

Dec. 8, 1953

W. F. HENNESSEY, JR., ET AL
ELECTRICAL CONNECTOR HAVING A GROMMET AND MEANS
TO AXIALLY AND RADIALY COMPRESS THE SAME
Filed March 7, 1950

2,662,219

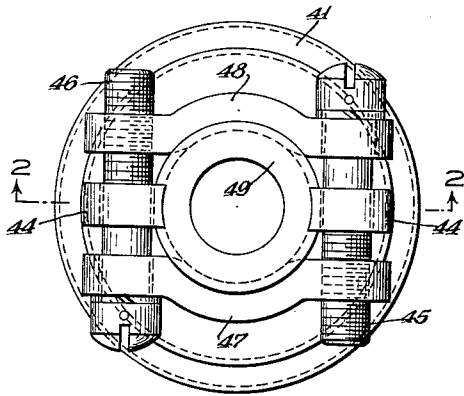


FIG. 1.

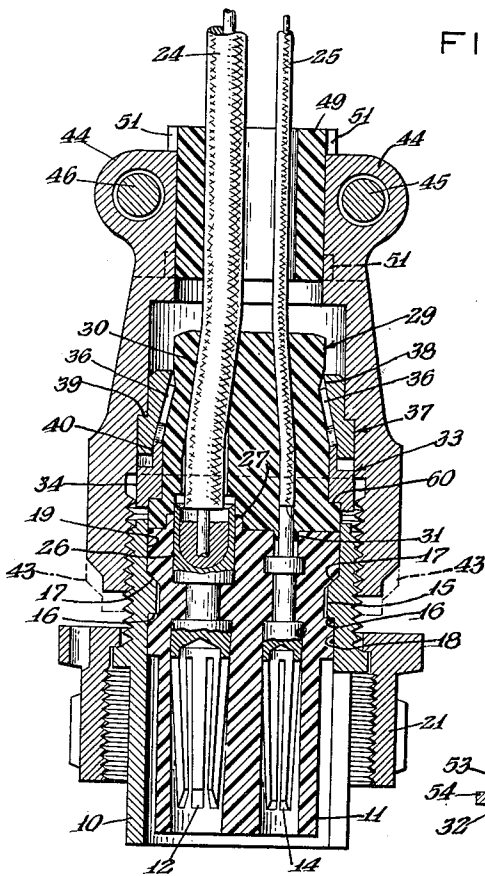


FIG. 2.

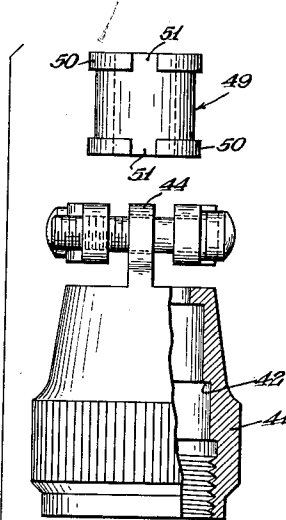


FIG. 3.

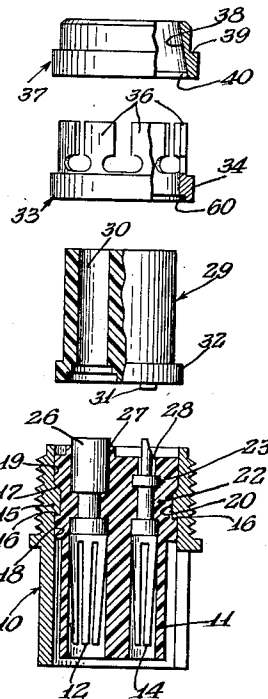


FIG. 4.

