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V. E. LEGG

1,841,486

COMPOSITE METALLIC STRAND

Filed June 8, 1929

FIG. 1

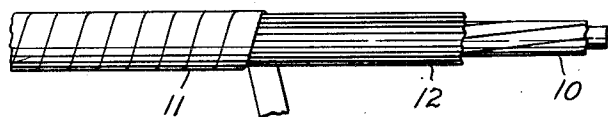


FIG. 2

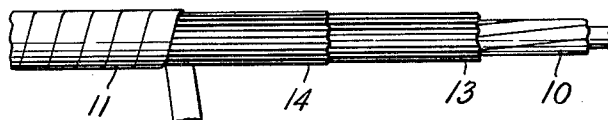


FIG. 3

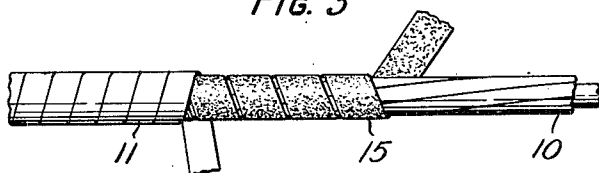
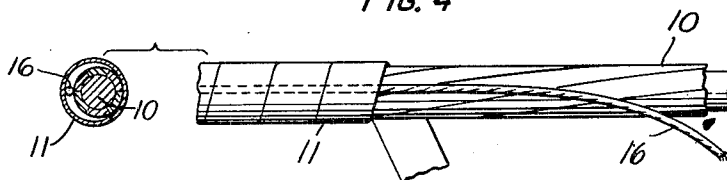


FIG. 4



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COMPOSITE METALLIC STRAND

Application filed June 8, 1929. Serial No. 369,482.

This invention relates to composite metallic strands such as continuously loaded conductors and more particularly to conductors of this type which require heat treatment after the loading material has been placed about the conducting strand in order that one or more of its properties may be developed.

An object of the invention is to provide an efficient continuously loaded conductor of this type on which the loading material after the heat treatment, has a slight looseness about the conductor in order that the characteristics of the loaded conductor shall be uniform through its length.

The loading materials used for loading of the conductor in modern communication cables usually require a heat treatment subsequent to their application to the conductor. This heat treatment involves temperatures between 600 and 1000° C. and results in the development of their magnetic properties to some desired extent. As is well known in the art, unless precautions have been taken against it the loading material has a tendency to adhere to the copper during the cooling period of the heat treatment, which may result in impairment of the desired magnetic properties and always will be the cause of lack of uniformity in the properties of the loaded conductor.

Many suggestions have been advanced in the art to solve this difficulty. Some of these suggestions have involved the use of a spacer between the conductor and the loading, which was supplied with sufficient volume to secure the desired spacing. The spacers were modified or removed before or during the heat treatment. However, it has been found that many of the spacing materials suggested for this purpose, which were admitted to the heat treating furnace, would render the copper extremely brittle due to the generation by those materials of reducing gases at the high temperatures.

In accordance with the present invention the desired spacing between the loading and the conductor is obtained by the use of a spacing material which is combustible at the temperatures of the heat treatment and which contains or has associated with it a quantity

of oxygen in some form and sufficient to insure a more or less complete combustion during the heat treatment of the combustible material of the spacer and, if desired, of such other combustible substances which may accidentally adhere to the loaded conductor. The spacing material will be converted into ash during the heat treatment, and the volume of the spacing material will thereby be reduced sufficiently to provide for the desired looseness of the loading material about the conductor.

In the accompanying drawings Figs. 1 to 4 show alternative forms of continuously loaded conductors provided with spacers in accordance with the invention.

Commercial copper, such as has commonly been used for conductors, contains a small proportion of oxygen mostly in the form of oxides lodged at the crystal boundaries. When such copper is subjected to high temperatures in the presence of reducing agents, the reducing gases rapidly diffuse into the copper and combine with the oxygen to form steam which causes a dislocation of the crystals, with the result that the copper becomes brittle.

This embrittling effect may be greatly reduced or completely overcome in accordance with the invention, since the oxygen, necessary for the combustion of any combustible material which may be present between the conductor and the loading, is placed in intimate relation to the combustible materials and in sufficient amounts to prevent the reducing gases from working into the copper.

The spacing material may be in the form of a continuous layer consisting of an adherent coating, or it may be in the form of one or more strands wound about the conductor or placed substantially parallel thereto. The material of the separator may be a more or less intimate mixture of combustible materials and oxidizing agents, that is, these materials may be present in separate layers or separate strands or they may be intermixed and applied in a single application; thus one material may be a carbonaceous material containing cellulose and the other may be an active oxidizing agent such as one of

the permanganates. The spacing material may furthermore be in the form of a chemical compound containing both carbonaceous and oxidizing substances such as cellulose nitrate which may be applied in any desired form.

The use of spacing materials as herein described may serve to avoid the necessity of using specially treated non-embrittling copper but it may be advantageous to use them with copper which has been treated to render it wholly or partly non-embrittling.

The features of the invention may be applied in many different ways for the purpose of separating the elements of a composite strand which would be likely to interact with each other during a heat treatment. A few applications which are typical will be described in connection with the attached drawings.

