H. J. LOHMANN.

PERMEATING PROTECTIVE FOR IRON AND STEEL ARTICLES.

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1,039,978. Patented Oct. 1, 1912.

Fig. 1.

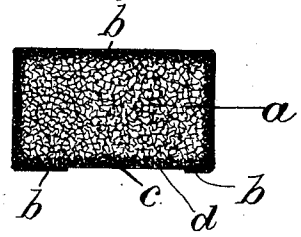
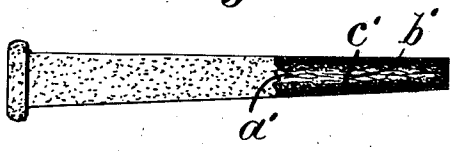


Fig. 2.



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UNITED STATES PATENT OFFICE.

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PERMEATING PROTECTIVE FOR IRON AND STEEL ARTICLES.

1,039,978. Specification of Letters Patent. Patented Oct. 1, 1912.

Application filed October 8, 1910. Serial No. 585,952.

To all whom it may concern:

Be it known that I, HERMAN J. LOHMANN, a citizen of the United States, residing at 90 Monticello avenue, Jersey City, county of Hudson, and State of New Jersey, have invented certain new and useful Improvements in Permeating Protectives for Iron and Steel Articles, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to articles of iron or steel which require protection from rust, corrosion, or other destructive chemical action. Heretofore, various means have been devised for protecting the surface of the article by the application of non-corrodible metal coatings, all of which are found commercially to possess certain limitations as the coating, however adherent, may be of a superficial character. Such articles have also been treated with metallic and other vapors while in a highly heated state, with the object of penetrating the substance of the article, but without securing an actual chemical union therewith. Such processes are very expensive and are not practically applicable to very large objects, as the expense of a furnace for adequately heating such articles is prohibitive; and the present invention therefore provides a means for permanently protecting iron and steel articles of any shape or dimensions by a mere immersion in a molten bath of non-corrosive metal, after a special preparatory treatment which produces a material penetration of the molten metal into the substance of the article, and a chemical union of such permeating metal with the iron or steel. The coating is thus actually anchored in the substance of the article and is not liable to scale off, and any penetration of corrosive agents through the coating is prevented from affecting the surface of the article, by the protective metal which penetrates its pores.

The coating described herein, and the permeating metal extended from it into the article, forms a double protection to the article so that if the outer coating be wholly removed and the original surface of the article exposed, corrosion is still efficiently prevented by the permeating metal.

Experience has shown that the most practicable non-corrosive coating is formed of metals in the so-called "lead group," as lead, zinc and tin, the zinc being cheap, and its resistance to corrosion being greatly enhanced by admixture with a large proportion of lead, as 30 to 50 per cent. of the entire mixture.

Articles of this character will resist for a great time the action of salt air along the coast of the ocean, also the action of salt water, the alkaline action of certain spring waters, and the sulfur and other acid fumes found in mines, and generated by the combustion of coal in round houses, smelters, and chemical works.

Owing to the permeation of the protective metal, malleable articles thus protected may be swaged, bent, or stamped without wholly destroying the influence of the protective metal, as any superficial scaling of the protective metal which may be displaced by extension or compression of the same beyond the limits of elasticity, will not destroy the protective effect of that portion of the protective metal which has permeated the body of the article. Thus, a rod exactly one inch diameter, after the application of such a permeating metal protective, may have the protective metal entirely removed from its surface, restoring the rod to exactly its original diameter, but still be protected by that portion of the protective metal which has entered into the substance of the rod, and thereby still capable of resisting corrosive influences.

A treatment to produce the permeative connection of the non-corrosive metal or alloy with the iron article is described herein, and such treatment has been found essential to produce the permeation of the coating into the substance of the iron article.

The protective alloy is commonly composed of zinc, lead and tin mixed in such proportions as to meet the conditions under which the treated metal is to be used. The iron or steel article is treated with a pickle or acid to give a receptive condition, and then immersed in a bath of the protective metal adapted to protect or ornament the surface of the article. An acid liquor adapted to give such iron or steel articles a "receptive condition" is fully set forth in my Patent No. 990,443 granted April 25, 1911 covering a "process for combining a permeating metallic protective with the surfaces of ferric articles", which describes the

liquor as consisting of a cleaning acid mixed with a salt of mercury with or without a catalyzer like ammonium chlorid. The treatment with such a pickle or acid wholly removes any scale and thoroughly cleanses the surface of the article, and the article is subjected to such pickle for a considerable length of time to penetrate the substance of the article and produce a condition receptive of the alloy. The article is then immersed in a bath of molten protective metal at a temperature of 950 to 1000 degrees Fah. for a suitable period of time to permit the penetration of the protective metal into the substance of the article. The penetration is limited only by the porosity of the metal treated, being greater in castings and soft ductile iron, as cut nails; and less in articles of dense steel.

