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ELECTRO-ACOUSTIC TRANSDUCERS

This invention relates to electro-acoustic transducers, and in particular to transducers of the type in which the active element comprises a foil diaphragm formed from a piezo-electric plastics material.

Electro-acoustic transducers, such as may be employed in a telephone subscriber's instrument, have recently been developed using a piezo-electric foil diaphragm as the active element. Such transducers are for example described in our published specification Nos. 1,593,271; 1,593,272; 1,593,273 and 1,593,274. Typically the diaphragm comprises an electrically polarised plastics material such as polyvinylidene fluoride (PVDF) which has been stretched in an electric field to provide a permanent polarisation of the material.

One of the major problems experienced with such transducers is the provision of electrical contacts to the diaphragm without causing excessive loading of the diaphragm and hence an inferior frequency response. Also it has been found that contacts provided on a movable portion of the diaphragm are extremely fragile and are readily dislodged if the transducer is accidentally jarred or dropped.

The object of the invention is to minimise or to overcome these disadvantages.

According to the invention there is provided an electro-acoustic transducer, including a housing

comprising front and rear interlocking members, a first conductive annular member supported on said front member and having an inwardly directed annular flange, a circuit board supported on the annular member, a second conductive annular grid member of smaller diameter than and concentric with the first member, the second member being clamped between the flange of first member and the board, an insulating spacer ring disposed between the annular members, and a metallised piezo-electric foil diaphragm supported via a rim portion clamped between the second annular member and the flange whereby the diaphragm is electrically contacted, wherein the second annular member has a perforated portion formed integral therewith which perforated portion is provided with a foam pad whereby the movable portion of the diaphragm is supported.

An embodiment of the invention will now be described with reference to the accompanying drawings, in which:-

Fig. 1 is a cross-sectional view of an electro-acoustic transducer assembly;

Figs. 2a and 2b are two different views of the frame of the transducer of Fig. 1;

Fig. 3a is an exploded view of the grid assembly of the transducer, and Fig. 3b is an underside view of the grid assembly;

Fig. 4 shows the circuit board of the transducer; and Fig. 5 shows the screen of the transducer.

Referring to the drawings, the transducer assembly is mounted in a housing comprising a substantially cup-shaped plastics back cover 11 provided with an annular lip 12 whereby a front cover 13 having a plurality of openings 14 is secured to the back cover 11. Typically the housing is so dimensioned as to fit into a telephone handset. The housing contains a frame 21 which frame locates a grid assembly 31 and a circuit board 41. The circuit board 41 carries an amplifier/

interface circuit (not shown) whereby the transducer may be coupled to a telephone instrument via terminals 52.

As shown in Fig. 2 the frame 21 comprises a hollow cylindrical body formed from a conductive plastics material such as a carbon loaded polypropylene. One end of the frame has a flange 22 provided with an annular channel 23 in which an annular raised portion 15 on the inner surface of the top cover 13 engages when the transducer is assembled. One or more orientation recesses 24 may be formed in the channel 23 these recesses engaging with corresponding spigots (not shown) extending from the annular raised portion 15 of the top cover to provide correct orientation of the frame 21. The other end of the frame 21 is profiled so as to define internal and external shoulders 25 and 26 respectively, and has one or more cut-outs 27 each of which may be provided with a location recess 28.

The grid assembly of the transducer is shown in Fig. 3 and comprises a conductive plastics, e.g. carbon loaded polypropylene, grid 31, a plastics mesh damper 32 and a plastics foam pad 33 on which the diaphragm 34 is supported. The grid 31 is formed on a hollow cylinder closed adjacent one end by a perforated sheet 35 formed integral with the grid and defining a saucer shaped depression in which the damper 32 and the foam pad are located. The one end of the grid also has an annular shoulder 36 for receiving an insulating spacer ring 37 (Fig. 1) whereby the grid assembly is mounted within the frame 21. Preferably the spacer ring is formed from the same material as the diaphragm. The other end face of the grid is provided with a location and contact recess 38. The grid is so dimensioned that, its external diameter is somewhat less than the internal diameter of the frame. Thus when the grid is fitted in the transducer assembly it is spaced from the frame and electrically insulated therefrom. The spacer ring

overcomes the problem of machining the grid and frame to very close tolerances to avoid the risk of shorting therebetween.

