United States Patent [19]

Bethea et al.

[11] **3,765,160**

[45] **Oct. 16, 1973**

[54] **MECHANIZED BOBBIN HANDLER**

[75] Inventors: **Thomas J. Bethea; Joe L. Ritchie,** both of Rock Hill, S.C.

[73] Assignee: **Celanese Corporation,** New York, N.Y.

[22] Filed: **May 28, 1971**

[21] Appl. No.: **147,951**

[52] **U.S. Cl.** **57/53**

[51] **Int. Cl.** **D01h 9/10**

[58] **Field of Search** ..... 57/1 R, 34 R, 52, 57/53; 242/35.5, 35.6

[56] **References Cited**

UNITED STATES PATENTS

3,347,033	10/1967	Sanders et al.	57/53
3,374,616	3/1968	Hidden et al.	57/53
3,408,806	11/1968	Fess et al.	57/53
3,411,281	11/1968	Guido et al.	57/34

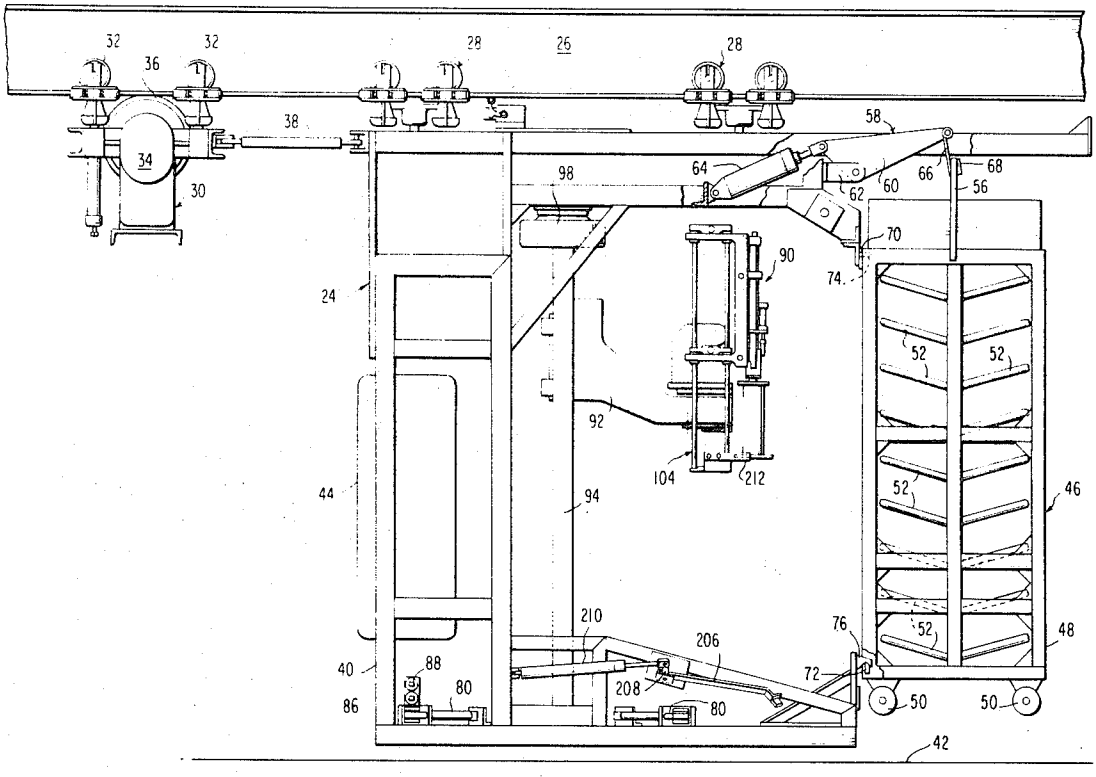
Primary Examiner—Werner H. Schroeder

Attorney—Thomas J. Morgan, Stephen D. Murphy and Robert J. Blanke

[57] **ABSTRACT**

Method and apparatus for automatically removing filled bobbins from spindles spaced apart along the length of a spinning machine. The bobbin handling apparatus includes a carriage that moves along the length of the spinning machine and in timed sequence removes a plurality of filled bobbins from their spindles, transfers the filled bobbins to a rack or bobbin transporter, picks up a plurality of empty bobbins, transfers the empty bobbins to the previously doffed spindles, and then travels to the next position, where the process is repeated. The carriage includes guide means to position precisely the rack with respect to the spindles.

17 Claims, 22 Drawing Figures



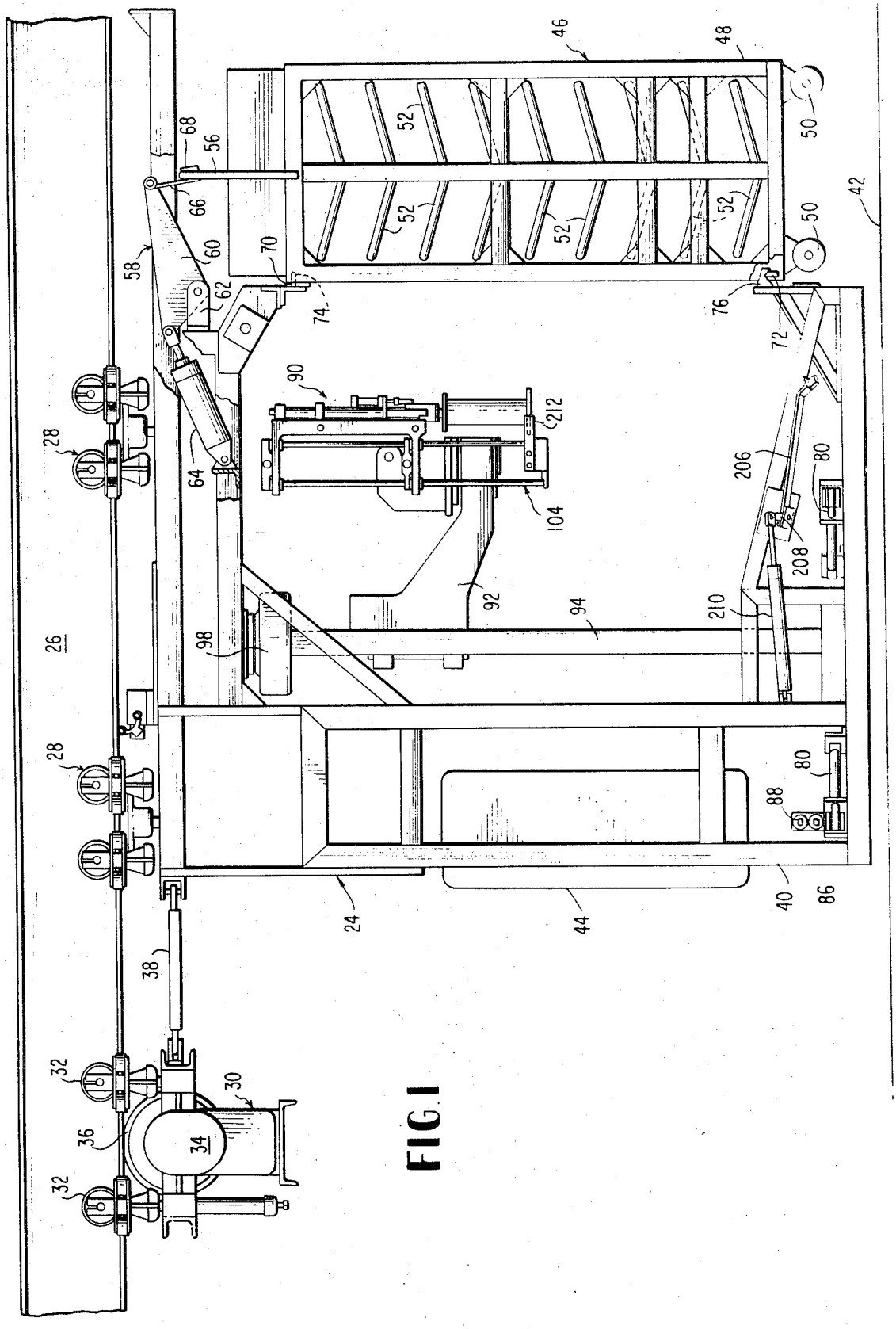

46
48
52
50
42
68
56
66
60
70
58
62
74
76
72
90
212
64
206
80
104
208
92
94
210
98
26
28
88
24
44
40
86
38
32
30
36
34

