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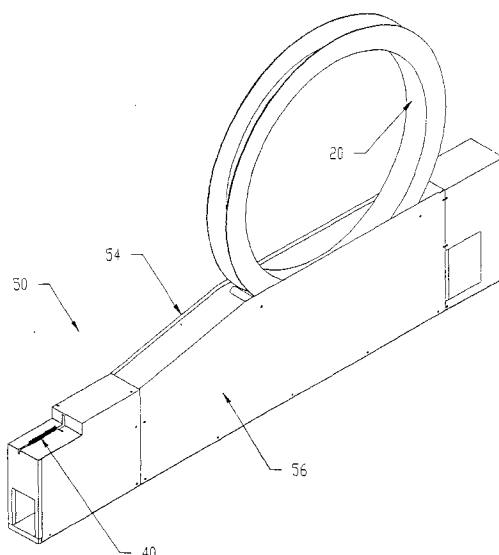
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(54) Continuous strip pin header feeder

(57) A programmable feeder system for handling a continuous strip of pin header stock. The feeder system responds to controller commands to advance the end of the pin header stock to a pin pulling station, pull a pin identified by the controller at the key position, cut a pin header to a programmed length, and hold the finished pin header at a pickup station for pickup by an insertion system. The feeder system includes a pin header strip

drive apparatus including a timing belt having lugs spaced to match the strip pin pitch and engage the pins in the strip. A stepper motor drives the belt to advance the strip under controller command to position the pin to be pulled at a pulling station, and thereafter to advance the strip by a distance needed to provide the programmed header length. A cut/clamp station clamps the advanced strip portion and cuts the receptacle strip to separate the pin header from the continuous strip.

FIG. 1



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Description

TECHNICAL FIELD OF THE INVENTION

This invention relates to feeder equipment used for automated cutting and handling of pin headers provided as a continuous strip.

BACKGROUND OF THE INVENTION

One type of connector device in common use today on printed circuit boards is known as the pin header. This device includes a number of conductive pins arranged in an aligned configuration of one or two rows by insertion into matching interconnected receptacles made of plastic. The pins extend through the bottom of the receptacles into a matching hole pattern formed in the printed circuit board (PCB), where the ends can be soldered or otherwise electrically connected to circuit elements or conductive traces. The exposed portion of the pins above the receptacle is available for jumpering, or other connection to circuit elements. Typically, to prevent misinsertion, one pin of the pin header is removed as a key, and the matching hole pattern for the PCB or the connector apparatus to which the pin header is to connect does not include a hole for the missing pin. This provides a keying function to prevent the part from being installed backwards.

A given PCB may be populated with pin headers of different lengths, i.e., different numbers of pins. As a result, the PCB fabrication processor has had to inventory a number of different pin header parts, and, in the case of insertion equipment used for automated population of the PCBs, a different feeder device would typically be required to handle each type of pin header part. This leads to increased capital cost of the insertion system, and increases the size of the insertion equipment station, since space for a number of feeders must be accommodated.

Recently, pin headers have become available in the form of reeled continuous pin headers. A very long continuous strip of the pin header is fabricated, with the plastic pin receptacles attached to adjacent receptacles to form the long strip. The strip is stored and supplied from a reel. This parts can then be cut to length as desired for a given application. One supplier of the continuous pin header system is Autosplice, 10121 Barnes Canyon Road, San Diego, CA 92121, which markets the "Autoheader" (TM) header system as a straight, single row .018, .020, .025 (inch) square/round pins on .100 inch centers. The same source also markets an "Autotrimmer" bench top automatic machine for cutting lengths of up to 40 pin positions from the reel.

There is a need for a programmable feeder apparatus for handling the reel of continuous strip of pin header so as to cut the part to a programmed length as commanded by an automatic insertion system controller, and make the cut part available at a pickup station

for pickup, e.g., by an insertion system arm for automated insertion into the PCB.

SUMMARY OF THE INVENTION

A programmable feeder system is described for programmably providing pin header connector devices of a programmed length size from a continuous pin header strip, the continuous strip including a continuous pin receptacle strip of a row of pin receptacles spaced apart by a given pitch and with pins disposed in the receptacles. The feeder system includes a programmable drive apparatus for engaging the pin header strip and advancing the leading edge of the pin header strip through a cutting station, the drive apparatus being responsive to control drive signals which set a programmed length of the strip to be advanced through the cutting station. A clamp/cut station is included for clamping the programmed length in place and for cutting through the continuous pin receptacle strip to separate the programmable length of the strip from the continuous strip to provide a pin header connector device of the programmed length size. In an exemplary embodiment, the programmable drive apparatus includes a continuous belt having a series of protruding cogs spaced apart by an integer multiple of the pin pitch, the belt engaging the pins of the continuous strip.

According to another embodiment of the invention, the feeder system further comprising a programmable pin removal station for removing a programmably selected pin from a corresponding pin receptacle of the advanced strip portion. The pin removal station includes a grip jaw for closing against the programmably selected pin, the grip jaw being secured to a movable platform, and a platform drive apparatus for moving the platform and jaw away from the corresponding pin receptacle to remove the pin.

In accordance with a further embodiment of the invention, the feeder system includes a reel suspension system for permitting the reel to rotate in response to tension forces exerted by the drive apparatus, lateral movement means permitting the reel to move laterally from a rest position in response to the tension forces, and biasing means for biasing the reel to return to the rest position. The suspension system prevents excess slack from forming in the portion of the strip unwound from the reel, which could otherwise cause a jerky motion and impact loads on the continuous strip.

BRIEF DESCRIPTION OF THE DRAWING

These and other features and advantages of the present invention will become more apparent from the following detailed description of an exemplary embodiment thereof, as illustrated in the accompanying drawings, in which:

FIG. 1 is an isometric view of a feeder system for feeding parts cut from a reel of continuous strip pin

header.

FIG. 2 is a side view of the feeder system, taken with a side cover removed.

FIG. 3 is a partial top view of the feeder system, showing the arrangement of the drive station, the pin pull station and the cut/clamp station.

FIG. 4 is an isometric view of a portion of the drive station comprising the feeder system.

FIGS. 5, 6 and 7 are respective top, side and end views of the strip drive station of the feeder system of FIG. 1.

FIG. 8 shows an enlarged view of a portion of the drive belt and the end portion of the continuous strip of pin head material, illustrating the engagement of the belt with the pins of the pin head strip.

FIG. 9 is a top view of a pin header part cut to length by the feeder system.

FIGS. 10 and 11 illustrate the pin puller clamp jaw assembly comprising the pin puller station, with the clamp jaws respectively in the closed and open positions.

FIG. 12 is a simplified front view of a portion of the pin puller station.

FIG. 13 is a simplified side view of a portion of the pin puller station.

FIGS. 14, 15 and 16 are respective simplified side, front and top views of the cut/clamp station of the feeder of FIG. 1.

FIG. 17 is a further simplified front view of the cut/clamp station, with elements removed to show the blade assembly.

FIG. 18 is a simplified side view of the cut/clamp station) showing the clamp and clamp tension spring without the cutter.

FIG. 19 is a simplified side view of the cut/clamp station, showing the cutter without the clamp and clamp tension spring.

FIG. 20 is a partial side view of the feeder system, illustrating the reel suspension system.

FIG. 21 is a partial side view of a feeder system employing an alternative embodiment of the reel suspension system.

FIG. 22 is a simplified schematic block diagram of the control system comprising the feeder system of FIG. 1.

FIG. 23 is a simplified operational flow diagram illustrating an exemplary operational sequence for the feeder system of FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows an isometric view of a continuous strip pin header feeder system 50 embodying this invention. In this embodiment, the pin header continuous strip is fed from a reel 20 which is supported for rotation on rollers comprising a reel suspension system, as will be described in further detail below. The system 50 includes

a drive station 100 which drives the continuous strip through a pin puller station 150 and a cut/clamp station 200 (FIGS. 2 and 3), and provides a pin header part 40 of programmable length at a clamped pickup location. The system 50 includes a pair of side cover plates 54 and 56 which extend parallel to the longitudinal feeder axis. A feature of the feeder system is its narrow footprint, which conserves valuable space around a work station with which the feeder system is used, e.g., an automatic PCB insertion system for inserting electronic components on a PCB.

A side view of the feeder system 50 is shown in FIG. 2, with the side cover plate 54 removed for clarity. As shown therein, the reel 20 rides on rollers 52A and 52B, and is constrained to a generally vertical orientation by the side cover plates 52A and 52B. A continuous strip 30 of the pin header material is wound around the reel 20, and an end portion of the strip is driven by a drive station 100 through a pin puller station 150 into a cut/clamp station 200. In reaction to the drive force on the end portion of the strip 30, the reel rotates on the rollers 52A and 52B in a counterclockwise direction, indicated by arrow 58 from the perspective of FIG. 2, as a length of the strip is unwound from the reel.

FIG. 3 is a partial top view of the feeder system 50, showing the linear feed path 125 of the continuous strip product 30 through the drive station 100, the pin pull station 150 and the cut/clamp station 200. Various sensors comprising the control system of the feeder are shown in FIG. 3 as well, including the home sensor 260, the left and right pin pull closed sensors 190 and 192, the part present sensor 230 and the cut open and cut closed sensors 240 and 250. The functions of the sensors will be described in further detail below.

The drive station 100 of the feeder system 50 is shown in detail in FIGS. 2-8. The station includes a stepper drive motor 102 which drives a belt pulley 104. A timing belt 108 is reeved around the drive pulley 104 and an idler belt pulley 106. The timing belt is a flexible belt having a series of spaced lugs 110 interconnected by link portions 110; the lugs are spaced by a pitch distance which in this exemplary embodiment is equal to twice the pin spacing in the continuous strip 30. Thus, the belt pitch is an integral multiple of the pin spacing or pitch in the strip 30. The exemplary belt is fabricated of an elastomeric material, and belts suitable for the purpose are commercially available, e.g., as the neoprene 1/5 pitch, double sided timing belt marketed as part number A GR S-D040025, by Stock Drive Products, 2101 Jericho Turnpike, Box 5416, New Hyde Park, NY 11042-5416. A belt guide 112 provides a belt position constraining surface 112A which serves to assure contact between the belt and pin header strip 30 in a pin engaging region 120 between the pulleys 104 and 106. Other drive belts or mechanisms could alternatively be employed at the drive station. Instead of a cogged belt which positively engages between the pins of the strip, a flat friction belt could be used to engage the pins of

the strip, for example.

The continuous strip 30 of the pin header material can be a single row or multiple row strip. A single row product is shown in the isometric view of FIG. 4; a double row product is shown, e.g. in FIG. 5. The exemplary multiple row strip 30 illustrated in FIG. 5 includes rows 30A and 30B. The feeder system 50 can accommodate single or multiple row strips without requiring any hard tooling changes.

