

[54] COUPLER DEVICE FOR TUBING ENDS
PROVIDING MECHANICAL AND
ELECTRICAL CONNECTIONS THEREWITH

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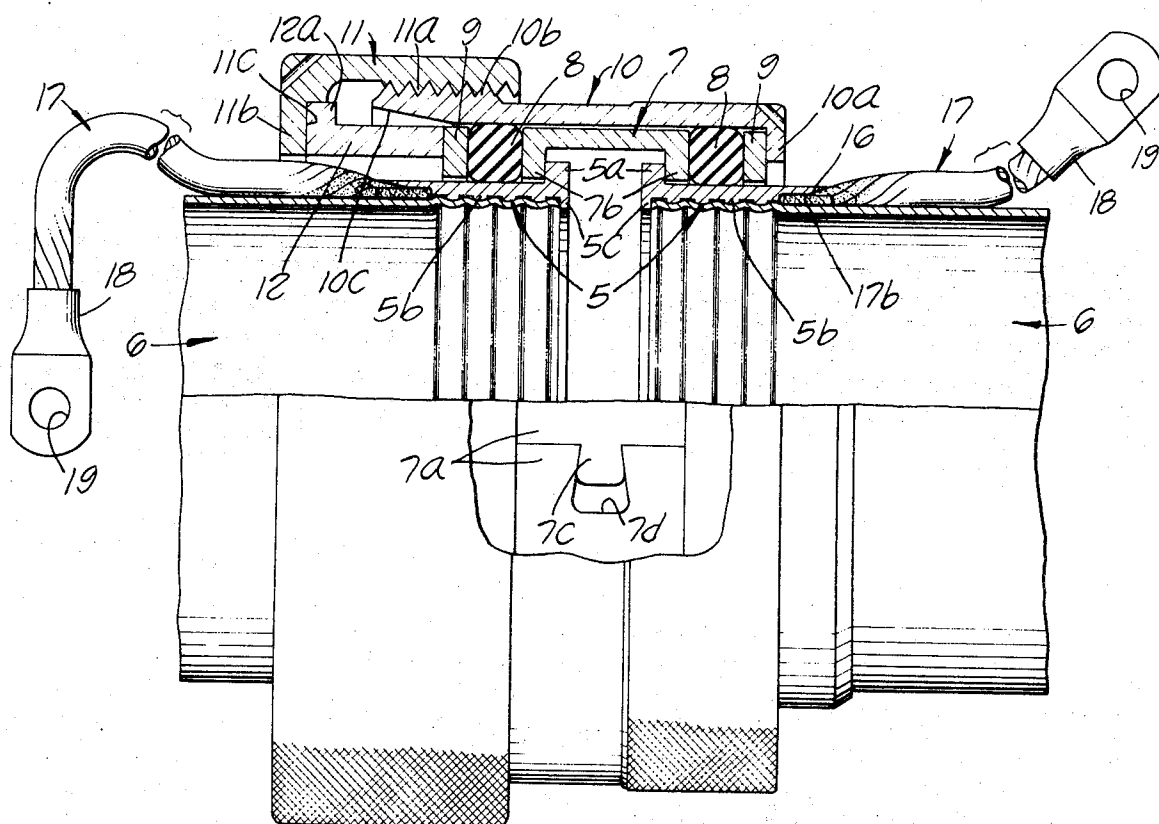
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[57] ABSTRACT

A unique coupler device for effecting mechanical and electrical connections with the coupled ends of fluid conducting tubing, which utilizes a flanged ferrule swaged to each coupled end of the tubing, with the ferrules in each case serving the double purpose of a mechanical connecting component of the coupler, and a permanent securement component for anchoring one end of an electric conductor cable to the tubing end to provide an electrical connection with the tubing.

