Aug. 8, 1933. L. L. LEWIS 1,921,934

ART OF ANNEALING

Original Filed Dec. 2, 1929

FIG. 1.

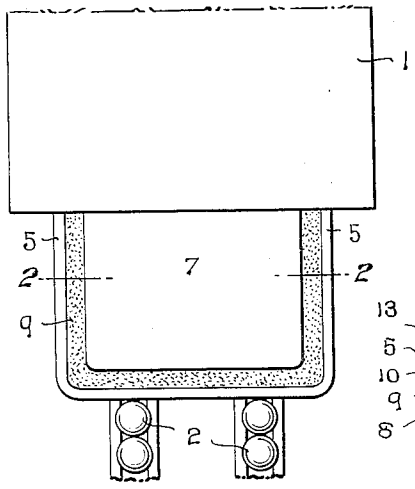


FIG. 2.

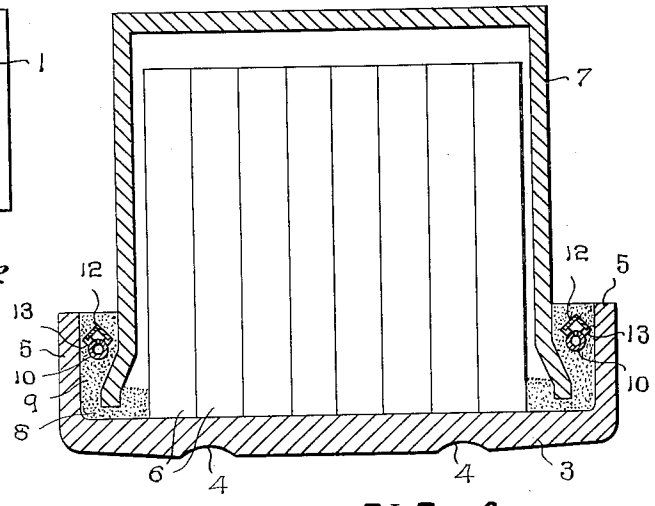


FIG. 3.

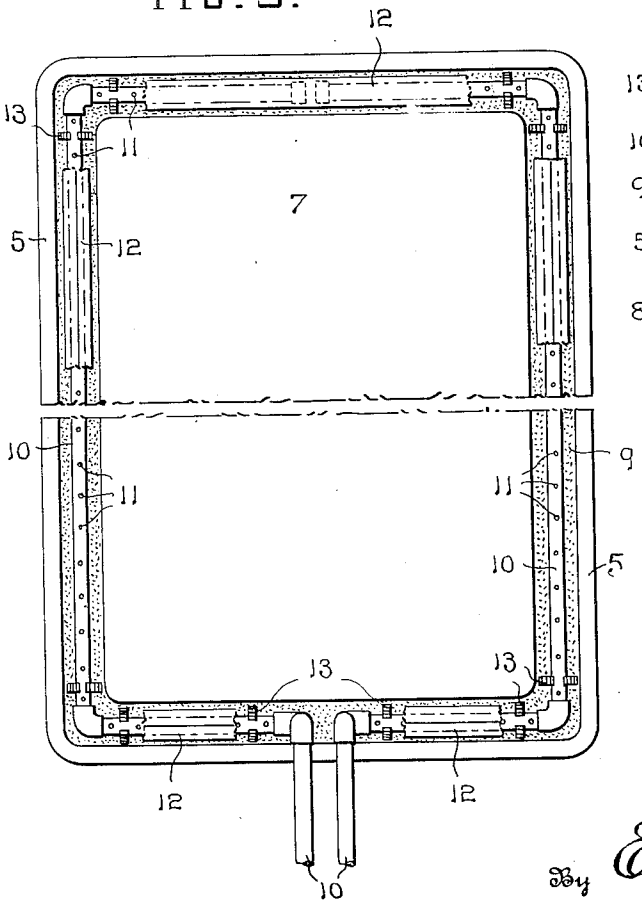


FIG. 4.

