

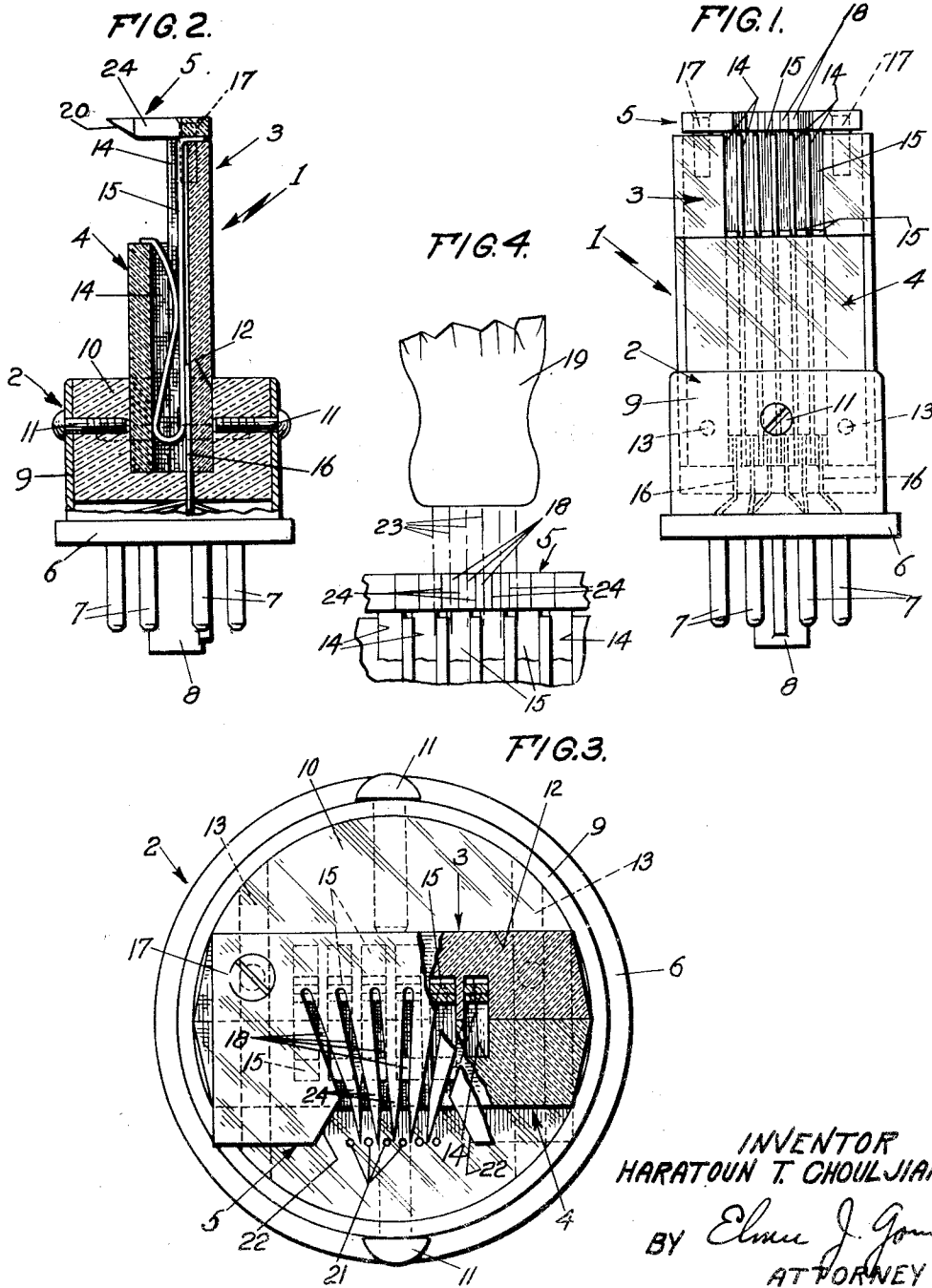
Aug. 5, 1952

H. T. CHOULJIAN
GUIDING DEVICE FOR CONTACT LEADS OF
ELECTRICAL ELEMENTS UNDER TEST

2,606,228

Filed Feb. 14, 1948

2 SHEETS—SHEET 1



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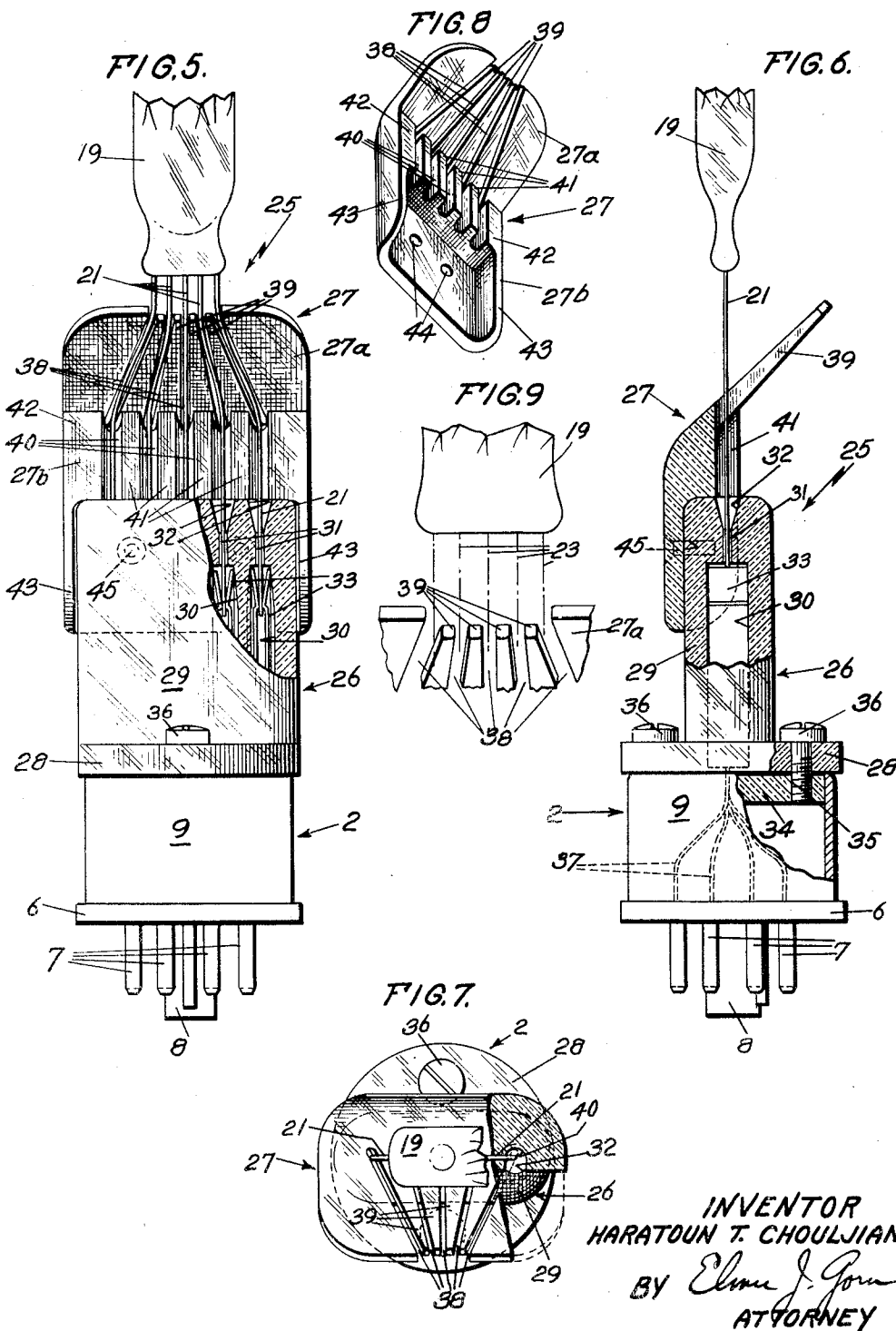
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UNITED STATES PATENT OFFICE

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GUIDING DEVICE FOR CONTACT LEADS OF ELECTRICAL ELEMENTS UNDER TEST

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6 Claims. (Cl. 173-344)

1

This invention relates to adapters for electron discharge tubes, and more particularly to adapters useful in production testing of tubes of the so-called subminiature type such as those used in hearing aids, pocket radios or other portable devices intended to be carried on the person.

A common type of such tubes is the flat-bulb type, in which the lead-in wires for the tube elements are sealed through a flat press into the bulb in a single line. Tubes of the aforementioned type are of necessity, due to the uses to which they are to be put, extremely small, the width or maximum dimension of the flat press being on the order of 0.35 inch, for example. Because of such limited space available for the plurality of lead-in wires (of which there may be four, five, six or in some cases even more), the spacing between adjacent lead-in wires in the press and at the outer edge of the press must also be very small, on the order of 0.05 inch, for example. That is, in such tubes the center-to-center distance between adjacent lead-ins is on the order of 0.05 inch.

