Sept. 3, 1946. T. H. CLARK 2,406,805

CONDUCTOR JOINT AND METHOD OF MAKING SAME

Filed June 27, 1942

FIG. 1

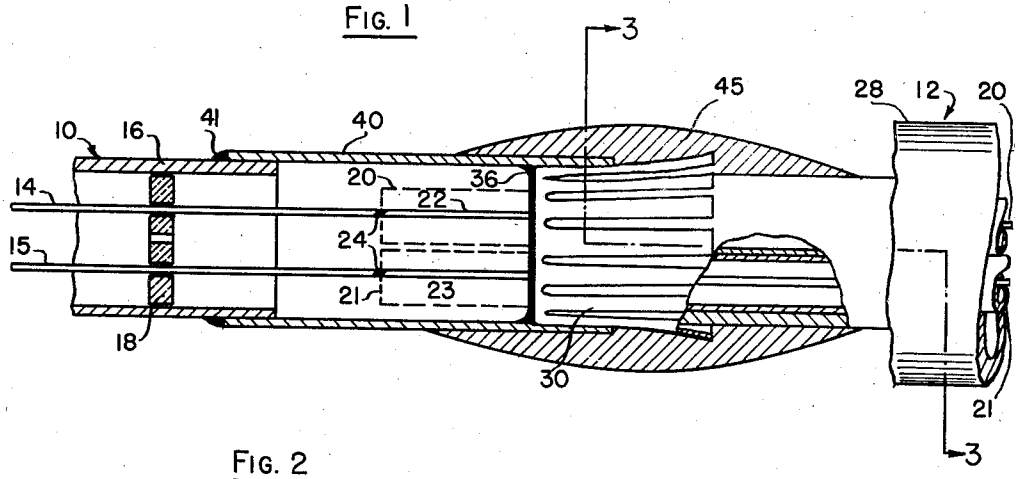


FIG. 2

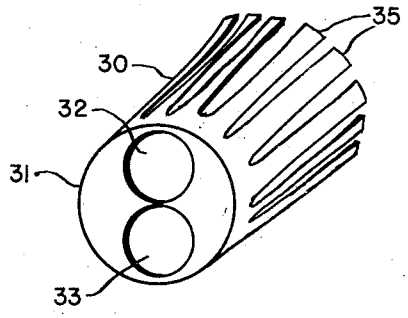
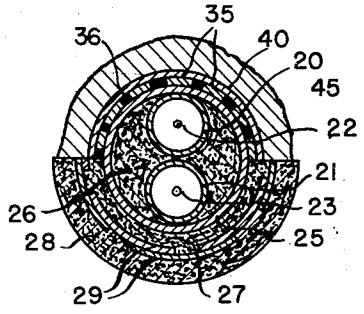


FIG. 3



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Patented Sept. 3, 1946

2,406,805

UNITED STATES PATENT OFFICE

2,406,805

CONDUCTOR JOINT AND METHOD OF MAKING SAME

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Application June 27, 1942, Serial No. 448,737

14 Claims. (Cl. 174—21)

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This invention relates to conductor joints and more particularly to a method of connecting or splicing together a cable of the shielded pair type and a cable of the twin coaxial type.

It is quite often desirable in transmission line installations for high frequency circuits to use one or more lengths of cable of the twin coaxial type because of the high strength, flexibleness, corrosion resisting, and other desirable qualities of such cable. The coaxial type of cable, for example, may be buried in the ground, and being flexible may be readily bent to avoid obstructions, etc. The twin coaxial cable, however, is not easily adaptable for connection to instrument boxes or terminated in gas-tight fashion with the aid of commercial adapters as is often required, because of the flexibleness and non-even periphery of the lead sheath thereof. For this reason, it is desirable to splice to the twin coaxial cable a terminal length of shielded pair cable, the sheath of the latter being rigid and shape-retaining is readily adaptable for use with commercial fittings.