The end portion 30A of the continuous strip 30 is guided through the driving station by several part guides, including guides 114, 116 and 118 (FIG. 7). The strip 30 includes pins 32 and pin receptacles 34, with the double row product including pins 32A and pin receptacles 34A in row 30A, and pins 32B and pin receptacles 34B in row 30B. Part guide 114 extends in the space (of width "G" shown in FIG. 8) between the rows of protruding pins above the rows of pin receptacles (best shown in FIG. 7). Part guide 116 extends below the strip 30, so that the lower tips of the pins extending below the pin receptacles are guided by the surface of the guide 116. Guide 118 guides the outside edge of the pin receptacles 34A of row 30A.

The lugs 110 of the timing belt 108 fit in the interstices of the pin row 30A between adjacent pins. As the pulley 104 is driven in the counterclockwise direction (as seen in FIG. 5), the pin engaging region 120 extending along the continuous belt 108 between the pulleys 104 and 106 translates linearly, advancing left to right in the direction of arrow 122.

FIG. 8 is an enlarged view, showing the engagement of the drive belt with the pins 32A of the row 30A. It is a feature of this embodiment of the invention that the belt does not engage purposely with the pin receptacle strip comprising the row 30A, but instead only against the pins themselves. This adds to the flexibility of the system 50 to accommodate different forms of strips having different types or configurations of receptacles. Of course, it is possible to provide an alternate embodiment, wherein the belt engages against the receptacles.

The drive station 100 drives the end portion of the strip 30 along an essentially linear path 122A, as illustrated in the partial top view of FIG. 3, through the pin puller station 150 and to the cut/clamp station 200. The length of the advanced portion is programmable, by controlling the drive stepper motor 102 to advance by a given number of steps. A home sensor 260 is located in the path of the strip 30 between the drive station 100 and the pin pull station 150. When the feeder 50 is loaded with new product, the feeder controller feeds the end portion of the new product until the leading edge of the end portion triggers the home sensor. The home sensor in the exemplary embodiment is an optical beam sensor, which is tripped when the pins of the continuous strip interrupt an optical beam. The controller then operates the drive station to advance the strip by a predetermined, calibrated distance D to feed the leading edge

of the strip product to a ready position at the cut plane 200A of the cut/clamp station 200. This is done by commanding the motor to advance by a predetermined number of steps, which is determined to produce a linear motion of the strip which corresponds to the advancement distance D. The feeder system is now ready to accept commands from a host controller to provide a new part of a programmable length.

According to one embodiment of the invention, the drive station advances the product from the ready position in response to commands from a host controller which specify the length of the part to be prepared and the position or positions of the pin(s) to be pulled. The advancement is by controlling the drive motor to rotate by that number of steps to produce a linear movement of the strip which corresponds to the distance needed to advance the leading edge of the part enough to position the pin to be pulled at the pin pull station in a first drive movement, and, thereafter, in a second drive movement, to control the drive motor to rotate by that number of steps to produce a linear movement of the strip to position the strip such that the trailing edge of the part 40 to be created is now positioned at the cut plane 200A. An exemplary finished part 40 of length S is illustrated in FIG. 9. In this example, the sixth pin in each row has been pulled. To produce this part, the motor is commanded to move by a number of steps which produces a linear movement of distance S1. This incremental distance will position the sixth pin in each row at the pin pull station. With the drive motor stopped, the pins are pulled. Now the motor is commanded to advance a second number of steps to produce a linear movement of distance S2 to position the trailing edge of the part to be produced at the cut plane. The part is then separated from the strip by the operation of the cut/clamp station 200. The incremental distances S1 and S2 equal the part length S. Simply commanding the motor to advance by the number of steps is a faster and more reliable method of control than if a sensor were used to count the number of pins advanced, and then stop the drive action after the desired number of pins had been counted.

The pin puller station 150, shown in further detail in FIGS. 10-13, provides the capability of pulling a single pin or pins in either of the multiple rows, from a programmably determined position relative to the continuous strip 30. The station includes an elevator platform 156 mounted on slide pistons 154 of a double acting pneumatic cylinder 152 (FIG. 2). A pin puller clamp jaw assembly 160 is mounted on the elevator platform. The elevator platform is raised to position the grip jaw assembly adjacent the exposed lower ends of the pins in the strip. Once the pin row position at which the pin(s) is to be removed has been advanced to the pin puller station, the grip jaw member(s) is closed to clamp the pin(s), and the elevator cylinder is actuated to lower the grip jaw assembly, pulling the pin out of its receptacle as the assembly is lowered. A bottom support guide 180

(FIGS. 12 and 13) extends below the plastic pin receptacle portion of the continuous strip at the pin puller station to support the receptacle portion of the strip during the pin pulling operation. This support prevents the pulling forces from breaking the receptacle strip.

FIGS. 10 and 11 show end views of the grip jaw assembly 160 in respective "clamp jaws closed" and "clamp jaws open" configurations. The assembly is carried on the elevator platform 156, which includes an up-right side member 162. A center fixed clamp jaw 164 is attached to the side member 162 and protrudes between the two rows of pins 32A and 32B. Two moving clamp jaws 166A and 166B are disposed on the opposite sides of the pins from the center jaw, and are actuated through respective link arms 168A and 168B which are rigidly attached to the jaws 166A and 166B, respectively. The respective link arms and attached jaws pivot about pivot pins 170A and 170B, respectively, disposed adjacent the jaw ends of the link arms. The opposite ends of the link arms are connected to a respective piston 172A and 172B of double acting pneumatic cylinders 174A and 174B by pivot pins 176A and 176B. The cylinder housing end disposed away from the cylinder end from which the piston extends is also pivotally mounted to the elevator platform by a pivot pin (not shown). Actuation of the cylinders 174A and 174B rotates the jaws 166A and 166B through the link arms 168A and 168B, clamping the respective pins 32A and 32B against the center jaw 164.

The cylinders 174A and 174B can be operated independently, and typically only one pin will be removed from a particular pin header part to be cut. The disclosed arrangement permits a pin from either or both rows 30A, 30B of the header strip 30 to be selectively removed from its corresponding pin receptacle.

A pair of optical vane sensors 190 and 192 (FIG. 3) are arranged to detect the jaw open/closed status, and provide sensors signals indicative of the sensed jaw status to the system controller. Sensor 190 detects the status of the clamp jaw 166A, and sensor 192 detects the status of jaw 166B.

The cut/clamp station 200 is shown in FIGS. 14-19. The feeder system 50 includes a vertical front end plate 60, which supports a horizontal cut/clamp platform 202. A pneumatic double acting cut/clamp cylinder 204 is mounted on the platform 202, and its piston 206 is oriented along a vertical axis. The piston is attached by a clevis pin 208 to one end of a link arm 210. The other end of the arm 210 includes an opening through which a shaft 212 extends; the arm 210 is fixed to the shaft 212. The shaft 212 is mounted for rotation on bearings 212A. A cutter blade assembly 214 is fixed on the shaft 212. As the cylinder piston 206 is extended, and the link arm end pivotally attached by clevis pin 208 is raised with the piston, the shaft 212 is rotated. The cutter blade assembly 214 in turn rotates with the shaft 212, swinging the blade assembly on an arc toward and through the section of the strip 30 located at the cut/clamp station.

The blade 216 is passed through the pin receptacle strip to cut the end of the strip to a desired part length.

FIG. 17 is a simplified side view of the cut/clamp station 200, with various elements not shown to expose the blade assembly 214. The assembly 214 includes clamp arm 214A which is secured on the shaft 212, and a cutting blade clamp plate 214B. The clamp plate is secured to the clamp arm by fasteners 214C. A space is defined between adjacent surfaces of the clamp plate and arm to slidably receive the blade 216. A wedge block 214E is positioned in a tapered opening 214F formed in the clamp arm 214A. A threaded bolt 214D extends through an oversized opening in the wedge block and is received in a threaded bore in the clamp arm. By tightening or loosening the bolt 214D, the wedge block is pushed against the blade 214, clamping it in place against the clamp plate 214B, or loosens the wedge block to permit the blade to be inserted or removed from the blade clamp.

The blade 216 is preferably an inexpensive, replaceable part, and may have multiple blade edges along one edge of the blade, which can be successively used by raising the blade 216 within the clamp. Blades similar to those used in wallpaper cutters can be employed, wherein blade segments can be successively broken off along score lines as a blade edge segment is dulled. The blade clamp permits easy servicing of the feeder to replace the blade edge.

A clamp member 220 (FIG. 18) is also mounted on shaft 212, but rotates freely on the shaft. A tension spring 222 is connected between the lower end 220A of the clamp member 220 and an attachment arm 224 extending from the platform 202, and biases the clamp element 226 mounted at the opposite end 220B of the clamp toward the pin header strip 30. A contact block 228 (FIG. 19) is attached to the cutter blade assembly 214. When the piston 206 is retracted, the block 228 contacts the clamp element 220, and prevents it from moving to the clamp position to clamp the pins of the header strip at the station 200. As the piston is extended, rotating the assembly 214 and block 228 counterclockwise, the block will move, permitting the clamp element 220 to rotate freely on the shaft 212 in response to the tension force of the spring 222 and clamp the pins of the pin header. As the piston is retracted, the block 228 contacts the clamp and rotates it away from the pin clamp position.

FIG. 19 is a simplified side view of the cut/clamp station 200, showing the cutter blade assembly without the clamp element 220. FIG. 18 is a simplified view of the cut/clamp station 200, showing the clamp elements without the cutter blade assembly. Optical vane sensors 240 and 250 provide sensor signals indicating status of the cut/clamp elements. The sensors are indicated diagrammatically in FIGS. 18 and 19. A part present sensor 230 senses the presence of flag 232 attached to the clamp element 220. The flag 232 moves through an arc 234 as the piston is extended, and will interrupt an op-

tical beam generated by the sensor 230 when the clamp element is in place against pins of the strip 30. The beam interruption indicates that a part is present at the cut/clamp station. If no part is present, the flag will rotate past the sensor beam, so that at its travel limit the sensor beam is not interrupted. The fact that the beam is not interrupted with the flag at its travel limit indicates that no part is present. For an exemplary part having a .025 inch square pin present at the cut/clamp station, the clamp is stopped .025 inches from the end of its travel. The sensor is "on" when the clamp is not at the end of its travel, and is "off" when a part is in the clamp and when the clamp is fully open.

The station 200 also includes cut open sensor 240 and cut closed sensor 250 (FIG. 19). These sensors are also optical vane sensors.

