Feb. 8, 1944. G. HOLLAND 2,341,275

SOUND REPRODUCING INSTRUMENT

Filed Nov. 16, 1940

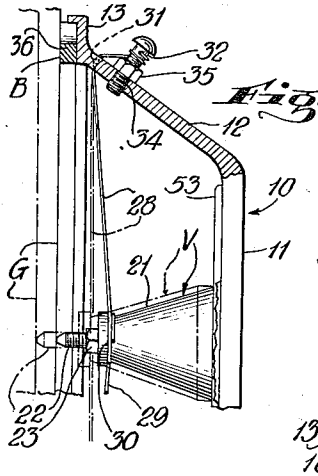


Fig. 3.

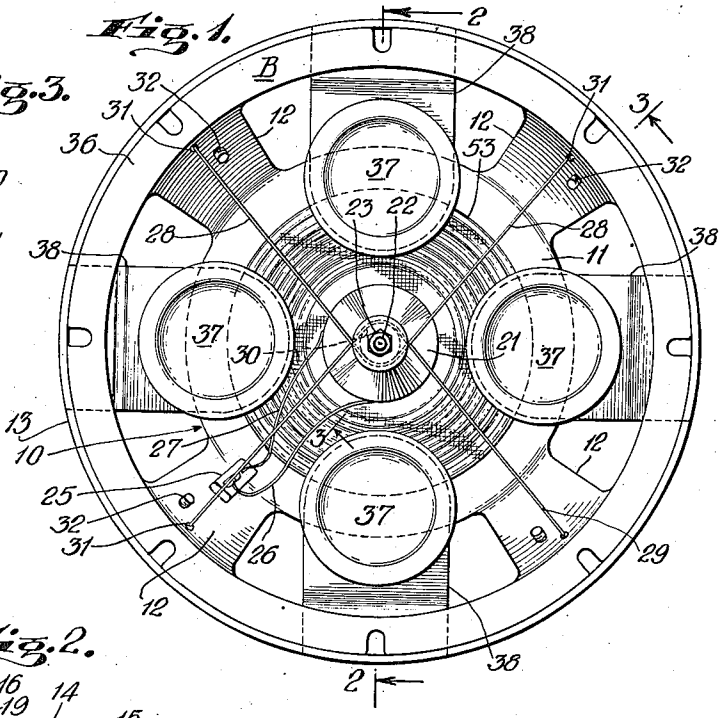


Fig. 1.

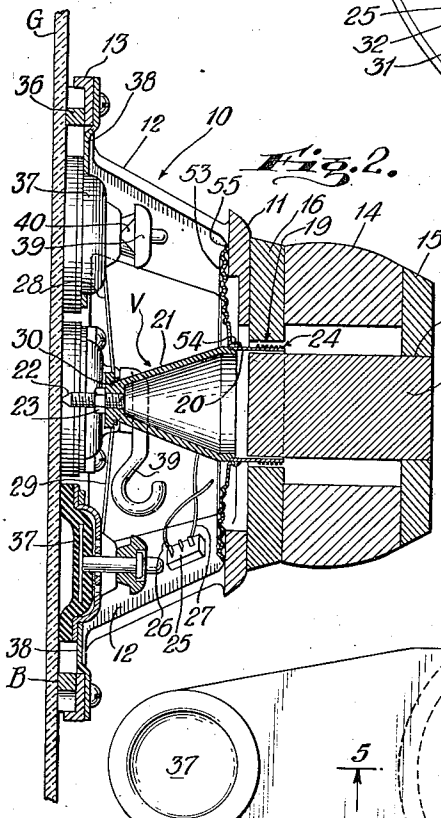


Fig. 2.

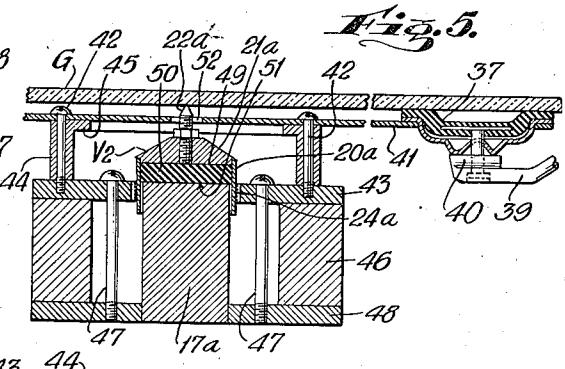


Fig. 5.

