March 2, 1943. F. W. TOMLINSON ET AL 2,312,506

ELECTRIC CABLE OR OTHER INSULATED CONDUCTOR

Filed June 20, 1939

FIG. 1.

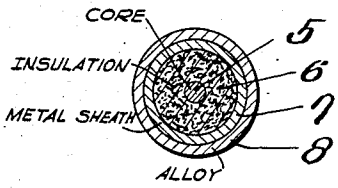


FIG. 2.

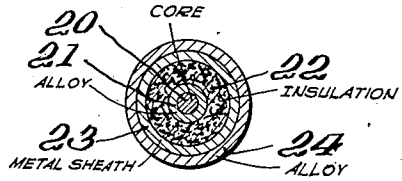


FIG. 3.

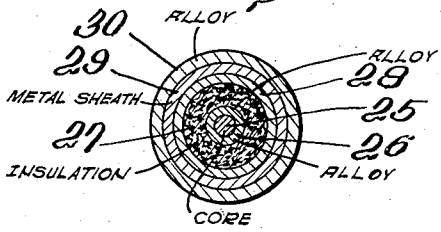


FIG. 4.

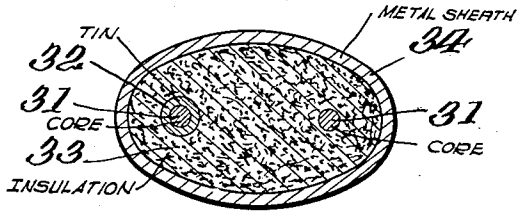


FIG. 5.

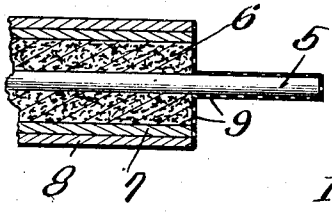
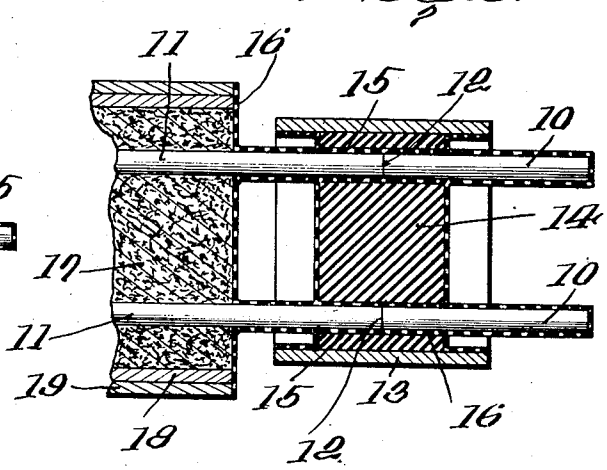


FIG. 6.



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ELECTRIC CABLE OR OTHER INSULATED CONDUCTOR

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5 Claims. (Cl. 174—102)

This invention relates to electric cables or other insulated conductors for power conduction or heating purposes of the type comprising one or more conducting cores separated from a surrounding metal sheath by pulverulent mineral insulation such, for example, as magnesia.

In a preferred manufacturing process for a cable of this type the insulating material in the form of completely dehydrated compressed blocks, is inserted together with the conducting core or cores into a metal sheath and the work-piece so formed is subjected to a drawing or other metallurgical treatment to break down the insulating blocks into the form of a homogeneous powder and to bring the cable to its final dimensions.

In a cable or other insulated conductor according to the present invention at least one of the metal parts (comprising the core or cores and the sheath) is furnished with a layer of ductile material different from that of the part to which it is applied. Intimate contact between the layer and the part to which it is applied is preferably ensured by a drawing or other metallurgical treatment which may be constituted wholly by the treatment employed for bringing the work-piece to its final dimensions, or may consist wholly or in part of a separate treatment.

The material of which the layer is composed may vary and may for instance be chosen to suit the purpose to which the finished cable or other insulated conductor is to be applied.

Thus, when a cable of the type to which the invention relates is employed under conditions which may tend to cause scaling and/or corrosion of the metal (usually copper) employed for the core and sheath, for example in cases of exposure to considerable heating or to chemically charged atmospheres, as in internal connections of electric cooking appliances, or dye works or battery rooms, not only the sheath but also the exposed ends of the core or cores are liable to be impaired. The materials which will satisfactorily resist these conditions, in general have too high an electrical resistance for use for the actual cable core or cores, and therefore also for the sheath (since it is usually more convenient for the manufacturing processes to employ the same metal for both core and sheath). Even when different metals are employed for the sheath and the core, the choice for the sheath of a metal proof against corrosion or scaling would render the cable very expensive. This difficulty can, however, be overcome by the present invention since it enables the core or cores still to be made of copper or other good conducting metal and yet to be protected by means of a relatively thin layer, for example of heat and/or corrosion resisting alloy, such for example as aluminium brass, or aluminium bronze, or nickel alloys, or tin, or lead, or alloys of tin or lead.

