

April 10, 1962

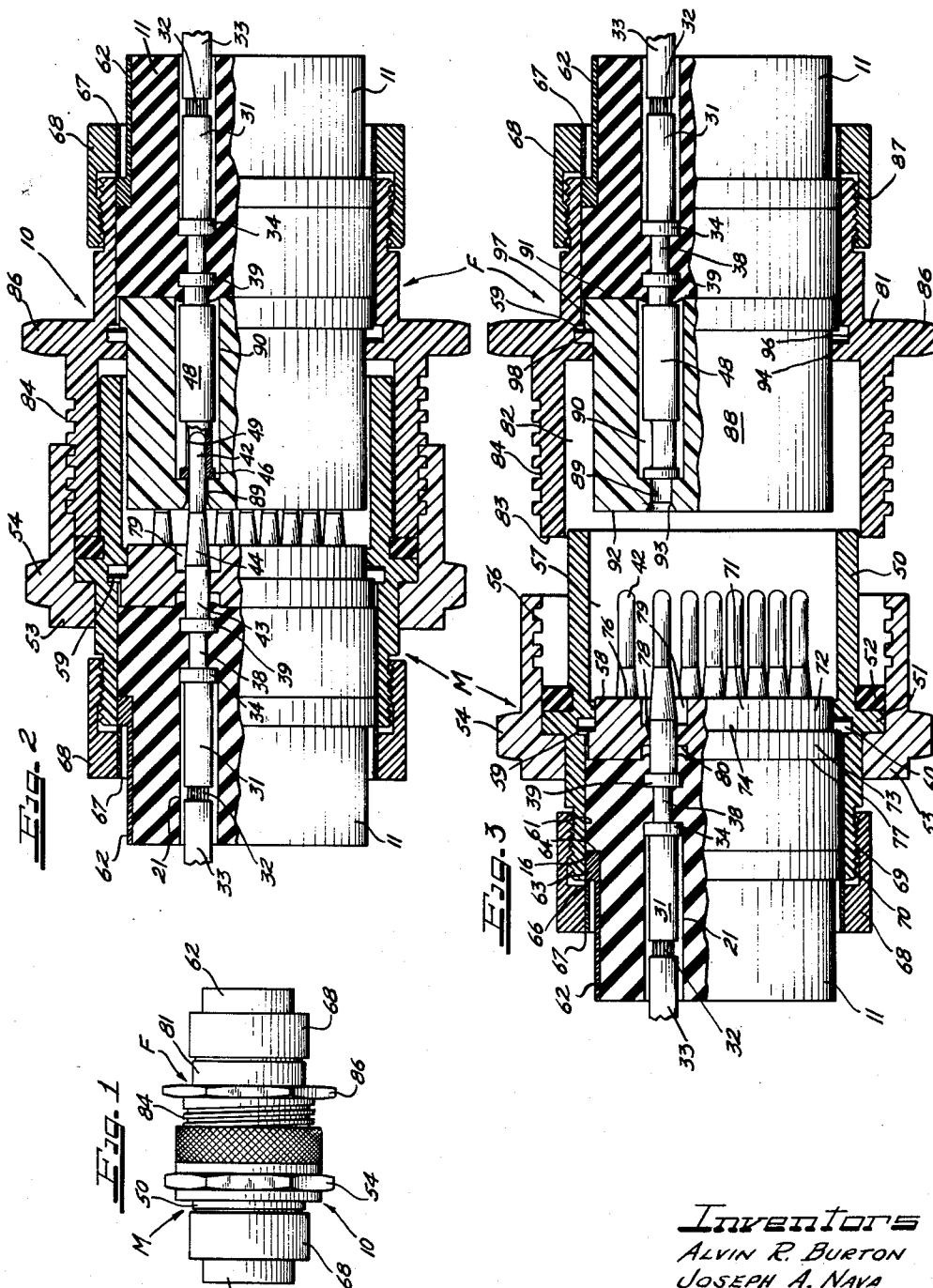
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3,029,407

