March 18, 1952 WILBURN F. BERNSTEIN 2,589,766
NOW BY JUDICIAL CHANGE OF NAME
WILBURN F. BRADLEY
MAGNETIC OIL SEAL CONSTRUCTION
Filed May 4, 1945

Fig. 1.

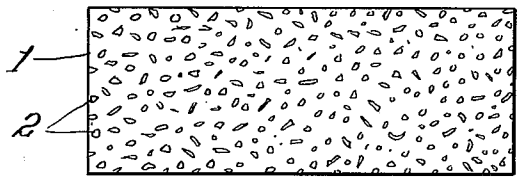



Fig. 2.

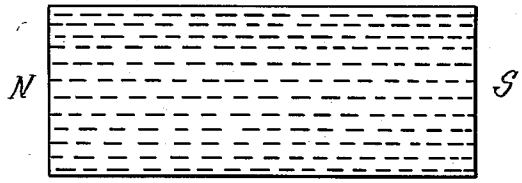
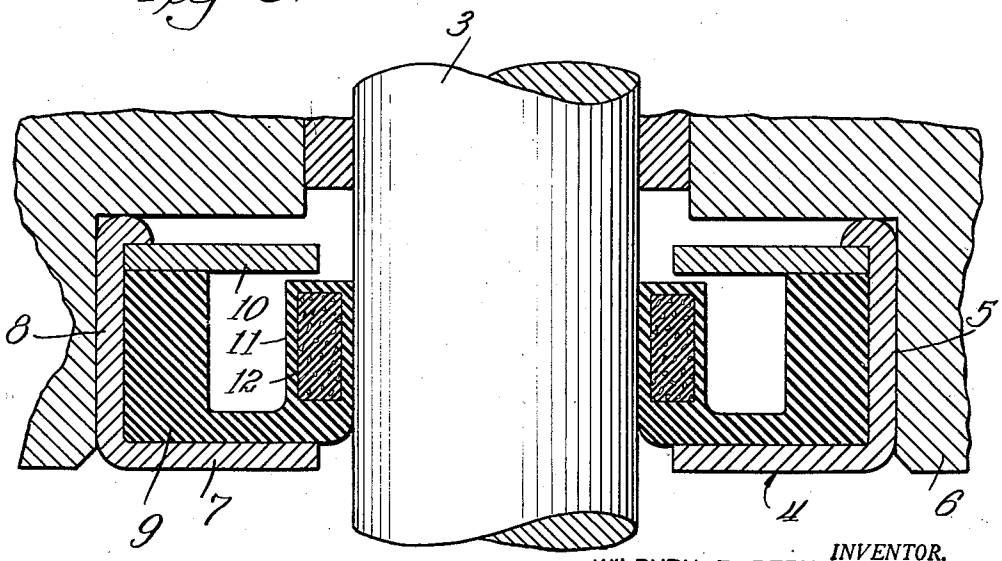



Fig. 3.




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# UNITED STATES PATENT OFFICE

2,589,766

## MAGNETIC OIL SEAL CONSTRUCTION

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2 Claims. (Cl. 288—3)

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The present invention relates generally to improvements in permanent magnetic materials, and has reference particularly to a new and improved oil seal comprising a flexible composition of matter having a high degree of magnetic retentivity.

Permanent artificial magnets are commonly made of solid materials, such for example as hard steel or steel alloys, and are provided in a large variety of forms to serve different useful purposes. However, because of their rigidity of form and other limiting physical characteristics, these materials have restricted the use of magnets primarily to electrical devices and appliances, and have necessitated comparatively expensive methods of manufacture to produce magnets of the desired form for each individual purpose.

An object of the present invention is to provide a new and improved oil seal comprising a flexible lip incorporating a magnet or magnetized material capable of exerting a tractive effort, and operable by reason of its capacity of flexure or deformation in response to magnetic stress to maintain close bearing contact with a relatively movable part of magnetic material, i. e., a material subject to magnetic attraction.

