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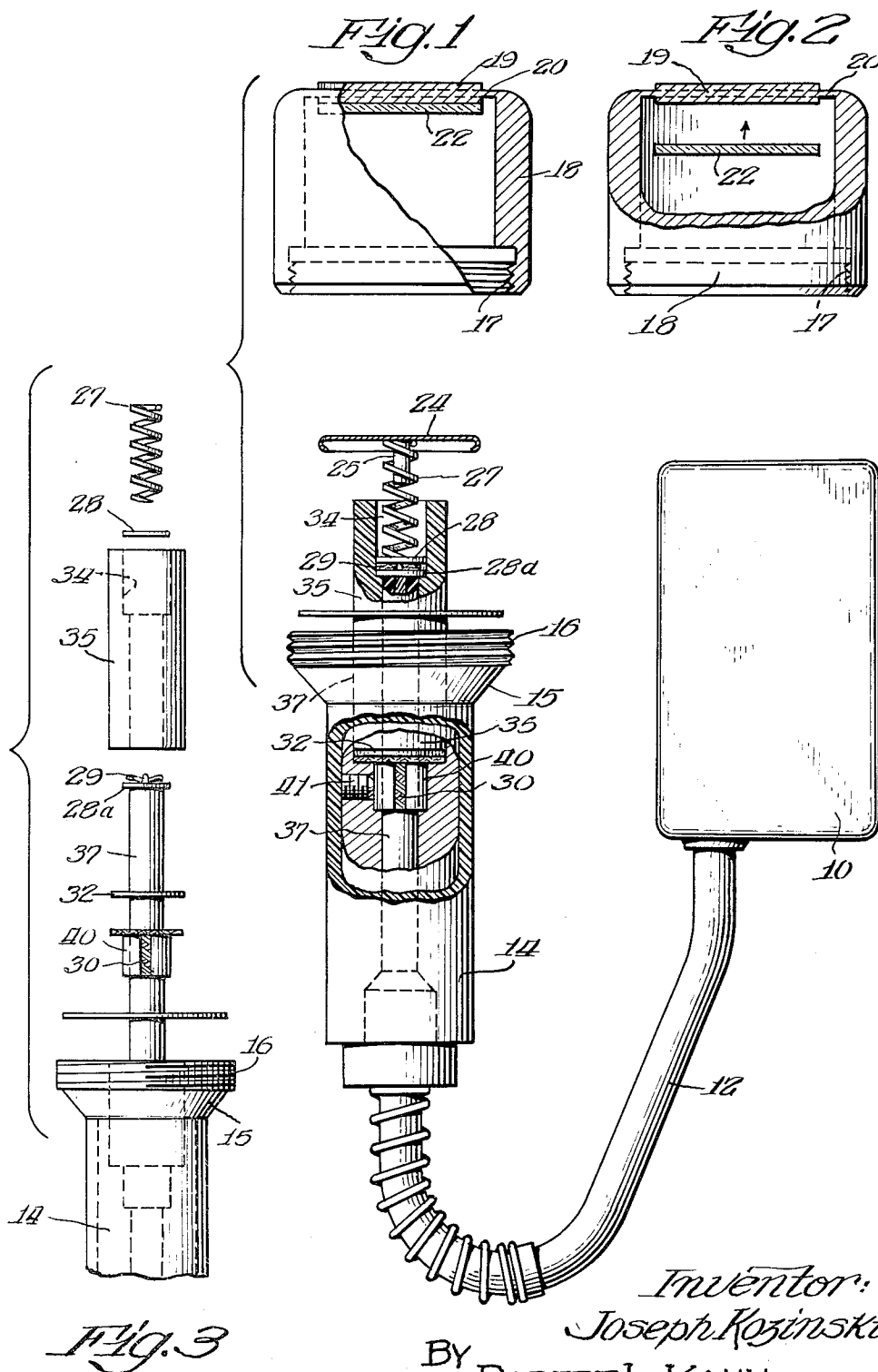
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ULTRA-SONIC ELECTRODE APPLICATOR

