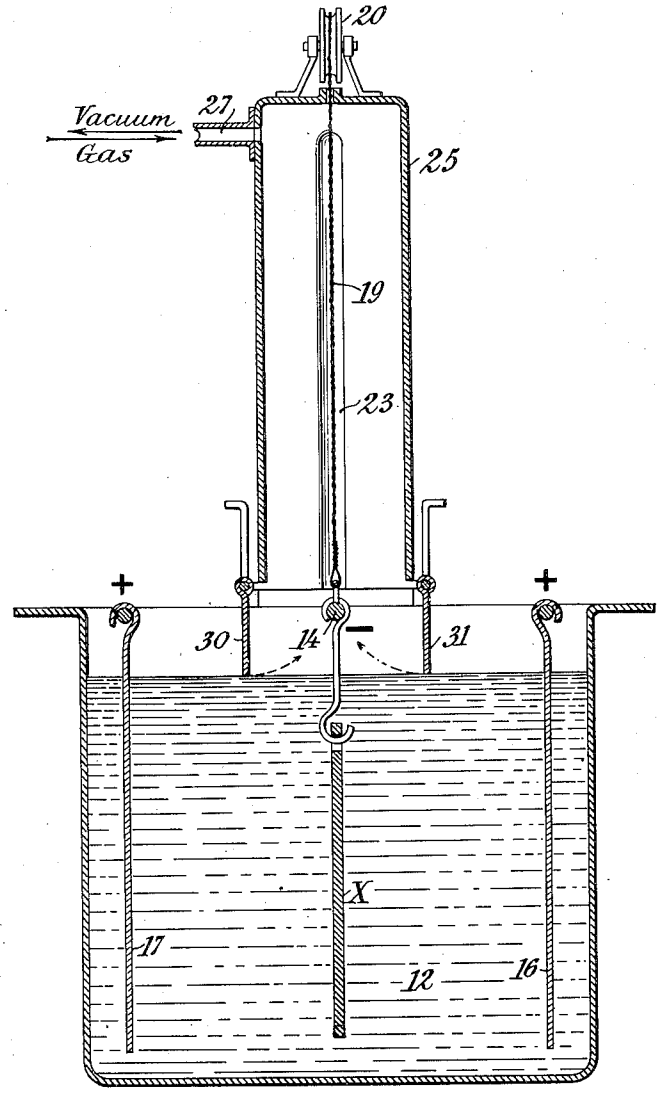
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PROTECTIVE METAL COATING AND PROCESS AND APPARATUS FOR PRODUCING THE SAME

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UNITED STATES PATENT OFFICE

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PROTECTIVE METAL COATING AND PROCESS AND APPARATUS FOR PRODUCING THE SAME

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This invention relates to a process for producing protective and resistant coatings, and aims to provide improvements therein.

Steel and other foundation metals, when plated with protective coatings such as copper, zinc, silver, lead, nickel, cobalt, chromium, molybdenum, tungsten, tantalum, titanium, platinum, gold, etc., or when plated with metals which are both protective and resistant, such as lead, nickel, cobalt, chromium, molybdenum, tungsten, tantalum, titanium, platinum, gold, etc., at least unless the plates are relatively thick, show attack when subjected to the action or influences of the air, sea-air, and acids. This is due in all probability to defects in the plating, called "pin-holes", where the foundation metal is covered with an adherent gas-bubble of some kind and the protective or protective and resistant metal is thereby prevented from depositing on the foundation metal at this point. Test-pieces of steel having a plate of a protective or of a protective and resistant metal thereon, when dipped in salt water and hung up over night, show extensive discoloration.

The invention provides a process for producing a coating or plate of a protective and resistant metal such as copper, zinc, silver, lead, nickel, cobalt, chromium, molybdenum, tungsten, tantalum, titanium, platinum, gold, etc., or of such a metal with another metal applied thereon, which protects the underlying foundation metal from the action of atmospheric influences, sea-air, or acids, or from several or all of these agents.

The invention further provides a process for producing a coating of the character described having a bright or metallic lustre.

According to the present invention, metal (or alloy) articles (steel for example) are plated with a protective and resistant metal, such as above set forth, according to any suitable method of plating, and then treated to eliminate or heal the "pin-holes" therein, by a method involving the intermittent exposure to air or other gas at a sub-atmospheric pressure down to the pressures ordinarily referred to as a "vacuum".

It is believed that the so-called "pin-hole" defects observable in plates and particularly in thin plates of electrolytically deposited metal are almost always due to the presence of molecules or groups of molecules, of gas, i. e., hydrogen.

