

Dec. 11, 1962

J. A. NAVA ET AL

3,068,443

MULTI-CONDUCTOR CONNECTOR

Filed May 5, 1960

Fig-1

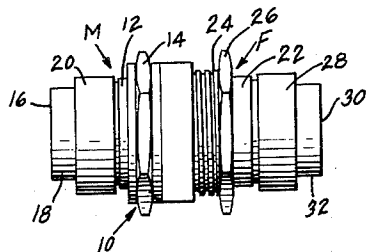


Fig-4

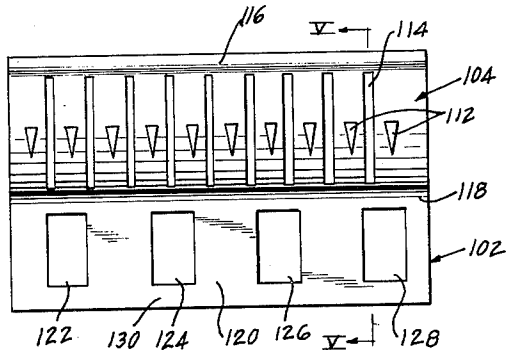


Fig-2

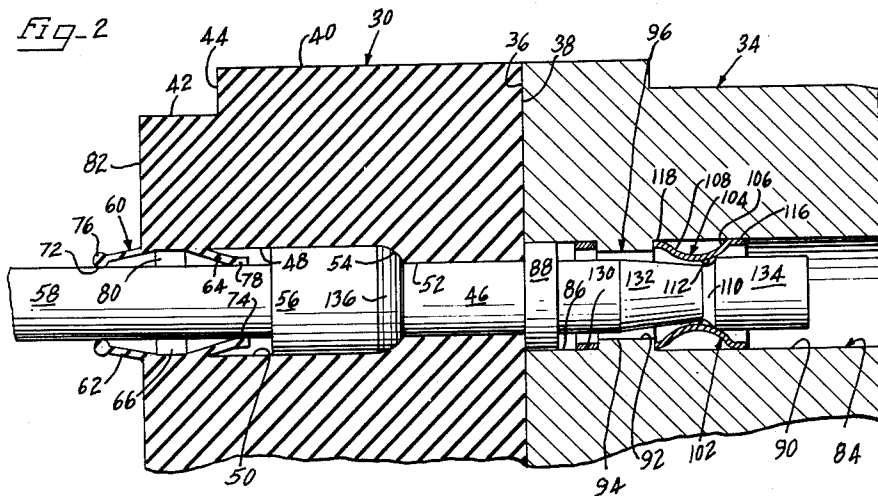
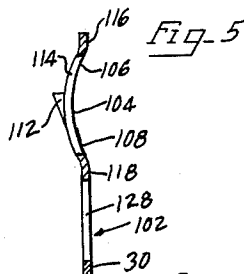
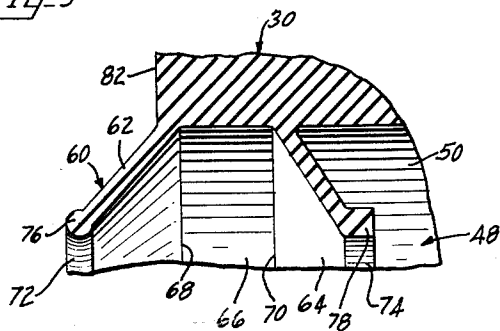


Fig-3



Inventors  
Joseph A. Nava  
Robert L. Hume

by Hill, Sherman, Meroni, Gross & Simpson Attys.

1

3,068,443

## MULTI-CONDUCTOR CONNECTOR

Joseph A. Nava, Villa Park, Ill., and Robert Lee Hume, Parma Heights, Ohio, assignors to Pyle-National Company, Chicago, Ill., a corporation of New Jersey  
Filed May 5, 1960, Ser. No. 27,032  
8 Claims. (Cl. 339-217)

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

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

Another 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.

Another object of the invention is to provide spring means affording coaxing snap-in engagement for mating contact members of the connector.

Still another object of the present invention is to provide an electrical connector of the multi-contact type wherein the current continuing contact members are securely sealed by double-acting seal means which accommodate variations in diameter, and are effective over a wide range of temperature and pressure.

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 on the accompanying sheet of drawings in which a preferred 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 connector incorporating the principles of the present invention;

FIGURE 2 is a fragmentary enlarged cross sectional view of current continuing means according to the invention as assembled in retaining means therefor;

FIGURE 3 is an enlarged fragmentary view of sealing means utilized in the structure shown in FIGURE 2;

FIGURE 4 is a top plan view of a blank from which snap-in spring retaining means according to the invention is formed; and

FIGURE 5 is a vertical sectional view taken along the lines V-V of FIGURE 4.

