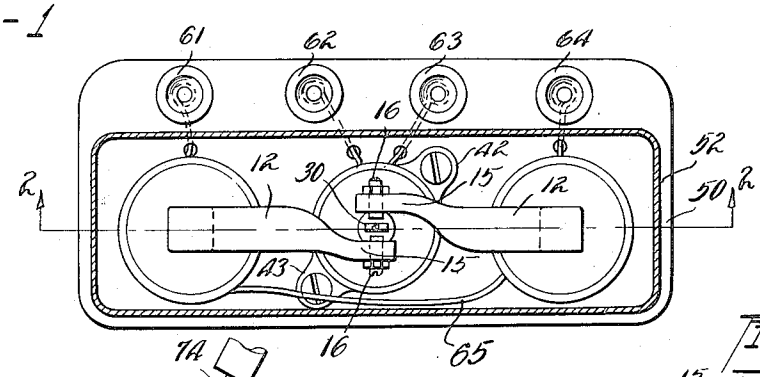
F. J. AND W. L. KAEHNI.

ELECTROMAGNETIC SOUND PRODUCING DEVICE.

APPLICATION FILED JUNE 9, 1922.

1,426,743. Patented Aug. 22, 1922.

Fig. 1



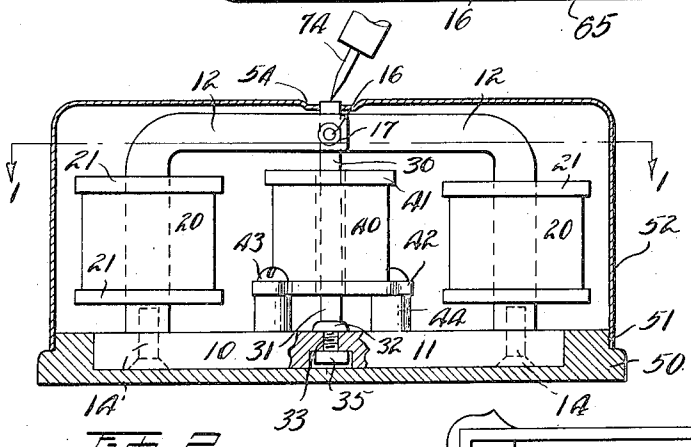
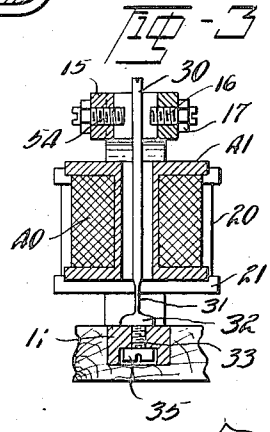


Fig. 2

Fig. 3



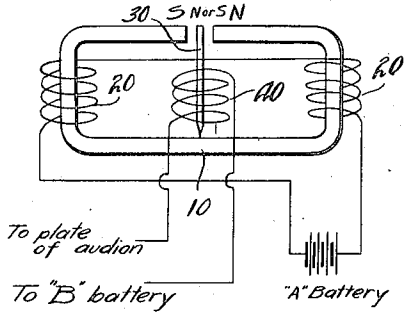


Fig. 5

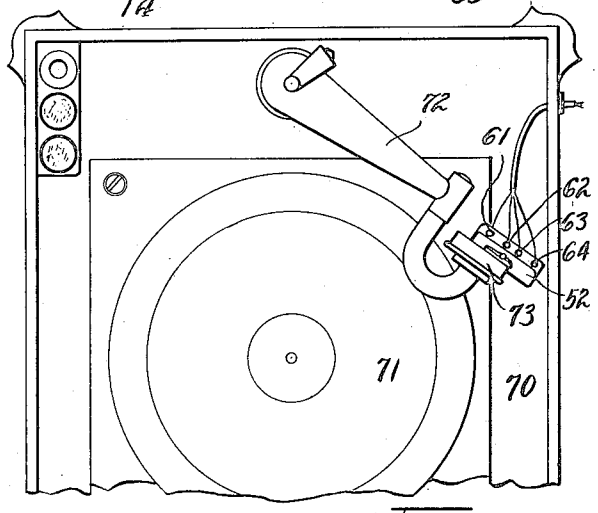


Fig. 4

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ELECTROMAGNETIC SOUND-PRODUCING DEVICE.

1,426,743. Specification of Letters Patent. Patented Aug. 22, 1922.

Application filed June 9, 1922. Serial No. 567,042.

