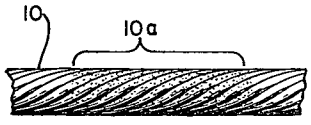
Oct. 9, 1956 T. F. PETERSON 2,766,157

METHOD OF PROTECTING AND CONNECTING MATING ELECTRICAL CONDUCTOR

Filed Jan. 15, 1953



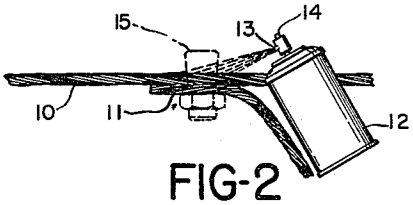


FIG-2

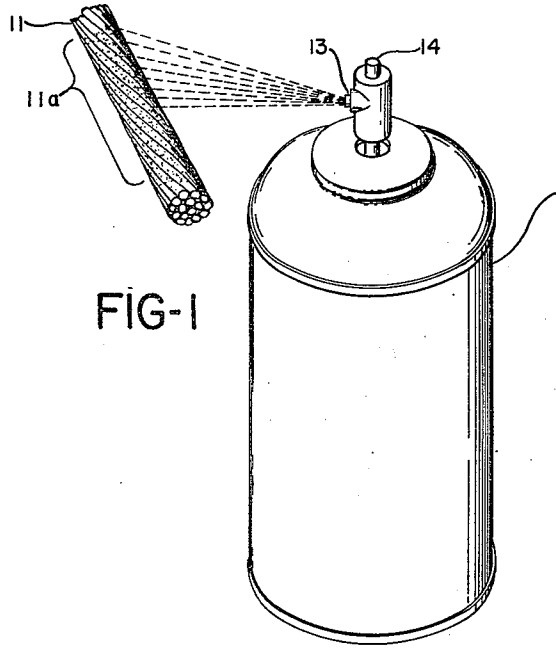


FIG-1

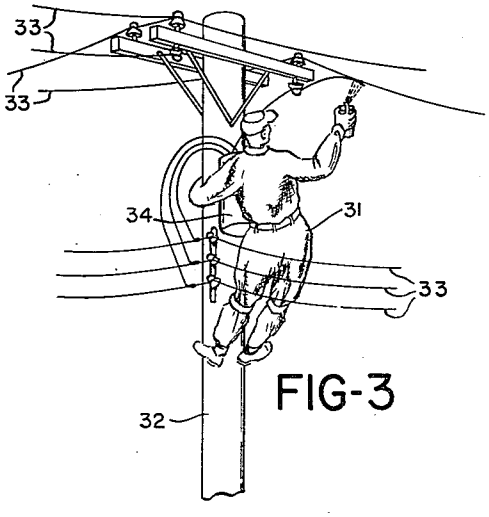


FIG-3

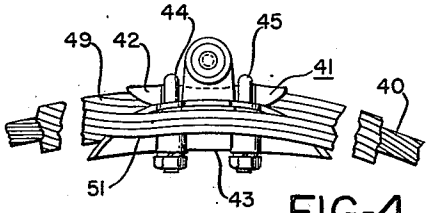


FIG-4

INVENTOR.
THOMAS F. PETERSON
BY Richard W. MacCallum
Attorney

United States Patent Office

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METHOD OF PROTECTING AND CONNECTING MATING ELECTRICAL CONDUCTOR MEMBERS

Thomas F. Peterson, Shaker Heights, Ohio, assignor to Preformed Line Products Company, Cleveland, Ohio, a corporation of Ohio

Application January 15, 1953, Serial No. 331,367

2 Claims. (Cl. 154—2.22)

My invention relates to methods and materials for protecting electrical conducting members, for example against corrosion, oxidation and electrolysis, and more particularly the invention relates to means for protecting such members by methods using an aerosol dispenser containing a liquid composition comprising a semi-solid polyisobutylene, a surface active agent, a volatile solvent diluent, and an aerosol propellant.

In the past considerable difficulty has been experienced due to oxidation and corrosion causing poor contact between mating metallic electric current carrying members. Even if the members are not of dissimilar metals such effects may lead to eventual connector failure, but if the mating members are of dissimilar metals, such as copper and aluminum, or copper and lead, the situation is further aggravated by electrolytic action and stray currents which cause pitting.