As shown on the drawings:

Referring now to 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 at M and a female component indicated at F, the two components M and F constituting separable members of a multi-pin or a multi-contact connector assembly. The male component M constitutes a cylindrical housing 12 configured to engage an internally threaded nut 14. The housing 12 is internally structured to receive a mounting member 16 for retaining male contact members (not shown) and a rigid thin walled sleeve or tube 18 around the member 16. The sleeve 18 is retained in position by a nut member 20 which is internally threaded for engagement with an externally threaded portion of the housing 12.

For the female component F there is provided a housing 22 sized to receive in telescoping relation an end of the housing 12 and externally threaded as at 24 for engagement with the internally threaded nut member 14.

A tool-engaging flange 26 is formed on the female

2

housing 22 and the outer end thereof is externally threaded for cooperation with a nut member 28 similar to the nut member 20.

A mounting member 30 is retained within the housing 22 by means of the said nut 28 and associated structure such as a thin walled rigid sleeve or tube 32 corresponding to the sleeve or tube 18. Desirably, the mounting member 30 also corresponds structurally to the mounting member 16, and has an insulating disk 34 of rigid material in abutting engagement therewith as indicated in FIGURE 2, a suitable insulating disk (not shown) also being provided for abutting engagement with the mounting member 16 within the housing 12.

The mounting members 16 and 30, which are as stated structurally similar, are formed of a mass of elastic material such as rubber or a rubber compound and in accordance with the principles of the present invention, any elastic material of suitable characteristic may be used desirably having a durometer in the order of about Shore "A" 40 to 80, a durometer of 60 having been utilized with a high degree of effectiveness.

The mass of elastic material constituting the mounting members 16 and 30 is shaped in generally cylindrical form, and will hereinafter be described with reference to the mounting member 30. Thus the member 30 has a radially extending front face 36 formed for abutting engagement with a complementary face 38 on the insulating disk 34, and an external peripheral surface 40. Desirably also, the member 30 further includes a reduced portion 42 so that an annular radial shoulder 44 is provided between the reduced portion 42 and the peripheral surface 40. This structure, as suitably dimensioned, may be utilized for engaging the thin walled tube 32 in telescopic relationship and with the tube 32 closely surrounding and confining the member 30, the tube 18 correspondingly closely surrounding and confining the member 16. It will be understood that variations in the external configuration of the mounting member 30, as well as of the mounting member 16, may be encompassed within the scope of the invention, but the nuts 20 and 28 may be configured to urge the tubes 18 and 32 axially inwardly as by means of inter-engaging shoulders on said nuts and tubes respectively to assist in providing an abutting sealing engagement between contacting surfaces of the respective mounting and insulating members such as the surfaces 36 and 38 as set forth and illustrated in the copending application for "Electrical Connector With Pop-In Current-Continuing Means" Serial Number 806,590, filed April 15, 1959, now issued as Patent No. 3,029,407, dated April 10, 1962.

The mass of elastic material constituting the member 30 is shaped to form a plurality of through openings, each having a bore wall shaped to engage a contact member such as the member 46 shown in FIGURE 2. The bore wall in the mounting member 30 is designated generally by reference numeral 48, and it will be seen that it includes a relatively large diameter portion 50, and a relatively reduced portion 52 connected to the portion 50 by a preferably arcuate shoulder 54. This construction corresponds to the configuration of the female contact member 46, wherein a socket portion 56 is provided so that a conductor wire 58 may be crimped or otherwise secured in the socket portion 56 with the wire portions thereof being bared within the socket portion.

The conductor wire 58 may be sheathed with a suitable material, and in order to seal the interior of the mounting member against differential pressures, the invention provides for a sealing gland or boot 60 to be formed integrally with the mounting member 30 and at the portion of the bore 48 receiving the conductor wire 58. It will be understood that a similar butterfly gland will be

utilized for the mounting member 16, and that the individual through openings in the respective mounting members will be similarly formed with corresponding sealing members.

