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ELECTRO-ACOUSTIC TRANSDUCER

This invention relates to electro-acoustic transducers, and especially to such transducers for use in telephone subscriber's instruments.

Such transducers often need a reduced sensitivity at low frequency to prevent low frequency noise from interfering with the required signals, and in the case of telephone transducers both transmitters (microphones) and receivers (earphones) may require such low frequency sensitivity reduction. The usual way to produce the drop in sensitivity is to make a small hole through the diaphragm. At low frequencies, air can pass through the diaphragm, so little energy is transferred between acoustic and electrical forms. As the frequency increases the acoustic mass of the hole increasingly impedes the flow of air and the attenuation is reduced. However, the hole increases low frequency distortion, particularly in the region at which the reduction begins. This effect occurs both with transmitters and receivers, but the main problem is for receivers where the diaphragm movements are larger. This suggests that the problem is due to the high particle velocity of air flowing through the hole, which must be small (diameter of the order of 0.7mm) to give the required frequency response. Thus the flow becomes turbulent and the relationship between the pressure across the hole and the flow of air through the hole is non-linear. The distortion effect may also be partly due to relative

velocity between the air and diaphragm which, because the diaphragm is itself in motion, is greater than through a stationary hole.

An object of the invention is to provide a transducer in which the above difficulties are at least minimised.

According to the invention there is provided an electro-acoustic transducer of the moving coil type, which includes a diaphragm unit including the diaphragm and coil and a magnet unit including a magnet and pole-pieces so located as to define an annular air gap in which the coil is located, wherein the diaphragm has a substantially circular central part and a substantially annular part so arranged that the coil is supported in the air gap by both parts of the diaphragm, wherein the outer part of the diaphragm is a flat annular part linked to the coil by a shallow coniform region, wherein the flat outer annular part is supported at its periphery by a stationay annular support member which is part of the casing of the transducer, wherein the magnet unit is wholly within said outer casing and includes a central member which carries a central pole-piece for the magnet unit, which central member is a solid cylindrical member, wherein one or more holes or tunnels are provided in the support member, the or each said hole or tunnel having its axis substantially parallel to the plane of said outer peripheral region and adjacent to that region, wherein each said hole or tunnel has its width short compared with its length, and wherein the or each said hole or tunnel couples the air in a region within the outer casing and in front of the diaphragm with the air in a region also within the outer casing and behind the diaphragm, which coupling is effected round the outer-most periphery of the diaphragm.

Thus we have one or more holes or tunnels through the support for the diaphragm. As the path for the air to travel through these holes or slots is longer than that though the thickness of the diaphragm, they have a larger total cross-sectional area than the prior art diaphragm hole to produce the same low frequency cut. The larger area results in lower relative air velocities, as does the fact that the holes are stationary. Thus the longer holes or tunnels have greater acoustic resistance, which reduces distortion.

We have found that the harmonic distortion is reduced by these means from 7% to less than 1.5% in a preferred embodiment of the invention.

There follows a detailed description with reference to Figures 1 and 2 of the accompanying drawings of two implementations of this invention. Both are moving coil types of the sort described in our Patent Specification No. 2114855 B, but the invention is also applicable to other types of transducer.

The first form is shown in Figure 1. It consists of a moving coil transducer arrangement having a magnetic assembly formed by the magnet 1, ring 2, inner pole 3 and outer pole-piece 4. The air gap for the coil is between the ring 2 and the inner pole 3. The magnetic assembly is mounted in a support ring 5 and is held in place by the rear cover 6. The diaphragm 7 supports the coil 8, which is movable in the annular gap between ring 2 and inner pole-piece 3. The transducer is completed by terminals 9 and front cover 10. In practice acoustic resistance may be included to produce a smooth frequency response, but the means of providing this is not shown. Further details of such a transducer will be found in the above-mentioned application. Instead of the normal hole through the diaphragm, the volumes on either side

of the diaphragm are connected by holes 11 through the support ring 5. Only one such hole is shown but more may be provided if this is found to be desirable.

In an alternative, and preferred arrangement, see Figure 2 the hole is replaced by one or more slots 12 formed by grooves in the upper surface of the support ring 5 and the diaphragm 7. This method is preferred because when the support ring 5 is a thermo-plastics moulding the manufacturing tooling is simpler and the part less expensive.

Both versions have the diaphragm attached to the support ring by adhesive or welding. The invention may also be applied when the diaphragm is clamped in place. The grooves or radial holes are then needed in the clamping members on each side of the diaphragm.

The invention can also be applied to a moving coil transducer in which the diaphragm rim is clamped between two members: however, in this case the holes or grooves or slots are provided in both of those members.

It will be noted that, as in the transducer described in the above-quoted patent specification, the diaphragm is in both embodiments of the invention, in two parts, one of which is a circular central part and the other is an annular part, the coil being carried by the central part and attached to the outer part. The outer periphery of the outer part is supported on a stationary support ring member 5.

CLAIMS :

1. An electro-acoustic transducer of the moving coil type, which includes a diaphragm unit including the diaphragm and coil and a magnet unit including a magnet and pole-pieces so located as to define an annular air gap in which the coil is located, wherein the diaphragm has a substantially circular central part and a substantially annular part so arranged that the coil is supported in the air gap by both parts of the diaphragm, wherein the outer part of the diaphragm is a flat annular part linked to the coil by a shallow coniform region, wherein the flat outer annular part is supported at its periphery by a stationay annular support member which is part of the casing of the transducer, wherein the magnet unit is wholly within said outer casing and includes a central member which carries a central pole-piece for the magnet unit, which central member is a solid cylindrical member, wherein one or more holes or tunnels are provided in the support member, the or each said hole or tunnel having its axis substantially parallel to the plane of said outer peripheral region and adjacent to that region, wherein each said hole or tunnel has its width short compared with its length, and wherein the or each said hole or tunnel couples the air in a region within the outer casing and in front of the diaphragm with the air in a region also within the outer casing and behind the diaphragm, which coupling is effected round the outer-most periphery of the diaphragm.

2. A transducer as claimed in claim 1, wherein the or each said hole or tunnel is formed within the diaphragm support .

3. A transducer as claimed in claim 1, wherein the or each said hole or tunnel is a groove in the diaphragm support member which is closed or partly closed by the peripheral rim of the diaphragm.

4. An electro-acoustic transducer, substantially as described with reference to Figure 1 or Figure 2 of the accompanying drawings.