

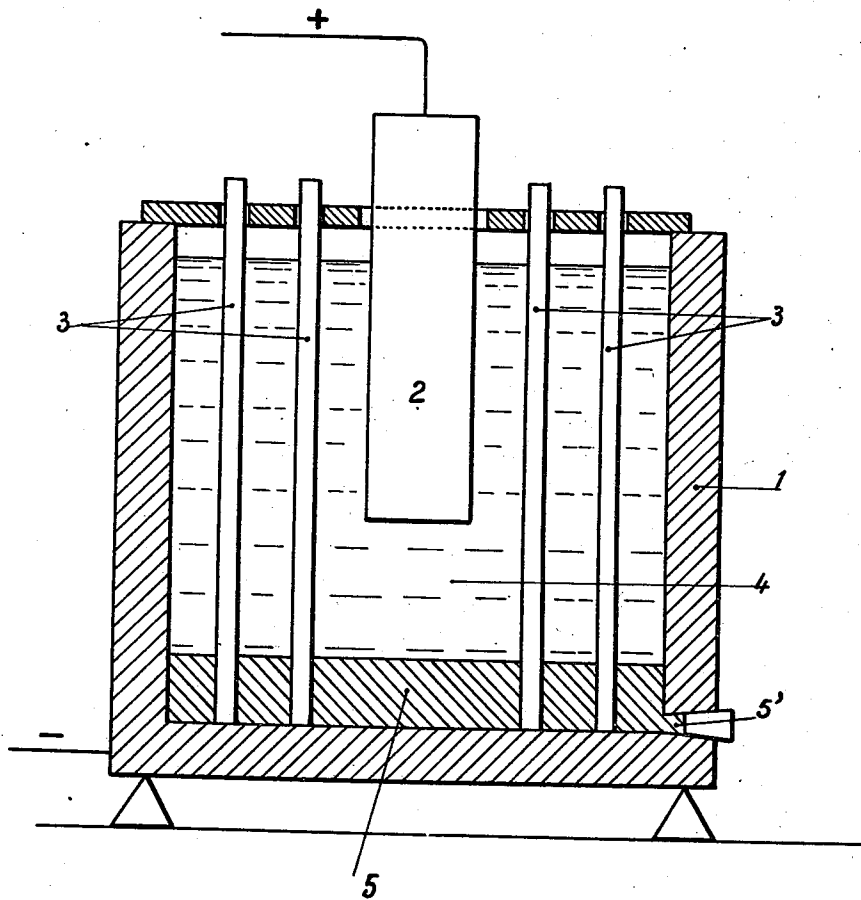
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PROCESS FOR THE MANUFACTURE OF ALLOYS CONTAINING BORON

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PROCESS FOR THE MANUFACTURE OF
ALLOYS CONTAINING BORON

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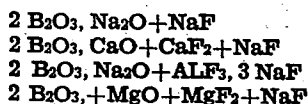
3 Claims. (Cl. 204—19)

The present invention relates to the manufacture of alloys containing boron. It constitutes an improvement in the French Patent No. 638,345 of 1st December 1926 and of the two additions
5 No. 34,495 of 1st October 1927, and No. 37,559 of 17th June 1929.

It consists essentially in producing the alloys in question directly by electrolyzing by means of metallic cathodes, a bath constituted, as in the
10 case of the parent patent and the additions above mentioned, by boric anhydride or borates in the fused state with the addition in most cases of halogen salts of alkalies or alkaline earths (for example fluorides), the operating being conducted at a temperature slightly above the melting
15 point of the eutectic having a composition in a neighbourhood of that of the alloy which it is desired to obtain.

The notable result is that the metal or the alloy into which it is proposed to introduce boron can be employed in the solid state as cathode, that the actual alloy is obtained in the fused state at as low a temperature as possible and that it can be collected by casting without interrupting the
20 progress of the operation so that the manufacture of molten boron-alloys is ensured by a continuous process.

The baths employed can have among others the following molecular compositions:



It is advantageous for the good progress of the process to maintain the proportions of the constituents of the electrolytic bath practically constant by additions of boric anhydride or of the other substances decomposed.

The electrolysis is preferably effected in vats of carbon with central anodes likewise of carbon, the vat being connected to the negative pole of the source of current so as to serve as current supplying device.

The boron liberated in the electrolysis becomes fixed on the metallic cathode thus giving an alloy which fuses and flows when its content of boron is in the neighbourhood of that of the eutectic alloy; the composition of the alloy formed is thus to some degree a function of the temperature of electrolysis and it is necessary that this temperature should remain practically constant.

By way of a simple example of the application
55 of the invention there may be mentioned the pro-

duction of nickel-boron alloys. The nickel, the point of fusion of which is 1450°C. , forms with the boron, which fuses at about 2300°C. , several eutectics of which the most fusible contains 12.5% of boron and melts at 990°C.

In utilizing solid nickel as cathode for the electrolysis, at about 1050°C. , of one of the above baths, boron is separated and becomes fixed on the nickel.

The alloy fuses and flows to the bottom of the vat and can be drawn off without interrupting the operation.

Such an alloy obtained at 1050°C. can in addition, during its period of remaining at the bottom of the vat, be enriched up to 16% of boron.

