

March 19, 1957

L. P. FRIEDER ET AL
EARPHONE APPARATUS

2,786,102

Filed Nov. 6, 1952

3 Sheets-Sheet 1

Fig. 1

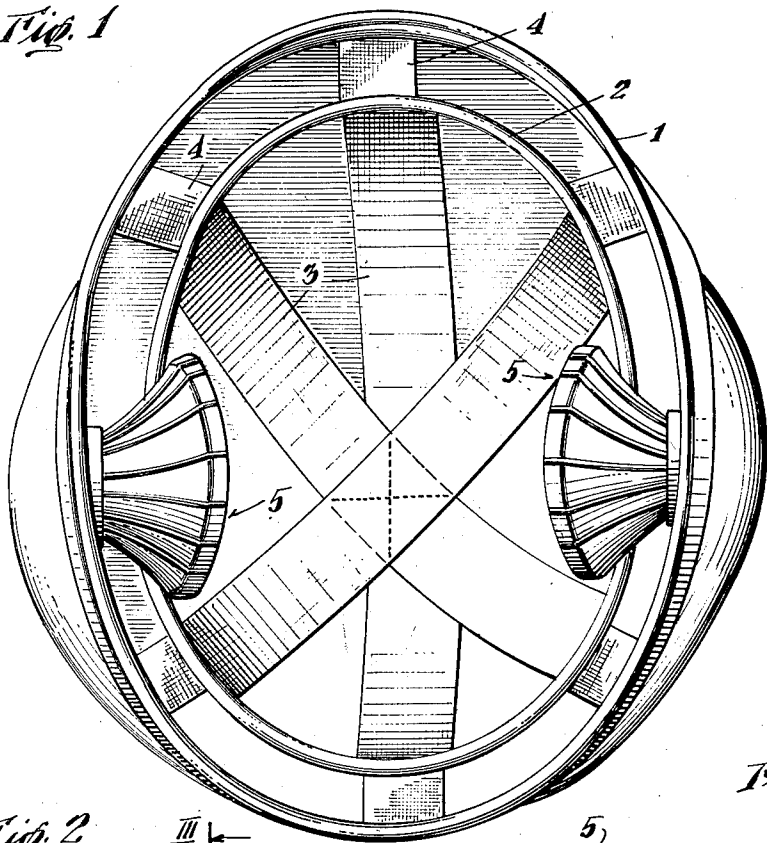


Fig. 2

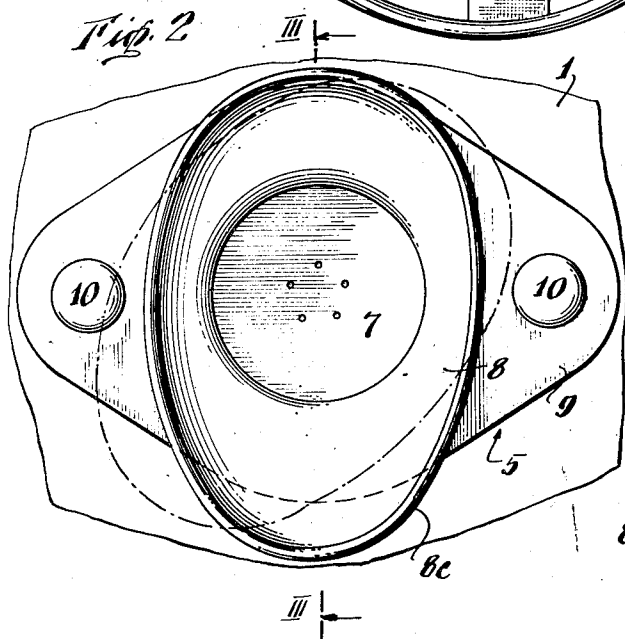
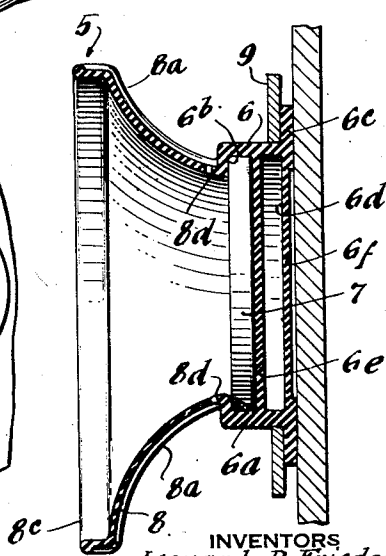