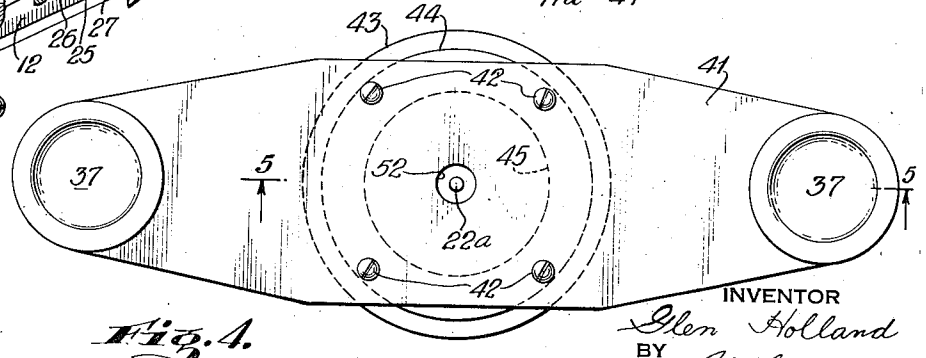


Fig. 4.

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Patented Feb. 8, 1944

2,341,275

UNITED STATES PATENT OFFICE

2,341,275

SOUND REPRODUCING INSTRUMENT

Glen Holland, Bronxville, N. Y.

Application November 16, 1940, Serial No. 365,929

12 Claims. (Cl. 179—115.5)

This invention relates to a sound reproducing instrument of the type utilizing a voice coil which is adapted to vibrate relatively to a magnetic field when electric current of audio frequency is conducted through the voice coil.

More particularly, my invention relates to means whereby vibrations in a voice coil may be imparted to any suitable sound producing medium, as, for instance, a table top, a pane of plate glass, or any other body which will act as a sounding board. Even more particularly, my invention contributes to the art a voice coil assembly which may be readily applied to any suitable medium for transmitting sound through said medium.

As a feature of my invention, I secure to a voice coil a stylus, which may have any particular shape desired, depending on the medium to which the vibrations of the coil are to be transmitted, and through this stylus, I transfer the vibrations of the voice coil to the particular desired medium. While I have found it possible, with actual structures which I have built incorporating my invention, to transfer the voice coil vibrations to many mediums, I have concentrated especially on the transmission of the vibrations to plate glass windows. This manner of utilizing my invention has great commercial value, since sound may readily be transmitted by the voice coil within a store window to the plate glass window, and therefore to the outside of a store. An application of this class is particularly desirable for advertising, for the giving of demonstrations, and for other uses which will occur to those skilled in the art.

As a feature of my invention, the voice coil of my instrument is yieldingly supported relatively to what I prefer to call a base member, and with a portion of the voice coil within a magnetic field maintained by means supported on the base member. The stylus which is mounted on the voice coil, may be applied to a plate glass window, for example, and with the yielding supporting means under stress through the suitable securing of the base member to the plate glass window. Such securing means I have found, in the case of a plate glass window, may be the usual type of commercial vacuum cup well known in the art, and which readily adapts itself to my purpose.

Naturally, with the entire structure secured as indicated, vibrations of the voice coil will, through the stylus maintained pressed against the plate glass window, transmit to the plate glass window the vibrations of the voice coil. It may be well to point out that the initial stress of the yielding supporting means of the voice coil, maintains the stylus firmly pressed against the plate glass window so that there will be no relative motion between the stylus and the window, which motion would create a knocking and pounding effect and would prevent an effective transmission of the sound vibrations, all as will be well appreciated by those skilled in the art.

As a feature of my invention, I utilize a rather novel means for mounting the voice coil relatively to the base member. In one modification, I utilize wires maintained under tension for holding the voice coil in a central initial position in the magnetic field relatively to which it vibrates. In a second modification, I secure the voice coil relatively to a core member mounted in the magnetic field through what I prefer to call a rubber bearing. This rubber bearing may be fabricated from highly resilient sponge rubber, or conceivably from some suitable artificial product having properties similar to sponge rubber.

As a further feature of my invention, I provide means for protecting the magnetic field from the entrance of foreign particles therein, all as will be set forth hereinafter. I have thus set forth the general theory of operation of my invention, and its particularly outstanding features in order that the specific forms of mechanisms embodying my contribution to the art which I shall hereinafter describe, may be better understood.

For a description of specific preferred forms of my invention, I shall refer to the drawing wherein Fig. 1 is a view showing the assembly of my sound reproducer looking toward it from the side which is secured to the plate glass window in a preferred application thereof. Fig. 2 is a view along lines 2—2 of Fig. 1, while Fig. 3 is a view taken along lines 3—3 of Fig. 1. Fig. 4 is a view similar to Fig. 1 showing a modified form of my invention. Fig. 5 is a sectional view taken along lines 5—5 of Fig. 4.

