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Snyder et al.

[11] **3,878,026**

[45] **Apr. 15, 1975**

[54] **ELECTRICAL COMPONENT SEQUENCER AND TAPER**

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[73] Assignee: **Universal Instruments Corporation,** Binghamton, N.Y.

[22] Filed: **Aug. 23, 1973**

[21] Appl. No.: **391,030**

[52] **U.S. Cl.** **156/552;** 156/562; 53/200

[51] **Int. Cl.**..... **B65b 15/04;** B65h 5/26

[58] **Field of Search** ..... 156/552, 540, 541, 542, 156/559, 560, 562; 221/219; 53/198 R, 200; 206/330, 331; 29/203 R

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Primary Examiner—Charles E. Van Horn
Assistant Examiner—M. G. Wityshyn
Attorney, Agent, or Firm—Fidelman, Wolffe & Leitner

[57] **ABSTRACT**

An apparatus for removing electrical components from their manufacturing strip and taping them to form a continuous sequential group of components. The components are extracted as a group from a plurality of supply stations by a plurality of spindles and transported to a taping unit. The taping unit is driven by the linear movement of the spindle carriage and includes a take-up reel to receive the sequentially taped components.

9 Claims, 12 Drawing Figures

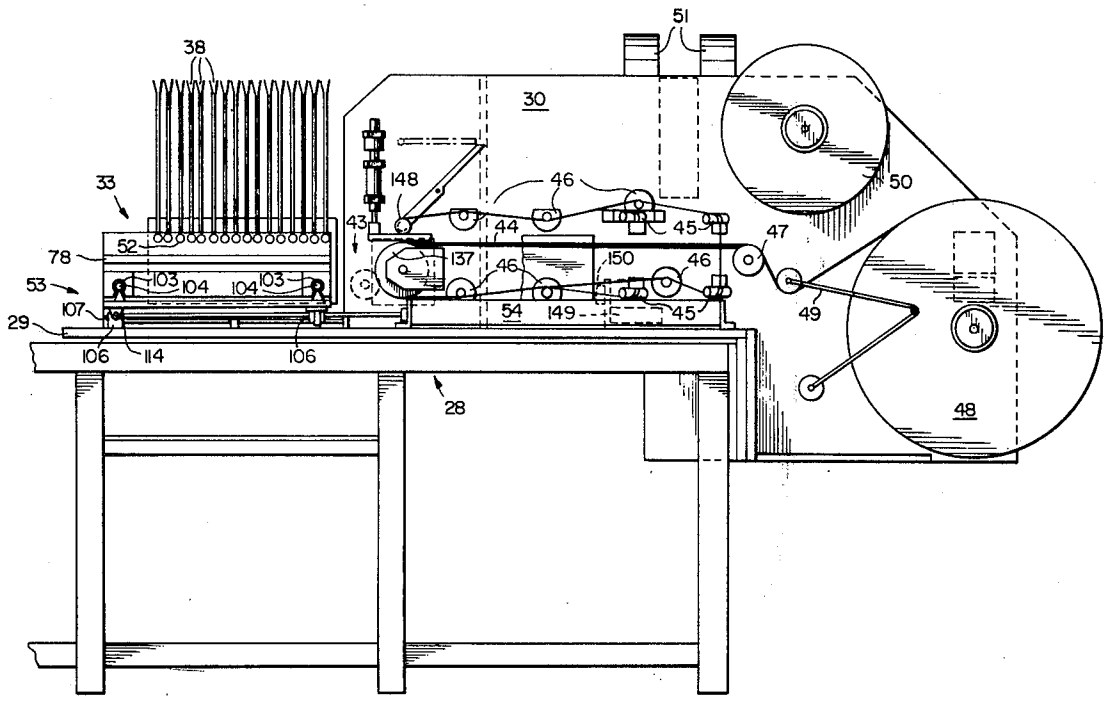


FIG. 1

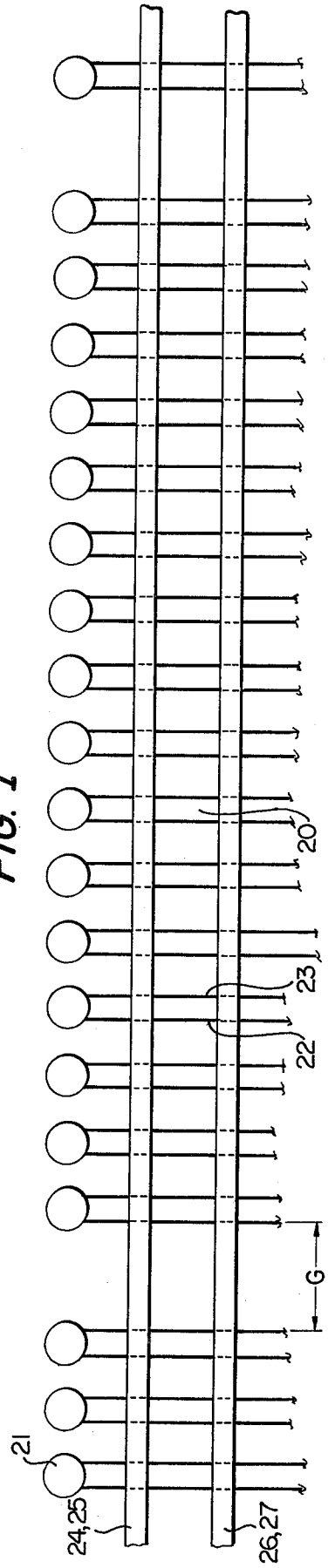


FIG. 7B

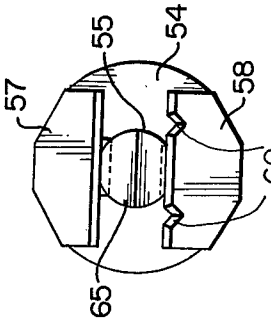
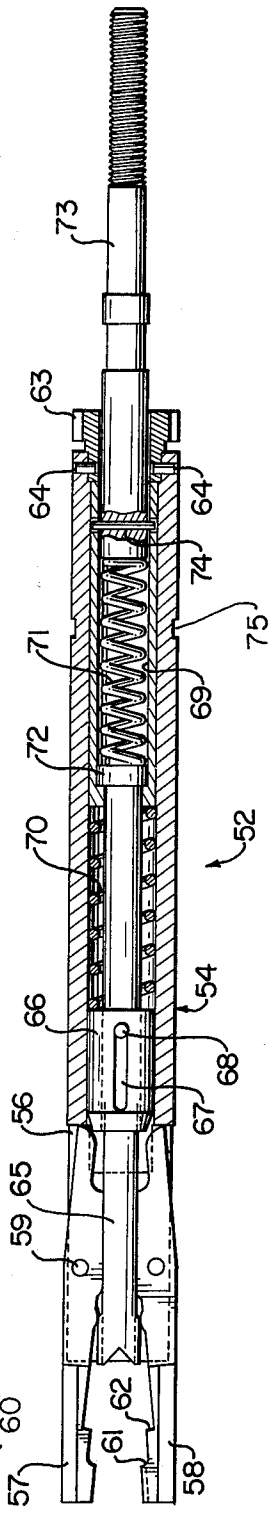


