

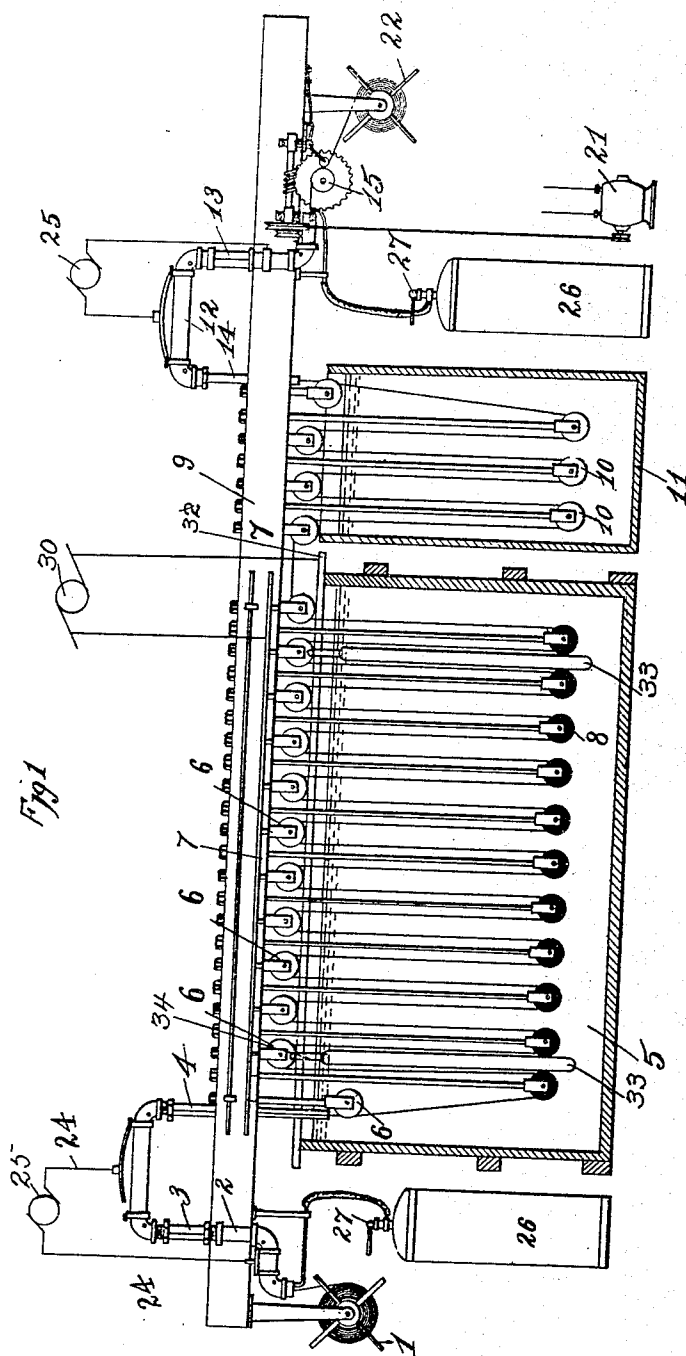
No. 781,867.

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PATENTED FEB. 7, 1905.

J. W. AYLSWORTH.
APPARATUS FOR NICKEL PLATING.
APPLICATION FILED SEPT. 15, 1903.

3 SHEETS—SHEET 1.



Witnesses:

