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[21] Appl. No.: **423,242**

[52]	U.S. Cl.....	140/147; 72/DIG. 10
[51]	Int. Cl.....	B21f 1/02
[58]	Field of Search.....	140/1, 105, 147; 72/DIG. 10

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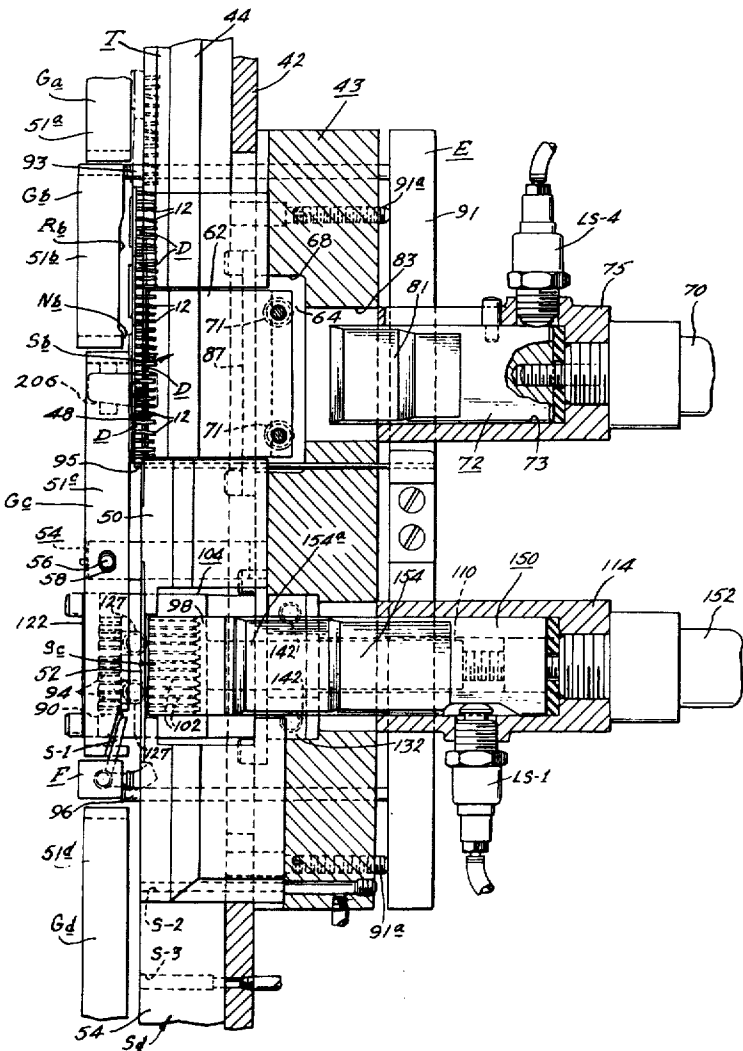
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Attorney, Agent, or Firm—Howson and Howson

[57] **ABSTRACT**

Apparatus for reconditioning electronic devices having an elongated body portion and a plurality of leads extending from the opposite side edges of said body portion and disposed at a predetermined angle relative thereto comprising an elongated generally vertically oriented trackway, a spreader station disposed along said trackway having means for spreading outwardly any leads projecting inwardly relative to a predetermined plane through the longitudinal axis of said device and a forming station having means for aligning the leads on opposite side edges of said device in a row at a predetermined angle relative to said body portion and wherein the leads in each row are uniformly spaced relative to one another.

18 Claims, 23 Drawing Figures



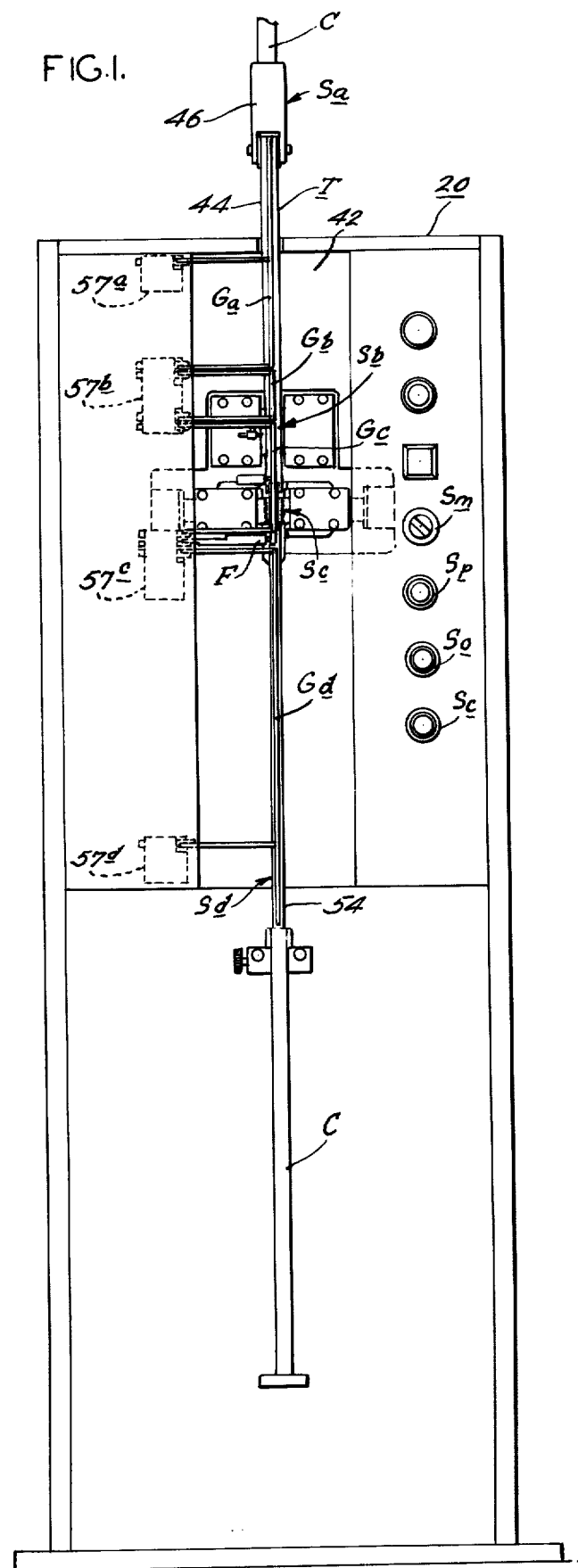


FIG. 1a.

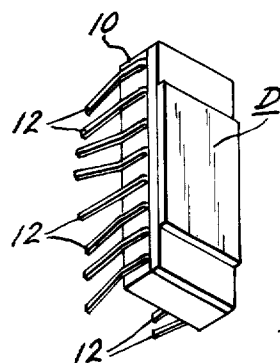


FIG. 1a'

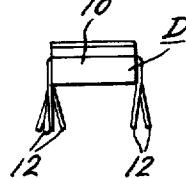


FIG. 1b.

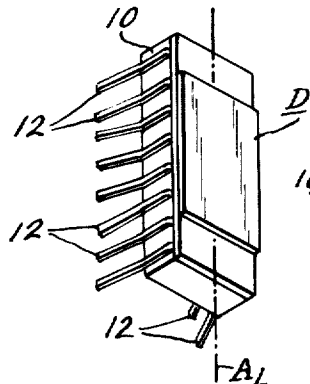


FIG. 1b'

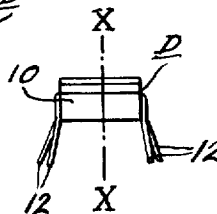


FIG. 1c.

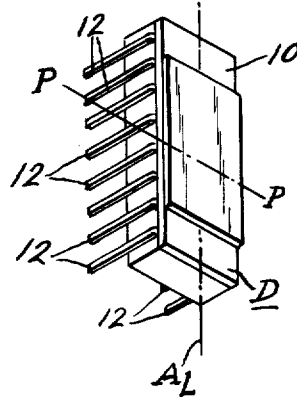


FIG. 1c'

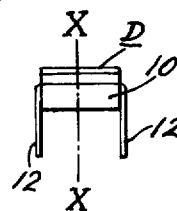


FIG. 3.