Fig. 3



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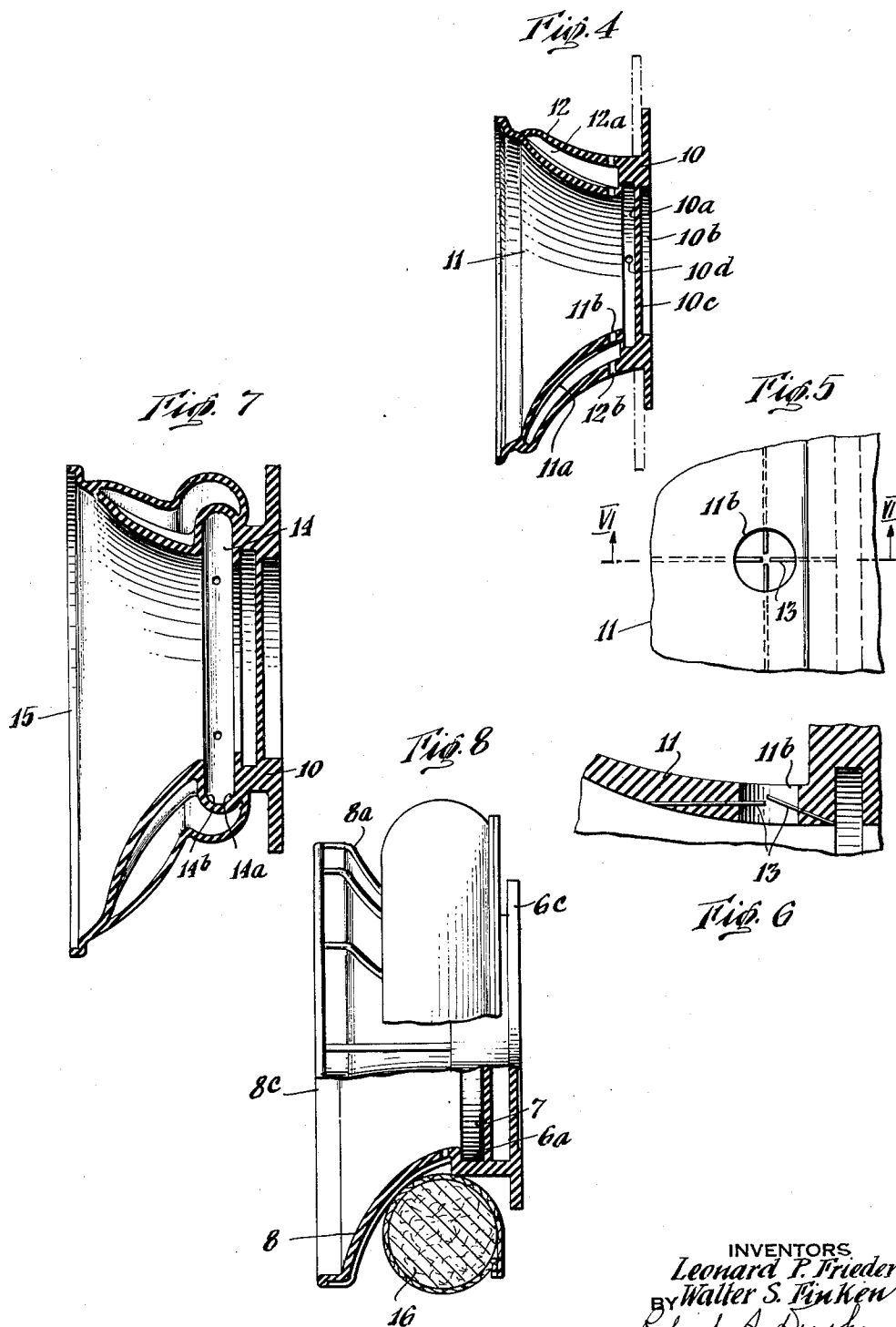
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3 Sheets-Sheet 3