FIG. 1

FIG. 4

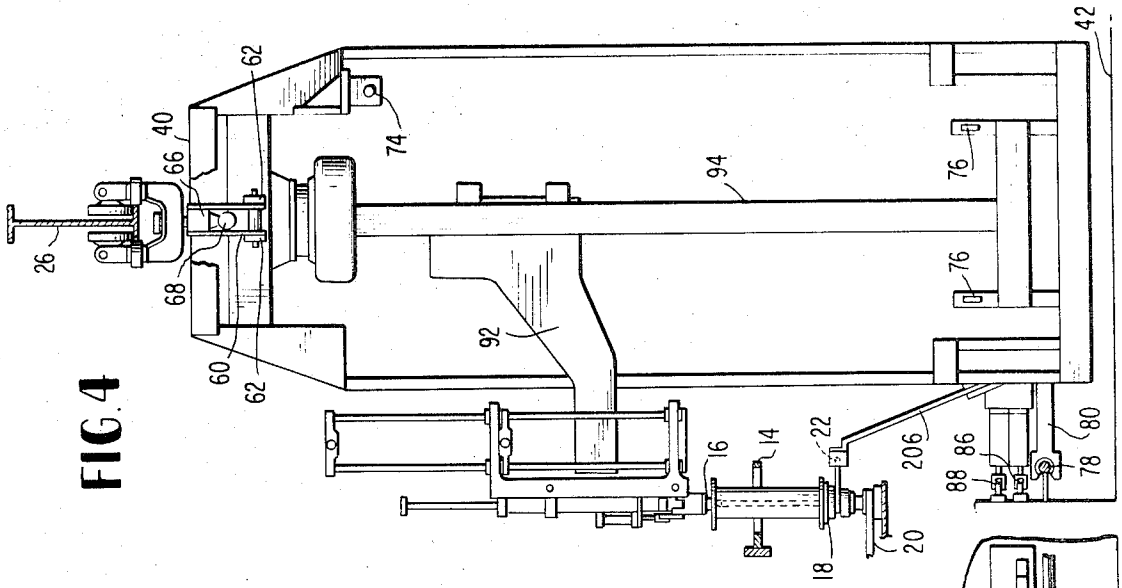


FIG. 3

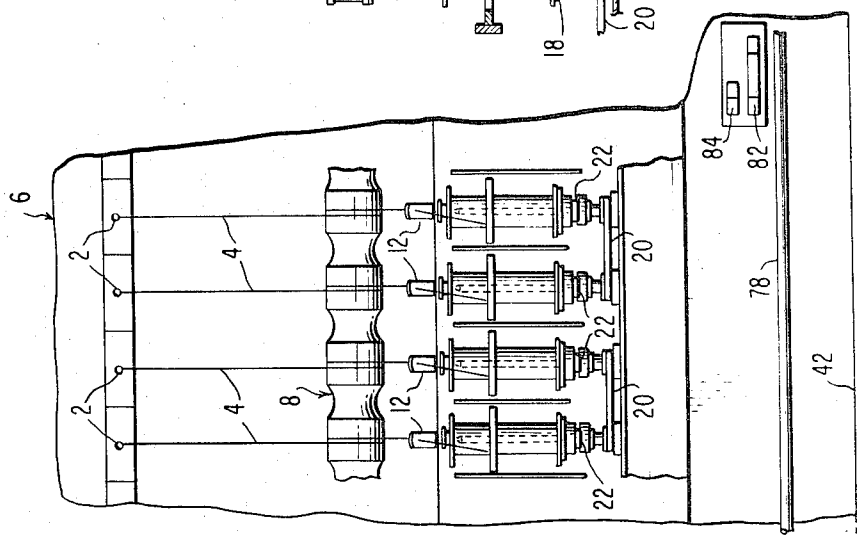


FIG. 2

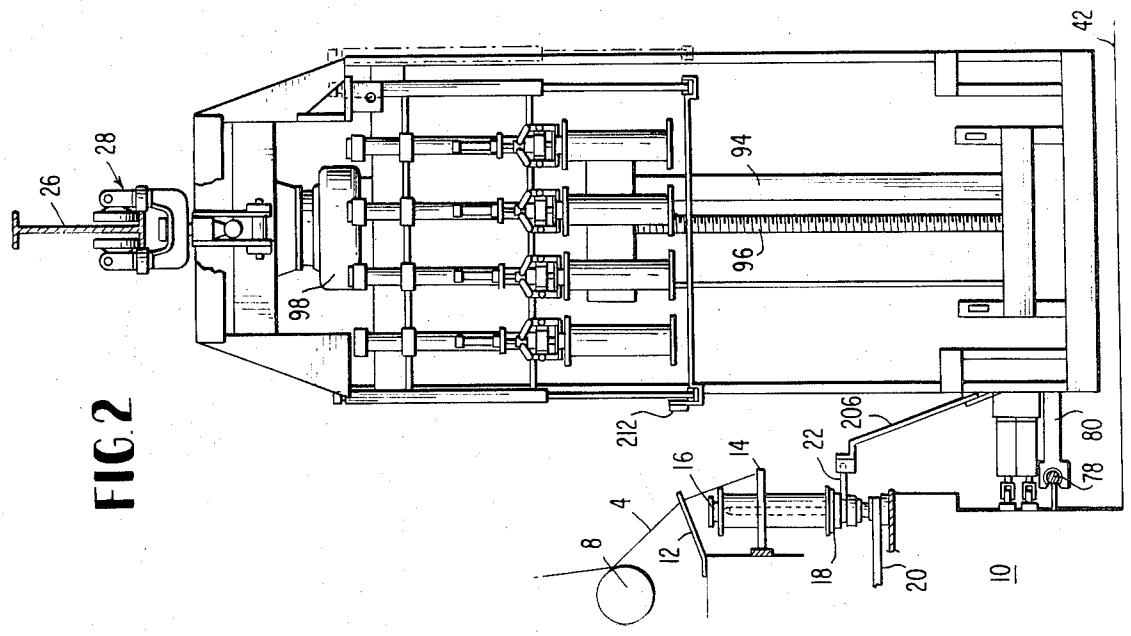
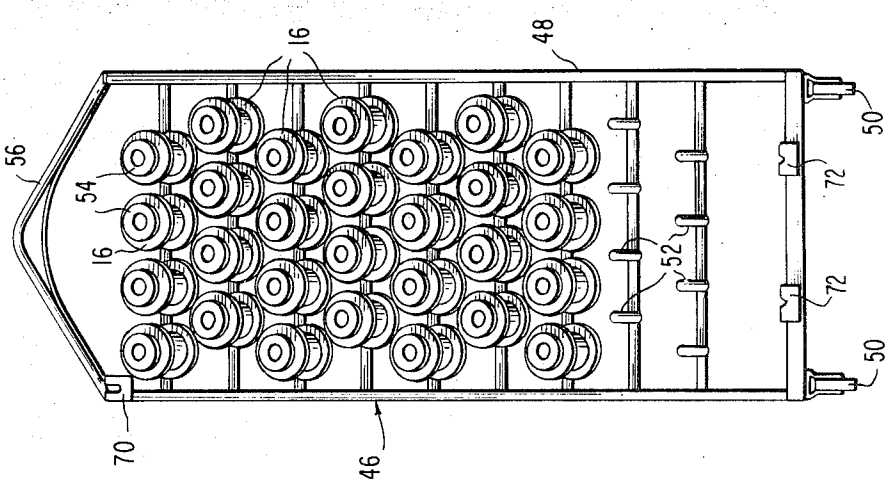