To all whom it may concern:

Be it known that we, FRANK J. KAEHNI and WILLIAM L. KAEHNI, citizens of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Electromagnetic Sound-Producing Devices, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

The object of this invention is to provide a very simple electro-magnetic device for producing a comparatively large volume of sound corresponding in its rate of vibration to variations in the electric current through the device. Our sound producer has a vibratory magnetic member controlled by a coil and adapted to coact with a needle of a reproducing diaphragm as used in a phonograph.

Our vibrating device has a special use in radio telephony, and is well adapted to enable the current variations so caused to operate the reproducer of a standard phonograph and thus utilize such reproducer and the horn and sound chamber of the phonograph as a "loud speaker". Our device is very simple and compact and may readily stand on a phonograph table adjacent the rotating disc in position to be engaged by the needle of the reproducer without any change whatsoever in the phonograph mechanism.

Our invention is illustrated in the drawings hereof and is hereinafter more fully described and its essential features are summarized in the claims.

In the drawings, Fig. 1 is a plan of our sound producing device, and Fig. 2 is a side elevation thereof, the casing in each case being shown in section; Fig. 3 is a central vertical section transversely of the device; Fig. 4 is a plan of a phonograph showing our device in position thereon; and Fig. 5 is a diagram illustrative of the operation.

Referring first to Fig. 5, 10 indicates a horseshoe magnet, shown as an electromagnet energized by coils 20 connected with a suitable battery indicated by A. 30 indicates a bar of magnetic material which is fixedly mounted at one end and has its other end free and adapted to vibrate between the poles, N and S, of the horseshoe magnet. 40 designates a coil loosely surrounding the bar 30 and adapted to be placed in the plate circuit of a suitable audion.

When no current is flowing through the coil 40, the bar 30 is neutral, but the current in one direction through the coil 40 causes the upper end of the bar to become a north pole, while current in the opposite direction makes it a south pole. If it is a north pole, it will move toward the south pole of the horseshoe magnet; being both attracted by such south pole and repelled by the north pole, and of course, a current through the coil in the oposite direction produces a reverse movement. Thus, a vibration is given to the bar 30 dependent on the current variations in the circuit through the coil 40, and if the phonograph needle is resting on the upper end of the bar, such vibrations will be transmitted to the needle and thence to the diaphragm, producing sound vibrations in the horn and sound chamber. The upper end of the bar 30 has a small depression 38 adapted to receive the point of the phonograph needle.

Figs. 1 to 4 illustrate our device specifically embodied with reference to use in a phonograph. In these views, the horseshoe magnet consists of a suitable base 11 and two L-shaped arms 12 tightly secured thereto, as by screws 14. The vibrator bar 30 is secured to the mid-point of the core base 11. It has preferably a reduced shank 31 to enable its more ready vibration, an enlarged collar 32 below such shank, which is adapted to rest on the top of the base 11, and a screw-threaded stud 33 extending into the base. This stud receives a nut 35 for tightly holding the bar on the base member of the magnet.

The end portions of the magnet core are preferably narrowed and extend to the opposite sides of the vibrator bar, as shown at 15 in Fig. 1. Thus this bar being alternately repelled and attracted by each pole piece is caused to vibrate in a plane transverse to the general plane of the magnet core 10. Each of these end portions 15 carries an iron screw 16 threaded in the portion 15 and locked by a jamb nut 17. These screws form the ultimate pole pieces of the horseshoe magnet and by reason of their adjustment enable these pole pieces to stand equidistant from the bar 30 when the normal direct current from the "B" battery is flowing through the coil 40, or where there is normally no current.

The core member described may be a permanent magnet, but we prefer to make it of soft iron and surround it by one or more coils 20 heretofore mentioned which are energized by a suitable battery. There are preferably two coils 20 wound in the ordinary manner upon the core members 12 and between suitable heads 21. The coil 40 is wound on a hollow headed spool 41 through the bore of which the bar 30 loosely extends. As shown, the lower head of the coil 40 is extended to provide ears 42 for securing it in place, and suitable screws 43 pass through these ears and through distance blocks 44 into a suitable base.

The device mentioned is mounted on a suitable base, as for instance a wooden block 50 which as shown is recessed to receive the magnet base 11. It also receives the screws 43 which hold the coil 40 in place. 52 indicates a suitable casing which houses the various parts mentioned and may rest on a shoulder 51 of the base. This casing has an opening 53 in its top through which the bar 30 extends. The casing is preferably depressed about the opening as shown at 54, so that the bar will not extend beyond the casing and hence will not be liable to displacement.

