

[72] Inventors William E. Stoppard
Warwick;
Thomas E. Pitts, Cranston; John Nelson,
North Kingstown, Rhode Island

[21] Appl. No. 667,500

[22] Filed Sept. 13, 1967

[45] Patented Dec. 1, 1970

[73] Assignee Leeson Corporation
Warwick, Rhode Island
a corporation of Massachusetts

3,037,715	6/1962	Higgins et al.	242/18(EW)
3,279,712	10/1966	Furst	242/35.5
3,295,775	1/1967	Raasch et al.	242/35.5
3,074,660	1/1963	Furst	242/35.6
3,300,962	1/1967	Haagsma	57/53X

Primary Examiner—Stanley N. Gilreath
Attorneys—Albert P. Davis and Burnett W. Norton

[54] **BOBBIN HANDLING**
34 Claims, 18 Drawing Figs.

[52] U.S. Cl.	242/35.6
[51] Int. Cl.	B65h 54/22
[50] Field of Search	242/35.6, 35.6(E), 35.5, 18, 18(EW), 19, 27

[56] **References Cited**

UNITED STATES PATENTS			
1,029,020	6/1912	Marazzi	242/18(EN)UX
1,855,814	4/1932	Zindel	242/18
3,029,031	4/1962	Furst	242/35.6
3,043,529	7/1962	Furst	242/35.6

ABSTRACT: An apparatus and method for readying filled bobbins from a spinning or twisting machine for further processing on a winding machine. Each bobbin is delivered to a receiving station and then advanced from station to station. These stations includes a first processing station at which the bobbin is cleaned, a terminal or inner end of the strand of yarn is broken from the bobbin, and surplus windings of the unwinding or outer end (such as a hutch and tailing coils) are removed. Then the unwinding end is transferred to a bunch making station and is formed into a bunch of relatively large random loops. The bobbin is also transferred to the bunch making station and the bunch is deposited in a hollow of the core of the bobbin for retention therein until subsequent retrieval at the winding machine. From the bunch making station the bobbin passes through an inspection station to a discharge station.

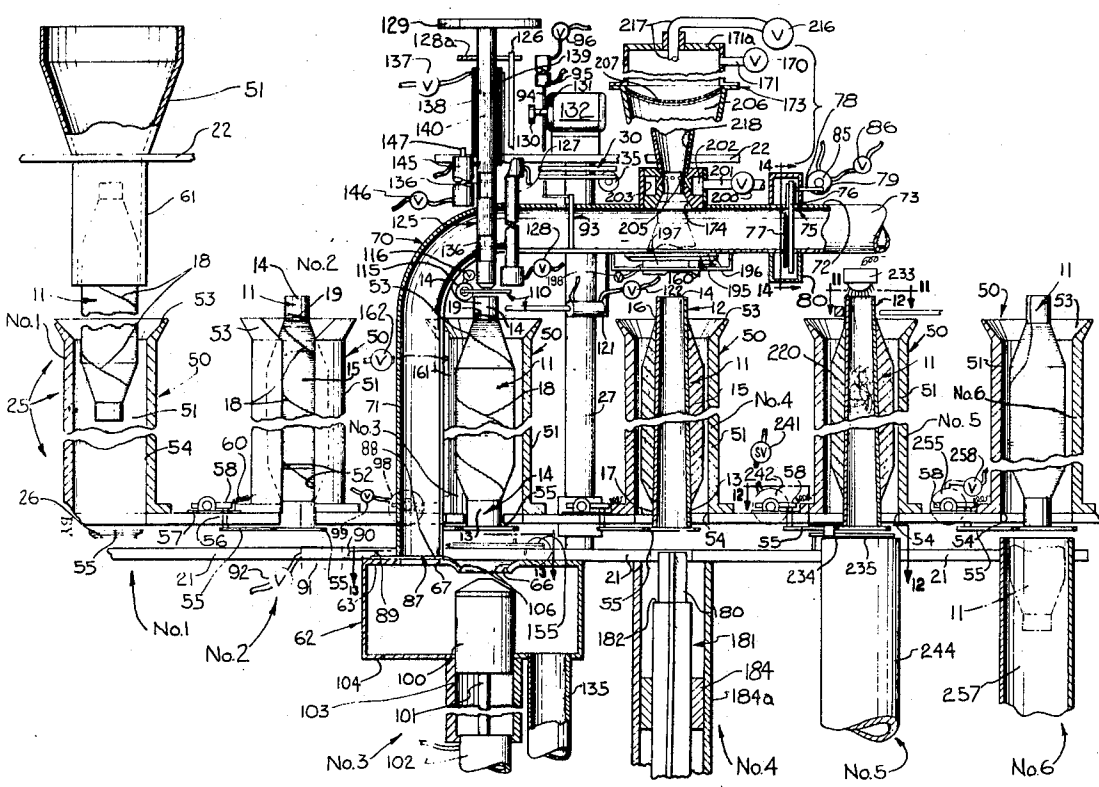


FIG. 1

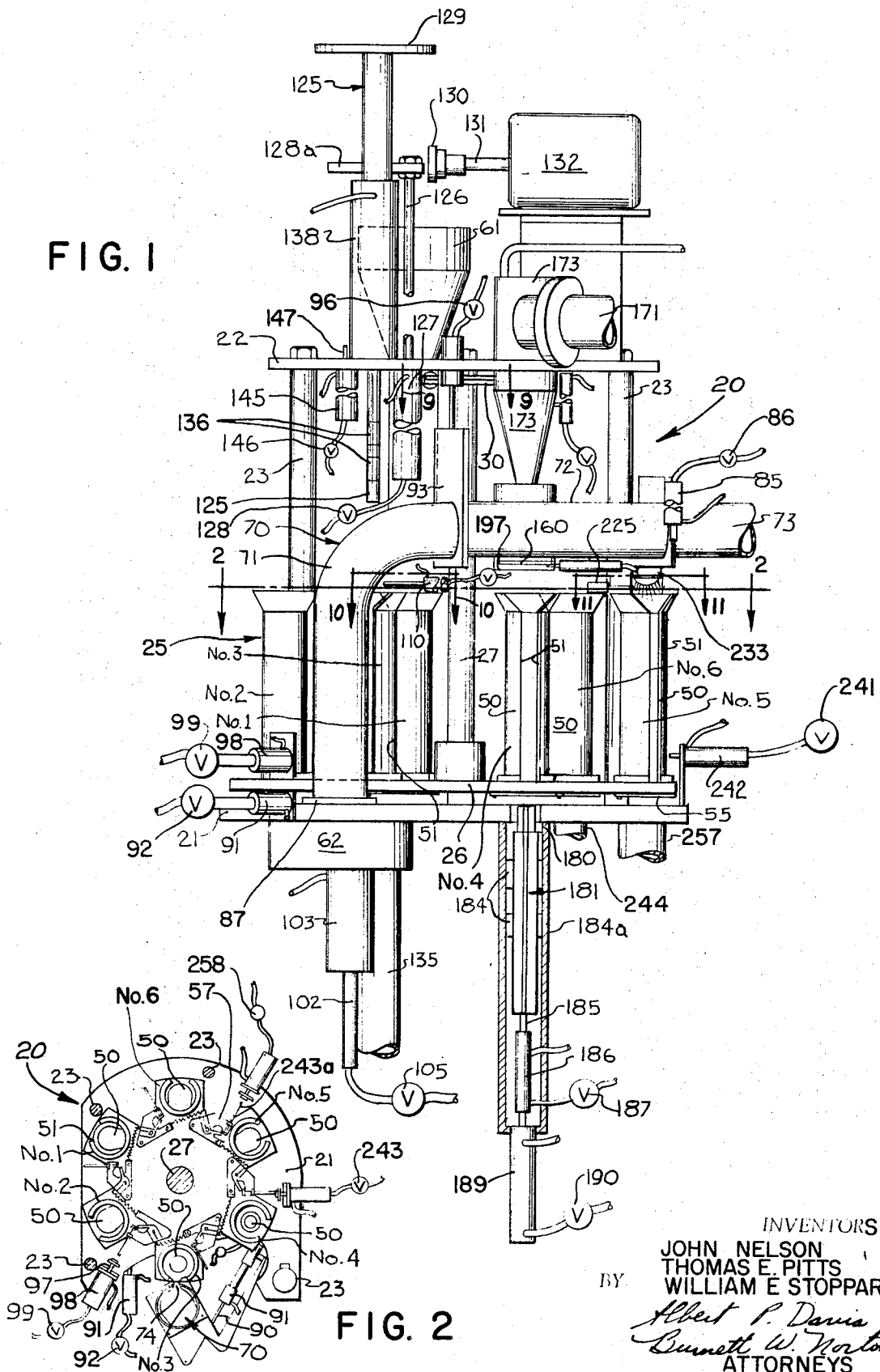


FIG. 2

INVENTORS
 JOHN NELSON
 THOMAS E. PITTS
 WILLIAM E. STOPPARD
 BY
Albert P. Davis
Burnett W. Norton
 ATTORNEYS

