United States Patent [19]

Ryder

[11] **3,789,164**

[45] **Jan. 29, 1974**

[54] **EARPHONE ASSEMBLY**

[76] Inventor: **Robert Ryder,** P.O. Box 90331, Los Angeles, Calif. 90009

[22] Filed: **Mar. 3, 1972**

[21] Appl. No.: **231,560**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 64,484, Aug. 17, 1970, abandoned.

[52] **U.S. Cl.** ..... **179/156 R,** 179/1 G

[51] **Int. Cl.** **H04m 1/05,** H04r 5/00

[58] **Field of Search** 179/1 GP, 156, 182, 1 VE, 1 PC

[56] **References Cited**

UNITED STATES PATENTS

2,978,543	4/1961	Kennedy	179/1 GP
3,450,839	6/1969	Scanlon	179/1 VE
2,946,862	7/1960	Wadsworth et al.	179/182 R
2,846,521	8/1958	Beidler	179/182 R
2,827,514	3/1958	Murray	179/1 GP

Primary Examiner—William C. Cooper

Attorney, Agent, or Firm—Jessup & Beecher

[57] **ABSTRACT**

An earphone assembly is provided of the pneumatic type such as are presently used on aircraft, and which is constructed to improve the reproduction quality of the instrument by providing high frequency transducers directly at the ear pieces for producing high frequency sound signals which would otherwise be attenuated in the flexible plastic tubes coupling the ear pieces to the main electrical/acoustical transducer.

