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SOLID AGENT FOR BORIDING METALS

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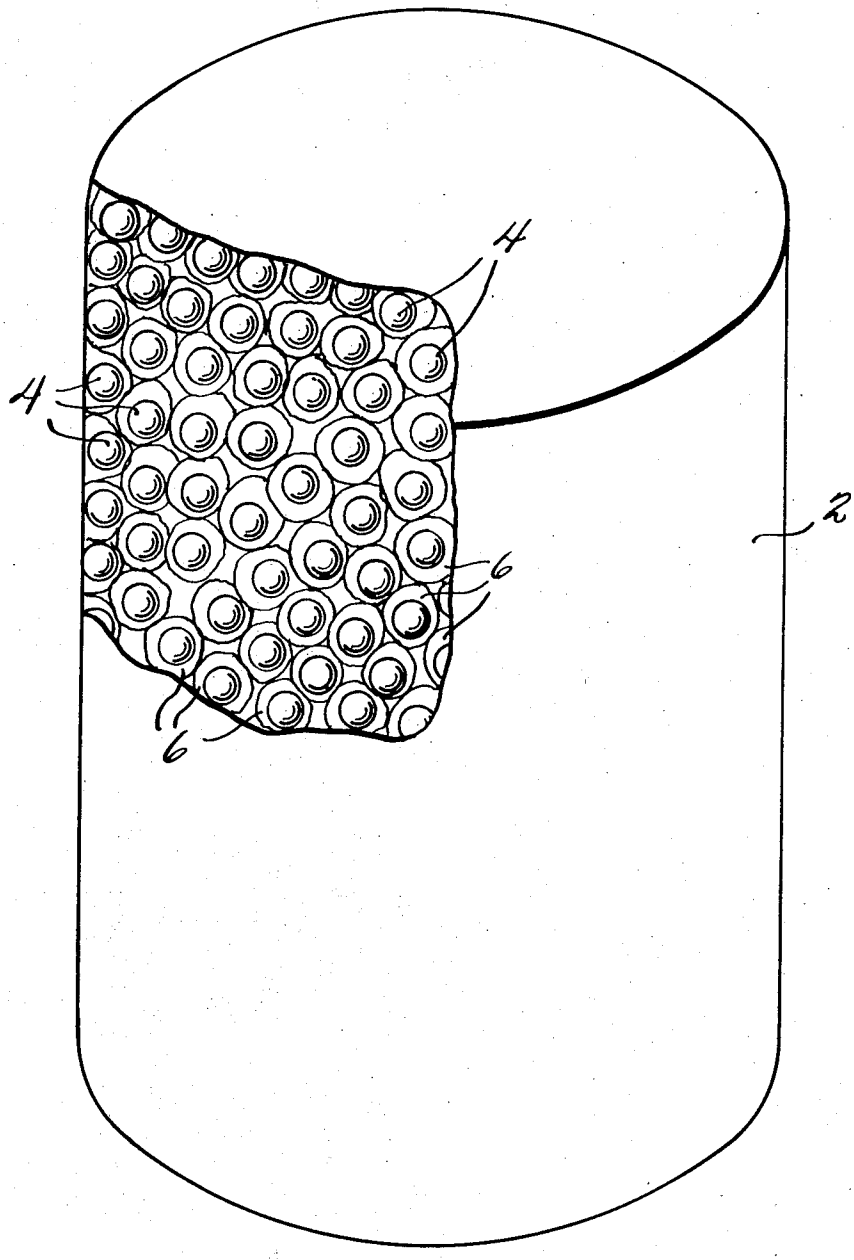

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SOLID AGENT FOR BORIDING METALS

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ABSTRACT OF THE DISCLOSURE

A solid agent for the boriding of metals, especially steel and iron is made by intimately mixing boron yielding compounds and activators and jointly pressing to a granulate.

The boriding of steels which leads to very hard surface layers and therefore continually is finding greater use in the solution of problems of wearing out in prefabricated parts and tools is preferably carried out in a boron yielding powder. This process requires only a small expenditure for apparatus. To carry out the process the component parts are arranged in a box and surrounded with the boron yielding powder. After that the box is pushed into a suitable furnace and treated for several hours at temperatures of the order of 800 to 1100° C. After that the box is taken out of the furnace, cooled off and then emptied.

As boriding powder there are used mixtures which consist of a boron yielding constituent, as for example, amorphous boron, crystalline boron, ferroboron, boron carbide, borax and mixtures of these materials. There can also be present activating additives. Finally there can be added to these boriding powders fillers or diluents. Through the boriding there arise layers which can be formed of the ductile Fe_2B or the more brittle FeB or both. An adjustment in the proportion of FeB to Fe_2B in many cases is desirable. The quality of the boride layer can be so regulated that the boriding powders contain lower or higher concentrations of the boron yielding agent or are variably strongly activated. Also the quality of the steel of the part to be borided has an influence on the composition of the boriding powder, so that also control of the boriding powder composition in view of the choice of steel appears desirable.

The previously used boriding powders, however, have two severe disadvantages in practice.

One of these is that the pulverulent, carbon black like powder mixtures are very disagreeable to handle. Because of their small apparent density it is often difficult to compress the powder sufficiently tight in the boxes. Besides the powder sinters together during the annealing treatment as a result of which it is difficult to take the parts out after the conclusion of the treatment. In many cases therefore there has been a change to let the boxes cool off in air to about 200° C. after the annealing treatment and then to place them in a container filled with hot water in order to soften the strongly sintered powder. The parts are then withdrawn from the black sludge to which the powder has been converted and still need a thorough final purification by intensive washing or brushing. This process has the limitation that the very expensive boriding powder cannot be used again although from the chemical composition a repeated use would be theoretically possible. A further use would assume that the boriding agent, which had become a sludge, would be dried and ground. This cumbersome and expensive process has no relation to the savings in cost which could be attained in this manner.

