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DIAPHRAGM FOR ELECTRICAL REPRODUCTION OF SOUND

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This invention relates to magnetic diaphragms for electrical reproduction of sound and, more particularly, to telephone diaphragms, and the like, made from a plastic composition having a comminuted magnetic metal incorporated therein.

Diaphragms used in acoustical systems, as in the receivers of telephones or other magnetic diaphragms for electrical reproduction of sound, and designed to be actuated by changes in a magnetic field, have heretofore susually been made of iron, iron alloys, or other magnetic metals. Such diaphragms have been subjected to certain definite objections. They will rust if not suitably protected by a surface coating; they are subject to some distortion through fatigue, with the result that their sensitivity and their ability to transmit faithfully become impaired with age. Furthermore, the necessity for achieving a correct combination of susceptibility to a magnetic field and of mechanical stiffness and elasticity, has made it necessary in the manufacture of such diaphragms to work out a careful balance between the magnetic properties of the alloy and its stiffness.

An object of the present invention is to provide a novel type of diaphragm for telephones, and the like, which is not subject to rusting. A further object is to provide a diaphragm wherein the magnetic properties and the mechanical properties may be varied substantially independently. A still further object is to provide a method of preparing diaphragms of superior acoustical properties and permanence by the use of a plastic composition having a comminuted magnetic metal incorporated therein.

The above objects are accomplished according to the present invention by making the telephone diaphragm, or the like, from polymerized methyl methacrylate plastic having incorporated therein a comminuted magnetic metal.

Polymerized methyl methacrylate is a clear, transparent, rigid resin capable of being readily fabricated into various shapes by molding. It has been discovered that a diaphragm, such as a disc, made essentially of polymerized methyl methacrylate and having pulverized iron, or ferrous alloy, or other magnetic metal incorporated therein, in which the former serves as a binder and the latter as a filler to yield a composition analogous to existing molding compounds, has unexpectedly advantageous properties for use in telephone receivers, and the like. It will be understood that the finished diaphragm will comprise a continuous body of the polymerized methyl methacrylate plastic in which are dispersed the individual comminuted particles of metal.

The magnetic properties of the diaphragm may be varied in accordance with the selection of the magnetic metal, it being well known that magnetic metals differ considerably among themselves in magnetic strength. The magnetic properties of the diaphragm may also be varied by regulating the percentage of magnetic metal particles contained in it.

In unplasticized form, polymerized methyl methacrylate discs possess the stiffness of the order requisite for use in telephone receivers, and the like. The addition of finely divided magnetic metal tends to increase this stiffness in accordance with the usual stiffening effects of fillers upon plastic substances. If the stiffness of the resulting composition is too great, it may be reduced by the incorporation of plasticizers. Obviously the particular percent of plasticizer, if any, to be used in any particular composition for diaphragms for a particular purpose, will be determined by a certain amount of testing to obtain the optimum effect. However, this can be readily accomplished by those skilled in the art upon consideration of the present disclosure.

The method of forming a composition of polymerized methyl methacrylate plastic and comminuted magnetic metal may be carried out in different ways, as well as the making of the diaphragm proper. In the following examples methods of carrying out the present invention are given, parts being by weight throughout:

Example 1.—100 parts of polymerized methyl methacrylate are ball milled with 39 parts of pulverized iron until a uniform, fine grained powder results.

A telephone receiver diaphragm is formed from this composition by molding in a die a disc of 2" diameter and 0.031" thickness. The die is heated to a temperature of 150° C. and a pressure of 2500 pounds per square inch is applied to effect the molding. The temperature of the die is subsequently reduced to about 80° C. while pressure is still maintained upon the die. Thereafter the die is opened and the disc removed. The resulting thin disc is ready without further treatment for use as a telephone diaphragm, or the like.

Example 2.—In this example a diaphragm is made as in Example 1, except that there is added to the composition 0.5 parts of ethyl palmitate which serves as a mold lubricant and facilitates removal of the molded disc from the die.

