

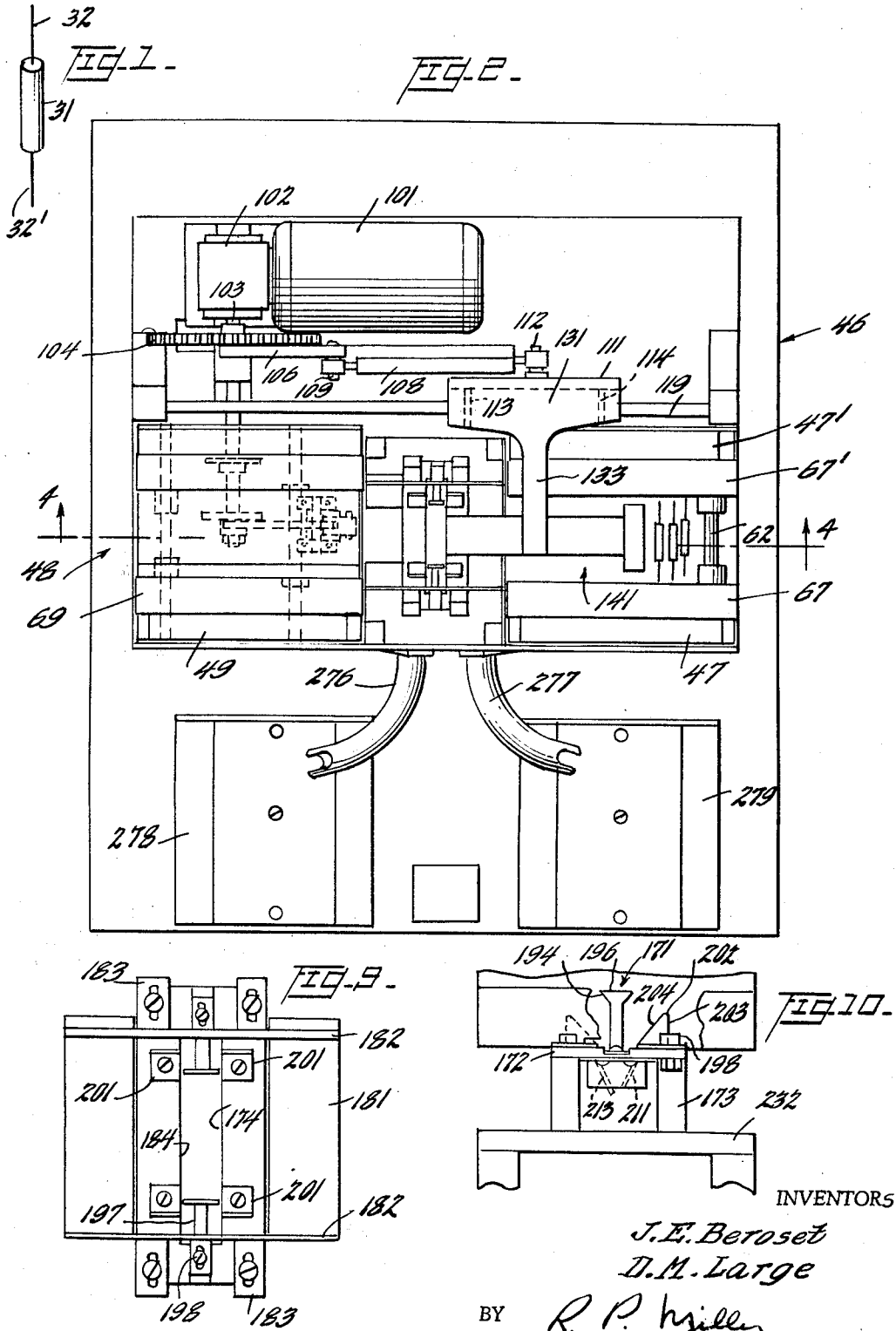
June 18, 1968

J. E. BEROSET ET AL
METHODS OF AND APPARATUS FOR SELECTIVELY REMOVING AND
SORTING COMPONENTS FROM A MASS OF
SPATIALLY SUSPENDED COMPONENTS

3,388,795

Filed March 10, 1966

5 Sheets-Sheet 1



INVENTORS

J. E. Beroseť
D. M. Large

BY

R. P. Miller

ATTORNEY

June 18, 1968

J. E. BEROSET ET AL
METHODS OF AND APPARATUS FOR SELECTIVELY REMOVING AND
SORTING COMPONENTS FROM A MASS OF
SPATIALLY SUSPENDED COMPONENTS

3,388,795

Filed March 10, 1966

5 Sheets-Sheet 2

FIG. 3.

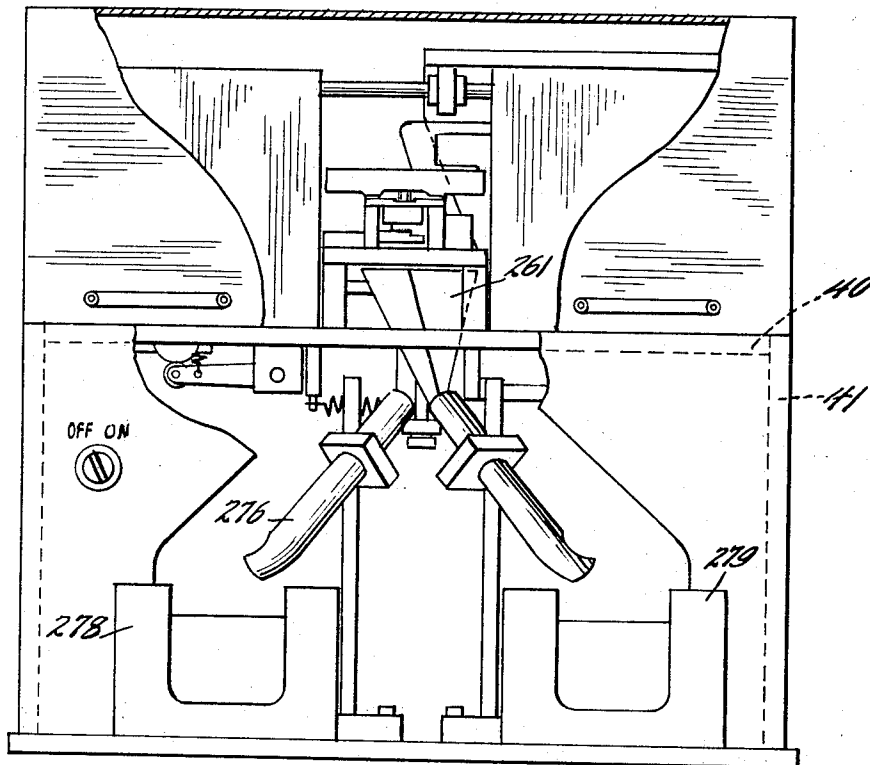


FIG. 7.