6 Claims, 7 Drawing Figures

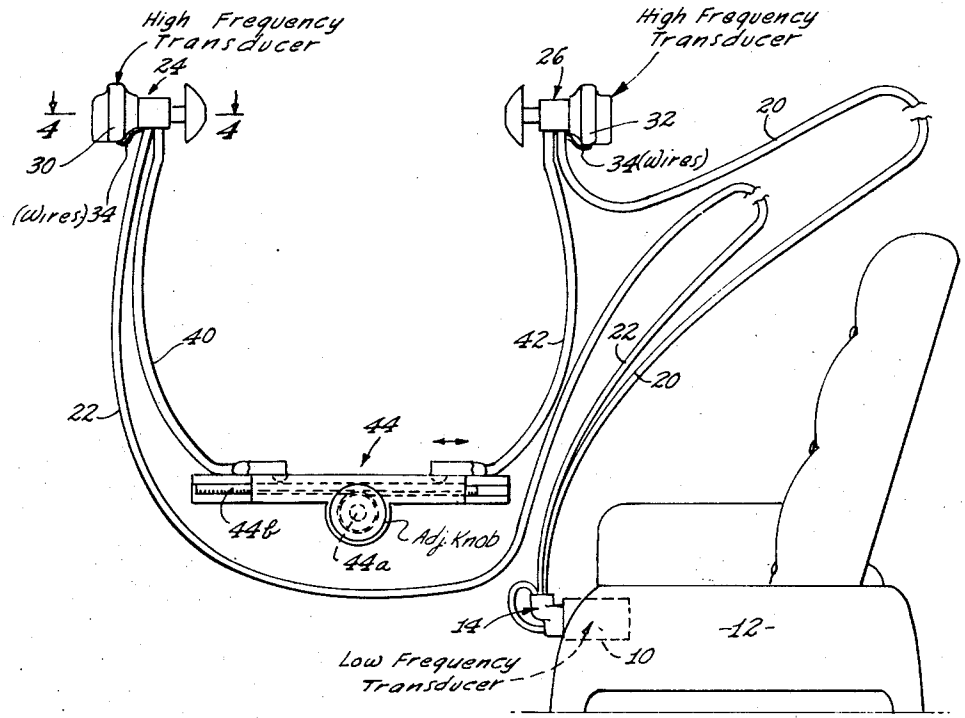


Fig. 1

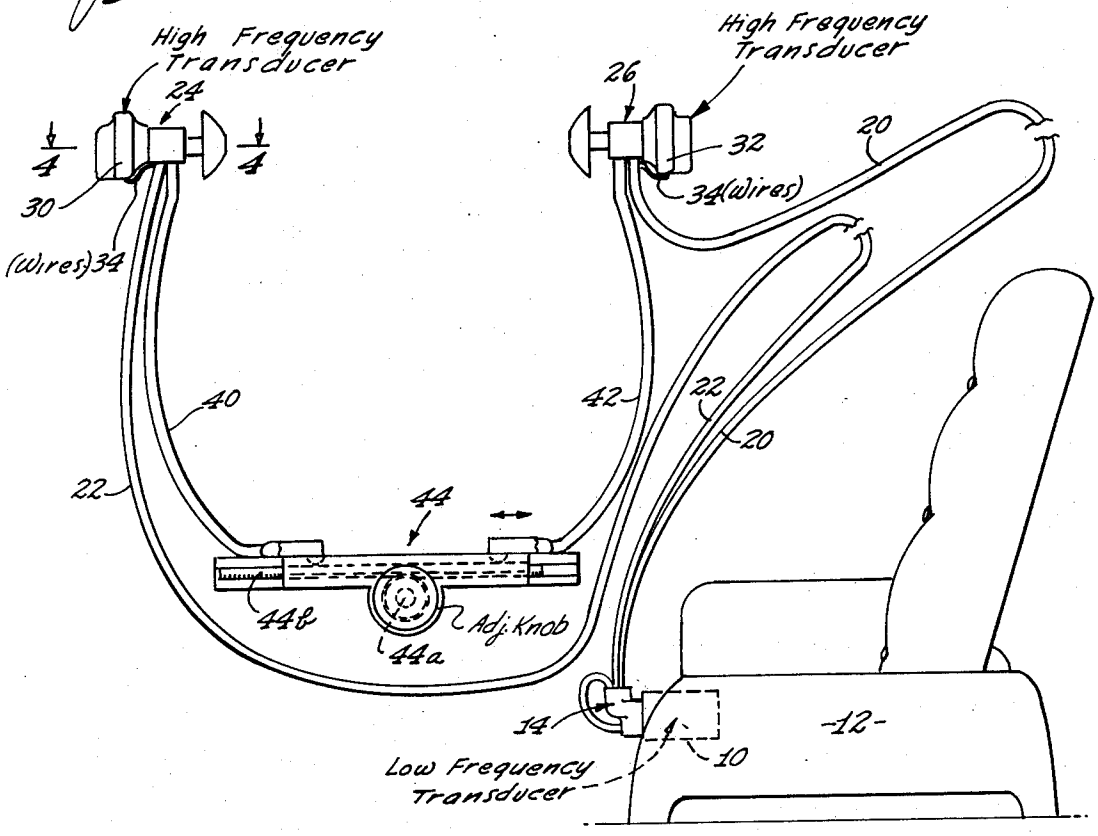


Fig. 2

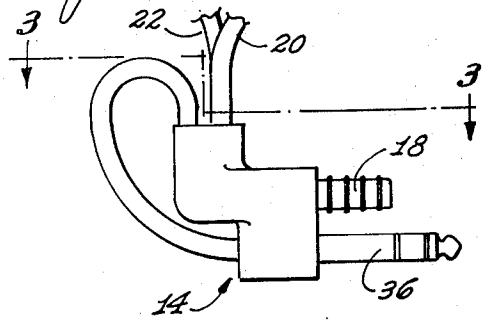
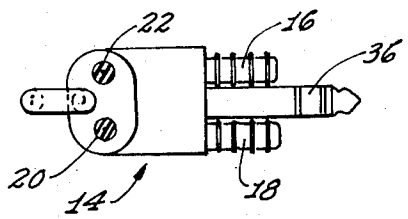


