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PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION

Improvements in Electro-mechanical Sound Recording Devices more especially of the Moving Coil Type.

We, ALAN DOWER BLUMLEIN, British subject, of 57, Earl's Court Square, London, S.W.5, and HERBERT EDWARD HOLMAN, British subject, of 64a, The Chase, Clapham Common, London, S.W.4, do hereby declare the nature of this invention to be as follows:—

This invention relates to apparatus for recording sound upon wax or other like discs or blanks with particular reference to electro-magnetic moving coil recorders. The object of the present invention is to devise an improved form of recorder of the above character which obtains its damping from the electrical circuit connected to it, such damping being sufficient to reduce the resonance peak of the response characteristic to a very smoothed topped rise which may then be easily corrected either by circuits introduced between the amplifier and recorder, or by modifying the amplifier characteristic or both.

This invention consists in an electro-magnetic sound recorder of the moving coil type in which the coil consists of a single turn of material of low resistance and low density (such as aluminium), having parts located in a magnetic air gap curved about the axis of rotation of the coil, and so shaped that the width and thickness of the coil increases towards the axis of the rotation. Preferably the parts in the air gap are made as thin and light as possible to enable the gap to be reduced to a minimum and to reduce the moment of inertia of the coil.

A further feature of the invention consists in the introduction in parallel with the recorder of a shunt (comprising an inductance or suitable combination of resistances, inductances and condensers) of such a value that its impedance at the mechanical resonance frequency of the recorder (which is usually chosen at a low frequency) is small compared with the impedance of the recorder itself, so that the shunt will smooth out the resonance peak; while at high frequencies the impedance of the shunt is of the same order of magnitude as that of the recorder which therefore responds efficiently to this range.

Still further features of this invention will appear from the following description.

In carrying one modification of the invention into effect an electrical transformer core, preferably joined together by its ends to form a complete circuit for the permeating magnetic flux, and preferably laminated to reduce reluctance to a minimum, is thickened at one point in its length to form a cylindrical bulbous portion. Adjacent to and on opposite sides of this bulbous portion are wound the primary coils of the transformer, through which are passed varying audio frequency electric currents dependent upon characteristics of the sound being recorded. Mounted to rotate about an axis passing through the axis of the bulbous portion, and encircling it, is a rigid coil consisting of a single turn of material, such as aluminium, having small electrical resistance and low density.

To obtain the required rigidity such a coil may be suitable cut from a solid block of the material. The coil may have a substantially rectangular shape, in which case the tow sides parallel to the axes of rotation are cut as thin and narrow as possible (subject to the desired strength), while the other two sides have increased width and thickness as they approach the axis of rotation. In this way the electrical resistance is reduced without materially increasing the moment of inertia of the coil. For the purpose of mounting the coil for rotation there may be, integral with it, shafts extending outside the coil along the desired axis. Alternatively a separate single shaft may pass through suitable holes in the thickened portion of the coil, and through a clearance hole in the bulbous portion of the transformer core. It will now be clear that variations in the audio-frequency currents passed through the primary windings of the transformer will induce corresponding currents in this rotatable coil, which encloses the same core.

With their magnetic axes at right angles to the axis of the transformer core, and to the axis of rotation of the coil, are mounted, one on each side of the coil, the poles of a permanent or electro-magnet. These poles are shaped to form concave cylindrical surfaces corresponding with the convex cylindrical surfaces of the bulbous portion of the transformer core, and are mounted as near as is possible thereto, to reduce the air gap to a minimum possible for clearance of the coil the curved sides of which are moveable in the curved air gap. The bulbous portion of the transformer core forms also a core between the magnetic poles, thus assuring a strong and uniform field.

It will be seen from the suspension of this magnetic field on the coil in which audio frequency currents are being induced will cause it to oscillate about its axis of rotation. To ensure that in rotation the coil does not contact with the core or magnet the pivoting shafts are located by bearings, knife edges or elastic connections. Such bearings and support for the coil must be carefully insulated or suitable positioned so that no short circuited turn of low resistance is made round the audio frequency AC flux path. The mean or neutral position of the coil may be located by springs which may be adjustable and serve to tune the mechanical resonance period to any frequency desired.

The movements induced in the coil are used by suitable connection to a recording stylus to cut the wax disc or other blank. In one such arrangement, using a coil with integral pivotal shafts, a short arm is fitted to one of the shafts at right angles to its axis, and carries at its other end a stylus parallel to the shaft axis. The axis of the shaft is, in this case, mounted perpendicular to the wax surface; but it will be appreciated that many other orientations are possible, and the invention is not limited to this arrangement.

Unless mechanical or electrical damping of some type is introduced the mechanical impedance of this device will be very small at frequencies close to resonance; also, at these frequencies the response will be very large. In order to control the response and to provide a reasonably

high mechanical impedance, so that the recorder is not unduly affected by irregularities, etc., in the wax, it is necessary to provide damping which will be effective at frequencies close to the resonant frequency of the moving parts and spring control. Therefore in this recorder electrical damping is used to control the device at resonance thus avoiding the difficulties associated with obtaining efficient mechanical damping.

In order to provide this electrical damping in accordance with one form of the invention a shunt is connected in parallel with the recorder. The natural resonance frequency of the recorder is then adjusted (by springs as described above), and the impedance of the shunt so chosen that, at that frequency, the shunt impedance is small compared with the impedance of the recorder, so that the resonance peak of the recorder is reduced to a normal value. The shunt impedance is so chosen that at any other frequencies (particularly at very high frequencies) it will be of a value comparable with that of the recorder, which will therefore be operated more effectively. Alternatively by suitably adjusting the thickness and masses of the members of the moving system it is possible to introduce additional resonances to modify the response characteristics. Thus, for example, the compliance of the pivotal shafts, or the inertia of the stylus arm might be adjusted to give a high frequency resonance, which would then serve to modify the high frequency portion of the response curve.

From the above description it will be clear that many modifications of the device are possible without departing from the scope of the invention, and it must be understood that the description is given only to indicate the nature of the invention and must not be considered as having any limiting effect.

Dated this 7th day of May, 1931.

Marks & Clerk.

COMPLETE SPECIFICATION

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