Nov. 14, 1939. J. F. WENTZ 2,179,971

MEANS AND METHOD OF SECTIONALIZING COAXIAL CABLES

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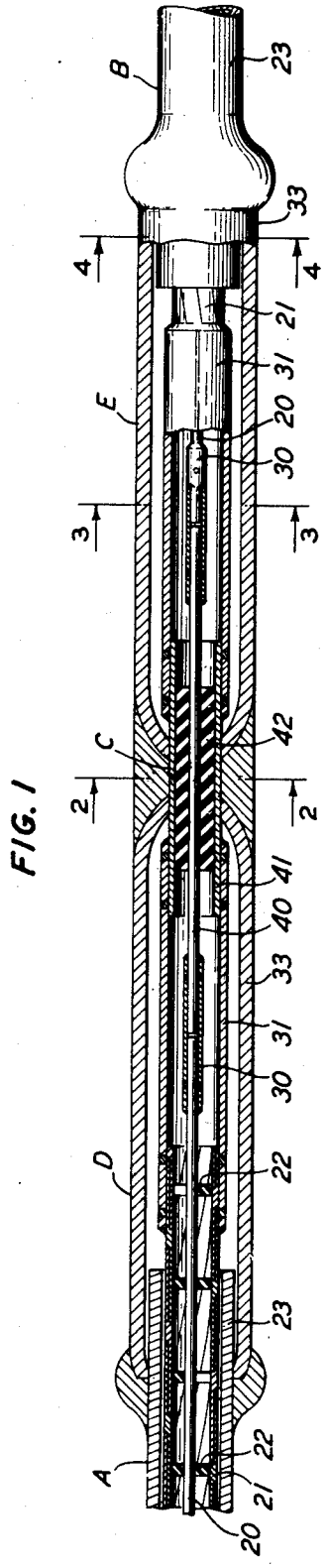

FIG. 1

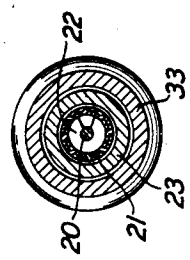

FIG. 4

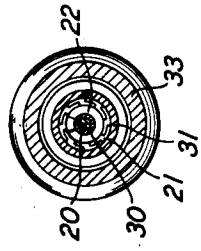

FIG. 3

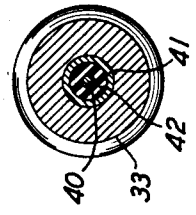

FIG. 2

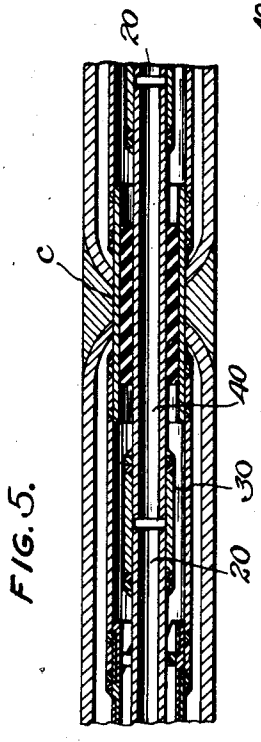

FIG. 5.

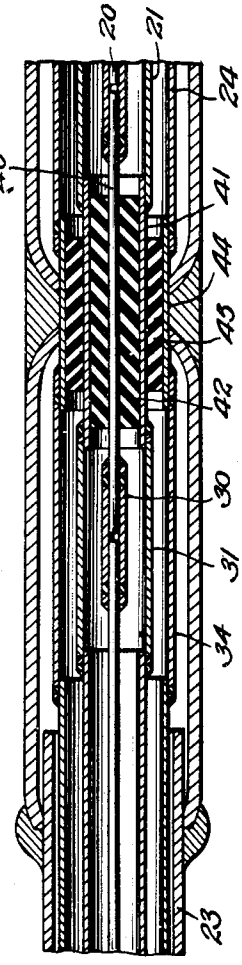

FIG. 6.

