

UNITED STATES PATENT OFFICE.

MARVIN J. UDY AND FRANK C. NICHOLSON, OF KOKOMO, INDIANA, ASSIGNORS TO
THE UDYLTE PROCESS COMPANY, OF KOKOMO, INDIANA, A CORPORATION OF
INDIANA.

RUST-PROOF PIANO-WIRE.

1,383,174.

Specification of Letters Patent.

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No Drawing.

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To all whom it may concern:

Be it known that we, MARVIN J. UDY and FRANK C. NICHOLSON, citizens of the United States, residing at Kokomo, in the county of Howard and State of Indiana, have invented certain new and useful Improvements in Rust-Proof Piano-Wire, of which the following is a specification.

The present invention relates to wires for stringed musical instruments and particularly to piano wire, pins and other metallic parts of pianos.

The fact that the process of rusting and of corrosion under the influence of the atmosphere gradually impairs the qualities of piano wire and finally leads to total uselessness has been recognized a long time ago. Continuous efforts have been made to remedy this evil, but so far as we are advised with little success.

Iron and steel structures are generally protected against the oxidizing action of the atmosphere by covering them with a film of a metal which is not readily attacked. Also non-metallic materials have been used for the same purpose. The first efforts to protect piano wire were therefore also to coat the wire with a suitable material. It was of course soon realized that out of the number of materials found available for protection of steel and iron in general only comparatively few could find practical application for the specific purpose, since the problem was not merely a coating problem pure and simple. It was soon found that all forms of coating were detrimental to the function of the wire as a sound producer, some more, others less. It was merely a question as to which coating has the least disturbing effect. Thus we find that gold, silver, copper, lead, nickel, tin, brass, cobalt, and a few other metals have almost exclusively been resorted to for the particular purpose. These metals have been applied in various ways and by various processes in unceasing efforts to make the film mechanically as perfect as possible and to reduce the injurious effect upon the tone quality, but so far as we are advised all these efforts have been more or less a failure.

Nickel, copper, silver and other non-rusting metals have a distinct tendency to hinder and deaden the vibrations of the wire to

the extent of materially impairing its tone quality, no matter how evenly and perfectly the coating is applied. This defect is principally due to the fact that a film of these metals is inherently relatively thick and since the modulus of elasticity and other mechanical characteristics of these metals are materially different from those of the steel wire, the interference with the material function of the wire is considerable. To put some of these metals on a wire requires copper-plating first which renders it practically useless.

Another drawback found to militate against the successful use of these metals for coating is the fact that the coating almost invariably peels off. This is probably due to various causes including principally the difference in the mechanical and physical properties between them and the steel wire, the insufficiently intimate union between the wire and the coating and perhaps the fact that these metals are themselves not absolutely immune against the action of the atmosphere. While it is not possible to assign with certainty the causes of the peeling off, it is probable that under the influence of the vibrations whereby the coating is alternately expanded and compressed the coating cracks or breaks and opens a path for the atmosphere to do its destructive work upon the wire and that the rust thus eats its way laterally of the cracks and destroys the union between the coating and the wire. As small and imperceptible as this initial process of rusting may be at first, it accentuates the crack, opening the way for the atmosphere a little further with the result that the portions of the coating adjacent the crack are free and coil outwardly as is natural. The continuation of this process is the peeling off of the coating irregularly over the surface with the consequent destruction of the tone quality.

It has also been found that copper-plated wires not only deaden the tone as above pointed out, but also become covered with a green coating which is due to the action of the carbon dioxide in the air which forms copper carbonate and is necessarily injurious to the function of the wire.

It is applicants' object to provide a rust proof coating sufficiently thin so as not to

interfere sensibly with the normal function of the wire as a sound producer, of such mechanical properties that it does not break under the action of the vibrations or on bending or kinking and does not peel off.

The invention will be described hereinafter in detail and particularly pointed out in the claims.

As has been previously stated, we preferably carry out the invention by covering the wire with a film of cadmium and the process of coating is preferably carried out by electroplating.

The treatment of the wire may comprise the following steps:

I. Preparation of plating solution.

A solution containing about 25 grams of cadmium per liter of solution, we have found, is most convenient for the purpose. Enough of a salt of cadmium such as the sulfate or chlorid to yield 25 grams of metallic cadmium is weighed and dissolved in as small amount of water as possible. If metallic cadmium is used, it may be dissolved in hydrochloric acid to form a neutral solution or it may be dissolved in nitric acid and evaporated to dryness with hydrochloric acid to remove the nitric acid. After the cadmium is dissolved and is in a neutral or nearly neutral solution, a solution of sodium or potassium hydroxid is slowly added until the cadmium is precipitated and the solution is red to phenolphthalein. Sodium or potassium cyanid is now slowly added until the precipitated cadmium oxid is all dissolved, an excess of cyanid being avoided. The solution is then diluted to one liter. The solution as thus prepared constitutes the bath used for electroplating the wire. Other strengths of solution may, of course, be used, but a solution of 25 grams cadmium per liter we find preferable for use. The anode is metallic cadmium. A current density of 7 amperes to 50 amperes per square foot of cathode area can be used. About 7 amperes per square foot are preferred. Lower and higher current densities have been used, and, in fact, the current density does not seem to affect the deposit. Only from 1-5 minutes are required and the average time of treating a wire is about 3 minutes. Deposits from this plating solution are very smooth.

