June 15, 1954 H. B. SHAPER 2,681,389

BONE CONDUCTION HEARING AID UNIT

Filed Feb. 25, 1949

FIG. 1.

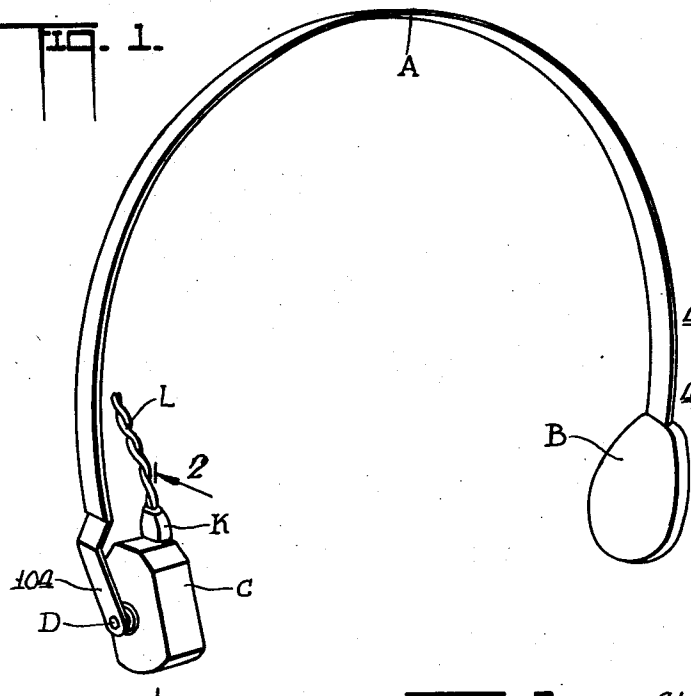


FIG. 4.

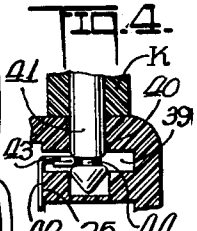


FIG. 3.

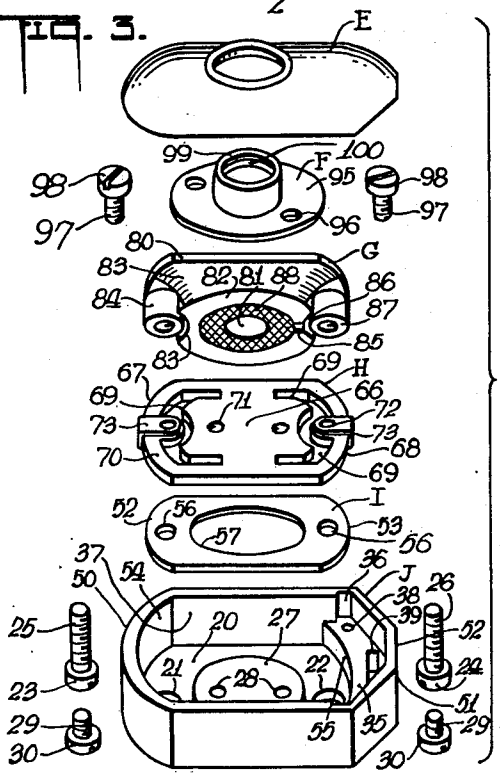
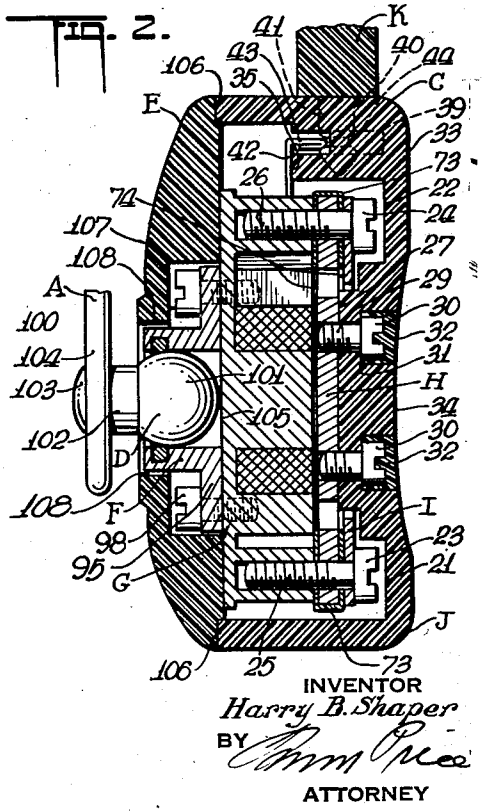


FIG. 2.



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BONE CONDUCTION HEARING AID UNIT

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1 Claim. (Cl. 179—107)

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The present invention relates to a bone conduction hearing aid device.

Considerable difficulty has been experienced with hearing aid bone conduction units because of the lack of compactness and because they do not have efficiency necessary to permit a satisfactory amount of energy to the cochlea with the audio energy available from past conducting amplifiers.

