June 1, 1965 C. D. MULLIN 3,187,115

TRANSDUCER MOUNTING

Filed Feb. 21, 1962

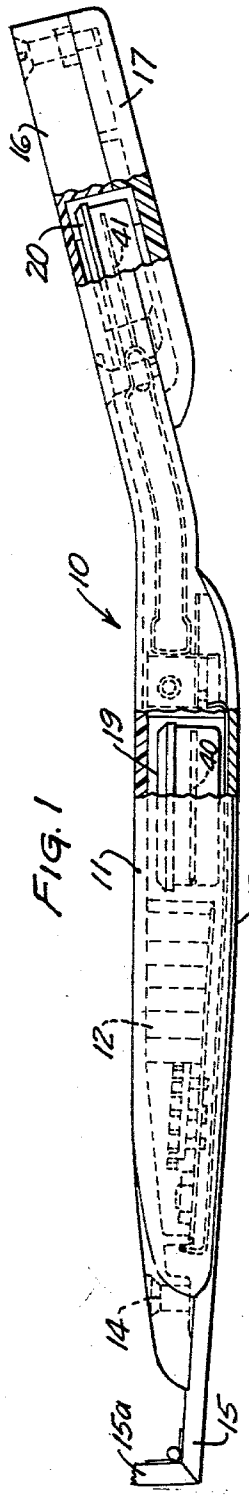


FIG. 1

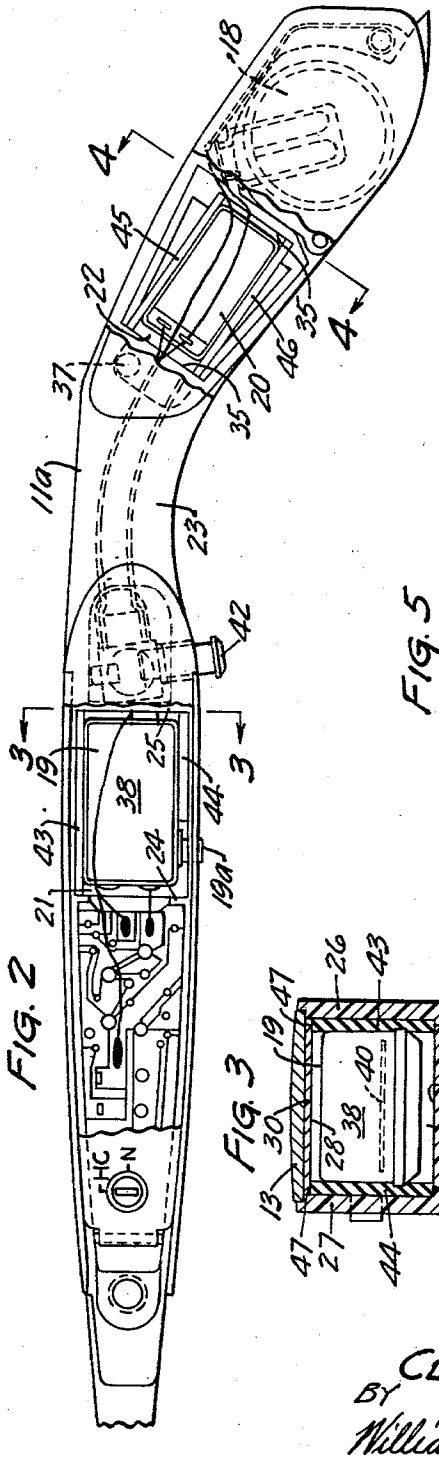


FIG. 2

FIG. 3

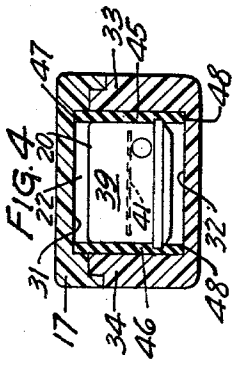


FIG. 4

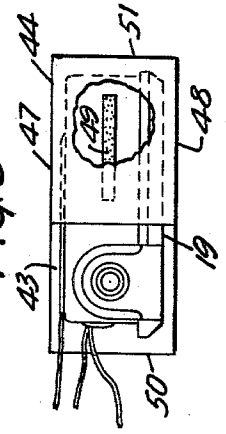


FIG. 5

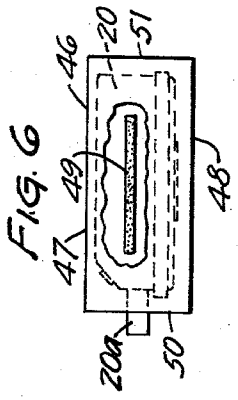


FIG. 6

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TRANSDUCER MOUNTING

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4 Claims. (Cl. 179—107)

This invention relates to hearing aids and more particularly relates to the mounting of electro-acoustical transducers of such hearing aids.