Fig. 9

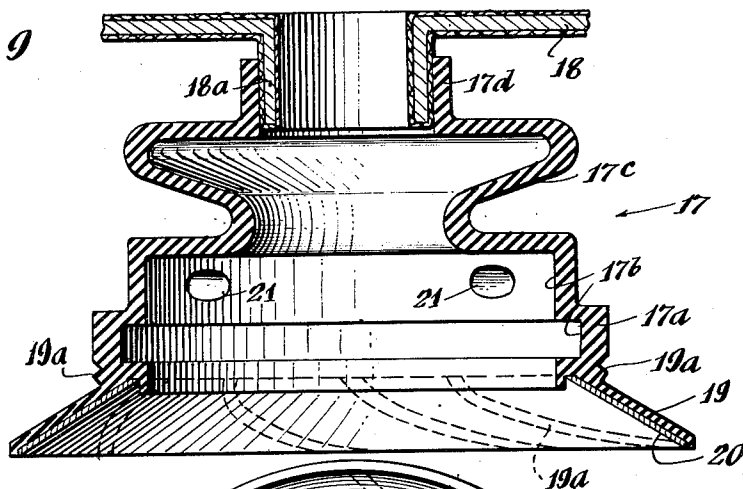
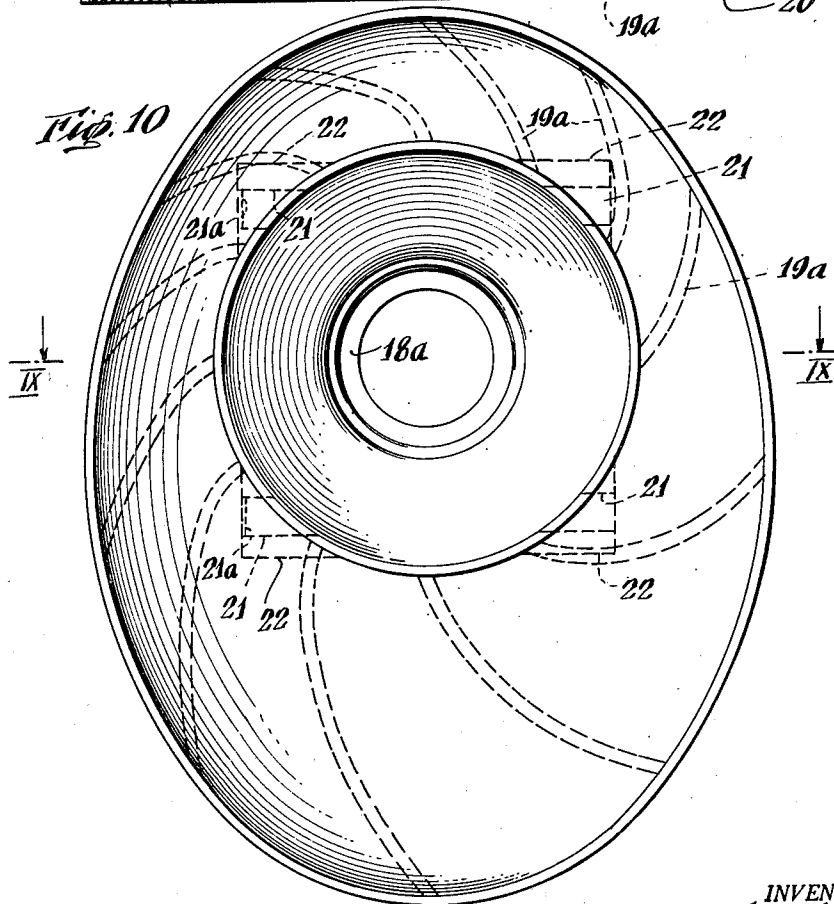


Fig. 10



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2,786,102

EARPHONE APPARATUS

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Application November 6, 1952, Serial No. 319,134

7 Claims. (Cl. 179—156)

The present invention relates to earphones, and particularly to apparatus for supporting earphones on the head so as to inhibit access to the ear by sound waves from external sources.