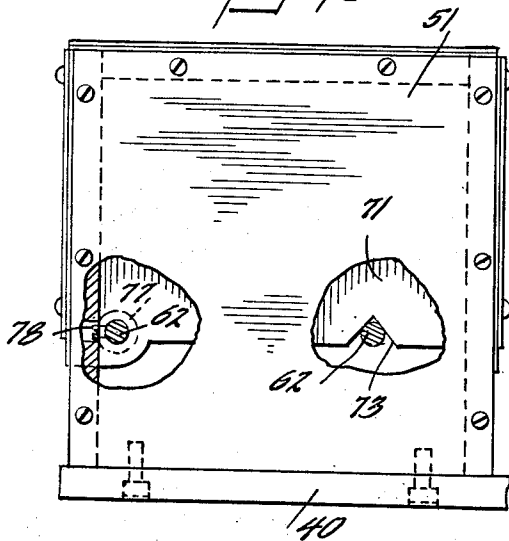
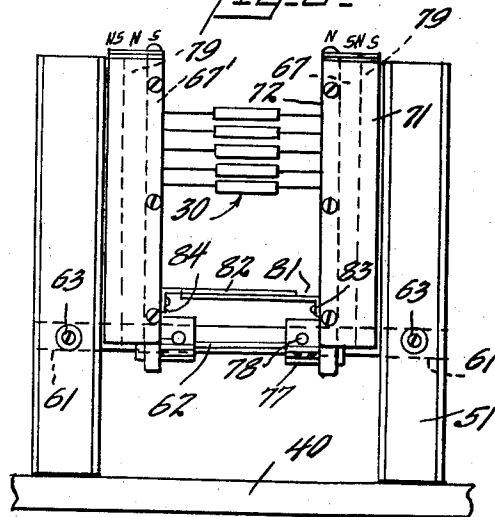


FIG. 8.



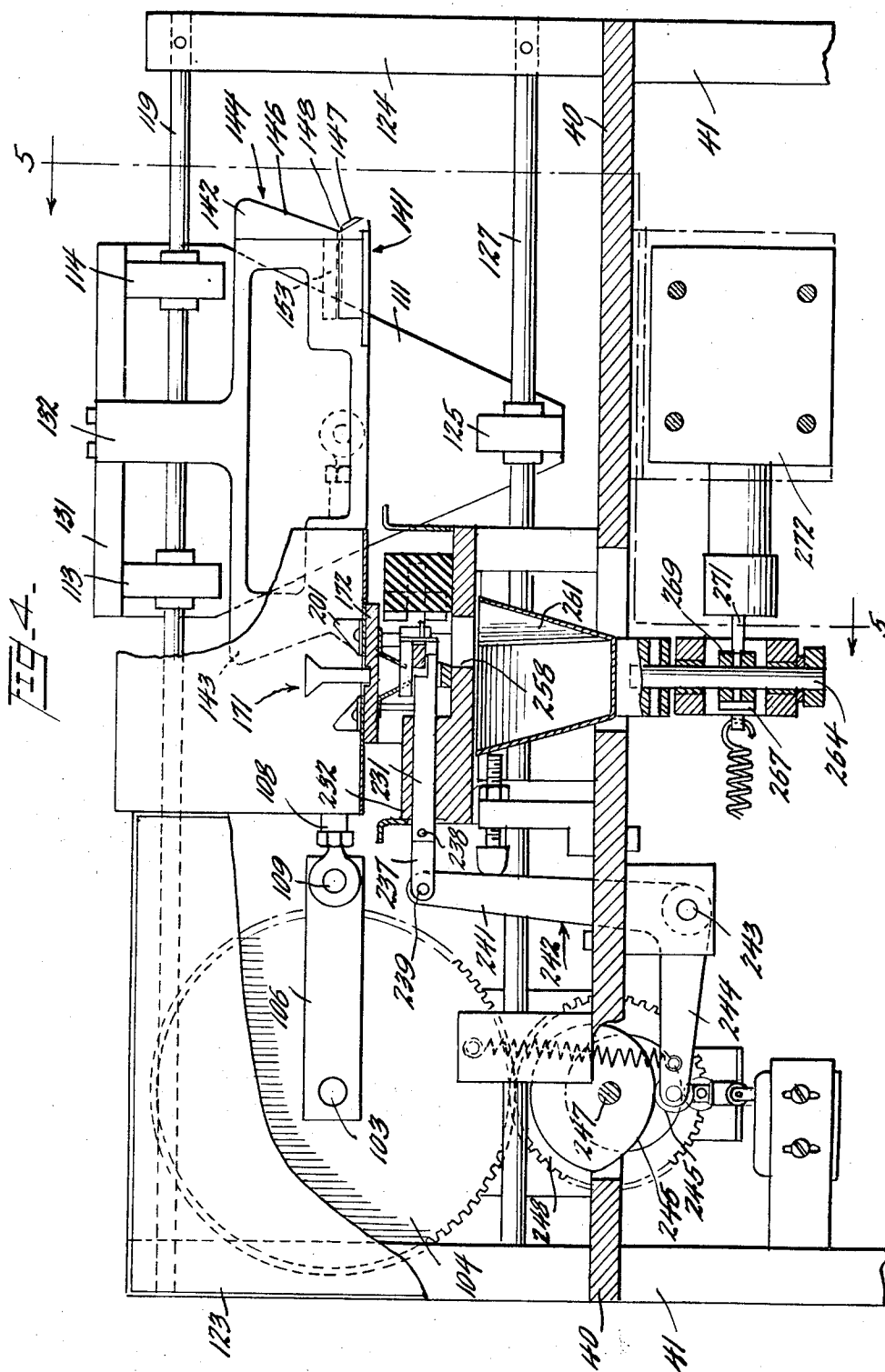
June 18, 1968

J. E. BEROSET ET AL
METHODS OF AND APPARATUS FOR SELECTIVELY REMOVING AND
SORTING COMPONENTS FROM A MASS OF
SPATIALLY SUSPENDED COMPONENTS