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John B. Randolph

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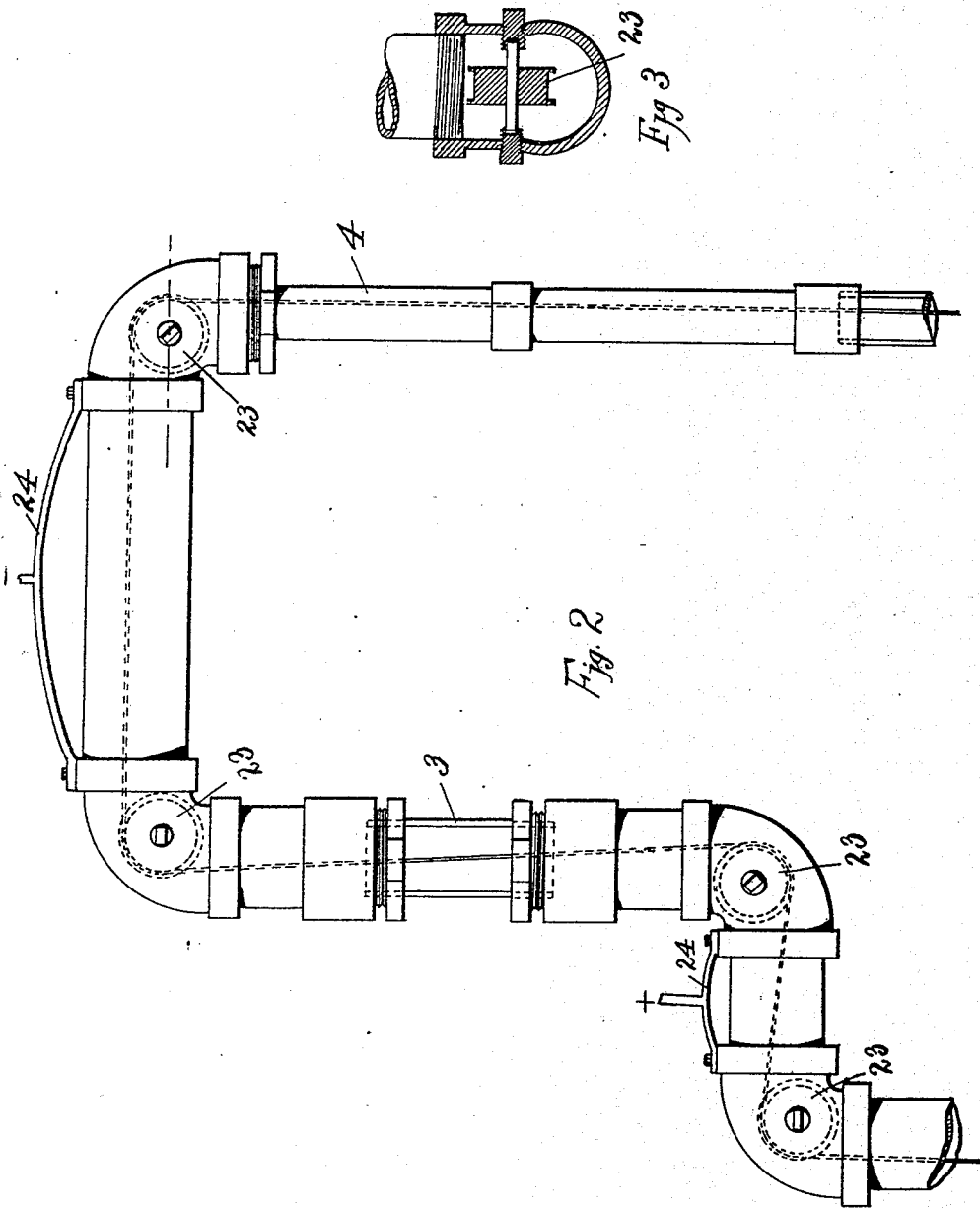
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3 SHEETS—SHEET 2.



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3 SHEETS—SHEET 3.

