

March 8, 1938.

G. HOLST ET AL

2,110,153

MAGNETIC SYSTEM

Filed Oct. 19, 1935

Fig. 1

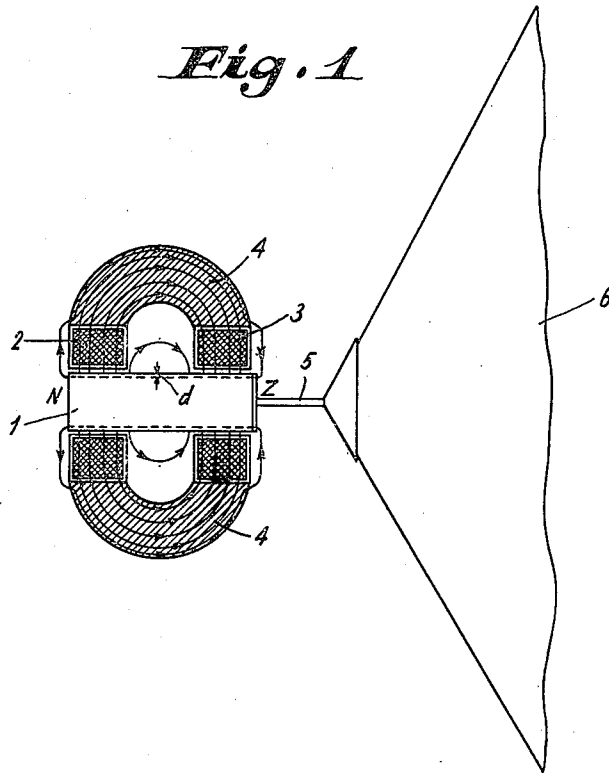
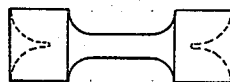


Fig. 2



INVENTORS
GILLES HOLST
GOTTFRIED BRUNO JONAS
BY *W. B. Swann*
ATTORNEY

UNITED STATES PATENT OFFICE

2,110,153

MAGNETIC SYSTEM

Gilles Holst and Gottfried Bruno Jonas, Eindhoven, Netherlands, assignors to N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands

Application October 19, 1935, Serial No. 45,745
In Germany October 19, 1934

1 Claim. (Cl. 179—115)

This invention relates to a magnetic system for electro-acoustic or other apparatus for the recording and reproduction of oscillations and in particular to a driving system for loudspeakers.

In the loudspeaker industry it is already known to use so-called electrodynamic driving systems. Such systems are formed by one or more permanent magnets generating a magnetic field in an air gap of preferably annular shape and by a speech modulated current coil movably arranged in the said gap. The arrangement is such that the magnetic lines of force intersect the coil according to the planes of winding so that when an electric current passes through the coil, the latter is subjected in the field to a force in the direction of the coil axis only and thus can be used for driving a diaphragm.

The invention is based on the idea of using for the driving of the diaphragm the force of reaction which in the electrodynamic systems as described hereinbefore is exerted on the magnetic frame. According to the invention, for this purpose the device contains a movable permanent magnet and one or more stationary coils for the acoustic or other alternating currents and means are provided by reason of which the magnetic lines of force extend in or almost in the winding planes. The expression "in or almost in" is to be understood to mean that for obtaining the best results the lines of force should, preferably, extend according to the winding planes but that satisfactory results can also be obtained when the lines of force intersect the winding planes at an angle. It will be appreciated that for obtaining a sufficiently powerful magnetic field a permanent magnet of higher residual magnetism and higher coercive force is required.

Now, it has been found that the present state of art of magnetic alloys permits of making such magnets with a weight that does not exceed the weight of usual driving coils and that such magnets are especially suitable as the vibrating element for electro-acoustic or similar apparatus. As magnetic alloys, nickel, cobalt, aluminium and titanium alloys are particularly adapted.

The serviceability of a magnetic steel is governed by its (B. H.) maximum value. For the purpose aimed at by the invention this value has to be at least 10^6 c. g. s. units.

