May 21, 1946. J. S. P. ROBERTON ET AL 2,400,662

TELEPHONE TRANSMITTER AND RECEIVER

Filed May 18, 1942

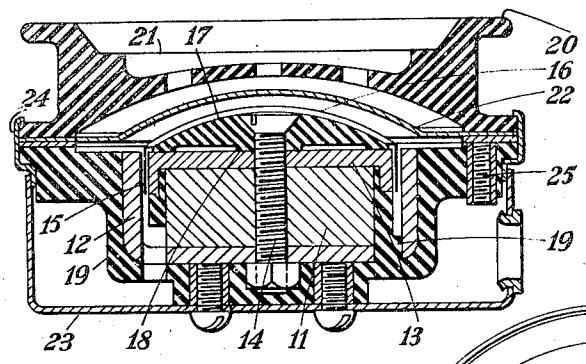
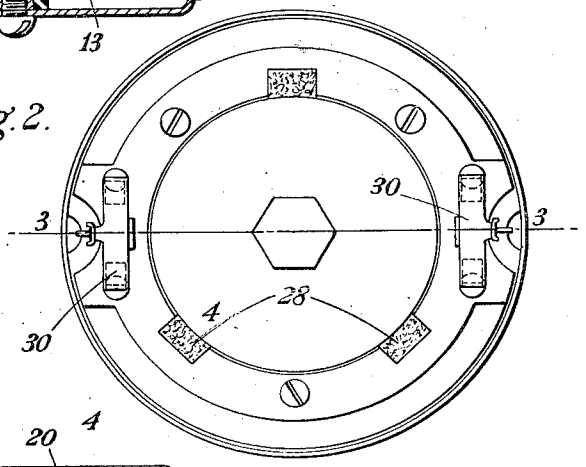


Fig. 1.

Fig. 2.



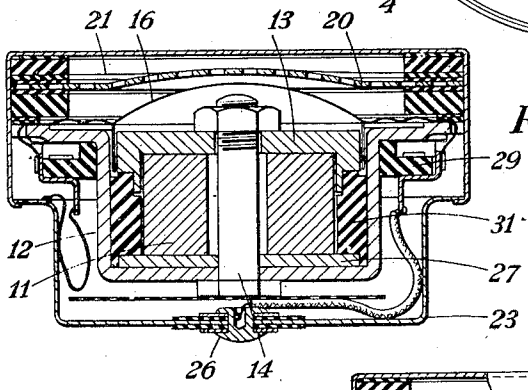
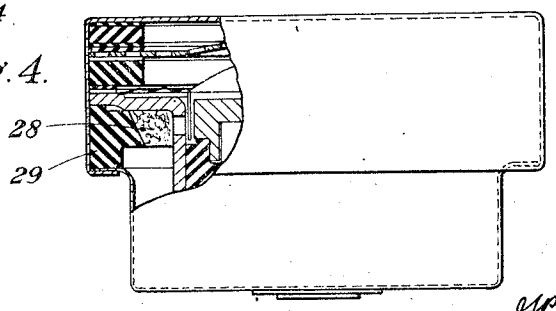


Fig. 3.

Fig. 4.



INVENTORS
J. S. P. Roberton
A. Gayford
BY R. F. Morris
ATTORNEY

Patented May 21, 1946 2,400,662

UNITED STATES PATENT OFFICE

2,400,662

TELEPHONE TRANSMITTER AND RECEIVER

James Samuel Paterson Roberton and Michael Lawrence Gayford, London W. C. 2, England, assignors to International Standard Electric Corporation, New York, N. Y.

Application May 18, 1942, Serial No. 443,424
In Great Britain May 27, 1941

5 Claims. (Cl. 179—115.5)

This invention relates to electro-acoustic transducers, that is to say to telephone transmitters and/or receivers, of the moving-coil type; and consists in improvements in the manufacture of such transducers whereby the pole-pieces are accurately and permanently fixed in position.

The invention has been found particularly useful in its application to that type of transducer which comprises a pot of magnetisable material, a permanent magnet disposed concentrically within the pot so that the rim of the pot will constitute an annular outer pole, a disc of magnetisable material overlying the magnet in the mouth of the pot so that its rim will constitute an annular inner pole, a vibratile diaphragm overlying the mouth of the pot, and a speech-coil fixed to the underside of the diaphragm and disposed within the annular air-gap formed between the inner and outer pole-pieces.

