June 14, 1927. 1,632,416

C. E. PEARSON

ADJUSTING MEANS FOR SOUND REPRODUCING MECHANISM

Filed Oct. 13, 1926 2 Sheets-Sheet 1

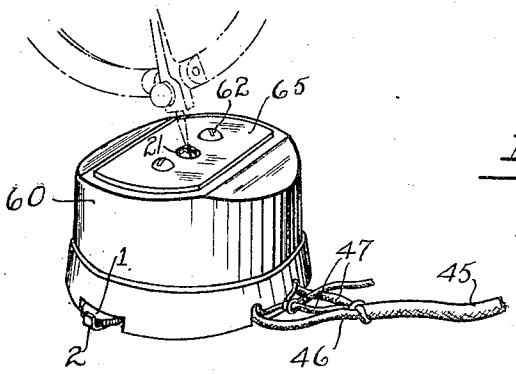
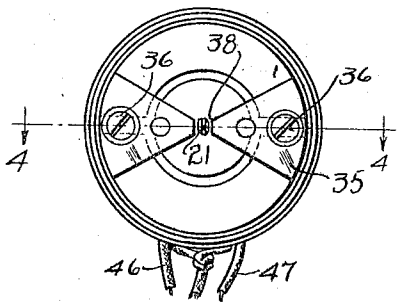


Fig. 1

Fig. 2



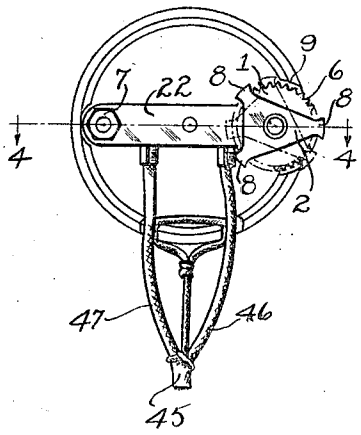


Fig. 3

Inventor

Carl C. Pearson

By Bates, Macklin, Golrick & Teare

Attorneys

June 14, 1927. 1,632,416

C. E. PEARSON

ADJUSTING MEANS FOR SOUND REPRODUCING MECHANISM

Filed Oct. 13, 1926 2 Sheets-Sheet 2

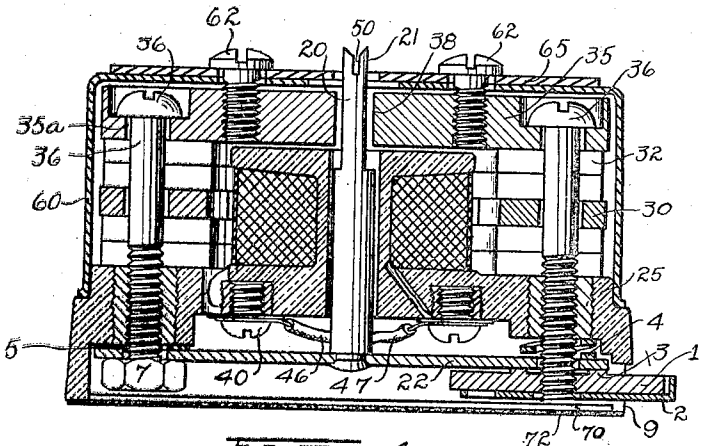


Fig. 4

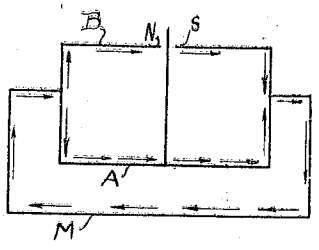


Fig. 5

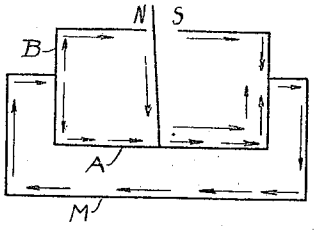


Fig. 6

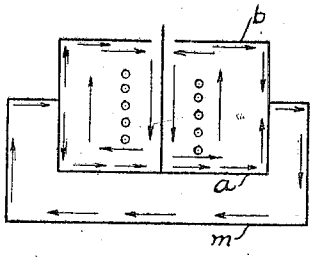


Fig. 7

Inventor

Carl E. Pearson

By Bates, Mecklin, Gobrick & Teare

Attorneys

Patented June 14, 1927. 1,632,416

UNITED STATES PATENT OFFICE.