FIG. 7A



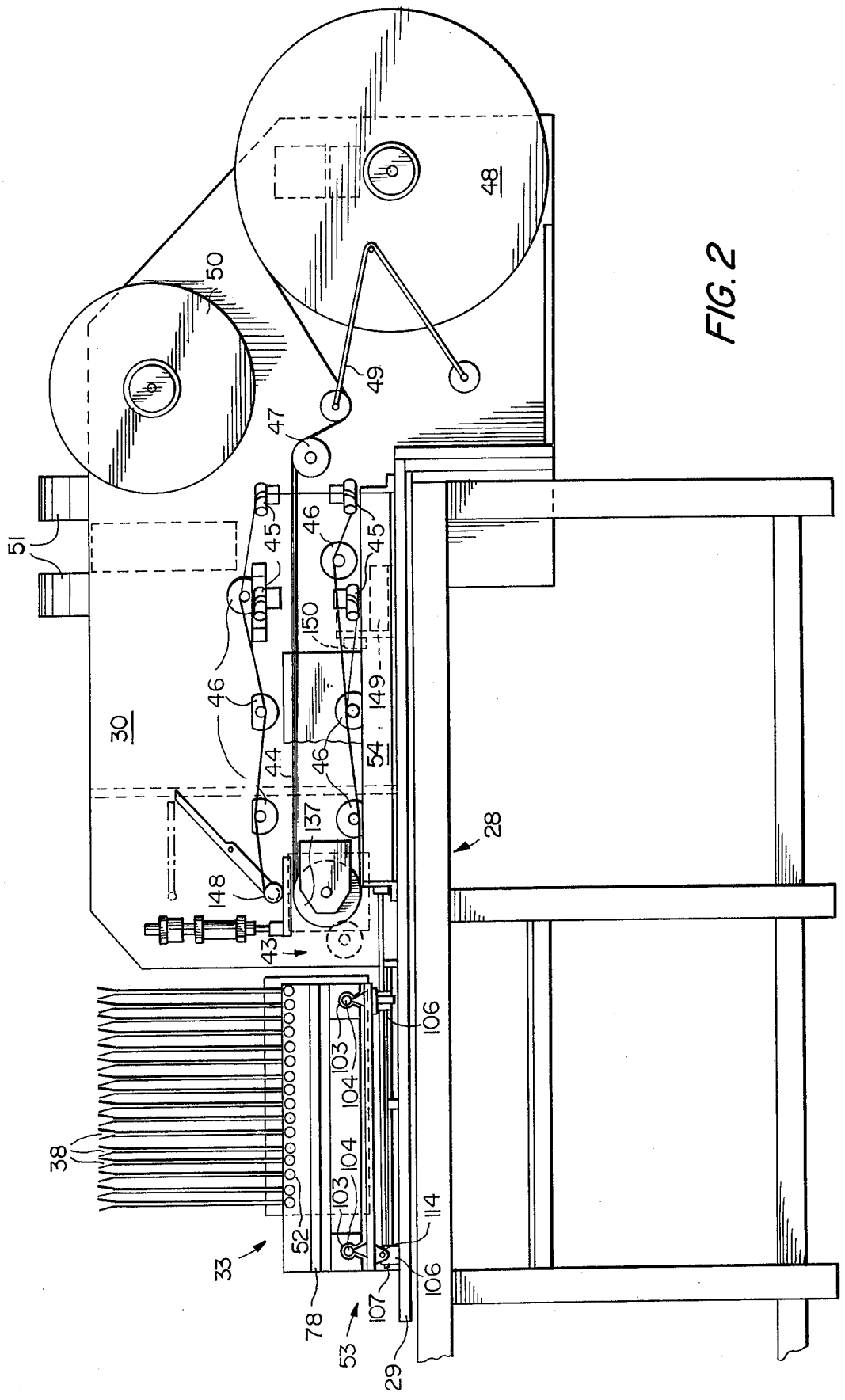

48
50
49
47
51
45
46
150
149
54
44
137
148
43
30
28
106
103
104
38
52
114
33
78
107
53
29

FIG. 2

FIG. 3

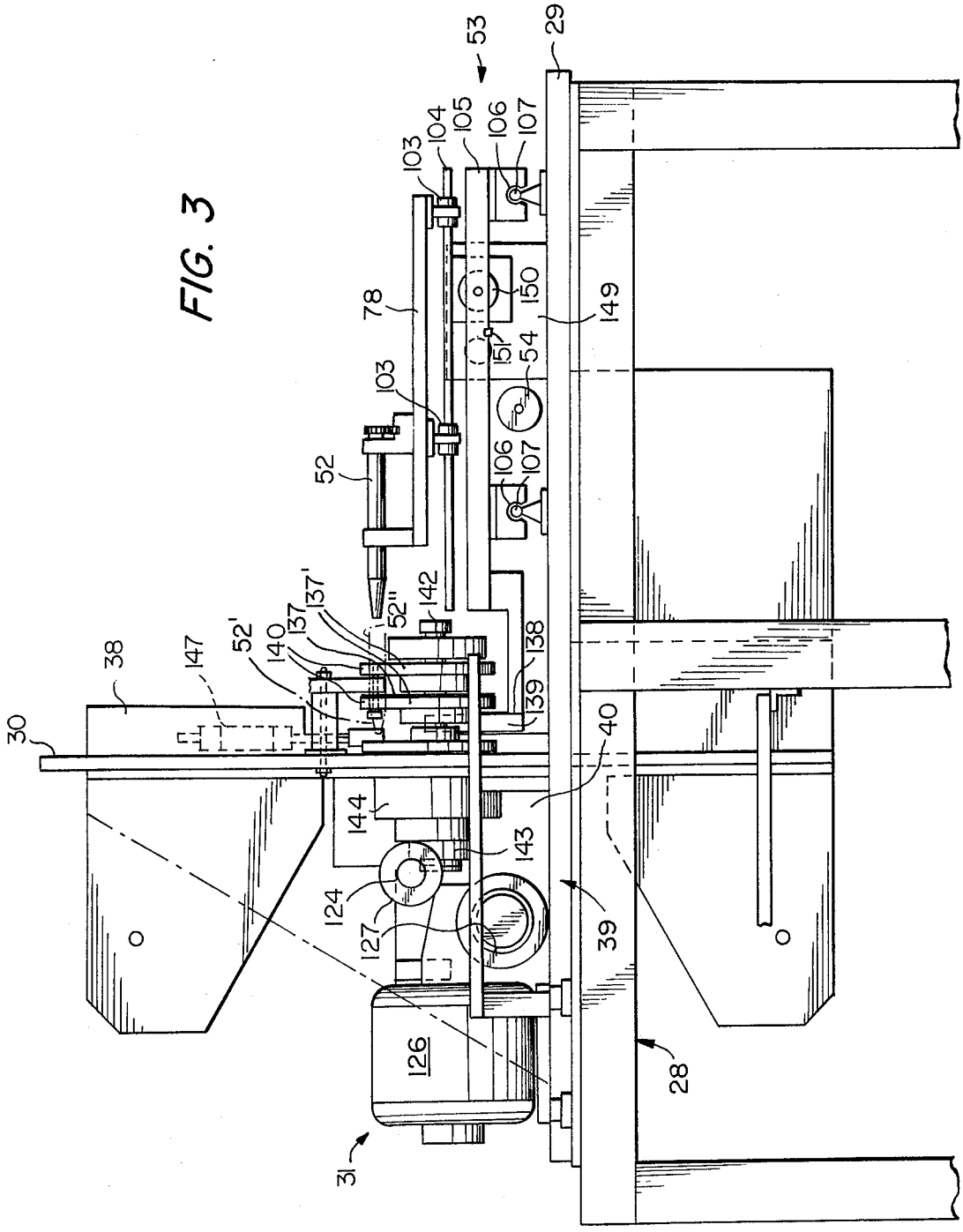

53
29
103
104
105
106
107
78
150
149
151
54
52
142
52''
137'
137
52'
140
147
38
30
138
139
40
144
143
124
127
39
126
28
31

