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DEVICE FOR RECORDING AND REPRODUCING ACOUSTIC VIBRATIONS

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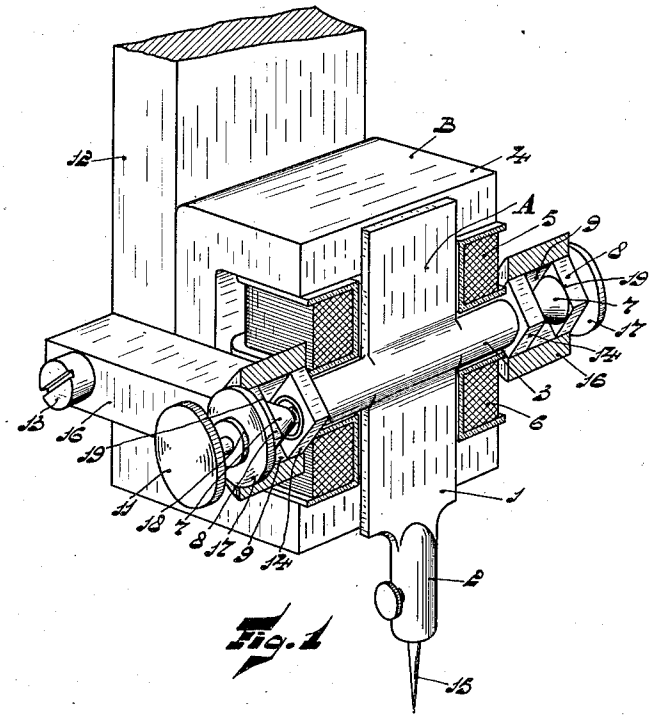


Fig. 1

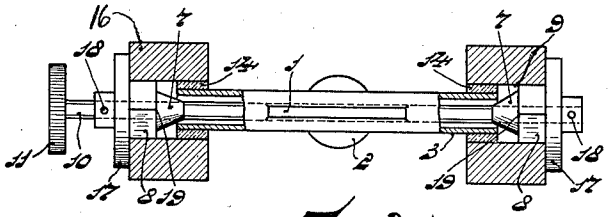


Fig. 2

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DEVICE FOR RECORDING AND REPRODUCING ACOUSTIC VIBRATIONS

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5 Claims. (Cl. 179—100.41)

The present invention relates to a device adapted for the recording and reproduction of acoustic vibrations.

I shall describe my invention in connection with so-called home recording apparatus in which a sound record is made on a carrier, for example, by means of an electromagnetically-actuated stylus, and the record is played back using the same apparatus. However, it should be well understood that my invention is not limited to such an apparatus, but broadly relates to devices which serve both for recording and reproduction by means of the same instrumentalities.

In so-called home recording devices, as is well known, the sound is recorded on a carrier by the sound waves setting up vibrations in a microphone, which vibrations are transformed into electric or electromagnetic oscillations. These oscillations, after proper amplification, cause a member, for instance a needle, to assume correspondingly mechanical vibrations and to effect a record on a suitable carrier, for instance on an aluminum disc.

The record, so recorded, can be played back by using the same device with the same or a similar stylus. During this reproducing process, the device acts as a pick-up following the undulations of the record, and sets up by its vibrations corresponding electric oscillations, which, after proper amplification, reproduce by means of a loud-speaker, sound-waves corresponding to the vibrations recorded on the record.

I have found that for the proper recording and reproducing, it is important that the natural or resonance frequency of the mechanical vibratory system be different, and more particularly, I have found, that the best results are obtained for recording if the vibratory system has a comparatively high natural frequency, of the order of at least 1000 cycles, whereas for reproducing it is preferable that the vibratory system is given a comparatively low frequency, preferably less than 50 cycles.

I have found that the above requirement, of a widely differing resonance frequency of the vibratory system for recording and reproducing, can be conveniently obtained in a single apparatus by providing means to change the resonance frequency of the vibratory system to such an extent as to provide the most favorable resonance frequency of the vibrator system for both recording and reproducing.