3,388,795

Filed March 10, 1966

5 Sheets-Sheet 3



June 18, 1968

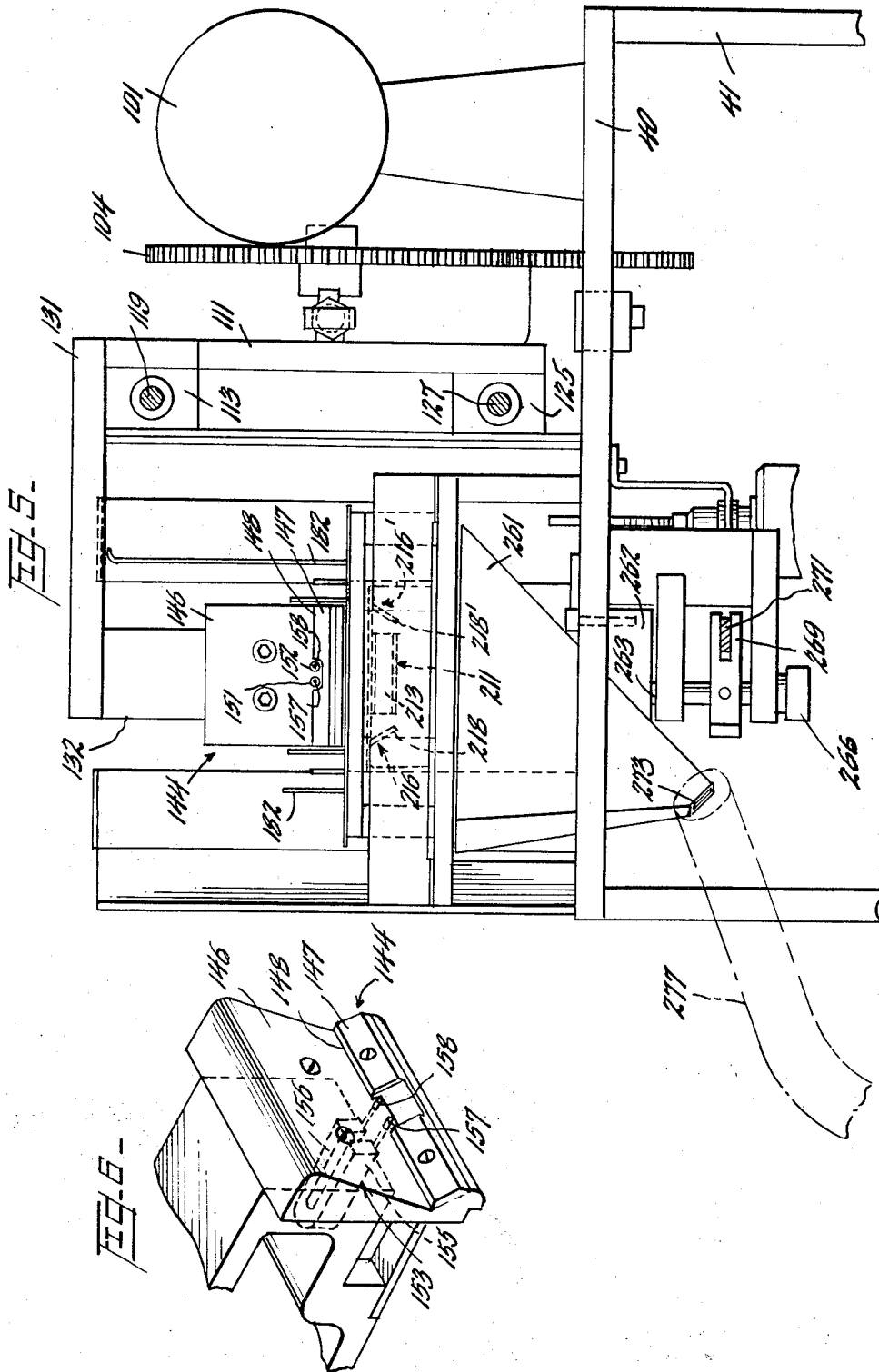
J. E. BEROSSET ET AL

3,388,795

METHODS OF AND APPARATUS FOR SELECTIVELY REMOVING AND
SORTING COMPONENTS FROM A MASS OF
SPATIALLY SUSPENDED COMPONENTS

Filed March 10, 1966

5 Sheets-Sheet 4



June 18, 1968

J. E. BEROSSET ET AL
METHODS OF AND APPARATUS FOR SELECTIVELY REMOVING AND
SORTING COMPONENTS FROM A MASS OF
SPATIALLY SUSPENDED COMPONENTS

3,388,795

Filed March 10, 1966

5 Sheets-Sheet 5

FIG. 11.

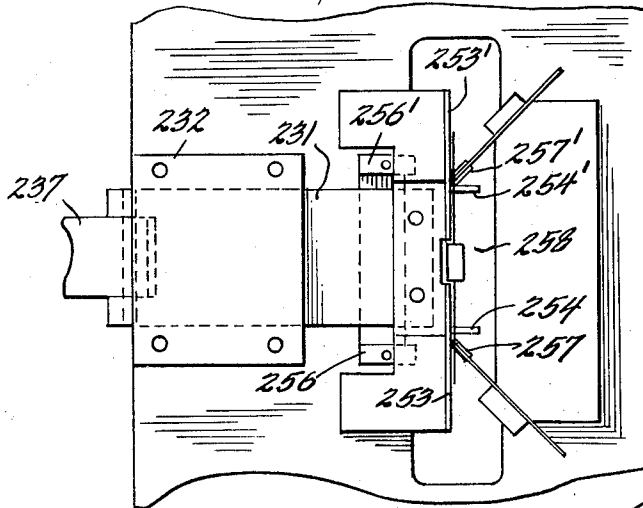
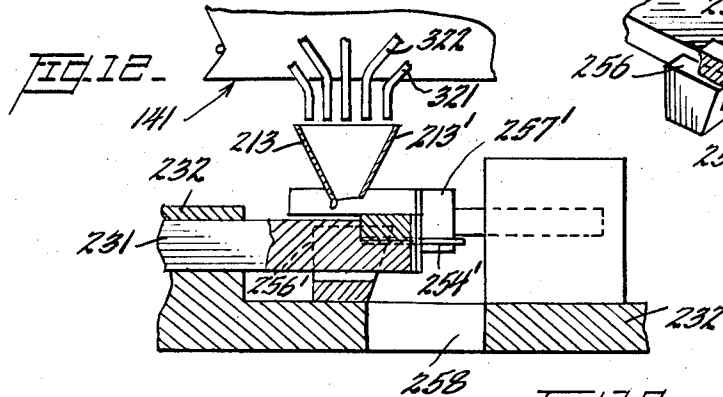
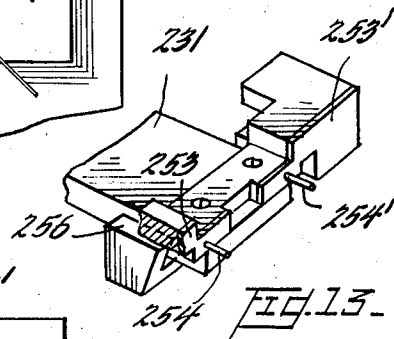


FIG. 14.

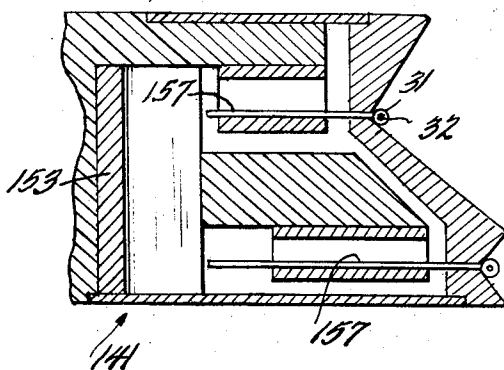
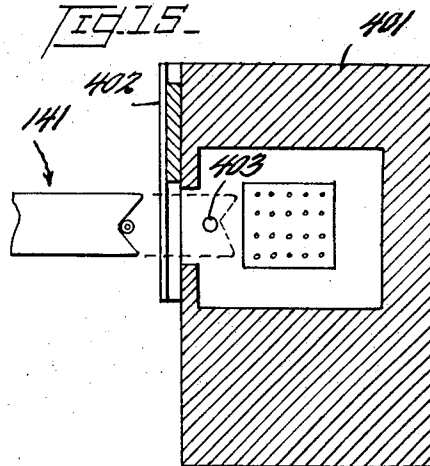


FIG. 15.



