

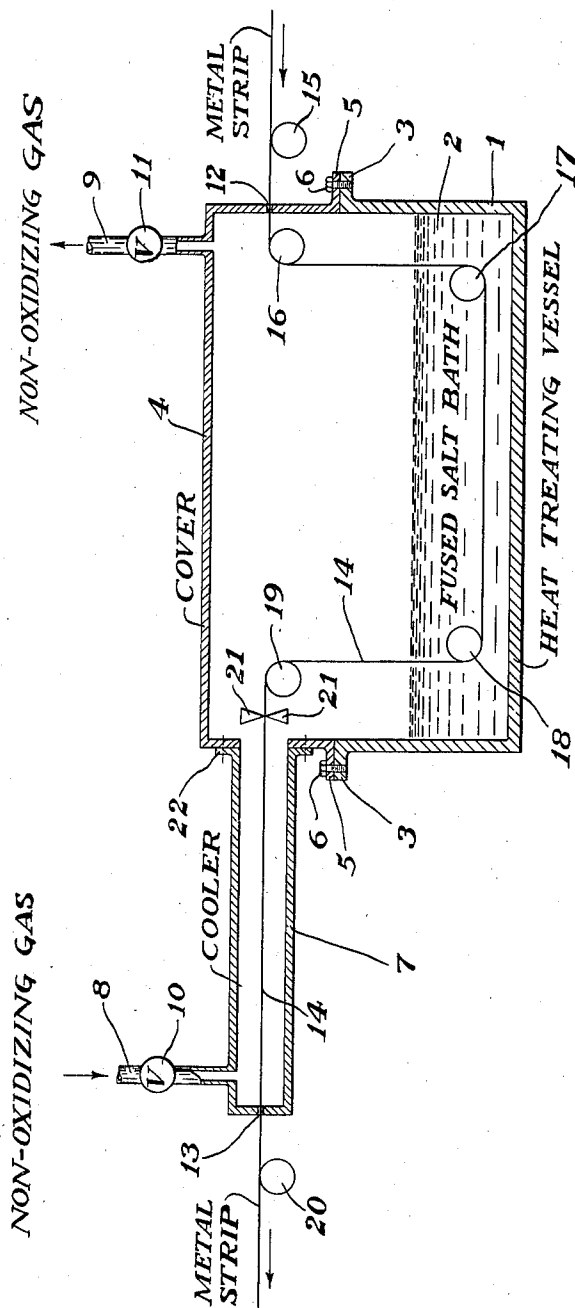
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HEAT TREATING PROCESS

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HEAT TREATING PROCESS

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This invention relates to the heat treatment of metal articles and more particularly to heat treatment by means of fused salt baths.

Heat treating operations for articles of various metals are often carried out by immersing the metal articles to be treated in a fused salt bath. This method of heat treatment is advantageous because of the rapid transfer of heat from the salt bath to the metal articles, thus providing a rapid process well adapted to large scale production. However, difficulties sometimes are experienced in heat treating steel articles in fused salt baths because the salt baths usually cause more or less decarburization of the steel surface. Heretofore this decarburizing effect has been overcome by introducing a carburizing material, for example, alkali metal cyanide or other cyanogen compound, into the fused salt bath. By this method the carburization which occurs, more or less compensates for the decarburizing effect of the bath. However, in commercial work it is practically impossible thus to continuously maintain a bath at a substantially neutral condition; that is, in such condition that the net effect is neither carburization nor decarburization. If the amount of carburizing material is exactly proportioned so that the carburizing effect equals the decarburizing effect, the carburizing power of the bath soon decreases and the steel then becomes decarburized. If more cyanide is added, the steel is case carburized.

