

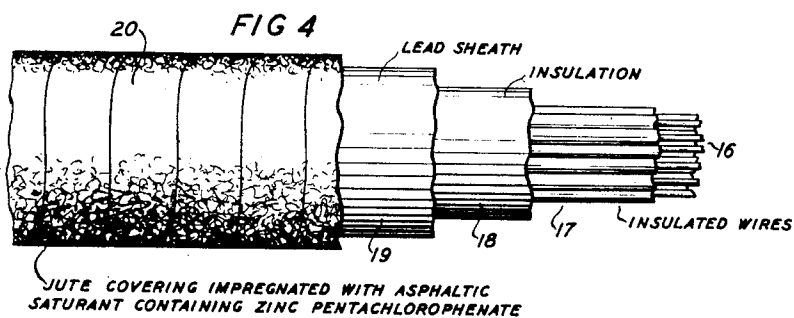
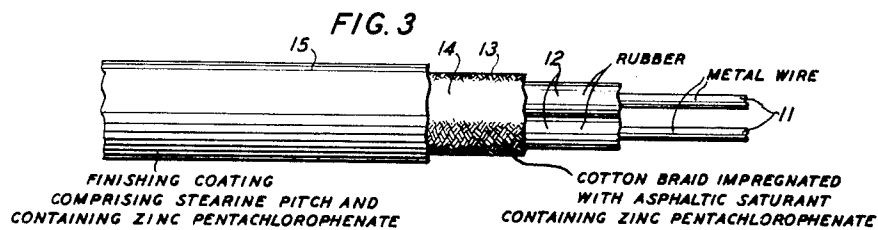
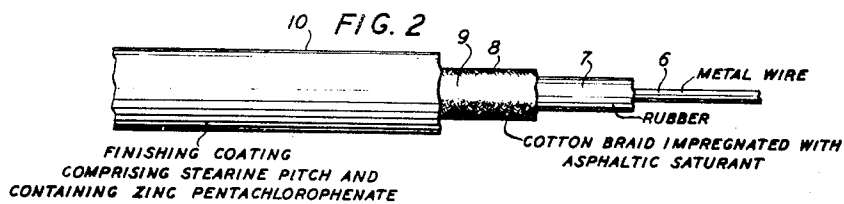
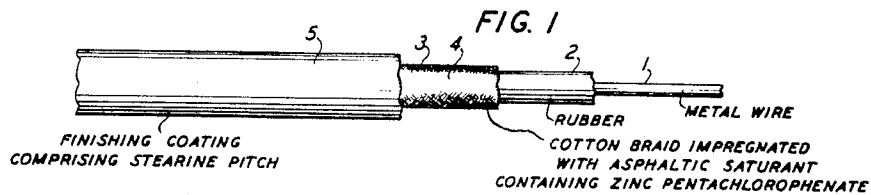
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INSULATED ELECTRICAL CONDUCTOR

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INSULATED ELECTRICAL CONDUCTOR

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This invention relates to fibrous materials such as cellulosic materials normally subject to deterioration or decay due to fungal or bacterial action, which are impregnated and/or coated with a material containing an agent which inhibits fungal or bacterial action. More particularly, the present invention relates to electrical conductors having insulating or protective jackets comprising such impregnated or coated fibrous materials.

For convenience the present invention will be discussed in connection with electrical conductors each having a fibrous cellulosic jacket which is impregnated or coated with a protective compound containing an agent which protects the jacket from fungal or bacterial action which can cause decay or deterioration.

Electrical conductors, such as telephone drop wires or the like, for many uses are provided with an outer jacket of fibrous cellulosic material designed to protect the inner structure of the conductor, which usually contains insulating material, against deterioration from abrasion, weathering, oxidation, moisture, or other causes. The cellulosic jacket, which usually takes the form of a braided or knitted covering of cotton or other cellulosic thread, is impregnated and/or coated with a suitable compound to protect the jacket as well as the inner insulating material against deterioration due to causes such as those indicated above.

Protective compounds comprising asphalts such as petroleum asphalts, and/or pitches such as stearine pitches or coal tar pitches, usually are employed. These protective compounds are usually applied to the cellulosic material while the compounds are molten and hence at considerably elevated temperatures; the use of solvents is generally avoided because of the economic loss involved if they are wasted and because of the difficulties involved in recovering them. The temperatures at which the protective compounds are applied are usually quite high to cause the viscosity of the protective compounds to be so low as to permit thorough impregnation or covering.