The splicing of twin coaxial and shielded pair cables have heretofore been proposed but when the prior existing splices are used for such cables carrying high frequency currents, considerable objectionable reflections and standing waves occur. This objectionable feature of prior existing splices for such cables is apparently due to a lack of continuity at the connection of the surface connections of the shielding portions of the cables. This is particularly true with respect to the end portions of the tubular conductors and the sheath of the coaxial cable. While the tubular conductors may be in contact with the lead sheath which surrounds them, the contact may not provide proper conduction therebetween at the end of the conductors thereby leaving a substantial stub which for the conduction of high frequency currents produces objectionable reflections.

It is one of the objects of this invention, therefore, to provide a method for connecting a shielded pair cable to a twin coaxial cable so that the joint provides a direct connection having a minimum variance in the continuity of the line thereby minimizing greatly the transition effects normally experienced with splices heretofore proposed.

Another object of my invention is to provide a method for connecting a shielded pair cable to a twin coaxial cable in such a way as to provide a continuous metallic connection between the peripheral surfaces of the tubular conductors of

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the coaxial cable and the surrounding portions of the sheaths of the two cables.

Still another object of the invention is to provide an improved connection or splice joining together a cable of the shielded pair type and a cable of the twin coaxial type.

The above objects and others ancillary thereto will become more apparent upon consideration of the following detailed description to be read in connection with the accompanying drawing, in which,

Fig. 1 is a longitudinal sectional view with parts broken away of an improved connection in accordance with this invention;

Fig. 2 is a perspective view of a part used in making the connection; and

Fig. 3 is a view in cross-section taken substantially along line 3—3 of Fig. 1.

In Fig. 1 of the drawing, I show a splice constructed in accordance with this invention joining together a shielded pair type of cable 10 and a twin coaxial type of cable 12. The shielded pair type of cable 10 comprises a pair of conductors 14 and 15 surrounded by a sheath 16. The conductors 14 and 15 are spaced apart and from the inner surface of the sheath 16 by a suitably shaped insulator 18. This type of cable may be obtained in various sizes, the sheath 16 being rigid and shape retaining so that commercial adapters may be readily secured thereto to provide gas-tight joints.

The twin coaxial type of cable 12 may be of any suitable construction, the usual construction comprising two coaxial conductors formed of tubular conductors 20 and 21 and coaxially disposed wire conductors 22 and 23 respectively (Fig. 2). The space within the coaxial conductors is normally filled with dry air or other suitably desiccated gas. The conductors 20 and 21 are shielded by a lead sheath 25 and the spaces between the lead sheath and the conductors are usually filled with jute yarn 26. Directly surrounding the lead sheath is usually a layer of jute yarn 27 about which may be wrapped one or two layers of helical steel tape 29. Surrounding the steel tape is usually an additional layer of jute yarn 28 which may be impregnated with a suitable asphalt material to protect the cable from corrosion and other underground or exposure effects.

To splice the two cables together in accordance with this invention, the outer covering of the twin coaxial cable 12 is removed from about the sheath 25 for a distance of about 3 to 6 or 8 inches depending upon the size of the cable and the length

of splice desired. The sheath 25 may be cut back from the ends of the tubular conductors 20 and 21 sufficient to expose the end portions thereof. The exposed ends are indicated in broken lines in Fig. 1.

In order to effect a direct and continuous conductive connection to the portions of the tubes 20 and 21, I apply onto the end of the sheath 25, a thimble 30. The thimble comprises an end portion 31 substantially disc-shaped having a pair of openings 32 and 33 therein which, when the thimble is applied to the sheath 25, are adapted to receive the tubular conductors 20 and 21. These openings, however, may be arranged so as to be in substantial registry with the conductors 20 and 21 should it be desirable to apply the thimble to the sheath without cutting the sheath back to expose the end portions of the conductors. The reason I expose the ends of the conductors is that I find it more convenient to properly solder the portion of the thimble which defines the openings 32 and 33 to and about the peripheral surfaces of the conductors 20 and 21. After this soldering operation is completed, the portions of the tubular conductors extending beyond the soldered connection are trimmed away.

