June 5, 1962 H. W. BLOOM 3,038,038

ACOUSTICAL INSTRUMENTS

Filed Oct. 29, 1959

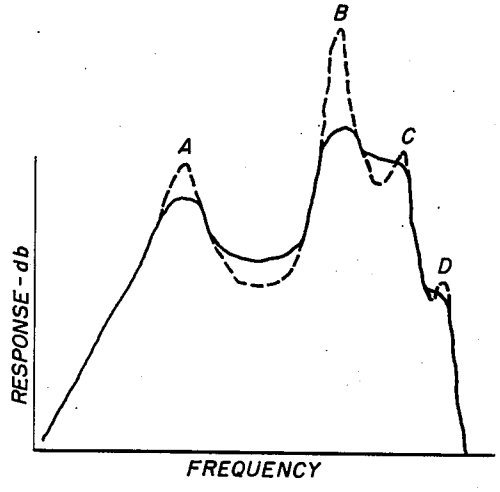


FIG. 1.

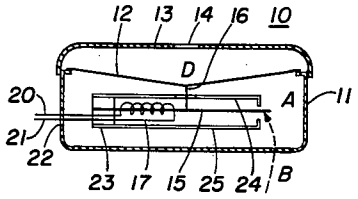


FIG. 2.

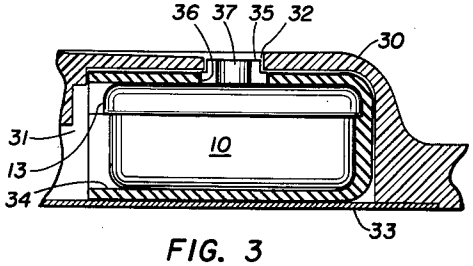


FIG. 3

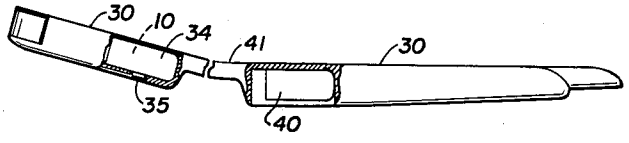


FIG. 4.

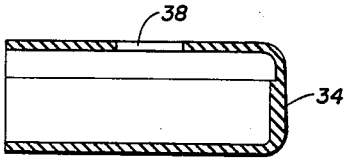


FIG. 5.

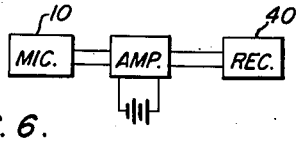


FIG. 6.

INVENTOR.
HOWARD W. BLOOM
BY Kenneth D. Siegfried
AGENT

United States Patent Office 3,038,038 Patented June 5, 1962

3,038,038

ACOUSTICAL INSTRUMENTS

Howard W. Bloom, Minneapolis, Minn., assignor to Maico Electronics, Incorporated, Minneapolis, Minn., a corporation of Minnesota

Filed Oct. 29, 1959, Ser. No. 849,494
5 Claims. (Cl. 179—107)

This invention relates to the field of acoustical instruments and more particularly to the field of hearing aids and hearing aid components.

A problem frequently encountered with miniaturized hearing aids worn on the body and especially with eyeglass hearing aids is that of oscillation or "singing" in the receiver of the hearing aid due to feedback between the hearing aid receiver and microphone. The problem is most acute in the miniaturized hearing aids because of the relative compactness of the hearing aid components within the hearing aid housing. The problem is made even more acute in eyeglass hearing aids because in the attempt to produce more natural hearing, it is desirable to locate both the receiver and the microphone as near to the ear as possible. By placing the components in near proximity to each other, especially the microphone and receiver, the oscillation problem is amplified. In some cases, the close proximity is prohibited by the unwanted oscillations or vibrations which are set up in the hearing aid and received by the wearer through the acoustical means provided to conduct the sound to the ear.