INVENTORS
Walter F. Hennessey, Jr.
George J. Swanson
BY

Dale A. Bauer
ATTORNEY

UNITED STATES PATENT OFFICE

2,662,219

ELECTRICAL CONNECTOR HAVING A GROMMET AND MEANS TO AXIALLY AND RADIALY COMPRESS THE SAME

Walter F. Hennessey, Jr., and George J. Swanson, Sidney, N. Y., assignors to Bendix Aviation Corporation, New York, N. Y., a corporation of Delaware

Application March 7, 1950, Serial No. 148,234

10 Claims. (Cl. 339—103)

1

This invention relates to electrical apparatus and more particularly to connectors for electrical conductors, such as plug and socket connectors adapted for electrically connecting flexible cables or the like either singly or in bunches.

One of the objects of the present invention is to provide in a connector assembly novel means for preventing the destruction or failure of the connections between flexible and rigid conductors which might otherwise result from vibration, mishandling or the like.

Another object of the invention is to provide a novel connector unit for electrical conductors wherein a plurality of parts for shielding and insulating the conductors may be readily assembled, disassembled and reassembled for examination, replacement or repair.

Still another object is to provide a novel connector assembly for electrical conductors and contact members wherein the chief detrimental effects of vibration and the like are substantially eliminated.

A further object is to provide novel apparatus of the above character wherein the parts are so constructed and arranged as to avoid any misalignment or improper positioning of the various parts during assembly.

Still another object is to provide an electrical connector assembly wherein a plurality of conductors are novelly and adequately insulated from each other at joints in the surrounding insulation.

A still further object is to provide a novel assembly of a plurality of rigid and flexible parts under axial and radial compression around one or more electrical conductors.

The above and further objects and novel features of the invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended as a definition of the limits of the invention.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

Fig. 1 is an end view, taken from the top in Fig. 2, of a unit of a plug and socket connector embodying one form of the invention;

Fig. 2 is a longitudinal sectional view of said unit, the section being taken substantially on line 2—2 of Fig. 1;

Fig. 3 is a partially exploded view of the unit of Fig. 2 showing certain of the parts in section

2

or partially in section before assembly and others in assembled relation and in section; and,

Fig. 4 is a detail view, partly in section, of a modification.

The embodiments of the invention illustrated in the accompanying drawings, by way of example, are shown in the form of a socket contact portion or receptacle of a multi-contact plug and socket connector. That portion of the illustrated structure comprising shell 10, insert 11, and socket members 12 and 14, i. e., the socket contact assembly, is disclosed and claimed in a copending application of Uline et al. Serial No. 646,788, filed February 11, 1946, and is adapted to mate with a pin contact assembly (not shown) of similar construction, as fully disclosed in said copending application. Said assembly is sometimes herein-after referred to as supporting means for the rest of the parts. Hollow shell 10 is generally cylindrical and is made of a rigid substance, such as metal. An annular land or rib 15 is provided on the inner surface of the shell, one end 16 of which is radial and the other end 17 of which is inclined or tapered. The radial or square end 16 joins a cylindrical portion 18 of the internal wall of the shell which preferably has an appreciably smaller diameter than the cylindrical bore 19 which connects with the tapered end 17 of the rib. Insert 11 is preferably made of resilient material and has a sliding compressive fit in shell 10. The lower end of insert 11, as viewed in the drawings, has a reduced diameter to facilitate insertion thereof into the shell over the bevelled or tapered end of rib 15 and in some instances to provide space for the end of the shell of the mating assembly referred to above. The various diameters of the remaining portion of the insert are, before assembly, slightly greater than the corresponding inside diameters of the shell, so that the insert is under radial compression when installed in the shell. The tapered shoulder 17 and the corresponding taper of the groove 20 in the surface of the insert facilitate removal of the latter from the shell. The square end 16 of the rib, which is engaged by a radial end wall of groove 20, holds the insert against movement in the shell when the mating pin and socket contact assemblies are joined together by a nut 21 with the inserts of the mating assemblies in compressive end-to-end engagement.

