Oct. 18, 1932. J. A. TERRELL 1,883,100

SUSPENSION MEANS FOR SOUND TRANSLATING DEVICES

Filed May 16, 1931

Fig.1.

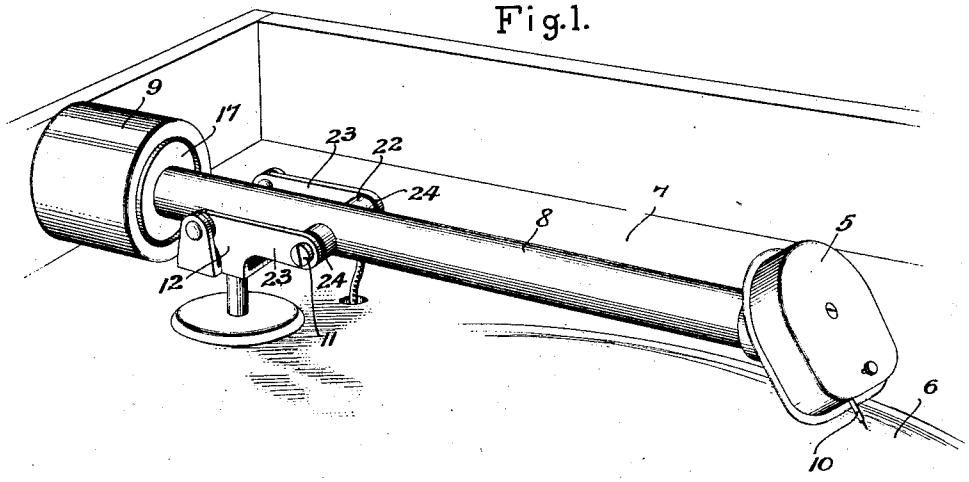



Fig.2.

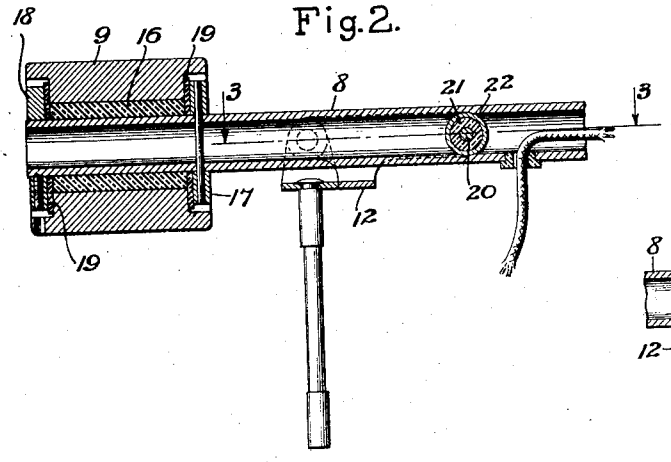



Fig.3.

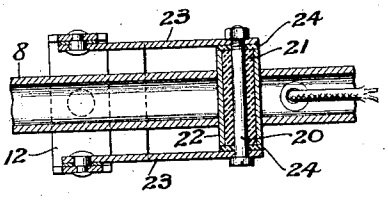
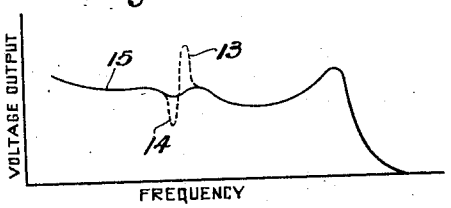



Fig.4.




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# UNITED STATES PATENT OFFICE

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## SUSPENSION MEANS FOR SOUND TRANSLATING DEVICES

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The present invention relates to suspension means for sound translating devices, such as electric pickup devices and the like, whereby such devices may be mounted in sound translating apparatus and may be permitted to move in operative relation to sound records.

A common form of such suspension means includes an elongated arm member or beam, arranged to carry the translating or pickup device at one end of it, and pivotally mounted in a suitable pedestal or fixed supporting means adjacent its opposite end to permit the necessary horizontal and vertical movement of the device incident to its use and operation in connection with a moving or rotating sound record disc or tablet. A suitable counterweight may be provided upon the arm to relieve the pressure of the stylus of the translating device upon the record groove in the record tablet.

A beam of the character of the usual suspension arm cannot be made perfectly rigid, and in a sound translating apparatus, vibrational movement takes place therein, laterally in a plane and torsionally about its longitudinal axis. Torsional vibration takes place, in many types of suspension arms such as those of the beam type above referred to, generally about its longitudinal axis, or about an axis approximately determined by and extending through the center of mass of the pickup device and the pivotal connection of the arm with its support, and is caused chiefly by vibrational movement of the stylus, in translating the sound record.