FIG. 4

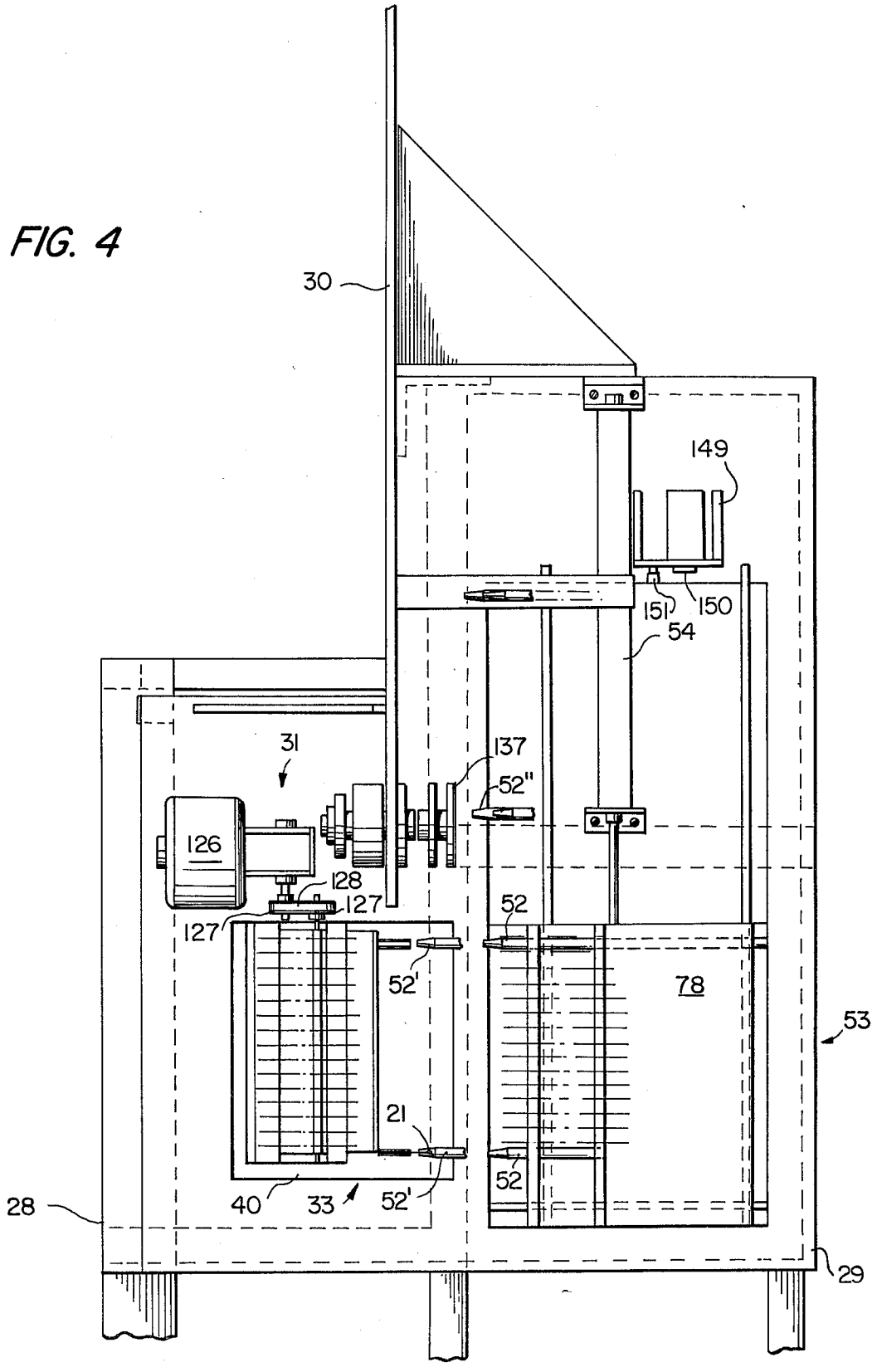
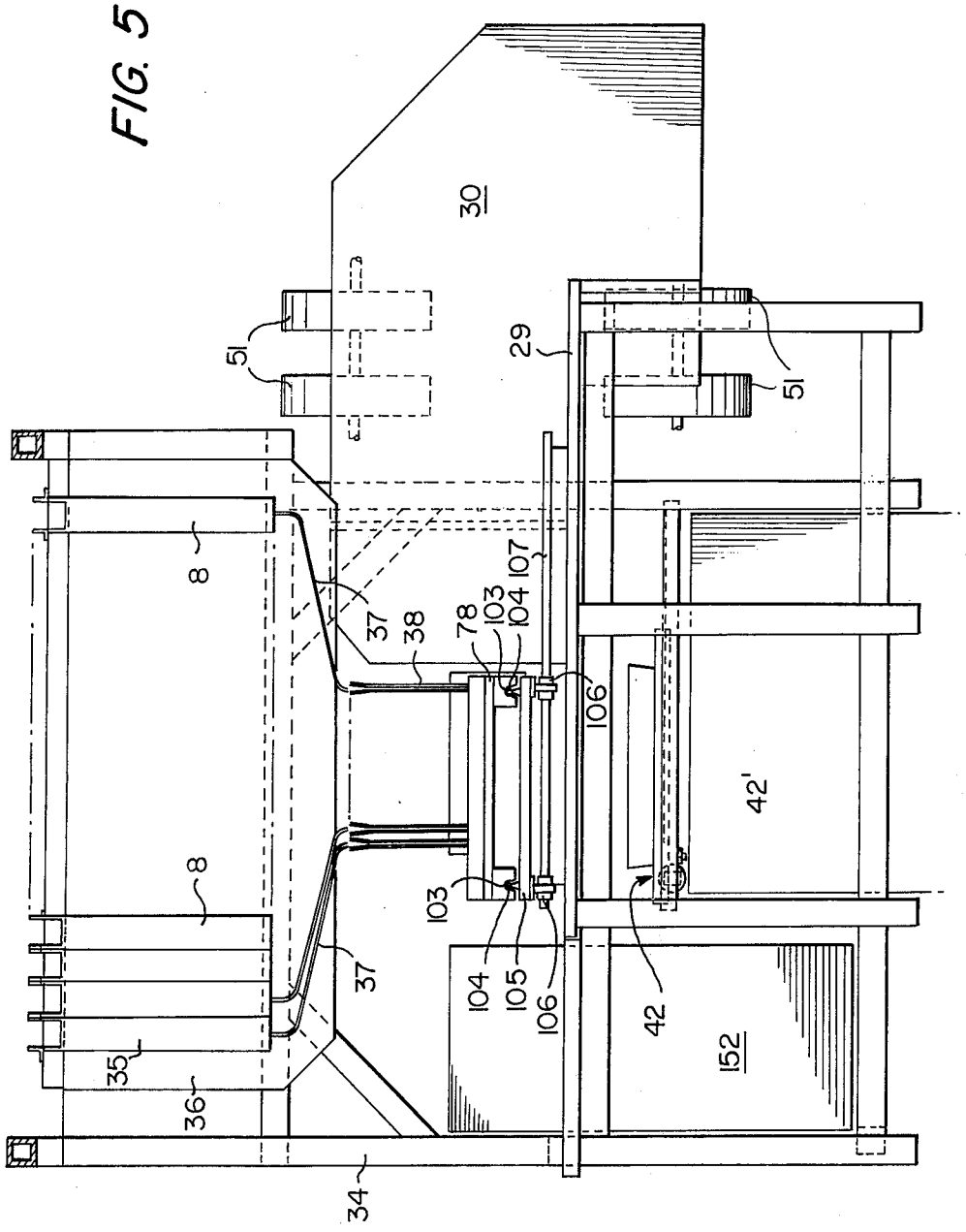

