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ELECTRICAL INSULATING COMPOSITION

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This invention relates broadly to a novel insulating composition. More particularly, the invention is concerned with, and has as a main object to provide, a composition of improved utility as an insulating, filling, and sealing agent in types or kinds of electrical apparatus in which heretofore has been used plain or inorganic filled resinous, asphaltic, or other solid or semisolid material of a similar nature.

The present invention utilizes resinous material comprising pine wood pitch obtained by the extraction of pine wood and comprising oxidized resin acids, oxidized terpenes, polyphenols, and polymerized terpenes. Such a material is described, for example, in U. S. Patent No. 2,060,856, issued November 17, 1936, to J. M. DeBell. Resinous material of this kind is produced and sold by the Hercules Powder Company under the trade-mark "Vinsol". In accordance with this invention, substantially inert and nonmoisture-absorbing inorganic substance of high heat conductivity and low dielectric constant, in pulverized or powdered state, is incorporated with resinous material of the kind described, thereby providing an improved insulating, sealing, and filling composition.

Filling and insulating compounds of various kinds, for example, a mixture of coal-tar pitch and quartz dust, heretofore have been used in different parts of electrical apparatus, for instance, in the space between the porcelain and the insulated conductor of certain transformer high voltage bushings, in the space over the copper on the inside end of certain distribution transformer low voltage bushings, in the space between the coils and container of sign- and street-lighting transformers, for sealing cut-outs, and the like.

In such applications, it is important that the particular composition employed be of the highest possible dielectric strength and show minimum tendency to flow under abnormal temperature conditions encountered in service use, for example, from a bushing at temperatures of the order of 100° to 110° C. When the composition is used in apparatus in which it does, or may, come in contact with oil, for example, in oil-filled electrical equipment such as transformers, it is also desirable that the resinous portion of the composition have minimum oil solubility. In addition, it must be possible in electrical applications to apply the material by pouring, and the solidified composition must withstand mechanical shocks and low temperatures met during service operation without showing any tendency to crack or to powder. Preferably, too, the compound should convey heat from its inner to its outer portions with maximum rapidity. The composition of this invention fully meets the service requirements above-mentioned and is outstanding in such properties as dielectric strength, oil insolubility, and resistance to flow at temperatures around 100° to 110° C.

The novel features which are characteristic of this invention are set forth in the appended claims. The invention itself, however, will best be understood by reference to the following specification.

Resin of the kind hereinbefore described, and which, as stated, is used in practicing this invention, has exceptional electrical insulating value, being superior to ordinary wood rosin in dielectric strength and actually approximating high grade transformer oil in this characteristic. For example, the dielectric strength at 85° C. of a sample of such resin has been found to be of the order of 20,000 volts, when tested for one minute intervals at 60 cycles between one-inch disk electrodes spaced 0.1 inch apart. At lower temperatures the dielectric strength of these resins will run as high as about 50,000 volts. Table I shows the results of electrical tests on a representative sample of such resin:

Table I

Temperature °C.	Power factor in percent	Dielectric constant
103	15.2	6.5
80	11.9	5.18
55	5.2	3.29
25	0.5	2.81

The unusually low power factor rise with increase in temperature of this resinous material is clearly indicated in the foregoing table.

In practicing my invention, I incorporate with resinous material of the kind hereinbefore described substantially inert and nonmoisture-absorbing powdered inorganic material of good heat conducting and electrical resistance properties, for example, quartz, flint, slate, magnesium oxide (magnesia), aluminum oxide (alumina) or the like in dust or powder form. It is advantageous to use materials that are practically clay free because of the somewhat higher dielectric constant of clay as compared with the dielectric constant of such substances as those just mentioned by way of illustration. The mixture may be prepared for use by melting the resinous material and stirring in the inorganic substance, which preferably is previously heated to about the same temperature as the resin, in order to prevent solidification of the resin when the powdered mineral matter is added thereto. Mixing is continued until a homogeneous mass of resin and inorganic material has been obtained.

Another method of preparation consists in grinding the hard, brittle resinous material to powder form and mixing it thereafter with the

desired amount of powdered inorganic substance. Prior to application in electrical apparatus, this dry mix composition is placed in a heated receptacle provided with agitating means, for example, with a mechanical stirrer, and the resin reduced therein to molten state while agitating the mass. The resulting composition consists essentially of liquid resin with powdered inorganic material homogeneously distributed therethrough. In such state it is introduced into, around, or upon the desired parts of devices where it is to function as an insulating, sealing or filling agent, for example, in electrical apparatus at such points as hereinbefore mentioned. Upon cooling, a mass of resinous material intimately associated with inert mineral matter results.