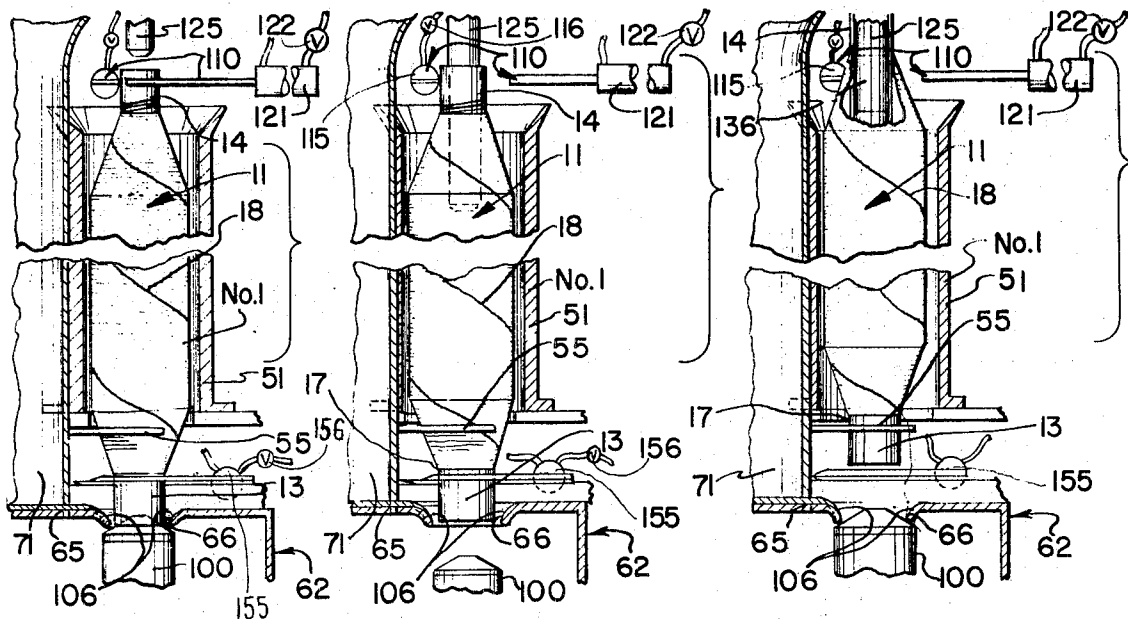


FIG. 4

FIG. 5

FIG. 6

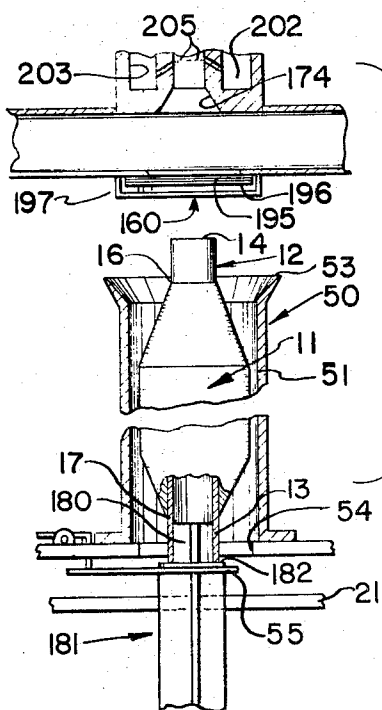


FIG. 7

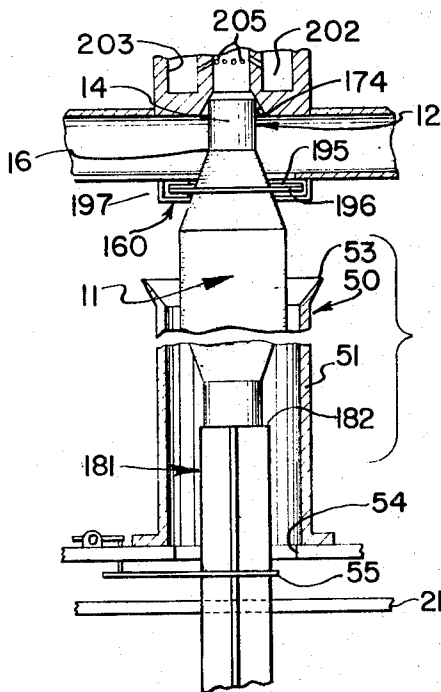
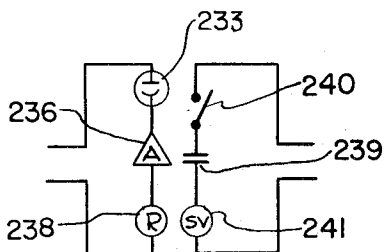


FIG. 8

FIG. 18



INVENTORS
JOHN NELSON
THOMAS E. PITTS
WILLIAM E. STOPPARD
BY
Albert P. Davis
Burnett W. Norton
ATTORNEYS

