June 3, 1924. 1,496,746

L. B. SLICHTER

SUBMARINE SIGNALING DEVICE

Filed Dec. 8, 1922 2 Sheets-Sheet 1

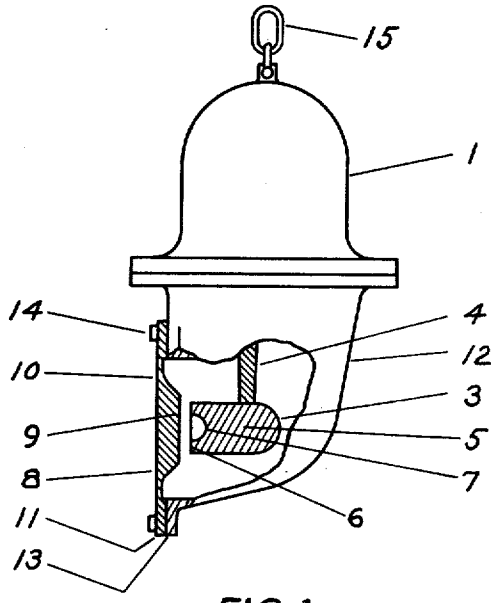


FIG 1

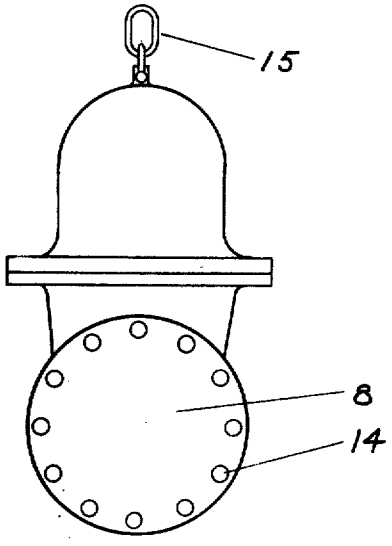


FIG 2

Inventor:
Louis B. Slichter:
per
Attorney.

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SUBMARINE SIGNALING DEVICE

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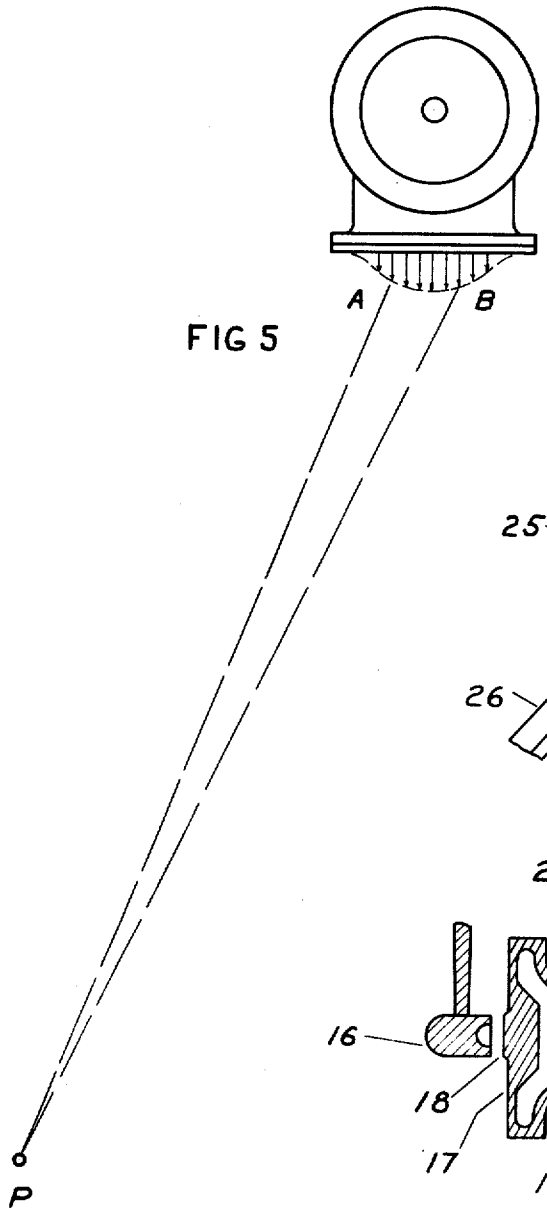