In recent years hearing aids have been substantially reduced in size, and are frequently mounted in extremely small housings which in some forms comprise or are mounted on the temple members of eyeglasses and in other forms are independently suspended on the wearers ear. When the several major components of the hearing aid, such as battery, amplifier, receiver and microphone are confined in a small housing, the physical isolation of the transducers, such as the microphone and receiver, from each other is important so as to prevent audio frequency vibrations from being transmitted through the housing from one transducer to another. Such feed back of audio frequency vibration will cause howling or squealing in the hearing aid and may have other undesired results. Frequently it is desirable to mount the transducers with their vibrating diaphragms lying in substantially parallel planes or in a common plane. When the transducers are so disposed the physical isolation to prevent vibration feedback or interaction, is particularly acute.

Although hearing aid transducer mountings have been known in the past, substantially all have been unduly complicated, or unsuitable to produce the desired result.

With these comments in mind, it is to the elimination of these and other disadvantages to which the present invention is directed, along with the inclusion of other novel and desirable features.

An object of my invention is to provide a new and improved hearing aid transducer mounting of simple and inexpensive construction and operation.

Another object of my invention is the provision of a novel mounting for hearing aid transducers which is readily and easily applicable to the transducers and permits mounting of the transducers in small spaces.

Another object of my invention is to provide a novel hearing aid with simple and inexpensive mountings carrying the receiver and microphone with their vibrating diaphragms disposed in parallel planes and producing physical isolation of the receiver and microphone so as to prevent vibration interference or feedback through the hearing aid housing.

These and other objects and advantages of my invention will more fully appear from the following description made in connection with the accompanying drawings wherein like reference characters refer to similar parts throughout the several views and in which:

FIG. 1 is a partial top plan view, partly shown in section of an eyeglass hearing aid device incorporating the present invention;

FIG. 2 is a partial elevation view, partly shown in section and embodying the present invention;

FIG. 3 is a detail section taken at 3—3 in FIG. 2;

FIG. 4 is a detail section taken at 4—4 in FIG. 2;

FIG. 5 is an enlarged detail side elevation view, partly broken away of one of the electro acoustical transducers embodying the present invention;

FIG. 6 is an enlarged detail elevation view, partly broken away and illustrating another of the electro acoustical transducers embodying the present invention.

The acoustical device or eyeglass hearing aid is indicated in general by numeral 10 and has a housing 11 for the hearing aid amplifier circuitry 12. All of the forward

interior chambers are closed by an elongate cover plate 13 which is secured to the housing 11 as by screws 14 and which projects forwardly at the front end portion 15 to which the hinge of the frame 15*a* will be connected at a suitable location, depending on the size of the person's head who will be wearing the hearing aid 10. A rear portion 16 of the housing 11 is designed to project rearwardly of the person's ear, and is provided with a cover plate 17 for enclosing the interior of the housing. The battery 18 for the amplifier circuitry 12 is disposed in the extreme rear end portion 16 of the housing and is connected to the circuitry by suitable wiring. The hearing aid 10 also includes a pair of electro-acoustical transducers which include the microphone 19 and receiver 20 which are respectively disposed in interior chambers 21 and 22 respectively and in the form shown, the microphone and receiver are respectively disposed at positions forwardly of and rearwardly of the person's ear which will be in supporting relation with the intermediate narrow portion 23 of the housing 11.

It will be seen that the interior chamber 21 of the housing has fore-and-aft endwalls 24 and 25, transverse sidewalls 26 and 27 and top and bottom walls 28 and 29 respectively. It will be seen that the top wall 28 is defined by an inner cover plate 30 which underlies the cover plate 13 and is at least semi-permanently affixed in the housing 11 so as to prevent tampering with the circuitry by inexperienced persons.

The chamber 22 has top and bottom walls 31 and 32 respectively, opposite sidewalls 33 and 34 and fore-and-aft endwalls 35 and 36 respectively. It will be noted that the top wall 31 of the chamber is defined by the cover 17 which is removable but which is normally held in position by nuts 37.

It will be noted that each of the transducers 19 and 20 has a generally box-like rectangular outer shell 38 and 39 respectively. The outer shells are proportioned similar to the shape of the chambers 21 and 22, but are somewhat smaller than the chambers. The outer shells 38 and 39 of the transducer 19 and 20 have tops and bottoms, opposite transverse sides, and fore-and-aft ends which are respectively positioned in confronting relation with the corresponding walls of the chambers 21 and 22, but are maintained in spaced relation with the chamber walls. The microphone 19 has a sound tube 19*a* which projects outwardly through an aperture in the housing 11 for transmitting sound into the shell of the microphone to produce movement of the diaphragm 40 thereof. Similarly, the receiver 20 has a sound tube 20*a* through which sound is emitted when the sounds are produced by the diaphragm 41 therein. It will be noted that the diaphragms 40 and 41 in the transducers lie substantially in planes located between the tops and bottoms of the transducers, and the diaphragms 40 and 41, being of substantially conventional construction as is common in electro-acoustical transducers of this type, will move in a direction substantially normal to the plane occupied by the diaphragms. It will be noted that the several diaphragms 40 and 41 of the transducers 19 and 20 lie in planes which extend longitudinally of the elongate housing 11.