FIG. 9

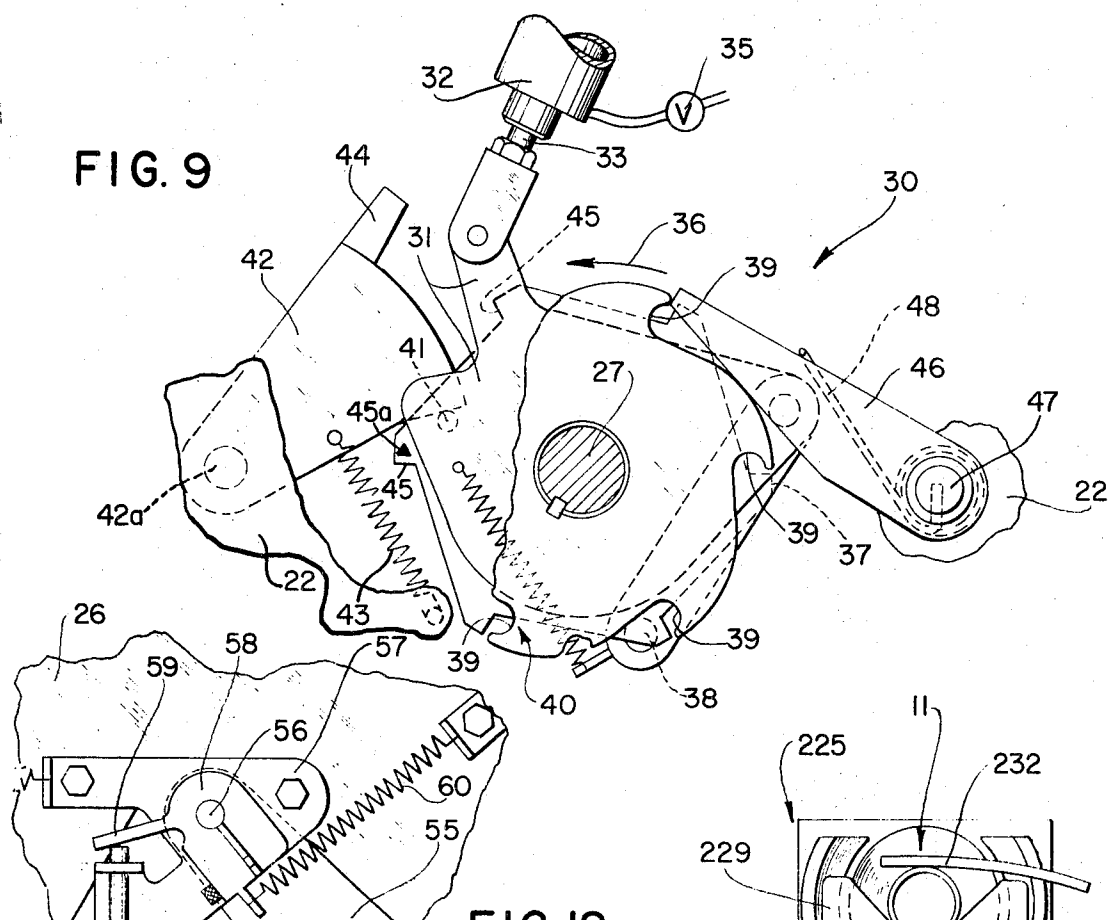


FIG. 12

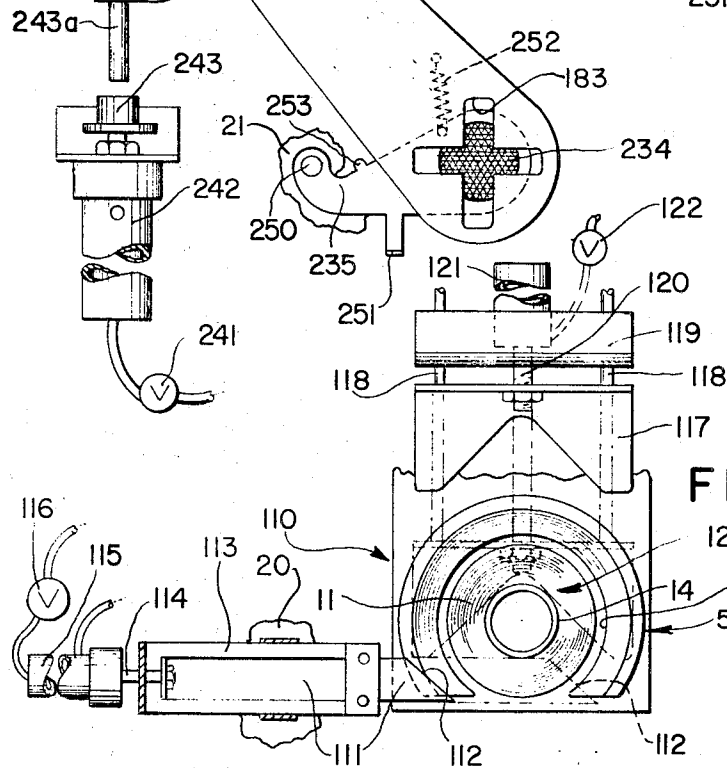


FIG. 11

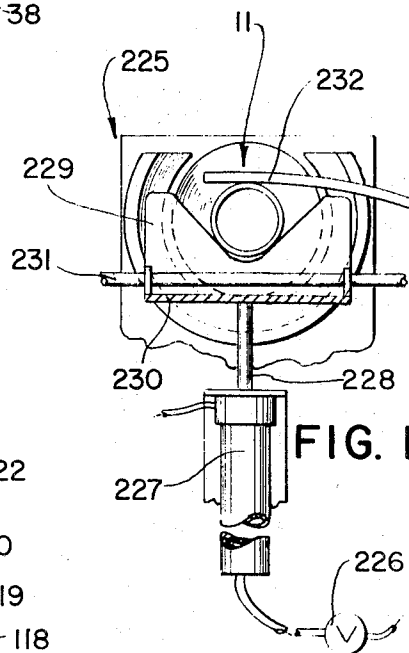
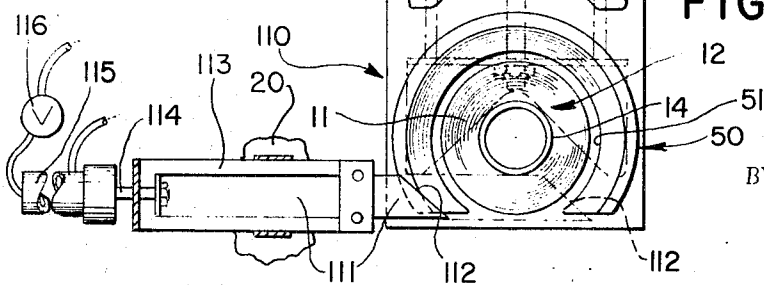


FIG. 10



INVENTORS
JOHN NELSON
THOMAS E. PITTS
BY WILLIAM E. STOPPARD
Albert P. Davis
Burnett W. Norton
ATTORNEYS

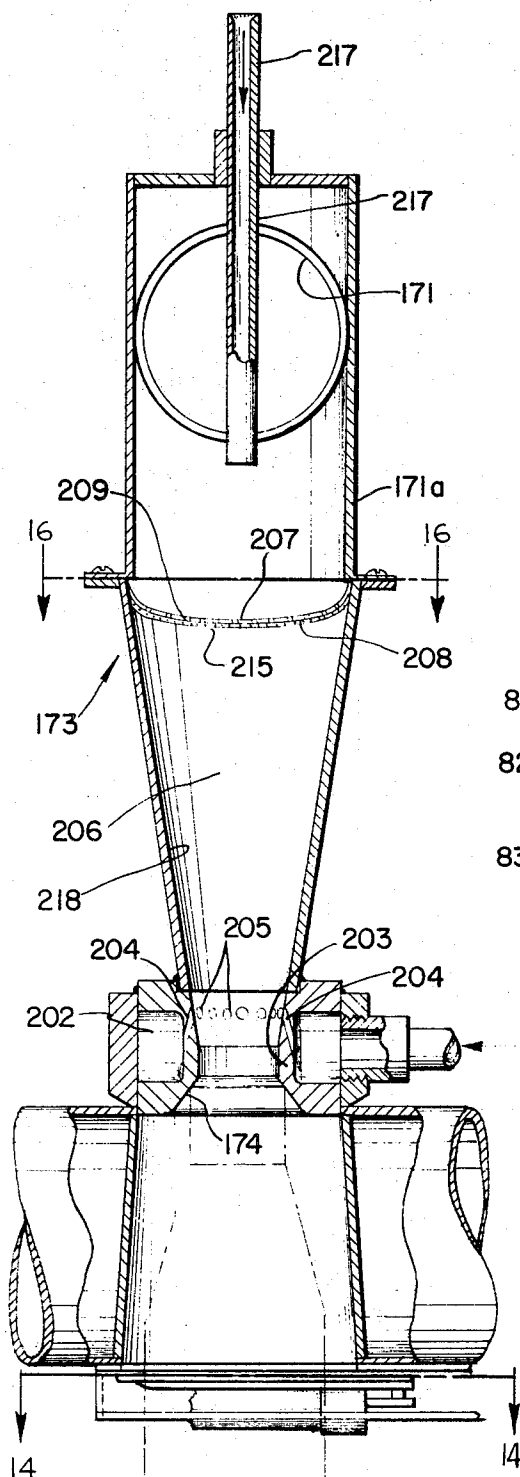


FIG. 15

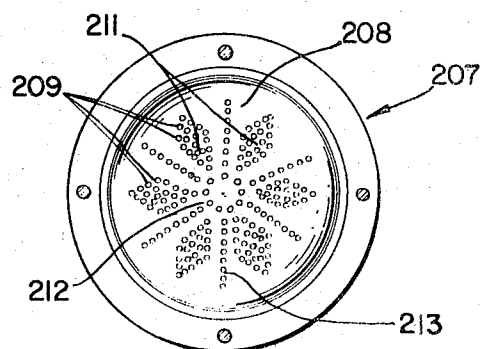


FIG. 16

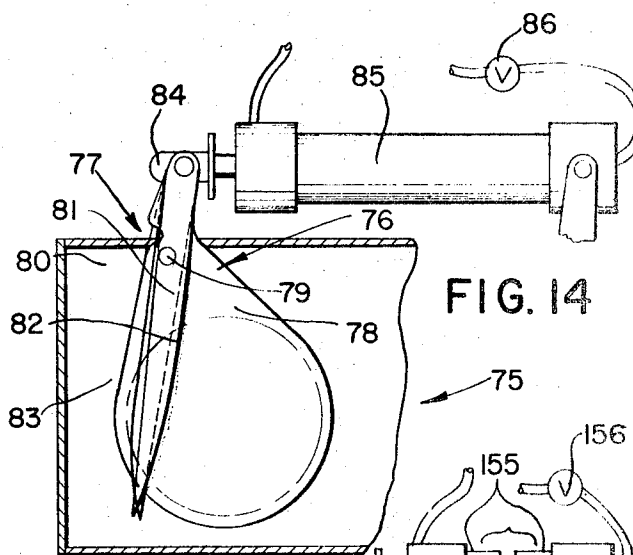


FIG. 14

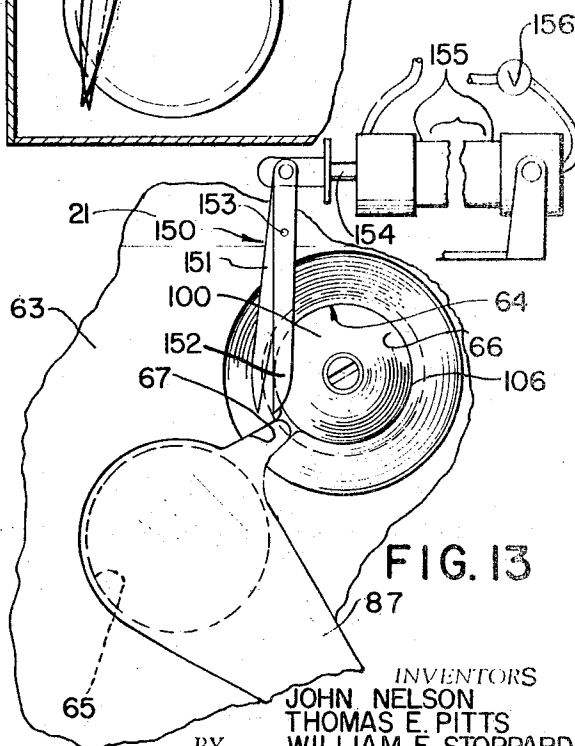


FIG. 13

INVENTORS
JOHN NELSON
THOMAS E. PITTS
WILLIAM E. STOPPARD
BY
Albert P. Davies
Burnett W. Norton
ATTORNEYS