One method of reducing the feedback oscillations between the receiver and microphone is to use a form of resilient means to support the receiver and thereby reduce the coupling between the receiver and the hearing aid housing. However, the microphone is still sensitive to sounds produced by the wearer's clothing on miniaturized hearing aids and is also subject to certain internal housing acoustic pressures built up within the chamber of the housing which contains the microphone in both miniaturized and eyeglass hearing aids. These pressures are developed by vibrations of the hearing aid case and/or the housing which forms a part of the body member of the hearing aid, and are further developed as the result of air being trapped between the microphone and the wall of the chamber in which it is placed, and where the air is compressed by the movement of the microphone with respect to the housing due to normal movements of the wearer as well as movements of the microphone casing caused by its own operation.

Each microphone generally has several parts which can produce resonant vibrations at different frequencies. The response of the microphone at these resonant frequencies is irregular in that the sensitivity tends to "peak" at the resonant points and thus the resonant points aid the feedback between the microphone and receiver to further aggravate the oscillation problem.

The present invention contemplates isolating the microphone in such a manner that the vibrations caused by normal usage and the vibrations produced by the internal housing acoustic pressure, are reduced so that the resonant "peaks" are reduced and therefore the feedback is also reduced. By placing a small tubular member over the opening of the microphone and causing the member to project into an opening adjacent to the microphone in the housing, an acoustic seal is formed so that internal housing acoustic pressures are not produced on the microphone diaphragm.

It is therefore a general object of this invention to provide an improvement in means for reducing feedback oscillations in a hearing aid.

It is another object of the present invention to provide means for reducing resonant-causing vibrations in an eyeglass hearing aid where the receiver and microphone are in close proximity.

It is another object of the present invention to provide a resilient device to be placed between a hearing aid microphone and housing to reduce the effects of the vibrations between the microphone and receiver even though no force is applied to said resilient means in forming an acoustic seal.

It is yet another object of the present invention to effectively reduce resonant mechanical vibrations by fixedly attaching a hollow member to the hearing aid microphone so that the member extends outwardly through the hearing aid housing.

It is still a further object of the present invention to effectively eliminate transmission of internal airborne vibrations between a hearing aid receiver and microphone.

These and other features of the present invention will become more apparent by examination of the specification, and drawings in which:

FIGURE 1 is a chart showing a comparison of a hearing aid microphone response before the invention was incorporated, and after it was incorporated;

FIGURE 2 is a diagrammatic drawing of the cross section of a variable reluctance microphone;

FIGURE 3 is a cross section of a microphone chamber of an eyeglass hearing aid;

FIGURE 4 is a sectional view of a housing of the above mentioned eyeglass hearing aid showing the proximity of the receiver to the microphone;

FIGURE 5 is a sectional view of a resilient sleeve member which is used to encompass the microphone; and,

FIGURE 6 is a block diagram of the hearing aid circuit.

Referring to FIGURE 2, it can be seen that a microphone **10** has a casing **11**. Microphone **10** may be of the crystal or variable reluctance type, however, for my embodiment, the variable reluctance type was used. Fixedly attached to the casing **11** is a diaphragm **12** in the shape of a cone and covering casing **11** is a cover **13** having an aperture **14**. This allows sound vibrations to enter aperture **14** and impinge upon diaphragm **12** to produce diaphragm motion. Diaphragm **12** is connected to an armature **15** by a connecting link **16**. Encompassing armature **15** is a coil **17** which has connected to its ends, a pair of connecting leads **20** and **21**, which are brought outside casing **11** through an opening **22**. Armature **15** is clamped at one end **23**, between a pair of pole pieces **24** and **25**. Pole piece **24** is positioned adjacent to diaphragm **12**, and includes an opening through which link **16** is connecting to armature **15**.