Fig. 3



INVENTOR
Robert Ryder
Kemp and Beecher

By Warren T. Jessup
ATTORNEYS

Fig. 4

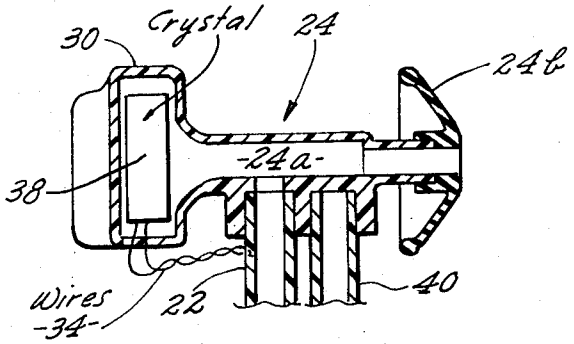
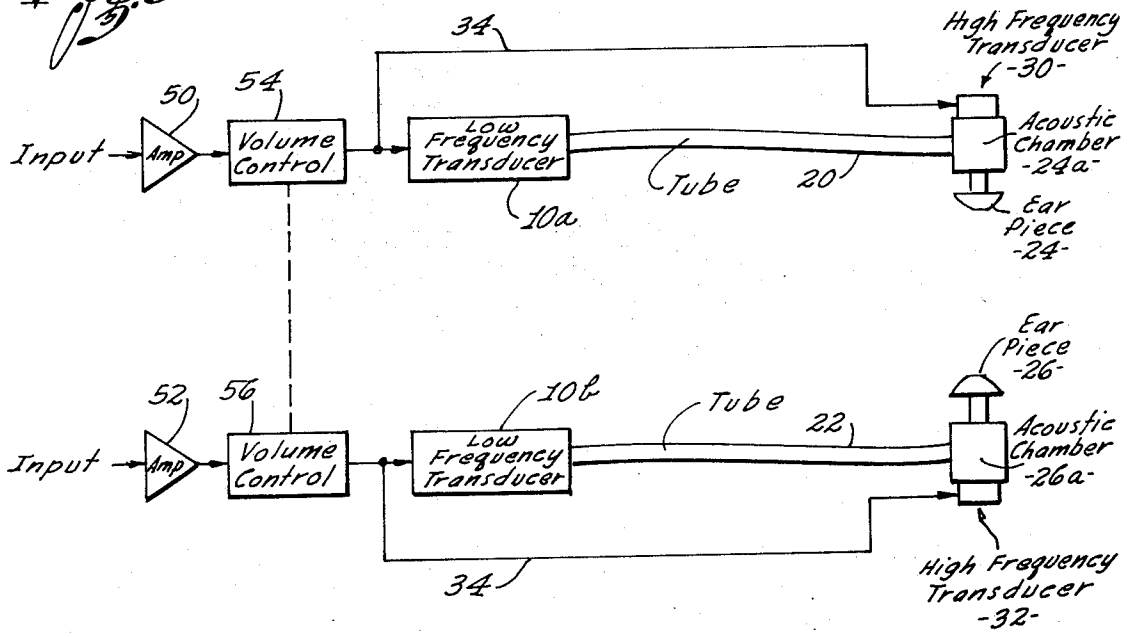
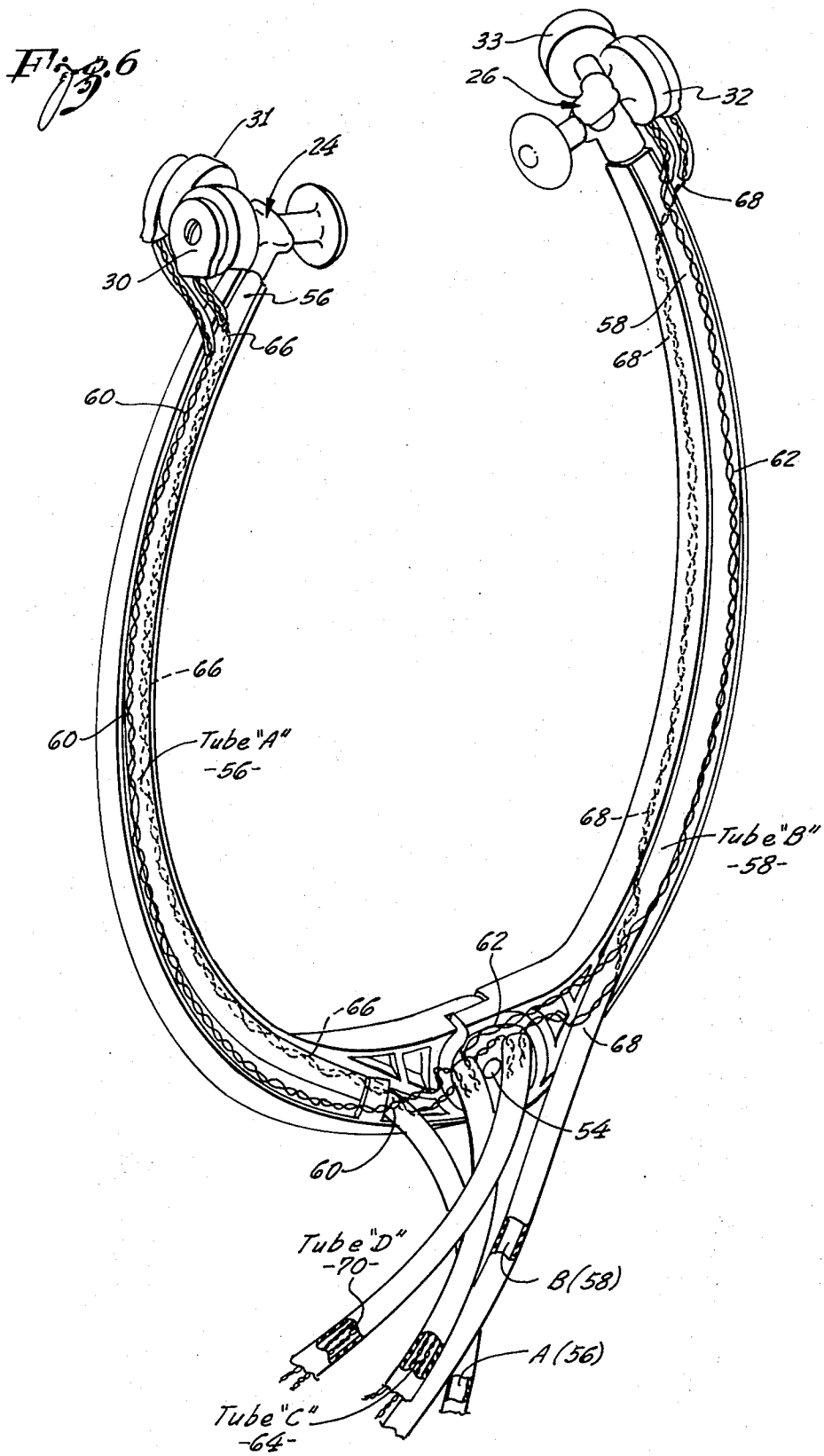