The continuous strip 30 is fed from reel 20 in response to forces applied to the end region of the strip by the drive station 100. The bonds between adjacent pin receptacles is somewhat fragile, and as a result, the strip 30 is susceptible to breaking apart between pin receptacles due to the application of these forces. Such breakage would require operator intervention to correct. The feeder system 50 can include a suspension system 300 for the reel 20, illustrated in FIG. 20. This exemplary embodiment includes rollers 302 and 304 which are engaged by the exterior peripheral edge 22 of the reel. The rollers permit the reel to rotate in the direction indicated by arrow 306 in response to the drive force exerted by the drive station 100 pulling on the strip 30. The suspension system 300 prevents the rotation of the reel from causing excess slack in the strip 30, which in turn would lead to jerky motion and impact loads on the drive system, and could cause the strip to kink, bend and/or break.

The suspension system 300 includes two pairs 310 and 312 of pivot arms which pivot respectively about pivot shafts 314 and 316 supported between the system side cover plates 56 and 56. The rollers 302 and 304 are supported between ends of the respective arm pairs. Pivotaly attached to the opposed ends of the pivot arms is a connector link 320. A first spring 322 is connected between a stationary anchor 326 and an attachment 324 mounted to the connector link. A second spring 328 is connected between stationary anchor 332 and an attachment 330 mounted to the connector link. The springs bias the connector arm to a centered position. When a tension force is exerted on the end of the strip 30, pulling on the strip end and tending to cause the reel to rotate, the suspension system cradle defined by the arms 310, 312 and 320 rocks in the direction toward the tension force, and the reel rotates to unwind some of the strip 30. At the same time, the reel 20 tries to over rotate, and the cradle re-centers due to the spring tension imbalance, thereby taking up the excess slack caused by the over-rotation. As a result, the system has no tendency to bend or break the strip. The springs could alternatively be attached to the pivot points 338 and 340 instead

of at the middle of the link 320.

The suspension system 300 is useful for use with reels which are open in the center and are supported on their outer peripheral edge. Some reels have a center structure, and are supported and rotate on a center shaft. This alternate form of reel 20' is illustrated in FIG. 21, which also illustrates an alternate suspension system 350. The reel 20' rotates on a shaft 352 which is supported for rotation at the end 354A of a pair 354 of arms. The arm pair 352 pivots about pivot 356. A pair of tension springs 360 and 362 are connected at point 358 to the other end 354B of the arm pair 354, and to respective anchor points 364 and 366. This suspension system will operate in a similar manner to take up slack in the strip 30 as described above regarding the embodiment of FIG. 20.

FIG. 22 is a simplified control diagram for the system 50. The feeder system includes a feeder controller 500, which in this exemplary embodiment is a micro-processor-based programmable logic controller, which is connected via a serial communication bus 502 with a host controller 600, typically controlling the various devices comprising an insertion system work station. The control system includes a distribution power supply 504, an input/output (I/O) drive distribution circuit 506, a stepper motor drive circuit 508 for providing drive signals to the stepper motor 102, an optical encoder 510 which supplies motor shaft rotation signal data, I/O modules 512 and sensing and actuation circuit 514. The circuit 514 generates the drive signals for actuating valves which actuate the pneumatic cylinders 152 (pin pull), 174A-174B (pin clamp), and 204 (cut/clamp). In addition, the circuit 514 receives the sensor signals from the various sensors 190-192 (pin pull clamp jaws), 230 (part present), 240 (cut open), 250 (cut closed), 260 (home), 270 (low part), and 280-282 (the pin pull extend and retract sensors). The low part sensor 270 (FIG. 2) detects the condition that quantity of product remaining on the reel has diminished to the point that the trailing edge of the strip 30 has come free of the reel, releasing tension in the strip between the reel and the drive station. The low part sensor 270 thus warns the system that the reel is empty and the feeder system will run out of product soon. The pin pull extend and retract sensors 280 and 282 sense the position of the elevator cylinder pistons 154, to provide signals indicating that the pin pull elevator platform 156 is extended to the pin engagement position, or retracted away from the strip. The I/O module 512 is connected via an I/O bus to an I/O module comprising the host controller 600.

FIG. 23 is an exemplary operational flow diagram illustrating an exemplary sequence of operations performed in the course of operation of the feeder system 50. At step 700, the system controller 500 receives a serial communication from the host 600 interface. This communication specifies the part length and location of the pin or pins to be pulled for the next part to be cut and prepared for pickup. At step 702, the controller 500 pro-

vides control signals which are interpreted by the stepper motor drive circuit 508 to drive the end region of the continuous strip to the pin pull station 150, and position the strip in relation to the pin pull grip jaws so that the pin(s) to be pulled are positioned at the grip jaws. At step 704, the pin pull grip jaw(s) is closed by actuating the cylinder(s) 174A-174B as appropriate, and the pin grip closed condition is sensed by sensors 190-192. At step 704, the cylinder 152 is actuated to retract its piston and pull the pins; the pin pull station retracted condition is sensed by sensor 282. Thereafter, the pin grip jaws are opened (step 708) and the pin pull station extended (710) to ready the pin pull station for the next part. Simultaneously, the motor drive station is actuated in response to control signals provided by the controller 500 to advance the product to its cut length, positioning the programmably determined end of the part to be cut at the cutter of the cut/clamp station 150 (Step 712). The cut/clamp cylinder 204 is actuated to cut and clamp the part, and this condition is sensed (step 714). At step 714, the part present condition is sensed by sensor 230. At this point, the part 40 is ready to be picked from the feeder, and so a ready signal is sent to the host controller 600 from the system controller 500 (step 718). Thereafter, the part is picked from the cut/clamp station (step 720) by, e.g., an automatic insertion device, and the cut/clamp cylinder is opened to release the part (step 722). Operation then returns to step 700 in readiness to prepare the next header part.

It is understood that the above-described embodiments are merely illustrative of the possible specific embodiments which may represent principles of the present invention. Other arrangements may readily be devised in accordance with these principles by those skilled in the art without departing from the scope and spirit of the invention.

Claims

1. A programmable feeder system (50) for programmably providing pin header connector devices (40) of a programmed length size from a continuous pin header strip (30), the continuous strip including a continuous pin receptacle (34) strip of a row of pin receptacles spaced apart by a given pitch and with pins (32) disposed in the receptacles, comprising:

a reprogrammable drive apparatus (100) for engaging the pin header strip and advancing the leading edge of the pin header strip through a cutting station, the drive apparatus being responsive to control drive signals which set a programmed length of the strip to be advanced through the cutting station;

a clamp/cut station (200) for clamping the programmed length in place and for cutting through the continuous pin receptacle strip,

wherein the programmable length of said strip is separated from said continuous strip to provide a pin header connector device of said programmed length size.

2. The feeder system of claim 1 wherein the programmable drive apparatus (100) includes a continuous belt (108) having a series of protruding cogs (110) spaced apart by an integer multiple of the pin pitch, said belt engaging said continuous strip.
3. The feeder system of claim 2 wherein the cogs (110) positively engage between adjacent pins (32).
4. The feeder system of claim 2 or 3 wherein the programmable drive apparatus includes a drive motor (102) for driving the belt in an advancement direction in response to motor control signals.
5. The feeder system of claim 4 wherein the programmable drive apparatus includes first and second rotatable pulleys (104,106) around which the belt is reeved, and apparatus for coupling the motor to said first pulley to rotate the first pulley and drive the belt.
6. The feeder system of claim 5 wherein the first and second pulleys (104,106) rotate about first and second pulley centers, the feeder system is characterized by a longitudinal feeder axis, and wherein said first and second pulley centers define a line extending parallel to said longitudinal feeder axis.
7. The feeder system according to any preceding claim wherein the drive apparatus does not engage the continuous receptacle strip in driving the header strip.
8. The feeder system according to any preceding claim wherein the drive apparatus (100) engages pins (82) of the pin header strip.
9. The feeder system according to preceding claim further comprising a programmable pin removal station (150) for removing a programmably selected pin from a corresponding pin receptacle of said advanced strip portion.
10. The feeder system of claim 9 wherein said pin removal station (150) includes a grip jaw (166) for closing against the programmably selected pin, the grip jaw being secured to a movable platform, and a platform drive apparatus for moving the platform (156) and jaw away from the corresponding pin receptacle to remove the pin.
11. The feeder system of claim 9 or 10 wherein the pin removal station (150) and the clamp/cut station

(200) are respectively positioned along a strip advancement path (125) such that the leading edge of the advancing continuous strip (30) reaches the pin removal station before reaching the clamp/cut station.

12. The feeder system according to any of claim 9, 10 or 11, further including a drive controller (500) for generating the drive control signals in response to selection data indicating the pin to be removed and the length size of the pin header connector device, the drive signals for first advancing the leading edge of the continuous strip by a first selected distance to position the pin to be removed at the pin removal station (150), stopping the drive apparatus for a time interval to permit the selected pin to be removed, and for thereafter advancing the leading edge by a second selected distance to advance a strip length equal to the selected device length size past the clamp/cut station to position the strip portion at the clamp/cut station for clamping and cutting.

13. The feeder system according to any of claims 2 to 6, further including a strip guide member (116) disposed adjacent a pin engaging region at which said belt engages said pins of said continuous strip, said guide member spaced from, said pin engaging region so that pins of said continuous strip are guided between said pin engaging region and said guide member.

14. The feeder system of claim 13 wherein said guide member (116) is arranged so as not to contact said continuous pin receptacle strip.

15. The feeder system of claim 13 or 14 wherein said continuous pin header strip (30) includes first and second aligned rows (30A, 30B) of pins and pin receptacles spaced apart by a row spacing, there being a gap between the first and second rows, and wherein said continuous strip is received at said drive apparatus such that said first row of pins is received between said pin engaging region and said guide member (116), said guide member positioned between pins of said first and second rows in said row gap.

16. The feeder system according to any preceding claim wherein said system operates without part changes on either single row or double pin row continuous pin header strips.

17. The feeder system according to any preceding claim wherein said continuous pin header strip is fed from a reel (20) containing a length of the strip wound around the reel, and wherein said feeder system further includes a reel suspension system

(300), said suspension system comprising means (302,304) for permitting rotation of the reel in response to tension forces exerted on the continuous strip by the drive station to unwind and pay out the continuous strip, and lateral movement means (310,312,314,316) permitting lateral movement of the reel in response to the tension force exerted by the drive station on the continuous strip, said lateral movement means including a biasing means (322,328) for biasing the lateral position of the reel to a rest position, said biasing means biasing the reel to return to the rest position, thereby preventing excess slack in the length of continuous strip between the reel and the drive station.

