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Kothe et al.

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[54] **PRESSURE RESISTANT CABLE**

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[62] Division of Ser. No. 116,845, Feb. 19, 1971, abandoned.

[52] **U.S. Cl.** ..... **174/105 R,** 174/23 R, 174/106 R, 174/107, 174/108, 174/126 CP

[51] **Int. Cl.** **H01b 11/06**

[58] **Field of Search** ..... 174/106 R, 106 D, 108, 174/102 D, 107, 105 R, 105 B, 36, 126 CD, 128, 23 R

[56] **References Cited**

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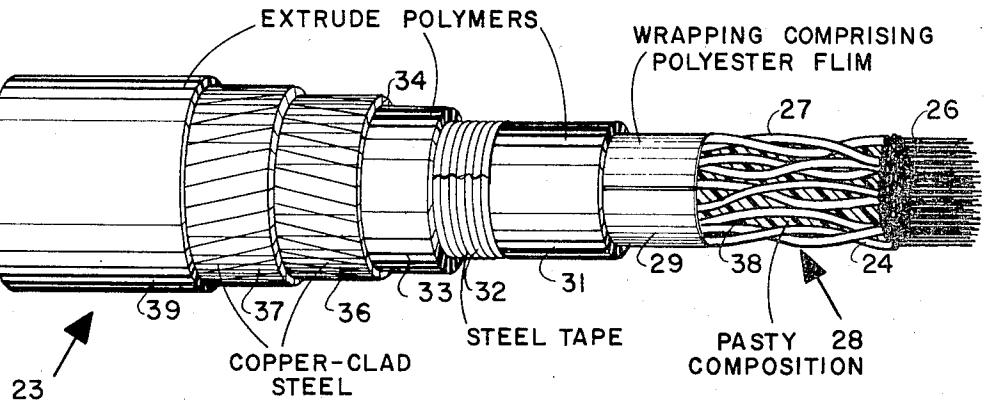
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[57] **ABSTRACT**

A land lines communication cable system resistant to shock pressures comprises an integral tensile unit wherein tensile tapes covering the cable lengths are secured to splice cases, and an integral compressive unit wherein a plurality of both cable lengths and splice boxes are filled with an intercommunicating incompressible pasty composition.