The penetration of cast-iron and wrought-iron is illustrated in a diagrammatic form in the drawing, in which—

Figure 1 shows a section magnified of a square bar of cast-iron having a coating of protective metal upon its sides and then broken to show the penetration, a part of the coating being removed upon the under side to indicate the normal or original surface of the iron. Fig. 2 shows a section magnified of a nail of Swedish iron.

In Fig. 1, the crystals in the body of the cast iron bar are marked *a*, the coating *b* is represented by dark stippling, and the permeation *c* of the coating metal into the substance of the article is illustrated by the concealment or envelopment of the sub-surface crystals by an extension of the stippling over and between such surface crystals.

A portion of the coating is shown removed at the space *d* upon the lower side of the article showing the protection afforded by the permeation of the coating material, which protection is efficient when such superficial coating is removed.

With ordinary castings, a practically permanent protective coating is furnished if the coating be little more than one-thousandth of an inch thick; whereas the permeation extends from one-fortieth to one-twentieth of an inch into the substance of the iron so that the permeating protective is at least twenty times as deep as the thickness of the superficial coating.

In practice, no line of demarcation can be distinguished between the coating and the surface of the article, as the permeation of the coating into the article is continuous with the coating and changes the color of the iron (when sectioned at right angles to the coating) to the same shade or color as the coating itself.

In the coating for iron articles intended for ordinary use, as for atmospheric exposure, even in mines where the air is especially corrosive, the proportions of the coating may be ten parts by weight of zinc to ten of lead and one of tin, but where the article is to be bent or swaged after treatment, the coating requires a greater ductility and the proportion of lead is increased.

In wrought iron nails of 8d size, the protective alloy may penetrate all the way through the body of the nail. A small nail is shown magnified and partly in section in Fig. 2, with the letter *a'* applied to the inner fibers, the letter *b'* applied to the coating, and the letter *c'* to the permeating portion of the protective metal extending inward continuously from the coating.

In spring steel leaves $\frac{3}{16}$ (three-sixteenths) of an inch thick, the protective alloy may penetrate in some parts all the way through the steel, and in other parts at least $\frac{1}{32}$ of an inch, the penetration and union of alloy with the steel article being such that there is no clear line of demarcation. A microscopic examination of such articles shows that all the exposed surface crystals of the iron or steel are wholly combined with the protective metal, apparently forming a chemical union therewith and producing an air-tight and impermeable condition of the alloy at the surface of the article.

The alloy described has no affinity for the alkaline earths which are common in many spring waters, and are the cause of scale deposits in steam boilers which destroy boiler-tubes and produce corrosion of the tube-sheets. Boiler-tubes having the permeating protective metal applied are protected from corrosion for a great length of time, as the protective alloy is anchored in the pores of the steel and prevents any adhesion to the tubes of the alkaline earths which form the scale.

It is well-known that so-called "galvanizing" is a mere superficial coating upon the surface of iron articles, and so pervious to moisture that the iron beneath the coating is readily oxidized; but the articles claimed herein not only have a coating of protective metal, but an extension of such coating into the substance of the article which is readily perceptible by physical tests, and measurable by suitable observation and instruments.

Articles coated by my invention are readily distinguished from those having a protective metal coating of superficial character, as the superficial coating may be removed from an article embodying my invention as stated above, so as to leave the article of its initial size and form, and still protected from atmospheric corrosion by the combination of the protective metal with the substance of the iron or steel beneath the surface of the latter.

The invention is applicable to all articles in commercial use composed of iron or steel which are subject to deterioration by atmospheric elements or other corrosive influences.

A special modification of the protective alloy is made where it is applied to culinary utensils in place of enameling, and with this modification it makes such vessels a complete substitute for solid aluminum vessels. For protecting culinary vessels aluminum is substituted for lead, (as lead possesses poisonous properties when used in cooking utensils), and the alloy then consists substantially of ten parts of zinc to ten of aluminum and one of tin.

Having thus set forth the nature of the invention what is claimed herein is:

1. An article of iron or steel having a coating of a metal of the lead-group disposed upon its surface, and also a penetration of such coating metal into the substance of the article to a material and measurable depth and forming a chemical union therewith, such permeating portion of the coating operating to protect the article from corrosion independently of the surface coating.

2. An article of iron or steel having a coating of an alloy containing at least one metal of the lead-group anchored in the substance of the article by permeation into the pores of the same and chemical union therewith, and such permeating portion operating to protect the article from corrosion independently of the surface coating.

3. An article of iron or steel having a coating of alloy composed of lead, zinc and tin, with the said alloy permeating the substance of the metal and in chemical union therewith, and such permeating portion adapted to protect the article from atmospheric corrosion, wherever the surface coating may be removed.

4. A boiler-tube of iron or steel having a coating of an alloy of metals of the lead-group deposited upon its surface, and also a portion of such alloy permeating the pores of the metal below its surface and forming a chemical union therewith, such permeating metal being adapted to protect the article from corrosion independently of the surface-coating, and such surface-coating preventing adhesion of scale to the tube.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

HERMAN J. LOHMANN.

Witnesses:
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THOMAS S. CRANE.