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(54) Equalization system of a telephone piezoceramic transducer

(57) The improvement consists in providing an acoustic filter capable of generating an acoustic resistance which is precise and stable.

Such a filter is realized by providing the surface of the transducer bottom base, on which the piezoceramic circular diaphragm abuts, with channels of very small section.

By varying the number and section of the channels it is possible to obtain the required precise and repetitive acoustic resistance as well as a response curve in function of the frequency which is sufficiently linear and suitable for the requirements in the telephone field.

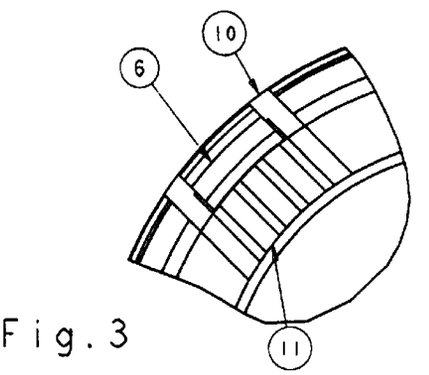

Fig. 3

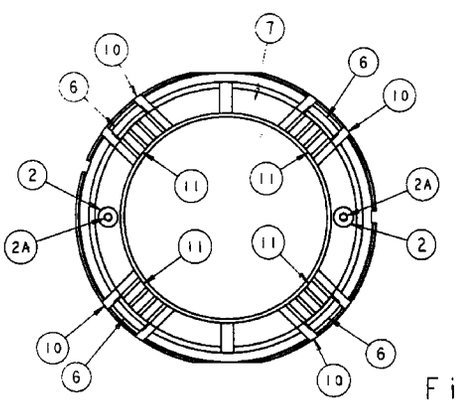

Fig. 2

EP 0 751 696 A1

Description

The present invention relates to a telephone piezoceramic transducer including essentially a bottom base having the form of a circular spool supporting terminals, a circular piezoceramic diaphragm having its peripheral poles in pressure contact with two nail-shaped terminals forced into respective through-holes axially extending in the spool, and elastic O-ring for generating the necessary pressure contact and a cover provided with openings for the transmission of the acoustic waves generated by the vibrations of the diaphragm, disposed in such a way as to hold the elastic O-ring pressed against the diaphragm.

A transducer of this kind is disclosed e.g. in EP-0456968 (corresponding US Pat. 5,195,142) to the Applicant.In an improvement of this transducer, as disclosed in the European Patent Application n 94102787.2 (cooresponding US Pat. 5,479,521) filed by the Applicant, the cover is in the form of a disc which, along with the O-ring and the diaphragm are housed inside a stepped cylindrical cavity, hollowed out in the surface of the spool facing the diaphragm and coaxial with the spool itself. The diaphragm abuts on the first step close to the bottom of the cavity, on the annular surface of what there are the heads of the nail-shaped terminals, and it is held in contact therewith through a slight pre-loading by the elastic O-ring pressed on the back side of the diaphragm by the cover which, in turn, is held in its position by resilient pawls extending axially inside respective cuts machined in the outside wall of the spool.

These piezoceramic transducers are simple, cheap and feature good performances.

A feature common to all the telephone audio transducers using a piezoceramic diaphragm lies in that they have a high mechanical resonance resulting in a high acoustic pressure level at certain frequencies (comprised between 1000 and 2000 Hz).

In order to overcome this drawback it is customary to use a damping network like, e.g., a nylon gauze or the like, glued or ultra-sound soldered on a small hole drilled on the back wall of the transducer and which acts as an acoustic resistance capable of lowering the magnitude of the acoustic pressure. It constitutes an acoustic filter and must be capable of generating an acoustic friction at the involved frequencies, whereby the gauze must have well defined wire gauge and frame and is also characterized by a delivery in liters of air, when the system is subjected to a certain pressure, as it is well known to those skilled in the art.

Through a system like this it is difficult to keep the process under control and thus obtain a sufficient accuracy in the electroacoustic parameters.

This is due to the uncertainty of several factors, such as the quality of the material used, the fixing system, etc.

Therefore, from the industry point of view, it is difficult to maintain the acoustic resistance constant, within the required limits.

It is an object of the present invention to provide the piezoceramic telephone transducer mentioned at the outset with a precise acoustic resistance so as to be easily replicated and with constancy.

Another object of the present invention is to provide a piezoceramic transducer of the type mentioned above which further allows the reduction of the manufacturing costs.

These objects are reached by an improved piezoceramic transducer for telephone instruments which is characterized by a plurality of channels, provided on the surface of the base on which the piezoceramic diaphragm abuts, designed to connect the air chamber comprised between the base and the diaphragm with the outside, thus creating the necessary acoustic resistance.

