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W. L. WALKER

SOUND TRANSMITTER

Original Filed March 18, 1922 2 Sheets-Sheet 1

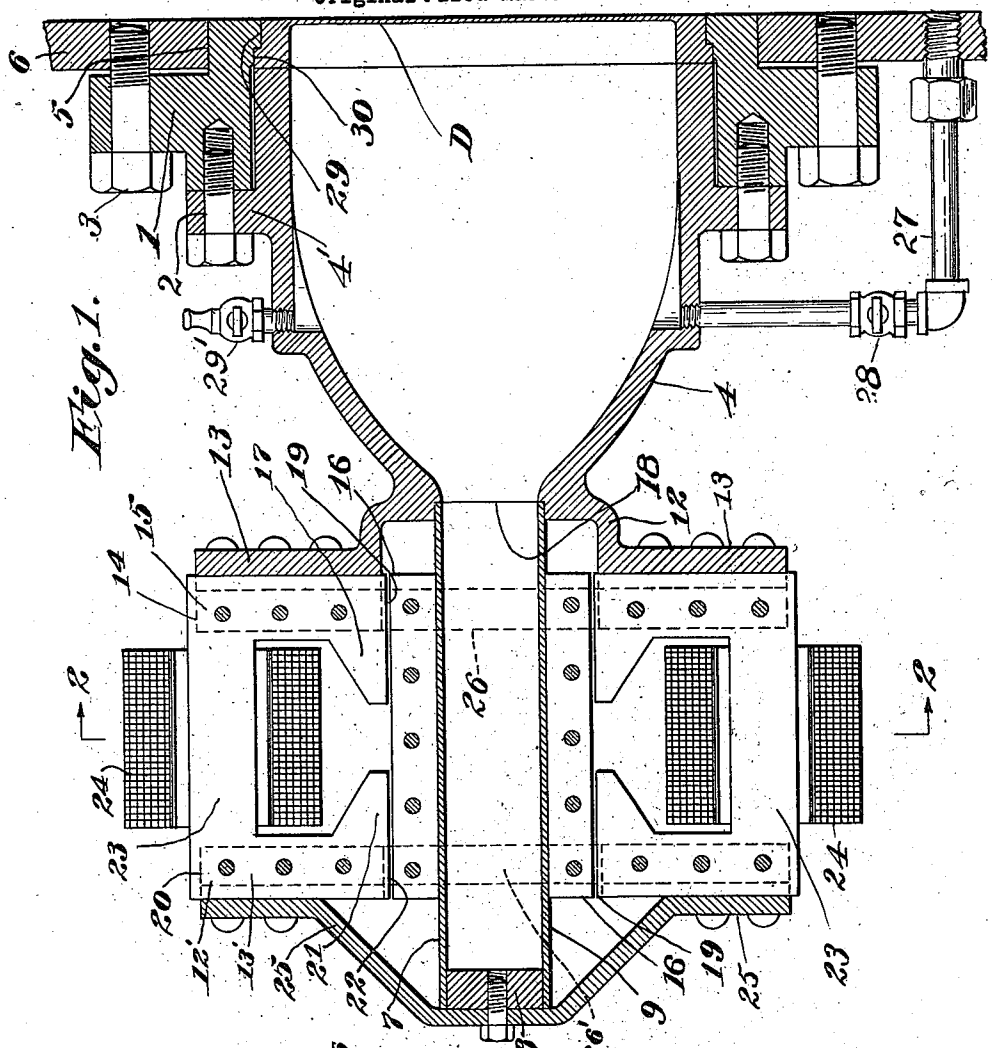


Fig. 1.

