

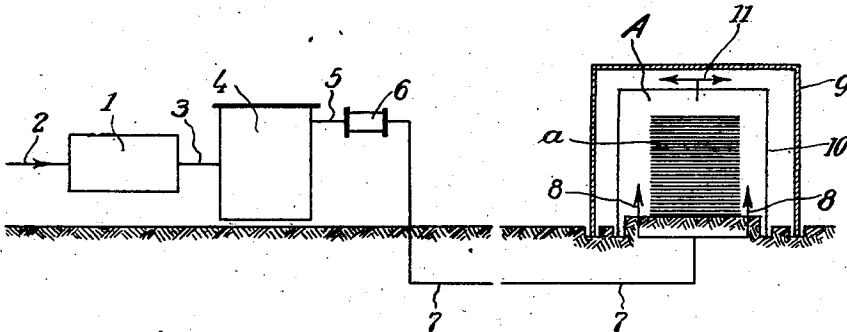
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METHOD OF ANNEALING IRON SHEETS OR STRIPS

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METHOD OF ANNEALING IRON SHEETS
OR STRIPS

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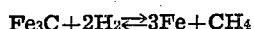
3 Claims. (Cl. 148—16)

When iron sheets are hot-tinned, for example, for the purpose of improving their quality, it often occurs that some parts are rough or do not take the tin. Investigations have shown that the rough parts are caused by alloying of iron and tin, whereas not tinned parts are due to non-adherence of the tin.

The applicant has found that both faults have the same cause. Generally, they occur if the iron sheets, after normal annealing, pickling, and straightening, are annealed once more in the range of recrystallisation. The faults are caused by carbon deposits produced by gases discharged in annealing the iron sheets. It is known that in box annealing the iron sheets give off gases, containing principally carbonic acid, carbon monoxide, and hydrogen.

The gas compositions at the various annealing temperatures have been found to be as follows:

The greatest quantity of gas is developed between 250° and 400° C; at the lowest temperatures the gas composition consists of CO₂ and O₂, at about 150° the development of H₂ commences, and at about 250° the hydrocarbons are liberated. In the present case, only the hydrocarbons, such as methane (CH₄), ethylene (C₂H₄) and acetylene (C₂H₂), are of importance. These hydrocarbons are generated by the reaction of the hydrogen, absorbed in pickling, with the hydrocarbon compound of the iron. The action in the case of methane may be imagined according to Schenck (Körber and Ploum, "Mitteilungen aus dem K. W. I.", 14, Lfg. 16, p. 232) to be as follows:



The equilibria are at 1 atmosphere pressure at approximately 300° C. entirely on the right side, and only at 900° to 1000° C. the equilibrium is shifted to the left side. The hydrocarbons thus generated are rapidly decomposed with rising temperatures disengaging carbon (Gmehlin, "Eisen A", p. 1355). In this decomposition the iron acts highly catalytically. Whether the carbon disengaged in this way is absorbed by the iron or whether it is deposited on the surface of the iron depends upon the rapidity of the diffusion and the adsorption. If the rapidity of the diffusion is exceeded by that of the adsorption, a rapid decomposition is connected with the deposition of carbon on the surface (Gmehlin, "Eisen A", p. 1356). It is known that in the decomposition of hydrocarbons the rapidity of the adsorption exceeds that of the diffusion, that is, if the conditions are favourable for the de-

composition of the hydrocarbons, carbon will always be separated.

The carbon deposits are not distributed uniformly over the entire surface of the material annealed. I have found that certain parts of the surface are preferred in the deposition of carbon. In normal annealing of iron sheets it occurs that mill scale particles are reduced to metallic iron, and that in pickling, the parts of the iron sheet not covered with scale are roughened still more. These parts, for example reduced iron and roughened parts, especially the former, are favourable for the deposition of carbon.

If these carbon deposits are too dense to be removed by pickling, some parts of the surface will not take the tin in the tinning process. In the case of less dense carbon deposits, which merely retard the pickling action and prevent the underlying reduced iron zones from being entirely removed, it is found that, when the iron sheet is put into the tinning hearth, these reduced iron parts on the surface of the iron sheet, owing to their large active surface, will very rapidly be dissolved in the tin and will form an iron-tin alloy. This iron-tin alloy has a higher melting point than the tin itself and adheres, owing to its smaller viscosity, to the surface of the iron sheet, producing the mentioned rough parts.

In both cases the carbon deposit is the secondary cause.

These disadvantages are obviated by the method according to the invention.

A device for practising the method is shown diagrammatically, by way of example, in the accompanying drawing.

In the drawing, 1 is a combustion retort in which a gas, for example coal-gas, is burnt, entering through a pipe 2. The exhaust gases are conducted through a pipe 3 into a device 4, in which the generated CO₂ is washed out and the remaining nitrogen is purified. This gas is conducted through a pipe 5 to an apparatus 6, suitable to regulate the amount of O₂ contained in the nitrogen. Finally, the nitrogen is conducted through a pipe 7 to the annealing box A which it enters, for example via the pipes 8. The annealing box A consists, in the example illustrated, of the annealing hood 9 and the protective hood 10. The washing gas passes through the pipe indicated at 11 from below the protective hood 10 to the space between the protective hood 10 and the annealing hood 9. The gases are then discharged from this space in

any desired way. At a the material to be annealed, for example a pile of iron sheets, is indicated.

According to the invention, as shown, the inert scavenging or washing gas, which consists of nitrogen and only a small adjustable percentage of oxygen (0.5 to 0%), is passed through the annealing box A while annealing, in order to prevent the separation of carbon. In accordance with the ascertainment that the greatest quantity of gas is developed in the temperature range of 250° to 400° C., the material to be annealed is kept at this temperature for a certain time for the purpose of complete degasification, at the same time washing the annealing box with the mentioned washing gas containing about 0.5% of oxygen. This is done in order to vary the equilibrium by the oxygen contents in such a way that no carbon can be separated and in order to discharge the new reaction gases. After the iron sheets have been degasified, the temperature is raised to the proper annealing temperature (about 600° C.), at the same time removing the oxygen contents of the washing gas as far as possible.

Hitherto, only reducing gases served as protective gases. It is a new idea to intentionally use within certain temperature ranges an indifferent washing gas with a small percentage of oxygen, that is a slightly oxidizing atmosphere.

While the reaction gases are discharged, the washing gas prevents the hydrocarbons from decomposing and in addition an excessive oxida-

tion is avoided at the higher annealing temperatures (500° to 600° C.).

For a particularly effective execution of the process it is advantageous to take the following precautions:

(1) Reduce absorption of hydrogen and too much pickling of parts of the iron sheet by using an economical pickling substance.

(2) The absorbed hydrogen is removed by rinsing in hot water of a temperature of 80° to 100° C.

(3) In normal annealing, the furnace atmosphere must be regulated so that any scale present or formed will not be reduced.

What I claim is:

1. A method of annealing iron sheets and the like, more particularly before applying a coating of another metal, for example tin, in a closed annealing chamber, comprising heating the sheets to a temperature of from 250° C. to 400° C. in the presence of a substantially inert scavenging gas containing about 0.5% oxygen, maintaining the temperature until the sheets have been completely degasified in order to prevent carbon separation and finally increasing the temperature to about 600° C. for annealing the sheets.

2. A method as claimed in claim 1, wherein the scavenging gas contains 0.5% oxygen.

3. A method as claimed in claim 1 wherein the scavenging gas contains 0.5% oxygen and further comprising the step of decreasing the oxygen content while increasing the temperature to 600° C.

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