FIG. 8



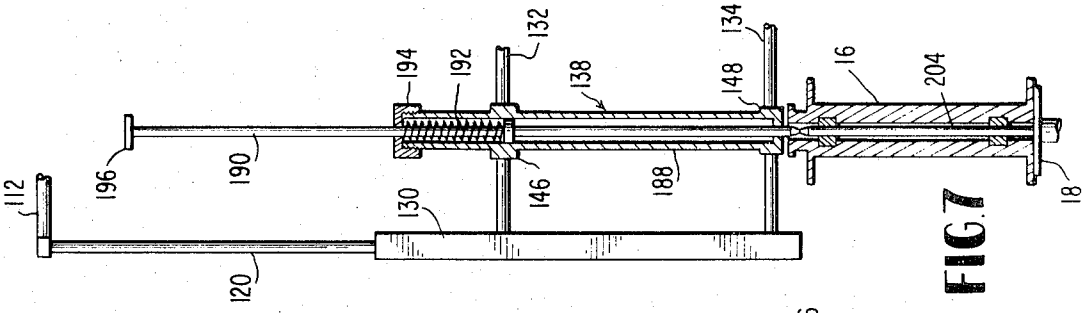


FIG. 7

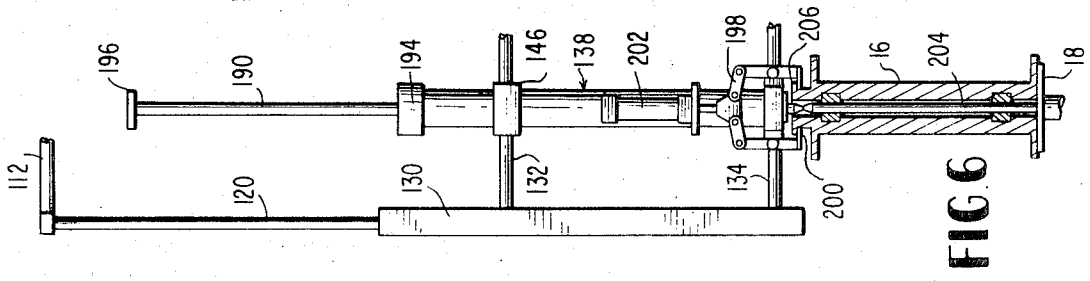


FIG. 6

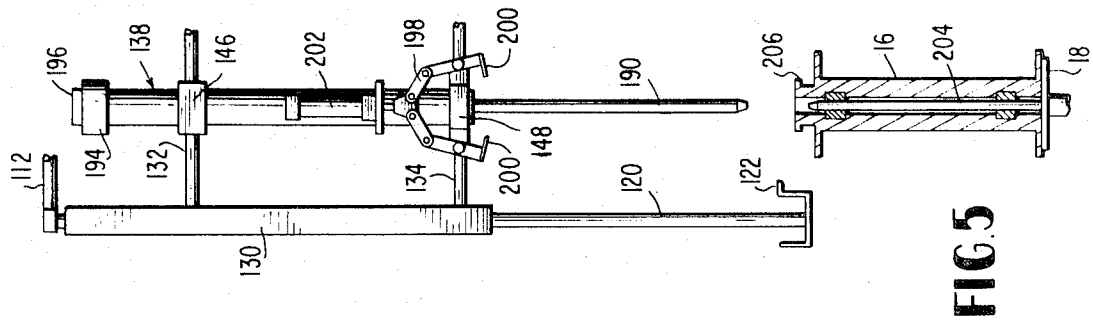


FIG. 5

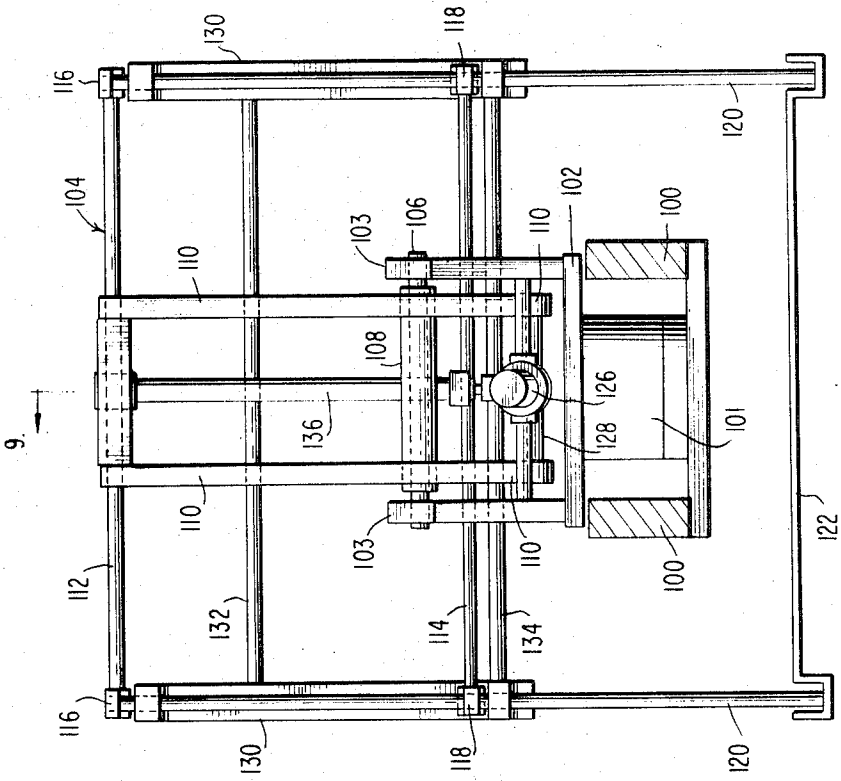


FIG. 10

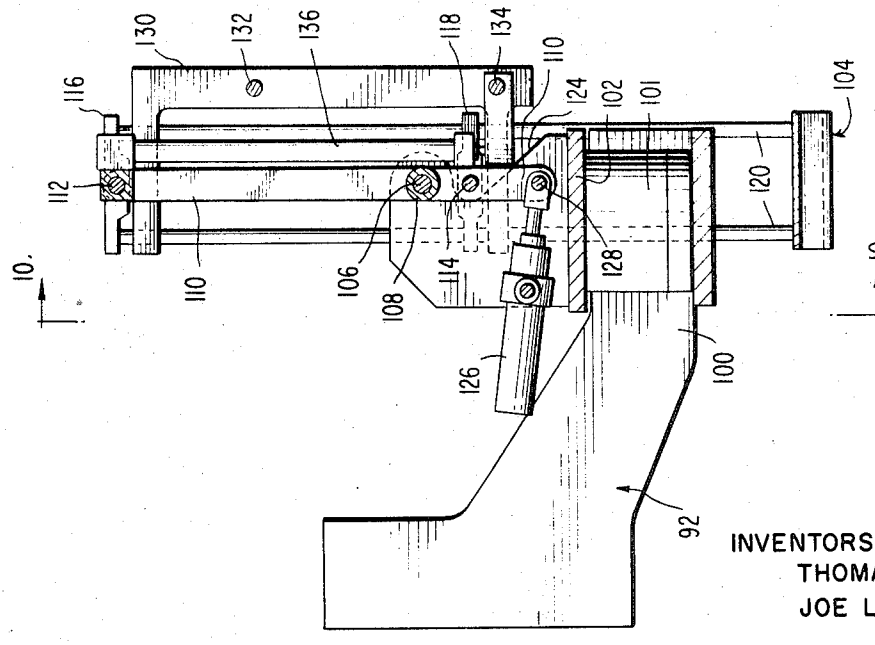


FIG. 9

INVENTORS
THOMAS J. BETHEA
JOE L. RITCHIE

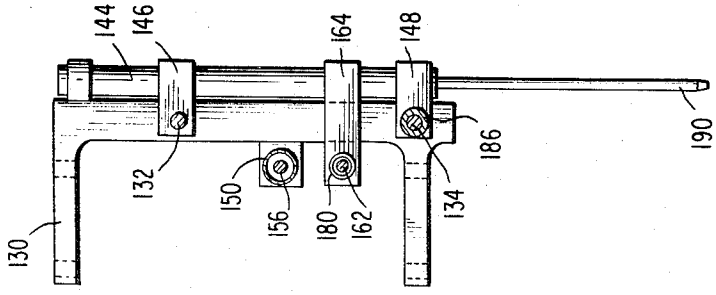


FIG. 12

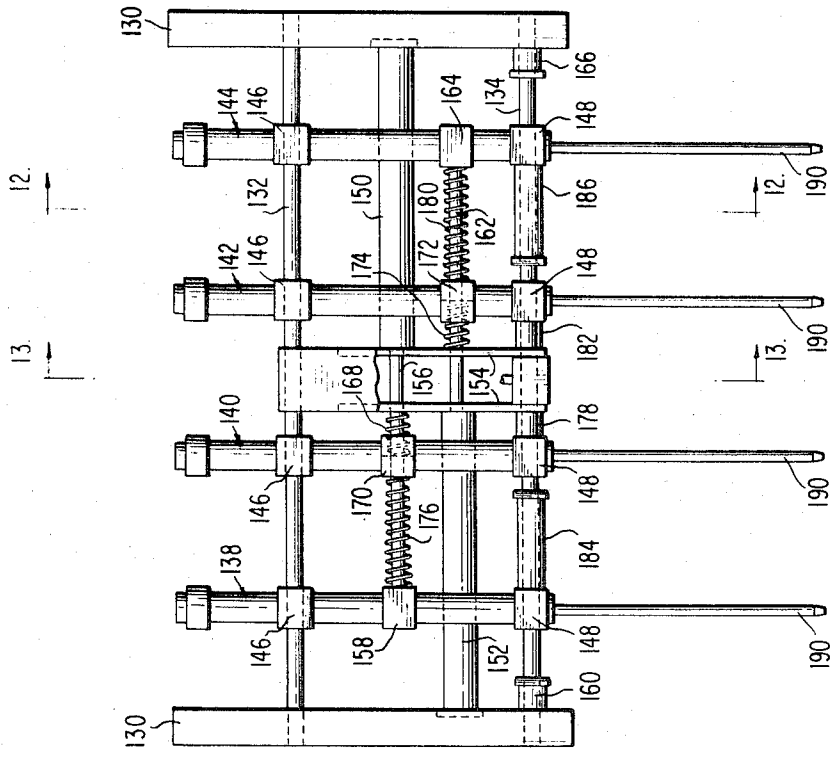


FIG. 11

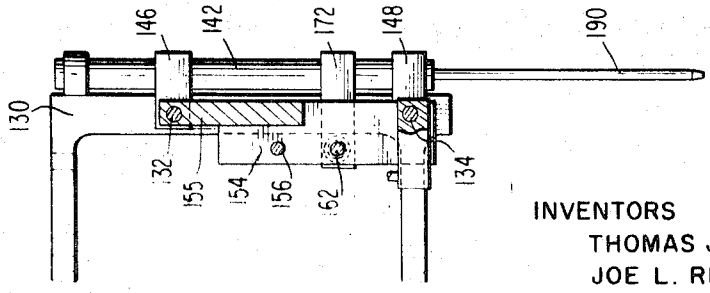


FIG. 13

INVENTORS
THOMAS J. BETHEA
JOE L. RITCHIE

FIG. 14

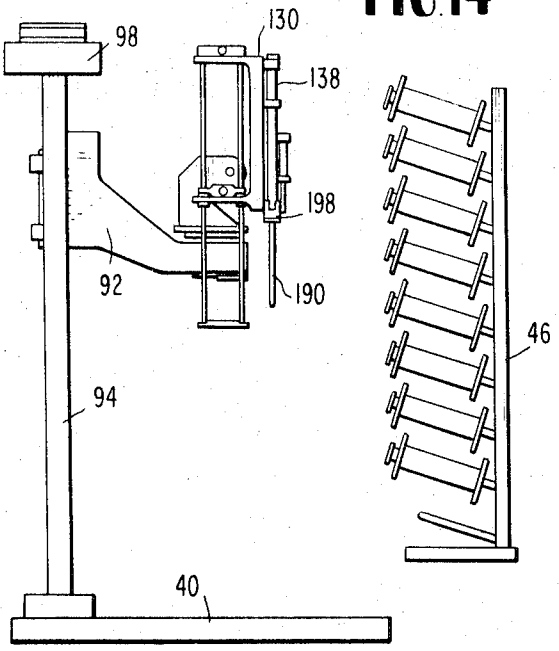


FIG. 15

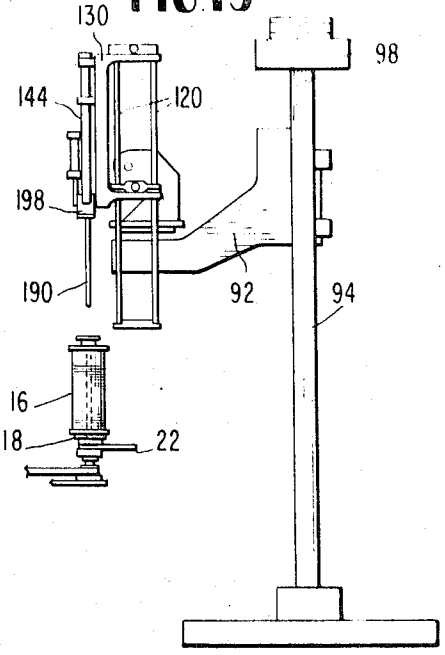


FIG. 16

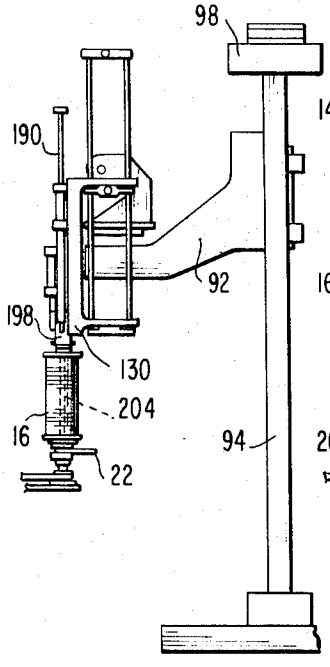


