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METHOD OF COATING IRON OR STEEL ARTICLES WITH ALUMINUM

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Fig. 1.

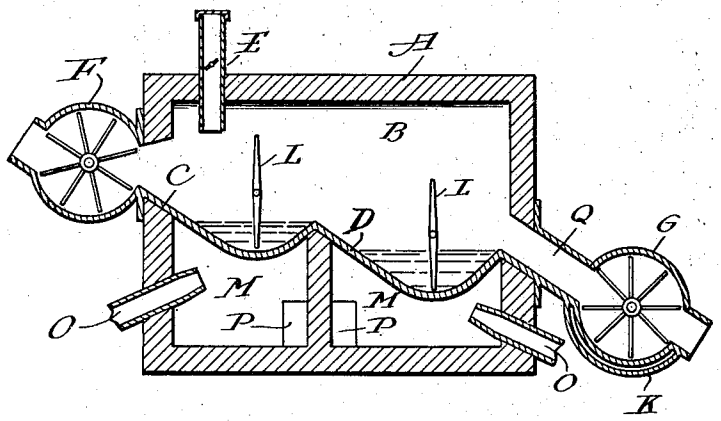
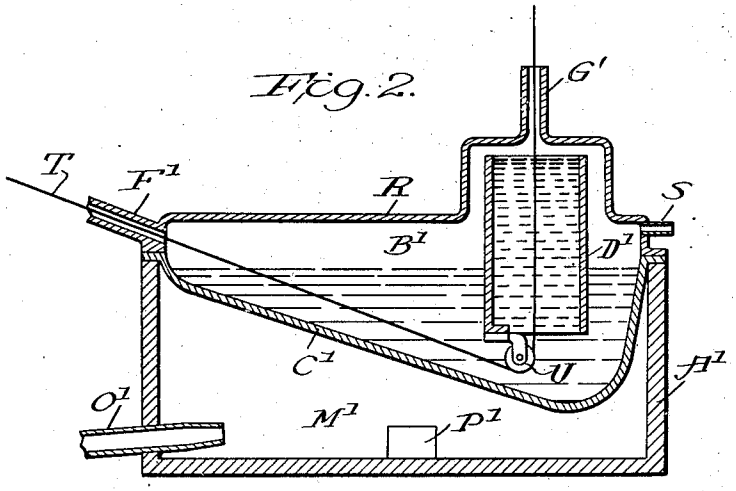


Fig. 2.



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METHOD OF COATING IRON OR STEEL ARTICLES WITH ALUMINUM

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11 Claims. (Cl. 91—70)

The invention relates to a method of and apparatus for coating articles of iron or steel with aluminum in such a manner that the entire surface of the articles will be covered with aluminum and that on the surface an aluminum-alloy is formed.

It is known for this purpose to dip the articles into a bath of molten salts and subsequently into a bath of molten aluminum. It is further known in the art of coating metallic articles with aluminum to provide a reducing atmosphere over or on the top of the aluminum baths employed.

These known suggestions, however, failed to solve the problem in a satisfactory manner.

The articles to be coated with aluminum are subjected according to the present invention to a preliminary treatment preferably in a bath of molten salts and subsequently to a treatment in an aluminum bath while the same are kept within an atmosphere or zone of reducing gases free of air or oxygen. In other words according to the present invention it is imperative that all air be removed from the furnace and a reducing atmosphere or zone be provided in the furnace preferably by introduction of suitable reducing gases and the articles treated in the furnace are allowed to remain within said reducing atmosphere or zone for a sufficient length of time so as to be cooled therein.

The bath of molten salts, preferably chlorides, the aluminum bath and the atmosphere or zone on top thereof are kept at such a degree of temperature as will be sufficient to impart to the articles the temperature required for the purpose in view.