30
149
151
150
54
31
137
52"
126
128
127
127
52
52'
78
53
21
52
28
40
33
52'
29

FIG. 5


30
51
29
51
8
37
38
78
103
104
107
106
42'
8
103
37
104
105
106
42
152
35
36
34

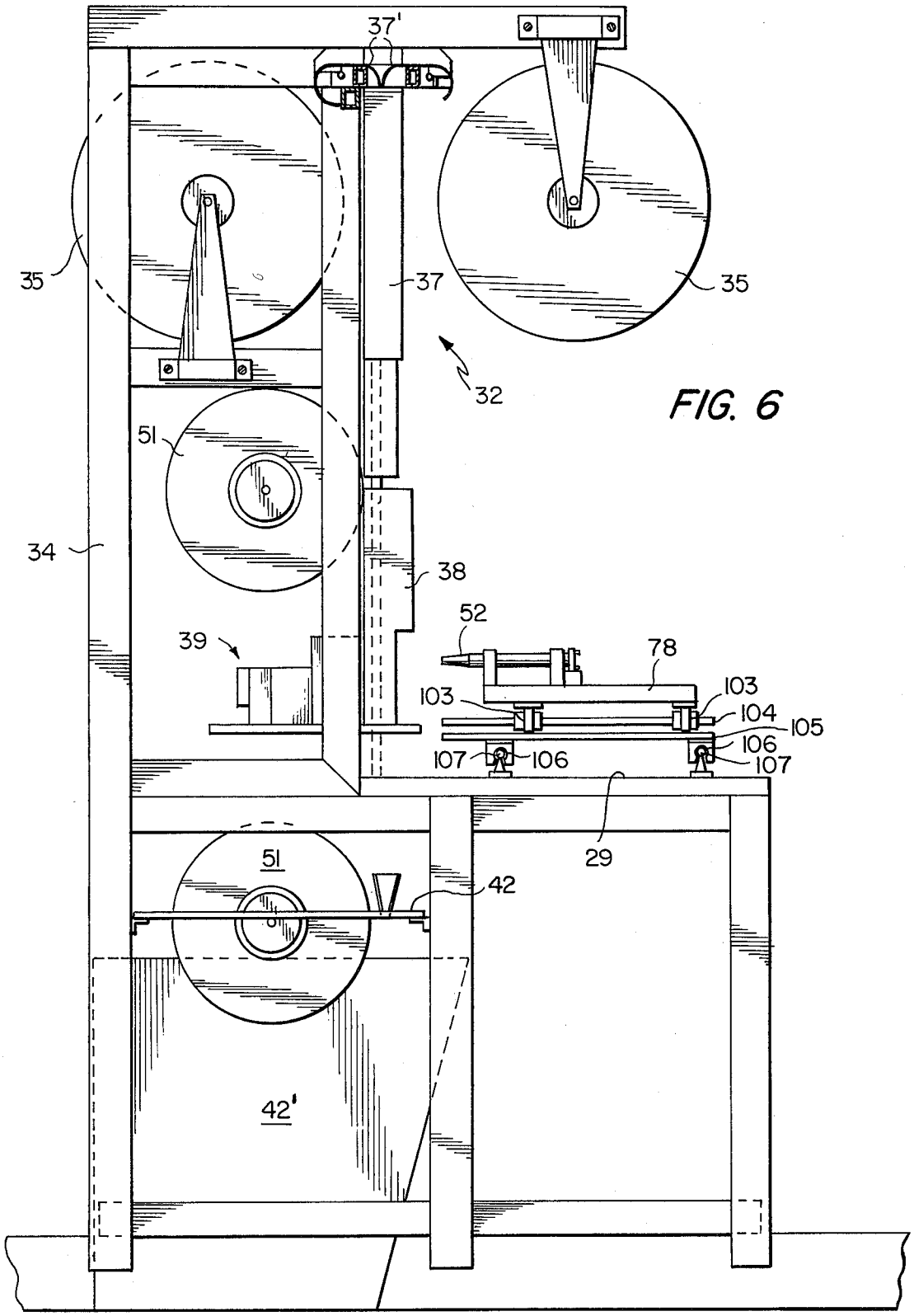
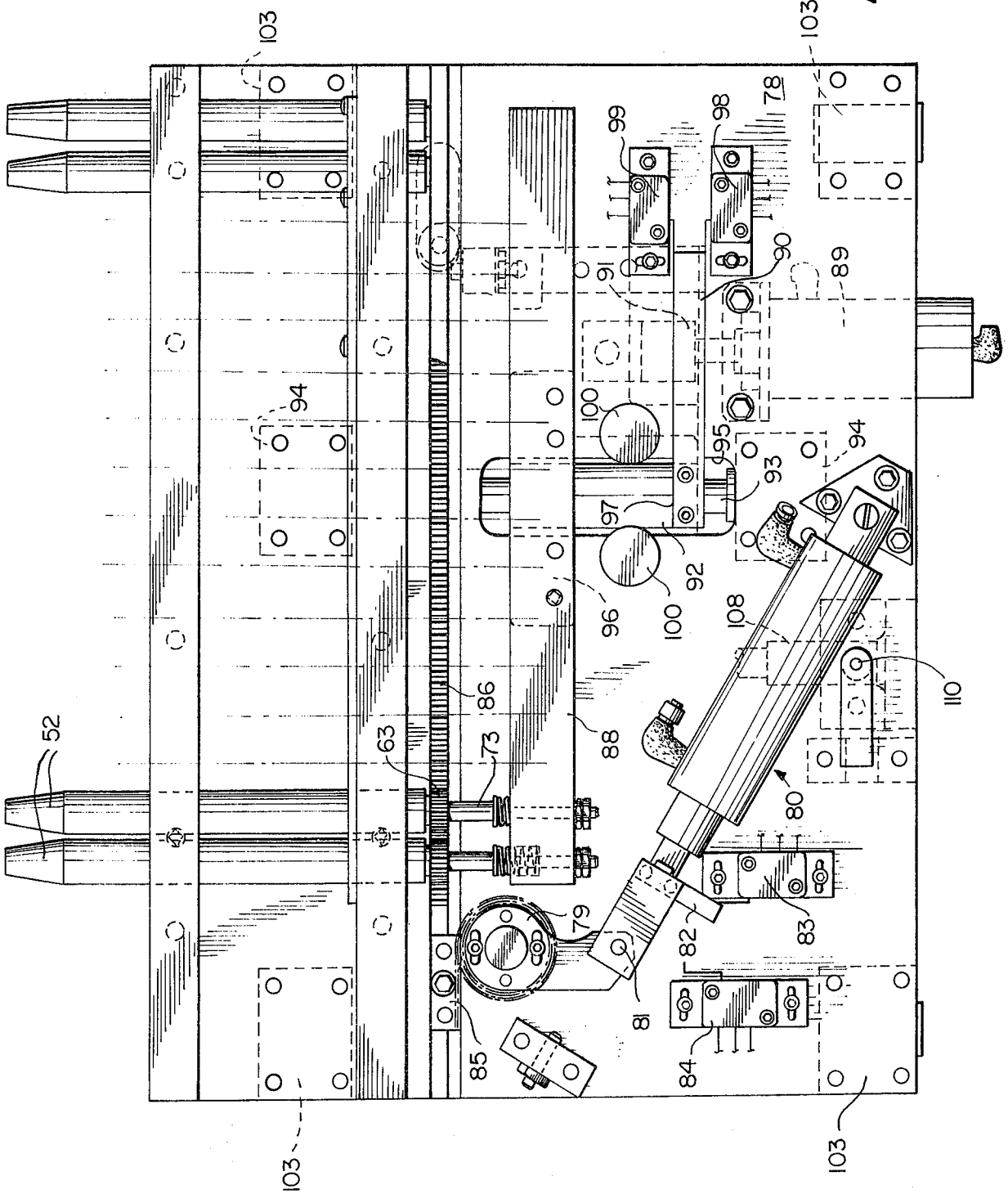

37'
35
37
35
32
51
34
38
52
39
78
103
103
104
105
106
107
106
107
29
51
42
42'

FIG. 6

FIG. 8


103
103
78
99
98
90
89
91
100
94
95
93
97
92
96
108
110
86
88
52
63
73
80
79
82
83
81
84
85
103
103

