

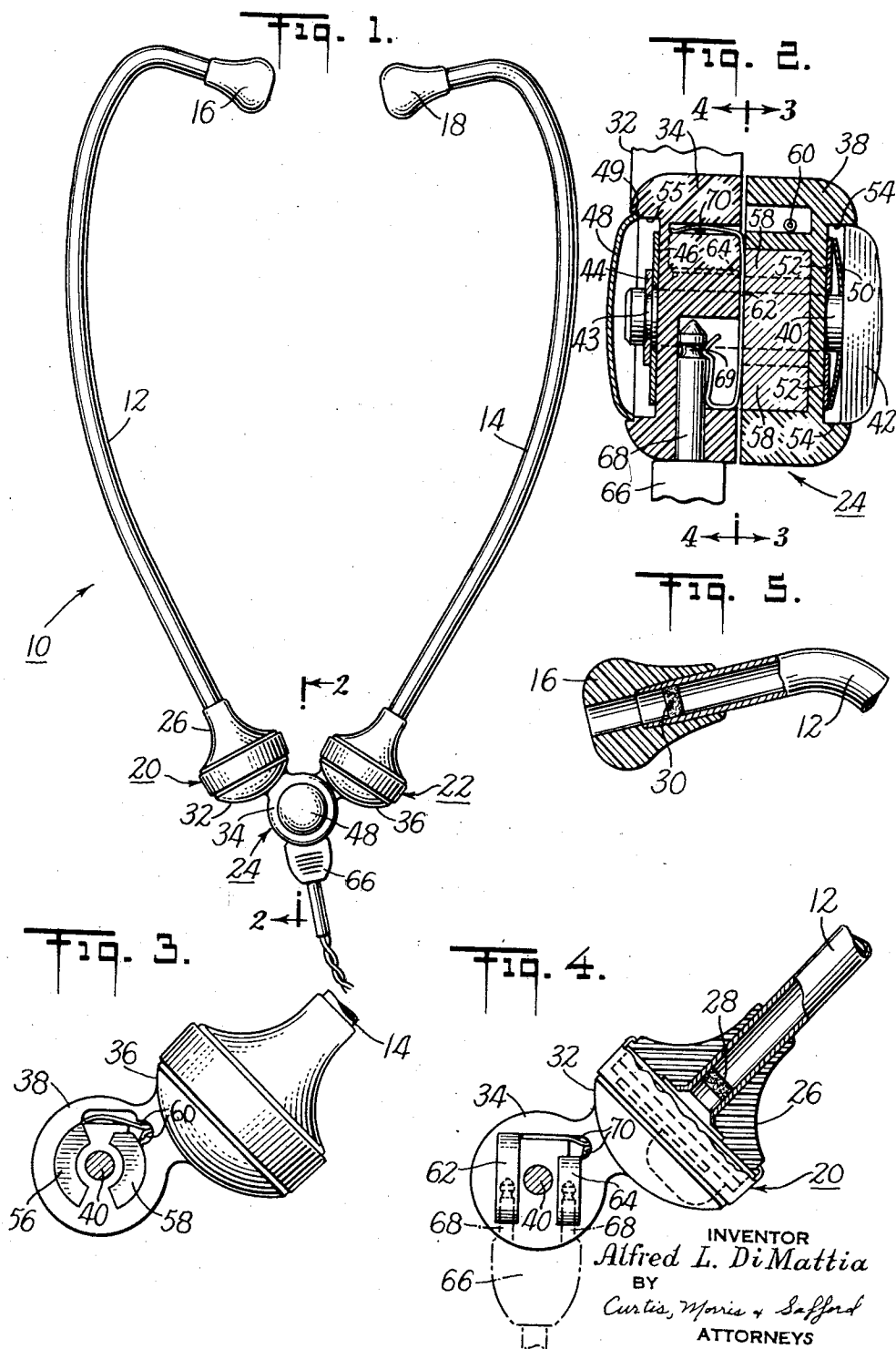
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HEADPHONE DEVICE

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## HEADPHONE DEVICE

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4 Claims. (Cl. 181—24)

This invention relates to headphone devices for use in sound-reproducing systems, and more particularly to a headphone assembly of the stethoscope type for use with such sound-reproducing systems as machines for transcribing office dictation wherein the prerequisite of maximum intelligibility necessitates a broad and uniform response characteristic in such apparatus. This application is a division of copending application Serial No. 261,242, filed by the present applicant on December 12, 1951, now U.S. Patent No. 2,849,533.