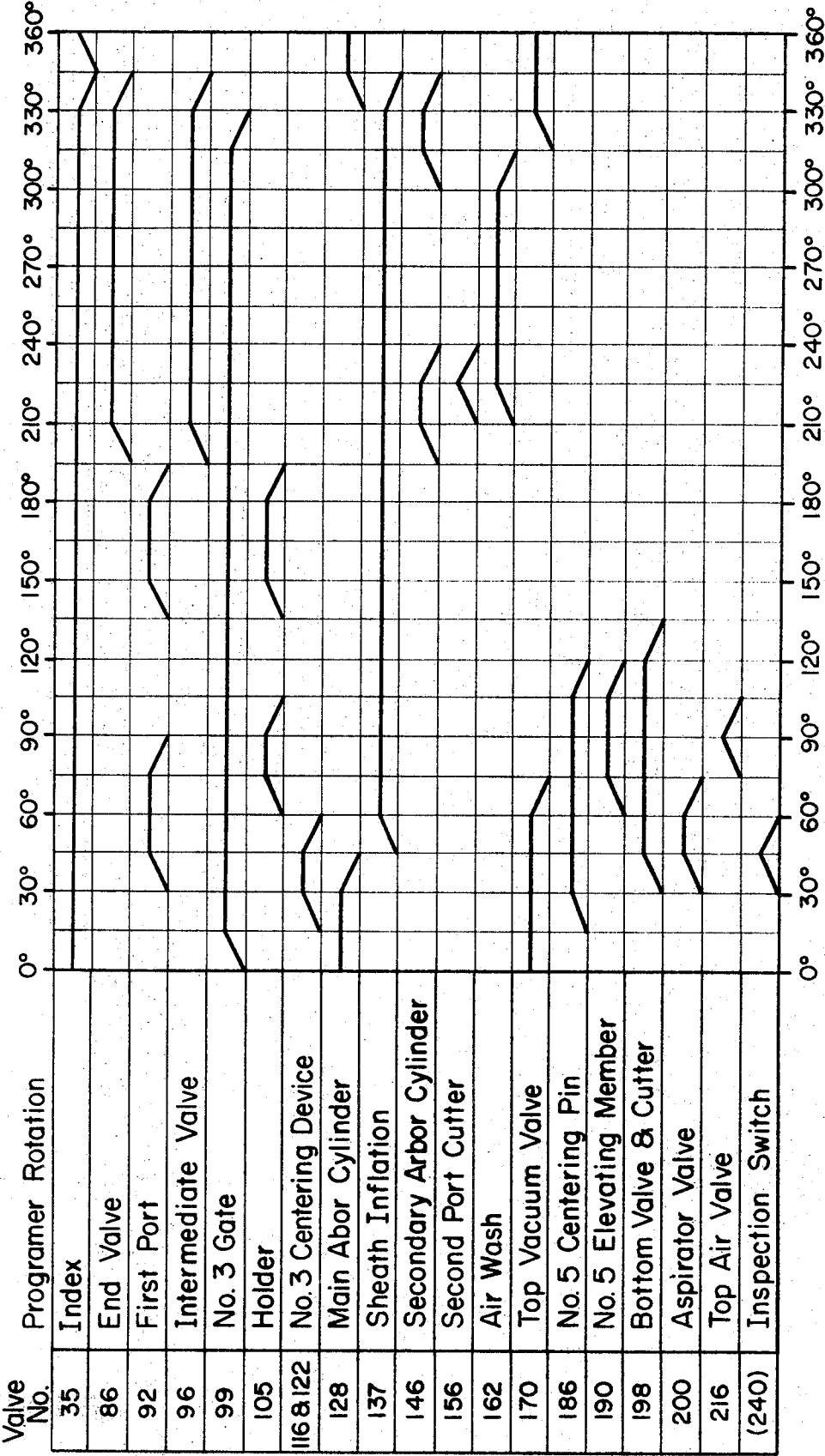


FIG. 17

BOBBIN HANDLING

As used herein the term "bobbin" means an article having a body of yarn or other strand material wound so that it may be moved from place to place. The term "filled bobbin" means a bobbin whether full or partially full. The term "yarn" is employed in a general sense to apply to all kinds of strand material, either textile or otherwise.

Various expedients have been proposed for preparing a bobbin for automatic threading at a winding station of a winding machine. Such expedients include winding the outer end of the strand of yarn about the bobbin core, or depositing the free end of the strand in the hollow core. These expedients leave much to be desired in facilitating retrieving the outer end for threading at the winding station. This is usually accomplished by vacuum retrieval means such as an aspirator, or by a hook or similar mechanical device, and often by hand.

The invention is, in brief, directed to an apparatus and a method for readying a filled bobbin for use in a winding machine. The bobbin is cleaned and the terminal and unwinding ends of the strand are prepared for reception by a winding station. The unwinding end of the strand of yarn is formed into a bunch which is positioned on the bobbin for ready and easy retrieval at the winding station, and more particularly, the bunch is deposited in a hollow of a core of the bobbin.

It is a primary object of this invention to provide a new and improved apparatus and method for readying a filled bobbin for subsequent use and, more particularly, for use by a winding machine.

Another object of this invention is to provide a new and improved apparatus and a method for preparing the unwinding end of a strand of yarn on a bobbin for retrieval at a winding station and, more particularly, for forming this end into a bunch which is deposited on the bobbin. A related object is provision for depositing the bunch in a hollow core of the bobbin.

A more specific object is provision of a new and improved apparatus and method for readying a bobbin for use at a winding station and including, cleaning the bobbin, trimming the terminal end of the strand of yarn wound on the bobbin, finding the unwinding end of the strand and removing surplusage this end such as the halch and tail coils and then forming a bunch out of the unwinding end and depositing the bunch in a hollow core of the bobbin for subsequent retrieval at the winding station.

These and other objects and advantages of the invention will be apparent from the following description and the drawings in which:

FIG. 1 is a fragmentary, schematic elevational view of a preferred embodiment of the invention;

FIG. 2 is a reduced scale, fragmentary schematic plan sectional view taken generally along the line 2-2 in FIG. 1;

FIG. 3 is an enlarged, fragmentary, developed elevational view of the apparatus shown in FIG. 1, showing various stations in position immediately following indexing of the apparatus, with parts broken away and in section for clearer illustration;

FIGS. 4-6 are fragmentary views similar to a portion of FIG. 3, and show progressive stages in the operation of a Station No. 3;

FIGS. 7 and 8 are views similar to FIGS. 4-6 and show progressive stages in the operation of a Station No. 4 shown in FIG. 3;

FIGS. 9-11 are enlarged, schematic sectional views taken generally along the lines 9-9 through 11-11 in FIG. 1;

FIG. 12 is an enlarged, fragmentary plan view taken generally along the line 12-12 in FIG. 3;

FIGS. 13 and 14 are enlarged, fragmentary sectional views taken generally along the lines 13-13 and 14-14, respectively, in FIG. 3;

FIG. 15 is an enlarged, fragmentary schematic elevational view of a portion of the apparatus shown in FIG. 3, with parts broken away and removed for clearer illustration;

FIG. 16 is a sectional view taken generally along the line 16-16 in FIG. 15;

FIG. 17 is an operating diagram of a portion of a control circuit for the apparatus; and

FIG. 18 (Sheet 3) is a wiring diagram of a portion of the control circuit.

While the invention herein disclosed may be applied to the processing of various types of bobbins, it is illustrated in conjunction with a typical spinning frame or twister bobbin 11, as may best be seen at Station No. 4 in FIG. 3. Referring to this Figure, such a bobbin 11 has a hollow core 12 with a large lower end 13 and a smaller upper end 14. The bobbin core 12 is filled with a winding of a strand of yarn to form a body of yarn 15 having the general configuration shown in the drawing with an unwinding or outer end 16 and a terminal or inner end 17. The unwinding end 16 is usually wound (Station 1-3) in broad spirals around the body 15 to form a halch 18 and then in tail coils 19 on the core at its smaller upper end 14. Both the terminal end 17 and the unwinding end 16 of the strand of yarn usually extend outwardly from the body of yarn 15 and the opposite ends of the body of yarn are spaced inwardly from the adjacent opposite ends of the core 12.

The operating diagram (FIG. 17) illustrates the opening and closing operating sequence and timing of various control valves as they affect the processing cycles at certain stations and indexing of the bobbins, to be more fully described hereinafter. Throughout the following description reference may be had to this operating diagram as an aid to a clear understanding of the sequence of operation.

The control valves are three-way valves. Each has an actuator which opens the valve for the passage of fluid (80 p.s.i. for example) to one end of an actuating cylinder. When the actuator is released, the valve vents this end of the cylinder (i.e. releases the 80 p.s.i. pressure) and lower pressure (40 p.s.i.) constantly applied to the opposite end of the cylinder, returns the plunger to its starting position.

Referring to FIGS. 1 and 2 of the drawings, the apparatus includes a base structure 20 including a lower base plate 21 and an upper base plate 22 rigidly connected by posts 23, with a plurality of stations for serially receiving bobbins 11 and readying the bobbins for use at a winding machine (not shown). As indicated these stations include, in order, a receiving station No. 1 (reference symbol "No. 1," and so forth), a reserve station No. 2, a first processing station No. 3, a second processing station No. 4, an inspection station No. 5, and a discharge station No. 6. Movement of the bobbins 11 from station to station is provided by a carrier 25 including a carrier plate 26 fixed to a column 27 journaled on the lower base plate 21 and the upper base plate 22.

