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Steinitz

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[54] **PERMANENT MAGNET ALLOY USING MOLYBDENUM AND TITANIUM**

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[52] **U.S. Cl.** **75/170**, 148/31.55, 148/31.57

[51] **Int. Cl.** **C22c 19/00**

[58] **Field of Search** .. 75/170, 123 J, 123 K, 123 M; 148/31.55, 31.57

[56] **References Cited**

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[57] **ABSTRACT**

A semihard permanent magnet alloy characterized by relatively high coercive force, relatively high residual induction, high ductility and low magnetostriction and consisting essentially of cobalt, iron, titanium and molybdenum. The molybdenum content of this alloy, as expressed in percent by weight, falls within the approximate range 3 – 6 percent. The titanium content falls between 3 – 6 percent. The sum of the cobalt and iron falls within the approximate range 88 – 94 percent. The ratio by weight of cobalt to iron falls within the approximate range 6.5:1 to 7.5:1.

3 Claims, No Drawings

PERMANENT MAGNET ALLOY USING MOLYBDENUM AND TITANIUM

BACKGROUND OF THE INVENTION

Many types of electronic components and subsystems require the use of semihard permanent magnet alloys characterized by relatively high coercive force, low magnetostriction, high ductility and relatively high residual induction. Special alloys have been developed for this purpose. One type of known alloys consist primarily of cobalt and iron, the ratio by weight of cobalt to iron being approximately seven, together with a third metal, titanium.

I have discovered that the relatively high coercive force of this type of alloy can be sharply increased at the cost of slightly reduced residual induction by adding molybdenum. In certain critical electronic applications, the increased coercive force is an extremely useful characteristic and the slight reduction in residual induction can be tolerated.

SUMMARY OF THE INVENTION

In accordance with my invention, my alloy consists essentially of 3 – 6 percent by weight of molybdenum and 3 – 6 percent by weight of titanium, balance cobalt and iron, the ratio of cobalt to iron falling with the range 6.5:1 to 7.5:1 [This ratio is required to maintain very low magnetostriction and, thus, very low stress sensitivity of the magnetic properties.] In forming the alloy, the titanium and molybdenum go into solution with the cobalt-iron matrix at high temperature and precipitate during the aging heat treatment as intermetallic compounds thereby increasing substantially the coercive force over that obtained by the use of titanium alone. The alloy is highly ductile and can be drawn readily into fine wire. The coercive force can range upwardly over 110 Orst. Moreover the alloy exhibits relatively high residual induction which ranges upward over 8,000 Gauss.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In forming my alloys, a thorough homogenization at about 2,100°F is required for all compositions. All alloys have to be cold worked, at least to between 85 – 95 percent and, preferably, between 95 – 99 percent. The higher the degree of cold work, the faster the molybdenum and titanium will coprecipitate in the cobalt-iron matrix, whereby lower temperatures and shorter time periods can be employed in processing. Optimal heat treatment depends upon the desired magnetic properties; to some degree, temperature and time can be interchanged.

Further information will be found in the specific examples which follow:

EXAMPLE I

An alloy homogenized and cold worked as described above was found to have the following composition:

cobalt	79%
iron	11%
molybdenum	5%
titanium	5%

The alloy was drawn into wire of 0.04 inches in diameter and heat treated at a temperature of 1,200°F for a period of 2 hours. Measurements showed that the coercive force was 110 Orst; the residual induction was 8,300 Gauss; and the squareness ratio of the hysteresis curve was 0.87.

These results can be compared with those obtained from a known alloy processed and tested in the same manner and having the following composition:

cobalt	83%
iron	12%
titanium	5%

This known alloy had a coercive force of 39 Orst, a residual induction of 11000 Gauss and a squareness ratio of 0.87.

EXAMPLE II

An alloy was produced having the following composition:

cobalt	80.5%
iron	11.5%
molybdenum	3.0%
titanium	5.0%

This alloy was processed and tested as in Example I. The coercive force was 50 Orst; the residual induction was 10,600 Gauss; and the squareness ratio was 0.88.

The combination of titanium and molybdenum in a cobalt-iron matrix produces a higher coercive force then either addition alone, without impeding the ductility of the alloy. Moreover, the total percent addition of both metals should fall within the range 6 – 12 percent to maintain the desired magnetic properties.

What is claimed is:

1. A semihard permanent magnet alloy consisting essentially of cobalt, iron, titanium and molybdenum, the total amount of cobalt and iron being from about 88 percent to about 94 percent by weight of said alloy and the weight ratio of cobalt to iron being from about 6.5:1 to about 7.5:1 and the amount of molybdenum and titanium each being from about 3 to about 6 percent by weight of said alloy.

2. An alloy in accordance with claim **1** having the following composition:

cobalt	79%
iron	11%
molybdenum	5%
titanium	5%

3. An alloy in accordance with claim **1** having the following composition:

cobalt	80.5%
iron	11.5%
molybdenum	3.0%
titanium	5.0%

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