Sept. 9, 1952 W. T. ENGEL 2,609,858

LEAD STRAIGHTENING MACHINE

Filed Dec. 30, 1948 2 SHEETS—SHEET 1

Fig. 1

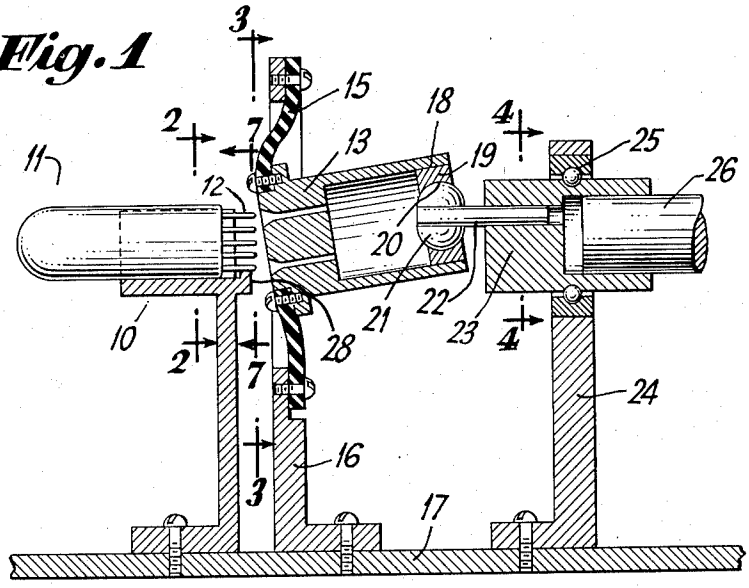


Fig. 2

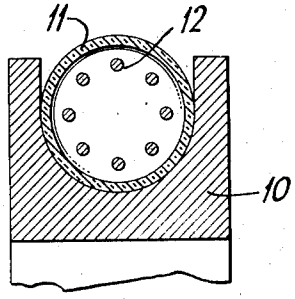


Fig. 3

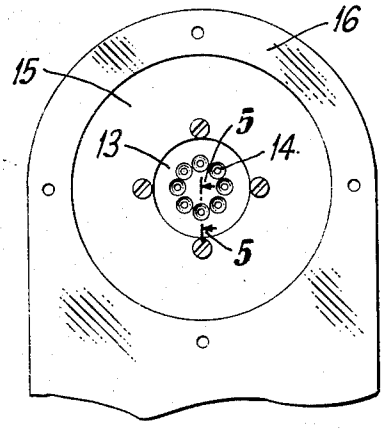
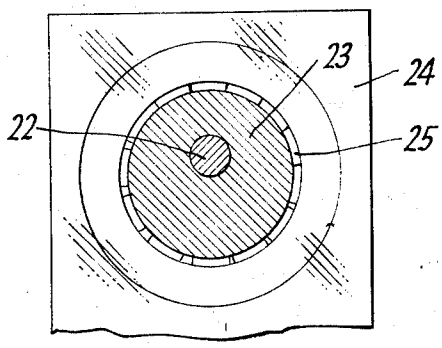


Fig. 4



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Fig. 5

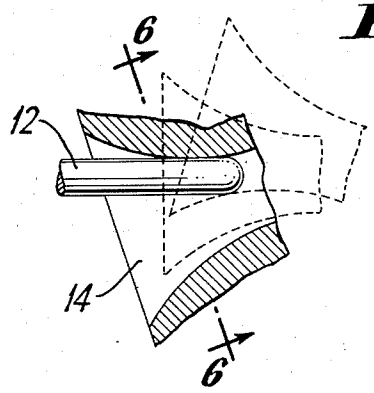


Fig. 6

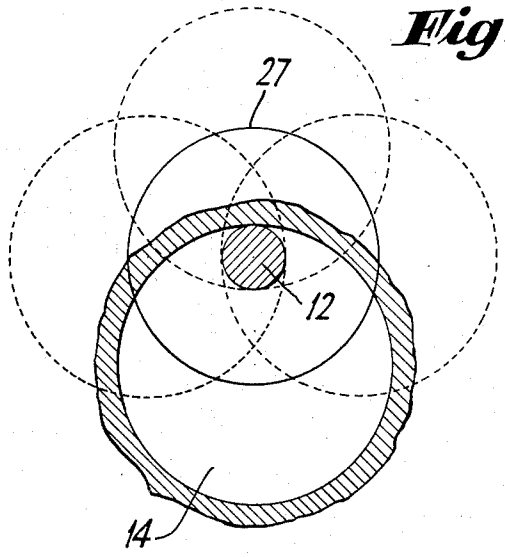
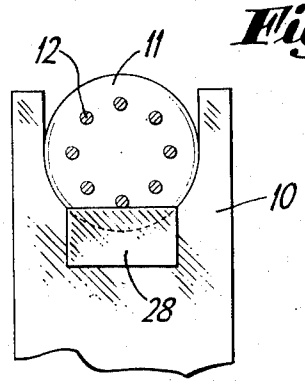


