Nov. 19, 1946. I. C. CLEMENT 2,411,146

SOUND SIGNALING APPARATUS

Original Filed June 14, 1933

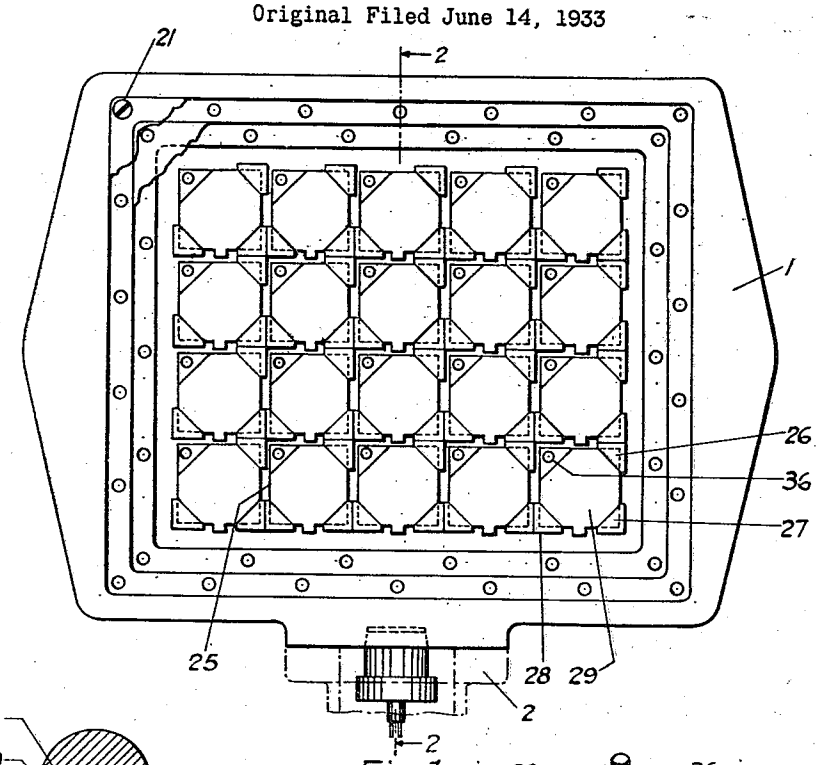


Fig. 1

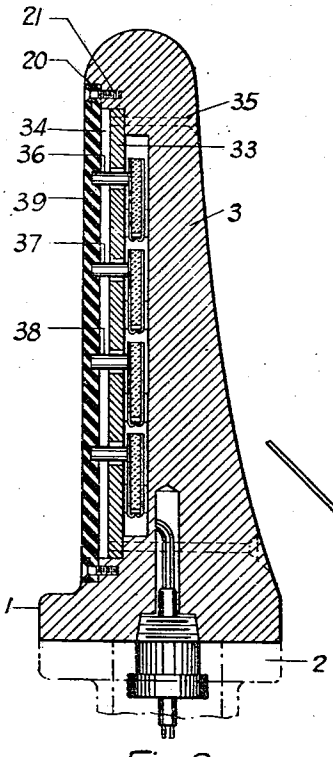


Fig. 2

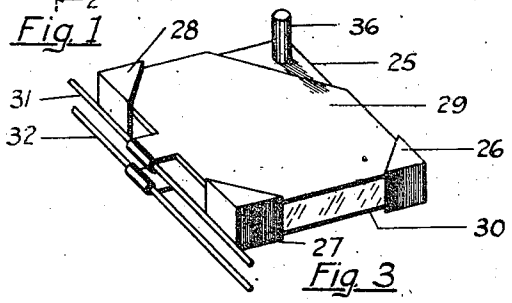


Fig. 3

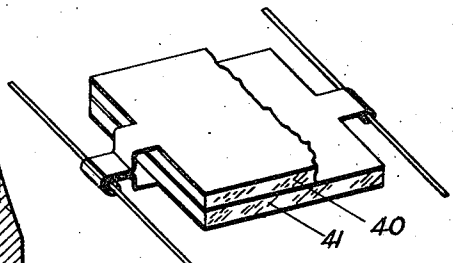


Fig. 4

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SOUND SIGNALING APPARATUS

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Original application June 14, 1933, Serial No. 675,700. Divided and this application September 29, 1936, Serial No. 103,163

8 Claims. (Cl. 177—386)

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The present invention is a division of my copending application Serial No. 675,700, filed June 14, 1933.