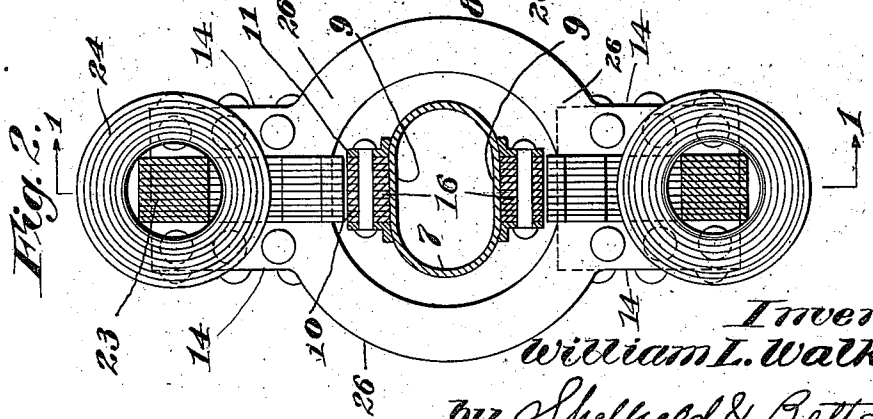


Fig. 2.

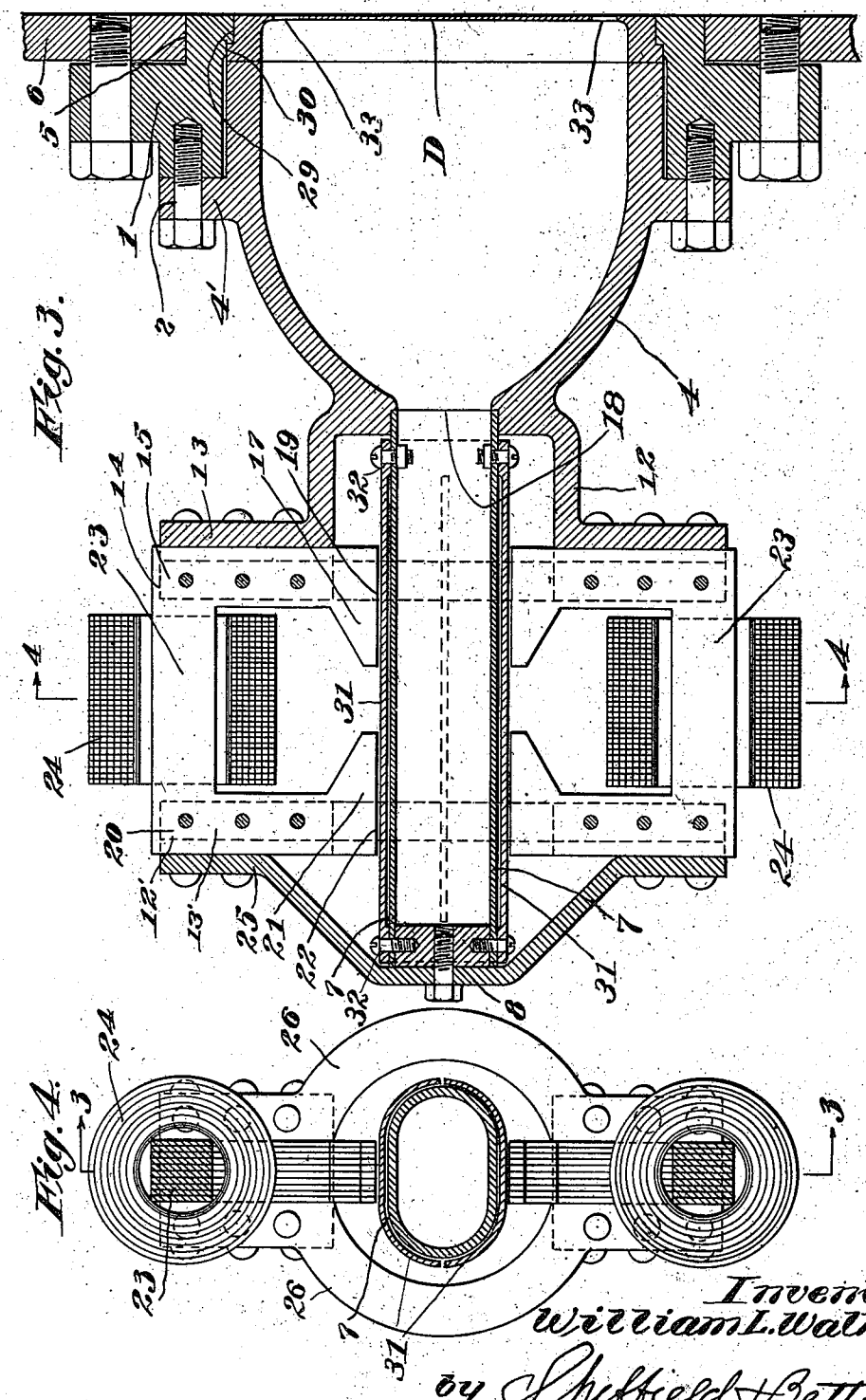
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UNITED STATES PATENT OFFICE.