The so-called "stethoscope" type headphone has always been one of the most popular of hearing devices for use in dictation transcribing machines. This device is similar to a doctor's stethoscope in that it comprises a pair of hollow hearing tubes, one end of each being adapted to be placed in the ears of the listener with the other ends hanging down over the chest of the listener where they are flexibly joined together and are connected to a source of sound signals, i.e. either a sound tube or an electro-acoustic driver mechanism or "speaker." Hereinafter the term "hearing tube assembly" will be used to denote one tube and associated apparatus from the flexible joining point to the ear piece end.

Heretofore the stethoscope type of headphone has suffered from the disadvantage of having a relatively poor response characteristic. This has been due in part to the fact that the acoustical path, for the sound from the electro-acoustic driving unit to the ear pieces, had to pass through a hinge, which pivotally joined the lower ends of the hearing tubes. This hinge inherently permitted pressure leaks in the acoustic path which reduced the range of frequency response by attenuating the low frequency end of the audible spectrum. In addition, as the ear pieces were adjusted to suit the individual's head size and preference, the length of the respective acoustical paths from the driver unit to each ear piece varied with each such adjustment, thus changing the acoustical characteristics of the device and introducing undesired distortion. Also, with a hinge or pivotal mounting for the hearing tubes positioned in the acoustical paths, there was a large air cavity in front of the diaphragm which resulted in attenuation of the high frequency end of the audio spectrum.

According to the present invention, special damping plugs are provided in particular locations in each hearing tube assembly to produce a system having a relatively broad, substantially uniform response characteristic with a resultant minimum of distortion.

It is a primary object of this invention to provide a stethoscope headphone device having a substantially smooth and constant response characteristic over a wide range of frequencies. It is another object of this invention to provide a stethoscope-type headphone device having a pair of hearing tubes adapted for pivotal movement about one end thereof without thereby causing acoustical losses or frequency discrimination. It is a still further

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object to provide an easily manufactured hearing device of the stethoscope type having hearing tubes of proper dimensions and construction to produce an acoustical system having a relatively wide and uniform frequency response.

These and other and further objects will be in part apparent and in part pointed out as the specification proceeds. The invention accordingly consists in the features of construction, combinations of elements, methods of operation and arrangements as will be exemplified in the structure to be hereinafter described.

The principles of the invention will be more readily perceived in connection with the following detailed description of a specific illustrative embodiment and from the accompanying drawings in which:

Figure 1 is an overall plan view of a headphone device according to the present invention;

Figure 2 is an enlarged detailed section of the hinge portion of this device taken on line 2—2 of Figure 1;

Figure 3 is a section on a slightly reduced scale looking in the direction of the arrows on line 3—3 of Figure 2;

Figure 4 is a section similar to Figure 3 looking in the direction of the arrows on line 4—4 of Figure 2;

Figure 5 is an enlarged sectional view of the ear piece end of one of the hearing tubes of the device of Figure 1.

Referring now to Figure 1, the headphone unit, generally indicated at 10, comprises a pair of hearing tubes 12 and 14 attached to two electro-acoustic driving units 20 and 22, respectively, which in turn are joined for pivotal movement with respect to each other by a hinge structure, generally indicated at 24, through which the electrical circuit is introduced to the driving units 20 and 22. The hearing tubes 12 and 14 are bent toward each other at their upper ends, which are provided with ear pieces 16 and 18, respectively, shaped to fit snugly into the ear cavities of the user, and are curved smoothly downwardly and toward each other from this upper bend to the hinged driver units 20 and 22, so as to hang comfortably from the ears of the listener.

