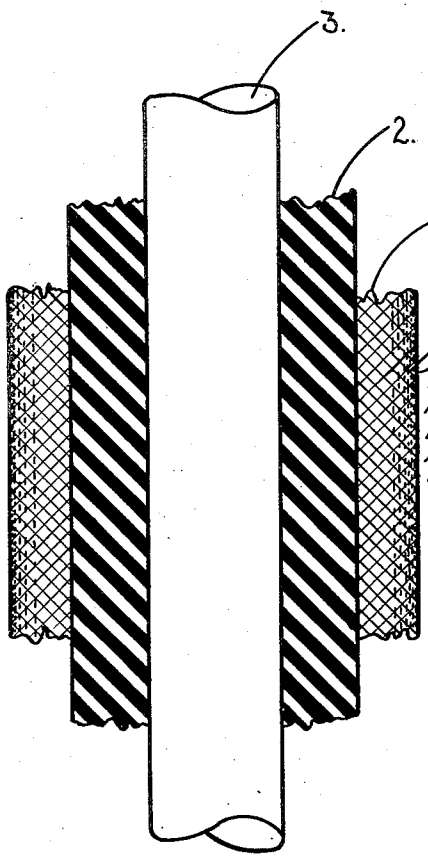
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FIRE RESISTANT ELECTRICAL CONDUCTOR

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FIRE RESISTANT ELECTRICAL CONDUCTOR

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This invention relates to a material for impregnating and treating textiles, paper and the like, in order to render them incombustible and fire resistant, and to the articles thus treated, particularly wire which is covered with an insulating covering, and to the method of flameproofing such articles.

Chlorinated naphthalenes, particularly the normally wax-like products, have been applied to materials such as wood or fabric to render them more or less flameproof to the extent that if a flame is applied to the material, the chlorinated naphthalene prevents the material from supporting combustion. The difficulty heretofore has been that if the chlorinated naphthalene is heated, for instance when it is subjected to a flame, it will melt and run out of the material to which it has been applied, and therefore the full fire-proofing effect has not been obtained at the time when it is most necessary. Furthermore, the higher chlorinated naphthalenes are wax-like crystalline substances which have a tendency to break or crack or flake off of the fabric or paper, etc., to which they are applied, whenever they are sharply bent, with the result that the flameproofing loses its effectiveness.

The general object of the present invention is to obviate the difficulties which have heretofore been experienced by the use of such fireproofing materials. The material which is disclosed in the following description contains a halogenated cyclic compound such as chlorinated or brominated or iodinated naphthalene or anthracene, which is a fireproofing substance, but in addition thereto and as a part thereof, the material contains a plasticizer which preferably is also a fireproofing compound so that the finished material is more plastic than are the pure highly chlorinated or otherwise halogenated naphthalene or anthracene, thus enabling the article, for instance, a flameproofed fabric-covered wire, to be bent without damage to the fireproofing coating; and in addition to the plasticizer, the material contains an inert substance, such as a colored pigment, or clay, asbestine, fuller's earth, etc., which is inert as to any substantial chemical reaction with the other ingredients of the material and which preferably is also incombustible and inert as to its reaction to flame. This inert substance is not a mere filler for the flameproofing material but acts to fill the pores in the paper or textile which is to be fireproofed. It gives a body on the article to be fireproofed, which is incombustible and absorbs some of the heat. Moreover it is found that the inert substance holds the fireproofing material in place when heated to such a temperature that the mixture without its inclusion would otherwise run out of the pores of the fireproofed article. Apparently each small particle of the inert material forms a center or nucleus about which the waxy naphthalene and the plasticizer collect so that when an article so coated is heated to a temperature sufficient to melt the mixture of naphthalene and plasticizer, the fused ingredients do not collect into drops but remain in their distributed condition. For instance, in the case of a fabric which is applied to any supporting element, such as the wall of a room or the covering of a book, or in the case of a fabric wound or braided around a wire, and the fabric coated as herein described is subjected to a flame or a short circuit occurs which heats the wire, the inert ingredient acts not only as an individual flameproofing and heat absorbing material, but it also acts to hold the halogenated naphthalene and the plasticizer in position on the heated portion of the fabric under an application of flame or heat that would cause the latter two ingredients alone to ordinarily melt and run away from the heated part, particularly where the fabric or wire is supported in a vertical position.

These and further objects and features of the invention will more fully appear from the following claims taken in conjunction with the description and accompanying drawing which, however, must be construed as merely illustrating and in no way limiting the invention to the embodiment shown and described.

The single figure of the drawing shows a wire coated with rubber which is covered with a fabric impregnated with the material, it being understood that this figure is used merely for descriptive purposes to illustrate one of the many applications of the invention.

