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ENAMEL COMPOSITION

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This invention relates to varnish and enamel compositions, and more particularly to such varnish and enamel compositions as are applied to wires.

The compositions used in the present state of the art for coating wires are, to a large extent, composed of a treated oil or mixtures of oils to which is added suitable thinner or diluent, so that the compositions may be applied to the wire in a continuous operation by passing the wire through a bath of the enamel and then through a heated chamber to remove the thinner and solvent from the composition which has been applied, and finally baking the solid portion remaining on the wire. Single or multiple coats may be applied in this fashion. In the manufacture of such enameled wire, care must be exercised to produce a coating which is continuous and uniform in thickness. Wires coated or enameled in this fashion find extensive use in the electrical equipment industry as in the manufacture of coils, motors, generators, relays, transformers, radio parts, etc.

As previously noted, the solvent or diluent portion of the present type of wire enamel must be removed from the film during the drying and baking process. Some of the solvent is lost from the liquid enamel in the enameling bath by evaporation during the process of application and must be replaced to maintain proper concentration of the enamel base in order to secure optimum results, as far as application of the enamel and properties of the finished wire are concerned. This evaporation of solvents results in a contamination of the air in the enameling or baking oven and in the surrounding atmosphere. These solvent vapors are more or less irritating to the workman and their presence also results in a fire hazard. The replacement of the solvent lost by evaporation also involves an economic condition which it is desirable to overcome. If the concentration of the enamel composition is not kept uniform, non-uniform results are obtained with regard to film thickness and other desirable properties on the enameled wire.

This invention has as its principal object the provision of a wire enamel which does not require the use of solvents or diluents either during its preparation or its application to the wire.

A further object is the provision of a wire enamel which, when applied to a wire, will produce a continuous uniformly baked enamel film of uniform thickness and color, free from bubbles or pits and possessing improved adhesion to the metal.

A still further object is the provision of a wire enamel which may be applied to wire or metal strips in heavy coats, producing films of uniform thickness which, when suitably baked, do not soften under the influence of heat, are highly resistant to abrasion and retain their flexibility on aging or in service.

Another object is the provision of a wire enamel which can be easily applied in varying thickness, reduces the cost of application in the saving of heat necessary to evaporate the solvent, requires a minimum of attention in its application and removes a safety and health hazard due to the absence of solvent or thinner. Other objectives will be apparent from the description of the invention.

These and other objects are accomplished by the following invention in which a raw or treated animal or vegetable oil of the drying or semi-drying class or mixtures thereof and a natural or synthetic resin or mixtures thereof, together with suitable driers are combined according to specified procedures.

The enamels of the present invention may be applied to wire made from copper, steel, aluminum, alloys or any other metal in a continuous process. This may be conveniently done by unwinding the bare wire to be enameled from a spool and running it continuously through a heated bath of the enamel and then passing the wire to which the enamel has been applied through a baking chamber or oven which is of a suitable length and heated to a suitable temperature to bake the enamel. The temperature of the bath of the enamel, the speed of the passage of the wire through the bath of enamel and the temperature of the baking chamber are controlled according to procedures well known in the art to insure a uniformly coated and baked wire. The enamel bath may be heated by means of a free flame, electric heating unit, steam coils, hot gases from the oven or by any other desirable and convenient means. The temperature will vary with the size of the wire to be enameled, the speed of the enameling, design of the enameling machine and the size and type of the baking chamber used. This temperature is preferably maintained between 175° F. and 275° F., but may be above or below this range in conformity with other conditions. The enameling operation may be modified so as to employ mechanical smoothing rolls, wipers, dies or other means of smoothing the enamel film, but equally satisfactory results may be obtained by the commonly known dip method.

