July 24, 1928. 1,678,182

M. S. ESTES

TRANSMITTER FOR HIGH FREQUENCY SOUND SIGNALING

Filed Nov. 25, 1919

Fig. 1.

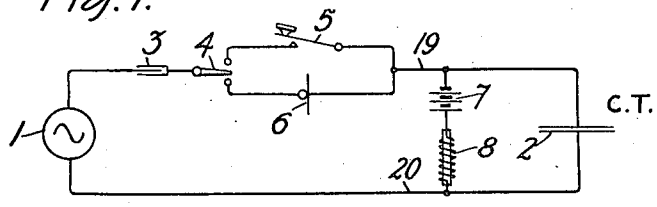


Fig. 2.

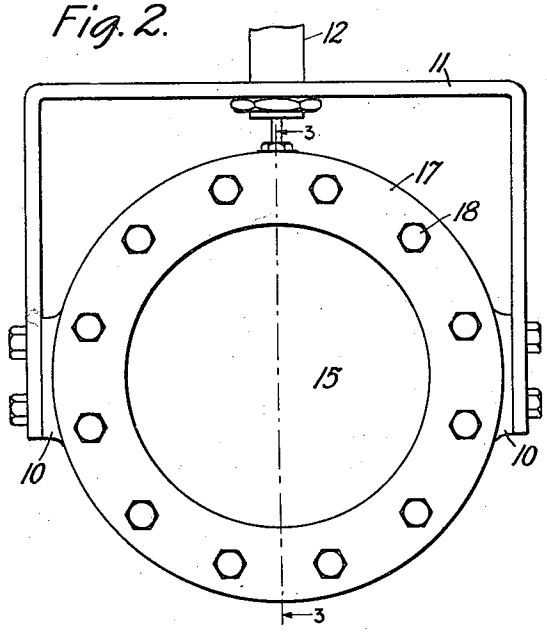


Fig. 3.

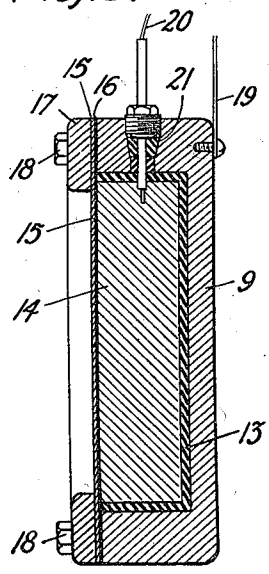
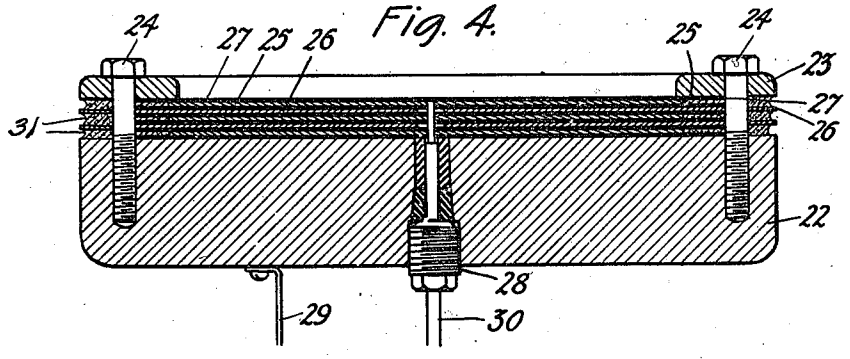


Fig. 4.



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UNITED STATES PATENT OFFICE.

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TRANSMITTER FOR HIGH-FREQUENCY SOUND SIGNALING.

Application filed November 25, 1919. Serial No. 340,555.

This invention relates to transmitters for high frequency sound signaling. More particularly, it relates to a device of the condenser transmitter type for use in submarine signaling.

An object of the invention is to provide a high frequency sound transmitter.

Another object of the invention is to provide means for converting the energy of high frequency electrical waves into that of sound waves of corresponding frequency.