Tubes of the aforesaid type, as they come off the manufacturer's production line as finished products, do not ordinarily include pins or prongs soldered to the lead-in wires, since no base is attached to the envelopes of such tubes. These tubes as finished ordinarily have relatively stiff lead-in wires extending for a length on the order of two inches below the flat press; this length of wire is ordinarily greater than the overall length of the bulb or envelope itself, from the bottom of the press to the top of the sealed-off exhaust tubulation at the top of the flat bulb.

These tubes are ordinarily tested with a test set as they come off the production line, and it may be desired to make tests on them at other times, after they have been put into use. Also, certain tubes are placed on the aging rack, to be given a life test.

Adapter fittings, for readily connecting tubes of the flat-bulb type to pin-type sockets for test purposes, have previously been devised. One example of such a fitting is disclosed and claimed in the copending application of L. G. Lawrence, Ser. No. 655,471, filed March 19, 1946, now Patent No. 2,481,207, issued September 6, 1949. Such adapters, since they are designed to be used with tubes having lead-in wires which are sealed through a flat press and which are therefore linearly arranged, have in turn a plurality of linearly-disposed spring fingers or spring contacts which are insulated from each other, each such finger or contact making an electrical connection with a corresponding lead-in wire of the

2

tube being tested; each finger or contact is connected internally of the adapter to a separate corresponding one of the pins or prongs of a pin-type socket in which the pins are circularly disposed. In order to obtain a long life for such adapters, to thereby reduce the maintenance and repair costs thereon, it is necessary that the spring contacts be of a large size as compared to the lead-ins of the tube, to thereby provide the necessary resistance to wear and fatigue, as well as the resiliency necessary to obtain proper electrical contact, over a long period of time.