Fig. 5



INVENTOR
Robert Ryder
Jessup and Beecher
By Warren T. Jessup
ATTORNEYS

Fig. 6


33
26
32
31
24
68
30
56
58
66
68
60
62
66
60
Tube "A"
-56-
68
Tube "B"
-58-
62
66
68
54
60
Tube "D"
-70-
B(58)
A(56)
Tube "C"
-64-

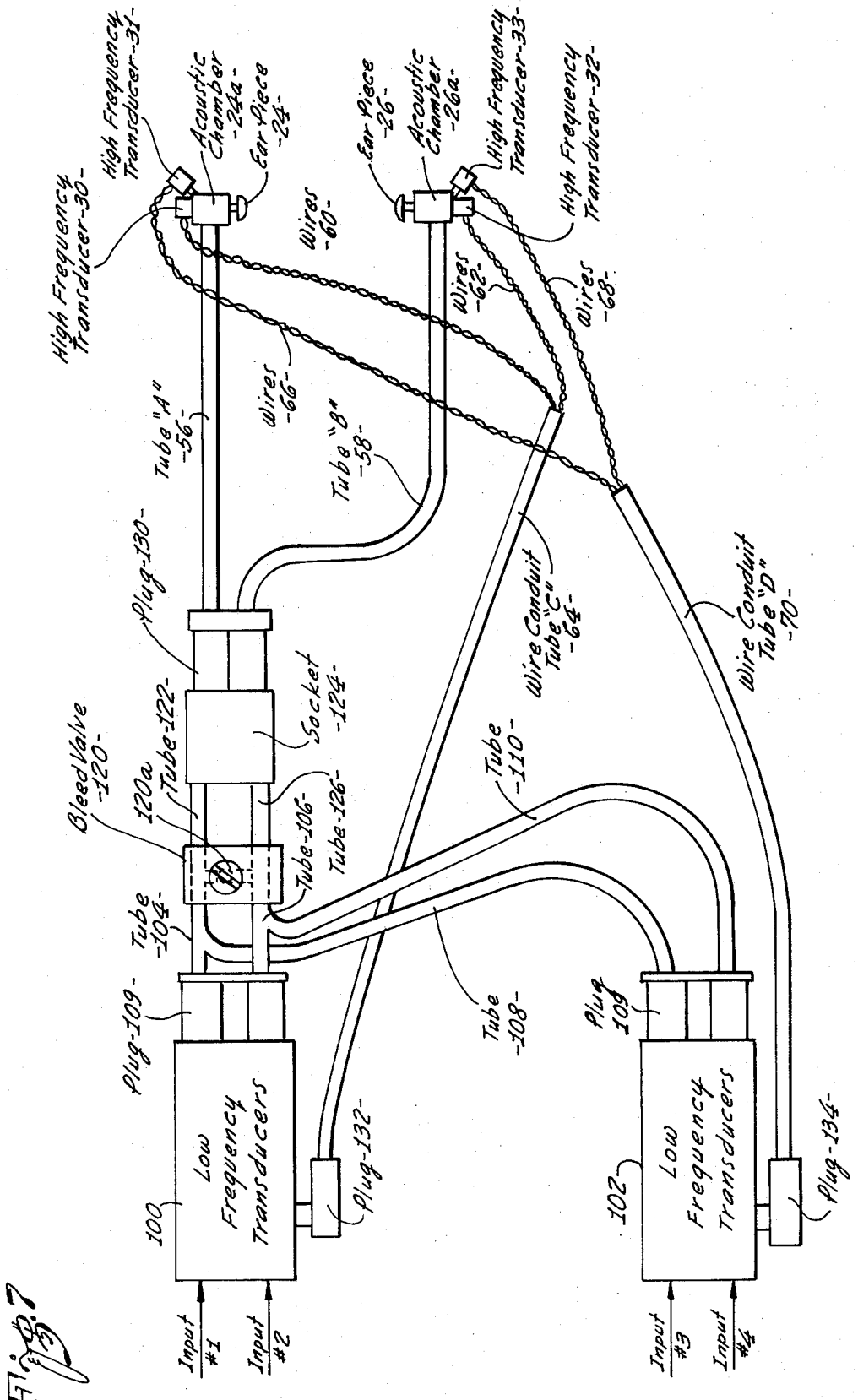

High Frequency Transducer -30-
High Frequency Transducer -31-
Acoustic Chamber -24a-
Ear Piece -24-
Ear Piece -26-
Acoustic Chamber -26a-
High Frequency Transducer -33-
High Frequency Transducer -32-
Wires -60-
Wires -62-
Wires -68-
Wires -66-
Tube "A" -56-
Tube "B" -58-
Plug -130-
Wire Conduit Tube "C" -64-
Wire Conduit Tube "D" -70-
Socket -124-
Bleed Valve -120-
120a
Tube -122-
Tube -106-
Tube -126-
Tube -110-
Tube -104-
Plug -109-
Tube -108-
Plug 109
Low Frequency Transducers
100
102
Plug -132-
Plug -134-
Input #1
Input #2
Input #3
Input #4

Fig. 7

EARPHONE ASSEMBLY

This application is a continuation-in-part of copending application Ser. No. 64,484 filed for Robert Ryder on Aug. 17, 1970, and entitled "EARPHONE ASSEMBLY," now abandoned.

BACKGROUND OF THE INVENTION

In the sound reproducing systems used in present day aircraft, it is usual to install an electro/acoustical transducer at each seat. Earphones are provided for the individual passengers, and these are plugged into sockets in the corresponding transducers. The earphones comprise simply a pair of acoustical ear pieces, and flexible plastic tubes extending from the ear pieces to a tubular plug assembly which may be plugged directly into the aforesaid transducer. In this way the sound signals produced by the transducer are carried through the plastic tubes to the ear pieces, and into the ears of the passenger wearing the earphone assembly.

It has been found, however, that the higher frequency sounds are attenuated in the aforesaid flexible plastic tubes, and the quality of the sound reproduction by the prior art systems of the aforesaid type is somewhat impaired. This situation is corrected by the system of the present invention, in which small high frequency electro/acoustical transducers are mounted directly adjacent the ear pieces and are electrically connected to the electrical audio signal source, so that the higher frequency sounds are not lost and high fidelity reproduction may be achieved.