Lacquers, paints and varnishes are not available to protect mating contact surfaces because such materials oxidize or polymerize into hard insulators having no elastic or flow characteristics which would allow the conducting surfaces to properly mate under applied pressure with good electrical contact or allow the coating to yield and stretch with bendings. While it has been known to use grease, for example on battery terminals, present grease materials and presently used methods of applying such materials with a finger, a stick or brush, result in irregular and permeable coverings which do not properly protect the entire surfaces which ought to be protected. I have found that while mineral oil, mineral grease, petroleum grease or petrolatum applied to bright metal does afford some degree of corrosion protection, it can be readily demonstrated that a polished piece of metal coated with such ordinary materials will develop a corroded condition in several days in an atmosphere which is maintained at 100° F. and saturated with moisture. This is apparently due to the fact that the material intended for corrosion protection either did not "wet" the metal properly, or did not "cover" it completely, or did not "adhere" to it sufficiently, or due to a combination of these factors.

Mating electrical conducting members are characterized by point contacts which are very small in area, both individually and collectively. If such members are not protected at all, or are merely protected by an ordinary grease slopped on in usual manner, oxidation, corrosion and/or electrolysis will further reduce the small area of total contact, allowing moisture and atmospheric contamination to more readily enter between the members to further accelerate the formation of voids which are most susceptible to oxidation and corrosion. Eventually this will bring about a poor bond and possibly even a complete failure of the connection.

It is an object of the present invention to provide simple and inexpensive means for overcoming the above mentioned difficulties and for providing adequate protection for mating contact members.

Other objects and advantages will become apparent

and the invention will be better understood from consideration of the following description taken in connection with the accompanying drawing, in which:

Fig. 1 is a diagrammatic illustration of a pair of electrical conductors separated and being sprayed from a can during one step of protecting mating conducting portions of conductors in accordance with one aspect of the invention;

Fig. 2 is a diagrammatic illustration of the same electrical conductors joined together and being sprayed in accordance with another aspect or step of a method of the invention;

Fig. 3 is a diagrammatic illustration of a power utility pole top with a lineman thereon processing mating electrical conductor members against corrosion, oxidation, electrolysis, etc. in accordance with the invention; and

Fig. 4 is a side view in elevation of a stranded cable surrounded by helically preformed reinforcing elements which intertwine within and about a cable support and illustrate one application in which the invention may be very usefully applied.

Referring now to Fig. 1, I have shown a pair of electrical conductor members of dissimilar metals and comprising an aluminum conductor **10** and a copper conductor **11**. In accordance with the invention in one of its aspects, these members in a separated state, are sprayed around and throughout their mating portions, **10***a* and **11***a*, respectively, with a compound capable of being sprayed and having properties necessary to properly protect the electrical conductor members. Such a compound is hereinafter described and, in its boader aspects, includes a protective "plastic" semi-solid component, a surface active agent, a volatile solvent acting as a diluent for the protective component and surface active agent, and an aerosol propellant compressed into a liquid state and contained in an aerosol dispenser which may take the form of can **12** provided with means such as a valved small orifice **13** for suddenly releasing a portion of the mixture to form a spray which can be directed upon the conductor member mating portions.

For the protective "plastic" or semi-solid component I prefer to use polymers of isobutylene having rubber-like consistencies, either alone or in combination with a mineral oil, a grease, or a parafin wax such as petrolatum having a melting point of 150° F., or above. The polymers of isobutylene are available in many different viscosities ranging in form from liquids to hard solids, the viscosity increasing with increasing molecular weight. They are sold to the trade as "Vistanex" a trademark of Enjay Company, Inc., New York, N. Y., and may be purchased in such grades as soft, medium soft, medium hard and hard. I have obtained very good results by using varying proportions from 10% to 100% by weight and based on the semi-solid component of "Vistanex" of such grade depending upon actual proportions that the resultant viscosity with or without oil, grease or petrolatum (but without solvents) is very nearly leather-like in consistency, although it will "cold flow" or spread at room temperature.

