Patented Apr. 23, 1946 2,399,032

UNITED STATES PATENT OFFICE

2,399,032

PROCESS FOR MAKING PERMANENT MAGNET ALLOYS CONSISTING OF SILVER, MANGANESE, AND ALUMINUM

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No Drawing. Original application July 29, 1943, Serial No. 496,620. Divided and this application November 30, 1945, Serial No. 632,125

2 Claims. (Cl. 148—11.5)

This application is a division of my prior copending application Serial No. 496,620, filed July 29, 1943. The present invention is a process for manufacturing permanent magnet alloys consisting of silver, manganese and aluminum. Magnets of that composition are disclosed in Faus Patent 2,247,804, July 1, 1941, and consist of 2 to 8% aluminum, 5 to 15% manganese with the remainder substantially all silver. A preferred alloy consists of about 86.5% silver, 8.8% manganese and 4.7% aluminum. The very high coercive force possessed by such alloy magnets makes them desirable for use in many fields, for example in maintaining polarity in reverse current relays and as control magnets for moving magnet instruments and the like.

It is an object of the present invention to provide a process for improving the magnetic properties of such alloys and particularly to provide an alloy of this composition which has uniform properties, a high flux value and a high total energy value.

To illustrate the present process the alloy may be cast into rods about ¾" in diameter. The rods are heated at a temperature in the neighborhood of 760° C. for about one-half to one hour to effect a condition of solution in the alloy and then water quenched from that temperature. Thereafter the alloy rods are cold reduced about 60 to 65% by swaging, given a homogenizing treatment at about 760° C. for about one-half to one hour to effect a condition of solution in the alloy, water quenched therefrom and aged at 250° C. for about 48 hours. The alloy rods are then given a further cold reduction of about 15 to 20% and again aged at about 250° C. for about 48 hours. With this process it is possible to obtain permanent magnet alloys having the above-noted preferred composition, a total flux value of 190 to 200 in magnets .410" in diameter and .156" long. Magnets of the above composition treated in this manner also have a B_r of 747, a jH_c of 5840 and a $BH_{max.}$ of 2,075,000.

In heating the alloy to effect the solution condition therein the temperature should not exceed 800° C., and preferably should be maintained at about 760° C. for best results. Although I prefer to maintain the alloy at the solution temperature for one-half to one hour, the desired effect might be obtained in as short a time as 15 minutes. Although heating the alloy at the solution temperature for a longer period of time than one hour does not have any adverse effect it also does not have any advantage. The aging temperature employed in my process preferably is about 250° C. and this temperature should not be varied greatly. The aging period, however, may be varied. Preferably, however, it should be maintained for about 36 to 72 hours.

By homogenizing the present alloy it is possible to obtain a magnet which has better magnetic properties and which is more stable both metallurgically and magnetically than would be possible without such treatment.

The total cold reduction in cross sectional area of the alloy by cold swaging preferably should amount to about 75% although good results may be obtained with a total cold reduction in area varying from about 50 to 95%. While good properties may be obtained in the alloy if the cold reduction is effected by a rolling operation, the maximum magnetic properties which are obtained by cold swaging the alloy cannot be duplicated by cold rolling unless the rolling operation is employed to produce very thin material, for example strip about $\frac{1}{32}$" in thickness. In rolling, the alloy is free to flow in a perpendicular direction as well as in the rolling direction while in swaging the alloy is severely strained since it can flow only in one direction which accounts for the improved magnetic properties obtained through swaging. The cold reduction of the alloy may be effected either by flat rolling, rolling with grooved rolls or by swaging, the latter being the preferred method except for the production of very thin material where flat rolling should be employed.

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

1. A method for improving the permanent magnet properties of an alloy containing about 2 to 8% aluminum, 5 to 15% manganese with the remainder substantially all silver, which comprises heating the alloy at about 760° C. to effect a condition of solution therein, quenching from that temperature, swaging the alloy to effect a cold reduction in area of about 60 to 65%, homogenizing the alloy at about 760° C. and quenching therefrom, aging the alloy at about 250° C., again cold swaging the alloy to effect a reduction of about 15 to 20% in cross sectional area and finally aging said alloy at about 250° C.

2. A method for improving the permanent magnet properties of an alloy containing about 2 to 8% aluminum, 5 to 15% manganese with the remainder substantially all silver, which comprises heating the alloy at about 760° C. to effect a condition of solution therein, quenching from that temperature, swaging the alloy to effect cold reduction in area of about 60 to 65%, homogenizing the alloy at about 760° C. and quenching therefrom, aging the alloy at about 250° C., again cold swaging the alloy and finally aging said alloy at about 250° C. the total cold reduction being not more than 95%.

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