Movement of the carrier 25 step by step from station to station is provided by an indexing mechanism 30 FIGS. 1, 3 and 9) mounted immediately below the upper base plate 22. This mechanism includes an actuator plate 31 (FIG. 10) journaled on the column 27 and reciprocated by means of a double acting cylinder 32 having a plunger 33 pivotally connected with the actuator plate 31. The cylinder 32 is first actuated by an associated three-way control valve 35 to cock the actuator plate 31 to the position shown in FIG. 9 and is then operated by the control valve 35 in the opposite direction to rotate the actuator plate 31 counterclockwise, as indicated by the arrow 36, thereby moving a link 37 pivoted to the actuator plate 31 so that a pin 38 engages an adjacent one of six first abutments 39 on a ratchet plate 40, and rotates the ratchet plate counterclockwise. The carrier supporting column 27 is fixed to the ratchet plate 40 so that the carrier 25 and its bobbins 11 are moved in a counterclockwise direction. As the actuator plate 31 is rotated counterclockwise, a stop pin 41 on this plate allows a pawl 42, pivoted by a pin 42a to the upper base plate 22 and seated against this stop pin, to rotate under the influence of a tension spring 43 secured to the pawl 42 and the upper base plate 22, to position a tip 44 of the pawl 42 in the path of one of six second abutments 45 on a stop plate 45a, fixed to the column 27 below the ratchet plate 40, and thereby limit rotation of the carrier 25. A second pawl 46 pivoted by a pin 47 to the upper base plate 22 and urged in a counterclockwise direction by a coil spring 48 to ride on the periphery of the

ratchet plate and engage behind one of the first abutments 39 to prevent reverse rotation of the ratchet plate 40 when the actuator plate is next cocked.

Six bobbin receivers 50 of the carrier 25 each include a vertical chute 51 fixed to the carrier plate 26. Each chute has a wide vertical gap 52 extending from a flared open upper end 53 to an open lower end 54. A gate 55 FIGS. 3 and 12), one for each chute 51, is fixed to a pin 56 journaled in a mounting bracket 57 fixedly secured to the carrier plate 26 for swinging movement of the gate 55 between a closed position for retaining the bobbin 11 in the chute 51 and an opened position for permitting the bobbin to drop downwardly. An actuating member 58 is fixed to the pin 56 on a side of the bracket 57 opposite the gate 55 and is movable by means of a tab 59, in a clockwise direction (as seen in FIG. 13) for opening the gate. Return of the gate 55 to closed position is provided by a tension spring 60 connected to the actuator 58 and to an adjacent mounting bracket 57.

At the receiving station No. 1, a bobbin 11 is delivered through a tube 61 mounted on the upper base plate 22. The bobbin 11 drops into receiver chute and onto the gate 55 at the first station. When the carriage 25 is next indexed, this bobbin is moved in its receiver 50 to the reserve station No. 2. Upon the next indexing of the carrier 25, this bobbin is moved to the first processing station No. 3.

A vacuum chamber 62 is fixed to and depends from the lower base plate 21 at station No. 3. A top wall 63 of the chamber 62 has an opening 64 (FIG. 13) including a first port 65 and a second port 66 interconnected by a neck portion 67. A conduit 70 FIGS. 1-3 for cleaning the bobbin 11 of extraneous matter and for handling the unwinding end 16 of the strand on the bobbin, communicates with the first port 65 and is fixed to the lower base plate 21. The conduit 70 has a tower portion 71 which extends upwardly from the first port 65 and along the gap 52 in the bobbin receiver chute 51 and then has a portion 72 which extends horizontally along the second processing station No. 4 and to a vacuum tube 73. A slot 74 (about one-sixteenth inch wide) in the conduit 70, communicates with the neck portion 67 of the opening 64 and extends longitudinally the entire length of the conduit 70, and faces the chute gap 52 along the tower portion 71 and extends along the bottom of the horizontal portion 72 of the conduit to an end assembly 75 (FIG. 14) including end shutter valve 76 and a scissor-type strand cutter 77 between the end of the conduit and the vacuum tube 73. A valve member 78 is pivoted by a pin 79 to a valve housing 80 fixed to the conduit 70 and the tube 73. A blade 81 of the cutter 77 is fixed, as by a weld 82, to the valve member 78 with the cooperating blade 83 similarly fixed to the housing 80. This valve 76 and cutter 77 are actuated by the plunger 84 of a double acting cylinder 85 fixed to the base structure 21 and connected through a three-way control valve 86 with a suitable source of air pressure. At the first port 65 and lower end of the tower 71 there is another pivoted shutter-type valve 87 (FIG. 13) similar to the previously described valve, and this valve has its valve member 88 pivoted by a pin 89 to the upper wall 63 of the vacuum chamber 62 and is actuated by the plunger 90 of a double acting cylinder 91 (FIG. 2) and associated three-way control valve 92 to open and close the tower 71 to vacuum in the chamber 62 and to close the first port 65 and the neck 67 to passage of air into the chamber 62. A sliding shutter-type valve 93 (FIG. 2) is positioned in the conduit 70 intermediate the end valve and cutter assembly 75 and the first port valve 87 and between the tower portion 71 of the conduit 70 and the assembly 75, and is similarly actuated by the plunger 94 of a double acting control cylinder 95 and associated three-way control valve 96.

With the bobbin 11 at station No. 3 in a first bobbin position on its bobbin retaining gate 55 (FIG. 3), the gate is opened by extension of the plunger 97 (FIG. 2) of a Station No. 3 gate actuating cylinder 98 fixed to the lower base plate 21 and connected through a three-way control valve 99 with a suitable source of compressed air. The larger, lower end 15 of the bob-

bin core now drops onto a frustoconical bobbin holder 100 (FIG. 4) which tends to center the lower end of the bobbin, and the bobbin is in a second bobbin position. This holder 100 is the upper free end of a plunger 101 (FIGS. 1 and 3) of a double acting cylinder 102 fixed to the bottom of a sleeve 103 which guides the holder 100 and depends from a bottom wall 104 (FIG. 3) of the vacuum chamber 62 with the plunger extending through this wall. Operation of a three-way valve 105 associated with this cylinder moves the plunger 101 and its holder 100 from a closed position seated against a converging annular rim 106 FIGS. 3 and 13) extending downwardly in the second port 66, to an open position spaced downwardly from this rim.

A bobbin centering device 110 (FIGS. 1, 3 and 10) is mounted on the base structure 20 at station No. 3 for urging the top 14 of the bobbin core 12 into vertical alignment. Centering of the top of the bobbin 11 is particularly desirable in handling partially full bobbins which may be canted in the bobbin receiving chutes 51. This centering device includes a blade 111 (FIG. 10) having a beveled free end 112 for moving the top 14 of the core 12 as the blade is slid, in a mounting bracket 113 fixed to the base structure 20, from a retracted position to an extended position (dotted) lines in FIG. 10) by the plunger 114 of a double-acting cylinder 115 upon operation of an associated three-way control valve 116. This blade 111 is extended simultaneously with extension of a V-shaped centering plate 117 slidably mounted by guide pins 118 on a supporting bracket 119 fixed to the base structure 20 and movable between extended and retracted positions by the plunger 120 of a double-acting cylinder 121 upon operation of an associated three-way valve 122.

After centering the bobbin 11 in its chute 51, an arbor 125 at station No. 3 is fully lowered (FIG. 5) into the hollow bobbin core 12 while the bobbin is seated at its lower end 13 on the closed bobbin holder 100. This arbor is operable to an intermediate position for supporting and elevating the bobbin 11 in a third bobbin position (FIG. 5) slightly above the first bobbin position (FIG. 3) on its gate 55, and for rotating the bobbin to unwind the unwinding end 16 of the strand of yarn when the bobbin is in its second position (FIG. 4) on the closed holder 100. The arbor 125 is mounted for vertical sliding movement and rotation in a suitable journal mounting (to be described) on the upper base plate 22. Releasable retention of the arbor in a fully elevated position, as shown in FIGS. 1 and 3, is provided by a fully extended plunger 126 of a main double-acting cylinder 127 fixed to the upper base plate 22. When a three-way control valve 128 associated with this cylinder 127 is operated, the plunger 126, secured to a plate 128a fixed to the arbor 125, is retracted and the arbor 125 drops into the hollow bobbin core 12 until a disk 129 fixed to the top of the arbor engages a constantly rotated drive wheel 130 on the shaft 131 of a motor 132 mounted on the upper base plate 22, to rotate the bobbin 11 later in the cycle.

Simultaneously with the operation of the arbor's main cylinder valve 128, the control valve 92 for the first port and tower valve 88 is operated to open the first port valve 88 so that vacuum in the chamber 62 causes a stream of air to be drawn across the bobbin 11 thus cleaning the bobbin by removing any extraneous strands of yarn, lint and other foreign matter from the bobbin and passing such matter into the vacuum chamber, from which it is removed through a vacuum connection 135 opening through the bottom wall 104 of the chamber 62.

