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A. McL. NICOLSON

1,830,328

CAST PIEZO ELECTRIC DEVICE

Filed Dec. 20, 1926

Fig. 1

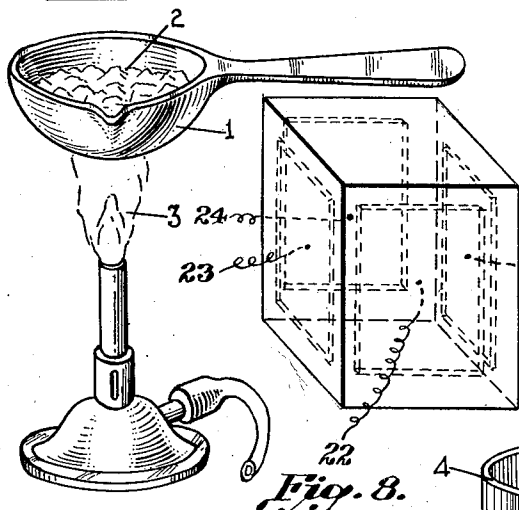


Fig. 2

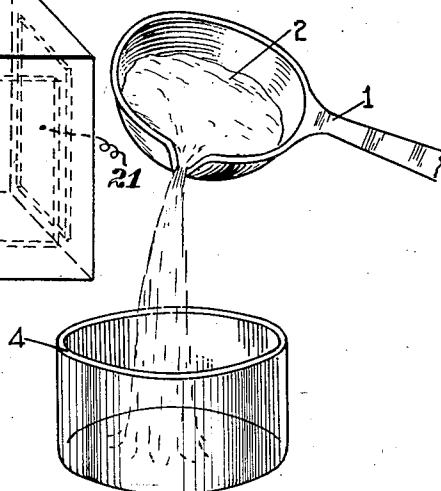


Fig. 3

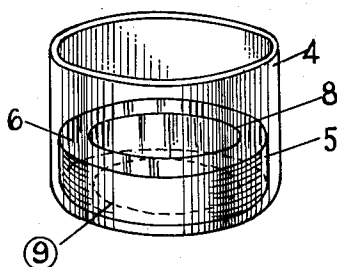


Fig. 4

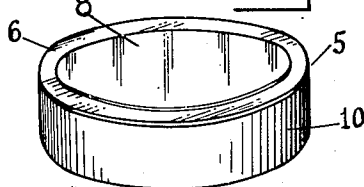


Fig. 7

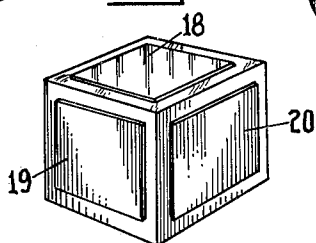


Fig. 6

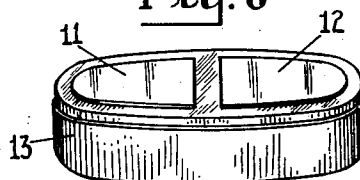
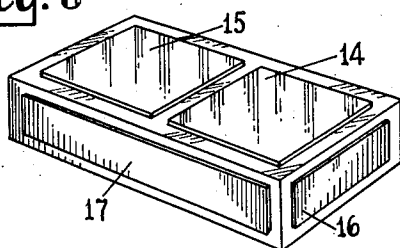


Fig. 5



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CAST PIEZO-ELECTRIC DEVICE

Application filed December 20, 1926. Serial No. 155,897.

This invention relates to a piezo-electric device, more particularly adapted and arranged to be utilized in connection with electric circuits, and to a method of producing the same. It has been known for some time that crystals of certain substances such as Rochelle salt, quartz, tourmaline, and the like, produce an electro-motive force if subjected to physical stress or movement, and conversely, produce physical stresses or movement in response to the impression of an electro-motive force upon them. Such crystals are capable of wide use and application in the electrical arts, and particularly in those arts which deal with the generation, transmission and utilization of alternating currents or potentials, whether of audible frequency or of the highest radio-frequency.