The side walls of the thimble 30 may be solid but preferably they are formed of an open work which may be porous or comprise a plurality of fingers 35. When the thimble is thus formed with fingers 35, the thimble may be made from a flat piece of metal by a suitable stamping operation, the fingers being cut and bent to the shape substantially as shown in Fig. 2. When the thimble is applied to the sheath 25 as shown in Fig. 1, the fingers 35 overlie in close relation the outer surface of the sheath 25. Thus positioned, an abundant amount of solder 36 is applied to the fingers along the lengths thereof and at the peripheral edge portion of the end 31. If desired, the thimble or at least the fingers thereof may be pretinned and/or coated with solder before applying the thimble to the sheath 25.

At about this stage in the construction of the splice, the conductors 14 and 15 may be connected to the conductors 22 and 23 by any suitable process such as by butt welding 24.

A tubular extension 40 previously slid onto the sheath 16 of the cable 10 may now be moved along the sheath 16 to an overlapping relation with respect to the space between the sheath 16 and the sheath 25 with one end of the extension 40 overlying at least partially the fingers 35 of the thimble 30. The end of the extension 40 overlying the end of the sheath 16 may be secured thereto by any suitable process such as by silver soldering as indicated at 41. The splice may now be completed by applying a body of lead 45 over the junction portions of the extension 40, thimble 30, and the sheath 25. The lead 45 may be applied by the well-known "wiping" process whereby the lead is applied in a fluent heated condition. The heat of the lead thus applied melts the solder 36 on the fingers 35 causing the solder to flow and form not only a good connection between the fingers 35 and the sheath 25 but also between the thimble and the inner surface of the extension 40 along the peripheral edge portion of the end 31.

It will be readily apparent from the foregoing description that the joint formed in accordance with this invention provides a continuous metallic connection about the peripheral surfaces of the tubular conductors 20 and 21 and the disc-like end portion 31 of the thimble 30. The thimble in turn

is embedded in solder and lead forming a continuous connection with the sheath 25, and due to the sweating operation caused by the heat of the lead when wiped onto the joint, the extension 40 is securely and thoroughly connected by solder along the inner surface thereof adjacent the peripheral edge of the disc-like end portion 31. The flow of solder during the lead wiping operation insures this connection to the extension 40 so that all danger of leaving free-end stubs either of the sheath 25 or of the conductors 20 and 21 is avoided. The joint thus formed is air tight and the continuity of sheath and conductor connection insures the line against the occurrence of transition effects at high frequencies.

While I have shown but one form of cable connection, I recognize that the connection may be varied in many respects such as to the shape and arrangement of the thimble, it being readily apparent that the thimble may in some cases be in the form of a disc only and in others, the sides may comprise a continuous wall having openings or other open work form; also the steps of the method may be varied in their order of application and the steps themselves may be modified without departing from the invention. The method, for example, may be varied by effecting the heating or sweating operation by a heating step other than by a lead wiping operation. It will be understood, therefore, that the method and the splice herein described are to be regarded as illustrative of the invention only and not as restricting the appended claims.

What I claim is:

1. In a connection joining a cable having a sheath shielding a pair of conductors to a twin coaxial cable having a sheath shielding the coaxial conductors thereof, means connecting together the sheaths of the two cables, means including a disc-like portion having openings therein disposed about said coaxial conductors, and said disc-like portion being secured to the outer conductors of said coaxial conductors about the peripheral surfaces thereof and to the connected sheaths along the peripheral edge of said disc-like portion.

2. In a connection joining a cable having a sheath shielding a pair of conductors to a twin coaxial cable having a sheath shielding the coaxial conductors thereof, means connecting together the sheaths of the two cables, means including a disc-like portion having openings therein, said portion being so disposed as to locate the openings therein in substantial registry with respect to the outer tubular conductors of said coaxial conductors, and said disc-like portion being secured to said tubular conductors about the peripheral surfaces thereof and to the connected sheaths along the peripheral edge of said disc-like portion.