The fireproofing and impregnating material is applied to any fabric which may be the fabric covering 1, over a rubber insulation 2, of a conducting core or wire 3.

One of the ingredients of the impregnating material is a halogenated normally wax-like cyclic compound, preferably an organic compound such as a highly chlorinated naphthalene or anthracene, which is halogenated in any desired manner by one or more of the halogens. One of the most familiar halogenated cyclic compounds is a chlorinated naphthalene, principally tri-, tetra-, penta-, and hexachlor, but other halogenated cyclic compounds, such as

halogenated anthracene, may be used, and these hydrocarbons may be halogenated with only one of the halogens, for instance, chlorine, or they may be halogenated with a plurality of the halogens, for instance naphthalene may be halogenated with both chlorine and bromine. Bromine is a better fireproofing agent than chlorine but at present is regarded as too expensive for general use; but as less material is necessary and therefore a thinner coating may be used with the same fireproofing effect, the brominated cyclic compounds may be used at approximately the same or less cost than the chlorinated compounds. Iodine is a better fireproofing agent than bromine but at the present time its cost is prohibitive. In general, the higher these cyclic compounds are halongenated the more fire resistant is the compound and the higher is the melting point. The higher halogenated wax-like cyclic compounds, such as tri- to hexa-naphthalene and anthracene, have a crystalline structure and if the textile on the wire or the wall is deformed, the halogenated cyclic compound tends to crack along the crystal faces. This cracking is undesirable because in addition to being a flameproofing material, such halogenated cyclic compounds are, in general, very effective insulators for electricity, and therefore if a crack occurs in the coating, there is an opportunity for moisture to enter the fabric and cause a leakage of current from the wire which is within the fabric, if no insulation such as rubber is used or the rubber has deteriorated.

In order to prevent the cracking or flaking or disruption of the coating material, a plasticizer which is miscible with or soluble in the halogenated cyclic compound, is used as one of the ingredients of the impregnating material. The plasticizer may be an organic compound such as a halogenated diphenyl, acenaphthene or phenanthrene which is also preferably an incombustible material in order to add its fireproofing effect to that of the halogenated cyclic compound.

Diphenyl, acenaphthene or phenanthrene may be chlorinated or otherwise halogenated to be substantially flameproof in themselves and they form syrupy, viscous liquids and amorphous resin-like solid materials, depending upon the degree of halogenation. When added to the crystalline chloronaphthalene or other halogenated cyclic compounds, they yield very excellent flexible impregnating materials. The structureless or amorphous property of the plasticizers and the fact that they are syrupy, viscous or resin-like materials, prevents the chlorinated naphthalene or anthracene from cracking along the crystalline surfaces whenever the textile or wire is deformed, thus preventing the occurrence of any opening which would form a leakage path through which electricity might pass from the wire or which may weaken the coating and tend to lower its resistance to the action of flame.

A third ingredient of the impregnating material is an inert substance such as a pigment, clay, asbestine, fuller's earth, iron oxide, lithopone, slate, copper oxide, etc. The pigments, clay, fuller's earth and similar substances are preferably in the form of very fine particles, while the abestos or asbestine, if used, may be in the form of fine threads or fibers. Whatever the form of the inert ingredients, they are preferably flameproof themselves. So long as the article is at room temperature, the inerts are partially held on the textile by the chlorinated cyclic compound and the plasticizer, but when a flame is applied to the textile or it is otherwise heated, for instance, by a short circuit in the wire, the finely divided particles of the inert ingredient form centers or nuclei on which the liquefied naphthalene or plasticizer may collect thereby preventing the liquefied ingredients from collecting in large drops and running down the fabric or dropping off of it as it otherwise might do. When the inert ingredient is a substance such as clay, which forms very fine particles, the particles go into the pores and interstices of the fabric and when the inert ingredient is a finely divided fibrous material such as asbestos, the fine fibers partially go into the pores of the textile but most generally work into the interstices; but in any event they serve to hold the chlorinated naphthalene and the plasticizer in position to flameproof the hot spot even though the fibers of the textile may be charred and thus weakened.

When the article is impregnated, a portion of the inert ingredients collect in the article near the surface forming a layer 4. In addition to their other properties, the inerts are preferably chosen from materials which have the property of absorbing heat so that when a flame is applied to the article, an appreciable quantity of the heat is absorbed by the inert material before it can pass into the article. Also, if the article is attacked by a flame at one place, the inert materials exert their heat absorbing effect to prevent the smoldering fire from moving along the article to another place.