With the arbor 125 lowered into the hollow core 12 of the bobbin 11 seated at its lower end on the closed bobbin holder 100, a pair of axially spaced inflatable rubber sheaths 136, sealed about lower portions of the arbor and within the core 12, are inflated by operation of a three-way valve 137 connected between a compressed air supply and a chamber 138 nonrotatably mounted, as by a key structure 139, for vertical sliding movement on the upper base plate 22 and for vertical movement with the arbor 125. This chamber 138 communicates with a passage system 140 in the arbor 125 for inflating

sheaths 136 to tightly grip the bobbin core 12, thus rotating the core as the arbor rotates through engagement of the arbor disk 129 with the drive wheel 130 on the motor shaft

Simultaneously with inflation of the arbor sheaths 136, and rotation of the bobbin 11 at station No. 3, the centering device valves 116, 122 are operated to withdraw the centering blade 111 and plate 117, respectively.

Next the bobbin holder 100 is lowered to its open position (FIG. 5) by operation of its control valve 105. The terminal end 17 of the strand of yarn, and the unwinding end 16 of the strand if tangled with the terminal end, are transferred into the vacuum chamber 62. The first port valve 88 at the lower end of the tower 71 is now closed by operation of its control valve 92 and the terminal end 17 of the strand is transferred away from the first port 65 toward the vacuum connection 135 which is located so that the second port 66 (at the holder), is intermediate the first port 65 and the vacuum connection 135, thus positioning the strand across the holder 100. After the first port control valve 92 is closed, the holder control valve 105 is again actuated to close the holder 100, thus clamping the terminal end 17 and possibly the unwinding end 16 of the strand between the holder 100 and the arcuate flange 106 about the second port 66. The strand is broken between its clamped portion and the bobbin 11 because of rotation of the bobbin.

With the strand end or ends severed, the bobbin holder 100 is again lowered (FIG. 5) and the first port valve 88 is opened, and any surplusage windings of the unwinding end 16 of the strand on the bobbin 11, such as the tail coils 19 and halch 18, are unwound through rotation of the bobbin 11 and are disposed of through the vacuum chamber 62 and its vacuum connection 135. Now, the first port valve 88 is again closed so that the surplusage windings of the unwinding end 16 of the strand are transferred through the neck 67 and run through the second port 66. The arbor 125 is raised by means of a secondary double-acting cylinder 145 which upon operation of its three-way control valve 146 extends its plunger 147 against the plate 128a secured to the arbor 125, disengaging the disk 129 from the drive wheel 130 of the motor 132, thus stopping rotation of the bobbin 11, and raising the bobbin 11 since the sheaths 136 are still inflated. The holder control valve 105 is again actuated to close the holder 100 against the annular flange 106 of the second port 66 and clamp the unwinding end 16 of the yarn.

A cutter 150 (FIGS. 3 and 13) now cuts the surplusage of the strand which is disposed of through the vacuum connection 135 to the vacuum chamber when the holder again opens. This cutter 150 includes a cutting blade 151 fixed to the upper face of the lower base plate 21 and a cooperating cutting blade 152 pivoted by means of a pivot pin 153 on the base plate 21 and operated by the plunger 154 of a double-acting cylinder 155, mounted on the base plate, and an associated three-way control valve 156.

Simultaneously with operation of the cutter 150 to cut the unwinding end of the strand, the end valve 76 and intermediate valve 93 in the conduit 70 are opened through operation of their respective control valves, so that the upper end of the conduit 70 is in communication with the vacuum tube 73 at the end valve 76 and airflow through the conduit slot 74 is upward through the tower 71 and then to the right in the horizontal portion 72 of the conduit 70 as seen in FIGS. 1 and 3. (It should be noted that a shutter valve 160 along the bottom of the horizontal portion 72 of the conduit 70 at station No. 4 is closed at this time. This valve 160 and its function will be described later.) Thus, the unwinding end 16 of the strand now moves through the slot 74 and the conduit 70 from station No. 3 to station No. 4, and through the open end valve 76 with the strand riding across the top of the valve 160 at station No. 4.

An airstream stream or wash at station No. 3 is passed against the strand wound on the bobbin 11 and this stream is directed opposite the direction of rotation of the bobbin 11 so that when the bobbin is again rotated the unwinding end 16 of

the strand, which is carried through the conduit 70, will not be carried with the bobbin 11 and wound in reverse thereon. This air wash is provided through a tube 161 (FIG. 3) secured to and coextensive with the tower 71. Air is admitted to the tube 161 by means of a control valve 162 and is emitted from the tube through a plurality of small ports.

With the air wash from the tube 161 passing against the bobbin 11, the secondary arbor cylinder 145 is lowered through operation of its control valve 146 and the arbor disk 129 again engages the motor drive wheel 130, to rotate the bobbin 11 thus unwinding the end 16 of the strand for passage through the conduit 70 and the end valve 76.

The air wash emitted through the tube 161 is now shut off and the secondary arbor cylinder 145 is again actuated to raise the arbor 125 to its intermediate position (FIG. 6), stopping rotation of the bobbin. Then the bobbin receiver gate 55 is closed through operation of the station No. 3 gate control valve, and the arbor sheaths 136 are deflated by operation of their air supply valve 137, thus permitting the bobbin 11 to drop back onto its gate 55, whereupon the arbor main cylinder control valve 128 is operated to raise the arbor 125 out of the bobbin core 12.

While the arbor 125 is being raised to its intermediate position (FIG. 6) at station No. 3, a vacuum valve 170 connected through a tube 171 with an upper end 171a of a bunch maker chamber 173 at station No. 4 is opened and then the intermediate conduit valve 93 and the end conduit valve 76 are closed through operation of their control valves. Closing of the end valve 76 also operates the associated cutter 77 so that the unwinding end 16 of the strand is severed whereupon the unwinding end still on the bobbin is drawn through a mouth 174 of the bunch maker chamber 173 opening into the top of the conduit 70 at station No. 4. Simultaneously, the indexing cylinder control valve 35 is actuated to cock the indexing mechanism 30. Next this control valve 35 is again actuated to move the bobbin 11 to station No. 4, thereby providing slack in the outer end 16 of the strand. This slack is drawn up into the bunch maker chamber 173, but no substantial amount of yarn is unwound from the bobbin 11 at this time.

Upon arrival at station No. 4, the lower end 13 of the bobbin 11 is centered on its gate 55 by a tapered centering pin 180. This pin is at the upper end of a vertically elongated elevating member 181 having a cross section in the shape of a cross and a shoulder 182 at the bottom of the centering pin portion 180. The elevating member 181 is extended from a retracted position (station No. 4, FIG. 3) to an intermediate position (FIG. 7) extending through a complimentary but larger cross-shaped opening 183 (FIG. 12) in the gate 55, so that the centering pin 180 centers the bobbin, and lifts the bobbin very slightly off of its gate 55 through engagement of the bottom end 13 of the bobbin core 12 with the shoulder 182 on the elevating member 181. This member is slidably mounted in guide blocks 184 of a vertical frame 184a (FIG. 1) secured to and depending from the lower base plate 21. The lower end of the member 181 is received by the top of a plunger 185 of double-acting cylinder 186 operated by an associated three-way control valve 187 to lift the elevating member 181 to its intermediate position (FIG. 7). This cylinder 186 is received by the top of a plunger 188 of another double-acting cylinder 189 secured to the bottom of the frame 184a. The lower cylinder is connected with a three-way operating valve 190.

The station No. 4 valve 160 is mounted on the conduit 70 at the bottom of the conduit directly compressed the bunch maker mouth 174. (FIGS. valve 160 has a pivoted shutter valve member 195 (FIG. 3) and is associated with a cutter 196 below the valve member. The valve and cutter are generally similar to the end valve 75 and cutter 77 FIGS. 3 and 14). The bottom valve 160 and cutter 196 are operated between open and closed position by the plunger of a double-acting cylinder 197 (FIG. 3) (mounted on the base) and an associated three-way control valve 198 in the same manner as the end valve 75 and cutter 77.

The bottom valve 160 is opened simultaneously with opening of an aspirator blast valve 200 (FIG. 3) which passes compressed air through a tube 201 FIGS. 3 and 15) and into an annular chamber 202 around a neck portion 203 of the bunch maker chamber 173. This neck extends upwardly from the mouth 174. From the annular chamber 202, compressed air (80 psi) is directed through a plurality of radially disposed upwardly inclined passages 204 opening through ports 205 at neck 203 for the passage of jets of air into an upwardly diverging frustoconical portion 206 of the bunch maker chamber 173. These jets of air, acting at the neck 203 into the diverging chamber 206 provide an aspirator action which rapidly unwinds yarn from the unwinding end 16 of the bobbin and advances the yarn into the diverging chamber 206.