3. In a connection joining a cable having a sheath shielding a pair of conductors to a twin coaxial cable having a sheath shielding the coaxial conductors thereof, means connecting together the sheaths of the two cables, means including a disc-like portion having openings therein, said portion being so disposed as to locate the openings therein in substantial registry with respect to the outer tubular conductors of said coaxial conductors, and said disc-like portion being secured to said tubular conductors about the peripheral surfaces thereof and to the connected sheaths along the peripheral edge of said disc-like portion, and an annular body of lead covering

the junction of said disc-like portion and said sheaths.

4. In a connection joining a cable having a sheath shielding a pair of conductors to a twin coaxial cable having a sheath shielding the coaxial conductors thereof, means including a disc-like portion and a cylindrical portion, said disc-like portion having openings therein, said cylindrical portion being received on and secured to the end of the sheath of the coaxial cable with the openings of the disc-like portion disposed about the said coaxial conductors, said disc-like portion being secured to the outer conductors of said coaxial conductors about the peripheral surfaces thereof, and means connecting together the sheaths of said cables including a body of solder disposed along the peripheral edge of said disc-like portion.

5. In a connection joining a cable having a sheath shielding a pair of conductors to a twin coaxial cable having a sheath shielding the coaxial conductors thereof, a thimble having a pair of openings in the end thereof received on and conductively secured to the end of the sheath of said coaxial cable with the coaxial conductors received in said openings and the outer of the coaxial conductors conductively connected to the thimble along the edge portions defining said openings, and means connecting the sheath of the first mentioned cable to said thimble along the peripheral surface of the said end thereof.

6. In a connection joining a cable having a sheath shielding a pair of conductors to a twin coaxial cable having a sheath shielding the coaxial conductors thereof, a thimble having a pair of openings in the end thereof received on and conductively secured to the end of the sheath of said coaxial cable with the coaxial conductors received in said openings and the outer of the coaxial conductors conductively connected to the thimble along the edge portions defining said openings, a sleeve at least partially received on said thimble and secured to the sheath of the first mentioned cable, and means securing said thimble to said sleeve along the peripheral surface of the said end of the thimble.

7. In a connection joining a cable having a sheath shielding a pair of conductors to a twin coaxial cable having a sheath shielding the coaxial conductors thereof, a thimble having a pair of openings in the end thereof received on and conductively secured to the end of the sheath of said coaxial cable with the coaxial conductors received in said openings and the outer of the coaxial conductors conductively connected to the thimble along the edge portions defining said openings, a sleeve at least partially received on said thimble and secured to the sheath of the first mentioned cable, and means securing said thimble to said sleeve along the peripheral surface of the said end of the thimble, and an annular body of lead overlying the junction of the sleeve and thimble.

8. In a connection joining a cable having a sheath shielding a pair of conductors to a twin coaxial cable having a sheath shielding the coaxial conductors thereof, a thimble having a pair of openings in the end thereof, the sides of said thimble being formed of open work, said thimble being disposed with the sides received on the end of the sheath of said coaxial cable with the tubular conductors of the coaxial conductors in substantial registry with the openings in the end portion of the thimble, the peripheral surfaces of the tubular conductors being soldered to the portions defining said openings, an extension of the sheath of the first mentioned cable overlying at least partially the sides of said thimble, solder securing said extension to the sides of said thimble and to the sheath of said coaxial cable, and an annular body of lead overlying the juncture of the thimble and the sheaths.

9. The method of connecting a cable having a sheath and a pair of conductors shielded thereby to a twin coaxial cable having a sheath shielding the coaxial conductors thereof comprising preparing the latter cable to expose the end portions of the tubular conductors of the coaxial conductors, connecting the conductors of the first mentioned cable to the inner conductors of the coaxial cable, applying an element having a disc-like portion with openings therein about the coaxial conductors and adjacent the end of the sheath associated with such conductors, conductively securing the element to said tubular conductors about the peripheral surfaces of the tubular conductors, and conductively connecting said sheaths to said element along the peripheral edge portion thereof.

