UNITED STATES PATENT OFFICE.

M. SOREL, OF PARIS, FRANCE.

IMPROVED MODE OF ALLOYING COPPER, IRON, AND OTHER METALS BY CEMENTATION.

Specification forming part of Letters Patent No. **924**, dated September 17, 1838.

To all whom it may concern:

Be it known that I, M. SOREL, gentleman, of Paris, Kingdom of France, have invented, constructed, made, and applied to use a new and useful Process for Alloying Metals by Cementation, applicable particularly to the preservation of copper, iron, and other metals, and also operating a change in their outward appearance, and giving them more gloss, which process is specified in the words following, viz:

The said process consists in alloying the surface, or even the mass of copper, either with zinc, tin, lead, or other metals more fusible than copper, and capable of being alloyed with the same. These various metals may either be employed singly or in combination; but I have obtained the best results in every respect from the use of zinc alone. By an analogous process I also alloy iron and other metals, as herein fully described and made known.

The mode of cementing zinc with copper may also be employed for the cementation of other metals. I begin by scouring the metal I wish to alloy or cement. I surround it afterward with pulverized charcoal and zinc. The zinc is prepared for that purpose by forming an alloy between the said metal and iron, which alloy may be easily reduced into powder. Zinc minutely divided by other means may also be employed. The copper thus surrounded or covered is placed in a furnace, where it is to be raised to a pale red heat, and the same temperature must be kept up during a longer or shorter period of time, according to the dimensions of the pieces of copper operated upon and the depth to which it is desired to operate the cementation. It is, however, proper that the operation should not last too long, as on the copper there might then be formed a coating of brass, which would be liable to corrode and to produce verdegris, which defect may be obviated in two ways—first, by stopping the operation before the alloying between the copper and the zinc be completely effected, and, second, by sifting pulverized zinc over the substances which cover the copper a few minutes before it is drawn from the fire.

In the process of cementation just described instead of the pulverized zinc may be substituted thin sheets of zinc, or even *lapis calaminaris*. When it is not required that the cementation should penetrate deeply into the copper this metal may be previously coated with zinc according to the usual process of tinning, and then submitted to the cementing process, as above described. This process of cementation is applicable to all metals in the rough or the finished state—such as copper, brass, bronze, melchior, or German silver—and is of much importance in metallurgy. Among thousands of applications may be mentioned the preservation of the copper sheathing of ships, the preservation of metals and other precious articles of bronze, and the cleanliness and consequent salubrity of culinary utensils.

It is worthy of remark that zinc, which by itself is so easily corroded by acids, becomes quite proof against sulphuric acid in the cold state, let it be ever so concentrated, provided the cementation of zinc and copper be stopped at the proper point to avoid the formation of brass. While on the other hand zinc alloyed by fusion with one-half or one-third of its weight of copper is dissolved by sulphuric acid as rapidly as if it were pure and unalloyed.

The application to iron of the process of alloying by means of cementation is to be next explained. This process preserves iron from rust, and, moreover, gives to wrought or cast iron the appearance of gold or silver. With an alloy of copper and zinc in different proportions, and by prolonging more or less the operation a gold or silver, color is given to the iron operated upon. These colors are brilliant, lasting, and do not produce verdegris, and the metal resists the action of sulphuric acid more or less diluted with water. The process is as follows, and consists of two operations, which, though analogous in their effects, are yet different from one another.

First. The iron must be covered by immersion into the fused metal, which is intended to be used as a coating. Secondly, the iron must be alloyed by means of cementation with the metal which has been thus made to cover it. This last operation gives to the coated metal new properties, and renders its surface more smooth. To coat iron with an alloy of copper and zinc I melt about two parts of copper with three parts of zinc, and I dip in this alloy, while in a fused state and covered with borax or other suitable flux, the pieces of iron I wish to prepare. These pieces must be well scoured

or previously coated with zinc. If the pieces be very massive, they must be heated before being dipped in the fused metal. By way of lessening the quantity of borax necessary to the process, a saturated solution of this flux may be made and brought to boiling-point, and the pieces are then immersed in this solution before being introduced into the fused metal. When extracted from the melted metal the pieces of iron will not have yet assumed the color of copper, and their surface will be rough; but the second operation imparts to them the proper color and removes the asperities.

The second operation is as follows: The pieces of iron which have been submitted to the first operation must be covered with powdered charcoal and exposed to a red heat for a longer or shorter space of time, according to the color and the result to be obtained. The iron is better preserved from rust when the operation is rapidly effected; but in that case the color is not so good. The pieces of iron must be drawn from the furnace along with the charcoal which covers them, and in that state immersed in water and allowed to cool.

The second operation may be effected in a reverberatory furnace.

The same process may be modified so as to dispense with the previous coating of zinc given to the iron. To effect this an alloy of zinc and copper is made, with the same proportions of each metal indicated for the first process. When cool this alloy must be reduced to powder in a mortar, and a certain quantity of borax must be added. The pieces of iron to be operated upon must be scoured and covered with a greasy or viscus substance, or merely wetted with water. They are next strewn with the pounded alloy and borax, and finally embedded in powdered charcoal in the same manner as in the second part of the first process. They must be heated long enough to allow the excess of zinc to evaporate. It is easy to ascertain that the operation is terminated when only a small quantity of vapor escapes from the mass. The pieces of iron are then drawn from the fire and thrown, while red-hot, and still covered with charcoal, into water. After this immersion the iron is completely coated with copper, the brilliancy of which may be increased by dipping it into nitric acid containing a little soot. It may then be burnished, polished, and even gilded, exactly as if it were massive copper.

I shall finally describe a second modification of the process for alloying iron with another metal by cementation. First scour perfectly the iron, immerse it in a solution of sulphate of copper, and let it remain therein during a greater or less period of time, according to the thickness of the copper coating which it is desirable to obtain. The copper precipitates on the iron, and when the covering is sufficiently thick the pieces operated upon must be taken out of the solution and covered with very fine clay softened in water. Over this are strewn borax and zinc pulverized and mixed together. Instead of strewing borax and zinc powder in this way, a paste may be made with clay, borax, and zinc powder, and the pieces of iron be covered with the same. The pieces of iron are next to be buried in powdered charcoal and exposed during a few minutes to a white heat. They may then be withdrawn from the fire, and they will be found to be covered with a coating of the alloy containing a greater or less proportion of zinc, according to the proportion contained in the powder employed and the duration of the process.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The manner herein described of cementing copper and other metals or mixture of metals with zinc in the manner, with the limitations, and for the purpose set forth.

2. The manner of protecting iron by the process or processes herein fully described and made known, together with such modifications of said process or processes as are substantially the same in their nature and effects.

SOREL.

Witnesses:

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CHAS. SUMNER.