WILLIAM L. WALKER, OF NEW YORK, N. Y.

SOUND TRANSMITTER.

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My invention relates particularly to means for generating and transmitting sound vibrations or oscillations in an elastic medium, and particularly in water. The invention is especially applicable to transmission of submarine sound signals from one vessel to another or from land stations to vessels in the vicinity of said stations.

The object of my invention is the production of strong sustained oscillations or vibrations of water or other medium so that the same may be transmitted long distances and with the least possible consumption of power. In other words, I am enabled to obtain high efficiency in sound generation and transmission through the use of simplified and practically unitary parts without making use of joints or pivots which consume energy and which occupy considerable space. To attain high efficiency it is necessary that the apparatus be designed so that it shall make use of the best known acoustic principles in order to convert the energy which generates the sound from electrical to mechanical or acoustic form.

It is known that nearly all bodies of elastic material have a certain natural period of vibration similar to the natural oscillating period of an electrical circuit, and in order to have the sound transmitting apparatus efficient, the principle of resonance must be taken into account and the apparatus so designed that the natural period of vibration will be as nearly that desired as possible, since it requires much greater energy to energize a vibrating body at some other period than its own natural period of vibration on account of the damping effect.

Furthermore, owing to inertia and high damping effect of large bodies of fluid, such as water, the vibrations impressed upon such bodies of fluid must be of low amplitude, but at the same time be produced by strong forces. On the other hand, the vibrations produced by the alternating field of an electromagnet must be of considerable amplitude and of comparatively reduced force. It therefore becomes necessary to transform or convert the comparatively large amplitudes of vibrating armatures of an electromagnet into vibrations or oscillations of comparatively small amplitude and larger force at the point where the same are impressed upon the transmitting fluid.

These principles have been embodied in the apparatus which is described below taken in connection with the accompanying drawings which form a part of the specification.

In said drawing Fig. 1 is a longitudinal sectional view of one form of my improved apparatus taken substantially on the line 1—1 of Fig. 2. Fig. 2 is a transverse sectional view taken substantially on the line 2—2 of Fig. 1.

Fig. 3 is a longitudinal sectional view of a modified form of my transmitter taken on the line 3—3 of Fig. 4, and Fig. 4 is a transverse sectional view taken on the line 4—4 of Fig. 3.

Referring to the drawings, the numeral 5 indicates an opening in the side 6 of a vessel or other structure from which it is desired to transmit sound waves. The numeral 1 indicates a flanged collar secured to the side of the ship by means of bolts 3, and having a cylindrical part 30 which lies substantially flush with the outer surface of the side 6 and is provided with an inwardly extending rib or flange 29 for engaging the outer end of the amplifying portion 4 of the apparatus. This amplifying or bell shaped portion 4 is secured to the flanged collar 1 by means of bolts 2 passing through outwardly extending flange 4′. The letter D indicates a diaphragm which closes the outer end of the amplifier 4 and lies flush with the sides 6 of the vessel or other structure, in order to prevent eddy currents and undesirable sounds produced thereby. The electromagnetic sound generating device is attached to the inner end of the amplifier 4 as indicated at 18 and consists essentially of the following parts: The numeral 7 indicates a tube of resilient material such as bronze, or steel coated or plated to prevent corrosive action of the water. This tube is flattened as indicated in Fig. 2 in order that the flattened sides 9 may vibrate toward and away from each other. One end of this tube 7 is fixed to the amplifier as at 18 and the other end engages the plug or block 8 which is bolted to a frame comprising the brackets or supports 25. The inner end of the amplifier 4 is also provided with similar brackets 13 between which and the brackets 25 the laminated cores 23 are held. The pairs of brackets 13 and 25 are each connected together transversely by means of semicircular connecting braces 26 and 26′. The plates of the cores 23 of the electromagnets are clamped between wings 14 and 20 by means of suitable rivets or bolts, as indicated. The cores 23 of the