This problem is less serious when the articles to be treated are of relatively massive proportions and the time of heat treatment is relatively short. However, this tendency of the salt baths to decarburize steel has heretofore made the salt bath method unsuited for practicable heat treatment of thin, steel articles, such as steel sheet or small steel wire. For example, when a thin steel sheet is heat treated in a salt bath which has a decarburizing action, the sheet is very rapidly and almost completely decarburized throughout its depth, thus producing a sheet of entirely different characteristics than that desired. On the other hand, when cyanide is added to the bath used for heat treating a steel sheet, the small amount of carburization which occurs often is sufficient to substantially entirely carburize the sheet throughout. Hence, it has heretofore been impossible to heat treat steel sheet or iron sheet in the fused salt bath without materially changing its carbon content to an undesirable extent. For this reason, steel sheet commonly is heat treated in furnaces, such as muffle furnaces, in stacks. This involves handling the sheets to stack and unstack them,

and ordinarily the sheets become coated with oxide scale which often must be removed prior to subsequent use. The stacked sheets often stick together, requiring considerable labor to separate the sheets.

An object of the present invention is to provide a new and improved method for heat treating metal articles in fused salt baths. A further object is to provide a satisfactory method for heat treating iron and steel sheet in a fused salt bath. Another object is to provide an improved heat treating fused salt bath which is substantially neutral in character, that is, which neither carburizes nor decarburizes steel articles treated therein. A still further object is to provide a method for heat treating steel articles in fused salt baths without carburizing or decarburizing the steel. Another object is to provide a method for operating a fused salt bath containing cyanide or equivalent carburizing ingredient, whereby the carburizing action of the bath may be inhibited or controlled. Still other objects will be apparent from the following description of my invention.

The above objects are attained in accordance with the present invention by heating metal articles in a fused salt bath, preferably one containing cyanide or equivalent material, which bath is maintained in an atmosphere of an oxygen-free non-oxidizing gas which is substantially chemically inert towards the metal treated. I have discovered that the decarburization and other disadvantageous effects of salt baths on iron, steel, and other metals is caused by the entrance of small amounts of oxygen into the bath, for example, oxygen from the air. Accordingly, I maintain an atmosphere of an oxygen-free, non-oxidizing gas over the surface of the fused salt bath in such manner as to substantially completely prevent the introduction of air or other oxidizing substances into the bath.

In the preferred modification of my invention a small amount of a carburizing material, such as alkali metal cyanide, for example, is added to the bath. The reason for this is that small amounts of oxidizing materials inadvertently may be brought into the bath when operated over long periods of time. For example, small amounts of air may remain occluded or adsorbed on the surface of the metal articles to be treated and also oxide layers on the surface of the metal articles tend in time to impart an oxidizing character to the bath. I have found that alkali metal and alkaline earth metal cyanides and cyanamides as well as other cyanogen compounds such as polymers of hydrocyanic acid, cyanamide,

dicyandiamide and its polymers act as reducing agents in fused salt baths and quickly reduce any oxidizing materials brought into the bath before they have an opportunity to affect the metal articles therein.

I have further discovered that, although ordinarily cyanogen compounds such as alkali and alkaline earth metal cyanides in fused salt baths are very active in causing carburization and nitriding of iron or steel, carburization of the iron or steel does not occur to any appreciable extent and the nitriding effect is decreased to a marked degree or substantially eliminated when the salt bath is protected by an atmosphere of non-oxidizing gas in accordance with the present invention. Therefore, I may heat treat iron or steel articles in a fused salt bath which contains even large amounts of a cyanide or other cyanogen compound and so long as the bath is maintained under an atmosphere of non-oxidizing gas, the iron or steel articles treated therein will be substantially neither carburized nor decarburized. By this means I am able to rapidly and effectively heat treat iron or steel sheet or similar thin iron or steel articles without substantially altering the carbon content thereof. Hence by means of my process, I am able to heat treat steel sheet more rapidly than heretofore and thereby obtain a superior product with no loss of stock.

