United States Patent Office 2,695,275 Patented Nov. 23, 1954

2,695,275

SILVER PAINT

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No Drawing. Application February 5, 1949, Serial No. 74,851

7 Claims. (Cl. 260—8)

This application is a continuation in part of my application, Serial No. 592,946, filed May 10, 1945, now abandoned.

This invention is a metal paint for applying coatings to be fixed by heating or firing. Among its advantages are electrical conductivity permitting capacity measurement during application, dry film strength, freedom from bubble formation, and safety. Further objects and advantages appear in the specification and claims.

Paints for producing metallized coatings on refractories such as ceramics, mica, quartz, and glass have heretofore consisted of a base, a vehicle, and a pigment and flux. These comprise a compatible mixture in which each ingredient performs its function independently of the others and at a different stage in the coating operation. The base functions as a thinner providing the desired consistency for spreading, dipping or spraying. The film forming vehicle functions as a temporary binder giving sufficient strength to the coating so that it will adhere until the firing or setting operation. The pigment is reduced by firing to a metallic film held in place by the flux which fuses or vitrifies. Fluxes are well known. Common fluxes are bismuth, subnitrate, mercuric oxide, lead oxide, lead borate, lead silicate. These fluxes although known as ceramic fluxes are usable on other materials.

The function of the base starts with providing the desired consistency of the paint and ends with the drying of the applied film. After the film is dried, the base no longer has any function.

The function of the film forming vehicle starts with the application of the wet film and ends with the firing operation. The vehicle provides the necessary adherence of the unfired film. During firing, the vehicle breaks down.

The function of the pigment and flux starts with the firing operation.

The prior paints have all had high electrical resistance until the firing operation. If the electrical properties of the coating were important, as is the case in electrical condensers, it has heretofore been necessary to wait until after the firing operation to learn whether the coating has the desired properties.

The present paint has the property of high electrical conductivity prior to drying of the applied film which permits the determination of the electrical properties of the film before firing. The high electrical conductivity of the wet paint film makes the paint particularly applicable to the manufacture of condensers as disclosed in my application Serial No. 592,946, filed May 10, 1945. The paint comprises an evaporating electrically conductive base, a film forming vehicle, and a silver pigment and flux. The vehicle or temporary bonding agent is from a large class of materials having the property of adhering in both the wet and dry state. Such materials include natural and synthetic gums, glue sizes, resins. The vehicle is merely a compatible adhesive agent which holds the paint film until firing and which breaks down at firing temperature. If the base is water or water alcohol, the film forming vehicle should be compatible with the base. Polyvinyl alcohol, dextrin, methyl cellulose are common vehicles. Others are known. The high electrical conductivity is obtained from the evaporating base. The high electrical conductivity may result from ionizing of the base, ionizing of an electrolyte added to the base or ionizing of the pigment or to a combination of these effects. Ideally the base should supply the high electrical conductivity when the paint is wet and then evaporate completely. This ideal result is achieved by a water or water alcohol base with or without an added evaporating electrolyte such as ammonia. Water also ionizes silver oxide. In water alcohol mixtures, the water is the main source of high electrical conductivity. It is, however, equally satisfactory if the base contains nonevaporating solids so long as the residue is compatible with the pigment and flux. Water-silver nuclineate (silver protein e. g. "Argyrol") solutions have the desired high electrical conductivity and the residue after evaporation is compatible with the silver pigment. The addition of electrolytes such as silver nitrate in reasonable quantities to increase the hydrogen ion concentration and thereby increase the conductivity does not affect the fired silver film.