The process gives not only excellent results in the manufacture of the boron-nickel alloys (with 10-16% of boron), but also in that of boron-cobalt alloys which can be obtained under the same conditions and with the same contents of boron. It can be applied with success to the preparation of other alloys of the metals with boron, even when the eutectics of these alloys are formed at more elevated temperatures. Thus, for example, it is possible to prepare the alloys of iron and boron by employing cathodes of iron or cast iron and by effecting the electrolysis at a temperature of about 1300°C.

Being obtained electrolytically these alloys do not contain large quantities of carbon, silicon or of the reducing element as in the case of those prepared by the electro-thermal method.

The process permits likewise of preparing ternary or more complex alloys. For this purpose it is possible to operate in several ways for example:

1. By adding to the electrolysis vat in which the first alloy is formed in the fused state, the metal (copper, zinc, aluminium etc. . .) or the metals which it is proposed to introduce into the final alloy, this addition being capable in some cases of facilitating the casting of the product.

2. By adding to the electrolytic bath suitable quantities of an oxide or of a salt (salt containing oxygen or halogen) of the metal (or metals) to be alloyed with the metal of the cathode and the boron.

Thus for example by adding to the electrolysis baths small quantities of oxide of chromium, tungsten, molybdenum, vanadium, titanium, aluminium or beryllium etc., there are obtained with cathodes of nickel (or cobalt) ternary alloys containing with the nickel (or cobalt) and the

boron small quantities of the metals corresponding to the oxides added.

3. By taking as cathode bars, plates or sheets constituted by the alloy into which it is proposed to introduce the boron.

For example by employing bars of ferro-nickel, ferro-cobalt, nickel-chromium or ferro-nickel-chromium etc., there are obtained respectively alloys of iron-nickel-boron, iron-cobalt-boron, nickel-chromium-boron or iron-nickel-chromium-boron etc., which can contain up to 16% of boron.

One of the best modes of application of the process is characterized by the particular arrangement which it is advantageous to give to the cathode. The metal or the alloy of the cathode is in fact employed in the solid state in the form of sheets, plates, grids or bars which are arranged vertically between the anode and the interior walls of the carbon vat and rest on the bottom of this latter which alone is connected directly to the negative pole of the source of current. When bars are employed these can also be inclined in such a manner that their lower extremities are placed under the central anode.

The accompanying drawing represents diagrammatically a vat for the manufacture of alloys containing boron arranged in accordance with the said characteristic.

In the drawing 1 is the vat, 2 the central anode, 3 the metallic bars, 4 the electrolytic bath and 5 the alloy produced in the fused state, 5' being the casting hole.

In proportion as they are attacked the metallic bars descend under their own weight and remain in contact with the bottom of the vat; in order to maintain them in position the vat is in part covered by a plate pierced with holes or by a grid into which the bars are placed.

The alloy formed at the commencement of the operation collects at the bottom of the vat where it forms a liquid layer. It results from this arrangement that in the course of the operation the cathodic surface is constituted on the one hand by the solid plates or bars and on the other hand by the liquid alloy at the bottom of the vat into which the bars plunge, all devices for suspension and connection of these bars being thus eliminated.

It likewise results therefrom that the active surface of the bars or the plates is constantly renewed, that the alloy formed flows slowly off becoming collected at the surface of the liquid alloy which surface on account of this fact is likewise renewed. This continuous renewal of the entire active cathodic surface favours the forma-

tion of the alloy and the enrichment thereof in boron.

In order to increase the active surface it is preferable to take bars of small diameter and to arrange them in several concentric rows, in quincunx in a circular vat. This arrangement presents the advantage of damping the movements of convection in the cathodic zone and consequently preventing the conveying towards the anode of the free boron; it thus increases the yield and protects the carbon vat of which it reduces the wear.

I claim:

1. A continuous electrolytic process for producing molten alloys containing boron which consists in: immersing the metal to be alloyed in a bath composed of boric anhydride or borates in a fused state; utilizing said metal as a cathode in carrying on the electrolytic process; maintaining the proportions of the constituents of the bath substantially constant; maintaining the temperature of the bath substantially constant and at least at the melting point of the eutectic formed by the metal and the boron, but below the melting point of the metal; and drawing off the molten product thus formed while continuing the electrolytic process.

2. A continuous electrolytic process for producing molten alloys containing boron which comprises: immersing, in a bath containing fused boric anhydride or borates, the lower portion of an elongated cathode containing the metal to be alloyed, arranged to feed by gravity into said bath to compensate for removal of said metal from the cathode; maintaining a supply of the boron compound in said bath; maintaining the bath at a temperature between the melting point of the eutectic formed by the boron and said metal and the melting point of said metal; and drawing off the molten alloy thus formed while continuing the electrolytic process.

3. A continuous electrolytic process for producing molten alloys containing boron, and having a composition approximating a predetermined eutectic, which consists in: immersing the metal to be alloyed in a bath composed of boric anhydride or borates in a fused state; utilizing said metal as a cathode; maintaining a supply of the boron compound in said bath; maintaining the temperature of said bath close to the fusing temperature of said eutectic and not below said fusing temperature; and drawing off the molten product thus formed while continuing the electrolytic process.

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