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(19)

(54) IMPROVEMENTS IN OR RELATING TO ELECTRICAL CONNECTORS

(71) We, BUNKER RAMO CORPORATION, a Corporation organised and existing under the laws of the State of Delaware, United States of America, of 900 Commerce Drive, Oak Brook, Illinois, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

In electrical connectors utilizing hollow shells and internal insert members carrying one or more electrical contact members, it has often been difficult to locate the insert members in exact predetermined axial positions between and snugly against immovable stop surfaces of the shells particularly when the shells are of one-piece construction. Manufacture of insert members usually results in some variation in the axial dimensions thereof due to the effects of manufacturing tolerances. If the stop surfaces are spaced apart to accommodate an axial dimension greater than the lower limit of the range of values for the axial dimension, a slight gap can occur between the insert member and one of the stop surfaces which could permit some movement of the insert member.

One solution to the problem has been to construct one of the stop surfaces on an adjustable member to accommodate insert members of differing axial dimensions. In some instances, one of the stop surfaces is provided on a separate shell member and axially moved to snugly engage the insert member. In other instances, a wave washer or other spring member provides an adjustable stop surface to accept insert members of varying axial dimensions. A tapered retaining ring is positioned against a tapered surface in the shell and includes a stop surface providing retention of the insert member. The axial position of the stop surface will vary depending on the portions of the tapering surfaces which meet in engagement and the axial dimension of the insert member.

The above described retention techniques utilizing adjustable stop surfaces on separate shell members or on separate retaining members add to the cost and complexity of electrical connectors. Therefore, it would be desirable to provide an electrical connector in which the insert member is retained between and snugly against immovable stop surfaces in which some variation in axial dimension in the insert member is permitted.

According to this invention, there is provided a method of fitting a plastics insert or insert assembly in snug retention between first and second opposed shoulders separated by a predetermined distance within an electrical connector housing, the insert or insert assembly having a dimension measured from an abutment surface, which abutment surface when the insert or insert assembly is fitted in the housing cooperates with said first shoulder, to and including a retention portion, which retention portion, when the insert or insert assembly is fitted in the housing, cooperates with said second shoulder, said dimension being greater than said predetermined distance, comprising the steps of providing said retention portion with a peripheral portion which is more easily permanently deformable by compressive stress than is the remainder of the periphery of the insert or insert assembly and which has a length greater than the difference between said predetermined distance and said dimension; providing the housing with deforming means in close juxtaposition with said second shoulder; moving the insert or insert assembly into the housing to a position in which said abutment surface

is in contact with said first shoulder; and, during the last part of said movement of the insert or insert assembly into the housing, subjecting said peripheral portion to compression by said deforming means so that it is permanently deformed to provide a second abutment surface on the insert or insert assembly which is in engagement with said second shoulder.

The invention also includes an electrical connector comprising an elongate housing and an insert or insert assembly mounted within said housing, wherein said housing has an opening in one end thereof connected via a restricted passageway with an interior cavity of said housing and said cavity has a wall surface formed with a first stop at a position longitudinally spaced from said restricted passageway and with a second stop adjacent said restricted passageway and wherein said insert or insert assembly extends into said cavity with a first abutment surface thereof engaigng said first stop and with a retention portion thereof cooperating with said second stop, said retention portion, which is of larger cross-section than said restricted passageway, having a peripheral portion which is more easily permanently deformable by compressive stress than is the remainder of the periphery of said insert or insert assembly, said insert or insert assembly having been mounted within said housing by inserting it through said opening and at least partly through said restricted passageway and said peripheral portion of said retention portion having been subjected, during such insertion, to compression by a wall part of said passageway and having been thereby permanently deformed so as to provide a second abutment surface in engagement with said second stop.

The invention will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a side elevational view, partially in section, illustrating one embodiment of the invention,

Figure 2 is a longitudinal sectional view of the top half of an insert combination shown in Figure 1,

Figure 3 is a longitudinal sectional view of a retention disc forming part of the insert combination of Figure 2,

Figure 4 is an end view of the retention disc of Figure 3,

Figure 5 is a longitudinal sectional view of a shell member shown in Figure 1,

Figure 6 is a fragmentary view of adjoining parts of the insert combination of Figure 2 and the shell member of Figure 5, and

Figure 7 is a partial view of other forms of a knurled portion of the insert member of Figures 3 and 4.

