United States Patent

Lawrenson

[15] **3,678,177**

[45] **July 18, 1972**

[54] TELECOMMUNICATION CABLES

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[52] **U.S. Cl.** .....**174/113 C,** 174/113 AS, 174/113 R, 174/116

[51] **Int. Cl.** **H01b 11/02**

[58] **Field of Search**.....174/113 R, 113 AS, 113 C, 116

[56] **References Cited**

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Primary Examiner—E. A. Goldberg

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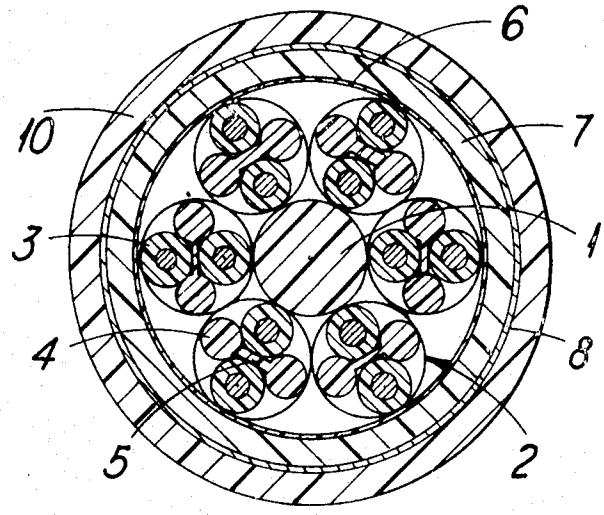
[57] **ABSTRACT**

In a telecommunication cable comprising a plurality of pairs of twisted together insulated conductors in which one or each of the interstitial spaces present within the circumscribing cylinder of each of some or all of the pairs of insulated conductors is occupied by an elongate member of electrically insulating material, which elongate members serve to prevent displacement of one pair with respect to an adjacent pair, each elongate member is integral with or secured to one of the insulated conductors of the pair with which it is associated or is integral with or secure to the elongate member, when present, occupying the other interstitial space of the pair.

17 Claims, 8 Drawing Figures



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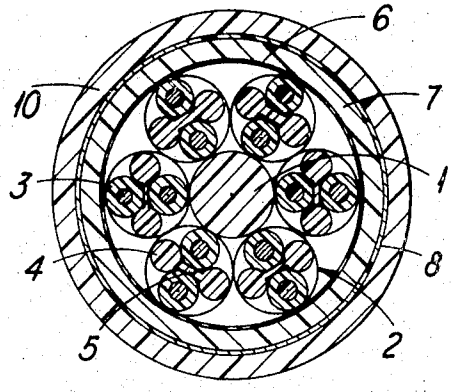

Fig. 1.

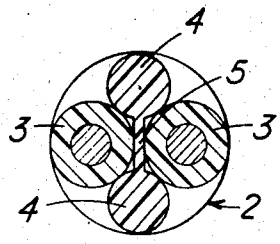

Fig. 2.

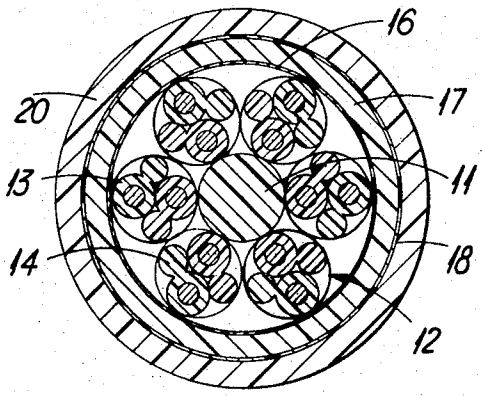

Fig. 3.

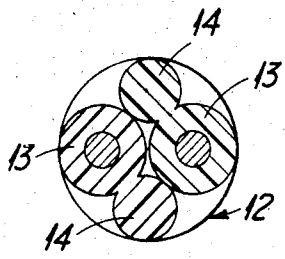

Fig. 4.

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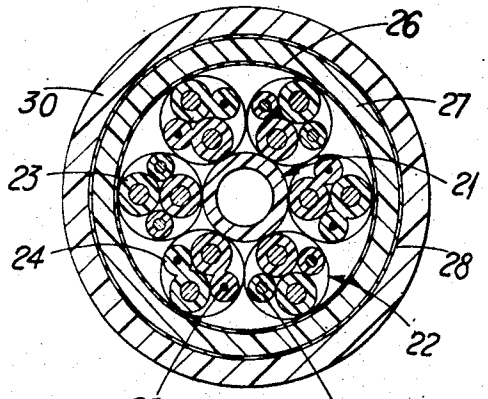

Fig. 5.