A further and more general object is to provide a new and improved flexible magnet or magnetized material which is adapted for use in a seal construction and which is simple and inexpensive to produce either in large stock lots for subsequent fabrication, or in special molded or formed shapes, and which is readily deformable under magnetic stress to conform closely and intimately to the surface of a contacting member of magnetic material.

Other objects and advantages will become apparent as the description proceeds.

In the accompanying drawing,

Figure 1 is a fragmentary longitudinal sectional view on an enlarged scale through a yieldable bar magnet embodying the features of the present invention.

Fig. 2 is a diagrammatic view of the bar magnet illustrating the orientation of the magnetic axes of the internal elementary magnets.

Fig. 3 is a fragmentary axial sectional view of an oil seal packing illustrating one use of the yieldable permanent magnet.

The flexible magnet or magnetic material, which is contemplated by the present invention, in general comprises a body or matrix 1 of any suitable flexible or resilient base stock deformable in response to magnetic stress, and any suitable magnetic material having a high degree of magnetic retentivity and being divided into particles 2 embedded in and interspersed through the matrix.

The base stock, which serves as the bonding medium for the magnetic particles and defines the external form of the magnet, is flexible and preferably resilient in character, and may consist for example of natural or synthetic rubber,

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rubber composition or other rubber-like material. Included in the class of materials that may be used are, by way of illustration but not limitation, Buna N, Buna S, butyl rubber, a product known in the trade as "Neoprene" and comprising polymerized chloroprene, and another product known in the trade as "Thiokol" and comprising organic polysulphide. The rubber-like material may be compounded with various other ingredients, as is customary in the rubber art, affecting vulcanization, plasticity, tensile strength, weight and resistance to abrasion, etc., and in general to obtain the most desirable characteristics for a particular intended use. As one typical illustration, the base stock may comprise a suitably treated composition of the following ingredients in the following proportions by weight:

| | Parts |
|---|---|
| Buna N | 100 |
| Carbon black | 20 |
| A softener, such as coumarone indene resin | 10 |
| Zinc oxide | 5 |
| An anti-oxidant, such as phenol beta naphthalene | 2 |
| Sulphur | 1 |
| An accelerator, such as di-butyl amine | 0.5 |

The magnetic particles 2, which are bonded in the base stock 1, may comprise any suitable material which can be permanently magnetized by induction upon being introduced into a proper magnetic field. Thus, the particles 2 may consist of crushed or comminuted iron, steel or any one of various ferrous alloys, such for example as a number of aluminum-nickel-iron alloys known in the trade as "Alnico," "Alnic" and "Nipermag."

Although the magnetic material 2 should be finely divided, and preferably is used in pulverant form, the degree of fineness is not closely critical. It is desirable, however, that the particles 2 be as small as practicable so as to permit of close and substantially uniform interspersion thereof, and to obtain greater continuity of the rubber or rubber-like binder defined by the base stock. For example, satisfactory results are obtained if the magnetic material is comminuted to a fineness of approximately a 120 mesh screen.

The amount of finely-divided magnetic material 2 that may be suitably compounded with the flexible bonding material may be varied over a considerable range, and is influenced by the characteristics that are desired in the resultant product. In general, as the amount of the magnetic material 2 in the composition is increased, the resultant product experiences a corresponding increase in magnetic strength and decrease in flexibility or resiliency. If a comparatively stiff magnet is desired, the magnetic material 2 may be added to the mixture in amounts up to 90% by weight as a maximum limit with satis-

factory results. If this limit is exceeded, the magnet will be too rigid for many purposes, and will lack physical strength. On the other hand, where a strong magnetic flux is unnecessary, and a high degree of flexibility is desired, the magnetic material may be added to the mixture in amounts down to 10% as a minimum limit. The optimum proportions for most purposes comprise by weight approximately 75% of the divided magnetic material and 25% of the rubber or rubber-like bonding material.