The resilient insert 11 has a plurality of axially extending passages therethrough which are generally cylindrical for receiving socket contact members of various types, such as socket contacts 12 and 14 or similarly constructed pin contacts

3

(not shown) of the character disclosed in the above mentioned copending application. Intermediate the ends of each passage in the insert is a land or rib 22, which has a snug fit in a groove 23 in the contact member to hold the latter against appreciable longitudinal movement relative to the insert during normal use. The composition of the resilient insert and the depth and length of the groove in the contact member are so chosen as to permit insertion and removal of the contact members from the insert. Additionally, those portions of each contact member which are engaged by the insert have diameters slightly greater than the normal or initial diameters of the surrounding surfaces of the insert opening so that the insert has a compressive fit around each contact member. The connector unit hereinabove described is thus rendered substantially gas-tight and moisture-tight so that it may be used in the walls of pressurized cabins of aircraft, water-tight walls of amphibious or under-water vehicles or the like.

In the illustrated embodiment, two types of contact members 12 and 14 are shown, the same being designed for connection with a relatively large flexible insulated conductor 24 and a relatively small flexible insulated conductor 25, respectively. The connections between said conductors and the contact members are preferably made by soldering the ends of the conductors in wells formed in the ends of the contact members. The well-end 26 of contact member 12 is substantially cylindrical and has a close fit in insert 11. A portion of the projecting end of member 12 is surrounded by a thin sleeve 27 that is formed as an integral part of the insert. For a purpose to more fully appear hereafter, the insert is recessed at 28 around the well-end of the smaller contact member 14.

The present invention comprehends novel means in combination with the above-described contact unit for insulating and protecting the connection between cables 24, 25 and contact members 12, 14 whereby the flexible cables are firmly held against vibration relative to the other parts at the most vulnerable point, moisture is effectively shut out, and the parts are held against longitudinal displacement which might result from rough handling or usage. In the form illustrated, such means comprises a grommet 29 of resilient material, such as natural or synthetic rubber, having longitudinal passages therethrough for the insulated conductors 24, 25. At the end of the grommet adjacent insert 11, which is made of similar or like material, the passage 30 for cable 24 has a stepped bore adapted to snugly receive the projecting end of contact member 12 and sleeve 27 on the insert. At the end of the opening for cable 25 the grommet is provided with a cylindrical extension or sleeve 31 which has a compressive fit in recess 28 and around the well-end of contact member 14. The end face of grommet 29 engages the end face of insert 11 and is pressed against it in a manner to herein-after more fully appear, the plane of contact being preferably within the end of shell 10. Grommet 29 is also provided with an external end flange 32 for a purpose to be explained.

Closely surrounding grommet 29 and butting against flange 32 is a metallic adapter sleeve 33 consisting of a rigid ring portion 34 and a relatively thin reduced portion slotted along axially extending lines to form a plurality of angularly-spaced, readily-bendable prongs or fingers 36 which closely engage the outer surface of grom-

4

met 29. Ring portion 34 has an external diameter somewhat greater than that of flange 32 to permit engagement thereof with the end of shell 10 when the parts are assembled and to thus limit the axial movement of grommet 29 and the compression of flange 32 thereby. Preferably, the flange 32 extends for a portion of its length into an enlarged bore of sleeve 33 and against a shoulder 60. The narrowest or thinnest portion of each finger 36 is preferably adjacent ring portion 34, thereby determining the point at which the primary flexing of the finger takes place when the parts are assembled in the manner hereinafter described. Fingers 36 preferably terminate intermediate the ends of grommet 29 when the parts are assembled in order to exert the desired gripping action on the grommet.

In order to insure proper action of the parts during assembly, there is provided around the reduced fingered portion of sleeve 33 a rigid adapter ring 37 having a conical or cone-like bore 38 and a stepped external surface forming a shoulder 39. At its enlarged end the bore 38 may have a cylindrical portion 40 that is just large enough to receive the ends of fingers 36 (Fig. 3) before the latter are bent inwardly (Fig. 2) during the assembly process.

