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COUPLING DEVICE WITH DEFORMABLE GRIPPER FINGERS FOR CONNECTING TELESCOPING MEMBERS

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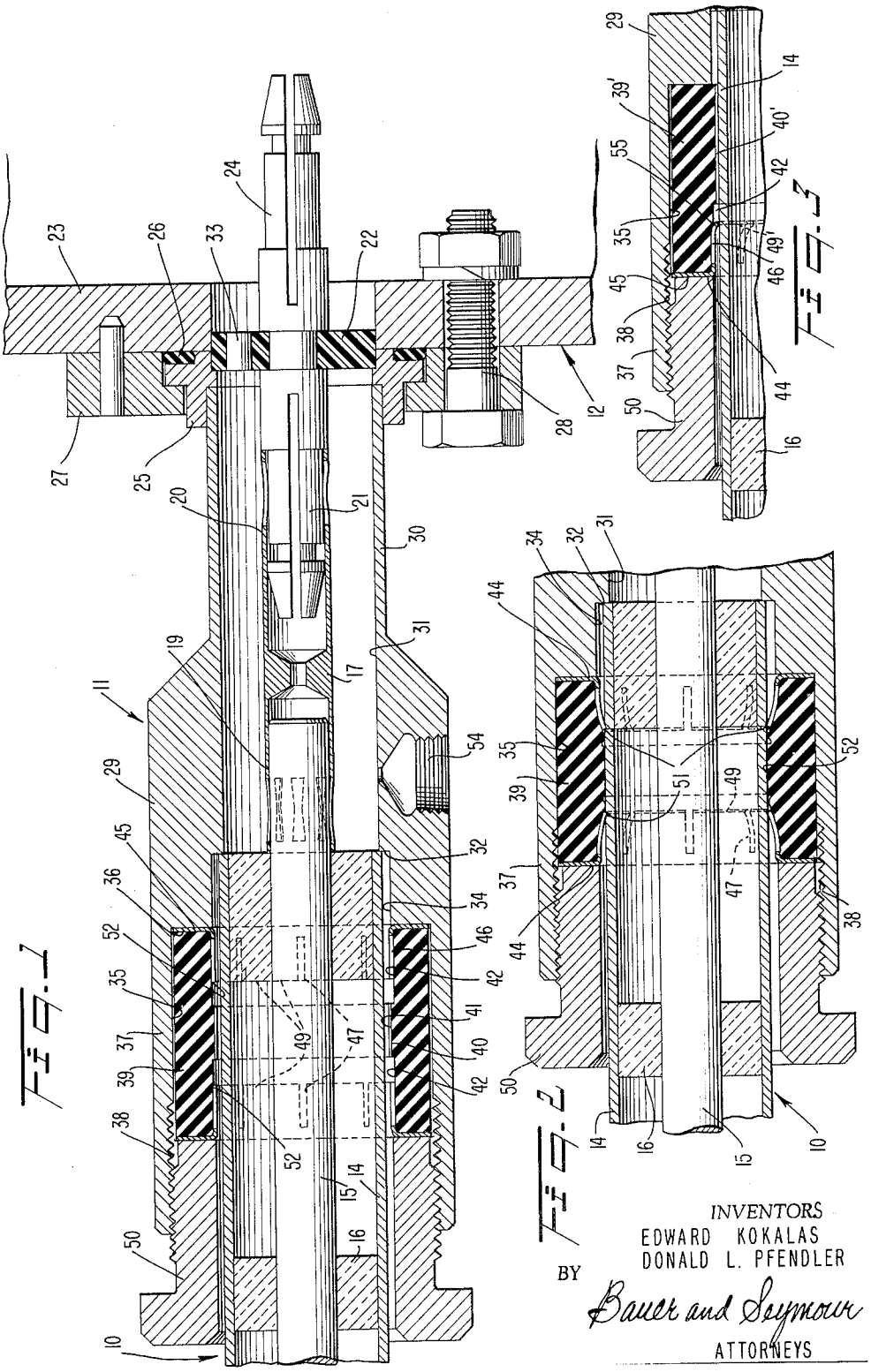

FIG. 1



FIG. 3



FIG. 2

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# COUPLING DEVICE WITH DEFORMABLE GRIPPER FINGERS FOR CONNECTING TELESCOPING MEMBERS

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9 Claims. (Cl. 174—75)

This invention relates to a coupling device for connecting an elongated cylindrical article, such as a sheathed cable, to a fitting or like termination. In the illustrative preferred embodiments, the device grips, electrically connects the sheath of the cable to the housing of the fitting, and establishes a seal between the sheath and the housing.