Vibrational waves are generated by and transmitted from the stylus to the suspension arm through the mechanism of the translating device or pickup and travel along the arm to the counterweight or mass at the opposite end where they are reflected back along the arm to the translating device or pickup and produce an irregularity in the voltage-frequency output characteristic thereof, by changing the relative movement between the stylus and the body of said device. When the generated and reflected waves are in phase, a peak occurs in this relative movement, and when in opposition, a depression.

Such irregularties are objectionable in the reproduction of sound, since they are accompanied by a corresponding distortion of the volume of the sound being translated, and for the further reason that they are often accompanied by an imperfect tracking of the stylus of the pickup in the record groove, particularly for sounds of low frequency and great amplitude.

An object of the invention is therefore, to provide an improved suspension means for a sound translating device which is free from the above described objectionable effects.

A further object of the invention is to provide a suspension means for a sound translating device in which the effect of torsional vibration therein, upon the translation of sound, is rendered unobjectionable.

A further object of the invention is to provide, in a suspension arm assemblage for a sound translating device, means for damping or absorbing torsional vibrational forces therein, thereby to prevent its reflection to the translating device and a resulting distortion in the translating action of said device.

The above objects are accomplished by providing, in a suspension means, a structure or means for absorbing the energy of the vibrational forces and thereby damping the vibrational waves which such forces set up tending to introduce distortion into the translation of sound by the translating device or pickup. I have found that suitable means to this end, include a body of energy absorbing material positioned between the mass of the counterweight and the beam or arm, by which arm the translating device is carried, said material being arranged to insulate mechanically the counterweight from the arm against the transmission of vibrational forces. Similar material is also provided, to this end, preferably in the pivotal mounting of the beam or arm on its support or pedestal, whereby the beam or arm is provided with a damping means between it and its fixed support.

Other objects and advantages of the invention will appear from the following description when considered in connection with the

accompanying drawing, and its scope will be pointed out in the appended claims.

In the drawing:

Fig. 1 is a view in perspective on a reduced scale, of a suspension means embodying the invention and adapted for an electric pickup device;

Fig. 2 is a sectional view, on the same scale, of an end portion of the suspension means of Fig. 1, more clearly illustrating the construction embodying the invention;

Fig. 3 is a sectional view, also on the same scale, of a detail of construction taken on line 3—3 of Fig. 2, and

Fig. 4 is a curve diagram illustrating the operation of the suspension means and pickup device shown in Fig. 1.

Referring to Figs. 1, 2 and 3 of the drawing, 5 is a sound translating device of the electric pickup type which is held in operating relation to a sound record 6 is a phonograph apparatus 7 by a suitable suspension arm 8 in the form of a tube to which it is secured at one end.

The opposite end of the arm or tube is provided with a counterweight 9 for the arm and the translating device, whereby the latter is caused to engage the record 6 through its stylus 10 without excessive pressure.

The suspension arm is pivotally mounted to move in a vertical plane on a suitable pivot axis 11 provided in a suitable bracket or pedestal 12 mounted in the apparatus 7.

In an arrangement of this character wherein the suspension means is rigidly mounted, the suspension arm or beam, carrying the mass of the translating device at one end and the counterweight mass at the opposite end, is subjected to a torsional vibration transmitted from the stylus of the translating device operating connection with the record 6. At the natural frequency of the counterweight mass and the torsional compliances of the suspension means, the movement of the translating device produces an irregularity in the translation characteristic of the device. Referring to Fig. 4 along with Figs. 1, 2 and 3, in the case of an electric pickup device of the character indicated, the voltage output-frequency characteristic curve is considerably distorted at a certain point as indicated at 13, 14 in such a characteristic curve 15 for the device shown. I have found that this result is occasioned by torsional vobration about the axis of the suspension arm at the natural frequency of the suspension means when the counterweight is rigidly secured to the arm. A point of reflection is produced which causes standing waves in the suspension means. To prevent such distortion, a body of vibration absorbing material is interposed in the suspension means, preferably between the mass of the counterweight and the suspension arm, thereby reducing the effect of the resonance in the arm at the natural period of vibration thereof.

Accordingly, there is provided in the construction of the present example, a body 16 of resilient vibration damping material, such as soft rubber, interposed between the mass of the counterweight 9 and the arm 8, as indicated more clearly in Fig. 2. The resilient damping material is placed on the tubular arm of the present example in the form of a sleeve upon which the counterweight is mounted in the form of an annular ring. The counterweight assembly is then held against axial movement along the arm by two collars 17 and 18 secured to the arm as indicated. Interposed between the collars and the counterweight assembly are two washers 19 of the same or similar resilient material.