Furthermore, many units are very susceptible to damage upon dropping, pulling or accidental hammering.

It is among the objects of the present invention to provide a novel bone conduction hearing aid unit which will be quite durable and not be readily subjected to damage and the internal critical elements of which will not be subject to displacement or deformation upon dropping, pulling or accidental hammering.

Another object is to provide a bone conduction hearing aid unit which will be small and compact and readily manufactured at low cost and which will be highly efficient to transmit substantial energy to the cochlea with the normal milliwatts of audio energy available from a vest-pocket amplifier.

Still further objects and advantages will appear from the more detailed description set forth below, it being understood, however, that this more detailed description is given by way of illustration and explanation only and not by way of limitation, since various changes therein may be made by those skilled in the art without departing from the scope and spirit of the present invention.

In accomplishing the above objects it has been found most satisfactory to provide a construction in which the heavy part of the hearing aid device, or the magnet and its associated structures, is attached to the head band and the armature is maintained mounted upon the casing and its movement in respect to the magnet structure limited by the guard plate.

The swivel joint of the head band is attached to the magnetic structure instead of the housing and the forces developed between the armature and the main magnetic assembly are transmitted to the bone structure by the casing.

As a result there is very little likelihood of dropping, pulling or accidental hammering, tending to permanently deform the armature, since on the preferred construction, the extreme movement of the armature is limited by the guard plate, for example, to as small a movement as between .003" to .007".

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In general, the unit consists of a cup-like casing, preferably of plastic material, with an adhesively attached cover. Through a central opening in the cover is positioned a ball socket connection between the hand bank and the back of the magnetic structure.

Mounted in the bottom of the cup-like casing is the diaphragm which is provided with fixed spacer or guard plates to prevent distortion or deformation thereof beyond the maximum desired limited movement thereof, for example, .005".

With the foregoing and other objects in view the invention consists of the novel construction, combination and arrangement of parts as hereinafter more specifically described, and illustrated in the accompanying drawings, wherein is shown an embodiment of the invention, but it is to be understood that changes, variations and modifications can be resorted to which fall within the scope of the claim hereunto appended.

In the drawings wherein like reference characters denote corresponding parts throughout the several views:

Fig. 1 is a side perspective view showing a hearing aid bone conduction unit in accordance with the present invention, with a head strap.

Fig. 2 is a transverse vertical sectional view upon the line 2—2 of Fig. 1 upon an enlarged scale as compared to Fig. 1.

Fig. 3 is a perspective exploded or separated view of the combination or unit of Fig. 2.

Fig. 4 is a detail fragmentary side sectional view showing how electrical connection is made to said unit.

Referring to Fig. 1, there is provided a head band A, a head contact portion B, and the hearing aid bone conduction unit C which is mounted upon a swivel combination D.

The unit C, as best shown in Fig. 3, has a plastic cover E, a retainer sleeve F forming part of the swivel combination, a magnet assembly G, a diaphragm or armature H, a guard plate I, a main casing unit J and a plug-in connection K with electrical wires leading to the vest pocket amplifier unit, not shown.

Referring specifically to Fig. 3, the casing J has a base 20 with the recesses 21 and 22 formed therein to receive the heads 23 and 24 of the screws 25 and 26. The central portion of the base 20 is provided with a platform 27 with the openings 28.

The two openings 28 receive the shanks 29 of the screws 30, which are held in place by the shoulders 31. The recesses are then filled up by

plastic material 32 so that a smooth face 33 with the conforming curvature 34 will fit against the side of the head and in contact with the skull or mastoid bone.

At one end of the casing J there is a ledge 35, the ends of which extend into the recesses 36 in the side straight walls 37 of the casing J. The top of the ledge 35 is provided with the recesses 38 and 39.

The elongated recesses 39 communicate with the openings 40 (see Fig. 4), into which extends the prongs 41 of the plug K.

The recesses 38 receive screws or rivets which hold the plates 42 (see Fig. 4) in position. These plates 42 are provided with the inwardly bent, downturned fingers 43. The fingers 43 contact the recesses 44 in the prongs 41, where they project into the recess 39.

It will be noted (see Fig. 3) that the end wall 50 of the casing J is curved whereas the end wall 51 is polygonal so as to form a flat surface 52 for the plug K. The guard plate I fits into the plastic receiver J with its curved edges 52 and 53 contacting the inner curved faces 54 of the walls 50 and 55 of the ledge 35.

The guard plate I has the openings 56 receiving the screws 25 and 26. The heads 23 and 24 of the screws 25 and 26 abut against the plate, as best shown in Fig. 2.

The central portion of the guard plate I is provided with an opening 57 through which projects the platform 27 (see Fig. 3). The platform 27 contacts and abuts the central portion 66 of the armature or diaphragm H.

The diaphragm or armature H has the end curved edges 67 and 68 (see Fig. 3) fitting closely against the curved faces 54 and 55 of the interior of the receptacle J.

