Aug. 28, 1928.

R. L. WILLIAMS

1,681,963

MAGNETOPHONE

Filed Jan. 2, 1920

3 Sheets-Sheet 1

Fig. 1.

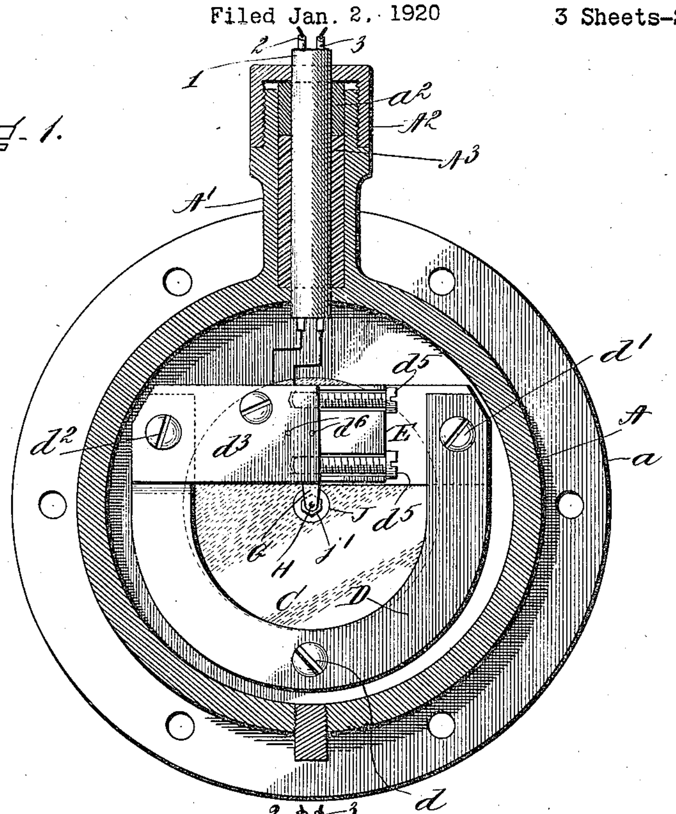

Fig. 2.

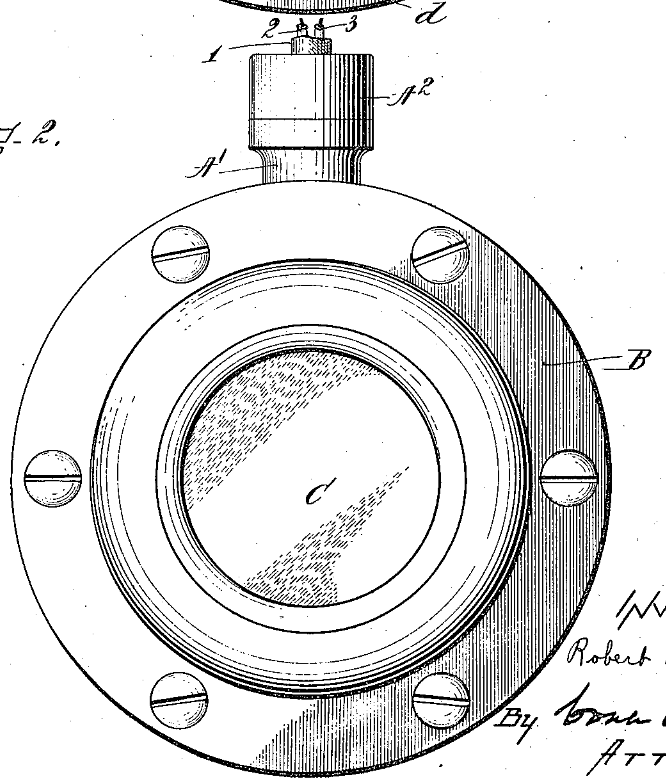

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Fig-3.

