H. J. W. FAY.

MECHANISM FOR THE TRANSMISSION AND RECEPTION OF SOUND.

APPLICATION FILED MAR. 16, 1915.

1,321,197. **Patented Nov. 11, 1919.**

Fig. 1.

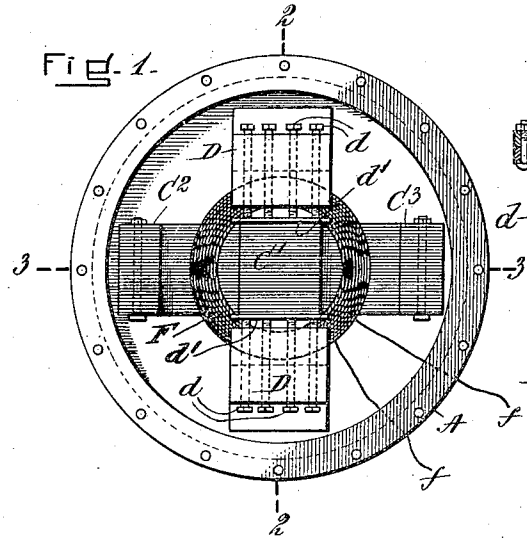


Fig. 2.

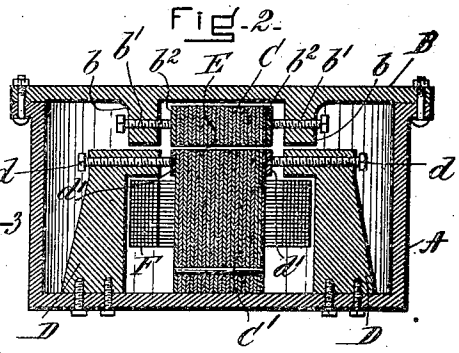


Fig. 3.

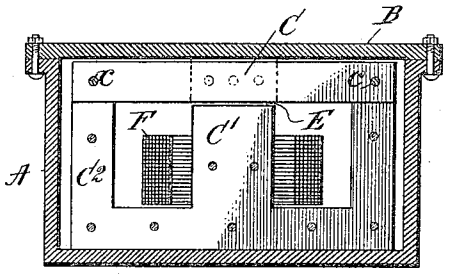


Fig. 4.

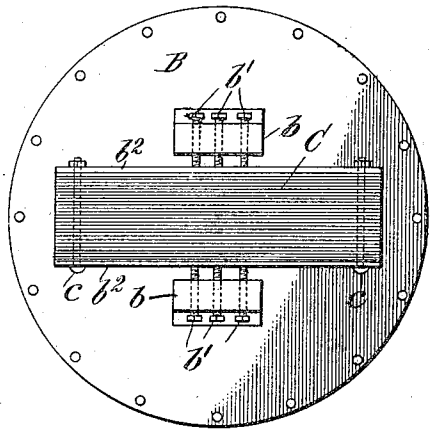
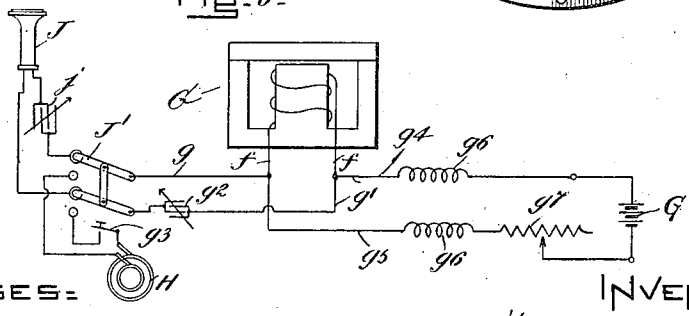


Fig. 5.



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MECHANISM FOR THE TRANSMISSION AND RECEPTION OF SOUND.

1,321,197. Specification of Letters Patent. Patented Nov. 11, 1919.

Application filed March 16, 1915. Serial No. 14,811.

To all whom it may concern:

Be it known that I, HAROLD J. W. FAY, of Westboro, in the county of Worcester and State of Massachusetts, a citizen of the United States, have invented a new and useful Improvement in Mechanism for the Transmission and Reception of Sound, of which the following is a specification.

My invention relates more especially to the transmission and reception of sound through water though it may have other uses. More specifically it comprises a device analogous to a telephone receiver with such structural changes as will adapt it when used as a transmitter to produce a maximum of vibration for a minimum of electrical energy to cause said vibration. Like a telephone receiver the said device may convert vibrations into electrical energy and if such electrical energy be used to actuate a telephone receiver, vibrations of very minute intensity may be detected.

My invention will be understood by reference to the drawings in which—

Figure 1 is a plan, the diaphragm and yoke piece carried by it being removed.

Figs. 2 and 3 are sections on lines 2—2 and 3—3, respectively, of Fig. 1.

