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ENAMELING METAL.

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Our invention relates to the provision of a product for enameling chiefly a sheet, which has a definite composition, and character, in view of which as an enameled product it possesses many excellent properties, including those of being capable of deep drawing prior to enameling, firm adherence of enameled coating, absence of bubbles or unevenness in surface of vitreous enameled coatings.

The importance of our invention includes among other things the possibility of control of its production to the end of producing a uniform product, and our object generally stated is to produce a deep drawing steel which will take smoothly and hold permanently a coating of enamel, particularly vitreous enamel.

The application of vitreous enamel is attended by raising the temperature of a piece of metal coated with enamel to a temperature of around 1600 degrees Fahrenheit, and our steel withstands this temperature, while at the same time, being formable in dies and by spinning into various objects while cold, and prior to being enameled.

We have also discovered that this steel has the property of box annealing at a much lower temperature, than other types of steel used for similar purposes, and, therefore, the material is not so likely to prove defective on account of any under annealing which may be imparted thereto.

Our new steel is of the type known as "killed" steel, and contains silicon in greater quantities than any deep drawing and spinning steel with which we are familiar. In fact the silicon content is as high as steel used for casting purposes, while the other ingredi-

ents in the steel are within the mild steel range.

As a typical analysis for a steel which we have found to give excellent results as above outlined, we give the following:

|                  | Per cent. |    |
|------------------|-----------|----|
| Silicon -----    | .15       | 45 |
| Sulphur -----    | .035      |    |
| Phosphorus ----- | .015      |    |
| Carbon -----     | .08       |    |
| Manganese -----  | .40       |    |
| Copper -----     | .04       | 50 |

The silicon is added to the material after it has been refined to the range of mild steel, and kills the steel, by which we mean it prevents the evolution of the gases contained therein in the ingot mold. Since killing of a steel with silicon in an amount as high as around .15 percent will result in a piped ingot unless something is done to prevent excessive pipe, we recommend that care be taken to prevent excessive piping, if the best economy in production is desired.

So far as we are advised it has been the practice and teaching in the metallurgical art that steel for the purposes outlined, should be free from silicon, and it should be noted, that in our steel we have radically departed from this practice, producing a mild steel and deliberately increasing the silicon content.

The typical analysis which we have given is intended as a guide and not as a limitation of our invention, and indicates a regular mild steel product such as is produced in the open hearth or other metallurgical refinement process.

It is probable that the silicon present in

the sheet is some way united with the enamel in the vitreous enameling process, giving the enamel a firm anchorage or bond with the base metal. No gases are freed in an enameling process to cause bubbles in the finished surface, which results in a perfectly smooth enamel coat.

Naturally the silicon should be kept below the range which would impart stiffness thereto, and do away with the deep drawing and spinning qualities, which is one of the main objectives of our product.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent, is:—

1. A vitreous enameled article formed of steel, which except for silicon comes within the mild steel range, and has in addition a quantity of silicon sufficient to give a bond with enamel, when put through an enamel-

ing process, but not sufficient to spoil the deep drawing and spinning property in the steel prior to enameling.

2. A vitreous enameled article formed of steel, which contains below one tenth of one percent of carbon and in excess of one tenth of one percent of silicon.

3. A vitreous enameled article formed of steel, which contains below one tenth of one percent of carbon, below five tenths of one percent of manganese and above one tenth of one percent of silicon.

4. A vitreous enameled article formed of steel to which has been added a quantity of silicon such as is found in casting steels, but in which the carbon is not more than .1% of the steel.

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