Referring to the drawings, Figure 1 illustrates an electrical connector 10 with a receptacle 12 and a plug 14 partially mated and coupled by a coupling ring assembly 16 for releasably locking the connector members together by a bayonet latching system. The receptacle 12 includes a housing in the form of a shell 18 with a longitudinally extending internal cavity 20 and provided with insert retention means constituted by first and second radial shoulders 24 and 26 separated by a predetermined axial distance 28. A retention disc 30 and a front insert 32 are positioned in snug engagement with the shoulders 24 and 26 respectively and include axially extending openings 34 and 36 respectively which are axially aligned with each other and in which are positioned one or more contact members 38, the or each contact member 38 being connected to a corresponding conductor 40. Rearwardly positioned in the receptacle 12 is a sealing grommet 42 and screwed over the receptacle 12 from the rear end thereof is a retention nut 44. In a similar manner, the plug 14 includes a shell 46 housing two inserts in the form of a retention disc 48 and a front end insert 50. Axially aligned openings 52 and 54 are provided respectively in the disc 48 and the insert 50 for carrying one or more contacts 56. Flanges 57 provided on the contacts 56 engage retention tines 58 for axial retention of the contacts 56 in the insert. The contacts 56 are connected at their rear ends to external circuits by conductors 60 and a sealing grommet 62 and retention nut 64 are provided at the rear end of the plug 14. As shown in Figures 1 and 2, the retention disc 48 and the front end insert 50 have axially extending sleeve portions 68 and 70 respectively which telescope together with the free end portion of at least one of these sleeve portions abutting an opposing shoulder on the member provided with the other sleeve portion. A passageway 66 provides an entry for mounting the front end insert 50 in a cavity 49 in the shell 46 of the plug 14.

In Figures 2 and 3, the front end insert 50 and the retention disc 48 are illustrated prior to deformation of the latter. The retention disc 48 is formed with an outer annular collar 72 which extends peripherally around the disc 48 in a direction transverse to the central axis thereof. The collar 72 is formed, on the flank thereof which is nearer the receptacle 12, with a ramp 74 in order to facilitate insertion of the retention disc 48 in the direction of the arrow 75 (Figure 2) through the passageway 66 in the shell 46. At its other end the collar 72 has a relatively weak peripheral

portion 76, i.e. a portion which is weaker than other parts of the collar 72 more particularly in regard to its ability to withstand radial compression without becoming permanently deformed. This relatively weak portion extends over only a minor part of the width of the collar and embodies a plurality of axially extending ,circumferentially spaced apart ridges 78 which form a retention shoulder when deformed. These ridges project radially outwardly from relatively wide bases to sharp radially outer edges.

As shown in Figures 3 and 4, the high points 78 have the form of knurls 80 arranged in a plurality of groups 82 around the periphery of the retention disc 48 to provide a plurality of peripherally spaced apart retention surfaces. Other forms of knurl-like portions 92 and 94 are illustrated in Figure 7.

As shown in Figure 5, the shell 46 not only has the internal cavity 49 already referred to, but also has first and second radial shoulders 53 and 55 separated by a predetermined axial distance 59 (Figure 5). The diameter of the passageway 66 is such that, during insertion of the front end insert 50 and the retention disc 48 into the cavity 49, the insert 50 will pass freely through this passageway before being brought to rest in its fully inserted position by engagement with the first radial shoulder 53, whereas, before the retention disc 48 reaches its fully inserted position in the cavity 49, the main portion of the collar 72 thereof will have been resiliently compressed and the relatively weak portion 76 permanently deformed by the action of the wall 86 of the said passageway. Final positioning of the retention disc 48 is accomplished by a quick motion in which the collar 72 is forced into the cavity 49 permitting the portion 27 of the wall 86 at the junction of the latter with the second radial shoulder 55 to compress and deform the relatively weak portion 76 to provide a deformed portion 88 as shown in Figure 6 for retaining the disc 48 in the cavity 49.