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MEANS AND METHOD OF SECTIONALIZING COAXIAL CABLES

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5 Claims. (Cl. 174—22)

This invention relates to means and methods of sectionalizing signaling cables of the coaxial type.

In the coaxial type of cable unit the central conductor is usually a solid strand of copper and the coaxial conductor is usually made up by spirally winding a Z-shaped copper tape with appreciable overlap about the central conductor. The conductors are held in coaxial relation by means of spaced insulating washers. It has recently been proposed to insure high insulating properties of the space between the two conductors by enclosing the two conductors within a continuous lead sheath. A problem has therefore arisen similar to that encountered with lead sheathed multiconductor telephone cables, namely that of checking the condition of the lead sheath to prevent entrance of moisture into the interior of the cable. For this purpose the cable is filled with an inert gas, such as nitrogen, under pressure and well-known means are provided for checking the gas pressure and thereby detecting the presence of leaks.

In this connection it has therefore become desirable to sectionalize the cable in a manner analogous to that used for multiconductor telephone cables. However, in view of the difference in structure of the two types of cables, it is not convenient to use the methods of and means for sectionalizing which are suitable for the multiconductor cables.

It is, therefore, an object of the invention to provide practical means and procedures for sectionalizing the air circuit in cables of the coaxial type.

It is a more particular object to provide a unitary sealing connector for insertion between the ends of two adjacent sections of coaxial cable so that field operations may be reduced to a practical minimum.

It is furthermore an object to provide a connector unit in which the conductors are separated by high grade insulation which also will form a seal that will remain impervious for a long time.

In accordance with a feature of the invention, a coaxial cable unit is divided into two sections by cutting the cable and inserting between the separated ends a sealing connector. The sealing connector is a unitary structure provided with the necessary number of coaxially disposed conductors, the annular space between adjacent conductors being sealed by means of a suitable insulating compound for preventing passage of gas in a lengthwise direction of the connector. The conducting elements of the connector are of solid construction to prevent passage of gas in the radial directions of the connector.

In accordance with another feature of the invention the insulating compound acting as the sealing plug in the connector is placed in position while in a semi-plastic state and the entire unit is subsequently treated to change the compound to a non-plastic condition.

In accordance with still another feature the conducting elements of the connector are staggered in length, the inner conductor being longer than the next outer conductor to facilitate connection to the corresponding cable conductors.

In accordance with a more specific feature of the invention a connector having two conducting elements has its outer sleeve conductor connected to the outer conductors of the cable sections and also has sealed thereto lead sleeves connecting with the lead sheaths of the cables to form both a connecting link between the tubular conductors of the cables and also to form part of the external sheathing.

For a clearer understanding of the invention a description will be given in connection with the attached drawing in which:

Fig. 1 shows two adjacent ends of coaxial cable sections interconnected and sealed by means of a connector in accordance with a preferred form of the invention.

Figs. 2, 3 and 4 are sectional views of the arrangement shown in Fig. 1 taken on the lines 2—2, 3—3, and 4—4, respectively, in Fig. 1.

Fig. 5 shows an alternative form of the connector shown in Fig. 1 especially adapted for cables with a hollow central conductor.

Fig. 6 shows an alternative form of the invention particularly adapted to cables having more than two concentric conductors within the cable sheath.

As shown in the drawing, a cable section A and a similar cable section B are interconnected with a connector C by means of sleeve connections D and E, respectively. The cable sections A and B being of nearly similar construction, the whole arrangement is symmetrical with respect to the mid-point of the connector C.

The cable A has a central conductor 20 surrounded by a coaxial conductor 21 formed by winding Z-shaped copper tapes in a helix with considerably overlapping turns. The conductors 20 and 21 are maintained in concentric relation by means of slotted washers 22 of insulating material and spaced at regular intervals along the cable. Immediately on the outside of the coaxial

conductor 21 there is placed a continuous lead sheath 23. The cable B is of the same construction. For the purpose of preparing the cable ends for interconnection the outer conductor 21 is shortened with respect to the inner conductor 20 and the lead sheath is still further shortened substantially as shown in the drawing.