The second severe disadvantage is the fact that the desired regulation of the boriding action is realized only poorly in practice due to the change of the concentration of the boriding constituent because the suggested mixtures on occasion incline to separate into their components.

These disadvantages are removed according to the invention by intimately mixing the boron providing compounds and activators and jointly pressing them to a granulate. For the production of the boriding powder, for example, the named constituents are first mixed in powdered form and then mixed with a charcoal tar so that a pasty mass is formed which can be pressed or molded. By pressing with the help of a suitable tool there are produced small cylindrical objects which then are annealed at 450° C. As a result all volatile constituents escape and there remains behind a relatively solid framework of free carbon in which are embedded the various constituents of the boriding powder.

The product of the invention eliminates the described disadvantages of the prior art.

On the one hand the product does not tend to sinter together in carrying out the boriding treatment. After carrying out the boriding treatment and cooling off it can be easily discharged from the boxes and is immediately suitable for a further use. Besides the composition, once it is produced by mixing, remains constant even after frequent used and this is true even if the individual granules become mechanically abraded during the multiple use.

As the boron yielding constituent there can be employed any of the conventional materials such as amorphous boron, crystalline boron, ferroboron, boron carbide, boric anhydride and borax or mixtures of these materials in any proportion.

As activating materials there can be used those customary in the art, e.g. ammonium, alkaline metal and alkaline earth metal halides such as ammonium chloride, potassium chloride, sodium chloride, calcium chloride, barium chloride, potassium fluoride, barium fluoride, magnesium fluoride, sodium bromide, sodium fluoride and calcium bromide as well as mixtures thereof.

The composition can also contain the customary diluents such as graphite, silicon carbide, aluminum oxide and other stable compounds. The amount of activating agent is usually between 2 and 15%. The amount of boron containing material is usually at least 10% of the composition and usually 30 to 90 weight percent, preferably 82 weight percent. When a diluent is employed, it is used in an amount of 5 to 88%.

As the binder there can be used in place of charcoal tar other carbonaceous materials such as organic oils. The binder is usually used to provide carbon in an amount of 2 to 40% of the composition. The annealing of the pressed materials to remove volatile materials can take place at 400 to 600° C., preferably 450° C. for 0.5 to 2 hours. The pressing can be done at pressures of 2 to 25 kg./cm.^{2}.

The boriding treatment can take place as is customary at 800 to 1100° C. The boriding treatment is primarily adapted to the boriding of iron and steel but can be used to boride other metals such as nickel and molybdenum.

Unless otherwise indicated all parts and percentages are by weight.

The invention will be understood best in connection with the drawing wherein the single figure shows a granule of the present invention.

Referring more specifically to the drawing there is formed a cylindrical granulate 2 composed of boron carbide composition 4 bound together by a carbon framework 6. The granules usually have a height of 2 to 6 mm. and diameter of 1.5 to 4 mm.

EXAMPLE 1

For boriding there was produced a granular product consisting of 66% boron carbide (B_4C), 16% borax, 10% potassium fluoride and 8% carbon. The granular product was prepared by intimately mixing 66 parts of boron carbide, 16 parts borax, 10 parts potassium fluoride and 40 parts of charcoal tar, pressing into small cylinders (about 4 mm. high and 2.7 mm. diameter at 20 kg./cm.^{2} and then annealing at 450° C. for 1 hour. A sample of steel Ck 15, normalized was borided by treatment for 5 hours at 900° C. with this product. The boriding was carried out 4 times successively with the same product. In the first experiment there was produced a layer thickness of 240 millimicrons while in the fourth experiment this declined to 190 millimicrons.

EXAMPLE 2

The experiment was carried out as in Example 1. However, in each new treatment 15% of fresh boriding agent of the described type was added. As a result in all cases (i.e. the four samples) the thickness of the boriding layer was 230 to 240 millimicrons.

What is claimed is:

1. A solid agent for boriding metals comprising a pressed granulate of intimately mixed boron providing compound and activator.

2. A boriding agent according to claim **1** wherein the boron providing compound is selected from the group consisting of amorphous boron, crystalline boron, ferroboron, boron carbide and borax.

3. A boriding agent according to claim **1** wherein the granulate is annealed to 400 to 600° C.

4. A boriding agent according to claim **3** wherein the granulate is annealed at 450° C.

5. A boriding agent according to claim **1** wherein the activating agent is selected from the group consisting of potassium chloride, sodium chloride, ammonium chloride, calcium chloride, barium fluoride and magnesium fluoride.

6. A boriding agent according to claim **1** wherein the boron containing material is 10 to 90 weight percent of the granulate.

7. A boriding agent according to claim **6** wherein the boron containing material is 82 weight percent of the granulate.

8. A boriding agent according to claim **1** wherein a carbonaceous material is used as a binder.

9. A boriding agent according to claim **8** wherein the binder is charcoal tar.

10. A boriding agent according to claim **8** wherein the carbon content of the granulate is between 2 and 40 weight percent.

11. A boriding agent according to claim **1** wherein the particle size of the boriding product is 0.4 to 12 mm.

12. A boriding agent according to claim **11** wherein the particle size is 2 to 3 mm.

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