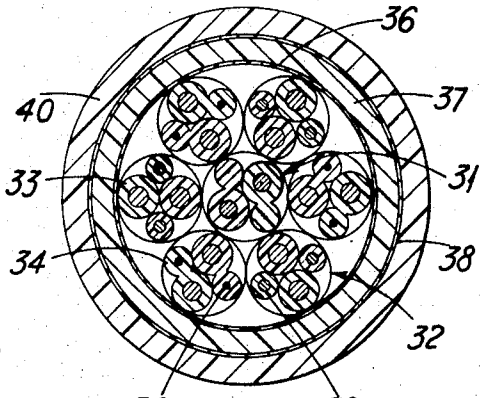

Fig. 6.

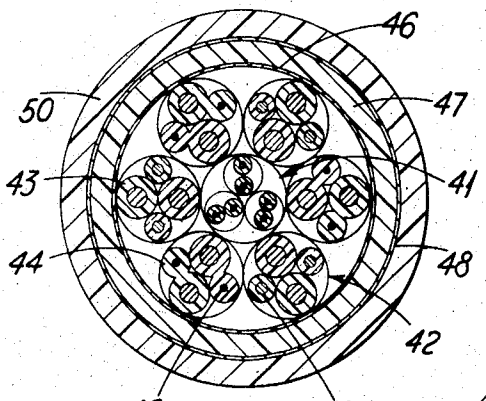

Fig. 7.

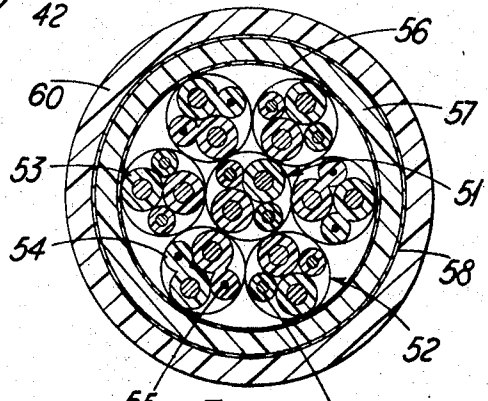

Fig. 8.

TELECOMMUNICATION CABLES

This invention relates to telecommunication cables and in particular to cables of the kind comprising a plurality of pairs of twisted together insulated conductors.

With the object of preventing displacement of one pair of insulated conductors with respect to an adjacent pair it has been proposed to locate in one or each of the interstitial spaces present within the circumscribing cylinder of each of some or all of the pairs of a telecommunication cable an elongate, electrically non-conducting non-metallic member which extends alongside the pair of conductors throughout their length. During manufacture of a telecommunication cable incorporating displacement-preventing members of this kind difficulty is often experienced in ensuring that a displacement-preventing member does not project locally beyond the circumscribing cylinder of the pair with which it is associated thus making the assembly of pairs and displacement-preventing members inconsistent throughout the cable length and to overcome this difficulty it is the normal practice to apply about the assembly one or more helical lappings of insulating binder tape.

It is an object of the present invention to provide an improved telecommunication cable which is of such a construction that the aforesaid difficulty is substantially reduced without the necessity of using one or more binder tapes.

In the telecommunication cable in accordance with the invention in which one or each of the interstitial spaces present within the circumscribing cylinder of each of some or all of the pairs of insulated conductors is occupied by an elongate member of electrically insulating material, which elongate members serve to prevent displacement of one pair with respect to an adjacent pair, each elongate member is integral with or secured to one of the insulated conductors of the pair with which the member is associated or is integral with or secured to the elongate member, when present, occupying the other interstitial space of the pair.

Where each of the interstitial spaces of a pair is occupied by a displacement-preventing member, preferably the members are integral with an intervening web of insulating material which lies between the insulated conductors of the pair, the composite displacement-preventing member so formed being of substantially dumb-bell-shaped cross-section. Where the or each displacement-preventing member of a pair is integral with the insulation of one of the insulated conductors, the composite insulated conductor and displacement-preventing member so formed is preferably of 8-shaped cross-section. The displacement-preventing members may each be made wholly of insulating material, for instance polyethylene, or may each have embedded therein throughout its length an elongate flexible reinforcing member, of another electrically insulating material, for instance, a thread or strand of insulating material.

The invention is especially, but not exclusively, applicable to a known form of telecommunication cable comprising a plurality of audio pairs and a plurality of video pairs, each audio pair being associated with a video pair to form a "pod." The audio pair of each "pod" has the same length of pair twist as that of the video pair with which it is associated and has one of its conductors lying in one of the two interstitial spaces formed by the conductors of the video pair and the other of its conductors lying in the other of the two spaces.

In applying the present invention to the telecommunication cable of the aforesaid patent the or each video pair, which is naturally larger than an audio pair, that does not have an audio pair associated with it preferably has one or each of its interstitial spaces occupied by a displacement-preventing member in accordance with the present invention.