So that my semi-solid component will preferentially wet the electrical conductor members, I add up to about 15% by weight and preferably about 4% based on the semi-solid component, of a surface active (i. e. "wetting") agent. Such agent may be any petroleum sulfonate, or a metal salt or ester of mono or polybasic acids. Glycerol mono oleate is a preferred surface active agent. Degras lanolin has also been used satisfactorily.

So that my mixture will readily flow through a small discharge orifice (such as **13**) I have found it preferable to mix the semi-solid component (plus surface active agent) with from 10% to 75% (by weight) of a volatile solvent diluent. Such a solvent might be a light petro-

leum distillate such as naphtha, kerosene, or benzene. Good results have been obtained with toluol.

As has been known in the past, a conventional aerosol for spraying protective compositions may comprise a substantial proportion of a non-oxygenous halogenated hydrocarbon such as dichlorodifluoromethane, often known by the trade name of "Freon 12" and which at atmospheric pressure and ambient temperature would be a gas but which is liquified (as is also true of the total mixture) because of the pressure of storage of the mixture in the can, and which acts as a propellant for the remainder of the mixture.

In some cases, depending on viscosity of "Vistanex" and amount of solvent used and consequent propellant pressure requirements, very good results have been obtained by using a mixture of about 30% (by weight liquified by pressure or freezing). Freon 11 (i. e. trichloromonofluoromethane) and the remainder (70%) Freon 12.

In accordance with practice conventional for spraying insecticides and paint, the can is provided with the small discharge orifice 13 and a hand operated valve 14 to enable the operator to readily direct a fine mist containing the material to be sprayed. This mist contains only the "semi-solid" component, wetting agent, volatile liquid and gases so that the component and wetting agent alone will soon cover the conductor portions at which the mist is directed because the volatile diluent almost immediately evaporates. Due to this spraying method of application the compound will easily follow any irregularities and enter fine cracks and crevasses such as exist between the strands of stranded wire and cable.

In some cases it may be desirable first, before spraying, to remove oxides and impurities, dirt and the like from mating portions of the conductor members and then, immediately, coat the exposed clean metal with the protective compound.

After an initial spraying the members may be connected together as shown in Fig. 2, and with or without a clamp means 15 (shown dashed), and the final assembly then given a final coating of "compound" from the same can 12.

There is believed to be a real need for such methods which more adequately assure uniform protective coatings on mating electrical conductor members. As an example, and as indicated by Fig. 3, a lineman 31 at the top of a pole 32, confronted with wires which often form a greater maze than that indicated by the few wires 33 in the drawing, and possibly confronted with a transformer 34, and possibly numerous other devices such as lightning arrestors and cutouts (not shown), does not take kindly to the idea of carrying with him a can of grease, removing the lid from the can, and using his fingers, a stick or a brush to spread grease upon mating conductors before and after making a juncture. Such an individual is subject to no "over-the-shoulder" supervision and is exposed to considerable physical danger, and it is more logical to expect him to use a single tool, such as can 12 of Figs. 1 and 2, to spray mating conductors in accordance with methods of the invention.

Referring now to Fig. 4, I have shown a stranded cable 40 that is supported by a well known type of supporting clamp 41, the clamp comprising upper and lower clamp members 42 and 43 drawn together against wires resting therein by U-bolts 44 and 45. As more fully described in my U. S. Patent 2,587,521, issued February 26, 1952, and entitled "Cable Re-Inforcing and Supporting Device," the cable is protected from the clamp, and any necessary splices or taps readily made and held together by surrounding the cable with a reinforcement comprising a plurality of resilient metallic elements 49—51, each at least at its ends helically preformed to a preformed inner diameter less than the outside diameter of the stranded cable 40, and with the pitch and direction of lay of the reinforcing elements the same as that of the strands of the cable in order to provide very effective means for holding the elements in strong frictional contact and with good electrical contact and without danger of wear. As also disclosed in the patent, eddy current loss in the clamp is minimized by having some of the preformed strands (51) pass outside the clamp. In accordance with the present invention a compound comprising a polyisobutylene, a solvent, a wetting agent and a propellant such as dichlorodifluoromethane under pressure may be sprayed to provide a protective film (displacable by pressure of mating) between or around all mating contact portions of this assembly, to provide very effective corrosion protection. Alternatively the compound may be sprayed on the preformed armor rods alone, in the factory where they are made, to serve not only as a corrosion protecting medium but incidentally as an excellent adhesive for holding Alundum grit particles later applied to the "compounded" armor rods for increasing the coefficient of friction between the rods and the cable to which they are ultimately to be applied.

