June 23, 1936. J. C. KIENTZ, JR 2,045,392

ANNEALING STEEL AND THE LIKE

Original Filed Feb. 20, 1934

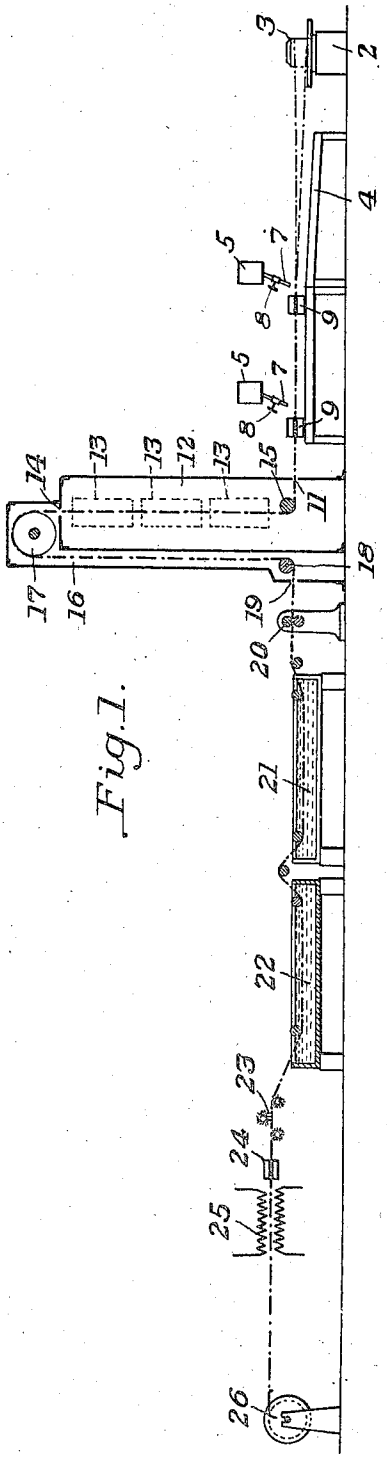


Fig. 1.

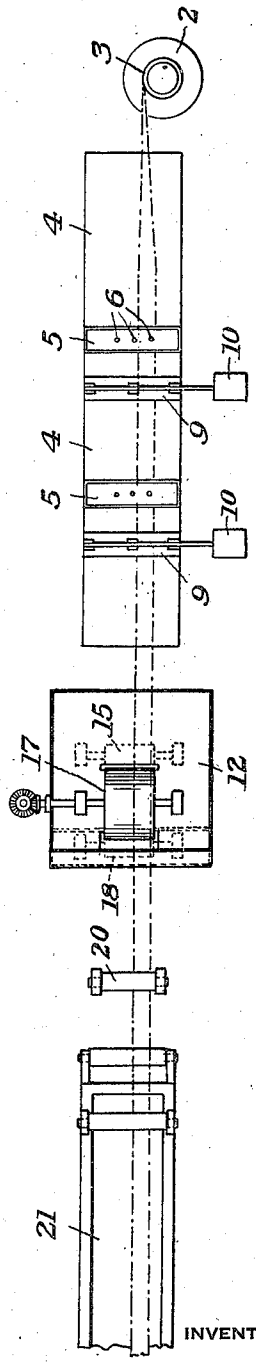


Fig. 2.

INVENTOR

Joseph C. Kientz Jr.

by Kell, Elmer & Lincoln

his Attorneys

Patented June 23, 1936 2,045,392

UNITED STATES PATENT OFFICE

2,045,392

ANNEALING STEEL AND THE LIKE

Joseph C. Kientz, Jr., Carnegie, Pa., assignor to Superior Steel Corporation, Pittsburgh, Pa., a corporation of Virginia

Original application February 20, 1934, Serial No. 712,184. Divided and this application February 13, 1936, Serial No. 63,789

7 Claims. (Cl. 148—14)

This invention relates to annealing steel and the like, and more particularly to improved annealing processes. It relates still more particularly to the application to material being annealed of a substance controlling oxidation during annealing. In certain of its more specific aspects the invention relates to the annealing of chromium containing corrosion resistant ferrous metals, and especially the control of the oxide formed thereon during annealing.