The compositions of the present invention may

- be used on both vertical and horizontal enameling machines and produce a baked film of enamel having improved properties of hardness, smoothness, flexibility, non-porosity and adherence to the wire at baking temperatures and speeds within the range of the present types of enamels which employ solvents or diluents; for example, the compositions of the present invention, may be applied to a #19 B. & S. gauge copper wire at a speed of 25 feet per minute, baked at a temperature of approximately 735° F. with a baked enamel film of approximately .002 inch in thickness, in three coats by maintaining the temperature of the enamel bath at approximately 240° F.
- The film thickness of the enamel on the wire may be controlled by varying the temperature of the enamel bath and/or the speed of the wire passing through the bath; thus, for example, the film thickness on the wire may be increased by lowering the temperature of the bath or by maintaining the enamel bath at a constant temperature and increasing the speed of the wire passing through the enamel bath. The film thickness may conversely be decreased by increasing the temperature of the enamel bath or by lowering the speed of the wire passing through the bath. Since there is no loss of volatile material in the present invention, the thickness of the coating on the wire will not vary if the temperature of the enamel bath, speed of passing the wire through the bath and the oven temperature are held constant. If desired, the enamel compositions of the present invention may be applied over wire or metal strips which have been previously covered with such materials as paper, cotton, asbestos, regenerated cellulose sheeting, etc., and the enamel baked to form a protective outside coating for the wire or metal strip. Where wire or metal strips have previously become protected with an absorbent material, a quantity of the enamel may penetrate the absorbent material and thus serve to more securely bind the covering to the wire in addition to giving increased mechanical strength to the wire. Such previously covered wire may be coated with the enamel compositions according to the procedure previously outlined for bare wire.

The following examples will illustrate compositions of enamels within the scope of the present invention, but it is understood that the invention is not limited thereto:

Example I

	Parts by weight
Wood rosin	50
Alkyd resin*	150
Perilla oil	205.5
Fish oil	15
Chinawood oil	73.5
Manganese resinate	.3
Ferrous resinate	.45
Cobalt acetate	.25
Zinc resinate	1

*This resin is a glyceride of rosin treated with maleic anhydride or maleic acid.

- The wood rosin, alkyd resin, and the fish oil are heated to 500° F. in approximately 20 minutes time. The manganese resinate, ferrous resinate, and cobalt acetate are added and the temperature raised to 585° F. in approximately 12 minutes. The source of heat is removed and the Chinawood oil and zinc resinate added with stirring. The mass is cooled as quickly as possible by any suitable or convenient means to a temperature of approximately 300° F. The material

is filtered while still hot and stored in a warm tank.

Example II

	Parts by weight
Copal ester	200
Corn oil	50
Perilla oil	270
Chinawood oil	150
Manganese resinate	.74
Cobalt acetate	.35
Iron resinate	.7

The copal ester, corn oil and perilla oil are heated to 500° F. in 20 minutes. The metallic driers are then added and the temperature raised to approximately 585° F. in about 12 minutes time. The source of heat is removed and the Chinawood oil added with stirring. The finished product may be filtered and stored in the usual manner.

Example III

	Parts by weight
H rosin	200
Perilla oil	150
Fish oil	75
Chinawood oil	74
Lime	1.66
Manganese resinate	.30
Ferrous resinate	.43
Cobalt acetate	.24

This composition was prepared in the manner as described under Example I.

Example IV

	Parts by weight
Fossil gum, when run approximately	200
Soya bean oil	200
Chinawood oil	100
Manganese oxyhydrate (54% Mn)	.08
Cobalt linoleate (8.2% Co)	.12
Ferrous resinate (8% Fe)	.71

The fossil gum used may be kauri, copal or similar type gum.

The fossil gum is run to a very fine melt in one kettle while the soya bean oil and half the Chinawood oil are heated to 550° F., quickly, in another kettle. The manganese oxyhydrate cobalt linoleate and ferrous resinate are then added to the oil which is in turn slowly added to the melted gum and the mixture heated to 585° F., in approximately 15 minutes. The source of heat is then removed and the balance of the Chinawood oil added with vigorous stirring. The material is then cooled as quickly as possible by any convenient means to approximately 300° F., filtered and stored in a warm tank.

