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PERMANENT MAGNET STEEL

David R. Howerton, Riverside, Ill., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

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This invention relates to a permanent magnet steel, and more particularly to a permanent magnet steel alloy including among other ingredients tungsten and chromium.

It has been the practice in manufacturing certain types of magnet steels to use an alloy of iron, cobalt, and molybdenum and small amounts of carbon, manganese and silicon. Although this composition produces an alloy of suitable magnetic qualities, the alloy has a relatively low impact strength. It certain uses this feature constitutes a distinct disadvantage.

It is the object of the present invention to provide a permanent magnet alloy having good impact strength.

A typical composition heretofore used in the manufacture of a permanent magnet steel is as follows:

	Per cent
Iron	70.5
Cobalt	12.0
Molybdenum	17.0
Carbon	[1].04
Manganese	.35
Silicon	[1].10

[1] Maximum.

This composition produces a steel known commercially as Remalloy, which has excellent remanence and high coercive strength. As is well known to the art, these are very desirable qualities in a permanent magnet. However, for certain purposes a higher impact strength is desired than is afforded by this alloy.

It has been found that the mechanical properties, particularly impact strength can be greatly improved by adding small quantities of tungsten and chromium to this steel alloy. Scrap cobalt steel containing relatively large quantities of tungsten and chromium has been used in amounts up to 25% of the charge as a source of both the chromium and the tungsten with satisfactory results. The exact proportion that may be used depends on the amount of tungsten and chromium in the scrap cobalt steel. Other ingredients of the charge are introduced in conventional manner.

Iron, cobalt, cobalt steel scrap and ferro manganese may be melted together under a lime slag. Iron ore is then added to oxidize the bath thoroughly until the carbon content is .03% or less and then the slag is replaced. The charge is then superheated and ferro manganese and ferro molybdenum are added. A typical analysis of the alloy produced in this manner is: 11.84% cobalt, 16.08% molybdenum, .58% tungsten, .07% chromium, .03% carbon, .10% silicon, .35% manganese, and the rest iron.

This alloy is readily hot workable and possesses magnetic qualities similar to Remalloy. Tests have indicated that in addition to these desirable features it has an impact strength at least 50–60% higher than similar alloys previously used which did not include chromium and tungsten.

These tests were made by dropping a weight on a bar of alloy, the weight being raised a predetermined distance each time. An arbitrary scale having 26 equal divisions was used and the weight was raised division after division until the bar broke. Sample bars were taken from numerous melts to give an average. The tests with alloy bars which did not contain tungsten or chromium showed an average dropping distance, required to break the bars of 9.3 divisions on the above scale, while the dropping distance with bars containing chromium and tungsten averaged 15.25 divisions, which is clearly a very substantial improvement.

In practice, it has been found that the essential composition of this alloy may be varied somewhat, as follows, without substantially affecting the final product:

	Per cent
Cobalt	11 –13
Molybdenum	16 –18
Tungsten	.50– 1.00
Chromium	.05– .50
Carbon	[1].04
Silicon	[1].10
Manganese	.20– .50

Rest iron.

[1] Maximum.

It will be understood that the alloy here described is merely illustrative of the present invention and that many changes may be made therein without departing from the spirit or scope of the invention.

What is claimed is:

1. A permanent magnet steel comprising 11–13% cobalt, 16–18% molybdenum, .5–1% tungsten, .05–.5% chromium, a maximum of .04% carbon and of .10% silicon, .30–.50% manganese, and the rest iron.

2. A permanent magnet steel comprising 11.84% cobalt, 16.08% molybdenum, .58% tungsten, .07% chromium, .03% carbon, .08% silicon, .35% manganese, and the rest iron.

DAVID R. HOWERTON.