The use of "Vistanex" or other polyisobutylenes is desirable for the applications described because such materials are very inert (being highly resistant to acids, alkalis, ozone and oxygen), will not run off with warming (but will form a very durable film), are quite compatible with oils, greases and waxes, and will not mix with water which is of importance in the outdoor applications. Yet it is not always essential that the semi-solid component contain "Vistanex" or other polyisobutylenes. In some cases good results can be obtained with other "plastic," "sticky" materials such as a "grease" containing an appreciable amount of silicone or latex rubber, with or without Vistanex depending on proportions actually used.

While I do not mean to thereby limit the present invention, novel methods of which may be performed by using ordinary grease and propellants alone, there follows a table of operable and preferred ranges of constituents of some preferred mixtures and a specific example of proportions found useful in performing the invention.

	Broad Operable Range, Percent	Preferred Range, Percent
Percentage of A plus B by weight:		
A. Protective Component	80 to 99	95 to 97
B. Surface Active Agent	20 to 1	5 to 3
Percentage of A plus B plus C by weight:		
A plus B	25 to 90	40 to 67
C. Volatile Solvent	75 to 10	60 to 33
Percentage of Total, by weight liquid:		
A plus B plus C	30 to 60	45 to 50
D. Propellant	70 to 40	55 to 50

Specific example—Parts by weight

Vistanex (LM—MS grade)	23.
Glycerol monoleate	1.
Toluol	24.
Dichlorodifluoromethane (Freon 12)	36 (liquified).
Trichloromonofluoromethane (Freon 11)	15 (liquified).

While I am aware that solvents have previously been used in spray cans to dissolve and assist in carrying nonvolatile substances desired to be sprayed, their use with either "Vistanex," or a wax or even a grease to be sprayed is believed to be unique in the art, and use of a solvent with the preferred protective material of the invention allows selection of a "Vistanex" leather-like viscosity which will allow the final product to have a unique sticky and tacky coating which stays with the metal quite satisfactorily and also holds grits as previously described if that is desired.

Yet in most cases the use of a "wetting agent" is also necessary for I have observed that when petrolatum and "Vistanex" alone are applied (with or without a volatile solvent) and a propellant such as Freon 12 is used, the mixture "froths" and bubbles badly leaving any parts coated somewhat vulnerable to corrosion. But by using

a surface active agent such as glyceral monoleate, or alternatively using some Freon 11 or preferably doing both, the combination will "wet" the metal properly and will result in a smooth, tightly adhering, weather resisting and oxidation inhibiting pressure displaceable soft film coating, particularly suitable for electrical connections.

There is thus provided means of the character described capable of meeting the objects above set forth.

While I have illustrated and described particular embodiments, various modifications may obviously be made without departing from the true spirit and scope of the invention which I intend to define in the appended claims.

I claim:

1. Method for protecting mating electrical conducting members against corrosion without impairing conductivity which comprises: pressure spraying from an aerosol dispenser the contact surfaces of the members, while separated, with a coating of a pressure-displaceable corrosion-inhibiting composition having as its essential major component a normally semi-solid polyisobutylene with the composition reduced by a liquid diluent to form a mist upon release under the action of a pressure-liquefied gaseous propellant contained within the dispenser; and then assembling the coated members and thereby displacing the composition at the contact surfaces and establishing conductivity between the members.

2. Method for protecting mating electrical conducting members against corrosion without impairing conductivity which comprises, pressure-spraying from an aerosol dispenser the contact surfaces of the separated members with a composition having as components from eighty to ninety-nine parts by weight of a normally semi-solid polyisobutylene and from twenty to one parts of a surface-active agent in a liquid diluent in amount to reduce the composition to a sprayable liquid mist under the action of a pressure-liquified gaseous propellant in the dispenser in order to deposit a pressure-displaceable coating on said surfaces; and assembling the coated members.

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