Patented Jan. 9, 1951

2,537,108

UNITED STATES PATENT OFFICE

2,537,108

COATED ELECTRICAL APPARATUS AND METHOD OF MAKING

Levi Frank Wagner and George A. Bresler, Lincoln Park, Pa., assignors to The Glidden Company, Cleveland, Ohio, a corporation of Ohio

No Drawing. Application April 28, 1944, Serial No. 533,266

3 Claims. (Cl. 117—167)

1

Our invention relates to plastic compositions in general, and to such compositions useful for solid dielectric and protective coverings for electrical apparatus, and particularly for the current-transmitting components of such apparatus. More specifically, our invention is directed to plastic compositions useful for covering the current-transmitting components of transformers, condensers, batteries, distributor coils, and the like, and for filling the interstices and spaces within or between such components contained within the electrical units of the types described. Such compositions are known to industry as potting compounds.

Heretofore materials used for filling high frequency radio transformers, electrical condensers, dry batteries and other electrical units have consisted of compositions of coal tar, asphalt, wax, or gilsonite or the like, or of compositions comprising mixtures or combinations of these materials. In addition, certain halogenated products have been utilised, as have also compositions of the materials described above in conjunction with these halogenated materials. Another group of substances, which has been employed for the same purpose, consists of mixtures or combinations of vegetable oils such as China-wood oil or castor oil together with chemical plasticizers which are polymerized with compounds such as ferric chloride immediately antecedent to the application of the combination on the desired surfaces. These combinations gel very rapidly, even at temperatures of the order of substantially 70° F., that is, at about room temperature, the rate of gelation increasing with increase in temperature. Application of such combinations therefore is frequently attended with some degree of difficulty and must be accomplished rapidly to assure complete coverage and protection. Alternatively, coverage may be obtained by maintaining the compound at an elevated temperature, beyond that at which it will solidify. For this type of application, temperatures in excess of 212° F. are common, and indeed many compounds have melting or softening points approaching 300° F.

The requirements for potting compounds in general are very stringent, demanding a combination of properties difficult to produce in a single composition. They should possess good heat transfer characteristics, but at the same time should have high dielectric strength. It is essential that the compounds adhere tenaciously to the surfaces to be protected, form continuous and uninterrupted films or coatings, be capable of flowing into all crevices and interstices of the

2

object to which it is applied, and of maintaining uninterrupted coverage without cracking, slipping or peeling through a wide temperature range; that is, from temperatures of the order of —40° F. to temperatures of about 160° F. It is also necessary that the compounds be non-corrosive to the surfaces on which they are applied, non-toxic, stable, and must not be appreciably changed in volume on solidification.

It has not been possible hitherto satisfactorily to meet all of the requirements for a potting compound, and for specific applications sacrifice has had to be made of some virtues and qualities to obtain the most essential characteristics to the required degree. For example, some radio frequency transformers are so constructed that they suffer serious damage if subjected to temperatures in excess of about 160° F. It is therefore impossible to utilise any composition which must be heated to temperatures in excess of 160° F. before it can be applied to the surface which it is desired to protect.

It is an object of our invention to provide a plastic composition suitable for use as a potting compound, and characterized by being susceptible to application at ambient temperatures, and being free from the undesirable properties of toxicity, corrosiveness, or volume change on solidification accompanied by interruption of the continuity of the coating.

Another object of our invention is to provide a plastic composition suitable for use as a potting compound and characterized by being applied to the surface to be coated in liquid form to flow into all crevices and interstices between said surfaces with subsequent solidification at ambient temperatures.

Still another object of our invention is to provide potting compounds in which the rate of solidification can be controlled to meet specific requirements for application of the compounds.

Other objects and a clearer understanding of our invention will be perceived on examination of the following description and claims.

The compositions of the present invention differ from such potting compounds as have been hitherto employed in that they are not materials which solidify by polymerization or by cooling below the normal solidifying point or melting point of the compositions. The production of a solid material on the surfaces to be protected is achieved by a chemical action between constituents of the compositions, and the solidification is caused to proceed at a definite rate which is capable of control within wide and useful limits.

The critical reactions in the compositions of the present invention involve the formation of new metallic compounds, primarily those resulting from the inter-action of metallic oxides, hydroxides or carbonates and fatty acids or resinous materials, or combinations of fatty acids and resinous materials.

Again, such compositions are especially advantageous in the treatment of electrical equipment to provide a solid plastic covering in that the application as a liquid enables the compositions to flow readily into all interstices and crevices in the said electrical equipment, such as, for example, between the wires in coils contained in small instruments. After solid-setting, the equipment would thus have been provided with a very complete solid plastic covering by an inexpensive and convenient means.