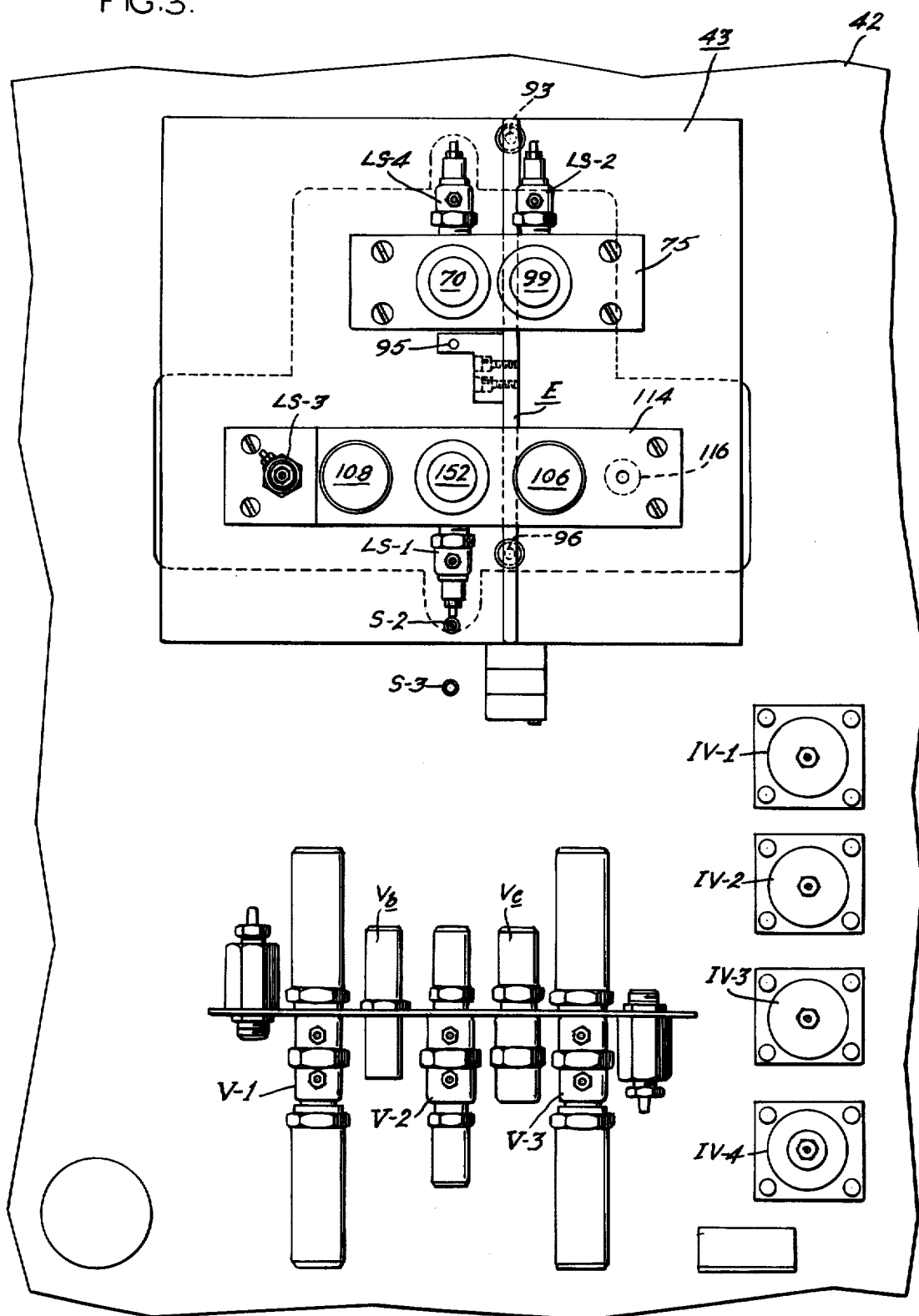


FIG. 4.

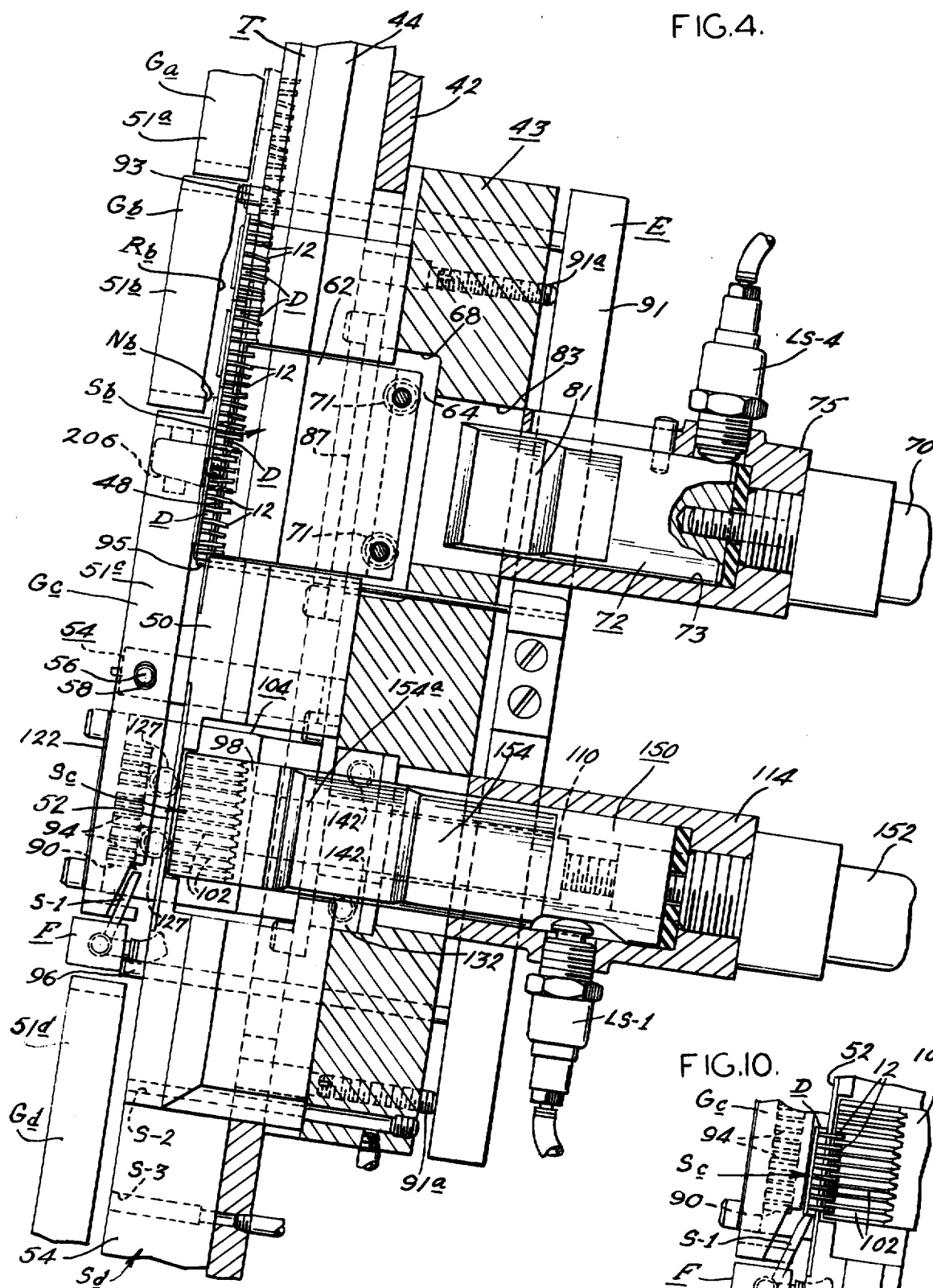
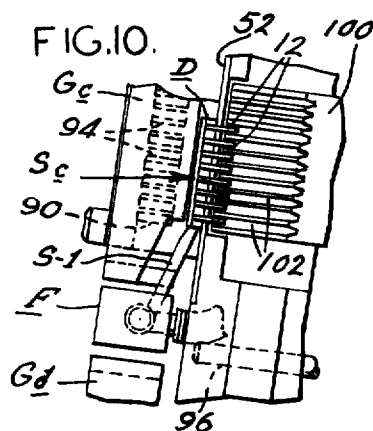


FIG. 10.



