ABSTRACT OF THE DISCLOSURE

An electrical connector including a body of dielectric material having a bore, a contact in the bore, and a retainer member in the bore, the retainer member being a tubular member having at least one tab inclined inwardly toward the contact, the tab having a substantially radial edge to fit adjacent the shoulder on the contact to prevent rearward movement of the contact, and a substantially longitudinal edge extending from the shoulder to the line of connection to the tubular member.

This invention pertains to a device for making electrical connections, which includes an improved means for holding the electrical contact within the adjacent structure.

The device of this invention is usable with different types of electrical connector devices, such as multiple pin-and-socket electrical connectors or terminal junc tions. In devices of this character, a pin contact to which a wire is connected fits within a socket opening of a mating contact or bus bar. A major design problem centers around the mounting means for the contact to hold it within the insulating block that surrounds it. For many uses, such as for aircraft and space vehicles, the available space and weight for the electrical connector is securely limited. The clips to hold the contact within the support consequently must be small and of light-gauge material. Nevertheless, it is imperative that the contact be held securely.

For convenience of installation and removal, a rear release system of contact support is desirable, allowing the electrical contact to be both installed and removed from the rearward end of the supporting element. It has been conventional to employ a cylindrical sleeve as a contact retainer clip, providing the sleeve with a forwardly and inwardly inclined spring finger. This snaps in place behind a shoulder on the electrical contact when the contact is inserted. Subsequently, it can be pried outwardly from the rearward end to release the shoulder and permit the contact to be removed.

This type of retainer has certain disadvantages, however. It is necessary for the thin unsupported spring finger to absorb longitudinal loads on the contact as a column. Its capacity to withstand these loads is limited as the forces on the contact ultimately will cause the spring finger to buckle. Consequently, the retainer clip must be made of material with adequate gauge and tensile strength to provide the spring finger with enough load-carrying capacity. Also, it is necessary to make such devices relatively long so that the spring inclines forwardly at a shallow angle. Otherwise, it will not be loaded as a column, and its ability to withstand forces on the contact will be even less. Moreover, of the spring finger is bent inwardly too sharply, it may be flexed beyond the elastic limit as the contact is installed and removed. This, of course, will destroy the usefulness of the retainer clip.

The present invention provides an electrical connector device in which the contact is held in place by an improved retainer clip arrangement. In this construction, the retainer clip includes one or more integral resilient tabs bent laterally inwardly in a spiral fashion. Each tab has a longitudinal edge extending generally axially of the clip that meets a radial edge which is intended to engage the shoulder of the contact when the contact is inserted in the connector. The tab joins the body of the clip along a line which is inclined relative to the axis of the clip. When the tab is bent inwardly, it assumes a slight compound curvature, which improves its flexure characteristics by avoiding abrupt curvatures at the rearward end of the tab. This retainer clip is of great holding strength and will not be damaged even when high loads are imposed upon the contact. This allows the clip to be made of light-gauge material while still satisfactorily retaining the contact in the connector. Upon insertion or removal, the engagement with the tab is made gradually, progressively flexing the tab outwardly, with a minimum of force necessary. This also permits the use of plastic removal tools for bending the tabs out of the way of the shoulder of the contact when the contact is to be taken from the connector. There are no sharp edges engaged by the tools which would result in damage to them. The high strength characteristics of the holding tabs mean also that the retainer clip may be made very short in length and of thin material, so that the overall volume occupied by the connector may be reduced. The tab not only holds the contact within the connector, but it also serves to bias the contact to one side so that it will bear against the wall of the socket opening in which it is inserted in a form a good electrical connection.

An object of this invention is to provide an electrical connector having an improved retention arrangement for an electrical contact.

Another object of this invention is to provide a rear release type contact retaining system of increased load capacity, lighter weight and greater compactness than conventional designs.

A further object of this invention is to provide a device that will both retain a contact and impart a lateral sideward load on the contact to bias it into a position of electrical engagement with a mating contact.