By the expression "video pair" is meant a pair of separately insulated conductors suitable for use at a frequency lying within the range 1 to 10 megacycles/second. The expression "audio pair" is intended to mean a pair of separately insulated conductors which is not suitable for use as a video pair as hereinbefore defined but which is normally suitable only for use at a frequency within the audio frequency range.

In a preferred construction the "pods" and/or the or each pair and its associated displacement-preventing member or members are laid up helically around a central core. The central core is preferably of insulating material and is preferably in the form of a tube of insulating material but it may be of solid cross-section. Alternatively the central core may comprise one or more than one "pod" or pair and its associated displacement-preventing member or members or several low frequency pairs of separately insulated conductors.

The conductors of the audio and video pairs are preferably made of copper but if desired the conductors of some or all of the audio and/or video pairs may be made of aluminum.

The invention will be described in more detail, and by way of example, with reference to the accompanying diagrammatic drawing, in which:

FIGS. **1** and **3** are cross-sectional views on an enlarged scale of two forms of telecommunication cable in accordance with the invention,

FIGS. **2** and **4**, respectively, are cross-sectional views drawn on a scale greater than that of FIGS. **1** and **3**, of pairs of insulating conductors of the cables shown in FIGS. **1** and **3** and

FIGS. **5** to **8**, inclusive, are cross-sectional views on an enlarged scale of four further forms of telecommunication cable in accordance with the invention.

Each of the cables shown in FIGS. **1** and **3** comprises a central core **1**, **11** of solid polythene around which are laid up helically six pairs **2**, **12** of polythene insulated conductors **3**, **13** each comprising a copper conductor and a covering of polythene insulation. The length of lay of each pair **2**, **12** is different from that of each of the remaining five pairs. Each assembly is lapped with a tape **6**, **16** of polyester film and is provided with a seamless covering **7**, **17** of polythene. The polythene covered assembly of each cable has a screen **8**, **18** comprising a lapping of copper tape and is enclosed in a seamless sheath **10**, **20** of polythene.

Referring now to the cable illustrated in FIGS. **1** and **2** the interstitial spaces of each pair **2** of insulated conductors **3** are occupied by solid elongate polythene members **4**, the members **4** of each pair being integral with an intervening web **5** of polythene which lies between the insulated conductors of the pair.

In the cable shown in FIGS. **3** and **4** the interstitial spaces of each pair **12** of insulated conductors **13** are occupied by solid elongate polythene members **14**, one member being integral with the insulation of one insulated conductor **13** of the pair and the other member being integral with the insulation of the other insulated conductor **13** of the pair.

In both cables the elongate members **4**, **14** lie within the circumscribing cylinder of the pair **2**, **12** of insulated conductors with which they are associated and serve to prevent displacement of one pair with respect to an adjacent pair.

Each of the cables shown in FIGS. **5** to **8** comprises a central core around which are laid up helically six pairs **22**, **32**, **42** and **52** of polythene insulated conductors **23**, **33**, **43** and **53** each comprising a copper conductor and a covering of polythene insulation. The length of lay of each pair is different from that of each of the remaining five pairs. The interstitial spaces of each of three of the pairs **22**, **32**, **42** and **52** are occupied by insulated conductors **29**, **39**, **49** and **59**. The interstitial spaces of each of the other three pairs **22**, **32**, **42** and **52** are occupied by polythene members **24**, **34**, **44** and **54**, embedded in each of which is a reinforcing strand **25**, **35**, **45** and **55** of another insulating material, one member of each pair being integral with the insulation of the insulated conductor **23**, **33**, **43** and **53** of the pair and the other member being integral with the insulation of the other insulated conductor of the pair. Each assembly is lapped with a tape **26**, **36**, **46** and **56** of polyester film and is provided with a seamless covering **27**, **37**, **47** and **57** of polythene. The polythene covered assembly of each cable has a screen **28**, **38**, **48** and **58** comprising a lapping of copper tape and is enclosed in a seamless sheath **30**, **40**, **50** and **60** of polythene.

In each of the cables shown in FIGS. **5** to **8** the central core about which the six pairs **22**, **32**, **42** and **52** are helically laid

up is of a different form from that in the other cables. In the cable shown in FIG. 5 the central core is a tube 21 of polythene. In the cable shown in FIG. 6 the central core 31 comprises a pair of insulated conductors, the interstitial spaces between the pair being occupied by solid elongate polythene members, one member being integral with the insulation of one of the conductors of the pair and the other member being integral with the insulation of the other conductor of the pair. In the cable shown in FIG. 7 the central core 41 comprises three pairs of insulated conductors and in the cable shown in FIG. 8 the central core comprises a pod 51 consisting of an audio pair and a video pair.