A further object of the invention is to provide means for causing electrical waves of large amplitude to set up sound waves of corresponding amplitude and wave form.

A further object of the invention is to provide a condenser transmitter capable of acting directly upon water or other sound transmitting media to set up sound waves therein.

A still further object of the invention is to provide a high frequency sound wave transmitter which will be directive in its effect so that the high frequency sound waves will be propagated as a beam.

According to the present invention, a condenser of rugged type is so constructed that it may be immersed in water and maintained polarized to a high potential while immersed. One conducting plate of the condenser is made thin and is either exposed to the water or separated therefrom by a thin flexible sheet of dielectric material, and upon application of electrical oscillations to the condenser, this plate is acted upon by electrostatic attraction so that it vibrates and sets up corresponding sound waves in the water immediately adjacent to its surface. These sound waves, which are preferably of high frequency, are transmitted through the water and are received and detected by suitable receiving means.

Referring to the drawing, Fig. 1 illustrates diagrammatically a circuit arrangement in which this invention may be employed; Fig. 2 is a plan view of a condenser transmitter or vibrator; Fig. 3 a section on line 3—3 of Fig. 2; and Fig. 4 a similar section of a modified form of vibrator.

As shown in Fig. 1, a source 1 of alternating current is connected in circuit with the condenser transmitter 2 through a large capacity blocking condenser 3. A switch 4 serves to connect in series with the circuit either a key 5 or a microphone 6. A source 7 of unidirectional current is also connected to the terminals of condenser transmitter 2 to polarize it. A high frequency retard coil 8 serves to exclude the current produced by source 1 from the path including source 7. Blocking condenser 3 prevents flow of unidirectional current through the path including source 1.

The structure of one form of a condenser transmitter according to this invention is illustrated in Figs. 2 and 3. A heavy annular metallic casing or base member 9 has outstanding bosses 10 to which are connected the ends of yoke 11, the central portion of which is suitably connected to a tubular supporting member 12. Fitted within a circular recess in casing or base member 9 and separated therefrom by insulating casing 13 is a conducting plate 14. A thin circular conducting plate 15 covers the exposed face of conducting plate 14 and is insulated therefrom by interposed dielectric material 16. An annular clamping ring 17, preferably of conducting material, secured to casing 9 by bolts 18, serves to hold the parts in position. Conducting plates 14 and 15 with interposed dielectric material 16 constitute a condenser transmitter. A conducting terminal member 19 is attached to casing 9 and an insulation covered terminal conductor 20 passing through an insulating bushing 21 in casing 9 is electrically connected to plate 14. Ring 17 is electrically connected to casing 9 in any suitable manner as, for example, by bolts 18. The joint between the casing 9 and the conducting plate 15 may be sealed in any desired manner to make it fluid-tight. It has been found that a suitable joint may be secured by applying valve grease to the parts at the joint and by heating the transmitter during assembly to melt the grease. Plate 14 is thus effectively insulated from casing 9, conducting plate 15 and the surrounding medium.

In Fig. 4 is shown a modified form of condenser transmitter having a flat back plate or base member 22, a clamping ring 23 attached to the casing by means of bolts 24 and a multiple-leaved condenser element clamped between the plate 22 and ring 23. The condenser element consists of a series of conducting plates 25 alternately interposed with another series of conducting plates 26. A sheet of insulating material 27, preferably very thin, covers the outer face of outer

plate 25 and dielectric material is placed between each two adjacent plates of the condenser element and also the inner plate or base member 25 and back plate 22. The joint between plate 22 and ring 23 is preferably sealed fluid-tight in any suitable manner as by material 31. Insulated conductor 30 passes through a central insulating bushing 28 in back plate 22 and is electrically connected to each of the conducting plates 25. Conducting plates 26 are provided with central apertures through which conductor 30 passes, and these apertures are of such size as to prevent electrical contact between these plates and the conductor. If desired, annular washers of insulating material of the same thickness as the conducting plates may be placed in the apertures. A conductor 29 is connected to the back plate 22 and plates 26 are electrically connected to the back plate by any suitable means such as bolts 24.