The butterfly gland 60 is characterized, as best seen in FIGURE 3, by a seal structure having individual conical sealing sections 62 and 64 diverging at a desired angle from a plane taken perpendicular to the axis of the bore 48, in opposite directions. For example, an angle of approximately 45° may be utilized. The conical sections 62 and 64 extend to a junction 66 which, in the form shown, preferably constitutes an annular surface having a diameter substantially equal to the diameter of the enlarged bore portion 50, and of a predetermined axial dimension such as to maintain the juncture lines 68 and 70 of the sections 62 and 64 in a desired proximate relation. In the normal position of the conical sections 62 and 64 shown in FIGURE 3, openings 72 and 74 are defined thereby whose diameter is substantially less than the minimum diameter of a wire to be inserted in sealing engagement therethrough, such as the wire 58. Thus when such a wire is inserted, as shown in FIGURE 2, the butterfly gland becomes elongated and the orifices 72 and 74 become relatively widened. However, because of the firm connection of the sections 62 and 64 with the mass of material 30, a biasing action radially inwardly will be afforded for each of the conical sections such as to effect a firm sealing engagement with the ends thereof around the wire.

For this purpose, the outer ends of each of the sections are formed with a bead or lip construction indicated by reference numerals 76 and 78 respectively. At least the external bead 76 has a "doughnut" shaped configuration such that regardless of the angular position of the conical section 62 as it engages the wire 58, a tangential line of contact between the wire and the bead 76 will be afforded which is completely continuous to prevent leakage therethrough. Thus the conical section 62 will have a thickness less than the diameter of the bead 76 and desirably will intersect the bead along a plane such as to provide a bead surface of predetermined arcuate extent both internally and externally of the section. The bead 78, however, may have a rectangular configuration so as to define an annular flange extending axially of the wall 48, at least when engaging a wire such as the wire 58. Thus a surface contact will be afforded of relatively large extent between the bead 78 and the wire.

Accordingly, pressure differentials may be effectively maintained between the interior 80 of the gland 60, and the exterior portions thereof, and any relatively large pressure externally of the structure 30 will tend to force the section 62 downwardly so that the bead 76 engages the wire or conductor 58 with considerable sealing force. Furthermore, the natural resilience of the elastic material of which the housing 30 and the sections 62 and 64 are integrally formed is such as to afford a further downward compressive force on the bead 76 as well as on the bead 78, and a wide range of temperatures and pressures may be resisted by the gland without significant effect on the sealing action.

As an example of dimensions which may be utilized in the gland 60, the orifices 72 and 74 may have a normal diameter of approximately .020 inch, and the inner surface 66, as well as the bore wall 50, may have a diameter of approximately .112 inch. The section 62 and the section 64 may have an overall thickness of approximately .006 inch, for example, and it will be seen that the section 62 preferably merges with the rear wall 82 of the mounting portion 30 in spaced relation to the surface 66 such as to maintain the described resilient downward action on the said section 62. For example, the spacing between the line 70 and the wall 82 may be approximately .045 inch for this purpose. The bead 76 may have a diameter of approximately .012 inch in a construction of the general dimensional range indicated, and

the bead 78 may have a width of approximately .012 inch also. However, variations in the particular size of the sealing gland, and the sections such as the sections 62 and 64 are, of course, encompassed within the scope of the invention.

The "doughnut" shaped configuration of the bead 76 permits the contact element 46, and the conductor 58, to be inserted therethrough without any tendency of the gland to fold inwardly or to resist such entry.

The insulator member 34 is provided with a plurality of through passages 84 corresponding in number and placement to the number and placement of the through passages 48. Each passage 84 is counterbored as at 86 to receive a shoulder 88 on the female contact member 46, the portion 86 and the shoulder 88 preferably having a dimension essentially corresponding to the dimension of the portion 50 of the passage 48 and the socket portion 56 of the contact 46. Likewise, the bore 84 includes a portion 90 of similar diametrical dimension and, as seen in FIGURE 2, an intermediate bore portion 92 is provided which defines a plurality of segmental shoulders 94 and 96 as hereinafter described.

In order to secure the female member 46 in position in the insulator 34 and to hold the insulator in abutting engagement with the member 30, a spring member or collet 102 may be used, as for example, a collet formed from the blank shown in FIGURE 4, to be snugly inserted in the through opening or bore 84 as shown in FIGURE 2. It will of course be appreciated that in the relationship shown in FIGURE 1, the portion 34 will be at the innermost portion of the female structure F, whereas the portion 30 will constitute an end cap.