A typical formula for a satisfactory impregnating material is:

100 parts of chlorinated naphthalene (65% chlorine)
10 parts of chlorinated diphenyl (65% chlorine), and
10–25 parts of finely divided clay or fuller's earth.

This material melts at 130–135° C.

Another formula is:

100 parts of chlorinated naphthalene (55–60% chlorine)
10 parts of chlorinated diphenyl (65% chlorine)
10–25 parts of finely divided pigment.

This material melts at 110–120° C.

A third formula is:

100 parts of chlorinated naphthalene (45–50% chlorine)
8 parts of chlorinated diphenyl (65% chlorine)
12 parts of finely divided asbestos fiber.

This material melts at 80–90° C.

In making the impregnating material, the chlorinated naphthalene and plasticizer are thoroughly mixed and heated until they are thinly fluid after which the desired amount of inert material is mixed in with such agitation as will distribute the inert ingredient very evenly through the mix. If it is desired to prepare the flameproofing material and sell it as such, it is cooled until it hardens while still being stirred to keep the inert ingredient evenly distributed through it. If the material is to be used immediately after being prepared, the article to be treated, for instance covered wire, is run through the hot mix while the mix is being stirred. The wire should be permitted to

remain in the bath for a sufficient length of time for the liquid ingredients to thoroughly penetrate and impregnate the paper or the fibers of the textile. The fabric covering of a wire is sufficiently impregnated in 20–30 seconds if the fabric has been previously heated. If the wire is at room temperature when introduced into the heated bath, the covering is impregnated in 40–55 seconds. As the liquid ingredients go into the pores of the paper or the interstices of the textile, they tend to carry the inert ingredient with them but to some extent the inert ingredient is caught in or at the surface of the textile where it forms a fire resistant coating 4 and serves to catch and hold the chlorinated naphthalene and plasticizer when they ooze out of the textile if a flame is applied to the article thus fireproofed. After the fabric covering on the wire is thoroughly impregnated and cooled until the impregnating material is in a somewhat mushy condition, the wire is drawn through a suitably sized die to scrape off the excess material and smooth it down to give a smooth continuous coating. The die may, if desirable, be heated to assist the smoothing action.

The amounts of the ingredients may, of course, be varied for different conditions and uses. If a rather stiff impregnating material is desired, the amount of chlorinated naphthalene or inert material may be increased, the greater the amount of inert ingredient, the more body the material will have, and the greater the amount of chlorinated naphthalene, the more wax-like will be the coating and the more fluid will be the mix when the article to which the material is applied is being coated or when the article is subjected to flame. It will, of course, be understood that other halogenated cyclic compounds may be used, for instance, halogenated anthracene may be substituted for naphthalene in the above formulæ. Waxes such as petroleum waxes, which decrease the tackiness or stickiness apt to result from using large amounts of the halogenated plasticizers where an extremely plastic or flexible material is desired, can be added, the waxes supplying some of the plasticity or flexibility while overcoming stickiness. Certain pitches such as the stearin and cotton seed pitches can likewise be included but all such additions, if of the combustible type, should be in small amounts, where the fireproofing property of the finished composition is important.

As inert materials, it is possible and quite frequently desirable to use materials which are pigments in addition to being inert. Pigments are very frequently used where the covering of wires is to be impregnated, the different colors of the pigments serving to identify the different wires. Such combined pigments and inerts are for example, iron oxide for a red color, lithopone for white (asbestine also gives white), various ground slates for various shades of grey, copper oxide for black, and suitably dyed or colored clays or other pigments for the other colors. Combinations of these are used to produce the various shades.

In the case where the inert material is finely divided asbestos fiber, these fibers, may if desired, be dyed different colors for a similar purpose. Also, the greater the amount of chlorinated naphthalene, the more tendency there will be toward cracking and rupture of the coating when the textile is deformed. Increasing the proportion of plasticizer makes the coating more flexible and decreases the tendency to rupture when the textile is deformed; also, increasing the amount of plasticizer increases the fluidity of the mix when it is heated in order to apply the material to the textile or when flame is applied to the article.

In order to give the treated article a pleasing appearance, it is preferable to use a refined chlorinated naphthalene in the materials prepared according to the previous formulæ, as the refined product is fairly clear and of a light straw color. This enables the color of the pigments to show up very clearly. In order to lower the cost of the finished treated article it may first be partially impregnated with a crude chlorinated naphthalene, which is much less costly than the refined product although it has a dark color. The material made according to the previous formulæ with refined chlorinated naphthalene, may then be applied over the crude product.

