Jan. 2, 1940. J. B. LUNSFORD 2,185,558

ELECTRICAL CONDUCTOR

Filed Feb. 27, 1935

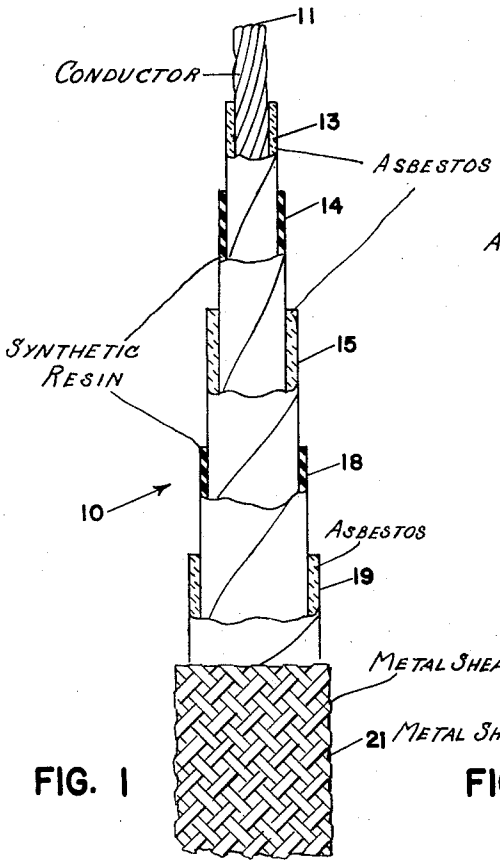


FIG. 1

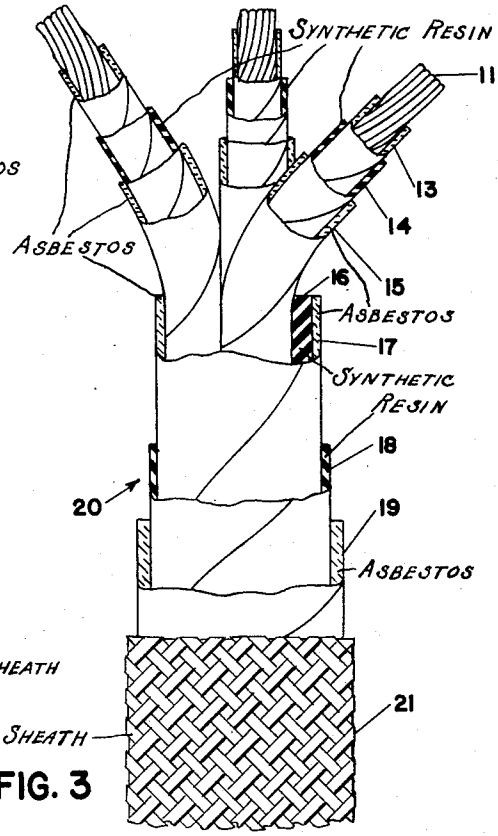


FIG. 3

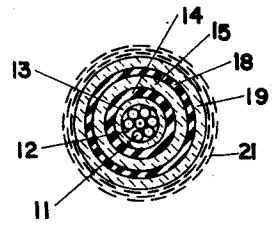


FIG. 2

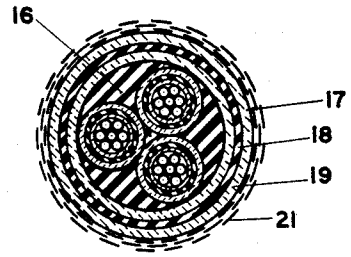


FIG. 4

J. B. LUNSFORD
INVENTOR

BY John J. Fitzgerald

ATTORNEY

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ELECTRICAL CONDUCTOR

Jesse B. Lunsford, Washington, D. C.

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5 Claims. (Cl. 174—116)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

This invention relates to an electric conductor and has for an object to provide an improved means of insulating electric conductors so that the insulation will remain effective over long periods of time and under high temperature and be relatively proof against deterioration while exposed to higher temperatures either internally or externally than with the present and known insulating means.

Electrical conductors containing various types of insulation are well known. In an attempt to provide suitable heat and flame resisting properties to the insulating means, asbestos, mica or other materials having similar flame resistant properties have been used as part of the insulating medium inclosing the conductor. With such materials, however, it is necessary to provide some seal or barrier against moisture, because if even an exceedingly small amount of moisture is allowed to percolate through the insulating wall, filamentary conducting paths are established which have a ruinous effect upon the electrical insulating value of such a wall.

To prevent this action it has been common practice to use natural resinous, gummy, or waxy compounds, and even other compounds of natural origin, which possess satisfactory water-seal properties and at the same time possess satisfactory dielectric properties.