I am aware that it has been proposed heretofore to cover the surface of fused salt case hardening baths with a floating layer of charcoal or graphite, which to some extent prevents contact of the air with the surface of the bath. However, I have found that such protective layers do not prevent cyanide baths from carburizing iron or steel, nor do they prevent decarburization of steel when used on non-carburizing salt baths. Further, such floating layers mix with the fused salt to form a viscous scum which sticks to the work taken from the bath and is difficult to remove therefrom. This is especially disadvantageous in the treatment of thin articles such as steel sheet. Also, it has been proposed heretofore to operate case hardening baths on the surface of which combustible materials, e. g. hydrogen or carbonaceous substances, are permitted to burn. Such operations are not contemplated in my invention, since the products of combustion (water, carbon oxides) are harmful in contact with my treating baths and also such layer of burning material does not effectively prevent diffusion of air into the bath.

In order to attain the objects of my invention it is also necessary to avoid the presence of solid oxidizing materials in the salt bath, for example, strongly oxidizing salts such as nitrates, chromates, and the like. In general I prefer to avoid the introduction of any oxygen- or sulfur-containing salts into the fused salt bath in any proportions which will be likely to cause oxidation effects. However, alkali metal carbonates may be used as the bath constituents. Accordingly, I prefer to use only alkali metal and alkaline earth metal halides, carbonates, and cyanides as the principal bath constituents.

While alkaline earth metal salts, e. g., the halides of barium, strontium and calcium also may be used in my fused baths and may be desirable for some operations, in general, I prefer to omit them. One disadvantage of the alkaline earth metal salts is that they react with any alkali metal carbonate in the bath to form carbonates having a low degree of solubility, causing precipitation if present in large amounts.

Another disadvantage is that the alkaline earth metal salts tend to carburize steel, even under the non-oxidizing gas atmosphere when the bath is first made up, probably because of a reaction such as follows:



The carbon thus formed will tend to carburize iron or steel present when the reaction occurs. However, if the bath is heated at the operating temperature from one to several hours before use, the bath then will reach a state of equilibrium and thereafter substantially will not carburize steel treated therein, so long as the bath is properly protected by the non-oxidizing gas atmosphere, in accordance with my invention. In operating such bath to carry out my herein described non-carburizing heat treating method, I prefer to add a small amount of cyanide at the conclusion of each day's operation and the next day to heat the bath for at least one hour under the non-oxidizing atmosphere before resuming the heat treating operations.

In the preferred embodiments of my invention, the fused baths will contain one or more of the alkali metal chlorides and carbonates, and I may add thereto a cyanogen compound, for example 0.5-40% by weight of sodium cyanide. The invention is not restricted to any particular proportion of cyanogen compound, so long as the bath is substantially fluid at the operating temperature. For example, I may employ a bath of substantially pure sodium cyanide or other fusible cyanide with satisfactory results. Likewise, I may omit the cyanogen compound, although generally I prefer to have cyanide or other cyanogen compound in the bath. Specific examples of preferred fused bath compositions for practicing my invention are as follows.

Bath No. 1

Sodium cyanide: 15-30% by weight.
Remainder, sodium carbonate.

Bath No. 2

Sodium cyanide: 2-20% by weight.
Remainder, equal parts of sodium carbonate and potassium carbonate.

Bath No. 3

Sodium cyanide: 2-20% by weight.
Remainder, the mixture:

	Per cent by weight
Barium chloride.....	50
Potassium chloride.....	30
Sodium chloride.....	20

Bath No. 4

Same as Bath No. 3, but 0.05 to 0.5% by weight of solid hydrocyanic acid polymer in place of the sodium cyanide.

Various other fused baths may be made for practicing my invention, which contain one or more of the following salts: alkali metal halides and carbonates, alkali metal cyanides and alkaline earth metal halides. Such baths may be made with or without the cyanides or other cyanogen compounds. The methods of mixing and fusing the salts, as well as the proportions used to obtain baths having melting points adapted for the desired operating temperatures, will be known to those experienced in the use of fused salt baths for heat treating metals and need not be described here.

