J. GARDNER.

SUBMARINE SOUND SIGNALING.

APPLICATION FILED JULY 31, 1917.

1,310,011. Patented July 15, 1919.

Fig. 1.

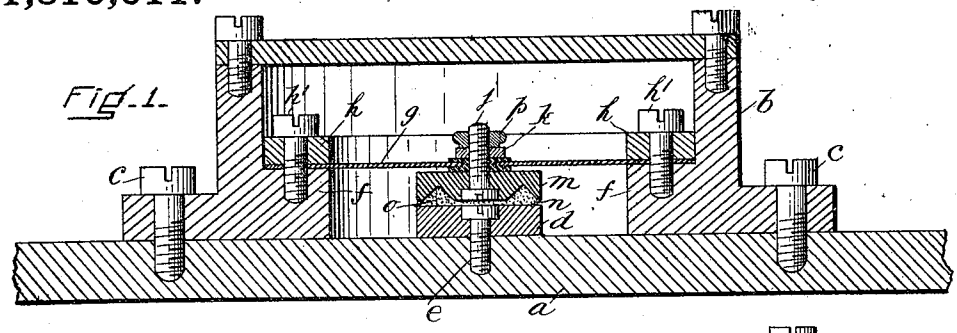


Fig. 2.

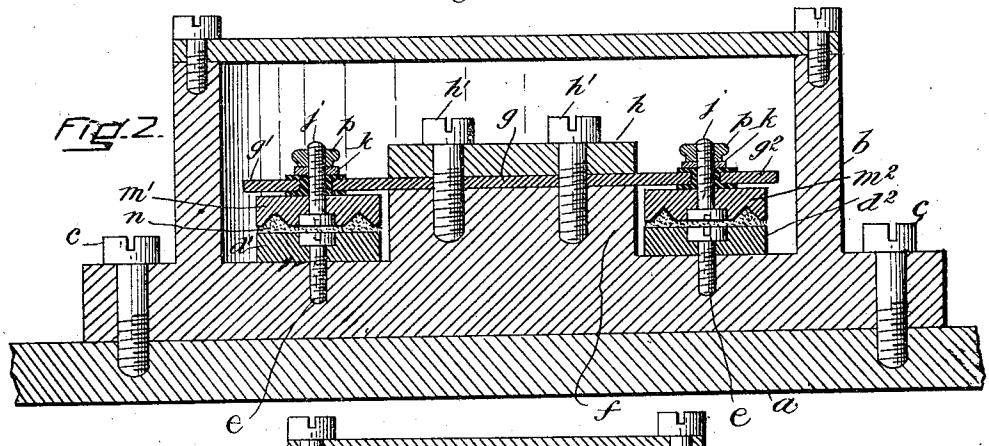


Fig. 3.

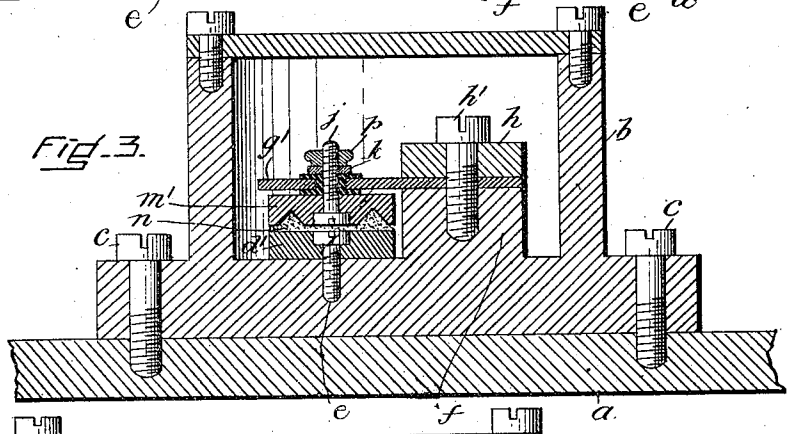
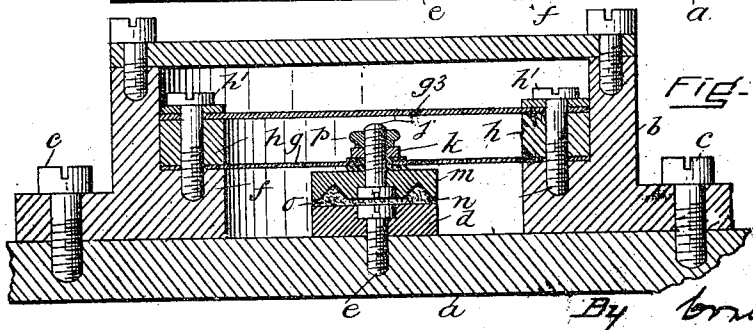


Fig. 4.