With the above and other objects in view which will become apparent from the following detailed description the invention is shown in the drawing in which:

Figure 1 is a cross sectional view of one modification;

Figure 2 is a cross sectional view of another modification;

Figure 3 is a cross sectional view of a still further modification of the invention;

Figure 4 is a cross sectional view of a still further modification;

Figure 5 is a longitudinal sectional view of a cable end; and

Figure 6 is a longitudinal sectional view of a modified construction for a cable end.

Referring to the drawing, in which like reference characters are used throughout the various figures to indicate similar parts, the modification shown in Figure 1 shows a copper core 5 embedded in the pulverulent insulation 6. This insulation may be formed for example by preformed blocks of magnesia furnished with passages to receive the cores. The core 5 is generally of copper and the insulation 6 and the core 5 is arranged within a copper sheath 7. The copper sheath 7, which together with the core 5 and insulation 6 constitutes a work-piece is inserted into a tube 8 which may be of aluminium brass alloy, for example that known under the registered trade mark "Alumbro" having approximately 76% copper, 22% zinc and 2% aluminium.

There is provided just sufficient clearness to permit entry of the sheath insulation and the work-piece as a whole is then subjected to mechanical working, for example by drawing through a die, so that as the work-piece is drawn down the tube surrounding the core and the sheath is firmly closed into intimate contact with the sheath. Several of such drawing operations may be effected with or without an intermediate annealing stage or stages. The exposed sheath therefore is fully protected against scaling or corrosion except for the small annular area at the exposed end of the copper sheath. The core 5 being embedded in the insulation is also protected and the exposed ends of the copper sheath and core may be covered by a flux of a soda lead silicate composition.

A protective layer on the outside of the cable sheath is generally sufficient. This is the case for example when the exposed ends of the conducting core or cores are enclosed within the casings which afford the necessary protection against scaling or corrosion or when a special enclosure for this purpose is provided for the cable end.

The exposed end of the copper core or cores may be coated with a soft flux of a soda lead silicate composition 9 as shown in Figure 5 applied in a melted condition. This coating preferably extends also over the exposed end of the insulation and the copper sheath 7.

However a terminal connection such as shown in Figure 6 may be used. In this modification terminal leads 10 of a suitable metal, which is not subject to scaling or corrosion are attached to the ends of the cores 11 and the joints 12 are enclosed within a hollow bushing 13 containing a plug 14 provided with separate passages 15 through which the leads 10 pass. The remaining space within the bushing is filled with a molten glazing flux 16 which extends over the end of the cable insulation 17, sheath 18 and protecting tube 19 and between the copper cores 11 connected to the leads within the bushing.

The glazing flux when employed as above described not only acts as an insulating medium and as a hermetic seal for the magnesia insulation, but also protects the copper parts, which would be otherwise exposed, against oxidizing air.

A protective layer on the outside of the sheath alone may also suffice in other instances where, for example, mechanical rather than corrosion-resisting protection is required, and in such instances the material of the layer would be chosen more especially for its mechanical properties, e. g., hardness. In this respect the aluminium brass alloy referred to is not only suitable for protection against corrosion, erosion and oxidation or scaling at high temperatures but combines with these properties a ductility which is not appreciably less than that of copper. Moreover, this material is also suitable for affording mechanical protection. If desired, however, there may be employed, instead of aluminium brass alloy, a nickel chromium alloy or an aluminium bronze alloy, and though these materials are somewhat less ductile than the aluminium brass alloy and may tend to reduce the flexibility of the cable, this difficulty may be overcome by reducing the thickness of the protective tube or layer applied.

Another modification is shown in Figure 2 wherein the core 20 is inserted into a tube 21 of the aluminium brass alloy and the core 20 with its surrounding tube 21 is embedded in the pulverulent insulation 22. The core, tube and insulation is arranged within a copper sheath 23 and these elements are inserted into a tube 24 of the aluminium brass alloy. The work-piece so constituted is then subjected to mechanical working in the same manner as described with reference to the modification shown in Figure 1. In this instance also the exposed sheath and the core or cores where they emerge at the ends of the cable are fully protected against scaling or corrosion except for the small annular areas at the exposed end of the copper sheath and core which may be covered by a flux of a soda lead silicate composition in the manner illustrated in Figure 5 or 6.

In certain instances it is desirable to use for the insulation of the cable or other insulated conductor a pulverulent material which is sufficiently hard to cause damage to the core and/or sheath during the drawing or other metallurgical process. The invention enables this difficulty to be overcome by the use on the core or cores and the inner surface of the sheath of a protective skin or layer of suitably hard material.