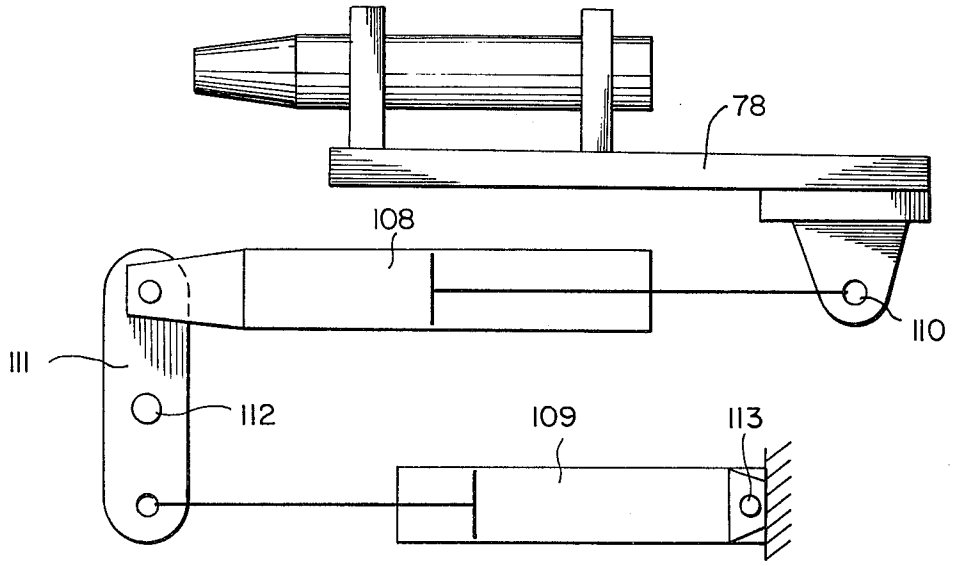

78
108
110
111
112
109
113

FIG. 9

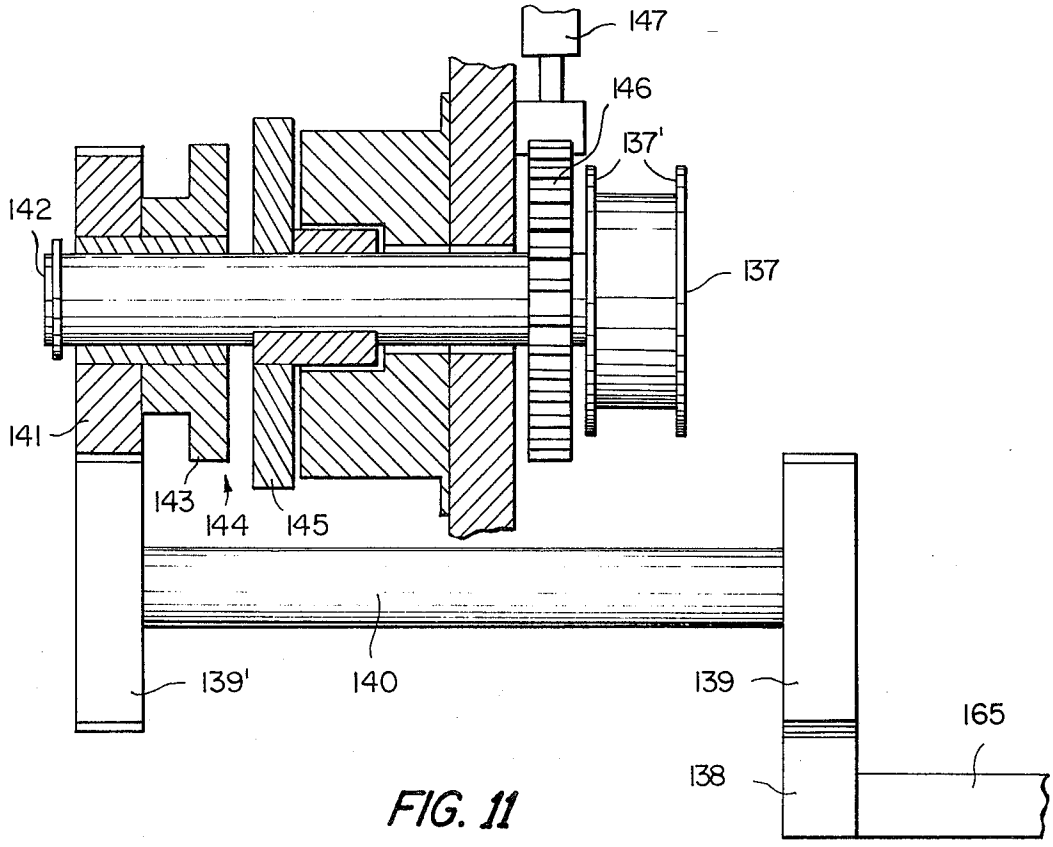

147
146
137'
142
137
141
143
144
145
139'
140
139
165
138

FIG. 11

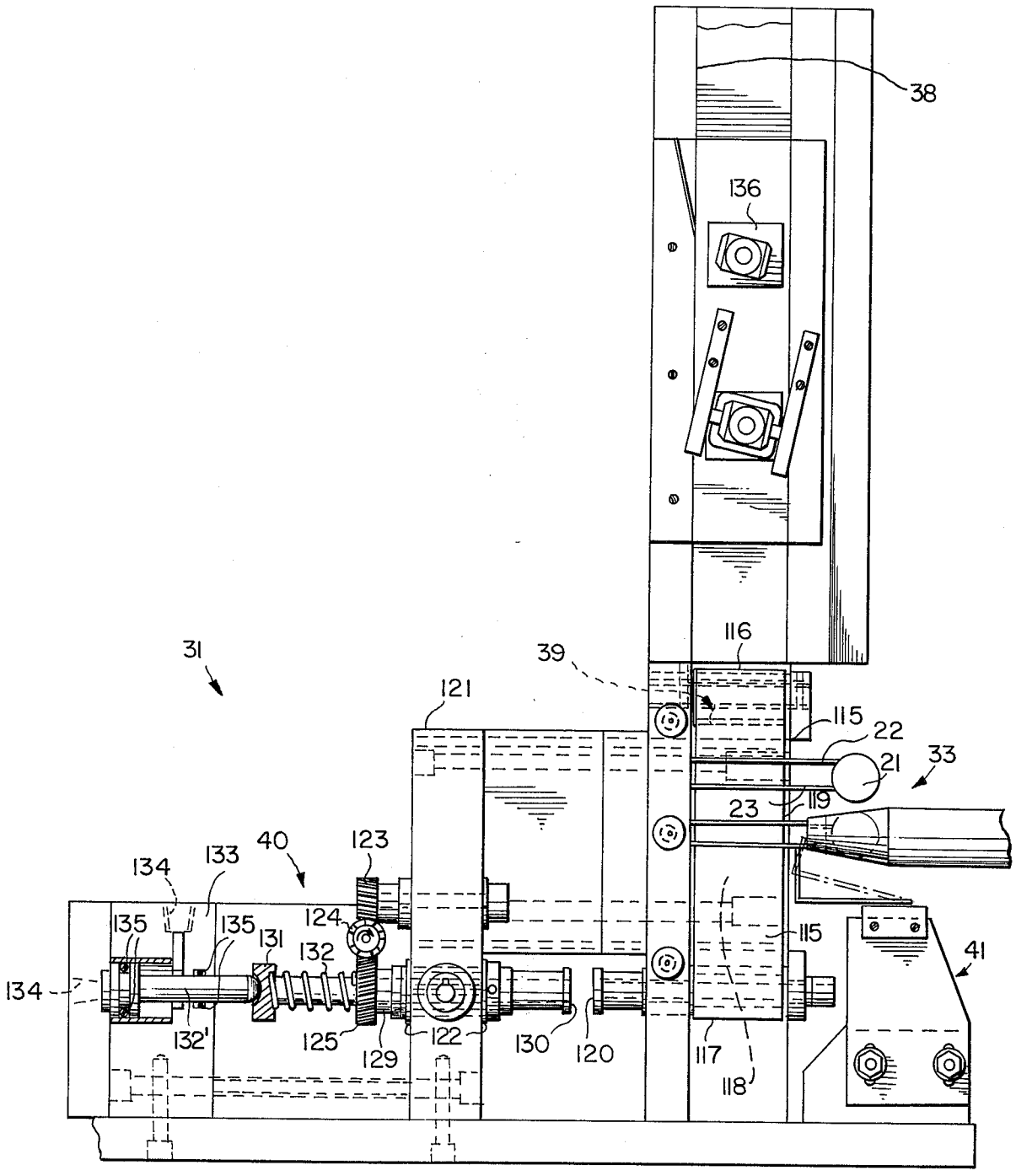

38
136
116
39
31
121
115
22
21
33
23
119
40
123
134
133
124
135
135
131
132
115
41
134
132'
125
129
122
130
120
117
118

FIG. 10

ELECTRICAL COMPONENT SEQUENCER AND TAPER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an apparatus for removing electronic components from their manufacturing strips and taping them in sequence between continuous ribbons of adhesive tape with equal spacing and having a check gap between preselected sequential groups.

2. Description of the Prior Art

In the field of electronic component insertion devices, there are many machines which will insert components having axial leads. The older machines include a bin storage taking one component at a time and inserting it into a printed circuit board. The newer machines utilize electronic components which are sequenced and taped and then placed on a continuous roll to be fed into the newer insertion machines. By taping components in sequence or order, the machine can proceed without using a plurality of supply stages.

Though there are a large number of machines which will tape, sequence and insert axial lead electronic components, there are very few machines which will tape or sequence or insert electronic components whose leads are not axial. Two major examples of non-axial lead components are transistors and disc capacitors. An example of a machine which will tape transistors for later use and insertion in a machine is U.S. Pat. No. 3,616,089, dated Oct. 26, 1971 This patent is assigned to Universal Instruments Corporation, the assignee of the present invention. This patent also exemplifies the processing of loose electrical components from a bin to a sequential tape. Further, a machine which will insert taped non-axial lead components is disclosed in U.S. Pat. No. 3,636,624, dated Jan. 25, 1972, which is also assigned to Universal Instruments Corporation.

