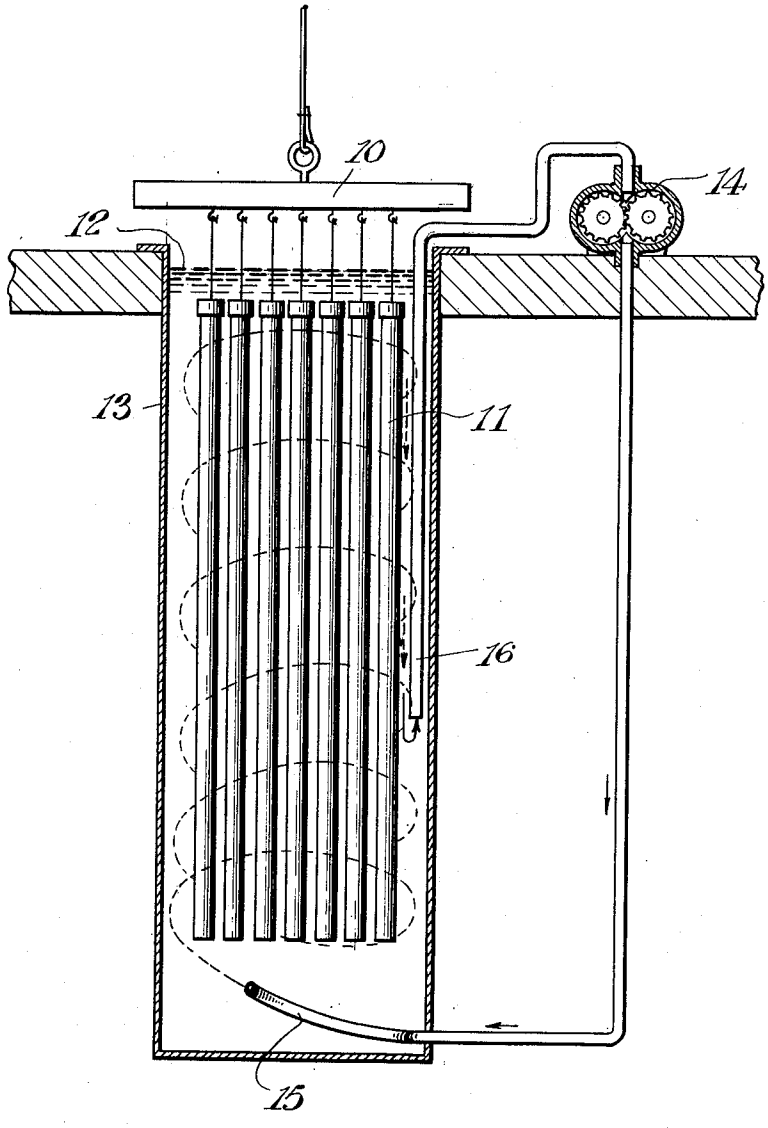
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PROCESS AND APPARATUS FOR COATING

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PROCESS AND APPARATUS FOR COATING

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This invention relates to the art of coating metal surfaces with metal, for example, coating a metal which is subject to various injurious effects with another metal which is not to any extent subject to these effects.

One of the objects of the invention is to put upon a metal object a metallic coating which is highly resistant to deleterious atmospheres and exacting physical actions. When uncoated metals such as iron or steel are placed in atmospheres containing strong acid fumes, ammonia gas, steam or other oxidizing vapors, salt spray and the like, they quickly deteriorate. Even when coated with enamel, zinc or other common protective agents, the metals under such severe conditions deteriorate almost as rapidly as if uncoated.

Aluminum among other metals has been found to resist the action of these atmospheres to a high degree. Aluminum is named in the present disclosure because it is the most common and inexpensive of the class and resists a great number of the injurious effects which it is commonly necessary to guard against.

The manner in which aluminum is applied to surfaces, however, largely determines the effectiveness of the coating and—what is equally important—affects the cost of its application. Put on in certain ways, the aluminum coating readily separates from the base and falls off, particularly if the base be bent or otherwise distorted; or the coating will crack; or is full of pin holes even when relatively thick as a whole; or is not sufficiently hard and tough to withstand abrasive effects. Furthermore, according to certain methods of application, those parts of the objects which are somewhat inaccessible will not be properly coated. Thus, the interior of pipes is frequently left uncoated or is coated only a short distance from each end. Again, the coating may not be uniformly applied to all of a number of objects being treated or even may not be uniformly applied to the entire surface of a single object.