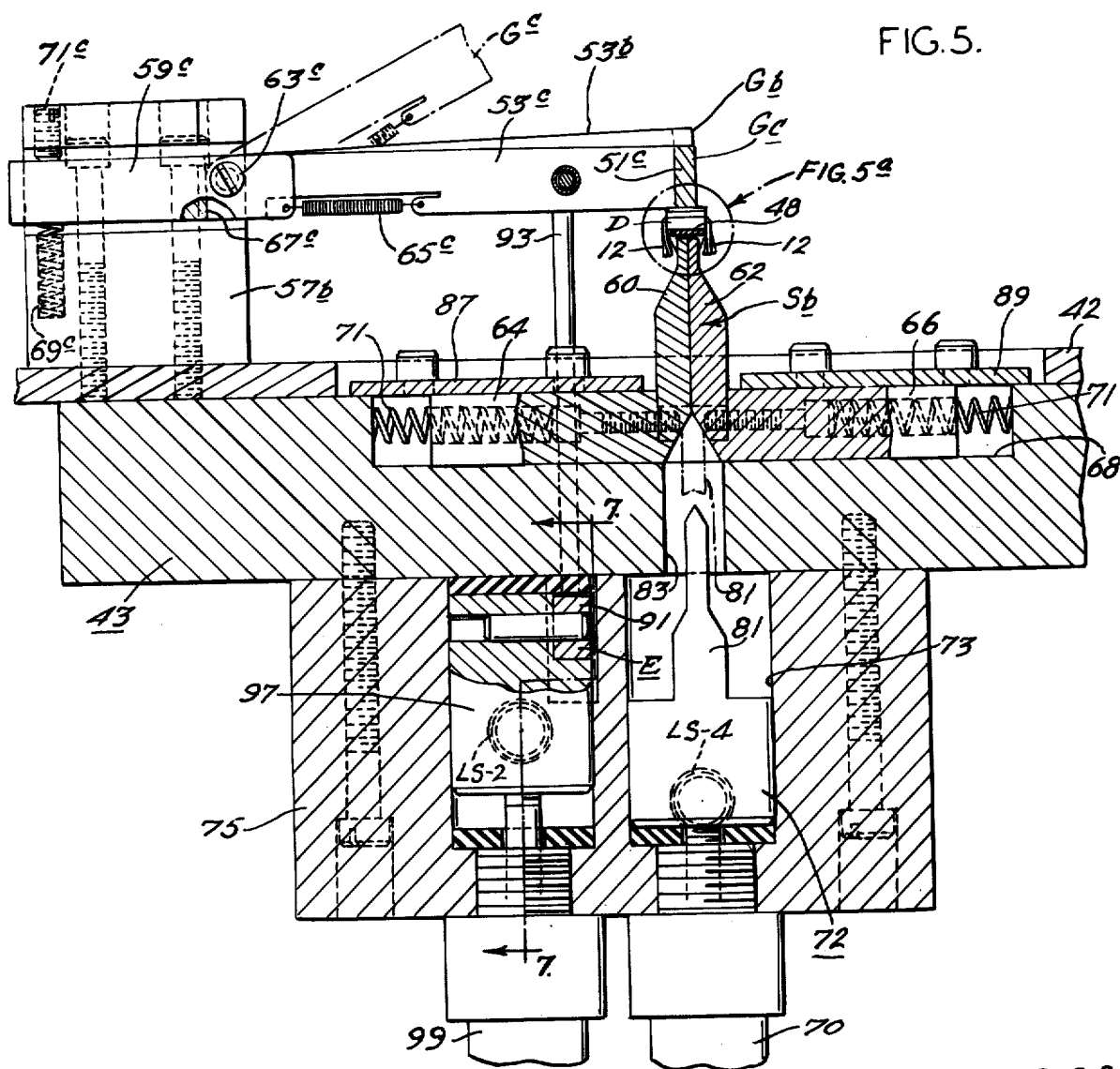


FIG. 7.

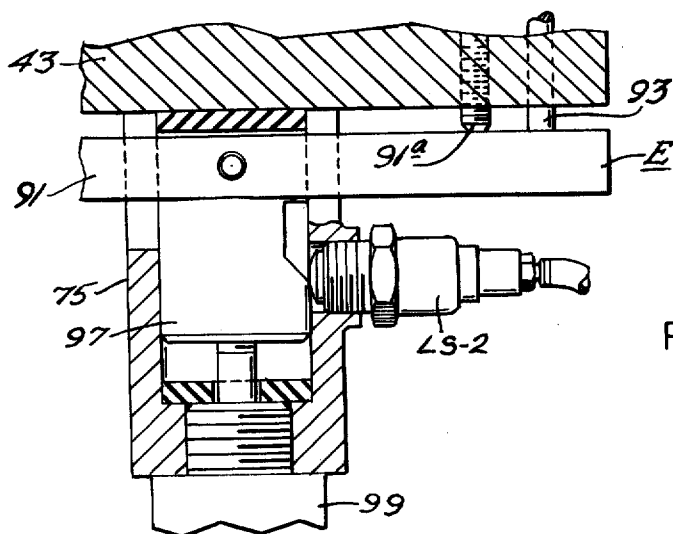


FIG. 5a.

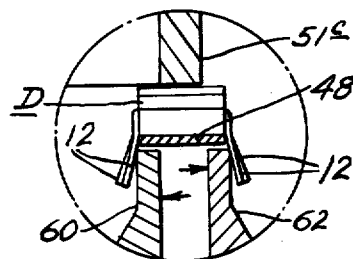
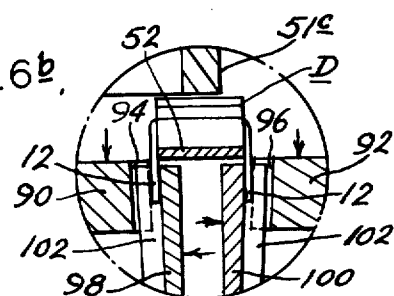


FIG. 6b.



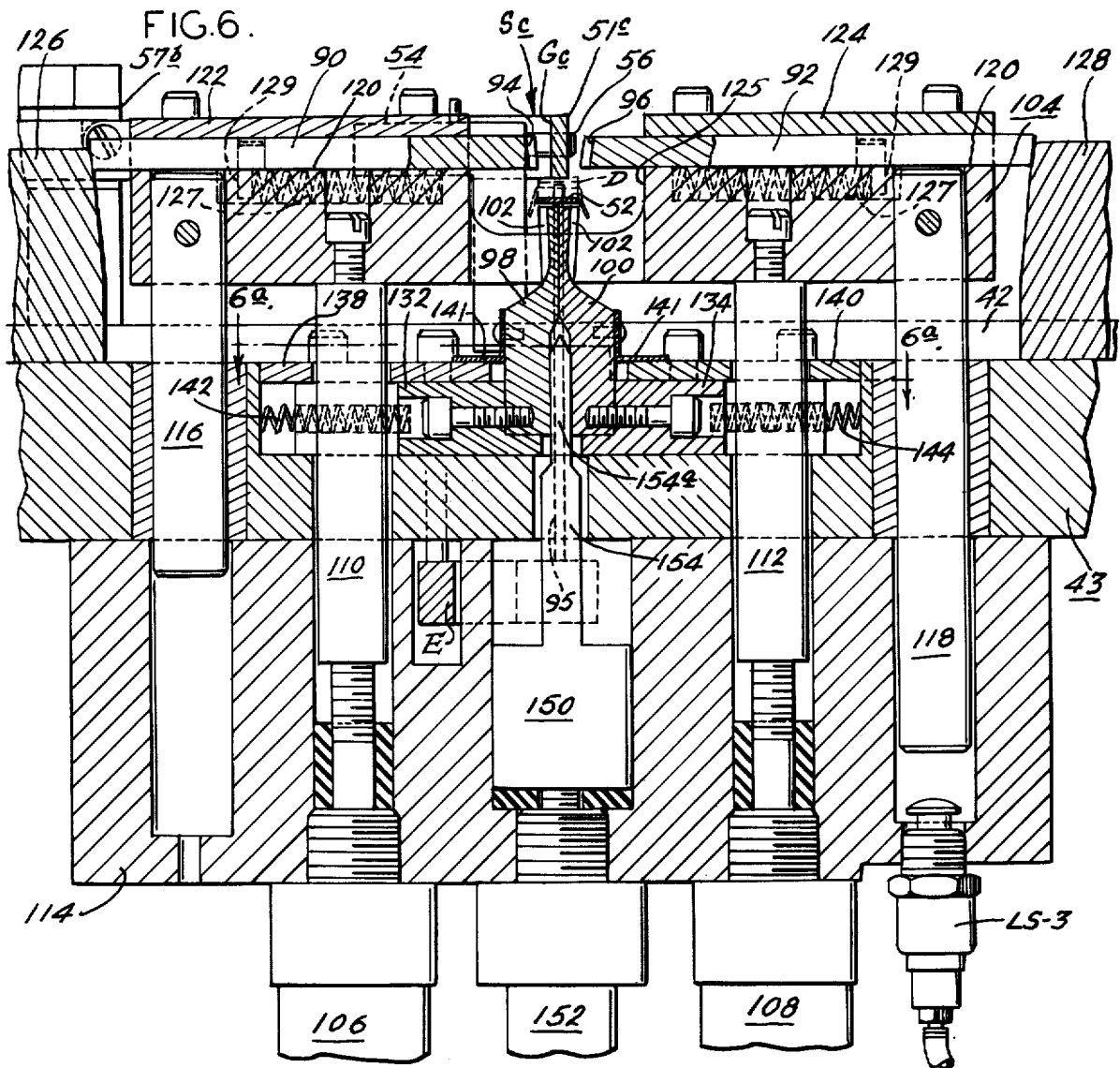


FIG. 6a.