FIG 5

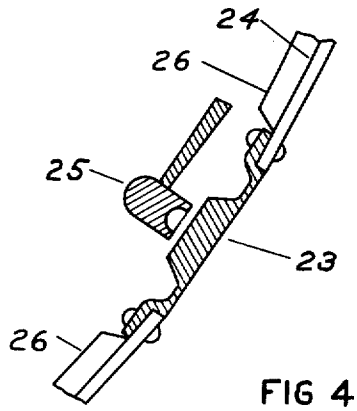


FIG 4

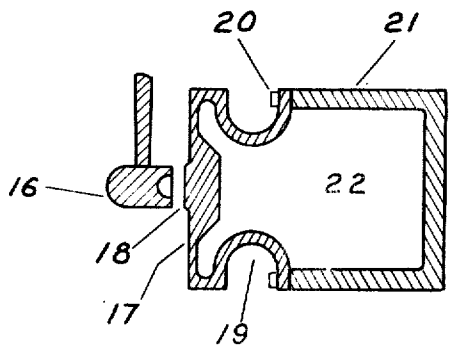


FIG 3

Inventor:
Louis B. Slichter:
per
Attorney.

Patented June 3, 1924. 1,496,746

UNITED STATES PATENT OFFICE.

LOUIS B. SLICHTER, OF CAMBRIDGE, MASSACHUSETTS, ASSIGNOR TO SUBMARINE SIGNAL COMPANY, OF PORTLAND, MAINE, A CORPORATION OF MAINE.

SUBMARINE SIGNALING DEVICE.

Application filed December 8, 1922. Serial No. 605,604.

To all whom it may concern:

Be it known that I, LOUIS B. SLICHTER, of Cambridge, in the county of Middlesex and State of Massachusetts, a citizen of the United States, have invented a new and useful Improvement in Submarine Signaling Devices, of which the following is a specification.

This invention relates to a sound-transmitting device in which the vibrations of the transmitting elements are highly damped and the sound resulting therefrom is of an explosive type, in contradistinction to the present-day type of sound-sending devices which try to sustain the oscillations of the transmitting member. The use of oscillators and bells in the art of submarine signaling is well known and many different types of both have been employed in sound-producing devices. Electrical sounders or oscillators have been designed and built having diaphragms which vibrate as a piston, but it has been the purpose in all types of sounders to sustain the vibration over a comparatively long number of vibrations, either by application of the energizing force during these vibrations or by the construction of tuned vibratory systems.

It is the purpose of the present invention to construct a sound-producing device which will vibrate as an oscillator of the piston type over a comparatively few number of vibrations, preferably only one, and thereby concentrate into one vibration the energy for transmission which would otherwise be distributed in a number of vibrations. It is the purpose of this invention to deliver directly to the water a single intense impact causing a single piston type vibration of a maximum intensity and reducing any unavoidable subsequent vibrations to a minimum.

It is well known from theory and experiment that when a flat plate such as a circular disc or a curved plate such as a submarine bell is struck, some parts of the bell or sounder are causing compression of the elastic medium immediately about the sounding device at the same time that other parts are causing rarefaction of the elastic medium. The intensity at any distant point in the medium is the result of the effects transmitted from every point of the sound-emitting surface or sound source. Thus at any such distant point the intensity or amplitude of the sound is the algebraic sum of two or more components which tend to interfere with each other and form a resultant less than a possible maximum.

A purpose of my invention is to make a device which will cause the elastic medium immediately about the sounding parts of the apparatus to vibrate in the same sense at the same time, thereby forming a resultant intensity or amplitude at any point in the medium which is greater than that obtained with the means just described.