2 Claims, 2 Drawing Figures



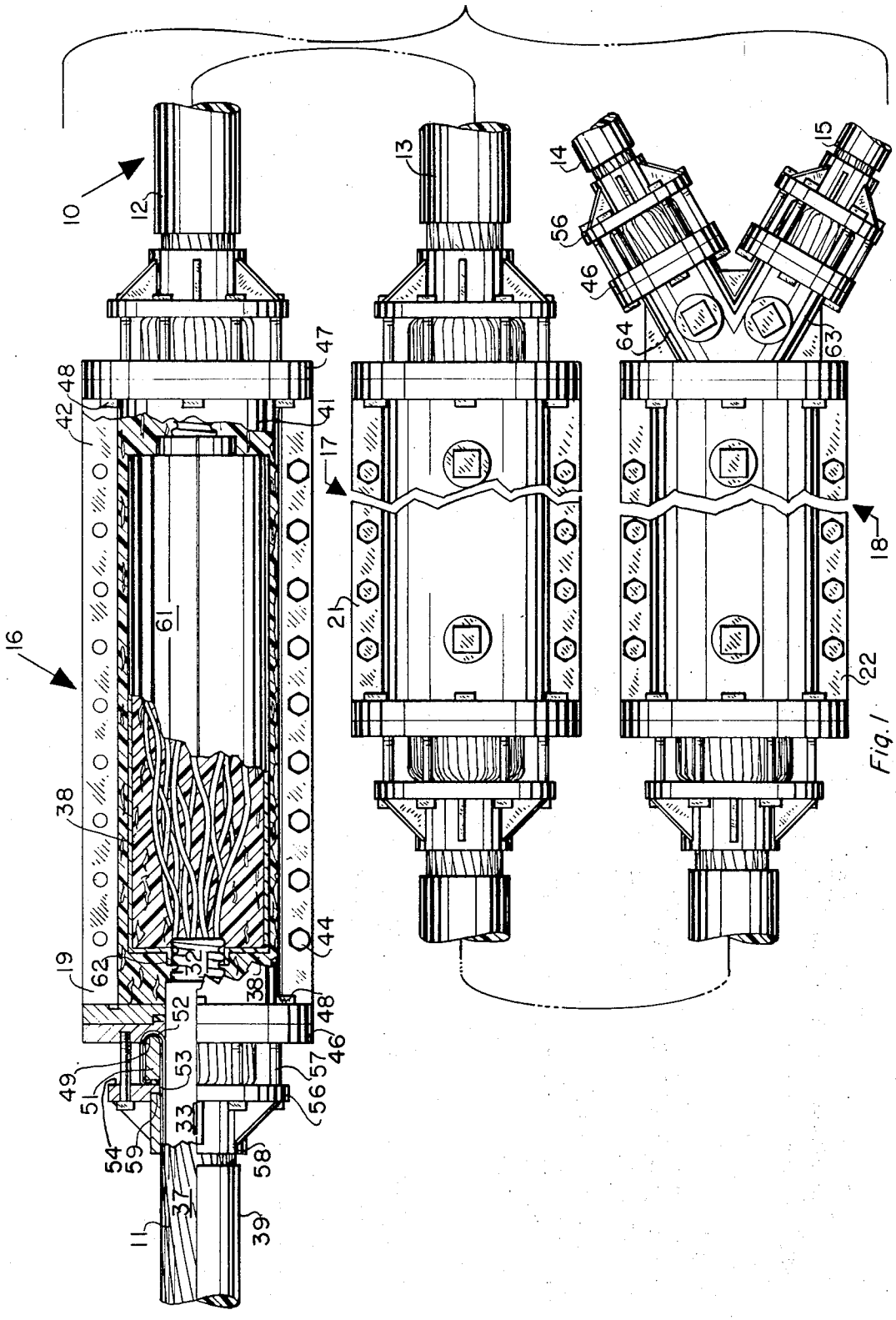


Fig. 1

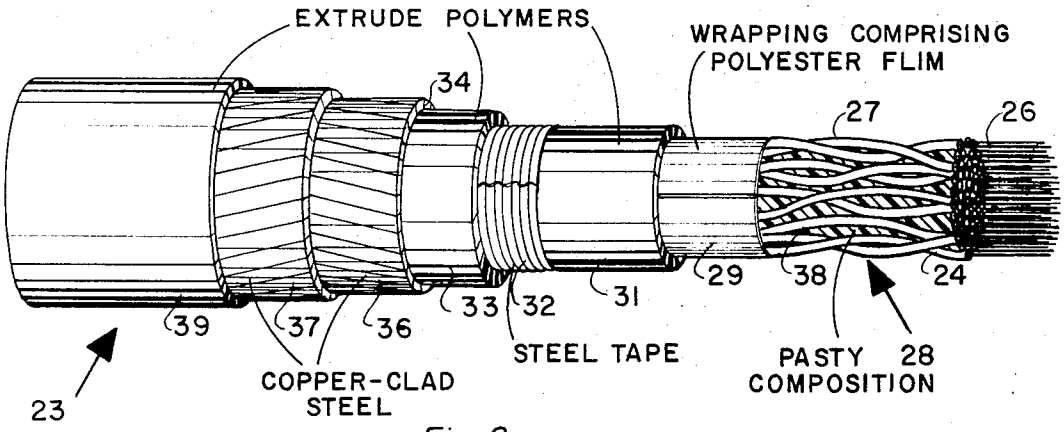

EXTRUDE POLYMERS
WRAPPING COMPRISING POLYESTER FLIM
34
27
26
29
38
24
39
37
36
33
32
31
23
COPPER-CLAD STEEL
STEEL TAPE
PASTY 28 COMPOSITION

Fig. 2

PRESSURE RESISTANT CABLE

This is a division of application Ser. No. 116,845 filed Feb. 19, 1971 now abandoned.

BACKGROUND OF THE INVENTION

Communication cables, which in this application are construed to include cables for communicating not only voice signals but signals other than voice signals including what are sometimes designated control cables, are herein designated land lines cables as distinguished from submarine cables. Such cables in combination with splices and/or auxiliarly equipment such as amplifiers comprise a cable system which may be buried in whole or in part. While it has been known to protect cables, including communications cables, from mechanical damage by covering them with armor wires or tapes, this has not provided protection against gaseous pressure waves that pass through interstices in the armor, or tensile forces so great in extent that they affect areas beyond the termination of the armor. Conventional cables, even if they are protected by armor, can be crushed by high external gas pressures so that the conductors within the cables are severed or shorted to each other by the destruction of their insulation. Although it has been known to fill communication cables with pasty compositions to keep out moisture, such compositions have not constituted any protection against local crushing pressures since a filling of composition would yield under pressure either by being extruded to an opening in the cable sheath or swelling or bursting the sheath at a low-pressure area.