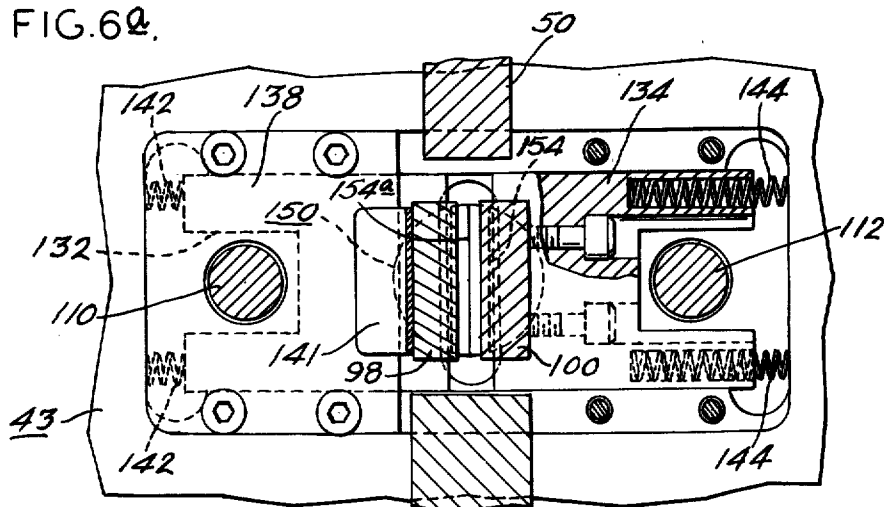


FIG. II.

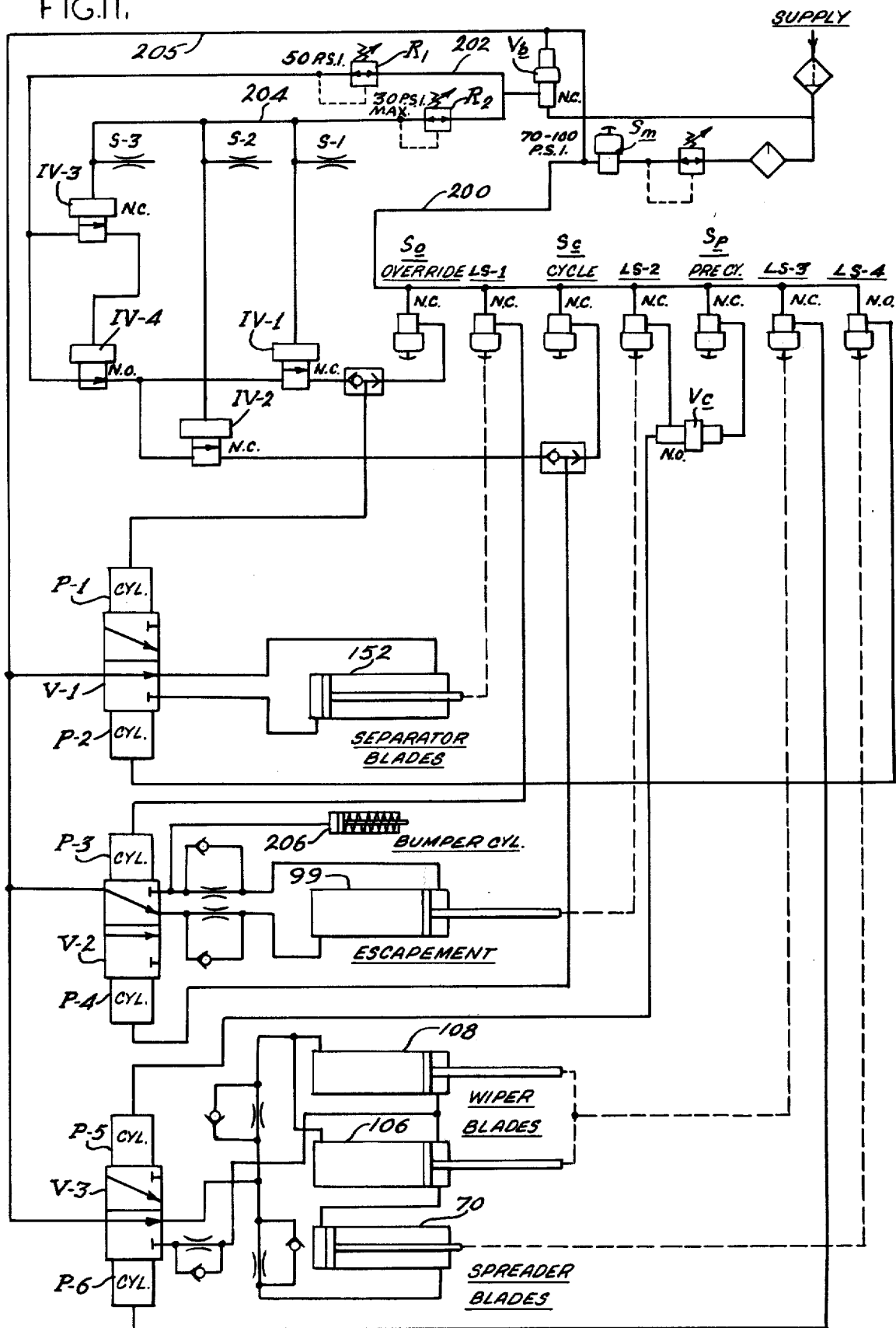


FIG. 12.