When the grid assembly is fitted to the frame the diaphragm 34 is clamped between the end face of the grid 31 and the underside of the of the flange 22 of the frame. Such an arrangement not only secures the diaphragm 34 but also provides electrical contact to its upper and lower surfaces. As can be seen from Fig. 1, the spacer ring 37 prevents direct electrical contact between the frame 21 and the grid 31.

Referring now to Fig. 4, the circuit board 41 of the transducer assembly comprises a substantially circular insulating sheet member dimensioned so as to fit into the end of the frame 21 and having an array of contact pins 42 and conductive tracks 43 for receiving an amplifier circuit (not shown), the amplifier providing electrical matching between the transducer assembly and e.g. a telephone line. The circuit board 41 is provided with an integral location tab 44, which tab engages the cut-out in the frame and carries a pin contact 42A for engaging and contacting the recess in the frame cut-out. A further pin contact 42B is so positioned as to recess 38 in the grid 31 (Fig. 3) thereby providing electrical contact thereto. Electrical contact to the transducer assembly is effected via terminal posts 45 mounted on the circuit board. When the transducer is assembled the circuit board is inserted into the frame 21 such that the board abuts the shoulder 25 with the tab 44 engaging the cut-out.

The transducer screen 51 of Fig. 5 is made of a conductive material, typically steel, and provides electrostatic screening of the transducer. The screen is circular in form and has a raised lip 52 around its periphery, the lip abutting the shoulder 26 (Fig. 2) when the screen 51 is fitted to the end of the frame 21. Openings 53 are formed in the screen for receiving the

terminal posts 45 these openings being somewhat larger than the posts to prevent shorting therebetween.

The transducer may be assembled by the following sequence of operations.

The damper 32 and the foam pad 33 are mounted on the grid followed by location of the spacer ring, on which the metallised diaphragm is mounted, on the shoulder 36 of the grid. The grid assembly is next inserted in the frame thereby clamping the diaphragm between the frame and the grid and at the same time providing electrical contact to both surfaces of the diaphragm. The circuit board 41 is next fitted to the frame such that the contacts 42A and 42B contact the frame and grid respectively and the screen 51 is fitted over the end of the frame. Finally the assembly is mounted on the front cover 13 such that the channel 23 of the frame engages the annular raised portion 15, and the back cover is snap fitted to the front cover to secure the assembly.

The transducer described herein has general application both as a transmitter and receiver. It is however particularly advantageous for use in a telephone subscriber's instrument where it provides a physical and electrical replacement for the conventional carbon transmitter and electromechanical receiver.

CLAIMS:-

1. An electro-acoustic transducer, including a housing comprising front and rear interlocking members, a first conductive annular member supported on said front member and having an inwardly directed annular flange, a circuit board supported on the annular member, a second conductive annular grid member of smaller diameter than and concentric with the first member, the second member being clamped between the flange of first member and the board, an insulating spacer ring disposed between the annular members, and a metallised piezo-electric foil diaphragm supported via a rim portion clamped between the second annular member and the flange whereby the diaphragm is electrically contacted, wherein the second annular member has a perforated portion formed integral therewith, which perforated portion is provided with a foam pad whereby the movable portion of the diaphragm is supported.

2. A transducer as claimed in claim 1, wherein the cylindrical members are made of a conductive plastics material.

3. A transducer as claimed in claim 2, wherein the plastics material is a carbon loaded polyproylene.

4. A transducer as claimed in any one of the preceding claims, wherein said diaphragm comprises a metallised polyvinylidene fluoride (PVDF) foil.

5. A transducer as claimed in any one of the preceding claims, and which is provided with an electrostatic screen.

6. A transducer as claimed in any one of claims 1 to 5, wherein the spacer ring is formed from the same material as the diaphragm.

7. A transducer as claimed in any one of the preceding claims, wherein the circuit board is provided with an amplifier circuit for coupling the transducer to a transmission line.

8. A transducer substantially as described herein with reference to the accompanying drawings.

9. A telephone subscriber's instrument fitted with one or more transducers as claimed in any one of claims 1 to 8.

The text of the specification has been reproduced by photocopying the applicants original typescript. It may contain a few amendments which are difficult to read. The original typescript containing these amendments may be inspected on the premises of the Patent Office



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