The invention has among its objects the provision of a novel grip for elongated cylindrical articles.

Another object of the invention resides in the provision of a novel grip for sheathed cables, such as coaxial cables.

Yet another object of the invention lies in the provision of a novel gripping device for use with a cable having an electrically conductive sheath, such device electrically and mechanically connecting the sheath of the cable to the housing of a fitting or other terminal.

A still further object of the invention lies in the provision of a gripping device of the type indicated which provides a gas-tight seal between a fitting and an elongated cylindrical article secured thereto.

A further object of the invention lies in the provision of a novel gripping device of the type indicated which is particularly characterized by the economy of its manufacture, the ease with which it is used, and the security of its holding of an elongated cylindrical article, the security of electrical connection established thereby between the article and the housing of a fitting at which the gripping device is employed, and the security of gas seal established thereby between the article and the fitting.

The above and further objects and novel features of the invention will more fully appear from the following 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 a view in longitudinal axial section through an assembly of a fitting, a fragmentarily shown closure to which the fitting is attached, and a coaxial cable, the fitting incorporating a first illustrative embodiment of cable grip which is shown in a preliminary, as yet untightened condition, certain of the parts being shown in elevation;

FIG. 2 is a fragmentary view in axial section of a part of the assembly of FIG. 1, the cable grip being shown tightened into operative relationship with the cable sheath, the central conductor of the cable being shown in elevation; and

FIG. 3 is a view similar to the upper portion of FIG. 2 but showing a second embodiment of cable grip in untightened relationship with the sheath of the coaxial cable.

The coupling device of the invention is illustrated, by way of example, in connection with its use in a terminal fitting for a coaxial cable. It is to be understood, however, that the device of the invention is capable of use to advantage in other applications wtih various elongated cylindrical articles such as rods and tubes when it is desired to grip the article at a fitting, to mechanically and electrically connect the article to the fitting, or to grip, electrically connect, and seal the article to the fitting. The illustrative coaxial cable has the tubular electrically conductive sheath thereof mechanically gripped, electrically connected, and sealed to a terminal fitting.



There are a number of requirements which a successful connection between a coaxial cable and a terminal fitting must meet. The connection should provide secure mechanical holding of the cable by the fitting, so as to prevent any movement of the cable with respect to the fitting. Further, the shielding of the central conductor should not be interrupted at such connection, and so a second electrical connection must be established between the electrically conductive sheath of the cable and the metal shell or housing of the fitting. The gripping of the cable by the gripping device must entail no disturbing of the impedance match between the sheath of the cable and the inner central conductor thereof. Accordingly, the gripping device must not distort the inside diameter of the sheath. When the coaxial cable is of the gas filled type, it is necessary to establish a seal between the fitting and the sheath of the cable. It is also desirable that the space around the central conductor in the housing of the fitting be sealed so that such space and the space within the closure to which the fitting is attached may likewise be filled with gas under pressure.

Turning now to the drawings, the coaxial cable with which the gripping or coupling device of the invention is shown employed is designated generally by the reference character 10. The fitting is designated generally by the character 11 and the closure to which the fitting is attached and sealed is designated 12. The coaxial cable 10 has an impervious electrically conductive sheath 14 which is in the form of a tube. Sheath 14 may be made, for example, of aluminum. Accurately disposed axially of sheath 14 is a central inner conductor 15 in the form of a tube, rod or wire. Conductor 15 is held in axial position by suitable insulating spacer means 16 of any well known type interposed between the conductor 15 and the sheath 14. Such cable may be semi-rigid in character, and capable of being bent only in curves of large radius.

Within the fitting 11, which is made of strong electrically conductive material such as aluminum, and disposed coaxially of the passage therethrough there is provided a double ended socket connector 17 which electrically connects the central conductor 15 to a centrally disposed conductor, which may be a pin contact 21, located outwardly of closure 12, contact 21 being shown integral with a further contact 24 disposed within the closure and adapted to be connected to a circuit element (not shown) within the closure. Connector 17 has a first sleeve portion 19 which is telescoped over and makes secure electrical contact with the end of conductor 15. Sleeve 19 may be longitudinally slotted at zones spaced peripherally thereabout, as indicated in dotted lines in FIG. 1, and indented between the slots to thereby provide spring fingers which resiliently engage conductor 15 in a known manner. The other end of connector 17 is provided with a sleeve 20 within which the contact 21, which is longitudinally split to provide resilient contact fingers, is received.