3 Claims, 5 Drawing Figures



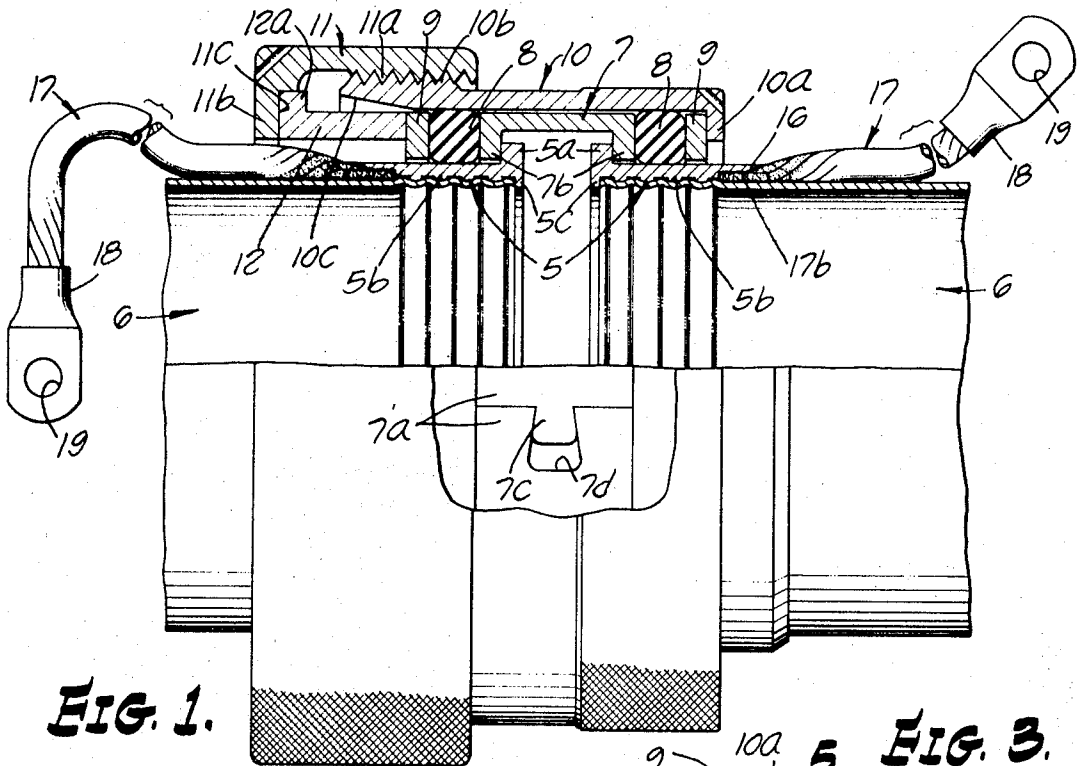


FIG. 1.

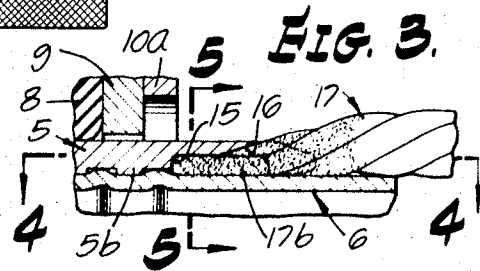


FIG. 3.

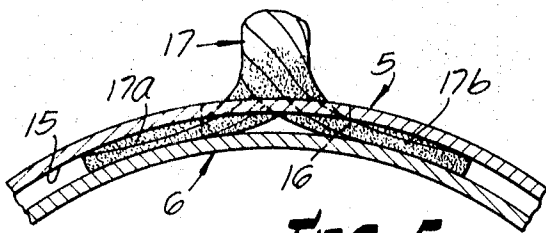


FIG. 5.

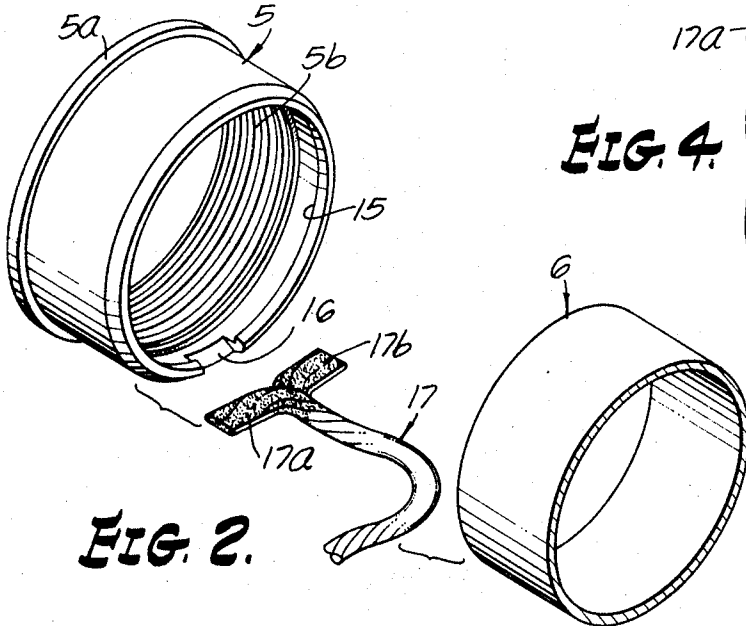
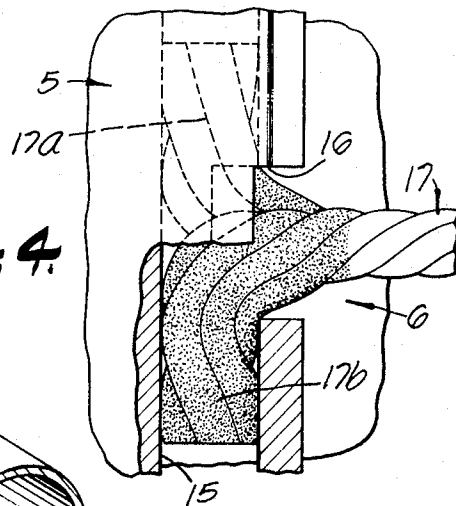