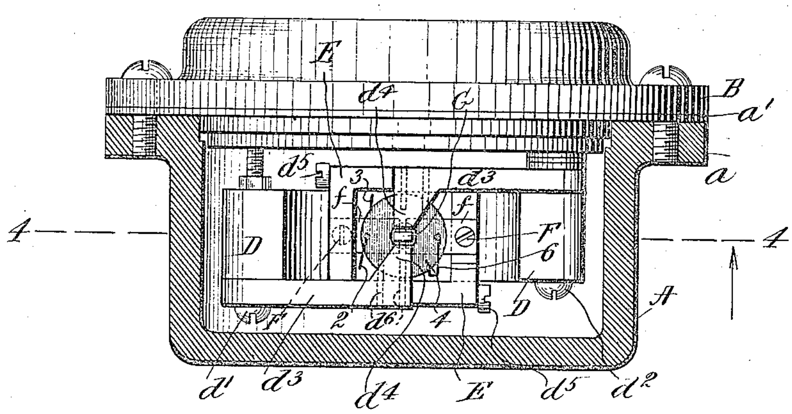

Fig-4.

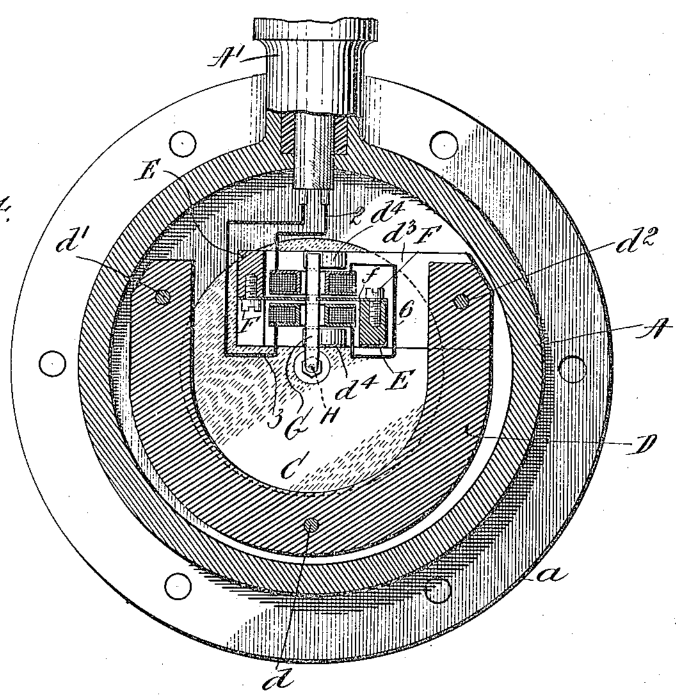

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Fig. 5.

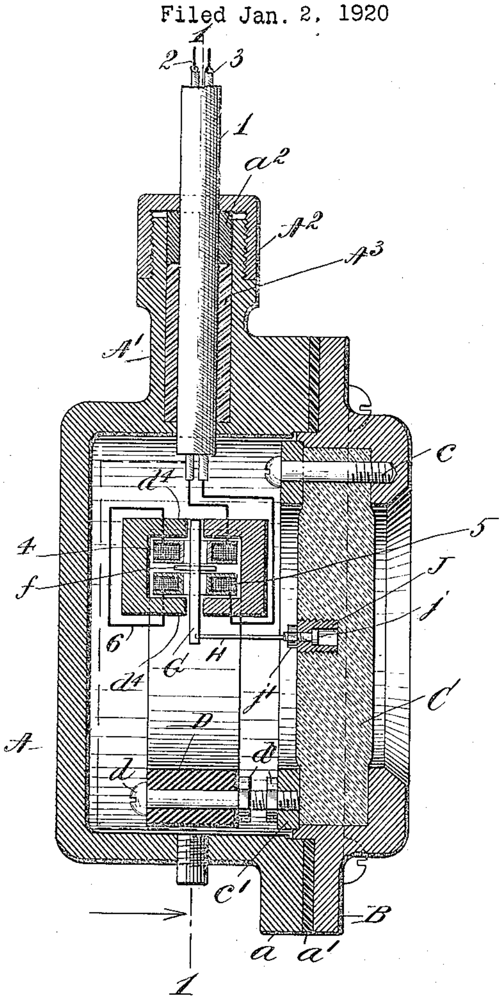
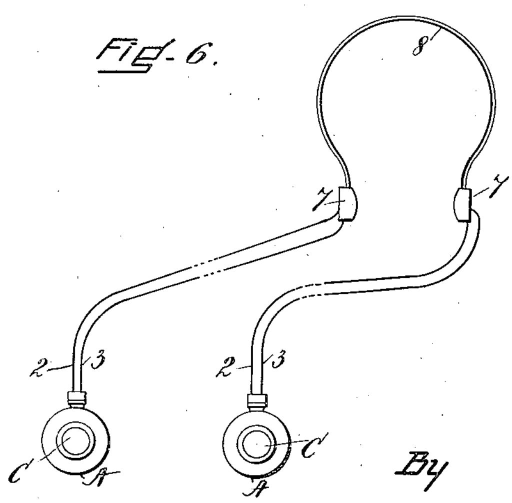