The final action of assembly is effected by means of a nut 41 which is shown as having internal threads cooperable with external threads on shell 10 and an internal shoulder 42 engageable with shoulder 39 on clamping adapter 37. The construction of the parts is such that when the same are loosely assembled, the threads on nut 41 will operatively engage the threads on shell 10. As the nut is then screwed onto the shell there occurs a simultaneous radial and axial compression of grommet 29. The primary initial movement of grommet 29 and adapters 33, 37 is in an axial direction, thus pressing the grommet into compressive face-to-face engagement with insert 11. This axial movement of sleeve adapter 33 is limited by its end-to-end engagement with shell 10 and the axial movement of grommet 29 thereby is likewise limited. The permitted axial movement of the grommet is so chosen as to provide firm face-to-face engagement between the grommet and insert 11 without danger of pushing the latter out of its proper position in shell 10.

After ring 34 moves into engagement with shell 10 continued turning of nut 41 results in continued axial movement of adapter 37 which slides axially along fingers or prongs 36 and bends them inwardly against grommet 29. The latter is thus radially compressed into firm gripping engagement with cables 24, 25 to thereby provide a seal around the cables to prevent the entrance of moisture and at the same time unite the end portions of these cables with the remainder of the parts into a relatively rigid structure which will vibrate as a unit. If, as shown, the ends of fingers 36 terminate short of the outer end of grommet 29, they will bite into the yieldable material of the grommet and effectively prevent it from being moved further in an axial direction in the shell after sleeve 33 engages the shell and during the application of the radial bending pressure to the fingers by continued axial movement of ring 37. During this application of pressure, nut 41 slides angularly relative to adapter 37 and the latter slides axially along fingers 36 so that there is no rotational movement of any of the parts except nut 41. It is of course not harmful if there is some

5

rotational or angular movement of adapter ring 37 on the sleeve 33. In this connection it is preferable that the space between the outer ends of adjacent fingers 36 be sufficiently small to prevent undue bulging of the adapter 29 therebetween and into contact with adapter 37 before the parts are moved into final assembled position. The torque applied to the parts by the turning of nut 41 is sufficiently small so that there is no appreciable danger of the same causing any misalignment of the parts or tilting of the contact members. The parts are preferably so designed as to permit nut 41 to move adapter 37 axially into engagement with the ring portion 34 of adapter 33 to thereby permit tightening of the nut against a rigid stop and thus minimize the danger of the nut becoming loose during use. Thus, in fully assembled position, nut 41 will preferably assume the dotted line position 43 (Fig. 2) and flange 34 will be firmly clamped between adapter ring 37 and the end of shell 40.

In most commercial constructions, the number of conductors, such as cables 24, 25, will usually be in excess of the two herein illustrated by way of example, and there will be a corresponding number of contact members and suitable passages through grommet 29 and insert 11. For the purpose of affording further protection for these bunched cables entering or emerging from the connector unit, additional novel means are provided for clamping the same together beyond the outer compressed end of grommet 29. Said means as shown comprise two diametrically disposed lugs or arms 44 on nut 41, the same being transversely or tangentially bored to loosely receive bolts 45, 46. The latter extend in opposite directions and support a pair of clamping bars 47, 48. Bolt 45 extends loosely through openings in bar 48 and one of lugs 44 and has threaded engagement with bar 47, whereas bolt 46 extends loosely through openings in bar 47 and the other lug 44 and has threaded engagement with bar 48. A cylindrical grommet or sleeve 49 of rubber or other similar material having a passage which is preferably just large enough to loosely receive the flexible cables emerging from grommet 29 is interposed between posts 44, 44 and bars 47, 48. The latter fit between external end flanges 50, 50 on grommet 49 and said posts fit into the slots 51 in said flanges. When bolts 45, 46 are tightened to draw bars 47, 48 closer together and against grommet 49, the latter will be compressed around the emerging cables, such as 24, 25, the pressure applied by each bar being of substantially equal intensity by reason of the floating clamp. The ends of bars 47, 48 are seldom moved into contact with lugs 44 so that the bundled cables are permitted some freedom of movement which is yieldably opposed and hence tends to absorb vibratory movement. If desired, the bolts 45, 46 may have threaded engagement with the same bar 47 or 48. These clamp elements may also be assembled in other ways, the important feature being that the clamp is free to float relative to nut 41 and the cables.