The present invention is particularly intended for use in connection with headgear or helmets of the types shown and claimed in our copending applications, Serial Nos. 201,904, filed December 21, 1950, and 292,824, filed June 11, 1952, now Patents Nos. 2,739,309 and 2,739,310 respectively, granted March 27, 1956. The headgear structures there disclosed include a relatively stiff protective helmet enclosing the head but spaced therefrom by means of an internal supporting harness which engages the head of the wearer. Such headgear are commonly worn by aviators and others who are sometimes required to wear earphones simultaneously. The earphones commonly worn with such headgear structures in the past have been more or less conventional earphones, mounted on the head of the wearer, and independent of the headgear and its supporting harness. Since the supporting harness of the headgear is quite complex, the earphone supporting structure necessary for conventional earphones, when used in conjunction with such a headgear, results in the simultaneous use of two separate supporting structures on the head of the wearer. Each of these structures is rather bulky and at least some portions of each structure must engage the wearer's head closely. The resulting arrangement is uncomfortable to the wearer, both because of the weight and the confining effects of the two supporting structures and also because of attendant local increases in temperature.

It is, therefore, an object of the present invention to provide an improved earphone structure of the type described which is adaptable for mounting on a headgear of the type mentioned above. Another object is to provide an earphone structure in which the sound emitting unit is spaced from the wearer's ear, and including a novel, flexible shell structure enclosing the space between the sound emitting unit and the wearer's ear.

A further object is to provide an earphone supporting structure of the type described which is adjustable with respect to the headgear.

A further object is to provide an earphone supporting structure of the type described including improved sound barrier structures for inhibiting access to the ear by sound waves from external sources.

A further object is to provide improved venting arrangements for the interior of the shell structure to equalize pressures between its interior and exterior attenuating sound waves passing through the vents.

The foregoing and other objects of the invention are attained by providing an earphone support including a base portion having a recess adapted to receive a sound emitting unit and a shell portion encircling the sound emitting unit and projecting divergently therefrom to an extremity whose periphery is contoured to encircle the ear of one listening to the earphone.

The base portion of the support is also provided with

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a flexible adjustable plate by which the base portion may be attached to the inside of a helmet or other headgear structure.

Sound barrier chambers are provided on the side of the sound emitter unit away from the head and may also be provided around the entire periphery of the shell structure. The shell structure is preferably constructed of rubber or other flexible material and is provided with reinforcing ribs extending longitudinally from the base portion to the head engaging periphery, and also with a reinforcing rib extending around the head engaging periphery.

Small apertures are provided in the shell structure to allow equalization of the internal and external pressures.

Where a peripheral sound barrier chamber is used, pressure equalizing vents may be provided in one or both walls of that chamber. The pressure equalizing vents may be provided with vibrissa-like filaments projecting into the vents from the surrounding material. These filaments aid in preventing the passage of compression waves, such as sound waves.

Other objects and advantages of the invention will become apparent from a consideration of the following specification, taken in connection with the accompanying drawings, in which:

Fig. 1 is a bottom view of a helmet in which an earphone structure constructed in accordance with the present invention has been mounted;

Fig. 2 is an elevational view of a single earphone structure and its supporting plate, shown mounted in place on a helmet, only a fragmentary portion of which is shown;

Fig. 3 is a sectional view taken on the line III—III of Fig. 2;

Fig. 4 is a sectional view similar to Fig. 3, showing a modified form of earphone supporting structure;

Fig. 5 is a fragmentary elevational view on an enlarged scale, showing the details of one of the pressure equalizing vents with its associated vibrissa filaments;

Fig. 6 is a sectional view taken on the line VI—VI of Fig. 5;

Fig. 7 is a sectional view similar to Figs. 3 and 4, showing another modification; and

Fig. 8 is a sectional view similar to Fig. 3, showing an additional padding arrangement which may be used.

Fig. 9 is a sectional view, taken on line IX—IX of Fig. 10 showing another modified form of earphone supporting structure; and

Fig. 10 is a plan view of the structure of Fig. 9.