When using the material for impregnating the fabric covering of a wire which has a rubber insulating coating under the fabric, an impregnating material which has a low melting point should, in general, be used, because if a high melting point material is used, the heat which is necessary to melt the material for impregnating the fabric may cause the rubber to swell and otherwise deteriorate. None of the compounds having the formulæ previously given, have a melting temperature sufficiently high to materially affect the usual rubber insulation of wires during the time that it takes to impregnate the fabric covering. The melting or flow point of the undercoating of crude chloronaphthalene or of the impregnating material can be temporarily lowered by adding to it a temporary softener, for instance a volatile solvent such as carbon tetrachloride. Depending upon the amount of such volatile solvent that is used, materials having different degrees of fluidity may be prepared, in fact they can be made so fluid that little or no heat is required to melt them. The volatile solvent rapidly evaporates and leaves the non-volatile ingredients in the fabric covering. For commercial treatment of wire having no rubber insulation, it is deemed best to use as little volatile solvent as possible so as to get more of the non-volatile ingredients into the fabric at one treatment of the wire. If the wire has a rubber insulation, no solvent should be used that attacks the rubber.

When the material is used on wires or cables, particularly those having a rubber insulation under a fabric covering, it is deemed preferable to apply sufficient of the material not only to impregnate the fabric but to form a continuous layer on or in conjunction with, the fabric. This prevents the air from coming into contact with the rubber insulation to cause oxidation and cracking or other deterioration of the rubber. The continuous coating is particularly desirable where wires or cables are used in places where there may be a crowd of persons and relatively little ventilation, for instance in a theater or in a subway. In such places the danger to human life is not so much from the actual fire as it is from the stampede which occurs when the insulation continues to smolder and to give off fumes and smoke, after the short circuit and the possibility of a general conflagration is past. Thorough impregnation of the fabric with the beforementioned materials pre-

vents the fabric from smoldering because neither the halogenated cyclic compounds nor the halogenated plasticizers nor the inerts will support combustion, the inerts absorb the heat of the smoldering fire and hold the other flameproofing ingredients in place and the continuous coating (with no cracks) prevents the access of air and thereby prevents smoldering of the rubber which may not be impregnated.

From the above description it will be seen that there are many different forms and applications of the invention as well as many different formulæ which may be used to prepare the impregnating material and it is therefore to be understood that, although a particular and preferred form of the invention has been described it is recognized that many modifications may be made and it is desired that the invention may be construed as broadly as the claims taken in conjunction with the prior art, may allow.

I claim:

1. A covered wire having an inner conducting core and a cover impregnated with a material including a halogenated condensed nucleus cyclic compound, an incombustible plasticizer therefor, and an inert substance filling the pores and interstices of the cover to assist in retaining the said material on the wire in case of fire.

2. A covered wire having an inner conducting core and a cover impregnated with a material including a halogenated condensed nucleus cyclic compound, an amorphous plasticizer therefor, and an inert substance filling the pores and interstices of the cover to render the covering more resistant to fire.

3. A covered wire having a conducting portion and a cover impregnated with a material including a halogenated cyclic compound of a crystalline character, a plasticizer therefor comprising an amorphous halogenated cyclic compound, and an inert substance filling the pores and interstices of the cover to assist in retaining the said material on the wire at high temperatures.

4. A covered wire having a conducting portion and a cover impregnated with a material including a crystalline halogenated cyclic compound, a plasticizer therefor comprising a member of the group consisting of diphenyls, acenaphthene, and phenanthrenes, and an inert substance filling the pores and interstices of the cover to assist in retaining the said material in place on the wire.

5. A covered wire having a conducting portion and a cover impregnated with a material including a crystalline halogenated cyclic compound, a plasticizer therefor comprising a halogenated derivative of the group consisting of diphenyls, acenaphthene, and phenanthrenes, and an inert filler filling the pores and interstices of the cover serving as a base for said material in case the cover burns.

6. A covered wire having a conducting portion and a cover impregnated with a material including a wax-like halogenated naphthalene, a plasticizer therefor comprising a halogenated diphenyl, and a finely divided inert substance filling the pores and interstices of the cover to assist in retaining the said material on the wire in case the material softens to a condition where it would flow without the inert substance.

7. A covered wire having a conducting portion and a cover impregnated with a material including a wax-like substance comprising principally tri- and tetra- chloronaphthalenes, a plasticizer therefor comprising a chlorinated diphenyl, and an inert pigment filling the pores and interstices of the cover and coloring it and also assisting in retaining the said material on the wire at high temperatures.

8. A covered wire having a conducting portion and a cover impregnated with a material including a major portion of a wax-like halogenated naphthalene and a minor portion of a plasticizer therefor comprising a resin-like cyclic compound, and an incombustible filler filling the pores and interstices of the cover to render the covering more resistant to fire.

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