The sound tube 20*a* of the receiver 20 communicates with a sound tube 11*a* in the housing 11 through which sound tube extends generally forwardly and then communicates with a nipple 42 projecting downwardly from the housing so as to be adapted for connection to a flexible sound tube and ear piece which will fit into the ear canal.

The electro acoustical transducers or microphone 19 and receiver 20 are provided with mounting slabs 43, 44, 45 and 46 which lie against the opposite transverse sides of the transducer shells 38 and 39 and against the

transverse sidewalls **26** and **27** of chamber **21** and sidewalls **33** and **34** of chamber **22**. The mounting slabs **43–46** are all constructed of resiliently compressible material such as rubber. The thicknesses of the slabs **43–46** is such as to substantially fill the space between the transducer shells and the transverse sidewalls of the chambers **21** and **22** without placing the slabs in a state of compression. Each of the slabs has upper and lower edges **47** and **48** respectively which engage the top and bottom walls **28** and **29**, and **31** and **32** of the chambers **21** and **22** respectively, and the slabs are of such sizes as to maintain the engagement of the edges as described without maintaining the rubber slabs in a state of compression.

Each of the slabs **43–46** is secured to the corresponding transverse side of the adjacent transducer shell by strips **49** of adhesive which extend along longitudinally extending lines substantially midway between the tops and bottoms of the transducers and parallel to the planes of the diaphragms **40** and **41**. It will be seen that the adhesive strips **49** are substantially narrower than the height of the transducers and very substantially narrower than the widths of the slabs between the upper and lower edges **47** and **48** thereof. The adhesive strips between the slabs and the transducer shells provide the sole means for physically attaching the slabs on the transducer shells.

It will be seen that the fore-and-aft end edges **50** and **51** of the slabs project endwise from the corresponding ends of the transducers and engage the end walls of the chambers **21** and **22** and maintain the transducers in spaced relation with these endwalls.

It will be seen that as the transducers **19** and **20** are operated, thereby producing vibration of the diaphragms **40** and **41** in directions substantially normal to the planes of the discs, the mounting slabs **43–46** will absorb the vibration of the transducer shells **38** and **39** and will substantially completely prevent any transmission of the vibrations to the substantially rigid plastic housing **11**. It will be seen that although the mounting slabs **43–46** are essentially planar in shape, a substantial length of the slab, between the adhesive strips **49** and the upper and lower edges **47** and **48** of the slabs is available for absorbing any vibration of the transducer shells **38** and **39** which may exist. The mounting slabs **43–46** will absorb vibration in directions through their thickness and in directions longitudinally thereof toward the end edges **50** and **51**, but vibration in these directions is relatively small as compared with the vibration in the direction normal to the planes of the diaphragms **40** and **41**. Although it is preferable that the mounting slabs have no normal compression in a direction between the upper and lower edges thereof, it will be recognized that certain manufacturing tolerances may cause some latent or residual compression of the rubber in this direction; but even if there is a slight compression, the compression is distributed over substantially the entire width of the slabs between the upper and lower edges **47** and **48** thereof so as to minimize the residual compression of the slab and thereby allow for a substantial additional compression due to the effect of the vibrating diaphragms.

It will further be noted that even though the transducers **19** and **20** are oriented such that the diaphragms **40** and **41** are both lying generally longitudinally of the housing **11**, the transducers are well isolated physically from the rigid housing **11** so as to prevent any transmission of the vibrations through the housing and thereby prevent any feedback of vibrations from the receiver to the microphone. It will be understood that the microphone **19** and receiver **20** are connected to the signal amplifying circuitry **12** and battery **18** in a substantially usual manner commonly employed in hearing aid amplifier circuits. It will further be understood that the exact nature of the amplifier circuitry **12** is of relative unimportance so far as the present invention is concerned.

It will be noted that the present invention allows the spaces between the tops and bottoms of the transducers

and the confronting top and bottom surfaces **28**, **29**, **31** and **32** of the transducer housing or compartments to be open and unobstructed and without the need for any resilient material in these spaces. The transducer mountings engage the top and bottom surfaces of the compartments along only a minimum of area and therefore minimize transmission of vibrations, because the slabs are secured to the transducers along only a line located substantially midway between the edges of the slabs, tolerance variations in the sizes of the slabs are relatively unimportant because any small degree of residual compression on the slabs is spread over substantially half the width of the slabs or substantially one-half the distance between the upper and lower edges **48** and **47** thereof.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the parts without departing from the scope of my invention which consists of the matter shown and described herein and set forth in the appended claims.