Various oxygen-free gases may be used to maintain a non-oxidizing atmosphere above the surface of the bath, for example, hydrogen, nitrogen, gaseous hydrocarbons; the rare gases such as argon, krypton, and helium; or ammonia. I prefer to use hydrogen, nitrogen, or mixtures thereof, since these gases can be readily obtained in a substantially oxygen-free condition and are not unduly expensive. Ammonia is probably the least desirable of the above mentioned gases because of its tendency to nitride the iron or steel articles when the articles are withdrawn from the bath, which is sometimes disadvantageous. However, unless the ammonia comes into direct contact with the work or is introduced into the bath, it has substantially no nitriding effect in my process. Neither carbon dioxide nor carbon monoxide are suitable for use as a non-oxidizing atmosphere in carrying out my process. Although carbon monoxide ordinarily is considered a non-oxidizing gas, for the purpose of the present invention it must be considered as substantially an oxidizing material because it reacts at the bath temperature to form carbon dioxide, and should not be present in the non-oxidizing gas to any material extent. It is also preferable to use substantially dry gases, since an excessive amount of water vapor will have an undesirable oxidizing effect. I may use either a pure gas or various mixtures of non-oxidizing gases in practicing my invention.

The efficacy of my process is shown by comparative experiments, in which steel samples were treated in a cyanide bath in contact with air and in contact with a non-oxidizing gas. Samples of cold rolled steel bars $\frac{1}{4}$ inch square were heated for 30 minutes in a fused bath of substantially pure sodium cyanide (analysis, 97.2% NaCN) at a temperature of about 800° C. In the first run, the cyanide was melted in an air-tight vessel under an atmosphere of nitrogen of 99.8% purity and the bath was maintained under the nitrogen atmosphere while the steel bars were treated therein. In the second run, the cyanide bath was exposed to the air while the steel was being treated therein. The treated samples were water quenched, sectioned, polished, etched with the standard "Nital" etching fluid (mixture of 5% nitric acid in alcohol) and examined to determine the extent of case hardening. The samples thus treated in the cyanide bath exposed to the air exhibited a definite case, clearly visible to the unaided eye. The case depth in these samples, measured under the microscope at 100 diameters, was found to be about 0.005 inch. On the other hand, the samples treated under the nitrogen atmosphere had no case visible to the unaided eye. Under the microscope at 100 diameters magnification, these samples showed a very slight case, too small to be accurately measured under the microscope at 100 diameters, definitely less than 0.001 inch.

Methods for maintaining the atmosphere of non-oxidizing gas over the heat treating baths will be obvious to those who are acquainted with the art of heat treating metals and need not be described in detail in this specification. For example, in heat treating metals it is common practice to use a muffle furnace filled with non-oxidizing gas such as hydrocarbon gas or hydrogen and by constantly passing gas into the furnace so that it flows out through the aperture through which the articles to be treated are inserted or removed, the entrance of air into the furnace is prevented. I may apply the same method of

operation to maintain a non-oxidizing atmosphere over the salt bath in practicing my invention. For example, the fused bath is maintained in a suitable vessel similar to those now in use but which is covered with a suitable tightly fitting cover or hood provided with a suitable inlet for the non-oxidizing gas to be used. One or more openings are provided in the cover for the introduction and removal of work to be treated, such opening or openings being as small as can be conveniently arranged. So long as these openings are open for the passage of work, the non-oxidizing gas is fed into the cover of the vessel, so that a continuous stream of non-oxidizing gas issues from those openings, thus preventing the entrance of air. If desired, such openings may be closed tightly during the heat treating operation.

During idle periods, so long as the heat treating bath is in a fused condition, I prefer to maintain the non-oxidizing atmosphere over the bath surface, in order to prevent absorption of oxygen or other oxidizing gases in the bath. When a fused salt bath is freshly made up or if it has for any reason absorbed oxygen or other oxidizing gas, it may be placed in a non-oxidizing condition by maintaining it in a fused condition for several hours, e. g., one or more hours, while passing the non-oxidizing gas over or through the melt. Alternatively I may also deoxidize such bath by introducing a cyanogen compound such as alkali metal cyanide or other suitable reducing agent.

