Feb. 25, 1969 D. E. THIELEN 3,430,007

DYNAMIC TRANSDUCER WITH WALL MOUNTED DIAPHRAGM

Filed March 16, 1966

FIG-1

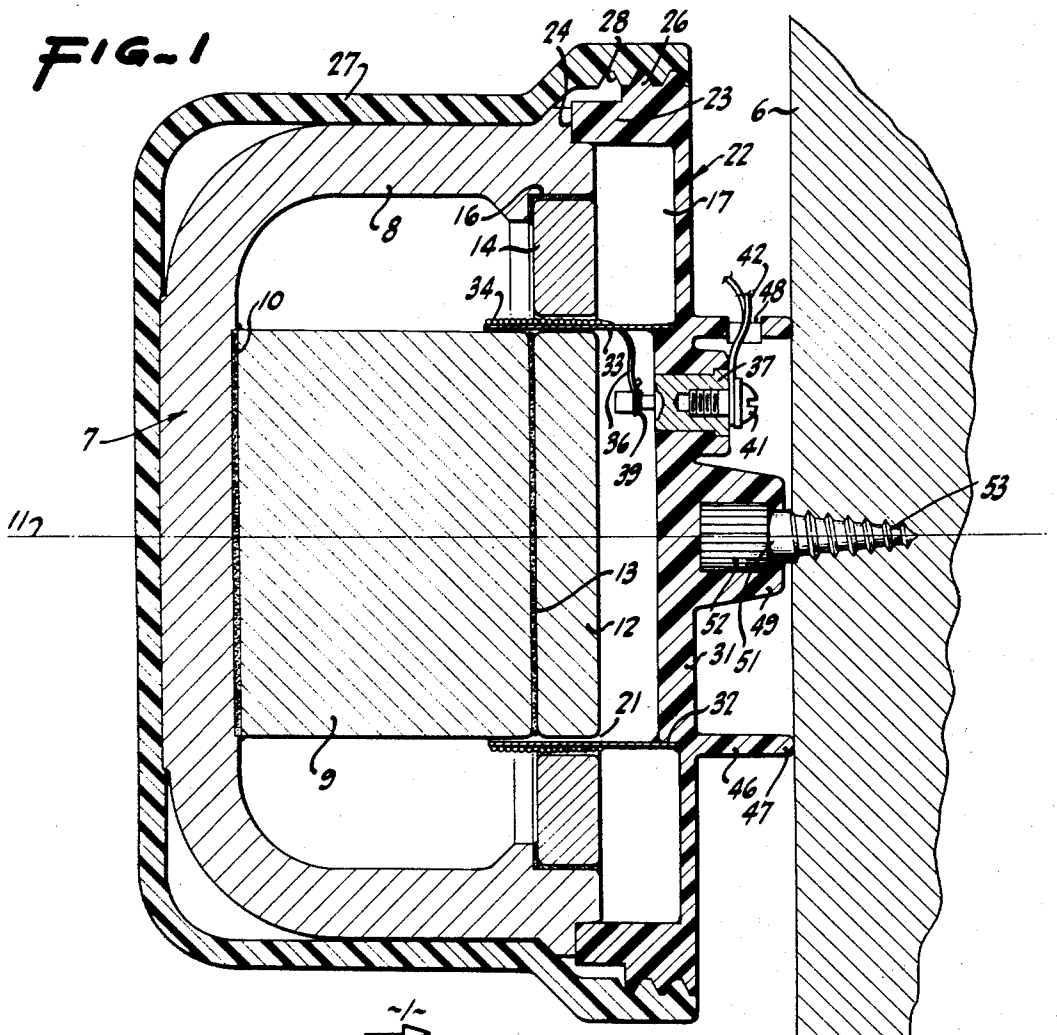
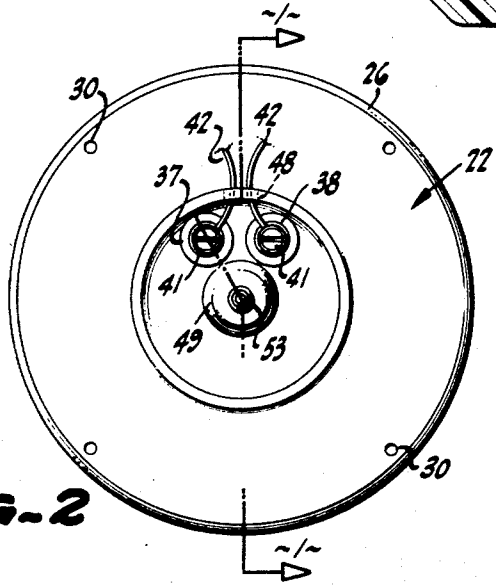


