

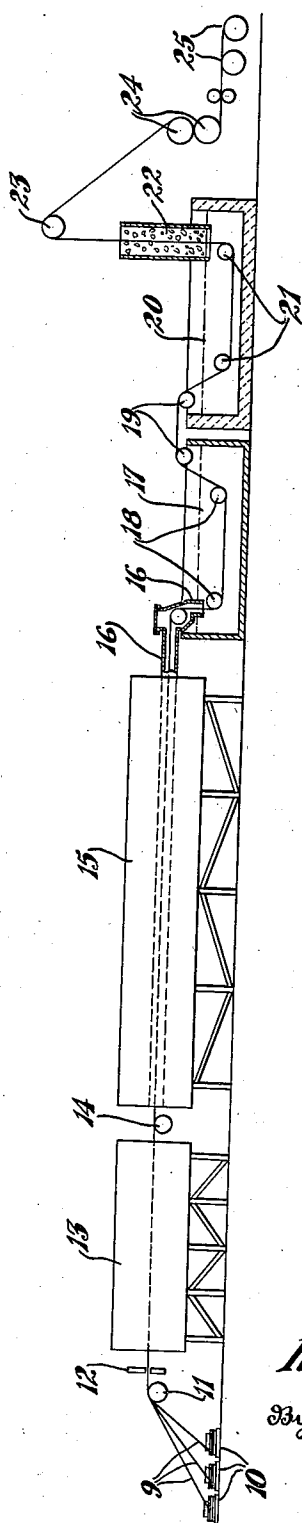
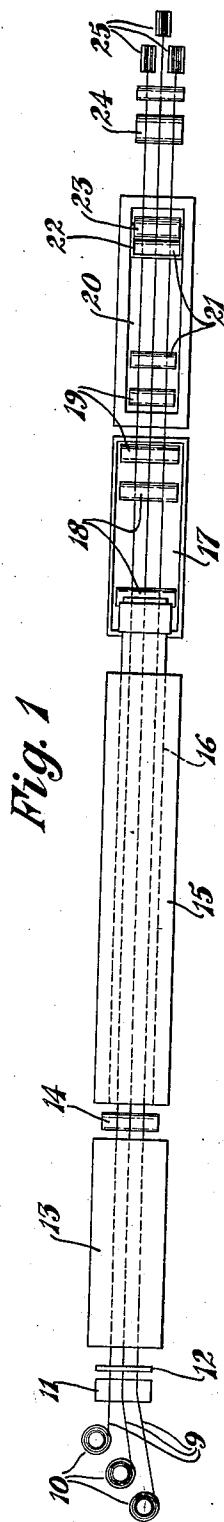
June 10, 1941.

R. F. RENKIN

2,245,225

METHOD OF COATING METAL

Filed Dec. 14, 1939



Inventor
Robert F. Renkin
By *Freese and Bishop*
Attorneys

UNITED STATES PATENT OFFICE

2,245,225

METHOD OF COATING METAL

Robert F. Renkin, Sharon, Pa.

Application December 14, 1939, Serial No. 309,224

12 Claims. (Cl. 91-70.3)

The invention relates generally to the coating of metal products, and more particularly to the galvanizing of steel sheets, stripsheets, strips or wire.

The present method preferably includes as one step the cleaning of steel in preparation for coating by means of a so-called "dry pickle" treatment instead of the usual wet pickle in an acid bath. Said "dry pickle" treatment per se is not part of this invention and may be described preferably as including passing the steel through a heated controlled active atmosphere adapted for carrying off scale and other surface impurities in the form of gases or vapors.

For zinc coating or galvanizing certain kinds of steel, a relatively satisfactory galvanized coating can be obtained by passing the steel from a usual cleaning step directly into the spelter pot. However, the coating on the coated product thus obtained may not be sufficiently ductile or adherent for certain purposes, and if straight zinc spelter is used the coating powders or flakes off under forming operations.

Moreover, when the carbon content of the steel being coated is substantially below about 0.1%, it becomes increasingly difficult to obtain a galvanized coating which is ductile and adherent.