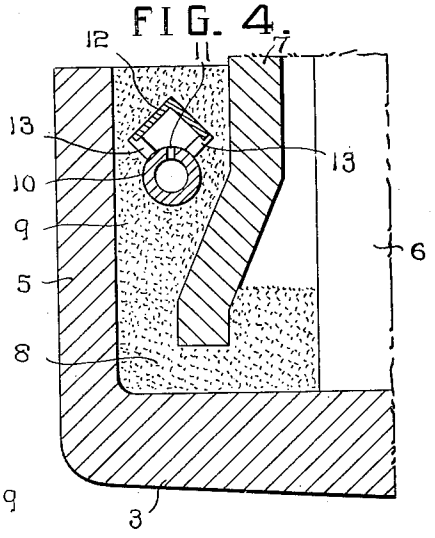
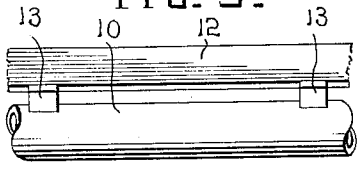


FIG. 5.



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UNITED STATES PATENT OFFICE

1,921,934

ART OF ANNEALING

Lester L. Lewis, New Castle, Pa., assignor of two-thirds to Blair Strip Steel Company, New Castle, Pa., a Corporation of Pennsylvania

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10 Claims. (Cl. 143—1)

This invention relates to improvements in the art of heat treating metal for largely eliminating discoloration and increasing ductility, and has as its essential object the material improvement of the product as compared with that secured by standard practice.

Under standard practice, it is customary to enclose work to be annealed in a housing commonly referred to as an annealing pot and to introduce the pot into a furnace where it with the enclosed work is raised to the requisite temperature and maintained at such temperature for the necessary period of time for effecting annealing, both the temperature and time varying according to the character, individual bulk of the work, and other controlling factors. After the heating operation, the pot is immediately withdrawn from the furnace and allowed to stand in the open air for a sufficient time for cooling before the work is removed. It is known to be desirable to avoid access of air to the work during cooling, and, to this end, it is standard practice to provide a seal of comminuted material, such as iron filings, located along the line of jointure between separable parts of the annealing housing, and, after the housing and its contained work have been removed from the furnace, it has heretofore been proposed to restrict access of air to the work while cooling by introducing a neutral gas into the housing under pressure sufficient to penetrate the seal from the interior and to work out through the seal against oncoming air pressure. Such proposed method has not been successful in avoiding oxygen discoloration and carbon deposits which practically invariably occur as an expected result, and which show that some air and possibly other discoloration agents have found access to the interior of the annealing housing in sufficient quantity to enable combustion to release carbon from the natural gas. In such proposed method of introducing gas under pressure to the interior of the pot during cooling, it has been the practice to insert tubes through the comminuted seal, and while I am not fully informed as to all the detrimental action occurring incident to disturbing the seal, I have observed in addition to the carbon deposits and oxygen discoloration of the work a substantial limit to the degree to which the work will draw, that is, its ductility is limited. The ductility is greater and the discoloration less when the neutral gas under pressure is introduced and caused to percolate outward through the comminuted seal during the cooling operation than when no gas is used, and I conclude, therefore, that the provision for internal pressure acting outwardly aids in excluding air from access to the cooling work but does not completely succeed, and a certain amount of air and other discoloration agents find their way into the housing despite such pressure of the gas from within.

In carrying out the present invention superior results are obtained, and a ductility of the work is secured far exceeding that heretofore known, due to the character of the treatment which includes avoiding disturbance of the seal of the annealing housing, and at the same time effectively precluding entrance of air or other discoloration agents to the housing without introduction of gas directly into the housing.

Among the various objects in view, some of which will be hereinafter pointed out and others become apparent, is the very material increase in ductility of the metal work annealed; a substantial decrease in the cost of production, and a marked improvement in the surface appearance and condition of the treated work.

With these and other objects in view, the invention comprises the art of annealing metal work while practically wholly precluding access of discoloration-producing agents to the interior of the work-containing housing during cooling of the work after the annealing thereof, and involves certain novel steps and combinations of steps as will hereinafter be set forth and subsequently pointed out in the appended claims.

As the art or process will best and most readily be understood by a specific illustration, the same will be described with reference to the operation of a physical structure with the understanding that such structure is only an illustrative embodiment to which the art is not limited, and, to that end, reference is had to the accompanying drawing in which,—

Figure 1 is a fragmentary plan view of a furnace and work-containing housing of the type to which the present invention appertains.