FIG. 17

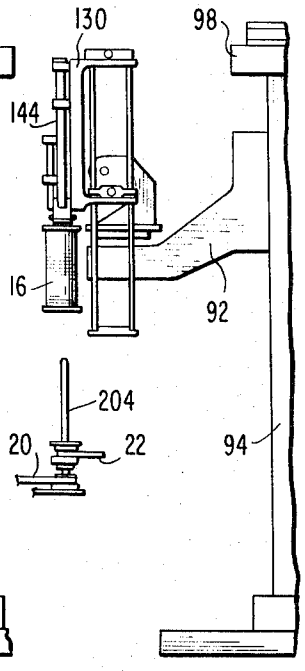
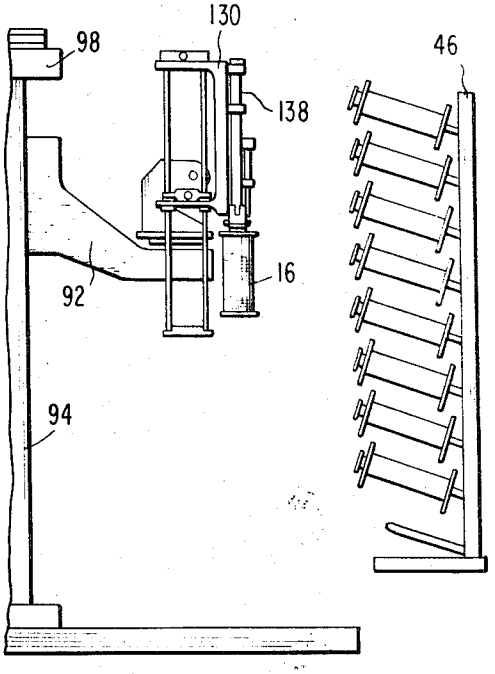


FIG. 18



INVENTORS
THOMAS J. BETHEA
JOE L. RITCHIE

FIG. 19

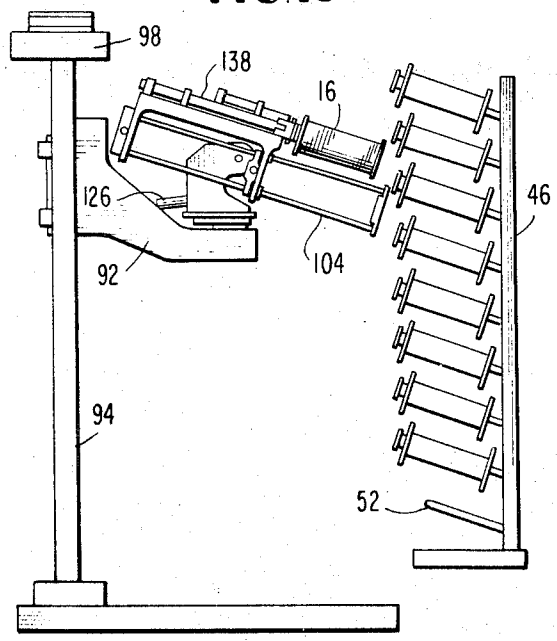


FIG. 20

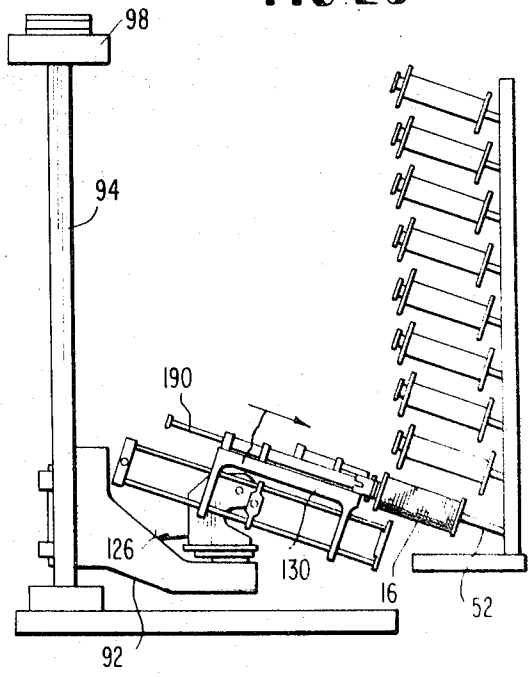


FIG. 21

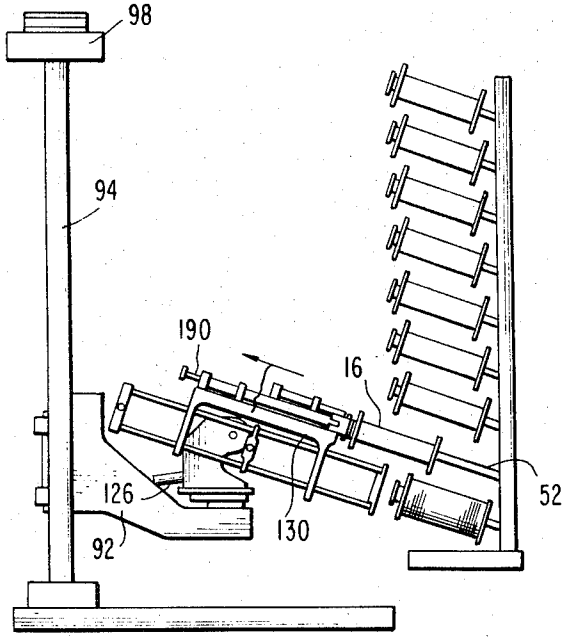
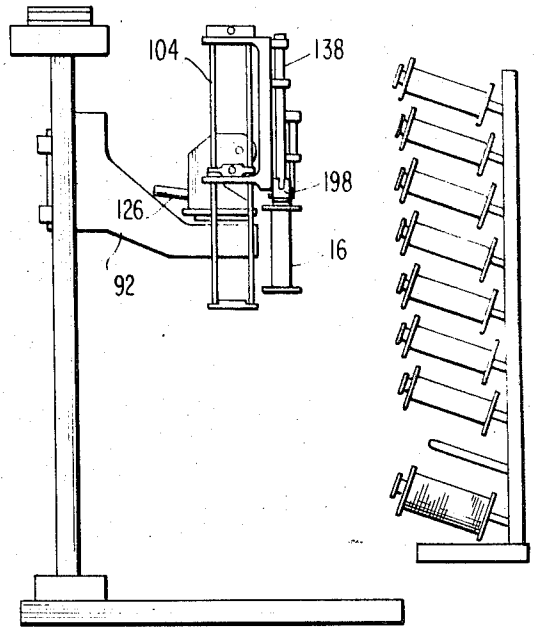


FIG. 22



INVENTORS
THOMAS J. BETHEA
JOE L. RITCHIE

MECHANIZED BOBBIN HANDLER

BACKGROUND OF THE INVENTION

This invention relates to textile apparatus, and more particularly, to apparatus for replacing filled bobbins with empty bobbins in spinning machines, or similar machines.