Where it is desired to galvanize steel having a very low carbon content, as for instance steel telephone wire requiring .02% or .03% carbon as well as a low phosphorus and a low sulphur content, the passing of the steel directly into the spelter pot gives a very poor coating which has little adhesion and flakes off very readily, especially when the standard test of twisting the wire around its own diameter is applied.

I have discovered that, by passing the steel product directly from the dry pickle cleaning treatment through a special liquid flux and then through a galvanizing bath containing a small amount of aluminum, the coating obtained is very adhesive and ductile, and does not flake when subjected to the standard twisting test.

A general object of the present invention is to provide a novel and improved method of galvanizing metal.

A more specific object is to provide a method of galvanizing steel having a low carbon content.

Another specific object is to provide an improved method of coating steel telephone wire with a ductile and adhesive galvanized coating.

A further object is to provide a novel and improved method of coating metal which has been cleaned by a dry pickling treatment.

Another object is to provide a special fluxing bath between a dry pickling treatment and a galvanizing step for forming a uniform film on the steel product prior to the coating treatment.

A still further object is to provide a special galvanizing bath for forming a ductile and adhesive coating on the steel product after it passes through the special fluxing bath.

These and other objects are accomplished by the improvements, methods, combinations and sub-combinations comprising the present invention, a preferred embodiment of which is hereinafter described in detail and defined in the appended claims.

In general terms the invention may be defined as including the steps of passing a steel sheet, strip or wire product through a preheating zone, then through a dry pickling or cleaning zone, then through a liquid flux of zinc ammonium chloride with nickelous chloride, and then through a galvanizing bath of pure zinc spelter with a small percentage of aluminum.

In the drawing I have shown by way of example a diagrammatic representation of apparatus adapted for the continuous coating of steel wire, but it will be understood that the apparatus can be greatly varied with respect to construction and arrangement and the material being coated can be steel strip or steel sheets or various other products, without departing from the scope of the invention as defined in the claims.

In the drawing—

Figure 1 is a diagrammatic plan view of a preferred embodiment of apparatus for carrying out the present improved method; and

Fig. 2 is a diagrammatic side elevation thereof partly in section.

Like reference characters refer to like parts throughout the drawing.

In continuously coating steel wire the strands of wire 9 may be pulled from pay off reels 10 over a feed roll 11 and welder 12, all in a usual manner, and thence through a preheating furnace indicated at 13, which is maintained preferably at a temperature of about 1000° F.

An example of wire 9 treated may be steel telephone wire or No. 101 wire having an approximate analysis of .03 carbon, .10 manganese, .029 sulphur, .008 phosphorus, and no silicon additions. Steel wire used as telephone wire is required to have such an analysis in order to have the required electrical properties and characteristics, and it is exceedingly difficult if not substantially impossible to obtain a sufficiently ductile and adherent galvanized coating on such

wire by using any of the conventional coating processes in commercial use.

The wire 9 passes from the preheating furnace 13 over a suitable guide roll 14 and thence through a cleaning furnace indicated at 15. This cleaning furnace 15 may be called a "dry pickling" furnace and is provided with a muffle 16 inside the furnace through which the wire 9 passes. The furnace is maintained at a temperature of about 1200 to 1250° F., and a mixture of gases is circulated through the muffle for cleaning the surface of the wire. The mixture of gases contains preferably air, natural gas, and chlorine in certain definite proportions, as for example the air may be passed through the muffle at the rate of 42 cubic feet per hour, the natural gas at 7 cubic feet per hour and the chlorine at 7 cubic feet per hour, said proportions being dependent upon the capacity of the furnace.

The construction of the dry pickling apparatus and the method of cleaning per se which is performed thereby is not in itself a part of this invention, except that the cleaning step is an important step in the combination of steps constituting the method of the present invention.

