Oct. 18, 1938. J. J. HARLEY 2,133,448

JOINT FOR ELECTRICAL CONDUCTORS

Filed July 23, 1936 2 Sheets-Sheet 1

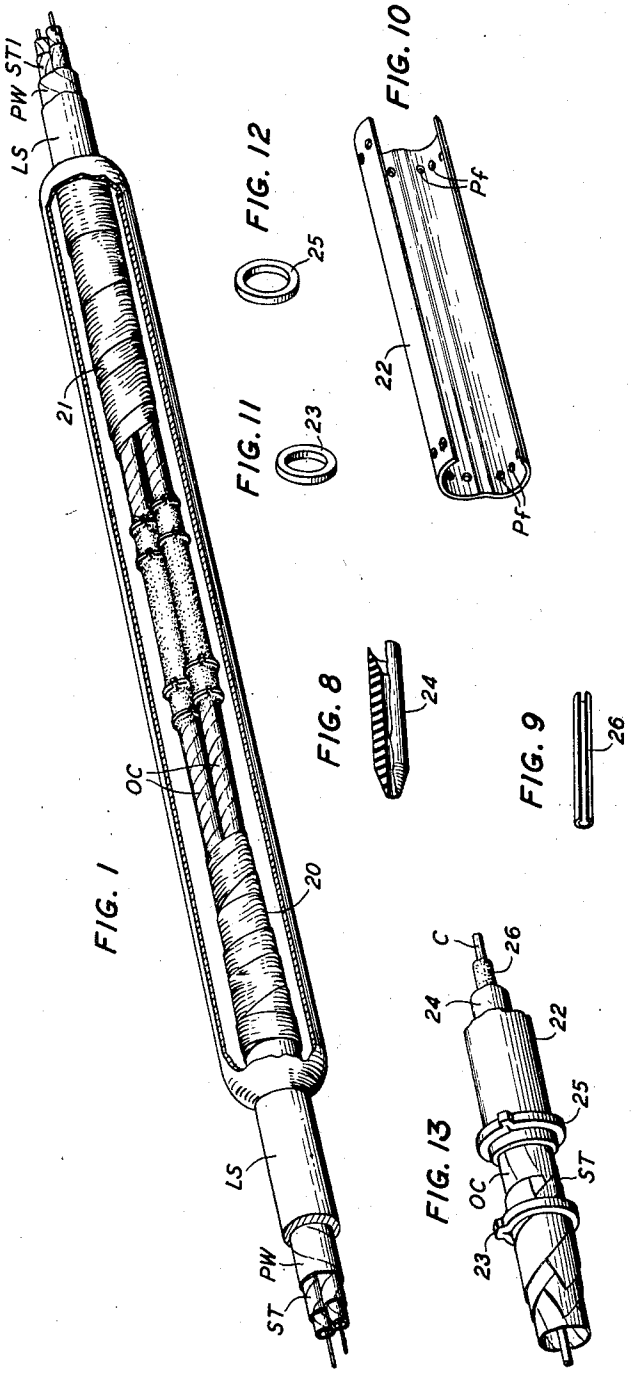

FIG. 1

FIG. 12

FIG. 11

FIG. 10

FIG. 8

FIG. 9

FIG. 13

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FIG. 2

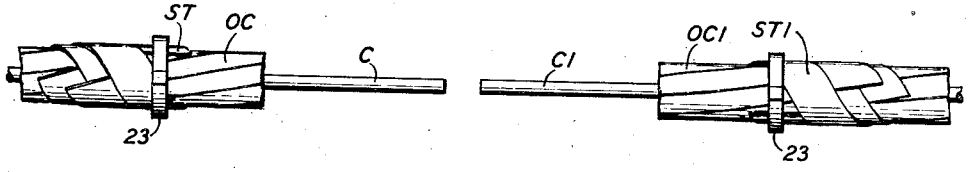


FIG. 3

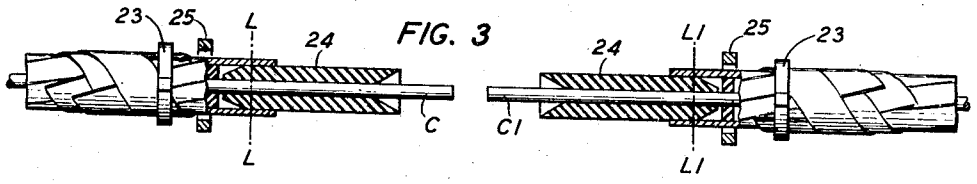


FIG. 4

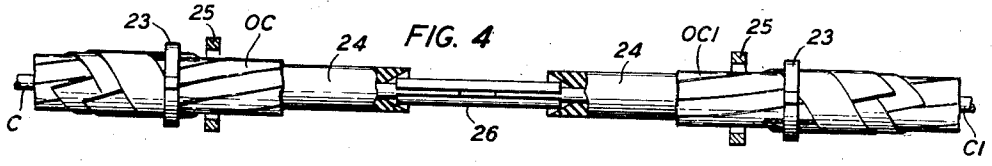


FIG. 5

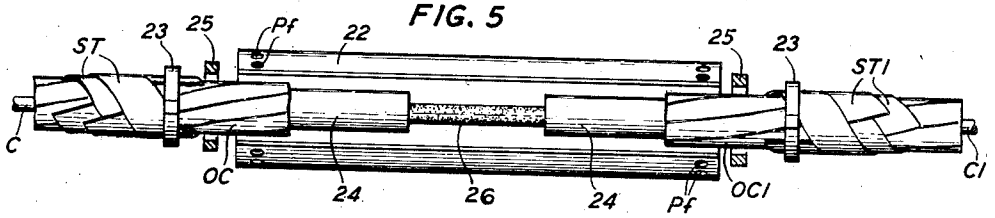


FIG. 6

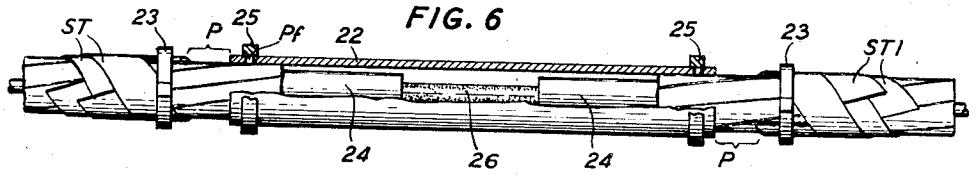
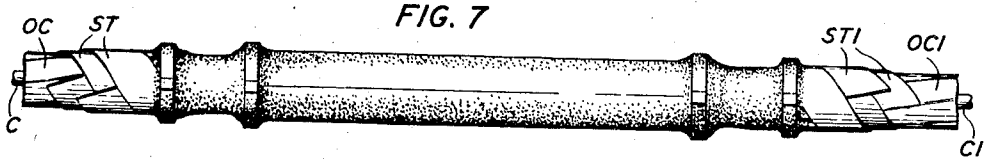


FIG. 7



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JOINT FOR ELECTRICAL CONDUCTORS

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Application July 23, 1936, Serial No. 92,122

7 Claims. (Cl. 173—268)

This invention relates to splices or joints for electrical conductors or cables formed of concentrically disposed conductors generally referred to as coaxial cables and the invention has particular reference to a method of making splices in such conductors.

The coaxial cable to which the splice of this invention is particularly applicable generally consists of a flexible tubular conductor which is formed of a plurality of helically disposed interlocking conducting strips, a centrally disposed conductor in the form of an ordinary wire which is supported concentric to the outer conductor by a plurality of equally spaced insulating disc members, a plurality of steel tapes which are wound helically on the tubular or outer disposed conductor to provide electromagnetic shielding for the conductors and a protecting lead sheath insulated from the tubular conductor by a covering of insulating material. In practice, a number of concentric cables are enclosed and protected by the same lead cable sheath. To distinguish from the cable which contains the concentric conductors, each pair of concentric conductors making up a coaxial cable will be referred to as a coaxial unit. Two of these coaxial units may be enclosed in the same lead sheath.

Cables of this type, as is well known, are used for transmitting high frequency currents and it is essential that such conductors be spliced in such a manner as to minimize cross-talk between the different coaxial units of the cable.

The object of the invention is to provide a method of and means for splicing coaxial units of concentrically disposed conductors to prevent cross-talk between the units.

