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Early Thermal Spray Application—*JTST* Historical Patent #21*

UNITED KINGDOM PATENT OFFICE

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IMPROVEMENTS IN OR CONNECTED WITH THE COATING OF SURFACES WITH METAL, APPLICABLE ALSO FOR SOLDERING OR UNITING METALS AND OTHER MATERIALS

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Application 7 March 1910. Patented 26th January 1911.

I, Max Ulrich Schoop, of La Garenne Colombes, (Seine), France, Electro-Chemist, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:

The object of the present invention is to provide improved means for applying homogeneous strongly adhering metal coatings, with or without an admixture or surface layer of oxide, to articles of metal, wood, glass and other materials.

The invention substantially consists in applying the metal in a liquid condition by means, of steam at high pressure or highly heated compressed air, or other gas which carries the metal in the form of spray.

The pressure and diffusion by the gaseous vehicle are essential, and differentiate the invention from previously proposed processes of coating metal with metal in n finely divided state.

The invention is differentiated from the so called Cowperizing process, in which metal such as zinc is evaporated in a muffle in the presence of a reducing gas, and then deposited on iron or other metal, by the fact that in my improved process the molten liquid metal is merely sprayed by means of the gas or vapor. That is to say, it is merely heated to fluidity, but never vaporized; evaporation of the metal would seriously interfere with the working of my process. The use of superheated steam has heretofore been proposed for producing coatings of tin and other metals of low melting point but not according to the principle of spraying the metal onto the surface by means of a jet of steam.

By means of my improved process metal coatings of any thickness can be produced at low cost and in a simple way, such coatings being distinguished by uniformity, strong adhesion and good appearance. As material for these coatings, the metals specially suitable are those which have not too a high melting point, such as tin, zinc, lead, aluminium and their alloys.

It is of special importance that the process enables aluminium coatings to be made, as aluminium has over many other metals important advantages such as cheapness and resistance to chemical and atmospheric influences, and it has hitherto been impossible to produce such coatings in a simple manner, for example by dipping or by direct application. In comparison with the known so-called aluminium plating processes in which a hot aluminium sheet is pressed on a copper or like plate, whereupon the two sheets, welded thus together, are rolled to the desired thickness, the new process has the advantage that it can be used for coating the surfaces of both finished and unfinished articles, and is applicable to all materials capable of bearing a metal coating.

The process can be carried out with spraying apparatus of any convenient known kind, the apparatus being selected according to the particular purpose in view and to the degree of fluidity of the metal.

If the metal has a tendency to oxidize on leaving the spraying nozzle, and it is desired to obtain a coating free from oxide, a chemically indifferent gas is preferably selected as pressure and spraying agent. But in some cases the use of a chemically active gas may be desirable. In some cases it may be advantageous to effect the treatment in a closed chamber, which contains an oxidizing or reducing atmosphere. With an oxidizing atmosphere, a coating of metal mixed with oxide or having an oxidized surface is produced.

Although the metal is divided in the form of spherical, exceedingly minute drops, the finished metal coating is not granular but of perfectly smooth surface, due to the fact that the metal is emitted from the spraying nozzle with great force, and the individual originally spherical drops of metal are deposited side by side and upon each other in the form of thin films; they form thus an intimately united layer of very compact and tough structure. The articles provided with such metal coatings can be submitted to any of the usual mechanical treatments, such as grinding, polishing, pressing, stamping, rolling and the like, without risk of detaching the applied metal layer.

The nature and character of the coating depend on various conditions, and it is not possible to indicate these conditions for each individual case. They depend:

1. On the melting point of the metal;
2. On the character and the nature of the material to be coated;

[1] COMPLETE SPECIFICATION. (Under International Convention) Date claimed for Patent under Patents and Designs Act, 1907, being date of first Foreign Application (in Germany), 27th Apr., 1909. Date of Application (in the United Kingdom), 7th Mar., 1910. At the expiration of twelve months from the date of the first Foreign Application, the provision of Section 91 (3) (a) of the Patents and Designs Act, 1907, as to inspection of Specification, became operative. Accepted, 26th Jan., 1911.