Fig. 7



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LEAD STRAIGHTENING MACHINE

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14 Claims. (Cl. 153—32)

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The present invention relates to an apparatus for straightening the leads of electron discharge tubes and similar devices.

Certain classes of electron discharge devices such as miniature tubes are provided with lead-in connections extending through the stem of the tube for connection to electrodes within the device and for providing contact pins externally of the tube. While the lead-in conductors referred to are relatively rigid, the portions thereof extending externally of the tube are not as rugged as sleeve-type contact pins employed on some large types of electron discharge devices. As a consequence, the contact pins of miniature tubes sometimes are bent during handling. Since sockets in which such tubes are intended for use have openings therein disposed in a predetermined array for receiving the contact pins, it is necessary to straighten bent pins to facilitate their entrance into the socket openings referred to. One practice heretofore followed has been to manually straighten the pins individually with a tool, such as a pair of pliers.

Several disadvantages characterize this past practice. The straightening operation is relatively slow not only because it involves manual treatment, but because each lead is individually dealt with one at a time. In addition, the accuracy of the straightening operation is dependent on the judgement of the operator, as a consequence of which it may not always be as critical as might be required. The prior art practices, therefore, in straightening bent leads are relatively expensive and lack assurance that the leads are properly straightened.

It is therefore the object of the invention to provide an apparatus for rapidly and accurately straightening leads extending from an article such as an electron discharge device.

A further object is to provide an apparatus for straightening leads extending from a fragile article without producing objectionable strains or otherwise damaging the article.

Another object of the invention is to provide a machine for automatically and accurately straightening the leads of a device such as an electron tube, in one operation.

It is a further object to provide a lead straightening machine wherein the operation is mechanically controlled.

An additional object is to provide a lead straightening machine wherein a manual feed of a device having leads to be straightened is controlled by mechanical means.

Another object is to provide a lead straightening machine permitting a feed of pronged devices under mechanically controlled conditions to a prong receiving member for simultaneously and accurately straightening the pins forming said prong.

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Another object is to provide a machine for guiding the travel of an object having a lead extending therefrom in a predetermined path and for receiving said lead in a space formed by a plurality of courses of the side walls of an opening of said machine and extending axially along a straight line from said object, for straightening said lead-in.

Further objects and advantages will become apparent as the present specification continues.

Referring to the drawing for a better understanding of the invention but not by way of limitation thereof;

Figure 1 shows a side elevation in section of an apparatus according to my invention;

Figure 2 is a section along the lines 2—2 of Figure 1 and shows the feed member of my machine which receives a device such as an electron tube in an appropriately restrained manner for suitably orienting the device with respect to the lead straightening member of the machine;

Figure 3 is a view along the lines 3—3 of Figure 1 and shows a front view of the lead straightening die and support therefor, included in my machine;

Figure 4 is a section along the lines 4—4 of Figure 1 and indicates the eccentric arrangement of the driving member of my machine;

Figure 5 is a view greatly enlarged of a section along the lines 5—5 of Figure 3 showing the position of one of the openings of my die during one portion of the cycle of operation of my machine, the dotted lines indicating other positions of the opening during other portions of the cycle of operation, and the effect of these various positions of the opening in straightening a lead;

Figure 6 is a view partly in section along the lines 6—6 of Figure 5 and indicates the action of the die of my machine, particularly the wall of an opening thereof, in controlling the position of a lead therein and,

Figure 7 is a view along the lines 7—7 of Figure 1 and shows a stop means that I may employ on my feed member for stopping the travel of an electron discharge device thereon.