Although theoretically there is, of course, no objection the electrodynamic driving systems being simply reversed that is to say to the coil being arranged so as to be stationary and the magnetic system being united to the diaphragm, it will be appreciated at once that practically

this entails difficulty. For obtaining a good frequency characteristic curve it is necessary to have an oscillatory system that is as light as possible. Thus, for example, a weight of about 2 grams has been found to be efficient for the movable part of the driving system of loudspeakers. As may be readily appreciated a satisfactory magnetic structure, for example a pot magnet, having such a low weight can only be made with difficulty and there is the additional difficulty that there must be a sufficiently large air gap for housing the current coil.

According to the invention, the system is therefore constructed otherwise, viz. in such manner that a preferably rod-shaped permanent magnet forms the oscillatory part of the system and is surrounded by one or more stationary coils for the alternating currents to be produced or the driving alternating currents. Preferably, two coils are used in this arrangement, because a rod magnet has two poles, consequently two points at which the field intensity in the neighborhood is a maximum.

In order that the driving forces brought about with loudspeakers or other reproducing apparatus or the electric voltages with microphones, pick-ups and other recording apparatus may be a maximum, it is desirable first of all that the field intensity at the point at which the coil windings are arranged should be a maximum and secondly that the lines of force should extend in or almost in the winding planes. In order to obtain these results it is preferable that soft iron parts should be used so that the magnetic flux through iron is closed as far as possible and in addition the desired direction is given to the lines of force.

For the same purpose the magnet may be given a special shape.

As already described hereinbefore, a weight of about 2 grams for the movable part of the driving system is to be looked upon as efficient. If the specific weight of the magnetic steel is assumed to be about 8g/cm^3 only 250 mm^3 of magnetic steel can be used. As for the purpose of obtaining a high efficiency it is necessary that the coils should surround the magnet as closely as possible and the internal diameter of the coil practically cannot be smaller than a given measure in order that the winding difficulties may not occur it is preferable that the magnet should be tubular. A practical device is obtained, for example, when the tube is given an external diameter of 8 mms. and a length of 25 mms. It will be appreciated that the invention is not limited

ited to driving systems for loudspeakers but can be used as efficiently, preferably, for microphones and pick-ups.

5 In order that the invention may be clearly understood and readily carried into effect one embodiment thereof will now be described more fully with reference to the accompanying drawing, in which

10 Figure 1 shows a driving system according to the invention for a loudspeaker having a diaphragm of large surface area.

Figure 2 shows a special form of a driving magnet.

15 Referring to Figure 1, 1 designates the magnet which in this case is tubular. The thickness of the wall is designated by d . Two coils 2 and 3 surround the ends of the magnet and are traversed by the speech modulated currents. A soft iron ring 4 is used for increasing as much as possible the field intensity in the coils and for deflecting the lines of force in such a way that they are caused to be located in the direction of the winding planes. The soft iron ring is shown in section. A small leakage field cannot be avoided 20 entirely. As shown in the figure, the main field has, however, the direction required. The magnet 1 the poles of which are designated by N and Z is united by means of a rod 5 to the apex of the diaphragm 6. All of the movable parts can

be constructed in known manner. The figures do not show any guide, as this is unnecessary for a better understanding of the invention and would only render the figure more complicated and indistinct.

5 Figure 2 shows a special construction of the magnet for giving the lines of force the desired direction when no tubular magnet is used. The figure is an elevation of the magnet. The latter is constructed as a solid of revolution. The section is indicated more fully by dotted lines. This magnet can be used without additional means 10 instead of the magnet 1 shown in Figure 1.

What we claim is:

15 A device for the interconversion of electrical oscillations and mechanical vibrations comprising a permanent magnet bar adapted to be movable in an axial direction, a pair of axially disposed stationary voice coil windings, one surrounding each end of said magnet bar, a soft iron yoke member extending between the coil windings to provide a ready path of the magnetic flux 20 between the poles of the permanent magnet bar and through the coil windings, said permanent magnet bar being tubular and closed at one end, and mechanically vibrated means attached to said closed end. 25

GILLES HOLST.

GOTTFRIED BRUNO JONAS.