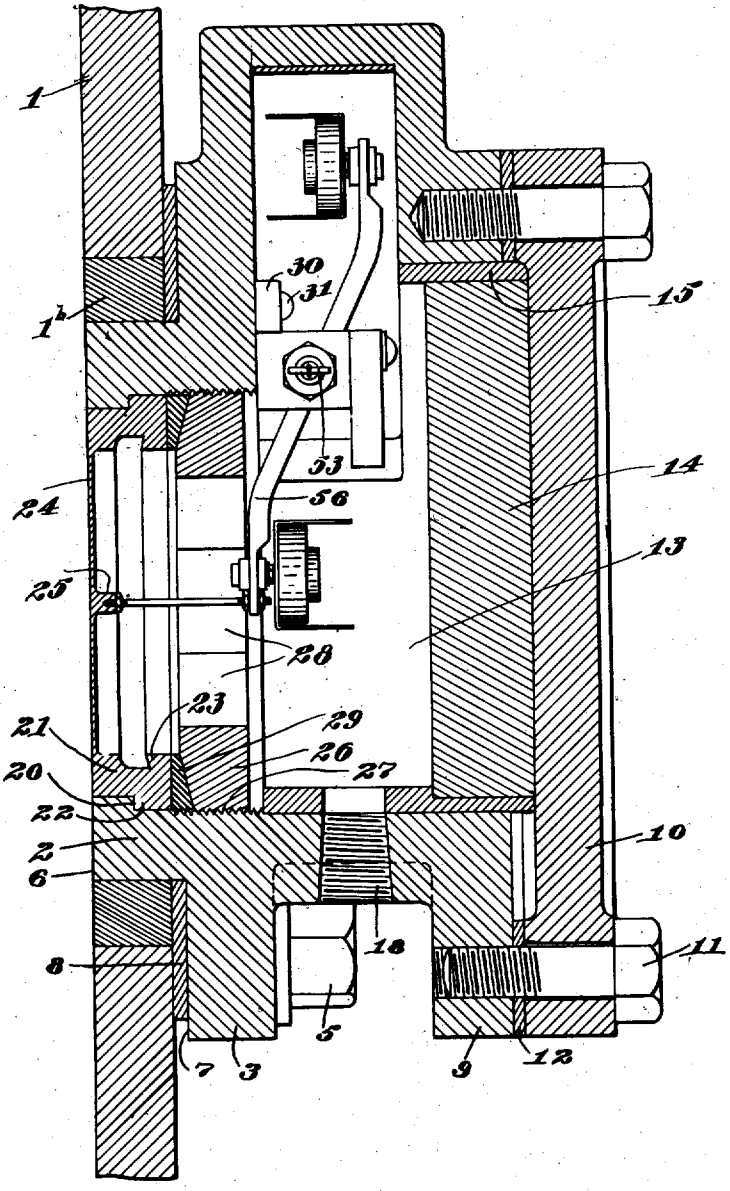
April 27, 1926. 1,582,105

W. L. WALKER

SUBMARINE SIGNALING APPARATUS

Filed May 11, 1921 4 Sheets-Sheet 1

Fig. 1.



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April 27, 1926. 1,582,105

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SUBMARINE SIGNALING APPARATUS

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Fig. 2.

