An improved receiver assembly includes a hollow metal casing for the receiver having a number of compliant members supporting the receiver from the inner surface of the casing. The compliant support members reduce the transmission of mechanical vibration and protect the receiver from external mechanical shock. The improved assembly includes a flexible tube for conducting sound from the receiver to an acoustical load and a metallic nozzle connected to the receiver casing and covering the flexible tube. An annular recess is defined on one end of the nozzle for receiving a ring seal which provides an efficient connection to the acoustical load. Flexible wires conduct an electrical signal to the receiver. The receiver casing and nozzle provide an acoustically sealed hollow enclosure around the receiver which prevents unwanted leakage of acoustic energy.

5 Claims, 3 Drawing Figures
IMPROVED RECEIVER ASSEMBLY INCORPORATING ACOUSTICAL ENCLOSURE FOR RECEIVER

This is a continuation of application Ser. No. 94,321, filed Dec. 2, 1970, now abandoned.

BACKGROUND OF THE INVENTION

This invention is generally related to an improved assembly for a hearing aid receiver. A hearing aid receiver is a device which converts electrical signals into acoustical energy, or sound, to be delivered to a person's ear. In many hearing aids in the prior art, the receiver is housed within the hearing aid case and acoustically coupled to a person's ear through a hollow tube. In this design the receiver must be compliantly supported within the hearing aid case in order to prevent mechanical vibration generated by the receiver from being transmitted to the vibration sensitive microphone of the hearing aid which would produce undesirable feedback and possibly cause the hearing aid to oscillate. A portion of the sound conducting tubing and also the electrical signal conducting wires must also be flexible for the same reason.

Generally, such a receiver is mounted within the hearing aid case by means of compliant mounting structures which separate the receiver from the other components within the hearing aid case. These support members must be accurately located within the case to prevent the receiver from contacting the other hearing aid components. Great skill and accuracy is required in the design and assembly of the hearing aid to insure accurate location of the support members and reliable electrical and acoustical connections. Since the receiver is mounted within the aid, testing of the mounted receiver with its flexible electrical and acoustical connections is made impossible prior to the construction of the hearing aid.

Because the receiver in such a device is housed in the hearing aid case together with the hearing aid microphone, sound leakage from the receiver is readily transmitted to the microphone. This type of sound leakage can occur by transmission of sound through the walls of the flexible sound tube, through the receiver walls and through pressure developed by the motion of the receiver. Sound transmission from the receiver to the microphone produces undesired feedback which can cause the hearing aid to oscillate.

Accordingly, it is desirable to provide a simple and efficient hearing aid receiver assembly in which a receiver is mounted within a sealed acoustical enclosure to reduce sound transmission from the receiver to the other components of the hearing aid. It is also desirable to provide such a hearing aid which includes compliant support members to reduce the transmission of mechanical vibration from the receiver to other components of the hearing aid and to protect the receiver from mechanical shock, and which includes a flexible sound tube and flexible electrical conductors, all within an easily installed container or casing which can provide electrostatic and magnetic shielding. It is additionally desirable to provide such a receiver with a seal at the sound outlet port thereof which allows a non-leaking connection of the receiver to an acoustical load.

SUMMARY OF THE INVENTION

In a principal aspect, the present invention relates generally to an improved receiver assembly for a hearing aid including a casing means for preventing transmission of sound leakage occurring within the casing, a flexible tube means connected from the receiver to a port in the casing for conducting sound from the receiver to an acoustical load, and flexible wires for conducting an electrical signal to the receiver. The casing means is provided with a number of compliant support members adapted to secure the receiver spaced apart from the inner surface of the casing. Additionally, the improved assembly includes a nozzle means for covering the flexible tube which is spaced apart from a portion of the tube so that the nozzle and the casing form a hollow chamber around the receiver for acoustically insulating the receiver.

In a preferred embodiment, the nozzle and the casing are formed of electrically conducting and magnetically permeable material so that the receiver is shielded from external electro-magnetic radiation. Also in a preferred embodiment, an annular recess is defined on the end of the nozzle means and adapted to receive a ring seal for sealing the assembly to an acoustical load so that an efficient connection with a minimum of sound leakage is provided.

BRIEF DESCRIPTION OF THE DRAWINGS

There follows a brief description of the drawings showing a presently preferred embodiment of the present invention wherein like numerals refer to like elements and wherein:

FIG. 1 is a cross-sectional view of a hearing aid assembly employing the improved hearing aid receiver assembly of this invention;
FIG. 2 is a side view of the improved receiver assembly shown in FIG. 1 with a portion of the assembly broken away to show the internal design of the assembly; and
FIG. 3 is a front view of the receiver of FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIG. 1, the improved receiver assembly 10 of this invention is connected within the overall hearing aid structure 12. The assembly 10 includes a receiver casing 14 containing a sound outlet port which takes the form of an outwardly projecting nozzle 16 of metal or other durable material. The nozzle 16 is connected to the receiver casing 14 at a receiver outlet port 18 by means of solder joints 19 as will be more fully described hereafter.

