

SPEAKER UNITS FOR HEADPHONES

This invention relates to speaker units particularly, but not exclusively, for headphones.

Generally, open air type headphones include an ear cup forming a perforated housing, and an ear pad which is formed of polyurethane or similar material having air permeability, so that sound which is generated and obtained from a diaphragm of the headphone will be radiated therethrough to the user. Such open air type headphones are comfortable to wear and do not cause excessive pressure against the ears.

In such open air type headphones, however, since the sound is radiated to the outside of the headphone housing, stronger sound pressure is required than in closed type headphones. Therefore, open air type headphones are constructed so that the amplitude of motion of the diaphragm is larger than in closed headphone types.

A result is that if there is a very high output level from an amplifier connected to the headphone, and this may for example occur accidentally, the diaphragm will be very strongly vibrated and the bobbin which carries the voice coil and is attached to the diaphragm will have a large movement. At such times, the bobbin can be caught on the yoke or pole piece comprising the magnetic circuit of the speaker and cannot then return to its predetermined rest position. In the prior art, the compliance or linearity of the edge portion of the diaphragm is intentionally selected to be smaller than that of the remaining portion of the diaphragm, so as to protect the diaphragm from protruding. However, a speaker constructed in this manner will have less dynamic range and poor sound characteristics.

According to the present invention there is provided a speaker unit comprising;

a frame;

a magnetic circuit having a magnetic gap and mounted in said frame;

a diaphragm with its outer edge mounted on said frame;

a bobbin wound with a voice coil connected to said diaphragm and disposed within said magnetic gap; and

protecting means attached to said frame and disposed at the front of said diaphragm, said protecting means having at least one opening and one projection facing said diaphragm, and said protecting means being engageable with said diaphragm only when said diaphragm is over-driven.

5 According to the present invention there is provided a speaker unit comprising;

a cylindrical frame member;

a diaphragm with its outer edge attached to said frame member;

10 a cylindrical shaped bobbin of axial length T attached to the rear side of said diaphragm and a voice coil mounted thereon;

a magnetic circuit with a pole piece attached to said frame adjacent to said bobbin and magnetically coupled to said voice coil; and

15 a front protective cover attached to said frame and having at least one inwardly extending projection which extends towards said diaphragm and is engageable therewith when said diaphragm is over-driven.

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

Figure 1 is a perspective view of a headphone including an embodiment of speaker unit according to the invention;

20 Figure 2 is a sectional view of an embodiment; and

Figure 3 is a front plan view of a protector utilized in an embodiment.

Figure 1 illustrates a headphone 1 which has a left headphone unit 2L and a right headphone unit 2R connected by a headband 3. Each of the units 2L and 2R are constructed in the same manner, and includes as a housing 4 an open ear cup which is perforated with a plurality of air vents 4a on the side away from the ear and an ear pad 5 which is composed of air permeable material such as polyurethane and which is attached to the ear cup 4 on the side engageable with the ear.

30 As shown in Figure 2, the headphone unit 2 includes a speaker unit 6 which is mounted within the housing 4. The speaker unit 6 comprises a yoke 7 of the shape illustrated in Figure 2 and comprises a hollow portion 7a in the centre of the yoke 7 and with a disc-shaped extending portion 7c which extends from the hollow portion 7a and is formed with openings 7d for controlling the back pressure of the speaker. The outer edge 7b of the yoke 7 is ring-shaped as shown in Figure 2. A permanent magnet 8 is attached to

the hollow portion 7a and has a pole piece 9 attached to the upper portion of the magnet 8 as illustrated in Figure 2.

A cylindrical shaped bobbin 10 carries a voice coil 11 which is wound about the bobbin 10 and is attached to the back surface of a diaphragm 13 so as to be disposed in a magnetic gap 12. The connecting junction between the diaphragm 13 and the bobbin 10 is designated 13a in Figure 2. The outer edge of the diaphragm 13 is attached to the outer edge 7b of the yoke 7 with a diaphragm ring 14.