It has proved hitherto to be a matter of some difficulty to make a transducer of this latter type with the required degree of accuracy in the spacing of the inner and outer pole-pieces, and more especially with such mechanical rigidity that the initial accurate spacing shall be maintained throughout the length of life which is otherwise to be expected of such an instrument. The present invention makes this possible: the magnet system is assembled loosely, i. e. not so tightly that the next step is hindered, the pole-pieces are positioned accurately by a temporary insert in the air-gap, and the pot is filled with a setting material. Then, when the material has set and the insert is removed, the parts will have been rigidly bound into a single unit.

In order that the invention may be clearly understood, a description will now be given of two of its embodiments as shown in the accompanying drawing, in which:

Fig. 1 shows the first embodiment in transverse section;

Fig. 2 the second embodiment in rear end view with the cover removed;

Fig. 3 a transverse section on the line 3—3 of Fig. 2; and

Fig. 4 a part-section on the line 4—4 of Fig. 2.

As shown in Fig. 1, a short cylindrical magnet 11 of high coercive force material carries an outer pole-piece in the form of a pot 12 fitted over the magnet from its lower end and an inner pole-piece in the form of a flanged disc 13 fitted onto the magnet at its upper end. The magnet and its pole-pieces are clamped together by a central nut and bolt 14. The inner and outer pole-pieces 13 and 12, which are of high permeability material, define between them an annular air-gap; and in this air-gap is located a speech coil 15, in the form of an edge-wound aluminium tape, which is fixed upon the rear or underside of a diaphragm 16.

The central part of the diaphragm 16 is domed forwardly; and the space thus formed between the rearside of the diaphragm and the upper surface of the inner pole-piece 13 is partly filled by a segment 17, preferably of synthetic-resin moulded material, which is held in place by the central nut and bolt 14, with its flat surface against the flat top of the inner pole-piece. For acoustic reasons the segment has within it a hollow space communicating through slits with the space behind the diaphragm. The hollow space may be provided by a recess formed in the otherwise flat underside of the moulded segment, and the slits by the introduction of a spacing shim at the position 18 surrounding the bolt 14 or by slight projections spaced around the underside of the periphery of the segment.

By a process of injection moulding an insulating casing 19 is formed over the pot 12 and also enters through openings in the base of the pot into the space around the magnet 11. The three parts of the magnet system are thus firmly embedded in the hard resinous material, and this has the valuable effect of fixing the parts rigidly with respect to one another and thus assuming the maintenance of a uniform air-gap, it being noted that, with the powerful permanent magnets which modern materials make possible, any initial lack of concentricity of the pole-pieces at the air-gap is apt to become rapidly aggravated because the magnetic attraction across the air-gap is at its greatest on that radius at which the gap is narrowest. This design also permits the acoustic properties to be improved: the moulding material is allowed to flow into the pot up to a predetermined contour whereby the proper volume of air space inside the pot (behind the moving coil) is secured. The holes in the outer pole-piece, through which the moulding material flows, are afterwards drilled out and covered with acoustic resistance material such as silk, to provide acoustic damping.

A front cover 20 for the device may be a mouthpiece, as shown, or an earpiece. In the case of a mouthpiece there is stretched across the front a moisture-proof membrane 21, preferably of oiled silk or similar textile material, treated with anti-freeze compound, and secured by adhesive at its margin. To equalise air pressure inside and outside of the unit a small channel or hole may be provided in the front cover or mouthpiece to allow air to pass in or out from the chambers between the membrane and the front of the diaphragm. Pressure changes in the air behind the diaphragm will be prevented by air flow through the silk covered holes in the frame.

This embodiment of the invention has been designed so as to be suitable for use on aircraft;

consequently one of the requirements is that its magnetic field shall not influence a compass even at short range, and the efficiency of the magnetic screening is one of the features of this design.

In the first place it has been found that the pot-with-internal-magnet design (parts 12 and 11) is very satisfactory in reducing the external field to a small value. However, there is inevitably some flux leakage, especially around the air-gap and to a lesser extent from the back of the pot pole-piece, and to reduce this still further if not eliminate it completely the magnetic structure is completely enclosed by magnetic screens. There is a front screen 22, which overlies the diaphragm 16, a back screen 23, which is in the form of a cup fitting over the insulating casing 19 and secured by screws, and a clamping ring 24 which overlaps both of the other two and which, being spun into position, serves mechanically to hold the assembly together. It has been found necessary to have the screening surface as nearly possible continuous all round the unit. The front screen 22 is of course in the form of a grid, i. e. it is apertured; but the holes in the mouthpiece or earpiece do not register with the holes in the front screen 22 so that it is not possible to injure the diaphragm by poking anything through the holes.

