

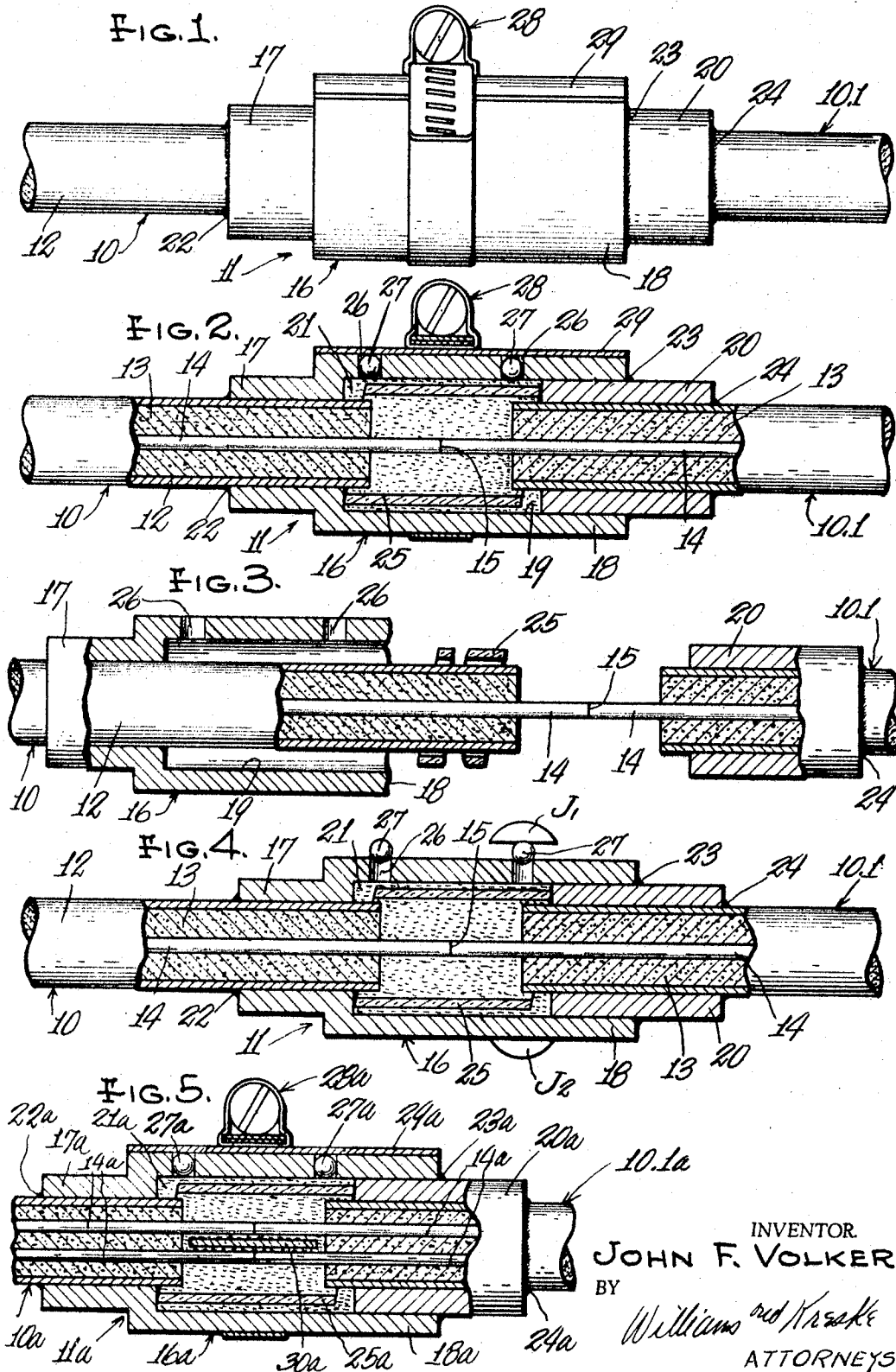
July 29, 1969

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3,458,648

ELECTRICAL CONNECTOR

Filed Oct. 11, 1967



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3,458,648

ELECTRICAL CONNECTOR

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Filed Oct. 11, 1967, Ser. No. 674,392
Int. Cl. H02g 15/08, 15/24

