UNITED STATES PATENT OFFICE.

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HIGH-RESISTANCE IRON ALLOY.

952,290. Specification of Letters Patent. Patented Mar. 15, 1910.

No Drawing. Application filed January 7, 1908. Serial No. 409,676.

To all whom it may concern:

Be it known that I, WILLIS R. WHITNEY, a citizen of the United States, residing at Schenectady, in the county of Schenectady and State of New York, have invented certain new and useful Improvements in High-Resistance Iron Alloys, of which the following is a specification.

My invention comprises an alloy of iron and boron, which may be termed a boron-steel, possessing electrical properties especially adapting it for use in electrical apparatus, such as transformer plates.

It is well-known in the electrical art when iron is traversed by a varying magnetic field there occur certain losses of energy, which reappear as heat. These losses, known as "core losses", are due to eddy, or Foucault, currents and to hysteresis effects. Even when the iron cores are laminated to suppress the eddy currents as far as possible, the core loss through eddy currents and hysteresis is considerable, and increases in degree during the use of the apparatus. It is, of course, most desirable to reduce this loss to the lowest possible limit. Iron, to be used for magnetic purposes, must not only be strong and of high magnetic permeability, but must be of such quality as to give a minimum "core loss." Such iron should have a high electrical resistance, at the same time retaining the desirable mechanical and electrical properties before mentioned.

I have found that the addition of the elements boron or beryllium increases the resistivity of iron to a high degree, at the same time improving its mechanical properties, making a valuable alloy for the above-mentioned purposes.

According to my belief, the resistivity of iron is increased by the presence of alloying elements, to a degree inversely to their atomic weights, because of the increased number of molecules furnished by an element of low atomic weight per unit weight of alloy. In other words, a given weight of alloy, containing given percentages of iron and an alloying element, will have a higher resistance if the atomic weight of the alloying element is low, as a given percentage of the element introduces a relatively greater number of molecules than the same percentage of an element of higher atomic weight.

The novel features of my invention are pointed out in the appended claims.

In making my high resistance alloy, I melt a mixture of commercially pure steel and a suitable portion of "ferro-boron" in a fire-clay crucible as commonly used in the crucible steel process. "Ferro-boron" is an alloy or mixture of iron and boron containing a relatively high percentage of boron, for example, as high as 30 per cent. boron. Ferro-boron is a well-known product and may be purchased in the market. The proportion of boron in the high-resistance alloy may vary from about .2 per cent. to 5 per cent. boron, but for most purposes the lower limit of boron content is preferable. The percentage of boron in the finished product may readily be controlled by analyzing the ferro-boron and calculating the amount of ferro-boron to be added necessary to give the desired percentage in the finished product. The steel should preferably be as free as possible from sulfur, phosphorus, or other ingredients. After a thorough mingling and alloying of the iron and boron, or beryllium, the molten mass is cast into ingots and subsequently rolled into desired form by any well-known means. The melting, casting and mechanical treatment of the steel being similar to that given any crucible steel, is so well-known as to need no description.

What I claim as new and desire to secure by Letters Patent of the United States, is—

1. A new article of manufacture for use in electrical apparatus, consisting of sheet steel containing boron in amounts varying from .2 per cent. to 5 per cent.

2. A high resistance alloy for electrical purposes, consisting of iron containing .2 per cent. to 5 per cent. of boron.

3. A magnetic material for electrical apparatus consisting of iron alloyed with boron, said material being characterized by high electrical resistance.

4. A magnetic material for electrical apparatus consisting of iron alloyed with an element whose atomic weight is less than that of carbon, said material having high electrical resistance.

In witness whereof, I have hereunto set my hand this 6th day of January, 1908.

WILLIS R. WHITNEY.

Witnesses:

EVELYN J. WHITNEY,

HELEN ORFORD.