Pin contacts 21 and 24 are supported on an electrically

insulating disc 22 which is disposed within a seat provided in an opening through the sidewall 23 of closure 12. An inner flanged ring 25 partially overlies insulating disc 22 as shown, ring 25 being sealed to the sidewall 23 of the closure by a sealing O-ring 26 which is disposed in an annular seat in ring 25 and between the ring and the sidewall 23 of the closure. Ring 25 is secured in place by an outer flanged ring 27 which is secured to the wall of the closure by a plurality of bolts 28 (one shown).

The fitting 11 has a thick walled annular portion 29, portion 29 being connected by an outwardly frusto-conical zone to a rear thin walled tubular portion 30. Portions 29 and 30 have a circular cylindrical longitudinal passage 31 therethrough, such passage having a diameter which is at least slightly less than the outer diameter of sheath 14 of the coaxial cable. The rear end of portion 30 of the fitting is received within an annular seat in a ring 25 as shown, parts 30 and 25 being secured and sealed together as by welding. The annular space between the rear end of conductor 15 and the prolongation thereof provided by the connector 17 and the pin contact 21 and the wall of passage 31 is thus sealed from the atmosphere by members 25, 26, and the sidewall 23 of closure 12. Such space, however, in the embodiment shown, is placed in free communication with the space within the sealed closure 12 by one or more passages 33 through insulating disc 22.

Intermediate the length of portion 29 of the housing of fitting 11 there is provided a counterbore 34 which provides an annular transverse shoulder 32 at one end thereof. Counterbore 34 at least slightly exceeds in diameter the outer diameter of sheath 14 of the coaxial cable so that the terminal end of the sheath may be received within the seat provided by the counterbore as shown. The open end of the sheath abuts shoulder 32. Forwardly of counterbore 34 there is a second larger diametered counterbore 35 in the housing of the fitting, counterbores 34 and 35 being connected by a transverse annular shoulder 36. The relatively thin walled portion of the housing of the fitting at the zone of counterbore 35 is designated 37. The outer or forward end of portion 37 is provided with internal threads 38 as shown.

Counterbore 35 forms an axially extended seat which receives a rubber-like gland 39 of substantial radial thickness. Gland 39 has a relaxed outer diameter which is slightly less than the inner diameter of seat 35. The gland 39 may be of symmetrical shape in an axial direction, and may, but does not necessarily, have a central annular portion 40 of relatively less inner diameter and two annular zones 42 at the opposite ends thereof of relatively greater inner diameter. The relaxed inner diameter of central zone 40, as shown, somewhat exceeds the outer diameter of sheath 14 of the coaxial cable, so that the end of the cable may be freely passed through the gland when the gland is in its relaxed condition.

Disposed within the seat in reversed positions in an axial direction are two clamping inserts 44, one insert being disposed at one end of the seat and the other insert being disposed at the other end of the seat. Each insert has a transversely disposed radially outwardly extending flange 45 on one end thereof, the flange being of such outer diameter as to be substantially accurately received within the seat 35. Extending axially from the inner edge of flange 45 and disposed within the respective annular zone 42 of gland 39 is a sleeve 46 which overlies the sheath 14 of the cable. Each of sleeves 46 is provided with a plurality of peripherally spaced axially extending slots 47 therein, the slots extending from the free edge of the sleeve to a zone adjacent the junction between the sleeve and the flange 45. Such slots form the sleeve into a plurality of similar axially extending fingers 49 which closely overlie but are suitably spaced from the sheath 14 when the gripping and sealing gland 39 is in a relaxed condition, as shown in FIG. 1.



