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METHOD OF MAKING PERMANENT MAGNETS

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The present invention relates to magnetic material and more particularly to cast alloy magnets and to a method of making them.

It is one of the objects of the present invention to provide a method whereby permanent magnets which have desirable and substantially unvarying magnetic characteristics, may be readily and cheaply fabricated.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention however will best be understood from reference to the following specification.

My improved magnetic material consists substantially of about 60% to 70% iron, about 6% to 15% aluminum and about 20% to 30% nickel, the quantity of aluminum employed being usually equal to about one-half the quantity of nickel. A preferred composition consists of about 65 parts iron, about 25 parts nickel and about 13 parts aluminum.

In fabricating the alloy the ingredients are melted in any suitable crucible and the molten mass permitted to cool. When the temperature of the molten metal is slightly above the melting point thereof and the metal has begun to solidify around the edges of the crucible it is poured into a heated permanent or chill mold which has the effect of quickly cooling the cast metal. I prefer to heat the mold to a temperature a few hundred degrees above room temperature i. e. about 500 to 600° C. prior to pouring. The casting may be cooled in the permanent mold or if desired it may be pulled out of the mold while still at a red heat, i. e. a temperature of about 600 to 900° C. and quickly cooled or quenched in an air blast.

If the casting is made in a sand mold the metal is poured into the mold after the metal has begun to solidify around the edges of the crucible. As soon as the surface of the casting has solidified in the mold the casting is quickly cooled or quenched by sprinkling with water. The sprinkling preferably should be started before the casting is removed from the sand. If desired, when the casting has cooled to a temperature at which it is strong enough to support its own weight when seized with tongs, it may be removed from the mold and quenched by immersing in a suitable cooling medium such as water. It is preferable to cool the sand castings in an air blast or by sprinkling since the castings have a tendency to crack when immersed in a cooling fluid.

By pouring the molten metal at a relatively low temperature, i. e. after it has begun to solidify around the edges of the crucible or slightly prior thereto, I obtain castings having an equiaxed crystal structure. Such castings have a fairly high tensile strength. While satisfactory castings may be made in both sand and chill molds, it will be found that the chill mold in general gives more uniform results.

Permanent mold castings of the present alloy have been made as indicated above which have a coercive force of about 460 and a residual of about 6000. Sand mold castings of the alloy which have been quickly cooled by sprinkling or immersing in cooling fluid such as water have a coercive force of about 380 to 445 and a residual of about 7000 to 7600. Sand mold castings cooled slowly in sand have a coercive force of about 325 to 355 and a residual of about 4300 to 5000.

The permanent mold employed may be made of any suitable material such as steel. Very satisfactory results however have been obtained by constructing the permanent mold of the same alloy as the cast magnets.

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

1. The method of making a permanent magnet consisting substantially of about 6% to 15% aluminum and 20% to 30% nickel and the remainder iron, which comprises melting the ingredients of the alloy, cooling the alloy to a point only slightly above its melting point, pouring the molten metal into a mold and quickly cooling the cast metal.

2. The method of making a permanent magnet consisting substantially of about 6% to 15% aluminum and 20% to 30% nickel and the remainder iron, which comprises melting the ingredients of the alloy, and pouring the molten metal, after it has begun to solidify slightly, into a permanent mold heated to a temperature a few hundred degrees above room temperature.

3. The method of making a permanent magnet consisting of about 6% to 15% aluminum and 20% to 30% nickel and the remainder iron, which comprises melting the ingredients of the alloy, pouring the molten metal, after it has begun to solidify slightly, into a permanent mold heated to a temperature of about 500° C. to 600° C.

4. The method of making a permanent magnet consisting substantially of about 6% to 15% aluminum and 20% to 30% nickel and the remainder iron, which comprises melting the ingredients of the alloy, and pouring the molten metal while at a temperature only slightly above its melting point into a permanent mold heated to a temperature a few hundred degrees above room temperature.

5. The method of making a permanent magnet consisting of about 6% to 15% aluminum and 20% to 30% nickel and the remainder iron, which comprises melting the ingredients of the alloy, pouring the molten metal while at a temperature only slightly above its melting point into a permanent mold heated to a temperature of about 500° C. to 600° C.

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