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COATED SHEET METAL

Sidney G. Henderson, Winsford, England, assignor to Colin Stewart Limited, Winsford, England, a British company

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1 Claim. (Cl. 117-127)

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This invention relates to an improved preparation for use in the production of an electrically insulating layer on metal and has more particular reference, but without limitation, to the production of insulated rolled steel sheet, such as is employed in the manufacture of rotor laminations.

In the production of such insulating layers it is necessary that the layer shall:

- (a) be electrically insulating when applied;
- (b) be of such a nature that it may be applied in a thin uniform coat on the metal, a coating thickness of the order of $\frac{1}{1000}$ inch being frequently employed;
- (c) be sufficiently adhesive to enable it to be handled in the factory and passed through the fabrication process without being removed from the sheet;

- (d) be of such a nature that it will not crack or craze when dried and/or heated.

It has been known hitherto to manufacture such coatings from finely powdered insulating material such as kaolinite or other clays, usually bonded with a cereal binder such as starch. In practice it has been found that such clays shrink when dried and shrink still further when heated strongly (above 600° C.) when their water of combination is driven off. Furthermore, such clays are relatively soft and break down easily to particles of greater fineness.

The use of organic binders, such as starch, when mixed with clay entails considerable mixing problems. Also, if the insulating layer is heated to a high temperature the breakdown of the organic binder and the consequent formation of carbon considerably reduces the efficiency of the insulation of such a layer, particularly if the clay film shrinks.

The invention aims at avoiding the aforesaid disadvantages associated with such insulating layers.

According to the invention a preparation for use in the production of an insulating coating on metal consists of finely powdered silica of a particle size of not more than 5 to 10 microns, and a binder of sodium silicate, mixed with water to make a paste or slip of the required consistency.

The art of applying liquid insulating coatings to the metal is well known, and this new coating may be applied to the metal and subsequently dried in any convenient method.

The amount of sodium silicate added is in the order of 5% to 20% by weight of the silica.

It is believed that the particle size of the insulating constituent in such preparations is of

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great importance and also that in order to get the most homogeneous coating the powder and the binder should be of an analogous nature, particularly where high temperatures are applied.

By the use of finely powdered silica according to the invention in conjunction with a binder of sodium silicate a far more homogeneous mixture is obtained than is possible when using materials such as clay and starch. The standard ground silicas of commerce are of no use for the purposes of the invention, since their particle size range is irregular and the overall size of the particles is too large. The solubility of silica in an alkaline solution is considerably increased when the particles are of an average size of 1 to 5 microns, or not more than 5 to 10 microns.

The use of silica ensures that the particle size of the insulating material is substantially unaltered when mixed with water, and by the use of particles of a size not exceeding 5 to 10 microns it is possible to obtain uniform insulating coatings of the order of $\frac{1}{1000}$ inch or 25 microns in thickness.

A further advantage in the use of silica with sodium silicate as a binder lies in the fact that inorganic material generally permit of more accurate control in a manufacturing process and are less subject to uncontrollable variations than organic materials.

Instead of pure ground silica, of the particle size specified, it is possible to use, for the purposes of the invention, certain natural stones, mud or clay-like substances containing a high proportion of fine silica as quartz; or a mixture of such a clay-like substance and pure silica may be employed. Whatever material is employed, the particle size should not exceed 10 microns.

The soda-silica ratio of the sodium silicate binder has an influence on the binding properties of the material but all ratios give a degree of binding power. Sodium silicate which has been found to give good results in practice has a composition $1 \text{ Na}_2\text{O} : 2 \text{ SiO}_2$. In general the alkaline sodium silicates are the best.

The ratio of sodium silicate (the binder) to ground silica (the insulating constituent) affects the hardness and tenacity of the coating. Illustratively a mixture consisting of 80 parts by weight of ground silica and 15 parts by weight of sodium silicate of a composition $1 \text{ Na}_2\text{O} : 2 \text{ SiO}_2$ gave excellent results. Mixtures containing smaller proportions of sodium silicate tended to give rather softer coatings, and higher proportions of sodium silicate, although giving a satisfactory coating, would be more expensive.

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It must be clearly understood that although specific proportions are given illustratively, other ratios of binder to ground silica give satisfactory results and the proportions given are not limiting ones, but purely illustrative. If a solution of sodium silicate and water is used instead of dry sodium silicate, the water content must be allowed for in assessing the correct proportions. Illustratively, if proportions of 2 parts by weight of dry sodium silicate to 10 parts of ground silica are required, and if it is desired to use a solution of sodium silicate in water, consisting of equal parts by weight of dry sodium silicate and water, it would be necessary to use proportions of 4 parts by weight of this particular sodium silicate solution to 10 parts by weight of ground silica.

The amount of water needed to make a coating of the required viscosity varies, and each user will determine the correct quantity of water required to meet his particularly requirements.

It has been found in practice that if an alkaline sodium silicate is used, the mixture should be made up with cold water. If very hot water is used the coating slip becomes very viscous due to a reaction between the free soda and the fine particles of silica. This reaction with the application of heat, almost certainly has a bearing on the hardness and tenacity of the coating after drying; that is, after it has been subjected to heat.

It has been found that insulating layers prepared with the aforesaid mixtures retain their insulating properties to a substantial degree after heating to 850° C., and indeed become more homogeneous on heating as the ingredients of similar nature combine. The water content of such layers is lower than a starch-kaolinite mix-

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ture of equivalent viscosity, thereby effecting a reduction in drying costs and shrinkage. Also, since layers produced according to the invention contain little or no combined water a homogeneous silica or silicate coating is formed on drying, gelatinous silica being precipitated from the sodium silicate, and the layer not cracking or crazing.

I claim:

As a new article of manufacture, sheet metal electrically insulated by a coating preparation consisting principally of finely powdered silica of particle size in the order of 1 to 5 microns and a binder of sodium silicate, said sodium silicate being 5% to 20% by weight of the silica.

SIDNEY G. HENDERSON.

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