Cl. 106

Published May 11, 1943

Serial No. 345,372

ALIEN PROPERTY CUSTODIAN

ENAMELS

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No Drawing. Application filed July 13, 1940

The present invention relates to new enamels, and more particularly it relates to new enamels in which at least a part of the usually present boron compounds is replaced by a titanium compound forming a clear melt with the other usual constituents of the enamel.

Up to now titanium dioxide has been used in some cases in the enamel industry, to increase the resistance of the enamels to acids. Often also trials have been made to turbid enamels by means of titanium dioxide or other titanium compounds. For the melting of the titanium in enamels has been further proposed, to use a sodium titanium silicate instead of titanium dioxide, to facilitate the dissolution of the titanium in the molten enamel and to avoid, certain difficulties which appear during the melting of the titanium dioxide. The trials hitherto made for the use of titanium compounds for manufacturing of enamels were directed on the one hand to the fact, to add titanium oxide or other titanium compounds as opacifiers on the mill, to keep them in the enamel flux substantially as cristalline substance. On the other hand, one tried to influence the properties of the enamels in a certain direction in general for increasing the acid resistance, by the admixture of titanious materials to the common enamel raw batch whereby these materials are molten in the enamel.

In accordance with the present invention it has been found, that in enamel batches the boron compounds which are up to now looked upon as essential constituents by the enamels, can be substituted partially or in the whole by such titanium compounds, which form with the other glass-forming constituents of the enamel batch a clear melt. There have been produced sometimes enamels which are free of boron or contain only few boron whereby the missing boron portion was substituted substantially by metal compounds. Such enamels differ in their properties so far from the normal borax silicate enamels, that they only can be looked upon as bad substitutes. In accordance with the present invention it is, however, possible to manufacture enamels poor in boron or free of boron, which in the fact are not inferior in quality than boron containing enamels.

As the titanium is intended to work as a fluxing material such compounds come preferably into question which are easily dissolved in the enamel raw batch during melting, respectively form clear melts with the glass-forming materials. Such compounds are e. g. alkali metal titanium silicates, titanium fluoro compounds and titanates. Preferably sodium titanium silicate corresponding to the formula

$$Na_2O.TiO_2.SiO_2$$

is used. When using this compound it is not necessary to use a compound having the stoichiometric composition, it is, however, preferable to employ compounds of the following composition:

	Per cent
Alkali	20–35
TiO_2	5–45
SiO	20–60

The fusion point of such alkali metal titanium silicates can be lowered by the introduction of certain quantities of alkaline earth metal compounds or of the elements of the 3rd group of the periodic system, suitable in connection with fluorine. As titanates and titanium fluoro compounds come preferably compounds of the alkali metals into consideration, e. g. Na_2TiO_3 and Na_2TiF_6. But also titanates or titanium fluoro compounds of the alkaline earth metals as well as of coloring elements come into question.

The titanium compounds mentioned serve to a partial or complete substitution of the boron compounds. It is e. g. possible to substitute 50–70%, even also 100% of the borax portion in the enamel mixture by the titanium compounds mentioned without a further alteration of the mixture being necessary. Hereby in general instead of one part of borax about 0.5–0.8 parts of alkali metal titanium silicate has to be introduced. By this substitution the gloss and the chemical resistance of the enamels is considerably increased.

EXAMPE 1.—*White frit*

	Normal composition	Boron substitution
Borax	25.0	8.0
Feldspar	22.4	22.4
Quartz	26.0	26.0
Cryolith synth	12.4	12.4
Soda ash	6.1	6.1
Sodium nitrate	3.0	3.0
Calcium carbonate	5.1	5.1
Sodium titanium silicate		10.0
	100.0	94.0

In a similar manner also the alkali metal titanates and alkali metal fluorides suit for the substitution of the borax without further alteration.

EXAMPLE 2.—*Ground coat*

	Normal composition	Boron substitution
Quartz	12.0	12.0
Feldspar	37.5	37.5
Borax	38.0	20.0
Soda ash	6.0	0.8
Sodium nitrate	2.0	2.0
Fluor spar	3.3	3.3
Nickel oxide	0.6	0.6
Cobalt oxide	0.2	0.2
Pyrolusite	0.4	0.4
Na_2TiF_6		10.0
	100.0	94.0

The melting of the enamels according to these compositions as well as the further working up is effected in the usual way.

An enamel completely free of boron will be obtained in accordance with the following example:

EXAMPLE 3.—*Black frit free of boron*

Quartz	40.3
Feldspar	11.4
Soda ash	13.7
Sodium nitrate	3.4
Barium carbonate	3.4
Fluor-spar	3.4
Pyrolusite	1.7
Cobalt oxide	1.1
Strontium fluoride	3.4
Zinc oxide	5.7
Black pigment (product usual in commerce consisting of strongly calcined oxides of Co, Mn, Fe, Cr)	3.4
Sodium titanium silicate	9.1
	100.0

Also such mixtures free of boron are worked up in the usual manner and present enamels which are distinguished by a special nice colorotion, high gloss and considerable resistivity to acids.

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