This requirement of large contact area, and also the requirement that such large contacts be properly insulated electrically from each other (which is necessary to prevent short-circuits in said contacts, make it necessary that the spacing between adjacent adapter contacts be substantially larger than the extremely small spacing between adjacent lead-in wires of the tube at the press thereof, the adapter contact spacing being on the order of 0.2 inch, for example. As the flat-press tubes of the type hereinabove referred to emerge from the production line, the relatively long lengths of free lead-in wires of each tube are randomly-spread or arranged in divers ways with respect to each other; one or more of the lead-in wires may overlap or be twisted with one or more of the others in an almost infinite variety of ways. At any rate, it would be an uncommon occurrence for the free ends of the lead-in wires to be found extending linearly and with uniform spacing from the press of the tube. Therefore, with these tubes, in order to apply such tubes to an adapter mounted on a test set, it was necessary, prior to this invention, to manually straighten out the leads and then to spread or separate the free ends of adjacent leads from each other the proper distance (which distance corresponds to the adapter contact spacing and is large compared to the lead spacing at the tube press) and thread each lead into a corresponding hole in the adapter to cause each lead to contact the corresponding adapter contact associated with each hole. This procedure requires the use of a rather large amount of the operator's time, even though said operator becomes rather dexterous with practice. This condition is undesirable since it increases total labor costs.

Therefore, an object of this invention is to devise an adapter of the aforesaid type which enables a reduction in the labor cost of the use of the same, as compared to the corresponding cost with adapters previously available.

Another object is to devise an adapter attach-

3

ment which will enable an adapter to be utilized in a more efficient and less laborious manner.

A further object is to devise a novel adapter fitting for readily and quickly connecting tubes of the flat-bulb type to pin-type sockets for test purposes.

A still further object is to devise an inexpensive labor-saving attachment for adapters.

An additional object is to devise an adapter for flat-bulb subminiature tubes for the utilization of which no tube lead-straightening operation is necessary.

The foregoing and other objects of the invention will be best understood from the following description of some exemplifications thereof, reference being had to the accompanying drawings, wherein:

Fig. 1 is an elevation of an adapter according to this invention;

Fig. 2 is a longitudinal cross-section through the device of Fig. 1, certain parts being shown in elevation;

Fig. 3 is a top view of the device of Fig. 1 on an enlarged scale, a portion thereof being broken away to show details;

Fig. 4 is a schematic representation of a portion of the device of Fig. 1 and a tube to be tested;

Fig. 5 is a front view of another form of adapter according to this invention, with a tube for which the adapter is designed shown therein, a portion of the structure being broken away;

Fig. 6 is a side view, partly in section, of the structure of Fig. 5;

Fig. 7 is a top view, with a portion broken away, of the device of Fig. 5;

Fig. 8 is a perspective view of one of the constituent members of Fig. 5, disassociated from the rest of the structure; and

Fig. 9 is a view, similar to Fig. 4, of the Fig. 5 embodiment.

Now referring to the drawings, and particularly to Figs. 1-3 thereof, the adapter unit designated generally by numeral 1 consists of a base portion 2, an upstanding rear portion 3, an upstanding front portion 4, and a substantially horizontal comb portion 5.

Base portion 2, which is of cylindrical configuration, includes a molded disc-shaped base 6 of insulating material having apertures therein in which is rigidly mounted a plurality of metallic electrically-conducting hollow pins or prongs 7 extending downwardly from said base 6. Projecting downwardly from the center of base 6 is a plug 8 of insulating material having a locating lug thereon which serves to insure that the adapter unit is properly plugged into its receptacle on the test board or rack. Firmly attached to base 6 is a thin metallic shell 9, this shell being attached to base 6 by any suitable means, such as by clamping portions of the lower edge of the shell around or over said base. The above-described elements of base portion 2 may be the same as the corresponding parts of an intermediate standard shell octal-pin base for a glass bulb radio receiving tube.

A cylindrical body 10 of insulating material is fitted snugly inside shell 9, and is held firmly therein by a pair of horizontally-extending diametrically-opposite screws 11 which pass through suitable holes in shell 9, the heads of said screws engaging the outer surface of said shell and the shanks of said screws threadedly engaging tapped apertures provided in body 10. The upper surface of body 10 is substantially flush with

4

the upper end of shell 9, while the lower surface of said body is somewhat above base 6, as shown. An elongated horizontally-extending channel 12 is cut in body 10, this channel opening at the upper surface of said body and having a depth which is a substantial portion, approximately three-fourths, of the total height of said body, channel 12 having its long sides extending parallel to a diameter of base 6 and extending in this direction entirely across body 10.

Channel 12 accommodates, with a snug fit therein, the upstanding back and front members 3 and 4 of insulating material, which are of prismoidal configuration, which have trapezoidal horizontal cross-sections, and the bottom faces of which engage the bottom face of channel 12. Members 3 and 4 have trapezoidal cross-sections so that the lower portions thereof will fit within the circular shell 9. The elements 3, 4 and 10 are held together as a unit by means of a pair of spaced horizontally-extending pins 13 which pass through spaced horizontally-aligned apertures provided in said elements, the pins 13 being located near opposite ends of members 3 and 4. If desired, the inner ends of screws 11 may engage the vertical faces of the corresponding members 3 and 4 as shown, to thereby also assist in holding members 3 and 4 in position in the assembly.

Members 3 and 4 are placed with their adjacent vertically-extending faces in firm engagement, as shown in Fig. 3. A plurality, here shown as six, of spaced parallel vertically-extending channels 14 is provided in each of the members 3 and 4, each of these channels extending throughout the full height of the corresponding member and having a depth extending inwardly from the adjacent surfaces of the two members which is approximately equal to half the depth of the corresponding member. Each of the channels in member 4 is aligned with a corresponding one of the channels in member 3, so that when members 3 and 4 are assembled together, as shown in Fig. 3, six spaced linearly-arranged vertically-extending recesses having rectangular horizontal cross-sections are provided by the abutting of members 3 and 4. Due to the fact that these recesses thus formed are spaced from each other, the recesses are entirely electrically insulated from each other, the space between the recesses providing insulating partitions between said recesses. As may be seen from an examination of Figs. 1 and 3, the channels are located in the central portion of the length of members 3 and 4, between the pins 13, and are arranged in a single straight line.

