# UNITED STATES PATENT OFFICE.

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## MAGNET-STEEL.

1,338,134. Specification of Letters Patent. Patented Apr. 27, 1920.

No Drawing. Application filed October 22, 1917. Serial No. 197,839.

*To all whom it may concern:*

Be it known that I, KOTARO HONDA, D. Sc., a citizen of Japan, residing at No. 21 Kanoko Shimidzu, Yonega-fukuro, Sendai, Japan, have invented certain new and useful Improvements in Magnet-Steel; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to novel magnet steels and to magnets made therefrom. More particularly, the invention relates to the manufacture of permanent magnets from alloys comprising carbon steel, cobalt, and one or more metals of the chromium family. Magnets made in accordance with the invention materially excel magnets heretofore known especially in point of strong residual magnetism and large coercive force.

In the particular embodiment of the invention here chosen for purposes of illustrating and explaining the broad principles involved, molybdenum is the particular metal of the chromium group constituting an essential ingredient of the alloy, the use of chromium in addition to molybdenum being very desirable but not essential. In my copending application Serial No. 197,837, filed October 22, 1917, the generic invention, of which the present application covers a specific phase, is broadly claimed.

In a typical instance, a magnet embodying the principles of the invention may be made of an alloy steel having the following range of composition:

Cobalt, 5–60%; molybdenum, 1–10%; chromium, 0.5–10%; carbon steel (with 0.5–2% carbon) the remainder. Most desirably the cobalt content is from 20 to 60%, and 35% has been found particularly suitable. The chromium, although a desirable constituent, may be omitted without seriously diminishing the magnetic property of the alloy. Other elements commonly present in steel may also be present in the alloy, and vanadium or the like may also be added.

In manufacturing this alloy steel, a mixture of the above-mentioned metallic ingredients may be melted at a temperature of, say 1700° to 1800° C., and poured to form an ingot. When sufficiently cooled the ingot is forged and worked into the form of a magnet, and is then hardened as by quenching at a temperature of say around 1100° C., for example, this temperature being considerably higher than the quenching temperature for ordinary magnet steel which is about 800° C. After quenching, the shaped body of paramagnetic metallic material is strongly magnetized with the aid of a powerful magnet or coil.

The magnet produced in the manner described is far superior to magnets heretofore known in the art, particularly as regards

(1) Coercive force which in magnets of the best type heretofore known does not exceed 75 C. G. S. units, whereas in the present magnet, the specific coercive force reaches 200 C. G. S. units. For this reason, loss of magnetism or so-called magnetic decay, due to shock or lapse of time is exceedingly small in the case of the present magnet.

(2) Intensity of magnetization per unit volume, which in the known magnets of the best type rarely exceeds 450 C. G. S units after artificial aging; whereas owing to its large coercive force the intensity of magnetization of the present magnet commonly exceeds 700 C. G. S. units after artificial aging.

The foregoing remarkable distinguishing characteristics of my new magnet obviously render the same capable of wide use to an increased extent in arts in which the magnet plays an important part.

What I claim is:

1. The method of preparing permanent magnets which comprises quenching at a temperature substantially above 800° C. a body of an alloy steel containing cobalt and molybdenum, and thereafter magnetizing said body.

2. The method of preparing permanent magnets which comprises quenching at a temperature substantially above 800° C. a body of an alloy steel containing cobalt, molybdenum and chromium, and thereafter magnetizing said body.

3. As a new article of manufacture, a magnetized body of an alloy steel containing cobalt and molybdenum.

4. As a new article of manufacture, a magnetized body of an alloy steel containing cobalt, molybdenum and chromium.

5. As a new article of manufacture, a per-

manent magnet made of an alloy containing from 5 to 60 per cent. cobalt, from about 1 to 10 per cent. molybdenum, and carbon steel of from about 0.5 to 2 per cent. carbon.

6. As a new article of manufacture, a permanent magnet made of an alloy containing from 5 to 60 per cent. cobalt, from about 1 to 10 per cent molybdenum, from about 0.5 to 10 per cent chromium, and carbon steel of from about 0.5 to 2 per cent. carbon.

In testimony whereof I hereunto affix my signature.

KOTARO HONDA.