In straightening the contact pins of electron discharge devices an axis of the device is usually used as a reference line with which the contact pins are disposed in parallel relation when straightened. A feature of the invention is the

provision of a feed member adapted to support an electron discharge device so that its reference axis is disposed in alignment with the axis of motion of a cylindrical die having apertures or openings in one face thereof for receiving the contact pins referred to. Another feature of the invention resides in a resilient mounting of the apertured end portion of the cylindrical die and the connection of the opposite end thereof to an eccentric drive member so that in operation a constant angular shifting of the axis of the die with respect to the reference axis on the electron discharge device will take place. This angular shifting of the axis of the die results in the application of a lateral force to bent leads extending into the openings thereof. The application of such lateral force or forces by a plurality of courses described by the walls of the openings in generating a cylindrical space accomplishes a straightening of the leads in line with the reference axis of the electron discharge device. The angular shifting of the axis of the die during operation may be characterized as a wobbling action and as a result thereof a predetermined restricted cylindrical space is generated in each of the openings in the die permitting clearance for straight leads. The wobbling action of the die further results in urging bent leads into the restricted space in each opening resulting in a straightening of such bent leads.

Referring now to the drawing in more detail, there is shown in Fig. 1 thereof a machine employing my invention and including a feed member 10 designed to receive a device such as an electron tube 11 having contact pins 12, and a die 13 suitably positioned and oriented with respect to the feed member to permit contact pins 12 to enter the apertures or openings 14 therein.

The openings 14 are provided with bell-type tapering walls resulting in funnel-shaped passageways, the wider ends of which terminate in the die surface facing the feed member 10. This widened end portion of the openings 14 permits entry therein of contact pins disposed in a variety of different positions as the result of bends therein, and while the die 13 is in any one of the many different positions it assumes during a cycle of operation. The die 13 is supported in a central apertured portion of a disc or diaphragm 15 made of resilient or flexible material, such for example as rubber or resistoflex. The disc or diaphragm 15 is supported at its outer edge portion on support member 16 shown more clearly in Figure 3. The support member 16 is in turn mounted on base 17. The feed member 10 is also mounted on base 17 to assure a desired orientation of the feed member with respect to the die.

My die may assume the form of a cylinder having a tubular portion 18, at one end thereof, to the inner walls of which is fixed ring 19 having a surface inwardly curved in cross section as shown at 20 to receive a portion of universal ball bearing 21. The universal bearing 21 is fixed to one end of shaft 22, the other end of the shaft being fixed eccentrically to one end of tubular shaft 23 as shown in Figure 4. Shaft 23 is supported for rotation in support 24 on bearings 25. The other end of shaft 23 receives in fixed engagement a further shaft 26, which may be connected to a suitable power source, not shown, for receiving rotational movement therefrom. Support 24 is also mounted on base 17 for fixing appropriate orientation of the tubular shaft 23 and the eccentrically mounted shaft 22 with respect to the die 13 and the feed member 10.

The operational characteristics of my novel lead straightening machine will now be described in the interests of a better understanding of my invention.

The feed member 10 as shown in Figures 1 and 2 is trough-shaped, including a rounded bottom and curved side walls and open at the top and at the ends thereof. The dimensions of the trough are such as to receive snugly a device of predetermined shape such as a miniature electron tube having prongs requiring straightening. The feed member 10 shown in Figure 1 is made long enough to hold a tube thereon against falling. Once a tube is placed in the feed member 10 it is in suitable alignment with the die 13. The tube is then rotated manually through a small arc on its longitudinal axis so that the pins 12 thereon are brought into appropriate alignment with the flared openings 14 in the die. The tube 11 is then given manually a longitudinal movement resulting in engagement of the pins 12 by the walls of the openings 14.

During a continuous straightening operation involving a plurality of devices, the shafts 22, 23 and 26 may constantly rotate, causing the tubular end 18 of the die to follow the eccentric travel of shaft 22. Since the end portion of the die facing the feed member 10 is supported on the diaphragm or disc 15, which in turn is fixed to support 16, the effect of the eccentric travel of end 18 of the die is to dispose the face of the die successively in a plurality of angular planes characteristic of a wobbling action, the angular displacement of the face of the die from one plane to another being permitted by the resilient or flexible nature of the diaphragm 15.

