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PERMANENT MAGNET MATERIAL

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9 Claims. (Cl. 75-124)

This invention relates to permanent magnets and compositions of material suitable for making permanent magnets.

An object of the invention is to produce compositions of good permanent magnet properties which are more workable than previously known compositions.

Numerous materials for making permanent magnets have hitherto been proposed and most, if not all, of them have a poor degree of workability.

In accordance with the present specification which comprises a portion of the invention of our application Serial No. 411,156, filed September 17, 1941, and is a continuation-in-part thereof, compositions for making permanent magnets and permanent magnets contain nickel between 10 and 30 per cent, aluminum between 5 and 10 per cent, vanadium between 2 and 10 per cent, cobalt between 5 and 15 per cent, copper any amount above 0 up to 10 per cent, which tends to increase workability and the balance iron. Generally the iron content is around 40 to 70 per cent. In order that this may be accomplished, less than maximum amounts of some of the other recited elements are included, although there is no rigid limitation in this respect.

Typical compositions are indicated in the following table:

	Fe	Ni	Al	Co	Cu	V
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
(a).....	41	28.5	9.5	11.4	4.8	4.8
(b).....	50.4	19.0	9.5	11.5	4.8	4.8

Compositions of this type may be given different heat treatments adapted for production of good permanent magnet properties with varying results. Some compositions give better results with one heat treatment and others with another. The following is illustrative:

Composition a as cast had a coercive force of 382 and a remanence of 4138; then it was prepared by casting, then heated to 1200° C. and cooled in "Silocel," a trade name for a finely divided infusorial earth consisting largely of silica. This results in a slow cooling. After this the material was raised to a temperature of 650° C. and aged for five hours followed by slow cooling. It exhibited a coercive force of 318 oersteds and a remanence of 2,654 gauss.

When the heat treatment was varied by cooling the material from 1200° C. in air and then aging for five hours at 650° C. the coercive force

was 655 and the remanence 3,756. Before aging the material had a quite substantial coercive force and remanence but in each case less than after aging.

When the same material was hot worked and thereafter similarly cooled in "Silocel," and thereafter similarly aged, it had a coercive force of 482 and a remanence of 2,757; after air cooling and aging it had a coercive force of 551 and a remanence of 3,280.

Composition b when cast, similarly cooled in "Silocel," and similarly aged had a coercive force of 557 and a remanence of 5,522. The corresponding values as cast before cooling in "Silocel" and before aging were 286 and 7,002.

When the material b was cast and hot worked and then heated to 1200° C. and cooled in "Silocel" the coercive force was 490 and the remanence 6,698. After aging the coercive force was 490 and the remanence was 6,476. With air cooling followed by aging the remanence was higher at 7,264 but the coercive force was considerably lower at 159 in such case.

In the foregoing description the process of cooling in "Silocel" refers to completely covering a test sample of material in a substantial body of "Silocel" which is a very poor conductor of heat.

Bodies of such materials of any and all shapes commonly employed for permanent magnets may be magnetized by the usual processes; they are workable by hot rolling and swaging.

What is claimed is:

1. A workable permanent magnet alloyed composition comprising nickel between 10 and 30 per cent, aluminum between 5 and 10 per cent, vanadium between 2 and 10 per cent, cobalt between 5 and 15 per cent, copper any amount above 0 up to 10 per cent and the balance iron.

2. A magnet having a composition as set forth in claim 1 cooled after alloying, aged at around 650° C. and then magnetized.

3. An alloyed composition adapted to serve as a magnetic material comprising iron 41 per cent, nickel 28.5 per cent, aluminum 9.5 per cent, cobalt 11.4 per cent, copper 4.8 per cent and vanadium 4.8 per cent.

4. An alloyed composition adapted to serve as a magnetic material comprising iron 50.4 per cent, nickel 19 per cent, aluminum 9.5 per cent, cobalt 11.5 per cent, copper 4.8 per cent and vanadium 4.8 per cent.

5. An alloy suitable for permanent magnet purposes composed of nickel from 10 to 30 per cent, aluminum from 5 to 10 per cent, vanadium from

2 to 10 per cent, cobalt from 5 to 15 per cent, iron 40 to 70 per cent, and copper any part of the balance not in excess of 10 per cent, no element except those enumerated and except reasonably unavoidable impurities being present.

6. An alloy suitable for permanent magnet purposes composed of aluminum from 5 to 10 per cent, vanadium from 2 to 10 per cent, cobalt from 5 to 15 per cent, iron 40 to 70 per cent, copper from an appreciable amount up to 10 per cent, and the balance nickel not less than 10 per cent or more than 30 per cent.

7. A workable permanent magnet alloyed composition comprising nickel between 10 and 30 per cent, aluminum between 5 and 10 per cent, vanadium between 2 and 10 per cent, cobalt between 5 and 15 per cent, copper from a trace characteristic of the impurities of commercial ferrous materials up to 10 per cent and the balance iron.

8. A workable alloyed composition adapted to be magnetized to serve as a permanent magnet comprising nickel between 10 and 30 per cent, aluminum between 5 and 12 per cent, cobalt between 5 and 15 per cent, some vanadium and some copper with the total vanadium and copper being between 2 and 20 per cent, and the balance iron.

9. A workable alloyed composition adapted to be magnetized to serve as a permanent magnet comprising nickel between 10 and 30 per cent, aluminum between 5 and 12 per cent, vanadium between 2 and 10 per cent, cobalt between 5 and 15 per cent, and the balance iron and copper of which the copper is not over 10 per cent of the total.

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