CARL E. PEARSON, OF CLEVELAND, OHIO, ASSIGNOR TO THE CLEVELAND TRUST COMPANY, TRUSTEE.

ADJUSTING MEANS FOR SOUND-REPRODUCING MECHANISM.

Application filed October 13, 1926. Serial No. 141,404.

This invention relates to sound reproducing devices of the type generally disclosed in the application of Frank J. Kaehni and William L. Kaehni, Serial No. 742,633 filed October 9, 1924 and also shown in connection with the application of Pearson, Kaehni and Smith, Serial No. 754,495 filed December 8th, 1924. The common characteristics of these inventions is that an electric current of audio frequency is used to effect a mechanical vibration of a diaphragm generally through the medium of the stylus and sound box of a phonograph. It is among the objects of the present invention to achieve a refinement of operation and a nicety of adjustment that has not heretofore been obtained.

It has been found in operating devices of this sort that under certain conditions the reed or vibrating member has been found to stick against one of the pole pieces or the other. To overcome this objectionable feature, the air gap has been widened. This obviously has been an undesirable expedient and has resulted in a less efficient and less satisfactory reproduction of sound. I have therefore been concerned both with the matter of adjustment and with the improvement in the quality of the sound produced by this device.

It appears that if the reed is placed by the manufacturer, exactly between two pole pieces, and the stylus or needle of the phonograph exerts a lateral pressure, either by reason of the machine being tilted or for some other external reason, that the reed may be forced nearer one pole than the other. In the event of the reed touching the pole it is apt to stick and render the device temporarily inoperative. Even if the reed were not to stick but merely touch one of the pole pieces while vibrating, a metallic or rasping sound would result which would greatly interfere with satisfactory reception. There is another factor which tends to urge the reed nearer one pole piece than the other and that is the quality or nature of the input current. If the reed is accurately adjusted in the middle of the air gap between the pole pieces and the input current is a true alternating current, that is, a current in which the instantaneous positive values are approximately the same as the instantaneous negative values, the tendency of the reed will be to vibrate with its amplitude evenly spaced relative to the center line of the air gap. If however, the input current is a pulsating current wherein all the values are either positive or negative but varying in amount the amplitude of vibration of the reed will be displaced from the center of the air gap.

Other objects will become apparent from the description hereinafter set forth, reference being had to the accompanying drawings which illustrate a preferred embodiment of my invention. The essential characteristics are summarized in the claims.

In the drawings Fig. 1 is a perspective view of the exterior of the apparatus positioned to carry a needle and a stylus of a phonograph; Fig. 2 is a top plan view the outer casing having been removed; Fig. 3 is a bottom plan view the lower cover plate having been removed; Fig. 4 is a vertical cross-sectional view taken along the line 4—4 of Fig. 1; Fig. 5 is a diagrammatic representation of the normal path of the flux due to permanent magnetism; Fig. 6 is a diagram representing the path of the flux due to the permanent magnetism, the reed being abnormally defected; Fig. 7 is a diagrammatic representation of the path of the flux due both to the permanent magnetism and to the excitation of the coil surrounding the reed.

