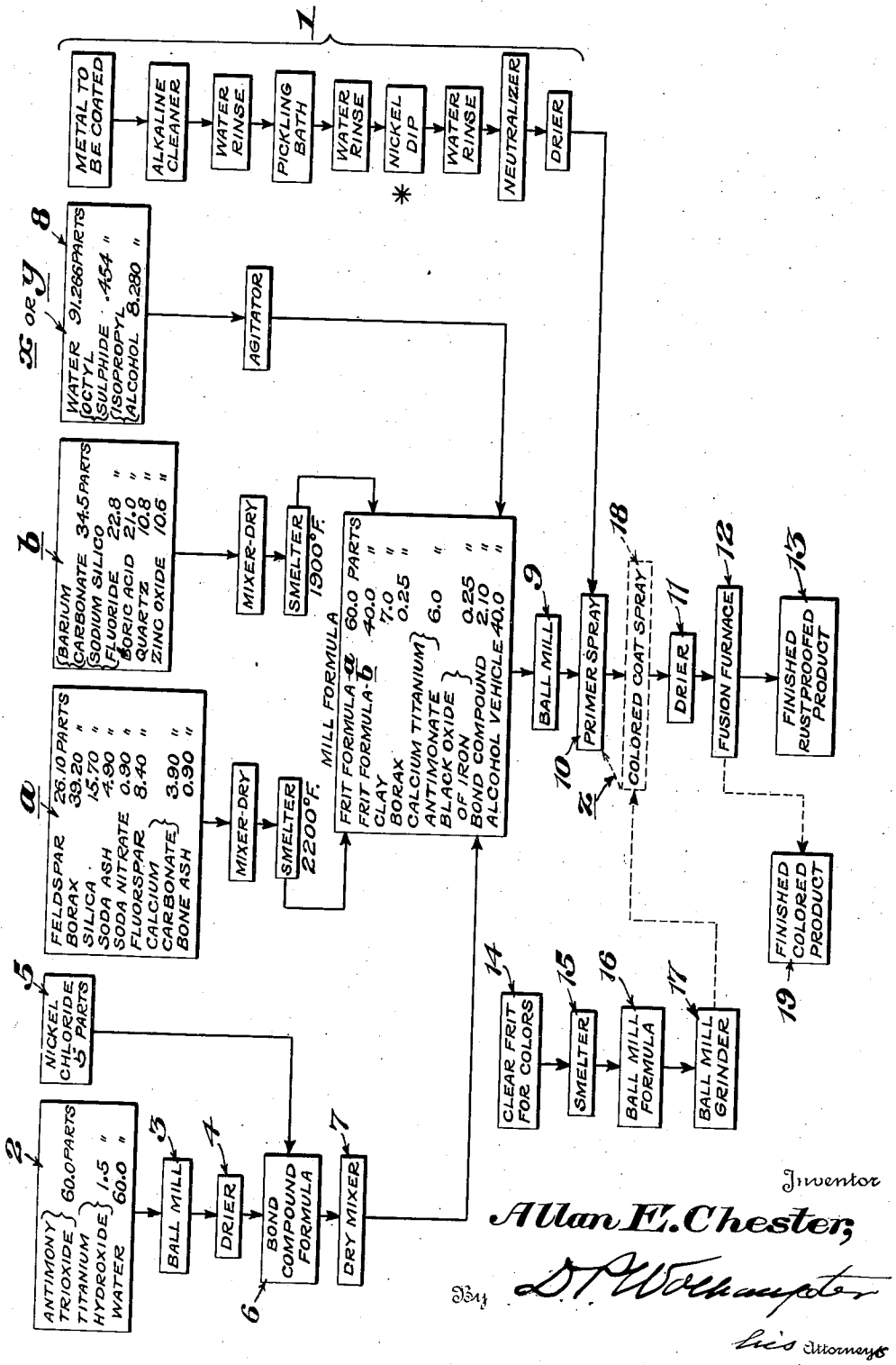
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ENAMEL COATING FOR FERROUS METALS

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ENAMEL COATING FOR FERROUS METALS

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2 Claims. (Cl. 106—48)

This invention relates to a step in the process of enamel-coating ferrous metals involving the use of materials or bonding agents to control the amount or degree of thermal oxidation, and to provide for the firm adherence of the enamel coat to the metal, the invention primarily contemplating a new and useful bonding compound which includes vitrifiable ingredients, and having the practical quality of being used as a spray, like paint, in a single coat on the metal sheet to be enameled.

Further, the invention is particularly applicable for use with medium and low firing enamels, as distinguished from those enamels of the art which function with cobalt, extensively employed in enameling procedure and which only functions at temperatures in excess of 1580° F. and which will not provide adherence or bond when used with enamels fusing below 1580° F., e. g., enamels which fuse in the range of approximately 1100° F. to 1460° F.