In the production of synthetic yarns, a plurality of filaments emerge from the extrusion cabinet and pass over a feed roll and are then twisted together and wound on a bobbin. Typically, as many as a hundred spindles, or more, are mounted vertically in a row that extends longitudinally of the machine frame below the extrusion cabinet. A plurality of filaments are looped around the feed roll and conducted through a balloon guide and a ring traveler and are wound on the bobbins. Each bobbin is rotated by a drive mechanism connected with the spindles. A clutch and brake under each spindle allows the spindles to be individually stopped.

In accordance with conventional practice, doffing of the filled bobbins is done manually by doffing operators. The operator is paced by a timing chain which runs the length of the machine frame. The chain has a plate which projects sufficiently to engage a brake lever which is provided on each spindle assembly. As the timing chain moves progressively down the machine frame, the plate strikes the brake levers sequentially, causing the spindles to stop rotating. The chain driven plate, which is known as a pacer, moves continuously along the machine frame and the doffing operator follows the pacer to carry out the doffing operation at each spindle assembly, when the bobbin stops rotating. The pacer assures that approximately the same amount of yarn is wound on each bobbin, and since only a few spindles are stopped at a time, very little yarn is wasted while the bobbins are being changed.

At each spindle assembly, the doffing operator raises the hinged balloon guide, cuts the yarn at the ring traveler and lifts the filled bobbin off the spindle pin and places it on a rack or bobbin transporter. The transporter is a wheeled dolly having a plurality of inclined pegs projecting from a vertical panel. The filled bobbins are received on the pegs. An empty bobbin is removed from another peg on the transporter and is inserted over the spindle pin. The brake is released manually and while the bobbin is rotating, the yarn is threaded through the traveler ring. During the doffing operation, the feed roll continues to rotate, the filaments continue to pass from the extrusion cabinet to the feed roll and are accumulated on the surface of the feed roll. Subsequently, the accumulated filaments are removed by the doffing operator.

Conventional hand doffing imposes a psychological strain on the operator to maintain the rate that is set by the pacer. If the operator bets gets far behind the pacer, excessive waste yarn accumulates on the feed rolls and the quantity of yarn wound on the bobbins is not the same for all the bobbins because the yarn is being wound on some bobbins for a longer period of time than other bobbins. Another factor contributing to the fatigue of the doffing operator is the weight of the filled bobbins. These bobbins may weight between five and twenty pounds depending upon the size of the bobbins and the quantity of yarn being wound on the bobbins.

Although previous attempts to mechanize the doffing operation, such as the apparatus disclosed in U.S. Pat. No. 3,374,616, have achieved some improvement in the handling of filled bobbins, such machines do not operate rapidly enough to improve the efficiency of the doffing operation sufficiently to justify the costs of the machine. Also, attempts have been made to mount such automatic doffing machines on tracks extending along the floor in front of the winding machine. The tracks, however, interfere with the movement of personnel and equipment across the floor and often do not cause the doffing machine to be located accurately with respect to the spindles on the winding machine. An automatic doffing machine must be capable of operating over a long period of time without mechanical failures and must operate precisely so that there is no chance of failing to pick up a filled bobbin from every spindle on the winding machine.

SUMMARY OF THE INVENTION

In view of the disadvantages of manual bobbin doffing, it is an object of this invention to provide an improved bobbin doffing machine to relieve the doffing operator from at least a major portion of the manual effort presently required.

Another object of this invention is to provide improved mechanized bobbin handling apparatus which permits filled bobbins to be removed and replaced with empty bobbins more rapidly.

A further object of this invention is to provide improved mechanized bobbin handling apparatus which is capable of transferring relatively heavy filled bobbins from a row of spindles in timed sequence without failing to complete each doff successfully.

These objects are accomplished in accordance with a preferred embodiment of the invention by bobbin handling apparatus which includes a carriage or movable frame which is suspended from an overhead rail extending along the length of a spinning machine, such as a metier in which the spindles are mounted vertically in a row extending from one end of the machine to the other. The suspended frame is guided precisely along the metier by a horizontal guide rail on the metier. Actuators on the frame cooperate with locating devices spaced along the front of the metier adjacent the guide rail for controlling the position of the frame relative to the spindles on the metier. A traction motor suspended from the rail is connected with the frame to drive the frame along the length of the metier. The frame includes means for supporting a bobbin transporter or rack containing storage receptacles for empty and filled bobbins, and includes a swinging arm which moves in timed sequence to grasp a plurality of filled bobbins and place them in a selected receptacle, and then remove a plurality of empty bobbins from another receptacle and replace them on the spindles. The apparatus also includes means for applying the brake to each spindle as the machine moves along the length of the metier. An arm is preferably provided to move the balloon guide to facilitate removal of the filled bobbin.

The method of this invention includes precisely positioning the carriage relative to the spinning machine, and moving the transfer arm along a programmed path relative to the carriage to pick up filled bobbins from the spindles of the spinning machine, placing the filled bobbins in a rack on the carriage, picking up empty bobbins from the rack and placing the empty bobbins on the spindles from which the filled bobbins were removed. The carriage then advances to the next doffing station where the process is repeated.

DESCRIPTION OF THE DRAWINGS

This preferred embodiment is illustrated in the accompanying drawings in which:

FIG. 1 is a side elevational view of the bobbin handling apparatus in accordance with this invention;

FIG. 2 is an end elevational view of the apparatus, showing schematically a spindle on the metier;

FIG. 3 is a front elevational view of the metier, showing four spindles;

FIG. 4 is an elevational view, as in FIG. 2, but showing the transfer arm aligned with the bobbin spindles;

FIG. 5 is a side elevational view, partially in cross-section, showing the relative positions of the bobbin spindle and the grasping device on the transfer arm prior to engagement with the bobbin;

FIG. 6 is a side elevational view, as in FIG. 5, but showing the clamp device engaging the bobbin;

FIG. 7 is a cross-sectional view of the grasping device, showing the tubular guide in cross-section;

FIG. 8 is a front elevational view of the bobbin transport;

FIG. 9 is a cross-sectional view of the transfer arm and frame along the line 9—9 in FIG. 10;

FIG. 10 is a cross-sectional view of the transfer arm and frame along the line 10—10 in FIG. 9;

FIG. 11 is a detail elevational view of the slide and pin assemblies;

FIG. 12 is a cross-sectional view of the slide along the line 12—12 in FIG. 11;

FIG. 13 is a cross-sectional view of the slide along the line 13—13 in FIG. 11;

FIG. 14 is a side elevational view, showing schematically the position of the transfer arm at the beginning of the doffing cycle;

FIG. 15 is an elevational view of the transfer arm as in FIG. 4 before the filled bobbins are picked up;

FIG. 16 is an elevational view of the transfer arm showing the bobbins grasped by the respective clamps on the transfer arm;

FIG. 17 is an elevational view of the transfer arm as in FIG. 16, but showing the bobbins lifted off of the spindles;

FIG. 18 is an elevational view of the apparatus showing the transfer arm returned to the position shown in FIG. 14 with the filled bobbins;

FIG. 19 is an elevational view of the apparatus showing the transfer arm moving downwardly into alignment with the bottom row of pins on the transport;

FIG. 20 is an elevational view of the apparatus showing the filled bobbins being placed on the bottom row of pins of the transport;

FIG. 21 is an elevational view of the apparatus showing four empty bobbins being removed from the second row of pins on the transport; and

FIG. 22 is an elevational view of the apparatus showing the transfer arm in position to move into alignment with the spindles.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The bobbin handling apparatus is designed to be used with spinning apparatus of the type used in the continuous production of a plurality of filaments in an elongated cabinet with as many as 100 or more spindles spaced along the length of the cabinet. As shown in FIG. 3, there is associated with each spindle a yarn guide 2 through which a plurality of filaments 4 emerge from the extrusion cabinet 6. The filaments are wrapped on a metering roll 8 of a ring spinning machine 10 which is coextensive with the cabinet 6. The filaments 4 pass around the metering roll 8 and through a guide (not shown) which is located behind the metering roll.

From the metering roll 8, the filaments 4 pass through individual guides 12 to a ring traveler 14 which twists the filaments and winds the filaments on a rotating bobbin 16. The bobbin is mounted on a spindle assembly 18 which is driven by means of a drive belt 20. A clutch and brake is provided in each spindle assembly 18 and is operated by means of a brake lever 22. The spindle assemblies 18 are equally spaced along the length of the metier 10, but to simplify the illustration, only four spindle assemblies are shown in FIG. 3. These four assemblies constitute one doffing station for the bobbin handling apparatus of this invention.

Referring to FIGS. 1 and 2, the bobbin handling apparatus of this invention includes a carriage 24 which is suspended from an overhead rail 26 by a pair of trolleys 28 which engage a flange extending along the bottom of the rail 26. The trolleys include side wheels which serve as guides to maintain the carriage 24 centered on the rail 26. A tractor 30 is also suspended from the rail 26 by trolleys 32. The tractor 30 includes a rotary hydraulic motor 34 and a drive wheel 36 which engages the bottom flange of the rail 26. A towbar 38 connects the tractor 30 with the carriage 24.