An additional object of this invention is to provide an electrical connector in which the contact retaining device is readily detachable for removal of the contact and will not damage removal tools made of soft materials.

Yet another object of this invention is to provide an improved contact retaining device that can be manufactured at low cost and is easily installed and used.

These and other objects will become apparent from the following detailed description taken in connection with the accompanying drawing in which:

FIGURE 1 is a fragmentary longitudinal sectional view of an electrical connector utilizing the invention;

FIGURE 2 is an enlarged transverse sectional view taken along line 2—2 of FIGURE 1;

FIGURE 3 is a perspective view of the retainer clip separated from the other components of the connector as seen generally from the rearward end and at one side;

FIGURE 4 is a side elevational view of the retainer clip;

FIGURE 5 is a perspective view of the retainer clip as seen from the forward end;

FIGURE 6 is a longitudinal sectional view illustrating the use of the contact removal tool;

FIGURE 7 is a fragmentary longitudinal sectional view of a terminal junction embodying the invention, with the retainer clip modified to include a single resilient tab; and

FIGURE 8 is a perspective view of the retainer clip used in the device of FIGURE 7.

As illustrated in FIGURES 1 and 2, the arrangement of this invention is in the form of a multiple pin-and-socket type electrical connector. The unit includes two mating sections 10 and 11, which are held together by a suitable clamping arrangement, not shown. The connector section 10 includes a block 12 of rigid dielectric material, having a forward face 13 of softer resilient
elastomeric material bonded to it. The latter element engages the forward face of the mating connector section 11, only a small fragment of which is shown in FIGURE 1. At the rearward end of the rigid block 12 is an additional section 14 of a soft elastomer.

Within the block 12 is a bore 15, which communicates with similar openings 16 and 17 in the elements 13 and 14, respectively. An electrical contact 18 is received in the bore 15 of the member 12 and, in the example shown, is in a paired relation having a forwardly projecting cylindrically shaped section 19 that enters an opening 20 in the mating socket contact 21 carried by the other connector section 11. A socket contact could be substituted for the pin contact 18 as the invention operates with either type. The engagement of the pin 19 in the socket opening 20 provides an electrical connection between the contacts 18 and 21. Generally, the connector will include a number of the pin-and-socket combinations.

An insulated wire 22 extends out of the connector section 10 through the opening 17 in the rearward resilient element 14 and connects to an associated item of the electrical circuit. A similar wire (not shown) extends from the socket contact 21. Annular sealing beads 23 are provided in the opening 17, engaging the wire 22 and closing the rearward end of the opening into the electrical connector section 12 so as to prevent entry of moisture or other foreign matter. The insulation is removed from the inner end of the wire 22, which is inserted into the forward tubular section 24 of the contact 18, which is crimped about the wire end to join the contact to the wire.

The contact 18 is held within the bore 15 of the insulating block 12 by means of retaining clip 26. This clip, shown in enlarged detail in FIGURES 3, 4 and 5, is of relatively light-gauge sheet metal rolled into tubular form and provided with an axially extending slot 27 that runs for its entire length. The clip 26 also is provided with a pair of resilient tabs 28 and 29 bent laterally inwardly from the circumferential wall 30 of the retaining clip. The tabs 28 and 29 are formed first by making a longitudinal and a circumferential cut in the wall 30 for each tab, and then bending the material inwardly in a spiral shape. For the tab 28, therefore, a cut 31 is made in the wall 30, extending from a location adjacent the rearward end 32 of the clip to a location near the forward end 33. The cut 31 is parallel to the axis of the clip and adjacent the slot 27. The forward end of the cut 31 meets the end of a circumferential cut 34 that extends laterally away from the vicinity of the slot 27. Similar longitudinal and circumferential cuts 35 and 36, respectively, are made for forming the tab 29.

