

UNITED STATES PATENT OFFICE

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COATING OF BODIES WITH METAL

No Drawing. Application filed April 1, 1929, Serial No. 351,820, and in Germany September 11, 1926.

In the coating of bodies with metal in which the metal in a finely divided condition, for example in the condition of powder, is brought into contact with the body to be coated and the latter subsequently subjected to further treatment by rolling, hammering, pressing and the like, and in which no exterior source of electric current is employed, there are three main methods of procedure differing widely from one another in vogue.

In the first method, a liquid containing a metallic salt in solution is brought into intimate contact with the body to be coated, which is in this case metallic, by immersing for example the body in the liquid. After the body has remained for a long time in the liquid, the potential difference between the metal of the body and the salt dissolved in the liquid effects by contact electrolysis the production of a metallic precipitate which is thin and which cannot be made stronger. This method in which the body is subjected to a subsequent rolling, hammering, drawing or the like treatment, does not serve to protect the surface of the body against chemical and atmospheric action, but actually for the technical purpose of assisting the mechanical treatment following the coating process. The coating must either reduce or increase the friction between the surface of the body and the tool working upon this, for example the die, pressure roller or the like, according to the nature of the metal used for the coating and the object sought. The coating, however, must always disappear automatically in the subsequent mechanical treatment or it must be removed again, for example by means of a solvent, after it has served its purpose as indicated above. This process is not concerned with any permanent coating.

In the second method, in which the coating is mechanically built up subsequently, as for example, by the sherardizing or calorizing process, the body is inserted into a mass of powdered coating material and subjected to the action of heat and other auxiliary means, care being taken to ensure that the vapours can escape from the powdered coating material and penetrate more or less deeply into the metallic structure of the surface of the

body. A superficial alloy is thus formed between the metal of the body and the occluded metal which merges upon the surface of the body itself into a covering consisting only of the metal of the coating material and which is certainly very thin but may be compressed by subsequent mechanical treatment. This process is applicable mostly only for articles produced in masses, but in any case, if applied to articles of smaller proportions, it requires complicated and expensive apparatus, and in carrying out the process the uniformity and quality of the protecting layers obtainable are dependent upon great care in the conduct of the process and upon many other factors.

In the third kind of process, metal in a molten finely divided condition, or also as heated powder or even in the vaporized condition, is projected with great force against the body by the action of compressed and subsequently expanded gas, as in the known spraying method. All the metallic coatings thus produced are, however, very porous and permeated throughout with oxides. The many and most varied proposals for the mechanical building up of the metal coatings obtained by the spraying process have only shown meagre results. The metal of the coating forms throughout a kind of metallic casing which is full of flaws and is brittle. It also resists only to a small extent, tension, bending and twisting stresses, and the individual parts adhere together only by matting together and are insecurely attached to the surface of the body. On account of these bad properties, the sprayed coatings, in spite of their particular advantages as an effectual means against chemical and atmospheric attacks, have not come into vogue.

The present invention also employs a finely divided metal as the starting material for the metal coatings to be produced, and after depositing the latter, makes use of a subsequent mechanical treatment of the body by rolling, hammering or the like. It is essentially distinguished, however, from the known proposals, by the metal to be deposited upon the body as a coating being contained in the finest state of division in a suit-

able liquid exercising a strong heating effect, and by the liquid being placed on the body in this form before the latter is subjected to the effect of a rolling, hammering, pressing or like treatment for the purpose of forcing in the metal and its carrier, that is the liquid mentioned above.

In contradistinction to the known bronze varnish paints, with or without the use of heat, as also to those proposals in which wires are drawn through an emulsion consisting of powdered tin suspended in oil or glycerine in a particular manner, and in which the adhering tin dust afterwards is melted, the novelty and distinguishing feature of the present invention consists in the fact that the liquid which serves as the carrier of the very finely divided metal in it, and which can be applied to the body by means of a paint brush, or also in other ways, for example by the sprayed varnish process, must assist the forcing of the metal into the pores and structure of the substance of the body by means of the action of the rolling, hammering or pressing tool in a much more intimate manner than can take place without such tool.

It has been found in practice that the mobility of the liquid metal carrier assists in quite an extraordinary manner the passage of the metal particles into the pores of the article being treated. Furthermore, the liquid metal carrier, which itself must have the appropriate consistency according to the particular nature of the body to be treated and the metal coating to be produced, firmly holds the metal particles which are attached to it by adhesion at the moment of operation of the working tool to the surface of the body, thus prevents them from giving way under the surface pressure of the working tool and thus not only favours uniformity in the distribution and the density of the metal particles distributed over the surface of the body by the liquid metal carrier, but also the operation of the tool. The latter not only forces the metal particles distributed in the carrier liquid and brought into contact with the body into the pores and inequalities of the body, but it also has particularly the task of altering the shape of the metal particles by pressing, hammering or rolling them for example out of their spherical or granular shape into a flat surface so that in this manner those parts of the surface of the body which do not receive a sufficient number or even none at all of the metal particles contained in the carrier liquid, are nevertheless covered with metal by the spreading out of the latter, that is to say, small interspaces existing, before the subsequent mechanical treatment is carried out, between the metal particles, are filled up after the metal particles are flattened. In none of the methods

of coating previously referred to is there a similar effect obtained.