1

3,388,795

METHODS OF AND APPARATUS FOR SELECTIVELY REMOVING AND SORTING COMPONENTS FROM A MASS OF SPATIALLY SUSPENDED COMPONENTS

John E. Beroset, Flemington, N.J., and Donald M. Large, Temple, Pa., assignors to Western Electric Company, Incorporated, New York, N.Y., a corporation of New York

Filed Mar. 10, 1966, Ser. No. 533,330
20 Claims. (Cl. 209—73)

ABSTRACT OF THE DISCLOSURE

Methods of and apparatus for storing a mass of elongated, paramagnetic articles between a pair of parallel, upstanding walls, spaced apart a distance slightly greater than the length of the articles. Magnets within each wall establish horizontal lines of flux so that the articles are suspended in generally parallel relationship along the lines of flux density. A pickup member having a pair of magnetized poles on one end thereof is moved into the magnetic field to attract and hold a predetermined number of articles from the mass of articles, whereafter the pickup member is moved out of the field with the predetermined number of articles held thereagainst. The articles are released from the pickup member, tested and then sorted in accordance with the test characteristics.

This invention relates to methods of and apparatus for selectively removing and sorting components from a mass of spatially suspended components and more particularly, to improved methods of and apparatus for cyclically withdrawing a predetermined number of components from oriented supplies of magnetically suspended components, thereafter removing and sorting the components in accordance with the electrical characteristics of each component.

Certain semiconductor devices such as diodes must be, at several stages of a manufacturing process, physically arranged in a uniform manner so that a particular operation, such as testing may be rapidly performed. One of the difficulties in these manufacturing operations resides in maintaining a sufficient rate of feeding of the articles in an oriented manner between the various stages of the manufacturing process to use the full capacity of adjunct assembly machines and/or a testing apparatus.

In the past, diodes have been discharged from a random mass in a hopper and then conveyed in single file along a track to a test set, or other apparatus, with perhaps, some assistance from a vibratory device. This feeding apparatus has proven to be slow and time consuming. Another problem is the jamming of bent components which necessitates frequent manual correction. All such feeding operations are very wasteful in that the adjunct apparatus is unused for a significant portion of the running time.

A more recent device contemplates the use of magnetic force to align a mass of diodes in a hopper after which cyclically operable mechanisms are rendered effective to release the diodes and feed the diodes singularly along a track. There is still a need for an apparatus in which a mass of components may be spatially suspended and cyclically withdrawn, if not bent, and thereafter sorted.

An object of this invention relates to new and improved methods of and apparatus for selectively removing and sorting components from a mass of spatially suspended components.

An additional object of this invention is to provide an

2

apparatus for holding a plurality of articles in magnetic suspension and for moving a member into and out of engagement with the articles to withdraw a predetermined number of articles.

It is another object of this invention to provide an apparatus for individually testing the polarity of elongated articles that have been withdrawn from a suspended mass of the articles for the purpose of orienting masses of articles with their anodes arrayed in the same direction.

A further object of this invention is to provide methods of and apparatus for individually electrically testing elongated articles that have been withdrawn from a suspended mass of the articles and to sort the articles in accordance with the tested electrical characteristics.

With these and other objects in view, the present invention contemplates methods of and apparatus for moving a pickup member into and out of a mass of spatially suspended articles to remove a number of the articles after which the articles are released to a testing device and subsequently sorted according to the characteristics of the articles.

More particularly, a mass of elongated paramagnetic articles is spatially suspended between a pair of spaced magnetic plates with the elongated axes of the articles suspended along parallel magnetic lines of force established between the plates. A movably mounted pickup member is moved in a first direction transverse to the lines of force between the magnetic plates to attract and hold a predetermined number of articles. The pickup member is then moved in a second direction out of the magnetic field, whereupon a stripping device is rendered effective to pull the articles from the pickup member. The articles are then conveyed to an electrical testing device and are subsequently sorted in accordance with the electrical characteristics of the articles.

These and other objects and advantages of the present invention will be apparent by reference from the following detailed description and accompanying drawings wherein:

FIG. 1 is a perspective view of a typical component, a mass of which may be suspended and then individually removed and sorted by the apparatus constituting the present invention;

FIG. 2 is a plan view of a feeding and sorting apparatus embodying the principles of the present invention, showing a pickup or shuttle member mounted for movement alternately into and out of each of two spaced, aligned magnetic bins;

FIG. 3 is a side elevational view of the feeding and sorting apparatus particularly illustrating a sorting mechanism;

FIG. 4 is a sectional view taken along line 4—4 of FIG. 2 showing the mechanism for driving the pickup and operating the sorting mechanism;

FIG. 5 is a sectional view through the feeding and sorting apparatus taken along line 5—5 of FIG. 4 depicting the relationship of the sorting mechanism with relation to a discharge funnel;

FIG. 6 is a detailed perspective view of one end of the pickup or shuttle member showing a magnet mounted therein with wires extending from the poles thereof to the outside of the shuttle;

FIG. 7 is an enlarged side elevational view of one of the magnetic bins;

FIG. 8 is an end view of the magnetic bin shown in FIG. 7;

FIG. 9 is a detailed plan view of a stripper arrangement;

FIG. 10 is a detailed side elevational view of a stripper arrangement for removing the components from the pickup member;

FIG. 11 is a plan view of a probing device which es-

establishes electrical contact with the components to be tested;

FIG. 12 is a side elevational view of a slidable push bar and contact probes;

FIG. 13 is a perspective view showing the front end of the push bar;

FIG. 14 is a detailed sectional view of another shuttle or pickup member embodying an alternative feature of the invention; and

FIG. 15 is a schematic sectional view of a mass of articles spatially suspended within a controlled temperature chamber embodying further features of the invention.

Referring to FIG. 1, there is shown a diode 30 of the type that may be mass loaded into an apparatus embodying the principles of the present invention and then magnetically withdrawn therefrom in predetermined quantities. The diode 30 consists of a semiconductor body 31 having paramagnetic leads 32 and 32' axially extending therefrom.

Attention is directed to FIGS. 2 and 3 which show the apparatus used to magnetically remove axially leaded components 30 from an oriented mass thereof. The apparatus is mounted on a rectangular base plate 40 supported at each corner by a standard 41. A bin 46 is formed on the right hand end of the base plate by mounting opposed spaced supports 47-47' onto the plate 40 adjacent the edge thereof. Similarly, another bin 48 is formed on the opposite left hand end of the base plate, having a pair of opposed space supports 49-49'. The bins 46 and 48 are spaced from each other and aligned so that support 47 is colinear with support 49 and support 47' is colinear with support 49'.

Each of the supports 49 or 49' comprises a base plate-like block 51 (see FIGS. 7 and 8) that is secured to the top of the base plate 40. A pair of spaced horizontal bores 61 are formed in each base block so that the bores in opposing supports are aligned one with the other. Rods 62 are journaled through opposing bores and secured therein by set screws 63 to support a pair of opposing housings 67-67' and 69-69' (see also FIG. 2).

Each of the housings 67-67' (or 69-69') is assembled with a pair of side plates 71 and 72 which have notches 73 (see FIG. 7) along the bottom edges to receive the rods 62. Furthermore, as shown in FIG. 8, the side plates 72 of each housing which faces into the bin, has a bushing 77 integrally formed therewith along the bottom edge of the plate. The bushing 77 is secured against the left hand rod 62 (as viewed in FIG. 7) by a set screw 78. The notched ends of the side plates merely rest on top of the right hand rods 62 (as viewed in FIG. 7).