Figs. 1 to 3

There is shown in Fig. 1 a helmet 1 of the type shown in our copending application, Serial No. 292,824, now Patent No. 2,739,310, previously mentioned. This helmet includes an outer casing and an internal harness for supporting the helmet on the wearer's head. This harness includes an encircling band 2, diametrical straps 3 which extend across the top of the wearer's head, and flexible elements, here shown simply as bands or loops 4, which connect the head band 2 to the outer casing 1 and which are preferably constructed to hold the band in spaced relation inwardly of the shell.

In Fig. 1 there are shown two earphones, generally indicated at 5, mounted on the helmet 1 and projecting inwardly therefrom. This earphone structure is shown in more detail in Figs. 2 and 3 and includes a base portion 6 having a recess 6a adapted to receive a sound emitter unit, which may be any conventional earphone unit such as one of the magnetically vibrated diaphragm type, one such being shown at 7. The base portion 6 is formed of flexible resilient material such as rubber, so that the sound emitter unit 7 may be pushed

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forcibly into the recess 6a, whereupon a flange 6b of the base portion holds it in place. Suitable holes, not shown, may be provided in the base portion 6 for passage of wires connected to the sound emitter 7 (see hole 10d of Fig. 4, described below). Projecting outwardly from the base portion 6 toward the ear of a listener is a shell 8, also constructed of flexible material such as rubber and provided with longitudinal reinforcing ribs 8a. The shell 8 diverges in an outwardly curving direction away from the base portion 6 and has its outer periphery contoured to enclose a wearer's ear, as illustrated at 8c. Thus the rim 8c may be oval-shaped and somewhat eccentric of the central axis of the receiver unit 7.

The base portion 6 is provided with a flange 6c at its end farthest from the wearer's ear.

A flexible mounting plate 9 encircles the base portion 6, being apertured to fit the base portion snugly. The plate 9 is preferably formed of leather or other readily flexible material, which is sufficiently stiff to frictionally engage the periphery of the base portion 6 and hold it against rotation. The plate 9 carries a pair of snap elements 10 which cooperate with mating snap elements mounted on the helmet 1 and not shown in the drawing. The earphone support including the base portion 6 and the shell 8 may be rotated on the plate 9 by virtue of the frictional engagement between the plate 9 and the base portion 6, so as to correct for various angles at which the helmet may be mounted on the wearer's head.

The shell 8 may be provided with pressure equalizing vents 8d, through which the pressure inside the shell 8 is allowed to equalize with the outside pressure. The axial length of the shell between its inner periphery 8c and the base portion 6 is preferably more than enough to take up the spacing between the helmet and the wearer's ears. Consequently, the shell will normally be compressed axially when in use, so that the inner periphery fits snugly against the head of the wearer. The shell is thereby effective to exclude substantially all external sound waves, so that the wearer hears only the sounds issuing from the emitter unit 7.

In the base portion 6, in between the emitter receiving recess 6a and the flange 6c is formed a sound barrier chamber 6d, which is simply an empty chamber in the base portion 6. Barrier chamber 6d is effective to attenuate substantially all sound waves transmitted through the helmet 1, which might otherwise be transmitted through the earphone supporting structure to the ear of the wearer. In the device shown, the barrier chamber is enclosed by front and rear walls 6e, 6f, of rubber, integral with the remainder of the earphone structure, which as stated is made of flexible and preferably elastic material. The front wall 6e may be the rear wall of the receiver-holding recess 6a.

Figs. 4 to 6

These figures illustrate a modified form of earphone support again made of rubber or other elastic, flexible material and including a base portion 10 having a recess 10a for a sound emitter unit and another recess 10b which serves as a barrier chamber for sound waves transmitted through the helmet or other supporting structure. The recesses are preferably separated by a thin wall 10c of elastic material integral with the remainder of the support.

The side of recess 10a is provided with one or more holes 10d through which wires for the sound emitter unit may be threaded.

A shell 11 is mounted on the base portion 10. The internal structure of the shell 11 is substantially the same as that of the shell 8 of Fig. 3. Around the shell 11 is provided an outer wall 12 which, together with the shell 11, defines an annular sound barrier chamber 12a.