The employment of the process according to the invention is particularly important to the protection of metal plates such as, for example, by coating plates or sheets of iron with aluminium. In this way the coating on the iron plate can be effected by a process which produces a very strong connection between the plate and the coating in that, for example, the liquid carrier is made completely hard in an oven or by a hot air blast or by other indirect or direct action, for example is burned in. The metal plate provided with the burned in coating is then passed through rollers once or a number of times. It has been found that in this way the plate may be rolled out to any thickness desired without in any way damaging the metal coating. The latter does not crack, tear nor scale off but unites very intimately with the plate or sheet of iron. Instead of rolling the plate a drop hammer or stamp may be employed to effect an equally intimate union between the plate and the coating. The plate is completely protected from exterior chemical action and an iron plate coated with aluminium is entirely rust-proof.

One particular method of carrying out the present process will now be described by way of example. The carrier liquid for the particles of metal is produced in the following manner:—Castor oil is mixed with about 10 per cent of zinc oxide and the mixture heated to about 300° to produce ricinic wax. A varnish is then prepared by esterifying, for example, with glycerine, a copal or resin such as so-called American resin. The product then obtained is diluted with linseed oil or wood spirit and then further diluted with turpentine. 80 parts of the varnish thus obtained are mixed with 10 to 20 parts of the ricinic wax. About 80 parts of the mixture are then added to about 20 parts of the finest ground metal powder. Although in the case already referred to this is aluminium powder, other metal powders, such as brass, lead, or the like may, of course, be used. The carrier liquid containing the metal powder is next applied to the article to be coated, for example, by means of a paint brush and the coating heated in a stove until dry and hard. The product thus obtained is then subjected to a mechanical treatment by passing it through rollers in order to force the metal powder into the pores of the article being coated.

During the mechanical treatment of the body and its coating, a certain amount of heat is generated. This favours the firm attachment of the coating to the body and the intimate uniting together of the metal particles so that quite a smooth skin is produced upon the body being coated. For this reason, bodies coated according to the novel

process can, for example, have their shape changed in bending machines without the coating being damaged in any way, and also in drilling machines no alteration whatever in the surrounding of the holes takes place.

The present process has the further advantage that the body covered with aluminum, for example iron plates or strips, remains elastic and malleable during the rolling process, and these bodies can be rolled out without heating to much smaller thickness than if no coating were present. This is owing to the fact that by the rolling or hammering operation the metal particles of the coating are forced deeply into the pores of the coated body, and it thereby makes it more malleable than it was previously. In this manner a final product is obtained, which in the case of iron coated with aluminium is entirely equivalent to a product consisting of an aluminium iron alloy.

If the body to be coated is to have a particular thick and pure layer of the coating metal on the surface, a still further quantity of the coating metal is, according to the invention, brought into contact with the body after the carrier liquid containing the metal has been applied to the body to be coated. The body is then subjected to a mechanical operation with this particular quantity of metal in a similar manner to that as has been described above.

In the carrying out of this further process the metal content in the liquid to be brought into contact with the body can be extraordinarily small. In the selection of the correct method for bringing this liquid layer on to the body, for example with a special kind of burning in the metal content of the liquid can in some circumstances sink until nearly or right to nothing.

The additional coating metal will preferably be used also in a finely divided condition, for example as fine metal powder. The metal added can, however, also be used in the condition of thin metal sheets so called foils.

I claim:

1. The method of forming a protective coating upon plane metallic work-pieces, consisting in intimately mixing a liquid agglutinant with a pulverulent metal, coating the surfaces to be protected uniformly with said mixture, heating the coated surfaces until the agglutinant commences to harden, introducing the respective work-pieces between rollers, moving each coated work-piece forward between the rollers and subjecting it at the same time to a pressure of such a strength that the thickness of the coating is reduced and a part thereof is forced into the pores and inequalities of the metallic surface coated, substantially as set forth.

2. The method of forming a protective coating upon plane metallic work-pieces, consisting in intimately mixing a liquid ag-

glutinant with pulverulent aluminum, coating the surfaces to be protected uniformly with said mixture, heating the coated surfaces until the agglutinant commences to harden, introducing the respective work-pieces between rollers, moving each coated work-piece forward between the rollers and subjecting it at the same time to a pressure of such a strength that the thickness of the coating is reduced and a part of its aluminum particles is forced into the pores and inequalities of the metallic surface coated, substantially as set forth.

3. The method of forming a protective coating upon plane metallic work-pieces, consisting in intimately mixing a liquid agglutinant with a pulverulent metal; coating the surfaces to be protected uniformly with said mixture, heating the coated surfaces until the agglutinant commences to harden, introducing the respective work-pieces between rollers, moving each coated work-piece forward between the rollers and subjecting it at the same time to a pressure of such a strength that the thickness of the respective work-pieces, as well as the thickness of the coating, is reduced, the metallic particles of the coating are distributed and compressed, and a part of these particles is forced into the pores and inequalities of the metallic surface coated, substantially as set forth.

In testimony whereof I affix my signature.

WALTER BAUR.

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