Another purpose of my device is to communicate the vibration of the sounder directly to the elastic medium and by such means that all parts of the sounding surface shall act in the same algebraic sense at the same time in imparting the energy to the medium.

Another purpose of my invention is to concentrate the energy emitted into one or very few vibrations of the radiating member so as to obtain a maximum intensity with the input used, thereby increasing the range of acoustical reception, the radiating member being thus what may be termed a single phase member.

By single phase radiating member I mean one the construction and motion of which is of such a type that the pressure changes produced in the sound transmitting medium at any single instant are predominately and substantially entirely of the same algebraic sign over all parts of the surface of the radiating member. That is to say the motion of the surface in the fluid adjoining it produces either a compression of the medium at all points at a given instant or else a rarefaction but not a compression at some points of its surface and a rarefaction at others. Thus the phase of the compressional wave is the same or single at all points at a given time.

I have found also that direction is more easily determined with the impact type of signals than with other types on account of better binaural centering obtained by the observer, thereby affording a useful purpose in the adoption of an impulse signal.

In the drawings in which my invention is embodied in preferred form Fig. 1 shows

a vertical side elevation of the invention with the housing partly removed.

Fig. 2 shows a vertical front elevation of the invention.

Fig. 3 shows a modification of the form of the invention shown in Fig. 1.

Fig. 4 shows the invention applied to use on a ship, and

Fig. 5 is a diagram illustrative of the operation of my invention.

In Fig. 1, 1 is the upper housing containing the striking mechanism (not shown) to impart the proper motion to the striker 3 as is common in the art of submarine bells. The striker consists of a rod 4 connected to the operating mechanism at the upper portion and having a striking head 5 at its lower end. The head 5 preferably has a striking surface 6 and a hollow center part 7, the striking face being so designed that a uniform intense blow will be struck upon the surface of the radiating member on operation of the striker. The radiating member has a thick central portion 8 of a considerable area which decreases in thickness towards its edge to a thin annular portion 10 and then increases again in thickness to a somewhat thicker portion 11 at its circumference. The thinner portion 10 serves as a spring thus allowing a free movement of the central portion 8 without imparting movement to the housing. The purpose of this construction of the radiating member is twofold, first to obtain a surface of considerable area which will vibrate as a whole like a piston so that every point of it will be substantially effective as an originator of compressional waves in the same direction at the same time. This may be called a single phase radiation since at any point in the medium the components of the sound from the parts of the radiating surface all act in the same sense. The second purpose is to obtain a radiating member which when struck will be as nearly critically damped as possible and thus transmit substantially all its energy to the medium in one vibration.

The lower casing 12 is supported and hermetically sealed to the casing 1 at its upper end by suitable means (not shown). The lower casing 12 is turned in an elbow of approximately 90 degrees and flanged at its lower end, to which flange 13 the radiating member or diaphragm is rigidly secured by bolts 14. As shown the whole mechanism is supported by a chain 15 which may be suspended from a buoy or other suitable means. The whole apparatus is so rigidly constructed as to material and weight that substantially no parts of it vibrate or move except the diaphragm when emitting sound. The mechanism for imparting energy to the striker may be of any suitable nature, mechanical, pneumatic or electrical, but it should be of such a nature that the energy imparted to the diaphragm is imparted in one stroke of the striker as in the case of a bell.

In Fig. 3 a modified form of the apparatus is shown. Here the striker 16 is placed outside the housing, but it may be placed inside the housing as in Fig. 1. The diaphragm 17 is similar to the construction of the diaphragm 8, but its raised center 18 is struck by the striker instead of its flat surface. The diaphragm is provided with a curved support 19 which serves at the same time as a spring for the radiating member. The cylindrical curved support 19 is bolted by bolts 20 to the cylindrical casing 21 and hermetically seals the interior space 22 from the surrounding outer medium.