It will therefore be seen that substantial differences exist in the mechanisms by which we attain the results sought, and those which have been established in the prior art described above. For example, the tung oil-ferric chloride compounds are dependent for their suitability upon the polymerization of the tung oil employed, and modification of the properties of the final product is achieved by addition of extraneous materials possessing physical properties which are transferred to the final project, necessarily with some measure of diminution due to proportionality of composition. Again, compositions utilizing materials such as bitumens, gilsonite and the like depend totally for their efficiency upon the melting or solidifying points of their constituents, and must be employed at elevated temperatures. On the other hand, the beneficial results obtained from the utilization of compositions of the present invention are attained by reason of the formation of these new metallic compounds produced under controlled conditions and existing in the solid composition which forms the final product affording the desired protection or covering.

A typical embodiment of our invention would involve the preparation of two independent compositions designed to be mixed prior to application to produce the desired result. For example, we first prepare a mixture of reactive resins with fatty acids together with a terpene alcohol or ketone. We have found that the resins contribute to the hardness and rigidity of the final product, while the fatty acids provide a highly reactive and plasticizing material. We have also discovered a most important function of the terpene alcohols and ketones, that is the ability to control the reaction rates between the fatty acids and esters and the alkali employed. Separately, we prepare a composition of a metallic oxide, hydroxide or carbonate in intimate admixture with a neutral fatty oil, the incorporation being usually effected by grinding the oxide into the oil.

When application has to be made of the composition, the two mixtures previously prepared are brought together, and the resultant viscous liquid mixture is then applied to the surface to be protected, either by brushing, dipping, spraying or knife coat application, or by any other convenient means. It is usually unnecessary to apply heat, unless the formation of the solid compound is sought in a very short period of time.

By changes in the proportions of the constituents of the composition, or by substitution of some or all of them, it is possible to obtain a wide range of solid protective compounds, to satisfy specific requirements.

For example, a very useful composition, capable of application for many purposes is prepared as follows:

The first composition, which we shall designate as #1 Plotting Compound consists of:

29% run Congo resin
65% linseed fatty acids
6% alpha terpineol

This mixture is heated with agitation until a homogeneous viscous composition results.

The second composition, identified as #2 Plotting Compound, is prepared by incorporation of:

24% magnesium oxide in
76% neutral alkali refined linseed oil

When the oxide has been intimately admixed with the neutral fatty oil, usually by grinding, the resultant suspension will remain as a viscous liquid for extended periods of time, as in storage, without substantial settling out of the solid component.

For use in industry, these two compounds are mixed prior to application, and can be applied at the ambient temperature, or if desired may be heated slightly. It is usually unnecessary to heat to temperatures above substantially 120° F. for quick setting. A considerable variation is permissible in the proportions of the #1 Compound to the #2 Compound, and these proportions will be dependent primarily upon the desired rate of solid-setting and upon the degree of hardness sought in the finished product. We have found that in general the most satisfactory combinations lie between the values of from substantially 2 parts to 4 parts of the #1 Plotting Compound to 1 part of the #2 Plotting Compound.

At temperatures normally understood to be in the range of room temperature, that is, about 70° F., the mixture of the two compounds will become too viscous to pour within time intervals of about 30 minutes to about 3 hours, depending upon the proportions used, and solidification will be completed within a period of from substantially 3 hours to substantially 12 hours.

When solidification has been completed, the final solid product is found to be a hard plastic substance with excellent qualities of adhesion and resistance to fracture. The melting or softening points of the compositions described above are in all cases higher than 160° F. and in the case of the solid produced from admixture of 2 parts of the #1 Compound to 1 part of the #2 Compound the softening point lies in the range of substantially 250° F.

In the specific examples given above, the composition included a substantial proportion of a run Congo resin. We have found that it is possible to prepare solid-setting compositions without the use of resins, but we prefer to employ a proportion of a reactive resin to enhance the properties of hardness and rigidity of the final solid product. The nature of the fatty acids used in the same example is not critical, and we may use a single fatty acid such as oleic or stearic acids or any convenient mixture of fatty acids commonly found in commerce.

As has been stated earlier, the function of the terpene alcohol or ketone is to control the rate of solid-setting of the final composition. If no terpenol or terpenone be used, we have found that the reaction proceeds so rapidly that application of the composition is attended with considerable difficulty. Indeed, to produce the solid composition of desired hardness and other beneficial

qualities directly upon the substance to be coated or protected would be practically impossible, particularly if the substance were at a temperature somewhat higher than the ambient temperature, in the absence of the retarding agents disclosed.