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SUBMARINE SOUND-SIGNALING.

1,310,011. Specification of Letters Patent. Patented July 15, 1919.

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To all whom it may concern:

Be it known that I, JOHN GARDNER, of Knott End, Fleetwood, in the county of Lancaster, England, a subject of George V, King of England, have invented a new and useful Improvement in and Relating to Submarine Sound-Signaling, of which the following is a specification.

This invention relates to a microphonic appliance for the reception and amplification of sound vibrations, and is especially useful in submarine sound signaling. The principal objects of the invention are to so arrange such appliances that they shall be as fully responsive as possible to arriving vibrations, and that an operator with a musical ear may simply and easily tune an appliance for the reception of any given sound.

A microphonic appliance in its preferred form constructed in accordance with this invention comprises essentially an electrode rigidly attached to a support, the complementary coöperating electrode being carried by a vibratory diaphragm properly supported in such a way that its operative impulses are received solely through the node formed by its point of attachment, together with means for adjustably weighting the diaphragm to tune it as may be desired, a resistance-varying medium being arranged between the electrodes.

My invention will be understood by reference to the drawings in which it is shown in its preferred forms.

Figure 1 is a longitudinal section of a device embodying my invention.

Fig. 2 is a similar section of a modification in which two microphones are used.

Fig. 3 is also a similar section of a modification in which the diaphragm member is supported at one end only, its other end being free to vibrate, and

Fig. 4 is a similar section of the device shown in Fig. 1 having an additional diaphragm as below described.

On the drawing and in the following description like marks of reference indicate like parts.

Referring first to Fig. 1 of the drawing, *a* is the base to which one of the electrodes is attached. It is shown as the skin of the sound-receiving ship though it may be otherwise. It preferably has rigidly attached to it by screws *c* a casing *b*. Within the casing *b* an electrode *d* is rigidly secured parallel to the skin *a* by a screw *e* so that it partakes, without loss, of all vibrations affecting the skin *a*. Surrounding or at either side of the electrode *d*, the casing is provided with a supporting ledge *f* to which a vibratory diaphragm *g* is clamped by a ring *h* and screws h^1, the support *f* forming the node or nodes of said diaphragm. The vibratory diaphragm *g* may be a circular disk, in which case the support *f* will be annular or of other suitable formation. Preferably the diaphragm *g* is in the form of a strip or reed. The diaphragm *g* has attached to it by means of a screw *j* and nut *k* an electrode *m* adapted to coöperate with the electrode *d* with which it is electrically connected by means of carbon balls or granules or other suitable resistance-varying medium *n* preferably arranged in cup-like depressions or cavities *o* in the face of the electrode *m*. The diaphragm *g* is weighted by a variable weight *p* screwed on the screw *j*.

On receipt of sound vibrations the skin *a* and electrode *d* rigidly attached thereto are vibrated. The diaphragm *g* is also vibrated, the vibrations, as just stated, being transmitted through its nodes *f*, and the inertia of its free portion to which the electrode *m* is attached serves to bring about, through the resistance-varying medium *n*, the variations in electrical resistance between the electrodes *d* and *m* necessary to produce the desired effect in a telephone with which the appliance is in circuit.

The diaphragm *g* is given a natural period of vibration corresponding to the distant sound generator. This may be done by suitably arranging its length, thickness, or tension or the load carried by it, *i. e.*, by varying the weight *p*. By the latter means an operator having a musical ear can simply and quickly tune the diaphragm to attain the greatest amplitude of vibration when it is subjected to a sound of the desired frequency.

Although I have described and illustrated the strip or reed constituting the diaphragm *g* as being supported at both ends and consequently having two nodes through which it receives its operative impulses, it may be supported at one end only and be free at the other end and receive said impulses through a single node (see Fig. 3).

The appliance first above described may be provided with a second diaphragm g^3 not carrying an electrode. This additional diaphragm will be fixed parallel to and on the

supports carrying the diaphragm g (see Fig. 4) by the screws h^1. The two diaphragms will be given different natural periods of vibration. For example the diaphragm g carrying the electrodes m may be tuned to a prominent overtone of a bell, and the additional diaphragm tuned to the fundamental note of the bell, the framework of the instrument serving to convey the vibrations imparted to the additional instrument from the skin a, to the electrode m on the diaphragm g.

As a further modification (see Fig. 2) the microphonic apparatus as first described may be duplicated, one set having its diaphragm tuned to respond to a fundamental note and the diaphragm of the other set being tuned to a prominent overtone. Both sets may be in the same telephone circuit, arranged in series or in parallel, or otherwise and in circuit with other apparatus such as may occur to one skilled in the art.