In comparing the response of a typical hearing aid, it will be noted in FIGURE 1 that the curve approximates that of a typical microphone **10**. This is due to the combined response curves of the microphone **10** and receiver. FIGURE 1 shows that a peak exists at point A (which is shown with a broken line) and this peak is representative of the response for the microphone **10** which can be largely attributed to the resonant cavity created by casing **11** and diaphragm **12**. This is designated by A in FIGURE 2. Progressing upward in frequency, it will be noted that a second peak designated as B, is produced by the mechanical vibration of armature **15**, and this is similarly marked in FIGURE 2. Moving upwardly in frequency from point B, it will be seen that another peak exists designated as C which is caused by the resonant vibrations of the cavity formed by the front chamber of the receiver and for my embodiment is the space formed adjacent to the cover of the receiver which is not shown but is similar to the cavity in the microphone which will now be described. At the uppermost point in frequency, a small peak designated D will be seen which is caused by

cavity which is formed by a diaphragm 12 and cover 13, and this is marked as D in FIGURE 2. It is generally well-known to those skilled in the art that the response curve of a hearing aid should not contain the peaks just mentioned, but should be relatively smooth such as shown by the solid line response curve. The incorporation of the present invention will remove peaks A, B, C, and D so that the response curve seeks the more ideal conditions such as shown by the solid line.

FIGURE 3 shows an embodiment of my invention wherein a housing 30, which forms a part of an eyeglass hearing aid, has a chamber 31 in which microphone 10 is generally located. An aperture 32 is located in housing 30 adjacent to microphone 10 and opens into chamber 31. A cover plate 33, which closes the opening formed by chamber 31 and cover plate 33, may be fixedly secured to housing 30 by an suitable fastening means such as screws, rivets, etc. Encompassing microphone 10 is a resilient jacket or sleeve member 34. Resilient sleeve member 34 is generally formed from neoprene rubber which is molded to conform to the external dimensions of microphone 10. The resilient sleeve member 34 is formed from any cushioning material which has a low durometer reading. Located in aperture 32 is a resilient tubular member 35 which is fixedly secured to cover 13 of microphone 10 by a suitable means such as cement or liquid adhesive. Tubular member 35 is formed from rubber or similar material having a low durometer reading. In the particular embodiment shown, tubular member 35 has a flange 36 on the end which is fixedly secured to cover 13 and has a hole 37 which is coaxial with the longitudinal axis of member 35, and aperture 14 in cover 13. When placed in position, tubular member 35 resides in an aperture 38 which is made in sleeve member 34 as found in FIGURE 5.

Tubular member 35 is placed in aperture 32 in such a manner that member 35 is not compressed, but still forms an acoustic seal. It will be further noted that tubular member 35 is not compressed at the flange portion and that resilient sleeve member 34 butts adjacent to flange 36 in aperture 38 so that an acoustic seal is formed there also. Tubular member 35 may also be formed from a metal material in the shape of an unused shoe eyelet, and fixedly secured to cover 13 to accomplish the same purpose for particular applications. Cover plate 33, when fastened in place, exerts no force on microphone 10 so that microphone 10 is substantially floated in chamber 31 that is, only frictional force is used to hold microphone 10 in place. Thus the vibrations or oscillations from housing 30 are attenuated so that peaks A, B, C, and D of FIGURE 1 are effectively reduced. Without tubular member 35, any vibration or feedback which is received by microphone 10 from a receiver 40 (such as shown in FIGURE 4) will cause a pressure or sound wave to exist over the aperture 14 or microphone 10 and thereby increase the resonant oscillations. By placing tubular member 35 in the position shown, the pressure is not allowed to build up or form an acosutic wave over opening 14 and the resonant peaks are further reduced. It has been found that it is necessary not to apply force any greater than frictional force as mentioned above to microphone 10, otherwise the resonant oscillations will be increased. In other words, the acoustical contact is effectively broken between microphone 10 and housing 30, but relative movement between microphone 10, housing 30 and cover plate 33 is still possible.

FIGURE 4 shows the relative positions of the microphone 10 in its resilient jacket 34 with respect to receiver 40 as contained in an eyegless hearing aid housing 30 such as may be found in Patent 2,904,639 which issued September 15, 1959, in the name of Clayton D. Mullin and John F. Rose and assigned to the same assignee. FIGURE 4 shows that housing 30 has a narrow section 41 between receiver 40 and microphone 10 and this is shown in a broken section in order to give a better view. Ordinarily, the rearward portion of housing 30 which contains microphone 10, is formed downwardly and bent to conform to the wearer's head where narrow section 41 is placed over the ear.

