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J. J. GILBERT

2,066,525

CONDUCTOR

Filed March 29, 1929

FIG. 1



FIG. 2

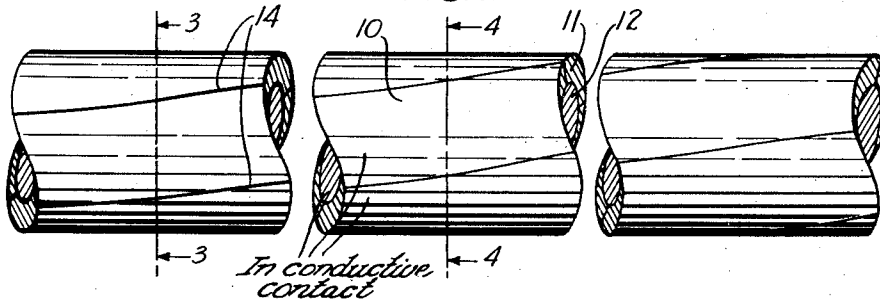


FIG. 3

Strands
individually
insulated

(Insulation) 14

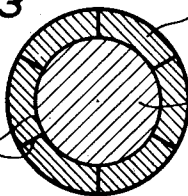


FIG. 4

Strands
conductively
joined

In conductive
contact

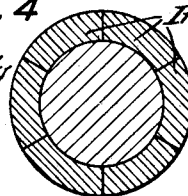


FIG. 5

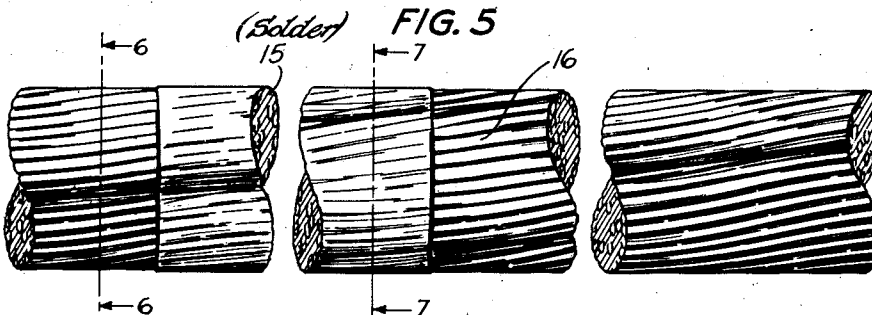


FIG. 6

Strands
individually
insulated

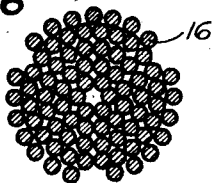
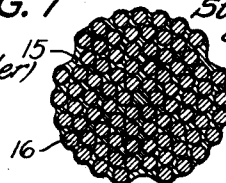


FIG. 7

(Solder)

Strands
conductively
joined



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CONDUCTOR

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Application March 29, 1929, Serial No. 350,839

3 Claims. (Cl. 173—13)

This invention relates to electrical conductors and more particularly to stranded, braided or otherwise finely divided submarine cable conductors.

It has heretofore been proposed by others to use conductors for telephone or carrier frequency submarine cables composed of a number of strands twisted or braided together in such a manner that each strand changes its position at intervals from the outer to the inner part of the conductor with each strand insulated from the others. A difficulty arises in connection with such conductors in case one or more strands become broken and in accordance with the present invention it is proposed to overcome this difficulty by leaving off the insulation at suitable intervals and conductively connecting all the strands together by means of a block of highly conductive material such as solder or molten lead.

For reducing the increase of resistivity in a twin core conductor, generally designated proximity effect, it is also proposed in accordance with the present invention to make up a conductor of a central core surrounded by flat tapes, the core and tapes being well insulated from one another by copper or other oxide or other material so that current will not pass from one element of the conductor to another within the distance of a single twist of the twin core pair. At intervals of several twists the insulating material between the core and tapes is left off so that the current will adjust itself in the case of a break in the core of one or more but not all of the tapes.

The invention is further disclosed in connection with the accompanying drawing in which:

Fig. 1 shows a pair of twin cores;

Fig. 2 is a side view of one form of a conductor of the cores;

Fig. 3 is a cross section on the line 3—3 of Fig. 2;

Fig. 4 is a cross section on the line 4—4 of Fig. 2;

Fig. 5 is a side view of another form of a core conductor in which a plurality of discrete conductors or strands are braided or stranded;

Figs. 6 and 7 are cross sections on the lines 6—6 and 7—7 respectively of Fig. 5.

The drawing is illustrative only and is not drawn to scale.