The tabs are then bent inwardly in a spiral shape so that their free edges incline from the cylindrical wall 30 to a position closer to the axis of the clip. The tab 28, therefore, has a generally longitudinally extending edge 37 as well as a radial edge 38. The edges of the tab 28 slant inwardly toward the inner corner 39 of the tab. The other tab 29 has corresponding generally longitudinal and radial edges 40 and 41 inclined inwardly to meet at the tab corner 42. The tabs 28 and 29 are bent inwardly in opposite directions so that the inner corners 39 and 42 are adjacent.

When the tabs are bent inwardly in this manner, they assume a compound curvature. Each tab is slightly dome-shaped, having a convex outer surface. As may be seen in the elevational view of FIGURE 4, the juncture between the compound curve of the tab 28 and the circumferential wall 30, as indicated by the line 43, is at an angle relative to the axis of the cylindrical wall 30 extending between the ends of the tab edges 37 and 38. This is not a sharp bend line, but represents a tangency of the two curved surfaces. The line 43 is not straight but is slightly bowed, presenting its concave side toward the edges 37 and 38 of the tab. This has the advantage of lengthening the curvature of the tab, which is of particu-
flexed during installation and removal without overstressing the material. This offers an advantage over prior methods of securing the spring elements employed in the past, which must be relatively long and at a shallow angle. Therefore, the retainer clip of this invention may be made shorter and more compact than retainers here-tofore employed.

Another advantage lies in the manner in which the tabs engage the contact so as to produce a lateral force on the contact. As best seen in FIGURE 2, the inner corners 39 and 40 of the tabs 28 and 29 bear against the shoulder 51 of the contact and, by virtue of their resilience, impart a lateral force on the contact. This moves the contact to one side, so that the projecting portion 19 of the contact is caused to bear firmly against the surface of the socket opening 20. This engagement assures that a good electrical circuit is produced between the pin contact 18 and the socket contact 21, so that electrical continuity exists through the connector.

The contact 18 is easily removed from the retainer clip by prying the tabs 28 and 29 outwardly to free the shoulder 51 from the radial edges 38 and 41 of the tabs. When this is done, the contact, through the wire 22, is readily pulled rearwardly from the interior of the connector. Contact removal may be effected by a plastic tubular tool 52, as indicated in FIGURE 6. The tool 52 has a longitudinal split permitting it to be slipped laterally over the wire 22, after which it is slid forwardly over the tubular section 24 of the contact and within the circumferential wall 30 of the retainer clip. As the removal tool is advanced, it will pry the tabs 28 and 29 outwardly, so that their edges 38 and 41 no longer bear against the shoulder 51 of the contact. In accomplishing this, the tool moves smoothly along the tabs without cutting or other damage to the tool.

The retainer clip also may be made to include only a single tab, as illustrated in FIGURES 7 and 8. While this is a particularly simple construction of the clip, it does not provide as much axial retaining force as where two tabs are included. The general arrangement of the retainer clip is the same as in the previously described embodiment. Thus, the retainer clip 53 of FIGURES 7 and 8 includes a longitudinally split cylindrical wall 54 from which the single tab 51 extends inwardly in a spiral contour. The tab 55 includes a generally longitudinally extending edge 56 and a radial edge 57. The latter fits behind the radial shoulder 58 of the contact 59 when the unit is assembled.

As shown in FIGURE 7, the retainer clip 53 is employed in holding the contact 59 in a terminal junction rather than a multiple pin-and-socket connector as in FIGURE 1. The invention is equally adapted for either type of electrical connector device, and the retainer clip 26 also may be used in a terminal junction. The unit, shown in FIGURE 7 includes an insulating block 60 that is adjacent a bus bar 61 having an opening 62 that receives the projection 63 of the contact 59. A sealing gasket 64 is positioned forwardly of the opening 62, while a cover plate 65 fits over the gasket. The enlarged bore 60 in which the retainer clip 53 fits is formed in the insulating block 60 for a major portion of its length and extends into the bus bar 61. A shoulder 67 in the bus bar contacts the enlarged bore portion 66 and the opening 62.