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ULTRA-SONIC ELECTRODE APPLICATOR

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This invention relates to an ultra-sonic electrode applicator and more particularly to an ultra-sonic electrode applicator having a crystal cemented to the applicator. Ultra-sonic frequencies ranging up to about one megacycle are used in many fields, such as, for example, in medicine. Thus certain disorders deep in living tissue are treated by the application of such vibratory energy. In general, a suitable oscillator for generating electric potentials at desired ultra-sonic frequency is provided. Such a generator may assume a variety of forms, all well known, and the output of the generator in the form of electric potentials at the desired frequency is fed to a transducer. The present invention is particularly concerned with such transducer.

The function of a transducer is to convert energy existing in one form into energy existing in another form. Insofar as the present invention is concerned, the function of the transducer is to convert energy in the form of ultra-sonic electric oscillations into ultra-sonic mechanical vibrations. To accomplish this, it is customary in the art to use a crystal, usually quartz.

As is well known, when a suitable crystal has electric potentials applied thereto, the crystal responds by undergoing minute changes in physical dimensions. The physical vibrations of the crystal resulting from the application of oscillator potentials to the crystal are transmitted to a combined metal electrode and applicator for the desired mechanical purposes. As a rule, such ultra-sonic applicators consist of a metal plate or preferably a cup in which there is disposed the crystal transducer element. The metal cup bottom against which the crystal is disposed functions as one electrode, for applying potentials to the crystal and also functions as a transducer element. The other electrode, usually the high potential electrode, is spring pressed upon the opposing crystal face.

In order to provide a usable and convenient applicator assembly, it is desirable to firmly attach the crystal to the metal cup bottom to avoid the possibility of losing the crystal when disassembling the applicator. In addition, it is important that the crystal make firm contact with the bottom of the metal cup during operation of the applicator. The bottom of the metal cup itself must have accurate mechanical properties to function as a transducer element for transmitting the vibration from the crystal to the load. In the case of a medical applicator, the load will consist of human tissue.

It has been found that proper and efficient transducer operation requires firm contact between the crystal and the bottom of the metal cup and that the contact be uniform and have uniform energy transmitting characteristics over the entire area of contact. In attempting to permanently attach a crystal to the bottom of a metal cup, considerable difficulty has been experienced. Conventional cementing means, such as, for example, wax cement, epoxy resin cement, and the like, are generally unsuitable unless extraordinary precautions are taken. In the use of wax cements, it has been found that minute air bubbles become trapped between the crystal and metal. Considerable vibratory energy is dissipated in these air bubbles and results in the undesired generation of heat and considerable loss of energy. This action occurs even though care is exercised in preparing the cemented surfaces.

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In the case of a material like epoxy resin, there is apt to be created minute lumps of the resin between the crystal and metal in the path of vibratory energy. The same undesired effects occur in these lumps of cement as in the minute air bubbles pointed out above.

I have determined that of all adhesive or cementing materials known to me, only one cement is completely satisfactory for cementing a quartz crystal to the metal portion of an ultra-sonic applicator. This cement is available on the market as Eastman 910 Adhesive and is manufactured by Eastman Kodak Company of Buffalo, New York, and sold by Eastman Chemical Products, Inc., of Kingsport, Tennessee. The above identified cement is a polymerized cyanoacrylate modified with a thickening agent and provided generally with a plasticizer.

The above-identified adhesive cement is a low viscosity liquid which can be easily squeezed out between opposed solid surfaces to provide a thin layer of cement and exhibits no tendency to maintain air bubbles or to produce any lumps or granular particles. The cement has the very desirable property of setting at normal room temperature within seconds, or a minute or two at the most. The cement adheres to both quartz and metal such as aluminum and the cemented joint is quite strong. Another desirable characteristic of the cement is that no mixing with a catalyst is necessary, the cement itself being uniform and homogeneous. The cemented joint resists vibration.