As the unwinding end 16 of the strand is unwound from the bobbin 11 and passes into the diverging chamber 206, it is drawn upon itself against a perforate cupped disk member 207 extending completely across the top of diverging chamber 206 and immediately below the upper end portion 171a of the chamber into which the vacuum connection 171 opens. This perforated member 207 is shown in FIG. 16 and preferably has a convex lower face 208 facing into the diverging chamber 206. Perforations 209 form a generally star-shaped pattern having diamond-shaped arms 211, a center circle 212 and lines 213 extending outward from the circle 212 and between the arms 211. The perforation may be of any suitable size, for example about .050 inch diameter. In a prototype, a total open area of .375 square inches and 12-14 percent open area to total area of the lower disk face was found to be adequate to cause the outer end of the strand to whip across the lower face 208 of the perforate member 207 and form relatively large loops upon itself near the outside of the face 208. It is preferable that these loops be approximately at least twice as long as the circumference of the hollow in the bobbin core 12, as will become apparent. The lower face 208 of the perforated plate 207 is preferably covered by a screen 215 of approximately 150 mesh, which is desirable for preventing the yarn from entering the perforations 209 of the perforated member 207.

The top vacuum valve 170 (FIG. 3) and the neck jet valve 200 are now closed and the elevating member 181 is fully extended through operation of the lower cylinder control valve 187 (FIG. 1) to move the top 14 of the bobbin core 12 against the mouth 174 of the bunch maker chamber 173.

An upper air valve 216 (FIG. 3) is now opened for the passage of high-pressure air (80 p.s.i.) through a tube 217 (FIGS. 3 and 15) into the top of the upper end 171a of the bunch maker chamber 173 above the perforate member 207, whereupon the strand, which is looped on the screen 215 covering the lower face 208 of the member 207, is blown off of the screen in a mass and downwardly in a converging path along a downwardly converging sidewall 218 of the chamber portion 206 to form a bunch 220 which is ejected through the neck 203 and mouth 174 into the hollow core 12 of the bobbin 11.

By forming large loops of yarn in the chamber portion 206 and then compressing these loops along the converging sidewalls 218 and ejecting the compressed loops through the bunch maker mouth 174 and into the core hollow which has a diameter about that of the neck 203, the bunch 220 wants to expand in the bobbin core and thus holds itself in the core.

The position of the bunch 220 in the core 12 may be regulated, either by regulating the length of the centering pin 180 at the upper end of the elevating member 181 so that the bunch 200 is received on top of the centering pin, or alternatively by regulating the bleeding of air from the lower end 14 of the hollow core 12 by providing limited air passage between the core 12 and center pin 180 and shoulder 182 to establish a pressure equilibrium in the core above and below the bunch 220 as it is moved into the core by the air from the bunch maker chamber.

The air valve 216 for the top 171a of bunch maker chamber 173 is now closed, as are the control valves to the elevating member cylinders 186 and 187, thus lowering the elevating

member 181 and its center pin 180 to below the gate 55. The control valve 198 for the station No. 4 bottom conduit valve 160 is now operated to close the bottom valve and operate the strand cutter 196 on the bottom face of the valve member 195 for cutting the strand in the event that the bunch 220 was not properly ejected from the bunch maker.

The indexing control valve 35 is now operated to cock and then release and index the carrier 25 to move the bobbin 11 to the inspection station No. 5. First, a centering device 225 (FIGS. 3 and 11) mounted on the base structure 20 at the top of the bobbin 11 in the inspection station is operated by opening a three-way control valve 226 to a double-acting cylinder 227 whose plunger 228 carries a V-shaped bracket 229. This bracket 229 includes a flange 230 transverse to the plate and the flange is pivoted on a shaft 231 mounted on the base structure 21. The plunger 228 engages the bracket at the juncture of the plate and flange to pivot the "V" of the plate into engagement with the bobbin core 12. Thus the top 14 of the bobbin 11 is moved against a fixed centering blade 232 to center the bobbin with respect to a photoelectric cell 233 (FIG. 3). The photoelectric cell 233 is mounted on the base structure 20 and directly above the hollow bobbin core 12. The cell is directed downwardly toward a prismatic reflector 234 fixed on an arm 235 pivotally mounted on the lower base plate 21 in position for passage of the gate 55 above the reflector when the carrier 25 is indexed. The photoelectric cell 233 is constantly energized in circuit as shown in FIG. 18 and if it does not detect a bunch 220 in the core 12, a signal from the cell passes through an amplifier 236 to energize a relay 238 closing its contact 239 in circuit with a switch 240 closed by the programmer of the control system when it is time to inspect for the bunch 220. Thus a three way solenoid valve 241 is opened to actuate a double-acting cylinder 242 and operate its plunger 243 and telescope a rod 243a in the mount 57 to open the gate 55, thus discharging the defective bobbin 11 from the receiver chute 51 into a discharge tube 244 for suitable disposal. If the bunch 220 is in the bobbin core 12 the photocell 233 does not operate the relay and the bobbin stays in its chute 51.

As shown in FIG. 12, a pivot pin 250 mounts the reflector 234 on the lower base plate 21 and an upstanding tab 251 on the reflector arm 235 is engaged by the gate 55 as the gate opens, to swing the reflector arm 235 out of the path of the bobbin 11. A tension spring 252 connected between the reflector arm 235 and the lower base plate 21 returns the reflector arm against a stop 253 on the base plate as the gate closes, so that the reflector 234 is again properly positioned with respect to the photoelectric cell 233.

The carrier 25 is again indexed, moving the bobbin 11 from the inspection station No. 5 to the discharge station No. 6. A double-acting cylinder 255, mounted on the lower base plate 21, is positioned for movement of its plunger 256 into engagement with the gate actuator tab 59 to open the gate 55 when it is desired to discharge the inspected bobbin 11 from its receiver chute 51 to a discharge chute 257 for conveying the bobbin to a desired location. A solenoid operated three-way control valve 258 (FIG. 3) for the station No. 6 gate cylinder 255 is normally controlled from an external signal to open the gate when a bobbin 11 is required by apparatus for using the bobbin.

The sequence of operation of the assembly is shown diagrammatically in FIG. 17. Control of the assembly is the function of a "Programmer" shown in a Leesona Corporation, application Ser. No. 620,454 of Charles C. Bell and Edward L. Kent, and Kurt W. Niederer, filed Mar. 3, 1967. While not illustrated herein, in brief, each function of the assembly is controlled by one of a plurality of cams fixed to a shaft for step by step rotation with the shaft. The shaft is driven step by step in equal increments after starting of the cycle of rotation of the shaft. Each cam has suitable lobes for operating the three-way control valve actuators and, as shown in FIG. 17, the heavy lines indicate the period during which a particular valve actuator is operated. The upwardly inclined portion at the left end of each of these heavy lines extends through one increment of

movement of the shaft and indicates the actuator being operated. Actually the actuator may operate much faster but will be fully actuated within the step indicated by the left-hand inclined portion of the heavy line. Similarly the right-hand declining portion of each heavy line indicates the valve actuator moving back to its normal position. Obviously, since discharge of the bobbin from the discharge station No. 6 is controlled by an external signal, this signal is fed into the programmer to control the start of a new cycle and the resultant automatic operation of its indexing signals. Suitable safety interlocks are provided, in a manner indicated in the previously mentioned patent application.

Because of its greater mass, the bunch 220 provided by this invention is much easier to retrieve by vacuum means such as an aspirator or strand holder, or by a hook or similar devices, than prior expedients for placing the unwinding end of a bobbin.

While this invention has been described with reference to a particular embodiment in a particular environment, various changes may be apparent to one skilled in the art and the invention is therefore not to be limited to such embodiment or environment except as set forth in the appended claims.

We claim:

1. A method of processing a filled bobbin having an unwinding end of a strand, comprising forming said end into a bunch, and compressing and positioning the bunch in holding engagement with the bobbin for retention of the bunch by the bobbin and subsequent retrieval from the bobbin.
2. A method as set forth in claim 1 in which the bobbin has a hollow and in which the step of compressing and positioning the bunch comprises positioning the compressed bunch in the hollow of the bobbin and expanding the compressed bunch into holding engagement with the bobbin within the hollow.
3. A method as set forth in claim 1 in which the bobbin has a hollow and the step of positioning the bunch comprises positioning the bunch in said hollow.
4. A method as set forth in claim 1 in which the bobbin has a hollow, and the step of compressing and positioning the bunch comprises positioning the compressed bunch in said hollow.
5. A method as set forth in claim 1 in which the bobbin has a hollow, and the step of forming the bunch comprises forming the bunch as a disoriented bunch, and the step of compressing and positioning the bunch comprises positioning the compressed and disoriented bunch in said hollow.
6. A method of processing a filled bobbin having an unwinding end of a strand and a terminal end opposite said unwinding end, comprising the steps of finding said terminal end severing said terminal end by clamping the terminal end and breaking the strand between the bobbin and the clamped portion of the strand, forming said unwinding end into a bunch, and compressing and positioning the bunch in holding engagement with the bobbin for retention of the bunch by the bobbin and subsequent retrieval of the bunch from the bobbin.
7. A method as set forth in claim 6 in which the step of breaking the strand comprises rotating the bobbin to break the clamped strand.
8. A method as set forth in claim 1 in which the step of forming the bunch comprises advancing said unwinding end, depositing the advancing unwinding end upon itself, and compressing the deposited end to form the bunch.
9. A method as set forth in claim 8 in which the step of depositing the unwinding end comprises depositing the unwinding end in a random looping pattern.
10. A method as set forth in claim 8 in which the strand is deposited on a perforate member and the step of advancing the unwinding end of the strand comprises entraining the strand in discharging stream, and directing the stream through the member to deposit the strand on the member.
11. A method as set forth in claim 10 in which the step of compressing the deposited strand comprises passing a stream through the member and then against the deposited strand for substantially simultaneously discharging the deposited strand from the member and then passing the discharge strand through a converging path.