In the drawings:

Fig. 1 is a perspective view of a completed joint in a cable having two coaxial units showing the protective lead sleeve in section;

Fig. 2 shows conductors to be electrically connected prepared according to the method of the invention;

Fig. 3 is a view similar to Fig. 2 showing the outer disposed conductor and the insulating plugs in section, the insulating plugs holding the centrally disposed wire concentric relative to the outer conductors;

Fig. 4 shows a conducting sleeve pressed around the adjacent ends of two centrally disposed conductors for holding them in coaxial relation;

Fig. 5 shows the conducting sleeve on the adjacent ends of the centrally disposed conductors united to these conductors by a layer of solder with a sleeve positioned over the adjacent ends of the outer conductors;

Fig. 6 shows the conducting sleeve pressed around the ends of the outer disposed conductors with the clamping rings crimped on the ends of the sleeve;

Fig. 7 is a view of a completed joint in one coaxial unit showing the outer disposed conductors, the connecting sleeve, the clamping rings, and the steel tapes covered with a coating of solder;

Fig. 8 is a perspective view of an insulated plug shown partly in section;

Fig. 9 is a perspective view of the sleeve used for connecting the centrally disposed conductors;

Fig. 10 is a perspective view of the sleeve used for connecting the outer disposed conductors;

Fig. 11 is a perspective view of a metallic ring used for securing the steel tapes on the ends of the outer disposed conductors;

Fig. 12 is a perspective view of a metallic ring used for securing the sleeve on the ends of the outer disposed conductors; and

Fig. 13 is a partial view of a joint in perspective showing the shape of the clamping rings after each crimping operation.

In the drawings as shown in Figs. 1, 2, 3, 4, 5, 6 and 7 the adjacent ends of two sections of coaxially disposed concentric conductors enclosed in the lead sheath LS and insulated therefrom by a paper wrapping PW may be spliced or connected in coaxial relation by first cutting the lead sheath from the end of each section of the two sections of cable to be spliced, to expose the concentric conductors a length equal to the protruding ends of the centrally disposed conductors C and C1 relative to the ends of the outer conductors OC and OC1 plus the distance of the outer conductors OC and OC1 relative to the ends of the steel tapes ST and ST1 and the ends of the steel tapes relative to the ends or butts of the protecting lead sheath LS.

The adjacent ends of the steel tapes ST and ST1 are secured on the periphery of the outer conductors by similar metallic rings 23 crimped thereon as shown in Fig. 13 for preventing these tapes from unwinding during the making of the joint, this condition being shown in Fig. 2.

An insulated plug 24 shown in Figs. 3, 4, 5, 6 and 7 is slipped over the end of each centrally disposed conductor in telescopic engagement with the tubing or outer conductors OC and OC1, these plugs being provided for insulatively supporting the conductors C and C1 concentric relative to

their associated conductors OC and OC1 as shown in Fig. 3.

A ring **25** is placed on each end of the outer conductors OC and OC1 prior to the placing of a split conducting sleeve **26**, Figs. 4 and 9, on the adjacent ends of wires C and C1 in abutting relation with similar ends of plugs **24**, this condition being shown in Fig. 4.

The sleeve **26** after being pressed on the wires C and C1 is soldered thereon as shown in Fig. 5, after which a conducting sleeve **22** is placed in position to be pressed on the ends of the outer conductors OC and OC1 where it is held securely by the rings **25** above mentioned crimped on the ends of the sleeve **22**, Figs. 10 and 5 at points over the circular rows of perforations *pf* as shown in Fig. 6 which correspond to the distance between the lines L, L and L1, L1 shown in Fig. 3. This serves to mechanically connect the outer conductors and to secure the plugs **24** against axial movement relative to wires C and C1 and the tubular conductors OC and OC1. The perforations *pf* permit the solder to flow between the periphery of the conductors OC and OC1 and the under side of sleeve **22**, when this sleeve, the rings **25**, the portions P shown in Fig. 6 of the outer conductors OC and OC1 disposed between the ends of the steel tapes ST and ST1 and the opposite ends of sleeve **22**, the steel tapes and their clamping rings **23**, are covered with a coating of solder. By virtue of this construction the short lengths of outer coaxial conductors between the ends of the steel tapes and the edges of the outer connecting sleeve are tinned over their entire areas to form the equivalent of solid walled tubes, which construction reduces cross-talk between the two coaxial units of the cable to a low enough value to meet very exacting requirements.

Upon the completion of the joints in the pair of coaxial units as shown in Fig. 1 these joints are covered by a common lead sleeve soldered in the ordinary manner to the ends of the lead sheath LS of each section, the adjacent ends of such lead sheath being each previously wrapped with a length of tape **20** and **21** of insulating material extending as shown in Fig. 1 a substantial length over the steel tapes ST and ST1 of each section.