Example 3.—100 parts of polymerized methyl methacrylate, 50 parts of pulverized iron, and 50 parts of acetone are kneaded together to form a dough which is then worked on mixing rolls to effect thorough and homogeneous dispersion of the pulverized metal. The dough is then formed into a block upon a grooved plate by application of a temperature of 120° C. and pressure of 500 pounds per square inch of area of the plate. This block is chilled under pressure and removed from the press in which it is formed.

From the block are then sliced sheets of the thickness required for a telephone diaphragm, proper allowance for shrinkage in thickness during subsequent evaporation of the solvent being made. The sheeting is then hung in the air at a temperature of 45° C. until it ceases to lose weight through evaporation of solvent. The sheeting thus seasoned is straightened and polished by pressing between polished metal plates at a temperature of 135° C. and a pressure of 1000 pounds per square inch. The sheets are cooled under pressure. From the straightened and polished sheets the diaphragm discs are blanked out.

Example 4.—Into the bottom half of a die of suitable dimensions is sprinkled comminuted polymerized methyl methacrylate in quantity sufficient to form about ⅓ of the thickness of the disc to be molded. There is then sprinkled a thin layer of finely divided iron on top of the layer of polymerized methacrylate. There is then added a sprinkling of comminuted polymerized methyl methacrylate sufficient to complete the filling out of the die. Molding under heat and pressure as in Example 1 yields a disc suitable for use as a telephone diaphragm. In carrying out this example 50 parts of polymerized methyl methacrylate are first introduced into the mold, then 39 parts of finely divided iron, and last 50 parts more of polymerized methyl methacrylate.

Example 5.—A diaphragm is made as in Example 1 except that the following composition is employed:

	Parts
Polymethyl alpha methacrylate	100
Dibutyl phthalate	5
Pulverized iron	42
Ethyl palmitate	1

Example 6.—Molding powders are made by ball milling separately 100 parts of polymerized methyl methacrylate and 1 part of butyl stearate as a mold lubricant, on the one hand, and 100 parts of polymerized methyl methacrylate and 45 parts of finely divided iron on the other hand. Into a disc mold are sprinkled two level layers of the first mixture with a level layer of the second mixture interposed, the total being sufficient, when molded, to fill out the die. Molding procedure as in Example 1 is followed.

It is to be understood that the above examples are merely illustrative and that the present invention broadly comprises a diaphragm for electrical reproduction of sound made of polymerized methyl methacrylate plastic having incorporated therein a comminuted magnetic metal. As shown in the example, the comminuted metal may be uniformly incorporated throughout the plastic or may be disposed in fairly well defined layers. According to the present invention, polymerized methyl methacrylate will form a major constituent of the plastic but it will be understood that plasticizers may be included, if desired, and also various modifying agents as mold lubricants, and the like. Relatively smaller proportions of other polymerized esters of methacrylic acid may be included, if desired.

An advantage of the present invention is that it provides a magnetic diaphragm for electrical reproduction of sound which is non-rusting and in which a desired balance between magnetic properties and mechanical stiffness may be achieved by mere selection and proportioning of the ingredients of the plastic composition from which the diaphragm is made. A further advantage of the diaphragms of the present invention is that they have definitely superior acoustical properties. Also, if it should be necessary to make a diaphragm of intricate shape, this can very readily be accomplished by molding the compositions herein disclosed, whereas the shaping of a metal disc presents considerably more difficulty.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

I claim:

1. A magnetic diaphragm for electrical reproduction of sound, said diaphragm being made of polymerized methyl methacrylate plastic having incorporated therein a comminuted magnetic metal.

2. A magnetic diaphragm for electrical reproduction of sound, said diaphragm being made of polymerized methyl methacrylate plastic having incorporated therein a comminuted magnetic ferrous metal.

3. A magnetic diaphragm for electrical reproduction of sound comprising a thin disc having a layer of polymerized methyl methacrylate plastic on each surface thereof with at least one intermediate layer of a comminuted magnetic metal.

4. A magnetic diaphragm for electrical reproduction of sound, said diaphragm being made of polymerized methyl methacrylate having uniformly incorporated therein a comminuted ferrous metal.

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