According to the invention, the vibratory system can be given two different ranges of resonance frequencies and by a simple adjustment the system can be brought into the desired condition for either resonance frequency.

My invention will be more fully described in connection with a specific example illustrated in the drawing which forms part of the specification, and in which:

Figure 1 is a partly sectionized perspective view of a device according to the invention with the right-hand pole piece assembly and part of the magnet omitted.

Fig. 2 is a detailed, partly sectionized top view of the rotary armature shaft and associated parts of the device of Fig. 1.

According to the invention, the vibratory system consists, as a rule, of an armature of magnetic material carrying a stylus, which is usually a removable needle and sometimes of different type for recording and reproduction. The armature is subjected to two magnetic forces of considerable but equal and opposing strengths, and thereby, unless subjected to the vibrations imparted during recording or reproduction, is in a balanced condition and at rest. The natural frequency of the vibratory system is made adjustable so as to have two values which fall comparatively wide apart. This can be achieved, for instance, by providing an elastic suspension of the vibratory armature, which is effective when a low resonance frequency of the system is desired and which is rendered ineffective when a high resonance frequency of the system is desired.

Figure 1 shows the armature assembly A, the left-hand pole-piece assembly B and part of the magnet 12, whereas the right pole-piece assembly—which is complementary to B and of the same construction—and part of the magnet 12 are omitted for the sake of clarity.

The armature assembly A comprises an armature 1 made as a whole with a shaft 3 and movable together with the shaft. The armature is of suitable ferromagnetic material of comparatively high permeability and low coercivity. A stylus 15, for instance a needle such as is used for the recording or reproduction, is removably secured in the reduced and rounded end 2 of armature 1. The armature 1 is disposed between two pole-piece assemblies B—B (of which, as stated, only the left-hand one is shown), and is under the balanced influence of the magnetic fields produced by the permanent magnet 12 between the opposing faces of the U-shaped pole-pieces 4 of the two assemblies and the armature. The pole-piece 4 which is of suitable ferromagnetic material, for instance soft iron, is in inti-

mate magnetic contact with and secured to the preferably U-shaped permanent magnet 12 (only a portion of which is shown).

Encircling the armature 1 above and below the shaft 3 are two coils 5 and 6 of identical construction, only the left halves of which are shown, which coils can be connected in series or in parallel at will and through which flows the impressed amplified current during recording and the induced current during reproduction.

As shown in greater detail in Fig. 2, the shaft 3 is hollow and carries at each end a square rubber bushing or cushion 14, which is suitably secured to the shaft 3, for instance by means of an agglutinant or by means of suitable corrugations or grooves provided at the ends of the shaft, whereby the shaft itself cannot be displaced with regard to the contacting rubber surface. The bushings 14—14 snugly fit into corresponding square-shaped bores 9—9 of cross-rods 16—16 secured by means of screws 13—13 at their ends to the legs of the magnet 12. The bores 9—9 act as bearings for the shaft 3, in which the shaft can oscillate or vibrate under the elastic twisting of the rubber bushings 14—14. The rubber bushings 14—14 thereby provide for means which reduce the natural frequency of the vibratory system.

Within the hollow shaft 3 and extending beyond the two ends thereof and also beyond the bores 9—9 is a spindle 10 provided on one of its ends with a right-hand threading and on its other end with a left-hand threading. Around each end of the spindle 10, and slidable within the corresponding bore 9, is a member 19 comprising a conical inner portion 7 and an outer portion 8 forming a square nut. The member 19 is provided with internal threading which engages the corresponding threads of spindle 10. Lateral displacement of the spindle 10 is prevented by end-plates 17—17, which abut against the outer faces of the cross-rods 16—16 at the bores 9—9, and which are secured to the spindle 10 by pins 18.