The present invention relates to an apparatus for transmitting and receiving submarine or subaqueous signals, and more in particular to the use of compressional waves in a frequency range above or near the upper limit of audibility of the human ear.

The invention further relates to the transmission of a directive beam of compressional waves with the use of piezo-electric crystals which may be quartz but preferably are Rochelle-salt crystals or crystals having similar piezo-electric properties.

In the present invention crystals of the Rochelle-salt type are not used purely as a so-called compressional crystal in which a compression between two faces of the crystal sets up an electrical potential in a direction parallel to the faces and normal to the opposite faces, but the crystals are used as bending crystals, and in this connection the method of support and the method of applying the vibratory energy to the crystal are substantially different. The crystals as indicated may be used individually or they may be mounted in groups in face-to-face relation, the outer electrodes being connected together and serving as one pair of electrodes while the inner face-to-face electrodes serve as the common electrode.

The device of the present application may in particular be used to receive supersonic waves within a broad range of frequencies and by the use of a plurality of crystals substantially aligned in the same plane covering a large surface as compared with the wave length of the wave which is being transmitted or received. A directional beam may be transmitted when the device is used as a transmitter or the device may act as a directional receiver, in which case it receives waves from substantially one direction.

The apparatus will be more fully described in connection with the description of the embodiment illustrated in the drawings in which Fig. 1 shows a plan view of the apparatus with the diaphragm and cover plate removed; Fig. 2 shows a sectional view along the line 2—2 of Fig. 1; Fig. 3 shows an enlarged perspective view of the arrangement of an individual crystal; and Fig. 4 shows a perspective view of a modification of Fig. 3.

With reference to Figs. 1, 2 and 3 of the drawings a plurality of crystals 25 is mounted within a casing 1 which is supported preferably by a

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central piece 2 at the bottom of the casing. This support may be circular so that the whole device can be mounted in a bearing and rotated about a vertical axis. The casing 1, which may be of metal, is provided with a heavy back plate 3 which tapers somewhat to the top of the apparatus as shown more particularly in Fig. 2. Within the back plate 3 is a recess within which a plurality of piezo-electric crystals is mounted. Each of the crystals 25 is supported by rubber corners 26, 27 and 28 into which the corners of the crystal fit. Each crystal is provided with electrodes 29 and 30 on opposite sides thereof. The electrode 29, as indicated, may be connected to conductor 31 and the electrode 30 to the conductor 32. All the crystals may in this manner be connected in parallel with each other or in some other desired manner. The corners 26, 27 and 28 supporting the three corners of the crystal may be of any yielding material such as molded rubber but I prefer to use the substance which is known as "glyptal" and is a synthetic rubber possessing the desirable quality that it is yielding but has only slight elasticity.

The crystals with the molded corners attached are held in position in the casing 1 by means of the plate 33 which is supported on a shoulder 34 in the casing by means of the screws 35. The plate 33 is perforated at points corresponding to the free corners of the crystals and through these perforations the rods 36, 37, 38, etc., operate transmitting acoustic vibrations to the free corners of the crystals. The rods themselves may be of rubber or other molded material or they may be metallic. The rods are by one end firmly attached to the crystals and by the other end to a diaphragm 39 which is preferably made of soft rubber. The diaphragm 39 can be held in place by a clamping ring 20 suitably fastened to the back of the casing by means of the screws 21 arranged around the periphery of the casing.

