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MAGNET SYSTEM HAVING LITTLE STRAY
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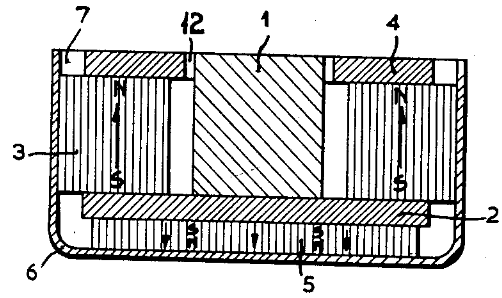

FIG. 1

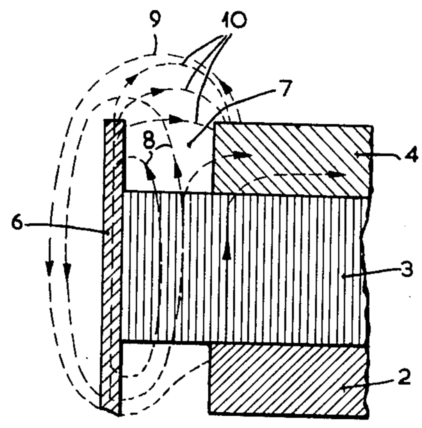

FIG. 2

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MAGNET SYSTEM HAVING LITTLE STRAY

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The invention relates to a magnet system having little stray, particularly for use in loudspeakers, especially in television apparatus, in microphones and the like. A system is known comprising a core with a bottom plate of soft magnetic material, at least one annular permanent magnet, preferably of an oxidic material and a top plate of soft magnetic material, in which system an effective annular air gap is formed between the top plate and the core, while on the free side of the bottom plate provision is made of a second permanent magnet preferably also of oxidic material, which is magnetized axially and in opposite direction relative to the first or annular permanent magnet, and a housing of soft magnetic material engages the free pole of the second magnet, this housing surrounding the system on three sides.

In this known system each of the two permanent magnets furnishes an essential part of the magnetic flux produced in the effective air gap. For this reason the housing must have an adequate wall thickness to conduct the flux. This implies the disadvantage in a loudspeaker that, before the cone with the coil and the frame are arranged on the top plate, this housing must be compressed under a very high pressure to reduce the reluctance of the transition from the housing to the top plate to a permissible low value. Owing to this requirement it is not feasible to assemble the frame and cone beforehand.

Moreover, in the prior art system the magnets are to be magnetized before assembly since in the complete system (i.e. subsequent to compression) magnetization is no longer possible. It has been found from practice, that magnetizing the magneto before assembly of the cone involves a high loss of, for example, about 30% owing to very high magnetisable particles which get into the air gap during mounting so that the coil will establish a contact.

In accordance with this invention the annular magnet is proportioned so that it produces substantially the desired flux in the effective air gap for driving the cone, whereas between the top plate and the top side of the relatively thin-walled housing an additional annular gap of larger length than the effective air gap is left, while the second magnet is proportioned so that it eliminates at least for the major part the harmful stray flux in the additional gap. The dimensions of both magnets can be calculated in a known manner dependent on the dimensions of the system and the magnetic values of the magnets.

This invention therefore provides various advantages over the above described prior art.

A thinwalled housing with the second magnet, in accordance with one aspect of the invention, can be constructed in the form of a readily arranged unit, and the top part of the magnet system can also be constructed as a unit magnetized with cone and coil assembled, so that the aforesaid disadvantage of a high loss is obviated. Moreover, use may be made of permanent magnets which are first magnetized in a strong field, demagnetized in a reverse field and can be magnetized to saturation in a weak field as fully described in U.S. Patent 2,924,758.

The said top part unit may furthermore serve separately as a complete system, though the amount of stray is not particularly low. If a low-stray system is desired, the said unit (thinwalled housing and second magnet) may be

slipped simply on the system or top part, since there is no contact with the top plate, the sleeve portion of the housing bearing on the outside of the annular magnet.

The magnet system according to the invention is therefore more universal.

The wall thickness of the housing is preferably not more than 2 mms., usually, however, 1.5 mms.

The invention will be described, by way of example, more fully with reference to the accompanying figures.

FIGURE 1 shows a magnet system according to the invention and

FIGURE 2 shows a detail of FIGURE 1 on an enlarged scale.