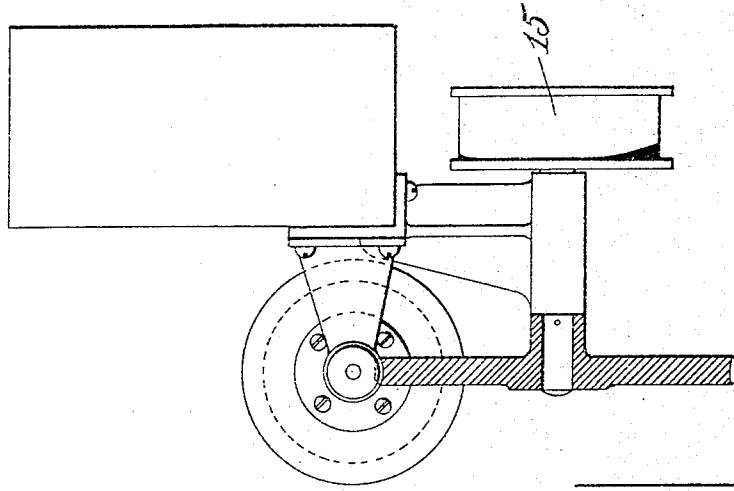


Fig. 5

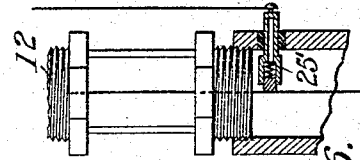


Fig. 6.

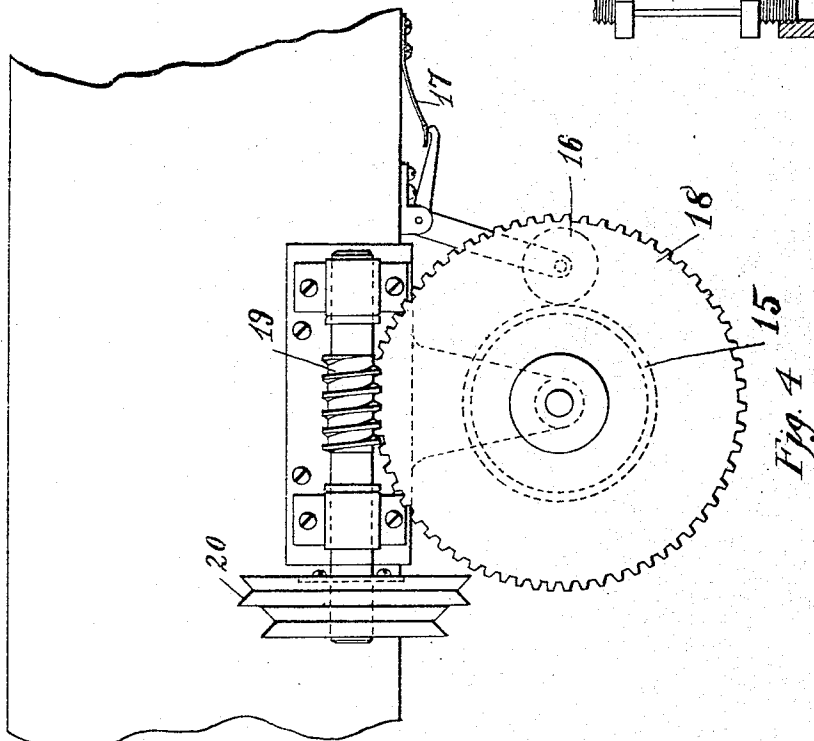


Fig. 4

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR NICKEL-PLATING.

SPECIFICATION forming part of Letter Patent No. 781,867, dated February 7, 1905.

Application filed September 15, 1903. Serial No. 173,221.

To all whom it may concern:

Be it known that I, JONAS W. AYLSWORTH, a citizen of the United States, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Apparatus for Nickel-Plating, of which the following is a description.

My invention relates to improved apparatus for nickel-plating after the manner of the process described in patent to Thomas A. Edison, No. 734,522, of July 28, 1903, wherein the nickel film electrolytically deposited on the iron or steel surface is welded thereto by heat in a non-oxidizing atmosphere, whereby the plated coating is relieved of any condition of tension and is practically homogeneously united to sheet, plate, or other article.

