United States Patent

Taj

[15] **3,691,291**

[45] **Sept. 12, 1972**

[54] **SPLICE FOR JOINING HIGH VOLTAGE CABLES**

[72] Inventor: **Hatim H. Taj,** Schenectady, N.Y.

[73] Assignee: **General Electric Company**

[22] Filed: **April 19, 1971**

[21] Appl. No.: **135,166**

[52] **U.S. Cl.** .....**174/73 R,** 174/88 R

[51] **Int. Cl.** **H02g 3/06**

[58] **Field of Search** .....174/73 R, 73 S, 84 R, 84 S, 174/88 R, 88 S, 94 R, 94 S

[56] **References Cited**

UNITED STATES PATENTS

2,640,719 6/1953 Dennington, Jr. ....174/84 S X

3,401,959 9/1968 Reiss et al.....174/84 S X

FOREIGN PATENTS OR APPLICATIONS

917,189 8/1954 Germany.....174/84 S

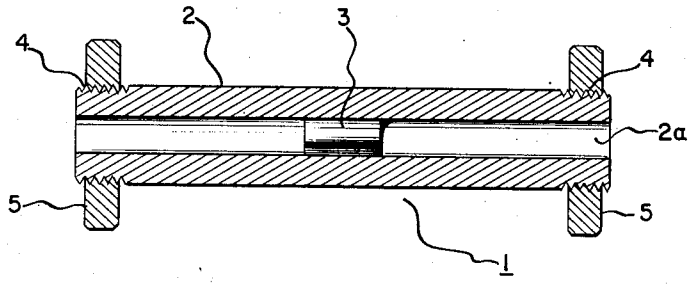
Primary Examiner—Darrell L. Clay

Attorney—Howard I. Schlansker

[57] **ABSTRACT**

A connector for electric cable joints or splices has an adjustable collar on each connector end, the connector ends serving to join the cables and the collars serving to electrically connect the connector structure to the connector cavity shield, to provide an efficient heat path from the connector, and to prevent any cable adaptor tube from moving into the connector cavity.

4 Claims, 3 Drawing Figures



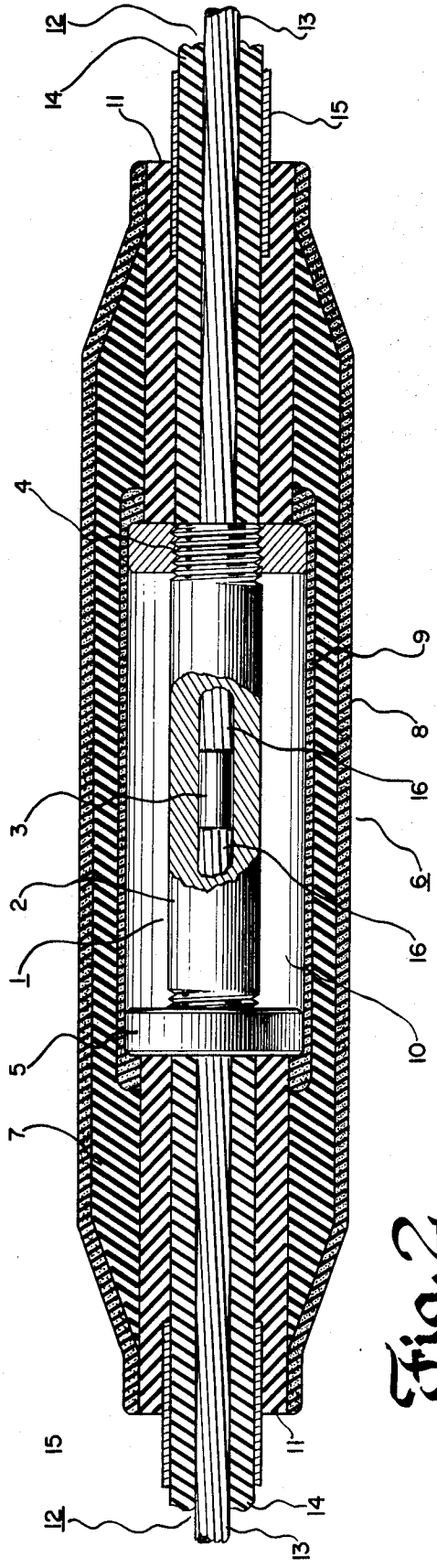


Fig. 2

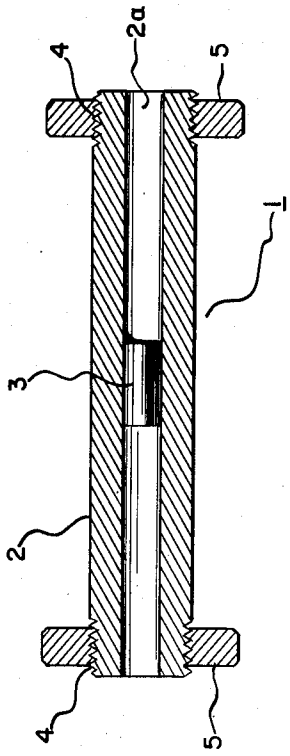


Fig. 1

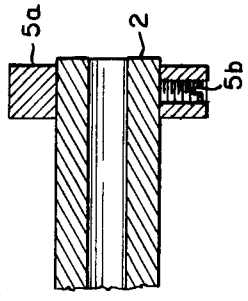


Fig. 1a

INVENTOR

HATIM H. TAJ

BY Howard D. Schlanker

HIS ATTORNEY

SPLICE FOR JOINING HIGH VOLTAGE CABLES

This invention relates to connectors for high voltage cable splices or joints.