With the above and other considerations in view, one specific embodiment of the invention will now be particularly described, it being distinctly understood that there is no intention to limit the scope of the invention in any respect by such a particular description. In this description reference will be made to certain illustration found in the accompanying drawing wherein the single figure is a sectional elevation of apparatus for dipping elongated objects such as pipes.

The articles to be coated are first thoroughly cleaned and freed from dirt, grease, scale or other surface adhesions. If iron pipes are to be coated they are subjected to a pickling action as by being dipped while suspended at a slight inclination to the horizontal in a bath of a 5% solution of sulphuric acid. Following this the pipes are dipped while so suspended in an alkaline bath which preferably is heated. Successive dippings in clean water remove the alkali and all remaining traces of acid. The water is preferably quite hot, perhaps 180° F., to heat the pipes so that when they are later drained in a nearly vertical position the heat of the pipes causes the water film to be evaporated. Thus when the pipes stop steaming it can be safely assumed that they are thoroughly dry.

If necessary a stiff brush may be pulled through the pipes to remove any particles which have been loosened but left therein.

For objects other than iron pipes the cleaning process should be equally thorough, the kind of process being that best suited to the particular object being treated.

Next the objects are given an application of the aluminum coating preparation and allowed to drip. Preferably the objects are dipped while suspended with their longer dimensions vertical.

The dipping liquid requires particular consideration as the kind of vehicle with which the alminum powder is mixed greatly affects the characteristics of the final coating. Some of the outstanding requirements for the vehicle are: That it will thoroughly wet the surface; that it will not dry too quickly; that it will when dried be hard and tough; that it will withstand relatively high temperatures without becoming brittle, discolored and without completely evaporating; that when dried the residual film will successfully

withstand the atmospheres which the aluminum itself is expected to withstand; that when heated will promote the proper disposition or "leafing" of the aluminum particles; and that throughout the time the aluminum powder is mixed therewith will effectively prevent oxidation thereof, any oxidation of the aluminum hindering the combination of the aluminum coating with the base metal.

I have found that an oleo-resinous vehicle which evaporates to the extent of about 55% leaving about 45% residue as a film with the aluminum powder gives best results in practice undertaken up to the present time. Such a vehicle, to give an example, may be made of a mixture of China-wood oil, linseed oil, certain gums such as East India gum, Kauri gum or ester gum, and certain metal salts such as the salts of lead, manganese or cobalt which act as catalyzers.

The aluminum powder employed is of the kind which has been ground under conditions suitable for preventing surface oxidation of the particles and which has been preserved until ready for mixing with the liquid vehicle in such a way as to maintain the non-oxidized condition of the surfaces of the particles. The methods of thus preserving the particles forms no part of the present invention, it being merely understood that such un-oxidized aluminum powder is to be used, and that the material used to preserve the particles will not be injurious to the final coating as obtained by the present process.

The aluminum powder is thoroughly mixed into the vehicle, preferably so as to leave the final mixture relatively thin. While the proportions may vary greatly good results have been obtained by a mixture made up in the ratio of two pounds of aluminum powder to each gallon of liquid vehicle.

As stated above the articles may be dipped into this coating material, with constant agitation to keep the aluminum powder thoroughly mixed in. Dipping is generally preferred but so far as some of the other steps of the process are concerned the mode of application may in some cases be other than by dipping.

If, for example, tubes or pipes are to be dipped they may be suspended by one end and lowered vertically into an elongated tank of liquid. In the figure, a plate 10 carries a group of pipes 11, care being taken to keep the pipes separated from each other at all times. These pipes are shown immersed in a bath of the coating liquid standing to the line 12 in a tank 13. If the interior of the pipes is not to be coated the ends may be plugged. The pipes shown are receiving an inside coating as well as an outside coating. Indeed, the present process and apparatus are especially designed to give a perfect inside as well as outside coating whereas previously the inside coating has been but indifferently applied.