In the operation of the device the sound wave energy impressed upon the diaphragm 39 is transmitted through the rods 36, etc., to free portions of the crystals, thereby causing a bending of the crystals between the free and supported corners. This bending creates a potential difference between the faces of the crystals which is detected in the receiver or receiving circuit. If the device is used as a transmitter, electrical energy is applied to the electrodes of the crystals and the latter are made to bend in the same manner as they are bent when excited by compressional waves. It will be noted that the crystals are placed in substantially the same plane and

that the rods connecting the diaphragm with the crystals end in substantially a single plane. With this arrangement the sound energy approaching normal to the surface of the diaphragm excites all of the crystals in the same phase while the sound energy approaching from any but a normal direction excites the crystals out of phase.

In this way it will be readily understood that the device is highly directional in a direction normal to the surface of the diaphragm.

In Fig. 4 a slightly different form of crystal structure is shown. In this figure two similar crystals 40 and 41 are mounted in face to face contact with an electrode between them. The crystals are arranged so that the same polarity is produced at the top and bottom electrodes of the combination with the other polarity on the common electrode between the two crystals. The crystal structure or unit illustrated in this figure may be substituted for that shown in Fig. 3 and will operate and act in substantially the same way but with an enhanced effect.

Having now described my invention, I claim:

1. A submarine transceiver including a casing having a rigid back element, a plurality of piezo-electric crystals of the Rochelle salt type having two parallel flat surfaces of polygonal shape, means for mounting said crystals in said casing in substantially the same plane, supporting the same at some of the corners thereof and means acoustically connecting said crystals to the propagating medium to exert acoustic vibrations on at least one of the unsupported corners thereof.

2. A submarine transceiver including a casing having a rigid back element, a plurality of piezo-electric crystals of the Rochelle salt type having two parallel flat surfaces of polygonal shape, means for mounting said crystals in said casing in substantially the same plane, said means including corner elements for holding said crystals and means holding said corner elements in place, and means acoustically connecting said crystals to the propagating medium to exert acoustic vibrations on the unsupported corners thereof.

3. A submarine transceiver including a casing having a rigid back element, a plurality of piezo-electric crystals having two parallel flat surfaces of polygonal shape, means for mounting said crystals in said casing in substantially the same plane, said means including corner elements for holding said crystals, means for holding said corner elements in place and means acoustically connecting said crystals to the propagating medium to exert acoustic vibrations on unsupported portions of said crystals.

4. A submarine transceiver including a casing having a rigid back element, a plurality of piezo-electric crystals having two parallel flat surfaces of quadrilateral shape, means for holding said crystals by three corners in substantially the same plane, a diaphragm and a plurality of rods each secured to the free corners of each of said crystals and to said diaphragm.

5. A submarine transceiver including a casing having a rigid back element and a recess in one face thereof, a plurality of piezo-electric crystals of prismatic shape, means for mounting said crystals in said recess leaving at least one corner of each crystal free, a diaphragm secured to said casing and adapted to cover said recess and means for connecting the free corners of the crystals to said diaphragm.

6. A submarine transceiver including a casing having a rigid back element and a recess in one face thereof, a plurality of piezo-electric crystals of prismatic shape, means for mounting said crystals in said recess leaving at least one corner of each crystal free, a plurality of rods, one secured to a free portion of each crystal, a plate having a plurality of apertures therein adapted to fit over said rods in non-contiguous relation thereto and adapted to be secured to said casing and a diaphragm secured to each of said rods and to said casing for acoustically connecting the rods to the sound propagating medium.

7. An electromechanical interchanging device, comprising in combination, a diaphragm, a casing, a plurality of piezo-electric crystal units, means for mounting said crystal units within said casing substantially in the same plane for flexural movement with at least a portion of each unit free from the mounting means and individual means for connecting said units at least at the unsupported portions thereof to the diaphragm at a plurality of spaced points over the same.

8. An electromechanical energy interchanging device comprising, in combination, a diaphragm, a casing, a plurality of piezoelectric crystal units, means mounting and supporting said crystal units in some areas near the side edges thereof within said casing with the crystal units positioned substantially in the same plane, and individual means connecting each of said crystal units in areas at other side edges thereof to the diaphragm at a plurality of spaced points over the same, said crystal units being otherwise unsupported in said last-mentioned areas whereby said crystal units are operated with a flexural movement.

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