The invention therefore primarily has in view a new step in the process of enamel coating ferrous metals which consists in subjecting the metal sheet, preferably a nickel-dipped sheet, to a bonding-glass compound carried in an aqueous-alcohol vehicle and employed as a spray which will insure complete dispersion of the compound over the metal surface, as well as firm adherence of the same to the metal. To that end the invention contemplates the use of a bonding-glass compound in which is combined certain essential ingredients or components permitting the same to be used as a single fired rustproofing coat on a metal sheet, or as the primer coat or base for a clear glass color coat superimposed thereover when the metal is to be used for purposes other than merely for rustproofing.

So far as known, the invention of the present application represents for the first time in the art the use of an aqueous-alcohol vehicle for spray mixtures containing not only bonding elements but also vitrifiable elements, the use of the alcohol vehicle serving to increase the rate of drying of the mixture to a point where by the time a subsequent color coat may be applied when desired, the primer coat, consisting of the bonding-glass compound carried in the aqueous-alcohol vehicle, is substantially dry. Furthermore, the new bonding-glass compound includes in connection with the aqueous-alcohol vehicle an ingredient, preferably octyl sulphide, which, by lowering the surface tension of the slip, permits the penetration of the primer coat into serrations of the steel or ferrous metal, which results in the formation of a flat smooth spray which enhances the smoothness of the surface when the vitreous body is fused.

The drawing is a diagrammatic flow-sheet indicating the special processing steps employed in preparing and developing the new bonding compound, preliminary to spraying the same as a priming coat on the metal sheet to be enameled.

In carrying forward the invention the new bonding compound, ground colloidally fine, is preferably made up according to the formulae and procedure as exemplified by the flow-sheet drawing, to wit:

It has already been pointed out that the present invention of the new bonding-glass compound is specially applicable for use with nickel-dipped steel, and for illustrative purposes there is shown on the flow-sheet a series of operations indicated by the numeral 1 which are conventional operations in the preparation of a metal or steel plate, preliminary to having applied thereto an enamel coating. The said series of operations includes, as shown, after the pickling step, the nickel-dipping of the metal sheet and its subsequent rinsing, neutralizing and drying, to prepare the same ready for the application of the enamel coating thereto.

In the processing of the new bonding-glass compound, the primary bonding ingredients are prepared according to the flow-sheet, namely, first, as indicated at 2, a colloidal suspension is made of antimony trioxide and titanium hydroxide and water, in the proportions of 60 parts on antimony trioxide, 1.5 parts of titanium hydroxide, and 60 parts of water.

This mixture is introduced into a ball mill, as indicated at 3, for thorough grinding, and then the mixture of the primary bonding ingredients, from stage 3, is introduced into a drier as at 4, following which step nickel chloride, from a source of supply 5, is combined with the said ingredients in the proportions, as indicated at stage 6, of 100 parts by weight of said combined primary ingredients and 5 parts nickel chloride, thereby completing the bond compound per se.

The above completed bond compound formula is then carried to a dry mixer, as at 7, and at that stage the said complete bond compound is ready for incorporation in a mill formula consisting of a vitrifiable rustproofing composition which constitutes the complete bonding-glass compound.

Referring in detail to this mill formula which includes two separate frit formulae *a* and *b*, a new and distinctive part thereof is the combina-

tion of a conventional frit or raw glass batch of relatively high maturing temperature, designated *a*, as a hard member in a two component formula with a sharply defined eutectic composition, non-feldspathic and containing at least 27% barium oxide and 10.2% sodium fluoride to provide the soft or fluid member, designated *b*, which latter also greatly increases the bonding or adherence of the fused vitreous body to the metal surface. A typical example of a commonly used or so-called Standard raw glass batch or frit, combinable in a practical way with the new frit formula *b* is as follows:

	Parts by weight
Feldspar	26.10
Borax	39.20
Silica	15.70
Soda ash	4.90
Soda nitrate	0.90
Fluorspar	8.40
Calcium carbonate	3.90
Bone ash	0.90

The said new frit formula *b* is of the following composition:

	Parts by weight
Barium carbonate	34.5
Sodium silica fluoride	22.8
Boric acid	21.0
Quartz	10.8
Zinc oxide	10.6

As indicated on the flow-sheet the two frit formulae *a* and *b* are respectively and separately carried through the stages of a dry mixer and smelted respectively at the temperatures of approximately 2200° F. for formula *a* and approximately 1900° F. for formula *b*. These two frit formulae are then finally brought together, as indicated on the flow-sheet, to form component parts of the aforesaid mill formula which is preferably of the following composition:

	Parts
Frit formula *a*	60.0
Frit formula *b*	40.0

	Parts by frit weight
Clay	7.0
Borax	0.25
Calcium titanium antimonate	6.0
Black oxide of iron	0.25
Bonding compound	2.1
Aqueous alcohol vehicle (*x*)	40.0