Rear member 3 has a greater height than does front member 4, the height of said front member being approximately two-thirds of the height of said rear member, so that the upper portions of the channels in rear member 3 are exposed to view from the front of device 1.

A separate resilient metallic spring contact 15, having the shape shown in Fig. 2, is positioned in each of the grooves or channels or recesses 14, the contacts each having such width as to have a slip fit into the corresponding groove. Each of the contacts 15 is formed from a strip of suitable material and has a pair of horizontally-extending flanges at its opposite ends; one of these flanges seats on the upper end surface of member 3 and the other seats on the upper end surface of member 4. The contacts 15 are substantially U-shaped, with the legs of the U

extending vertically. At a point somewhat less than halfway down from the top of the shorter leg of the U, said shorter leg is bowed toward the longer leg sufficiently to firmly touch said longer leg, thereby providing in each of said contacts a contact area at which said legs touch and at which the vertically-extending lead-in wire of a tube to be tested makes adequate electrical contact with the corresponding spring contact 15.

A separate wire 16 is soldered to each of the contacts 15, said wire being connected to the rear lower portion of the longer leg of the corresponding spring contact. A plurality of spaced aligned vertically-extending holes, equal in number to the number of spring contacts, is provided in body 10, these holes being aligned with the corresponding wires 16 and extending from the bottom of the channel 12 to the bottom or lower surface of body 10. One of the wires 16 passes through each of the aforesaid holes, and these wires are fanned out below the lower end of body 10 to corresponding prongs 7, the lower ends of said wires being soldered in corresponding separate prongs 7 to electrically connect said wires to said prongs. In this manner, each of the adapter contacts 15 is electrically connected to a corresponding one of the circularly-arranged prongs of the pin-type base.

The comb portion 5 is made of insulating material, is substantially rectangular in outer configuration, and is mounted on the upper surface of rear member 3, projecting forwardly from said rear member with the rear vertical wall of the comb lying in substantially the same vertical plane as the rear vertical wall of member 3. Comb 5 is attached to member 3 by means of a pair of screws 17 which pass through holes drilled through said comb and which threadedly engage corresponding tapped apertures provided in the upper end of member 3, said apertures being located beyond the opposite end grooves 14 toward the sides of said member. It should be noted that the lower surface of comb 5 engages and seats on the upper surfaces of the upper horizontal flanges of contacts 15, which in turn seat on the upper surface of member 3, so that when screws 17 are tightened, not only is comb 5 fastened securely to member 3, but the contacts 15 are firmly clamped between members 3 and 5, thereby holding said contacts in position in their corresponding grooves 14.

The center-to-center spacing between adjacent recesses or grooves 14 and between adjacent contacts 15, although it is fairly small, is yet very large as compared to the center-to-center spacing between adjacent lead-in wires at the flat press of the tube to be tested, and in fact was approximately twice as large as this latter spacing in an actual adapter construction according to the invention. The contact spacing in the adapter cannot be further reduced below a certain minimum value such as that illustrated because of the necessities of providing spring contacts 15 of adequate size and of providing adequate electrical insulation between adjacent contacts. According to this invention, an adapter structure is provided whereby the randomly-spread lead-in wires of the tube to be tested are automatically correctly linearly arranged, spread apart, and guided toward and to the appropriate respective contacts 15. The spreading apart of the wires is necessary because of the above-mentioned disparity in spacing between the adapter contacts and the tube lead-in wires.

A plurality of horizontally-extending slots 18, equal in number to the number of lead-in wires of the tube 19 to be tested (see Fig. 4), is provided in comb 5, these slots extending entirely through the thickness dimension of comb 5 and being open-ended, the slots opening at the front side of comb 5 and extending toward the rear side. Comb portion 5 receives its name because of the said comb-like slots and the comb-like insulating teeth 24 which separate and define said slots. In order to sharpen the front end of the teeth of the comb, the front end of the comb 5 is preferably bevelled as at 20 to form a sharp front edge for the comb. The open or front ends of all of the slots 18 are arranged in substantially a straight line parallel to the front vertical face of member 4, as may be seen in Fig. 3.

The slots 18 are non-parallel and diverge with respect to each other from their open or front ends to their closed or rear ends, the amount of divergence or "spread" and the length of the slots being made such that the closed end of each slot directly overlies or is in substantially vertical alignment with a bowed or contact portion of a corresponding one of the spring contacts 15, as may be seen in Fig. 3. Each of the slots 18 has a width sufficient to permit free movement therein, without any binding, of the lead-ins of an electron discharge tube to be tested; in Fig. 3, these lead-ins are indicated at 21 and are illustrated in a position just at the fronts or open ends of the slots 18. For ease of insertion of the lead-ins 21 in the slots 18, the entrances to the two end slots 18 are widened as at 22, by cutting away portions of the main body of the comb at the front thereof.

One very important feature of this invention, that the closed ends of the slots 18 all overlie or are in alignment with corresponding spring contacts 15, and therefore that such closed ends lie substantially on a straight line which is parallel to the line of the front or open ends of the slots, has already been discussed. Another feature, which is essential, will now be explained in connection with Figs. 3 and 4. In Fig. 4, lines 23 are the longitudinal center lines of the lead-ins 21 of a flat-bulb electron-discharge device 19 which is to be tested and for which the invention is particularly designed, this flat-bulb device having a flat press at its lower end through which the lead-ins are sealed, the lead-ins being linearly arranged through this press and having a certain optimum constant spacing between adjacent leads at their press or fixed ends. The distance or spacing between the longitudinal center lines of adjacent slots 18 at the front or open ends of the slots is made to correspond to or be exactly equal to the fixed horizontal distance between adjacent leads 21 at the press or fixed ends of said leads; this is indicated in Fig. 4 by the showing that the lines 23 fall exactly along the centers of the open ends of the respective slots 18, or exactly halfway between the points of the sharp-pointed teeth 24, the teeth having their points at their front ends since the slots diverge from the front ends. In Fig. 3, also, it can be seen that the leads 21 are exactly centered in the respective slots 18 at the front or open ends thereof.