[2] Extension of Patent. Patent No. 5,712, AD. 1910. A new Patent has been granted until December 31st, 1928, by Order of the High Court. The Patent Office, August 18th 1925.

*This series of historical patents concerned with thermal spray technology has been compiled by C.C. Berndt (SUNY at Stony Brook, NY) and K.A. Kowalsky (Flame-Spray Industries, Inc., NY).

3. On the thickness of the coating;
4. On the pressure and temperature of the vapor or gas acting as pressure and spraying agent.
5. On the construction of the spraying nozzle and the thickness of the stream of liquid metal to be sprayed;
6. On chemical action (if any) between the metal and the spraying agent.

At a gas pressure of 20 atmospheres, for example, coatings are produced, the density and hardness of which are above the normal values; at a gas pressure of only 5 atmospheres the density and hardness are below the normal values.

The conditions favourable for each individual case can be predetermined easily by one or more tests.

In many cases it may be advisable to free the articles to be coated, before their treatment, from the adhering dirt, fat and oxide, by means of suitable processes, for example by means of sand-blast.

If the surface to be treated is previously heated, the adhesion between the said surface and the metal applied is so intimate that a joining similar to welding takes place.

To increase the fluidity of the metal used for coating, other metals or suitable flux may be added in the melting pot, or fluidity of the metal issuing from the nozzle may be increased by adding a flux in the form of vapor to the dry steam, hydrogen or other spraying agent used. The added vapor may have a reducing or oxide-dissolving effect on the metal, and ensures that the particles are deposited on the surface in a purely metallic state.

In producing aluminium coatings, for instance, vapors of the alkali chloride salts and alkali fluoride salts can be use with advantage, and serve to instantaneously dissolve any thin film of oxide which may be formed on the metal particles. The oxide-dissolving or reducing effect can also be produced by directing a separate stream of the vapor against the surface to be coated. The fields of utility for the improved process are numerous.

Thus for example, the process may serve for "metallizing " all sorts of articles and has great advantages over the known galvanizing process in cases where it is required to coat electrically non-conductive surfaces (wood, glass, plaster) with metal. Furthermore, matrices, stamps, dies and cliches of all kinds can be reproduced quickly and cheaply by the process; seamless metal pipes can be made, by removing the original supporting material after the metal coating has been applied. Articles of materials such as wood and iron, which suffer by being in constant contact with water, or weather, can be rendered waterproof and weather-proof by means of a metal coating, for example the frames of flying machines and the hulls of boats and yachts, which have hitherto been protected by riveted aluminium sheets.

The process can also be used for various decorative purposes.

With this process, it is also possible to produce joints similar to welded and soldered joints between two parts of metal or other material, by spraying the melted metal as finely as possible on to the heated joining place, whereby a solid continuous metallic joining is effected.

In this way for example two lead-sheets can be joined by means of a jet of finely divided, melted lead, that is to say, the sheets can be autogenously soldered together without the use of a jet flame.

Non-metallic articles can be connected to each other and reinforced by metallic, coatings applied as described. For example, the wooden ribs of the planes of a flying machine may be strengthened at selected places by a sprayed metal coating, and the joints thereof, for example at points of intersection, can be made by the same means.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

1. The process of applying metallic coatings to articles of metal or other material, of any shape, characterized by the fact that the molten coating metal is sprayed on to the surface by means of steam or hot gas under pressure.
2. The process of applying metallic coatings as set forth in Claim 1, for uniting surfaces as by soldering.
3. The process set forth in Claim 1, with a chemically active gas, for example a reducing gas, used as vehicle for the metallic spray.

Dated this 7th day of March, 1910. Herbert Haddan & Co., Agents for Applicant, 31 & 32, Bedford Street, Strand, London, W.C.

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