The shell 11 is provided with reinforcing ribs 11a, similar to the reinforcing ribs 8a of Fig. 3. Pressure equalizing vents 12b and 11b are provided in the outer

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wall 12 and the shell 11. As illustrated in Figs. 5 and 6, either or both of these vents may be provided with vibrissa-like filaments 13. These filaments are simply fibers of nylon or other suitable material, which are sewn into the structure of the shell 11 and cut off to the lengths shown, with their free ends projecting into the vents 11b. These filaments have a sound deadening function, particularly effective in the case of sound waves having a high rate of attack, such as sound waves resulting from explosions.

It has been found effective in some cases to omit either the pressure equalizing vents 11b or the vents 12b or both, so as to maintain a higher pressure inside the shell 11 than exists outside. Since the helmet and earphones are normally put on by the aviator at ground level, the periphery of the shell 11, closely engaging the head of the wearer, will trap air at ground level pressure in its interior. As the aviator goes up to higher altitudes, the air outside becomes less dense and is therefore a less effective transmitter of sound. By omitting pressure equalizing vents, the air inside the shell is maintained at a higher density and is thus a better transmitter of sounds passing between the emitter unit and the ear, while sounds from external sources are transmitted through the air of lower density outside, which is a less efficient sound transmitter. It is assumed that in the situation just described the aviator is also preferably using a breathing mask of such character as to tend to prevent loss of pressure, from the shell 11, through an internal route.

Fig. 7

The modification shown in this figure includes a deflection chamber 14 which is formed in the wall of a shell portion 15. The deflection chamber 14 includes an outwardly diverging portion 14a attached to the base portion 10 and an immediately adjacent outwardly convergent portion 14b. The deflection chamber constitutes a sort of single fold accordion structure which collapses readily when the earphone is put on, so as to accommodate the earphone structure to a wider range of head size variations. The structure shown in Fig. 7 is otherwise similar to that shown in the previous modifications and will not be further described.

Fig. 8

This figure illustrates an accessory which is in conventional use with other types of earphone supports and which may be used if desired in connection with the earphone of the present invention. This accessory consists simply of a doughnut-shaped pad 16 which encircles the shell 8. This pad serves to attenuate some sound waves from external sources and also may serve to absorb shocks due to relative movement between the helmet 1 and the wearer's ear.

Figs. 9 and 10

These figures illustrate a modified form of our invention, in which the earphone is supported closer to the ear of the listener than in the modifications previously described. In this modification, there is also provided mechanism for adjusting the spacing between the helmet or other support and the shell structure which engages the listener's ear.

Referring to the drawings, there is shown a housing 17 including a body portion 17a having a recess 17b adapted to receive a sound emitter. On its end nearest the helmet the body portion 17a is provided with a longitudinally collapsible portion 17c which terminates in a projecting circular collar 17d. The collapsible portion 17c not only serves to accommodate movements of the wearer's head with respect to the helmet, but also serves as an enclosure for a sound barrier chamber similar in function to the chamber 6d of Fig. 3.

A mounting plate 18 is provided for supporting the housing 17 on a helmet. The mounting plate 18 is similar in function to the mounting plate 9 of Fig. 2, and may

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be provided with similar means (not shown in Fig. 9) for attaching it to the helmet. The plate 18 is provided with a central aperture encircled by a flange 18a whose external diameter is substantially the same as the internal diameter of the collar 17d on the housing 17. The housing 17 and plate 18 are preferably made of molded rubber or some similar material and the plate 18 is provided with a bonded cloth covering. When so constructed, the collar 17d frictionally engages the flange 18a, so that it will remain in any position to which it is adjusted. The collar 17d may be rotated angularly on the flange 18a and it may also be moved axially along that flange. The housing 17 is thereby made adjustable not only angularly but longitudinally with respect to the supporting helmet. If desired, suitable fastening means may be provided on the collar 17d and flange 18a, for attaching these parts firmly after an adjustment is completed.