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a representation of an earphone assembly constructed in accordance with one embodiment of the invention and which plugs, for example, into an electro/acoustical transducer mounted in the arm of an aircraft seat;

FIG. **2** is an enlarged view of an appropriate plug used by the assembly of FIG. **1**;

FIG. **3** is a plan view of the plug of FIG. **2**, taken along the line **3—3** of FIG. **2**;

FIG. **4** is a somewhat schematic representation of a section of one of the ear piece units of FIG. **1**, and taken essentially along the line **4—4** of FIG. **1**;

FIG. **5** is a schematic functional diagram of the system of FIG. **1**;

FIG. **6** is a representation of an earphone assembly constructed in accordance with a second embodiment of the invention; and

FIG. **7** is a schematic diagram of the electro/acoustical system associated with the earphone assembly of FIG. **6**.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

As shown in the drawings, a first electro/acoustical transducer **10** is mounted, for example, in the arm of an aircraft seat **12**, and the transducer **10** includes a socket which receives, for example, a dual plug assembly **14**. The dual plug assembly **14**, as shown in FIGS. **2** and **3**, for example, includes a first pair of tubular plugs **16** and **18** which extends into appropriate sockets in the transducer **10**, so as to introduce the corresponding sound signals into a pair of flexible plastic tubes **20** and **22**, the plastic tubes extending to a pair of acoustical ear pieces **24** and **26**.

The system illustrated in the drawings, as is usual with most systems used in present day installations, is a stereo type of system so that two tubes **20** and **22** and two separate plugs **16** and **18**, are provided for carrying the stereo sound signals to the ear pieces **24** and **26**.