Figure 2 is a transverse section of the housing detached and taken on the plane indicated by line 2—2 of Figure 1, the parts being seen on an enlarged scale.

Figure 3 is a top plan view of the parts seen in Figure 2, parts of the cover angle for the gas pipe being broken away.

Figure 4 is an enlarged, detailed, fragmentary section similar to a part of Figure 2.

Figure 5 is a further enlarged, detailed, fragmentary elevation of the gas pipe and cover angle detached.

Referring to the drawing by numerals, 1 indi-

cates any well known or standard type of annealing furnace having the usual ball or roller tracks 2 for facilitating movement of a tray 3 thereon into and out of the furnace 1. The tray 3 is of standard construction well known in the industry, and is preferably provided with guiding grooves 4, 4, for receiving the balls or like rollers 2 so as to direct movements of the tray 3 and allow the tray to be moved readily into and out of the furnace. The tray 3 is formed with upstanding flanges 5 bordering the complete margin of the tray so as to provide a relatively deep receptacle. It is standard practice to place work, such as indicated at 6, 6, on the tray 3 which forms part of the housing for the work, and to complete the housing by covering the work with a hood 7 which is commonly referred to in shop parlance as a "pot". The pot 7 and tray 3 are ordinarily heavy castings and it is standard practice to place a bed or seal 8 of comminuted material, such as iron filings or sand, on the upper surface of tray 3 all about the work 6 before the pot 7 is lowered into the space surrounded by the flange 5, and the margins at the open under face of the pot 7 rest in and cause the sand to be compact and to provide a seal against access of air to the work 6. It is also common practice, after the pot 7 has been lowered over the work to enclose the same and to rest on the sand bed 8 to further guard against ingress of air by packing sand at 9 all about the lower portion of the pot 7 outward to the flange 5 until the space between the pot and flange is completely filled and effectively tamped.

According to the present invention, however, I do not completely fill the said space but prefer to leave about one-third of the space unfilled; that is to say, with a tray 3 having a flange 5 of ten inches in width I would recommend filling the space within flange 5 and about the pot 7 for a height of about six inches, although some variation in the height is, of course, allowable, and the fill may vary from five inches to seven inches, more or less. At all events, there should be left room enough below the plane of the upper edge of the flange 5 to accommodate the parts to be inserted therein as now to be described. But for the fact of failure to completely fill the space between pot 7 and flange 5 and the fact that no tube is inserted through the seal 8, so that the seal 8 remains undisturbed, the parts are introduced into the furance 1 as in standard practice, and the work 6 is subjected to the annealing temperature as required according to the work being treated. For low carbon steel rolled strips, a temperature of from 1400° to 1600° F. may be maintained for about sixteen hours. Naturally, the temperature and time will vary according to the bulk of material to be annealed, and it is not my object to suggest any variation from the standard practice so far as time and temperature of treatment are concerned. My first departure from standard practice consists in omitting the tube customarily supplied to introduce gas under pressure to the interior of the housing made up of pot 7 and tray 3. Such a tube is commonly inserted through the sand seal before the housing is introduced into the furnace 1, and gas under pressure is connected to the tube and discharged therethrough as soon as the housing is withdrawn from the furnace for cooling. The gas used in such standard practice invariably contains moisture, and while it has been proposed and attempted to eliminate the moisture by heating the gas and passing it through a carbon bed for absorbing the moisture, I am unaware of any instance where all of the moisture has been successfully eliminated, and, therefore, the gas which is thus introduced in standard practice into the housing carries with it certain elements destined to injuriously affect the work 6. It is true, of course, that before the use of the introduced gas the results were much poorer than obtained by the use of the gas, and it has been popularly supposed and is probably true that the supply of gas under pressure within the housing largely protects the work 6 against ingress of air through the sand seal during the cooling operation, both because of the presence of the gas under pressure and because the pressure on the gas is great enough to cause it to penetrate the sand and act as a reagent against the ingress of air. But notwithstanding the superior results of the standard practice of the use of natural gas or like gas under pressure in the housing as compared with results previously obtained without the gas, the results secured by the use of the gas are far from perfect and leave much to be desired both because of surface discoloration, carbon absorption, and relatively low degree of ductility resulting in the work when so treated.

