said flexible elements for moving said beam between said positions according to a predetermined program.

6. An improved automatic doffing apparatus according to claim 5, wherein said pilot means includes hanger arms, one for each of said spindles, each of said hanger arms having free ends each supporting a chuck thereon, said arms being fixed on said beam and said beams being turnably mounted on its axis.

7. An improved automatic doffing apparatus according to claim 6, wherein said control means includes a piston for causing the delivery of said flexible elements, a drive motor for causing a difference in the delivering length between said pair of flexible elements and a differential gear mechanism operated by said drive motor.

8. An improved automatic doffing apparatus according to claim 5, wherein said flexible element means includes a second pair of flexible elements connected to said beam for suspending same, said second pair of flexible elements being displaced longitudinally of said beam from said first-mentioned pair of flexible elements, and each of said pair of flexible elements including first and second flexible elements having one end of each connected to said beam, said first and second flexible elements in the vicinity of said one end thereof extending outwardly from said beam in different radial directions relative to the longitudinal axis of said beam so that said flexible elements define an angle therebetween.

9. An improved doffing apparatus according to claim 8, wherein said control means includes first and second rotatable drive means, and wherein the other end of said first flexible element is connected to said first rotatable drive means and wherein the other end of said second flexible element is connected to said second rotatable drive means.

10. An improved automatic apparatus for simultaneously doffing all full packaged bobbins from spindles of a textile machine and carrying said bobbins by way of chucks capable of alternately engaging or disengaging with a shoulder of an axial bore of each bobbin, comprising at least a movable beam extending along said machine and turnably holding said chucks, means for displacing said beam between a rest position thereof and a plurality of dispositions including a position for inserting said chucks into a bore of corresponding full packaged bobbins held by spindles respectively, pilot means for piloting said chucks positively away from any contact with surrounding machine parts, said pilot means including pilot sticks each having a free end and operator means accompanying said pilot sticks for control thereof, magnet means disposed at the free ends of said pilot sticks for acting on said bobbins, and means for controlling displacing motion of said beam according to a predetermined program.

11. An improved automatic doffing apparatus according to claim 10, wherein said control means includes a pair of cams mounted on a common rotational cam shaft connected to a given drive source which is actuated for rotation at the time of doffing.

12. An improved automatic apparatus for simultaneously doffing all full packaged bobbins from spindles of a textile machine and carrying said bobbins by way of chucks capable of alternately engaging or disengaging with a shoulder of an axial bore of each bobbin, comprising at least a movable beam extending along said machine and turnably holding said chucks, means for displacing said beam between a rest position thereof and a plurality of dispositions including a position for inserting said chucks into a bore of corresponding full packaged bobbins held by spindles respectively, pilot means for piloting said chucks positively away from any contact with surrounding machine parts, means for controlling displacing motion of said beam according to a predetermined program, and drive means for said spindles including a drive shaft and belt means drivingly connected between said drive shaft and said spindles for rotating same, said drive means including clutch means associated with said shaft and having a driven clutch disk nonrotatably connected to said shaft and a driving clutch disk engagable with said driven clutch disk, fluid pressure cylinder means drivingly connected to said driving clutch disk and including a movable piston rod and arm means drivingly connected between said piston rod and said driving clutch disk.

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