The end of the housing 17 nearest the listener's ear is provided with a projecting shell portion 19, generally similar to the shell 8 of Figs. 1 to 3. The shell 19 is provided on its outer surface with reinforcing ribs 19a which have curvatures in three dimensions, so that their projections on a plane perpendicular to the axis of the housing 17 are spirals, as illustrated in Fig. 10. These curved ribs provide a somewhat stiffer structure than the ribs 8a of Fig. 3. The face of the shell 19 nearest the listener's ear is provided with a recess to receive a covering 20 of leather or other similar fabric, which provides a better sound absorbing surface than the molded rubber of the shell 19. The covering 20 thereby reduces to a negligible minimum any internal reflections and echoes which might distort the sound from the emitter.

The recess 17b is provided with apertures 21 for the insertion of electrical terminal plugs. Four such apertures 21 are provided, extending outwardly through bosses 22 which project from the outer surface of the housing 17. Only the two apertures 21 on one side are actually used for electrical connections on any particular earphone housing. The housing is provided with two bosses 22 and apertures 21 on each side so that any housing may be used on either the right or left side of the head. As constructed, the apertures 21 do not extend completely through the bosses 22, but terminate at thin walls 21a at their outer ends, as seen on the left hand bosses in Fig. 10. The walls 21a on one side only are then pierced to allow insertion of the electrical connections.

While we have shown and described what we now consider to be preferred embodiments of our invention in accordance with the applicable statutes, numerous other embodiments will be suggested to one skilled in the art and our disclosure is to be considered as illustrative only and not as limiting our invention in any way.

We claim:

1. In an earphone, a housing having a portion adapted to receive a sound emitter and a hollow flexible shell attached to said housing and encircling said portion, said shell projecting generally divergently from said housing to an extremity having a periphery contoured to encircle a listener's ear, said periphery being adapted to engage flexibly the head of the listener about the ear so as to enclose substantially completely the space between the sound emitter and the ear, said shell having integral stiffening ribs curved in three dimensions and extending along the outer surface of the shell.

2. An earphone, comprising a housing including a body portion having a recess adapted to receive a sound emitter, said recess being open at least at one side corresponding to a sound emitting side of the emitter, means including a supporting portion of said housing for supporting said

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body portion with said open side of the recess in alignment with the ear of the listener but spaced therefrom, said body supporting means including a mounting structurally separate from the housing, said housing having a hollow flexible shell portion mounted on said body portion and encircling the open side of said recess, said shell portion projecting divergently from said body portion to an extremity having a periphery contoured to encircle the listener's ear, and means for adjusting the position of the shell toward and away from the ear with respect to the mounting, so that the periphery of the shell portion engages flexibly the head of the listener about the ear, so as to enclose substantially completely the space between the emitter and the ear.

3. Earphone apparatus comprising a helmet having a portion adapted to extend over the ear of a wearer, means inside the helmet and attached thereto for supporting it on the head of a wearer with the inner surface of said portion spaced from the wearer's ear, a housing having a recess adapted to receive a sound emitter, means supporting said housing on the inside of said portion of the helmet in a position to align the emitter with the wearer's ear when the helmet is supported on the wearer's head, said housing including a hollow flexible shell projecting inwardly of the helmet to an extremity having a periphery adapted to engage the wearer's head about the ear, so as to enclose substantially completely the space between the sound emitter and the ear, said housing supporting means including a support member, cooperating detachable connectors on said support member and said helmet, and a frictionally rotatable connection between said housing and said support member to permit angular adjustment of the housing and shell with respect to the helmet to accommodate different angular relationships between the helmet and the wearer's head.

4. Earphone apparatus as defined in claim 3, including an outer flexible wall cooperating with said shell to form a generally closed chamber extending around the periphery of said shell throughout a major portion of the distance between the housing and the shell extremity, said chamber being effective to attenuate sound waves from external sources.

5. Earphone apparatus as defined in claim 4, in which said outer wall has at least one pressure equalizing vent connecting said chamber and the atmosphere.

6. Earphone apparatus as defined in claim 3, in which said shell has at least one vent effective to equalize the pressure in said enclosed space with that of the ambient atmosphere.

7. Earphone apparatus as defined in claim 6, including a plurality of vibrissa-like filaments projecting from the shell into said vent.

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