As the iron or steel articles under treatment are exposed to the action of an overlying atmosphere of purifying and reducing character containing any of the known reducing agents such as chloride of zinc, chloride of ammonium and the like, which are known in the art to be capable of purifying metallic surfaces when in gaseous condition or of reducing gases such as hydrogen, lighting-gas and the like, the outer surfaces of the same will be freed from oxide particles, so as to be in best condition for the subsequent treatment in an aluminum bath.

The dipping-treatment in an aluminum bath is effected immediately thereafter and without exposing the purified articles to the action of air or any other injurious gases. The aluminum combines substantially at once with the surfaces of the iron or steel or within a few seconds so as to form an alloy at the contacting surfaces of the article and a thin coating of aluminum is then deposited thereon.

The articles thus coated with an aluminum film are withdrawn from the furnace through a channel or passage which does not contain any air and is adapted to be cooled by water by means of a cooling jacket. In this way the articles are cooled to such a degree that oxidation cannot set in, when the articles are subsequently passed into the outer air.

I shall now proceed to describe my invention more in detail with reference to the accompanying drawing showing diagrammatically an apparatus or furnace especially constructed and adapted for carrying the invention into effect.

Fig. 1 shows a vertical section of an apparatus suitable for carrying out my process. Fig. 2 is a vertical section of a modification thereof.

In the construction illustrated in Figure 1, A denotes the furnace and B the upper part of a chamber thereof filled with lighting-gas. C indicates a crucible containing the molten salts and D denotes a crucible charged with aluminum in molten condition. The tube E in the top of the furnace is provided with a valve and a covering cap and serves the purpose of introducing into the chamber B a substance, such as $ZnCl_2$ or NH_4Cl which will volatilize in the chamber due to the high temperature prevailing therein so as to mix with the lighting-gas.

The iron or steel articles to be treated in the described furnace are supplied to the crucible C by means of an air-tight closing winged wheel F. After the articles have been treated in the crucibles C and D they are discharged from the furnace through an inclined channel Q and through a winged wheel G similar to the wheel F, the housing of the wheel G is totally or partly enclosed in a cooling jacket K. The revolving paddle-boards L are provided for the purpose of forwarding the articles through the two baths and into the channel Q as will be readily understood upon inspection of Figure 1. M, M denote heating chambers for heating the crucibles C and D by means of suitable burners O, O. P, P indicate outlet-channels for the hot combustion gases.

In some cases it will be advisable to employ a lead-bath or a bath of any other suitable metal in lieu of the salt-bath C.

In the modification shown in Figure 2 separate juxtaposed crucibles are dispensed with. The modification of the furnace is especially intended and adapted for use in coating iron or steel wire or band-iron in coiled form with aluminum, and is chiefly distinguished from the fur-

nace illustrated in Figure 1 by two containers or crucibles C' and D' which are filled with the preliminary and the aluminum-bath and are arranged to constitute communicating vessels, the crucible D' containing the aluminum bath being shaped to form a vertical tube open at opposite ends and immersed with its bottom end in the bath C' preferably of molten lead for preliminary treatment so as to fill or occupy the bottom end of the tube as will be readily understood on inspection of Figure 2.

In the modification of the furnace shown in Figure 2 obviously the bath for preliminary treatment can be made or consist of metals or alloys only which are not susceptible of alligation with aluminum at all or susceptible of such alligation to a very moderate degree only at the temperature of about 700° C. required for coating iron or steel with aluminum. The furnace shown in Figure 2 is particularly adapted for carrying out the present improved method in a continuous manner.

In Figure 2 A' indicates the furnace in general and C' denotes a crucible or container shaped and arranged to form a cover at the top of the furnace, so that the furnace chamber M' will be closed and not communicate with the outer air. The tubular opening S serves for the introduction of the purifying or reducing gas into the room B' enclosed by the cover R and the wire or band T to be coated with aluminum is supplied to the container or crucible C' through a nozzle F' equipped with suitable packing means. The wire or band is caused to pass through the metallic bath provided in the crucible C' and to run over a roller U vertically upwards into the aluminum bath in the tube D' and to be discharged from the furnace through a stand-pipe or nozzle G' which may be integrally connected with the cover R. The said roller U is connected with the bottom end of the tube D'.

