

EARPHONES

This invention relates to earphones.

Earphones used for listening to music or the like include air-tight magnetic type earphones and so-called dynamic type earphones.

5 In magnetic type earphones, a vibratable iron member is disposed in front of a coil and yoke which form a magnet circuit for vibrating the iron member, and a vinyl tube is attached to a projection having a vent hole and disposed in front of the iron member. In use, the vinyl tube is inserted into the external auditory canal. However, this is not very comfortable and moreover, because the vinyl tube supports the earphone to prevent it from
10 disengagement from the concha, the iron member is located remote from the eardrum, so that satisfactory high fidelity reproduction cannot be obtained.

In dynamic type earphones, a diaphragm is vibrated by a voice coil disposed in the magnetic field of a magnetic circuit including a yoke, a
15 magnet and a plate. This type of earphone also comprises a projection having a vent hole, and an attachment formed of polyurethane and attached to the projection is inserted into the interior of the external auditory canal.

According to the present invention there is provided an earphone comprising:

20 a housing formed so as to be capable of being received in a recess of the concha;

a magnetic circuit accommodated in said housing and having an air gap;

a diaphragm having a voice coil disposed in said air gap, the diameter of said diaphragm being substantially equal to that of said housing; and

25 a protector provided in front of said diaphragm for protecting said diaphragm and having a plurality of openings for transmitting sounds originated by said diaphragm to the eardrum;

the rear of said housing being provided with a plurality of openings for communicating between the inside of said housing and the atmosphere, and
30 being provided with a peripheral surface capable of engaging lugs of the concha when said housing is received in the concha.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a longitudinal section of an embodiment of earphone according to the invention;

Figure 2 is a front view of portions of the earphone of Figure 1 when it is in a recess of the concha;

5 Figure 3 is a partially cutaway side view of the earphone of Figure 2; and

Figure 4 is a partially cutaway side view of a modified embodiment.

10 As shown in Figure 1, an earphone 20 comprises an electroacoustic transducer 23 formed by a vibrating system 21 and a magnetic circuit 22, and a housing 24 in which the transducer 23 is mounted. The vibrating system 21 is formed by a diaphragm 25 having a sufficiently large effective area to reproduce sound satisfactory, a voice coil 26 wound around the outer periphery of an annular portion of the diaphragm 25, and an edge portion 27 for supporting the diaphragm 25 in place. The diameter of the diaphragm 25 is substantially equal to that of the housing 24. The magnetic circuit 22 is formed by an annular magnet 28 formed of rare earth cobalt system magnets such as samarium cobalt magnets, which have an excellent magnetic performance, and a yoke 29 which with a pole piece 41 concentrates magnetic flux from the magnet 28 in an air gap where the voice coil 26 is located.

20 In the housing 24 are mounted the respective parts of the vibrating system 21, the magnetic circuit 22 and other parts. The housing 24 is formed on the outer periphery of the front face with an annular flange 30 projecting outwards. As shown in Figures 2 and 3, the flange 30 is located at the inlet of the external auditory canal 31 and it engages with the cartilaginous lugs 33a located at predetermined positions of the outer periphery of a recess 33 in the central portion of the shell-like concha 32 surrounding the external auditory canal 31, so as to prevent the earphone 20 from careless disengagement from the concha 32 after the housing 24 is received in the recess 33. The flange 30 is formed to have an outer diameter dimension l_1 of about 1.8 cm for example.

30 The flange 30 is formed on the outer periphery with a cylindrical portion 34 inside which is a ring 36 supporting the outer periphery 35a of a protector 35 disposed in front of the diaphragm 25. The flange 30 is formed with a plurality of vent holes 30a and the protector 35 is formed with a plurality of vent holes 37. The front face of the protector 35 may be

covered with a material, for example polyurethane, through which sound can pass. In this embodiment, the thickness l_2 of the cylindrical portion 34 is about 1.5 mm so as to be satisfactorily received in the recess 33 in the concha 32.

5 A terminal board 39 connected to one end of a lead 38 is fixed to the back of the housing 24 by a moulded portion 40 of synthetic resin. The housing 24, the terminal board 39, the moulded portion 40, the yoke 29, the magnet 28 and the pole piece 41 are respectively formed with a central through hole 42, so that the inside and outside of the housing 24
10 communicate to each other. Thus, the back of the housing 24 is open to the atmosphere, which provides a particularly satisfactory tone quality. Also, the moulded portion 40 effects a buffer action on the cartilaginous lugs 33a of the concha, so as to avoid discomfort when the earphone 20 is attached to the concha.

15 The use and the operational effect will now be described. As shown in Figure 3, the earphone 20 is received in the recess 33 of the concha 32 such that the protector 35 is directed inwards towards the external auditory canal 31 of the concha 32. Particularly if the earphone 20 uses a samarium cobalt magnet 28 and is consequently compact and light, it can easily be
20 received in the recess 33 of the concha 32.

Also, because the earphone 20 is received in the inlet of the external auditory canal 31, the diaphragm 25 can be located close to the eardrum, while the effective area of the diaphragm 25 can be large enough for high fidelity sounds to be obtained.

25 Moreover, because only a portion of the earphone 20, such as the outer periphery of the protector 35, engages the concha 32, the earphone 20 is comfortable in use.

Figure 4 shows a modified embodiment with an example of an attachment for more securely attaching the earphone 20 to the concha 32.

30 In this example, the housing 24 of the earphone 20 of Figure 1 is provided with a cord 50 carrying a pair of grip members 51 each formed of a magnetic material. At least one of the members 51 is formed of a permanent magnet material, for example rare earth cobalt system permanent magnet material such as samarium cobalt, having a very high
35 magnetic attraction.

The other member 51 may be formed of magnetic material such as iron. Preferably, however, both members 51 are formed of permanent magnetic material so as to support the earphone 20 stably.

5 As shown in Figure 4, the members 51 grip both sides of the concha 32 after the earphone 20 has been received in the recess 33 of the concha 31. Since magnets having very high magnetic attraction, for example, samarium cobalt magnets, are used for the members 51, they are firmly secured to the concha 32. Accordingly, the earphone 20 is more firmly secured to the concha 32.

10 While in this embodiment a pair of members 51 grip the upper portion of the concha 32, a pair of grip members may be provided on the lead 38 to grip the lower portion of the concha 32.

CLAIMS

1. An earphone comprising:

a housing formed so as to be capable of being received in a recess of the concha;

a magnetic circuit accommodated in said housing and having an air gap;

a diaphragm having a voice coil disposed in said air gap, the diameter of said diaphragm being substantially equal to that of said housing; and

a protector provided in front of said diaphragm for protecting said diaphragm and having a plurality of openings for transmitting sounds originated by said diaphragm to the eardrum;

the rear of said housing being provided with a plurality of openings for communicating between the inside of said housing and the atmosphere, and being provided with a peripheral surface capable of engaging lugs of the concha when said housing is received in the concha.

2. An earphone according to claim 1 wherein said housing has attached to it a flexible cord carrying a pair of grip members for gripping said concha.

3. An earphone according to claim 2 wherein at least one of said members is formed of permanent magnetic material.

4. An earphone according to claim 1, claim 2 or claim 3 wherein said housing is provided on the back with a buffer member.

5. An earphone substantially as hereinbefore described with reference to Figures 1 to 3 of the accompanying drawings.

6. An earphone substantially as hereinbefore described with reference to Figures 1 to 3 as modified by Figure 4 of the accompanying drawings.