U.S. Cl. 174-88

9 Claims

ABSTRACT OF THE DISCLOSURE

A connector assembly for joining a pair of metallic sheathed electrical conductors in end-to-end relation with the sheaths spaced axially apart and including a metallic sleeve extending between and connecting respective adjoining sheath ends. The sleeve provides a pair of transverse apertures in communication with the space between the conductor sheaths and the apertures are spaced axially along the sleeve. The interior of the sleeve is completely filled with a fluid dielectric, spherical plugs are force-fitted into respective apertures to close the same, and a clamp encircles the sleeve for retaining the plugs in respective apertures. Disposed within the sleeve, in an annular space between the latter and respective conductors, is a dielectric sleeve member which, in combination with the fluid dielectric, reduces the possibility that electrical energy will jump the gap between the electrical conductors and the metallic sleeve.

Preamble

The use of mineral insulated cables, both heating cables and power transmission cables, has rapidly increased in recent years giving rise to the necessity of development of a satisfactory structure for joining such cables together in the field. Since mineral insulated cables are designed for use under severe conditions, any connection joining such cables must also be capable of functioning under such conditions. Heretofore, field-made connections between mineral insulated cables have been difficult and time-consuming to make and have frequently not met the required high quality standards. In the past, it has all too frequently been necessary to dismantle a completed connection and start over again.

The present invention simplifies making connections between mineral insulated cables under field conditions and is adequate for factory installation as well. The advantages of the present invention will readily become apparent from a study of the following description and from the appended drawings.

Description of the drawings

In the drawings accompanying this specification and forming a part of this application there is shown, for purpose of illustration, embodiments which the invention may assume, and in these drawings:

FIGURE 1 is a side elevational view of a connection of the present invention between a pair of mineral insulated cables,

FIGURE 2 is a longitudinal sectional view through the structure seen in FIGURE 1,

FIGURES 3 and 4 are sectional views similar to FIGURE 2 but at preliminary assembly stages, and

FIGURE 5 is a view similar to FIGURE 2 but of another embodiment of the invention.

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Detailed description

With reference to FIGURES 1 and 2, a pair of mineral insulated, metallic sheathed cables 10 and 10.1 are shown joined together in end-to-end relation by a connector assembly 11. As illustrated in FIGURE 2, each cable may be of the well-known type having respective tubular metallic sheaths 12 filled with highly compacted electric-insulating refractory material 13 such as powdered magnesium oxide. Centrally disposed within each tubular sheath 12 and embedded in the material 13 are respective electrical conductors 14 which project axially beyond respective sheath ends. The free ends of conductors 14 are disposed in abutting relation and are connected together, as by brazing at 15, to provide a strong joint of minimum electrical resistance.

Extending between and hermetically joined to respective cable sheaths is a metallic sleeve 16, having a first portion 17 of an internal size to closely but slidably fit over the sheath of cable 10, and a second portion 18 having a bore 19 of a size materially larger than that of the cable sheaths. Closely encircling a portion of the sheath of cable 10.1 adjacent its end is a tubular metallic spacer 20 whose exterior is dimensioned to closely fit within the sleeve bore 19. The arrangement is such that a chamber 21 is provided within the sleeve 16 in which are disposed the abutting ends of conductors 14 and the adjoining ends of the cable sheaths 12.

As previously mentioned, the sleeve 16 is hermetically joined to respective cable sheaths and as herein disclosed, sleeve portion 17 is welded at 22 to the sheath of cable 10 while the sleeve portion 18 is welded at 23 to the tubular spacer 20 which is in turn welded to the sheath of cable 10.1 at 24. To insure complete sealing, the welds 22, 23 and 24 are, of course, annular.

In order to reduce the possibility of arcing between the conductors 14 and the sleeve 16, a dielectric sleeve 25 is preferably disposed about the exposed conductors and within the chamber 21. For a purpose to appear, the ends of the dielectric sleeve are cut at an angle of less than 90 degrees with its axis.