The object of my present invention is to provide an apparatus which will permit such a process to be carried on continuously, the article or articles being electroplated and the deposited coating being subsequently welded by successive automatic operations, whereby previously nickel-plated articles or plated portions of the same article (when the latter is in the form of a long strip) will be subjected to the welding operation simultaneously with the plating of successive portions of the same article or of successive articles, all as shall be more fully hereinafter described and claimed.

The apparatus also provides approved facilities for automatically washing the plated articles or article (when the latter is in the form of a strip) subsequently to the plating and previous to the heating thereof, and it also provides improved means for treating the article or articles previous to the plating so as to remove any film of oxid or grease, which would interfere with or reduce the character of the deposited coating.

The apparatus also provides means for electrically heating the articles or article for the purpose of welding the deposited coating thereon, although, obviously, and in some cases preferably, the heating may be applied in other ways. The deoxidizing or cleaning of the ar-

ticle or articles can also be effected by electrically heating them in a reducing atmosphere, although in this respect the apparatus is susceptible of obvious modification.

I shall select as a good illustrative embodiment of my invention, an apparatus for nickel-plating, a long, very thin, finely-perforated strip of steel, which I subsequently cut up into sections of the required length and form into pocket-sections for receiving the active materials in the make-up of storage batteries of the Edison type, and from this illustration the changes and modifications will be obvious to skilled persons as will be necessary to adapt the apparatus for use in connection with the nickel-plating of other continuous objects or of separate objects connected together like a chain or secured to wires or other continuous supporting and carrying devices.

In order that the invention may be better understood, attention is directed to the accompanying drawings, illustrating the apparatus in question, and in which—

Figure 1 is a longitudinal sectional view, partly diagrammatic; Fig. 2, a separate elevation, on an enlarged scale, showing one of the heating-chambers; Fig. 3, a cross-sectional view through the heating-chamber, illustrating one of the pulleys for supporting the strip; Fig. 4, a detailed elevation of the feeding mechanism; Fig. 5, a view taken at right angles to Fig. 4 and partly in section; Fig. 6, a sectional view of a part of the welding-chamber, showing the employment of a contact-brush for furnishing current to the strip.

In all of the above views corresponding parts are represented by the same numerals of reference.

The article to be plated, in the present instance a long, very thin, perforated steel strip, is carried on a reel 1 and passes through the tubular heating-chamber section 3 therein and bottom section 4. The strip will be insulated from this heat-

pipe 4, whose lower end may be immersed in a nickel solution in the plating tank or vat 5. Any suitable nickel solution may be used, such as nickel-ammonium sulfate. Nickel anodes, preferably in the form of rectangular bars 33, are suspended from the conductors 32 along both sides of the tank by means of hooks 34. The conductors 32 are electrically connected to any suitable source 30 of electromotive force. The strip forms the cathode. It passes back and forth over conducting-pulleys 6 at the top, all connected through the conductor 7 to the source 30, as indicated, and over insulating-pulleys 8 at the bottom, so as to be immersed in the solution, all said pulleys being supported from a beam 9. The pulleys 6 and 8 may be of any suitable construction. From the plating-bath the strip passes over pulleys 10 in a wash-tank 11, containing water in which the strip is washed, and thence upward through the heating-chamber 12, corresponding to the heating-chamber 2 and having a glass section 13. If desired, the extension 14 of the heating-chamber 12 may be immersed below the surface of the liquid in the tank 11, so as to form a seal, as will be explained; but this is not necessary and said extension may be terminated above the level of the liquid, as shown. From the heating-chamber 12 the strip passes over a feed-wheel 15, (see Figs. 4 and 5,) being held in frictional engagement therewith by an idler 16, actuated by a spring 17. The feed-wheel 15 is driven in any suitable way—as, for example, by a worm-gear 18 with which the worm 19 meshes, driven by pulleys 20 from a small electric motor 21. I illustrate two pulleys 20 to permit different speeds to be secured, as will be obvious. From the feed-wheel 15 the strip is wound on a reel 22, which may be driven automatically or operated by hand. In order to heat the strip in the heating-chamber 2, I run the same over pulleys 23 therein and make electric connection by conductors 24 with a source of supply 25, as shown, so that the current will pass through the strip and heat the same, the voltage being properly regulated so as to give the desired heating effect. The glass section 3 not only serves to insulate the two sections of the heating-chamber and cause the current to traverse the strip, but also permits the strip to be observed in the heating-chamber in order that the proper heating thereof may be assured. The pulleys 23 may be of any suitable material; but I prefer to use bronze, silver-plated. The strip is heated in the heating-chamber 12 from a source of current connected to the two sections of the heating-chamber 12, as shown, the upper and lower sections being provided with similar pulleys similar to those in the heating-chamber 2, and each provided with a spring 17, which engages