In considering this invention it would be remembered that the preceding disclosure is for illustration only and the scope of the invention should be based solely on the following claims.

I claim as my invention:

1. Apparatus in combination with a hearing aid for effectively reducing resonant mechanical vibrations comprising: a hearing aid having components including at least a microphone, amplifying means, and a receiver; a housing for containing said components, said housing having an aperture adjacent to said microphone; resilient means encompassing said microphone and having an aperture therethrough to communicate with said microphone to attenuate vibrations between said receiver and said microphone; and a tubular member having one end fixedly attached to said microphone and positioned in said housing to extend through the aperture of said resilient means into the aperture in said adjacent housing so that an acoustic seal is substantially established between said microphone and said housing for effectively reducing transmission of airborne vibrations therebetween.

2. In a hearing aid, apparatus for reducing the effect of resonant mechanical vibrations comprising: a hearing aid including as components a microphone, amplifying means, and a receiver; a housing for containing said components, said housing having an aperture adjacent to said microphone, resilient means encompassing said microphone and having an aperture therethrough to communicate with said microphone; and a resilient member having one end fixedly attached to said microphone and positioned in registered spaced relation with said aperture of said resilient means so that a seal is effected between said microphone and said housing, said resilient member being of a material having properties of low acoustic and mechanical vibration conductivity.

3. Apparatus for effectively reducing mechanical oscillations of an eyeglass hearing aid comprising: a hearing aid including as compenents, a microphone, amplifying means, and a receiver; a housing having a plurality of chambers for containing said hearing aid components so that said components are substantially separate, said chamber containing said microphone having an aperture extending through said housing; a resilient covering encompassing said microphone and having an aperture therethrough to communicate with said microphone to attenuate resonant oscillations between said receiver and said microphone; a first cover plate fixedly attached to said housing for covering said plurality of chambers containing said amplifying means and said receiver; a second cover plate fixedly attached to said housing for covering said chamber containing said microphone; and a resilient tubular member having a flange on one end fixedly secured to said microphone, said tubular member extending through said apertures of said resilient covering and said housing chamber to position said microphone so that the chamber is acoustically sealed, thereby substantially minimizing transmission of airborne vibrations of said microphone.

4. Apparatus in combination with an eyeglass hearing aid for reducing resonant mechanical oscillations of said hearing aid comprising: a hearing aid including as components, a microphone, amplifying means, and a receiver; a housing having a plurality of chambers for containing said hearing aid components, said chamber containing said microphone having an aperture extending through said housing; an elastic jacket enclosing said microphone and having an aperture therethrough to communicate with said microphone to attenuate resonant oscillations between said receiver and said microphone; a first cover plate fixedly attached to said housing for covering said plurality of chambers containing said amplifying means and said receiver; a second cover plate fixedly attached to said hous-

ing for covering said chamber containing said microphone; and a resilient tubular member having one end fixedly secured to said microphone, said tubular member extending through said apertures of said resilient covering and said housing chambers to position said microphone so that any acoustical contact is effectively broken between said microphone and said housing, but permitting relative movement between said microphone, said housing, and said cover plate.

5. Apparatus for mounting a microphone of a hearing aid comprising: a hearing aid microphone; a housing having a chamber for containing said microphone and having an aperture extending therethrough; a resilient jacket encompassing said microphone and having an aperture therethrough to communicate with said microphone; a cover plate fixedly attached to said housing for covering said chamber; and a resilient member having one end fixedly secured to said microphone, said member extending

through said apertures of said resilient covering and said chamber to position said microphone to form an acoustic seal thereby effectively eliminating transmission of airborne vibrations between said microphone and said housing, but allowing relative movement between said microphone, said housing, and said cover plate.

References Cited in the file of this patent

UNITED STATES PATENTS

2,718,563	Nicholides	Sept. 20, 1955
2,909,619	Hollingsworth	Oct. 20, 1959
2,930,858	Hollingsworth	Mar. 29, 1960
2,962,562	McCarrell	Nov. 29, 1960

FOREIGN PATENTS

794,347	Great Britain	Apr. 30, 1958
1,059,033	Germany	June 11, 1959