Fig. 6.



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Patented Aug. 28, 1928. **1,681,963**

UNITED STATES PATENT OFFICE.

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MAGNETOPHONE.

Application filed January 2, 1920. Serial No. 348,935.

My invention relates to means for receiving sound waves and transmitting them to a suitable indicator, and more especially to an instrument for the receiving of submarine signals, which may be useful to determine the direction from which signals are approaching.

It comprises an aperiodic diaphragm, that is, one which has no inherent periodicity, but will respond equally well to vibrations of any periodicity, to which diaphragm is attached an armature to move positively therewith in a magnetic field, as will be understood by the description below.

My invention in its preferred form is shown in the drawings, in which—

Figure 1 is a section on line 1—1 of Fig. 5.

Fig. 2 is a front elevation.

Fig. 3 is a top view or plan, the casing being in section.

Fig. 4 is a section on line 4—4 of Fig. 3.

Fig. 5 is a vertical section, and

Fig. 6 is a diagrammatic view showing the use of these parts binaurally.

A is a cup-shaped casing having a flange a to which is attached by screws a ring B. This ring is recessed and to it is attached by screws c and a clamping ring c^1 an aperiodic diaphragm C made preferably of fairly thick soft rubber. A gasket a^1 is used to keep the interior of the casing water-tight.

The casing A has a neck A^1 forming with the nut A^2 and gland A^3 and packing a^2 a stuffing box through which passes out the cable 1 comprising the leads 2 and 3.

To the ring B is also attached by screws d, d^1, d^2 and suitable set nuts a permanent horseshoe magnet D. The poles of this magnet are made separate therefrom for purposes of easy construction. Each comprises a flat plate d^3 which is suitably attached, to a terminal of the magnet, for example, by a screw d^1, d^2, the two plates being attached to the outer surfaces of the magnet and each having fingers d^4 projecting from the opposing sides of these plates and extending within the area surrounded by the magnet so as nearly to meet (see especially Figs. 3 and 5). There are in all four fingers, two projecting from each plate.

E are L-shaped supports of non-magnetic metal by which the ends of the plates d^3 are supported, d^5 being screws projecting from the ends of the plates and resting in suitable grooves in the supports. The screws enable the supports and plates to be clamped together. There are two of these supports, one attached to each plate, and the screws attached to one plate rest in the grooves on the support attached to the other plate. Thus the plates and supports form a housing within which is located two coils 4, 5, connected together by a wire 6 and in circuit with wires 2 and 3. Pins d^6 projecting from the plates d^3 lie between the two coils and keep them apart.

The supports E serve also to carry a leaf spring f attached thereto by screws F. For this purpose the supports are shaped so as to allow room for the screws F so that the spring f will lie midway between the coils 4 and 5.

To the springs f is attached an armature or flapper G, the two ends of the armature being in close proximity to the tips of the fingers d^4 so that it is polarized, the tension of the springs f keeping the armature normally midway between the fingers or poles of the permanent magnet.

The wires 2 and 3 lead to a receiver 7 and in practice two of these instruments are used, each connected to a receiver, the receivers being connected to a headband 8 (see Fig. 6). It is evident that movements of the armature G from its neutral position will create currents in each circuit 1, 3, 6, 4, 2, 7, and hence cause an indication in the receiver.

The armature G is moved by a connection such as the wire H between the diaphragm C and the armature. As shown, an inverted socket piece J is screwed into or otherwise attached to the diaphragm. The socket piece has a hole through it through which passes the bolt j to which one end of the wire H is attached. A nut j^1 clamps the bolt to the socket piece. Thus each vibration of the diaphragm, however small, will be communicated to the armature, moving it and exciting a current in the circuit which operates the receiver in the ear piece.