Due to the above-described divergent tooth-and-slot or comb construction, with the interslot spacing at the slots' open ends being equal to the interlead spacing at the leads' press or fixed ends, with the interslot spacing at the slots' closed ends being equal to the intercontact spac-

ing, and with the slots' closed ends located in vertical alignment with the corresponding or respective contacts, the open and closed ends of the slots being located on two separate parallel lines, the tube leads 21 which are to be connected to the adapter contacts 15 may be very readily and very rapidly applied thereto, without the necessity of manual lead-straightening, lead-spreading, or lead-threading operations; but utilizing the tubes directly as they come from the production line with randomly-spread leads. In utilizing the device described above, the flat-bulb flat-press subminiature tube 19, having a plurality of linearly-arranged relatively elongated lead-ins 21 extending from the press thereof, the number of leads being equal to the number of slots 18, is brought up adjacent comb 5, with the fixed or press ends of the leads 21 positioned as in Fig. 3, at the open linearly-arranged ends of the slots 18. The cut-away portions 22 assist in properly laterally positioning the lead-ins 21 in the proper slots 18. The tube 19 is then moved upwardly with respect to adapter 1 and simultaneously toward the rear member 3. Each of the lead-ins enters a separate corresponding slot 18 in the comb, since the inter-slot spacing at the slots' open ends is equal to the interlead spacing at the leads' press or fixed ends.

As the tube is moved upwardly and toward the rear of the adapter 1, each of the lead-ins 21 moves without binding along its corresponding slot 18, the lead-ins being automatically straightened or properly arranged with respect to each other due to the fact that slots 18 are separate and are separated by insulating teeth, and also being automatically spread or caused to diverge from each other toward their free ends by the divergence of slots 18 with respect to each other from their open ends toward their closed ends. The lead-ins move in the corresponding slots as the tube is moved upwardly and toward the rear of the adapter, the lead-ins being guided by said slots to the respective contacts 15 as said lead-ins reach the rear or closed ends of the slots, since such closed ends are located in substantial vertical alignment with corresponding contacts 15. As the tube is moved upwardly and toward the rear of the slots, care must of course be taken to avoid raising the tube to such a height that the free ends of the lead-ins move upwardly entirely out of the slots 18; the tube must be moved upwardly an appreciable amount as it is moved toward the rear of the slots 18 because it is of course impossible to spread the leads with respect to each other at their upper sealed-in or fixed ends, but such leads can be spread with respect to each other at or toward their free ends.

When the lead-ins have reached the rear or closed ends of their respective slots 18, each of the lead-ins will be aligned with its respective contact portion or area of a corresponding contact 15, and tube 19 and lead-ins 21 are then pushed downwardly until the leads make good electrical contact with the respective contacts 15 at the contact portions thereof, each of the lead-ins sliding down on the front surface of the rear leg of its corresponding contact until such contact area is reached. This motion of the lead-ins is effectuated by the guiding action of the closed ends of slots 18 and of the recesses 14 in member 3. Due to the fact that the upper portions of the channels in rear member 3 are exposed to view from the front of the adapter,

it can be readily visually ascertained whether each of the lead-ins is proceeding properly to its corresponding spring contact 15.

It may be seen, from the above, that by the provision of a comb structure as above described, with separate spaced and diverging slots, the lead-straightening and lead-spreading of the randomly-spread leads will be automatically accomplished, as well as the threading of the leads into their corresponding channels and contacts, thus doing away with the tedious and time-consuming manual operations of this character which were formerly necessary.

Although for purposes of illustration the number of slots 18 has been shown as equalling the number of contacts 15, it is desired to be made clear that this is not necessarily the case; the number of slots may be less than the number of contacts. Since the comb 5 is demountable from member 3 by manipulation of screws 17, a plurality of interchangeable combs similar to comb 5 may be provided, each such comb having a different number of slots therein which number corresponds with the number of leads of the tube to be tested. For each comb, the inter-slot spacing at the slots' open ends must correspond exactly to the fixed interlead spacing at the leads' press or fixed ends, and, for test purposes, the open end of each slot must be in alignment with the appropriate one of the contacts 15, this being determined by the manner in which the contacts are connected to the respective pins or prongs 7 of the base, as well as the test potentials applied to such pins. By providing interchangeable combs in this manner, tubes having different numbers of lead-ins may be simply and easily connected to the same adapter merely by mounting the appropriate comb thereon.

Now referring to Figs. 5-9, these figures illustrate a modified and preferred embodiment of the invention. Parts the same as those of Figs. 1-4 are denoted by the same reference numerals. The adapter is designated as a whole by numeral 25, and is shown in Figs. 5-7 with a flat-bulb flat-press subminiature tube 19 inserted in the upper end thereof, as the adapter would appear when it is being used for the purpose of testing said tube. Tube 19 has a plurality of lead-in conductors, here shown as five in number, sealed through a flat press in a spaced linearly-arranged disposition, as shown.

The adapter unit 25 consists of a base portion 2, an upper or upstanding portion 26, and a comb portion 27. Base portion 2 includes elements 6-9 which are the same as those in Figs. 1-3, except that the thin shell 9 has an inwardly-projecting substantially horizontal lip or flange at its upper end.