SUMMARY

We have invented a land lines communication cable system at atmospheric pressure that is highly resistant to destruction by severe external shock pressures. This system comprises a plurality of lengths of cable each comprising a plurality of insulated communications conductors and a tubular sheath, such as a polymeric extrudate, surrounding the conductors and a plurality of layers of high-tensile-strength armor tapes surrounding the sheath. Our system also comprises at least one connection between the cable lengths comprising a splice between the conductors of the different cable lengths and a splice case enclosing the splice and, possibly, auxilliary apparatus. The splice case is characterized by the fact that, although it is normally maintained at atmospheric pressure, it has substantial hoop strength and is capable of withstanding high tensile and compressive shock forces. The case comprises means at both ends for securing the armor tapes of different lengths of cable so that tensile stresses are carried through one of the lengths, the case, and the tapes of another length acting as one continuous tensile member. An incompressible pasty composition fills all void spaces within the cable sheaths and the splice case and can flow from one to the other under a high pressure differential. Since, however, the case is filled with composition and has an exceedingly high hoop strength the composition in the cable has no outlet to flow into when a portion of the cable is subject to compression. It cannot burst out of a remote section of the cable itself because of the high tensile strength of the armor tapes.

A preferred embodiment of cable for our system comprises a continuous extruded tubular polymeric sheath surrounding a plurality of insulated communication conductors, a corrugated steel shielding tape wrapped with an overlapped longitudinal seam to surround the sheath, and a continuous extruded polymeric jacket over the shielding tape. This tape has an overlapping portion of itself and would be free to yield under compression in the absence of pasty filler. A first layer of high-tensile-strength armor tapes is helically wrapped around the cable jacket with one direction of lay and is directly covered with another layer of high-tensile-strength armor tapes with a reverse direction of lay. In addition to their structural effect the armor tapes provide additional electric and magnetic shielding of the conductors and we have found that this shielding is enhanced as a result of the separation of the armor tapes from the corrugated shielding tapes by the extruded sheath. A continuous, polymeric, outer jacket is extruded over the second layer of armor tapes. These jackets and also the sheath, preferably comprise a polyolefin and our system may comprise a number of splice boxes and cover a distance miles in extent.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a side view, partly in section, of the cable system of our invention.

FIG. **2** shows a cut-away pictorial view of a cable of our invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A cable system, designated generally by the numeral **10,** comprises a plurality of cable lengths **11, 12, 13, 14 15** with interconnections **16, 17, 18** comprising splice cases **19, 21, 22** of which we shall describe the interconnection **16** and splice case **19** in more detail hereinbelow. The structure of a cable **23** forming the cable lengths **11–15** is shown in detail in FIG. **2** to comprise a plurality of insulated conductors **24,** twisted into pairs in a known manner. Each of the insulated conductors has a copper wire **26** and a surrounding wall of polyethylene insulation **27.** Our invention is, of course, not limited by the particular type of communication conductors in the cable **23** which may include coaxial cables, quads, unpaired conductors, and, indeed some additional strands other than communication conductors. 25 pairs of the insulated conductors **24** are stranded together to form a core **28.** In the illustrated cable the conductors are No. 16 Awg (American Wire Gage) solid copper with 20-mil walls of solid polyethylene insulation, and the core formed by these conductors is wrapped with an 0.016-inch-thick tape **29** of SBR (styrene-butadiene rubber) backed with polyester film. A sheath 31,90 mils thick, of low-density polyethylene is extruded over the core **28** and over this has been folded a ten-mil corrugated shielding tape **32** of low-carbon, tin-coated steel. Over the steel tape **32** is extruded a 120-mil jacket **33** of low-density polyethylene to a diameter of 1.845 inch. A plurality of high-tensile strength tapes **34** are wrapped around the jacket **33** in two layers **36** and **37.** The tapes **34** are rolled from copper-clad steel to a dimension of 0.050 × 0.200 inch, the layer **36** being applied with a 12 ½ inch right hand lay and the layer **37** with a 12½ inch left hand lay. The reverse lays of the layers **36** and **37** keep the cable balanced under tension and the pitch diameter of the armor tape layers is long enough to provide an extremely high tensile strength for the cable as a whole, easily withstanding a pull of 30,000 pounds without damage, while

at the same time being short enough to provide the hoop strength necessary to confine the contents of the core when portions of the cable are subjected to compression.