II. Cleaning of wire.

Before plating the wire is cleaned of all rust and dirt by polishing with a very fine grade of emery cloth. If necessary, it may also be cleaned by dipping in dilute sulfuric acid or other chemical solutions and finally in water.

III. Electroplating.

After the wire is cleaned it is immediately

electroplated. To do this we preferably coil the wire into a small coil, place it in the cadmium bath and allow it to uncoil on the bottom of the bath to the sides of the vessel. One end of the wire is bent so as to project above the solution to make connection with the circuit. The anode of cadmium is placed in a vertical position in the center of the coil and equally distant from all sides. It extends above the solution to make connection with the circuit of a D. C. source. This wire when polished is satisfactory for the purpose but is improved by the following heat treatment.

IV. Heating.

After the wire has received its coating, it is washed in water and placed in an oven and heated to about 150° C. to 200° C. The maximum in an ordinary oven is about 200° C. It has been our practice to hold the wire at about 185° C. for 3-4 hours. The time is not a very important factor as good results were obtained by heating for 24 hours. Any reasonable length of time, from 2 to 24 hours will serve the purpose well. The temperature should be such that there is only a slight coating of cadmium oxid formed on the wire. Excessive oxidation must be avoided. By burying the wire in calcium hydroxid the temperature may be raised to about 250° C. without excessive oxidation. The degree of oxidation, of course, is governed by the temperature employed and the atmosphere in which the heating takes place.

The heat treatment has the purpose to alloy the cadmium with the iron of the wire and also to harden the coating. It also serves the purpose of removing an excess of cadmium by burning it to oxid if it happens that the coating is too thick. After the heat treatment the coating is very resistant to wear. Since the coating is very thin, this resistance is very important.

V. Polishing.

After the wire is thus treated it is buffed and polished. This removes the slight coating of cadmium oxid and leaves a bright polish on the surface. To give the wire a finishing touch and a very fine polish, it may be replaced in the electroplating bath to give it a very light additional deposit of cadmium. It is then washed in water and buffed to a very fine polish. Repeated coatings may be applied, but the treatment as above described has been completely satisfactory.

We have prepared wires by dipping them into molten cadmium, but we prefer electroplating which is more economical and more satisfactory.

Wires produced as above described have the following principal qualities:

They offer a high resistance to rusting.

Their tensile strength is not impaired.

The coating is exceedingly thin.

The coating is integral with the wire and alloyed thereto.

5 The tone qualities of the wire are not impaired.

We claim:—

1. A metal article having a coating of cadmium alloyed thereto.

10 2. A vibratory element for sound-producing instruments having a thin coating of cadmium.

3. A vibratory element for sound-producing instruments having a thin coating of
15 cadmium alloyed thereto.

4. A piano wire having a thin coating of cadmium.

5. A piano wire having a thin coating of cadmium alloyed thereto.

20 6. The process of coating metal articles, which consists in first applying a thin coating of cadmium and then subjecting the coated article to heat under conditions causing an alloying of the coating and the metal
25 of the article.

7. The process of coating metal articles, which consists in first electrodepositing a thin coating of cadmium and then subjecting the coated article to heat under conditions
30 causing an alloying of the coat and the metal of the article.

8. The process of treating vibratory elements of sound-producing instruments to make them rust-proof, which consists in
35 first applying a thin coating of cadmium and then subjecting the coated element to heat

under conditions causing the coating and the metal of the element to alloy.

9. The process of treating vibratory elements of sound-producing instruments to
40 make them rust-proof which consists in first electrodepositing a thin coating of cadmium and then subjecting the coated element to heat under conditions causing the coating and the metal of the element to alloy.
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10. The process of treating vibratory elements of sound-producing instruments to make them rust-proof, which consists in first electrodepositing a thin coating of
50 cadmium, then subjecting the coated element to heat under conditions causing the coating to alloy to the metal of the article, and to be outwardly oxidized and then polishing the elements.

11. The process of treating a piano wire
55 to make it rust-proof, which consists in electroplating the wire with a thin coating of cadmium, then heating the wire to alloy the coating to the wire and then polishing the wire.
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12. The process of treating a piano wire to make it rust-proof, which consists in electroplating the wire with a thin coating of cadmium, then subjecting the wire to heat under conditions which cause the coating to
65 alloy to the wire and to be outwardly oxidized and then polishing the wire.

In testimony whereof we affix our signatures.

MARVIN J. UDY.
FRANK C. NICHOLSON.