It is deemed sufficient to say that the wire strands entering the muffle 16 in the dry pickling furnace 15 may have on their surface the usual iron oxide scale, and also other impurities and foreign matter such as oil, rust, dirt, lime, grease, and carbon; and the effect of the gas treatment at the particular furnace temperatures maintained is to chemically react with and gasify or vaporize substantially all of these impurities. The impurities are carried off as gases or entrained in the gases so that the wire strands emerge from the furnace 15 with a clean surface except for a slight uneven film of chemical salts.

This salt film is uneven and spotty, and if the wire is passed directly from the furnace 15 into a galvanizing pot, the coating is not uniformly ductile nor sufficiently adherent, but will flake off when the wire is tested by twisting or coiling it about its own diameter. The flaking off of the coating apparently occurs at the places where the spots or accumulations of the salt film are located when the wire emerges from the dry pickling furnace.

Passing the wire through the usual flux of zinc chloride before the wire enters the spelter does not satisfactorily eliminate this flaking difficulty, but I have found that if the wire is passed directly from the dry pickling furnace 15 through a separate flux bath of special composition, and then through a galvanizing bath of substantially pure zinc with a small addition of aluminum, the resulting coating is uniformly ductile and very adherent so as not to flake off when tested by twisting it about its own diameter.

Accordingly, the wire strands leaving the furnace 15 are passed through the depending portion 16' of the muffle directly into a separate flux bath 17 and around hold down rolls 18 therein. The composition of the flux bath 17 is a solution of zinc ammonium chloride containing about 0.5% to 1.0% of nickelous chloride or 0.5% to 1.0% aluminum chloride, or preferably 0.5% to 1.0% of each, forming a flux with a Baumé reading of about 25° at about 160° F., which is constantly being filtered, thereby removing all impurities and maintaining a good clean flux at all times.

The effect produced by the presence of nickelous chloride and aluminum chloride in the flux is not clearly understood, but they appear to uniformly spread or distribute the salt film over the surface

of the wire, and the aluminum chloride also improves the flow in the galvanizing bath, and the coating is uniformly adherent and does not flake off when twisted.

From the flux bath 17 the wire strands are led over suitable exit and entry rolls 19 into a galvanizing bath 20, and in the galvanizing bath the strands pass under hold down rolls 21, and then upward through a palm oil and charcoal wipe 22 or other conventional wipe, and over a pull-over roll 23 and tension rolls 24 to the take up reels indicated generally at 25.

The galvanizing bath 20 is preferably made up entirely of a high grade spelter which is zinc having a very low content of impurities with an addition of from .06% to .1% of aluminum, and the bath is maintained at a temperature of approximately 800° to 840° F. The addition of aluminum to the galvanizing bath improves the coating obtained by breaking down surface tension, and by giving a better color and flow to the coating, as well as rendering it more ductile.

The present method is particularly adapted to the use of aluminum in the spelter, because the flux is in a bath separate from the galvanizing bath. Where the flux is located on the galvanizing bath the presence of aluminum in the spelter has a deleterious effect in that it produces a black scum at the surface of the bath and deadens the flux.

I have found by actual experiment that the method of this invention will produce a much better galvanized coating on ordinary strip steel than can be produced by the conventional method of wet pickling with acid and then coating in the usual galvanizing pot, and that the improvement in the coating becomes more pronounced when the carbon content of the steel approaches .05% or under.

Also by this method I am able to produce a coated steel product giving a very low Rockwell and a high Olsen test. I believe that these unusual results are due largely to the impossibility of the occurrence of any hydrogen absorption, causing embrittlement, which condition is always a hazard when the steel is treated in a conventional manner by wet pickling.

An example of a steel product coated by this method wherein the steel is soft and the coating ductile is as follows: low carbon (under .09%) strip steel .014" thick has been coated according to this method and then rolled to .003" thick, and still retains a uniform and ductile coating which will not flake or powder when bent flat on itself.

These results are substantially duplicated in galvanizing wire, and where the wire has an analysis of the order of 101 telephone wire, as for example .03% carbon, .10% manganese, .029% sulphur, and .008% phosphorus, a coating obtained by the method of this invention is far more than uniform, ductile and adherent than it has been heretofore possible to obtain by known commercial methods of galvanizing.