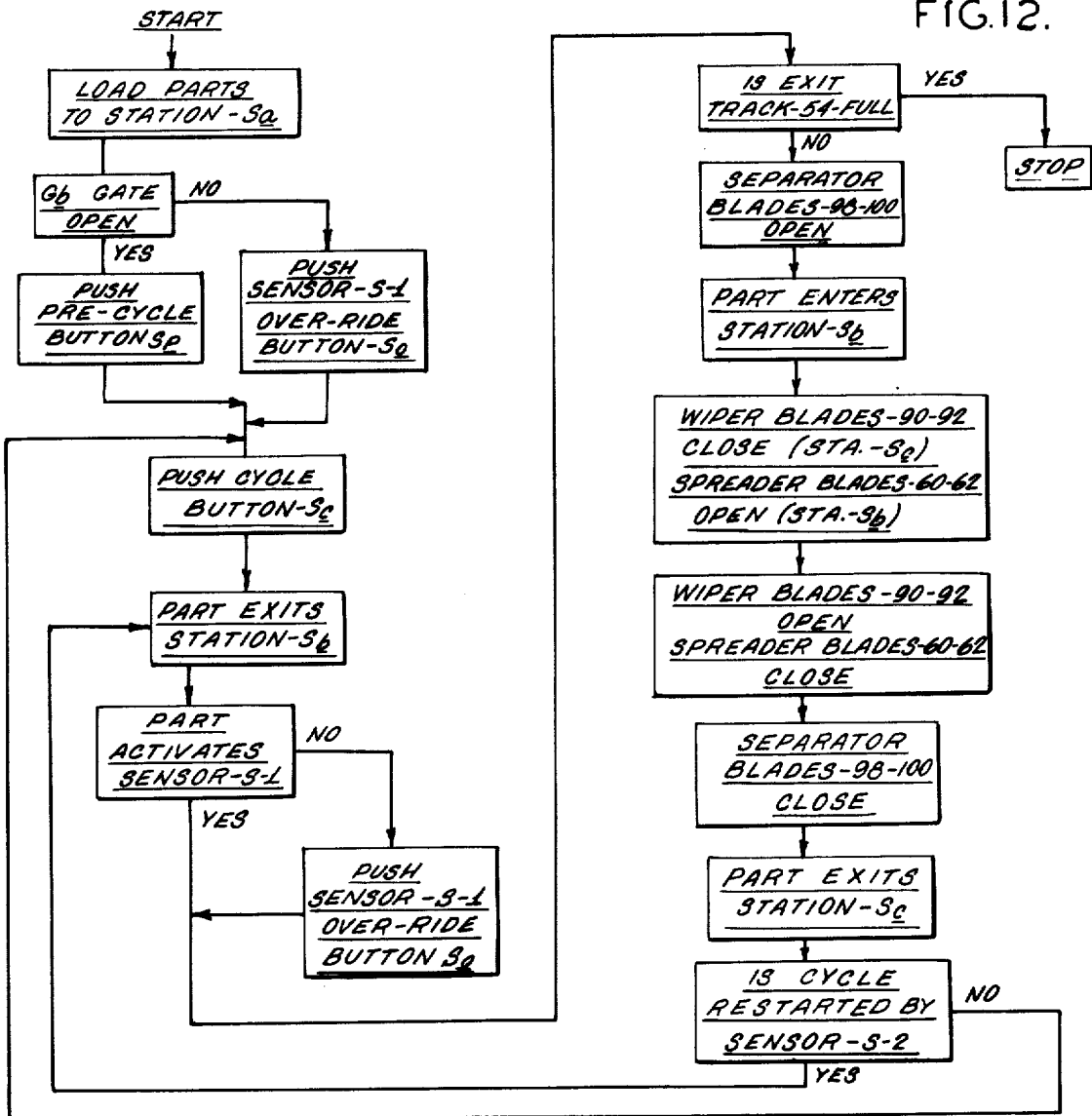


FIG. 2a.

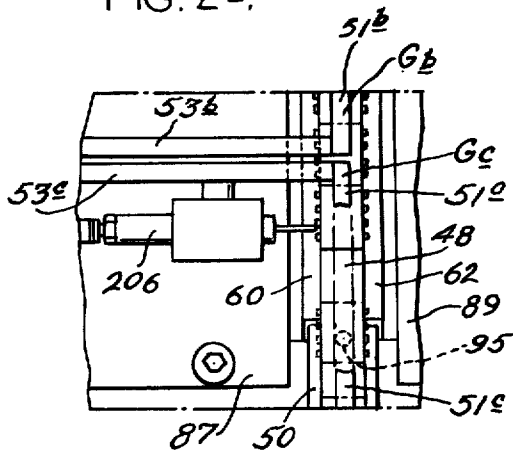
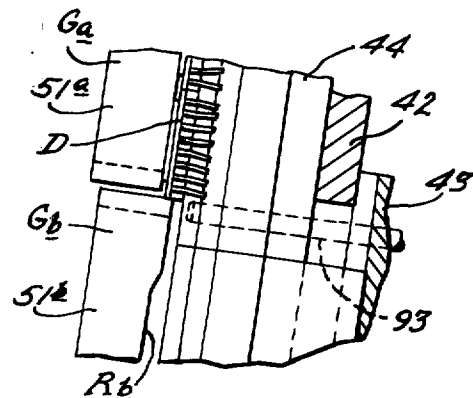


FIG. 4a.



METHOD AND APPARATUS FOR STRAIGHTENING ELECTRONIC COMPONENTS

The present invention relates to new and improved method and apparatus for straightening electronic components.

More specifically, the invention is directed to a novel method and apparatus for straightening so called dual-in-line devices (DIP devices) used as semi-conductors or resistors in integrated circuit boards or the like. These components typically comprise an elongated generally rectangular body portion made of moldable material having embedded therein a plurality of leads arranged in rows and disposed at a predetermined angular relation to the body portion. These components engage in a socket in the circuit board comprised of a plurality of rows of aligned openings to receive the leads of the DIP devices.

The manufacturer of these DIP devices typically packages the same in elongated plastic tubes or cartridges having a channel of U-shaped cross section to conform generally to the cross section of the component. It has been found, however, that during the manufacture, testing and shipping, these components are handled in bulk and the leads are slightly deformed or bent to a condition where they have to be straightened before they can be assembled in the socket openings of an integrated circuit board or the like. In accordance with some prior known methods the DIP devices are straightened either by hand or by manually operable equipment. This, of course, is extremely time consuming and often the hand straightening operation is not accurate enough to properly recondition the DIP device for insertion into the circuit board.

With the foregoing in mind, an object of the present invention is to provide a new and improved method and apparatus for automatic processing of electronic components particularly DIP devices of the type described above.

Another object of the present invention is to provide a method and apparatus for straightening DIP devices which easily accepts distorted DIP devices which are up to 100 mils from true position in any direction and will restore them to within 9 mils or better at the lead tips.

A still further object of the present invention is to provide method and apparatus which is completely automatic and wherein the straightening operation is done accurately without stressing the hermetic seal of the component.

These and other objects of the present invention and the various features and details of the operation and construction thereof are hereinafter more fully set forth with reference to the accompanying drawings wherein;

FIG. 1 is a front elevational view of apparatus in accordance with the present invention for straightening electronic components;

FIGS. 1a and 1a' are perspective and end views respectively of DIP devices prior to being processed in the apparatus of the present invention;

FIGS. 1b and 1b' are perspective and end views respectively of DIP devices after partial processing;

FIGS. 1c and 1c' are perspective and end views respectively of DIP devices after final processing in the apparatus of the present invention;

FIG. 2 is an enlarged front elevational view of the spreader and straightening station with parts broken away to show the internal construction more clearly;

FIG. 2a is a fragmentary front view of the bumper in an engaged position;

FIG. 3 is an enlarged fragmentary rear elevational view of the back panel of the apparatus;

FIGS. 4 and 5 are enlarged sectional views taken on lines 4—4, 5—5 and 6—6 respectively of FIG. 2;

FIG. 4a is a side elevational fragmentary view showing the gate at the spreader station closed;

FIG. 5a is an enlarged view of the encircled portion of FIG. 5 showing the spreader blades in an expanded position;

FIG. 6 is an enlarged sectional view taken on lines 6—6 of FIG. 2;

FIG. 6a is a sectional view taken on lines 6a—6a of FIG. 6;

FIG. 6b is an enlarged view of the portion of the apparatus encircled in FIG. 6 showing the separator blades in an expanded position;

FIG. 7 is a sectional view taken on lines 7—7 of FIG. 5 showing the escapement bar and actuator;

FIGS. 8 and 9 are enlarged sectional views taken on lines 8—8 and 9—9 of FIG. 2;

FIG. 10 is a fragmentary side elevational view of the straightening station;

FIG. 11 is a schematic of the pneumatic circuitry for the apparatus of the present invention; and

FIG. 12 is a flow chart showing the operational stations of the apparatus of the present invention.

Referring now to the drawings, FIGS. 1a, 1b and 1c show the type of electronic component for which the apparatus and method of the present invention are particularly suited to straighten. These electronic components, commonly known in the trade as dual-in-line devices, are hereinafter referred to as DIP devices. The DIP devices are generally designated by the reference letter D and comprise an elongated, generally rectangular body portion 10 made of a moldable material, such as a ceramic or plastic, having embedded therein a plurality of leads 12 which ideally are uniformly spaced apart and are parallel to a plane P—P perpendicular to the longitudinal axis A_L (see FIG. 1c). The DIP devices vary in size generally between a small device having 8 leads to a large device having 18 leads. The leads 12 are also aligned in a straight row and parallel or at a slight outward angle to a plane X—X through the axis A_L (see FIG. 1c') of the body portion so that they may be inserted into socket openings in an integrated circuit board. Even though the method and apparatus of the present invention are particularly suited for straightening electric components, specifically of this type, it is, of course, to be understood that this is only by way of example and the apparatus and method may be employed for devices of various sizes as well as performing other operations, for example, trimming the DIP lead tips.