Referring now more particularly to the drawing, and especially Figs. 1, 2 and 3, the base member of my invention is designated generally by reference numeral 10, and is preferably formed of a single casting having a circular base plate 11 and four radially and outwardly extending arms 12 terminating in a circular peripheral portion 13. For maintaining the magnetic field already discussed generally, I use a circular magnet 14, which may be formed of some suitable highly magnetic material, such as Alnico or Nipermag. The magnet 14 is suitably housed between circular low carbon steel plates 15 and

16, and is secured through the medium of those plates to the base plate 11 of the base member 10, as by a series of bolts which are not illustrated in the modification of Fig. 3, but which are shown in the modification of Figs. 4 and 5, and to which reference will be made later.

A central low carbon steel plug 17 is secured as by a pressed fit at 18 relatively to the plate 15, and is spaced relatively to a central circular opening 19 in the plate 16 to allow vibrating movement of a sleeve portion 20 of the voice coil assembly V relatively to the magnetic field maintained by magnet 14. Actually, the space between the plug 17 and the peripheral surface of the opening 19 of the plate 16 may be as little as .020".

The sleeve 20 of the voice coil assembly V is preferably formed of aluminum, as is an extending cone portion 21 thereof. Secured to the cone portion 21 is what I term a stylus 22, which is merely threaded into the end of the cone and then locked by a nut 23. Suffice it to say that the stylus 22 vibrates with the cone 21 and the sleeve portion 20 as audio frequency current traverses the wire coil 24 wound about the sleeve portion of the voice coil assembly, all in a manner which will be well understood by those skilled in the art. For supplying current to the voice coil, there is utilized a suitable plug member 25 from which wires 26 and 27 extend to the wire coil 24.

The voice coil assembly is held yieldingly by wires 28 and 29 in a predetermined position relatively to the magnetic field maintained by the magnet 14. Each of these wires fits within a portion of a groove 30 on the cone 21 of the voice coil assembly V, the ends of the wires extending through holes 31 formed in the arms 12, and into winding relation to screws 32 threaded at 34 into the arms 12. Lock nuts 35 secure the screws in any rotated adjusted position. It is obvious that by rotating the screws 32, the tension in the wires 28 and 29 may be increased or decreased to properly center the voice coil, and to determine the degree of tension with which it will be maintained in its predetermined normal axial position relatively to the magnetic field and the core 17, which predetermined normal position is shown in dotted lines in Fig. 3. It will be noted that the voice coil assembly V in its dotted line position of Fig. 3, the stylus 22 will lie beyond the plane of the medium to which the vibrations of the coil are to be transmitted when the peripheral portion B of the base member 10 is applied against the said medium. The application of the base member thus places the wires 28 and 29 under tension, and moves the voice coil out of its predetermined normal position. Incidentally, in Figs. 2 and 3, the medium is designated by the reference letter G, and is intended to represent a plate glass window.

In applying my sound reproducer to the plate glass window G, I place the base member 10 against the window until a circular washer 36 fitting against the circular peripheral portion 13 of the said base member, lies firmly against the glass G. In this position, the voice coil and the stylus 22 will move to the right relatively to the base member, as is best illustrated in Figs. 2 and 3, the wires 28 and 29 being stressed or tensioned as the voice coil and stylus so move relatively to the base member 10. It will be readily appreciated that if the voice coil now vibrates relatively to the base member 10 and the magnetic field, and since all vibrations will be toward the plate glass, it will have no motion relatively to that plate glass, thereby avoiding any hammering of the stylus against the plate glass. Actually, the vibrations of the voice coil will be accurately transmitted through the stylus to the plate glass window, the plate glass window acting as a sounding board, or diaphragm. Those on the outside of the window will hear reproduced the particular sounds intended to be reproduced by the voice coil.

For holding the base 10 of the sound reproducer against the plate glass window, I prefer to use a series of four vacuum cups 37 each secured through the medium of a bracket 38 to the peripheral member 13 of the base 10 of my instrument. The structure of the vacuum cups is shown, but need not be described in detail, it being quite apparent to those skilled in the art that when the actuating arm 39 of each of the vacuum cups is rotated, its cam portion 40 will raise the central part of the rubber vacuum cup 37 to hold the base member 10 firmly against the plate glass window, and of course with the wires 28 and 29 stressed, as has already been described. Naturally, securing means other than vacuum cups may be used if desired, and it is conceivable that in some installations where the instrument is to be used face downward, the mere weight of the instrument will be sufficient to apply the initial stress required.