For example, as shown in Figure 3 the copper core 25, or each copper core when there is a plurality of them, is inserted in a metal tube 26 which is somewhat harder than copper, for example one of the alloys above referred to, nickel chromium and aluminium bronze alloys having a somewhat greater mechanical resistance than aluminium brass. Each core with its protective tube 26 is embedded in the pulverulent insulation 27, for example apertured pre-formed blocks as described, and the blocks containing the cores are inserted in a further protective tube 28 preferably of the same material as that surrounding the core or cores. The protective tube 28 containing the insulation and cores is then inserted into a copper sheath 29 and the work-piece so formed is subjected to one or more mechanical working stages, with or without an intermediate annealing stage or stages, the protective tubes being thereby simultaneously drawn down and forced into intimate contact with the core or cores and the inner surface of the copper sheath. If desired a further protective tube 30 may be provided over the copper sheath of the work-piece prior to the mechanical working.

The invention may also be applied in order to facilitate identification of the cores of a multi-core cable of the type to which the invention relates. This modification is shown in Figure 4. In this construction one of the cores 31 is provided with a thin skin or layer of material 32 which differs in appearance from that of the metal of the cores 31. This layer 32 may at the same time have one or more of the protective properties above referred to. For example, according to one method, one of the cores 31 of a twin-core cable is coated with pure tin and the cores then embedded in the pulverulent insulation 33 within the outer metal sheath 34. The work-piece thus formed is subjected to one or more mechanical working stages, with or without an intermediate annealing stage or stages, so that the sheath, insulation and cores are brought to the desired final dimensions. The tinned surface applied to one core retains its separate identity throughout the mechanical working so that the cores of the finished cable are readily distinguishable at any cross-section in the length of the cable.

It will be understood that instead of applying the protective or distinguishing skin or layer to a core by the drawing process of the work-piece, the core may be inserted in a tube of the protective or distinguishing material and the two parts subjected to a drawing or other metallurgical treatment so as to bring them into intimate contact before they are embedded in the pulverulent insulation. Alternatively, the skin or layer may be applied either to the core or to the sheath in the form of a coating, for example by dipping or spraying, or by electro-deposition.

It will be appreciated that the methods above described are given by way of example only and that the methods adopted in practice, as also the materials employed, will be chosen to suit requirements. For example, the material employed as the protective layer will be selected to

suit the conditions under which the cable is to be used, though reasons of economy will not always permit the use of the most suitable material, e. g., silver in some chemical works, in which cases a somewhat cheaper though slightly less effective material will be employed. Further, in cases where the skin or layer is intended solely for protection against corrosion the layer may be formed of tin, lead, or a lead alloy, or a layer of lead or lead alloy may be used as a distinguishing layer on a core.

In cases where each core is protected by the protective skin or layer except at its extreme end where its cross-section is exposed, this may be protected by brazing or welding a coating of alloy to the end, or a terminal plug may be brazed or welded on. However, where conditions are not severe no precautions need be taken to protect the exposed cross-section of the core since the exposed area is not only small but does not constitute a vital part.

What we claim as our invention and desire to secure by Letters Patent is:

1. An insulated electric conductor comprising at least one conducting core, a surrounding metallic sheath, pulverulent mineral insulation separating the core from the sheath, and a layer of ductile material applied to the surface of at least one of the metal parts, such ductile material being harder than the metal of the part to which it is applied and being airtight and encircling all the exterior of the metal part covered.

2. An insulated electric conductor comprising at least one conducting core, a surrounding metallic sheath, pulverulent mineral insulation separating the core from the sheath, and a layer of ductile material applied to the surface of at least one of the metal parts, such ductile material being resistant to heat and to corrosion and being harder than the metal of the part to which it is applied and being airtight and encircling all the exterior of the metal part covered.

3. An insulated electric conductor comprising at least one conducting core, a surrounding metallic sheath, pulverulent mineral insulation separating the core from the sheath, and a layer of ductile material applied both to the inner surface of the sheath and to the surface of the core, such ductile material being harder than the metals of the sheath and the core and being airtight.

4. An insulated electric conductor comprising at least one conducting core, a surrounding metallic sheath, pulverulent mineral insulation separating the core from the sheath, and a layer of ductile heat-resisting and corrosion-resisting material applied both to the surface of the core and to the inner and outer surfaces of the sheath, such ductile material being harder than the metals of the core and the sheath and being airtight.

5. An insulated electric conductor comprising at least one copper core, a surrounding copper sheath, pulverulent mineral insulation separating the core from the sheath, and a layer of an aluminium brass alloy applied to the surface of at least one of the copper parts and being airtight and encircling all the exterior of the metal part covered.

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