It has been found, however, that when electrical conductors having jackets of fibrous cellulosic material thus impregnated or coated with such protective compounds are employed in environments where they are in close proximity to or contact with the earth, the cellulosic materials of the jackets often deteriorate or decay apparently because of fungal or bacterial action. It has been also found that when such conductors are employed in environments in which they are remote from the earth, as when they are strung between poles or in buildings, the cellulosic materials of the jackets often deteriorate or decay apparently because of fungal action, particularly if the conductors are disposed in warm, damp places. The deterioration or decay occurs

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even though the fibrous cellulose jacket is impregnated or coated with a protective compound, such as one comprising asphalt or stearine pitch, which would be expected to protect the cellulosic material against fungal or bacterial attack.

Destruction or deterioration of the protective cellulosic jacket exposes the inner structure of the conductor to deterioration due to abrasion, oxidation, moisture, weathering, or other causes and renders the conductor dangerous or inoperative.

It is desirable to incorporate in the impregnated cellulosic material one or more substances having pronounced fungicidal and bactericidal properties to protect the cellulosic material. In general, such a substance should have the following properties:

It should, of course, be effective to inhibit or prevent the life and growth of those fungal and/or bacterial organisms which attack the cellulosic material of the jacket.

It should have a sufficiently powerful biocidal effect and be of sufficiently low cost to permit its economical use.

It should be miscible and compatible with the impregnating or coating compound so that it will remain in the compound during the application of the compound to the cellulosic jacket and will not appreciably be lost during use of the conductor by blooming or exudation from the surface.

The substance should be resistant to heat so that it does not break down into useless or harmful substances under the elevated temperatures employed in impregnating or coating of the cellulosic jacket.

The substance should have a low vapor pressure, so that harmful amounts of it are not lost due to evaporation during the high temperature application of the protective compound, or during use of the electrical conductor.

The substance should have a low solubility in water so that it will not leach out of the conductor during use and so that water solutions of the substance cannot permeate or attack rubber which may be employed in the internal structure of the conductor.

The substance should not appreciably ionize in water since ionization which might occur because of moisture encountered during use of the conductor might impair the insulation resistance of the insulated electrical conductor.

The substance of itself should not decrease the electrical insulation properties of the electrical conductor, or increase its inflammability.

The present invention provides an electrical conductor having an impregnated or coated fibrous cellulosic jacket containing zinc pentachlorophenate, which salt greatly inhibits or entirely prevents deterioration and decay of the cellulosic material and which substantially if not wholly satisfies all the requirements indicated

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above for a satisfactory inhibitor of fungal or bacterial action which causes deterioration or decay.

These and other advantages of the present invention, and the structure of electrical conductors embodying the invention will be more fully apparent from the following description in connection with the appended drawings, in which:

Fig. 1 represents to an enlarged scale a portion of an electrical conductor having an outer protective fibrous cellulosic jacket impregnated with a protective compound containing zinc pentachlorophenate;

Fig. 2 represents to an enlarged scale a portion of an electrical conductor having an outer protective fibrous cellulosic jacket coated with a protective compound containing zinc pentachlorophenate;

Fig. 3 represents to an enlarged scale a portion of an electrical conductor having an outer protective fibrous cellulosic jacket impregnated with a protective compound containing zinc pentachlorophenate and coated with a protective compound containing zinc pentachlorophenate; and

Fig. 4 represents to a smaller scale a portion of an electrical conductor of the cable type adapted to be buried in the earth and comprising a metallic sheath covered with an outer protective fibrous cellulosic jacket impregnated with a protective compound containing zinc pentachlorophenate.

Zinc pentachlorophenate is a white crystalline solid which is substantially insoluble in water but soluble in certain organic solvents. It may be produced by mixing a water solution of a zinc salt such as zinc chloride or zinc sulphate with a water solution of sodium pentachlorophenate or other water soluble pentachlorophenate. The quantities of zinc salt and pentachlorophenate should be chemically equivalent. The precipitate resulting from the reaction of these two compounds is zinc pentachlorophenate. It may be filtered, washed and dried and is then ready for use. When produced on a commercial scale it may contain small amounts of chlorinated phenols and other salts thereof.