For a full disclosure of the invention, reference will now be made to the drawings wherein:

FIGURE 1 is an exploded view in elevation, with certain parts broken away, of an applicator and oscillator, the applicator having the crystal cemented into position in accordance with the present invention.

FIGURE 2 is a detail with certain parts broken away, illustrating the metal cup and the crystal prior to cementing.

FIGURE 3 is an exploded view of certain parts of the applicator to illustrate how the electrical connections are established.

A generator of alternating electric potentials of the order of about one megacycle is provided within housing 10. No attempt is made to show the relative dimensions of the oscillator within housing 10 and the applicator, to be described. In practice, the oscillator and housing will be a substantially larger piece of equipment than the applicator and occupy a space of the order of about one and one-half cubic feet. The exact size of the oscillator is immaterial and the only requirement is that the oscillator put out electric potentials at a desired frequency and at a desired power level. The frequency will be determined in a substantial measure by the dimensions of the crystal, while the power level may generally be in the order of a few watts. Thus the output of the oscillator will be fed along cable 12 which may consist of a conventional electric cable for use at the desired frequency range. As a rule, cable 12 may be of the coaxial type, although this is not essential. Cable 12 leads into handle portion 14 of an applicator.

Handle 14 is of high dielectric material, as Bakelite or the like, and carries metal bell 15 at the top end thereof. Bell 15 has its exterior threaded at 16 to accommodate threaded portion 17 of aluminum cup 18. Cup 18 has a thick side wall and has heavy bottom portion 19 connected by thin annular support portion 20. Cemented to the inside face of bottom 19 is crystal 22 of quartz or other suitable material. Crystal 22 is cemented with the material previously identified. Cup 18 is electrically at ground potential. Contacting the free crystal face is electrode 24 consisting of an aluminum disk having central pin 25 extending downwardly therefrom. Disk 24 is spring biased upwardly by coil spring 27 which rests upon

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brass button 28. This brass button rests upon second brass button 28a which is connected to the inner copper conductor of coaxial cable 29 having copper braided outer conductor 30.

Brass button 28a has washer 32 immediately below it and is disposed in well 34 of insulating sleeve 35 of Lucite or similar high quality electrical insulator. Cable 29 has polyethylene layer 37 bared of shielding 30 and is disposed within the bore of sleeve 35. Coil spring 27 is adapted to be compressed and lie within well 34 of sleeve 35.

The cable proper has shielding 30 exposed and covered by split brass sleeve 40. The split sleeve 40 is tightly pressed about the cable by set screw 41 carried by handle 14.

Cup 18 has a shoulder at the inner end of threaded portion 17 which limits the movement of cup 18 over threaded portion 16 of the handle. The various parts are so designed and proportioned that aluminum electrode 24 is spring pressed against crystal 22. The ground return from bottom 19 of the cup is to the metal braid 30 via the metal of handle 14, screw 41. The potential field between 24 and 19 causes crystal 22 to oscillate, and these oscillations are transmitted to bottom 19 of the cup.

What is claimed is:

1. A transducer electrode structure comprising a quartz crystal cemented to a metal member functioning in the dual capacity of electrode and transducer element, said

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crystal being cemented to said metal element by a layer of polymerized cyanoacrilate resin, said cemented junction being thin enough to transmit vibratory energy from said crystal to said metal member without loss in air bubbles or lumps customary with conventional cements.

2. In an ultra-sonic applicator of the type used in applying ultra-sonic vibratory energy, the combination of a metal cup-shaped electrode, a quartz crystal transducer element disposed at the bottom of said cup, said crystal and cup bottom being cemented by a thin layer of polymerized cyanoacrilate resin.

3. The construction according to claim 2 wherein said cup bottom and crystal are proportioned to operate at a frequency of the order of about one megacycle.

4. The construction according to claim 3 where the cup has the bottom wall connected to the cup body by a reduced thickness of metal.

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