In designing connectors for high voltage cable splices or joints, it is important to design the connector which holds the cable ends so that it will carry the rated current without overheating. This is a relatively simple matter where there is a direct heat flow path through the joint structure from the connector. The problem is more severe when the connector in the finished splice or joint is spaced from the splice housing or surrounded by an air cavity or where adaptor tubes may be used to connect cables of different sizes or outer diameters using a common sized housing. Not only is the connector in this instance not supplied with a direct heat flow path through the splice housing but the outer periphery of the air cavity must be electrically shielded to prevent ionization. The shield must here be electrically connected to the connector. Various means have been employed where such air cavities exist to provide a heat flow path between the connector and the shield and thence through the splice structure. One such means is illustrated in U.S. Pat. No. 3,485,935 wherein a so-called spring packet is used to maintain contact between the bared end of the conductor outside of the connector and the shield. Such a spring would also, to some extent, serve to conduct any excess heat from the cable adjacent the connector to the cavity shield and thence through the remainder of the splice structure. However, such a spring packet leaves much to be desired because it must be carefully installed as a separate item and may, if not carefully handled, lose its springiness and ability to maintain heat transfer and electrical contact as desired. The same is true of so-called leaf springs which are arranged about the connector and shaped and tied or fixed in place to provide yielding contact as above. The problem is further complicated where so-called adaptor tubes are used to accommodate varying insulation diameters of electrical cables, thus making a splice housing of any particular size adaptable to a number of insulation diameters. Such adaptor tubes, slidably fitting as they do over the cable and inside the splice housing, tend, unless restrained in some way during assembly of the cable splice, to slide along the cable into the connector cavity upsetting the physical and electrical symmetry of the splice.

From the above it will be quite apparent that there is a need for high voltage cable connectors which when used in conjunction with joints or splices will efficiently perform a multiplicity of functions, and it is a principal object of this invention to provide such connectors.

Briefly, there are provided by the present invention connectors for high voltage electric cable joints or splices which not only serve to join the cable ends but also to join the connector proper and the connector cavity shield in electrical and heat transfer relationship and, in addition serve to hold in position any cable adaptor tubes which may be employed.

Those features of the invention which are believed to be novel are set forth with particularity in the claims appended hereto. The invention will, however, be better understood and further advantages thereof appreciated from a consideration of the following description and the drawing in which

FIG. **1** shows a typical connector of the present invention,

FIG. **1***a* shows a modification of the connector, and

FIG. **2** shows a typical use of the connector in a high voltage splice or joint.

Referring to the drawing, there is shown in FIG. **1** a typical connector **1** of the present invention. This connector comprises a tubular barrel-shaped or generally cylindrical hollow structure **2** having at either end a cable conductor pocket **2***a*. If desired, for purposes of positioning the cable end, there can be either fixed in the tube **2** or formed integrally therewith a stop **3**. The outer periphery of each end of the connector is threaded as at **4**, and collars or rings **5** having their inner periphery threaded to mate with threads **4** are threaded on the connector body **2**. With the cable conductor ends inserted in the connector pockets **2***a*, they are fixed to the connector in any of a desired number of ways, typical of which is to crimp or compress the metal of the connector which is typically of relatively malleable aluminum, copper or other electrically conductive but yet relatively malleable or deformable metal. It will be realized that the connector of FIG. **1** is typical only and that it may be made in any of a number of shapes to adapt to different types of splices. Thus, instead of being in a generally cylindrical shape to receive two cable ends as in FIG. **1**, the connector can be in the shape of a U or V, Z or any other desired shape to suit particular conditions. The connector can also be in the form of a Y or a T to receive three cable ends, each of the three ends of the connector once again being provided with a metal collar or ring **5** as in FIG. **1**. Then again the connector may take the general shape of an H wherein typically two parallel-arranged connectors of the general configuration of FIG. **1** are joined electrically. These configurations can be multiplied or repeated to provide connections for as many cable ends as it is desired to connect, once again each connector end being provided with a threaded collar of the above type. Other configurations including three-dimensional arrangements will occur to those skilled in the art.

Shown in FIG. **2** of the drawing is a high voltage cable joint or splice of a type in which the present connector can be utilized. Typically, this joint **6** comprises an outer insulating housing **7** of suitable material such as an elastomer having an outer integral or separate conductive coating or covering **8** and a conductive insert or integral coating **9** which acts as a shield for the connector cavity **10**. The cables **12** to be joined typically have a conductor **13** surrounded by insulation of any usual type **14** and an outer shield **15** which latter in the final splice is electrically connected to the outer layer or covering **8** of the splice in any convenient way, not shown. As shown, the shield and insulation are stripped from the cable to present cable ends **16** which are inserted in the cable end pockets **2***a* of connector **1**. As pointed out above, the cable ends can be held as by compressing or crimping the connector body **2** inside of collars **5** in any desired way. It will be realized by those skilled in the art that any other usual means may be used to so fix the cable ends. These include set screws, solder or other fusible alloys or any other desired methods which will not disrupt the threads **4**. It has been found that the crimping even up to the threads themselves of a connector will not disrupt or distort the threads which at this stage can be protected by the collars **5**.