The powdered inorganic material and resin may be mixed in any desired percentage proportions, depending upon the particular application of the resulting composition Preferably, however, I incorporate with the resin not more than about 65 per cent by weight of mineral substance. Such a composition is pourable at elevated temperatures and, when solidified, still provides a mass of adequate rigidity at operating temperatures. As an insulating, sealing, and filling compound of particular suitability for electrical applications, I have found that a composition comprising a mass consisting of about 50 to 60 per cent (that is to say, approximately 50 to 60 per cent) of the described inorganic matter and about 50 to 40 per cent of resinous material comprising extracted pinewood pitch of the kind hereinbefore set forth is outstanding in its ability to meet the service requirements of such a compound. This is demonstrated by the following illustrative example (Table II) of the difference in properties of an insulating, filling, and sealing compound especially suitable for use in high voltage bushings and consisting essentially of about 56 parts by weight of ground quartz and about 44 parts by weight of coal-tar pitch and one consisting essentially of about 56 parts by weight of ground quartz and about 44 parts by weight of the described resinous material.

Table II

	Composition consisting of about 56 parts by weight of powdered quartz and about 44 parts by weight of coal-tar pitch	Composition in accordance with this invention and consisting of about 56 parts by weight of powdered quartz and about 44 parts by weight of resin comprising extracted pine wood pitch
Dielectric strength at 85° C. when tested for one minute intervals at 60 cycles between one-inch disk electrodes spaced 0.1 inch apart.	20 to 25 kilovolts	50 to 60 kilovolts.
Solubility of organic portion in liquid petroleum hydrocarbon of low boiling range.	15 to 25 per cent	3 to 5 per cent.
Tendency to flow from bushing.	Very substantial amount flows out at 100° C.	Only a very slight amount flows out at 110° C.
Pouring temperature	250° to 275° C	225° to 250° C.

In addition to the foregoing differences which are indicative of the outstanding superiority of the composition of this invention in electrical insulating, filling and sealing applications, it should be mentioned that the small portion of the resin comprising extracted pine wood pitch that dissolves in the oil does not discolor the oil as does the oil-soluble portion of the coal-tar pitch. Further, my new composition has the advantage of having a lower viscosity at pouring temperatures and a higher viscosity after it has cooled somewhat than the composition containing the same amount by weight of, for example, coal-tar pitch.

The mineral matter used in making my improved compound must be stable; must be practically inert in contact with the resin material; must show a minimum tendency to absorb moisture from the air; must have good electrical resistant properties; should have good heat-conducting properties and, therefore, should have a dense rather than a porous structure. The mineral matter must be of such fineness that it will not settle out in substantial amount during the time the compound is in fluid state in preparation for use. For this reason, and in order to assure homogeneous distribution of the inorganic substance throughout the resin mass, the inorganic substance should be in powder or dust form; that is to say, it should be of a fineness that practically all of it will pass through a U. S. Sieve Series Number 100 sieve. It is advantageous that the material be of such fineness that practically all of it will pass through a U. S. Sieve Series Number 100 sieve and at least about 40 per cent of it will pass through a U. S. Sieve Series Number 200 sieve. By the use of mineral matter of the kind and of the fineness described, uniformly distributed throughout the resin mass, and especially when present in substantial amount, for instance, in an amount equal to about 50 to 60 per cent by weight of the whole, relatively rapid and uniform heat dissipation to the outer surfaces is assured during service use of the composition in electrical applications.

My invention provides an insulating, sealing, or filling composition that has a high dielectric strength. It is practically insoluble in oil. It does not appreciably discolor or otherwise contaminate, or detrimentally affect the usefulness in oil-filled electrical equipment of oil with which it may come in contact. It does not flow at either the operating temperature of apparatus in which it is used or at temperatures which unusual circumstances may cause such apparatus to reach. It is more fluid at a given elevated temperature than heretofore-used insulating compositions containing pitchy or resinous material and having the same content of like inorganic mineral matter. Hence, it is less likely to have a material detrimental effect upon the flexibility or electrical properties of parts of electrical apparatus with which the hot composition comes in contact during usual methods of application. Further, it has high thermal conductivity, thus assuring relatively rapid dissipation of heat. The new composition may be used to particular advantage in electrical applications in which plain or inorganic filled resinous, asphaltic, pitchy, or other solid or semi-solid resinous material heretofore has been used.

It will be understood that the improved electrical insulating composition produced in accordance with this invention may be used with various known electrical insulating materials.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Electrical insulation pourable at elevated temperatures and consisting of approximately 50 to 60 per cent by weight of substantially inert and nonmoisture-absorbing mineral matter of high heat conductivity and low dielectric constant and of such fineness that practically all of it will pass

through a U. S. Sieve Series No. 100 sieve and the remainder being pine wood pitch obtained by the extraction of pine wood and comprising oxidized resin acids, oxidized terpenes, polyphenols and polymerized terpenes, said insulation under conditions of service use being substantially non-flowing at a temperature of about 100° to 110° C., being practically insoluble in mineral oil, and being capable of withstanding mechanical shocks and low temperatures without cracking or powdering.

2. An electrical insulating, filling and sealing compound composed of about 50 to 60 per cent by weight of powdered quartz and about 50 to 40 per cent by weight of pine wood pitch obtained by the extraction of pine wood and comprising oxidized resin acids, oxidized terpenes, polyphenols and polymerized terpenes, said compound being pourable at a temperature of about 225° to 250° C., and under conditions of service use being substantially non-flowing at a temperature of about 100° to 110° C., being practically insoluble in mineral oil, and being capable of withstanding mechanical shocks and low temperatures without cracking or powdering.

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