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CONTINUOUSLY LOADED COMMUNICATION CONDUCTOR

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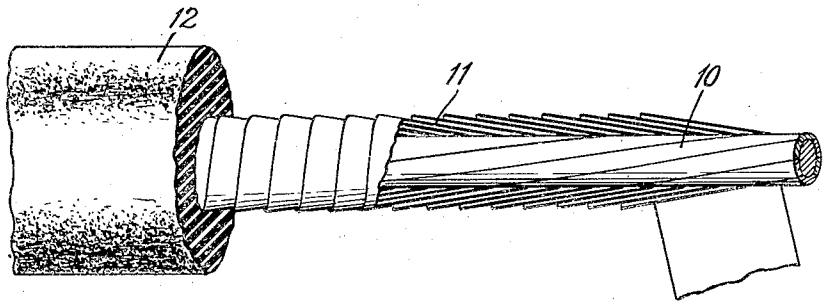

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CONTINUOUSLY LOADED COMMUNICATION CONDUCTOR

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This invention relates to continuously loaded communication conductors, and more specifically to continuously loaded submarine telegraph or telephone cables in which the loading material is applied to the conductor in the form of a thin tape or strip.

In cables of this type it has been the practice to apply the loading material in the form of a comparatively narrow tape and to wind it in one or more layers about the central conductor, each layer constituting a continuous helix wound with the edges of adjacent turns abutting as closely as practicable.

An object of the present invention is to reduce the eddy-current losses in the loading material in long cables for high frequency telegraphy or for telephone communication.

Another object of the invention is to reduce the component of the flux in the loading material which is parallel with the conductor in order to secure higher transmission efficiency.

Another object is to provide a loading which may be applied at low cost and with small chance of breakage.

Other objects which may be attained will be apparent from the following description.

To attain these objects the continuous loading for a communication conductor in accordance with the invention is composed of one or more tapes of magnetic material which are applied in a layer of helical turns with a considerable amount of overlap between adjacent turns. The loading material may be of any desired magnetic material such as iron or alloys of iron and nickel with or without cobalt, which may be found to be particularly suited for this purpose.

It has been found in the past that the eddy current losses, even in the most efficient loading materials, reach considerable values at frequencies such as occur in telephone cables and may be quite appreciable in high speed telegraph cables. The better grade loading materials have comparatively high resistance, and the resistance to eddy-currents has before been further increased by placing a plurality of successive layers of loading material about the conductor, in which case the thickness of the tape, of course, has been reduced to a fraction of the total thickness of the layer.

Experience has also shown that it is desirable under certain circumstances to reduce to a minimum the component of the flux which is parallel to the conductor and which is due to the pitch of the helix to which the tape is applied. This component of the flux increases with the pitch and for a given size of conductor it therefore increases with the width of the loading tape. It has therefore been found desirable to reduce the width of the tape as much as mechanical requirements would permit.

It is thus apparent that both of the conditions just referred to would require reduction to a minimum of the dimensions of the tape. However, the limit of reduction is determined by the strain under which the tape is placed during the operation of winding it about the conductor.

In the modern winding machine the taping head revolves with a very high speed in order that the output of the machine may be as large as possible. The chances of breakage of the tape therefore are quite large. It has been customary to produce tape as thin as 2 mils and of a width of about 20 to 30 mils. If the tape be further reduced in dimensions the speed of the winding head must be reduced or else the operation of the machine will be much more frequently interrupted due to breaking of the loading tape.

The present invention offers an opportunity to improve these conditions.

In order to facilitate the understanding of the invention reference will be made to the attached drawing, which shows a specific embodiment of a submarine cable constructed in accordance with the invention. The cable comprises a central conductor 10 which may be of any desired construction. A preferred form is shown in the drawing and comprises a solid core surrounded by a plurality of segmental strips formed to fit snugly about the core. About this conductor is placed a layer of loading material 11 shown partly in section. This layer consists of magnetic material formed into tape and wound heli-

cally about the core with a certain amount of overlap between adjacent turns, which in the embodiment illustrated amounts to 75%. The loading material thus forms in effect a multiple layer of a thickness which is approximately four times the thickness of the tape. The layer is shown as being composed of a single helix consisting of a single continuous tape wound in such a manner that each turn overlaps three-fourths of the width of its predecessor. This overlap may be increased or decreased in accordance with the requirements. It is also possible to wind the loading as a double, treble or quadruple helix by winding two, three, or four different tapes about the conductor in a simultaneous operation, in which case adjacent overlapping turns would be formed by different tapes.