FIG-2



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DYNAMIC TRANSDUCER WITH WALL MOUNTED DIAPHRAGM

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ABSTRACT OF THE DISCLOSURE

A dynamic sound transducer with the sole means of support being the center of the diaphragm fastened to the wall by a screw-threaded device.

The invention relates to means for converting electrical energy into sound energy and is particularly concerned with a transducer or loudspeaker effective for use in sound or music systems such as address or background systems and in other environments in which sound is to be dissipated throughout a substantial volume. A device of a related character is disclosed in the copending application of John L. Jamison, filed July 28, 1964, Ser. No. 385,592, now abandoned.

There is often a requirement for dissipating sound such as music or voice throughout a volume such as a living room, office, hotel lobby or comparable space. The Jamison application does this by providing means for including part of the room construction in the transducer mechanism. Thus a transducer can be connected to the wall of a room in such a fashion that when the transducer is energized the entire wall or a substantial portion of it vibrates. This gives a general rather than a focal source. Equally. a transducer can be fastened to any vibratile panel such as a cabinet wall, desk top, a room ceiling or the like. This permits an unobtrusive or concealed installation.

It is therefore an object of the invention to provide an improved sound transducer for use in environments, especially for operation in connection with vibratile panels, such as room walls as indicated above.

Another object of the invention is to provide an improved sound transducer for inconspicuous installation and easy reinstallation.

A still further object of the invention is to provide a sound transducer which readily can be installed in existing structures without making any material disturbance therein and without requiring alterations in the construction or particular provision for transducer mounting.

Another object of the invention is to provide a sound transducer which has a long life in various environments and is generally protected from adverse influences in the environment; for example, outdoor weather or indoor fumes and the like.

Another object of the invention is to provide a sound transducer which can easily and quickly be installed by unskilled labor.

Another object of the invention is to provide a sound transducer which is relatively inexpensive to manufacture and which will operate for a protracted period without services, but which if service is needed can easily be disassembled.

Other objects together with the foregoing are attained in the embodiment of the invention described in the accompanying description and illustrated in the accompanying drawing, in which:

FIGURE 1 is a cross section to an enlarged scale on a diametral plane through the axis of the sound transducer of the invention, the plane of section being indicated by the line 1—1 of FIGURE 2; and

FIGURE 2 is an end elevation to a reduced scale of the mechanism shown in FIGURE 1.

The sound transducer pursuant to the invention can readily be embodied in a number of different ways but has been embodied commercially in the form disclosed herein. In this arrangement it is considered that the transducer is to be installed on any vibratile panel, referred to herein and in the claims as a wall. A representative wall **6** or panel for convenience is considered as a normal building wall, usually fabricated for studding and a covering sheet such as gypsum board or lath and plaster or the like, but the wall **6** may even be a mold member such as a plank or any other comparable member.