The upper portion 26 of the adapter is made of insulating material, is made in one piece, and includes a lower clamping portion 28, of circular configuration, and an upper prismatic portion 29 extending upwardly from the center of clamping portion 28. This prismatic portion 29 is of smaller cross-sectional area than portion 28, as shown in Fig. 7, and has a horizontal cross-section of substantially rectangular form but with arcuate ends. A plurality, here shown as five, of elongated spaced linearly-arranged parallel interior recesses 30 is formed in portion 26 of the adapter. These recesses are substantially rectangular in horizontal cross-section and extend in a vertical direction, from the lower end of clamping portion 28, entirely through portion 28 and into

prismoidal portion 29 to a distance such that the length of said recesses is approximately three-fourths of the total length of portion 26. These recesses are separated from each other, throughout their lengths, by thin portions of the insulating material of the body 26, so that they are entirely separate from each other and are electrically insulated from each other. Although five recesses are shown in portion 26, there may be any desired number, such as four, six, or seven. The recesses 30 are arranged in a straight line.

A separate small aperture 31 is drilled through the top surface of prismoidal portion 29 into communication with each of the recesses 30, the center line of each of said apertures being collinear with the longitudinal center line of its corresponding recess and the apertures all extending parallel to the vertical dimension of the recesses. Each of the apertures is countersunk, as shown at 32, to a suitable depth.

A plurality of spring contacts 33 is provided, equal in number to the number of recesses. One of these contacts is mounted in each of the recesses 30, and the contacts are of such size and shape with respect to the size and shape of the recesses that they slip readily into such recesses when the device is assembled. Each of the contacts 33 comprises a strip of a resilient metallic alloy which is bent into substantially a U-shape. The two ends of the strip are bent toward each other so that they touch each other along a line of contact and then are bent so that they diverge from their line of contact toward the ends of the strip to provide a mouth. The leads 21, when inserted into these contacts, make good electrical contact therewith along the line of contact of the arms of the U.

In order to firmly attach the upper portion 26 of the adapter to the lower portion 2 thereof, a disk member 34, made of insulating material, is provided. This member is made of such diameter as to slidably fit inside shell 9. A pair of diametrically-opposite tapped openings 35 is provided in this disk, these openings being aligned with two diametrically-opposite apertures in clamping portion 28. Clamping portion 28 overlies the horizontal upper lip of shell 9, while disk 34 underlies said lip. By the insertion and tightening of a pair of screws 36 in the aligned openings in members 28 and 34, the upper lip of shell 9 will be clamped therebetween, holding disk 34 and portion 26 together and firmly securing both to base portion 2.

A separate wire 37 is electrically connected by soldering to each of the contacts 33, these wires each passing down through corresponding spaced vertical holes in the disk 34, which holes are each vertically aligned with a corresponding recess 30 and which holes are linearly arranged. These wires are fanned out below the disk 34 to corresponding prongs 7, the lower ends of said wires being soldered in corresponding separate prongs 7 to electrically connect said wires to said prongs. In this way, each of the adapter contacts 33 is electrically connected to a corresponding one of the circularly-arranged prongs of the pin-type base 2.

For a somewhat more detailed description of the device so far described in Figs. 5-7, reference should be made to the aforementioned copending Lawrence application.

Here, again, as in the embodiment previously described, the center-to-center spacing between adjacent recesses 30 and between adjacent contacts 33 is appreciable, and is very large as com-

pared to the center-to-center spacing between adjacent tube lead-in wires 21 at their press or fixed ends, being on the order of four times as large as this latter spacing, for example. The intercontact spacing cannot be reduced below a certain minimum because of physical and electrical limitations.

The comb structure 27 is provided to automatically straighten, spread, and guide the lead-in wires to the appropriate separate contacts 33. The structure of comb 27 itself is clearly shown in Fig. 8. The comb 27, similarly to the upper portion 26 of the adapter, is a molded one-piece body of insulating material. Comb 27 comprises a tooth-and-slot portion 27a and a channel portion 27b the midplanes of which meet each other at an obtuse angle.

Portion 27a is in general rather thin and has a plurality of rather narrow spaced non-parallel slots 38 therethrough which are open at the free or front end of said portion and which terminate near the intersection of portions 27a and 27b. The number of such slots is the same as the number of contacts 33 and equals the number of lead-ins 21 of the tube 19 to be tested. The slots are positioned approximately centrally of the width of portion 27a and are separated and electrically insulated from each other by intermediate intervening teeth 39. The open ends of slots 38 all lie in substantially a single straight line, or in other words, the open ends of the slots are linearly-arranged. For a purpose to be set forth hereinafter, the intermediate teeth 39 terminate somewhat sort of, or do not extend quite as far out as, the two opposite side parts or wings of portion 27a. Each of the slots 38 has a width sufficient to permit free movement therein, without any binding, of the lead-ins 21 of an electron-discharge tube 19 to be tested. The slots 38 diverge with respect to each other from the open to the closed ends thereof.

In Fig. 9, the lines 23 are the longitudinal center lines of the lead-ins 21 of a flat-bulb electron-discharge device 19 which is to be tested, this device having a flat press at its lower end through which the lead-ins are sealed, the lead-ins being linearly arranged through this press and having a certain optimum or fixed spacing between adjacent leads at their press or fixed ends. The distance or spacing between the longitudinal center lines of adjacent slots 38 at the front or open ends of the slots is made to correspond to or be exactly equal to the fixed horizontal distance between adjacent leads 21 at the press or fixed ends of said leads; this is indicated in Fig. 9 by the showing that the lines 23 fall exactly along the centers of the open ends of the respective slots 38, or exactly half-way between the points of the teeth 39, the teeth having their points at their front ends since the slots diverge from the front ends.