In order to provide the desired compression of the collar 72 of the disc 48, the diameter of the passageway 66 is made slightly smaller than that of the said collar 72, while the surface area of the main non-weakened portion of this collar is made sufficiently large to enable this portion of the collar to withstand the compressive force developed by wall 86 without permanent deformation of the plastics material. The diameter of the relatively weak portion 76 of the collar is substantialy the same as that of the non-weakened portion thereof, but its outer circumferential area is restricted so that it is insufficient to withstand the same compressive force as the non-weakened portion of the collar 72. When the collar 72 passes into the cavity 49, the weakened portion 76 is permanently deformed by the portion 87 of the wall 86 at the junction 87 of the latter with the second radial shoulder 55 so as to provide a deformed portion 88 (Figure 6) having a radial shoulder 89 and an axial surface 90 for effecting axial and rotational retention respectively of the disc 48. As shown in Figure 6 the relatively weak portion 76 extends axially across the radial shoulder 55 and is deformed to confine the disc 48 so that it is prevented from axial movement in a direction opposite to the direction of insertion of the said disc. When deformed, the relatively weak portion 76 remains partly positioned in the passageway 66 where it is held in compressive engagement by the wall 86 so as to provide rotational retention of the disc 48.

In a variant (not shown) of the embodiment described above with reference to Figures 1 to 6, the retention disc and the front end insert are combined to form a single one-piece insert.

The use of a one-piece shell 46 with first and second opposed retention shoulders 53 and 55 and a cavity 49 which is of larger diameter than the passageway 66 is particularly advantageous. The fitting of one or more plastics insert members in snug retention between the radial shoulders 53 and 55 within an electrical connector housing such as the shell 46 is advantageously carried out by providing the insert member or the assembly of insert members with an abutment means, such as the shoulder 67 (Figure 2) at one end and with a relatively weak portion 76 at the other end, the distance between the abutment means and the axially outer end of the relatively weak portion being slightly greater than the axial distance 59 separating the radial shoulders 53 and 55, providing the housing with deforming means such as the portion 87 between the wall 86 of the passageway 66 and the radial shoulder 55, axially moving the insert member or assembly of insert members into the shell 46 in the direction 75 indicated by the arrow 75 in Figure 2 so as to position the radial shoulder 67 of the insert member or of the assembly of insert members against the first radial shoulder 53 of the shell 46, and deforming the weakened portion 76 to provide a second radial surface 89 (Figure 6) in engagement with the second radial shoulder 55. Movement of the insert member or assembly of insert members into the cavity 49 is advantageously accomplished by providing a restricted entry passageway

66 leading to the shoulder 55 and the cavity 49, which passageway 66 has a wall portion 86 including means for deforming the relatively weak portion 76 of the insert member or of the assembly of insert members. Advantageously, the insert member or assembly of insert members is provided with a collar 72 having a main, non-deformable portion axially adjacent the relatively weak portion 76 for protection of the latter until the insert member or assembly of insert members is in its final fully inserted position.

In the manufacture of one-piece housings and multi-piece inserts as illustrated by the shell 46 and the insert members 48 and 50 respectively, tolerance variations due to manufacture of the parts can cause the axial dimension 59 (Figure 5) of the shell to differ from the axial dimension 61 (Figure 2) of the retention section of the insert members. The retention of an insert member or of an assembly of insert members in which the axial dimension 61 of the insert retention section varies within upper and lower limits can however be achieved by providing the insert member or one of the insert members with a weakened peripheral portion 76 to extend the lower limit of the axial dimension 61 of the insert retention section beyond the axial distance 59 and providing the passageway 66 in the shell 46 with a wall 86 having a diameter smaller than that of the collar 72, so that the portion 87 of this wall 86 between it and the second radial shoulder 55 will deform the weakened portion 76 of the collar 72 so as to provide a shoulder 89 on the said collar at essentially the axial distance 59 of the particular shell 46 in which the insert member or assembly of insert members is mounted.

