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VITREOUS ENAMELED ARTICLE

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A principal object of the invention is to provide vitreous or porcelain enameled sheets and other articles of better quality and having improved features and characteristics in other respects than those hitherto produced.

Other objects, advantages and novel features comprehended by the invention are hereafter more fully pointed out or will be apparent to those skilled in the art from the following description of certain ways of producing my improved sheets.

Vitreous or porcelain enameled sheets comprise a metallic base, usually of iron or steel, and a coating or coatings of a suitable enamel which is fused thereto after it has been applied to the sheets in any convenient way and my sheets are of this class. By extended experimentation and research I have found that the adherence of the enamel to the base and the stiffness, reduction of bending and warping during the firing of the enamel, and surface finish of the latter are largely controlled by the character of the base itself and that when the base is formed of a ferrous alloy containing nickel and copper in the ratio of approximately 2:1 with a suitable quantity of manganese, the finished sheet is of markedly improved character in the aspects to which I have just referred as well as in others hereinafter mentioned.

Since the fusing of the enamel is carried out at relatively high temperatures, I deem it preferable to use a ferrous base in which the carbon is comparatively low and the material therefore classed as an iron rather than as a steel, since the AC₃ point of iron is higher than that of steel and the enameling temperatures to which the base is subjected during the manufacture of the sheets therefore do not affect the grain structure of the metal to the same extent, if at all, as when a steel base is employed. However, I have obtained extremely satisfactory results with alloy bases which are properly classed as steels and in some instances their use will therefore be indicated.

An iron alloy suitable for a base for the production of my improved sheets comprises the following constituents:

	Per cent
Carbon	0.01 - 0.05
Manganese	0.01 - 0.30
Sulfur	0.001- 0.05
Silicon	0.001- 0.15
Nickel	1.90 - 2.10
Copper	0.95 - 1.05
Iron, including impurities in minute amounts	97.128- 96.30
	100.00 100.00

and within this range I prefer to utilize an alloy of the following specific analysis:

	Per cent
Carbon	.03
Manganese	.10
Sulfur	.025
Silicon	.007
Nickel	2.0
Copper	1.0
Iron, including impurities in minute amounts	96.838
	100.00

I have also obtained very satisfactory results using steel bases formed of alloys comprised within the following analyses:

	I	II
	Percent	Percent
Carbon	0.06-0.08	0.08-0.20
Manganese	0.30-0.50	0.50-0.65
Sulfur	0.00-0.035	0.00-0.035
Silicon	0.12-0.20	0.12-0.20
Nickel	1.90-2.10	1.90-2.10
Copper	0.95-1.05	0.95-1.05
Iron, including impurities in minute amounts	96.67-96.035	96.45-95.765
	100.00-100.00	100.00-100.00

It will of course be understood that irrespective of the particular composition of the alloy and whether it is properly classifiable as an iron or a steel, a sheet of suitable size and gage is first fabricated therefrom in the usual way and to this sheet, which is to form the base of the finished article, is applied in any convenient way a suitable commercial vitreous or porcelain ground coat enamel, cobalt ground coat enamel being generally employed. The coated base is then fired at a temperature of 1500° F. to 1600° F. so as to fuse the enamel thereto, and after cooling further coats of enamel may be applied and respectively fused to the subjacent coat in accordance with the practice customarily followed to thereby produce a finished article having the desired number and character of enamel coats. The actual processing of the base therefore does not differ in any material respects from the practice followed in connection with the bases hitherto employed.

However, the results I attain in accordance with my invention are markedly superior to those which, as far as I am aware, have hitherto been possible when the articles embody bases formed of the well known enameling iron and low carbon steels normally utilized for the purpose since, among other things, because of the high tensile strength of the bases I employ they do not bend and warp to the same extent when they are heated and fired in the enameling process, and

resistance to cracking and chipping off of the enamel coating is thereby materially enhanced. My improved sheets also exhibit greater resistance to impact and cross bending after they are enameled than those embodying bases of the said irons and steels, and I can therefore utilize bases of lighter gage without sacrificing ability to remain flat, due primarily to their greater rigidity and tensile strength. The decrease in weight of the finished sheets thus effected is of distinct advantage especially in architectural work since the duty imposed on the frame work or other structure supporting the sheets is correspondingly lessened.

Furthermore, I have proved by numerous tests that the enamel coating adheres much more tenaciously to a ferrous base of the character I employ than to the conventional bases heretofore in use, and while I do not know positively why this is the case, I believe it due to the more rapid oxidation of the iron than of the copper and nickel in the base when the ground coat is being fired thereon, and as the latter is not continuous when the base is introduced to the furnace and does not attain that condition until it fuses, a minute pitting or roughening of the surface of the base is thereby induced which increases the ability of the cobalt ground coat to cling thereto.

While I have referred more particularly to my invention as applied to flat sheets, it is of equal advantage in the production of sheet metal articles which are not flat or substantially so throughout their entire extent but are of varying shapes and, in fact, it is especially desirable in the manufacture of such articles when they are of unusual shape. In the production of such articles the base is of course first formed up to the desired shape from a flat sheet and then the enamel coatings are applied and fused successively thereon. Under these necessary conditions of manufacture, the blanks have a distinct tendency to warp or sag out of shape during the firing of the coatings and if the distortion thereby produced is considerable the articles are rendered imperfect because of the appearance of hair lines and cracks in the fused coating. When made in accordance with my invention, however, this difficulty is greatly minimized for the blanks, because of the character of the base, have less tendency to distortion so that a much smaller number of the finished articles are rendered defective and the losses due to such defects thereby correspondingly decreased.

My invention is therefore of great utility in that it results in a greatly improved product whether it be a flat vitreous enameled sheet or a vitreous enameled article of some other shape

and therefore I believe it marks a distinct improvement in the art to which it relates.

It will of course be understood that the several examples of alloys suitable for the fabrication of bases adapted for the production of my improved vitreous or porcelain enameled articles are to be considered as typical only and therefore capable of variation within the ranges they respectively define, and that the method employed for applying and fusing the enameled coatings to the bases as well as the specific composition of the coating themselves may conform to standard or other suitable practice without departing from the spirit and scope of the invention as defined in the appended claims.

Having thus described my invention, I claim and desire to protect by Letters Patent of the United States:

1. A vitreous enameled article embodying a ferrous base formed of an alloy comprising:

	Per cent
Carbon	0.01 -0.20
Manganese	0.01 -0.65
Sulfur	0.00 -0.05
Silicon	0.001-0.20
Nickel	1.90 -2.10
Copper	0.95 -1.05

with iron including impurities to make 100% and having a continuous fused enamel coating on its surface.

2. A vitreous enameled article embodying a ferrous base formed of an alloy comprising:

	Per cent
Carbon	0.01 -0.05
Manganese	0.01 -0.30
Sulfur	0.001-0.05
Silicon	0.001-0.15
Nickel	1.90 -2.10
Copper	0.95 -1.05

with iron including impurities to make 100% and having a continuous fused enamel coating on its surface.

3. A vitreous enameled article embodying a ferrous base formed of an alloy comprising approximately:

	Per cent
Carbon	0.03
Manganese	0.10
Sulfur	0.025
Silicon	0.007
Nickel	2.00
Copper	1.00

with iron including impurities to make 100% and having a continuous fused enamel coating on its surface.

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