In Fig. 1 the exterior of the device appears showing the casing 60, the outer periphery of the base 10, the adjusting nut 1 extending therethrough. The cord 45 contains conductors 46—47 which are adapted to lead actuating current to the device. Referring more particularly to Fig. 4, I will briefly describe the elements comprising the structure generally which is more adequately and accurately described in the applications mentioned above. The annular member 10, which may be made of hard rubber or insulating material such as "bakelite", comprises a base for the mechanism. In the center of the member 10 and extending upwardly I provide a spool shaped portion 11 with the upper flange 12a. In the spool may be wound the coil 15 which is adapted to receive the exciting current and act as a solenoid for actuating the device. A vertical central passageway is provided through the member 10 in which the reed 20 is disposed. This reed is of a highly permeable material and is responsive to slight change

in current value of the coil 15. The coil 15 is connected with leads 46 and 47 through the binding posts 40 as shown. In the base member 10 at 25 I provide internally threaded bushings which are firmly fitted or molded into the base. Mounted on the base I show approximately semi-circular laminated field members 32, (see also Fig. 2) spaced apart by the spacing member 30. These field members comprise of themselves a permanent magnet. On top of the members 32 (see also Fig. 2) are disposed the pole pieces 35 which may be pie shaped and may converge toward a central air gap in which the end of the reed 20 is disposed. One of the bushings 25 is reduced in vertical dimension to provide for the adjusting mechanism which will be presently described. The reed 20 may be of circular cross section for the greater part of its length but that portion of the reed which lies between the pole pieces is flattened as at 21. (See also Fig. 2.) In the upper end of the reed is a groove or a slot 50 in which the needle of the phonograph may be carried. By means of the enlarged openings 35ª in the pole pieces adjustment of the air gap can be made. Screws 62 clamp the name plate and the casing 60 onto the base 10. An opening in the casing is provided through which the reed may project. The screws 36 as shown project through the bushings 25 and present a threaded portion which is engaged by the nuts 7 and 1. Between the screws 36 and lying in the vertical plane of the pole pieces I provide a spring member 22 which may be made of spring steel and have a comparatively low permeability. The member 22 is firmly fastened between the nut 7 and one of the bushings 25, as shown. The spring may have an enlarged opening 5 whereby lateral adjustment may be effected. Thus the reed may be positioned centrally with regard to the pole faces 38. As mentioned above it is desirable for physical reasons to position the reed centrally between the pole faces but it is urgent for the sake of accurate reproduction of sound to have the magnetic center of the reed in the magnetic center of the field in which the reed vibrates. Referring now to the more delicate adjustment the nut 1 is threaded onto one of the screws 36 and is provided with an upturned annular flange 3 engaging the lower face of the spring 22 engaging the upper face of the spring 22. At this point I provide the spring 4 engaged by one of the bushings 25 as shown. Thus by movement of the nut 1, and by reason of the tension of the spring 4 the right hand end of the spring member 22, as shown in Fig. 4, may be raised or lowered which will in turn move the upper portion of the reed toward or away from one of the pole faces 38.

The outer periphery of the nut 1 may be grooved or knurled as indicated at 6. (See Fig. 3.) I provide a spider like member 2 with legs 8 which is adapted to be closely but removably fitted onto the nut in any given position. I provide a radial opening 9 in the annular depending flange of the base 10 through which part of the nut 1 may project. The legs 8 of the spider which are disposed within the annular flange of the base 10 will contact with the inner surface thereof adjacent the opening 9 when the nut is turned. It is my purpose that such adjustment be made when the device is assembled, that only minor adjustments need be made with the nut 1 when the device is in the hands of the user. The purpose of the spider is to limit the movement of the nut to an effective but harmless range. The lower cover plate 70 is adapted to fit closely to the bottom of the screws 36 so the spider cannot be removed from the nut except by removing the base plate 70. From the foregoing it appears that the spring 22 is aligned with the pole pieces 35. By so aligning the spring and pole pieces, raising or lowering one end of the spring gives a lateral movement or adjustment to the reed 20. There follows, however, another advantage due to this alignment which I believe an improvement over the prior disclosures mentioned above.