It is well known that no compound of natural organic origin will for long withstand, a continuous temperature in excess of 100° C. Some of the best natural resins are rated at considerably below 100° C. For example, rubber, which is undoubtedly one of the oldest and best known and most widely used natural resins for this purpose, is commonly accepted as being limited to a maximum continuous temperature rating of only 75° C. and varnished cambric, using a natural resin, is commonly rated at 90° C.

Whether the natural gum or "natural resin" is derived from the sap of a tree indigenous to Brazil, the oil of a nut from China, the secretion of an insect in India, fossils from Australia, or the oils from the seeds of flax, cotton, etc., the limitations in regard to temperature are much the same and differ only in degree. All life, including materials of natural organic origin, being nature's syntheses in aqueous solutions, it has been generally recognized that the temperature at which water ceases to be a liquid at normal atmospheric pressure, (100° C., 212° F.) is the temperature at which life stops and deterioration starts. This characteristic is inherent. The design of all electrical equipment the world over, employing electrical insulation of a natural, organic character, is based upon a given life expectancy at approximately this temperature. To be specific, 105° C. is the universally accepted theoretical "hot spot" limit, with 95° C. to 100° C. as the maximum observable (measurable) limit.

Such a water-seal takes two separate and distinct forms. One as an "impregnating" medium, filling the interstitial spaces; and the other, a cylindrical barrier which water cannot pass, such as a complete film or wall surrounding the asbestos or other insulating medium to be protected. As utilized in this invention the desired water-seal may be in either form, alone; usually, however, both forms are used to increase the degree of protection against water.

Heat affects electrical conductors from two sources, either internally produced by the passage of the current through the conductor, or externally through the insulating medium by necessarily being placed in the neighborhood of external heat as for instance when used in or adjacent to boiler rooms, etc. The internal heat can be reduced by increasing the size of the conducting medium relatively to the amount of current to be conducted thereby, but it is generally impossible to overcome the external heating effect when it is essential that the electric conductor be used in such neighborhood. On board ships, the weight of the electrical conductors used in the aggregate throughout the ship amounts to a great deal and the space occupied thereby is likewise a problem. With the present known types of electrical conductors it is impossible to reduce the size of the electrical conductor because of the fact that the smaller the size of the conductor for the same amount of current, the greater the amount of heat thereby produced. With an insulating medium including natural resin the insulating medium breaks down very quickly whenever the temperature exceeds the boiling point of water.

Petroleum distillation products such as asphalt, mineral pitch, and the like, have been used to overcome this disadvantage and instead they have the disadvantage that under high temperature they are converted into coke and other inflexible materials thereby losing the very desired and very necessary advantage of flexibility; and in addition, instead of being flame resistant, they provide a fuel for flame.

The object of this invention is to make it possible to provide a good insulating material which will retain its insulating properties indefinitely even though exposed for continuous periods of

time to temperature above that of boiling water, even sometimes as high as 120° to 150° C. Also, it is somewhat more flameproof than the present insulating mediums which include natural resins and will tend to resist the creeping of any flame along the conductor even more effectively than the present insulating mediums. As a result of this invention it is posible to considerably reduce the diameter and hence the weight of any electrical conductor which is capable of conducting the same amount of electrical current therethrough.

With this invention a wire of a certain diameter will safely carry a much greater current than would the wire insulated with present known mediums and compared to present known mediums the wire of the present invention may be safely overloaded for indefinite periods without losing any of the desired advantages, such as those of heat resistance, flame resistance, flexibility, long life, etc. The desired properties of applicant's invention become available and possible through eliminating the natural resins or the hydrocarbon distillation products now commonly used as a water-seal where asbestos, mica or other similar materials are used as part of the insulating medium and instead using artificial resins, including those of the phenol or glyceride type amongst others. Another advantage of applicant's particular invention is that it is highly resistant to the deteriorating effects of grease, lubricating oil, fuel oil, fumes and acid creep, storage battery electrolyte, or otherwise.

A further object of this invention is to provide an insulation which is balanced to meet all of the adverse conditions especially present in use on shipboard, including abnormally high insulation temperatures, condensation or fresh or sea water spray, contact with grease, lubricating or fuel oil, exposure to fumes and acid creep of storage battery electrolyte, occasional severe shock of naval gun fire or continuous vibration from the operation of machinery in the vicinity, rough handling during installation such as twisting, pulling, hammering and bending at short radii, continuous slight bending movements during service life, and danger of fire from internal and external sources. Certain of these adverse conditions have been successfully overcome in some prior insulation mediums but no single insulation medium prior to the present invention has been developed capable of meeting all these adverse conditions.

With the above and other objects in view, the invention consists in the construction, combination and arrangement of parts as will be hereinafter more fully described.