FIG. 2.

FIG. 4.



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COUPLER DEVICE FOR TUBING ENDS PROVIDING MECHANICAL AND ELECTRICAL CONNECTIONS THEREWITH

BACKGROUND OF THE INVENTION

The present invention relates generally to the field of tubing couplers.

It is a well-known physical phenomenon that static electricity can be created in tubing, ducts, and connection lines by the flow of fluid therethrough, and that when the electrostatic charge becomes sufficiently large it will be dissipated by moving to a ground or lower charged area. When the two areas are physically separated by means of an intervening gap, the discharge of the electrostatic charge from the point of high potential to a point of low potential can result in the creation of a spark which, under proper circumstances or in certain environments, can be a source of potential danger.

In order to guard against such contingencies and provide safe operating conditions, it is the usual practice as in the case of aircraft fluid lines carrying flammable fluids to ground the fluid carrying tubing or piping to aircraft frame structures by means of electrical conductors in order to prevent the occurrence of spark discharges which could ignite the fluid vapors. These grounding conductors are usually referred to as "bonding jumpers" and consist of a braided copper or aluminum wire or cable assembly in which swaged connection terminals are provided at each end, these terminals having bolt or screw receiving openings therein. The tubing is generally bonded at intervals of approximately two feet. Heretofore, the bonding jumpers have been attached to the tubing by means of a circular clamp utilizing a screw, nut, and washers. Before the clamp is applied, this method of bonding necessitated that the tube be stripped of surface finish in order to assure proper contact, and then painted after the clamp has been applied in order to prevent future corrosion. Such bonding methods and procedures added not only undesirable weight to the aircraft, but were expensive for the reason that they entailed the expenditure of additional labor costs.

In the present invention, the problems and disadvantages of the conventional procedures as explained above have been overcome and replaced by providing a unique tubing coupler which not only provides for mechanically connecting the fluid carrying tubes together, but also provides for the electrical connection of bonding cables to the mechanically connected tubing ends. By utilizing the end ferrules on the connected tube ends, electric cables or conductors are permanently secured to the tubing in such a way as to eliminate the use of screw clamps, as well as the additional labor required for treating the tubing and other parts in order to prevent future corrosion.

SUMMARY OF THE INVENTION

The invention relates generally to coupler devices for forming flexible and sealed mechanical interconnections between the adjacent ends of tubing sections, and is more particularly concerned with the additional provision in such coupler devices of electrical conductor connections with the coupled ends of the tubing sections.

Having in mind the inherent problems and disadvantages with respect to the presently known methods for

providing electrical bonding or grounding connections to fluid conducting lines, particularly for flammable fluids, the present invention has for one object the provision of an improved coupler device for tubing ends, which is constructed and arranged to provide a positive sealed flexible joint connection between the tubing ends, and at the same time provide permanently connected electrical conductor connections at each of the mechanically connected tubing ends.

A further object is to provide in association with a tubing coupler device, improved means for permanently securing an electric cable to a tubing by means of a swaged end ferrule on the connected tubing end.

Another object of the herein described invention resides in the provision of unique means for mechanically and electrically connecting a conducting cable to a tubing of a fluid flow line.

Still another object is to provide an article of manufacture in the form of a tubing section with a ferruled end which serves as a component for electrically connecting a cable conductor to the tubing.