The carriage 24 includes a frame 40. The bottom of the frame is spaced above the floor 42. Power for operating the bobbin handling apparatus is supplied by an electrical cable (not shown) that is suspended from the overhead rail 26. Since the spinning operation which produces the continuous filaments may be conducted in a flammable atmosphere, the electrical current supplied by the cable drives a pump for hydraulic fluid which is used to provide power for operating the components of the apparatus. Electrical controls for the apparatus are enclosed within an explosion-proof case 44. The carriage 24 moves toward the right as it is being operated along the length of the metier and the operator stands in front of the case 44 at the rear of the carriage. Controls on a panel on the case 44 are readily accessible to the operator.

A bobbin transport or rack 46 is supported at the front of the carriage 24. The bobbin transport, as shown in FIGS. 1 and 8, has a frame 48 with wheels 50 mounted on the bottom of the frame. The frame 48 has a plurality of rows of pegs 52 projecting forwardly and rearwardly from the center of the frame 48. As shown in FIG. 1, the pegs 52 are inclined about 75 degrees from the vertical and slope downwardly toward the center of the frame 48. The pegs 52 in each row are equally spaced apart from each other, and the pegs in one row are laterally offset from the pegs in the adjacent rows to permit closer spacing of the rows. Empty bobbins 16 are shown in FIG. 8 as mounted on the pegs 52. The bobbins 16 are of conventional construction and each bobbin is provided with a knob 54 to permit the bobbin to be grasped for lifting the bobbin off of the metier spindles.

A bail 56 is secured across the top of the frame 48. A hoist is mounted on the frame 40 for lifting the transport and attaching it to the carriage 24. The hoist 58 includes an arm 60 pivotally mounted in a bracket 62

on the frame 40. Power for swinging the arm 60 upwardly and downwardly is provided by a double-acting hydraulic ram 64. A hinged plate 66 is mounted on the end of the arm 60 and supports a grooved roller 68 which serves as a hook to engage the bail 56. In order to provide the proper alignment of the transport 46 with the frame 40, a bracket 70 is provided at one side of the frame 48 adjacent the top of the transport. At the bottom of the transport, a pair of alignment plates 72 are secured on the frame 48. As shown in FIGS. 1 and 4, the frame 40 has an alignment pin 74 projecting forwardly from the frame. At the bottom of the frame 40, there are a pair of locator plates 76 in position to engage the alignment plates 72 on the transport 46. As the arm 60 lifts the transport off of the floor 42, the pin 74 enters the vertical slot in the plate 70 to provide lateral guidance and when the alignment plates 72 engage the locating plates 76, upward movement of the transport stops. The three points defined by the pin 74 and the two plates 76 provides a secure and stable connection between the transport 46 and the frame 40. Fluid pressure in the ram 64 maintains the transport locked in the position shown in FIG. 1.

Since the bobbin transfer apparatus is mounted on the carriage 24, it is necessary to provide means for accurately locating the position of the carriage relative to the bobbin spindles on the metier 10. Lateral spacing of the carriage from the spindles is provided generally by the position of the rail 26, but since the carriage is suspended from the rail, it is necessary to guide the bottom of the carriage to assure that the proper lateral spacing is maintained. For this purpose, a horizontal guide rail 78 is provided on the metier 10. Movable clamps 80 extend outwardly at the front and rear of the carriage frame 40. While the clamps 80 are in engagement with the rail 78, the spacing between the frame 40 and the spindles is accurately controlled.

It is necessary to stop the carriage 24 at the proper position along the metier 10 to allow engagement of the bobbin transfer means on the carriage with the bobbins on the spindles. For this purpose, a pair of cams 82 and 84 are mounted on the metier immediately above the guide rail 78. The lower cam 82 cooperates with a cam follower 86 which controls the flow of hydraulic fluid to the tractor motor 34. As the follower 86 rides up the rise at the left end of the cam 82, the flow of fluid to the motor is decreased, causing the motor to advance the carriage at a slow rate. A second cam follower 88 is in position to engage the cam 84. The follower 88 operates a microswitch which actuates a hydraulic brake to the wheel 36. Since the carriage is moving slowly at the time the brake is applied, the carriage stops immediately and allows positioning of the carriage within a tolerance of one-eighth inch relative to the spindles on the metier. When the filled bobbins have been replaced with empty bobbins, the controls automatically override the switches controlled by the followers 86 and 88 to cause the carriage to progress to the next doffing station. A set of cams corresponding to cams 82 and 84 is provided at each doffing station which consists of four spindles.

The bobbin transfer means 90 which is mounted on the carriage 24 includes a transfer arm 92 which is secured on a vertical column 94. The arm 92 slides vertically along the column 94 and the position of the arm is controlled by a recirculating ball screw jack 96 (FIG. 2). The recirculating ball screw jack 96 is driven by a hydraulic motor to cause a ball screw nut retained in the carriage 24 to translate vertically along the column 94. The column 94 and the screw 96 for the jack are both supported at their upper ends in a rotary turret 98 that is mounted in the frame 40 and at their respective lower ends in a corresponding rotary turret. The upper turret 98 is driven by a hydraulic motor to cause the arm 92 to swing about a vertical axis relative to the frame 40. Suitable controls are provided in the case 44 to program the exact vertical position of the arm 92 relative to the screw 96, and the rotational position of the arm relative to the frame 40. The transfer arm 92 can be rotated to the left side of the frame 40, as viewed in FIG. 4 for doffing bobbins from a metier adjacent the right side of the carriage, or may be rotated to the corresponding position on the right side of the frame 40 for doffing bobbins from a metier extending along that side of the carriage. Right or left hand doffing may be selected by the operator before the start of the doff process, the selection being made by means of a switch disposed in the case 44.

The transfer arm 92 includes a pair of arm members 100 which are spaced apart from each other, as shown in FIGS. 9 and 10. The arm members 100 support a rotary motor 101 which drives a swivel plate 102 having a pair of spaced bearing plates 103. A swinging frame 104 is supported on the bearing plates 103 for swinging about a shaft 106. The frame 104 includes a sleeve bearing 108 journaled on the shaft 106 and a pair of levers 110 rigidly secured on the sleeve 108. The frame also includes a pair of transverse rods 112 which are rigidly secured on the levers 110. A pair of spacer blocks 116 and 118 are rigidly secured on the ends of the rods 112 and 114, respectively. The blocks 116 and 118 support a pair of guides 120 at each end of the frame 104. The lower end of each guide 120 is welded or otherwise secured in a brace 122 which extends across the bottom of the frame 104. Additional bracing in the form of metal plates may be applied to the opposite ends of the frame 104, if desired.

The frame 104 is capable of rotating about the shaft 106 relative to the arm members 100. The bearing plates 103 each have a recess 124 which is engaged by the rod 114 when the frame 104 is positioned vertically. Power for swinging the frame 104 counterclockwise about the shaft 106, as viewed in FIG. 9, is provided by a hydraulic ram 126. The ram 126 is mounted on the plates 103 by trunnions. The piston road of the ram is connected with the levers 110 by a crossbar 128.

A pair of slides 130 are journaled on the guides 120 for sliding movement from the position shown in FIG. 10 downwardly to a position, as shown in FIG. 4, in which the lower end of each slide 130 is adjacent the brace 122 and the upper end of each slide is adjacent the spacer blocks 118. The slides 130 are joined together by a pair of rods 132 and 134. The slides 130 are selectively displaced along the guides 120 by a double-acting hydraulic ram 136 (FIGS. 9 and 10). The cylinder of the ram 136 is mounted between the levers 110, while the piston rod of the ram 136 is connected with the slides 130. When the piston in the ram cylinder is displaced outwardly, the slides 130 are displaced downwardly to the position shown in FIG. 4.

The slide assembly is shown in greater detail in FIGS. 11, 12 and 13. Four pin assemblies 138, 140, 142 and 144 are mounted on the connecting rods 132 and 134.

Each pin assembly is provided with upper and lower bearing blocks **146** and **148** having transverse bores through which the rods **132** and **134**, respectively, extend. The pin assemblies are capable of sliding on the rods **132** and **134**. Since the pegs **52** on the bobbin transport **46** are spaced closer together than the spindles on the metier **10**, it is necessary to change the position of the pin assemblies **138-144** to allow the pins to be used for picking up the filled bobbins from the spindle assemblies **18** and depositing the bobbins on the pegs **52**.

This adjustment of spacing between the pin assemblies is accomplished by a pair of hydraulic rams **150** and **152**. The head ends of the respective ram cylinders are secured on the slides **130** and the rod ends of the cylinders are secured in a bracket **154** on a mounting plate **156** that extends between the rod **132** and **134**. The piston rod **156** of the ram **150** has its end secured in a bracket **158** on the first pin assembly **138**. Thus, as the piston in the ram **150** moves toward the left, as viewed in FIG. **11**, the pin assembly **138** slides along the rods **132** and **134** from the position shown in FIG. **11** until it engages an outer stop **160** on the rod **134**.