A part of the length of comb portion 27b, extending from the intersection of portions 27a and 27b toward the lower or free end of said latter portion, is thickened, and in this thickened part there is provided a plurality of spaced parallel vertically-extending round-bottomed guiding channels or grooves 40. Channels 40 are more or less arcuately-shaped, are separated by the parallel straight intervening intermediate ribs 41, and the number of such channels equals the number of slots 38 and the number of contacts 33. Channels 40 have lower open ends and extend substantially from the intersection of portions 27a and 27b toward the lower or free end

of portion 27b. Intermediate ribs 41, and also the opposite outer end ribs 42, intersect the corresponding teeth 39 and side wings of portion 27a along a straight line, and the overall width of portion 27b is made equal to that of portion 27a.

The upper ends of channels 40 are substantially closed by the teeth 39 and side wings of portion 27a. In the assembled device, as shown in Figs. 5-7, each of the channels 40 is vertically aligned with a corresponding one of the countersunk holes 32 and contacts 33 when the lower ends of all of the channels and ribs are seated on the upper surface of prismatic adapter member 29 as in Figs. 5 and 6. The closed ends of all of the slots 33 lie on a single straight line which is parallel to the line on which the open or front ends of the slots lie. The amount of divergence or "spread" of slots 33 with respect to each other and the length of the slots is made such that each slot terminates, or has its closed end lying, in the center of the bottom of a corresponding channel 40. In other words, each slot 33 runs down to the central bottom of the upper end of a corresponding channel 40, and therefore communicates with the upper end of a corresponding channel 40. To put it another way, in the assembled device the closed end of each slot 33 is in substantial vertical alignment with a corresponding recess 30 and a corresponding contact 33. The communication of slots 33 with channels 40, as well as the vertically aligned relation of the closed ends of slots 33 and contacts 33, is clearly shown in Figs. 5 and 6. The upper ends of channels 40 are therefore partially open because of the slots 33 which extend thereto. The comb 27 is so constructed that none of the end edges of any rib 40 projects into the line of any of the comb slots 33.

In order to mount comb 27 on the portion 26 of the adapter, the lower portion 27b of the comb is provided with an enlarged recess having arcuate corners, the upper end of this recess terminating channels 40 and ribs 41 and 42 and providing a substantially planar surface which is adapted to seat on the upper end surface of adapter portion 26 when the device is assembled. The curved corners and side edges of this enlarged recess provide a pair of opposite side wing-like portions 43 which embrace an appreciable part of the side surfaces of prismatic adapter portion 26 adjacent the upper end thereof. A pair of spaced horizontally-extending countersunk apertures 44 is provided through the recessed portion of comb portion 27b, below the lower ends of the channels 40. Matching spaced tapped apertures 45 extending into one of the wider faces of prismatic portion 26 are provided between pairs of adjacent vertical apertures 31. Two screws (not shown) are inserted through apertures 44 and threaded into apertures 45 in order to attach comb 27 to adapter member 26 and to hold said comb in position thereon with the lower ends of channels 40 and ribs 41 and 42 seating on the upper end surface of member 26.

Due to the above-described divergent tooth-and-slot or comb construction, with the interslot spacing at the slots' open ends being equal to the interlead spacing at the leads' press or fixed ends, with the interslot spacing at the slots' closed ends being equal to the intercontact spacing, with the slots' closed ends communicating with the corresponding channels, and with the lower ends of the channels being in vertical alignment with apertures leading to corresponding contacts,

the open and the closed ends of the slots being located on two separate parallel lines, the tube leads 21 which are to be connected to the adapter contacts 33 may be very readily and very rapidly applied thereto, without the necessity of manual lead-straightening, lead-spreading, or lead-threading operations, but utilizing the tubes directly as they come from the production line with randomly-spread leads. In utilizing the adapter of Figs. 5-9, the flat bulb flat-press sub-miniature tube 19, having a plurality of linearly-arranged relatively elongated lead-ins 21 extending from the press thereof, the number of leads being equal to the number of slots 38, is brought up adjacent comb 27, with the fixed or press ends of the leads 21 positioned at the open linearly-arranged ends of the slots 38. The fact that the intermediate teeth 39 terminate somewhat short of the two side parts or wings of portion 27a, assists in laterally locating or positioning the lead-ins 21 in the proper slots 38, since such lead-ins may be readily slid over the front edges of the wings to the center slotted portion of the comb. The tube is then moved upwardly with respect to adapter 25 and simultaneously toward the comb portion 27b. Each of the lead-ins enters a separate corresponding slot 38 in the comb, since the interslot spacing at the slots' open ends is equal to the interlead spacing at the leads' press or fixed ends.

As the tube is moved upwardly and toward the rear of adapter 25, each of the lead-ins 21 moves without binding along its corresponding slot 38, the lead-ins being automatically straightened or properly arranged with respect to each other due to the fact that slots 38 are separate and are separated by insulating teeth, and also being automatically spread or caused to diverge from each other toward their free ends by the divergence of slots 38 with respect to each other from their open ends toward their closed ends. The lead-ins move in the corresponding slots 38 as the tube is moved upwardly and toward the rear of the adapter, the lead-ins being guided by said slots to the upper ends of the corresponding channels 40 as said lead-ins reach the rear or closed ends of the slots, since such closed ends communicate with corresponding channels or grooves 40. As the tube is moved upwardly and toward the rear of the slots, care must of course be taken to avoid raising the tube to such a height that the free ends of the lead-ins move upwardly entirely out of the slots 38; the tube must be moved upwardly an appreciable amount as it is moved toward the rear of the slots 38 because it is of course impossible to spread the leads 21 with respect to each other at their upper sealed-in or fixed ends, but such leads can be spread with respect to each other at or toward their free ends.