The various figures in the drawings show a copper core 10 which may be solid or stranded as desired. The copper is the commercial product which is generally used for electrical conductors and which has the tendency to become brittle when heated to temperatures between 600 and 1000° C. in the presence of reducing gases.

Around the conducting core 10 is placed a continuous layer of loading material 11 which may be a wire or tape supplied in a helical wrapping around the conductor. The loading material may comprise one or more of the elements iron, nickel and cobalt and is of the type which requires a heat treatment after it has been wrapped about the conductor in order that its magnetic properties may be properly developed.

As shown in Fig. 1 a separator 12 is placed between the conductor and the loading in order that the loading material may have a slight amount of looseness during and after the heat treatment. The separator 12 comprises a combustible material which will burn at the temperatures of the subsequent heat treatment and an amount of oxygen sufficient to insure that the burning of the combustible material in the heat treating furnace will take place without depriving the copper of its oxygen, whereby embrittlement of the copper is prevented. The separator may either be a mixture or a compound of these main ingredients, such as a mixture of wood pulp and ammonium nitrate or a nitro-cellulose compound.

In accordance with Fig. 2 the separator comprises an inner oxygen containing coating 13 and an outer combustible coating 14. In this case the inner coating may be of cupric oxide painted with the outer coating 14 of varnish.

In the arrangement shown in Fig. 3 the separator 15 comprises a tape of fibrous material impregnated or coated with oxygen containing material and is applied as a helical wrapping around the conductor. The

tape in this case may be paper which has been impregnated with a nitrate such as ammonium nitrate or a permanganate, such as ammonium permanganate.

In accordance with Fig. 4 the separator 16 is in the form of one or more strands which may be placed substantially parallel with the conductor and may consist of a compound such as celluloid or may be a fibrous thread such as a cotton thread impregnated with, for example, ammonium nitrate.

In the appended claims references to a combustible or carbonaceous material and oxygen are intended to include cases where the oxygen is chemically combined with the combustible or carbonaceous material as well as the case where it is otherwise available, unless such interpretation is inconsistent with the context.

What is claimed is:

1. A composite conductor comprising a conducting strand, magnetic loading metal applied about said strand, a chemically disintegrable separator between said strand and said metal and a non-gaseous material also between said strand and said metal, said non-gaseous material yielding under the influence of heat, a supply of chemical to disintegrate said separator.
2. A composite conductor according to claim 1 in which said non-gaseous material is a substance yielding free oxygen when heated.
3. A composite strand requiring a heat treatment comprising a copper strand, a magnetic element surrounding said strand, and means for spacing said element from said strand which comprises a carbonaceous separating material and includes an oxygen supply within said magnetic element sufficient to prevent an appreciable reducing effect upon the metals of said composite strand due to the combustion of said carbonaceous material.
4. A composite metallic strand requiring a heat treatment comprising a conducting element, a magnetic element, and a single separating element placed between said elements for preventing harmful interaction between said elements during and after said heat treatment, said separating element comprising a combustible material and intimately associated with said material sufficient oxygen to insure combustion of said material with not more than a negligible reducing effect upon said elements during said heat treatment.
5. A continuously loaded conductor comprising a conducting strand, a layer of loading material about said strand requiring a heat treatment after being applied thereto, and a separator between said conducting strand and loading material, said separator comprising a strand of nitro-cellulose.
6. A composite metallic strand requiring

a heat treatment comprising a conducting element, a magnetic element and a separator placed between said elements for preventing harmful interaction between said elements during and after heat treatment, said separator comprising celluloid as one of its main constituents to insure combustion of said separator with not more than a negligible reducing effect upon said elements during said heat treatment.

7. A continuously loaded conductor comprising a conducting strand, a layer of loading material about said strand requiring heat treatment after being applied thereto, and a spacer element applied to said strand of combustible material containing in chemical combination therewith oxygen in sufficient quantity for the substantially complete combustion of said material.

8. A continuously loaded conductor comprising a conducting strand, a layer of loading material about said strand requiring heat treatment after being applied thereto and a spacer element applied to said strand of combustible material containing in intimate intermixture therewith oxygen in sufficient quantity for the substantially complete combustion of said material.

9. A continuously loaded conductor in accordance with claim 8 in which said spacer element is of paper impregnated with ammonium nitrate.

10. A composite conductor comprising a conducting strand, a layer of loading material surrounding said strand and requiring heat treatment after being applied thereto, spacing means within said layer comprising a carbonaceous separator and an oxygen containing coating contiguous with said separator for reducing harmful effect due to the reducing action by said separator during said heat treatment.

11. A composite conductor in accordance with claim 10 in which said oxygen containing coating is of a metallic oxide.

12. A composite conductor comprising a strand of copper containing traces of oxygen, a layer of copper oxide on said strand, a coating of varnish applied to said layer, and a magnetic loading sheath applied onto said coating which requires a heat treatment after being applied, said layer of oxide being sufficiently heavy to prevent embrittling of said strand during said heat treatment.

In witness whereof, I hereunto subscribe my name this 16th day of May, 1929.

VICTOR E. LEGG.