In Fig. 4 the application of this invention to a ship is shown. The diaphragm 23 of the same construction as the diaphragm 8 in Fig. 1 is attached to the skin 24 of a ship to close an opening therein, the skin 24 being reinforced by members 26, 26 so that the side of the ship in the vicinity of the diaphragm will be comparatively rigid with respect to the diaphragm. The striker 25, similar to striker 3, is positioned and operated to strike the striking surface of the diaphragm 23 within the ship, the driving mechanism for the striker being of any suitable kind.

The operation of the invention is illustrated in Fig. 5. When the head of the striker strikes the diaphragm, thereby imparting motion to the diaphragm, pressure is exerted upon the sound-transmitting medium in the direction of the arrows as shown in Fig. 5. The construction of the diaphragm is such that there will be one large vibration and only subsequent unappreciable vibrations on account of the great damping of the radiating member. In addition the vibration of the diaphragm is in the same sense of direction. Thereby at a point P in the medium the intensity or amplitude of the sound at any time will be the sum of the components transmitted from the points at the surface of the diaphragm, which components will all add in the same direction giving a maximum possible value. Had some of the arrows of Fig. 5 been reversed showing a certain amount of rarefaction instead of entire compression then the sum would not have been a maximum. This happens in the case of the present submarine bells where part of the bell is causing compression of the sound-transmitting medium while at the same time the rest is causing a rarefaction thereof. It is to be noted also that practically all the energy of the striker given to the radiating member is transmitted to the transmitting medium in one vibration of the radiating member.

It is to be noted also that the wave length of the sound in the case of water will be large in comparison with the size of the diaphragm so that the phase difference due to the difference in length between PA and PB, the paths of two components of the sounds, will be negligible.

It is apparent that the details of the invention may be varied while still retaining the same essential elements, and I therefore do not restrict myself to the special form shown and described.

What I claim as my invention is:—

1. A sound producing apparatus comprising a single phase radiating member and means for supporting it, said radiating member having a stiff central portion adapted when energized to move as a whole to produce a single large vibration with inappreciable subsequent vibrations, and means for energizing said member.

2. In a sound-producing apparatus, a single phase radiating member and means for supporting it about its periphery, said member consisting of a heavy center and a thinner annular portion, and a striker positioned to strike said radiating member whereby there will be produced a single large vibration of said radiating member.

3. A sound-producing apparatus for water consisting of a rigid housing, a single phrase radiating disc member having an outer peripheral portion firmly fastened and hermetically sealed to the housing, and a striker positioned to strike the radiating member to produce a single large vibration of the radiating member.

4. A sound-producing apparatus for water consisting of a rigid housing, a radiating disc member attached at its edge to said housing and exposed on one side to the water and hermetically sealed to the housing, whereby water will be excluded therefrom, and a striker positioned within the housing to strike the other side of the radiating member to produce a single large vibration of the radiating member.

5. A sound-producing apparatus for water consisting of a rigid housing, a radiating disc member of a thick, stiff, central portion, a thinner annular portion and a heavy outer peripheral portion, a curved spring portion connecting the radiating disc to the housing and hermetically sealing the interior of the housing and a striker positioned to strike the radiating member to produce a single large vibration of the radiating member.

6. In a sound-producing apparatus for water, a single phase radiating disc member having a thick, stiff, central portion, a thinner annular portion and a heavy outer peripheral portion, and a striker with a flat striking surface to impart a uniform blow to the radiating member over a large part of its radiating surface.

7. In a sound-producing apparatus for water, a single phase radiating disc member having a thick, stiff, central portion, a thinner annular portion and a heavy outer peripheral portion, and a striker having a heavy elongated head and a circular flat striking face with a slightly hollowed portion in the center and positioned to impart to the radiating member a blow of uniform intensity over its striking face.

8. A sound-producing apparatus comprising a disc member having a heavy peripheral portion whereby it may be attached to a suitable support, a thinner annular ring within said peripheral portion and a heavy, stiff, central portion, and means for causing the vibration of said central portion, and means whereby when said central portion is energized all parts thereof will energize the water to produce a single phase radiation of substantially a single vibration.

LOUIS B. SLICHTER.