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TELEPHONE SUBSCRIBER'S INSTRUMENT

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WITH A TONE SOUNDER

The present invention relates to a telephone subscriber's instrument with a tone sounder.

With the increasing use of electronic devices in telephoning and elsewhere, conventional electro-magnetic sounders, such as telephone bells, are becoming more and more out-moded. They are bulky and expensive, and not compatible with electronics, and are not readily adjustable.

An object of the invention is to provide an instrument whose tone sounder is simple and compatible with electronic circuitry.

According to the present invention, there is provided a telephone subscriber's instrument, which includes a tone sounder assembly mounted against an inner surface of the instrument, wherein the tone sounder assembly includes a disc of a piezo-electric ceramic material bonded to a thin metallic disc which acts as a diaphragm when the ceramic disc is energized electrically, wherein the metallic disc also forms one side of a Helmholtz resonator the other side of which has a set of holes each adjacent to a centre-point of that other side, wherein the other side of the resonator is adjacent to said inner surface of the instrument and is pivotted thereto at the centre-point of the resonator so that the resonator is rotatable about its centre-point, wherein the inner surface of the instrument has a set of holes each of which is adjacent to the pivot point, and wherein the sounder assembly is rotatable with

respect to the inner surface so that the degree of overlap of the two sets of holes can be varied to vary the volume of the sound which issues forth from the instrument.

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

Fig. 1 shows, for explanatory purposes, a simple tone sounder using a ceramic disc as the vibratile element;

Fig. 2 is a telephone subscriber's instrument using a tone sounder of the same type as that shown in Fig. 1, but which instrument embodies the invention.

Fig. 3 is a further telephone instrument embodying the invention.

Fig. 4 is a view on a larger scale of part of the arrangement of Fig. 3.

In the tone sounder to be described herein, the sounder element is a disc of a piezo-electric ceramic material, such as lead zirconate titante - PZT, bonded to a disc, e.g. brass, which acts as a diaphragm. Electrical connections are made to the ceramic disc by metallic conductive coatings on the faces of the disc. When a voltage is applied to these connections the PZT changes its shape, as does the diaphragm, which is normally flat, but takes up a concave or convex form depending on the polarity of that voltage. If an alternating voltage is applied, the diaphragm vibrates in sympathy to give a sound output, which is greater if the electrical drive frequency coincides with the natural resonant frequency of the sound element. This sound output is, in the arrangements to be described, enhanced by a Helmholtz resonant cavity in front of the diaphragm.

Fig. 1 shows one way of maintaining such a device in the base of a telephone. Here the sounder element is a thin piezo-electric ceramic disc 1 to which a thin brass disc 2 is bonded. The sounder element is mounted by a cylindrical wall 3 and on O ring 4 at its nodal diameter so that there

is no mechanical restraint on its vibration.

Opposite the diaphragm and facing downwards there is a resonant cavity 5 with an outlet 6 on its underside.

Hence a large sound output is obtained, which is
5 reflected by the surface on which the telephone stands, and is thus distributed evenly round the room.

Note that as already mentioned, such a tone sounder has applications other than to telephones.

Fig. 2 shows further details of the mounting
10 of such a sounder in a telephone case 8, one of the supporting feet of the instrument being seen at 9. In this case, the resonator has its lower face somewhat frusto-conical in form, with a rotatable volume control consisting essentially of a perforated
15 disc 10 rotatable with respect to a set of fixed holes. Hence the cavity can be detuned by varying the effective area of the outlet, and hence the volume of the output sound. Thus a continuously variable volume control may be obtained by rotating
20 the sounder and resonator assembly against the base of the telephone so that the holes coincide or are partly obstructed.

In this arrangement the electrical connections to the sounder element are made via
25 flexible wires (not shown).

Fig. 3 shows an arrangement in which the electrical connections to the sounder element are provided by spring contacts 15, 16. Contact 15 engages the centre of the metallisation on the upper
30 face of the piezo-electric ceramic disc, while contact 16 engages the brass disc and thereby establishes contact with the other face of the ceramic disc. In addition, the contact 16, see also the enlarged Fig. 4, is used to provide an "off" position
35 for the volume control.

In Fig. 3 the control is so arranged that with the holes of the volume control fully open, maximum sound output is obtained. As they are effectively reduced in area by rotating the assembly against the base the sound output is progressively reduced until the holes are closed, which gives the minimum output. As the assembly is rotated further, a ramp indicated at 17 impinges on the spring contact 16 to lift its contact-making portion 18 away from the sounder element, thus breaking the connections.

Note that in this arrangement the nodal diameter support for the sounder element uses two cylindrical walls 19, 20, each with "knife edge" to engage the element. However, the use of "knife edges" as shown in Fig. 3 is not essential to the operation. In any of the constructions illustrated the disc may be

a) clamped between a cylinder and a sealing ring, as in Figs. 1 and 2;

b) clamped between two cylinders, as in Figs. 3 and 4, but without the knife edges;

c) fixed by a flexible adhesive to a cylinder, in which case only one cylinder is used. Such an arrangement could follow the principles of Figs. 3 and 4, but only using a lower cylinder.

CLAIMS :

1. A telephone subscriber's instrument, which includes a tone sounder assembly mounted against an inner surface of the instrument, wherein the tone sounder
5 assembly includes a disc of a piezo-electric ceramic material bonded to a thin metallic disc which acts as a diaphragm when the ceramic disc is energized electrically, wherein the metallic disc also forms one side of a
10 Helmholtz resonator the other side of which has a set of holes each adjacent to a centre-point of that other side, wherein the other side of the resonator is adjacent to said inner surface of the instrument and is pivotted thereto at the centre-point of the resonator so that the resonator is rotatable about its centre-point, wherein the
15 inner surface of the instrument has a set of holes each of which is adjacent to the pivot point, and wherein the sounder assembly is rotatable with respect to the inner surface so that the degree of overlap of the two sets of holes can be varied to vary the volume of the sound which
20 issues forth from the instrument.
2. A telephone subscriber's instrument, which includes a tone sounder assembly mounted against the inner surface of the base of the instrument, wherein the tone
25 sounder assembly includes a disc of a piezo-electric ceramic material bonded to a thin metallic disc which acts as a diaphragm when the ceramic disc is energized electrically, wherein the opposite face of the ceramic disc from that bonded to the metallic disc is metallized at least at the centre thereof, wherein the energization
30 of the ceramic disc is effected via an electrical connection to said metallization and an electrical connection to the metallic disc, wherein the metallic disc also forms one side of a Helmholtz resonator which has a set of holes each adjacent to a centre point of another
35 side thereof, wherein the other side of the resonator is adjacent to said inner face of the instrument's base and is pivotted thereto at the centre-point of the resonator

so that the resonator is rotatable about its centre point, wherein the base of the instrument has a set of holes each of which is adjacent to the pivot point, and wherein the sounder assembly is so mounted as to be rotatable with respect to the base so that the degree of overlap of the two sets of holes is varied to vary the volume of the sound which issues forth from the instrument.

3. An instrument as claimed in claim 1 or 2, wherein when the sounder assembly reaches the lowest volume end of its travel in the course of its rotation it operates a switch to disable the electrical power for the sounder.

4. An instrument as claimed in claim 3, wherein the switch operation is effected by the co-operation of a spring contact on the sounder assembly and a stationary ramp which is part of the inner surface of the instrument, which ramp displaces the spring contact in the lowest volume position to effect said switch-off.

5. A telephone subscriber's instrument, substantially as described, with reference to Fig. 2 or Figs. 3 and 4 of the accompanying drawings.

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