Similarly, the piston rod **162** of the ram **152** is secured on a bracket **164** on the fourth pin assembly **144**. When the piston in the cylinder of the ram **152** moves toward the right, as viewed in FIG. **11**, the pin assembly **144** slides along the rods **132** and **134** until the lower block **148** engages an outer stop **166**. A compression spring **168** is compressed between a bracket **170** on the second pin assembly **140** and the bracket **154**, as shown in FIG. **11**. A corresponding bracket **172** is provided on the third pin assembly **142** to compress a spring **174** against the side of the bracket **154**. Another spring **176** is compressed between the bracket **158** and the bracket **170**. When the spring **176** is compressed to the extent shown in FIG. **11**, it exerts a force on the pin assembly **140** that is greater than the spring force of the spring **168**, thereby displacing the second pin assembly against the center stop **178** that is secured on the rod **134**. A spring **180** corresponding to the spring **176** is compressed between the brackets **164** and **172** to urge the third pin assembly **142** into engagement with its center stop **182**. Intermediate stops **184** and **186** are secured on the rod **134** to limit displacement of the first and fourth pin assemblies by their respective rams **150** and **152** toward the center of the slide assembly.

The structure and operation of the pin assemblies **138, 140, 142** and **144** is illustrated in FIGS. **5,6** and **7**, as represented by the first pin assembly **138**. The pin assembly **138** includes a tube **188** that is fixed in the supporting blocks **146** and **148**, previously described. A pin **190** is slidingly received within the tube **188**. A compression spring **192** is compressed between a flange on the pin and a cap **194** on the tube to urge the pin **190** downwardly toward the position shown in FIG. **5**. A head **196** engages the cap **194** to limit downward movement of the pin. A clamp **198** having pivoted jaws **200** is mounted on the pin assembly **138**. The jaws are pivoted toward and away from each other by a hydraulic actuator **202** which is secured on the tube **188**. In FIG. **5**, a bobbin **16** is shown mounted on a spindle assembly **18** with the spindle **204** extending through the center of the bobbin. With the jaws **200** open, as shown in FIG. **5**, the slide **130** moves downwardly along the guides **120** by operation of the hydraulic ram **136** (FIG. **9**). The lower end of the pin **190**, which is centered over the bobbin **16** enters the central bore of the bobbin and engages the upper end of the spindle **204**. Continued downward movement of the slide **130**, displaces the tube **188** downwardly relative to the pin **190**, until the slide reaches the position shown in FIG. **6**. The jaws **200** are positioned below the flange **206** on the knob at the upper end of the bobbin **16**. The actuator then closes the jaws to allow the jaws to grip the knob under the flange **206**, as shown in FIG. **6**. If the jaws **200** close at a distance below the flange **206**, upward movement of the slide **130** merely allows the jaws **200** to slide along the knob until they engage the flange **206**. The jaws **200** do not grip the shank of the knob tightly When the slide **130** is lifted upwardly from the position shown in FIG. **6**, the clamp **198** carries with it the bobbin **16**, progressively transferring the bobbin from the spindle **204** to the pin **190**. When the slide **130** returns to the position shown in FIG. **5**, the pin **190** extends through the bobbin **16**, coming to rest in a recessed position above the bottom of the bobbin.

The operation of the bobbin handling apparatus in accordance with this invention is illustrated schematically in FIGS. **14** to **22**. Initially, the bobbin transport **46** is filled with empty bobbins on all of the pegs **52**, except the bottom row of pegs. The transport **46** is picked up and locked on the carriage **24**. With doffing carriage **24** positioned at the end of the spinning machine, and the clamps **80** in engagement with the guide rail **78**, the operator initiates the sequence of operating for doffin the filled bobbins. The tractor motor **34** advances the carriage **24** toward the right, as viewed in FIG. **1**, along the overhead rail **26**, until the follower **86** engages the cam **82** on the side of the metier **10**. Movement of the carriage slows down until the microswitch follower **88** is operated by the cam **84** to apply the brake to the wheel **36** of the tractor. The carriage **24** is, therefore, aligned with the four spindles of the first station that is to be doffed by the bobbin handling apparatus.

In moving from one station to the next, apparatus on the carriage **24** may be utilized for automatically operating the brake lever **22** of each spindle assembly **18** and for swinging the yarn guide **12** to an offset position where it does not interfere with the removal of the bobbin **16**. The brake operating mechanism includes a lever **206** (FIGS. **1** and **2**) which is pivotally mounted between brackets **208** on the side of the frame **40**. A bell crank on the lever **206** is attached to the piston rod of a double-acting hydraulic ram **210** for swinging the lever **206** from the position shown in FIG. **1** to the position shown in FIG. **2**. When the lever **206** is extended, as shown in FIG. **2**, it is in position to engage the lever **22** of each spindle assembly **18** and, as the carriage moves along the spinning machine, the brake for each spindle assembly is operated before the movement of the carriage is stopped by the cams **82** and **84**. The transfer arm **92** is positioned to extend outward from the frame **40** a sufficient distance to engage the ends of the yarn guides **12**. The arm **92** is raised sufficiently so that the frame **104** does not engage the top of the bobbins **16**. A plate **212** on the side of the frame **104** engages the yarn guides for each of the spindle assemblies as the carriage moves along the spinning machine. The yarn guides **12** pivot out of the way as the plate **212** passes. Thus, when the carriage **24** stops in alignment with the station, the brakes **22** have been applied and the spindles have stopped rotating. The filaments **4**

then accumulate on the rotating metering roll **8** during the doffing operation.

At the beginning of the doffing operation, as shown in FIG. **14**, the pins **190** project downwardly from the pin assemblies **138** and the jaws **200** are opened, as shown in FIG. **5**. A programmed signal operates the motor in the turret **98** to swing the arm **92** approximately 90° to position the pins **190** directly over the filled bobbins **16**, as shown in FIG. **15**. The slides **130** remain raised to the upper end of the guides **120**. Then, as shown in FIG. **16**, the slides **130** move downwardly by operation of the ram **136**, causing the end of the pin **190** of each of the pin assemblies **138–144** to enter the hole in the respective bobbins **16** and contact the spindle **204**. As the slides **130** continue to move downwardly, the pins **190** are displaced upwardly, compressing the spring **192** until the jaws **200** of the clamp **198** are positioned below the flange **206** of the respective bobbins **16**, as shown in FIG. **6**. The actuator **202** of each pin assembly is then operated to close the jaws.

Referring to FIG. **17**, the slides **130** are raised by operating the cylinder **136**. Since the jaws **200** grasp the knob of the filled bobbin, the bobbin is lifted off of the spindle **240**, thereby allowing the pin **190** to drop through the bore of the bobbin to provide lateral support for the filled bobbin. Rotation of the column **94** by the turret motor **98** swings the arm into the center of the frame **40** opposite the bobbin transport **46**, as shown in FIG. **18**.

After picking up the filled bobbins, as shown in FIG. **17**, and prior to inserting the filled bobbins on the pegs **52**, the cylinders **150** and **152** are operated to retract their respective pistons, thereby drawing the outer pin assemblies **138** and **144** toward the center of the slide assembly to the position shown in FIG. **11**. The compression springs **176** and **180** displace the middle pin assemblies **140** and **142** toward the center stops **178** and **182**, so that the spacing between the respective pins **190** corresponds to the spacing of the pegs **52**.

Operation of the tilt cylinder **126** then rotates the frame **104** to an inclined position in alignment with the slope of the pegs **52**, as shown in FIG. **19**. Rotation of the screw jack **96** (FIG. **2**) lowers the arm **92** to the bottom row of pegs **52** on the transport **46**. It is also necessary to compensate for the lateral offset of the pegs on the transport, as shown in FIG. **8**. The bottom row of pegs **52** is shown as being offset toward the right, as viewed in FIG. **8**. In order to move the pin assemblies into alignment with the pegs **52**, the transfer arm **92** is rotated by the turret motor **98** through a relatively small angle, of the order of **7** degrees, from a position parallel to the spinning machine in a direction away from the spinning machine from which the bobbins were removed as shown in FIGS. **15**, **16** and **17**. In order to compensate for the angular motion of the frame **104** with the transfer arm **92**, the rotary motor **101** rotates the swivel plate **102** back through an angle approximately **7** degrees so that the frame **104** is substantially parallel to the row of pegs **52**.

As shown in FIG. **20**, the slides **130** are displaced toward the pegs by operation of the ram **136**. The respective pins **190** extend into, but not through, the hole in the bobbins **16** and allow the bobbins **16** to center on the pegs **52** and continued motion of the slides **130** transfers the filled bobbin **16** from the pins **190** to the respective pegs **52**. When the bobbin **16** is fully supported on the peg **52**, the actuators **202** of each pin assembly are operated to release the clamps **198**. The slides **130** are then displaced to the upper end of the frame **104** to separate the end of the respective pins **190** from the peg **52** of the bottom row. The screw jack **96** is then operated to raise the arm **92** into alignment with the second row of pegs. Due to the lateral offset of the pegs in the next row from the pegs in the bottom row, the arm **92** swings toward the spinning machine approximately 7° with the center line of the frame **40**. At the same time, the rotary motor **101** is operated to swing the frame **104** back into alignment with the row of pins **52**. The slides **130** are then displaced toward the pegs **52** of the second row until the jaws **200** are in position to grasp the knob of each empty bobbins **16**. The slides **130** are then displaced outwardly from the pegs **52** to draw the empty bobbins onto the respective pins **190**, as shown in FIG. **21**. The jack screw **96** then raises the arm **92** to the position shown in FIG. **22** and the tilt ram **126** rotates the frame **104** to a vertical position with the empty bobbins **16** suspended by the clamps **198**.