As mentioned above, it has been found that the higher frequency sound signals are attenuated in the tubes **20** and **22**. For that reason, the present invention provides for small high frequency electro-acoustical transducers **30** and **32** to be mounted directly on the respective ear pieces **24** and **26**. Electric wires, such as the wires **34**, which carry electric current to the transducers **30** and **32** are connected to the transducers, and these wires may be imbedded in the walls of the tubes **20** and **22** to extend along the tubes to the plug **14**. The plug **14** also includes, for example, an electric plug **36** to which the wires are connected. For the usual stereo system, three wires are used, and they are connected to the transducers **30** and **32** so that stereo signals may be produced by the high frequency transduers.

The transducers **30** and **32** may be of any appropriate type and, as shown in FIG. **4**, for example, the ear piece **24** may include a housing defining an acoustical chamber **24*a***, the tube **22** being coupled to the interior of the acoustical chamber, so that the sound signals may be passed into the chamber and through the section **24*b*** which is designated to fit into the ear of the wearer. The high frequency transducer **30**, for example, is mounted adjacent the acoustical chamber **24*a***, and it includes a conventional crystal transducer **38** energized through wires **34**. In this way, the transducer 3o produces high frequency sound signals which pass into the acoustical chamber **24*a***, and which are combined with the sound signals from the tube **22**, in order to compensate for any attenuation of the high frequency sound signals in the tube **22**. It will be understood, of course, that the ear piece **26** and transducer **32** are similarly constructed.

For satisfactory high fidelity reception, it is important that the ear pieces **24** and **26** be maintained in alignment with the ear canals of the listener, which means that the ear pieces should be held substantially on a horizontal axis regardless of the head width of the listener. An adjustment is provided in the earphone assembly of FIG. **1**, so that this criteria may be met for various head sizes.

In the illustrated embodiment, the ear pieces **24** and **26** are supported by a pair of elongated resilient members **40** and **42** each of which, for example, may comprise a resilient wire composed, for example, of steel, and surrounded by an appropriate tubular member which may, for example, be composed of polyvinylchloride. The free ends of the members **40** and **42** are mounted, for example, on a rack and pinion assembly **44**, or its equivalent.

An adjustment knob **44*a*** is provided, and it may be turned to move the rack **44*b*** in and out of the assembly, so as to adjust the distance between the ear pieces **24** and **26**, and to adjust the ear pieces to different head sizes. As mentioned above, the rack and pinion assembly **44** may be replaced by any equivalent adjustment, such as a lead screw, or the like.

It will be appreciated from a consideration of FIGS. **2** and **3**, for example, that the plug **14** has a right angle bend formed in its body portion. This is advantageous in that it provides a polarizing control for the plugs **16** and **18**, and assures that the plugs will be plugged into

the proper sockets in the transducer **10**, so that the proper sounds will be carried to the proper ears for the correct stereo sound effect. The electric plug **36** may be part of the same plug as the plugs **16** and **18**, as shown in FIGS. **2** and **3**, so that all the plugs may be inserted as a unit into the corresponding sockets in the transducer **10**. The ear pieces **24** and **26** need not necessarily be of such configuration that they penetrate the ear cavity or canal. They may assume, for example, the form of ear muffs in which the sound channels enter from diverse angles.

In the system of FIG. **5**, the stereo electrical input is amplified in separate amplifiers **50** and **52**. The amplifiers are connected through corresponding volume controls **54** and **56** to the low frequency transducers designated **10***a* and **10***b* in FIG. **5**. The volume controls **54** and **56** may be mechanically intercoupled so that a single control may be used to adjust the volume of the two stereo signals. As illustrated in FIG. **5**, the tubes **20** and **22** intercouple the transducers **10***a* and **10***b* to the respective ear pieces **24** and **26**, whereas wires **34** extend to the respective high frequency transducers **30** and **32**.

The response of the transducers **10***a* and **10***b* may be substantially uniform throughout the entire audio range, and the response of the high frequency transducers **30** and **32** may be such that they compensate for the resulting attenuation of the higher frequency sound signals in the tubes **20** and **22**. It is also appropriate to design the transducers **10***a* and **10***b* to respond only to the low frequency part of the audio signal range, so that only the lower frequency sound signals are produced by the transducers **10***a* and **10***b*, since these are the signals which may be appropriately carried by the tubes **20** and **22**. Then, the high frequency transducers **30** and **32** are controlled so that all the higher frequency sound signals are produced only by the latter transducer.