In the modification of Figs. 4 and 5, I use a base member in the form of a plate 41, at the ends of which are maintained the vacuum cups 37. Secured to this base member through the intermediary of the bolts 42 is a plate 43, the said bolts passing through an annular flange 44 extending from a separator plate 45. A magnet 46, similar to the magnet 14 of my first modification, is secured to the plate 43 and therefore to the base member 41, by a series of four bolts 47 extending into a back retaining plate 48. A central plug 17a, similar to the plug 17 of the first modification, is secured to the plate 48, just as the plug 17 in the first modification is secured to the plate 15.

The voice coil assembly V2 of my modification of Figs. 4 and 5 is quite similar to that of Fig. 3, and is clearly shown in Fig. 5 as having a cone portion 21a and a sleeve 20a on which is wound the wire 24a. Instead of being supported in floating relation to the magnetic field by the wires 28 and 29, as is the voice coil assembly V of the first modification, the voice coil assembly V2 in Fig. 5 is cemented at 49 to what I call a rubber bearing 50, the rubber bearing in turn being cemented at 51 to the plug 17a. This rubber bearing may be of highly resilient sponge rubber, or any equivalent artificial material, so that it may yield to allow movement of the voice coil assembly and the stylus 22a thereof out of a normal position when the sound reproducer is applied to a plate glass window G, as in Fig. 5, for transmitting sound through the medium of said glass. The application of the instrument to the glass, as by vacuum cups 37, places the rubber bearing 50 under compression sufficient to maintain the stylus 22a firmly against the plate glass window G, as shown in Fig. 5. Audio frequency current will naturally traverse the wire 24a of the voice coil assembly, effecting a vibration of the voice coil and the stylus 22a the vibrations being transmitted to the plate glass window G as in the case of the first modification.

In the modification of Fig. 5, the base plate 41 is formed with a small opening 52, through which

passes the stylus 22a, it being the function of the plate 41 to prevent, so far as is possible, the entrance of particles into the field of the magnet 46. In the modification of Figs. 1, 2 and 3, the same result is obtained by a suitable diaphragm 53, which may be formed of cloth or screening, or any other material adapted for the purpose, it being quite clear that the diaphragm 53 is secured as through cementing at 54 to the periphery of the cone 21 of the voice coil assembly V, and by cementing at 55 to the base plate 11, it being quite clear that in this position, it functions quite well for the purpose for which it is intended.

While I have shown and described two particular forms of my invention which I prefer to utilize, those skilled in the art will readily understand how my contribution to the art may readily be embodied in other structures. I therefore expect to obtain a monopoly which will prevent the utilization of my contribution in physical forms other than those herein illustrated.

I now claim:

1. In a combination of the class described, a moving coil, a base member, means on said base member maintaining a magnetic field, tension wires extending between said coil and base member for yieldingly supporting said coil on said base member for movement relatively to said magnetic field, a stylus, means securing said stylus to said coil for movement therewith and through which the vibrations of said coil may be transferred to a suitable medium, and means for securing said base member to said medium with said stylus maintained pressed against said medium through the initial tensioning of said wires.

2. In a combination of the class described, a moving coil, a base member, means on said base member maintaining a magnetic field, tension wires extending between said coil and base member for yieldingly supporting said coil on said base member in a predetermined normal position relatively to said magnetic field and for movement relatively to said magnetic field, a stylus, means securing said stylus to said coil for movement therewith and through which the vibrations of said coil may be transferred to a suitable medium, and means for securing said base member to said medium with said stylus maintained pressed against said medium and out of its said predetermined normal position through the initial tensioning of said wires.

3. A device adapted for application to a sound producing medium comprising a moving coil, a base member, means on said base member maintaining a magnetic field, a readily compressible and expansible rubber bearing interposed between said coil and said base member for yieldingly supporting said coil on said base member for movement through said bearing relatively to said magnetic field, a stylus secured to said coil for movement therewith and through which the vibrations of said coil are transferred to said medium, and means for securing said base member to said medium with said stylus maintained pressed against said medium through the initial compression of said rubber bearing.

4. A device adapted for application to a sound producing medium comprising a moving coil, a base member having a contact surface adapted to lie against said sound producing medium, means on said base member maintaining a magnetic field, a readily compressible and expansible rubber bearing interposed between said coil and said base member for yieldingly supporting said coil on said base member in a predetermined normal position relatively to said magnetic field and for movement through said bearing relatively to said magnetic field, a stylus secured to said coil for movement therewith and through which the vibrations of said coil are transferred to said medium, said stylus projecting beyond the contact surface of said base member when said coil is in its normal position, and means for securing said base member with its contact surface against said medium and said stylus pressed by said medium out of its said predetermined normal position through the initial compression of said rubber bearing.