As an example of a specific mode of practicing my invention, I may heat treat a sheet steel strip by continuously passing the strip through a fused salt bath at such rate that the desired time of heating at the temperature of the fused salt is attained. To accomplish this in accordance with my invention, the fused bath is maintained in a vessel which is closed by a tightly fitting cover having narrow slots arranged at opposite sides, which slots are just large enough for the steel sheet strip to pass through. Rollers may be situated adjacent to these slots, preferably on the outside of the cover, to facilitate the movement of the sheet. One or more rollers or other suitable guiding devices are also arranged within the heat treating vessel in order to guide the sheet below the surface of the fused salt bath and thence upward and out through the exit slot. A stream of a suitable non-oxidizing gas, such as hydrogen or nitrogen, is fed beneath the cover of the vessel at a rate sufficient to prevent entrance or diffusion of air through the openings through which the sheet is passing. Preferably, the distance between the surface of the fused bath and the point at which the treated sheet emerges into the open air is so arranged that the sheet will be cooled to a temperature below which the steel becomes stained by oxidation in air, e. g., 100-200° C. or lower, before the sheet emerges into the air. I have found that the fused salt which adheres to the work leaving the bath rapidly solidifies to form a brittle layer of solidified salt, which tends to crack with every movement of the sheet. If the sheet is brought from the bath directly into the open air, the metal is rapidly oxidized wherever the cracks in the salt layer appear. By maintaining the sheet in the non-oxidizing gas atmosphere until the sheet has been cooled to a temperature below that at which rapid oxidation occurs, I can effectually prevent the undesirable spotty oxidation of the sheet. The adhering solidified salt layer can

readily be removed from the cooled sheet by known means, for example, by mechanical removal or by washing with water. In the above described continuous treatment of steel strip, the fused bath may be, for example, one of the four specific baths described above, e. g. "Bath No. 1," which consists of a mixture of sodium carbonate and sodium cyanide. The bath temperature may be maintained at a temperature between the melting point of the bath and 900° C. or even higher, as desired, the temperature utilized depending upon the nature of the steel and the effect desired. The steel strip may be passed through the bath at a rate adapted to maintain the sheet in contact with the bath for a period of time from a few seconds to several minutes, depending upon the thickness of the sheet and the degree of recrystallization desired. The resulting product has substantially the same carbon content as the untreated sheet.

The continuous method of heat treating sheet steel strips described in the foregoing paragraph may be better understood by reference to the accompanying drawing showing a vertical sectional view of one form of an apparatus which may be used to practice the method. In the drawing 1 is a heat treating vessel containing a fused salt bath 2. The upper portion of the side walls of vessel 1 are flanged outwardly so as to form flange 3. Vessel 1 is provided with a cover 4 and the lower portions of the side walls of cover 4 are flanged outwardly so as to form flange 5. Cover 4 is secured to the top of the heat treating vessel 1 by means of flanges 3 and 5 which are secured together by means of bolts 6 so as to form a relatively gas tight fit between the vessel and the cover. Cover 4 is provided with a horizontally extending cooler section 7 and non-oxidizing gas is delivered under cover 4 by way of conduit 8 which is provided with valve 10. Non-oxidizing gas may escape from cover 4 by way of conduit 9 which is provided with valve 11.

Metal strip to be treated passes into the apparatus by way of slot 12 and out of the apparatus by way of slot 13. Slots 12 and 13 should be large enough to permit passage of the metal strip therethrough, but not large enough to permit entrance of any substantial amount of air into the apparatus by way of these slots. If desired, each side of the metal strip as it enters or emerges from the apparatus may be scraped by resilient contacting members (not shown in the drawing) secured to the adjacent walls of the cover in order to insure against entrance of any substantial amount of air into the apparatus by way of slots 12 and 13. However, the introduction of non-oxidizing gas into the cover in such amounts and at such a rate that streams of the gas are caused to escape from the apparatus by way of slots 12 and 13 generally provides adequate assurance against the entry of air into the apparatus.