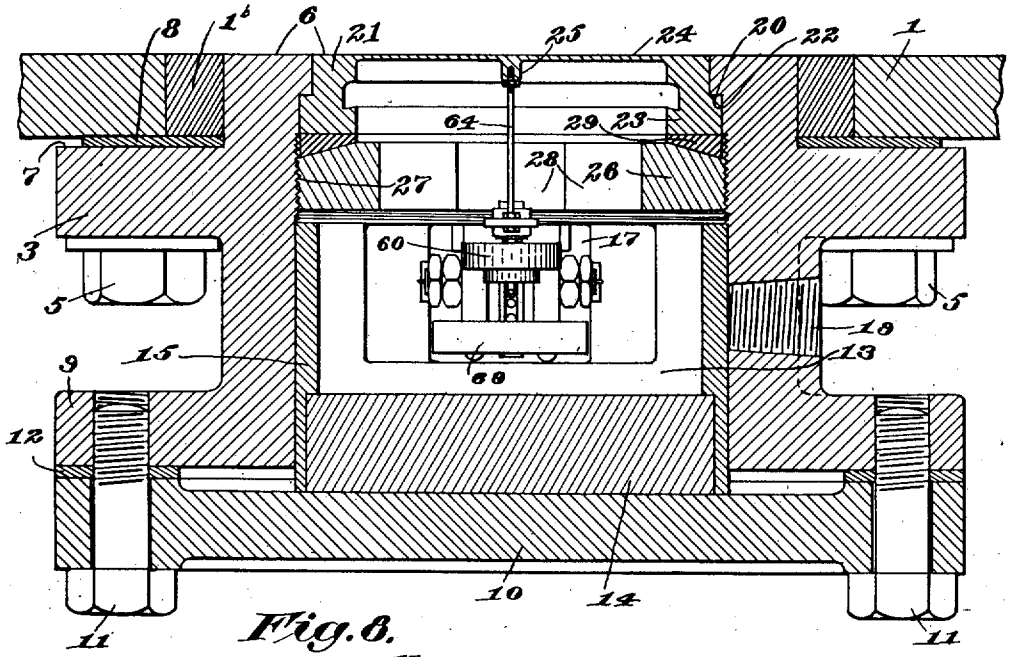


Fig. 6.

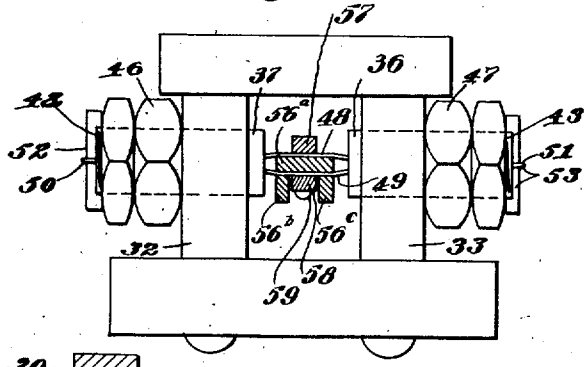
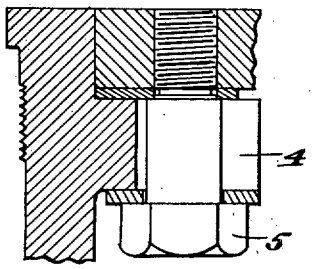


Fig. 4.



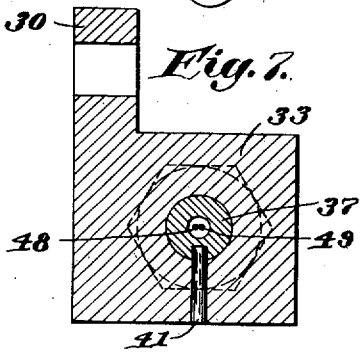


Fig. 7.

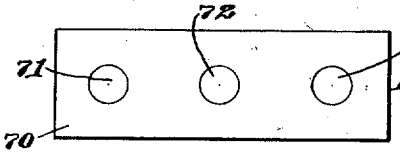


Fig. 9.

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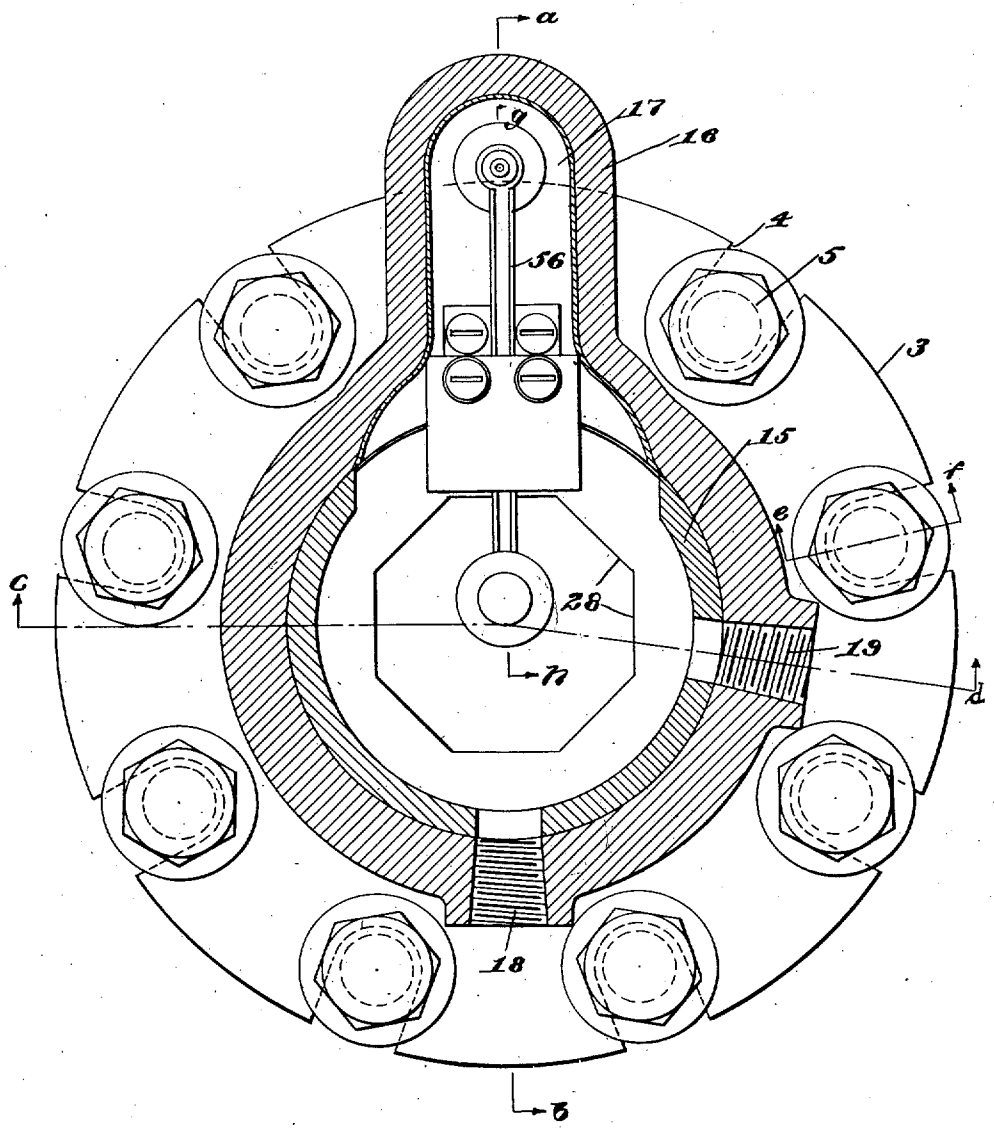
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SUBMARINE SIGNALING APPARATUS