By turning the spindle 10 by means of a knurled knob 11, the two members 19—19 move simultaneously either inwardly or outwardly, depending upon the direction in which the knob is turned. Thereby the conical portion 7—7 of members 19—19 may engage the ends of the shaft 3 and lock the same, or may be disengaged therefrom. In the latter case, which is the one shown in the figures the rotation or oscillation of the shaft 3 and the natural frequency of the system depend upon the elasticity afforded by the rubber bushings 14—14. This adjustment provides a comparatively low natural frequency and is used for reproduction.

On the other hand, if by turning the knob 11 the members 19—19 are moved inwardly to an extent sufficient to cause their conical portions 7—7 to enter into the inner bore of shaft 3 and firmly grip the same, the influence of the rubber cushions is placed out of effect and the resonance frequency of the system depends solely upon the elasticity of the shaft 3 and is consequently much higher than in the former case. This adjustment of the apparatus is used for recording.

The elasticity of the shaft 3 and the elasticity of the rubber bushings 14—14 are so selected that the natural frequency of the vibratory system in case of recording is preferably higher than 1000 cycles, and in reproduction preferably lower than 50 cycles.

Instead of having a single actuating means for the cones 7 of the members 19 as above described, the cones or similar members may be individually actuated, or instead of having two such movable members a single movable member, for instance a cone, can be used, whereas a corresponding fixed member is provided at the other end of the shaft. The latter construction, however, is only recommended in case the lateral displacement of such member is quite small, as in case of a greater displacement, the central position of the armature with respect to the pole pieces might be disturbed.

Instead of the above-described actuation of the vibratory system, the latter may be actuated in other known manners, for instance by means of an oscillatory voice coil.

While I have described my invention in regard to a specific example, I do not wish to be limited thereto, but desire the appended claims to be construed as broadly as permissible in view of the prior art.

What I claim is:—

1. In a device adapted for alternately recording and reproducing acoustic vibrations by electromagnetic means, a vibratory system, elastic restoring means to give said vibratory system a resonance frequency of a predetermined value suitable for reproducing purposes, a second elastic restoring means to give the vibratory system a resonance frequency of a value suitable for recording purposes, and adjusting means for selectively placing said restoring means into or out of operation.

2. In a device adapted for alternately recording and reproducing acoustic vibrations by electromagnetic means, a vibratory system including a shaft, elastic restoring means for said shaft to give said vibratory system a resonance frequency of a predetermined value and to make the device suitable for reproducing purposes, means for unyieldingly holding the ends of said shaft, the stiffness of the shaft being such that the resonance frequency of the vibratory system has a value suitable for recording purposes, and adjusting means to selectively place said restoring means into and out of operation.

3. In a device adapted for recording and reproducing acoustic vibrations by electromagnetic means, a vibratory system including an armature and a hollow shaft for said armature, elastic bearings for said shaft to decrease the resonance frequency of said system to a value suitable for reproducing, and conical members adapted to project into the ends of the hollow shaft and to fixedly hold the shaft, to eliminate the effect of the elastic bearings and to increase the resonance frequency of the vibratory system to a value suitable for recording.

4. In a device adapted for selectively recording and reproducing acoustic vibrations by electromagnetic means, a vibratory system including an armature and a hollow shaft therefor, elastic bearings for said shaft to give the resonance frequency of said system a predetermined low value for reproducing, conical members adapted to project into the ends of said shaft and to fixedly hold same to eliminate the effect of the elastic bearings and to give the resonance frequency of the vibratory system a predetermined high value for recording, and selecting means for moving said conical members into and out of contact with the ends of the shaft.

5. A device for recording and reproducing acoustic vibrations, comprising an electromagnet system having a vibratory armature, a stylus carried by said armature, a hollow shaft for said ar-

mature, said armature being adapted to vibrate with said shaft, members supporting said shaft with regard to said electromagnet system and forming bearings for said shaft, resilient bushings for supporting said shaft in said members and effective when the device is used for reproducing, and means to tightly grip said shaft with regard to said supporting members and to eliminate the influence of said resilient bushings when the device is used for recording.

AREND THOMAS VAN URK.