The connector unit C comprises a central conductor 40 formed of a straight, solid wire the length of which may vary from a few inches to a few feet. The connector further comprises a sleeve 41 formed as a tube of solid walls and appreciably shorter than the wire 40. The tube 41 is held in concentric relation with the wire 40 by means of a sealing plug 42 of suitable insulating material.

In making the connection between the connector C and the cable A, a sleeve 30 is used to unite the wires 20 and 40 by soldering and a sleeve 31 similarly unites the conductors 21 and 41. Similar sleeve connections are made between the connector C and the cable B.

For the purpose of completing the impervious envelope formed by the lead sheaths 23, a joint is formed by means of a lead sleeve 33 wiped to the outside of the sheath 23 of the cable A and soldered to the outside of sleeve 41 of the connector C. A similar lead sleeve 33 connects the lead sheath of cable B to the connector sleeve 41. The annular joints between the sleeves 33 and the lead sheaths and between sleeves 33 and the connector sleeve 41 must be carefully made to be impervious to gas and moisture. It may be particularly noted that the seal between the sleeves 33 and the outer sleeve 41 of the connector C must be impervious not only in a radial direction, but also in a lengthwise direction to insure complete separation by the air circuits of the two cable sections A and and B.

The connector unit C is preferably factory made, thereby insuring that the central conductor is accurately centered within the sleeve conductor, and also insuring that good seals are formed between the conducting surfaces and the insulating plug. The sealing or plugging material is preferably a rubber compound which can be rendered plastic at moderate temperatures and which is vulcanizable at higher temperatures; the finished vulcanized plug is substantially non-plastic at all temperatures met with under operating conditions.

In forming the plug for the tube, the rubber compound is first heated to a semi-plastic state which may be attained at temperatures around 100° F. The central wire 40 is then rotated in engagement with the surface of the tacky compound which adheres thereto, the rotation being continued until a sufficiently heavy layer has been formed. The surface of the adhering compound is then rolled within cleaned or chromium plated iron plates fixed a distance apart equal to the inner diameter of the outer conductor. In this manner, a mass is obtained which is substantially free of air bubbles, and which has a smooth cylindrical surface. The outer conductor is then placed in position about the plug which again is heated to about 100° F. and is pressed into engagement with the inner surface of the outer conductor by means of plungers inserted at both ends of the plug. Thus air next to the outer conductor is forced out and good contact is made. The unit is then heated in steam to vulcanizing temperature for about thirty minutes, the temperature approaching 300° F.

In order to insure that the compound is properly vulcanized to the metal parts, the conductors 40 and 41 may be entirely of brass or may be of other conducting material such as copper, having the surface engaging the plug coated with brass.

It should be understood that various modifications of the structures described and shown in Figs. 1 to 4 are possible without a departure from the spirit of the invention as defined by the claims. Thus, as shown in Fig. 5, the central conductor 40 of the connector unit C may be hollow, especially in the case where the central conductors 20 of the cable sections are hollow as for the purpose of passing gas. In the case of cables, such as shown in Fig. 6, with more than two concentrically arranged conductors 20, 21, 24, the connector unit may, of course, have a corresponding number of concentrically arranged conducting elements 40, 41, 44 and plugs 42, 45, each similar to the one shown in Fig. 1, may be placed between any two adjacent conducting elements of the connector for the purpose of separating corresponding gas chambers in the cable sections. Corresponding conducting elements would be connected together by conducting sleeves 30, 31 and 34.

Whereas it is important that the insulating compound should be caused to adhere closely to the opposing surfaces of the connector by the vulcanizing action, the vulcanization need not take place at elevated temperatures; the temperature and duration of the vulcanizing process will, of course, depend upon the choice and quantity of vulcanizing agents and accelerators.