The gland 39 and the gripping or locking inserts 44 are deformed into the condition shown in FIG. 2 by axial compression of gland 39. An internal nut 50 through which the cable 10 extends has threaded engagement with the threads 38 in the outer end of portion 37 of the housing. When nut 50 is turned so as to advance the nut to the right (FIGS. 1 and 2), gland 39 is subjected to a compressive force in an axial direction. Since the rubber-like material of which the gland is made is incompressible, the gland is resiliently deformed into substantially the shape shown in FIG. 2, wherein it fills substantially all the space remaining within seat 35 between shoulder 36 and the inner end of nut 50, between the fingers 49 and around the annular zone 52 of sheath 14 which directly confronts the gland. As a result, when nut 50 is screwed with sufficient force into the housing, the fingers 49 are strongly thrust inwardly so that the inner ends 51 of the fingers, which may have sharp corners or edges, forcibly engage and at least slightly bite into the outer surface of the sheath 14 of the cable to mechanically hold the same against either axial or angular movement relative to fitting 11 without appreciably distorting the inside diameter of the sheath. As a result, the cable 10 is strongly held mechanically from withdrawal from the fitting. Additionally, a gas tight seal is formed between the fitting and cable 10 at zone 52 of the latter, and secure electrical connection is established between sheath 14 of the cable and the housing of the fitting. In the embodiment shown, such connection is effected by both gripping inserts 44, the flange 45 on the right-hand gripping insert 44 being forcibly thrust against shoulder 36 of fitting 11, and the flange on the left-hand gripping insert being forcibly engaged by the inner end surface of nut 50.

Gland 39 may be made, for example, of natural or synthetic rubber; a rubber having a durometer rating of from 70 to 75 is satisfactory for such purpose. The gripping inserts 44 may be made of hard, strong, and preferably resilient material, such material being electrically conductive when it is desired securely electrically to connect the sheath of the cable to the fitting. Inserts 44 may be made, for example, of hard copper alloy or of spring steel stock, heat treated after forming.

The coupling device of the invention may be assembled in the manner shown in FIG. 1 prior to connection of the cable 10 to the fitting. Thus with the parts in the condition shown in FIG. 1 the end of the cable may be thrust freely inwardly through nut 50, through the gland 39 and into end engagement with the shoulder 32. Following this, the nut 50 is advanced in a tightening direction, as above explained, to bring the parts to the condition of FIG. 2 with gland 39 making sealing engagement with gland sheath 14 and housing portion 37. Should it be desired to remove the cable 10 from the fitting, it is necessary only to loosen nut 50, whereupon the parts regain substantially the condition shown in FIG. 1 so that the cable may be pulled axially from the fitting. When inserts 44 are made of spring material, they tend more fully to regain their original relaxed condition, so that the spring fingers thereof tend not to interfere with withdrawal of the cable when the nut is loosened.

After the closure 12 has been completed and connected to the end of the fitting as shown, the space within the closure, the fitting and the cable may be filled with gas under pressure, whereby to provide a desired atmosphere within the coupled elements to prevent the parts therewithin from oxidation, to prevent the entrance of moisture, and so forth. This may be done by connecting such space to a source of gas under pressure through an opening 54.

In FIG. 3 there is shown a second embodiment of the gripping and sealing device of the invention. Parts in FIG. 3 which are the same as those in FIGS. 1 and 2 are designated by the same reference characters. The

device of FIG. 3 differs from the first described embodiment by the omission of the gripping ring 44 at the inner end of seat 35, and by the omission of the annular zone of greater diameter in the inner sidewall of the gland at such end of the seat. Thus the gland 39' of FIG. 3 has an elongated circular cylindrical inner surface 40', which closely confronts the outer surface of sheath 14, and which extends from the inner end of annular zone 42 to the other end of the gland.

When nut 50 is tightened, gland 39 is deformed, as in the first described embodiment, causing the free ends of the fingers 49' to be thrust inwardly into forcible biting engagement with the outer surface of sheath 14 of the cable. In some installations it may be desirable to form the ends of fingers 40' sharply inwardly, as shown at 55, to increase the biting effect thereof against the sheath. The circular cylindrical inner wall 40' of the gland is thrust inwardly into firm sealing engagement throughout its length with sheath 14 and the outer periphery of the gland assumes a sealing engagement with the wall of counterbore 35. The gripping or biting member 44, as before, serves not only to form a secure mechanical connection between the cable and the fitting, but when such member 44 is made of metal, serves also electrically to connect the sheath of the cable to the fitting.

Although only a limited number of embodiments of the invention have been illustrated in the accompanying drawings and described in the foregoing specification, it is to be expressly understood that various changes may be made. For example, the right-hand end of fitting 11 may be like the left-hand end, as shown in FIG. 1, to make connection with another sheathed cable instead of closure 12. Also, the central zone 40 or 40' of gland or grommet 39 or 39' may have the same inside diameter as the zones 42, if desired, and the ends of fingers 49 in the embodiment of FIG. 1 may be curved inwardly in the same manner as in FIG. 3. Changes may also be made in the relative dimensions of the parts, materials used, and the like, as well as the suggested manner of use of the apparatus of the invention without departing from the spirit and scope of the invention as will now be apparent to those skilled in the art.

