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FLEXIBLE PERMANENT MAGNET AND COMPOSITION

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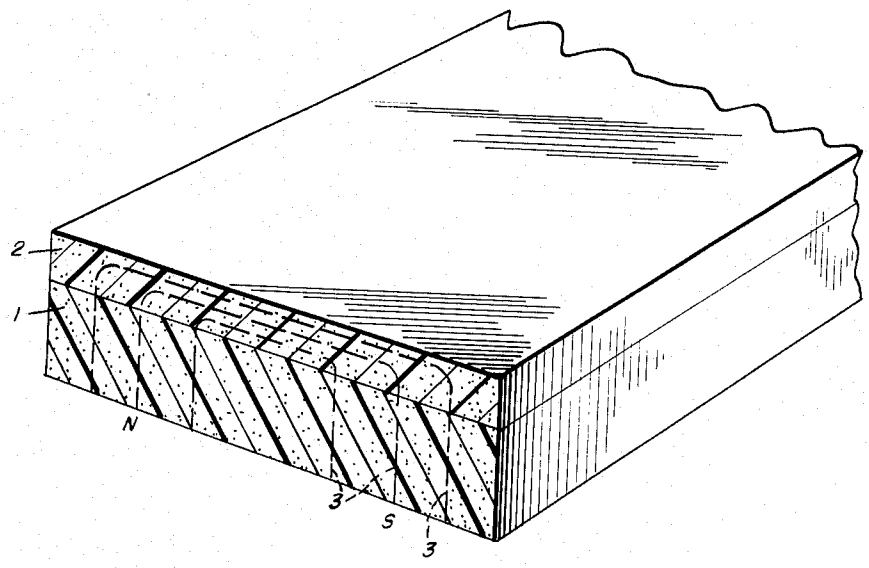

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FLEXIBLE PERMANENT MAGNET AND COMPOSITION

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The invention relates to magnetic compositions prepared from permanently magnetic powders and a non-magnetic binder.

Magnetic compositions of this type may be compressed into magnets or processed to more or less flexible sheets or bands from which the final magnetic shapes are punched or cut.

Such magnets frequently require pole pieces or return pieces of soft iron. It is known to place such iron parts in the die used in the manufacture of the magnets, or to join the parts to the compressed or punched magnets, for instance by cementing.

I have found a particularly simple procedure for the manufacture of permanent magnets which are provided with magnetically soft conducting pieces. According to the invention, said magnetically soft conducting pieces consist of iron powder and also of a non-magnetic binder.

The invention will be set forth more in detail with reference to the accompanying drawing, which shows a magnetic molding strip which adheres to a ferromagnetic base plate and is suitable, for instance, for door locks, particularly of refrigerators.

In the drawing, the reference numeral **1** designates the permanently magnetic part of the molding strip, which consists of a powdered permanently magnetic material of high coercive force in a non-magnetic binder. Joined thereto is a conducting piece **2** of iron powder and binder. Both parts are first sprayed separately as bands or profiles, or rolled to slabs (sheets), and then joined by rolling upon each other, cementing, pressing together, or similar treatments. The resulting laminated bands or profiles can be directly employed as adhesive molding strips.

Laminated sheets of substantial width may be divided into such bands. The magnetizing of such adhesive moldings is carried out in an arc form so that the adhering surface has a magnetic north and south pole.

Suitable permanent magnetic materials are compounds of the type $BaO \cdot 6Fe_2O_3$ and alloys known under the names Alni and Alnico, which have the following composition:

	Alni, percent	Alnico, percent
Al	10–13	5–15
Ni	20–30	10–30
Co	0–20	10–40
Cu	0–5	0–10
Ti		0–10
Fe	balance	balance

The invention is of particular value for permanent type magnets, which are first rolled to slabs or sheets and contain powdered permanently magnetic compositions of the type $BaO \cdot Fe_2O_3$. The particles of said magnetic materials are magnetically anisotropic and have the forms of hexagonal discs or platelets. The preferred direction of magnetization of such platelets is normal to

the plane thereof. When a sheet or strip is rolled, the platelets are oriented in the plane of the sheet, so that the finished magnetic material presents a direction of magnetization perpendicular to said plane, as noted by the numeral **3** in the drawing. In an arcuate magnetizing of a molding cut from such an anisotropic sheet, the magnetic flux would flow part of its way in 1 perpendicular to the anisotropic direction, such that the high magnetic value of the material could not be fully utilized.

According to the present invention, such a sheet or slab, is joined to a return piece **2**, which has been made similarly to piece **1**, but contains soft magnetic iron powder instead of a permanently magnetic powder. In said return member **2** the magnetic flux can flow in transverse direction to the direction of anisotropy of part **1** whereby said member can be magnetized throughout its entire volume up to the maximum value. As a result, the adhesive force of the thus prepared magnet is considerably increased.

Instead of using $BaO \cdot 6Fe_2O_3$ particles as permanent magnetic material, particles of the similar compositions $SrO \cdot 6Fe_2O_3$ and $PbO \cdot 6Fe_2O_3$ can be used, alone or in mixture with each other.

As non-magnetic binders, any thermoplastic resin such as homopolymers or copolymers or vinyl chloride, polyamides, cellulose acetate, also natural or synthetic rubbers may be used. I prefer to employ polyethylene.

I claim:

1. A flexible magnetic molding strip comprising a permanently magnetic layer having opposite flat surfaces and containing magnetic particles embedded in a non-magnetic binder, said magnetic particles being magnetically anisotropic and magnetized in a direction perpendicular to said surfaces, and a soft magnetic layer intimately joined to one of said surfaces and presenting an uninterrupted return path for the magnetic flux when the other of said flat surfaces is adhered to a ferromagnetic base, said soft magnetic layer consisting essentially of a non-magnetic binder and iron particles dispersed therein.

2. A molding strip as claimed in claim **1** wherein said magnetic particles are selected from the group consisting of nickel-aluminum-iron alloys and compounds $MO \cdot 6Fe_2O_3$, wherein M is a member of the group consisting of Ba, Sr, and Pb.

3. A flexible permanent magnet device comprising:

(A) a flexible plastic permanent magnet and

(B) a flexible plastic backing member of a high magnetic permeability coextensive with said flexible magnet,

(C) said backing member being positioned in back-to-face contact with said flexible magnet thereby forming a multi-layer unit which possesses an appreciably higher degree of magnetic holding power than the flexible magnet by itself.

References Cited by the Examiner

UNITED STATES PATENTS

2,627,097	2/1953	Ellis	317—159
2,698,917	1/1955	Van Urk et al.	317—201
2,797,370	6/1957	Bennett	317—158
2,892,248	6/1959	Weber et al.	29—155.6
2,900,344	8/1959	Stuyts et al.	317—201
2,932,545	4/1960	Foley	317—201 X
2,959,832	11/1960	Baermann	317—158
2,965,953	12/1960	Baermann	29—155.6

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