This constantly changing planar disposition of the face of die 13 during rotation of shafts 22, 23 and 26 results in a constantly changing angular disposition of the walls of the openings 14 with respect to the contact pins 12. As shown more clearly in a greatly enlarged view in Figure 5, the solid lines indicate the position of an opening when the face of the die is displaced in a maximum angular deflection downwardly from a vertical plane during a cycle of operation. In this position an upper portion of the flared walls of an opening 14 will be substantially horizontal and if a contact pin is bent upwardly out of a horizontal plane it will be deflected downwardly to a position where it is suitably straightened in a vertical plane. The upper dotted lines indicate the position of opening 14 during the upper maximum angular deflection of the die face from the vertical plane referred to. In this case a lower portion of the flared walls of the opening will engage a lead that may be bent downwardly to straighten it in a vertical plane. The intermediate dotted lines are a representation of the position of an opening during a maximum lateral angular deflection of the face of the die from the vertical plane referred to. In this case any component of the bend in a bent pin extending in a horizontal plane will be suitably straightened.

During each cycle of operation of my machine the face of my die 13 is successively angularly displaced in all directions from a vertical plane. As a consequence, the walls of the openings describe paths or courses that cumulatively cooperate to provide an elongated free cylindrical space in each opening having transverse di-

mensions substantially equal to those of a pin to be straightened. This cylindrical space is disposed in proper alignment with feed member 10 as would be required for a straight pin.

Since a contact pin inserted into one of the openings 14 of the die of my machine is caused to occupy the space referred to by the action thereon of the walls of the opening during a cycle of operation of my machine, such pin will be accurately and rapidly straightened.

This straightening action of my machine is further illustrated in Figure 6, which shows four positions of an opening in the die of my machine and indicates how these positions result in the definition of a free cylindrical space occupied by pin 12, after the pin has been straightened. It will be noted that the upper wall of opening 14 shown in full lines, forms an upper boundary for the space occupied by the straightened pin 12, while the lower wall of the socket in its upper position, shown in dotted lines, forms the lower boundary for the space occupied by the straightened pin. Side boundaries are also provided for the free space referred to, by the side walls of the opening, when the walls are successively inclined laterally of pin 12 in different directions as shown in the dotted line lateral array.

While only four positions of an opening are shown in Figure 6, it will be appreciated that during a cycle of operation involving successive deflections of die 13, angularly and in an infinite number of radial directions, all parts of an annular portion of the wall of an opening will successively engage all sides of a pin to be straightened. Since all the sides of the pin will thus be engaged by the opening walls, it will result in a straightening of the pin in all planes, parallel to the reference axis of the device from which the pin extends. Considering the movement of the die 13 during a cycle of operation as it affects an opening in the face of the die, it will be noted from Fig. 6 that each opening travels in a circular path, the solid line 27 indicating the successive positions of the axis of an opening during a cycle of operation.

In addition to being radially deflected, the openings of my die are longitudinally moved during a cycle of operation. Thus as noted in Fig. 1 the upper opening 14 is longitudinally closer to the contact pins of tube 11 than the lower opening. This is of advantage in a straightening operation. Thus, the straightening operation, while relatively rapid, is gradually performed to reduce strains in the pins and in the article from which they extend. It will be noted that in the position shown in Fig. 1 the ends of the upper pins first engage the bell-shaped portion of the walls of the upper opening that is relatively close to the die face. This accomplishes a slight straightening of the upper pins with the force applied to the pin ends. As the cycle continues and the tube 11 is held against movement, all the pins are engaged by the bell-shaped wall for a partial straightening thereof. The tube is then positioned farther towards the die with the result that the pins enter farther into the openings for complete straightening thereof. Since one pin at a time is engaged by an opening, reduction in strains on the pin as well as on the tube results.

The degree of deflection of the die face can be predetermined by suitably controlling the degree of eccentricity of shaft 22 with respect to shaft 23. This deflection can be made large enough so that the openings need only engage the end portions of the contact pins for fully straightening them. If desired, I may provide a stop 28, shown in Fig. 7 for stopping the longitudinal travel of the tube 11 in response to a manual pushing force applied thereto. The location of this stop and the degree of deflection of the face of die 13 may be coordinated to permit sufficient entrance of pins 12 into the openings 14 for accomplishing a complete and accurate straightening of the pins. This stop means however is not strictly required for the practice of my invention since the action of the die on the pins of the electron tube as previously explained herein is sufficiently smooth to permit a straightening operation with the pins extending farther into the openings than required for a full straightening action. As a matter of fact, the tube 11 may be pushed towards the die face until the stem or pronged end thereof abuts the face of the die. Such abutment disposition of the tube stem and the die face does not result in any impacts on the tube stem from the die for the reason that the wobbling motion of the die face always disposes a portion of the die face in a plane representing the maximum longitudinal displacement of the die towards the electron tube 11 during any portion of its cycle of operation. Consequently, there is no harm in pushing the tube far enough towards the die to contact the face thereof with its stem.