10. The method of connecting a cable having a sheath and a pair of conductors shielded thereby to a twin coaxial cable having a sheath shielding the coaxial conductors thereof comprising connecting the conductors of the first mentioned cable to the inner conductors of the coaxial cable, applying to the end of the sheath of the twin coaxial cable an element having a disc-like portion with openings therein with said openings in substantial registry with the outer tubular conductors of the coaxial conductors, conductively securing the element to said tubular conductors along the peripheral edges thereof, applying solder to the peripheral portion of said element, overlapping said peripheral portion with an extension of the sheath of the first mentioned cable, and heating the extension to cause the solder to flow and form a connection between said element and the sheaths of the cables.

11. The method of connecting a cable having a sheath and a pair of conductors shielded thereby to a twin coaxial cable having a sheath shielding the coaxial conductors thereof comprising preparing the latter cable to expose the end portions of the tubular conductors of the coaxial conductors, connecting the conductors of the first mentioned cable to the inner conductors of the coaxial cable, applying an element having a disc-like portion with openings therein about the coaxial conductors and adjacent the end of the sheath associated with such conductors, applying solder to said element, overlapping said element and the end of the sheath thereadjacent with an extension of the sheath of the first mentioned cable, and heating the overlapped parts to cause the solder to flow and thereby effect a metallic connection between said element and the sheaths.

12. The method of connecting a cable having a sheath and a pair of conductors shielded thereby to a twin coaxial cable having a sheath shielding the coaxial conductors thereof comprising connecting the conductors of the first mentioned cable to the inner conductors of the coaxial cable, applying to the end of the sheath of the twin coaxial cable an element having a disc-like portion with openings therein for registry with the coaxial conductors, applying solder to said element, overlapping said element and the end of the sheath thereadjacent with an extension of the sheath of the first mentioned cable, and ap-

plying lead in a fluent heated condition over the overlapped parts, the heat of the lead causing the solder to flow and thereby effect a metallic connection between said element and the sheaths.

13. The method of connecting a cable having a sheath and a pair of conductors shielded thereby to a twin coaxial cable having a sheath shielding the coaxial conductors thereof comprising connecting the conductors of the first mentioned cable to the inner conductors of the coaxial cable, applying to the end of the sheath of the twin coaxial cable an element having a disc-like portion with openings therein for registry with the coaxial conductors, soldering said element to said tubular conductors along the peripheral edges thereof, applying solder to the peripheral edges of said element, overlapping the peripheral edges of said element with an extension of the sheath of the first mentioned cable, and applying lead in a fluent heated condition over the overlapped parts, the heat of the lead causing the solder to flow and thereby effect a metallic connection between said element and the sheaths.

14. The method of connecting a cable having a sheath and a pair of conductors shielded thereby to a twin coaxial cable having a sheath shielding

the coaxial conductors thereof comprising preparing the latter cable to expose the end portions of the tubular conductors of the coaxial conductors, connecting the conductors of the first mentioned cable to the inner conductors of the coaxial cable, applying a thimble having openings in the end thereof and the sides of which are formed of open work over the end of the sheath of said coaxial cable so that said openings receive the exposed portions of said tubular conductors, soldering the peripheral surfaces of said tubular conductors to the portions of said thimble defining said openings, trimming off the portions of the tubular conductors extending beyond the soldered connection, applying solder to the sides of said thimble, connecting the pair of conductors of the first mentioned cable to the inner conductors of said coaxial cable, overlapping at least partially the thimble by an extension of the sheath of said first cable, and applying lead in a fluent heated condition over the overlapping parts, the heat of the lead causing the solder to flow and thereby effect a metallic connection between said element and the sheaths.

TREVOR H. CLARK.