There is thus provided novel apparatus for connecting one or a plurality of electrical conductors by readily detachable plug and socket means wherein novel means are provided for substantially eliminating the heretofore destructive relative vibration of the parts in such fabricated units. Additionally, said novel means operates at the same time to prevent the entrance or accumulation of moisture, which would other-

6

wise tend to create a short circuit between adjacent conductors or contact members, thereby making it practical and safe to assemble a larger number of conductors in a connector unit of given diameter. The novel unit provided is also substantially air-tight so that the same may be effectively used on and in connection with pressure cabins or the like and on amphibious and under-water vehicles or other similar structures. The novel clamping means contemplated is adapted for effecting a predetermined axial compression of the parts as well as radial compression to develop the assembled parts into a solid compact unit. The parts are also of simple construction and so designed as to facilitate proper assembly and disassembly thereof.

In Fig. 4 there is illustrated a modification wherein a rigid sleeve 52 is substituted for fingered sleeve 33. Instead of the fingers or prongs 36 sleeve 52 has merely a relatively thin annular end flange 53 which is bent or turned inwardly to form a tapered or cone-shaped portion. The inner diameter of the ring portion 54 is about the same as the smaller outside diameter of grommet 29 which it surrounds. Thus, when sleeve 52 is forced onto the grommet 29 to the operative position illustrated in Fig. 4, flange 53 will produce an annular indentation or groove in the resilient material of the grommet, just as do the outer ends of fingers 36 (Fig. 2), and thereby resist any axial movement of the grommet through the ring, especially in the downward direction, as viewed in the drawing. It will thus be seen that when sleeve 52 takes the place of sleeve 33 in the assembly of Fig. 2, adapter 37 will make direct contact with and slide axially relative to the reduced end of grommet 29 which extends through and beyond said sleeve. Although adapter 37 will thus tend to push the grommet axially through sleeve 52 when nut 41 is screwed in place, such axial movement will be prevented by the biting action of flange 53 in the same manner as such movement is prevented by the biting action of prongs 36. If desired, flange 53 may extend at a sharper angle and even at right angles to the longitudinal axis and into a pre-formed groove in the grommet.

Although only a limited number of embodiments of the invention are illustrated in the accompanying drawings and described in the foregoing specification, it is to be expressly understood that the invention is not limited thereto. For example, the specific construction of sleeve adapter 33 may be varied rather widely, particularly insofar as the fingers 36 are concerned. The latter may be greater or less in number and may be of different shapes than those illustrated. The slots between the fingers may be of uniform or varying widths and may extend at an angle to the axis, such as spirally. It is not essential that the contact carrying insert be unitary and of resilient material or that the contact members be of the particular construction illustrated. If desired, the shell may be provided with suitable flange means whereby the same could be secured to a wall or bulkhead and a cooperating land and groove may be provided in the insert and shell for angularly orienting one with respect to the other. Various other changes may be made in the design and arrangement of parts illustrated as well as in the materials herein suggested without reparting from the spirit and scope of the invention, as will now be apparent to those skilled in the art.