The permanent magnet or magnetic material may be advantageously made by a method which comprises processing the flexible resilient non-magnetic bonding material as is well understood in the art. Thus, the main or base ingredient is compounded in suitable conventional equipment with other modifying substances in the same manner as is commonly employed in the processing of rubber. The magnetic material 2 is crushed or comminuted to the desired degree of fineness, and is then added in the desired amount to the uncured rubber or rubber-like bonding material 1. It will be understood that the magnetic material 2 at this time is not magnetized since, if it were, the polar axes of elementary component magnets defined by the divided particles would be out of line and thus result in heterogeneous polarity. The comminuted magnetic material may be added at any time in the mixing operation, and then the composition is thoroughly mixed to intersperse the magnetic particles substantially uniformly throughout the bonding material 1. After the mixing operation, the composition may be further processed in the same manner as if the magnetic particles were not present to cure the bonding material, and to produce the resultant or finished product in the desired form. The resultant product is now permanently magnetized in any suitable manner, as for example by introduction into a strong magnetic field until permanent magnetization of the magnetic particles 2 is effected. According to the molecular theory, the elementary magnet elements are thereupon arranged with their magnetic axes parallel to the direction of magnetization as illustrated in Fig. 2, thus establishing north and south poles N and S at opposite ends of the bar. It will be understood that the direction of polarity may be controlled by disposition of the magnet within the magnetizing field.

The magnetized material, in the course of production, may be molded or otherwise shaped in stock lengths to be subsequently cut or fabricated into individual magnets of any desired form, or alternatively may be initially shaped into the desired form of the finished magnets. The material being readily severable by a knife, can be quickly and economically shaped into various complex magnet forms.

Magnets of the present invention, because of their flexibility or resiliency, will deform or flex through an air gap under magnetic stress to conform to and maintain close contact with a contiguous surface of magnetic attractive material. Thus, the flexible magnet is especially advantageous in oil seals for maintaining close contact of the sealing member with a relatively movable element such as a rotating shaft. One form of oil seal, utilizing a flexible magnet embodying the present invention, is shown in Fig. 3. Except for the use of the magnet, this oil seal is of conventional construction.

The oil seal is for a revolving steel shaft 3, and



comprises an outer shell 4 mounted within a counterbore 5 in a housing 6 through which the shaft extends. The shell 4 comprises a side wall 7 and a peripheral wall 8 in which a packing 9 in the form of a U-shaped resilient diaphragm is inserted. A retaining washer 10 is secured against the outer leg of the diaphragm 9. The inner leg of the diaphragm constitutes a yieldable sealing lip 11 which is flexed outwardly to engage the surface of the shaft 3 with deformation pressure. Molded within the sealing lip 11 is a flexible magnet 12 embodying the present invention. Due to the magnetic attraction between the shaft 3 and the magnet 11, the sealing lip 11 is held closely against the shaft to provide a fluid-tight seal regardless of rubber fatigue and without requiring the use of any additional pressure element, such as the commonly-employed garter spring (not shown). The sealing pressure created by the magnet 12 is uniform throughout the periphery of the shaft 3, and not subject to impairment.

I claim as my invention:

1. An oil-seal for a rotating shaft comprising, in combination, a yieldable packing having an annular sealing lip of rubber-like material adapted for engagement under flexure with the periphery of said shaft, comminuted particles of permanently magnetized material embedded in said lip and interspersed therein, said particles being arranged to define in said lip points of free opposite polarity producing external magnetic flux to maintain said lip in sealing contact with said shaft.

2. An oil seal for a rotating shaft comprising, in combination, a yieldable packing having an annular sealing lip of rubber-like material adapted for circumferential engagement under flexure with the peripheral surface of said shaft, and an annular permanent magnet molded within said lip and fully enclosed therein in position to encircle said shaft, said magnet comprising a matrix of rubber-like resilient material and a quantity of finely divided permanently magnetized material of high magnetic retentivity molded with and disbursed throughout said matrix.

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