ELECTRICAL CONNECTOR WITH POP-IN CURRENT-CONTINUING MEANS

Filed April 15, 1959

2 Sheets-Sheet 1



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Fig. 4

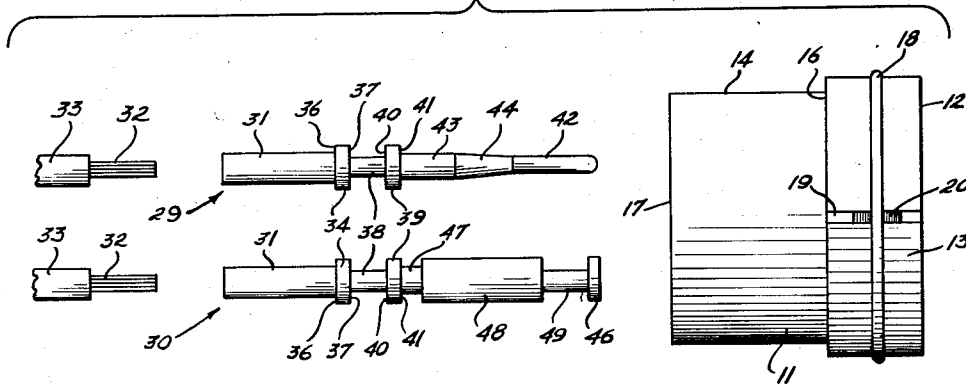


Fig. 5

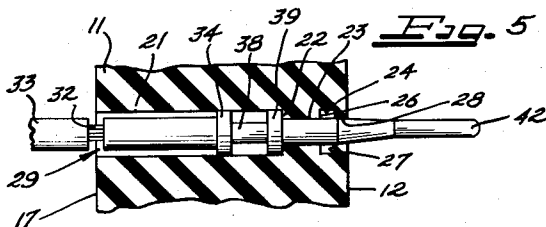


Fig. 6

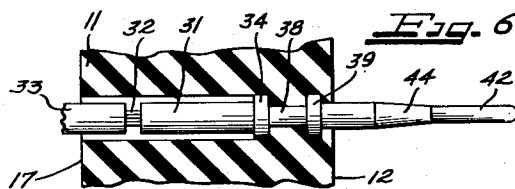
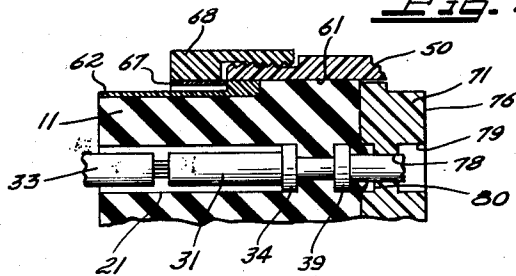


Fig. 7



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ELECTRICAL CONNECTOR WITH POP-IN CURRENT-CONTINUING MEANS

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This invention relates generally to electrical connectors
and more particularly relates to an electrical connector
having an elastic mounting member adapted to receive
current-continuing means in pop-in assembly therewith.

An object of the present invention is to provide an electrical
connector which overcomes the deficiencies of multi-
contact connector arrangements heretofore provided.

An object of the present invention is to provide an electrical
connector wherein a contact member is positively
retained against axial displacement while having positive
alignment in a plane of radial orientation.

A further object of the present invention is to provide
a connector resistant to moisture, shock and vibration.

Still another object of the present invention is to provide
an electrical connector of the multi-contact type
wherein the current-continuing contact member may be
inserted into the connector by a simple axial motion.

A further object of the present invention is to provide an
electrical connector which can be effectively used with-
out requiring special skills on the part of the user.

Another object of the invention is to reduce joint
termination in a multipin connector.

Still another object of the present invention is to elimi-
nate the necessity of using cement and special sealing de-
vices in a multicontact connector.

Many other features, advantages and additional objects
of the present invention will become manifest to those
versed in the art upon making reference to the detailed
description which follows and the accompanying sheet of
drawings in which a preferred structural embodiment of
an electrical connector incorporating the principles of the
present invention is shown by way of illustrative example.

On the drawings:

FIGURE 1 is an elevational view of an electrical con-
nector incorporating the principles of the present inven-
tion;

FIGURE 2 is a cross-sectional view of the connector
shown in FIGURE 1 with parts shown in elevation and
showing the male and female portions of the separable
connector joined together in fully assembled relation-
ship;

FIGURE 3 is a view similar to FIGURE 2 but show-
ing the male and female components of the connector
separated;

FIGURE 4 is an exploded view of the elastic mount-
ing member provided in accordance with the principles
of the present invention as well as a male and a female cur-
rent-continuing means and bared conductor wires, thereby
to illustrate the steps in the assembly of the structure dis-
closed herein;

FIGURE 5 is a fragmentary cross-sectional view with
parts shown in elevation illustrating an assembly step sub-
sequent to the assembly step illustrated in FIGURE 4;

FIGURE 6 is a fragmentary cross-sectional view simi-
lar to FIGURE 5 but showing another subsequent as-
sembly step; and

FIGURE 7 is a fragmentary cross-sectional view illus-
trating the completed assembly operation.