electromagnets are preferably given the shape indicated in Fig. 1 and are provided with widened pole pieces 17 and 21, as indicated. The energizing coils 24 are mounted on the connecting horizontal portions of these cores and are energized in any suitable way, such as by an alternating current dynamo having the desired period of vibration or oscillation required to be transmitted to the water. The armatures 16 are rigidly mounted on the flat sides 9 of the tube 7 and are separated from the pole pieces 17 and 21 by small air gaps 19, but are sufficiently close to allow the said armatures to come into contact with said pole pieces. The interiors of the tube 7 and the amplifier are preferably filled with fluid such as water and are preferably hermetically closed. However, a pipe 27 having a valve 28 therein is provided to allow communication between the outside water and the inside of the amplifier so that water may be admitted to the latter and the tube 7. An outlet cock 29′ is also provided to permit the filling of the amplifier 4 and allow the escape of air. By leaving the valve 28 open slightly the external and internal pressure on the diaphragm is equalized.

From the foregoing description it will be understood that my improved transmitter operates as follows:

The alternating magnetic field caused by the energizing coils 24 will periodically and synchronously draw the armatures 16 outward and then allow them to move inward owing to the action of the elasticity of the tube 7. This will alternately increase and reduce the volume of liquid in the said tube 7 and cause a longitudinal vibration of said liquid at the right hand end 18 of said tube, as shown in Fig. 1. This will set the liquid within the amplifier 4 into vibration at a corresponding period and will consequently vibrate the diaphragm D. However, these respective actions will operate in a way similar to the action of a force pump in an hydraulic press; that is, the displacement of the liquid at the right hand end of the tube 7 will be spread out over the entire surface of the diaphragm D so that the total pressure on said diaphragm during each quarter period of vibration will be in the proportion of the area of said diaphragm to the cross section of said tube, while the amplitude of the vibrations of said diaphragm will be decreased correspondingly. Thus the conversion of the energy of the electromagnets is accomplished without any movable mechanical parts and practically all of the energy used in said magnets is transmitted to the water on the outside of said diaphragm.

The pipe 27 and the valves 28 and 29′ may be omitted and small holes placed in the diaphragm for the ingress of water and the egress of air, as described in connection with the modification of the device, as follows:

The modification shown in Figs. 3 and 4 is similar to that of Figs. 1 and 2, and differs therefrom in that the armatures of the electromagnets are not connected directly with the vibrating tube.

In Figs. 3 and 4 the tube 7 is substantially inclosed between two curved plates 31 of a magnetic material similar in cross-section to the shape of the tube. The plates 31 are secured at their ends to the tube 7 as at 32, or in any other suitable manner, so that when vibrated by the action of the pole pieces 17 and 21 under the influence of the magnetic field of the coils 24, they will impinge upon the tube 7 and thereby strike it with a succession of sharp blows. This will displace the fluid within the tube 7 in a manner similar to that above described.

The numeral 33 indicates small holes adjacent the margin of the diaphragm for the admission of water and the egress of air, as above referred to.