I claim:

1. A method of coating metal which includes subjecting the metal to a dry pickling treatment, passing the metal through a separate liquid solution of zinc ammonium chloride containing nickelous chloride, and then passing the metal through a molten galvanizing bath of pure zinc containing a small amount of aluminum.

2. A method of coating metal which includes subjecting the metal to a dry pickling treatment, passing the metal through a separate liquid

flux solution of zinc ammonium chloride containing nickelous chloride and aluminum chloride, and then passing the metal through a molten galvanizing bath of pure zinc containing a small amount of aluminum.

3. A method of coating metal which includes subjecting the metal to a dry pickling treatment, passing the metal through a separate liquid flux solution of zinc ammonium chloride containing approximately from 0.5% to 1.0% nickelous chloride, and then passing the metal through a molten galvanizing bath of pure zinc containing from .06% to .1% aluminum.

4. A method of coating steel which includes preheating the steel to about 1000° F., subjecting the steel to a heated controlled active atmosphere at about 1200° F. containing chlorine, passing the steel through a separate liquid flux solution of zinc ammonium chloride containing nickelous chloride, and then passing the steel through a molten galvanizing bath of pure zinc with an addition of aluminum and maintained at an approximate temperature of from 800° F. to 840° F.

5. A method of coating steel which includes preheating the steel to about 1000° F., subjecting the steel to a heated controlled active atmosphere at about 1200° F. containing chlorine, passing the steel through a separate liquid flux solution of zinc ammonium chloride containing 0.5% to 1.0% nickelous chloride and 0.5% to 1.0% aluminum chloride, and then passing the steel through a molten galvanizing bath of pure zinc with an addition of from .06% to .1% aluminum and maintained at an approximate temperature of from 800° F. to 840° F.

6. A method of coating ferrous strip, sheets or wire of low carbon content and low metalloid content which includes preheating the ferrous product, subjecting the ferrous product to a heated controlled active atmosphere containing chlorine, passing the ferrous product through a separate liquid flux solution of zinc ammonium chloride containing nickelous chloride, and then passing the product through a molten galvanizing bath of substantially pure zinc.

7. A method of coating ferrous strip, sheets or

wire of low carbon content which includes subjecting the ferrous product to a heated controlled active atmosphere containing chlorine, passing the ferrous product through a separate liquid flux solution of zinc ammonium chloride containing nickelous chloride and aluminum chloride, and then passing the product through a molten galvanizing bath of substantially pure zinc.

8. A method of coating ferrous strip, sheets or wire of low carbon content which includes preheating the ferrous product, subjecting the ferrous product to a heated controlled active atmosphere containing chlorine, passing the ferrous product through a separate liquid flux solution of zinc ammonium chloride containing 0.5% to 1.0% nickelous chloride, and then passing the product through a molten galvanizing bath of pure zinc containing from .06% to .1% aluminum.

9. A method of coating ferrous strip, sheets or wire which includes the steps of passing a cleaned ferrous product through a separate liquid flux solution of zinc ammonium chloride containing nickelous chloride, and then passing the product through a molten galvanizing bath.

10. A method of coating ferrous strip, sheets or wire which includes the steps of passing a cleaned ferrous product through a separate liquid flux solution of zinc ammonium chloride containing nickelous chloride and aluminum chloride, and then passing the product through a molten galvanizing bath.

11. In a method of coating steel of minimum carbon content, the steps of passing the cleaned steel through a separate liquid flux solution of zinc ammonium chloride containing nickelous chloride and aluminum chloride, and then passing the steel through a molten galvanizing bath containing an aluminum addition.

12. In a method of coating steel having a metallic salt film thereon resulting from dry pickling, the steps of passing the steel through a separate liquid flux solution of zinc ammonium chloride containing nickelous chloride, and then passing the steel through a bath of pure molten zinc containing a small amount of aluminum.

ROBERT F. RENKIN.