the strip, so that the strip will be included in the circuit. In this way a continuation of the lower section is provided in which the strip will be permitted to cool below the oxidizing temperature while still surrounded by the non-oxidizing gas.

It will of course be understood that instead of heating the strip or other article electrically, as explained, the heating may be applied in other ways—as, for example, by externally heating the chambers 2 and 12 by a gas flame or retort.

In order to provide a reducing atmosphere in the heating-chamber 2 and a non-oxidizing atmosphere in the heating-chamber 12, I connect hydrogen-tanks 26 therewith, having valves 27 for regulating the flow. When the apparatus is used for the special purpose described and in connection with the manufacture of storage batteries, a plentiful supply of cheap hydrogen is always present, so that this gas is preferable. It will be understood, however, that any other reducing-gas may be used in the chamber 2, and any other non-oxidizing gas, such as nitrogen, may be employed in the chamber 12.

The operation is as follows: The strip is passed through the heating-chamber 2, through the plating-bath 5, through the wash-tank 11, and through the heating-chamber 12, and power is applied thereto at the feed-wheel 15, so as to feed the strip slowly forward. The reducing-gas is permitted to pass through the heating-chamber 2 and the non-oxidizing gas through the heating-chamber 12 from the tanks 26, so that the supply of such gas will be maintained in such heating-chambers and air or other oxidizing atmospheres will be excluded. The strip or other article or articles is or are heated in the chambers 2 and 12 electrically, as explained, or in any other suitable way. The proper connections are made at the plating-bath, so as to nickel-plate the strip as it slowly progresses through the same, the time that the strip will require to pass through the bath being so regulated as to permit a coating of the desired thickness to be secured. The heating of the strip in the chamber 2 and in the presence of hydrogen gas effects a very perfect reduction of any oxid or other objectionable matter, so that the strip enters the plating-bath in a thoroughly cleaned or deoxidized condition. After the strip has been nickel-plated it passes through the wash-tank, so as to be washed in the usual way, and then enters the heating-chamber 12, in which it is heated to a welding temperature, so as to cause the nickel-plated coating to be welded thereon. After this heating the strip while still in the non-oxidizing atmosphere is permitted to cool until its temperature is reduced below the oxidizing-point. The plated and welded strip accumulates on the take-up reel 22, from which it can be removed when desired. When the roll on the

reel 1 has become exhausted, a fresh roll is inserted in place, the new strip is connected to the rear end of the one progressing through the machine, and the operations described are maintained indefinitely.

While I have designed my apparatus for use in the nickel-plating of an article or a connected series of separate articles, it will be understood that it may be employed in connection with the electrolytic plating of any other metal the adhesion of which or whose character will be improved by subsequently subjecting the same to a welding temperature, whether in a non-oxidizing atmosphere or not. It will also be evident that the continuous preliminary cleaning of the article or articles and the subsequent continuous electroplating of the same require apparatus which may be effectively used in connection with the plating of many different metals and wherein the final welding operation is dispensed with, and such an apparatus I include in the scope of my invention. Finally, it will be understood that the apparatus employed in effecting the continuous electroplating of a strip-like article or of a connected series of separate articles may be made use of in plating with many different metals and wherein the preliminary cleaning and subsequent welding may be omitted, and such an apparatus I also include in the scope of my invention.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. In apparatus for continuously electroplating a continuous strip-like article or a connected series of separate articles, the combination with a heating-chamber through which the article or articles pass continuously and means for heating the article or articles in said chamber in the presence of a reducing atmosphere so as to deoxidize the article or articles, of a plating-bath and means for passing the article or articles continuously through said bath and for continuously plating a metal thereon in such transit, substantially as and for the purposes set forth.