The method of the invention will be presented hereinafter in conjunction with the description of the apparatus for carrying out the straightening process. A general understanding of the basis structure and operation of the apparatus may be gained by reference to several of the views that best show the basic components of the apparatus and the operation such as FIGS. 1, 2 and 4. Considering now the basic components of the apparatus in terms of function, the apparatus comprises a

main housing 20 mounting a generally perpendicularly oriented trackway T having a loading station S_a at its upper end, and a discharge station S_d at its lower end. A cartridge C for the DIP devices D is adapted to be mounted at the loading station S_a at the upper end of the trackway T whereby the DIP devices are gravity fed to the trackway for various operations at stations along the trackway. A plurality of pivotally mounted gates G_a , G_b , G_c , and G_d , each having a guide rail portion overlying the trackway and spaced therefrom insures movement of the DIP devices along the trackway. The DIP devices from the loading station S_a first pass through a spreader station S_b where they are momentarily detained by escapement means E and where a spreader mechanism conditions the DIP devices for a final forming operation in the present instance a straightening operation by displacing any inwardly bent leads outwardly (see FIG. 1b). The escapement means E then releases the DIP devices from the spreader station S_b and permits the spread DIP device to move by gravity down the trackway T to a final forming or straightening station S_c . The final forming station S_c includes a separator and wiper blade assembly which affects straightening of the leads so that they are uniformly spaced relative to one another and at a pre-selected angle relative to the body portion (see FIG. 1c). It is noted that in the reconditioned DIP device the leads may be parallel to the plane X—X or disposed outward at an angle of up to 10°.

Simultaneously with the final forming operation, DIP devices D on the trackway T are being spread at the first forming station S_b . A stop mechanism F retains the DIP devices at the final forming station S_c , the stop mechanism being selectively operable to release the finished part whereby the finished DIP device D drops by gravity to a discharge station S_d . Means including coordinated actuators and circuitry is provided for effecting operation of the various mechanisms in a predetermined timed sequence so that DIP devices D continuously feed through the apparatus and are conditioned in the manner described.

Considering now, more specifically, the structural details and arrangement of the apparatus, the trackway T is mounted on a generally rectangular face plate 42 and slide housing 43 of the main housing 20 and comprises an entrance rail 44, which pivotally mounts at its upper end, an adaptor assembly 46 for receiving the cartridge C. The adaptor 46 may be pivoted forwardly generally perpendicular to the entrance rail 44 within reach of the operator to permit the cartridge C to be easily assembled into the adaptor. The adaptor 46 is then pivoted upwardly so that the DIP devices D may be discharged and gravity fed to the entrance rail 44 of the trackway T (see FIG. 1). The trackway T further includes a first bridge track in the form of a plate 48 at the spreader station S_b and a short intermediate rail 50 between the first bridge track 48 and a second bridge track 52 at the final forming station S_c . Downstream of the second bridge track 52 is an exit rail 54 having means at its lower end for supporting an empty cartridge to receive the finished DIP devices D discharged from the machine. The trackway T is of a predetermined width less than the spacing between the inner terminal ends of the leads 12 to permit the DIP device D to straddle the trackway and move freely along the trackway without jamming. The bridge tracks 48 and 52 provide an opening in the trackway to facilitate op-

eration of the spreader and separator mechanisms in the manner described in more detail here below.

The DIP devices D are guided for movement along the trackway by means of a series of gates G_a , G_b , G_c and G_d having guide bar segments which align and overlie the various sections of the trackway T, to guide the DIP devices D during movement through the apparatus. Each of the gates is of generally U-shaped configuration and has a similar mounting arrangement including adjustment means for selectively varying the spacing between the guide bar segments and upper face of the trackway to accommodate DIP devices D of various sizes.

The various gate details and mounting are designated by the same numeral with different letter subscripts. Thus, the gate G_c , the details of which are best illustrated in various views of the drawings, consists of a guide rail segment 51c and a pair of arms 53c, which at their inner terminal ends are pivotally supported on a mounting assembly consisting of mounting blocks 57b and 57c secured to the face plate 42 of the housing 20, the mounting blocks have cutaway portions for links pivotally mounting the arms of a gate and a cap secured to the top of the mounting block overlying the cutaway portions and links. Each arm 53c of the gate G_c is pivotally secured to links 59c by shoulder pins 63c and is normally biased to a closed position by extension springs 65c connected between the arms and links as shown in FIG. 5. The inner end of each arm 53c abuts a shoulder 67c on the link to limit inward displacement of the gate, the gate being freely pivotable in an outward direction (broken line position in FIG. 5). The guide rail segment 51c may be adjusted relative to the trackway T by pivoting the links relative to the mounting block. Thus, as shown in FIG. 5, each link is urged to pivot outwardly toward the cap by a compression spring 69c in the mounting block, movement of the link being limited by a set screw 71c carried by the cap and which is adjustable to vary the gap between the guide rail 51c of the gate and top of the trackway T. Note that there is a common mounting block 57b for the gate G_b and adjacent arms of gate G_a and G_c . There is also a common mounting block 57c for adjacent arms of gates G_c and G_d which also pivotally mounts the stop mechanism F.

In the normal operation of the apparatus, each of the gates may be retracted to a position exposing the trackway, thereby facilitating easy and quick access in the event the DIP devices D are jammed in any part of the apparatus. The gate G_c , however, overlying the straightening station S_c , is provided with a manually operable latching mechanism 54 for locking the gate in its lower position (see FIG. 2). The latching mechanism simply consists of a spring biased pin 56 adapted to engage in a keeper hole 58 in the guide rail of the gate. This gate must be locked during the straightening operation at the final forming station S_c .

Now assuming the parts have been loaded in the apparatus in the manner discussed above, and one or more DIP devices D is located in the spreader station S_b , means is provided for spreading any inwardly deformed leads (see FIG. 1a) so that they are either parallel or slightly outwardly disposed relative to a plane X—X through the longitudinal axis A_L of the DIP device D. (see FIG. 1b) The spreader mechanism which is illustrated in FIGS. 4 and 5, comprises a pair of cooperating spreader blades 60 and 62, each having a reduced

terminal end portion smaller in combined width than the width of the first bridge track so that the parts drop freely through the station with the normal amount of inward deformation of the leads 12 discharged from the cartridge C. Each of the spreader blades is mounted on a slide carriage 64 and 66 engagable in a slotted opening 68 in a slide housing 43 secured to the rear portion of the face plate, the slotted opening 68 being covered by a pair of face plates 87 and 89 to confine the carriages 64 and 66. Each slide carriage is normally biased by compression springs 71 engaging the rear wall of the slide chamber and the slide carriage for each of the spreader blades. The spreader blades are adapted for displacement to spread the leads 12 of the DIP device D by means of a cam element 72 which is mounted in a cylindrical chamber 73 of a cylinder mount block 75 suitably mounted on the rear face of the slide housing 43. The cam element 72 is connected to the piston of a piston-cylinder actuator 70 and has a stepped cam blade 81 engagable through an opening 83 in the slide housing 43. When the cam element is displaced forwardly to the dotted line position, the stepped cam blade head engages the tapered inner ends of the spreader blades thereby moving the slide carriages outwardly in the slide chamber against the bias of the compression springs 71 and displacing the spreader blades outwardly to spread the leads 12 of the DIP device D outwardly as shown in FIG. 1b.

After the leads of the DIP device D are spread at the spreading station S_b , the escapement means E is actuated to a retracted position to permit the DIP device to fall by gravity to the final forming station S_c .

The escapement means E comprises an elongated escapement bar 91 which carries a pair of actuator pins 93 and 96 adjacent opposite terminal ends and an escapement pin 95 intermediate the pin 93 and 96. The escapement bar 91 is mounted for reciprocating movement between a forward limit position wherein the actuator pin 93 engages the gate G_b to raise it to a release position, the escapement pin 95 projects through the trackway T below the spreader station S_b to retain the DIP devices L as shown in FIG. 4 and the lower actuator pin 96 pivots the stop means F to a retracted position permitting discharge of DIP devices D from the final straightening station S_c . The escapement bar 91 is mounted on an adaptor 97 secured to the piston of a piston-cylinder actuator 99 supported on the cylinder mount 75. A pair of set screws 91a are mounted in slide housing 43 to limit forward displacement of escapement bar 91 and therefore the outward position of gate G_b and stop means F. This adjustment is necessary to maintain the desired minimum clearance between the gate G_b and the trackway T thereby to preclude DIP devices D from assuming a tilted attitude on the trackway and thereby jam the apparatus. The adjustment is also necessary to preclude engagement of the sensor probe S-1 and the cut out in the gate G_c which could tilt the gate and jam DIP devices in the trackway T under the gate G_c .

The stop means F comprises an elongated sensor arm 99a pivotally mounted to a link 101 and normally biased to a lowered position by a spring 103. The sensor arm mounts at its inner end a sensing probe S-1 which in the lowered position as illustrated in FIG. 10, provides a seat for a DIP device D to accurately position it at the final straightening station S_c and also serves as

part of the automatic cycling system as described later.