Through the equalization system of a telephone piezoceramic transducer, improved according to the teachings of the present invention, the following advantages are obtained:

- a precise and repetitive acoustic resistance and therefore process stability,
- manufacturing savings and hence lower costs.

The invention will now be described in connection with a specific embodiment thereof in a piezoceramic capsule for telephone instruments such the one illustrated in the above-mentioned European Patent Application n| 94102787.2 and with reference to the drawings attached merely by way of a not limiting example in which:

- Fig.1 is a vertical cross-section of a perspective view of an assembled piezoceramic capsule for telephone instruments;
- Fig.2 is a top-plan view of the bottom base of the capsule of Fig.1 , with the equalization system realized in accordance with the invention; and
- Fig.3 shows, in an enlarged view, a detail of Fig.2.

Referring now to the figures in detail, Fig.1 illustrates an assembled piezoceramic capsule for telephone instruments in a vertically sectioned perspective view. In it there are conventionally illustrated the bottom of the capsule or base consisting of a circular spool 1 formed from plastic material and having a cylindrical cavity 9, coaxial with the spool, designed to house, from inside to outside in an assembly order comprising respectively, the piezoceramic diaphragm 3, the elastic O-ring 4, and the cover 5 in the form of a perforated disc.

The cavity 9 has a first step 7 on which the piezoceramic diaphragm 3 abuts. A second step 8 serves as an an enlargement for housing the cover 5 which has a diameter greater than the diameter of the diaphragm 3. Mounted on the spool are two nail-shaped terminals 2, accessible from outside, forced into respective holes 2A

(see Fig.2) located at diametrically opposite positions and extending axially. A third hole 12 serves for receiving an eventual third terminal (not shown in the figure) of the auxiliary coil (optional) capable of generating the auxiliary magnetic field able to operate a deaf prothesis. The cover 5 is held in its position with a slight preloading on the O-ring 4 by four resilient pawls 6 which snap on its external surface and lock it through respective abutment steps. The resilient pawls 6 are obtained during the forming of the spool by pressing and extend in respective cuts 10 provided in the external wall of the spool 1.

When assembled, the diaphragm has its two poles in pressure contact with the heads of the nail-shaped terminals 2 abutting on the first step 7 of the cylindric cavity 9.

Further details can be found in the above-mentioned European Patent Application n| 94102787.2.

Originally, machined on the abutment surface of the first step 7 are a plurality of channels 11 grouped in the vicinity of each cut 10 and extending radially so as to connect the air chamber, comprised between the bottom of the cavity 9 and the diaphragm 3, with the outside through the cuts 10.

By acting on the number and dimension of such channels it is possible to control the acoustic resistance in a precise manner. In fact, by comparing the system to an electrical network, these channels act as an inductance in series with a resistance. This series resistance results from the acoustic losses caused by friction between air and the walls of the channels; as the length of these channels is fixed (in the figure it is equal to the width of the diaphragm's abutment surface i.e. the upper surface of the first step), the parameters which determine such resistance are the channel section (as small as possible) and the number of channels.

In the embodiment shown in Figs 2 and 3 there are five channels 11 for each cut 10.

Advantageously, they can be obtained by pressing and therefore at very low cost.

Obviously the smallest obtainable section is tied to the feasibility of the mould form.

The invention achieves all the above-mentioned objects.

In fact there is provided a piezoceramic telephone transducer which features a precise and repetitive acoustic resistance. Indeed, by acting on the number and dimension of the channels, it is possible to obtain an acoustic resistance which is precise enough and stable. Moreover, the possibility of obtaining such channels by pressing allows the achievement of repetitivity and precision of the involved parameters as well as a saving in manufacturing, since the glueing or welding operations are eliminated, and therefore a cost saving.

Lastly, being such channels located on the area abutting the diaphragm (on the first step 7 in the embodiment shown in the figures), they introduce the aforesaid acoustic resistance always in the back portion of the transducer thus equalizing the system satisfactorily and obtaining a response curve as a function of the linear frequency and suitable for the requirements in the telephonic field.

While the invention has been described with reference to a specific embodiment thereof, it is to be understood that the solution is applicable to all those telephone transducers using a piezoceramic diaphragm in the abutment on a supporting surface of the bottom base on which it is possible to produce, by pressing or by other means, the channels designed to connect the back air chamber, comprised between the diaphragm amd the bottom base with the outside.