Referring more particularly to the diagrams in Figs. 5, 6 and 7, I indicate the path of the flux by the arrows flowing through the permanent magnet in the lower and outer loop. The path through the pole pieces the screws 36 and the spring 22 is indicated at A and B in the several figures. I conceive the path of the flux to be divided, part of the flux flowing through the pole pieces and across the air gap and through the upper end of the reed 20 in a direction transverse to the reed and the other path being through the screws 36 and the spring member 22, and under certain circumstances longitudinally of the reed 20. When the reed is positioned centrally of the air gap the flux due to the permanent magnetism it is thought to follow in the direction of the arrows (see Fig. 5) and seek a divided path as shown with no flux flowing longitudinally of the reed. I propose to so magnetize the permanent magnet that the flux density in the spring member 22 will be very high on the saturation curve of the material of which the spring is made. The advantage of this will appear from a study of the next diagram (Fig. 6) wherein is shown the reed 20 deflected out of the center of the air gap towards the north pole N. As the reed is deflected toward the north pole the tendency of the flux is to flow downwardly of the reed and to increase the flux density in the right hand portion of the spring member 22, with the result that the reed is tended to be drawn into contact with

the north pole. If the reed were allowed to be drawn into contact, it would of course stick. As I have already indicated the permanent magnetism is such that the flux density in the spring member has reached the saturation point for the given magnetomotive force, so that the effect of the reed moving toward the north pole is actually to increase the total reluctance of the path of the flux so that the magnetic attraction is lessened rather than strengthened and the tendency of the reed to stick is greatly reduced. In former structures where the spring lies in a vertical plane normal to the pole piece the flow of flux through the spring due to the permanent magnetism is negligible, and then when the reed is forced toward contact with one of the pole faces, it would merely create a new path or shunt for the flux through the spring, the reed and the body of the magnet, wherein the reed is given every opportunity to stick. Fig. 7 is a diagrammatic representation of the flow of flux under operating conditions. Showing the instantaneous direction of the flux resulting from the solenoid action of the coil 15, partly in opposition and partly supplementary to the permanent flow. The polarity or the intensity of polarity of the upper portion of the reed 20 is changed in response to the nature of the current in the coil 15 and vibration of the reed results which has sound characteristics. In the light of Fig. 7 it might again be pointed out that my adjusting means is particularly valuable where the average current value in any particular radio set has either decided positive or negative characteristics, so that the center of the magnet field is displaced from the center line of the air gap. In such instances I am able, by tipping the reed within the limits determined by the spider 2 and nut 1, to compensate for this magnetic displacement by physical displacement of the reed.

I claim:

1. In a sound reproducing device the combination of an annular magnet, pole pieces mounted on said magnet and having an air gap therebetween, a ferro-magnetic reed positioned in the air gap and adapted to vibrate therein, a leaf spring member for carrying said reed, positioned diametrically of said annular magnet and secured thereto at one end and means for adjustably securing the other end of the spring to the magnet whereby the reed may be moved in the said air gap.

2. In a sound producing device the combination of an annular permanent magnet, pole pieces diametrically mounted on one side of said magnet and providing an air gap therebetween a reed of ferro-magnetic material positioned in the said air gap, a leaf spring member of ferro-magnetic material disposed on the opposite side of said annular magnet and extending diametrically across said magnet in the plane of the said pole pieces, the said reed being fixed to the midportion of said leaf spring so that the spring vibrates in harmony with the vibration of the reed, and means for tilting the spring member whereby the position of the reed in the air gap may be changed.

3. In a sound reproducing device comprising a magnet having an air gap, the combination of a reed disposed axially of the magnet and passing through said air gap, means for carrying said reed and means operable from the exterior of the device including a resilient member and a screw and nut cooperating with said first named means whereby the position of the reed in the air gap may be adjusted.