In all of the cables shown in FIGS. 5 to 8 the elongate members 24, 34, 44 and 54 lie within the circumscribing cylinder of the pair 22, 32, 42 and 52 of insulated conductors with which they are associated and serve to prevent displacement of the pair with respect to an adjacent pair.

It will be appreciated that since the or each displacement-preventing member of a pair of insulated conductors of the telecommunication cable of the present invention is integral with or permanently secured to an insulated conductor or another displacement-preventing member, any tendency during making of the cable for the displacement-preventing members to project locally beyond the circumscribing cylinder of the pair with which they are associated is substantially reduced with the result that a cable can be made that is more consistent throughout its length and hence has improved electrical characteristics than is possible when making other forms of telecommunication cables of this kind.

Although in a telecommunication cable in accordance with the present invention a binder tape or binder tapes need not be used to obtain the improved electrical characteristics resulting from the improved consistency of the cable throughout its length, it is to be understood that, if desired, one or more lappings of binder tape may be applied to an assembly of pairs and displacement-preventing members without detrimental effect on these improved electrical characteristics.

What I claim as my invention is:

1. A telecommunication cable comprising a plurality of pairs of twisted together insulated conductors in which at least one of the interstitial spaces present within the circumscribing cylinder of at least some of the pairs of insulated conductors is occupied by an elongate member made wholly of electrically insulating material, which elongate members serve to prevent displacement of one pair with respect to an adjacent pair, wherein each elongate member is a part of one of the other elements of the pair with which the member is associated.

2. A telecommunication cable comprising a plurality of pairs of twisted together insulated conductors in which at least one of the interstitial spaces present within the circumscribing cylinder of at least some of the pairs of insulated conductors is occupied by an elongate member made wholly of electrically insulating material, which elongate members serve to prevent displacement of one pair with respect to an adjacent pair, wherein each elongate member is integral with the insulation of one of the insulated conductors of the pair with which the member is associated.

3. A telecommunication cable as claimed in claim 2, wherein each composite insulated conductor and displacement-preventing member is of 8-shaped cross-section.

4. A telecommunication cable as claimed in claim 1, wherein each elongate member is integral with an elongate member of electrically insulating material occupying the other interstitial space of the pair with which the member is associated.

5. A telecommunication cable comprising a plurality of pairs of twisted together insulated conductors in which each of the interstitial spaces present within the circumscribing cylinder of at least some of the pairs of insulated conductors is occupied by an elongate member made wholly of electrically insulating material, which elongate members serve to prevent displacement of one pair with respect to an adjacent pair, wherein an intervening web of insulating material lies between the insulated conductors of each pair with which elongate members are associated and is integral with the elongate members associated with the pair.

6. A telecommunication cable as claimed in claim 5, wherein each composite displacement-preventing member associated with a pair of insulated conductors is of substantially dumb-bell-shaped cross-section.

7. A telecommunication cable comprising a plurality of audio pairs and a plurality of video pairs in which each audio pair is associated with a video pair to form a "pod," the audio pair of each "pod" having the same length of pair twist as that of the video pair with which it is associated and having one of its conductors lying in one of the two interstitial spaces formed by the conductors of the video pair and the other of its conductors lying in the other of the two spaces, wherein at least one video pair that does not have an audio pair associated with it has at least one of its interstitial spaces present within the circumscribing cylinder of the pair occupied by an elongate member of electrically insulating material which serves to prevent displacement of the pair with respect to an adjacent pair and which is a part of one of the other elements of the video pair with which the member is associated.

8. A telecommunication cable as claimed in claim 7, in which each of the interstitial spaces of a video pair is occupied by a displacement-preventing member, wherein the members are integral with an intervening web of insulating material which lies between the insulated conductors of the video pair.

9. A telecommunication cable as claimed in claim 7, wherein the conductors of the video pairs are of copper and the conductors of the audio pairs are of aluminum.

10. A telecommunication cable as claimed in claim 7, wherein the "pods" and each pair and its associated displacement-preventing member or members are laid-up helically around a central core.

11. A telecommunication cable as claimed in claim 10, wherein the central core is a tube of insulating material.

12. A telecommunication cable as claimed in claim 10, wherein the central core is an insulating member of solid cross-section.

13. A telecommunication cable as claimed in claim 10, wherein the central core comprises at least one pair of conductors with at least one displacement-preventing member.

14. A telecommunication cable as claimed in claim 10, wherein the central core comprises several low frequency pairs of separately insulated conductors.

15. A telecommunication cable as claimed in claim 10, wherein the central core comprises at least one "pod."

16. A telecommunication cable as claimed in claim 10, wherein the length of lay of the cores of each pair is different from that of the cores of each of the other pairs.

17. A telecommunication cable as claimed in claim 1, wherein each of at least some of the displacement-preventing members has embedded in it an elongate flexible reinforcing member of an electrically insulating material different from that of the member.

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