The structure of the speaker unit 6 thus described is similar to a conventional speaker unit, but in this embodiment a protector 15 is mounted at the front of the diaphragm 13. The protector 15 can be made of a metal such as aluminium and has a plurality of openings 15a as illustrated in Figures 2 and 3 at predetermined positions for ventilation. The protector 15 is connected to the outer edge 7b of the yoke 7 as illustrated in Figure 2. Extending inwardly from the central portion of the protector 15 are a plurality of projections 15b which are capable of engaging the diaphragm 13 and limiting its upward motion relative to Figure 2. The projections 15b of which there are four illustrated in Figure 3, although the invention is not limited to a specific number of projections, are located such that they engage the diaphragm 13 in alignment with the bobbin 10 as can be clearly seen in Figure 2.

The projections 15b have a length so that they are designed not to engage the diaphragm 13 under normal operation of the speaker and even when the diaphragm 13 is driven at the maximum range at which a normal audio signal is fed to the voice coil 11. Thus, in normal operation, the speaker operates without engagement between the projections 15b and the diaphragm 13.

However, when an abrupt high level signal which is greater than normally applied to the speaker is fed to the voice coil 11 which causes the diaphragm 13 to move an extreme amount as illustrated in Figure 2 by a broken line, the connecting junction 13a of the diaphragm 13 and the bobbin 10 will engage the projections 15b such that relative to Figure 2 the lowest portion of the bobbin 10 will not rise above the top surface of the pole piece 9 or the upper plane surface of the extending portion 7c of the yoke 7.

Thus, the projections 15b act as a protector for the diaphragm 13 in that they limit the upward motion of the bobbin 10 to the broken line

position illustrated in Figure 2 so that the speaker will not be over-driven so as to be injured by such abrupt high level signal changes which are fed to the voice coil 11.

Also, the protector 15 serves as an equilizer and it is formed with the plurality of openings 15a generally formed in the outer portions of the protector 15 as illustrated in Figure 3 rather than at the centre of the protector 15.

The arrangement of the openings 15a is such that the vibrations of the diaphragm 13 is controlled so that the frequency characteristics are smooth or flat, which has been observed in experiments.

In addition, of course, the protector 15 protects the diaphragm 13 from being injured by contact by an obstacle outside of the speaker unit 6.

Thus, it is seen that the protector 15 protects the diaphragm 13 and under normal operations the projections 15b do not engage the diaphragm 13. However, during extreme loads which are higher than normal and which indicate a condition which would overload the diaphragm 13 the projections 15b engage the diaphragm 13 and hold the bobbin 10 to the limiting position as illustrated in dashed line in Figure 2.

CLAIMS

1. A speaker unit comprising;
a frame;
a magnetic circuit having a magnetic gap and mounted in said frame;
a diaphragm with its outer edge mounted on said frame;
5 a bobbin wound with a voice coil connected to said diaphragm and disposed within said magnetic gap; and
protecting means attached to said frame and disposed at the front of said diaphragm, said protecting means having at least one opening and one projection facing said diaphragm, and said protecting means being
10 engageable with said diaphragm only when said diaphragm is over-driven.
2. A speaker unit according to claim 1 wherein said opening is provided in the outer area of said protecting means.
- 15 3. A speaker unit according to claim 1 wherein said projection is aligned with said bobbin.
4. A speaker unit according to claim 1 wherein said projection is positioned at the edge of said opening of said protecting means.
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5. A speaker unit comprising;
a cylindrical frame member;
a diaphragm with its outer edge attached to said frame member;
a cylindrical shaped bobbin of axial length T attached to the rear side of
25 said diaphragm and a voice coil mounted thereon;
a magnetic circuit with a pole piece attached to said frame adjacent to said bobbin and magnetically coupled to said voice coil; and
a front protective cover attached to said frame and having at least one inwardly extending projection which extends towards said diaphragm and is
30 engageable therewith when said diaphragm is over-driven.
6. A speaker unit according to claim 5 wherein said frame has openings formed in the portion at the rear of the diaphragm and said front protective cover has openings formed therein.



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7. A speaker unit according to claim 6 wherein said one inwardly extending projection is aligned with an edge of said cylindrical shaped bobbin.

8. A speaker unit according to claim 7 wherein a plurality of inwardly extending projections are aligned with the edge of said bobbin.

9. A speaker unit according to claim 8 wherein the lengths of said extending projections is such that the outward movement of said bobbin is limited to not more than the length T of said bobbin.

10. In a headphone a speaker unit according to anyone of the preceding claims.

11. A speaker unit substantially as hereinbefore described with reference to the accompanying drawings.

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