It has been found convenient in some instances in preparing splices of the above general type to provide so-called adaptor tubes **11** of suitable insulating material such as elastomers. These have the same outer diameter and will fit within the splice body or housing **7** but have varying inner diameters to accommodate any of a number of cable insulation diameters within a reasonable range. Thus, the same outer splice housing size can be used for a range of splices for different size conductors or for cables having different insulation diameters. This adaptor tube can, if desired, also be adapted to provide electrical stress relief and may also serve to connect the outer conductive layer **8** with the cable shield **15**. With the cable conductor ends **16** suitably fixed in the connector, and the adaptor tubes **11**, if used, in place, the collars **5** are adjusted to abut the adaptors **11**. The outer body **7** of the splice is then slipped over the already assembled parts and any other connections made if used such as the clamping of the splice ends to the adaptor tube and cable shield. Any suitable lubricant can be used if indicated to facilitate assembly of the elastomer joint parts. In emplacing the outer splice body **7**, the inner conductive shield **9** comes into interference contact with the outer periphery of collars **5** which then not only serve to check the inward movement or hold the adaptors **11** in place and provide electrical contact between the connector and shield **9** but also provide along the same path solid heat transmission means. The collars are readily adjusted to their final position in a positive manner and provide a rigid, as opposed to flexible, and thus readily displaceable or disrupted interconnecting structure. The collar adjustment also serves to compensate for any differential growth or expansion of the connector barrel because of variations in cable conductor sizes, connector barrel sizes and the type of installation tool used. The threaded system shown is much to be preferred, but it will be realized that other surface contact arrangements can be used. Thus, the collar can simply slidably fit the connector and be held in place by one or more set screws or other means. This modification is illustrated in FIG. **1***a* of the drawing in which collar **5***a* is slidably fitted over connector **2** and held in place with a set screw **5***b*.

Those skilled in the art will readily be capable of adapting the present connector as to size to any desired cable splice. When connectors of this type were tested in accordance with Edison Electric Institute Publication TDJ–162 Oct. 1962) with the conductor at from 100° to 110° C above ambient, the connector temperatures averaged from 10° to 20° C below the conductor temperatures. The connection was about 3¼ inches long with an outer diameter of about 0.7 inch, an inner diameter of about 0.4 inch using collars having an outer diameter of about 1.4 inches and the conductor was 1/0 stranded copper.

It has been found that not only are the electrical characteristics of the present connectors very desirable, but their heat conduction is as well very favorable. With the connector tube or body temperature at between 110° C and 120° C, it was found that with the collars fully threaded on the above described connector, the average temperature difference between a point on the surface of the connector midway between the collars and the outer collar periphery was 3° C. With the threaded areas of the collars 75 percent in engagement with the connector, the above temperature difference was 11° C as it was when the collars were 50 percent engaged. With 25 percent collar engagement, the temperature difference was 15° C. It will thus be seen that by the present invention there is provided a substantial and efficient means of conducting heat from the connector proper to the splice body, such heat conduction being much more efficient than simple air convection.

As pointed out above, the present connectors can be provided in any desired configuration and dimensional arrangement to fit any splice body or requirement. Thus, U, Z, V, Y, or T-shaped connectors may be provided as well as H-shaped connectors or any multiples or combinations of such connectors, it only being required that each cable end receptor be constructed as specified above. The splice body or housing can be constructed to suit the particular shape.

There are provided, then, by the present invention new and improved connectors for high voltage cables which at one and the same time serve a number of functions. They serve to fix the cable ends in place mechanically and electrically and by simple adjustment of the collars serve to fix in place adaptor tubes if used. Additionally, with the cable splice housing in place, the collars provide an interference fit between the connector air cavity shield, thus providing the necessary electrical contact between the connector proper and the shield and at one and the same time providing an efficient, solid heat transmission path between the same two points which provides for ready dissipation of heat generated in the connector during actual operation. The present connector can also be used with joints or splices which have separable and inter-mating parts as is well known in the art.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In an electric cable splice having a housing with shielded connector cavity means therein and electric cable connector means within said cavity means, and comprising a plurality of interconnected ends, each connector end having connected thereto an electric cable end, the improvement which comprises adjustably mounted on each of said connector ends a metal ring contacting its associated connector cavity shield.

2. A splice as in claim **1** which additionally contains adaptor tubes between the cable and splice housing, said metal rings abutting said adaptor tubes.

3. A splice as in claim **1** wherein said metal ring is slidably engaged on each of said connector ends and has means for fixedly engaging it thereto.

4. A splice as in claim **1** in which said metal ring is adjustably threaded on each of said connector ends.

* * * * *