As shown on the drawings:

An electrical connector embodying the principles of
the present invention is shown in FIGURE 1 at 10 and
comprises a male component indicated M and a female

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component indicated at F, the two components M and F
constituting separable members of a multipin or multi-
contact connector assembly.

Referring now to FIGURES 4-7 in connection with
FIGURES 2 and 3, it will be noted that the present in-
vention is particularly characterized by the utilization of
a mounting member or carrying member which is indi-
cated generally at 11 and which is identical in so far as
structural and functional features are concerned in both
the male and female components M and F.

The mounting member constitutes a mass of elastic
material such as rubber or a rubber compound and in ac-
cordance with the principles of the present invention, any
elastic material of suitable characteristics may be used
if it has a durometer hardness in the order of from about
Shore "A" 40 to 80.

It will be noted from the drawings that the mass of
elastic material constituting the mounting member 11 is
shaped into a generally cylindrical form, the member 11
having a radially extending front face 12 and an external
peripheral surface 13. The member 11 further includes
a reduced portion 14 so that an annular radial shoulder
16 is provided between the reduced portion 14 and the
peripheral surface 13. The reduced portion 14 terminates
in a radially extending end wall 17.

Reference to FIGURE 4 will indicate that the periph-
eral surface 13 is particularly characterized by the forma-
tion thereon of a sealing bead 18 projecting radially out-
wardly of the peripheral surface 13 and located inter-
mediate the end wall 12 and the annular shoulder 16.
The bead 18 is integral with the member 11 and is thus
constituted by the same elastic material characteristic of
the member 11. The bead 18 is circumferentially con-
tinuous although it will be noted that the surface 13, as
shown in FIGURE 4, is characterized by an axially ex-
tending groove 19 having a raised center portion 20 ad-
jacent opposite sides of the bead 18. The purpose of the
groove 19 is to cooperate with a locating rib in the con-
nector.

The mass of elastic material constituting the member
11 is shaped to form a plurality of through openings, each
having an irregularly-shaped bore wall prescribing longi-
tudinally spaced grooves and shoulders.

The specific configuration of a typical opening is de-
picted in FIGURES 2, 3, 5 and 6. As shown therein,
the opening is indicated generally at 21 and extends in-
wardly from the end wall 17 to a radially extending
shoulder 22 formed by a reduced section 23 of the open-
ing 21. The opening 21 is again enlarged as at 24, thereby
to form a second shoulder 26 which is spaced from the
shoulder 22 a predetermined longitudinal dimension.

On the opposite side of recess 24 from the shoulder
26 there is provided a second radial shoulder 27 and
a second reduced portion indicated at 28 opens out of
the wall 12.

In accordance with the principles of the present in-
vention, elongated current-continuing members of longer
length than the through opening 21 in the mounting
member 11 are provided. In order to accommodate
opposite portions of the connector, the current-contin-
ing members can be of the male type for use in the
male component M or of the female type for use in the
female component F. A typical male contact mem-
ber is indicated generally at FIGURE 4 by the refer-
ence numeral 29, whereas a typical female contact mem-
ber is indicated at 30. As to certain basic character-
istics necessary to effect cooperation with the mounting
members 11, 11, both male and female contact mem-
bers or current-continuing members 29 and 30 are simi-
lar. Thus, each current-continuing member 29 and 30
is provided with a socket portion 31 having a recess in
which the bared end 32 of a sheathed conductor wire

33 may be inserted. The socket portion 31 is then crimped to place the conductor wire 32 in firm assembly with either the male current-continuing means 29 or the female current-continuing means 30. Although crimping affords an excellent means of attachment of the male and female current-continuing means 29 and 30 to the conductor wires 32, 32, it will be appreciated that any suitable connection such as soldering or other conventional practices may be followed.

The socket portion 31 of each member 29 and 30 terminates in a radially enlarged circumferentially continuous rib 34.

Each rib 34, therefore, provides a rear shoulder 36 and a front shoulder 37. Each contact member 29 and 30 is further characterized by a reduced medial section indicated at 38 extending from the rib 34 to a second rib indicated at 39. Each rib 39 has a back shoulder 40 and a front shoulder 41.

Extending forwardly from the rib 39 on the male current-continuing means is a generally cylindrical contact portion 42 which is of reduced cylindrical size. The actual contact portion 42 is on the free end of the current-continuing member 29 and extends from the rib 39 via a cylindrical body portion 43 and a tapered section 44.

