

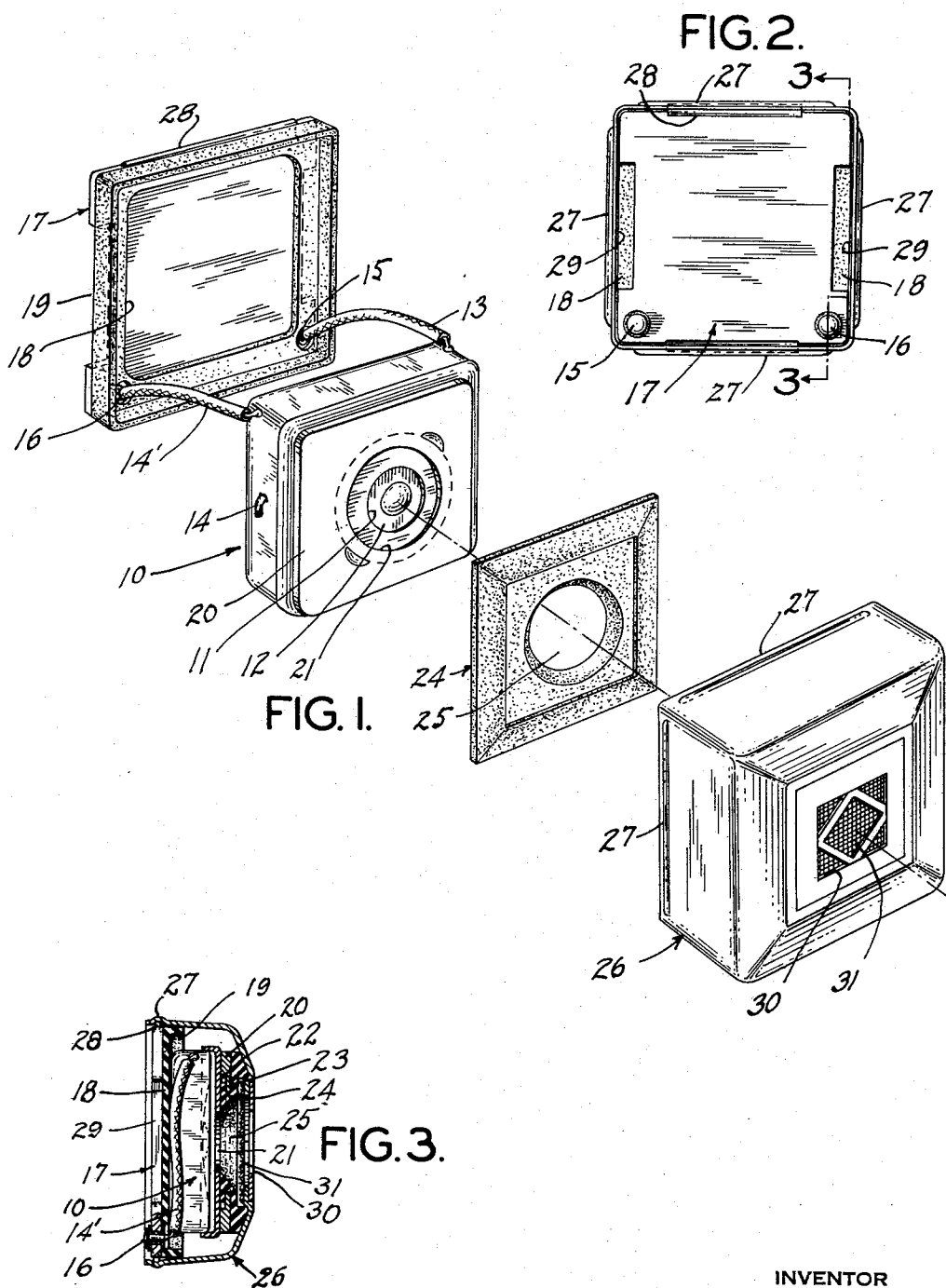
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E. C. NICHOLIDES

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INVENTOR
EMMANUEL C. NICHOLIDES

BY
Campbell Rumbough Rice & Glave
1115
ATTORNEYS.

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2,718,563

MICROPHONE

Emmanuel C. Nicholides, New York, N. Y., assignor to
Dictograph Products Company, Inc., Jamaica, N. Y., a
corporation of Delaware

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This invention relates to microphones, and has particular reference to microphones for hearing aid apparatus, although the invention is not limited thereto.