To further reduce the possibility of arcing between the conductors 14 and the sheath ends or between such conductors and the sleeve 16, the previously mentioned sleeve chamber 21 is completely filled with a dielectric fluid such as heavy oil or grease. At the present time it is preferable to fill the chamber with a silicon grease which has the necessary dielectric qualities along with the requisite temperature resistance. To provide for introduction of the dielectric fluid into the chamber 21, sleeve 16 is, at best seen in FIGURE 3, provided with axially spaced, transversely extending apertures 26 in communication with chamber 21. In FIGURE 2, apertures 26 are shown plugged by respective balls 27.

For retaining balls 27 in respective apertures and for another purpose to later appear, a conventional clamp 28 encircles the sleeve 16 and is tightly drawn thereabout. Since the clamp presently used is not wide enough to span the apertures 26, a metal strip 29 which is arcuate in cross-section overlies the apertures and underlies the clamp. Obviously, strip 29 could be omitted by using two clamps or by using a single clamp wide enough to span the apertures 26.

To form the assembly seen in FIGURES 1 and 2, the

cables 10, 10.1 will be disposed in end-to-end relation with respective conductors 14 abutting each other and with the metallic sleeve 16, the dielectric sleeve 25 and the spacer 20 assembled on the abutted cables as illustrated in FIGURE 3. The conductors 14 will then be brazed together at 15 and the spacer 20 will be welded at 24 to the sheath of cable 10.1 by the annular weld 24 as shown. If more convenient, spacer 29 may be welded to cable 10.1 prior to disposition of the cables in end-to-end relation and prior to welding of the conductors 14.

With the conductors welded together, dielectric sleeve 25 will be slid to the right from the position of parts seen in FIGURE 3 along the conductors to span the gap between respective cable sheaths. The sleeve 16 will then similarly be slid to the right until the bottom of its bore 19 abuts the dielectric sleeve 25 and the latter abuts the adjoining end of spacer 20. Annular welds 22, 23 will next be made to hermetically secure the sleeve 16 to the sheath of cable 10 and the spacer 20 respectively.

With the parts thus assembled and with reference to FIGURE 4, the dielectric fluid may be introduced into the chamber 21 through one of the apertures 26 while air is displaced from the chamber through the other aperture 26. It will be understood that with the dielectric sleeve ends cut at an angle, both ends of the sleeve will be open despite their abutment with the bottom of sleeve bore 19 and the end of spacer 20 so that the dielectric fluid will freely enter the sleeve and the contained air will freely escape therefrom.

Before disclosing the final assembly operation, it is pointed out that the sleeve apertures 26 are preferably cylindrical, as by being formed in a drilling operation. The apertures 26 and balls 27 are so proportioned that the latter have an interference fit with the former, that is, the balls are of a slightly larger diameter than the diameter of the apertures.

Assuming that the sleeve chamber is filled with the dielectric fluid as hereinabove described, the balls 27 are ready to be forced into respective apertures 26 for sealing purposes. An ordinary pair of pliers may be used to force the balls in place, one jaw J1 of the pliers engaging a ball 27 as seen in FIGURE 4, and the opposite jaw J2 bearing against the diametrically opposite outer surface of the portion 18 of sleeve 16. When pressure is applied by the jaws J1-J2 the ball 27 is forced into the aperture and since the wall thickness of the sleeve is greater than one-half the diameter of the ball, the latter cannot be forced through the aperture by the pliers.

The sleeve 16 is usually formed of a relatively soft metal and the balls are usually of hardened steel so that when a ball is formed into an interference fit aperture, zero clearance results therebetween and a good seal is made. When the joint is subjected to heat, the silicone grease may expand enough to create an internal pressure which would tend to pop the balls out of their seats. The addition of the strip 29 and the clamp 28 will prevent any such popping action. Also, when the joint is subjected to heat, the clamp 28 may expand and thus allow the balls 27 to slightly back out of their fully seated position in the apertures 26. However, since the balls were pressed to zero clearance fit in the apertures, they may move a slight amount backward without disturbing the seal.