Mounted within each of the housings 67-67' and 69-69' are a plurality of plate magnets 79 (see FIG. 8). As shown in FIG. 8, the plate magnets in housings 67 and 69 have a north magnetic pole facing a south magnetic pole in the housings 67' and 69', respectively. The magnets 79 establish a magnetic field having horizontal and parallel lines of force. After a mass of articles is fed into the bin, the articles are spatially suspended with the elongated axes extending along the lines of force (see FIG. 8).

The bottom of each bin includes a plate 81 having a downturned edge 83 attached to housing 67 and 69 just above the rods 62 (see FIG. 8). Similarly, a plate 82 having a downturned edge 84 is attached to each housing 67' and 69'. Each plate 81 and 82 laterally extends from its respective housing toward the opposite housing with plate 81 below and in sliding contact with plate 82.

The support arrangement of the housings 67-67' and 69-69' on the rods 62 and the use of overlapping plates permits the housings 67 and 67' or 69 and 69' to be moved toward one another to adjust the effective strength of the magnetic field by changing the distance between the plate magnets 79. This arrangement also permits the adaptation of the apparatus to different size components.

Referring now to FIG. 2, there is shown mounted on

the base plate 40 a motor 101 that functions to drive the various mechanisms of the overall apparatus. The motor 101 is connected to a gear reduction unit 102 driving a shaft 103 extending therefrom on which is mounted a spur gear 104. A crank 106 (see also FIG. 4) is mounted on the end of the shaft 103. The end of the crank bar 106 extends past the spur gear 104 and is connected to a link 107 by a pin 109. The opposite end of the link 108 is connected to a slider plate 111 by a pin 112. The slider plate 111 has journal bosses 113 and 114 laterally extending therefrom slidably mounted on a horizontal shaft 119 which is supported at its ends in posts 123 and 124, respectively, which rest on the base plate 40 (see FIG. 4). A journal boss 125 laterally extends from the bottom of the slider plate 111 to receive a second shaft 127 that is supported at its ends in posts 123 and 124, respectively.

A T-shaped plate 131 is attached to the top of the slider plate 111 and the bosses 113 and 114 and laterally extends toward the center of the bins. A vertically depending hanger 132 connects from the stem 133 of the T-shaped plate 131 to support a pickup shuttle or carrier member (in the form of an elongated bar-like member) 141 having first and second ends 142 and 143.

A non-magnetic shield 144 is attached to each end of the pickup shuttle (see FIGS. 4 and 5). The shield 144 comprises plate 146 joined to a plate 147 along a linear junction 148 with the plate 146 to form a somewhat irregularly V-shaped cross section. Two holes 151 and 152 (see FIG. 5) are formed in the shield along the junction 148 and are spaced a distance which is slightly greater than the length of the body 31 of the diode 30. As shown in FIG. 6, a magnet 153 having poles 155 and 156 is mounted in each end of the pickup shuttle 141. Pole extension wires 157 and 158 extend from the poles 155 and 156, respectively, and protrude slightly through the holes 151 and 152, respectively, in the shield 144 (see FIG. 5). The polarity of the magnet is arranged so that when the shuttle is moved into a bin, the polarity of the tip of wire 158, for example, will be opposite to that of the face of the wall 67' or 69'. Similarly, the polarity of the tip of wire 157 will be opposite to that of the interior face of the wall 67 or 69. It may be appreciated that upon movement of the shuttle into the spatially suspended components, the pair of magnetized wires 157 and 158 will attract and hold a component 30.

Considering now the facilities for stripping a component 30 from the shuttle, there is shown in FIGS. 4, 5, 9 and 10, a pair of stripper members 171 erected on a platform 172 which platform is positioned between the two magnetic bins 46 and 48 and supported at each corner by a post 173. The platform 172 is formed with an elongated slot 174 having the elongated axis thereof transverse to the longitudinal centerline of the apparatus. A plate 181 having upturned sides 182 is formed with laterally projecting ears 183 which extend over the posts 173 and are fastened together with the platform 172 to the posts. The distance between the upturned sides 182 is slightly greater than the overall length of the article and serve to prevent the articles from being thrown from the apparatus. The plate 181 has a slot 184 cut therein which coincides with the slot 174 in the platform 172.

Each of the stripper members 171 has an upstanding leg 192 comprising a narrow stem 193 which is connected by beveled edges 194 to a widened top 196 (see FIG. 10). The distance between the upstanding legs 192 of the pair of stripper members is less than the overall length of the component 30, but greater than the length of the body 31. A horizontal leg 197 of each stripper member extends under the plate 181 over the platform 172 and is fastened thereto by a fastener 198.

A pair of guides 201 having a triangularly shaped upstanding leg 202 are fastened to the platform at each end of the slot 174 with one of the plates on each side of the slot (see FIG. 9). The distance between the guides on the same side of the slot is greater than the distance between

the stripper members, but is less than the distance between the side plates of the platform. Each of the triangularly shaped legs 202 is formed with a vertical edge 203 away from the slot 174 and an inclined edge 204 sloping toward the slot 174.

A pair of angled funnel plates 211-211' are attached to the underside of the platform 172 on each side of the slot 174 with an inclined leg 213-213' sloping downward toward the longitudinal axis of the slot. Similarly constructed plates 216-216' (see FIG. 5) are attached to the underside of the platform 172 at each end of the slot with an angled leg 218-218' sloping down and in toward the longitudinal center of the bins. The funnel plates 211-211' and 216-216' serve to channel the fall of the components that are removed from the pickup shuttle 141 by the stripper members 171.

Attention is directed to FIGS. 4, 11, 12 and 13 for a consideration of the devices for testing a component stripper from the shuttle and deposited in slot 174. Referring first to FIGS. 4 and 12, it is shown that the lower edge of leg 213 of plate 211, extends downward a slight distance below the lower edge of leg 213' of plate 211' and approximately contacts the top of a push bar 231. The push bar 231 is slidably mounted in a support block 232. One end of the push bar has two earlike projections 234 (see FIG. 11) that are pinned to a link 237 that is connected to one arm 241 of a bell crank lever 242 pivoted on a stud shaft 243.

The bell crank lever 242 has a follower 245 mounted on the end of a second arm 244. The follower 245 rides along a cam 246 which controls the periodic movement of the push bar 231. The cam 246 is mounted on a shaft 247 which extends under the base plate 40 to support a spur gear 248 which in turn meshes the spur gear 104 that is mounted on the shaft 103 of the gear reduction unit 102.

The right hand end of the push bar 231 has a rectangular notch 252 formed therein to receive the body 31 of the article 30 and hence permit the push bar to press and maintain the leads 32-32' of the article in contact with a pair of contact probes 257-257'. A wear resistant face plate 253-253' is mounted against the right hand end of the push bar and insulated therefrom on each side of the notch 252. A pair of pins 254-254' extend horizontally from the face plates 253-253'.