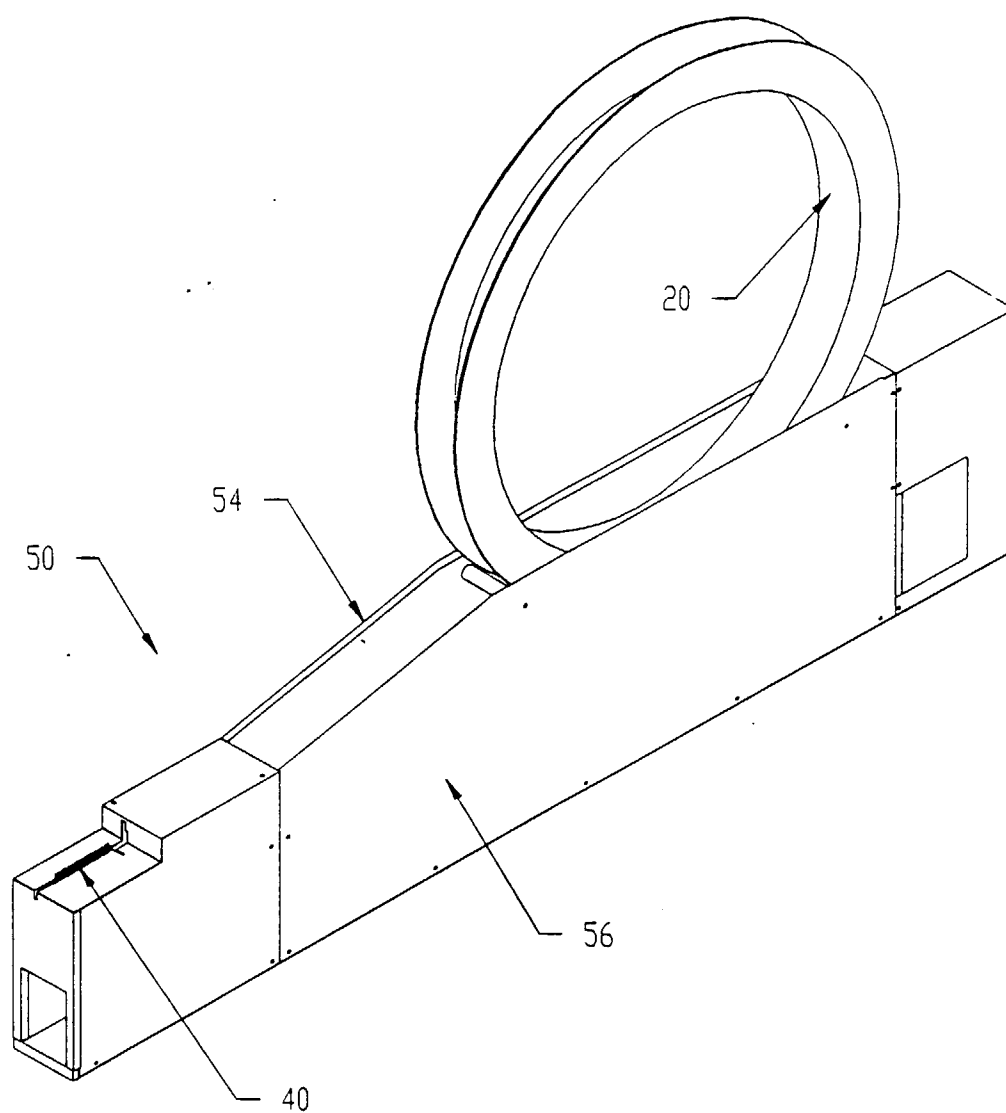
18. The feeder system of claim 17 wherein the lateral movement means includes a cradle (310,312,320) for engaging the outer periphery of the reel and means permitting a rocking movement of the cradle in response to the tension forces exerted on the strip by the drive station, and wherein the biasing means includes spring means (322,328) for biasing the cradle to the rest position.

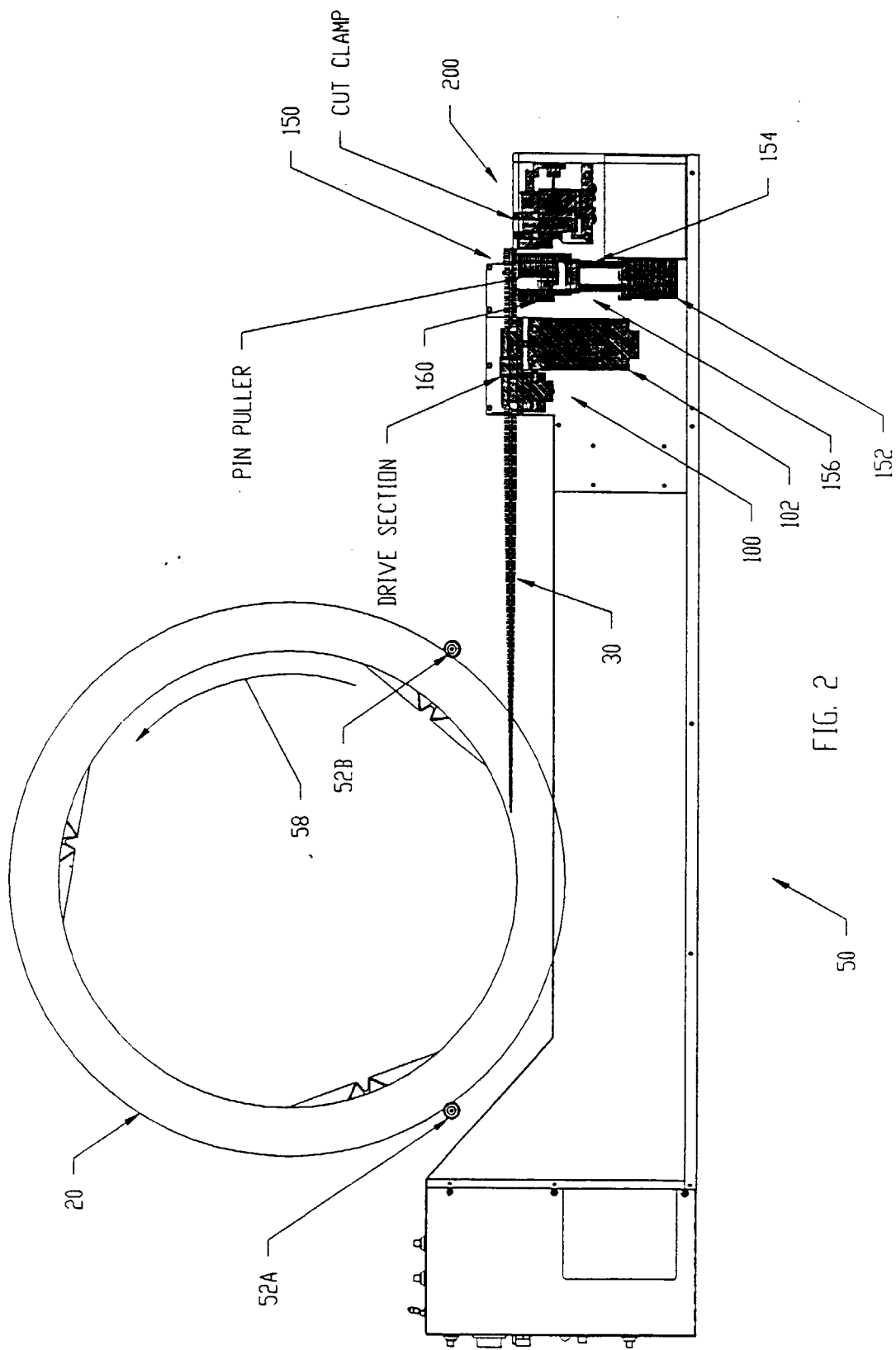
19. The feeder system of claim 18 wherein the means permitting rotation of the reel includes rollers (302,304) mounted on the cradle which engage against the outer periphery of the reel.

20. The feeder system of claim 17 wherein the means permitting rotation of the reel includes a shaft bearing structure located at a center of the reel and a shaft (352) extending through the bearing structure, so that the reel turns on the shaft, and wherein the lateral movement means includes a pivoted structure (354,356) for supporting the shaft, the structure including a pivot for pivoting the structure on an axis extending parallel to an axis of the reel shaft, and said biasing means (360,362) operates on the pivoted structure to bias the pivoted structure to the rest position.

21. The feeder system according to any preceding claim wherein the clamp/cut station includes a cutting blade, a blade clamp assembly (214), the blade clamp assembly include a releasable blade clamp (214E) which clamps the blade in a secured position, and can be released to permit replacement of the blade, and a mechanism for moving the clamp assembly and blade through a cutting motion to cut through said pin receptacle strip to separate the programmable length from the continuous strip.