The protective compounds in connection with which the zinc pentachlorophenate are employed are those which must be heated to relatively high temperatures of about 100° C. or more in order to permit their application in the molten state at a sufficiently low viscosity to the fibrous cellulosic material; zinc pentachlorophenate has the unusual property of resisting heat so well that it does not break down into harmful compounds, such as those including hydrochloric acid or the like, as do other chlorinated phenolic compounds, even though it is subjected to temperatures from about 100° C. to as high as about 160° C. The protective compound advantageously comprises petroleum asphalt, stearine pitch, coal tar pitch or mixtures thereof, hereinafter for convenience termed "hydrocarbon protective compounds." It advantageously is of the type customarily employed for impregnation or coating of fibrous cellulosic jackets on electrical conductors, but the protective compound may be formed of or include other materials such as synthetic resins. These asphaltic stearine pitch or coal tar compounds in general require application temperatures of above about 100° C. to permit satisfactory impregnation or coating.

According to one process embodying the invention, the zinc pentachlorophenate is dissolved

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in the molten protective compound prior to its application to the cellulosic jacket of the electrical conductor, in an amount ranging from about one to ten per cent or more by weight of the protective compound; from two to four per cent of zinc pentachlorophenate by weight of the protective compound is advantageously from a fungicidal and bactericidal standpoint as well as from an economical standpoint. After the salt has been dissolved in the protective compound, the molten protective compound is impregnated into or coated onto the cellulosic jacket on the conductor in any suitable known manner.

According to another process embodying the invention, the zinc pentachlorophenate may be applied to the fibrous material of the jacket before it is impregnated or coated with the protective compound, and the protective compound then applied. For example, the fibrous cellulosic material, either before or after being formed into the jacket on the conductor, may be treated with a volatile liquid having dissolved therein the salt; after evaporation of the liquid and deposition of the salt on the fibres, the cellulosic material may be impregnated or coated with the protective compound which may be in the molten state and at the elevated temperature indicated above.

A third process embodying the invention comprises first treating fibrous cellulosic material with a suitable solution of a zinc salt and then with a suitable solution of an pentachlorophenate, or vice-versa, to precipitate zinc pentachlorophenate upon the fibres of the cellulosic material. A jacket comprising such fibrous material containing zinc pentachlorophenate and formed about an electrical conductor is then impregnated or coated with a molten protective compound. At least a portion of the zinc pentachlorophenate dissolves in the protective compound.

The insulated electrical conductor shown in Fig. 1 comprises a metal core 1, such as a copper wire, surrounded by a layer 2 of a rubber compound. This layer 2 is surrounded by a cellulosic jacket 3 shown as a cotton braid. The jacket 3 is impregnated with a hydrocarbon protective compound 4 essentially comprising asphalt derived from crude oil and containing between about 10 and about 25 per cent by weight of a high melting wax such as montan wax which serves to reduce the viscosity of the asphalt; this compound contains between about 2 and about 4 per cent of zinc pentachlorophenate by weight of the saturant. The compound may be applied to the cellulosic jacket by any of the known procedures while molten and at a temperature of over 100° C.; the zinc pentachlorophenate is dissolved in the saturant while it is molten and before application of the saturant. The impregnated cellulosic jacket 3 is covered with a coating 5 of a finishing hydrocarbon protective compound comprising between about 70 per cent and about 90 per cent of stearine pitch derived from cottonseed, from about 0 per cent to about 20 per cent of asphalt derived from crude oil, and a minimum of about 10 per cent of high melting wax such as montan wax. The finishing compound is applied in a molten state at a temperature of over 100° C. by any one of the usual procedures. The conductor may be coated with one or more materials which reduce abrasion and serve as a lubricant; thus, the conductor may be coated with flake mica.

In the insulated electrical conductor shown in

Fig. 2, the metal core 6 which is a copper wire is also surrounded by a layer 7 of a rubber compound. This layer 7 is covered by a cellulosic jacket 8 comprising a cotton braid which is impregnated while molten and at a temperature of over 100° C. with an asphaltic saturant 9 similar to that described above as being employed in the embodiment of Fig. 1, but not containing any zinc pentachlorophenate. A finishing compound which is applied while molten and at a temperature of over 100° C. over the impregnated cotton braid to form a layer 10 has dissolved therein from about 2 to about 4 per cent of zinc pentachlorophenate; this finishing compound comprises in addition to the zinc pentachlorophenate from about 70 per cent to about 90 per cent of stearine pitch, from about 0 per cent to about 20 per cent of asphalt derived from crude oil, and a minimum of 10 per cent of high melting wax. The surface of the finished conductor may be coated with one or more materials to reduce abrasion and increase lubrication.