At the final straightening station, mechanism is provided for separating the leads 12 so that they are uniformly spaced relative to one another and disposed at a predetermined angle relative to the body portion. To this end the separating mechanism comprises a pair of wiper blades 90 and 92 having confronting serrated heads 94 and 96 at their ends. (see FIGS. 4, 6 and 6a)

The separator mechanism also includes a pair of separator blades 98 and 100 which have a plurality of grooves 102 therein, with which the serrated heads 94 and 96 cooperate to effect uniform separation of the leads of the DIP device D and positioning of the leads 12 at a predetermined angle relative to a plane X—X through the longitudinal axis A_L .

Considering now, more specifically, the structural arrangement of the separator mechanism, the wiper blades are mounted in a carriage 104 which as best illustrated in FIG. 6 is supported for reciprocating motion between an outer limit position (solid lines in FIG. 6) and an inner limit position as shown in FIG. 6b. To this end the carriage 104 is connected to piston-cylinder actuators 106 and 108 through connecting rods 110 and 112 respectively. These connecting rods as illustrated, extend through appropriate openings in the slide housing and cylinder mount block 114. Guide pins 116 and 118 are also provided which are disposed outboard of the connecting rods 110 and 112 and which engage and ride in appropriate cylindrical openings in the main slide housing and cylinder block 114. The carriage 104 has a transverse recess 120 therein, defining a way for the blades 90 and 92. The ways are closed by covers 122 and 124 secured to the carriage the covers being spaced apart at their inner ends to expose the serrated heads 94 and 96. The base of the recess on either side of the central opening 125 in the carriage has grooves formed therein for spring 127 which engages pins 129 on each of the blades to normally urge the blades to an outer position so that the outer ends thereof normally abut spaced cam blocks 126 and 128 mounted in cam block holder secured to the slide housing. The cam blocks, in the present instance, each have a face which converges inwardly at a preselected angle of about 3° so that when the blades are actuated inwardly they tend to wipe the leads of the DIP device D to a slightly inward angular inclination to allow for spring back of the leads to a normal condition. Of course, the cam blocks are selectively interchangeable when it is desired to vary the angle of the leads for a given DIP device D. The angle of the leads 12 may vary from a condition parallel to the plane X—X to a 10° outward inclination depending on the type of DIP device D and to accomplish this the cam blocks 126 and 128 are replaceable as well as the separator blades 98 and 100.

The separator blades which engage through the opening in the carriage 104, each are carried by a slide 132 and 134 mounted in a generally rectangular recess in the slide housing. The slides are confined in the recess by covers 138 and 140 and each of the separator blades mounts an angled shield 141 which has a portion overlying the cover to guide the blades for movement during the wiping operation. The covers 138 and 140, of course, are spaced apart to permit outward displacement of the separator blades during the wiping operation. The slides 132 and 134 are normally biased to position the separator blades in a closed position by com-

pression springs 142 and 144. The separator blades are adapted for spreading movement during the wiping operation to the position shown in FIG. 6b by means of a cam element 150 which is connected to the piston of a piston-cylinder actuator 152. The cam element 150 has a generally cylindrical stem portion engaging in a cylindrical opening in the cylinder block 114 and a stepped cam face 154, the outer portion 154a of which is normally engaged between the separator blades in the manner shown. The inner face of each of the separator blades is provided with a chamfered portion so that when the cam is engaged forwardly, the blades are readily displaced outwardly during the wiping operation. Means described in more detail hereinafter is provided for timed actuation of the cam element 150 to reciprocating movement of the wiper blades 90 and 92 to simultaneously spread the leads outwardly and align them relative to one another as the serrated head of the wiper blades engages in the grooves in the separator blades.

The pneumatic circuitry of the apparatus is schematically illustrated in FIG. 11 and will now be described briefly to point out the important operational concepts of the system and apparatus. To initiate operation of the machine, the main switch S_m is actuated to effect supply of air from the main supply through the line 200 to the bank of limit switches LS1, LS2, LS3 and LS4, and the control switches S_0 , override switch S_r and pre-cycle switch S_p . The operation of the main switch S_m also opens normally closed control valve V_b to effect flow of air from the main supply through the lines 202 and 204 and pressure regulators R_1 and R_2 to the interface pilot valves IV-1, IV-2, IV-3 and IV-4 and to sensor S-1, S-2 and S-3. Line 205 delivers air from supply to control valves V_1 , V_2 and V_3 .

Considering now the operation of the apparatus and specifically with reference to the circuitry for effecting automatic operation, a cartridge C is positioned in the adaptor assembly 46 at the upper end of the trackway T. The adaptor assembly is then pivoted upwardly so that the cartridge C is aligned with the entrance rail of the trackway T whereby the DIP devices D fall by gravity to the spreader station S_b . At this point, if gate G_b is in a raised position, then the escapement bar E is in an extended position and the first DIP device D engages the escapement pin 95 in the position illustrated in FIG. 4. In the event gate G_b is lowered, the escapement bar is in a retracted position and the first DIP device engages the top edge of the gate G_b . (For operation sequence refer to flow chart of FIG. 12)

Now in order to initiate operation of the apparatus, if the gate G_b is open or in a raised position, the pre-cycle switch S_p is actuated which through normally open valve V_r activates pilot P-5 of control valve V-3 for wiper blade and spreader blade actuators to lower the wiper blades and move the spreader blades to an extended position to spread DIP devices at the spreader station S_b . The spreader and wiper cycle is reversed through LS-3 which activates pilot P-6 of control valve V-3.

Thereafter, the normally closed cycle switch S_r is manually actuated to activate the pilot P-4 for the escapement control valve V-2 which in turn retracts the escapement bar E thereby lowering gate G_b , retracting escapement pin 95 and permitting the sensor arm to move to a forward limit position wherein the sensor probe S-1 is in a position to be engaged by the DIP de-

vice D on a trackway T entering the final forming station S_c . (see FIG. 10) A single spread DIP device D then is discharged from the spreader station S_b and falls by gravity to the final forming station S_c . It is noted that retraction of the escapement bar permits the gate G_b to lower whereby in the case of 16 lead devices of the type illustrated, the nose portion N_b formed at the lower end of the guide rail segment engages the next DIP device D in line to support the stack of DIP devices and insure passage of only one DIP device to the final straightening station S_c . The relief cut R_b in the guide rail segment of gate G_b provides a clearance between the gate and other devices in the stack to insure engagement of the nose portion N_b . Retraction of the escapement bar 91 also actuates the bumper piston 206 to retain DIP devices D on the trackway T at the spreader station S_b and aid in permitting only a single DIP device D to be discharged to the final forming station S_c . In the case of 8 lead devices of the bumper piston 106 insures discharge of only a single DIP device D to the final forming station and also the functions to slightly jar the devices on engagement and effect separation in the event the mold flashing of adjacent devices hold them together as is sometimes the case. (see FIG. 2a)

Retraction of the escapement bar E opens normally closed limit switch LS-2 (see FIG. 7) which in turn activates pilot P-5 of control valve V-3, thereby lowering the wiper blades and moving the spreader blades to an open position to spread DIP devices D at the spreader station S_b . Simultaneously, the leads of a DIP device at the final forming station are separated by the action of the wiper blades (see FIG. 6b), the separator blades being in an expanded or open position. When the wiper blades are fully lowered, guide pin 118 opens normally closed limit switch LS-3 to activate pilot P-6 for control valve V-3 thereby recycling the wiper blades and returning them to a raised position and retracting the spreader blades to a closed position thereby closing normally open limit switch LS-4 and activating pilot P-2 of control valve V-1 to close the separator blades.

The apparatus is now conditioned for automatic cycling. For example, as the DIP device enters the final forming station S_c , sensor S-1 is closed which in turn activates normally closed interface pilot valve IV-1 to open position which in turn activates the pilot P-1 for separator control valve V-1 to actuate the separator blades to a forward limit position to separate the leads 12 of the DIP devices D at the separating station S_b . The separator cam opens normally closed limit switch LS-1 to activate pilot P-3 for escapement control valve V-2. In response to the actuation of the escapement, normally closed limit switch LS-2 is opened to activate pilot P-5 through normally open valve V_r for wiper and spreader blade control valve V-3 thereby to cycle the wiper and spreader blades to separate the leads of the DIP device D at the final forming station. As the wiper blade assembly is moved inwardly, the guide pin 118 engages normally closed limit switch LS-3 which in turn activates pilot P-6 for the wiper and spreader blade control valve V-3 to return them to the normal position shown in the schematic. Simultaneously, spreader blade cam 81 closes normally open limit switch LS-4 in turn activating pilot P-2 for separator control valve V-1. Accordingly, the separator blades are spreading a DIP device at the spreader station S_b as the wiper and spreader blades are completing a cycle at the final straightening station S_c .