5. A device adapted for application to a sound producing medium comprising a moving coil, a base member, means on said base member maintaining a magnetic field, a metal core for said field secured to said base, a readily compressible and expansible rubber bearing interposed between said coil and said metal core for yieldingly supporting said coil on said metal core in a predetermined normal position relatively to said magnetic field and for movement through said bearing relatively to said magnetic field, a stylus secured to said coil for movement therewith and through which the vibrations of said coil may be transferred to said medium, and means for securing said base member to said medium with said stylus maintained pressed against said medium and out of its said predetermined normal position through the initial compression of said rubber bearing.

6. A device adapted for application to a sound producing medium comprising a moving coil, a base member, means on said base member maintaining a magnetic field, means yieldingly supporting said coil on said base member for movement relatively to said magnetic field, a diaphragm-like barrier extending from the periphery of said coil to said base member for protecting said magnetic field against the entrance of metal particles therein, a stylus secured to said coil for movement therewith and through which the vibrations of said coil may be transferred to a suitable medium, and means for securing said base member to said medium with said stylus maintained pressed against said medium through the initial stressing of said means yieldingly supporting said coil.

7. A device adapted for application to a sound producing medium to impart sound vibrations thereto, comprising a base member having a medium contacting surface, means on said base member maintaining a magnetic field, a moving coil, yielding means supporting said coil for vibration in said magnetic field, a stylus on the end of said coil, said yielding means holding said coil in a normal position in which its stylus extends beyond the medium contacting surface of said base member so as to be first to contact the medium as the base member is applied toward said medium whereby to prevent the securing of said base member to said medium until said stylus and coil are pressed back from said normal position through the stressing of said yielding means supporting the coil on the base member, and means for securing said base member with its medium contacting surface against said medium and with said stylus and coil pressed by the medium out of said normal position relatively to said base member through the stressing of said yielding means.

8. A device adapted for application to a sound producing medium to impart sound vibrations thereto, comprising a base member, medium engaging means secured on said base member,

means on said base member maintaining a magnetic field, a moving coil, supporting means yieldingly supporting said coil for vibration in said magnetic field, a stylus on the end of said coil, said supporting means holding said coil in a normal position in which its stylus extends beyond said medium engaging means of said base member so as to be the first to contact the medium as the base member is applied toward said medium, said stylus and coil moving back from said normal position through the stressing of said supporting means by said medium as said medium engaging means effect engagement of said medium to support said base member on said medium while said stylus vibrates the medium.

9. A device adapted for application to a sound producing medium to impart sound vibrations thereto, comprising a base member, a series of securing devices spaced peripherally about said base member, means on said base member maintaining a magnetic field, a moving coil, supporting means yieldingly supporting said coil for vibration in said magnetic field, a stylus on the end of said coil, said supporting means holding said coil in a normal position so as to be the first to contact the medium as the base member is applied toward said medium, said stylus and coil moving back from said normal position through the stressing of said supporting means by said medium as said series of securing devices secure the said base member on said medium.

10. A device adapted for application to a sound producing medium to impart sound vibrations thereto, comprising a base member, a series of vacuum cups spaced peripherally about said base member, means on said base member maintaining a magnetic field, a moving coil, supporting means yieldingly supporting said coil for vibration in said magnetic field, a stylus on the end of said coil, said supporting means holding said coil in a normal position in which its stylus extends beyond said vacuum cups of said base member so as to be the first to contact the medium as the base member is applied toward said medium, said stylus and coil moving back from said normal position through the stressing of said supporting means by said meduim as said vacuum cups are stressed to secure said base member to said medium.

11. In a device of the class described, a base member, means on said base member maintaining a magnetic field, a coil adapted to move in said magnetic field, a cylindrical support piece on said coil, and wires extending from said base member and into contact with opposed portions of the circumference of said cylindrical support piece for holding said moving coil in said magnetic field and for movement therein through the stressing of said wires.

12. In a device of the class described, a base member, means on said base member maintaining a magnetic field, a coil adapted to move in said magnetic field, a cylindrical support piece on said coil, and wires for securing said moving coil in said magnetic field and for movement therein, each wire being fixed at its opposite ends to spaced parts of said base member and extending about a portion of the periphery of said support piece, the cumulative effect of said wires being to centralize and hold said moving coil in said magnetic field.

GLEN HOLLAND.