In the conductor shown in Fig. 3, both the saturant and the finishing compound contain zinc pentachlorophenate. More specifically, the insulated conductor comprises two metal cores 11, each surrounded by an insulating layer 12 of rubber compound. Both of the insulated cores are enclosed in a braided cotton jacket 13 which is impregnated with a saturant 14 containing zinc pentachlorophenate and identical with that described above in connection with the conductor of Fig. 1. The impregnated braided jacket has a coating 15 of a finishing compound of the type described above in connection with the conductor of Fig. 2 and containing zinc pentachlorophenate.

In the electrical conductor of Fig. 4, the zinc pentachlorophenate is dissolved in the saturant which impregnates a cellulosic jacket surrounding a metal sheath. More specifically, the electrical conductor of Fig. 4 comprises a multiconductor lead-covered cable of the type adapted to be buried in the earth and comprising a plurality of metal conductors 16, each surrounded by an insulating layer 17 of paper or the like, all being enclosed in an insulating jacket 18 formed of suitable material such as rubber, paper, or the like, and serving to separate the conductors from the surrounding tubular lead sheath 19. The lead sheath 19 is covered by a jacket 20 formed of wrapped jute impregnated with an asphaltic or coal tar saturant containing between about 2 and about 4 per cent by weight of zinc pentachlorophenate. The saturant, which may be the kind described above in connection with the embodiment of Fig. 1, is applied to the jute jacket while it is in the molten condition and at a temperature of 100° C. or over.

It is the usual practice to enclose a lead-covered cable which is to be buried in the earth with a jute or other cellulosic jacket impregnated with a suitable hydrocarbon saturant, since it has been found that the cellulosic jacket protects the lead sheath of the cable against damage due to abrasion during the operation of burying the cable and during the settling of the cable in its trench after it has been buried. For maximum protection of the cable, it is desirable that the cellulosic covering endure throughout the period during which settling occurs, which may be several months. When the saturant contains a suitable amount of zinc pentachlorophenate, the cellulosic protective jacket for the lead sheath is preserved from rotting for a period of many

months and throughout the period during which settling occurs. Consequently, the life of buried cables is considerably increased.

In the above indicated embodiments various other modifications may be made. For example, the layer of insulation shown in each of Figs. 1, 2 and 3 as surrounding and contacting the metal core, and which is described as being formed of a rubber compound, may also be formed of synthetic rubber, synthetic resin, or other suitable insulating material. The impregnated jacket which is described as being a cotton braid may also be a cotton wrapping, a wrapping of braid, a felted cellulosic fibrous covering, or may be any other material which is subject to deterioration by bacterial or fungal action. The saturant and finishing compounds may be formed of other materials or of other compositions than those indicated above; those described are advantageous because of their low cost, effectiveness, and ease of application. In the embodiment of Fig. 4, various other modifications may be made also. For example, other types of cellulosic jackets than the wrapped jute covering described therein may be employed, and other types of saturants than the asphaltic saturant mentioned may be used.

The insulated conductor structures shown in the drawings are merely illustrative of the invention and it is apparent that other conductor structures embodying zinc pentachlorophenate may be made and may be employed. Various modifications other than those indicated above may be made in the structures embodying the invention, and in the process of incorporating zinc pentachlorophenate in the structures embodying the invention.

Electrical conductors having jackets formed of cellulosic other materials subject to attack and deterioration due to fungal and/or bacterial action and which jackets are saturated or coated with high melting materials containing zinc pentachlorophenate, are very advantageous because they do not deteriorate even though employed in environments where they are exposed to bacterial or fungal organisms which would tend to attack the jackets. The zinc pentachlorophenate is highly effective in inhibiting or preventing the life and growth of fungal or bacterial organisms which would otherwise harm the jacket. It has a powerful biocidal effect so that small proportions of it may be employed, and its cost is sufficiently low to permit its economical use. It is miscible and compatible with the impregnating or coating compounds usually employed in the manufacture of electrical conductors, so that it remains in such compounds during application of the molten compound to the jacket and does not bloom or exude from the surface of a compound during use of the conductor. The zinc pentachlorophenate is resistant to heat so it does not break down into useless or harmful substances even under the elevated temperatures employed in impregnating or coating the jacket. It has a high vapor pressure so that harmful amounts are not lost due to evaporation during the high temperature application of the impregnating or coating compound or during use of the electrical conductor. It has a low solubility in water and hence does not leach out of the conductor during use and does not form water solutions which can permeate or attack the rubber. The substance does not appreciably ionize in water and hence cannot form ionized conducting solutions which can permeate the insulation

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material and cause a decrease in insulation resistance, as can occur if alkali or alkaline earth salts are employed. The zinc pentachlorophenate does not harmfully decrease the electrical insulation properties of the electrical conductor and does not decrease its resistance to flame; in fact, the salt has flame-proofing properties because of its chlorinated hydrocarbon structure. Other advantages are apparent to those skilled in the art.