It has been found that if these plates of metal are exposed to air, or to oxygen, or to a number of other gases at reduced pressure, especially in the early stages of the electrodeposition, these pin-hole defects running entirely through the entire coating may be avoided, and a continuous or imperforate protective and resistant coating obtained.

An apparatus useful in carrying out the process is illustrated in the accompanying drawing. This drawing is a diagrammatic representation of the apparatus.

The process may be carried out by placing the article X, shown on the drawing as a sheet of metal, in a tank 10 of any suitable kind containing an electrolytic solution 12. The article X is as usual made the cathode and connected for example to the cathode bus-bar 14, between anodes 16, 17 of any suitable kind.

The current is allowed to pass to deposit the metal, and after an initial increment has been deposited on the article, a small fraction of a mill, for example.

For lifting the article X out of the solution, a cord and pulley 19, 20, is shown, the cord being conveniently attached to the bus-bar 14, and the ends of the bus-bar conveniently guided in grooves 23. Any other suitable means can be used.

A hood 25 may be provided above the bus-bar 14 into which the article X carried by the bus-bar 14 may be lifted when raised by the cords 19.

A suitable gas, as oxygen, for example, may be obtained in the hood, and a conduit 27 may serve for conducting the gas to the hood.

The pressure of the gas in the hood 25 may be reduced below that of the atmosphere, to a greater or less extent. A so-called vacuum may be produced in the hood corresponding to a few inches of mercury, such as can be obtained by ordinary rotary quick-acting vacuum pumps.

After depositing an increment of coating

metal the article X is lifted out of the solution 12 into hood 25 and exposed for a time to sub-atmospheric gas, and then returned to the solution and electroplating resumed. It will generally be sufficient to expose the plate for a minute more or less.

The gas which is adherent to the plate on article X detaches itself from the plate when subjected to sub-atmospheric pressures, as described.

In order that a sub-atmospheric pressure may be produced in the hood 25, doors 30, 31, adapted to be closed after the article X is lifted into the hood, are provided, and the evacuation may be effected through the conduit 27.

The molecular hydrogen adhering to the plate on the article X disappears, presumably by diffusion into the oxygen, in the air, or the gas itself.

Chromium is a metal having a number of remarkable properties rendering it very useful as a protective, a protective and resistant, and an ornamental, non-tarnishing coating for articles, or both the useful and fine arts, composed of less resistant foundation metals, such as iron, steel, brass, etc. Chromium is hard, wear-resisting, acid-resisting as regards most acids, may be deposited with a bright surface, and keeps its finish.

The present invention is of special advantage in the production of resistant and protective coats of chromium and similar metals.

A specific mode of procedure in producing resistant electrodeposited coatings of chromium, in which pin-hole defects do not extend through the entire coating to the underlying foundation metal, will be given by way of example.

A steel article, say a sheet X of steel, is made the cathode and placed in a bath 12 of chromic acid or other suitable chromium electroplating solution, and a thin coat of chromium deposited thereon. The process described in Fink Patent 1,581,188, dated April 20, 1926, and others, may be employed.

A small fraction of a mill of plate has been been deposited, the article X is removed from the bath and exposed to air at a reduced pressure by raising it for example by cords 19 or any other suitable means into a position above the tank, and into the hood 25 where it is desired to expose the plate to sub-atmospheric pressure or to a gas other than air.

The exposure to the atmosphere may be for about one-half a minute. This may be lengthened or shortened depending on the metal deposited. Thereafter the article X is again lowered into the electrolytic solution 12 and the plating resumed. In building a plate of five-tenths mill thickness an exposure may be made after each gain of a tenth mill in the thickness of the deposit. More or less frequent exposures could be made according to the results obtained with any particular article, the solution employed, etc.

The invention may be carried out by other apparatus and by other modes of procedure than those herein specifically described.

What is claimed is:

1. The process of producing protective and resistant coatings, comprising electrodepositing a relatively thin plate of the coating metal on an article, exposing the plate to gas at sub-atmospheric pressure, and resuming plating, thereby to produce a coating free from so-called "pin-hole" defects.

2. The process of producing protective and resistant chromium or the like coatings, comprising electrodepositing on an article a relatively thin deposit of chromium in the presence of a protecting hydrogen film, exposing the plate to gas at sub-atmospheric pressure, out of the electroplating bath, and resuming plating, thereby to produce a coating free from so-called "pin-hole" defects.

In witness whereof, we have hereunto signed our names.

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