FIG. 1





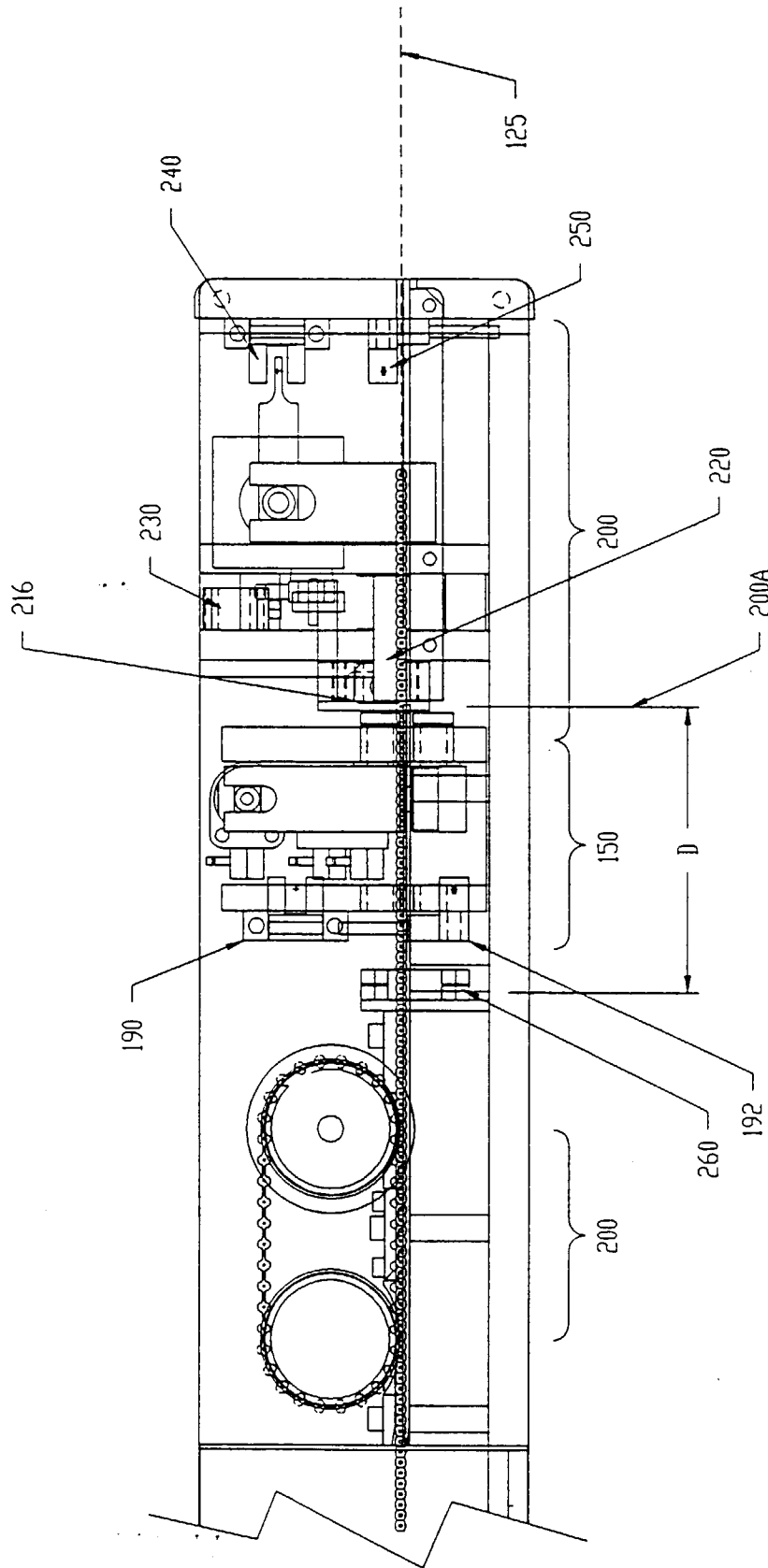


FIG. 3

FIG. 4

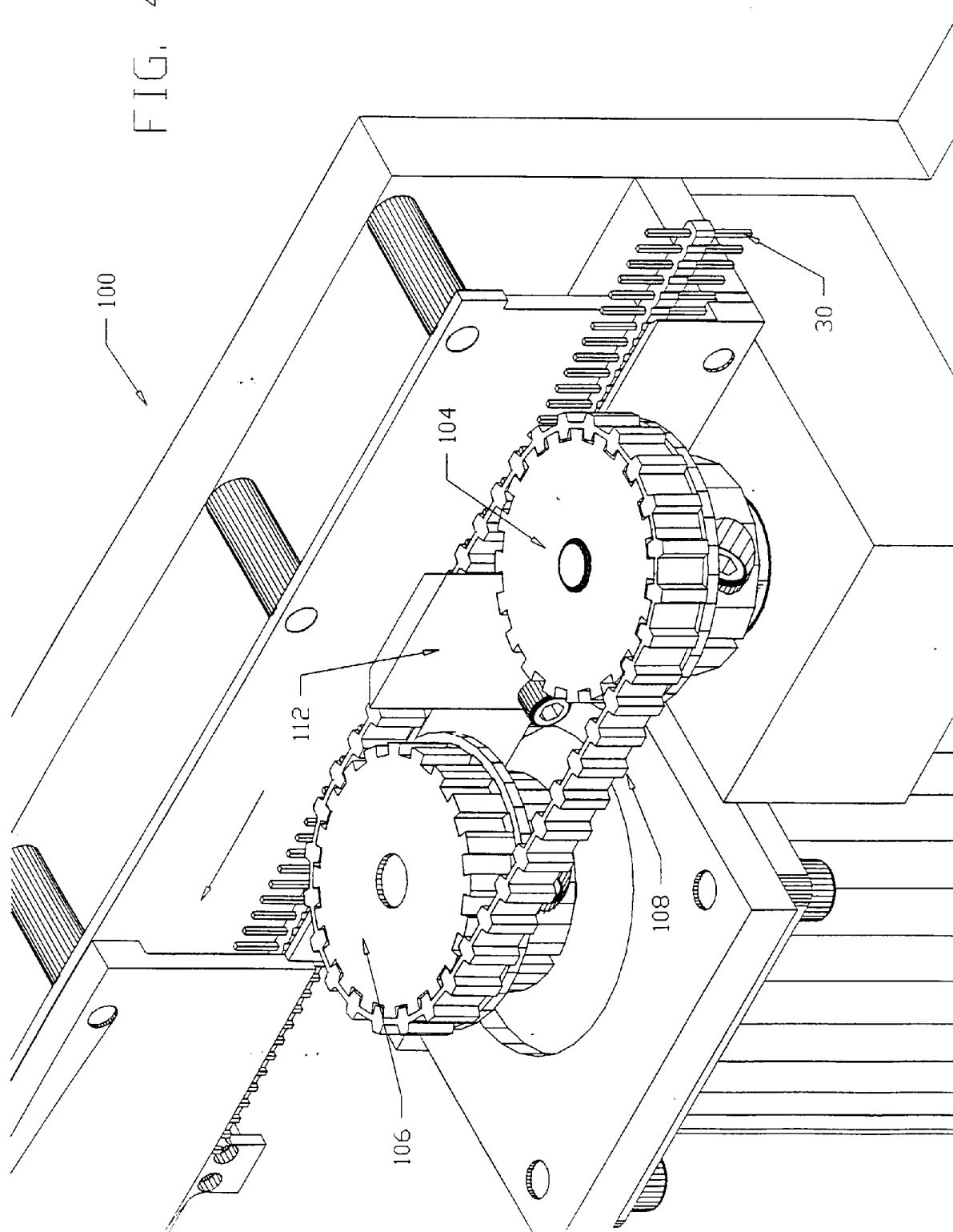


FIG. 5

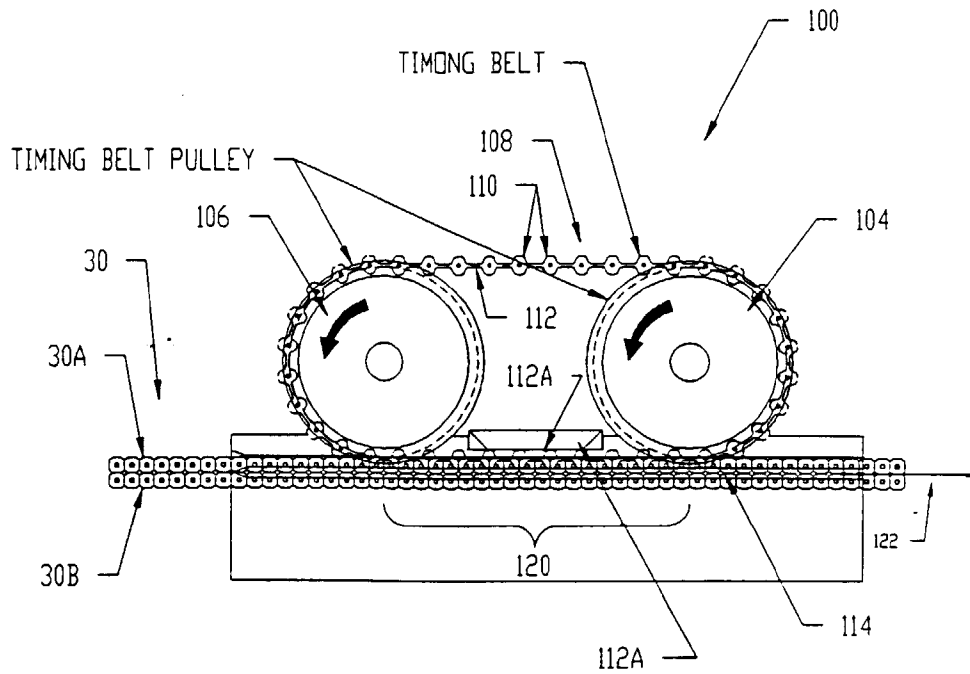


FIG. 6

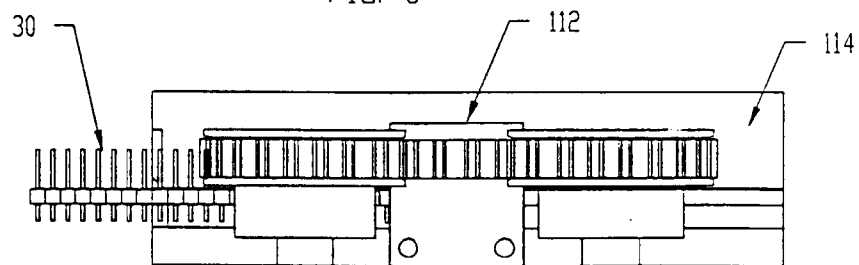


FIG. 7

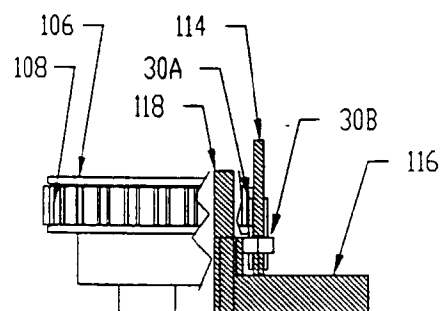


FIG. 8