In the above arrangements the parts may be so designed that the elasticity of the tube, the volume of the liquid therein and in the amplifier 4, and the elasticity of the diaphragm D may be so proportioned that the natural period of vibration will correspond very closely to the period of the impressed magnetic field produced by the coils 24. Thus there would be practically no damping effect which would otherwise exist owing to a lack of resonance, and there are no pivoted parts which would produce friction and so tend to consume energy.

Having thus described this form of my invention, I do not wish to be understood as being limited to the details of form and arrangement of parts set forth, for various changes may be made without departing from the spirit and scope of my invention.

What I claim and desire to protect by Letters Patent is:

1. A submarine signaling transmitter comprising an enclosing casing, enlarged at one end portion, a transverse resilient diaphragm closing said enlarged end, a resilient tubular portion communicating with said enlarged end portion, a substantially non-compressible liquid within said casing and means for vibrating said tubular portion whereby vibrations are impressed upon said diaphragm through said liquid.

2. A submarine signaling transmitter comprising an enclosing casing, enlarged at one end portion, a transverse resilient diaphragm closing said enlarged end, a tubular portion having longitudinal resilient walls and communicating with said enlarged end portion, a substantially non-compressible liquid within said casing, the natural vibration period of the resilient portions and said fluid being substantially the same, and means for vibrating said longitudinal

walls whereby vibrations are impressed upon said diaphragm.

3. A submarine signaling transmitter comprising an enclosing casing, enlarged at one end portion, a transverse resilient diaphragm closing said enlarged end, a tubular portion having resilient, flattened side walls and communicating with said enlarged end portion, a substantially non-compressible liquid contained in said casing, and means for vibrating said flattened side walls, whereby vibrations are impressed upon said diaphragm.

4. A submarine signalling transmitter comprising an enclosing casing, enlarged at one end portion, a transverse resilient diaphragm closing said enlarged end, a tubular portion having longitudinal resilient walls and communicating with said enlarged end portion, a substantially non-compressible liquid within said casing, and electro-magnetic means for vibrating said longitudinal walls.

5. A submarine signaling transmitter comprising a resilient elongated hollow member having flattened parallel side walls, resilient armatures operatively connected with and adapted to strike upon said walls for vibrating the same toward and from each other, and electro-magnets for operating said armatures.

6. A submarine signaling transmitter comprising a resilient elongated hollow member having flattened side walls and open at one end, resilient armatures supported at their ends and adapted to strike upon said walls for vibrating the same, electro magnets for operating said armatures, and a non-resilient casing connected with said hollow member at its open end and having at its opposite end a resilient wall, the area of which is greater than the area of said hollow member, said casing and member being filled with a substantially non-compressible liquid.

7. A submarine signaling transmitter comprising a resilient elongated hollow member having flattened side walls and open at one end, resilient armatures connected at their ends with and adapted to strike upon said walls for vibrating the same, electro-magnets for operating said armatures, a non-resilient casing connected with said hollow member at its open end and a resilient diaphragm carried at the outer end of said casing.

8. A submarine signaling transmitter comprising a resilient elongated hollow member having flattened side walls and open at one end, resilient armatures in the form of strips of magnetic material supported at their ends and attached thereat to the opposite ends of said side walls, the central portions thereof being adapted to strike upon said side walls for vibrating the same, electro magnets for operating said armatures, a non-resilient casing connected with said hollow member at its open end and a resilient diaphragm carried at the outer end of said casing.

9. A submarine signaling transmitter comprising a resilient elongated hollow member having flattened side walls and open at one end, resilient armatures comprising strips of magnetic material attached to said side walls at their ends, electro magnets having opposite poles located adjacent each of said strips, a non-resilient casing connected with said hollow member at its open end and a resilient diaphragm carried at the outer end of said casing.

10. A submarine signaling transmitter comprising a resilient elongated hollow member having flattened side walls and open at one end, resilient armatures comprising strips of magnetic material attached to said side walls at their ends, electro magnets of horse-shoe form having energizing coils located on the yoke portion of the same, a non-resilient casing connected with said hollow member at its open end and a resilient diaphragm carried at the outer end of said casing.

WILLIAM L. WALKER.