As seen in FIGURES 4 and 5, the structure 102 may include an arcuately bowed portion 104, which may have a slightly greater inclination at the upper portion 106 thereof than at the lower or rear portion 108 to merge with the rear portion 108. In the assembled condition of the collet illustrated, the portion 106 is disposed in alignment with a chamfered shoulder 110 on the contact member 46. A plurality of teeth 112 may be stamped in the bowed portion 104 to extend inwardly from the area 106 and to engage in abutting relationship with the shoulder 110. The bowed portion 104 may afford a biasing action urging the contact member 46 in the direction of the bore portion 90 of the member 34, although it will be understood that the collet 102 is in no sense indicative of the scope of structure which may be utilized in the invention. In the form shown, a plurality of transversely extending cuts or slots 114 may be provided between each of the teeth 112, thereby assisting the spring-like action of the collet. In the assembled condition of the device, therefore, the collet will have continuous margins 116 and 118 in axial alignment with the bore portion 90 and in abutting relation therewith.

Also in the example shown, the planar portion 120 of FIGURE 4 is provided with a plurality of rectangular cut-outs 122, 124, 126 and 128 which engage over the plurality of segmental shoulders in the bore portion 92, such as indicated by reference numerals 94 and 96, when the blank is formed and inserted in the insulator 34, to securely fix the collet in assembled position in the bore 84. In this position, the cut-outs 122 through 128 will have their greater dimension extending longitudinally of the bore, this dimension being substantially equal to the longitudinal dimension of the shoulders such as shoulders 94 and 96 to prevent slidable movement of the collet. The outer marginal edge 130 of the spring 102 thus lies within the bore region 86 in snug engagement therewith coextensively with the solid areas of the portion 120, which are received in arcuate recesses (not shown) of the bore portion 92 coextensively with the bore portions 86 and 90.

The contact 46 has a gradually sloping portion 132 leading to the shoulder 110 so as to pass freely into the collet 102, and a socket portion 134 is provided which

may receive a socket extension (not shown) and a napkin thereover (also not shown) affording a resilient contact finger for engagement with a male contact member. It will be understood that other variations in the particular construction of the female member 46 are also encompassed within the scope of the invention.

In accordance with the practice of the present invention, the current continuing contact member 46, as well as male members, such as may be similarly mounted in the mounting member 16, may have conductor means such as the wire 58 preassembled or crimped thereto at the socket portion 56, and it will be seen that when the socket portion 56 has its shoulder 136 in abutting engagement with the shoulder 54 in the bore 48, the shoulder 88 will abut the wall 36 of the mounting member flush with the wall 38 of the insulating member 34, as retained by the spring or collet 102 and the shoulder 54. Thus the female member 46 will be maintained against slidable movement with respect both to the mounting member 30 and the insulator member 34, thereby to implement the sealing action afforded by the gland 60 relative to the wire 58.

Accordingly, a plurality of the contact members 46 are matched to appropriate openings 48 in the mounting member 30 and corresponding contact portions are inserted in similar openings in the mounting member 16 of the male member M. The members 46 may be inserted past the glands 60 in the openings 48, it being noted again that the bead 76 will not interfere with such movement due to its beaded configurations and the shoulder 88 will move readily past the arcuate or chamfered shoulder 54 in the elastic mounting member 30 and emerge in snug abutting engagement with the outer end of the bore 48 so that a "pop-in" action is afforded.

Movement of the contact member 46 through the elastic material of the mounting member 30 may be effected by a suitable tool, and since the elastic material of the member 30 is of a selected durometer as above set forth, it responds to the resulting axial force by deformably displacing radially outwardly to permit thereby the shoulder 88 to pass the shoulder 54 as described. When the end 134 forming the socket holding means for the female member is passed beyond the collet 102 to an extent that the shoulder 110 is in register with the detent teeth 112, the device will be snugly held so that the walls 36 and 38 of the mounting member 30 and insulative member 34 are in the described snugly abutting, sealing engagement as urged by the collet or holding member 104 engaging the shoulder 110 of the contact 46 and the shoulders 94 and 96 of the member 34, with the shoulder 136 of the contact 46 engaging shoulder 54 of the member 30 as hereinabove set forth.

The irregularities on the bore wall 48 being complementary to the irregularities on the pin 46, a firm contact between the pin and the mounting member is provided. The described snug engagement between the shoulder 88 and the contact mounting member 30 thus produces an effective seal therebetween coacting with the gland 60 and the seal between the insulator 34 and mounting member 30.

Although I have herein set forth and described my invention with respect to certain specific principles and details thereof, it will be understood by those skilled in the art that these may be varied without departing from the spirit and scope of the invention as set forth in the hereunto appended claims.

We claim as our invention:

1. In an electrical connector, a rigid member having an opening therethrough for receiving a contact member, a collet inserted in said opening having means for releasably engaging the contact member in spring biased relationship to urge it in one direction axially, an elastic member having an opening therethrough for receiving the contact member and a shoulder in said opening for

engaging a shoulder on the contact member and facing oppositely from said one direction, said collet and said shoulder in said opening of said elastic member being disposed to urge said rigid member and said elastic member together in sealing relation when the contact member is inserted in said openings for engagement by said collet and said shoulder in said opening in said elastic member.