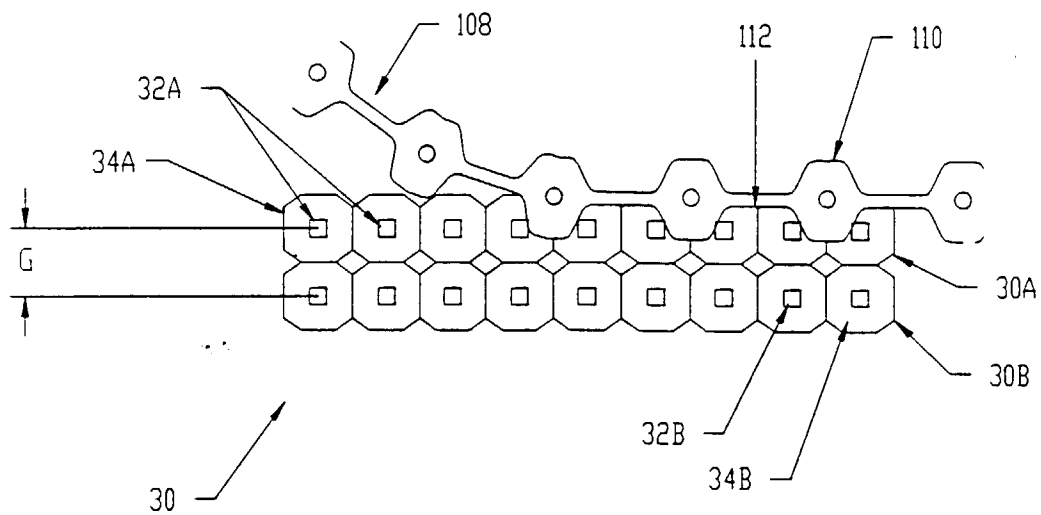


FIG. 9

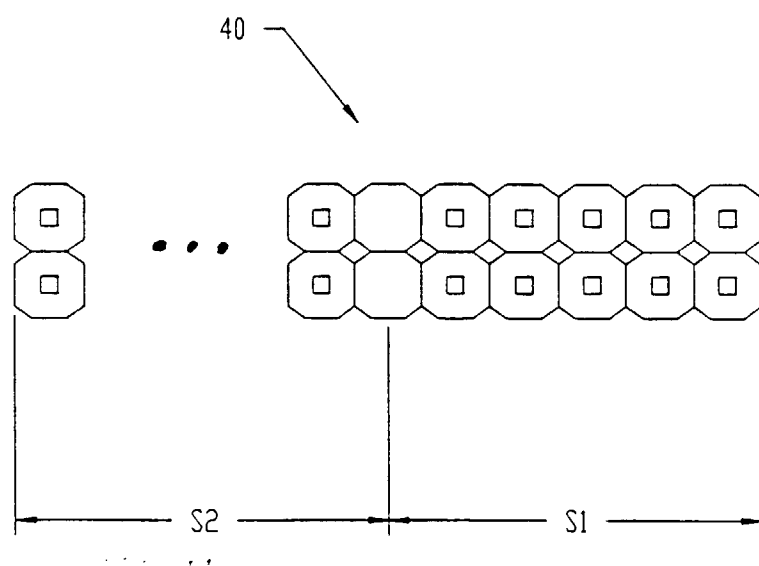


FIG. 10

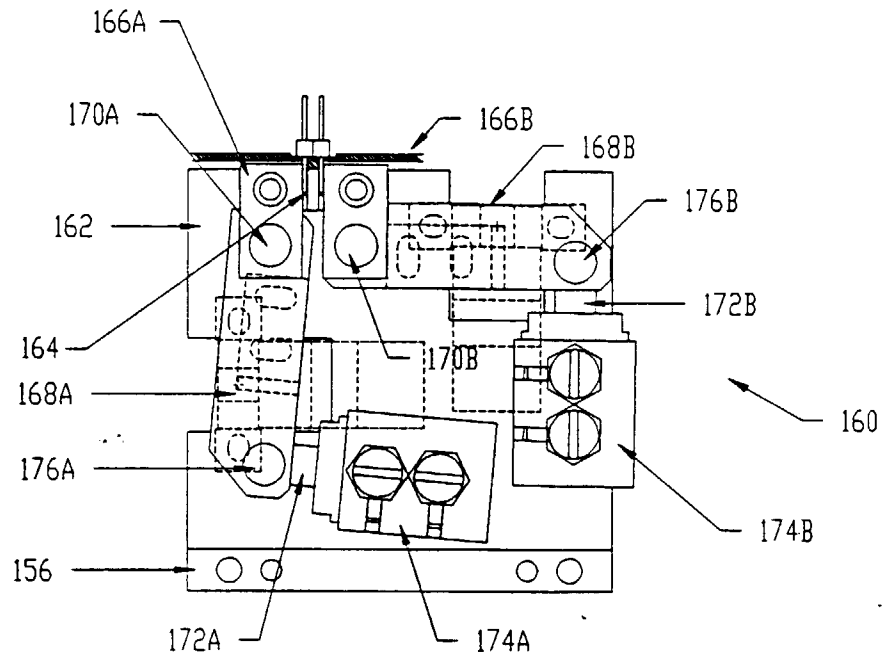


FIG. 11

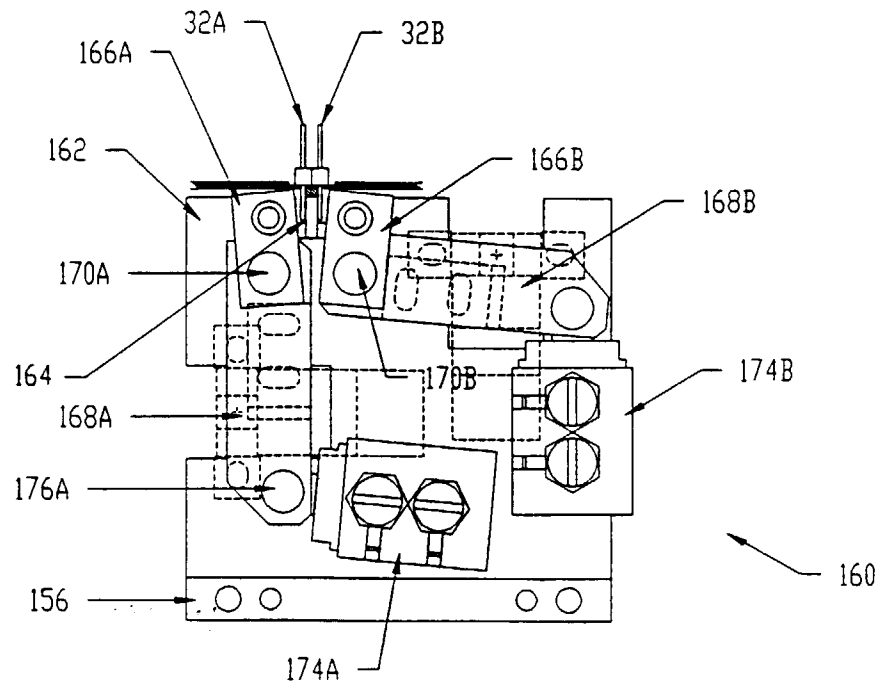


FIG. 13

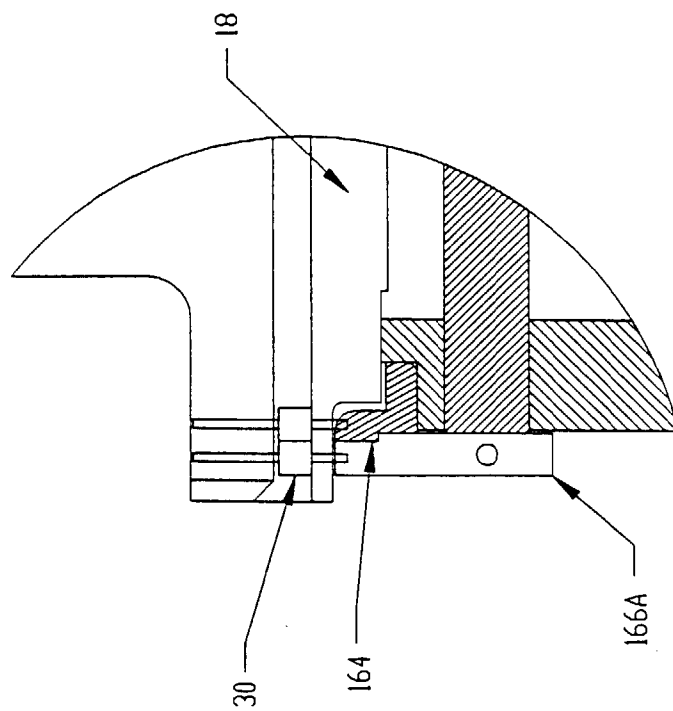
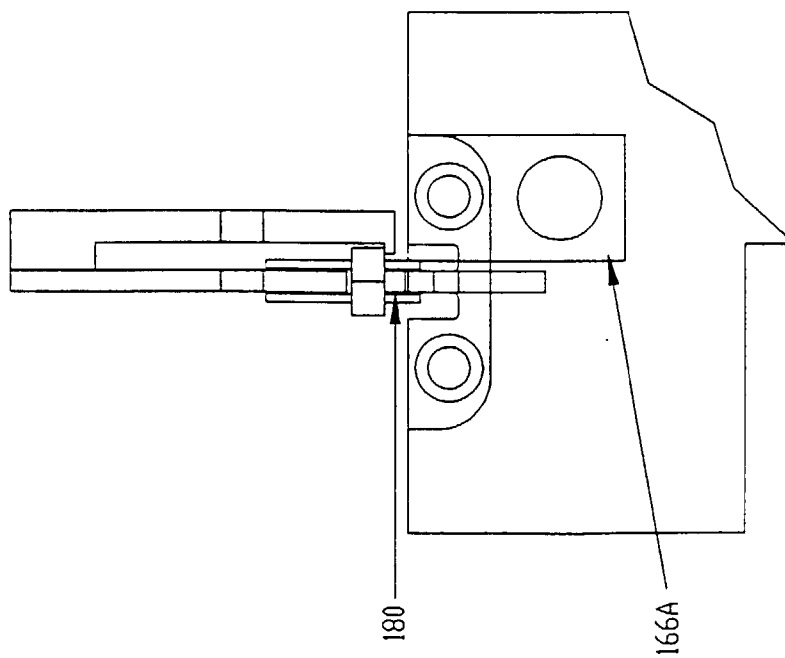