The passage of the metal strip 14 through the apparatus is facilitated by means of rollers 15, 16, 17, 18, 19 and 20. Elements 21 represent wipers which serve to remove excess fused salt composition which may adhere to the steel strip as it emerges from bath 2. However, such wipers are not necessary, since excess adhering fused salt composition may be easily removed from the treated metal strip mechanically or by washing after the strip has emerged from the apparatus. It will be noted that the cooler section 7 is shown as being connected to cover 4 by a flange connection 22. Attachment of the cooler to the

cover may be made in any other convenient manner. The length of cooler 7 will depend upon the amount of cooling required to reduce the temperature of the steel strip to about 200° C. or lower, e. g., to a temperature below that at which steel becomes rapidly stained by oxidation in air. If necessary, cooler 7 may be cooled externally, e. g. by means of cold air or cold water. It should be noted that by adjusting the rate of flow of non-oxidizing gas through conduits 8 and 9 by means of valves 10 and 11, respectively, it will be possible to prevent any substantial entrance of air into the apparatus. Thus by introducing gas into the cover by way of conduit 8 at a greater rate than that at which gas is removed by way of conduit 9, a portion of the non-oxidizing gas will be forced out of the apparatus by way of slots 12 and 13 so that the flow of gas through slots 12 and 13 or any other opening in the apparatus will be from the inside out rather than in the reverse direction. Cover 4 will normally be provided with door or gate arrangements, or the like, not shown in the drawing, for facilitating the introduction of salt composition into vessel 1 and for other obvious purposes. Various modifications of the apparatus illustrated in the drawing may be used.

In addition to non-carburizing heat treating operations, my invention may be practiced to effectively control the case hardening activity of case hardening baths in which cyanide or other cyanogen compound is used as the case hardening ingredient. That is, by varying the proportion of oxidizing gas in the atmosphere above the case hardening bath, the case hardening activity of the bath may be varied accordingly. For example, a cyanide case hardening bath may be operated under an atmosphere of nitrogen or other non-oxidizing gas and a suitable proportion of oxygen or other oxidizing gas may be mixed with the nitrogen. To decrease the activity of the bath, the atmosphere above the bath may for example consist of a nitrogen-oxygen mixture containing an oxygen concentration below that of the air, e. g., 1-5% by volume of oxygen. To increase the activity of the bath, the covering atmosphere may, for example, consist of air to which oxygen has been added. This method of control is generally applicable to case hardening baths containing cyanogen compounds and is not restricted to baths activated with cyanide.

Although I have described my invention as primarily adapted for the heat treatment of iron and steel articles and more particularly for the treatment of steel sheet, my process is also suitable for heat treating articles of other metals, for example, copper and its alloys such as brass or bronze; nickel and its alloys; and various other metals and alloys. The non-oxidizing character of my improved heat treating process is a distinct advantage in treating such readily oxidized materials as copper, brass, and the like. By my process such readily oxidized metals may be heat treated with substantially no surface oxidation, thereby eliminating after-treatments to remove scale or color.

My invention is not restricted to any particular temperature of heat treatment but is generally applicable to the various heat treating temperatures commonly utilized for fused salt bath metal heat treating operations, e. g., 450-900° C.

I claim:

1. A process for heat treating a metal article which comprises immersing said article in a substantially non-oxidizing fused salt bath contain-

ing a cyanogen compound while maintaining a substantially oxygen-free atmosphere of a non-oxidizing gas above the surface of said bath.

2. A process for heat treating a metal article which comprises immersing said article in a substantially non-oxidizing fused salt bath containing a cyanogen compound while maintaining a substantially oxygen-free atmosphere of a non-oxidizing gas above the surface of said bath, and thereafter removing said article from said bath into said oxygen-free atmosphere and cooling said article in said atmosphere.

3. A process for heat treating ferrous metal articles which comprises immersing said articles in a substantially non-oxidizing fused salt bath preponderantly composed of at least one salt selected from the alkali metal and alkaline earth metal halides, alkali metal carbonates and cyanides, which bath contains a cyanogen compound, while maintaining a substantially oxygen-free atmosphere of a non-oxidizing gas above the surface of said bath.