The leads from the speech-coil 15 are necessarily weak and fragile. In this design they are as short and as little exposed as possible, being taken to the tips of terminal screws 25 rigidly moulded in the frame; the winding end of the terminal is slightly below the level of the seating surface for the diaphragm. The back screen 23 forms a cover to protect the terminals.

Figs. 2 to 4 show a second embodiment of the invention. This is a capsule-type microphone, with one terminal of the speech-coil connected to the back screen 23 and the other connected to an insulated central contact 26 in the back of said screen.

One of the interesting features of this design which does not appear in that shown in Fig. 1 is the presence of the disc 27 of high permeability material in the bottom of the pot 12. The purpose of this is to reduce the flux leakage which, as already mentioned, occurs from the back (base) of the pot. The flux passing from the central magnet to the rim of the pot is concentrated in the material of the pot, and thus is subjected to something of a "bottle-neck" at that part of the base of the pot which lies immediately below the periphery of the magnet. Further out the conditions become easier, although the thickness of metal is not increased, simply because the annular cross-sectional area increases with the radius. The disc 27 serves to open up this bottle neck, thus reducing the concentration of flux, and also reducing the leakage. It then becomes possible to make the pot 12 of thinner material than would otherwise be necessary to carry a certain flux as prescribed by the thickness of the inner pole-piece 13. A thinner pot is easier of manufacture by a drawing operation, is of less weight, and gives more space behind for the terminals.

In this embodiment of the invention the diaphragm 16 seats upon a flange out-turned from the rim of the pot instead of upon a moulded part. Also, the acoustic resistance is provided by the lambswool filling 28 of slots in the moulding 29 which is secured to the pressed cup 12. This moulding carries the speech coil connections 30. In this construction there is only the internal filling of setting material and no external casing either continues with it or separate. The filling extends up on the outside of the flange on the disc 13, instead of inside it as in the previously described construction.

The capsule is normally fitted in a moulded holder which has a short rubber horn. The design of this horn and the front holes and cavity of this holder has been considered inasfar as it affects the performance. The action of these in conjunction with the holes, cavities and protective oiled silk (or substitute) membrane 21 all combine to enable the desired response to be obtained, there being, in effect, a series of front resonators. The protective membrane 21 is supported at its centre by the perforated metal dome 20. As it is held clear of this dome at the edges there is no trouble encountered through the membrane adhering to the dome when saturated with moisture and failing to transmit sound.

The internal filling 31 of the cup is preferably formed in position by injecting a suitable compound, such as plasticised polystyrene through small holes in the cup, a ring being held in the magnetic gap during this process. By the use of suitable pressures and temperatures, the cup can be filled without an undesirable "flash" being forced up the sides of the ring in the magnetic gap.

It will be understood that the invention may take other forms. In respect of the constructions already described for instance, the moving coil 15 might be of copper, and the dome 17 might be omitted.

What is claimed is:

1. An electro-acoustic transducer comprising a pot of magnetizable material, a permanent magnet disposed concentrically within the pot so that the rim of the pot constitutes an outer pole, a disc of magnetizable material overlying the magnet in the mouth of the pot so that its rim constitutes an inner pole, a diaphragm, a speech coil attached to said diaphragm and located within the annular air-gap formed between said poles, and a filling in said pot of setting material rigidly holding said poles in concentricity.

2. An electro-acoustic transducer according to claim 1, wherein said disc is formed with a downwardly projecting flange and said filling extends into the annular space between said flange and said magnet.

3. An electro-acoustic transducer according to claim 1, wherein apertures are provided in said pot which is embedded in a block of setting material which is continuous with said filling.

4. An electro-acoustic transducer according to claim 1, wherein said pot is embedded in a block of setting material and an aperture is bored in said block to provide an air-passage through it extending through said filling into said air-gap.

5. An electro-acoustic transducer according to claim 1, wherein said pot is embedded in a block of setting material and an aperture is bored in said block from its outside surface to provide an air-passage through it extending through said filling into said air-gap, and wherein said air-passage is covered with a layer of silk applied over the outer end of the bored passage.

JAMES SAMUEL PATERSON ROBERTON.
MICHAEL LAWRENCE GAYFORD.