12. Apparatus for processing a filled bobbin having a hollow and an unwinding end of a strand, the apparatus comprising, bunch making means for forming a bunch of said end, means for compressing the bunch, and means for positioning the bunch in the hollow in such a manner that the bunch expands into holding engagement with the bobbin.

13. Apparatus as set forth in claim 12 in which said bunch making means comprises a chamber having opposite ends, a mouth at one of said ends, means at the other of said ends for alternately withdrawing fluid from the chamber to move said end of the strand into the chamber and for passing fluid from said other end through said chamber and toward said mouth to move the bunch toward the mouth, and means comprising a perforate member extending across said chamber intermediate said chamber ends for receiving the end of the strand.

14. Apparatus for processing a filled bobbin having an unwinding end and an opposite terminal end of a strand, the apparatus comprising, means for rotating the bobbin, holding means for holding stationary relative to the rotating bobbin said terminal end of the strand to break the strand between the bobbin and the held portion of the strand, and means for handling said unwinding end and positioning the last said end in engagement with the bobbin for retention thereby in condition for subsequent retrieval of said unwinding end.

15. Apparatus as set forth in claim 14 in which the handling means includes bunch making means for forming a bunch of the last said end of the strand and for positioning the bunch in said engagement with the bobbin for subsequent retrieval.

16. Apparatus as set forth in claim 15 in which said handling means comprises bunch making means for receiving the last said end and forming said end into a bunch, and end handling means for finding the last said end and delivering said end to said bunch making means.

17. Apparatus as set forth in claim 16 in which said bunch making means comprises a chamber having opposite ends, a mouth at one of said ends, means including an outlet at the other of said ends for alternately withdrawing fluid from the chamber to move the last said end of the strand into the chamber, and including an inlet for passing fluid from said other end through said chamber toward said mouth to move the bunch toward the mouth, and means comprising a perforate member extending across said chamber intermediate said chamber ends for receiving the last said end of the strand.

18. Apparatus as set forth in claim 17 in which the bobbin rotating means and said holding means are at one station and said bunch making means is at another station, means for transferring said bobbin from said one station to the other station, and in which said end finding means is operable for finding the last said end at said one station and transferring said end to said bunch making means.

19. Apparatus for processing a filled bobbin having a strand end, the apparatus comprising a base having an opening including first and second ports connected by a neck, means including a conduit for handling the strand, said conduit having opposite ends with one of said ends communicating with said first port and a portion extending from said one end for receiving the strand end from an adjacent bobbin, first valve means at said first port for opening and closing said first port, second valve means operable between open and closed positions at an end of said conduit portion opposite said one end, means for operatively positioning a bobbin alongside said conduit portion and including bobbin retaining means for releasably retaining the bobbin in a first position, holding means for supporting the bobbin in a second position proximate the second port when the bobbin has been released by the retaining means, said holding means being operable between a first position for receiving the strand through said opening and in which position said second port is open, and a closed position for clamping the strand and in which position said second port is closed, means operable for rotating said bobbin in said second position, and for elevating said bobbin to a third position, a first chamber about said holding means and communicating with said opening and having a connection for the flow of fluid from said opening through the chamber, said con-

nection being positioned with said second port intermediate said connection and said first port, means for forming a strand bunch, the bunch forming means communicating with said conduit for receiving the strand therefrom and being positioned with said second valve means intermediate the bunch forming means and said conduit portion, and means for delivering the bunch to the bobbin.

20. Apparatus for processing a filled bobbin having a strand end, comprising a base having bobbin receiving stations and means defining an opening including first and second ports connected by a neck at one of said stations, a carrier structure mounted for movement relative to said base and having means including a bobbin receiver for moving a bobbin between said stations and operable between a bobbin retaining position for releasably retaining a bobbin and an open position for releasing the bobbin, means including a conduit having one end communicating with said first port and extending therefrom to another station, said conduit having a slot for receiving the strand end and said slot opening into said neck and extending longitudinally of the conduit for directing a stream to handle the strand, a first valve at said first port for opening and closing said first port, a cutter at said second port for cutting the strand, a second valve operable between open and closed positions adjacent an end of the conduit portion opposite said one end, means including a holder positioned on said base at the second port for receiving the bobbin through the second port and supporting the bobbin when said receiver is in said open position, and said holder being operable between an open position for receiving a strand through said opening and in which position said second port is open and a closed position for clamping the strand relative to said base and in which position said second port is closed, means for operating said receiver to said open position at the last said station to permit the bobbin to be supported by said holder, means operable for supporting and rotating said bobbin and for elevating said bobbin at said one station, a first chamber about said holder and communicating with said opening, said chamber having a fluid connection, said connection being positioned with said second port intermediate said connection and said first port, means for moving said carrier relative to said base to move said bobbin receiver from said one station to another of said stations, bunch forming means including a second chamber at the other station for forming a strand bunch in the chamber, said second chamber having a mouth for receiving the strand and for ejecting the bunch therethrough, said mouth communicating with said conduit for receiving the strand, and means for positioning said bobbin at said mouth to receive said bunch.

21. Apparatus as set forth in claim 20 in which said second chamber has a neck extending from said mouth to a portion of the chamber diverging from said neck to an opposite end of said chamber, means comprising a perforate member extending across the diverging portion of said chamber and intermediate said neck and said opposite chamber end for releasably retaining the strand thereon, and inlet means along said chamber at said neck for the injection of fluid into said chamber in a direction from said neck toward said perforate member to move the strand into the chamber, and means at said end on a side of said perforate member opposite said neck for alternately withdrawing fluid from the chamber through said perforate member to position the strand on the perforate member and, for injecting fluid through said perforate

member toward said mouth to eject the bunch from the chamber.

22. Apparatus as set forth in claim 20 in which said receiver has an end and a bobbin receiving gate mounted at said end for movement between a bobbin retaining position for releasably retaining a bobbin in the receiver and an open position for releasing the bobbin from the receiver, and said conduit has a portion extending from said one end for directing a stream along said bobbin.

23. Apparatus for processing a filled bobbin having an unwinding end of a strand, comprising means for forming into a bunch at least a portion of the end extending from the bobbin, the bunch forming means having a mouth for reception of the end of the strand and for passage of the bunch therethrough for receipt of the bunch by the bobbin, and means for positioning the bobbin and the mouth relative to each other for passage of the bunch to the bobbin.

24. Apparatus as set forth in claim 23 in which said bunch forming means comprises a chamber including said mouth, surface means spaced from said mouth for receiving the strand, and fluid control means for selectively passing fluid in a direction generally away from said mouth and toward said surface means to deposit a sufficient length of the strand on the perforate member to form a bunch, and for passing fluid in a direction generally from said surface means and toward said mouth to move the bunch toward the mouth.

25. Apparatus as set forth in claim 24 in which a portion of the chamber diverges from proximate said mouth toward said surface means.

26. Apparatus as set forth in claim 25 in which said chamber has a neck extending from said mouth toward the diverging portion of the chamber.

27. Apparatus as set forth in claim 26 in which said neck is substantially cylindrical.

28. Apparatus as set forth in claim 27 in which said fluid control means includes ports proximate said neck for passage of said fluid into said chamber.

29. Apparatus as set forth in claim 25 in which said surface means is a perforate member.

30. Apparatus as set forth in claim 29 in which said fluid control means includes positioning means for passing fluid from the chamber through said perforate member to so position the end on said perforate member, and further includes delivering means for passing fluid through said perforate member toward said mouth to move the bunch from said perforate member toward said mouth.

31. Apparatus as set forth in claim 30 in which said positioning means includes means adjacent said mouth for injecting fluid into said chamber in a direction from said mouth toward said perforate member to move the strand into the chamber.

32. Apparatus as set forth in claim 23 including strand handling means for receiving the end from the bobbin and delivering the end to the bunch forming means.

33. Apparatus as set forth in claim 32 in which said strand handling means includes a conduit having a portion adapted to extend along the bobbin for so receiving the end, and the bunch forming means communicates with said conduit for receiving the end therefrom.

34. Apparatus as set forth in claim 33 in which said conduit has a slot for directing a stream along said bobbin and for passage of said end therethrough.