The collar 72 may be raised above the front entry portion of insert 48 by about 0.010 inches and may extend about 0.040 inches axially with the knurled portion extending about 0.020 inches axially and having an outer dimension similar to the collar 72. The diameter of the collar 72 may be about 0.034 inches and that of the passageway 66 about 0.046 inches. The shells 48 and 46 are preferably metallic, e.g. made of aluminium, and the inserts 30, 32, 48 and 50 are formed of a plastics material capable of being permanently deformed and preferably of a thermo-plastic material such as polyaromatic sulfone.

WHAT WE CLAIM IS:—

1. A method of fitting a plastics insert or insert assembly in snug retention between first and second opposed shoulders separated by a predetermined distance with an electrical connector housing, the insert or insert assembly having a dimension measured from an abutment surface, which abutment surface when the insert or insert assembly is fitted in the housing cooperates with said first shoulder, to and including a retention portion, which retention portion when the insert or insert assembly is fitted in the housing cooperates with said second shoulder, said dimension being greater than said predetermined distance, comprising the steps of providing said retention portion with a peripheral portion which is more easily permanently deformable by compressive stress than is the remainder of the periphery of the insert or insert assembly and which has a length greater than the difference between said predetermined distance and said dimension; providing the housing with deforming means in close juxtaposition with said second shoulder; moving the insert or insert assembly into the housing to a position in which said abutment surface is in contact with said first shoulder; and, during the last part of said movement of the insert or insert assembly into the housing, subjecting said peripheral portion to compression by deforming means so that it is permanently deformed to provide a second abutment surface on the insert or insert assembly which is in engagement with said second shoulder.

2. An electrical connector comprising an elongate housing and an insert or insert assembly mounted within said housing, wherein said housing has an opening in one end thereof connected via a restricted passageway with an interior cavity of said housing and said cavity has a wall surface formed with a first stop at a position longitudinally spaced from said restricted passageway and with a second stop adjacent said restricted passageway and wherein said insert or insert assembly extends into said cavity with a first abutment surface thereof engaging said first stop and with a retention portion thereof cooperating with said second stop, said retention portion, which is of larger cross-section than said restricted passageway, having a peripheral portion which is more easily permanently deformable by compressive stress than is the remainder of the periphery of said insert or insert assembly, said insert or insert assembly having been mounted within said housing by inserting it through said opening and at least partly through said restricted passageway and said peripheral portion of said retention portion having been subjected, during such insertion, to compression by a wall part of said passageway and having been thereby permanently deformed so as to provide a second abutment surface in engagement with said second stop.

3. An electrical connector according

to claim 2, wherein said retention portion includes a protective portion located on that side of said peripheral portion which is nearer the first abutment, said protective portion being dimensioned so as to have been compressed by said wall part during insertion of said insert or insert assembly through said passageway but having sufficient elastic strength to enable it to withstand such compression without undergoing substantial permanent deformation.

4. An electrical connector according to claim 3, wherein said protective portion is provided, on that side thereof which is nearer the first abutment, with a ramp to facilitate the entry of said protective portion into said passageway during mounting of said insert or insert assembly within said housing.

5. An electrical connector according to claim 3 or 4, wherein said protective portion includes an outer collar on said insert or on a part of said insert assembly and said peripheral portion includes a plurality of axially extending knurls.

6. An electrical connector according to claim 2, wherein said insert or insert assembly consists of a plurality of insert members assembled end-to-end in the direction of insertion thereof into said housing.

7. An electrical connector according to any of claims 2 to 4 or 6, wherein said peripheral portion includes a plurality of radially outwardly projecting ridges extending parallel to the central axis of the connector.

8. An electrical connector according to any of the preceding claims, wherein the insert or insert assembly carries at least one electrical contact member.

9. An electrical connector according to any of the preceding claims, wherein the passageway wall part by which the said retention portion is subjected to compression during insertion of said insert or insert assembly into said housing is located at the junction between the inner circumferential surface of said passageway and said second radial shoulder.

10. A electrical connector substantially as described with reference to and as shown in Figures 1 to 6 of the accompanying drawings.