Although various dimensions may be given the parts of the transmitter, in one example actually used, the outer conducting plate of the condenser was approximately eight inches in diameter with thin leaves of mica for dielectric. This condenser had a capacity of 57 x 10^{-9} farads when polarized to 1600 volts D. C. and immersed in salt water.

In operation the transmitter may be suspended in water or any other sound-conducting medium by means of support 12. When electric currents of the frequency and wave form it is desired to transmit are applied to the conductors 19 and 20, to which the polarizing source may also be connected, the electrostatic action will cause a motion of the outer conducting plate which is transferred as a corresponding sound wave to the adjacent medium. When the switch 4 of Fig. 1 is thrown to the upper position, key 5 may be used to interrupt the high frequency waves for telegraph or other impulse signaling. When thrown to the opposite position, microphone 6 may be used to vary the amplitude of the high frequency waves in well known manner for the transmission of speech or other sounds. In the modification shown in Figs. 2 and 3, the outer conducting plate is directly in contact with the adjacent medium, but in the modification of Fig. 4, the outer conducting plate imparts its motion to insulation sheet 27, which is preferably thin mica, and this sheet in turn transmits the motion to the adjacent medium as a sound wave.

The surface from which motion is transmitted to the adjacent medium, that is, the surface of the outer conducting plate or the thin dielectric sheet covering it, as the case may be, is of large area and accordingly the transmission of sound by this apparatus is highly directive. The supporting member 12 may be used to position the plane of the sound transmitting member exactly with reference to any desired receiving point. As a practical example, it has been found that with the transmitting vibrator 8 inches in diameter, at a frequency of 75,000 cycles per second, and at a distance of 2,000 feet between transmitter and receiver, it is possible to determine the direction of the transmitter within one degree, and the sound is practically lost at the receiving station if the transmitter is turned five degrees from the direction of correct pointing. It is, therefore, possible to select any of a number of signaling stations to the exclusion of the others, provided the angular difference of their directions from the transmitting point is not too small.

The device is simple and rugged, both electrically and mechanically, as is required in submarine signaling with high polarizing voltage. The type of device illustrated in Fig. 4 permits any desired capacity to be obtained.

It is to be understood that this invention is not to be limited to the details shown and that the circuit of Fig. 1 is merely a diagram of a conventional circuit in which the novel transmitter may be employed. Although the transmitter has been described in connection with submarine signaling, it is obviously capable of use in any sound transmitting medium and in the transmitting and selecting of other controlling impulses of any wave form and frequency, as well as for signal transmission.

What is claimed is:

1. A transmitter of superaudible frequency waves comprising a rigid base member, an elastic condenser plate having a mass which is small as compared with that of the base member, a second condenser plate, means substantially rigidly connecting said second condenser plate, to said base member, means for electrically connecting said first plate with said base member and said other plate, and means hermetically covering both of said condenser plates, comprising an insulating sheet having a small mass as compared with that of either of said plates and arranged relatively to said first plate so that the motion of said first plate is transmitted therethrough to the medium.

2. A condenser transmitter comprising condenser plates of opposite polarity, a conductive base member supporting said plates, an electrical connection between one of said plates and said base member, solid insulating means surrounding the other of said plates and insulating it from the medium surrounding said transmitter, and means for making electrical connection with each of said plates.

3. A condenser transmitter comprising a conductive base member, a thin flexible sheet

of dielectric material joined to said base member, a condenser plate interposed between said sheet and said member and insulated from said member, and means for rendering fluid-tight the joint between said sheet and said member.

4. A condenser transmitter comprising a base member, a plurality of conducting plates mounted thereon, means electrically connecting said conducting plates, a plurality of conducting plates interposed between said electrically connected plates and insulated therefrom, said base member being massive as compared with each of said plates and said interposed plates and said base member being apertured, and a conducting member passing through said apertures and connected only to said interposed plates.

In witness whereof, I hereunto subscribe my name this 19th day of November, A. D. 1919.

MARION S. ESTES.