4. A process for heat treating ferrous metal articles which comprises immersing said articles in a substantially non-oxidizing fused salt bath preponderantly composed of at least one salt selected from the alkali metal and alkaline earth metal halides, alkali metal carbonates and cyanides, which bath contains a cyanogen compound, while maintaining a substantially oxygen-free atmosphere of a non-oxidizing gas above the surface of said bath, and thereafter removing said articles from said bath into said oxygen-free atmosphere and cooling said articles in said atmosphere.

5. A process for heat treating ferrous metal articles which comprises immersing said articles in a substantially non-oxidizing fused salt bath containing a cyanogen compound, while maintaining a substantially oxygen-free atmosphere of a non-oxidizing gas above the surface of said bath.

6. A process for heat treating ferrous metal articles which comprises immersing said articles in a substantially non-oxidizing fused salt bath containing an alkali metal cyanide, while maintaining a substantially oxygen-free atmosphere of a non-oxidizing gas above the surface of said bath.

7. A process for heat treating ferrous metal articles which comprises immersing said articles in a substantially non-oxidizing fused salt bath preponderantly composed of at least one salt selected from the alkali metal and alkaline earth metal halides, alkali metal carbonates and cyanides, containing about 0.5 to 40% by weight of at least one of said cyanides, while maintaining a substantially oxygen-free atmosphere of a non-oxidizing gas above the surface of said bath.

8. A process for heat treating steel articles which comprises immersing said articles in a

substantially non-oxidizing fused salt bath preponderantly composed of at least one salt selected from the alkali metal and alkaline earth metal halides, alkali metal carbonates and cyanides, which contains an alkali metal cyanide, while maintaining a substantially oxygen-free atmosphere of a non-oxidizing gas above the surface of said bath.

9. A process for heat treating steel articles which comprises immersing said articles in a substantially non-oxidizing fused salt bath preponderantly composed of at least one salt selected from the alkali metal and alkaline earth metal halides, alkali metal carbonates and cyanides, containing about 0.5 to 40% by weight of sodium cyanide, while maintaining a substantially oxygen-free atmosphere of nitrogen above the surface of said bath.

10. A process for heat treating steel sheet which comprises immersing said sheet in a substantially non-oxidizing fused salt bath containing a cyanogen compound, while maintaining a substantially oxygen-free atmosphere of a non-oxidizing gas above the surface of said bath.

11. A process for heat treating steel sheet which comprises immersing said sheet in a substantially non-oxidizing fused salt bath preponderantly composed of at least one salt selected from the alkali metal and alkaline earth metal halides, alkali metal carbonates and cyanides, containing about 0.5 to 40% by weight of an alkali metal cyanide, while maintaining a substantially oxygen-free atmosphere of nitrogen above the surface of said bath.

12. A process for heat treating steel sheet which comprises immersing said sheet in a substantially non-oxidizing fused salt bath preponderantly composed of at least one salt selected from the alkali metal and alkaline earth metal halides, alkali metal carbonates and cyanides, containing about 0.5 to 40% by weight of an alkali metal cyanide, while maintaining a substantially oxygen-free atmosphere of hydrogen above the surface of said bath.

13. The process for heat treating sheet steel strip which comprises continuously passing said strip through a substantially non-oxidizing fused salt bath containing an alkali metal cyanide, while maintaining an atmosphere of substantially non-oxidizing gas over the surface of said bath.

14. The process for heat treating sheet steel strip which comprises continuously passing said strip through a substantially non-oxidizing fused salt bath containing an alkali metal cyanide, while maintaining an atmosphere of substantially non-oxidizing gas over the surface of said bath and maintaining the portion of said strip emerging from the bath in said non-oxidizing gas until the strip has cooled to a temperature below about 200° C.

DONALD A. HOLT.

CERTIFICATE OF CORRECTION.

Patent No. 2,231,009.

February 11, 1941.

DONALD A. HOLT.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, first column, line 23, claim 4, for the word "meal" read --metal--; line 36, claim 5, for "hea ttreating" read --heat treating--; same page, second column, line 12, claim 9, for "sailt" read --salt--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 25th day of March, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.