It will be observed that at the point of compounding the above complete mill formula there is introduced into the same the above specified and important aqueous-alcohol vehicle *x* of the following composition, as noted at **8** on the flow-sheet:

	Parts by weight
Water	91.266
Octyl sulphide	.454
Isopropyl alcohol	8.280

The foregoing additions complete the mill formula constituting the bonding-glass compound, and with all of the ingredients of that compound incorporated the same is introduced into a ball mill at stage **9** on the flow-sheet, where the same is ground to a degree of fineness preferably one-half of one percent or less residue on a 200 mesh screen. Then the bonding-glass compound is ready for use in a spray gun, as at step **10**, for spraying onto the metal sheet a single coat of the said compound. If the metal sheet with the single coat of the said bonding glass is to be employed as a rustproof product, it is desirable to give a brief drying at stage **11**, in a suitable dryer or in the open air. The metal sheet is then subjected with its single coat to firing in a conventional fusing furnace, as at stage **12**, and with the formula of the coating as above given, the temperature or firing, at stage **12**, is preferably within the range of 1350° F. to 1400° F. The effect of the firing is to fuse the vitrifiable elements of the bonding-glass, and to provide firm and uniform adherence of the finished enamel coat to the metal surface. The metal sheet thus provided with a single finished enamel coat is ready for use, as indicated at stage **13** on the flow-sheet, as a finished rustproof product.

It has already been pointed out that in cases where it is desired to provide the coated sheet with a decorative color, that is, with a colored enamel finish, it is only necessary before drying the coated metal sheet to superimpose, on the first or single coat of the bonding glass, a clear glass color-coat, that is, a glass or frit having no adulterants nor bonding ingredients. The provision for this second enamel color-coat is indicated by dotted lines in the diagram of the flow-sheet where, at step **14**, is indicated the use of any conventional clear frit or glass composition usable with colors, which composition is prepared in the usual way in a smelter, as at step **15**, and the frit, following the smelting operation of the clear glass composition, may have, for example, the following color-enamel formula, viz:

	Parts by weight
Clear glass frit	100
A color oxide	4
Magnesium carbonate	¼
Clay	5
Water	38

This enamel color formula, indicated at step **16**, of the supplemental coating step is introduced into a ball mill grinder, indicated at step **17**, and the mixture ground to 1% or less residue on 200 mesh screen, after which the enamel color mixture is sprayed as a separate coat, as at step **18** on the flow-sheet, directly upon the primer coat of bonding glass, at step **10**, as indicated by the dotted arrow *z*. Then the thus double coated sheet is subjected respectively to the drying stage **11** and to the firing or fusing stage **12**, and the resulting product, as indicated at step **19** of the flow-sheet, becomes a finished one-fired colored enameled product, not only having rustproofing qualities but also usable for decorative purposes.

A variation of the process as described may be resorted to with advantageous results where certain conditions in an enameling plant, such as working temperature conditions within the mill or the character of the water employed, would not provide perfect results with the use of the aqueous-alcohol vehicle *x* previously referred to. This variation in the process would merely consist in substituting for the aqueous-alcohol vehicle *x* the aqueous-alcohol vehicle *y* composed of

	Parts by weight
Water	91.266
Octyl sulphide	.454
Butyl alcohol	8.280

In other words, in the variation of the process employing the aqueous-alcohol vehicle *y* there is merely a substitution of butyl alcohol for the isopropyl alcohol heretofore referred to, and an

equivalent of these two alcohols that may be substituted therefor is diethylene glycol mono butyl ether. In all other respects all of the formulae and the procedure are the same in providing either the single enamel rustproofing coat for the metal sheet, or the two-coat colored enamel sheet, as already described.

In the method described the temperature employed for firing the coated metal is much lower than that employed in the conventional sheet metal enamel processes, thereby permitting the invention to be carried out in connection with lighter gauge metal sheets than heretofore possible.

From the foregoing description it is thought that the essentials of the invention are fully defined, but it will be understood that any modifications or alterations in details of procedure, or in the proportion of parts employed, falling within the scope of the appended claims may be utilized, without departing from the spirit of the invention.

I claim:

1. A coating composition, for use in enamel coating process, consisting of a mill formula including an aqueous alcohol vehicle, a bonding compound formula composed of antimony trioxide, titanium hydroxide and nickel chloride, and a blend of a raw glass batch of relatively high maturing temperature with an eutectic frit of a relatively low maturing temperature.

2. A coating composition, for use in enamel coating process, consisting of a mill formula including an aqueous alcohol vehicle including octyl sulphide, a bonding compound formula composed of antimony trioxide, titanium hydroxide, and nickel chloride, and a blend of a raw glass batch of relatively high maturing temperature with an eutectic frit of a relatively low maturing temperature.

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