Claims

1. Telephone piezoceramic transducer including:

   - a bottom base mounting two terminals accessible from outside,
   - a circular piezoceramic diaphragm with its peripheral portion in abutment on said base and having its poles in pressure contact with said terminals,
   - an elastic O-ring for generating the necessary contact pressure between said poles and said terminals, disposed on the back side of said diaphragm, and
   - a perforated cover having openings for transmission of acoustic waves generated by the vibrations of the diaphragm, so disposed as to maintain said O-ring pressed against said diaphragm,

   said transducer being characterized in that, located on the surface of said base, which said diaphragm abuts on, are a plurality of radial channels designed to connect the air chamber, comprised between said diaphragm and said base, with the outside.

2. Piezoceramic transducer according to claim 1, characterized in that said radial channels are obtained by pressing.

3. Piezoceramic capsule for telephone instruments, including:

   - a circular bottom base mounting at least two nail-shaped feedthrough terminals extending axially, having the shape of a spool made by pressing from plastic material and provided with a stepped cylindrical cavity, coaxial thereto, designed to house from inside to outside, respectively:
   - a circular piezoceramic diaphragm in abutment on a first one of said cavity steps and having its poles in pressure contact with the respective heads of said nail-shaped terminals,
   - an O-ring made of elastomeric material dis-

posed on said diaphragm and designed to generate the contact pressure between said poles and said terminals, and

- a perforated cover-up disc disposed on a second one of said steps and pressing on said O-ring with a pre-load generated by a plurality of resilient pawls extending axially inside respective cuts machined in the external wall of said spool and acting on the cover through respective snap-action teeth,

said capsule being characterized in that, in correspondence with each of said cuts there are provided a plurality of channels machined on the abutment surface of said first step of said cylindrical cavity and extending radially so as to connect the air chamber, comprised between the bottom of said cavity and the diaphragm, with the outside.

4. Piezoceramic capsule according to claim 3, characterized in that said channels are five for each cut.

5. Piezoceramic capsule according to claim 3, characterized in that said channels are obtained by pressing.

6. Piezoceramic capsule according to claim 5, characterized in that said channels have the smallest section compatible with the pressing process.

