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ELECTROLYTIC BRIGHT DIP FOR IRON AND STEEL

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The present application is in part a continuation of our prior U. S. application filed October 9, 1929, Serial No. 398,557.

This invention relates to the treatment of iron and steel for the removal of rust, scale, and the like, and the obtaining of a clean bright surface. The removal of rust and scale from such materials is ordinarily attempted by the use of so-called pickles, either acting in a purely chemical manner or acting electrochemically. Various acids have been employed for such pickles, and in the case of electrochemical treatments for removal of scale and rust the article being treated has in some cases been made the cathode in an electrolytic circuit, and in others it has been made the anode. In all processes heretofore known, the pickling has not produced a clean bright surface, and it is a particular object of our present invention to provide a bright dip electrolytic treatment which may be employed after any of the known pickling treatments in order to obtain a good bright surface. Both in pickling and in bright dipping it is important to avoid etching or removing an undue amount of the metal itself, and for commercial reasons it is essential that the treatment should be completed in a short time, and furthermore should not result in the production of substantial quantities of objectionable fumes.

The method which forms the subject matter of the present invention has, in addition to its general object of providing a bright surface, the further objects of obtaining this result without removing an undue amount of the base metal or producing objectionable fumes, and without requiring an objectionable amount of time.

The invention will be clearly understood from a description of a treatment, including the original pickling for the removal of rust and scale and the subsequent treatment of the material in the electrolytic bright dip. It will be understood, however, that any suitable pickling or preliminary treatment may be employed, and that the essential novelty of the process resides in the electrolytic bright dip method.

Assuming, for example, the preliminary cleaning and pickling of the iron or steel by cathodic action in an acid bath, we may proceed as follows. The article is made the cathode in a sulphuric acid bath of from 2 to 20% strength, and a current of from 10 to 150 amperes per square foot of cathode surface is passed through the electrolytic circuit. The temperature of the solution may, for example, be from room temperature to 160° F. The treatment may continue for a period of from 1 to 6 minutes or longer, after which the article may be subjected, with or without previous rinsing, to the electrolytic bright dip, in which treatment the article is made the anode in an electrolytic circuit having a sulphuric acid electrolyte of from 25 to 75% strength. A particularly favorable strength of acid in this step is between 40 and 50% H_2SO_4.

We find that high current densities (80 to 200 amperes per square foot) and comparatively low temperatures (50°–90° F.) are favorable to the production of a good bright surface. With too low a current density or too high a temperature, the surface will be clean but not bright, and will have more the appearance obtainable by ordinary pickling methods. The effect of higher temperatures can to a certain extent be counteracted by the use of higher current densities, and at temperatures above 100° F. it is necessary to use 200 amperes or more per square foot of anode surface. It is more economical to keep the temperature below 80° F. and preferably between 60° and 70° F. A typical example of temperature and current density in the case of 40 to 50% sulphuric acid is a case in which 150 amperes per square foot are passed through the circuit at a temperature of 80° F. With temperatures between 60° and 70° F. somewhat lower current densities may be employed. Artificial cooling is desirable where large work is being treated, as otherwise the temperature may rise to a degree at which the work will become darkened.

There are some indications that the production of the bright surface is due to the anodic formation of persulphuric acid, the maintenance of which is favored by the high current density and the low temperature. At

any rate, it is significant that the bright surface, even after it has been obtained, can be dulled and darkened by further anodic treatment at higher temperatures or lower current densities. The anode and cathode areas in both the initial pickling step and in the final electrolytic bright dip, may be equal, though the invention is not limited to this particular relation of anode and cathode areas. In the electrolytic bright dip, the current density referred to is an initial current density which drops or decreases sharply at the beginning of polarization. Shortly after this sharp drop in current density the work becomes clean, but not bright, while the current still continues to decrease. A little later the work becomes bright, and the decrease in current ceases and the current remains steady at a greatly reduced value. The treatment may be completed in the space of 1½ minutes, under the conditions assumed, but it may be continued beyond this point for several minutes without injury to the material which is being treated. It should be borne in mind that favorable results require higher current densities when higher temperatures are used in the electrolytic bright dip. It is also of particular importance where high current densities are employed, such as here-in contemplated, that the contact resistance throughout the circuit be kept low, and that all contacts be positive or secure so as to avoid any unintentional fluctuation in the current density passing through the electrolyte.

After the electrolytic bright dip treatment, the work may be removed and washed or rinsed and dried. In the case of steel articles the surface obtained is particularly clean and bright, whereas articles of iron will ordinarily have a somewhat less bright surface than obtainable in the case of steel, although far superior to that heretofore obtained in the use of the known pickling methods. By the treatment described, the undesirable hardening of the surface, which has been a common fault in pickling methods heretofore employed, is apparently entirely avoided.

Those skilled in the art may employ addition agents of known function and character, in order to modify the electrolyte to suit their own special requirements or preferences. Since the high state of oxidation or the maintenance of persulphuric acid appears to be important in obtaining the desired result, such addition agents may include oxidizing agents such as chromic acid, sodium perborate, hydrogen peroxide or nitrate salts such as ammonium nitrate.

We claim:—

1. The method of bright dipping iron and steel, from which scale has been preliminarily removed, which comprises maintaining the iron or steel as an anode in a sulphuric acid electrolyte of from 25 to 75% strength with a current density of from 80 to 250 amperes per square foot of anode surface, and artificially cooling the electrolyte to maintain the temperature thereof between 50° F. and 100° F.

2. The method of bright dipping iron and steel, which comprises passing an electric current of from 80 to 250 amperes per square foot of anode surface through an electrolytic circuit in which the iron or steel article is the anode, in an electrolyte of sulphuric acid of from 25 to 75% strength, and artificially cooling the electrolyte to maintain the temperature thereof below 100° F.

3. The method of bright dipping iron and steel, which comprises passing an electric current of from 80 to 250 amperes per square foot of anode surface through an electrolytic circuit in which the iron or steel article is the anode, in an electrolyte of sulphuric acid of from 25 to 75% strength, and artificially cooling the electrolyte to maintain the temperature thereof below 80° F.

4. The method of bright dipping iron and steel, which comprises passing an electric current of from 80 to 250 amperes per square foot of anode surface through an electrolytic circuit in which the iron or steel article is the anode, in an electrolyte of sulphuric acid of from 25 to 75% strength, and artificially cooling the electrolyte to maintain the temperature thereof between 60° F. and 70° F.

5. The method of bright dipping iron and steel, which comprises maintaining the iron or steel as an anode in a sulphuric acid electrolyte of from 40 to 50% strength with a current density of from 80 to 250 amperes per square foot, and artificially cooling the electrolyte to maintain the temperature thereof between 60° F. and 70° F.

6. The method of bright dipping iron or steel articles, which comprises preliminarily removing the scale and then making the article the anode in a sulphuric acid electrolyte of from 40 to 50% strength with an initial current density of about 150 amperes per square foot of anode surface, and artificially cooling the electrolyte to maintain the temperature thereof in the neighborhood of 60° F. to 70° F.

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