As before, the contact is held securely in place and the retainer clip will withstand forces tending to dislodge the contact from its position. The tab 55 biases the contact to one side, as illustrated, so that the projecting portion 63 bears firmly against the wall of the opening 62 in the bus bar, and a good electrical connection is effected. Removal again is accomplished by bending the tab 55 outwardly, which may be done by a tubular plastic tool as for the other retainer clip construction.

The foregoing detailed description is to be clearly understo...
contact on one side of said contact for providing a lateral resultant force biasing said contact laterally toward the opposite side for making an electrical connection with a mating contact.

4. An electrical connector unit comprising:
a body having a forward end and a rearward end, said body having a bore extending from said rearward end toward said forward end, said bore having an annular enlargement providing a first shoulder adjacent said forward end and a second shoulder adjacent said rearward end, an electrical contact in said bore, and a retaining device for said contact, said retaining device including a tubular member in said annular enlargement of said bore with its ends adjacent said first and second shoulders, whereby said first and second shoulders axially position said tubular member, said tubular member circumscribing said contact in a spaced relationship therewith, said contact having a portion defining a first shoulder adjacent said forward end and a second shoulder adjacent said rearward end, said first shoulder of said contact being adjacent and opposed to said first shoulder of said body for preventing movement of said contact toward said forward end, said retaining device including at least one resilient tab integral with said tubular member and extending inwardly therefrom toward said contact, said tab being connected to said tubular member along a line angular relative to the axis of said tubular member, said tab having a first substantially radial edge extending from the forward end of said line of connection to a distal end of said tab adjacent said contact, said radial edge being adjacent and opposed to said second shoulder of said contact for preventing movement of said contact toward said rearward end, said tab having a second edge extending from said distal end generally longitudinally of said tubular member to the rearward end of said line of connection for providing said tab with inclined surface means to facilitate outward bending thereof during installation and removal of said contact.

5. A device as recited in claim 4 in which:
said retaining device includes a pair of said resilient tabs, said tabs extending inwardly from said tubular member in opposite directions so as to present adjacent inner portions thereof, said inner portions bearing against the periphery of said contact on one side of said contact for providing a lateral resultant force biasing said contact laterally toward the opposite side for making an electrical connection with a mating contact.

6. An electrical connector unit comprising:
a body having a forward end and a rearward end, said body having a bore extending from said rearward end toward said forward end, an electrical contact in said bore, said contact including a shoulder facing said rearward end, and a retaining means for holding said contact in said bore, said retaining means including a tubular member in said bore around said contact in a spaced relationship therewith, said tubular member having a longitudinal slot extending therethrough, said tubular member including at least one longitudinal cut in the circumferential wall thereof extending from a position adjacent said rearward end to a position adjacent said forward end, and at least one circumferential cut in said circumferential wall extending in one direction from the end of said longitudinal cut adjacent said forward end, and a resilient tab extending inwardly from said circumferential wall, said tab having substantially longitudinal and radial edges defined by said longitudinal and circumferential cuts, respectively, said tab being connected to said circumferential wall along a line angular relative to the axis of said tubular member extending between the end of said longitudinal cut adjacent said rearward end and the end of said circumferential cut remote from said longitudinal cut.

7. A device as recited in claim 6 in which said tab extends inwardly in a spiral contour.

8. A device as recited in claim 7 in which said tab is dome-shaped presenting a concave surface facing inwardly of said tubular member, and said line is curved being concave adjacent said edges.

References Cited

UNITED STATES PATENTS

3,158,424 11/1964 Bowen.
3,227,993 1/1966 Bentley.
3,229,244 1/1966 Bachman.

FOREIGN PATENTS

74,870 1/1961 France.

MARVIN A. CHAMPION, Primary Examiner.
R. S. STROBEL, Assistant Examiner.