2. In apparatus for continuously electroplating a continuous strip-like article or a connected series of separate articles, the combination with a heating-chamber and means for electrically heating the article or articles therein in the presence of a reducing atmosphere so as to deoxidize the article or articles, of a plating-bath, means for continuously progressing the article or articles through said bath, and means for simultaneously electrolytically depositing a metal thereon in such transit, substantially as and for the purposes set forth.

3. In apparatus for continuously electroplating a continuous strip-like article or a connected series of separate articles, the combination with a plating-bath and means for con-

tinuously progressing the article or articles through said bath and for simultaneously electrolytically plating a metal thereon, of a heating-chamber through which the article or articles continuously pass after leaving the plating-bath, and means for heating the article or articles in said chamber to a welding temperature in the presence of a non-oxidizing gas, substantially as and for the purposes set forth.

4. In apparatus for continuously electroplating a continuous strip-like article or a connected series of separate articles, the combination with a plating-bath and means for continuously progressing the article or articles through said bath and for simultaneously electrolytically plating a metal thereon, of a heating-chamber through which the article or articles continuously pass after leaving the plating-bath, means for heating the article or articles in said chamber to a welding temperature in a non-oxidizing atmosphere, and an extension of said heating-chamber in which said atmosphere is maintained and in which the article or articles are permitted to cool below the oxidizing-point while still surrounded by such gas, substantially as and for the purposes set forth.

5. In apparatus for continuously electroplating a continuous strip-like article or a connected series of separate articles, the combination with a plating-bath and means for continuously progressing the article or articles through said bath and for simultaneously electrolytically depositing a metal thereon, of a heating-chamber through which the article or articles pass after leaving the bath, and means for electrically heating the article or articles in said chamber to a welding temperature in the presence of a non-oxidizing atmosphere, substantially as and for the purposes set forth.

6. In apparatus for continuously electroplating a continuous strip-like article or a connected series of separate articles, the combination with a plating-bath and means for continuously progressing the article or articles through said bath and for simultaneously electrolytically depositing a metal thereon, of a heating-chamber through which the article or articles pass after leaving the bath, means for electrically heating the article or articles in said chamber above the welding temperature in the presence of a non-oxidizing atmosphere, and an extension of said heating-chamber in which the non-oxidizing gas is maintained and in which the article or articles are permitted to cool below the oxidizing-point while still surrounded by such gas, substantially as and for the purposes set forth.

7. In apparatus for continuously nickel-plating an iron or steel article or articles and subsequently heating the nickel-plated coating thereon, the combination with a plating-bath, means for progressing the article or articles

through said bath, of a heating-chamber through which the article or articles pass after leaving the plating-bath, and means for maintaining a non-oxidizing atmosphere in the heating-chamber, substantially as and for the purposes set forth.

8. In apparatus for continuously nickel-plating an iron or steel article or articles and subsequently heating the nickel-plated coating thereon, the combination with a plating-bath, means for progressing the article or articles through said bath, of a heating-chamber through which the article or articles pass after leaving the plating-bath, means for maintaining a non-oxidizing atmosphere in the heating-chamber, and a washing-tank interposed between the plating-bath and said heating-chamber for washing the article or articles subsequently to the plating thereof and previous to the welding of the nickel coating, substantially as set forth.

9. In apparatus for continuously nickel-plating an iron or steel article or articles and subsequently heating the nickel-plated coating thereon, the combination with a plating-bath in which the article or articles are successively plated, of a heating-chamber through which the article or articles are passed after plating, means for electrically heating the article or articles in said chamber, and means for maintaining a non-oxidizing atmosphere in said heating-chamber, substantially as set forth.