Further objects and advantages of the invention will be brought out in the following part of the specification, wherein detailed description is for the purpose of fully disclosing a preferred embodiment of the invention without placing limitations thereon.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring to the accompanying drawings, which are for illustrative purposes only:

FIG. 1 is a fragmentary longitudinal sectional view partly in elevation of a coupler device embodying the present invention and providing mechanical and electrical connections with the ends of connected tubing sections;

FIG. 2 is a fragmentary exploded perspective view showing the elements comprising the connecting components for effecting an electrical connection of a cable with a tubing, according to the present invention;

FIG. 3 is a fragmentary sectional view of the components shown in FIG. 2, in assembled relation;

FIG. 4 is a fragmentary sectional view of the assembled components, taken substantially on line 4—4 of FIG. 3; and

FIG. 5 is a transverse fragmentary sectional view of the same, taken substantially on line 5—5 of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring more specifically to the drawings, for illustrative purposes, the invention is shown in FIG. 1 as comprising generally a coupler device for mechanically connecting a pair of rigid and flanged ferrules 5—5 adapted to be fixed on the ends of tubing members 6—6, respectively, which are to be coupled together. These ferrules make it unnecessary to form beads adjacent the tubing ends, and provide stable anchoring base and sealing surfaces on which an annular retainer 7, a pair of sealing rings 8—8, a pair of split washers 9—9, an annular coupling body structure 10, and a nut unit 11 may be assembled to form a flexible and effectively sealed joint.

As here shown, each ferrule 5 is provided at one end with an annular flange 5a extended radially outwardly therefrom, and interiorly with a roughened or grooved surface as at 5b to form a bond with the material of the tubing upon the swaging of the latter to the ferrule.

This may be accomplished with the aid of a suitable swaging tool, not shown, in order to secure a ferrule on an associated tubing end. An inwardly directed flange 5c, opposite the flange 5a on each ferrule, acts as a stop for the end of the tubing to aid in positioning the ferrule for swaging.

The annular retainer 7 is formed as here shown of two sections 7a—7a, each provided with marginal flanges 7b—7b extended radially inwardly therefrom. At the ends of the sections are dove-tailed tongue and slot elements 7c and 7d which are cooperable for locking the sections together so as to form an annulus around the ferrules with the flanges 5a—5a on the ferrules disposed between and axially movable relative to the flanges 7b—7b on the retainer. With this arrangement, the ferrules and tubing ends are capable of appreciable relative axial movement while being securely held by the retainer against being pulled apart.

In the preferred embodiment of the invention, the coupler has a body 10 in the form of a cylindrical sleeve open at both ends and having at one end an annular flange 10a extending radially inwardly therefrom. At its other end, the body 10 is formed exteriorly with screw threads 10b. The relative dimensions of the body 10 and the ferrules 5 are such that in assembling the coupler the body may be moved freely axially over either of the ferrules; for example, so as to occupy a position surrounding the tubing ends that are to be connected.

An annular nut unit 11, as here shown, is provided adjacent one end with internal screw threads 11a and at the opposite end with a flange 11b. This flange extends radially inwardly and is provided on its inner face with a recess 11c in which is press fitted one end of a cylindrical member or sleeve 12 having a flanged end 12a in the recess 11c so that the sleeve is held concentric with the wall of the nut in spaced relation thereto. The relative dimensions of the ferrules 5—5 and the nut unit including the inner sleeve 12 are such that the nut unit may be moved axially over either of the flanged ferrules.

With reference to FIG. 1, it will be apparent that the sealing rings 8—8 are of a size such that the outer peripheries thereof project radially outwardly beyond the outer peripheries of the washers 9—9 and the retainer 7. Accordingly, the coupler body 10 has an internal diameter such that when the body is moved axially over the retainer 7 and engages the outer peripheries of the sealing rings, the rings will be radially compressed into pre-sealing engagement with the opposed surfaces of the body 10 and ferrules 5—5. To facilitate the axial sliding of the body 10 over the sealing rings 8 and the retainer 7 so that the rings will be radially compressed, one end of the bore through the body 10 is flared by providing a bevel as indicated at 10c.