The pin assemblies, each supporting an empty bobbin, is positioned as shown in FIG. **17**, directly over a corresponding spindle assembly.

The spacing between the ends **190** is then adjusted to correspond to the spacing between the spindles **204** on the spinning machine. This is accomplished by operating the rams **150** and **152** (FIG. **11**) to displace the outer pin assemblies **138** and **144** into engagement with the stops **160** and **166**. This allows the compressed springs **168** and **174** to slide the metal pin assemblies **140** and **142** outwardly against the stops **184** and **186**. The slides **130** are then displaced downwardly by the hydraulic ram **136** until the bobbins engage the upper end of the spindle **204** of each assembly. Continued downward movement of the slides **130** transfers the empty bobbin onto the spindle and when the clamps **198** are released, the slides **130** may be retracted upwardly, leaving the empty bobbin on the spindles. The transfer arm **92** is then rotated by the turret motor **98** back to the position shown in FIGS. **1** and **2** and the tractor-motor **34** is started automatically to advance the carriage **24** to the next station, where the cycle is repeated. When the machine completes doffing of the last station, it is programmed to stop for further instructions from the operator.

The operator follows the carriage along the spinning machine, pivoting the yarn guides back to the position shown in FIG. **2**, releasing the brake levers **22** and making the throw-ons, as in conventional manual doffing.

An important feature of this invention is the provision of means for precisely positioning movable components of the system relative to each other and relative to the fixed locations on the spinning machine which provide the necessary tolerance to allow the parts to fit together easily without binding or other failure. For example, in picking up the bobbins with the clamps **198**, the jaws **200**, as shown in FIGS. **5** and **6**, are in the form of thin plates, while the shank of the bobbin knob spaces the flange **206** a substantial distance above the body of the bobbin. Thus, a variance of as much as an inch in the vertical position of the slides **130** when the jaws **200** close around the knob of the bobbin is permissible. Another feature is the use of the pins **190** which have a diameter that is smaller than the bore of the bobbins **16**. Also, the entrance of the bobbin bores usually flares outwardly and the lower

end of the pins are chamfered to guide the pin into the central bore of the bobbins. This allows a tolerance of as much as one-half inch in the lateral position of the pin **190** relative to the bobbin **16.** Also the entrance to the bottom of the bobbin bores usually flares outwardly and the upper ends of the spindles and transport pegs are chamfered to allow the bobbin to guide onto the spindle or transport pegs without interference from the pins **190** which are recessed inside the bobbin during the transfer operation. A further means of obtaining alignment between movable components is the use of a guide rail **78** along the spinning machine to maintain the accuracy of the space between the spindles and the frame **40** on which the transfer arm **92** is supported. The combination of hydraulic throttling valve and the brake application on the tractor motor, as actuated by the followers **86** and **88,** cause the carriage to stop within a tolerance of about one-eighth inch. This tolerance is less than the tolerance required to align the pins **190** with the bobbins on the spindles **204.**

While this invention has been illustrated and described in accordance with a preferred embodiment, it is recognized that variations and changes may be made therein without departing from the invention as set forth in the claims.

What is claimed is:

1. Doffing apparatus comprising a carriage, means suspending said carriage from an overhead rail, propelling means for moving said carriage along the rail, a bobbin storage rack on said carriage, doffing means on said carriage for picking up filled bobbins from a row of spindles on a spinning machine adjacent said carriage and transferring the filled bobbins to said storage rack, said doffing means including an arm, arm moving means for displacing the arm upward and downward relative to said carriage and for rotating said arm about the vertical axis, said arm having a frame mounted thereon for tilting about a horizontal axis, power means for selectively tilting said frame relative to said arm, grasping means being mounted on said tilting frame for individually grasping a plurality of said bobbins substantially simultaneously, said doffing means being operable to remove empty bobbins from said storage rack and install the bobbins on the spindles of the spinning machine at the locations from which said filled bobbins were removed.

2. The apparatus according to claim **1** wherein said grasping means includes a slide movable on said tilting frame between a raised position and a lowered position, and power means for moving said slide relative to said frame between said positions.

3. The apparatus according to claim **2** wherein said grasping means includes a plurality of tubes secured on said slide, the central axis of said tubes being aligned with the direction of movement of said slide, said tubes being spaced apart laterally from each other, said tubes each having a pin therein, said pins being biased toward a lowered position relative to said tubes and clamp means on said slide cooperating with said pins to grasp and release filled and empty bobbins.

4. The apparatus according to claim **3** wherein said storage rack includes a plurality of inclined pegs for supporting bobbins, said pins on said slide being movable into axial alignment with said rack pegs.

5. The apparatus according to claim **1** wherein said storage rack is provided on a transport frame separable from said carriage and including means supporting said transport frame on said carriage, and alignment means locating said transport frame in a predetermined position relative to said carriage, whereby said transport frame is replaceable.

6. The apparatus according to claim **5** including hoist means on said carriage, means for selectively connecting said transport frame with said hoist means for lifting the transport frame relative to said carriage, said alignment means including guides on said transport frame and on said carriage cooperating to position said transport frame accurately relative to said carriage.

7. Apparatus for picking up and spinning machine mounted transporting bobbins of the type having a knob at its upper end with a flange on said knob spaced from the body of said bobbin by a shank portion, said bobbin having a central bore extending through said knob and through the body of said bobbin for supporting the bobbin on a spindle, said apparatus comprising:

a. a transfer arm;

b. supporting means for said arm, said supporting means including means for moving said arm along a vertical axis and means for rotating said arm about said vertical axis;

c. a plurality of pins on said transfer arm, said pins having longitudinal axes spaced apart laterally from each other; with reference to said machine

d. individual clamps jaw associated with each of said pins for gripping the knob of said bobbins; and

e. displacement means for displacing said pins and clamps as a unit independently of movement of said transfer arm.

8. The apparatus according to claim **7** wherein said displacement means includes a tilting frame on said transfer arm and a slide on said tilting frame, said slide being movable between a raised position and a lowered position, and including power means for moving said slide relative to said frame.

9. The apparatus according to claim **8** wherein said tilting frame is mounted on said arm for tilting about a horizontal axis, said frame including a pair of spaced guides movable with said frame about said axis, said guides extending substantially vertically in one position of said frame and extending in a direction inclined from the vertical in a second position of said frame, said slide being supported on said guides and being movable along said guides.

10. The apparatus according to claim **9** including a plurality of tubes mounted on said slide, said pins aligned with and being received in said tubes, spring means in said tubes biasing said pins toward a lowered position relative to said tubes, said clamps being mounted on said slide adjacent each of said tubes, said pins extending between the jaws of said clamps.

11. The apparatus according to claim **8** wherein said slide includes a plurality of transverse bars, a plurality of tubes mounted on said bars for sliding transversely on said slide, said pins being received in said tubes, power means for selectively displacing one of said tubes in one transverse direction along said bars, spring means between said one tube and an adjacent tube, and stop means on said slide, said adjacent tube being between said stop means and said one tube, whereby operation of said power means changes the spacing between said one tube and said adjacent tube.

12. The apparatus according to claim **11** wherein tubes are mounted on said rods for movement transversely of said slide, said slide includes stop means re-

stricting movement of said tubes along said rods toward the center of said slide, additional stop means on said slide limiting movement of said tubes along said rods away from the center of said slide, and spring means urging said tubes outwardly from the center of said slide.

13. A method of exchanging empty bobbins for filled bobbins on a spinning machine having a plurality of bobbin spindles spaced along the length of the machine, the method comprising:

a. positioning a movable carriage having a transfer arm movable relative to said carriage at a predetermined location relative to selected ones of said spindles;

b. arranging a plurality of empty bobbins on said carriage at predetermined positions in a rack, said rack including a plurality of pins; and

c. moving said transfer arm along a preselected path relative to said carriage in sequence to pick up filled bobbins from said selected spindles, lifting said filled bobbins vertically from said selected spindles, and subsequently tilting said bobbins into alignment with said pins and sliding said bobbins on said pins and to pick up empty bobbins from their respective positions in said rack and place said empty bobbins on said selected spindles.

14. The method according to claim **13** wherein said moving step includes changing the spacing between said filled bobbins after picking up said filled bobbins from said selected spindles and prior to depositing said filled bobbins on said pegs.

15. The method according to claim **13** wherein the pins in said rack are arranged in a plurality of vertically spaced rows, wherein said moving step includes depositing said filled bobbins on said pegs of one row and picking up empty bobbins from the pegs of a vertically spaced row in said rack.

16. The method according to claim **13** wherein said rack is on a separable transport frame, and including the additional step of supporting said transport frame on said carriage prior to moving said transfer arm, and subsequently separating said transport frame from said carriage whereby the empty bobbins may be arranged for the transport frame prior to the doffing operation and filled bobbins may be transported for subsequent processing.

17. The method according to claim **13** wherein said positioning step includes advancing said carriage by means of a wheel driven by a motor, subsequently reducing the rate of advance of the carriage upon reaching a location spaced from said predetermined location, and applying a brake to said wheel when said carriage reaches that predetermined location.

* * * * *