M' indicates the heating chamber or furnace properly speaking provided with a burner O' for heating the crucible C' and with an outlet-channel P' for the combustion gases to escape therethrough.

It is obvious that changes may be resorted to in the form and arrangement of the several parts without departing from the spirit and scope of my invention. Thus, for example, it may be advisable to protect the bottom of the crucible D of the furnace shown in Figure 1 by means of a layer of lead or any other suitable metal which will prevent the molten aluminum from exerting a dissolving action on the bottom of the crucible. This precaution is of importance and especially recommendable in case that the crucible is shaped to form a shallow container.

This application is a division of my copending application Serial No. 635,830, filed October 1, 1932.

I claim:

1. The method of coating iron and steel with aluminum which comprises preliminarily heating the surface of the metal in the presence of a non-oxidizing gas under conditions that the same will be free from oxide particles and will within a few seconds alloy with molten aluminum, and then while still in a non-oxidizing atmosphere, introducing the heated metal into an aluminum bath having the surface thereof at the point of entry of the metal in contact with the non-oxidizing gas.

2. The method of coating iron and steel with aluminum which comprises preliminarily heating the surface of the metal in the presence of a non-oxidizing gas under conditions that the same will be free of oxide particles and will within a few seconds alloy with a coating layer of aluminum, and then while still in a non-oxidizing atmosphere introducing the heated metal into an aluminum bath, and removing the metal from said bath into a non-oxidizing atmosphere where it is subjected to conditions to cool the coated metal.

3. The method of coating iron and steel with aluminum which comprises preliminarily treating the base metal by heating the same in an atmosphere of a reducing gas under conditions to free the surface of oxide particles and to permit the same to alloy within a few seconds with molten aluminum and then without exposing the base metal to an oxidizing atmosphere conducting the same to a bath of molten aluminum.

4. The method described in claim 3 in which the base metal is preliminarily raised to a temperature of 700° C.

5. The method of coating iron and steel with aluminum which comprises preliminarily treating the base metal by heating the same in an atmosphere of a reducing gas under conditions to free the surface of oxide particles and to permit the same to alloy within a few seconds with molten aluminum and then without exposing the base metal to an oxidizing atmosphere conducting the same to a bath of molten aluminum, and thereafter positively cooling the aluminum coated metal in a non-oxidizing atmosphere before it is exposed to the air.

6. The process as described in claim 3 in which the base metal is preliminarily raised to a temperature of 700° C. and wherein after the base metal has been conducted through a bath of molten aluminum, the aluminum coated metal is positively cooled in a non-oxidizing atmosphere before it is exposed to the air.

7. A method as described in claim 3 in which the base metal is preliminarily subjected to a heated non-oxidizing bath.

8. The method as described in claim 3 wherein the base metal is preliminarily subjected to a heated non-oxidizing bath and is raised to a temperature of 700° C. before introduction into the bath of molten aluminum.

9. The method as described in claim 3 wherein the base metal is preliminarily subjected to a heated non-oxidizing bath and the aluminum coated metal is positively cooled in a non-oxidizing atmosphere before it is exposed to the air.

10. A method as described in claim 3 wherein the base metal is preliminarily subjected to a heated non-oxidizing bath and is raised to a temperature of 700° C. before introduction to the aluminum bath and wherein the aluminum coated metal is positively cooled in a non-oxidizing atmosphere before it is exposed to the air.

11. The method of coating iron and steel with aluminum which comprises preliminarily heating the surface of the metal in the presence of a non-oxidizing gas for a sufficient length of time that the same will be free from oxide particles and will within a few seconds alloy with molten aluminum, and then while still in a non-oxidizing atmosphere, introducing the heated metal into an aluminum bath having the surface thereof at the point of entry of the metal in contact with the non-oxidizing gas.

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