This application is a division of my copending application, Serial No. 712,184, filed February 20, 1934.

More or less difficulty has always been encountered in annealing steel and like materials on account of the tendency toward oxidation during annealing. Various attempts have been made to prevent or control oxidation during annealing such as by introducing into the annealing chamber a non-oxidizing or reducing gas, sealing up the material to be annealed with charcoal, etc. The problem is particularly difficult in continuous annealing processes for sheets and strip and also in the annealing of chromium containing corrosion resistant ferrous metals.

Purely for the purpose of explanation, the continuous annealing of stainless steel strip may be considered by way of example. Considerable difficulty has been experienced in annealing stainless steel strip due to the formation on the strip during annealing of a fairly heavy blue or black oxide which is difficult or impossible of removal by pickling without damage to the surface of the metal itself. Strong pickling acids are necessary to remove this dark oxide, these acids resulting in pitting of the surface of the strip, requiring subsequent polishing or buffing to produce the desired commercial finish. The additional buffing step is undesirable in that it takes additional time and adds to the cost of production. Furthermore, the strong pickling acids are expensive and undesirable for other reasons. Also, pickling in a strong acid followed by buffing results in loss of metal.

It has heretofore been proposed to anneal stainless steel strip by passing the same through an annealing chamber containing hydrogen. However, this proved highly unsatisfactory due to the expense of the installation, the cost of the hydrogen, and especially the danger of explosion. Furthermore, the results obtained were not highly satisfactory. Various other methods of annealing stainless steel strip and other metals subject to oxidation during annealing have been attempted, but no completely satisfactory method has heretofore been discovered.

My annealing methods obviate all of the various disadvantages above pointed out, making it possible to anneal steel and the like, and particularly chromium containing corrosion resistant ferrous metals, at extremely low cost and with apparatus of the utmost simplicity. I can anneal stainless steel, for example, without the formation of the heavy dark oxide which is so difficult to remove, as I can control the oxidation so as to produce a light coating of an oxide which is easily removable by pickling and which usually has a brownish color. This oxide is highly desired and has heretofore been considered difficult or impossible to produce by any economical method. The brownish oxide which is usually formed on stainless steel in my annealing process is readily removable by comparatively weak pickling acids which do not damage the surface of the metal, making the added step of polishing or buffing unnecessary. For example, the oxide produced on stainless steel strip by my method of annealing may ordinarily be removed in an electric pickle by a weak solution of nitric acid without any pitting of the surface of the metal. The brownish oxide may vary in shade from a light tan to a dark brown or may have a reddish color, or may at times border on a gray, depending on the conditions and the material being annealed; the word "brownish" as used herein is accordingly to be interpreted as a word of broad definition and not of limitation.

I apply to the material being annealed a volatilizable liquid which volatilizes at temperatures materially above room temperature and assists in controlling oxidation. I prefer to use a volatilizable hydrocarbon or carbonaceous oil, such, for example, as kerosene, although other of the related hydrocarbons are also effective. I prefer to apply the volatilizable substance before the material is introduced into the annealing chamber so that it will volatilize in the annealing chamber. I believe that the volatilized substance serves in the nature of a protective blanket or coating over or about the material, reducing or controlling oxidation. In the case of chromium containing corrosion resistant ferrous metals the use of a volatilizable hydrocarbon in this manner results in the formation of the highly desired light coating of oxide having a brownish color and which is easily removable by pickling. My process is especially well adapted for continuous annealing as the protective substance may be applied by a suitable applicator posi-

tioned in or adjacent the path of the material as it moves to the annealing chamber. The material is preferably cooled below rapid oxidizing temperature before it is discharged into the outside atmosphere.

Other details, objects and advantages of the invention will become apparent as the following description of a present preferred embodiment thereof proceeds.