4. In a sound reproducing device comprising a permanent annular magnet having pole pieces diametrically spaced on one side of said magnet and providing an air gap between the said pole pieces, the combination of a reed disposed axially of the said annular magnet and passing through said air gap, means for carrying said reed lying normal to the reed and substantially parallel to the pole pieces, means for effecting lateral adjustment between the pole pieces and said first named means, and means for moving said first named means from the parallel relation with the pole pieces whereby the position of the reed in the air gap may be changed both by lateral displacement between the reed and the pole pieces and by tipping the reed.

5. In a sound reproducing device comprising a magnet having an air gap, the combination of a reed disposed in said air gap, a member disposed at right angles to the reed and adapted to carry the reed, and means operable from without the device for adjustably securing said member to said magnet whereby one end of the member may be moved in a direction substantially parallel to the axis of said reed so that the reed may be tipped toward or away from one of the poles of the magnet.

6. In a sound reproducing device comprising a permanent annular magnet having pole pieces diametrically aligned on one surface thereof, the combination of a reed disposed axially of the said annular magnet and lying within said air gap, a member disposed on the opposite side of said magnet and lying in the plane of said pole pieces and adapted to carry said reed, and means comprising resilient means opposed to a screw and nut couple for adjustably securing said member to said magnet whereby one end of the member may be moved in a direction parallel to the axis of said magnet so that the reed may be tipped toward or away from one of the pole pieces.

7. In a sound reproducing device compris-

ing a permanent magnet having pole pieces with an air gap and a ferro-magnetic reed extending into the said air gap, a member adapted to carry said reed and being secured at one end to said magnet and means for adjustably holding the other end whereby the member may be tipped and the reed moved relative to the pole pieces.

8. In a sound reproducing device comprising a permanent annular magnet having diametrically positioned pole pieces thereon with an air gap therebetween, the combination of a ferro-magnetic reed extending into the said air gap, a leaf spring of permeable material positioned substantially parallel to said pole pieces and on the opposite sides of the magnet and adapted to have the said reed mounted securely in its mid portion, said spring being secured at one end to the permanent magnet and being adjustable in a direction parallel to the axis of said magnet at its other end, whereby the reed may be tipped toward or away from one of the said pole pieces.

9. A claim according to claim 7 wherein the reed carrying member comprises a steel spring having a permeability less than the permeability of the reed, wherein the spring is mounted in a plane of the pole pieces but on the opposite side of the magnet, and wherein the spring lies in the path of the flux of the permanent magnet and is adapted to be saturated thereby to a point where a great increase in magneto motive force is necessary to effect a slight increase in flux density therein.

10. In a sound reproducing device having a magnet with an air gap, the combination of a reed adapted to be positioned in the air gap, means for carrying said reed, an annular base member having a radial opening therein, and adjusting means extending through said opening and adapted to cooperate with said first named means whereby the position of the reed in the air gap may be varied from without the device.

11. In a sound reproducing device including a magnet with pole pieces providing an air gap therebetween and a ferro-magnetic reed positioned in the air gap, the combination of a non-magnetic annular base member adapted to carry the magnet and having a radial opening therein, means for carrying said reed, and adjusting means cooperating with said first named means and adapted to extend through the annular opening of said annular base member, said adjusting means including a circular nut with ribs and grooves in the periphery thereof and lying partly within said radial opening in the base member so that part of the nut lies without the opening and part of the nut lies within the base member and a spider-like member engaging the nut and limiting the movement of said nut by contact with the base member adjacent said opening.

12. A claim according to claim 10 wherein the spider-like member comprises a Y-shaped portion adapted to lie against one surface of the nut and three leg portions extending at right angles to the Y-shaped portion and adapted to removably engage the grooves and ribs in the edges of the nut.

13. In a sound reproducing device, the combination of a magnet, a magnetically responsive vibrating member adapted to actuate a sound producing diaphragm and being disposed in the field of said magnet, means for causing said vibrating member to vibrate in response to a variable electric current, a resilient mounting for said vibrating member and adjusting means for changing the normal relative position of said vibrating member and magnet.

In testimony whereof, I hereunto affix my signature.

CARL E. PEARSON.