7. Telephone piezoceramic transducer as hereinbefore described and illustrated for the proposed objects.

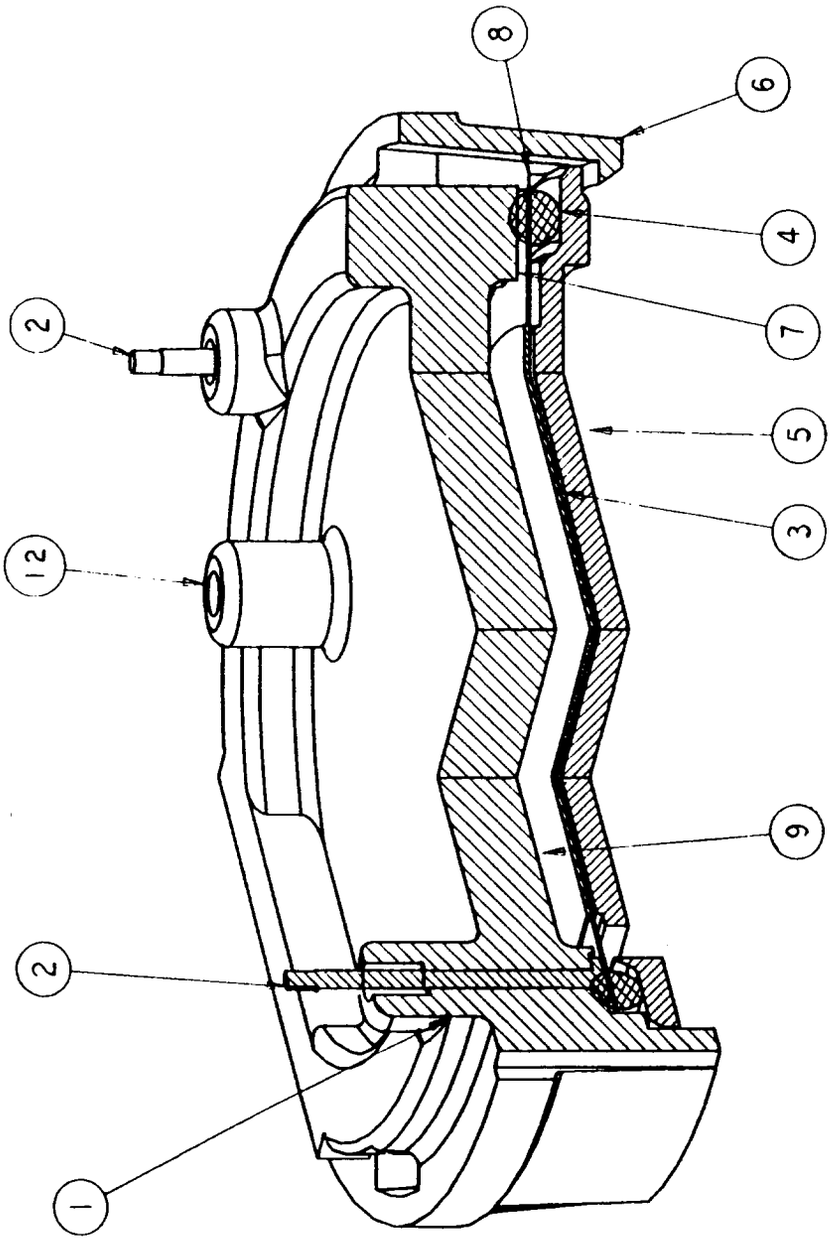

Fig. 1

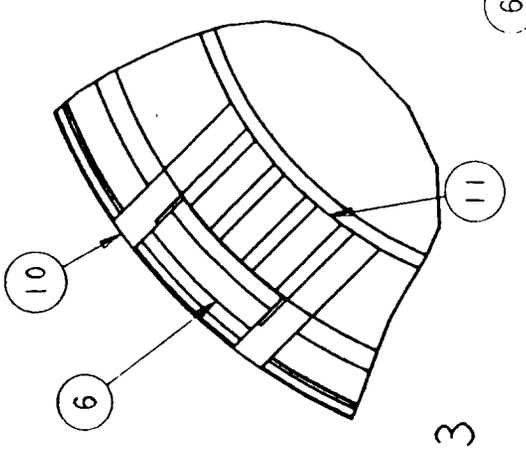

Fig. 3

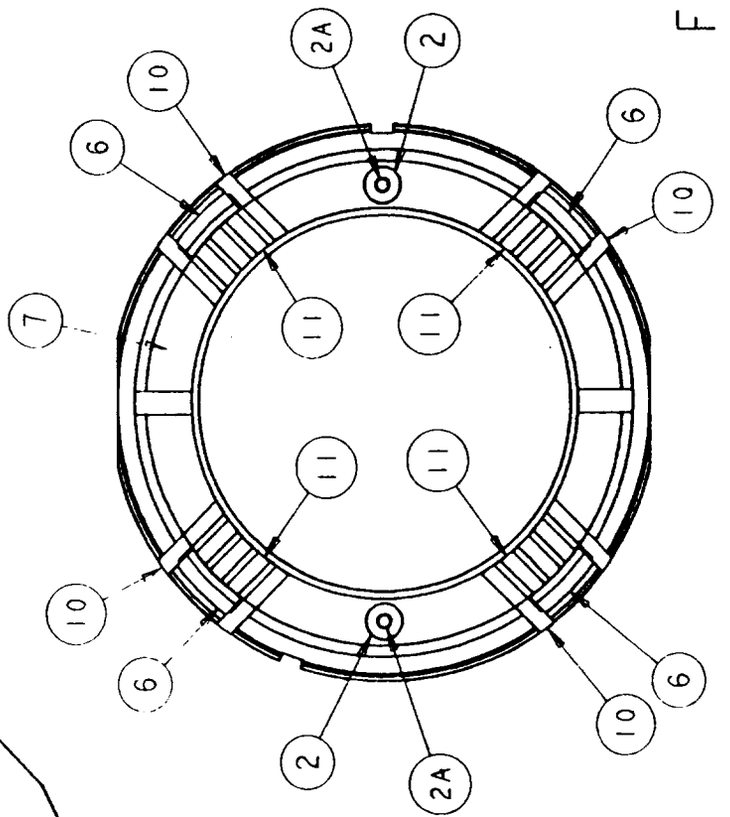

Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 10 9137

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y,D A	EP-A-0 613 323 (ALCATEL DIAL FACE SPA) * column 2, line 19 - column 3, line 56; figures *	1,3,7 2,4,5	H04R17/00 H04R1/22 H04M1/03
Y	DE-A-36 18 967 (HAGENUK GMBH) * column 1, line 30 - column 2, line 46; figures *	1,3,7	
A	DE-A-28 52 176 (TELEFONBAU & NORMALZEIT GMBH) * page 2, line 1 - page 4, line 14; figures *	1,3	
A	US-A-4 379 212 (MARTIN) * column 1, line 5 - column 2, line 68; figures *	1,3	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
H04R H04M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 October 1996	Gastaldi, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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