It should, furthermore, be pointed out that whereas vulcanized rubber is free from cold flow and thus is particularly suited for use in extremely hot climates, for cables subject to less extreme temperatures the connector units may be sealed with other insulating compounds, such as polymers of various hydrocarbons. A prerequisite is that the substance, when applied in melted form, should have a decided tendency to wet the metal surfaces thereby securing close adherence when hardened; it is furthermore important that the substance be not too brittle to withstand ordinary abuses in handling; the tendency to cold flow must of course be considered in view of the particular climatic conditions to which the cable will be subjected. A suitable polymer for this purpose would be styrene, used with or without suitable plasticizing agents to control its brittleness.

What is claimed is:

1. Two sections of coaxial cable and a sealing joint therefor, said two sections of coaxial cable each having a central conductor, a tubular conductor coaxial with the central conductor and a lead sheathing enclosing said tubular conductor, said joint comprising a short section of a central conducting rod connected to the central cable conductors, a still shorter open ended gas impervious conducting sleeve coaxial with said rod and of substantially the same inner and outer diameters as the tubular cable conductors and connected thereto, a gas impervious seal between said rod and sleeve of insulating material closely adhering to said rod and sleeve for a substantial part of the length of said sleeve, a lead sleeve connecting said conducting sleeve with one of the cable sheaths, and a lead sleeve connecting said conducting sleeve with the other cable sheath, said lead sleeves being connected to said sheaths and said connecting sleeve by gas impervious annular joints.

2. Two sections of coaxial cable and a sealing

connector for interconnection of said two sections of coaxial cable, said sections each having an inner conductor and each having an outer conductor coaxial with the inner conductor and formed into a highly conducting cylindrical element, and each having an outer metallic element forming an envelope for the interior of the cable normally impervious to gases and liquids, said connector constituting a structure for insertion as a unit between said cable sections and having an inner conducting element connected to said inner conductors and presenting a solid impervious outer wall, an outer solid highly conducting sleeve coaxial with said inner element and connected between said high conducting elements, an annular imperivous seal between said inner element and said sleeve of insulating material, and an annular impervious metallic seal between said metallic elements and said sleeve.

3. A three-element coaxial cable having a continuous central conducting strand, a continuous substantially tubular conductor placed coaxially about said strand and a gas impervious metallic sheath entirely surrounding said tubular conductor, a short length of said tubular conductor being in the form of a gas impervious cylindrical wall, a short length of said strand coincident with said impervious wall being in the form of a solid rod, gas impervious insulating material between said wall and rod entirely sealing the annular space between said wall and rod and closely adhering to both for a short distance, said sheath entirely enclosing said short length of tubular conductor and being connected thereto by an annular gas impervious metallic junction therewith.

4. A three-element gas-filled coaxial cable including a sectionalizing sealing joint, each section of said cable having a central conductor and an outer substantially tubular conductor coaxially disposed about said central conductor, and said cable including a continuous lead sheath entirely surrounding said conductors and said joint, and said joint comprising a central connector for interconnecting said central conductors and presenting a gas impervious outer wall, a substantially tubular connector coaxially disposed about said central connector and presenting a gas impervious tubular wall, an annular seal between said tubular and central connectors of gas impervious insulating material and adhering to said impervious walls, an annular seal between said tubular connector and said continuous sheath of lead and adhering to said tubular wall and said sheath, and connecting means between said tubular connector and said tubular conductors.

5. A three-element coaxial cable having a central conducting strand, a substantially tubular conductor placed coaxially about said strand and a gas impervious metallic sheath entirely surrounding said tubular conductor, said central strand and tubular conductor each forming a continuous physical structure of substantially uniform dimensions throughout said cable, a short length of said tubular conductor being in the form of a gas impervious cylindrical wall, a short length of said strand coincident with said impervious wall being in the form of a solid rod, gas impervious insulating material between said wall and rod entirely sealing the annular space between said wall and rod and closely adhering to both for a short distance, said sheath entirely enclosing said short length of tubular conductor and being connected thereto by an annular gas impervious metallic junction therewith.

JESSE F. WENTZ.