The nozzle 16 encases a flexible tube 20 which is connected between the receiver outlet port 18 and an acoustical load 22. The nozzle 16 is spaced apart from the flexible tube 20 along a section 24 of the tube 20 leaving a hollow acoustical isolation chamber 26 surrounding the flexible tube 20. At the end of the nozzle 16 is an annular recess 28 which is adapted to receive an O-ring seal 29 which may be slipped over the acoustical load end 30 of the nozzle 16. The end 30 of the nozzle 16 tapers inwardly to fit complimentary with the corresponding end of the flexible tube 20. This fits seals the chamber 26 and prevents sound leakage from the acoustical load 22.

When the O-ring 29 is positioned within the annular groove 28 of the nozzle 16, the O-ring 29 is compressed between the acoustical load section 22 of the hearing aid assembly 12 and the nozzle 16. The O-ring 29
thereby provides a sturdy, easily connectable, non-leaking compliant acoustic coupling.

As may be more readily seen in the side view of FIG. 2, the nozzle 16 is attached to the receiver casing 14 at the outlet port 18 of the receiver 32. A portion of the flexible tube 20 fits over and complements the outlet port 18. The receiver is secured within the receiver casing 14 by means of compliant supporting members 34 which are connected to the inner surface of the casing 14. These compliant support members 34 serve to separate the receiver 32 physically from the inner surface 36 of the receiver casing 14. The compliant support members 34 reduce the transmission of mechanical vibration and protect the receiver 32 from mechanical shock. The receiver casing 14 and the nozzle 16 form a sealed acoustical enclosure which traps sound leakage within the enclosure and prevents it from being transmitted out.

As shown in FIG. 3, flexible wires 40 extend from wire ports 42 defined in the casing 14. Flexible wires 40 are connected to receiver terminals 44 in order to deliver electrical signals to the receiver 32. These signals are in turn converted by the receiver into sound energy for transmission from the receiver sound outlet port 18 to the acoustical load 22. The flexible wires 40 are sealed at the wire entry ports 42 so as to maintain the isolation of the receiver 32 within the casing 14.

The nozzle 16 and casing 14 are preferably formed of material which is both electrically conductive and magnetically permeable so that the receiver 32 is shielded from electrical and magnetic radiation. Since receiver 32 is adequately isolated from mechanical vibration and shock within the casing 14, the receiver assembly 10 may be rigidly mounted within the hearing aid assembly 12. The assembly 10 of this invention may be constructed and tested prior to its insertion into the hearing aid assembly 12.

It is to be understood that although one preferred embodiment of the present invention has been described, modifications may be made to this embodiment by those skilled in the art without departing from the true spirit and scope of this invention.

What is claimed is:
1. An improved receiver assembly comprising, in combination:
   a hollow, rigid receiver casing means connectable within the casing of a hearing aid, said receiver casing enclosing a receiver and including a rigid, outwardly-projecting nozzle, forming at the outer end of said nozzle a sound outlet port for said receiver, said receiver casing means forming a first acoustical isolation chamber around said receiver, said nozzle having an outer periphery contoured to fit snugly into and conform to the shape of a channel forming an acoustical load, said channel being defined in said hearing aid,
   compliant coupling means on said nozzle for acoustically coupling said outer port of said nozzle with said channel,
   a plurality of compliant support members between said receiver casing means and said receiver, adapted to secure said receiver spaced apart from said receiver casing means, and
   flexible tube means within said nozzle for conducting acoustical energy from said receiver to said outlet port, said flexible tube means connecting said receiver to the outer end of said nozzle and spaced apart from said nozzle along a substantial portion thereof, said flexible tube means contacting said nozzle near the outer end of said nozzle, said nozzle portion of said receiver casing means forming a second acoustical isolation chamber between said flexible tube means and said nozzle, said second chamber communicating with said first chamber around said receiver, said receiver casing means thereby forming a single, sealed enclosure around said receiver and said flexible tube means, whereby said receiver may be assembled in said receiver casing apart from said hearing aid and connected to said hearing aid by inserting said nozzle into said channel and whereby transmission of sound generated within said sealed enclosure occurs only through said sound outlet port.

2. The improved receiver assembly as set forth in claim 1 wherein said receiver casing means is formed of electrically conductive material such that said receiver is shielded from external electrical radiation.

3. The improved receiver assembly as set forth in claim 1 wherein said receiver casing means is formed of magnetically permeable material such that said receiver is shielded from external magnetic radiation.

4. The improved receiver assembly as set forth in claim 1 wherein said means for acoustically coupling said outlet port with said channel comprises an annular recess defined on the end of said nozzle adjacent said outlet port and a compliant ring seal, said recess adapted to receive said compliant ring seal for acoustically coupling the outlet port of said nozzle with said channel.

5. The improved receiver assembly as set forth in claim 1 including a plurality of flexible wires connected to said receiver through a plurality of entry ports defined in said receiver casing means, said wires being sealed at said entry ports.