Example V

	Parts by weight
Alkyd resin	300
Chinawood oil	150
Linseed oil	84
Manganese naphthanate (6% metal)	.35
Cobalt naphthanate (6% metal)	.72
Iron naphthanate (6% metal)	.44

The resin, linseed oil and two-thirds of the Chinawood are heated in a suitable container to approximately 540° F. in approximately 20 minutes. This temperature is maintained until a 70 sample of the material placed on a glass plate is perfectly clear, which is usually for about 5 minutes. The source of heat is removed and the remainder of the Chinawood oil added with thorough stirring. The mass is then cooled to ap-

proximately 300° F., filtered while still hot and stored in a warm tank.

Example VI

	Parts by weight
5 Rosin	300
Soya bean oil.....	134
Fish oil.....	50
Cashew oil.....	50
10 Manganese resinate	.25
Cobalt acetate.....	.18
Iron resinate.....	.33

The rosin and oils are heated in a suitable container to approximately 500° F. in approximately 20 minutes. The manganese resinate, cobalt acetate and iron resinate are then added and the mass heated to 550° F. in approximately 7 minutes. The source of heat is removed and the material rapidly cooled by any convenient means to approximately 300° F. It is then filtered and stored in warm tanks.

It will be seen that in the present invention an oil, preferably a vegetable drying oil or a combination of such oils, either raw or treated, may be used. Of the drying oils Chinawood, linseed, perilla, or oiticica may be used and in some cases a semi-drying oil such as fish, soya bean, corn, sesame, cashew, cottonseed, or castor oil in combination with the drying oil may be used. Further alcoholized oil may be employed as all or part of the oil content of the compositions. In the claims the term drying oil is intended to be generic to all of those mentioned whether true drying oils or not. A variety of resins may be used and among such are included natural resins, synthetic resins as the phenol-formaldehyde type, polyhydric alcohol-polybasic acid type, oxidized rosin, ester gum, etc. The proportion of oil to resin may be varied to meet certain requirements of fluidity of the enamel or the properties of the baked film such as hardness, flexibility and general life.

As a general range for composition the enamels may be noted as varying in oil length between approximately 10 and 40 gallons with a preferred oil length of approximately 15-20 gallons. In such compositions the resin content would vary between approximately 24% and 56% with a preferred content of approximately 40%.

Oxidation inhibitors may be added to the enamels if desired in order to prevent thickening or gellation of the material during use. Among such may be mentioned phenyl, alpha, or beta naphthylamine, hydroquinone, creosol, thymol,

and eugenol. These are preferably added with thorough stirring after the enamel has been cooked and the temperature rapidly lowered to approximately 300° F.

The principal advantage of the enamels of the present invention is that it does not require the use of solvents or diluents either during preparation or use thereof, thus involving the economic advantages in saving of cost of solvents or diluents and in saving of heat necessary to volatilize the solvents or diluents as is necessary in the present type of wire enamels. The absence of solvents and diluents further removes the health and safety hazards entailed in the use of such materials. Further advantages are that uniformly continuous baked enamel films of uniform thickness and color and of a tougher and more solvent resistant nature may be produced than is practical by the present type of wire enamels. The films of the enamel of the present invention do not soften under the influence of heat, resist abrasion, retain their flexibility on aging and in service and are substantially unaffected by grease and oil. Other advantages will be readily apparent to those skilled in the art.

It is apparent that many widely different embodiments of this invention may be made without departing from the spirit and scope thereof; and, therefore, it is not intended to be limited except as indicated in the appended claims.

I claim:

1. An insulating enamel having approximately the following composition:

	Parts by weight
Wood rosin	50
Alkyd resin	150
Perilla oil.....	205.5
Fish oil.....	15
Chinawood oil	73.5
Manganese resinate	.3
Ferrous resinate.....	.45
Cobalt acetate	.25
Zinc resinate.....	1

2. Process of producing a thin flexible coating on a conductor which comprises passing the same through a liquid enamel bath free from volatile solvents at a temperature between 175° F. and 275° F. at a speed of at least 25 feet per minute, said bath containing a wood rosin, an alkyd resin, at least one drying oil, and a drier, and thereafter baking the said coated conductor at a temperature of approximately 735° F.

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