In the accompanying drawing I have shown a present preferred embodiment of the invention, in which

Figure 1 is a longitudinal elevational view, partly in vertical cross section, showing an annealing and treating apparatus; and

Figure 2 is a plan view to enlarged scale of a portion of the apparatus shown in Figure 1.

I shall describe by way of example, a continuous process of annealing stainless steel strip, although the invention is not limited either to the annealing of stainless steel or to the continuous annealing of strip, although it has particular advantages in the annealing of stainless steel. There is provided a support 2 for a reel 3 of strip from which the strip is adapted to be drawn through the apparatus. The strip fed from the reel 3 passes above a table 4 above which is or are mounted one or more receptacles 5 for the volatilizable protective substance which, for example, may be considered as kerosene. Each of the receptacles 5 has in its bottom one or more holes 6 each communicating with a discharge nozzle 7 controlled by a valve 8. The discharge nozzles 7 are appropriately distributed across the width of the table 4 and are adapted to discharge the kerosene onto the strip as it moves therebelow. The table and accompanying apparatus may be of sufficient width to accommodate two or more strips which may pass through side by side, the discharge nozzles 7 being arranged to supply kerosene to all of the strips. The valves 8 will ordinarily be adjusted so that the kerosene flows onto the strip in a very fine stream or in drops. The strip preferably passes through one or more wipers 9 comprising upper and lower pads which distribute the kerosene over one or both surfaces of the strip and remove any excess. The upper pad of each wiper is preferably pressed down against the lower pad by a weight 10 which may be adjusted to vary the pressure as desired.

The strip then passes through a narrow slot 11 into an annealing chamber 12 heated in any appropriate manner, as by electric resistance elements indicated diagrammatically at 13. The annealing chamber 12 has at its top a narrow slot 14 through which the strip passes, a roller 15 being provided within the annealing chamber to guide and change the direction of the strip. Upon passing through the slot 14 the strip enters a cooling chamber 16 and passes about a roller 17 and downwardly through the cooling chamber and about another roller 18 and out of the cooling chamber through a narrow slot 19. The annealing chamber and cooling chamber are substantially isolated from the outside atmosphere, the slots 11 and 19 preferably being only wide enough to permit free passage of the strip therethrough. If desired asbestos flaps or other devices may be used to substantially seal the slots while permitting the strip to pass through them. The slot 14 may be of the same size as the slots 11 and 19 or may be somewhat larger to permit part of the vapors from the annealing chamber to pass into the cooling chamber.

The kerosene applied through the nozzles 7 and spread by the wipers 9 is volatilized due to the heat in the annealing chamber and forms within such chamber a non-oxidizing atmosphere which reduces and controls oxidation. The vapors produced by volatilization of the kerosene are believed to form a protective blanket or coating over or about the strip, resulting, in the case of chromium containing corrosion resistant ferrous metals, in the production of the highly desirable light coating of oxide having a brownish color and which is easily removable by pickling referred to above. The strip is preferably cooled in the cooling chamber 16 below rapid oxidizing temperature so as to prevent undesirable oxidation upon discharge of the strip from the cooling chamber into the outside atmosphere.

The annealed and cooled strip passes between a pair of pinch rolls 20 and, by means of guide rollers clearly shown in the drawing, through a pickling bath 21, such, for example, as an electric pickle, and a wash bath 22 from which it may pass to a brusher 23, a wiper 24 and an electric dryer 25, being wound up on a reel 26 rotated by any suitable source of power (not shown). The tension on the reel 26 may be sufficient to pull the strip through the entire apparatus, or the pinch rolls 20 may be driven to assist in advancing the strip.

If the slots 11 and 19 are maintained substantially closed during operation the atmosphere within the annealing and cooling chambers will, as above described, become non-oxidizing or reducing. The character of the atmosphere within the annealing and cooling chambers may be controlled by the amount of air admitted and a substantially neutral atmosphere may be maintained by careful operation. Such an atmosphere may be desirable under certain conditions. On occasion it may be desirable to have the atmosphere within the annealing and cooling chambers slightly oxidizing, as when annealing 18—8 metal. This may be done simply by admitting a little more air into the annealing and cooling chambers. A slightly oxidizing atmosphere is desirable when annealing 18—8 metal, as it is found that this results in formation of a light coating of oxide which is easily removable by pickling.