It is common practice to utilize piezoelectric crystals as the vibration-sensitive elements of microphones for hearing aids and other telephonic instruments because of their high fidelity of response. However, the sensitivity of such crystals which renders them particularly advantageous for hearing aid use, also causes them to respond to unwanted sounds, particularly the noise caused by clothing rubbing on the instrument. Rubber supports for the crystal unit have been suggested to eliminate the clothing noise effect, but, whereas such resilient supports cushion the sounds conducted through the instrument, they are ineffective to reduce the acoustically conducted sounds, which usually are the more troublesome.

In accordance with the present invention, a microphone is provided utilizing a piezoelectric crystal, in which the crystal unit is protected acoustically from unwanted local noises and also is resiliently supported to protect it from shock injury and to cushion it against unwanted sounds conducted through the casing from clothing rubbing thereon.

In a preferred embodiment of the invention, the crystal container is suspended in a two-part casing between rubber cushions, one of which is perforated to admit the sound waves to the crystal in its container and the other of which seals the crystal cavity from acoustically conducted sounds so that only the desired sounds enter the cavity through the sound opening. Also, the microphone is so constructed that assembly and repair are facilitated and removal and replacement thereof is rendered simple and rapid by surface contacts adapted to engage surface contacts on the hearing aid casing.

It will be seen that the crystal is protected against unwanted sounds usually received by the crystal by conduction through the casing and acoustically, so that it is responsive to the desired sounds whereby great fidelity of reception is obtained.

For a more complete understanding of the invention, reference may be had to the accompanying drawings, in which:

Figure 1 is an exploded perspective view of the microphone of this invention showing the component parts thereof arranged in their assembly relation;

Fig. 2 is a rear view of the microphone; and

Fig. 3 is a section therethrough as seen along the line 3—3 of Fig. 2.

Referring to Fig. 1 of the drawing, numeral 10 generally designates the crystal unit which comprises a piezoelectric crystal housed within a metal container having a center opening exposing the foil diaphragm 12 to sound waves. The diaphragm 12 is connected at its center to the crystal whose terminals are connected to wires 13 and 14 extending through openings in one corner and one side of the container, as shown in Fig. 1. The unit thus described is a commercial product as supplied by the crystal manufacturer.

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The commercial crystal unit 10 is modified according to the invention by severing wire 14 close to the container surface, as shown in Fig. 1 and leading a substitute wire 14' through an opening in the container at the corner next adjacent the other terminal wire 13, so that both terminal wires 13 and 14' of the crystal extend in parallel relation from the same edge or side of crystal unit 10.

The free ends of the terminal wires 13 and 14' are connected to respective contacts 15 and 16 extending through the base plate 17 at the edge opposite that from which the wires 13 and 14' originate. The length of the terminal wires 13 and 14' is such as to permit them to be folded alongside the crystal unit 10 as it is laid on the inner flange 18 of the cup-shaped soft rubber cushion 19 overlying the base plate 17 and through which the wires 13 and 14' extend, as shown particularly in Figs. 1 and 3. It will be observed that the unit 10, base plate 17 and wires 13 and 14' fold and unfold accordion-fashion to and from each other.

Cemented or otherwise secured to the face of the unit 10 is a lead plate 20 having a center hole 21 registering with the opening 11 in the front of the crystal unit 10. The relatively heavy lead plate 20 increases the mass of the crystal unit 10 to improve the response of the crystal to sound vibrations in a known manner.

The rear wall of the lead plate 20 is undercut at 22 around the center opening 21 to provide a recess into which fits the rim 23 of a soft rubber cushioning cone 24 to hold the latter in place. The center opening 25 of rubber cone 24 registers with the center opening 21 of the lead plate 20 and sound opening 11 of crystal unit 10, as shown in Fig. 3.

The entire assembly, arranged as described with the wires 13 and 14' folded along the sides of the crystal unit 10 as shown in Fig. 3, is held together and covered by the cup-shaped sheet metal cap 26 cooperating with base plate 17 to form the microphone casing. As is shown especially in Figs. 1 and 3, each of the four sides of the sheet metal cap 26 is provided with an internal peripheral groove appearing as an external ridge 27.