Designed to cooperate with the wall **6** is the transducer itself. This includes a magnet **7** usually formed of ferrous material, although a magnetic ceramic material can likewise be utilized. The magnet **7** includes an outer cup-shaped portion **8** leaving a hollow interior partially occupied by a central pole piece **9** symmetrical about an axis **11**. The pole piece **9** is secured in place by adhesive **10** and is conveniently augmented by a magnetic disk **12** secured thereto by a layer **13** of adhesive. All of these parts are magnetically permeable and one or more; for example, the piece **9**, are magnetized.

The magnet **7** also includes an integral or separate pole piece such as a disk **14** secured in position by an adhesive **16** and constituting a peripheral pole piece disposed alongside of an air volume **17**. The central pole piece **9** including the disk **12** and the peripheral pole piece **14** and the cup **8** constituting substantially all of the magnet **7** define a figure of revolution about the axis **11**. The dimensions of the peripheral pole piece **14** and of the central pole piece comprised of the members **9** and **12** are such that an annular air gap **21** exists therebetween extending from the air volume **17** to the interior of the cup **8**.

Pursuant to the invention, there is provided a generally planar but somewhat configured diaphragm **22** designed to abut and to extend across the magnet, particularly spanning the annular gap **21**. The diaphragm **22** is conveniently molded of a plastic material; for example, epoxy resin, fortified with fiber glass included therewith, so that the diaphragm, although capable of ready flexing at and somewhat above and below audible frequencies, is also effective as a mechanical support. The diaphragm **22** around its periphery is shaped to provide a flange **23** designed to seat in a corresponding groove **24** around the outside of the magnet **7** and is also provided with external coarse threads **26**. A jacket **27** also conveniently formed of plastic, although not necessarily a reinforced plastic, encases the magnet **7**. The jacket is enlarged around its periphery to provide internal threads **28** engageable with the threads **26** and designed so that the jacket can be screwed upon the diaphragm **22**. Depressions **30** in the diaphragm receive a wrench so that the diaphragm can be held as the jacket is rotated to form a tight joint. When the jacket is tightly in position, the parts, including the magnet, are all enclosed and protected against ambient conditions.

The diaphragm **22** adjacent its central portion **31** is somewhat thickened to provide a reinforcement and a shoulder **32** of annular configuration. The shoulder supports a tube **33** of inert material on which a voice coil **34** is wound and fastened. The tube **33** is adhesively secured to the shoulder **32** and the voice coil **34** is fast on the tube. Movements of the voice coil **34** are thus transmitted to the central portion of the diaphragm **22** and vice versa. The voice coil has a pair of leads **36**, each of which is secured to an individual one of a pair of conducting terminals **37** and **38** conveniently molded into the enlarged portion **31** of the diaphragm and extending inwardly so that the leads **36** can be connected thereto by solder joints **39** or the like. Preferably, the conductors **37** and **38** are centrally

drilled and tapped to receive fastening screws **41** to hold individual ones of a pair of external conductors **42** detachably in place.

The central portion **31** of the diaphragm is also contoured to provide a support ring **46** integrally formed therewith and projecting from the diaphragm on the side thereof opposite to that of the voice coil. The ring has a curved terminus **47** and at a convenient point has an opening **48** so that the conductors **42** can readily be passed therethrough.

The diaphragm **22** in its central portion and preferably concentric with the axis **11** is enlarged to provide a hub **49** projecting in a direction away from the voice coil. Embedded in the hub **49** is a suitable fastening member **51**. For most purposes this takes the form of an insert having an enlargement **52** embedded in the plastic and of irregular configuration so as to be locked therein. The fastening member also includes a threaded extension **53**. In the present instance, the threaded extension **53** is provided with threads comparable to those of the usual wood screw. Other extensions for adhesive attachment or carrying machine threads or a threaded socket or including a nail-like member or otherwise constituting a support, fastener and sound transmitter can be provided. Conveniently the hub **49** does not project along the axis quite as far as does the ring **46**, but the threaded part of the fastening member extends considerably farther along the axis.