Electronic components, for convenience and component handling, are presently being shown in some form of packaging. This form of packaging is generally a manufacturing strip having the components attached thereto as shown, for example, in U.S. Pat. No. 3,135,375. Because of the present state of the art of the electric component shipping and packaging strips, there is a need for a machine which can process the electronic components from the manufacturing strips into a taped sequence of components for use in a standard electronic component insertion devices of the prior art.

SUMMARY OF THE INVENTION

The present invention is an apparatus for removing electrical components from a manufacturing strip and taping them in a continuous sequential group of components to be used in standard electronic component insertion machines. A plurality of manufacturing strips of electronic components present electronic components in a vertical plane wherein a plurality of transport means remove one electronic component apiece from the plurality of manufacturing strips. The plurality of transport means are spindles mounted to a single carriage which, upon removing the electronic components from the manufacturing strip, rotate the electric components and their leads 90° from a vertical plane to a horizontal plane. Each supply station for each manufacturing strip contains individually controlled drive means responsive to a sensor which detects the presence of electronic component at the extraction position to individually control the drive means.

After extraction and rotation, the spindle carriage moves in a horizontal plane in a direction orthagonal to the extraction motion to a taping unit. There the linear movement of the spindle carriage drives the taping unit so that the tapes and electronic components are moved at the same speed and are taped with the same spacing as that of the spindles. Once all the components have been taped, the spindle carriage moves in the reverse direction and a locking means prevents the taping unit from being driven by the reverse motion.

The present apparatus includes a take-up reel and an interliner for the tap components on the take-up reel. Below the extraction station is included a bin and a cutter for cutting the manufacturing strips into small pieces.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide a device for sequencing and taping electronic components which do not have axial leads.

Another object is to provide a sequencing and taping machine which extracts components from manufacturing strips.

A further object of the present invention is a common spindle carriage which moves in two orthagonal directions in a horizontal plane between the supply station and the taping unit.

Still another object of the present invention is the driving of the taping unit by the spindle carriage so that the components are taped at the same spaced interval as the spindles.

It is a still further object of the present invention to provide individual control and drive for the strip supply so that each supply station will guarantee the presentation of a single component to be extracted and taped without stopping the machine for missing parts in the manufacturing strip.

Other objects, advantages and novel features of the present invention will become evident from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view of the electronic components taped in a preselected sequence with a check gap;

FIG. 2 is a front view of the electronic component sequencer and taper without the component strip supply unit;

FIG. 3 is a left side view of the electronic component sequencer and taper without the component strip supply unit;

FIG. 4 is a top view of the electronic component sequencer and taper without the strip supply unit and the tape supply;

FIG. 5 is a front view of the strip supply unit and the cutter assembly;

FIG. 6 is a left side view of the strip supply unit of the tape supply and the cutter assembly;

FIGS. 7*a* and 7*b* are a sectional side view and end view, respectively, of the spindle assembly;

FIG. 8 is a top view of the spindle carriage;

FIG. 9 is a schematic of the drive assembly for the spindles in the Y direction;

FIG. 10 is a left side view of the strip drive assembly;

FIG. 11 is a schematic of the pitchwheel drive assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a segment 20 of sequenced and taped electrical components 21 having non-axial leads 22 and 23. The leads 22 and 23 are taped or retained between continuous tapes 24, 25, 26 and 27. As shown in segment 20 and as will be explained in the more detailed description of the present invention, sixteen electrical elements or less are sequenced upon a strip having a check gap, indicated as G, between sequential groups. The output yield of the machine may vary depending upon the number of parts in the sequence.

Using a base sixteen sequence, sequences of less than sixteen parts in length may be taped; however, the maximum output yield of the machine will be diminished. For example, an eight part sequence will require one complete machine cycle to tape eight parts since the two eight part sequences plus a check gap therebetween will sum to seventeen. Thus, using an eight part sequence, the efficiency of the machine would be cut in half. With a seven part sequence, however, two complete sequences plus a separating check gap (summing to fifteen) may be taped in one machine cycle, giving the yield of fourteen/sixteen or 87.5 percent of the maximum yield using a sixteen component sequence length.

OVERALL STRUCTURE

FIGS. 2–6 show the overall structure of the present sequencer and taper, which extracts electrical components from their manufacturing strips and tapes them in sequence. The sequencer and taper consists of a base frame 28 and tabletop 29 with a vertical support structure 30 running longitudinally down the machine, projecting upward.

Behind the vertical support structure 30 is mounted the strip drive assembly 31 for powering the strip transport mechanism which moves the cardboard manufacturing strips in which the electrical components are carried from the source or supply station 32 to an electrical component support or extraction station 33. Bolted to the tabletop 29 is a removable supply structure 34 which supports and positions 16 spools 35 of cardboard strip-mounted components. This supply structure 34 may be removed to facilitate running unspooled components. The spools 35 are positioned side-by-side in two rows of eight; one row on the side of the vertical supply support plate 36 towards the operator; and one row on the rear side of the vertical support plate 36. Mounted on the supply structure 34 which also holds the spools are sixteen strip-twist sections 37 which provide the vertical drop through which the cardboard strip is passed while being twisted 90° such that the cardboard is presented edgewise to the operator side of the machine, with the heads of the components 21 protruding from the cardboard towards the operator. At the top of strip-twist section 37 are strip entrance guides 37'.

Leaving the strip-twist section 37, each strip enters a guide 38 and has been closed to a distance therebetween equal to the distance between the individual transport spindles, which is also the distance desired between the respective electrical elements in the taped sequence. At the lower end of strip guide 38 is an electrical component drive section 39 which is motor driven as will be explained more fully in the description of FIG. 10, until an electrical component 21 is at component extraction position. Each electrical component drive section 39 is individually controlled by an individual selection assembly 40 which is responsive to a part sensor or microswitch 41, to cause the electrical component drive section 39 to drive the strips until the microswitch 41 senses or determines the presence of an electrical component in an extraction station or position 33. Once the electronic component is removed from the strip, the strip is driven further downward until an electrical component is in the extraction station. The strip moves down through an opening in the table top surface 29 and into the strip twist and cutter section 42. There it is cut into pieces or short lengths and dropped into a basket or bin 42'. The vertical support structure 30 which extends towards the right side, as seen in FIG. 2, supports the pitchwheel drive section 43, the taped components guide 44, the tape skew rollers 45, the tape guide rollers 46, taped component guide roller 47, and the take-up reel 48, take-up drive control dancer 49, and interliner spool 50. On the back side of structure 30 are supported tape spools 51 and the drive for the take-up spool.

A plurality of spindles 52, which as shown in the present embodiment is sixteen, are mounted upon a common spindle carriage 53 which moves along a horizontal table top surface 29 in two orthagonal directions, i.e., X and Y. The X direction is to the right in FIGS. 2 and 5, and the Y direction is to the left in FIGS. 3 and 4. The X and Y axes are orthagonal and form a plane parallel to the table top surface 29. The carriage 53 is shown in a home position, i.e., to the front and left side of the table top surface 29. The carriage moves in a Y direction towards the back of the table to a position indicated in phantom as 52', wherein it engages the electrical component 21 at their extraction station. The spindle carriage 53 is then retracted to a midway position which is indicated in phantom as 52'', thereby extracting the component from its cardboard manufacturing strip and moving it to the taping unit. Drive cylinder 54 moves the carriage in the X direction to the right to the taping unit.

When the first spindle 52'' reaches the taping unit, the linear X motion of the spindle carriage 53 drives the pitch wheel drive section 43 so that the tape and the periphery of the pitchwheel are moving at the same linear speed as the spindle carriage 53. By maintaining equal linear motion, the electrical components are taped with a separation equal to the separation between the spindles 52. As will be explained more fully in reference to FIG. 11, the pitch wheel drive section 43 includes a locking means to prevent rotation of the pitchwheel drive 43 during the reverse X motion of the spindle carriage 53 when the carriage returns to its original or home position once the sixteen components have been sequentially taped.