In the female current-continuing member 30, a female contact portion 46 extends away from the rib 39 and includes a cylindrical body portion 47 and an enlarged tubular portion 48 crimped or reduced at 49 to receive a clip or split sleeve to resiliently engage in good electrical contact the mating contact portion 42 of the male current-continuing member 29.

In accordance with the practice of the present invention, each of the current-continuing means 29 and 30 may be preassembled to a current-conducting means 33. For example, such preassembly may be effected as a bench operation. The contact members are then matched to appropriate openings 21 in a mounting member 11 and the respective contact portions 42 in the case of the male member 29 and 46 in the case of the female members 30 are respectively inserted through the corresponding opening 21 in the wall 17 so that the shoulder 41 on each respective rib 39 will engage against the shoulder 22 formed in the opening 21. Such operation is depicted in FIGURE 5 wherein a male member preassembled to a conductor wire 32 is shown partially inserted into a corresponding opening in the mounting member 11.

Since the elastic material is of a selected durometer, a tool is then applied to the current-continuing member for the purpose of applying axial force to the current-continuing member. The elastic material of the mounting member 11 responds to such axial force by deformably displacing radially outwardly, thereby permitting the shoulder 41 to pass the shoulder 22 and permitting the rib 39 to move past the reduced section 23 of the opening 21.

In accordance with the principles of the present invention, the projections and recesses in the bore wall of the openings 21 extending through the mounting member 11 are complementary in size and shape to the projections and reduced sections on the surface of the current-continuing means and as referred to in the components 31-41, respectively. Accordingly, the spacing dimension between the shoulders 22 and 26 is essentially the same as the spacing dimension between the shoulders 37 and 40. Moreover, the enlarged portion or recess 24 is essentially the same size as the rib 39 and the part of the opening 21 indicated at 28 is essentially the same size as the body portion 43 on the male member 29 and the body portion 47 on the female member 30. Furthermore, the outer diameter of the ribs 34 and 39 is essentially the same as the inner diameter of the opening 21. Thus, as the rib 39 moves past the reduced section 23 it will snap in or pop in to the recess

24, or, vice versa, the reduced section 23 as prescribed by the adjoining portions of the mounting member 11 will be elastically restored to original size whereupon the current-continuing member 29 or 30, as the case may be, will be received in pop-in assembly within the mounting member 11. The assembled condition of the contact member 29, by way of illustrative example, is shown in FIGURE 6 to show such relationship.

After all of the male current-continuing members 29 have been assembled in a corresponding mounting member 11 and after all of the female current-continuing members 30 have been assembled in a corresponding mounting member 11, the completed sub-assemblies are ready for incorporation into a separable connector.

Referring particularly to FIGURE 3, it will be noted that the male component M constitutes a cylindrical housing 50 having a radially outwardly extending rib 51 bottoming a sealing ring 52 and shouldering on its opposite side a flange 53 of a nut 54 internally threaded as at 56.

Internally, the housing member 50 has a cylindrical chamber 57 in which the contact portions 42 of the male current-continuing members 29 are adapted to be positioned. At the end of the cylindrical chamber 57 there is provided a radially inwardly extending shoulder 58 bottoming a resilient member 59 which comprises a prestressed biasing means bottomed on the shoulder 58 and yieldably deforming in axial direction. A grooved recess 60 is formed in the housing 50 adjacent the shoulder 58 thereby to confine the biasing means 59.

Extending away from the grooved recess 60 is a smooth bore wall 61 which is cylindrical in configuration and which is adapted to closely receive the peripheral surface 13 of the mounting member 11. The inner diameter of the bore wall 61 is preferably of approximately the same diameter as the outer diameter of the surface 13 and should be of somewhat smaller diameter than the outer diameter of the sealing bead 18, thereby to yieldably deform the sealing bead 18 into the body of the mounting member 11 for improving the seal between the housing 50 and the mounting member 11.

A rigid thin-walled sleeve or tube 62 closely embraces the reduced portion 14 of the mounting member 11 and extends rearwardly from the annular shoulder 16 formed on the mounting member 11. The thin-walled sleeve or tube 62 is preferably co-extensive in length with the reduced portion 14 having its outer end terminating flush with the radial end wall 17 of the mounting member 11. At the other end of the sleeve or tube 62, there is provided an enlarged radially outwardly projecting flange 63 having an outer diameter preferably approximately the same as the inner diameter of the bore wall 61, thereby to provide a radially extending shoulder 64 which engages against the adjoining shoulder 16 of the mounting member 11. At the opposite end of the flange 63, there is provided a shoulder 66 which is engaged by a ring or collar 67 carried in firm assembly by a nut member 68 threaded as at 69 for threaded engagement with a partially threaded portion 70 formed on the end of the housing 50.