It is intended that the patent shall cover by suitable expression in the appended claims whatever features are of patentable novelty residing in the invention.

What is claimed is:

1. An electrical conductor comprising a conducting core and a jacket surrounding the core formed of a non-metallic material susceptible to bacterial or fungal attack, which jacket has associated therewith a protective compound which because of its temperature-viscosity relationship must be heated to a temperature of at least 100° C. during its application to said jacket, said protective compound containing a biocidal agent which is compatible with said protective agent, and which does not decompose substantially at temperatures up to 160° C., said biocidal agent being zinc pentachlorophenate.

2. An electrical conductor comprising an insulated conducting core and, surrounding said core, a cellulosic jacket coated with a hydrocarbon compound which because of its temperature-viscosity relationship must be heated to a temperature of at least 100° C. during its application to said jacket, said hydrocarbon compound containing a biocidal agent which is compatible with said hydrocarbon compound, which is not substantially soluble or ionizable in water, which does not decompose substantially at temperatures up to 160° C. and which does not substantially increase the flammability or substantially decrease the insulating value of the hydrocarbon compound, said biocidal agent being zinc pentachlorophenate.

3. An electrical conductor comprising a conducting core, insulating material surrounding said core, and a cellulosic jacket surrounding said insulating material which jacket is impregnated with an asphaltic impregnating compound which because of its temperature-viscosity relationship must be heated to a temperature of at least 100° C. during its application to said jacket, said asphaltic impregnating compound having dissolved therein between about 1 and about 10 per cent by weight of a biocidal agent which is compatible with said asphaltic impregnating compound, which is not substantially soluble or ionizable in water, which does not decompose substantially at temperatures up to 160° C., and which does not substantially increase the flammability or substantially decrease the insulating value of said asphaltic impregnating compound, said biocidal agent being zinc pentachlorophenate.

4. An electrical conductor comprising a conducting core, insulating material surrounding said conducting core, a cellulosic jacket surrounding said insulating material which jacket is impregnated with a protective compound, and a coating on said jacket of a finishing compound which must be heated to a temperature of at least 100° C. while it is being applied as a coating to said cellulosic jacket comprising stearine pitch and having dissolved therein between about 1 and about 10 per cent by weight of a biocidal agent which is compatible with said finishing com-

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pound, which is not substantially soluble or ionizable in water, which does not decompose substantially at temperatures up to 160° C., and which does not substantially increase the flammability or substantially decrease the insulating value of said finishing compound, said biocidal agent being zinc pentachlorophenate.

5. An electrical conductor comprising a plurality of insulated conducting cores, a metal sheath surrounding said insulated cores, and a cellulosic jacket surrounding said metal sheath which jacket is impregnated with a protective compound which because of its temperature-viscosity relationship, must be heated to a temperature of at least 100° C. during its application to said jacket, said protective compound containing a biocidal agent which is compatible with said protective agent, which is not substantially soluble or ionizable in water, which does not decompose substantially at temperatures up to 160° C. and which does not substantially increase the flammability or substantially decrease the insulating value of the protective compound, said biocidal agent being zinc pentachlorophenate.

6. An electrical conductor comprising a conducting core and a jacket surrounding the core formed of a fibrous cellulosic material having upon its fibres a biocidal agent which is not substantially soluble or ionizable in water which does not decompose substantially at temperatures up to 160° C., and which does not substantially increase the flammability or substantially decrease the insulating value of said cellulosic material, said biocidal agent being zinc pentachlorophenate, which jacket has associated therewith a protective compound deposited from the molten condition said protective compound being one which must be heated to a temperature of at least 100° C. during its application to said cellulosic jacket.

7. A process of protecting the cellulosic jacket of an electrical conductor comprising a conducting core surrounded by a cellulosic jacket, which process comprises applying to said cellulosic jacket at a temperature of at least 100° C. a molten protective compound having dissolved therein at least about 1 per cent of a biocidal agent which is compatible with said protective agent, which is not substantially soluble or ionizable in water, which does not decompose substantially at temperatures up to 160° C. and which does not substantially increase the flammability or substantially decrease the insulating value of the protective compound, said biocidal agent being zinc pentachlorophenate.

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