The push bar 231 moves horizontally back and forth between a pair of stationary rails 256-256' (see FIGS. 11 and 12) parallel with the longitudinal axis of the apparatus. The top of the rails is a slight distance below the top of the push bar. The right hand edge of each of the rails 256-256' is angled down and toward the left. Furthermore, the right hand edges of the rails are slightly spaced from the pair of contact probes 257-257', respectively. The top of rails 256-256' are positioned a slight distance below the level of the push bar and a slight distance above the pins 254-254'.

A slotted opening 258 is formed in the support block 232 to permit passage of tested articles therethrough into a shiftable hopper 261 which occupies either of two positions. The hopper 261 is attached to and supported on a wedge-shaped block 262. The wedge block 262 is formed with a bore 263 for receiving one end of a vertical shaft 264. A collar 267 is mounted on shaft 264 beneath the wedge block. The end 269 of the collar is forked and has positioned therein an end of a plunger 271 extending from a solenoid 272. The bottom open end 273 of the hopper 261 is positioned over either one of two chutes 276 and 277 which carry the diodes to bins 278 or 279. The solenoid 272 is actuated in response to the electrical characteristics of each article to position the hopper opening 273 over the correct chute depending on the electrical characteristics of the article.

The hopper is shaped so that an article released from the testing apparatus through the slotted opening 258 falls only a short distance before it contacts a sloped surface of

the hopper. In this way, the article is prevented from flipping over during the conveyance to the storage bins.

OPERATION

In the first step of the method of practicing the invention, the distance between the housings 67-67' and 69-69' is adjusted to be slightly greater than the length of the articles to be fed. This is accomplished by turning the set screws 78 out of contact with the rods 62 to permit the housings to be slid along the rods 62 toward one another until the correct spacing is attained.

Then, a mass of articles 30 is deposited in each of the bins 46 and 48 either manually or by a mechanized feeder, whereupon the ends of the leads 32 of the articles 30 are attracted toward the opposed spaced enclosures 67-67' and 69-69'. The articles are held in a generally horizontal manner with the elongated axes of the articles extended along the magnetic lines of force established by magnets 79.

The motor 101 is started to drive gear reduction unit 102 which drives the spur gear 104. As the spur gear 104 turns, the crank 106 is rotated and carries the pinned end of link 108 through each revolution. The other end of the link is thereupon moved back and forth in a linear motion and carries with it the slider plate 111 which is slidably mounted on shafts 119 and 127.

As the slider plate 111 reciprocates back and forth along the shafts 119 and 127, the pickup shuttle 141 is moved alternately into bins 46 and 48, the articles which have been deposited in the bins congregate about the centers of the bins where the flux density is greatest. When the pickup member enters bin 46 or 48 it has a tendency to push all the articles 30 on the side of the bin nearest the pickup member toward the outer end of the bin.

When the pickup shuttle enters the righthand bin 46, for example, the shield 144 engages a plurality of articles 30, some of which are forced down the face of the shield along plate 146 toward the juncture with plate 141. One of the articles is attracted toward the pole extension wires 157 and 158 which protrude slightly through the holes 151 and 152. The body 31 of the article is pulled against the juncture 148 by the magnetic force of the pole extension wires against the lead ends 32-32' of the article. Should the leads of the article be bent, the article will not be picked up by the shuttle.

The strength of the magnet in the pickup shuttle is selected to be greater than the strength of the magnetic field established in the bins. Furthermore, the attracting and holding strength of the pickup shuttle may be varied by changing the diameter of the pole extension wires 157 and 158, or by changing the distance by which the pole extension wires protrude past the shield 144. Also, the distance between the ends of the pole extension wires and the poles 155 and 156 of the magnet 153 may be adjusted to increase or decrease the magnetic strength of the pickup shuttle.

The shield 144 is shaped so that when one article 30 is drawn to and held thereagainst by the force of the magnetic wires in the pickup shuttle 141 overcoming the strength of the magnetic field in the bin 46, it will be impossible to attract and hold another article. The wires 157 and 158 which extend from the poles 155 and 156 are spaced a distance slightly greater than the length of the body 31 of the article so that when the article is attracted to the pickup member 141, the wires 157 and 158 engage the leads 32-32' of the article.

The spur gear 104 continues to rotate and the crank 106 carries the link 108 and slider plate 131 to the left to move the right-hand end of the pickup shuttle 141 from the bin 46, and the left-hand end of the shuttle into bin 48. As the right-hand end of the pickup shuttle is retracted from bin 46 with a single article held thereagainst in a substantially horizontal manner, the outer lead ends 32-32' of the article engage the beveled edges 194 of the stripper member 171 on each side of the slot 174 on plat-

form 172. The pickup shuttle continues to move to the left a slight distance and the holding force of the magnetized wires 157 and 158 on the article is overcome by the mechanical force of the stripper 171 acting against the article to release the article.

The released article drops through the slot 174 and is guided by angled plates 211-211' and 216-216' until it comes to rest on the top of the push bar 231. At this time the right-hand end of the push bar is forward of the slot 174 and is holding an article released from a previous cycle of the pickup shuttle against the probes 257-257' for an electrical testing operation.

The spur gear 104 continues to rotate to move the left-hand end of the pickup shuttle out of the bin 48. The spur gear 104 turns spur gear 248 and thereupon rotates shaft 247 to rotate cam 246. Follower 245 rides along the cam 246 and forces the bell crank lever to rotate counterclockwise about the pin 243 to move the link 237 and the push bar to the left.

Because the lower edge of the inclined leg 213 of the plate 211 approximately contacts the top of the push bar 231, the article resting on top of the push bar is not carried rearwardly to the left by the bar. As the right-hand end of the bar 231 passes beneath the article, the article drops vertically with the lead ends coming to rest against the rails 256-256'. A pair of magnets (not shown) may be positioned in the top of the rails at the point where the article drops in order to dampen the bounce.

When the push bar has reached the limit of its movement to the left, it then begins to move forward, to the right, and pushes the article 30 along in front of it toward the contact probes 257-257'. Generally, the motion of the push bar will be sufficient to impart enough speed to the article to carry it across the gap between the rails and the contact probes. The push bar completes the movement to the right by almost instantaneously thereafter slamming the leads of the article against the contact probes. The probes 257-257' are composed of a springy material to take up any variation in the diameter of the leads 32-32'. The cam 246 is contoured with a dwell to permit the push bar to remain at rest in the right-most position against the probes 257-257' sufficiently long enough for a test of the article. During the test, short circuiting of the current through the front end of the push bar is prevented by the separation of the face plate 253-253' on the front end thereof into two parts.

Although the right-hand ends of the rails 256-256' are spaced slightly from the contact probes 257-257', it is improbable that the article will fall through the opening 258 and not be carried into contact with the probes because of two pins 254-254' which project from the right-hand end of the push bar 231. The pins are positioned a slight distance below the rails so that if an article is not carried across the gap between the rails and the probes by the rolling motion and falls through the gap, it will come to rest on the pins and will thereafter be carried into engagement with the contact probes.

After the electrical test has been completed, the push bar is moved to the left. This coincides with the release of another article from the left-hand end of the pickup shuttle 141 through the slot 174 which is arrested on top of the push bar as it begins to move to the left. As the bar moves away from the article, the article just tested drops through the slotted opening 258 in the support block 232 into the hopper 261. If the article has been resting on the pins extending from the front of the push bar, the article will be pushed off the pins, as the bar moves to the left, by the angled down portions of the rails.