SPINDLE ASSEMBLY

The spindles 52, shown in cross-section detail in FIGS. 7*a* and 7*b*, consist partially of a cylindrical body of housing 54 with a bore 55 running longitudinally through it. The cylindrical body 54 has a slot 56 at the component end running across the face thereof to provide a nest for the component recieving means or part-

clamping jaws **57** and **58.** Two pins **59** inserted at 90° to the slot provide the support for the jaws and allow them to pivot.

The jaw **58** has two channels or grooves **60** in which the leads of the electrical components lie during extraction from its manufacturing strip and transporting to and through the taping unit. The jaws **57** and **58** each have two indented or decreased width sections, **61** and **62.** At the rear of the cylindrical body **54** is a groove **75** into which a locking plate fits, preventing any movement of the spindle body in the bearings on the spindle carriage. A spur gear **63** is pressed into the rear end of the cylindrical body and secured to it by two pins **64.** As will be discussed in detail in FIG. **8,** the spur gear is driven to cause the cylindrical body **54** to rotate the electrical component from a vertical to a horizontal plane. Contained within the body is a component clamp rod **65,** the forward end of which is shaped such that when it is retracted, the jaws **57, 58** are cammed open and when the clamp rod is extended, the jaws **57,** 58 are free to close. A collar **66** with two slots **67** rides on the component clamp rod **65** and is constrained by a pin **68** pressed into the component clamp rod **65** to travel back and forth. The collar **66** is stopped by the pin contacting the ends of the slots. Also contained within the cylindrical body **54** is a chamber **69,** a collar spring **70,** and a clamp spring **71.** The collar spring **70** exerts pressure between the chamber end and the collar **66** and the clamp spring **71** exerts pressure against the end **72** of the component clamp rod **65** and the end of the push rod **73.**

The push rod **73** extends through the spur gear **63** at the rear of the cylindrical body and is pinned to the chamber at **74.** Thus, by extending the push rod **73,** the chamber **69** moves forward, carrying with it the component clamp rod **65.** As the chamber moves forward, the collar **66** moves with it until the bevelled front edge of the collar contacts the after end of the jaws **57, 58** and causes them to close. When the jaws are closed, the component clamp rod **65,** in its free position would be forward in the jaws far enough to clamp the smallest diameter component. If a large diameter component is in the jaws, the component clamp rod **65** is free to move back in the jaws compressing the clamp spring **71.**

SPINDLE CARRIAGE ASSEMBLY

The spindle carriage assembly **53** is made up of two subcarriage assemblies to be signified as the X assembly and the Y assembly, which moves the spindles **52** in the two orthagonal directions previously discussed.

The Y assembly shown in detail in FIG. **8** consists of the supporting structure **78** to hold the sixteen spindles **52,** as well as carrying the mechanisms to rotate the spindles and open their jaws. The spindles **52** must rotate **90** degrees from a jaws vertical position at which the spindles extract the electrical components from their manufacturing strip, to a jaws horizontal position at which the electrical components are taped. To accomplish this, a spindle rotation pinion gear **79,** which is mounted on the Y supporting structure **78** is rotated by means of a spindle rotation air cylinder **80** which is connected to pinion gear **79** by pin **81.** Extending transversely from spindle rotation cylinder **80** is an arm **82** which comes in contact with microswitches **83** and **84,** which sense the fully extended or retracted position of the spindle rotation cylinder **80.** The microswitches are connected to a central control unit which controls the supply of air of the spindle rotation cylinder. It should be noted that activation of microswitches **83** and **84** represents the spindle jaws' vertical and horizontal positions, respectively.

The spindle pinion **79** meshes with a spindle rotation drive rack **85** which is secured to a spindle rotation rack **86.** When the spindle pinion **79** is rotated by spindle rotation cylinder, the spindle rotation drive rack **85** and spindle actuator rack **86** move to the right, causing the sixteen spindles **52** to rotate through 90° simultaneously. The jaws **57** and **58** on the spindles **52** are opened and closed by the jaw opening cylinder **89,** secured to the underside of Y supporting structure **78,** actuation of which causes a pushrod actuator bar **88** to move, which drives the sixteen pushrods **65** simultaneously. The jaw opening cylinder **89** has a plate **90** pinned at **91** thereto, which is secured to a slide **92** which moves along rod **93** secured by brackets **94** to the underside of Y support structure **78.** The slide **92** extends through a slot **95** in the Y support structure **78** and is secured to pushrod actuation bar **88** by a transverse member **96.** An L-shaped **97** extends from the slide **92** and comes in contact with microswitches **98** and **99,** which sense the open or closed position of the spindle jaws.

The Y assembly has four bushings **103** secured to its underside which receive two rods **104** which are secured to the X assembly support structure **105.** similarly, the X assembly support structure **105** has four bushings **106** secured to the underside thereof, which receive two rods **107** which are secured to the table top **29.** The spindles **52** may be moved therefore in the Y direction by movement of a Y assembly drive and in the X direction by the movement of an X assembly drive. Y assembly drive is shown schematically in FIG. **9,** and consists of two cylinders **108** and **109,** each of which may be operated independently. This gives the Y assembly four discreet positions, i.e., **52, 52′, 52″** and one position not used, given by the full extension or retraction of two cylinders in various permutations. Cylinder **108** is pinned at **110** to the Y supporting structure **78** and at its other end to a connecting rod **111** which is pivotally fixed to the X assembly. The other end of connecting rod **111** is pinned to one end of cylinder **109,** whose other end is secured to the X assembly at **113.** The X stage, as previously described, is driven by cylinder **54,** which is secured to the table top **29** and attached to the underside of X stage at **114.**

STRIP DRIVE ASSEMBLY

The strip drive assembly **31** consists of sixteen electrical component drives sections **39,** each having a driven rubber endless belt **115** stretched over a pair of rollers **116** and **117,** the latter (**117**) having the driven roller. The belt face presses one side of the manufacturing cardboard component strip, the other side of the strip being in contact with a metallic guide wall (not shown). A support block **118** mounting and separating the two rollers **116, 117** contains spring-loaded rolls **119** which push the middle section of the drive belt **115** away from the support block, thus lowering friction and giving a degree of compliance to the "sandwich" area between the belt surface and the metallic guide, through which the strip passes. The driven roller **117** has a toothed clutch face **120** protruding out the back of the roller to be selectively engaged and driven by the selection assembly **40.**

In order to drive these rollers, a mechanism is employed as follows: a selection assembly support block **121** is mounted to table top **29** and supports a bushing **122** and worm-gear assembly comprising a worm idler **123**, a worm **124** and a worm gear **125**. All the worm gears **125** are connected to a single worm **124**, which is driven continuously by a single motor **126** through two pulleys **127** and a timing belt **128** (see FIGS. **3** and **4**). Extending through the center of the bushing **122** and worm-gear **125** is a shaft **129**, having a toothed clutch face **130** at its forward end and a concave aft end **131**. A spring **132** between the worm gear **125** and the concave end **131** of the shaft holds the clutch face **130** in its rearmost position (disengaged from clutch face **120**). The shaft **129** is keyed to the bushing-worm gear assembly such that it rotates with the worm gear, but is free to slide through it while rotating. Thus, when the shaft **129** is pushed forward, the clutch faces **120** and **130** mesh and the rotation of the worm gear **125** is transmitted to the belt-drive roller **117**. In order to push the shaft forward, a round-nosed piston **132'** is placed behind the concave face **131** of the shaft **129**. The pistons **132'** are housed in a common support **133** which has a plurality of pairs of forward and aft air ports **134**, one for each component supply station. There is an air tight fit between the rounded nose position **132'** and housing support **133** by O-ring seals **135**. When air pressure is supplied to the aft air port, the piston **132'** is driven forward, causing the belt drive to be actuated. The individual operation of the air-driven pistons **132'** are controlled by sixteen part-sensor switches **41** for selectively turning each of the sixteen drives on and off individually.

Above the drive-belt section, in the strip guide area, are spring-loaded skew rollers **136** which, when strip material passes by, forces the strip edge to contact the rear wall of the strip guide **38**. In loading the machine, the strip is hand-fed over the skew rollers **136** until it contacts the drive belt **115**. After that, the strip is machine-driven whenever the drive roller **117** is rotated. Approximately midway down the length of the drive belt section, the lower lead **23** of a strip-mounted component **21** contacts a microswitch actuator or part sensor **41**. Actuation of this switch stops the drive of the respective drive roller.