FIG. 12



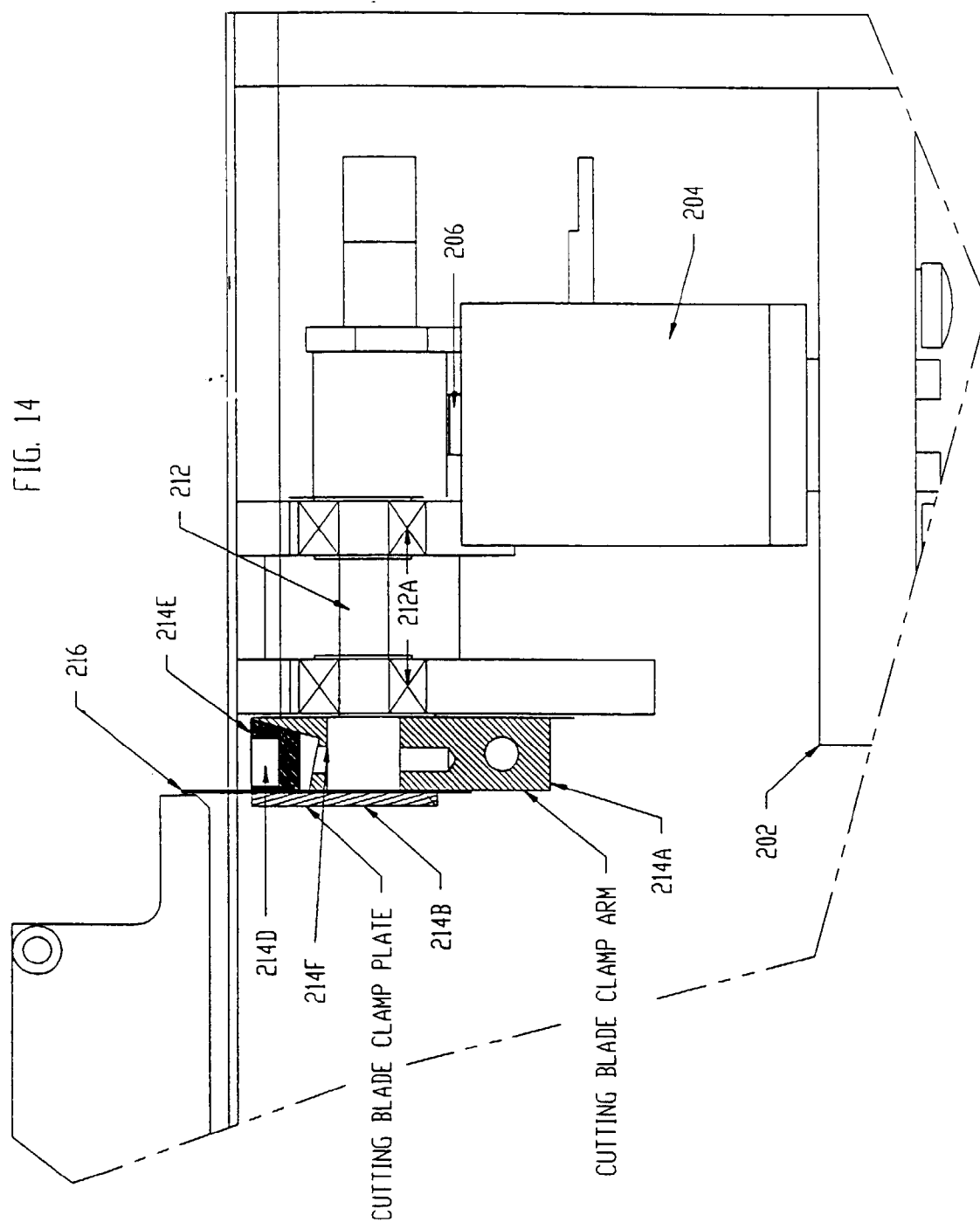


FIG. 17

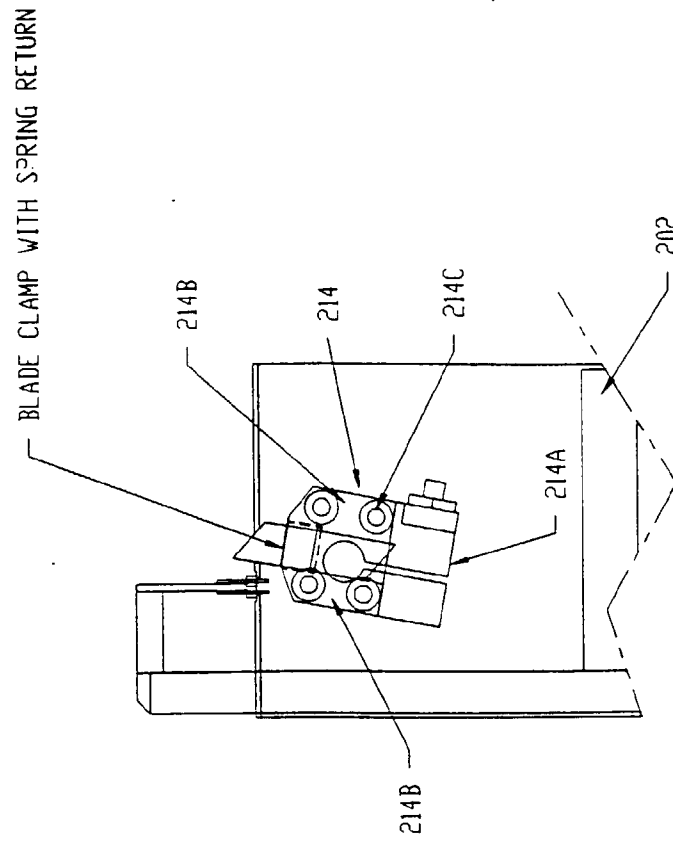
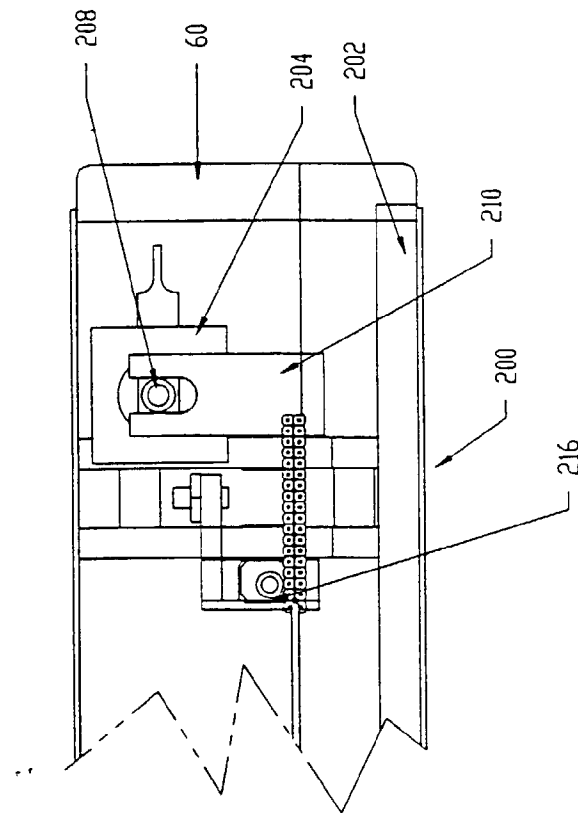
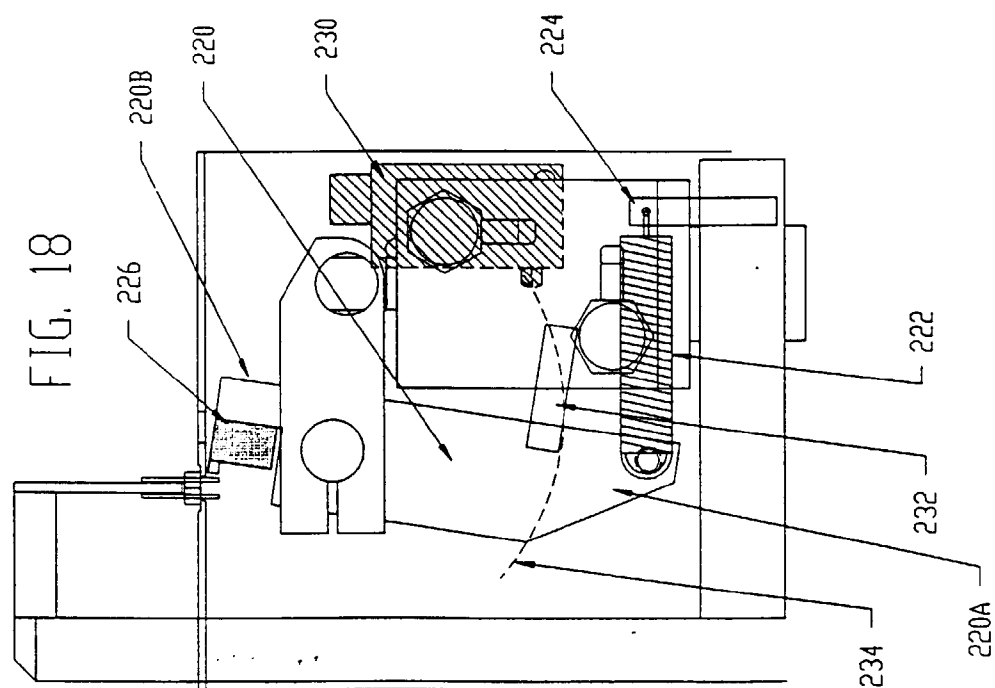
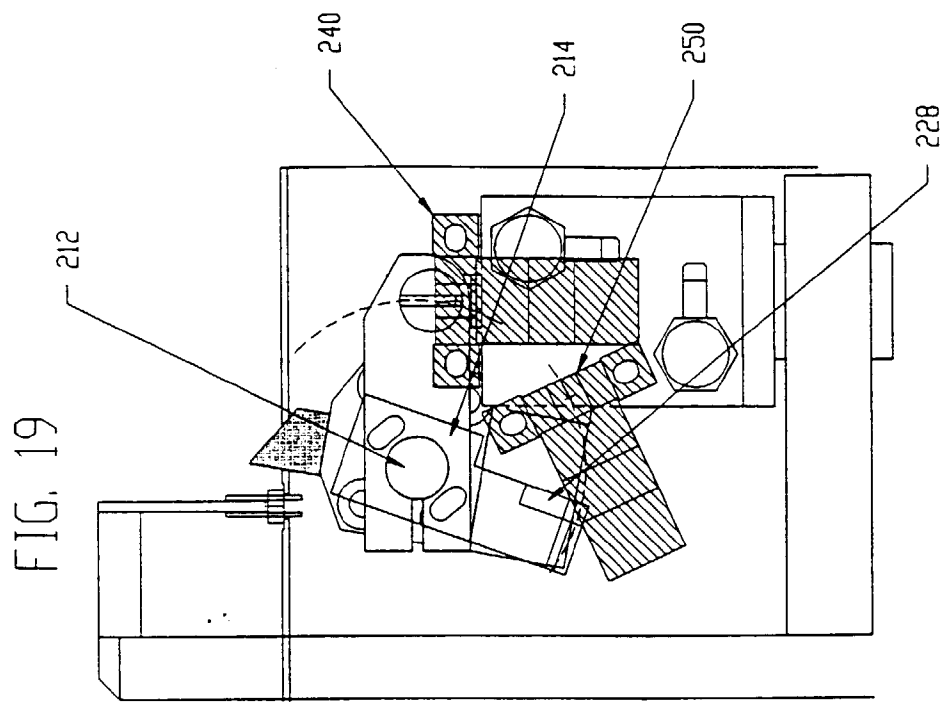