After the body 10 has been positioned over the sealing rings 8 and retainer 7 so that the flange 10a of the body is close to or abuts the adjacent washer 9, the nut unit 11 is moved axially toward the body 10 and threaded thereon. This threading of the nut unit 11 will cause the inner member or sleeve 12 to abut and forcibly press against the adjacent washer 9 as the nut unit is moved axially. The flange 10a on the body 10 and the inner sleeve 12 will coact as the coupler is axially contracted to move the washers so as to apply an axial force against the sealing rings and thus cause them to be compressed into effective sealing contact with the surfaces of the flanges 7b—7b, washers 9—9, body 10,

and ferrules 5—5 opposed thereto. With this arrangement the desired loading of the sealing rings to assure an effective sealing thereof may be controlled by simply hand torquing the nut unit 11, it not being required that a wrench be applied to the nut in order to properly assemble the connector or to load the sealing rings to assure effective sealing.

It is significant to note that the sealing rings may be substantially deformed axially and forced into pressure sealing contact with the ferrules, but radial deformation of the tubing end itself is prevented. Moreover, due to this construction higher forces may be applied to the seal ring causing maximum storage of energy for expansion upon variation in the relationship between the surfaces with which the seal rings are engaged as may be caused by angular misalignment of the coupler.

The coupler device structure as thus far described provides a mechanical interconnection between the adjacent ends of fluid conducting tubing. The details of the means for effecting electrical connection of cables to the tubings by means of the connector device will now be described in detail.

As clearly shown in FIG. 2, the ferrule 5 at its end opposite the annular flange 5a is internally provided with a circumferentially extending groove 15 which communicates at one point with a side entrance slot 16 in the groove wall.

Electrical connection is made by means of a bonding jumper cable 17 which is shown in this case as being of the multiple twisted strand type, and specifically as having seven twisted strands. The outer end of the cable is connected to a swaged terminal connector 18 (FIG. 1) of conventional construction with the usual hole or opening 19 for receiving a securing bolt or screw. At its other end, the cable strands are separated to form a four-strand group and a three-strand group, these groups being laterally deflected in opposite direction to form end portions 17a and 17b which cooperate with the adjacent main body portion to form at this end a generally T-shaped structure. As shown, the end portions 17a and 17b are preferably flattened by means of a crimping die. This end of the cable is then coated with an electrically conductive epoxy adhesive to prevent fraying, ravelling and distortion of the cable during subsequent handling and assembly.

The T-shaped cable end is then assembled by first coating the entrance slot 16 and adjacent portions of the groove 15 with the epoxy adhesive so as to form a sealant against contamination, and also to provide a strain relief for the cable. With the T-shaped end assembled so that the end portions 17a and 17b will extend into the groove on opposite sides of the entrance slot 16 which contains the adjacent main cable body, the ferrule is then mounted on the end of the associated tubing by a conventional swaging operation. As thus prepared, the ferrule, tubing and connected cable provide a separate article of manufacture in the form of a subassembly which can be sold as a separate item for replacement or assembly in a distribution system for mechanical interconnection by means of the coupler device as described herein.

From the foregoing description and drawings, it will be clearly evident that the delineated objects and features of the invention will be accomplished.

Various modifications may suggest themselves to those skilled in the art without departing from the spirit of the invention, and hence, it is not wished to be re-

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stricted to the specific form shown or uses mentioned, except to the extent indicated in the appended claims.

I claim:

1. The combination in a coupler for interconnecting the adjacent ends of tubing members in end-to-end axially aligned relation, comprising:

a. a generally tubular body structure including axially movable opposite end sections adapted to respectively receive endwise therein the end portions of tubing members which are to be interconnected;

b. an annular reinforcing member grippingly engaged around the received end portion of each of said tubing members, said reinforcing member comprising a ferrule having an inner circumferentially extending groove in communication with a side entrance slot;

c. abutting means extending between each annular member and its adjacent associated body end section;

d. means operable to axially contract said body struc-

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ture and move said opposite end sections toward each other to mechanically interconnect said tubing members; and

e. an electrical conductor at least at one end of said body structure, said conductor having an inner end extending through said slot and being grippingly anchored in said groove by the adjacent annular member in electrical conducting engagement with the tubing at such end.

2. The combination according to claim 1, wherein the conductor comprises a multiple twisted cable, and in which the end portion of the cable is T-shaped with oppositely extended leg portions of flattened strands positioned in the groove.

3. The combination according to claim 2, wherein an epoxy adhesive is applied to the T-shaped end portion and to adjacent surfaces of the groove, slot and tubing prior to being assembled.

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