There is provided a rigid disk-like insulating member which is indicated at 71 and which is of generally disk-like configuration having an outer peripheral surface 72 of a diameter closely approximating the inner diameter of the shoulder 58, thereby to be telescopically received therein in assembled relationship, the insulator member 71 further including an enlarged portion 73 providing a radial shoulder 74 which bottoms the biasing means 59.

The insulating member 72 has a front face 76 and a rear face 77 which are substantially parallel to one another and which are both intersected by a plurality of counterbored passages 78 corresponding in number and placement to the openings 21 through the mounting member 11. The counterbore for each passage 78 formed in the front face 76 is indicated at 79 and the counterbore formed in the rear face 77 for each passage 78 is indicated

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at 80. It will be noted that the body portion 43 on the male contact is slidably received in a corresponding passage 78.

As shown in FIGURE 7, the assembly is completed by placing the insulating member 71 in the housing 50 against the biasing means 59 whereupon the mounting member 11 with the male current-continuing members 29 in place is inserted within the housing 50 until the front face 12 is engaged against the rear face 77. The tube 62 being in place, the nut 68 is then threaded on the threaded portion 70.

For the female component F, there is provided a housing 81 having a cylindrical chamber 82 sized to receive in telescoping relation the end of the housing 50 and providing a radial end wall 83 for sealingly engaging against the sealing member 52. The housing 81 is externally threaded as at 84 so that the male component M can be locked in joined-together relationship with the female component F by threading the nut member 54 onto the female housing 81.

A tool-engaging flange 86 is formed on the female housing 81 and the end thereof is threaded as at 87 for cooperation with a nut member similar to the nut member already described and therefore identified by the same reference numeral 68.

Interiorly, the female component F varies from the male component M already described in utilizing a different form of insulating member herein indicated at 88. The insulator member 88 is made of a rigid material and is provided with a plurality of through passages 89 corresponding in number and placement to the number of female current-continuing members 30. Each passage 89 is counterbored as at 90, the counterbore being of sufficient length to accept the female contact portion 48. The insulator member 88 has a rear wall 91 and a front wall 92 and the front wall is provided with chamfered portions 93 at each passage 89, thereby to form a finding portion facilitating mating of the male and female contact portions 42 and 48, respectively.

The cylindrical chamber 82 has a shoulder 94 at the end thereof, the inner diameter of the shoulder 94 closely receiving the outer diameter of the insulator member 88. The female housing 81 is grooved as at 96 adjacent the shoulder 94 in the same manner as the groove 60 in the male housing 50, thereby to receive a biasing means again indicated at 59 since the function is the same as the biasing means 59 already described. The insulator member is provided with an enlarged flange portion 97, thereby to form a shoulder 98 bottoming against the biasing means 59 and it will be understood that the female component F is assembled in the same manner as the male component M in that the insulator member 88 is positioned within the housing 81 whereupon the pre-assembled female current-continuing means 30 in the mounting member 11 are then positioned in place and the tubular member 62 is tightened into position by the nut 68.

Three distinct sealing principles are afforded by the structure of the present invention. The first is an interference friction seal between the interengaging projections and recesses of the current-continuing contact members 29 and 30 and the elastic mounting member 11. The second results because of the deliberate displacement of the lip surrounding the contact cavity at the front face of the elastic mounting member in an axial direction into an adjoining counterbore in the rigid front insulating member, either 71 or 88. Such sealing is accomplished by axial design interferences between the current-continuing member 29 or 30 and the corresponding mounting member 11, which creates a surplus of elastic material actually displaced into the counterbores 80 in the back face 77 of the insulating member 71 or into the ends of the counterbores 90 intersecting the back face 91 of the insulating member 88. That action is controlled by the design of the prestressed biasing means 59 as well as the

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tube 62 and the nut 68. The controlled space afforded by the biasing means 59 restricts the actual displacement of elastic material created by the current continuing member so as to insure the action desired. In addition, the controlled space augments the friction seal described as the first sealing principle.

The third sealing principle afforded by the arrangement described, is that employed between the outer diameter of the mounting member 11 and the bore of the barrel 61. A normal interference fit between the two adjoining components is supplemented by the clamping action effected between the biasing means 59 and the tube 62, whereupon the elastic material of the mounting member 11 expands to sealingly engage the bore wall 61.