Actuation of the escapement bar to its forward limit position pivots the sensor arm outwardly to release the finished DIP lead and permit it to fall by gravity along the trackway from the final forming station S_c . As it passes the discharge rail, sensor S_2 is closed which in turn actuates interface pilot valve IV-2 to an open position thereby activating pilot P-4 of control valve V-2 to retract the escapement bar whereby the cycle is repeated.

If, at the start of operation, the gate G_b is closed, the DIP devices D engage the top edge of the gate G_b since the escapement is in a retracted position which means LS-2 is open and therefore P-5 is activated to cycle the wiper blades and spreader blades and thereby spread one or more DIP devices D at the spreader station. Thereafter, normally closed sensor override switch S_0 is manually actuated thereby to activate pilot P-1 of control valve V-1 for the separator piston-cylinder actuator 152. Actuation of the control valve V-1 in this manner moves the separator cam forward to effect displacement of the separator blades to their open position (see FIG. 6b). Actuation of the separator blade cam 154 opens normally closed limit switch LS-1 to actuate the pilot P-3 for escapement control valve V-2 to position the escapement bar E in a forward limit position. In this position the gate G_b is open and the DIP devices D engage the escapement pin 95 on the trackway T. The sensor arm F is also in a retracted position by reason of engagement of the lower actuating pin 96 of the escapement bar as shown in FIG. 4. Then the cycle switch S_c is actuated and automatic operation follows in the manner discussed above.

The finished DIP devices are accumulated in a cartridge C mounted at the discharge end of the trackway T and are periodically removed as the cartridge is filled and replaced with an empty cartridge. In the event a cartridge is not removed from the discharge station and the finished DIP leads accumulate to a level closing sensor S-3, this signals opening of the interface pilot valve IV-3 which, in turn moves pilot valve IV-4 to a closed position to shut down the operation of the machine. As soon as sensor S-3 is open, for example, by removing the filled cartridge, automatic operation of the machine continues.

The pilots P-1, P-2, P-5 and P-6 are conventional self resetting pilot actuators whereas pilots P-3 and P-4 are not of the self resetting type.

What is claimed is:

1. Apparatus for reconditioning electronic devices having an elongated body portion and a plurality of leads extending from the opposite side edges of said body portion and disposed at a predetermined angle relative thereto comprising an elongated generally vertically oriented trackway, a spreader station having means for spreading outwardly any leads projecting inwardly relative to a predetermined plane through the longitudinal axis of said device and a forming station having means for aligning the leads on opposite side edges of said device in a row at a predetermined angle relative to said body portion and wherein the leads in each row are uniformly spaced relative to one another, said spreader and forming stations being located along said trackway whereby electronic devices are gravity fed through said stations.

2. Apparatus as claimed in claim 1 wherein said spreader station includes a pair of cooperating spreader blades having terminal end portions smaller in com-

bined width than the width of said trackway when the spreader blades are in a closed position thereby permitting the devices to straddle the trackway at the spreader station, and including means for actuating the spreader blades transversely relative to the trackway to affect displacement of the leads of a device outwardly.

3. Apparatus as claimed in claim 2, including biasing means normally urging said spreader blades to a closed position.

4. Apparatus as claimed in claim 1 including stop means operable in a first limit position to retain devices at the spreader and forming stations respectively during the spreading and forming operations and in a second limit position permit discharge of the devices from the stations.

5. Apparatus as claimed in claim 4 wherein said stop means includes an escapement pin operable between extended position in the path of devices on the trackway at the spreader station and a retracted position out of the path of devices on the trackway.

6. Apparatus as claimed in claim 5 wherein said stop means includes sensing means operable to cycle the escapement pin between said limit position.

7. Apparatus as claimed in claim 1 including a separator mechanism at said forming station comprising a pair of wiper blades having confronting serrated faces disposed on opposite sides of said trackway and adapted for reciprocating transverse movement and a pair of cooperating separator blades having a plurality of grooves with which the serrated heads of the wiper blades cooperate to align said leads.

8. Apparatus as claimed in claim 7 including biasing means normally urging said wiper blades outwardly and cam members engagable by said wiper blades during reciprocating actuation thereof thereby providing means for controlling the angular disposition of said leads during the forming operation.

9. Apparatus as claimed in claim 7 including control circuit means for affecting cyclic operation of said spreader and separating mechanisms in a predetermined timed sequence.

10. Apparatus as claimed in claim 1 including a plurality of gates each having a guide bar segment overlying and aligned with said trackway and spaced therefrom thereby to confine and guide said devices for movement along said trackway through the apparatus.

11. A method for reconditioning electronic devices having an elongated body portion and plurality of leads extending from opposite side edges of said body portion and disposed at a predetermined angle relative thereto consisting of the steps of feeding the devices along a generally vertically oriented trackway through spreader and separator stations disposed along said trackway whereby devices are gravity fed through said stations, spreading outwardly any leads projecting inwardly relative to a predetermined plane through the longitudinal axis of said device and aligning the leads on opposite side edges in a row at a predetermined angle relative to said body portion.

12. Apparatus for reconditioning electronic devices having an elongated body portion and a plurality of leads extending from the opposite side edges of said body portion and disposed at a predetermined angle relative thereto comprising an elongated generally vertically oriented trackway, a spreader station disposed along said trackway having means for spreading outwardly any leads projecting inwardly relative to a pre-

determined plane through the longitudinal axis of said device, said spreader station including a pair of cooperating spreader blades having terminal end portions smaller in combined width than the width of said trackway when the spreader blades are in a closed position thereby permitting the devices to straddle the trackway at the spreader station, means for actuating the spreader blades transversely relative to the trackway to affect displacement of the leads of a device outwardly, and a forming station having means for aligning the leads on opposite side edges of said device in a row at a predetermined angle relative to said body portion and wherein the leads in each row are uniformly spaced relative to one another.

13. Apparatus as claimed in claim 12 including biasing means normally urging said spreader blades to a closed position.

14. A separator mechanism for aligning the leads of electronic devices having a body portion and a plurality of leads extending from the body portion comprising at least a pair of separator blades mounted for displacement relative to one another in a direction generally parallel to the plane of the body portion, each blade having at least one groove in one face thereof and at least one pair of wiper blades having along one edge a plurality of serrations and means for actuating said wiper and separator blades relative to one another so that the wiper blades engage the leads adjacent the body portion and move downwardly toward the terminal ends, the wiper blade serrations cooperating with the grooves in said separator blades to align the leads of the electronic device when it is positioned so that its leads confront the grooves in said separator blades.

15. Separator mechanism as claimed in claim 14 including biasing means normally urging said wiper blades outwardly away from one another and cam means engagable by said wiper blades during reciprocating actuation thereof thereby providing means for controlling the angular disposition of said leads during the forming operation.

16. The combination including a spreader mechanism and separator mechanism for aligning the leads of electronic devices having an elongated body portion and a plurality of leads extending from the opposite side edges of said body portion disposed at a predetermined angle relative thereto, said spreader mechanism including a pair of cooperating spreader blades having terminal end portions smaller in combined width than the width of said trackway when the spreader blades are in a closed position thereby permitting the devices to straddle the trackway at the spreader station, means for actuating the spreader blades transversely relative to the trackway to affect displacement of the leads of a device outwardly, said separator mechanism comprising at least a pair of separator blades mounted for displacement relative to one another in a direction generally parallel to the plane of the body portion, each blade having a plurality of grooves in one face thereof and at least one pair of wiper blades having along one edge a plurality of serrations and means for actuating said wiper and separator blades relative to one another so that the wiper blades engage the leads adjacent the body portion and move downwardly toward the terminal ends, the wiper blade serrations cooperating with the grooves in said separator blades to align the leads of the electronic device when it is positioned so that its leads confront the grooves in said separator blades.

17. Separator mechanism as claimed in claim 14 including biasing means normally maintaining said separator blades in a closed position and including cam means for displacing said separator blades to an open position.

18. Separator mechanism as claimed in claim 14 wherein the serrations of said wiper blades are disposed at an outwardly inclined angle and the grooves of said separator blades converge downwardly relative to a plane perpendicular to the plane of the body portion of the device.

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