PITCHWHEEL DRIVE ASSEMBLY

The pitchwheel drive assembly **43** consists of the mechanism to translate the linear motion of the X assembly support structure to a rotation of the taping pitchwheel **137** such that parts will be taped by the pitchwheel **137** at exactly the same rate that the spindles **52** travel by the pitchwheel **137**. Referring to FIG. **11**, the motion translation is accomplished by a gear rack **138** which is attached to the support structure and meshes with one of two change gears **139** and **139'**, mounted on a common shaft **140** which is supported by vertical support structure **30**. The second change gear **139'** also meshes with the pitchwheel driver gear **141** which free wheels on pitchwheel shaft **142**. Fastened to the pitchwheel drive gear **141** is one face **143** of an electromagnetic clutch **144** and the other face **145** of the clutch **144** is keyed to the pitchwheel shaft **142**. Also keyed to the pitchwheel shaft **142** is a detent gear **146** with seventeen detent positions. Above the detent gear **146** is a pawl **147** which is driven into engagement with the detent gear **146** when the clutch **144** is disengaged. This pawl **147** will accurately locate the pitchwheel **137** whenever it is driven into the detent gear **146**. The mechanism is such that when the clutch **144** is engaged and the detent pawl **147** is out, the motion of the X assembly support structure **105** causes direct rotation of the pitchwheel **137**. When the clutch **144** is disengaged and the pawl **147** is driven in to detent gear **146**, the motion of the support structure does not drive the pitchwheel **137**.

On top of the pitchwheel **137** is a pair of spring-loaded pressure rollers **148** (see FIGS. **2** and **3**) which apply the pressure needed to press the tape over the leads of the components being carried by the spindles **52**. The pressure rollers **148** may be manually removed from contact with the pitchwheel rollers **137'** to facilitate loading the machine with tape. At the exit of the pitchwheel taping point, a horizontal guide **44** supports the taped components along their route to the take-up spool **48**, where interliner paper from spool **50** may be applied and the components wound in the usual way.

The linear motion of the X assembly is limited by an adjustable snubber **149**. The snubber is adjustably secured to table top **29** and has an elastomeric shock absorbing material **150** to receive the lateral edge of the X assembly. The snubber may be positioned at 0.75 inch increments along the length of the X assembly travel path to allow the taping of a sequence whose length is less than the sixteen electro-component sequence used as an example in the preferred embodiment. A limit switch **151** is located on the X assembly to sense the end of the X assembly's rightward movement.

TAPE SPINDLE ASSEMBLY

The present sequencer and taper mounts and supports the four 2-mile tape spools **51** on the rear side of the vertical support structure **30**. A spring loaded tensioner arm (not shown) provides a sprung take-up system to reduce the load transmitted to the pitchwheel drive due to the inertia of the tape spools. The tape is fed through holes in the vertical support plate **30** to the front side of the machine where the tape is run over rollers **45** to change the direction of the tape such that it feeds into the taping section properly.

CUTTER SECTION

The strip twist and cutter section **42** (not shown in detail) is located below the table top surface **29** and consists of a set of guides that will twist the empty cardboard strips approximately 55°, whereupon they will be cut by a single knife blade actuated by a pneumatic cylinder. After being cut, the scrap will drop into a scrap container **42'** located beneath the machine.

SEQUENCE AND TAPER OPERATION

The machine operation starts with the X assembly at the left hand position and the Y assembly at the position closest to the front of the machine. The spindles shown in the **52** position in FIG. **4** have their jaws **57** and **58** open and in the vertical position. Component clamp rod **65** is in the rear position. Electrical components **21** are in an extraction position at extraction station **33** such that microswitches **41** prevent the part belt **115** from being driven. The pitchwheel clutch **144** is disengaged and the pitchwheel locking pawl **147** engages detent gear **146**. Worm **124** is driven by motor **126** and the knife blade is in the retracted position. The

machine cycle proceeds with the Y assembly extending to its maximum forward direction, as signified by **52'**, with the jaws enveloping the component **21** and closing thereabout. The Y stage retracts to the middle or taping position, signified as **52''**. The spindles **52** rotate from a vertical to a horizontal position.

The part sensing switches **41** detect a missing part and cause the air pressure to be supplied to the aft port **134** to move the rounded nose piston **132** into engagement with clutch shaft **129** so that clutch plates **130** and **120** are engaged to drive the drive roller **117** which in turn drives belt **115.** The component drive mechanism remains on until the part sensor **41** senses that a part is present in the extraction position and disconnects the drive from drive roller **117.** The X stage then translates to the right to a point where the first spindle is 0.75 inches to the left of the taping pitchwheel center line. Pitchwheel locking pawl **147** is disengaged from detent gear **146** and the pitchwheel clutch **144** engages, thereby transmitting the linear drive of the X stage to the rotational drive of the pitchwheel.

The X stage then proceeds at an increased rate of speed until contacting the snubber **149** and switch **151** therein, indicating the end of the stroke. In response to dancer roll **49,** the take-up spool motor turns on, taking up the taped components. Also, at this point the pitchwheel locking pawl **147** is driven into engagement with detent gear **146,** locking it against further movement. Air pressure is removed from the jaw opening cylinder **89** and the jaws are opened. The Y stage retracts to the position closest to the front machine and the jaws rotate to the vertical position. The X stage retracts to the leftmost position of travel. The cutter assembly twists the strips and cuts it into small pieces and returns to its original position. At this point, the cycle is again repeated, starting with the movement of the Y assembly to the extraction station.

The operation of the sequencer and taper is controlled by an electronic unit located at **152** (See FIG. **5**). This unit receives inputs from various sensors and thereby controls the various drive units.

Although the invention has been described and illustrated in detail using sixteen as a base, the present invention could be made using any number for the base. The number of supply spools, spindles and teeth on the detent gear would all correspond to the new base. The base sixteen is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of this invention being limited only by the terms of the appended claims.

What is claimed is:

1. An apparatus for sequencing electrical components having leads extending from their bodies and taping said leads between ribbons of tape comprising:

a support means;

a plurality of supply means attached to said support means for storing a plurality of said electrical components;

taping means attached to said support means for taping said component leads between ribbons of tape;

a plurality of transport means, one for each supply means, each adapted to receive one electronic component from said supply means and transporting said components from said supply means to said taping means; and a transport support means supporting said plurality of transport means for linear movement simultaneously;

first drive means responsive to said transport means for driving said taping means;

a second drive means for moving said transport means from said supply means to said first drive means in a first linear direction; and

a third drive means for moving said transport support means to and from said supply means in a direction orthagonal to said first linear direction.

2. An apparatus as in claim **1** wherein said first drive means rotatably drives said taping means in response to linear motion of said transport means in said first direction.

3. An apparatus as in claim **2** including a locking means for preventing rotational movement of said taping means when said transport means moves in a direction opposite said first direction.

4. An apparatus as in claim **2** wherein said plurality of transport means each comprise a housing, two component receiving means pivotally mounted to said housing for receiving and holding an electrical component therebetween, and a control means for determining the pivotal position of said receiving means.

5. An apparatus as in claim **4** including a rotational drive means connected to said housing for rotating a held component 90°.

6. An apparatus as in claim **5** wherein said component receiving means each comprise at least one jaw having a plurality of grooves in one face thereof adapted to receive said electrical component's leads and an indented portion large enough to receive said electrical component's body.

7. An apparatus as in claim **6** including a clamping means in said housing and received in said jaw's indented portion for holding said electrical component's body secure in said housing.

8. An apparatus as in claim **2** wherein each of said supply means comprises:

a guide means for receiving a strip having a plurality of electrical components attached thereto;

a strip drive means to move said strip through said guide means to a component extraction station; and

wherein each of said transport means comprises component receiving means for extracting a component from said strip.

9. An apparatus as in claim **8** wherein said guide means receives said strip in a first vertical plane and presents said strip to said extraction station in an orthagonal vertical plane, and wherein said component receiving means extract said components in a vertical plane and transport said components in a horizontal plane.

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