Since the transducers **30** and **32** are only required to produce the higher frequency sound signals, these transducers may be small and light, and also they may be inexpensive. Therefore, the high frequency transducers may be conveniently mounted directly on the ear pieces without adding materially to the cost or weight of the earphone assembly. The resulting assembly, including the adjustment means described above, may be comfortably supported in the ears of the listener, and it provides for an ideal high fidelity sound reproducing system.

In the assembly of FIG. **6** the ear pieces **24** and **26** are mounted on the ends of respective plastic elongated support brackets **50** and **52**, each of which has a generally arcuate shape, the support brackets being hinged by a suitable hinge member **54**. The hinge member **54** holds the brackets **50** and **52** in a relatively tight frictional engagement, so that they may be opened or closed to suit various head sizes of the users, and to cause the assembly to be firmly held on the head of the user.

The assembly of FIG. **6**, in addition to the high frequency transducers **30** and **32**, also includes a second pair of high frequency transducers **31** and **33** which are also mounted on the respective ear pieces **24** and **26**, as shown. As shown in FIG. **6**, the transducer **31** is coupled into the acoustical chamber of the ear piece **24** at an angle with respect to the transducer **30**. Likewise, the transducer **33** is coupled into the acoustical chamber of the ear piece **26** at an angle with respect to the transducer **32**. This angular relationship between the transducers **30** and **31** and between the transducers **32** and **33**, changes the character of the high frequency sound signals entering the respective acoustical chambers, since those from the transducers **31** and **33** effectively have to "bend around a corner" when entering the acoustical chamber. This relationship simulates the reflection of sound from the walls, for example, of an auditorium, so that a person using the assembly of FIG. **6** actually has the sensation of listening to a concert in full high fidelity range, and seated, for example, in an auditorium.

The assembly of FIG. **6** is intended to be used in conjunction with a four-channel stereo sound system. For that reason, a first tube **56** (tube "A") is coupled to the ear piece **24**, and a second tube **58** (tube "B") is coupled to the ear piece **26**. The tubes **56** and **58** correspond to the flexible plastic tubes **20** and **22** of the embodiment of FIG. **1**. In the case of the assembly of FIG. **6**, the tube **56** carries the low frequency sound signals from two of the stereo sources to the ear piece **24**, whereas the tube **58** carries the low frequency sound signals from the remaining two stereo sources to the ear piece **26**.

The high frequency sound components from one of the stereo sources are produced, as before, by the transducer **30**, whereas the high frequency sound signals from the second stereo source are produced, as before, by the transducer **32**. The transducer **31** reproduces the high frequency sound signals from the third stereo source, whereas the transducer **33** reproduces the high frequency sound signals from the remaining stereo source.

The transducer **30** is activated by wires **60**, and the transducer **32** is activated by wires **62**. The wires **60** and **62** are carried, for example, in a flexible plastic tube **64** (tube "C"). The transducer **31** is activated by wires **66**, whereas the transducer **33** is activated by wires **68**. The wires **66** and **68** are carried, for example, in a flexible plastic tube **70** (tube "D").

A portion of a four-channel stereo system for operation in conjunction with the assembly of FIG. **6** is shown schematically in FIG. **7**. As shown in FIG. **7**, the stereo electrical input signals from the first and second stereo sources are applied to a block **100**, whereas the electrical signals from the third and fourth stereo sources are applied to a block **102**. The blocks **100** and **102** contain appropriate low frequency transducers, such as described above, so that the low frequency sound signals corresponding to the various stereo sources may be obtained. The low frequency sound signals from the first stereo source are carried in a tube **104**, whereas the low frequency stereo signals from the second stereo source are carried in a tube **106**.

The tubes **104** and **106** are plugged into the low frequency transducers by means of a plug **109**. The low frequency sound signals from the third stereo source are carried by a tube **108** which, as shown, is coupled into the tube **104**, whereas the low frequency sound signals from the fourth stereo source are carried by a tube **110** which, as shown, is coupled into the tube **106**. The combined tubes **104** and **108** are coupled through a bleed valve **120** and through a tube **122** into a socket **124**, whereas the combined tubes **106** and **110** are coupled through the bleed valve **120** to a tube **126** which, likewise, is coupled into the socket **124**.