According to the present invention, no gas is introduced directly into the housing, and the sand seal 9 is maintained undisturbed. After the housing has been subjected to the correct temperature for the proper period of time within furnace 1, it is moved out along the track 2 and allowed to stand the necessary time for cooling down. However, according to the present invention, as quickly as practicable after the withdrawal of the housing from the furnace 1, a gas coil is located in the space surrounded by the flange 5 outside of pot 7 and gas similar to that above described is delivered through openings in the gas coil. The coil may consist of one or more layers of pipe and may and preferably will be covered with sand. As seen in the accompanying drawing, the gas coil preferably consists of a pipe 10 which, for facility of assemblage and removal, is divided up into two sections, one occupying one-half and the other the other half of the space about pot 7 below the upper margin of flange 5. Pipe 10 is provided with jet openings 11 in sufficient number to insure a uniform distribution of gas about the part 7. An angle plate baffle 12 is preferably arranged above pipe 10 and spaced therefrom, as by supporting lugs 13, 13, resting on pipe 10 and fixed to angle plate 12. The angle plate 12 serves as a baffle and the jets 11 cause the gas to be projected within the angle of the plate 12 and to be spread by the plate toward both sides of the space in which the parts appear. Thus, the discharging gas envelopes the entire area surrounding pot 7 and enclosed by flange 5 beneath the upper edge of said flange. I prefer to place loose sand on top of the baffle or angle 12 and to fill the space above said angle to the level of the flange 5. A sufficient amount of sand should be introduced above baffle 12 to insure against being blown out by gas pressure, and to aid in the distribution of the gas across the space between the pot 7 and the flange 5 so as to resist air pressure tending to cause seepage of air toward the interior of the pot. The pipe or coil 10 is located in proper position, as described, as quickly after the removal of the work-containing housing from the furnace 1 as practicable, and the gas is turned

on so as to provide a gas seal supplementing the sand seal 8. Of course, the high temperature of the surrounding parts will cause ignition of the gas, but that does not prevent the action of the gas in supplementing and protecting the seal. Furthermore, the pressure caused by the gas, whether ignited or not, is generally upward and is sufficient to counteract or prevent the tendency of air to seek access through the seal 8, and, therefore, the cooling of the work 6 progresses to completion without the presence of air or of carbon-forming substances within the housing, except such as may be present from the lubricant used in rolling, and it is preferable, when best results are to be secured, to employ as the rolling lubricant a non-carbonaceous fluid. However, as the treatment of metal, and particularly iron and steel, when rolled by a non-carbonaceous vehicle as a lubricant, is the subject of a separate invention which I have produced and on which I propose to file a patent application, and since effective results may be secured by the present invention notwithstanding the presence of a small amount of carbonaceous rolling vehicle on the work, further consideration of the treatment of the work prior to its introduction into the annealing housing is not here required. It may be noted, however, that carbon spots are always likely to occur on the surface of any work annealed after having been rolled with the aid of the usual oil or like carbonaceous vehicle, unless the surface of the work is wiped or otherwise effectively cleansed before the work is subjected to annealing.

It should be understood, of course, that the present improved art is effectively available in the treatment of any metal requiring annealing, but is especially effective with rolled iron and steel, and I have observed a very marked difference and superiority in the annealed product when treated according to this invention as distinguished from the standard practice, which superiority includes superior surface conditions and appearance and a very substantial increase in ductility.

The time for cooling, of course, will vary with different conditions and bulk of work and size of the pot, and I have observed that work which has been in the furnace from sixteen to twenty hours in a relatively small pot, say five-ton capacity, will ordinarily require from twenty-four to forty hours for cooling, and the gas should be maintained under pressure and supplied to the pipes 10 constantly until the cooling operation has been completed, and the operator is ready to lift the pot 7. The degree of pressure for the gas will be substantially the same as that heretofore employed for introduction of gas to the interior of the pot 7 and should sufficiently exceed an atmosphere to provide effective discharge of the gas for the supplementing sealing action above indicated. It should be observed also that while a single pipe line 10 is shown, a plurality of such pipes superimposed may be employed as additional precaution for preventing access of air through seal 8.