Two opposite edges of base plate 17 are pressed or swaged into thin flanges 28 which snap into the grooves formed by ridges 27 in the cap 26, so that the cap 26 and plate are locked together as shown in Figs. 2 and 3. By providing ridges 27 on all four sides of the cap, the plate 17 need not be especially oriented to snap into the cap 26. Also, the unused ridges 27, i. e., those that do not cooperate with the base plate 17, are adapted to snap onto mounting lugs of a hearing aid casing or other holder with the contacts 15 and 16 connecting the crystal in the hearing aid circuit in the manner shown in copending application Serial No. 198,116, filed November 29, 1950, by Stanley Osserman and applicant. The notches 29 in the edges of base plate 17 are provided to admit such mounting lugs to the corresponding ridges 27, but the presence of the notches 29 does not result in variations in the response of the microphone because the notches are closed by the rubber flange 18.

The front of cap 26 is provided with a sound opening 30 aligned with the opening 11 of the crystal unit, and opening 30 may be covered by a fine mesh wire screen to prevent entry of large particles or objects which might injure the microphone.

The assembly and operation of the microphone will be understood from the foregoing description, and the crystal is seen to be well protected by its floating support formed by the soft rubber cushions 19 and 24. Manufacture is facilitated by the accessibility to the back of contacts 15 and 16 for soldering the respective wires 13 and 14' thereto while the crystal unit 10 lies out of the way by reason of the extended wires 13 and 14', as shown in Fig. 1. Similarly, assembly and disassembly

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are facilitated since it is necessary only to fold or unfold the crystal unit 10 to and from its assembled position for access to the entire interior of the microphone, which may be opened and closed by unsnapping and snapping the cap 26 from and on the base plate 17.

As has been indicated, clothing sounds conducted from and through the hearing aid casing on which the microphone is mounted are minimized by the resilient suspension afforded by rubber cushions 19 and 24 and by the mass of the crystal unit 10 augmented by the lead plate 20, so that its fundamental mode of vibration is as low as is possible for practical manufacture. This resilient mounting and mass effect impart to the unit 10 the characteristics of a reaction type of vibratory system, which responds to any acoustic vibrations, although it is substantially immune to conducted vibrations. To minimize the effect of acoustic vibrations the unit 10 is acoustically sealed within its housing formed by the cap 26, base plate 17 and rubber flange 18, sealing notches 29, so that acoustic vibrations can enter only the opening 11, 25, 30. Accordingly, the unit 10 is protected from unwanted sounds, such as clothing noises, transmitted conductively and acoustically.

Although a preferred embodiment of the invention has been illustrated and described herein, it is to be understood that the invention is not limited thereby, but is susceptible of changes in form and detail within the scope of the appended claims.

I claim:

1. In a microphone for telephonic apparatus, the combination of a sound-sensitive unit having spaced opposite edges, a base plate having corresponding spaced opposite edges, a pair of electrical contacts adjacent one of said edges of said base plate, a pair of elongated flexible connecting wires leading directly to said contacts from the edge of said unit opposite said contacts, means securing said unit on said base plate, and cushioning means interposed between said unit and said base plate and securing means.

2. In a microphone for telephonic apparatus, the combination of a sound-sensitive unit of substantially rectangular shape, a base plate of substantially rectangular shape, a pair of electrical contacts at the corners of one side of said base plate, a pair of elongated flexible connecting wires leading directly from the corners of the opposite side of said unit to said contacts, and means securing said unit on said base plate.

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3. In a microphone for telephonic apparatus, the combination of a sound-sensitive unit of substantially square shape, a base plate of substantially square shape, a pair of electrical contacts on adjacent corners at one side of said base plate, a pair of elongated flexible connecting wires leading directly from adjacent corners at the opposite side of said unit to said contacts, and means securing said unit on said base plate.

4. In a microphone for telephonic apparatus, the combination of a sound-sensitive unit of substantially square shape, a base plate of substantially square shape, a pair of electrical contacts on adjacent corners at one side of said base plate, a pair of elongated flexible connecting wires leading directly from adjacent corners at the opposite side of said unit to said contacts, cushioning means interposed between said unit and said base plate, said cushioning means including portions parallel to said wires and interposed between the plate and the wires along their entire lengths to prevent uncushioned contact between the wires and the plate, and a cup-shaped cap enclosing and securing said unit on said base plate.

5. In a microphone for telephonic apparatus, the combination of a substantially square sound-sensitive unit having a center sound-receiving opening, a substantially square base plate, a pair of external contacts at adjacent corners at one side of said base plate, a pair of elongated flexible connecting wires leading directly to said contacts from adjacent corners at the opposite side of said unit, whereby the wires extend parallel to the corresponding opposite edges of said unit and plate, a resilient cushion overlying said unit and having an opening in registry with the sound-receiving opening thereof, and a perforate cup-shaped cap enclosing said unit and cushion and secured at its edges to said base plate.

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