In the past, crystals of the types which might be synthetically produced, such for instance, as crystals of Rochelle salt, have been produced by growing the crystal from a seed in a solution of the mother liquor. As will be understood, this is a relatively slow process, since the crystal grows as the solution cools off, and this must be done relatively slowly in order to insure perfect crystals. This is particularly true in case the crystal desired is one of fairly large size, in which case it will require a relatively long time to be grown.

I have discovered that it is possible to dispense with the growing of crystals from the mother liquor, and to produce crystals of the desired size, shape and characteristics, by fusing the desired salt, and permitting it to solidify or congeal in a mold having the shape desired. The resultant solid may be used without removal from the mold, if desired, or it may be removed therefrom, and ground if desired with the purpose of bringing it very precisely to the desired size, in case it is not so when removed from the mold.

Electrodes may be applied directly to the surface of the solidified salt, making physical and electrical contact therewith, or they may be separated therefrom by the interposition of a suitable dielectric. In the latter case, as is understood, the resistance between the electrodes is very large, practically in-

finite in the case of a good dielectric, whereas in the former case it will be the resistance of the crystal itself. They may also be placed in the mold in such a manner as to be secured in place, either upon the surface of the finished crystal, or in the interior thereof as desired, by the congealing of the crystal.

The features of novelty which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its fundamental principles and as to its practical application, will best be understood by reference to the specification and accompanying drawings, in which:

Fig. 1 shows the fusing of salt to a liquid condition,

Fig. 2 shows the transfer of fused salt to a suitable mold,

Fig. 3 shows the fused salt after it has been permitted to congeal or solidify in the mold,

Fig. 4 shows the fused salt crystal after removal from the mold, and Figs. 5, 6, 7 and 8, show different forms of crystal which may be produced.

Referring now to Fig. 1, 1 designates a suitable container such as a casserole capable of holding the necessary amount of salt, and in which is placed a body 2 of the desired salt, such as Rochelle salt. This body may comprise a mixture of fragments, broken crystals, and the like, and is heated in any suitable way, as for example over the flame 3 of a Bunsen burner, until the salt is fused, the temperature being controlled in accordance with the amount of water of crystallization it is desired to retain in the salt.

The fused salt may then be poured into a mold 4 as shown in Fig. 2, and permitted to solidify, or if desired the mold itself may be utilized as the vessel in which the salt is fused, and one or more seed crystals preferably warmed to a temperature such that they will not crack may be placed in the mass of fused salt to orient the molecules properly during solidification. After the salt has solidified, the solid body of salt may be removed from the mold and electrodes applied as desired, if not already in place, or it may be permitted to remain in the mold, and the

electrodes applied to the outer side or sides of the mold, if the same is of suitable material, such as glass. Special treatment may be given the congealed salt calculated to enhance its piezo-electric activity.

Referring now to Fig. 3, I have shown the container 4, in which the molten salt has been permitted to solidify, in the form of a cylinder and from which container, the salt cylinder 5 may be removed, and when removed, will present the appearance shown in Fig. 4. Electrodes may be applied to the various parts of the crystal after its removal, or the crystal may be permitted to remain in the mold, as already stated and the electrodes applied to the outer side of the mold, or if desired one or more may be applied to the outer side of the mold and one or more directly to the exposed surface of the crystal.

Referring again to Fig. 3, 8 designates an electrode which may be in the form of a sheet of metal foil, metal gauze, perforated metal plate, or the like, secured upon the face 6 of the crystal. Another electrode 9 may be secured upon the bottom of the mold upon the outside thereof and may be in the form of a sheet of foil secured to the bottom of the mold 4. It will also be understood that the electrodes may be placed upon the inside of the mold in the desired position so that after solidification of the salt therein, the electrodes will be in place either upon the outer surface of the crystals, or within the interior thereof.