Fig. 4 is a plan of the diaphragm and yoke piece looking from below, and

Fig. 5 is a diagrammatic view showing the circuits.

A is a cylindrical shell or casing made preferably of cast iron. To the top of this case is bolted the diaphragm B. This diaphragm has lugs b between which are clamped by screws b^1 a laminated yoke piece C of a construction similar to a shell type alternating current static transformer, this yoke piece lying diametrically across the middle of the diaphragm. Clamping strips b^2 of thicker metal are preferably placed between the clamping ends of the screws b^1 and the outer laminations for the protection thereof. The laminations are bound together by bolts c.

The core parts C^1, C^2, C^3 of the transformer construction are clamped by screws d (acting on clamping strips d^1 of brass), between the cast steel supports D attached to the bottom of the inside of the shell A. These core pieces are constructed of laminated steel insulated from each other in the usual manner of transformer construction and held together in any convenient way. The core pieces C^2, C^3 project very slightly above the core piece C^1 so that the ends of the yoke piece C rest on the core pieces C^2, C^3 and a minute air gap E is left between the under side of the yoke piece C and the core piece C^1. This construction allows the diaphragm B and yoke piece C to vibrate freely, increasing and decreasing the air gap. I have used brass clamping pieces d^1 to prevent shunting the magnetic circuit. Other means will suggest themselves for this purpose.

About the core piece C^1 I place a helix F of insulated copper wire having leads f, f which pass out through the case A.

In Fig. 5 the device as a whole is lettered G. When it is to be used as a producer of sound waves in water I employ a source of high frequency alternating current as indicated at H connected to the leads f, f by wires g, g^1 and a switch J^1. In the branch g^1 is a condenser g^2 and a key g^3. The frequency of this alternating current should be preferably equal to the natural mechanical period of vibration of the diaphragm B and its yoke C. The value of the condenser is adjusted until the power factor of the current flowing through the helix F is substantially unity under which condition a minimum of electro-motive force will produce a maximum of vibration in the diaphragm.

Leads g^4, g^5 having choke coils g^6 and an adjustable resistance g^7 are connected to a direct current generator circuit comprising a direct current generator G^1 and serve to polarize the device in an analogous manner to that which a telephone receiver is polarized by a permanent magnet.

The condenser g^2 serves to protect the alternating circuit from the direct current and the choke coils g^6, g^6 protect the direct circuit from the alternating current. The adjustable resistance g^7 enables a proper amount of direct current to be supplied to the winding which is common to both circuits according to the amount of alternating current.

In order to detect the presence of sound waves I connect the helix F and its condenser with a telephone J by means of the switch J^1, the switch cutting out the source of alternating current. The receiving or telephone

circuit should contain a condenser *j* and should be carefully adjusted to be electrically resonant to a frequency corresponding to the period of the diaphragm, this adjustment being secured in the circuit shown by adjusting the value of the condenser *j* in the telephone circuit.

I have found it practicable so to construct this device that the natural period of the vibrations of the diaphragm B and its yoke C shall be substantially 500 to the second, this natural period being very sharply defined so that a very slight change in the impressed frequency will make a very marked change in the amplitude of vibrations due to the mechanical principle of resonance.

The apparatus when designed as above is especially useful in sending and receiving sound waves for a maximum distance through water with a minimum expenditure of electrical energy, and for this purpose the joints between A and B should of course be watertight.

What I claim as my invention is:—

1. In a device for the production of sound waves in water, the combination with an electric circuit, of a water-tight metal casing having a part or cover serving as a diaphragm, a laminated steel yoke piece attached to said diaphragm, steel supports attached to the body of said casing, a laminated steel core piece clamped between said supports and slightly separated from said laminated yoke piece to leave a minute air gap, and brass clamping plates between which said steel laminated yoke piece and core piece are inclosed.

2. In a device for the transmission of sound waves in water, the combination with an electric circuit, of a water-tight casing having a part or cover serving as a diaphragm, said diaphragm having lugs, clamping screws passing through said lugs, a laminated yoke piece clamped in place by said screws and thus connected with said diaphragm, supports attached to the body of said casing, clamping screws passing through said supports, and a laminated core piece clamped in place by said last-named screws and slightly separated from said core piece to leave a minute air gap.

3. In a device for the transmission of sound waves in water, the combination with an electric circuit, of a water-tight casing having a part or cover serving as a diaphragm, said diaphragm having lugs, clamping screws passing through said lugs, a laminated steel yoke piece clamped in place by said screws and thus connected with said diaphragm, steel supports attached to the body of said casing, clamping screws passing through said supports, a laminated steel core piece clamped in place by said last-named screws and slightly separated from said core piece to leave a minute air gap, and brass clamping plates between which laminated steel yoke piece and core piece are inclosed and against which said clamping screws abut.

HAROLD J. W. FAY.