The expression "steel or the like" as used herein is intended to comprehend steel and other ferrous metals and metals containing iron having the characteristics of ferrous metals. Such expression is used for purposes of broad definition and not of limitation and is to be so construed.

While I have shown and described a present preferred embodiment of the invention, it is to be distinctly understood that the same is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims.

I claim:

1. A method of annealing chromium containing corrosion resistant ferrous metal comprising applying directly to the surface of the metal a coating of hydrocarbon which volatilizes upon the application of heat thereto and subjecting the thus treated metal to an annealing temperature in an annealing chamber, and thereby forming in intimate contact with the surface of the metal in the annealing chamber upon volatilization of the hydrocarbon a protective medium resulting in

formation on the surface of the metal of a light coating of an oxide easily removable by pickling.

2. A method of annealing chromium containing corrosion resistant ferrous metal comprising applying directly to the surface of the metal a coating of kerosene and subjecting the thus treated metal to an annealing temperature in an annealing chamber, and thereby forming in intimate contact with the surface of the metal in the annealing chamber a protective medium resulting in formation on the surface of the metal of a light coating of an oxide easily removable by pickling.

3. A method of annealing chromium containing corrosion resistant ferrous metal comprising applying directly to the surface of the metal a coating of hydrocarbon which volatilizes upon the application of heat thereto, subjecting the thus treated metal to an annealing temperature in an annealing chamber, and cooling the same below rapid oxidizing temperature before discharge to the outside atmosphere, whereby to form in intimate contact with the surface of the metal in the annealing chamber upon volatilization of the hydrocarbon a protective medium resulting in formation on the surface of the metal of a light coating of an oxide easily removable by pickling.

4. A method of continuously annealing chromium containing corrosion resistant ferrous metal comprising continuously passing the same through an annealing chamber, applying directly to the surface of the metal a coating of hydrocarbon which volatilizes upon the application of heat thereto, and subjecting the thus treated metal to an annealing temperature in the annealing chamber, and thereby forming in intimate contact with the surface of the metal in the annealing chamber upon volatilization of the hydrocarbon a protective medium resulting in formation on the surface of the metal of a light coating of an oxide easily removable by pickling.

5. A method of continuously annealing chromium containing corrosion resistant ferrous metal comprising continuously passing the same through an annealing chamber, applying directly to the surface of the metal prior to its entry into the annealing chamber a coating of hydrocarbon which volatilizes upon the application of heat thereto, and subjecting the thus treated metal to an annealing temperature in the annealing chamber, and thereby forming in intimate contact with the surface of the metal in the annealing chamber upon volatization of the hydrocarbon a protective medium resulting in formation on the surface of the metal of a light coating of an oxide easily removable by pickling.

6. A method of continuously annealing chromium containing corrosion resistant ferrous metal comprising continuously passing the same through an annealing chamber, applying directly to the surface of the metal prior to its entry into the annealing chamber a coating of kerosene, and subjecting the thus treated metal to an annealing temperature in the annealing chamber, and thereby forming in intimate contact with the surface of the metal in the annealing chamber a protective medium resulting in formation on the surface of the metal of a light coating of an oxide easily removable by pickling.

7. A method of continuously annealing chromium containing corrosion resistant ferrous metal comprising continuously passing the same through an annealing chamber, wiping onto the surface of the metal upon entry thereof into the annealing chamber a coating of hydrocarbon which volatilizes upon the application of heat thereto, and subjecting the thus treated metal to an annealing temperature in the annealing chamber, and thereby forming in intimate contact with the surface of the metal in the annealing chamber upon volatilization of the hydrocarbon a protective medium resulting in formation on the surface of the metal of a light coating of an oxide easily removable by pickling.

JOSEPH C. KIENTZ, JR.