It will be understood that crystals of any desired size and shape may be produced by choice of the proper size and shape of mold, such for example as the rectangular crystal shown in Fig. 5, which is produced by allowing the fused salt to congeal in a rectangular mold, the elliptical cylindrical crystal shown in Fig. 6, or the cubical crystal shown in Fig. 7.

The electrodes may be disposed in the most advantageous manner as dictated by the shape of the crystal, the location of its electrical poles and the exigencies of the situation. For instance, in the case of the crystal shown in Fig. 4, in addition to the top and bottom electrodes, there may be provided a band or equatorial electrode 10 as shown, secured upon the cylindrical wall of the crystal.

In the case of the rectangular crystal shown in Fig. 5, an electrode may be applied to each of the six faces of the crystal, or, if desired, more than one electrode may be disposed upon the same face. In this figure, 16 and 17 designate respectively electrodes mounted upon one end and one side of the rectangular crystal, while 14 and 15 designate separate electrodes mounted upon different electrical poles of the same crystal face.

Referring now to Fig. 6, showing a crystal in the form of an elliptical cylinder, 11 and 12 designate separate electrodes at different

electrical poles of the crystal, while 13 designates an equatorial or band electrode. It will be understood that similar electrodes may be applied to the faces of the crystals which are not shown.

Referring now to Fig. 7, showing a cubical crystal, 18, 19, and 20 respectively designates electrodes mounted on the various faces of the crystal, and in this case, as in the case of all the other crystals herein shown, and described, it will be understood that similar electrodes may be placed on the faces not shown. Figure 8 shows an arrangement similar to that of Figure 7, except that in this case the electrodes are disposed in the interior of the crystal and are provided with leads such as 21, 22, 23 and 24 by means of which connections may be established to such electrodes.

The congealed salt may be treated as by desiccation in alcohol, by curing or other treatment applied for the purpose of increasing or enhancing the piezo-electric activity of the cast device.

The stress or mechanical poles, that is, the points at which force may be applied to the crystal device, to produce an electro-motive force, and between which forces are developed, in response to the application of an electro-motive force, are along the various peripheries or edges, and at salient points, such as corners. The electrical polarity assumed by the various faces of the crystal is the same as that assumed by a crystal grown from a seed crystal in the manner set forth in my Patent No. 1,590,311. The operation of the crystals grown by congealing the salt is the same as that of crystals grown from a seed crystal.

While I have shown and described certain preferred embodiments of my invention, it will be understood that modifications and changes may be made without departing from the spirit and scope of my invention, as will be readily understood by those skilled in the art.

I claim:

1. The method of preparing piezo-electric crystals of any desired shape, which comprises fusing Rochelle salt and permitting the fused salt to solidify in contact with a seed crystal.

2. The method of securing electrodes to a piezo-electric device, which comprises positioning the electrode in a mold, and pouring fused piezo-electric salt therein, and permitting said fused salt to solidify.

3. A piezo-electric device comprising a body of piezo-electrically active salt, congealed from fused salt, with electrodes positioned internally therein said electrodes being in the same plane and parallel to the adjacent surfaces.

4. A piezo-electric device comprising a body of piezo-electrically active salt con-

gealed from fused salt and having electrodes secured in place by said congealed salt.

5 5. The method of preparing a piezo electric unit consisting of a piezo electric crystal and electrodes therefor which comprises positioning in a mold electrodes adapted to make
10 contact with said crystal and pouring fused Rochelle salt therein, and permitting said fused salt to solidify with respect to said electrodes while said electrodes are positioned
15 substantially parallel to faces of said crystal.

6. A piezo electric device comprising a body of piezo electrically active salt congealed from fused salt by permitting the
20 fused salt to solidify in contact with a seed crystal.

7. A piezo electric device comprising a body of piezo electrically active salt congealed from fused salt by permitting the
25 fused salt to solidify in contact with a seed crystal, said body of piezo-electrically active salt having electrodes positioned internally therein substantially parallel to the adjacent surfaces of said body.

In testimony whereof I hereunto affix my signature.

ALEXANDER McLEAN NICOLSON.

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