It is, of course, well known that during cooling of the work, the tendency to form a vacuum within the pot creates a suction, or, in other words, creates an unbalanced condition relative to atmospheric pressure. It is my theory that the present invention effectively precludes access of air by the reactive force of the discharging gas; and it is entirely possible, even probable, that portions of the gas discharged from pipe 10 find their way through the comminuted seal into the pot, but it is not my intention according to the present invention to directly introduce the gas to the interior of the pot. It should be obvious that any fas finding its way into the pot will not injuriously effect the contained work because the intense heat of the comminuted material forming the seal through which the gas must pass, and also the intense heat of contiguous parts of the pot and tray will free the gas from discoloration agents and render it a neutral gas so far as action on the contained work is concerned. In the operation of the apparatus described, when the pot is initially lowered over the work, a certain amount of air and other discoloration agents are liable to be present within the pot, and some of them remain even after the heating operation. During the heating operation, expansion of contained air and moisture causes the elimination of a large proportion of the thus contained discoloration agents by seepage through the comminuted seal even though no other exit is provided, so that, when the pot is removed from the furnace, only a comparatively small amount of discoloration agents remains, and the discoloration resulting therefrom is negligible, manifesting itself usually in the form of blued edges. The balance of the work and frequently a large portion of the edges are absolutely bright and free from discoloration.

While the seal for the housing has been illustrated and described as located at the bottom or lower portion thereof and as being formed of sand, iron filings or like comminuated material, it is well known and common practice to construct annealing housings with the seal at the top or otherwise located, and the present invention is equally applicable to seals so located and also to seals made of other materials than those stated.

The gas commonly employed by me is natural gas, but producer gas is also available, and any other gas may be used which is either neutral or which will become neutral from the action of the heat to which it will be subjected as it passes into and through the comminuted seal.

This application is a division of my co-pending application filed December 2nd, 1929, Serial No. 411,179, and covering improvements in annealing apparatus, since patented October 7, 1930, Patent No. 1,777,978.

What is claimed is:—

1. In the art of annealing metal work, heat treating the work in a container sealed against entrance of discoloring agents to the work, cooling the work in the container in air, and treating the seal during the cooling operation with a gaseous agent to preserve the container against entrance of discoloring agents.

2. In the art of annealing metal work, heat treating the metal work in a container, cooling the container and work in air, initially sealing the container against entrance of discoloring agents, and supplementally sealing the initial seal with a gaseous agent.

3. In the art of annealing metal work, heat treating the metal work in a container, cooling the container and work, initially sealing the container against entrance of discoloring agents, supplying fluid to the initial seal as a supplemental seal, and discharging the sealing fluid within the material of the initial seal.

4. In the art of annealing metal work, heat treating the metal work in a container, cooling

the container and work in air, initially sealing with comminuted material the container against entrance of discoloring agents, and supplementally sealing the initial seal with a gaseous agent

5. In the art of annealing metal work, heat treating the work in a container sealed against entrance of discoloring agents to the work, cooling the work in the container, supplementing the seal at or prior to the beginning of the cooling of the work, and supplying to within the body of the seal a fluid sealing agent during cooling of the work.

6. In the art of annealing, sealing work in a housing, raising the work to an annealing temperature for the requisite time for annealing, exposing the housing to cooling in air and thus cooling the work, and supplying gas to the seal at an exterior portion thereof sufficiently for guarding the seal against ingress from the atmosphere.

7. In the art of annealing metal work, enclosing work in a housing having spaced parts, locating a seal sealing said spaced part, raising the housing and work to the requisite temperature for the requisite time for annealing, cooling the housing and work, and discharging gas into the space between the parts of the housing adjacent the seal during such cooling.

8. In the art of heat treating metal in an enclosure, the steps of cooling heat treated metal in such enclosure, and jetting gas across air intake approaches to the interior of the enclosure during the cooling action.

9. In the art of heat treating metal in an enclosure, the steps of cooling heat treated metal in such enclosure, guarding the enclosure by a comminuted seal, and jetting gas within the seal across air intake approaches to the interior of the enclosure.

10. In the art of heat treating metal in an enclosure, the steps of cooling heat treated metal in such enclosure, guarding the enclosure by a comminuted seal, and jetting gas within the body of the seal and deflecting the gas within the seal across air intake approaches to the interior of the enclosure.

LESTER L. LEWIS.