The base 50 may readily extend at one side of the casing and be there provided with binding posts for the different circuits or other terminal arrangements may be made as desired. We have shown four binding posts 61, 62, 63, and 64 mounted on such extended portion of the base; the posts 61 and 64 forming terminals of the coils 20 (which are connected by a conductor 65), and the posts 62 and 63 forming the terminals of the coil 40.

In Fig. 4, 70 designates the table of a phonograph, 71 the rotating disc, 72 the sound arm, 73 the reproducer box thereof, and 74, Fig. 2, the needle of the reproducer. It will be noted that our magnetic device stands parallel to the general plane of the reproducer diaphragm and box, and the needle is thus vibrated in its normal direction, as when contacting with a record disc.

When our device is connected for use, the current from the battery A (which may be the usual six volt "A"-battery used in radio work) energizes the coils 20, and the audion may be connected with the coil 40 so that the current from the usual "B" battery in the plate circuit flows through this coil. The result is that the upper end of the bar 30 becomes a north or south pole of a certain intensity and thus moves a slight distance toward the south or north pole of the horseshoe magnet. The screws 16 having been adjusted so that the bar stands substantially mid-way of their ends when the "B" battery is on, the device is ready for use. Now, if the current from the "B" battery is varied by reason of variation in potential of the grid of the audion, the current through the coil 40 will be either strengthened or weakened. If strengthened, the bar 30 becomes a stronger pole than it was before and hence moves further toward the screw 16 of opposite polarity, while if the grid potential weakens the flow of current from the "B" battery, the bar 30 becomes a weaker pole than it was and moves in the opposite direction. We accordingly have vibrations of the bar 30 at audio-frequency corresponding to the variations in potential at the grid of the audion, and thus audio-frequency vibrations are transmitted directly to the phonograph needle causing sound from the sound arm and sound chamber.

If our device is coupled in the secondary circuit of an audio-frequency transformer, so that there is no direct current through the coil 40, the upper end of the vibrator will normally be neutral and will stand in mid position between the poles of the horseshoe magnet, but with an alternating current input will become alternately a north and a south pole, according to the direction of current. The result will be a vibration the same as already described.

The vibrations of the bar 30 are very slight, so slight as to be unobservable to the naked eye, though they may be detected by touch. Experience has demonstrated that they operate to give the needle the same kind of vibration which is received from an ordinary disc record and hence corresponding sound is produced. We have found that the mechanical resistance of the bar 30 and its inertia have a desirable effect in preventing extreme vibrations and reducing undesirable sounds caused by static electricity. We have accordingly been able to produce very satisfactory reproductions with this device.

Claims to the broader combination of a magnetic device actuating a phonograph reproducer are presented in applicants' copending application Serial No. 561,415, filed May 16th, 1922, for a sound reproducer, this application being limited to the separately magnetized armature connected to the phonograph reproducer needle.

We claim:—

1. The combination with a phonograph reproducer having a rockable stylus, a sound box, and a sound reproducing diaphragm, of a magnetic core having a pair of end portions adjacent each other overlapping and spaced apart, iron screws adjustably mounted in said end portions and forming pole pieces, a bar rigidly anchored at its lower end to the intermediate portion of the magnetic core and extending upwardly between said pole pieces and adapted to vibrate transversely to the general plane of the magnet core and having means at its upper end for connection to said phonograph stylus, a

coil surrounding said bar and spaced therefrom, and a casing surrounding the magnet and coil and having an opening adjacent the end of said bar.

2. The combination with a phonograph reproducing device comprising a sound box, a rockable stylus carried by the sound box, a sound reproducing diaphragm actuated by said stylus, of a base, a horseshoe magnetic core carried thereby having its end portions adjacent each other and overlapping and spaced apart, energizing coils on the two legs of the core respectively, an iron bar anchored at its lower end to the intermediate portion of the magnetic core and extending upwardly between said pole pieces and having a depression in its upper end for receiving a phonograph needle, a coil carried by the base and loosely surrounding said bar for changing the polarity of the bar causing it to vibrate said needle, and a casing surrounding the core and coils and bar and having an opening opposite the end of the bar to permit the stylus to engage said depression, said overlapping end portions of the magnet causing vibration of said bar transversely to the general plane of the magnet core and thus vibrating the needle transversely to the plane of the reproducer diaphragm.

In testimony whereof, we hereunto affix our signatures.

FRANK J. KAEHNI.
WILLIAM L. KAEHNI.