Fig. 2 discloses a copper conductor 10 having flat copper tapes or ribbons 11 surrounding a central core 12 of the usual type. These surrounding tapes or ribbons are sometimes called "surrounds." When such conductors are employed in a twin or multiple core cable such, for example,

as the conductors of two cores 13 laid together as indicated in Fig. 1, a desirable reduction of the increase in resistance known as proximity effect will be produced if the various surrounding tapes are lightly insulated from each other, for example, by a layer of copper oxide 14. In case one or more strands break in service or during laying a difficulty arises because of the loss of current flow through the broken strand or strands over a considerable distance. In accordance with this invention the central core and surrounding strands are insulated over the greater portion of their length but at intervals of several turns, for example, every 10 to 1000 feet the oxide insulation is left off the core and strands so that they are in good conductive relation. If a break occurs the current will be permitted to redistribute itself at the next point of conductive connection. The cross section of Fig. 4 indicates a point at which the insulation 14 is omitted.

It is also within the scope of the invention to provide at intervals a more perfect conducting connection between the various conductor strands than is provided by merely leaving off the insulation.

An embodiment of this more perfect connection is illustrated in Figs. 5, 6, and 7 which illustrate a conductor of the stranded type in which many lightly insulated strands are twisted or braided together to form a conductor suitable for voice or carrier frequency transmission. Preferably but not necessarily the several strands traverse the body of the conductor in such a manner as to pass at intervals from the interior to the exterior surface. Such a conductor may be used in a single conductor cable to reduce the increase in resistance known as the "skin effect". In multiple conductor cables such as illustrated in Fig. 1, the conductors of which are stranded as shown in Figs. 5, 6 and 7, the discrete strands may preferably but not necessarily traverse the body of the conductor in such a manner that they are all at the same average distance from the centers of the other composite conductors of the multiple conductor cable. Such multiple core cable conductors reduce the increase in resistance of the conductors with frequency known as "proximity effects". When desirable the discrete conductors of the composite core conductors of a multiple core cable may traverse the body of the conductor in such a manner as to pass at intervals from the interior to the exterior surface so that all of the conductors taken over the entire length of the cable or any unit length thereof occupy the same average distance from the center of the core and

in addition traverse the core in such a manner that they are all at about the same average distance from the centers of the other composite core conductors of the multiple core cable. In any such case the breaking of one or more strands causes a loss of conductivity which is cured in the present case by applying at suitable intervals a mass of lead or solder 15 in good conductive connection to the strands 16. Fig. 5 shows the conductor in side view at a point on line 7—7 where the lead or solder is located and at a point on line 6—6 where the conductive strands are insulated from one another.

The lead or solder may be applied by cleaning a small portion of the conductor by an ordinary soldering flux or the like and dipping it in lead or solder just above the melting point, or in any other suitable manner.

Conductors such as those illustrated are preferably to be employed in the unloaded condition when properly insulated and armored. However, they may be loaded with a suitable layer of magnetic material to increase the inductance. In case loading material is applied to conductors such as those of Fig. 5 the material 15 must have a melting point sufficiently high that the good conductive connection will remain after the heat treatment of the loaded conductor. Compositions having suitably high melting points and sufficiently high conductivity are known. An example is an alloy of about 70% copper, 30% zinc having a melting point of about 950° C.

It will be noted that in the case of transmission of relatively high frequency currents over a twin core cable such as that of Fig. 1 with solid conductors the magnetic fields of the currents in the two conductors will react on one another

to increase the effective resistance. In the case of a single core conductor such as that of Fig. 5 the magnetic field of the current set up by the current in the conductor itself has a similar effect, known as the skin effect.

In each case the subdivided construction of the conductor tends to reduce this increase of resistance.

What is claimed is:

1. A composite submarine cable conductor composed of several discrete conductors insulated from one another throughout the major portion of their length and so interrelated that each discrete conductor in passing along its length occupies successively different radial positions from the approximate center to the approximate external surface of said composite conductor but on the average lies at about the same radial distance from the center as any other discrete conductor for the purpose of preventing an increase in the effective alternating current resistance as the frequency increases, characterized in this, that at intervals the discrete conductors are in good conductive connection with each other.

2. A cable conductor in accordance with claim 1 in which the conductive connection at intervals is composed of blocks of conductive material.

3. A multiple cable core having the core conductor of each core in accordance with claim 1 for the purpose of decreasing "skin effect" and further characterized in that the discrete conductors of each core conductor occupy about the same average distance from centers of the other composite core conductors for reducing the increase of resistance with increased frequency due to "proximity effect".

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