When the lead-ins 21 have reached the rear or closed ends of their respective slots 38, each of the lead-ins will be positioned at the upper end or in the upper portion of a corresponding one of the channels 40; tube 19 and lead-ins 21 are then pushed downwardly. During such downward movement each lead follows vertically along and is guided by its corresponding channel 40 until it reaches the lower end of such channel or the upper surface of prismatic portion 29, in which apertures 31 terminate. During this downward movement so far described, the channels 40 function very effectively to constrain the movements of and properly guide the leads to corresponding apertures 31, with which

the respective channels 40 are vertically aligned.

As the downward movement of the tube 19 and its leads 21 is continued beyond the point at which the free ends of the lead-ins are located at the lower open ends of the channels 40, each lead enters a corresponding aperture 31 (each such aperture being vertically aligned with a corresponding channel 40), proceeding downward therethrough into a corresponding recess 30, the downward pushing of the tube and its leads being continued until each of the lead-ins just makes contact with a corresponding one of the contacts 33 at the line of contact of the arms of the latter. The lead-ins are properly guided to the corresponding contacts 33 by the combined effect or action of the closed ends of the slots 38 and the channels 40.

Due to the fact that the open sides of the channels are on the front of the adapter, the interiors of such channels are readily visible from the front of the adapter and it can be readily visually ascertained whether each of the lead-ins 21 is proceeding properly to its corresponding spring contact 33. The angle between the longitudinal centerlines of the slots 38 and the longitudinal centerlines of the channels 40 is obtuse, as above stated, this angle being made obtuse so that the operator can easily see what is happening when a tube is connected to the adapter 25 in the above-described manner. Also, making this angle obtuse enables the length of the slots 38 and teeth 39 to be shortened as compared with the slot length necessary if such angle were a right angle.

It may be seen, from the above, that, by the provision of a comb structure as above described, with separate spaced and diverging slots and communicating channels, the lead-straightening and lead-spreading of the randomly-spread leads are automatically accomplished, as well as the threading of the leads into their corresponding recesses and contacts, thus doing away with the tedious and time-consuming manual operations of this character which were formerly necessary.

The spacing between adjacent leads at the tube press could be any value different from that given as an example without going beyond the scope of this invention, as long as the interslot spacing at the slots' open ends matches the interlead spacing at the tube press.

Although five slots 38 and five lead-ins are illustrated in Figs. 5-9, the invention is applicable to any other number of leads and slots. If more slots are needed for more leads, the comb slots should be longer than those shown, so that the angles of the slots will not be too sharp, thus causing the leads to bind in the slots; if more leads are used, greater divergence of the slots with respect to each other is necessary because of greater end-to-end spacing of the line of contacts. Alternatively, instead of longer teeth in this case, the outer slots may be so curved as to prevent binding of the leads in the slots.

Of course, it is to be understood that this invention is not limited to the particular details as described above, as many equivalents will suggest themselves to those skilled in the art. For example, although the invention has been described in connection with electron-discharge devices, it is applicable to other electrical devices, such as condensers for example, as long as their leads are linearly arranged and the interlead spacing at the fixed ends of the leads is dif-

ferent from the intercontact spacing of the contacts to which the leads are to be connected. Various other variations will suggest themselves. It is accordingly desired that the appended claims be given a broad interpretation commensurate with the scope of this invention within the art.

What is claimed is:

1. A device for shaping and guiding flexible lead wires comprising a comb having a base member and a plurality of spaced fingers extending therefrom, the spaces between said fingers defining slots, and a structure including a plurality of guide means substantially contacting said base member and registering with said slots, all of said guide means lying in substantially the same plane.

2. A device for shaping and guiding flexible lead wires comprising a comb having a base member and a plurality of spaced fingers extending therefrom, the spaces between said fingers defining slots, and a structure including a plurality of guide means substantially contacting said base member and registering with said slots, all of said guide means comprising grooves lying in substantially the same plane.

3. A device for shaping and guiding flexible lead wires comprising a comb having a base member and a plurality of spaced fingers extending therefrom, the spaces between said fingers defining slots, the end fingers of said comb extending from said base member for a somewhat greater distance than the central fingers thereof, and a structure including a plurality of guide means substantially contacting said base member and registering with said slots, all of said guide means lying in substantially the same plane.

4. A device for shaping and guiding flexible contact leads comprising a comb having a base member and a plurality of spaced fingers extending therefrom, the spaces between said fingers defining slots, said fingers all lying in substantially the same plane, and a structure including a plurality of guide means substantially contacting said base member and registering with said slots, all of said guide means lying in substantially the same plane, the plane of said guide means being at an obtuse angle with respect to the plane of said fingers.

5. A device for shaping and guiding flexible lead wires comprising a comb having a base member and a plurality of spaced fingers extending therefrom, the spaces between said fingers defining slots, all of said fingers lying in substantially the same plane, the end fingers extending from said base member for a greater distance than the other fingers, and a structure including a plurality of guide means comprising grooves substantially contacting said base member and registering with said slots, all of said guide means lying in substantially the same plane, the plane of said guide means being at an obtuse angle with respect to the plane of said fingers.

6. A device for shaping and guiding flexible leads extending outwardly from the press of an electron discharge tube comprising a comb having a base member and a plurality of non-parallel spaced fingers extending therefrom, the spaces between said fingers defining slots, said fingers all lying in substantially the same plane, the end fingers extending from said base member for a greater distance than the other fingers, the spacing of said slots at the tips of said fingers

15

being substantially the same as the spacing of said leads at the points of egression of said leads from said press, and a structure including a plurality of guide means comprising grooves substantially contacting said base member and registering with said slots, all of said guide means lying in substantially the same plane, the plane of said guide means being at an obtuse angle with respect to the plane of said fingers.

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