The embodiment of FIGURE 5 is similar to that heretofore disclosed and therefore corresponding parts are identified by the same reference characters but with the suffix *a* added. In this embodiment, each cable 10*a*, 10.1*a* is provided with two conductors 14*a* in side-by-side relation instead of the single conductor heretofore disclosed. Furthermore, to reduce the possibility of electrical breakdown between the side-by-side conductors, a strip of dielectric material 30 is disposed between such conductors. Strip 30, of course, will be dimensioned to fit between the adjoining ends of respective cable sheaths and will further be dimensioned to closely fit within the dielectric

sleeve 25*a*. Such strip 30 will thus be confined against displacement from the position shown.

While the embodiments hereinabove disclosed show the connection of cables which are the same size, it will readily be apparent that cables differing in size from each other may readily be connected. For example, if a smaller cable 10.1 is to be joined to the cable 10, a spacer 20 having an appropriately smaller inside diameter may be employed. Similarly, if cable 10.1 should be larger, the spacer 20 may be provided with an appropriately larger inside diameter.

I claim:

1. A connector assembly for a pair of metallic sheathed electrical conductors disposed in end-to-end relation wherein the conductors extend axially beyond the ends of respective sheaths and are secured together in electrical continuity, wherein respective sheath ends are disposed in axially spaced relation, and wherein a transversely apertured metallic sleeve extends between adjoining sheath ends and is secured thereto in fluid-tight relation,

the improvement wherein the transverse aperture in said sleeve communicates with the space between respective sheath ends,

wherein the interior of said sleeve and the space between said sheath ends is filled with a fluid dielectric, wherein said sleeve transverse aperture is closed by a plug,

and wherein retaining means maintains said plug in said sleeve aperture and prevents escape of said dielectric fluid.

2. The construction of claim 1 wherein said plug and the defining walls of said sleeve transverse aperture have press fit engagement,

and wherein said retaining means comprises a clamp for holding said plug in engagement with the defining walls of said sleeve aperture.

3. The construction of claim 1 wherein said sleeve is formed of a relatively soft metal and said sleeve aperture is cylindrical,

wherein said plug comprises a ball of a relatively hard metal and of a diameter slightly larger than the diameter of said aperture and is pressed into the latter and has zero clearance therewith to form a seal,

and wherein said retaining means comprises a clamp holding said ball within said sleeve aperture.

4. The construction of claim 3 wherein said clamp comprises a band encircling said sleeve.

5. The construction of claim 1 wherein said sleeve has a pair of transverse apertures spaced from each other longitudinally of said sleeve, one of said apertures providing for injection of said dielectric fluid into said sleeve interior and said other aperture providing for displacement of air from said sleeve interior.

6. The construction of claim 5 wherein each sleeve aperture is closed by respective plugs having wedged interengagement therein,

wherein said retaining means comprises a band encircling said sleeve,

and wherein a rigid member extends between and overlies said sleeve apertures, said member underlying said band and being drawn thereby against said sleeve to hold said plugs within respective apertures.

7. The construction of claim 6 wherein the connections between said metallic sleeve and respective sheaths are of the metallic fused type.

8. A connector assembly for a pair of metallic sheathed electrical conductors disposed in end-to-end relation wherein the conductors extend axially beyond the ends of respective sheaths and are secured together in electrical continuity, wherein respective sheath ends are disposed in axially spaced relation, and wherein a transversely apertured metallic sleeve extends between adjoining sheath ends and is secured thereto in fluid-tight relation,

the improvement wherein the transverse aperture in

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said sleeve communicates with the space between respective sheath ends,

wherein the interior of said sleeve and the space between said sheath ends is filled with a fluid dielectric, wherein said sleeve transverse aperture is closed by a plug,

and wherein a dielectric sleeve is disposed within said metallic sleeve in encircling relation with said electrical conductors.

9. The construction of claim 8 wherein said dielectric sleeve is larger in diameter than said sheath ends and extends therebetween,

wherein said dielectric sleeve is smaller in diameter than said metallic sleeve,

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and wherein said dielectric sleeve is completely filled with said dielectric fluid and is completely surrounded thereby.

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U.S. Cl. X.R.

174—21, 76, 91