The loading material is surrounded by an insulating envelope 12, the dimensions and material of which is determined by the conditions under which the cable is to be used. The cable may further be provided with armoring or other protecting layers which, however, have not been shown in the drawing since they form no part of this invention.

Upon an examination of the drawing it will be noted that with the embodiment shown the width of the tape is four times the pitch of each turn, so that it is apparent that it is possible in accordance with the present invention for a given pitch to increase the width of the tape beyond the pitch or else to reduce the pitch for a given width of tape, this, in order to either increase the mechanical strength of the tape or else to reduce the flux component which is parallel to the conductor, or both. The increase in width of the tape, which may be obtained by this arrangement, would permit a decrease in thickness of the tape without loss of mechanical strength, which would result in a reduction of the eddy-current losses.

Thus, if in the case illustrated it be desired to provide a layer of loading 5 to 6 mils in thickness a tape 1 mil in thickness may be used with a three-quarter overlap to form, in effect, four layers; and if a pitch of 6 mils be desired the width of the tape would be 24 mils. The cross-sectional area of this tape would be 24 sq. mils, considering a case in accordance with the prior art using a tape of a thickness of 2 mils and a width of 12 mils, the cross-sectional area would also be 24 sq. mils and the tensile strength would be the same as of the tape described above. The loading layer in the latter case would be formed of 2 separate tapes wound in an inner and an outer layer. Whereas in the latter case the pitch would be 12 mils and the thickness of the tape 2 mils, in the first case the pitch would be reduced by one-half to 6 mils and the thickness of the tape also to one-half or 1 mil. The result of arranging the loading material in accordance with the invention would consequently be a reduction of the flux component parallel with the conductor by about one-half and a reduction of eddy-current losses by at least one-half, these reductions being obtained with practically no loss in mechanical strength.

It is, of course, possible in accordance with this invention to vary the conditions in order to satisfy the optimum requirements of the three factors—eddy-current losses, parallel flux component and mechanical strength.

What is claimed is:

1. In a continuously loaded communication conductor, a magnetic material surrounding the conductor and comprising a layer of helical turns of tape with not less than about 50% overlap of adjacent turns.

2. A continuously loaded signaling conductor comprising a magnetic tape of magnetic material wound about said conductor in helical turns of not less than about 50% overlap of adjacent turns.

3. A continuously loaded submarine cable comprising a central conductor, a layer of loading material about said conductor having eddy-current losses reduced therein by being formed into an effective multiple layer, said loading material being of a magnetic material formed into a very thin tape and wound in helical turns about said conductor with sufficient overlap of adjacent turns to produce the desired thickness of said multiple layer and an insulating envelope about said layer.

4. A submarine cable in accordance with claim 3 in which said layer of loading material is formed of a single continuous tape wound with not less than about 50% overlap.

5. A method of producing a continuously loaded signaling conductor whereby the eddy-current losses in the loading may be reduced which comprises forming the loading material into very thin tape and winding said tape helically about the conductor with sufficient overlap of adjacent turns to produce a layer of loading of the desired thickness.

6. A method in accordance with claim 5 in which the layer of loading is formed by winding a single continuous tape about the conductor with overlapping helical turns.

7. A continuously loaded signaling conductor having a metallic core loaded with a tape of magnetic material having a thickness not in excess of 2 mils, said tape being helically wound directly upon the core in conductive relation thereto with a substantial overlapping of the adjacent turns for producing a predetermined inductive load per unit length of said conductor.

8. A continuously loaded signaling conductor having a metallic core loaded with a tape of magnetic material having a thickness not in excess of 2 mils, said tape being wound helically upon said core in conductive rela-

tion thereto with an overlap of substantially one-half the width of the loading tape for predetermining the inductance of said conductor per unit length thereof.

In witness whereof, I hereunto subscribe my name this 8th day of April, 1929.

JOHN J. GILBERT.