In the installation of this device, it is simply taken in hand by a workman and the screw threads **53** are started into the wall **6**. The device is rotated as a body about the axis **11** until such time as the contoured edge **47** of the ring **46** is in firm abutment with the surface of the wall **6**. In the event the wall itself will not receive the screw **53**, a small block of wood, for example, can first be adhered to the wall and the screw can then be turned into the wood block.

When mounting has been accomplished, the conductors **42** connected to the conductors **37** and **38** are joined to any suitable source of audio current. When this circuit is energized, the audio current in the voice coil **34**, being situated in a magnetic field, causes the voice coil to move relative to the magnet **7**. The mass of the magnet and its associated materials is such with respect to that of the wall **6** that the wall itself vibrates very substantially in response to the movement of the coil. While of course the magnet **7** likewise is displaced, nevertheless a large portion of the electrical energy fed into the coil **34** is converted into vibratile energy of the wall **6**. Consequently, the wall and any associated structures vibrate with frequencies corresponding to those of the coil vibration, and the wall as a whole serves as a large diaphragm to dissipate the sound into the air.

The range of frequencies audible in the response depends quite a lot on the nature and character of the wall itself. It has been found in practice in normal installations in the customary environments that the wall itself serves as a very satisfactory dissipator of sound energy over a relatively wide range. Voices are easily reproduced with considerable fidelity and music of substantial range is itself reproduced with highly acceptable fidelity. Since the installation can be made either indoors or outdoors because the unit is entirely protected from its surroundings, and since the installation is made merely by rotating the unit about an axis with a single fastener, the labor of installation is easy and the transmission of the sound waves is readily accomplished in a highly satisfactory way without unwanted nodes of vibration being transmitted to the wall.

Because of the small size of the unit, it is quite unobtrusive even if installed in plain sight, and no structural or decorative changes need be made in its support. The unit can also be installed on the far side of a wall or ceiling and so does not affect room appearance at all.

While the principal present use of the device is as a loudspeaker, it can also serve as a microphone converting vibrations of the wall into output current in the conductors **42** for use in the usual way.

As an unexpected side result, it has been observed and confirmed by appropriate investigation that the effect of the vibration in the wall causes termites to abandon any infestation in the wall they may theretofore have made and inhibits them from establishing or conducting a new infestation. The reasons for or mechanism of this result are not now known.

What is claimed is:

1. A sound transducer for use with a wall comprising a magnet effective to establish a magnetic field, a vibratile diaphragm connected to said magnet, a voice coil disposed within said field and connected to said diaphragm, and a fastening member extending from said diaphragm in the vicinity of the connection of said voice coil thereto and adapted to engage said wall to support said sound transducer.

2. A sound transducer as in claim **1** in which said fastening member extends perpendicularly from the center of said diaphragm.

3. A sound transducer as in claim **2** in which said diaphragm has an annulus surrounding said fastening member and adapted to abut said wall when said fastening member is engaged therewith.

4. A sound transducer as in claim **1** in which said magnet is substantially a figure of revolution about a central axis to provide a central pole piece and a peripheral pole piece spaced therefrom to leave an intervening gap, said diaphragm is approximately planar and extends perpendicularly to said axis across said gap, said voice coil projects from one side of said diaphragm and is disposed within said gap, and said fastening member projects from the other side of said diaphragm along said axis.

5. A sound transducer as in claim **1** in which said magnet and said voice coil are connected to said fastening member solely by said diaphragm.

6. A sound transducer as in claim **1** in which the mass of said magnet with respect to that of said wall causes said voice coil when energized correspondingly to vibrate said wall in an audible manner.

7. A sound transducer as in claim **1** in which said diaphragm is clamped on said magnet and said fastening member is a screw-threaded device.

8. A sound transducer as in claim **1** in which said diaphragm is held on said magnet by a jacket encasing said magnet.

9. A sound transducer as in claim **1** in which said diaphragm includes a conductor adapted to be connected to said voice coil.

10. A sound transducer as in claim **1** in which said fastening member is a single screw.

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