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1574443 COMPLETE SPECIFICATION
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Sheet 1

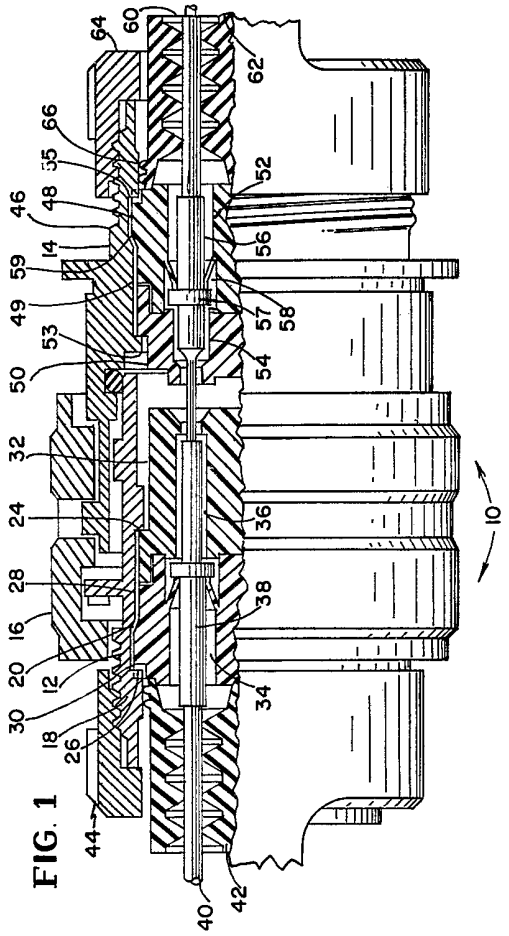

FIG. 1

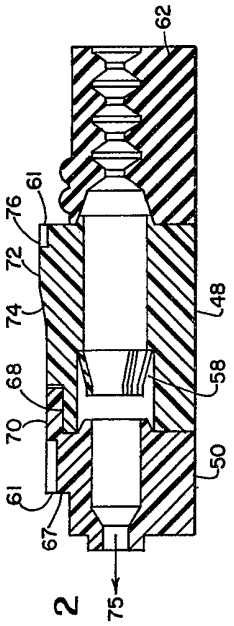

FIG. 2

1574443 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

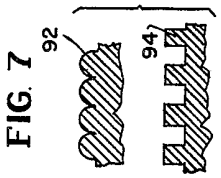

FIG. 7

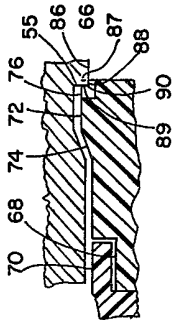

FIG. 6

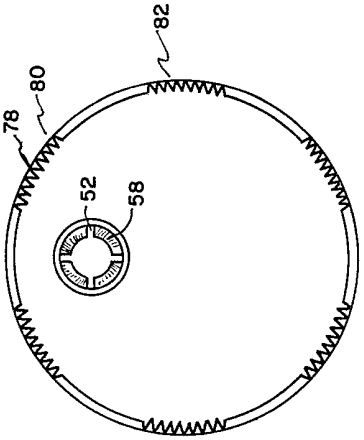

FIG. 4

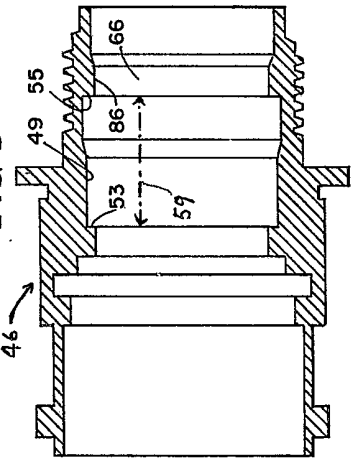

FIG. 5

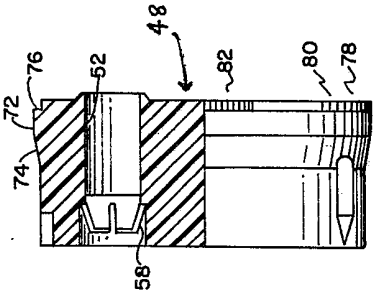

FIG. 3