The driving units 20 and 22 may be of any suitable type of electro-mechanical translating device for converting electrical signals into sounds. The specific construction of such devices is well known and consequently not described herein in the interest of simplicity. In the present embodiment of the invention these driving units 20 and 22 are mounted in housings 32 and 36, respectively.

The manner in which the lower ends of tubes 12 and 14 are attached to the driving units 20 and 22, respectively, is illustratively shown in detail in Figure 4 with respect to tube 12 and driving unit 20. Tube 12 is flared somewhat at its lower end and positioned in the housing 32 so that this end is closely adjacent the diaphragm of the driving unit 20. This flared end is surrounded by a fillet portion 26 which secures and supports the tube in the housing 32.

With this arrangement, a minimum air cavity is obtained in front of the diaphragm which prevents a loss of transmission through the tubes at the higher frequencies. In addition, by the provision of separate driving units for each hearing tube, the pressure leaks encountered heretofore in devices of this character have been eliminated, thus providing a materially increased low frequency range.

As shown in Figures 4 and 5, damping plugs or pads 28 and 30 are inserted in the hearing tubes adjacent the ends thereof. These plugs are cut slightly larger than the inside of the hearing tube and are forced into the

tube so that they remain in position therein by reason of their pressure against the tube wall. In a particular embodiment of the present invention found to be satisfactory, the plugs were cut from long-fibered 100% wool felt sheets one-sixteenth of an inch thick, having a density of 22% (relative to specific gravity of water), and, as shown in Figures 4 and 5, placed one-eighth of an inch from the upper or ear piece end and the driver end respectively of the hearing tubes. Furthermore, with the plugs so positioned a tube having an internal diameter of 0.157 inch and a length of 7.859 inches was found satisfactory.

In the particular embodiment described, the positioning of the damping plugs was found to have an important effect on the acoustic characteristics of the assembly. Advantageously, the upper plug is placed one-eighth of an inch plus or minus one-sixteenth from the upper end, and the lower plug is placed within one half of an inch from the driving unit end. With the plugs placed in these positions, they smooth out to a substantial degree the harmonic resonances that would appear in the upper frequency ranges and eliminate considerable distortion and hoarseness. This is due in part to the fact that in tubes of this type, without such plugs, standing waves are obtained when sound is introduced by a driving unit at one end, producing resonances at the various harmonics which must be smoothed out to prevent excessive distortion. It should be noted that plugs of this type will provide damping at some frequencies no matter where they are placed. However, suitable tube dimensions together with proper placing of the damping plugs, and selection of material therefor of suitable porosity for example, as described above, were found to combine to give the smoothest overall response obtainable compatible with simple manufacturing procedure. With this arrangement set forth above, it is possible to obtain a substantially smooth response characteristic from approximately 30 cycles per second to 5000 cycles per second with variations that do not exceed plus or minus 5 decibels.

While only the specific structure of the left-hand hearing tube assembly of the headphone device 10 has been described, it is to be understood that the right-hand hearing tube assembly is substantially identical except for the electrical contacts and plug assembly of the hinge structure.

Thus it is seen that, according to the present invention, a headphone unit is obtained which has a balanced and sealed acoustical system which produces a smooth response characteristic over a wide range of frequencies.

When a pair of separate driver units are employed, a special type pivot or hinge construction is required between the hearing tube assemblies. This hinge arrangement must provide an electrical circuit for each driving unit in addition to its normal mechanical pivoting function. Accordingly, as may be seen in Figures 3 and 4, the driving unit housing 32 has as an integral part thereof a projecting ear 34, and driving unit housing 36 has a similar projecting ear 38.