The pivot axis 11 of the arm is also preferably provided with means for absorbing vibration so that the support or pedestal 12 may also be prevented from providing a point of reflection for resonance vibrations. To this end, as indicated more particularly in Fig. 3, the pivot axis of the arm is provided by a pin 20 which is surrounded by a tubular body 21 of vibration absorbing or resilient material, such as soft rubber, and this in turn is carried by tubular member 22 pressed into and secured to the arm at a right angle to the axis thereof. The pin is carried at its ends by two arms 23 of the pedestal means and the tubular carrying member 22 is insulated therefrom mechanically at its ends by suitable washers 24, also of the same or similar resilient insulating material.

The introduction of the resilient insulating material between the counterweight mass and the suspension arm, and in the pivot axis of the arm between it and the fixed pedestal or supporting means, introduces mechanical resistance into the mechanical oscillating system and greatly reduces the amount of distortion of the output frequency characteristic of the translating device. For example, I have found that an arrangement of the character shown and described serves to flatten the distortion curve indicated at 13 and 14 of Fig. 4 to that indicated by the solid line of the curve 15 therethrough, thus greatly improving the character of the output of the translating device.

Any suitable vibration damping material, such as rubber, felt and the like, may be employed to provide the bodies 16 and 21 of the present example, and it is obvious that in other forms of translating device suspension means that the bodies may assume forms other than the simple tubular means as shown, although they are at present preferred as the tubular construction greatly facilitates production and assembly, with resulting reduction in the cost of manufacture.

From the foregoing description, it will be seen that in accordance with the present in-

vention, there is provided in a suspension arm assembly for a sound translating device, a vibration absorbing body interposed, preferably, between the mass of the counterweight for the translating device and the suspension arm proper, while at the same time the arm is mechanically insulated from its fixed support by a similar body of vibration absorbing material interposed between it and said support at the pivot axis about which it operates.

While I have illustrated and described what is at present believed to be a preferred embodiment of my invention, it should be understood that the invention is not limited to the construction shown and may be embodied in other forms within the scope of the appended claims.

I claim as my invention:

1. In a sound translating apparatus, the combination with a sound translating device, of a suspension arm therefor rigidly secured thereto, a supporting means for said arm providing a pivot axis about which said arm may move, a body of vibration absorbing material surrounding said pivot axis and being interposed between said supporting means and said arm, a counterweight for said arm, and means providing a second body of vibration absorbing material interposed between said arm and said counterweight.

2. In a sound translating apparatus, the combination of a sound translating device, a suspension arm therefor, a body of relatively great mass carried by the arm, and means interposed between said body and the arm for absorbing vibrational forces set up in said arm.

3. In a sound translating apparatus, a suspension arm, a sound translating device secured thereto, means providing a pivotal mounting for the arm, a counterweight carried by the arm and means for reducing the energy of vibration induced in the arm by operation of said device, said means including a body of vibration absorbing material interposed between the counterweight and the arm and a second body of vibration absorbing material interposed between the arm and said mounting means.

4. In a device of the character described, a suspension arm, a sound translating device carried by said arm, a counterweight carried by said arm, said device and counterweight being arranged in spaced relation to each other at opposite ends of said arm, a pivotal support for the arm connected thereto intermediate of its ends, and a resilient cushion means interposed between the counterweight and the arm.

5. In a device of the character described, a suspension arm, a sound translating device secured to the arm, a vibration reflecting body carried by the arm in spaced relation to said device and a body of vibration damping material interposed between the arm and said first named body.

6. An electrical sound translating unit including in combination an electric pickup device having a movable stylus, a tubular suspension arm for said device to which said device is secured at one end, an annular body surrounding said arm at the opposite end thereof to provide a counterweight for the translating device, a tubular body of resilient vibration absorbing material interposed between said counterweight and said arm and providing a connection between them, a pin providing a pivot axis for the arm, and a second body of resilient vibration absorbing material surrounding said pin and interposed between it and said arm, and a supporting means for the arm connected with said pin.

7. In an electrical sound translating unit including an electric pickup device having a movable stylus, and an elongated suspension arm therefor, means for reducing the effects of suspension arm resonance therein due to vibrational movement of said stylus, including a rigid connection between said arm and said device, a body of relatively large mass providing a counterweight for said device on said arm, a body of resilient material interposed between the counterweight and the arm, said counterweight and arm being thereby insulated against the transmission of undesired vibrational forces between them, and a resilient pivotal support for the arm, said pivotal support including a second body of resilient material whereby said arm and pickup device are insulated from the support against the transmission of undesired vibrational forces.

In testimony whereof, I have hereunto subscribed my name this 11th day of May, 1931.

JOHN A. TERRELL.