10. In apparatus for continuously nickel-plating an iron or steel article or articles and subsequently heating the nickel-plated coating thereon, the combination with a plating-bath in which the article or articles are successively plated, of a heating-chamber through which the article or articles are passed after plating, means for electrically heating the article or articles in said chamber, means for maintaining a non-oxidizing atmosphere in said heating-chamber, and a wash-tank between the plating-bath and said heating-chamber, substantially as set forth.

11. In apparatus for continuously nickel-plating an iron or steel article or articles and subsequently heating the nickel-plated coating thereon, the combination with means for deoxidizing the article or articles, a plating-bath, means for progressing the article or articles through said bath, of a heating-chamber through which the article or articles pass after leaving the plating-bath, and means for maintaining a non-oxidizing atmosphere in the heating-chamber, substantially as set forth.

12. In apparatus for continuously nickel-plating an iron or steel article or articles and subsequently heating the nickel-plated coating thereon, the combination with a heating-chamber containing a reducing atmosphere for heating the article or articles so as to deoxidize the same, means for maintaining a reducing atmosphere in said chamber, a plating-bath, means for progressing the article or articles

through said bath, of a second heating-chamber through which the article or articles pass after leaving the plating-bath, and means for maintaining a non-oxidizing atmosphere in the second heating-chamber, substantially as set forth.

13. In apparatus for continuously nickel-plating an iron or steel article or articles and subsequently heating the nickel-plated coating thereon, the combination with a heating-chamber containing a reducing atmosphere, means for electrically heating the article or articles therein so as to deoxidize the same, means for maintaining a reducing atmosphere in said chamber, a plating-bath, means for progressing the article or articles through said bath, of a second heating-chamber through which the article or articles pass after leaving the plating-bath, and means for maintaining a non-oxidizing atmosphere in the second heating-chamber, substantially as set forth.

14. In apparatus for nickel-plating an iron or steel strip and subsequently welding the nickel film thereon, the combination with a plating-bath, of a series of pulleys mounted in the bath for supporting the strip therein, a heating-chamber through which the plated strip passes, means for heating the strip in said chamber, and means for maintaining a non-oxidizing atmosphere in the heating-chamber, substantially as set forth.

15. In apparatus for nickel-plating an iron or steel strip and subsequently welding the nickel film thereon, the combination with a plating-bath, of a series of pulleys mounted in the bath for supporting the strip therein, a heating-chamber through which the plated strip passes, means for heating the strip in said chamber, means for maintaining a non-oxidizing atmosphere in the heating-chamber, a washing-tank between the plating-bath and heating-chamber, and a series of pulleys in said washing-tank over which the strip runs so as to be washed therein, substantially as set forth.

16. In apparatus for nickel-plating an iron or steel strip and subsequently welding the nickel film thereon, the combination with a plating-bath, of a series of pulleys mounted in the bath for supporting the strip therein, a heating-chamber through which the plated strip passes, means for electrically heating the strip in said chamber, and means for maintaining a non-oxidizing atmosphere in the heating-chamber, substantially as set forth.

17. In apparatus for continuously nickel-plating an iron or steel article or articles and subsequently heating the nickel-plated coating thereon, the combination with a heating-chamber containing a reducing atmosphere through which the strip passes, means for heating the strip therein so as to deoxidize the same, means for maintaining a reducing atmosphere in said heating-chamber, a plating-bath and series of pulleys in said bath

over which the strip runs, a second heating-
chamber for welding the plated coating there-
on, pulleys therein over which the strip runs,
means for heating the strip in the latter cham-
5 ber, and means for maintaining a non-oxidiz-
ing atmosphere therein, substantially as set
forth.

This specification signed and witnessed this
14th day of September, 1903.

JONAS W. AYLSWORTH.

Witnesses:

FRANK L. DYER,
JOHN F. RANDOLPH.