Reference is to be had to the accompanying drawing forming a part of this specification in which like reference characters indicate corresponding parts throughout the several views. In this drawing, wherein there are shown two examples of the construction of this invention:

Fig. 1 is a plan view of a section of a single conductor cable having several sheaths of material progressively removed to show the interior construction;

Fig. 2 is a section of the cable in Fig. 1;

Fig. 3 is a plan view of a 3-conductor cable similar to Fig. 1; and

Fig. 4 is a sectional view of Fig. 3.

The single conductor cable shown generally at 10 and the 3-conductor cable shown generally at 20 each include a conductor 11 which, if stranded as shown, will have its interstitial spaces filled with an artificial or synthetic resinous compound 12. The conductor 11 with its compound 12 is then inclosed in a sheath of asbestos fibers 13. Next an artificial or synthetic resinous substance or compound 14 is formed in the layer about the asbestos sheath 13. Another asbestos sheath 15 incloses the synthetic resinous sheath 14. In the case of the 3-cable conductor the interstitial spaces between the 3 cables are next completely filled with a packing of synthetic resin 16 which is inclosed within another sheath of asbestos fiber 17. About this last sheath 17 of the 3-cable conductor, or 15 of the 1-cable conductor, another sheath of synthetic resinous material 18 is placed and then a final asbestos sheathing 19 incloses this last synthetic resinous sheathing 18. A metal braid 21 of the usual form is then placed about the last asbestos fiber sheathing 19, thereby forming the completed 1-conductor cable 10 or 3-conductor cable 20.

The cables described above are merely set forth as examples of the particular construction of the invention and the principles of the invention may likewise be applied to conductors or cables of any desired size and intended for any desired utility purpose. Cables constructed in this manner are found capable of meeting all the adverse conditions especially incident to use on shipboard and more especially in the naval service. Cables constructed according to this invention as set forth are capable of carrying a much greater amount of current than is possible with the usual cable using natural resins as insulating mediums. Amounts of current that would be a serious overload for ordinary cables are carried by this cable in safety even though the internal temperature may rise as high as 120° C. So long as the principles of this invention are carried out, it is immaterial just how the various sheaths are placed about the conducting medium. They may be formed in situ thereon or they may be formed in strips and spirally wound thereon or in any other manner well known in the art. Elimination of the natural resins raises the breakdown temperature of the present cable to a degree greatly above that of boiling water, which is the absolute limit for a cable including any natural resin.

It will be understood that the above description and accompanying drawing comprehend only the general and preferred embodiment of my invention and that various changes in construction, proportion and arrangement of parts may be made within the scope of the appended claims without sacrificing any of the advantages of my invention.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. A multi-conductor cable comprising a plurality of individual conductors, a sheathing of asbestos individually inclosing each conductor, sheathing of synthetic resin inclosing each asbestos sheathing, a second asbestos sheathing inclosing said synthetic resin sheathing, a common asbestos sheathing inclosing said plurality of conductors and the insulation individual thereto, asbestos fiber filling interstitial spaces between said several conductors, a sheathing of synthetic resin of sufficient thickness to have the desired mechanical strength inclosing said common asbestos sheathing, a second common asbestos sheathing inclosing the last-mentioned synthetic

resin sheathing, and a protecting armor inclosing said latter asbestos sheathing, said resin being resistant to deterioration by storage battery electrolyte and fumes and by oil, substantially incombustible in the absence of continued application of heat above its kindling temperature, permanently flexible and of high dielectric strength.

2. A conducting cable, comprising a stranded metallic conducting portion and a synthetic resin filling the interstitial spaces between the conductor strands, said resin being repellent to moisture and storage battery acid, resistant to heat up to at least 20° C. above the boiling point of water, permanently flexible, and having high dielectric properties.

3. An insulated conductor, comprising a metallic conducting portion and a flexible synthetic resin insulating material covering said conducting portion, said resin being water repellent, resistant to pressure, heat and flame, and having high dielectric properties that are retained to at least 20° C. above the boiling temperature of water.

4. An insulated conducting cable including an electrically conducting portion and an electrically insulating portion enclosing said conducting portion, said insulating portion comprising a plurality of alternate layers of asbestos sheathing and synthetic resin sheathing, said synthetic resin being impervious to oil and water, permanently flexible to withstand bending on short radii and hammering during installation, resistant to heat to at least 120° C., resistant to combustion in the absence of continued application of extraneous heat above its kindling temperature, and of high dielectric strength.

5. An electrical conductor and insulation thereon, including a sheathing of synthetic resin, said resin being of so low combustibility that it will not propagate flame along a cable, resistant to deterioration by lubricating oil and by storage battery electrolyte and fumes, impervious to water, resistant to heat to at least 120° C., permanently flexible to permit bending on short radii, and its dielectric strength being substantially unimpaired up to said temperature.

JESSE B. LUNSFORD.