Therefore, the tube **122** carries the low frequency sound signals from the first and third stereo sources, whereas the tube **126** carries the low frequency sound signals from the second and fourth stereo sources. The tubes **56** and **58** are plugged into the socket **124** by means, for example, of a plug **130.** When so coupled, the tube **56** carries the low frequency sound signals from the first and third stereo sources to the ear piece **24,** whereas the tube **58** carries the low frequency sound signals from the second and fourth sources to the ear piece **26.**

The electrical inputs from the first and second stereo sources are also carried, by way of a plug **132** to the wires **60** and **62** respectively. The wires **60** carry the electric signals from the first source to the high frequency transducer **30,** whereas the wires **62** carry the electric signals from the second source to the high frequency transducer **32.** Likewise, the electrical signals from the third and fourth stereo sources are carried by way of a plug **134** to the wires **66** and **68.** In this way, the wires **66** carry the electric signals from the third stereo source to the high frequency transducer **31,** whereas the wires **68** carry the electric signals from the fourth source to the high frequency transducer **33.**

The bleed valve **120** has a control **120***a* which may be turned to cause an intermixing of the low frequency sound signals in the tubes, so that various blending effects may be achieved, if so desired. With the system described above, a desired blending of all the low frequency sounds may be achieved by setting the control **120***a* of the bleed valve **120.** Also, an "auditorium" effect is achieved with respect to the high frequency sounds from the third and fourth sources, by virtue of the positioning of the respective high frequency transducers **31** and **33** with respect to the respective acoustic chambers **24***a* and **26***a*.

It is apparent that although particular embodiments of the invention have been shown and described, modifications may be made. It is intended in the following claims to cover all modifications that fall within the spirit and scope of the invention.

What is claimed is:

1. An earphone assembly including:

a first ear piece defining a first acoustic chamber and a second ear piece defining a second acoustic chamber;

a first electrical/acoustical transducer for producing sound signals in response to audio electrical signals applied thereto;

a first tubular member intercoupling said first transducer to said first acoustic chamber for carrying the sound signals from said first transducer to said first ear piece;

a second electrical/acoustical transducer for producing sound signals in response to audio electrical signals applied thereto;

a second tubular member intercoupling said second transducer to said second acoustic chamber for carrying the sound signals from said second transducer to said second ear piece; and

a bleed valve member intercoupling said first and second tubular members and adjustable to produce an intermixing between the sound signals in said first and second tubular members.

2. An earphone assembly including: a first ear piece defining a first acoustic chamber and a second ear piece defining a second acoustic chamber; a first electrical/acoustical transducer for producing sound signals in response to audio electrical signals derived from a first signal source and applied thereto; a first tubular member intercoupling said first transducer to said first acoustic chamber for carrying relatively low frequency sound signals from said first transducer to said first ear piece; a second electrical/acoustical transducer for producing sound signals in response to audio electrical signals derived from a second signal source and applied thereto; a second tubular member intercoupling said second transducer to said second acoustic chamber for carrying relatively low frequency sound signals from said second transducer to said second ear piece; a first high frequency electrical/acoustical transducer mounted on said first ear piece for introducing relatively high frequency sound signal into said first acoustic chamber along a predetermined axis in response to applied audio electrical signals; a second high frequency electrical/acoustical transducer mounted on said second ear piece for introducing relatively high frequency sound signals into said second acoustic chamber along a predetermined axis in response to applied audio electrical signals; circuit means for introducing the audio electrical signals from said first signal source to said first high frequency transducer; and circuit means for introducing the audio electrical signals from said second signal source to said second high frequency transducer.

3. The assembly defined in claim **2,** and which includes a third high frequency electrical/acoustical transducer mounted on said first ear piece for introducing relatively high frequency sound signals into said first acoustic chamber in response to audio electrical signals applied thereto; circuit means connecting said third high frequency transducer to a third signal source for introducing audio signals from said third signal source to said third high frequency transducer; a fourth high frequency electrical/acoustical transducer mounted on said second ear piece for introducing relatively high frequency sound signals into said second acoustic chamber in response to audio electrical signals applied thereto; and circuitry connecting said fourth high frequency transducer to a fourth signal source for introducing the audio electrical signals from said fourth signal source to said fourth high frequency transducer.

4. The assembly defined in claim **3,** in which said first and third high frequency transducers introduce sound signals into said first acoustic chamber along respective axes displaced angularly from one another, and in which said second and fourth high frequency transducers introduce sound signals into said second acoustic chamber along respective axes angularly displaced from one another.

5. The assembly defined in claim **2,** and which includes resilient elongated means interconnecting said ear pieces to position said ear pieces in the ears of the listener.

6. The assembly defined in claim **5,** and which includes mechanically adjustable means interposed in said resilient means for adjusting the distance between said ear pieces to different head sizes.

* * * * *