FIG. 16





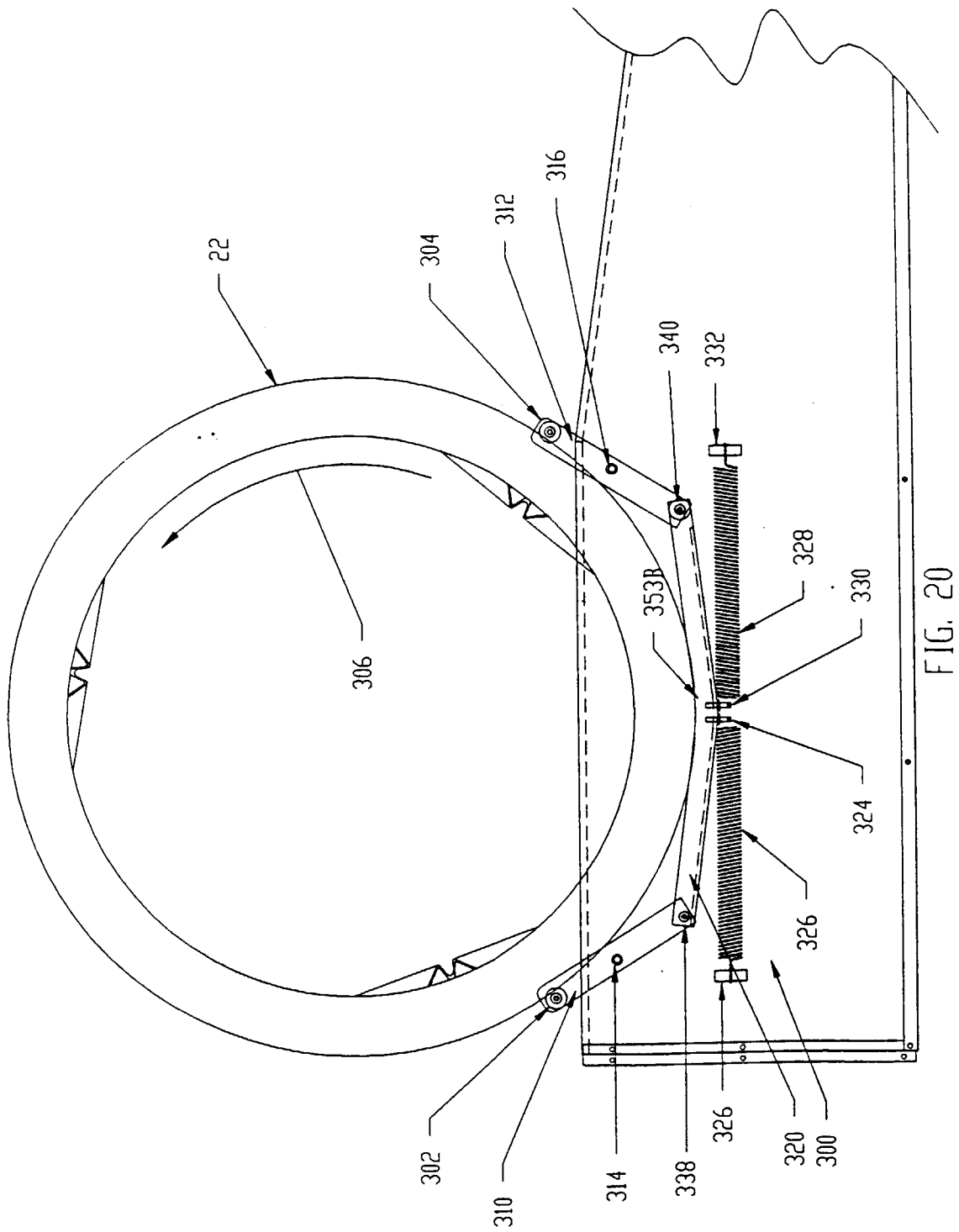
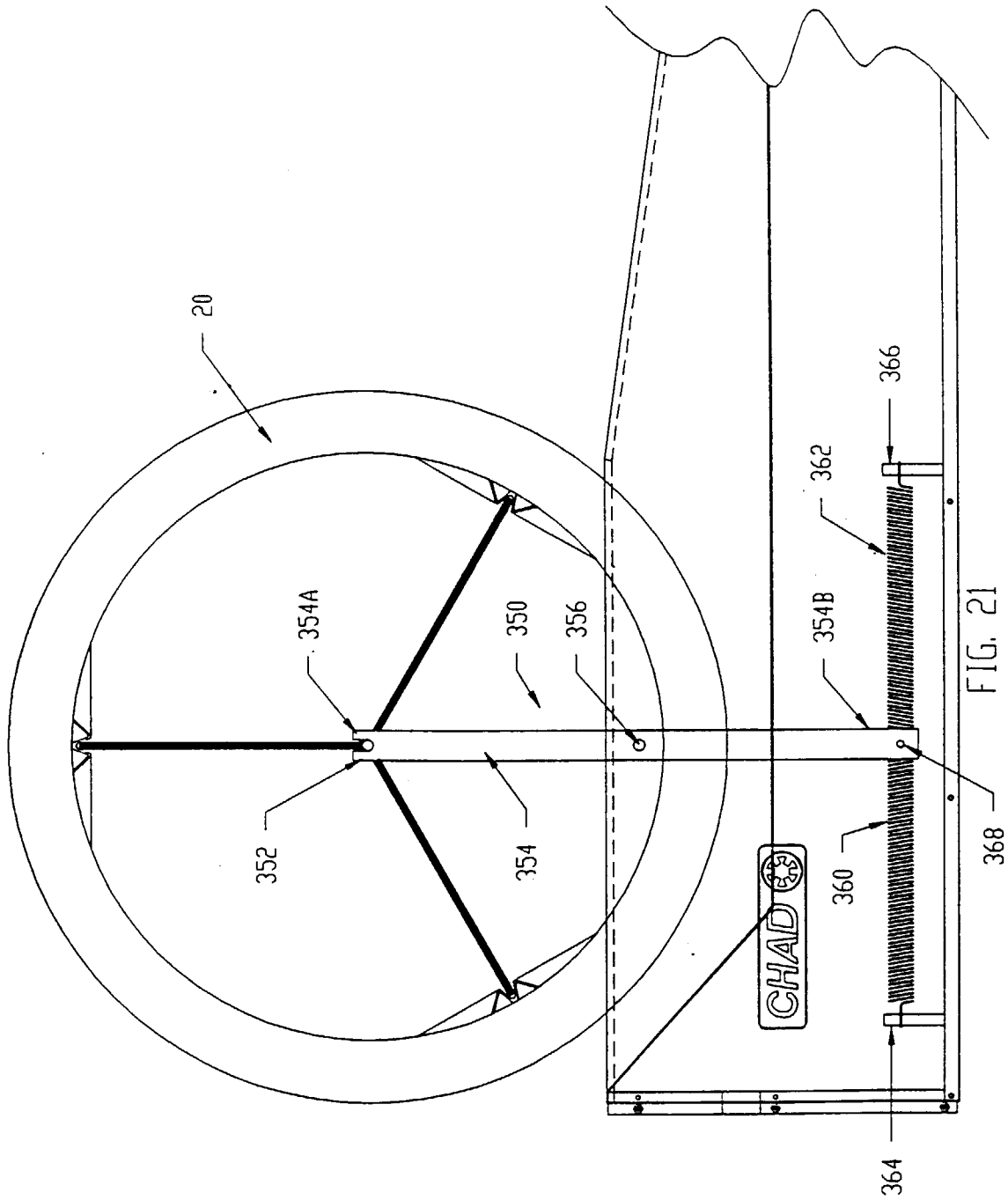


FIG. 20



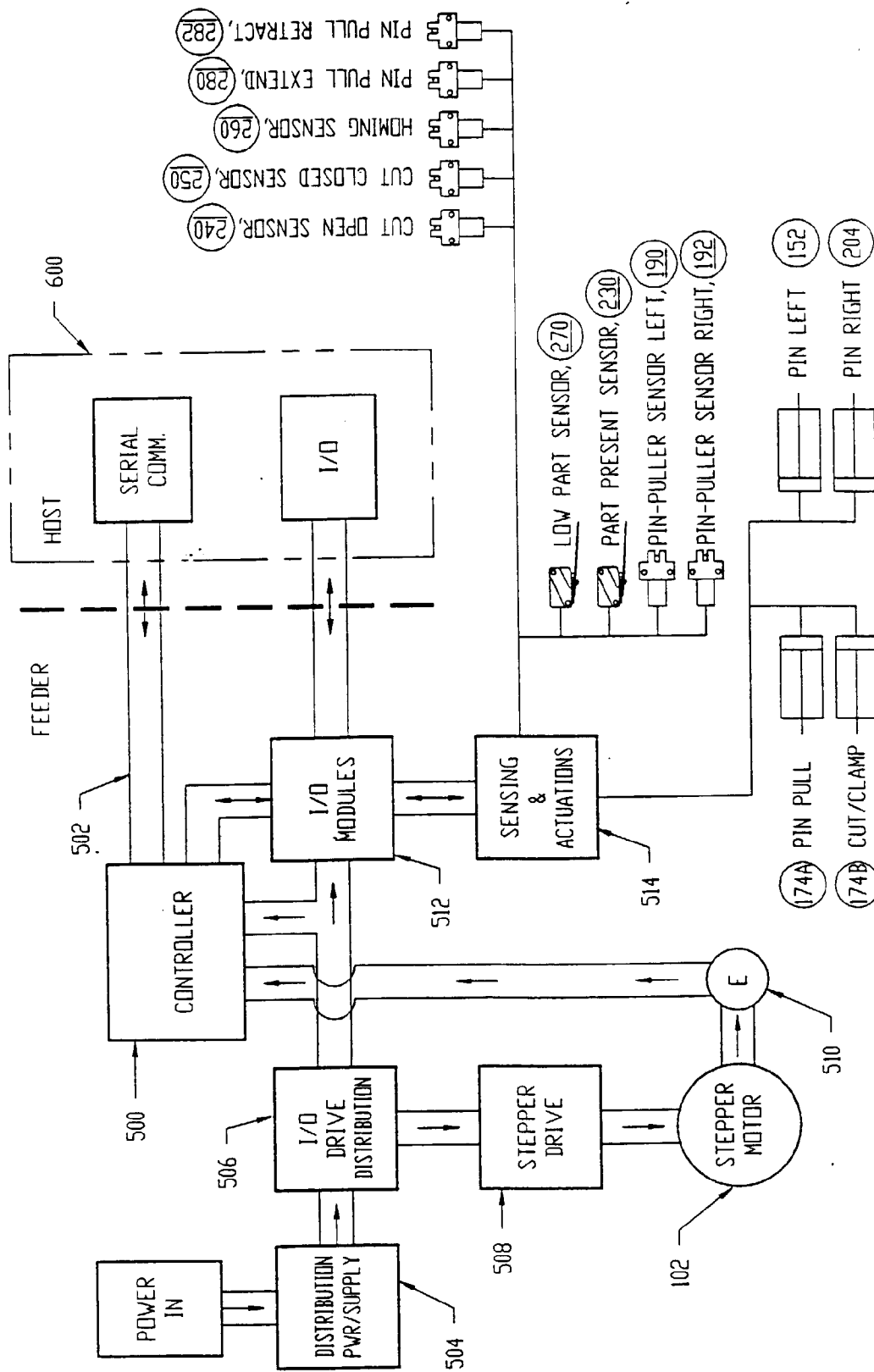


FIG. 22

FIG. 23