It will be appreciated therefore that I have provided an advantageous machine for straightening bent leads on devices such as electron tubes that requires a minimum of manual handling of the device and assures a correct positioning thereof with respect to a straightening die. The combination of a resilient support for a face end of the die and an eccentric coupling of the other end of the die to a source of rotary power imparts the required angular and longitudinal deflection to the face of the die and consequently to the openings provided therein, for effectively, rapidly and accurately straightening leads that are extended into said openings.

Various substitutions and modifications may be made in the elements constituting the illustrated embodiment of the invention without departing from the spirit and scope of the invention as pointed out in the appended claims.

I claim:

1. An apparatus for straightening contact pins of an electrical device comprising means for supporting and guiding said device in a predetermined path, and means mounted in said path for receiving said contact pins, said last-named means including a die, said die having openings constructed with mouths substantially larger than the cross-sections of said contact pins and with inwardly inclined walls leading from said mouths, a resilient support for said die and an eccentric power transfer device connected to said die whereby said die is eccentrically deflected for srtaightening said pins.

2. A machine for straightening external leads of an electrical device comprising means having openings in one end thereof constructed with mouths substantially larger than the cross-sections of said leads and with inwardly inclined walls leading from said mouths, means for guiding said device to cause said leads to enter said openings, said first-named means including a die, a flexible support at said one end of said die to permit tilting of said die while restraining axial rotation thereof, and an eccentric power shaft connected to the opposite end of said die, and means for rotating said power shaft on an axis parallel to and displaced from its

longitudinal axis, whereby said die is tilted to provide restricted paths in said openings for straightening said leads.

3. A machine for straightening external leads of electrical devices comprising an elongated die having openings at one end face thereof communicating with passageways for receiving said leads, said openings being substantially larger than the cross-sections of said leads and said passageways having inwardly inclined walls leading from said openings, a resilient diaphragm supporting said die adjacent said face thereof for tilting movement and against rotation, means engaging the other end of said die for imparting eccentric motion to said last-named end, and means adjacent said die for guiding said device to cause said leads thereof to enter said passageways in said die to a predetermined depth, whereby said leads are deflected by the walls of said passageways to a straightened condition.

4. A machine for straightening wire pins extending from a device, comprising means for receiving and guiding said device to a predetermined location, said means including a stop for limiting the movement of said body in one direction, and means having one face provided with openings adjacent said first-named means for receiving said wire pins when said body abuts against said stop, said openings being constructed with mouths substantially larger than the cross-sections of said pins and with inwardly inclined walls leading from said mouths, resilient means for supporting said second-named means adjacent said face thereof against rotation and for tilting movement, and means connected to said second-named means at a part thereof spaced from said face for imparting eccentric motion thereto, whereby said pins when received in said openings are deflected from a bent condition to a straightened position.

5. A machine for straightening a wire extending from one end of an article, comprising means for supporting said article and providing restraints to motions thereof laterally and downwardly, said means guiding longitudinal movement of said article and permitting rotational movement thereof, a die adjacent said means and having an opening in one face thereof, said opening being constructed with outwardly flared walls to provide a mouth substantially larger than the cross-section of said wire, for receiving said wire, guided thereto by said means, resilient means engaging said die adjacent said face for preventing rotary motion of said die while permitting tilting thereof, and means engaging another portion of said die for imparting rotary motion to said another portion eccentric with respect to said die whereby said face and said opening of said die are angularly deflected for straightening said wire.

6. A machine for straightening leads extending from one end of a device, comprising a guide member for receiving said device and restraining the same against lateral motion and permitting travel of said device longitudinally in a predetermined path, a die having openings forming an array across said path for receiving said leads on said device, said openings being constructed with mouths substantially larger than said leads and with inwardly inclined walls leading from said mouths, said die having an elongated structure, one end thereof having a face provided with said openings, a diaphragm having an opening therein receiving said end of said die, a support engaging the outer edge portions of said diaphragm, and means at the other end of said die for deflecting said end laterally, said means including a power shaft, an additional shaft mounted eccentrically at one end of said power shaft, said additional shaft being connected axially in a universal power transfer relation to said other end of said die whereby said die is tilted while restrained against axial rotation to dispose said walls in different successive angular positions for straightening said leads when extended into said openings.