In addition the armor tapes **34** reinforce the shielding effect of the tape **32.** The shielding effect of the armor layers **36, 37** is enhanced by the reverse lays of the two layers and the close spacing of the tapes within each layer. A pasty composition **38** fills the space between the conductors **24** in the core **28.** This composition is essentially incompressible and preferably will be water insoluble and have a high dielectric strength. A suitable composition is described in U.S. Pat. NO. 3,539,708.

An overall low density polyethylene jacket **39** is extruded over the layer **37** providing mechanical and moisture protection to the cable **23.** The large size and weight of the cable **23** limits the continuous length that can be delivered to any installation site so that connections will be required even in the absence of amplification or branching of the cable system.

To make a connection such as the interconnection **16,** the wires **26** of the cable lengths **11** and **12** can be spliced by any suitable means of which several are known, after cutting away the overlaying layers as shall be explained. The splice is finally protected by the heavy splice case **19** which is formed by bolting together upper and lower flanged sections **41, 42** with a large plurality of bolts and nuts **44** to provide a very high hoop strength. The ends of the sections **41, 42** bolt to end plates **46, 47** by means of cap nuts **48.** The end plates **46, 47** have circular grooves **49** scored for firm gripping of the armor tapes **34** which are wrapped around steel rings **51** shaped to fit the grooves **49** on one face **52** and flattened on the other face **53.** The flattened surface **53** serves to grip the ends of the tapes **34** against a scored surface **54** of a facing plate **56** which is locked against the ring **51** by means of long bolts **57** which thread into taps in the plate **46.** A gusseted stub tube **58** fits a counter bore **59** in the facing plate **56,** the plate **56** and tube **58** having an inside diameter closely fitting over the layer **37.** The case **19** encloses a split inner steel casing **61** having thin tubular extensions **62** that fit closely over the shielding tape **32** and make electrical contact with the shielding **32,** such as by being wired down upon the tape or soldered to it so that the casing **61** affords shielding continuity between tapes **32** of the two lengths **11,** and **12,** and so on. Thus throughout our system the shielding is continuous. Similarly the case **19** itself provides shielding continuity as well as structural continuity of the layers **36, 37.** The splices in the wires **26** are staggered within the casing **61** and the tapes **29, 32** and sheath, **31** are cut off so that they extend a short distance within the casing **61** to expose the conductors **24** for splicing. The jacket **33** is cut off so that it extends within the case **19** a short distance from the extension **62.** The tapes **34** are cut so as to leave enough free length for wrapping around the ring **51,** and the jacket **39** is cut just short of abutting the tube **58.**

Surrounding the splice in the wires, the casing **61** is completely filled with the pasty composition **38** forming a continuum with the composition in the cable cores. Outside of the casing **61** composition fills the remaining space in the case **19.** There is, in fact, a continuous pressure contact of the composition **38** within our system including the cable lengths **11, 12, 13, 14, 15** and cases **19, 21, 22.** The case **22** is bifurcated at one end to provide for a branched splice but each of bifurcations **63, 64** is provided with plates **56, 46** and ring **51** to anchor the tape armors in the manner of the case **19.**

We have invented a new and useful cable system of which the foregoing description has been exemplary rather than definitive, and for which we desire an award of Letters Patent as defined in the following claims.

We claim:

1. A cable for a land lines communication system resistant to destruction by high external shock pressures comprising:

A. a plurality of insulated communication conductors,

B. a wrapping comprising polyester film, surrounding said conductors,

C. a continuous, extruded, tubular polymeric sheath directly covering said polyester film,

D. an incompressible pasty composition completely filling all void spaces within said sheath at atmospheric pressure,

E. a corrugated steel shielding tape wrapped with an overlapped longitudinal seam surrounding said sheath,

F. a continuous extruded tubular polymeric jacket surrounding said shielding tape,

G. a first layer of high-tensile-strength copper-clad steel armor tapes helically wrapped around said jacket with a selected direction of lay,

H. a second layer of high-tensile-strength copper-clad steel armor tapes helically wrapped over said first layer with a direction of lay in reverse of the direction of said first layer,

I. a continuous extruded polymeric outer jacket surrounding said second layer.

2. The cable of claim **1** wherein said sheath and said jackets comprise polyethylene.

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