In many cases it is desirable to have in one instrument two microphones the diaphragms of which are or can be tuned to slightly different frequencies, that is, two fundamentals or two overtones. In the modification last described the diaphragms are tuned to different notes, namely, one to the fundamental note and the other to a prominent overtone of the distant sound generator. The said modification operates satisfactorily if there is a wide or marked difference in the frequencies of the two diaphragms, but if the latter are so tuned that their frequencies are nearly alike, one diaphragm then too easily controls the other with the result that they compromise on one frequency (the mean or approximately the mean of the two) and thus give a single fundamental tone instead of two distant tones, or one overtone instead of two separate overtones, notwithstanding that there are two microphones. To overcome this defect I, in the said cases, employ a single diaphragm of strip or reed form clamped to the ship's skin or other base over a large part of its middle portion and unsupported at both ends which are free to vibrate and carry electrodes which coöperate with complementary electrodes rigidly secured to the ship's skin as before. While there is thus only one diaphragm it vibrates with different frequencies at its two free ends, each end being musically independent of the other. The two microphones thus constituted may, as before, be used separately, or they may be used in combination, *i. e.*, in series or paralliel.

An embodiment of the modification just described is illustrated in Fig. 2 in which a is the skin of the ship or other base and b a casing rigidly attached thereto as before. The casing b is provided with a projecting support f which forms the node of the strip or reed diaphragm g and also the path for transmitting the vibrations from the skin a to the diaphragm g which is clamped to the support f by a clamping plate h and screws h^1. The diaphragm g and the node-forming support f are of such relative length that the ends g^1, g^2 of the diaphragm extend beyond the ends of the support and are free and the diaphragm is in contact with and clamped to the support over a large part of its middle portion. The free ends g^1, g^2 of the diaphragm carry electrodes m^1, m^2 adapted to coöperate through resistance-varying medium n with complementary electrodes d^1, d^2 rigidly secured to the casing b parallel to the skin a. The screws j which secure the electrodes m^1, m^2 are, as before, adapted to receive variable weights p for tuning the ends g^1, g^2 of the diaphragm g to adjust the natural periods thereof to the distant sound generator so that amplification may be secured for the desired sound with corresponding choking of undesired sounds.

In the improved instrument just described and also in those instruments previously described wherein the end or ends of the diaphragm is or are free, I prefer that the said free end or ends should extend beyond the middle of the electrode or electrodes carried by it or them so that the electrode or electrodes is or are nearer the middle than the extremity or extremities of the free end or ends of the diaphragm.

I also prefer to employ aluminum or aluminum alloy as the material of the diaphragm. The lightness of this material facilitates the attainment of the high frequencies often required.

Further, when one of the electrodes or one of each pair of coöperating electrodes is of cup-like formation or provided with cavities or depressions o for the retention of the resistance-varying medium n, I prefer that such electrodes should be that of those carried by the diaphragm in order that the slope of the ship's plating may not cause said medium to retire into the cup, cavities or depressions, and possibly break the circuit altogether.

While the above invention is particularly adapted for attachment to the side or skin of a ship, the device may be otherwise supported, and in using the term "skin of a ship" I do not mean to limit myself thereby. Moreover, in using the word "diaphragm" I do not mean to limit myself to a circular diaphragm, as my invention is equally applicable to a reed, bar, or other like vibratory member, and in using the word "diaphragm" in the specification and claims I mean to include thereby any such vibratory member as will be responsive to vibrations in the manner herein described.

What I claim as my invention is:—

1. In a device of the kind described, a

microphonic instrument comprising an electrode, a sound-receiving wall, said electrode being rigidly connected thereto, a diaphragm, a second electrode mounted thereon in electrical contact with said first electrode, a support for said diaphragm also connected to said sound-receiving wall, whereby the sound waves may be conveyed thereto and the electrode mounted thereon will be given a greater amplitude of vibration than said first electrode.

2. In a device of the kind described, a microphonic instrument comprising an electrode, a sound-receiving wall, said electrode being rigidly connected thereto, a diaphragm, a second electrode mounted thereon in electrical contact with said first electrode, a support for said diaphragm also connected to said sound-receiving wall whereby the sound waves may be conveyed thereto and the electrode mounted thereon will be given a greater amplitude of vibration than said first electrode, and means whereby the diaphragm may be tuned to a desired frequency.

3. In a device of the kind described, two diaphragms and a single means for supporting them in operative relation with each other, one diaphragm being tuned to the fundamental tone and the other to a prominent overtone of the sound to be received, and a microphone one element of which is mounted on one of said diaphragms, the other element being fixedly attached to said supporting means whereby it will vibrate in unison therewith.

4. In a device of the kind described, a pair of microphones, a single fixed support for one element of each microphone, and a vibratory support for the other element of each microphone, said vibratory support comprising diaphragms, one diaphragm being tuned to a fundamental tone and the other diaphragm being tuned to a prominent overtone of the sound to be received.

JOHN GARDNER.