In determining the direction of a submarine bell or oscillator signal binaurally by the use of a compensator, it is necessary that two transmitters be employed, one for each ear. The two transmitters, however, must be such that they transmit the sound waves in the same phase in which each receives them.

In determining the direction of propeller noises which are not musical, the phase at which the sound is transmitted is not so important as in this case it is the time of arrival of the first of a train of waves which enables the binaural effect to be obtained.

But with a musical note I have found that the phase is important as all the sound waves are alike and it is difficult to distinguish the time of arrival of the first of the train of waves.

On this account microphones will not always work binaurally listening to a musical note. This is because the microphone buttons do not always produce current in phase with the sound waves. For instance, two microphone buttons may be under the compressional effect of the same sound wave and one gives an increase of current while the other gives a decrease at the same instant. Moreover it is very difficult to secure two microphones which are exactly of the same standard because whereas they may each contain the same weight of carbon granules, the position of these granules will never be exactly the same position in the two microphones and hence at a given moment the resistance of the two microphones will not be alike. It is very desirable, if not necessary, that when two receivers are to be used in a binaural system they should be of such character that they will transmit the sounds received with equal efficiency to the ear pieces or other indicators.

Magnetophones, however, because of their construction do not have these faults, for it will be seen that when a sound wave strikes the rubber diaphragms they both deflect the "flappers" of the magnetophones in the same direction and produce currents flowing in phase with each other.

By the use of rubber for the diaphragm, I eliminate the trouble caused by the residual pitch of a metal diaphragm.

When listening to the same musical note, I find that if the transmitters have diaphragms of different residual pitch, the notes heard will not be of the same pitch, there being tones introduced due to the pitch of the individual metal diaphragms. This throws the trains of waves out of phase. The effect is marked after an oscillator or submarine bell signal ceases when the diaphragms gradually change their rate of vibration from that of the received signal to that of their own.

While this may be overcome by using metal diaphragms tuned exactly to the pitch of the signal, a diaphragm adapted for a high pitched bell signal would not be suitable for a low pitched oscillator signal. Also, it is difficult to produce diaphragms commercially all of exactly the same pitch and maintain them so in service. A rubber diaphragm does not have these objectionable features and reproduces the note of bell or other signaling device in perfect phase.

The "flapper" type of magnetophone has the advantage that the pull of the magnet does not put any strain on the diaphragm. The flapper is attracted equally by the opposing pulls of the magnet so that it does not tend to turn. It is thus practical to maintain the proper air gap between the flapper and the magnet pole face. With the ordinary type of telephone receivers, the pull of the magnets would strain the rubber diaphragm by drawing in an armature attached to the diaphragm and thus make it impossible to maintain the proper air gap.

Other forms of magnetophones may be substituted for that shown.

The intensity of the tone received can be amplified any desired amount by well known means.

What I claim as my invention is:—

1. A hydrophone comprising a casing, a rubber diaphragm mounted in said casing and exposed to receive the approaching sound waves, an armature connected to said diaphragm and operated thereby, and means including said armature and an electrical circuit for inducing a current in said electrical circuit.

2. A hydrophone comprising a casing, a rubber diaphragm mounted in said casing and exposed to receive the approaching sound waves, and electromagnetic means operated by the motion of said diaphragm, said electromagnetic means including a current carrying conductor located with relation to said electromagnetic means whereby a current will be directly induced in said conductor.

3. In combination a magnetophone and a diaphragm for receiving sound waves, said diaphragm being aperiodic, said magnetophone and said diaphragm being located in relation to each other and positively connected whereby the vibrations of the diaphragm will be communicated to the armature of the magnetophone and set up therein vibrations corresponding to the vibrations of said diaphragm.

4. In combination a plurality of magnetophones, diaphragms for receiving sound waves, said diaphragms being aperiodic, a telephone head set, and means for transmitting binaurally the electric impulses of said sound waves to the respective telephones of said head set whereby a binaural image is obtained, each diaphragm being operatively connected to its magnetophone whereby it will communicate its vibrations thereto

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