What is claimed is:

1. The method of connecting electrical tubular conductors, which method consists in placing a split sleeve of conducting material on the adjacent ends of the tubular conductors, and securing the ends of the sleeve on the ends of the tubular conductors by crimping a ring on each end of the sleeve and uniting the sleeve to the tubular conductors and the rings by soldering.

2. The method of connecting two electrical conductors of tubular cross-section each having a metallic tape wound thereon, which method consists in cutting the adjacent ends of the metallic tapes a certain distance from the adjacent ends of the tubular conductors, crimping a ring on each end of the tapes for securing them on the tubular conductors, placing a split sleeve on the adjacent ends of the tubular conductors and mechanically securing the conducting sleeve onto the conductors by crimping metallic rings on its ends and uniting the sleeve, the tubular conductors and the rings as by soldering.

3. The method of connecting a pair of concentrically disposed conductors, enclosed in lead sheaths the outer disposed conductors having metallic tapes wound thereon which method consists in cutting the adjacent ends of the lead sheaths for uncovering the concentric conductors a predetermined length from the ends of the lead sheaths, cutting the tubular conductors a predetermined length from the ends of the lead sheaths, cutting the adjacent ends of the metallic tapes a small distance from the ends of the tubular conductors, crimping rings on the ends of the metallic tapes for securing them on the tubular conductors, inserting insulating plugs on the ends of the centrally disposed conductors in engagement with the tubular conductors for holding them in concentric relation, inserting and soldering a sleeve on the centrally disposed conductors for connecting them, inserting a split conducting sleeve on the adjacent ends of the tubular conductors, and crimping a ring on each end of the split conducting sleeve for securing it on the ends of the tubular conductors and covering the sleeve, the ends of the tubular conductors and the rings by soldering.

4. The combination in a joint for concentrically disposed conductor members, the outer conductors each having a metallic tape wound thereon, a sleeve of conducting material crimped on the adjacent ends of the centrally disposed conductors for electrically connecting them, another sleeve of conducting material connecting the adjacent ends of the outer disposed conductors, a plurality of insulating members interposed between said conductors for holding them in concentric relation to each other, rings crimped on the end of the metallic tapes for securing them on said outer conductors and other rings crimped on the ends of the last-mentioned sleeve for securing it to said tubular conductors and the tubular conductors to said insulating members by a contraction of said tubular conductors at the points of application of said other rings.

5. In a joint for concentrically disposed conductor members, the outer conductors each having a metallic tape wound thereon, a sleeve of conducting material formed over the adjacent ends of the centrally disposed conductors for electrically connecting them, insulating means mounted on the centrally disposed conductors and extending into the tubular conductors for holding the centrally disposed conductors in concentric relation to the outer conductors, a sleeve of conducting material formed over the ends of the outer conductors for electrically connecting them, a ring crimped over each end of the last-mentioned sleeve for securing it on said outer conductors and a ring crimped over each end of said tapes for securing them on said outer conductors.

6. In a joint for concentrically disposed conductor members a split sleeve of conducting material pressed around the adjacent ends of the centrally disposed conductors for electrically connecting and holding them in axial relation to each other, an insulating sleeve placed on each end of the inner conductors in telescopic engagement with the outer disposed conductors for holding the inner conductors in concentric relation with the outer conductors, a split sleeve of conducting material pressed on the adjacent ends of the outer conductors and clamping rings crimped over the ends of the last-mentioned sleeve for securing it to the ends of the outer conductors.

7. In a joint for connecting the adjacent ends of two sections of concentrically disposed con-

ductor members, a sleeve of conducting material secured on the adjacent ends of the centrally disposed conductor members for electrically connecting them in coaxial relation to each other, a sleeve of conducting material engaging the adjacent ends of the tubular conductors for electrically connecting them in coaxial relation to each other, a metallic ring clamped on each end of the last-mentioned sleeve for securing it to the outer conductor member of each section, and a plurality of insulating means interposed between the centrally and the outer disposed conductors of each section for holding them in concentric relation to each other, said insulating means supporting the clamping effect of said rings on the ends of said sleeve and said sleeve on the ends of the outer conductor of each section.

JOSEPH J. HARLEY.