2. In an electrical connector, a rigid member having an opening therethrough for receiving a contact member, a collet inserted in said opening having means for releasably engaging the contact member in spring biased relationship to urge it in one direction axially, an elastic member having an opening therethrough for receiving the contact member and a shoulder in said opening for engaging a shoulder on the contact member and facing oppositely from said one direction, said collet and said shoulder in said opening of said elastic member being disposed to urge said rigid member and said elastic member together in sealing relation when the contact member is inserted in said openings for engagement by said collet and said shoulder in said opening in said elastic member, said elastic member having a sealing gland including a pair of sealing elements formed integrally with said elastic member at said opening, said sealing elements diverging from one another and extending inwardly to engage the contact member in sealing relationship.

3. In an electrical connector, a contact member, a rigid member having an opening therethrough receiving said contact member, a collet inserted in said opening having means releasably engaging said contact member in spring biased relationship, an elastic member having an opening therethrough receiving the contact member and a shoulder in said opening, said contact member having a shoulder for engaging said shoulder in said opening and a shoulder engaged by said collet means, said rigid member and said elastic member having opposed faces disposed in abutting sealing relationship by the spring action of said collet.

4. In an electrical connector, a contact member, a rigid member having an opening therethrough receiving said contact member, a collet inserted in said opening having means releasably engaging said contact member in spring biased relationship, an elastic member having an opening therethrough receiving the contact member and a shoulder in said opening, said contact member having a shoulder for engaging said shoulder in said opening and a shoulder engaged by said collet means, said rigid member and said elastic member having opposed faces disposed in abutting sealing relationship by the spring action of said collet, said contact member having a shoulder disposed in abutting sealing engagement with the said face on said elastic member.

5. In an electrical connector, a rigid member having an opening therethrough for receiving a contact member, a collet in said opening having means for releasably engaging the contact member in spring biased relationship, an elastic member having an opening therethrough for receiving the contact member and a shoulder in said opening for engaging a shoulder on the contact member, said collet and said shoulder in said opening of said elastic member being disposed to urge said rigid member and said elastic member together in sealing relation when a contact member is inserted in said opening for engagement by said collet and said shoulder in said opening in said elastic member, said elastic member having a sealing gland for engaging the contact member in sealing relationship.

6. A mounting member for use in an electrical connector comprising, a mass of elastic material having an opening therethrough for receiving a contact member, and a sealing gland formed integrally with said mass of elastic material and disposed in said opening, said sealing gland having a pair of separate relatively thin resilient extensions, said extensions joining said mass of elastic material in proximate relation to one another and extending radially inwardly from said mass of elastic material

7

in mutually divergent relationship, said extensions forming openings of lesser diameter than the opening through the mass of elastic material whereby said sealing gland is effective to sealingly engage a wire connected to a contact member in said opening.

7. The mounting member according to claim 6 wherein the radially innermost ends of said extensions have radially inwardly extending beads for engaging a wire in sealing relationship in any angular disposition of the extensions.

8. A collet for use in retaining a contact member in an electrical connector or the like comprising a resilient metal blank having one side longitudinally bowed with transversely spaced slots and teeth extending from the bowed areas between the slots outwardly of the bowed areas, and a plurality of openings in the longitudinal portion of the blank opposite said bowed portion, said blank being shaped as a ring with the bowed portion facing

8

inwardly to provide a resilient engagement of the teeth with a contact member shoulder, and the openings in the blank being adapted to retain the collet in an opening in a receiving member for the contact member with the material of the receiving member extending therethrough.

#### References Cited in the file of this patent

#### UNITED STATES PATENTS

|    |           |               |               |
|----|-----------|---------------|---------------|
| 10 | 2,252,553 | Campbell      | Apr. 12, 1941 |
|    | 2,411,861 | Antony et al. | Dec. 3, 1946  |
|    | 2,419,018 | Gudie         | Apr. 15, 1947 |
|    | 2,477,849 | Adams         | Aug. 2, 1949  |
|    | 2,750,573 | Mika          | June 12, 1956 |
| 15 | 2,800,526 | Moorhead      | July 23, 1957 |
|    | 2,881,406 | Arson         | Apr. 7, 1959  |
|    | 2,892,991 | Beebee et al. | June 30, 1959 |
|    | 2,935,720 | Lorimer       | May 3, 1960   |
|    | 3,017,597 | Nava et al.   | Jan. 16, 1962 |