The central portion 66 of the diaphragm H is partly severed by the slots 69 from the peripheral portion or rim 70 of said armature H. The central portion 66 of the armature H is provided with the openings 71 which receive the shanks 29 of the screws 30. The rim 70 is provided with the openings 72 which receive the screws 25 and 26.

To space the armature H from the guard plate I and the magnet assembly G, the U-shaped clips 73, which may be of brass, are provided on each end of the armature H. These clips are formed of sheet brass or copper of about 0.005'' in thickness. The clips 73 will assure proper spacing at 74 on each side of the armature H (see Fig. 2).

The magnet assembly G is formed of three units soldered together, namely a backing plate 80, a core 81 and an annulus 82 with the soldering 83 extending around the walls of the annulus 82.

The annulus 82 is recessed at 83 to receive the threaded tapped brass sleeve 84 and it is also slotted at 85 and recessed at 86 to receive the tapped brass sleeve 87.

The wire coil 88 is inserted between the core 81 and annulus 82 and the lead-in wires extend through the slot 85 and pass the tapped sleeve 87 to the arcuate contact plates 42 (see Fig. 2).

The slot 85 (see Fig. 3) as well as the recesses 83 and 86 not only give a more compact assembly, but also enable better connection of the lead-in wires 88 as well as improved electrical characteristics of the magnetic assembly G. The tapped sleeves 84 and 87 receive the ends of the screws 25 and 26 (see Fig. 2).

The swivel ball retainer F, as shown best in Figs. 2 and 3, has a base flange 95 with the openings 96 to receive the shanks 97 of the screws 98 and it also has an outwardly projecting sleeve 99 with a spring ring retainer 100 below which the ball 101 of the swivel arrangement D snaps.

The ball 101 has a stem 102 peened at 103 onto the end 104 of the head band or strap A. Hammering or violent motion of the ball 101 will result in its striking the back face 105 of the magnetic structure G (see Fig. 2).

The cover E is recessed at 106 where it is cemented to the side walls 50, 51 and 37 of the casing J. It is also recessed at 107 to receive the heads 98 of screws 97. The cover E also has a clearance at 108 in respect to the projection 99.

The elements of Fig. 3 may be readily put together to form the unit of Fig. 2. When so assembled, although the diaphragm or armature H will directly drive or vibrate the skull or mastoid bone, nevertheless dropping or pulling or hammering on the swivel D will not deform or put any particular stress upon the diaphragm H.

The spacing of the diaphragm H is controlled by the clips 73 while the guard plate I will prevent permanent deformation of said armature H.

This arrangement is much superior to an arrangement in which the swivel D can contact and act upon the diaphragm or armature H directly and it is also superior to a construction in which the magnet Q instead of the armature H, drives the casing where it is applied to the head or mastoid bone.

Moreover, by providing a central swivel D, mounted directly upon the magnet structure Q, a superior arrangement results.

The unit above described has an average loudness level per milliwatt of 90 db above threshold level.

The unit when placed over the mastoid of one ear nevertheless stimulates the cochlea of both ears and gives the hearer a balanced hearing feeling with most satisfactory amplification.

The unit is designed to cooperate with hearing aid amplifiers of medium hearing power and when coupled to the bone structure of the mastoid, normal listening loudness is obtained with 1 to 5 milliwatts of one watt of electrical energy.

The unit is designed to obtain maximum efficiency from a very small magnet structure and the entire unit may measure, in a preferred embodiment, 1.06'' long by .775'' wide by .5'' thick.

The frequency response will be 100 to 10,000 C. P. S. with maximum power, enabling capacity of 0.1 watt and an impedance of 50 or 120 ohms. The guard plate may be 0.020'' in thickness while the diaphragm may be 0.40'' in thickness. The magnets are preferably made of an aluminum-nickel alloy.

While there has been herein described a preferred form of the invention, it should be understood that the same may be altered in details and in relative arrangement of parts within the scope of the appended claim.

Having now particularly described and ascertained the nature of the invention, and in what manner the same is to be performed, what is claimed is:

A compact small size bone conduction hearing aid unit, less liable to damage, displacement, or deformation upon dropping, pulling or accidental hammering, of the type having a magnet structure with a head band pivotally connected thereto and having a cup casing with an armature mounted directly upon the base thereof, which base is to contact the side of the head of the wearer, said armature being provided with a guard plate to limit its movement to between

0.003'' and 0.007'', said unit including a cup-like casing of plastic material with an elevated central plateau in the interior base thereof and with an adhesively attached cover at the outer periphery thereof, said cover having a central opening, a head band having a ball socket male connection extending inwardly through said central opening into the casing, a magnet having a ball socket female sleeve connection inside of said casing and receiving said ball socket male connection, an armature mounted on and connected to the elevated central plateau on the bottom of the cup, a guard plate encircling said plateau and being positioned below the top of the plateau, and attachment means extending through and

connecting said guard plate, magnet and armature at periphery thereof, said guard plate being postioned between the periphery of the armature and the periphery of the casing and said magnet structure being connected to the periphery of the armature and being devoid of direct connection to the casing.

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