Patented Apr. 7, 1931 1,799,945

UNITED STATES PATENT OFFICE

WALTER BECK, OF FRANKFORT-ON-THE-MAIN, GERMANY, ASSIGNOR TO DEUTSCHE GOLD & SILBER SCHEIDEANSTALT VORMALS ROESSLER, OF FRANKFORT-ON-THE-MAIN, GERMANY, A CORPORATION

PROCESS FOR HEAT TREATMENT OF METAL ARTICLES

No Drawing. Application filed May 19, 1928, Serial No. 279,197, and in Germany May 20, 1927.

The invention relates to the heat treatment of metals such as iron, steel, copper, silver, nickel, brass, German silver and the like and articles made thereof.

If metals or their alloys of the described kind have been worked upon, for instance by rolling, pressing, beating, hammering, boring or the like, a certain hardness and brittleness is produced in the metallic structure which makes it extremely difficult or even impossible, to subject the said article, for instance a copper sheet, to the same treatment again, or, in the case of finished steel tools, to utilize them.

Wherever I use the expression "metal" in this specification and the appended claims I wish to include metal alloys. In order to eliminate the above mentioned hardness and brittleness thus making it possible to continue working upon or utilizing the metal articles, they must be subjected to a heat treatment. Hitherto this heat treatment comprised heating the articles either in a neutral gas atmosphere or embedded in coal such as wood charcoal or iron filings or the immersion in a molten salt bath, or the application of vacuum furnaces or the like. Generally the articles were heated in muffle furnaces or salt baths and subsequently cooled either by quenching or by allowing them to cool slowly according to the result aimed at. The temperatures to which the metal articles had to be heated and the length of time, during which they had to be kept at that temperature depended primarily upon the kind of metal.

This procedure has the great disadvantage that the non-precious metals or the non-precious metallic components of the alloys oxidize first with formation of a layer of oxide in spite of precautions taken. The formation of oxide goes often very far indeed. The scale thus produced on the surface makes it extremely difficult or impossible to further work upon the articles for instance by rolling, pressing or the like. In nearly all the cases it is therefore necessary to subject the articles before they are again worked upon to an intermediary treatment in order to remove the scale. This treatment consists for instance in pickling the metal articles with acids. This pickling entails losses of acid as well as of metal, besides requiring time and labour and is especially troublesome, if the thermal treatment has to be repeated several times. In such cases the loss of metal may be very heavy and may amount to as much as 25 percent of the original weight.

In the case of finished tools which have to be annealed in order to take away any brittleness caused by the immersion in the hot bath and to give them a tough core and a glass-like surface hardness, the oxidation of the outer layer damages the quality of the finished article in two respects, namely, the formation of the oxide has the consequence of at the same time softening the surface, carbon being burnt away and the steel becoming lower in carbon content, whilst the metal oxide formed on the surface prevents the subsequent quenching having its full effect.

According to my invention the thermal treatment is carried out in baths of fused salt in the presence of oxidizable substances. Such oxidizable substances are for instance finely divided carbon, such as wood or any other vegetable charcoal, animal charcoal and the like or salts of hydrocyanic acid such as sodium cyanide, potassium cyanide or such materials or compounds as are capable of being converted to carbon or salts of HCN under the prevailing conditions. Materials of this kind are for example carbonizable substances such as sawdust cellulose scraps and the like.

For the preparation of the fused salt bath such salts or compounds or mixtures thereof are taken as do not give disadvantageous reactions with the oxidizable substances added. Salts or compounds suitable for this purpose are for instance common salt, potassium chloride, soda carbonate and the like or a mixture of two or more of them. It is advantageous to select the components of the fused bath with a view of obtaining at the working temperature as thin a melt as is possible, in order to remove only very little of the fused melt when lifting out the immersed articles after treatment. Of a thin

melt the greater part will run off whilst very little only adheres. In order to obtain as thin a melt as possible, the salts or compounds are combined in the well known way, for instance by using salt mixtures with different metallic components such as sodium and potassium, or different acid components such as carbonates and chlorides or, also a mixture of both. Thus, a mixture of potassium chloride and sodium chloride may be used, or a mixture of soda carbonate and sodium chloride or of soda carbonate and potassium chloride. The addition of alkaline compounds, such as soda carbonate, especially of sodium or potassium hydroxide, has proved very useful since their presence facilitates the reducing action of the oxidizable substances.