The following are specific examples:

		Per cent
(1)	Precipitated silver (with or without silver chloride, an active impurity)	50
	Ceramic flux	2 to 10
	Polyvinyl alcohol	4
	Ammonia	.2 to 1
	Water	Balance
(2)	Precipitated silver oxide	50
	Ceramic flux	2 to 10
	Polyvinyl alcohol	2
	Ethyl alcohol	2 to 4
	Water	Balance
(3)	Precipitated silver oxide	50
	Ceramic flux	2 to 10
	Purified dextrin	4
	Silver nitrate	0 to 5
	Water	Balance
(4)	Finely divided silver (precipitated, flake, silver oxide)	60
	Silver nitrate	3
	Vehicle	2 to 4
	Ceramic flux	2 to 10
	10% solution of silver protein in water such as sold under the trade-mark "Argyrol"	Balance
(5)	Precipitated silver oxide	50
	Ceramic flux	2 to 10
	Polyvinyl alcohol	2
	Ethyl alcohol	2 to 4
	Water	Balance
	Silver nitrate	0 to 3

The pigment in the paint in Example (1) tends to settle so that the paint has to be stirred during application. The paints in Examples (2), (3) and (5) are very stable and can stand for some hours during use without requiring stirring. There is no trace of reaction between the constituents of Example (2) in six months. The silver nitrate should be added shortly before use to prevent breakdown of the vehicle. The paints can have a very low electrical resistance and are therefore adapted to coating by the striping or brushing process where the capacity is high enough to make the series resistance more than a few percent of the capacitive reactance. With all of the paints the dried coating has too high an electrical resistance for capacity measurements. The conductivity is due to the suspending medium and ions dissolved in it, since the pigments are insulated by the film forming material.

The constituents do not react chemically but form a mixture in which each of the constituents functions substantially independently of the other constituents. The percentage of pigment depends upon the thickness of the coating to be applied. After heating or firing the pigment forms a uniform silver coating held in place by and alloyed with the ceramic flux. The remaining constituents are broken down during the firing. The amount of ceramic flux necessary depends upon the type of ceramic or other dielectric. The amount and kind of flux for any particular dielectric is well known. Other bonding agents may be used. The firing or baking temperature is primarily determined by the heat necessary to set the bonding agent. Firing is used to define the necessary setting heat.

The film forming vehicle (or protective colloid) holds

the pigment in suspension and upon drying, holds the coating against the ceramic surface until the firing operation. The antifoaming agent (ethyl alcohol) is necessary with some vehicles but not with others. For example, the purified dextrin requires no antifoaming agent. The electrolyte or substance increasing the hydrogen ion concentration is selected from a known class of materials. Each of the constituents acts independently and belongs to a class of materials having well known properties.

The constituents are chosen to have no harmful reaction. For example, silver nitrate attacks some vehicles, such as polyvinyl alcohol, but does not attack dextrin within the normal period of use. With polyvinyl alcohol, the silver nitrate should be added immediately prior to use. Chlorides should be avoided as these have a tendency to form silver chloride which is undesirable in the finished coating. These factors are well understood in the art.

What I claim as new is:

1. A water base paint for producing a film having good electrical conductivity before drying and reducible by firing after drying to a metallic silver film comprising a finely divided metallic silver pigment, a vehicle of polyvinyl alcohol, water, and an antifoaming agent.

2. A paint for producing a film having good electrical conductivity before drying and reducible by firing after drying to a metallic silver film comprising a finely divided metallic silver pigment, and an aqueous solution of a water soluble protective colloid holding the pigment in suspension.

3. A paint for producing a film having good electrical conductivity before drying and reducible by firing after drying to a metallic silver film comprising finely divided metallic silver pigment, a ceramic flux, and an aqueous solution of a water soluble protective colloid holding the pigment in suspension.

4. A water base paint for producing a film having good electrical conductivity before drying and reducible by firing after drying to a metallic silver film comprising a finely divided metallic silver pigment, an aqueous solution of a protective colloid, and a water soluble agent increasing the hydrogen ion concentration.

5. The paint as claimed in claim 4 in which the agent increasing the hydrogen ion concentration is silver protein.

6. The paint as claimed in claim 4 in which the agent increasing the hydrogen ion concentration is ammonia.

7. The paint as claimed in claim 4 in which the agent increasing the hydrogen ion concentration is silver nitrate.

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