The aluminum particles have a pronounced tendency to settle to the bottom of the bath as well as to collect into lumps. To prevent this a pump 14 of the gear type is employed to crush the lumps, to thoroughly mix the particles with the liquid vehicle and as will be explained presently to assist in getting proper and even application of the coating upon the pipes or other articles suspended in the tank.

The pipes do not extend to the bottom of the tank but leave a space in which the discharge pipe 15 of the pump terminates, the same being inclined upwardly and bent to lie tangentially within the walls of the tank. In other words the pipe is spiraled upwardly. This produces a whirling upward circulation of the liquid causing it to flow through the pipes and uniformly about them in the most advantageous manner. Liquid may be withdrawn from the tank through the pump suction pipe 16 the end of which is located intermediate the length of the tank.

While either the bath or the dipped articles may be heated, the bath employed is such that good results may be obtained even in very cold weather without heating. If heat is applied it will not be a high heat as this would tend to evaporate part of the bath. This is not desired for the reason that such evaporation makes it difficult to keep the bath at the desired uniform and known quality and consistency. Moreover, the later steps of the process insure the proper spreading and uniform distribution of the coating even if the dipping should leave slightly thickened spots or "curtains".

After the articles have been dipped they may be allowed to drip over the tank, after which they are transferred to a suitable oven where the coating is baked on before it has had an opportunity to dry.

The oven employed preferably contains a non-oxidizing or reducing or inert atmosphere. Where the oven is heated by gas the carbon dioxide produced by the gas burners may be sufficient for the purpose. However, with the coating vehicle used which is to a certain extent non-oxidizing satisfactory results might be obtained even in an oxidizing atmosphere, for example air or steam.

Further, the oven may be provided with windows of proper size and color to assist the baking, although good results have been obtained in a dark oven.

The temperature of the oven is maintained sufficiently high to dry and set the coating but is kept below the carbonizing temperature of the vehicle used in the coating composition. For example, a temperature of 275 to 325 degrees F. applied for one hour has been found satisfactory where another coat is later applied and baked say at a tem-

perature of 350 to 375 degrees F. for two hours. If only one coat is desired either the temperature or time of baking may be increased. When two or more coats are applied the heat employed to bake the later coat or coats also further bakes the first coat and it is for this reason that the heating of the first coat is kept below the amount which would otherwise be required.

It has been found that the heating completely dissipates all curtains in the coating and leaves it uniform and thin so as to follow all contours of the article coated.

When the coating is applied according to this process the aluminum as shown by tests appears to have penetrated the surface and to some extent to have alloyed with the base metal, while part of the aluminum is carried in the thin film or non-oxidizable vehicle residuum.

The coating is extremely tenacious and shows no flaking or separation even when the coated article is severely bent, hammered, stretched or otherwise distorted.

While the specific embodiment chosen relates to the coating of pipes or the like, the process is applicable to sheets, wires and various other shapes.

It is to be understood that various modifications and changes may be made within the spirit of the invention as expressed in the appended claims.

What I claim is:

1. The method of coating metal objects with aluminum which comprises coating the objects with a bath containing finely divided aluminum and a vehicle including linseed oil, Chinawood oil, a resinous gum and a mineral salt, thereafter baking the coat thus applied in an oven at approximately 300° F., for one hour, applying a second coat of the same material and baking in an oven at approximately 350° F. for two hours.

2. The method of coating pipes which comprises suspending the pipes vertically within a coating bath containing a powdered metal and agitating the bath from the bottom to give it an upward swirling motion so as to enter the interior of the pipes as well as to evenly coat their exterior surfaces.

3. The method of coating pipes with aluminum which comprises dipping the pipes vertically in a tank containing a bath of aluminum powder and a liquid vehicle, which bath is circulated upwardly with a whirling motion from below the pipes so as to enter the interior of the pipes and to evenly flow over the exterior of the pipes.

4. The method of coating metal objects with a coating metal which comprises applying a coat of finely divided metal suspended in a liquid vehicle to the surface of the object and baking below the carbonizing temperature of the vehicle for a length of time sufficient to produce a surface alloying of the coating metal with the base metal; applying a second coat of the same material and baking it at a relatively higher temperature below the carbonizing temperature for a longer period of time.

In testimony whereof, I have signed my name to this specification this 18th day of December 1928.

GUSTAVE A. JOHNSON.