The quantities of oxidizable substances to be added may vary within very wide limits. In some cases, the addition of one percent or even less of finely divided charcoal is sufficient to obtain the result desired whilst of other oxidizable substances such as sodium cyanide slightly greater amounts such as one to three percent or even more are required. With metals like copper, nickel, silver and their alloys an excess of the oxidizable substance will not cause any harm, whilst with articles of iron, steel or the like an excess of the charcoal or the cyanide has to be avoided in order to prevent an undesired carburizing, since this cementation will take place chiefly at the sharp edges and corners will produce brittleness.

The temperatures to be applied with the bath according to my invention depend on the nature of the metals treated in so far as they must be sufficiently high to allow of the re-arrangement of the crystal structure formed during the working and causing the hardness. It is possible to exceed these temperatures to some extent as this will shorten the duration of the heating. Too high a temperature however has to be avoided as the articles may loose their shape.

Metal articles when immersed in a fused bath composed according to my invention and taken out after sufficient heating, the heating being carried on at about 500° C., leave the melt with a perfectly bright and clean surface. The thin coating of the fused melt, moreover, prevents any oxidation taking place while the article in question is cooling down or is transferred to a quenching bath of brine, oil or the like. This refers also to the sharp corners, edges and points of finished steel tools, which otherwise are especially liable to oxidation. They therefore need not be protected as was hitherto the case by layers of clay or the like previously applied, which layers had to be removed afterwards for instance by means of a sand blast. When treated according to my invention, the tools are immediately ready for use on leaving the quenching bath which means a considerable saving of time and expenditure whilst articles of copper, nickel or the like and their alloys do not suffer any loss but may be worked upon without any further treatment for the removal of scale or oxides.

The substances preventing the oxidation according to my invention may be added to the salt bath mixture either from the start, or they may be charged gradually and in small quantities into the hot melt. Any amounts used up during the process may be replaced by adding fresh quantities. Care has to be taken that the melt does not run too short of the oxidizable substances. As the charcoal does not readily mix with the hot melt and as there is a danger of the charcoal catching fire when lying on the top of the bath, it is advisable to previously prepare a mixture of the charcoal with some one or more ingredients of the bath by stirring the finely ground oxidizable substance into a small quantity of the fused salt or the salts. This mixture may be charged into the heated bath without any risk, the charcoal being distributed uniformly throughout the melt.

What I claim is:—

1. In the process for heat treatment of metal articles the step which consists in heating the said articles in a bath of fused salts in the presence of finely divided charcoal at temperatures low enough to prevent any chemical reaction between the metal articles and the constituents of the bath.

2. In the process for heat treatment of metal articles the step which consists in heating the said articles in a bath of fused salts in the presence of finely divided carbon at temperatures below about 500° C.

3. In the process of heat treatment of metal articles the step which consists in immersing said articles in a bath of fused salts in the presence of finely divided carbon and alkaline substances, at temperatures low enough to prevent any chemical reaction between the metal articles and the constituents of the bath.

4. In the process of heat treatment of metal articles the step which consists in immersing said articles in a bath of fused salts in the presence of oxidizable matter and sodium hydroxide at temperatures below about 500° C.

5. A salt bath for the heat treatment of metal articles comprising finely divided charcoal and alkali metal hydroxide.

6. A salt bath for the heat treatment of metal articles comprising finely divided charcoal and sodium hydroxide.

Signed at Frankfort-on-the-Main, Germany, this 4th day of May, A. D. 1928.

WALTER BECK.