What is claimed is:

1. A device gripping an elongated member and securing the member to a housing having a passage into which the member extends, comprising an annular seat in the housing surrounding the member, an annular rubber-like gland of substantial radial thickness telescoped over the member, said gland in its relaxed condition having a sliding fit within the seat in the housing and being appreciably spaced from the periphery of said member, a cylindrical sleeve fitted within one end of said gland in radially spaced relation to said member and having a plurality of axially directed fingers circumferentially spaced around the inner surface of the gland, the fingers being made of strong hard material and lying between the gland and the member, and means applying axial compressive pressure to the rubber-like gland, thereby expanding said gland radially inwardly and forcing only the free ends of the fingers inwardly into gripping and biting engagement with the outer surface of the member.

2. A device as claimed in claim 1, wherein the sleeve and fingers are parts of an insert mounted within the seat, the insert having a continuous outwardly directed annular flange at one end thereof overlying an end of the gland.

3. A device as claimed in claim 2, wherein the flange of the insert is coaxial of the annular seat and fits accurately within the seat so as substantially to center the insert in the seat, and wherein when the gland is in its relaxed condition the fingers of the insert are appreciably spaced radially outwardly of the member.

4. A device as claimed in claim 2, comprising a second insert similar to the first recited insert disposed in axially reversed position in the seat at the other end of the gland.

5. A device as claimed in claim 2, wherein the inner wall of the gland in its relaxed condition has a first annular zone of one diameter which receives the sleeve and fingers of the insert and a second annular zone of smaller diameter which relatively closely approaches but somewhat exceeds the outer diameter of said member, whereby said second annular zone of the gland is radially inwardly expanded into sealing engagement with said member by said axially compressive pressure.

6. A device as defined in claim 1 wherein said fingers have the free ends thereof pre-bent sharply toward said elongated member.

7. In a coupling device, a member having a passage therein comprising an enlarged counterbore forming an internal annular shoulder in the passage, an elongated cylindrical element extending into said passage, a resilient tubular gland of substantially incompressible rubber-like material slidably fitting into said counterbore around said element, the relaxed inner diameter of said gland being appreciably greater than the outer diameter of said element and one end of the gland abutting and having a radial thickness at least approximately the same as the radial width of said shoulder, a ring-like hard metallic insert comprising an annular radially extending flange extending across the other end of said gland, said insert further comprising a rigid sleeve portion slidably extending into said other end of the gland in appreciable radially spaced relation to said element and a plurality of flexible fingers extending axially from said sleeve portion within the gland, and means comprising a tubular portion extending into the housing around said element into engagement with said flange, the radial thickness of said tubular portion being at least approximately the same as the radial thickness of said other end of the gland, said tubular portion applying axially directed pressure to said gland, thereby flowing the latter radially inwardly into sealing engagement with said element and forcing the free ends of said fingers into biting engagement with said element to hold the latter against withdrawal from said passage.

8. A coupling device as defined in claim 7 comprising a second ring-like hard metallic insert having an annular radially extending flange between said shoulder and said one end of the gland, said second insert further having a rigid sleeve portion extending into said one end of the gland in appreciable radially spaced relation to said element and a plurality of flexible fingers extending axially from said sleeve portion along the inner surface of the gland, the radially inward flow of the gland effected by the application of axially directed pressure thereto by said tubular portion forcing the free ends of the fingers of said second insert into biting engagement with the peripheral surface of said element to hold the latter against further insertion into said passage.

9. A fitting connection to a coaxial cable having an elongated cylindrical sheath and a central conductor, said fitting having a housing with a passage therein into which the cable extends, the fitting having a device gripping the sheath of the cable and securing it to the housing of the fitting, said device comprising an annular seat in the housing surrounding the sheath, an annular rubber-like gland of substantial radial thickness telescoped over the sheath, said gland in relaxed condition having a sliding fit within the seat in the housing and being appreciably radially spaced from the periphery of said sheath, a rigid cylindrical sleeve closely fitted within one end of said gland in radially spaced relation to said sheath and having a plurality of axially directed fingers spaced around the sheath, the fingers being made of strong hard material and lying between the gland and the sheath in radially spaced relation to the sheath when the gland is relaxed, and means deforming the rubber-like gland forcing only the free

ends of the fingers into biting engagement with the sheath and an annular portion of the gland inwardly into gripping engagement with the outer surface of the sheath.


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