Referring now to Figure 2, it is seen that these two projections are joined by a shaft 40 having an integral head 42 on one end thereof. The head 42 is seated in a recess 54 in the outer face of the projecting ear 38. The other end of shaft 40 projects into a similar annular recess 55 in the outer face of projecting ear 34 and is provided with an annular groove 43 which is adapted to receive a lock washer 44 which rests on a retaining washer 46. An outer cover 48 is positioned in an annular step 49 in the recess 55 to close it and prevent dirt from entering the hinge assembly joining the driving units. Spring washer 50 and washer 52 are provided between the shaft head 42 and the inner portion of the recess 54 to urge the inner faces of the two projecting portions together to insure good electrical contact between the contact portions on the inner faces thereof, as will be de-

scribed hereinafter. The hearing tube assemblies can thus be rotated until stopped by the abutment of driver units 20 and 22 in one direction and the contact of driver unit 22 against plug 66 in the other.

Referring now to Figure 3, arcuate contact plates 56 and 58 are mounted in the inner face of projecting ear 38. These plates are connected to driving unit 22 by wires 60. Similarly, referring now to Figures 2 and 4, a pair of contact plates 62 and 64 are positioned in the inner face of ear 34 and connected to driving unit 20 by wires 70. These contact plates, as will be seen from Figure 2, form a part of a pair of curved spring clips which also make contact with prongs 68 of a plug 66 through which the signal to be heard is introduced into the hinge assembly. This arrangement provides a spring urged contact for the prongs 68 as well as a further spring pressure to insure proper contact between the contact plates as the hinge is rotated. The contact plates 56, 58, and 62, 64 respectively are positioned so that they insure contact between the parallel driving-unit circuits and the prongs 68 in all positions to which the hinge can be moved.

The plug 66 has a pair of prongs 68 which are adapted to engage, in a detent 69 therein, the bent over spring clip portion of the contact plates 62 and 64. Thus the signal to be heard is fed from plug 66 through prongs 68 and contacts 62 and 64 to the driving unit 20; and through the additional contacts 56 and 58 to driving unit 22, where it is, in each case, translated into sound and then fed through the hearing tubes 12 and 14 respectively, to the ears of the listener.

Hence, it is readily apparent that there is provided, in accordance with this invention, a headphone device having fixed and identical acoustical systems feeding into each ear without any possibility of leakage, which gives a greatly improved frequency response over a much wider range of frequencies than heretofore found possible.

While there is given above a certain specific example of this invention and its application in practical use, it should be understood that this is not intended to be exhaustive or to be limiting of the invention. On the contrary, this illustration and the explanation herein is given in order to acquaint others skilled in the art with this invention and the principles thereof and a suitable manner of its application in practical use, so that others skilled in the art may be enabled to modify the invention and to adapt it and apply it in numerous forms, each as may be best suited to the requirement of a particular use.

I claim:

1. A headphone device for use in a signal-reproducing system of the type wherein the reproduced signal is to be confined to the ears of an individual listener and including means for producing sound signals and for transmitting these sound signals to the ears of the listener, comprising in combination, translating means including movable sound-pressure-producing means adapted when energized to produce sound pressure signals, a pair of substantially rigid curved hollow hearing tubes each having at one end thereof an ear piece shaped to fit snugly into the ear cavities of the listener and pivotally joined together at the other end thereof, each of said tubes also having at least one sound damping plug positioned there-within adjacent an end thereof to minimize acoustic resonance effects, and coupling means to introduce said sound signals to said hearing tubes, said hearing tubes and said coupling means being adapted to form two separate paths for the transmission of said sound signals to the ears of said listener, said coupling means including means substantially sealing said paths from the outside atmosphere to minimize acoustic signal losses and thereby to provide a wide and relatively flat frequency response characteristic in the audible range.

2. A device as described in claim 1 wherein said hear-

ing tubes are from seven to eight inches long and have an inside diameter of from one-eighth to one-fifth of an inch.

3. A device as described in claim 2 wherein said plugs are made of a fibrous material and located from one-sixteenth to one-half of an inch from each end of each hearing tube. 5

4. A device as described in claim 1 wherein said plugs have a diameter slightly greater than the diameter of said tubes, and are radially compressed when in position in said tubes. 10

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