As a result of the test, a signal is dispatched through a circuit (not shown) to either actuate or not actuate the solenoid 272. If the solenoid is actuated, the plunger 271 is moved to turn the collar 267 to rotate the shaft 264. The shaft turns the wedge block 262 to pivot the hopper

over the other chute. When the hopper is positioned over the chute 276 or chute 277, the article is released from the testing position and will always hit the angled surface of the hopper in the same manner. In this way, the apparatus of the present invention can be used to test the polarity of a diode, for example, and this arrangement of the hopper will maintain the polarity-orientation of the article as it is conveyed to one of the bins.

It may be appreciated that the methods and apparatus disclosed herein may also be used to feed and sort components having a single paramagnetic lead extending from a body part thereof.

A further alternative embodiment provides for a more rapid rate of feeding by increasing the number of articles drawn to and held by each end of the pickup shuttle as it enters each bin. This is accomplished by forming the shield with a double V-shaped contour (see FIG. 14) with a pair of pole extension wires 157 and 158 extending a slight distance from each of the linear junctions of the two leg plates of each V. Furthermore, the pickup shuttle is constructed so that the double V-shapes in each end are offset one from the other.

In addition, the single stripper 171 on each side of the slot 173 in the platform 171 is supplemented by a plurality of pickoff pins 321 (see FIG. 12). Each additional V-shape formed in each end of the pickup arm requires an additional pickoff pin 321 on each side of the stripper on each end of the slot 174. As the pickup shuttle is retracted from bin 46, for example, having two articles drawn and held thereto, the topmost article will be pulled from the shuttle by the stripper 171 and will drop through the slot 174 onto the push bar for testing. Afterwards the leads of the lowermost article on the same right-hand end of the shuttle will engage a pair of pickoff pins 322, one positioned at each end of the slot the right-hand side of the stripper.

By reducing the ratio of diameters of spur gears 248 and 104 or by other modifications to the drive train common to the pickup arm and push bar, the push bar may be oscillated, for example, four times to each oscillation of the shuttle. In this manner, by the time the second article has been released from the arm, the first article is in the process of being tested and the second article merely drops onto the top of the bar as hereinbefore described.

Because of the increased oscillation of the bar 231 over and above that of the pickup arm, both articles carried out of bin 46 by the right-hand end of the shuttle will be tested and sorted by the time the left-hand end of the shuttle has moved to the pickoff point.

A second alternative embodiment may be used to adopt the aforementioned methods of and apparatus for practicing the invention to the improved testing of articles under controlled environmental conditions. For example, it may be desirable to maintain the bins 46 and 48 within a temperature chamber 401 having a slidably closable door 402.

Within the chamber is a test position 403 whereat an article removed from the mass held along lines of magnetic force is tested individually before being removed from the oven and sorted. This may be accomplished by incorporating a dwell time into the right- and left-hand movement of the pickup shuttle 141 by using a crank and lever cam arrangement connecting to the slider plate 111 instead of the hereinbefore described gear and linkage. The dwell time is calculated to coincide with the test position 403 in each bin 46 and 48 in each of the temperature chambers 401.

As the pickup shuttle retracts from the oven with the article drawn and held thereagainst, the oven door 402 closes. Simultaneous with the test, a signal is transmitted to the solenoid to correctly position the hopper in accordance with the test result. It should be noted that in this embodiment, the hopper and chutes may be posi-

tioned directly under the slot 174, and push bar 231 and contact probes need not be used.

It is to be understood that the above-described embodiments are simply illustrative of an application of the principles of the invention and many other modifications may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. In an apparatus for conveying and sorting elongated paramagnetic articles in accordance with predetermined test characteristics;
 - plural guide means for supporting an article;
 - a push bar slidably mounted between the plural guide means;
 - testing means positioned to be engaged by the article when said bar is advanced in a first direction;
 - a pair of magnetic devices for supporting a mass of said articles in parallel relationship with each other in a direction transverse to said plural guide means;
 - means for moving one of said articles in a transitory manner from said mass and for depositing said article in said guide means;
 - means rendered effective upon deposit of said article for moving said push bar in said first direction to advance said article into engagement with said testing means and to thereafter release said article; and
 - means responsive to said predetermined test characteristic for sorting said articles.
2. In a magnetic apparatus for conveying and sorting elongated paramagnetic components in accordance with predetermined electrical characteristics;
 - plural guide means for supporting a component;
 - a reciprocal test bar slidably mounted between the plural guide means;
 - a pair of test probes positioned to be engaged by the component when said bar is advanced in a first direction;
 - a pair of magnetic devices for supporting a mass of said components in a direction transverse to said plural guide means;
 - means for moving one of said components in a transitory manner from said mass and depositing said components on said guide means;
 - means rendered effective upon deposit of said component for reciprocating said test bar to move said component into engagement with said test probes, and to thereafter release said component;
 - a chute having a first end for receiving a component from said test bar and a second end mounted for movement from a first position to a second position;
 - means responsive to the engagement of said component with said test probes for selectively moving said second end of said chute from said first position to said second position; and
 - means rendered effective upon movement of said component from engagement with said test probes for releasing said releasable magnet to deposit said component in said second end of said chute.
3. An apparatus for testing and sorting a supply of elongated paramagnetic articles having leads axially extending from a center body thereof comprising:
 - a pair of spaced magnetic bins, each of said bins comprising two upstanding magnetized plates with a magnetic field having horizontal lines of force established therebetween, to hold the supply of articles in parallel relationship with the elongated axis of said articles extending along the lines of force, said plates spaced apart a distance slightly greater than the overall length of the articles;
 - pickup means mounted for alternate movement into and out of the magnetic bins;
 - means on said pickup means rendered effective upon movement of said pickup means into said bin for drawing and holding at least one of said magnetically supported articles on said member;