The prestressed biasing means perform the special function of providing a controlled pressure on the elastic material, thereby effecting a functional sealing, while compensating for manufacturing variations in the connector components.

Because of the controlled pressures applied in effecting a proper sealing relationship, the connector of the present invention is not required to depend upon frictional interference or on special clamping devices subject to the vagaries of field assembly. Moreover, the connector described affords positive retention of the current-continuing member 29 or 30 in forward direction together with positive alignment of a plurality of contacts or pins through the use of the rigid front insulation members 71 or 88. Furthermore, the female front insulation member 88 being rigid, it is not subject to abuse or abrasion by the male contact portions 42 and the rigid front insulation 88 also serves as a positive locator for assembly of the contacts into the connector after termination. Location is not only positive and accurate, but does not require special measurement or skill on the part of the assembler. The nut 54 is slidable and rotatable on the outside of the male component M. Accordingly, it is not necessary to restrain the pins and sockets from relative rotary movement since the initial turning of the nut 54 can readily be accomplished without imparting any torque to the pins and sockets.

We have described a connector which allows termination of the contacts to the conductors by manual or automatic means without encumbrance of other components. Furthermore, after termination, the contacts are simply and conveniently inserted into a connector assembly by a simple axial motion. Since the connector less contacts is factory-assembled, the functional integrity of the connector and the environmental resistance embodied therein is maintained without requiring the application of special skill on the part of the user.

Although various minor modifications might be suggested by those versed in the art, it should be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

We claim as our invention:

1. In an electrical connector, a housing having an internal annular shoulder, a prestressed biasing means bottomed on said shoulder and yieldably deformable in axial direction, a rigid cylindrical member having a plurality of spaced apart counterbored axial passages extending therethrough and having shoulder portions at its outer periphery engaged against said biasing means, an elastic cylindrical member axially adjacent said rigid cylindrical member and having a corresponding plurality of spaced apart axial passages extending therethrough, a corresponding plurality of current-continuing members inserted axially through said passages in pop-in assembly, each said passage and each said member having complementary projections and recesses formed therein relatively deformable temporarily with respect to one another upon axial insertion and restorable to effect pop-in retention, said elastic cylindrical member having an annular peripheral surface engaging an adjoining surface of said housing, said surface having a circumferentially extend-

ing radially projecting integral bead made of the same elastic material and being elastically deformable into the body of said elastic member upon insertion of said elastic member into said housing to improve the seal therebetween, said elastic member having a medial radial shoulder, a thin rigid tubular member closely surrounding and confining said elastic member and extending axially from said shoulder towards one end of said elastic member, said tubular member having an enlarged end flange engaging said shoulder, and a gland nut surrounding said tubular member threaded on said housing and engaging said end flange, thereby to compress said elastic member axially against said rigid cylindrical member to deformably displace said elastic member against said housing and said rigid member and into the counterbored axial passages to improve the seal therebetween.

2. In an electrical connector, a housing having an internal annular shoulder, a prestressed biasing means bolted on said shoulder and yieldably deformable in axial direction, a rigid cylindrical member having a plurality of spaced apart counterbored axial passages extending therethrough and having shoulder portions at its outer periphery engaged against said biasing means, an elastic cylindrical member axially adjacent said rigid cylindrical member and having a corresponding plurality of spaced apart axial passages extending therethrough, a current-continuing member inserted in each said passage, each said passage and each said current-continuing member having complementary surfaces formed with mating projections and recesses, the projections in said passage be-

ing temporarily deformable upon insertion of said current-continuing member to pop into the mating recesses of the current-continuing member, said elastic member having a medial radial shoulder, a thin rigid tubular member closely surrounding and confining said elastic member and having a wall extending axially from said shoulder towards the end of said elastic member, said tubular member having an enlarged flange engaging said shoulder at one axial end thereof, and a gland nut surrounding said tubular member threaded on said housing and engaging the opposite axial end of said enlarged flange, thereby to compress said elastic member axially against said rigid cylindrical member to deformably displace said elastic member against said housing and said rigid member and into the counterbored axial passages to improve the seal therebetween.

3. In an electrical connector as defined in claim 1, said elastic material being of a durometer hardness in the range of from about Shore "A" 40 to 80.

4. In a connector as defined in claim 2, said elastic material being of a durometer hardness in the range of from about Shore "A" 40 to 80.

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