What is claimed is:

1. Transducer apparatus for mounting in an acoustical device,

comprising an electro-acoustical transducer having a diaphragm lying generally in a plane and moving in a direction normal to the plane, said transducer having an outer shell confining said diaphragm, said shell having opposite sides lying normal to said plane and having a top and bottom in juxtaposition with said plane, said top and bottom being spaced from each other by a predetermined distance,

a pair of mounting slabs constructed of resiliently compressible material and disposed in confronting and spaced relation with each other and respectively lying against said opposite sides of the transducer shell and substantially normal to said plane, said slabs having edge surfaces facing in multi-directions and spaced outwardly of the transducer shell for engaging the acoustical device,

and means securing each of said slabs to the corresponding side of the transducer shell along only a band extending parallel to said plane and between said top and bottom, said band having a width considerably less than said distance.

2. Transducer apparatus for mounting in an acoustical device,

comprising an electro acoustical transducer having a diaphragm lying in a plane and moving in a direction normal to the plane, said transducer having an outer shell confining said diaphragm, said shell having a top and bottom in juxtaposition with said plane and also having fore-and-aft sides and opposite transverse sides lying substantially normal to said plane, said top and bottom being spaced from each other by a predetermined distance,

a pair of mounting slabs constructed of resiliently compressible material and disposed in confronting and spaced relation with each other and respectively lying against said opposite transverse sides of the transducer shell and substantially normal to said plane, each of said slabs having edge surfaces disposed in spaced relation above and below the top and bottom respectively of the transducer shell for engaging and mounting on the acoutsical device,

and means securing each of said slabs to the corresponding transverse side of the transducer shell along only a band extending parallel to said plane and between said top and bottom and having a width considerably less than said predetermined distance, whereby vibration of the transducer in the direction of diaphragm movement is absorbed along the slabs between said band and said edges.

3. In an acoustical device, the combination of a housing having an interior chamber with top and bottom walls, fore-and-aft end walls, and opposite transverse sidewalls,

an electro acoustical transducer in said chamber and

having an outer shell with a top and bottom, fore-and-aft ends, and opposite transverse sides respectively confronting but spaced from the corresponding walls of the chamber, said transducer also having a diaphragm lying generally in a plane oriented substantially normal with the sides and ends of the shell and disposed in juxtaposition with and between said top and bottom of the shell,

a pair of mounting slabs constructed of resiliently compressible material and disposed in confronting and spaced relation with each other, said slabs respectively lying against said opposite transverse sides of the shell and against the corresponding sidewalls of the chamber in the housing, said slabs having upper and lower edge surfaces respectively engaging the top and bottom walls of the chamber in the housing and also having fore-and-aft end edges engaging the fore-and-aft endwalls of the chamber in the housing,

and means securing each of said slabs to the corresponding transverse side of the transducer shell along only a line extending substantially parallel to said plane and located between said top and bottom of the shell, whereby vibration of the transducer in the direction of normal diaphragm movement is absorbed along the slabs between said line and said edges.

4. In an eyeglass hearing aid, the combination of an elongate housing having a pair of interior chambers spaced from each other in a direction longitudinally of the housing, said chambers having top and bottom walls, fore-and-aft ends, and opposite transverse sidewalls,

a sound-receiving electro acoustical transducer in one of said chambers,

a sound-emitting electro acoustical transducer in the other of said chambers,

said transducers having diaphragms lying in planes extending longitudinally of the elongate housing, each of the diaphragms moving substantially normal to the corresponding plane,

each of the transducers having a pair of substantially planar mounting slabs constructed of resiliently compressible material and disposed in confronting and spaced relation with each other and respectively lying against the opposite transverse sides of the transducer shell and substantially normal to the plane of the corresponding diaphragms, each of said slabs lying against a corresponding sidewall of the chamber of the housing, and each of said slabs having upper and lower edge surfaces engaging the top and bottom walls of the chamber of the housing and also having end edge surfaces engaging the fore-and-aft endwalls of the chamber in the housing,

and means securing each of said slabs to the corresponding side of the transducer shell along only a line extending parallel to said plane and between the top and bottom of the shell,

and signal-carrying circuit means interconnecting said transducers, whereby vibration of the transducers in the direction of normal diaphragm movement is absorbed along the slabs between said line and said edges and thereby prevent feedback of vibrations through the housing and between the transducers.

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ROBERT H. ROSE, *Primary Examiner.*