- means rendered effective upon movement of said pickup means out of the magnetic bin for releasing the held articles;
 - a slidably mounted testing bar for receiving articles from said releasing means;
 - a testing circuit including a pair of spaced testing probes for determining an electrical characteristic of each article;
 - means for moving said pickup means into and out of the magnetic bins, and for cyclically sliding said testing bar to engage the leads of the articles with the testing probes and to thereafter move the testing bar in the opposite direction; and
 - means rendered effective upon movement of said testing bar in the opposite direction for releasing said articles from said testing probes, and for sorting said articles in accordance with the electrical characteristics thereof.
4. An apparatus for testing and sorting a supply of elongated paramagnetic articles having leads axially extending from a center body thereof as defined in claim 3, wherein said means for sorting said articles in accordance with the electrical characteristics thereof comprises:
 - pivotaly mounted means for receiving the articles which have been released from said testing bar;
 - plural conveying means for transferring articles from the receiving means; and
 - control means responsive to the value of the electrical characteristics determined by the test circuit, for pivotaly moving the receiving means into alignment with one or the other of said plural conveying means to sort the articles.
 5. An apparatus for removing articles having leads axially extending from a center body part thereof, as defined in claim 3, wherein:
 - said holding means on said pickup means comprises a pair of magnets each having a pair of pole extension wires extending from an end of the pickup means, said pole extension wires spaced apart a distance slightly greater than the length of the body part and protruding from the end of the pickup means a distance no greater than one-half the diameter of the center body part of the article.
 6. In an apparatus for orienting semiconductor devices with their anodes arrayed in the same direction, said semiconductor devices each having a pair of oppositely disposed paramagnetic leads;
 - a pair of spaced means establishing a magnetic field with parallel lines of force for holding in suspension a mass of said semiconductor devices with the leads aligned along said lines of force and the anodes disarrayed in opposite directions;
 - a pair of receiving devices for storing said semiconductor devices;
 - a test set for determining the direction of orientation of an anode of one of said semiconductor devices;
 - means cyclically operable for removing said semiconductor devices from said magnetic field and for delivering each semiconductor device to said test set; and
 - means selectively positioned by said test set in accordance with the direction of orientation ascertained for delivering each of said semiconductor devices to a particular one or the other of said receiving devices.
 7. In a device for feeding a predetermined number of articles from a mass of articles;
 - means for holding a mass of articles in suspension;
 - means mounted for movement into and out of engagement with said mass of articles; and
 - pickup means on said moving means for attracting and holding a predetermined number of articles from said mass of articles upon movement of said moving means into engagement with said articles.
 8. In an apparatus for feeding and sorting articles;

- a feed device of the type set forth in claim 7;
 a test slide for receiving an article from said feed device;
 a test device for ascertaining a characteristic of said article;
 means for removing an article from said pickup means and depositing said article on said slide; and
 means operated during the movement of said moving means into said mass of articles for moving said test slide to advance said article to contact said test device.
9. An apparatus for feeding a predetermined number of elongated paramagnetic articles having leads axially extending from a center body part thereof comprising:
 means for suspending a mass of articles with the elongated axes of the articles parallel one to the other;
 means for adjusting the position of said suspending means to accommodate articles having different lengths;
 pickup means for attracting and holding a predetermined number of articles;
 means for moving said pickup means in a first direction into the suspended mass of articles and then in a second direction out of said mass; and
 means rendered effective upon movement of said pickup means in said second direction for releasing the articles.
10. In a device for feeding a predetermined number of elongated paramagnetic articles;
 a pair of spaced magnetic means establishing a magnetic field having parallel lines of force therebetween for supporting a mass of articles with the elongated axis of said articles extending along said lines of force;
 a member mounted for movement into and out of said magnetic field to engage said mass of articles;
 means on said member for drawing and holding said predetermined number of said magnetically supported articles on said member upon movement of said member between said spaced magnetic means; and
 means rendered effective upon movement of said member from between said magnetic means for removing the article held by said holding means.
11. In a device for feeding elongated paramagnetic articles as defined in claim 10, comprising:
 means for varying the space between said magnetic means to vary the strength of the magnetic field and for supporting masses composed of shorter or longer length articles.
12. In a device for picking up and transporting a group of paramagnetic articles from a mass of said articles magnetically suspended in parallel relation between a pair of spaced plate-like magnets;
 a U-shaped magnet, said magnet consisting of a pair of poles of opposite magnetic polarity;
 a plurality of pairs of pole extensions arrayed along and projecting in parallel planes from said poles, said pole extensions separated from each other;
 members of nonmagnetic material interposed between said pole extensions; and
 a carrier member on which said magnet is mounted, said carrier member having a plurality of recesses extending across said carrier member, said recesses being formed to receive the pairs of pole extensions to expose said extensions to attract and hold articles in said recesses.
13. An apparatus for feeding a predetermined number of components having leads axially extending from a center body part thereof, comprising:
 two aligned magnetic bins, each of said bins comprising a pair of upstanding magnetized plates to establish a magnetic field with horizontal lines of force to hold the components in parallel relationship between the plates, said plates spaced apart a distance

- slightly greater than the length of the components;
 pickup means having first and second ends with facilities on each end thereof for attracting and holding a predetermined number of components;
 means for alternately moving the first end of said pickup means into one of the bins and then the second end of the pickup means into the other bin; and
 means rendered effective upon movement of each end of said pickup means out of a bin for releasing the components from said pickup means.
14. In a feeding and sorting apparatus having leads axially extending from a center body part thereof; a chamber having a controllable environment therein;
 means in the chamber for suspending a mass of paramagnetic articles with the elongated axes of the articles parallel to one another;
 pickup means for attracting and holding an article;
 a testing device within said chamber having contact means for engaging and testing an article held by said pickup means;
 means for moving said pickup means in a first direction into the suspended mass to attract and hold an article, and then for moving said pickup means in a second direction to said testing station to test said article whereupon movement of said pickup means is resumed in said second direction out of said chamber; and
 means rendered effective upon movement of said pickup means out of said environment for releasing the articles and for sorting said articles in accordance with the tested characteristics thereof.
15. A method of removing a predetermined number of articles from a mass of articles, comprising the steps of:
 establishing a magnetic field having substantially parallel horizontal lines of force;
 depositing randomly a mass of the articles into said magnetic field whereupon the articles are suspended along the lines of force; and
 selectively engaging a predetermined number of articles within the suspended mass and removing said predetermined number of articles from said mass of articles.
16. A method of using a pickup device to feed a predetermined number of articles from a mass thereof to a testing device as set forth in claim 15 and including the further step of:
 successively stripping each of said predetermined number of articles from said pickup device.
17. A method of sorting elongated paramagnetic articles as set out in claim 16 and further comprising the steps of:
 testing each of said successively stripped articles removed from said magnetic field; and
 sorting each successive article in accordance with the characteristics of the test.
18. A method of using a pickup device having spaced pole pieces on one end thereof to feed a predetermined number of elongated paramagnetic articles from said magnetic field in accordance with the step set forth in claim 16, said pole pieces having a magnetic strength greater than that of said magnetic field, wherein the step of selectively removing a predetermined number of articles further includes:
 moving said pickup device through a section of the magnetic field to attract and hold the predetermined number of articles against said pole pieces; and
 withdrawing said pickup device from said magnetic field.
19. In an apparatus for feeding a predetermined number of articles from a mass of elongated paramagnetic articles;
 means for establishing a magnetic field having substantially horizontal parallel lines of force to suspend said articles therealong while urging said articles to congregate about the center of said field; and

13

means moved into the approximate center of said magnetic field for attracting and holding a predetermined number of articles from said mass of articles.

20. In an apparatus for feeding a predetermined number of articles from a mass of elongated paramagnetic articles as set forth in claim 19, and further including: 5

a first horizontally upstanding member;
a second horizontally upstanding member parallel to and spaced from said first upstanding member a distance slightly greater than the length of said elongated article; and 10

said first and second members supporting said means for establishing the magnetic field to suspend said

14

mass of articles in alignment with said attracting and holding means.

References Cited

UNITED STATES PATENTS

2,474,141	6/1949	Chatterton	271—18
2,952,233	9/1960	Gardner	221—312 X
3,179,248	4/1965	Manley	209—81
3,224,757	12/1965	Parke et al.	271—18

ALLEN N. KNOWLES, *Primary Examiner*.

ROBERT B. REEVES, *Examiner*.