7. An apparatus for positioning a conductor extending from an object parallel to a predetermined axis of said object including a support for supporting and guiding said object in a predetermined path, movable means adjacent said support and having an opening disposed in said path and communicating with a passageway therein having a tapered wall for receiving said conductor, said opening being substantially larger than said conductor, a resilient support for said movable means, and means for actuating said movable means to move said conductor transversely of said wall to a position parallel to said axis.

8. An apparatus for positioning a conductor extending from an object parallel to a predetermined axis of said object including tiltable means having openings therein for receiving said conductor, said openings being constructed with a mouth substantially larger than said conductor and with inwardly inclined walls leading from said mouth, a resilient support for said movable means, means for actuating said movable means to cause an angular movement of said walls for defining a path parallel to said axis, and a guide for supporting and permitting relative movement of said article towards and away from said tiltable means, said tiltable means being mounted for receiving said conductor in said opening thereof when said article is moved towards said tiltable means.

9. An apparatus for positioning a conductor extending from an object parallel to a predetermined axis of said object, including a support for supporting and guiding an object in movements in a predetermined path, movable means adjacent said support and having an opening extending therethrough and provided with a taper for receiving said conductor, a resilient support for said movable means, and means for actuating said movable means including an eccentric driving means coupled to said movable means for causing an angular movement of said opening, said movable means being mounted to receive said conductor in said opening thereof when said object is moved in said path, whereby contact between the taper and said conductor will position the conductor parallel to said axis.

10. An apparatus for straightening a bent conductor extending from an object including a member having a relatively wide opening communicating with a relatively narrow passageway, said opening being substantially larger than said conductor, for receiving said conductor, means for fixing said member against rotation, means for actuating said member while so fixed to cause said relatively wider opening therein to revolve in a predetermined circular path to thereby effectively widen said opening, and to cause said relatively narrow passageway to revolve in a shorter circular path than said first mentioned path, a support for supporting and guiding said object towards and away from

said member, said member being mounted to receive said conductor when said object is moved toward said member, whereby said bent conductor is initially easily received in said opening and extension thereof into said passageway effectively straightens said conductor in a predetermined line.

11. An apparatus for straightening a wire extending from an article, comprising means for supporting said article in a predetermined position, said means being constructed in the form of a guide to permit movement of said article in a predetermined path, a die adjacent said means and having an opening disposed in said path for receiving said wire during movement of said article in said path towards said die, said die being mounted to permit tilting thereof and to restrain axial rotation thereof, said opening being constructed with a mouth substantially larger than a cross-section of said wire and with inwardly inclined walls leading from said mouth, and means for tilting said die, whereby said wire when moved into said mouth is successively deflected by said walls to a straightened position.

12. Apparatus for straightening a wire extending from an article, comprising a die mounted for tilting movement while held against axial rotation, said die having an opening therein constructed with a mouth substantially larger than a cross-section of said wire and with inwardly inclined walls leading from said mouth, supporting means for said article constructed in the form of a guide to permit relative movement of said article toward and away from said guide, said die being mounted to receive said wire extending from said article as said article is moved towards said die in said guide, and means for tilting said die, whereby said wire is successively deflected by said walls to a straightened position.

13. An apparatus for straightening prongs of a pronged device, comprising a tiltable die, a guide member adjacent said die for guiding said device to and away from said die, and means for tilting said die, said die having openings constructed with mouths substantially larger than said prongs and with inwardly inclined walls leading from said mouths, said die being mounted to receive said prongs in said openings thereof when the article is moved towards said die, said tilting means including a diaphragm restraining axial rotation of said die and an eccentric drive connected to said die.

14. An apparatus for positioning a conductor extending from an object parallel to a predetermined axis of said object, comprising a die having an opening constructed with a mouth substantially larger than said conductor and with inwardly inclined walls leading from said mouth, a support for supporting an object in predetermined axial position and for guiding said object in axial movements toward and away from said die, said die being mounted to receive said conductor in said openings thereof when said article is moved toward said die, and to permit a tilting movement thereof while held against rotation, whereby said conductor is straightened.

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