The system comprises a cylindrical core **1** with a circular bottom plate or dish **2**, both of soft magnetic material, an annular primary permanent magnet **3**, a top annular plate **4** of soft magnetic material, defining an active annular gap **12** with the core **1**, a disc-shaped auxiliary permanent magnet **5** (which may be annular, as an alternative) and the thinwalled cup-shaped housing **6** of soft magnetic material, while an annular air gap **7**, which may be filled with a magnetically non-conductive material, is left between the housing **6** and the top plate **4**. The portion **1**—**4** (core **1**, dish **2**, magnet **3**, and annular plate **4**) is constructed in the form of a complete magnet system for use in loudspeakers, in which the magnet **3** of the system, completely with cone and accessories, can be magnetized. It is therefore possible to use a ferroxdure anisotropic oxidic magnet as described in U.S. Patent No. 2,762,778 with a much higher $(BH)_{max}$ value than the isotropic permanent magnetic material as described in the U.S. Patent No. 2,762,777, since the first-mentioned material, subsequent to magnetisation, is partly demagnetized outside the system or prior to assembly. Although the top plate **4** has a smaller diameter than the ring **3**, between 70% and 90% of the diameter of the outside diameter of ring **3**, preferably only 80% thereof, the involved loss due to stray is negligible, since it amounts to only 1 or 1.5%.

If a low-stray system is desired, the housing **6** shaped in the form of a sleeve (not shown) is arranged with the disc-shaped magnet **5**, which serves substantially only for maximum elimination of the stray field of the top plate **4** and the uncovered top side of the magnet **3**. The magnet **5** will therefore have, as a rule, a smaller outside diameter than the magnet **3**. Its height also is usually smaller.

The annular magnet **3** may also consist of two concentric rings (not shown), magnetized in the same axial direction and separated from each other by an air gap, the outer ring engaging the inner wall of the housing **6**. The inner ring provides the completion of the magnet system.

FIGURE 2 illustrates diagrammatically the at least partial compensation of the stray field. The tendency to stray is indicated by the lines of force **8** and **9**. This tendency is, however, suppressed for the major part by the lines of force **10** in opposite direction, originating from the magnet **5** of FIGURE 1.

The arrows in the figures indicate the direction of magnetization. Although in FIGURE 1 the internal diameter of the housing **6** is chosen to be equal to the outer diameter of the magnet **3**, which in fact yields the best results, this cannot always be the case for practical reasons. This embodiment has the disadvantage that the outer surface of the magnet **3**, for example, in the case of cast magnets, and also in the case of ferroxdure magnets, must, as a rule, be ground which involves an increase in cost price. In certain cases it may therefore be more economical to provide a larger diameter for the housing **6** while the space between the housing **6** and the magnet **3** can be filled with a substance applied to the cylindrical surface of the magnet **3** and having a smooth outer surface, for example synthetic resin. This substance is a magnetically non-conductive material.

As an alternative, however, the housing **6** may fit just around the unground outer surface of the magnet **3**. It is neither always necessary to choose the diameter of the top plate **4** to be smaller than that of the magnet **3**. In the case of equal diameters the top part of the housing **6** may be widened to an extent such that an annular air gap is obtained.

What is claimed is:

1. A magnetic system comprising at least one hollow permanent magnet, a core of soft magnetic material concentric within said magnet, a space between said magnet and said core, a bottom plate of soft magnetic material covering the opening in said hollow magnet, a top plate of soft magnetic material having an aperture concentric with said core, an effective air gap defined by said core and top plate, said magnet extending beyond the marginal edges of said top and bottom plates, housing means of soft magnetic material and a magnet of opposite polarity relative to said hollow magnet disposed on the opposite side of said bottom plate, from said opening, and a second air gap defined by the side walls of said housing and said top plate, whereby said magnet of opposite polarity reduces the flux in the air gap between said housing and said top plate.

2. A low stray magnetic system comprising a core piece and bottom plate each of soft magnetic material, at least one annular permanent magnet concentrically surrounding said core and contacting said bottom plate, a top plate of soft magnetic material having an annular opening surrounding said core and defining an effective air gap therewith, a second permanent magnet of opposite polarity relative to said annular magnet on the opposite side of said bottom plate, housing means concentrically surrounding said system on three sides, an air gap defined by said housing means and said top plate, said system characterized by said second magnet having a coercive force sufficient only to reduce the stray flux in said gap between said top plate and said housing means, and said annular magnet producing the flux in said effective air gap.

3. A magnet system according to claim 2 wherein the wall thickness of said housing means is not substantially greater than 2 mms.

4. A magnet system according to claim 2 wherein the ratio of the outside diameter of said top plate and the outside diameter of said housing means is 0.7 to 0.9 whereby the length of the gap defined thereby is determined.

5. A magnet system according to claim 2 wherein said second magnet is disk shaped and of a diameter appreciably less than the outside diameter of said annular magnet.

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