What is claimed is:

1. In electrical apparatus of the class described, a rigid shell, a contact carrying insert supported in said shell, at least one contact member supported in said insert, an electrical conductor connected to said contact member, a resilient grommet closely surrounding said conductor and having end-to-end engagement with said insert, a sleeve closely surrounding said grommet, said sleeve comprising a ring portion engaging an external shoulder on said grommet and a plurality of flexible, angularly-spaced fingers projecting from the ring portion away from the shell, an adapter ring having a cone-like internal surface engaging said fingers, and a nut threadedly engaged with the shell and operatively engaging said adapter ring, whereby, when the nut is screwed onto said shell, said adapter ring and sleeve may be moved axially thereby toward said shell to thus axially and radially compress said grommet until the flange on the ring portion of the sleeve is clamped between said shell and adapter ring.

2. Apparatus as defined in claim 1 wherein the shell extends beyond the end of said insert and an external flange on the grommet extends into said shell and is compressively interposed between said insert and said sleeve.

3. Apparatus as defined in claim 1 wherein the nut engages an external shoulder on said adapter ring for imparting axial movement to the latter.

4. Apparatus as defined in claim 1 wherein the free ends of the flexible fingers terminate intermediate the ends of the grommet, whereby said free ends bite into the surface of the grommet when bent into compressive engagement therewith.

5. In electrical apparatus, supporting means having at least one electrical conductor emerging therefrom, a resilient grommet closely surrounding said conductor, and means for axially compressing said grommet into compressive end-to-end engagement with said supporting means and for simultaneously radially compressing an end portion of the grommet into compressive circumferential engagement with said conductor, said compressing means comprising a sleeve surrounding said grommet intermediate the ends of the latter and having bendable prongs circumferentially arranged around said grommet and means for bending and holding the free ends of said prongs inwardly toward the longitudinal axis of said grommet, said means for bending the prongs including means operatively engageable with said supporting means for moving said sleeve axially to effect said compressive end-to-end engagement.

6. Apparatus as defined in claim 5 wherein the means for bending the prongs comprises an adapter ring surrounding the latter, said adapter ring

having a cone-like internal surface and the free ends of said prongs extending into said adapter ring from the end of the latter having the largest bore diameter.

7. Apparatus as defined in claim 6 wherein said means operatively engageable with said supporting means includes a nut operatively engageable with said supporting means and said adapter ring for moving the latter axially relative to said sleeve and supporting means.

8. In apparatus of the class described, supporting means including an externally threaded member, a nut threaded onto said member, a sleeve having a ring portion slidably fitting into said nut and a plurality of angularly spaced prongs extending axially from said ring portion, and an adapter ring slidably fitting into said nut and having a cone-like internal surface engaging said prongs, the free ends of said prongs engaging the surface of the small diameter portion of the bore of said adapter ring and said nut being engageable with said adapter ring to move the latter axially onto said prongs and thereby bend the latter inwardly and to move said sleeve axially into end-to-end engagement with said supporting means when said nut is screwed onto said support.

9. Apparatus as defined in claim 8 comprising a resilient grommet extending through said sleeve and being radially compressed by said unbent prongs into compressive circumferential engagement with a conductor passing therethrough.

10. Apparatus as defined in claim 8 comprising a resilient grommet extending through said sleeve and having a portion interposed between said sleeve and supporting means, said interposed portion being held under axial compression against said supporting means by said sleeve, adapter ring and nut.

WALTER F. HENNESSEY, JR.
GEORGE J. SWANSON.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
Re. 17,880	Stoeltzlen	Nov. 25, 1930
885,836	Bullock, Jr.	Apr. 28, 1908
1,376,066	Benjamin	Apr. 26, 1921
1,794,505	Andersen	Mar. 3, 1931
2,035,947	Davis, Jr.	Mar. 31, 1936
2,226,610	Heyman	Dec. 31, 1940
2,276,557	Woodhead	Mar. 17, 1942
2,281,654	Wulle et al.	May 5, 1942
2,291,793	Chandler	Aug. 4, 1942
2,371,551	Schmitt	Mar. 13, 1945
2,443,654	Else et al.	June 22, 1948

FOREIGN PATENTS

Number	Country	Date
235,644	Switzerland	Apr. 16, 1945