We have found that substances of the class consisting of terpene alcohols and terpene ketones are effective retarding agents for use with solid-setting compositions of the type disclosed. In general, no advantage is to be noted with the use of any individual of the group disclosed, and selection is usually made from the standpoint of availability. It is possible to use pine oil, which is a mixture of terpenes and terpene alcohol and other derivatives, but it is not as effective as a pure alcohol or ketone, probably in proportion to the concentration of the desired substances in the pine oil.

While we have discovered that these substances are effective in the control of rate of solid-setting, they are not the sole such factors in any composition. The nature of the reactant fats and resins, and the nature and concentration of metallic oxide, hydroxide, or carbonate employed, have considerable effect on the mechanism rates as well as on the physical and chemical characteristics of the final product.

We have found that the oxides, hydroxides or carbonates of various metals may be used to react with the fats and resins of the composition, but in general we prefer to use those of magnesium, calcium or zinc.

Again, while in the specific examples given, we described the incorporation of the metallic oxide in a neutral alkali refined linseed oil, we have found that the neutral fatty oils in general may be used with equal facility.

It will also be apparent that the potting compositions may be modified to include a wide variety of substances to obtain specific additional properties or enhancement of properties. For example, additions may be made of inert solid materials, such as silica or pigments, and of substances such as asphalts, resins, or oils. Incorporation of extraneous materials such as those described in no wise affects the operation of the solid-setting mechanism, and their presence in the final solid product represents only dilution of the reacting system.

Although we have described our invention with some degree of particularity, it is understood that the present disclosure has been made only by way of example, and that numerous changes in the compositions herein described may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What we claim is:

1. As an article of manufacture, electrical apparatus of the type having multitudinous crevices and interstices embedded in and having within its said crevices and interstices a solid plastic reaction product of (1) from 2 to 4 parts of a first composition containing at least 65% of a higher fatty acid, and an effective amount to 6% by weight of said first composition of at least one oxygenated terpene of the class consisting of terpene alcohols and terpene ketones, with (2) one part of a second composition consisting of a suspension in a neutral fatty oil of about 24% of an alkaline-reacting metal compound of the class consisting of the oxides, hydroxides, and carbonates of magnesium, calcium, and zinc, said article of manufacture being characterized by a more complete and thorough penetration of said solidified product into the interstices and crevices of said electrical apparatus than occurs when the oxygenated terpene is omitted from said first composition.

2. As an article of manufacture, electrical apparatus characterized by multitudinous crevices and interstices embedded in and having within its said crevices and interstices a solid plastic reaction product of (1) from 2 to 4 parts of a first composition containing more than 65% of a higher fatty acid, and an effective amount to 6% by weight of said first composition of an oxygenated terpene of the class consisting of terpene alcohols and terpene ketones, with (2) one part of a second composition containing about 24% of magnesium oxide suspended in about 76% neutral fatty oil; said article of manufacture being characterized by a more complete and thorough penetration of said solidified mass into the interstices and crevices of said electrical apparatus than would exist when the oxygenated terpene is omitted from said first composition.

3. In a process of the type wherein electrical equipment is imbedded within a plastic mass by (1) mixing about 2 to 4 parts of a first liquid containing at least about 65% of a higher fatty acid with one part of a second liquid which consists essentially of a dispersion in neutral fatty oil of about 24% of an alkaline-reacting metal compound selected from the class consisting of the oxides, hydroxides, and carbonates of magnesium, calcium, and zinc, and (2) pouring the resulting mixture of liquid around said equipment to penetrate its interstices and crevices while in a liquid state and thereafter to become solidified within and around the equipment as a result of a soap-forming chemical reaction between the ingredients of said first and second liquids, the improvement which consists of retarding the rate of said chemical reaction and the rate of solidification of said mixture of liquids by incorporating within said first liquid an effective amount to about 6% by weight of said first liquid of at least one oxygenated terpene selected from the class consisting of terpene alcohols and terpene ketones.

LEVI FRANK WAGNER.
GEORGE A. BRESLER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,192,158	Clark et al.	Mar. 27, 1934
2,058,598	Doenig	Oct. 27, 1936
2,175,491	Stresen-Reuter	Oct. 10, 1939
2,326,748	Brown et al.	Aug. 17, 1943

FOREIGN PATENTS

Number	Country	Date
7,329	Great Britain	1911
417,845	Great Britain	1934

OTHER REFERENCES

Gardner, Chemical Synonyms and Trade Names, 3rd ed., Rev. 1930, page 201.