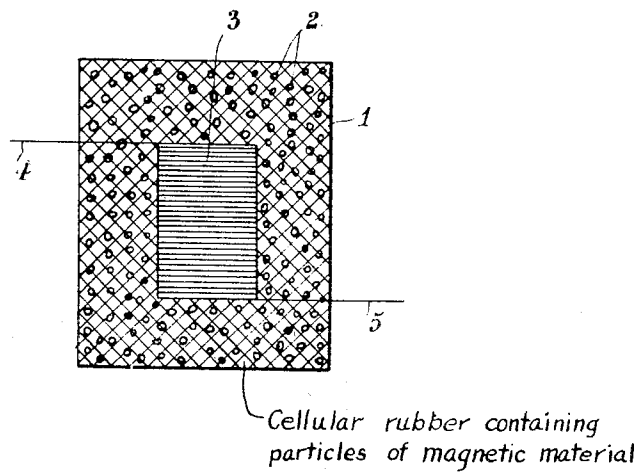


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ELECTROMAGNETIC ARTIFICIAL MUSCLE

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ELECTROMAGNETIC ARTIFICIAL MUSCLE

Robert Asche and Jean Jacques Hubscher,
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3 Claims. (Cl. 172-126)

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This invention is concerned with a composite product made up of paramagnetic particles and rubber-like insulating substances precluding any contact between the said particles. It will be appreciated that if the product be arranged in a magnetic field the paramagnetic metal particles will be subjected to forces that the rubber-like substance can only resist by yielding thereto.

The product may be manufactured in very many ways depending on the result aimed at; thus, microscopic particles of paramagnetic metal may be incorporated e. g. in the state of a powder into a mass of natural or synthetic rubber, preferably of porous character for the sake of greater elasticity and deformability; alternatively, coarser particles may be used in the form of granules, grains, balls or even small masses; paramagnetic metal sheets may also be piled together with the interposition of rubber sheets; it is also contemplated to locate the paramagnetic metal superficially or in any other manner suitable for the obtaining of the most varied deformations once the product obtained is interposed in a magnetic field.

However, if the metal particles were capable of movement with respect to the rubber surface with which they are in contact, wear would obviously be experienced in the long run; according to the invention, this inconvenience can be avoided by cementing the said particles to the rubber; effectively, various methods are now available whereby an adhesion of rubber to metal can be obtained which is almost equal to the ultimate strength of the rubber mass; where such an adhesion is obtained no displacement of the metal particle with respect to the rubber mass is liable to occur.

The magnetic field intended to produce the desired deformations may be obtained by means of magnetic devices arranged without the composite product. Yet, according to a further feature of the invention the said magnetic devices are arranged within the product itself and embedded in the same; they may consist e. g. of one or several electric coils adapted to partake of the deformations of the product in which they are embedded; of course, it is preferable to subject them to a preparatory treatment, e. g. by brass-electroplating or otherwise, by which adhesion is secured between them and the rubber.

Such a rubber-paramagnetic metal-coil aggregate provides an artificial muscle controlled by an electric current; where magnets are used as the metal particles, polarized deformations are obtained, which means that the direction of the deformation is reversed as a result of a change in the polarity of the current.

An embodiment of the subject-matter of the invention is illustrated diagrammatically in the appended drawing,

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Embedded in the rubber mass 1 are paramagnetic particles 2 and a coil 3; the only emerging parts are the coil input and output terminals 4 and 5.

Where an alternating magnetic field set up by the induction of a current within the composite product the coils may be short-circuited and no current input or output terminal needs be accessible from the outside.

The applications of this composite product are quite numerous; by way of example there may be cited: low-frequency resonators tuned in one or several directions of deformation; sound radiators of infra-audible, audible or ultra-audible frequencies, "robots" consisting of rubber-paramagnetic metal-coil muscles; propelling members, de-icing devices, etc.

The paramagnetic particles may be particles of iron, nickel, cobalt and of their alloys and oxides which are magnetically permeable.

What we claim as our invention and desire to secure by Letters Patent is:

1. An artificial muscle composed of paramagnetic metal particles and an elastic material possessing rubber-like as well as insulating properties that separates the said particles in combination with means to create a magnetic field adapted to influence the said paramagnetic metal particles, said elastic material possessing rubber-like properties having a cellular form.

2. An artificial muscle composed of paramagnetic metal particles and an elastic material possessing rubber-like as well as insulating properties that separates the said particles in combination with means to create a magnetic field adapted to influence the said paramagnetic metal particles, said elastic material possessing rubber-like properties containing cells by which its deformability is increased.

3. An artificial muscle composed of paramagnetic metal particles and an elastic material possessing rubber-like as well as insulating properties that separates the said particles in combination with means to create a magnetic field adapted to influence the said paramagnetic metal particles, said elastic material possessing rubber-like properties consisting of sponge rubber.

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