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Fig. 3.



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1,582,105

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SUBMARINE SIGNALING APPARATUS

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Fig. 5.

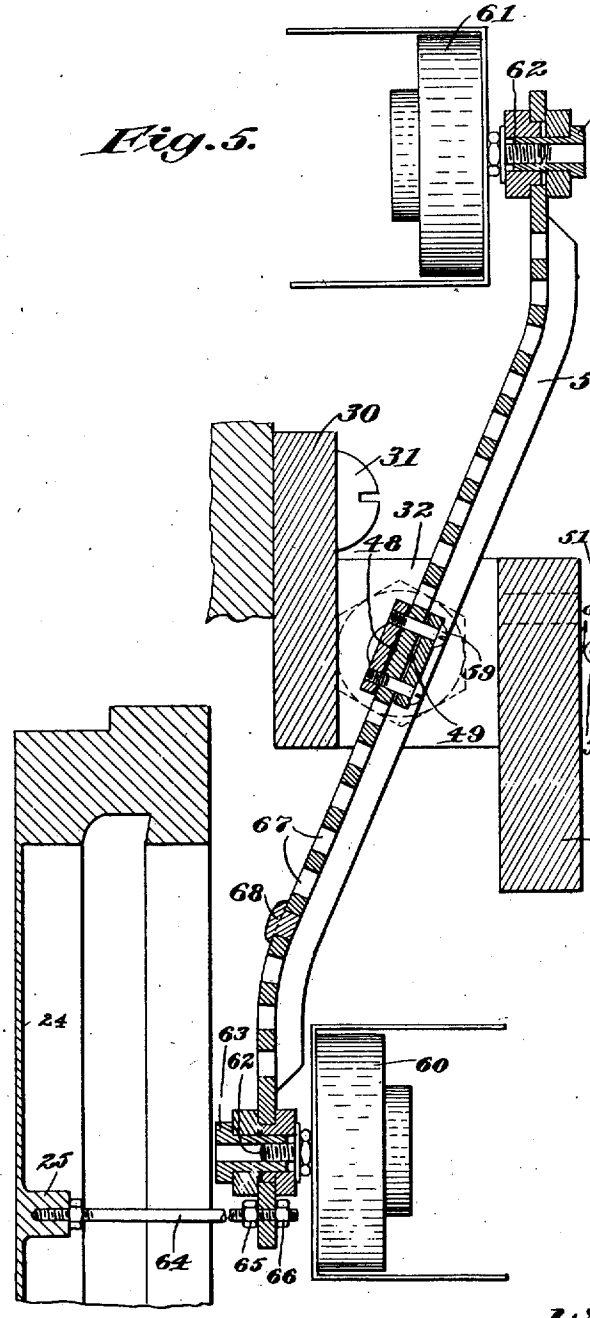
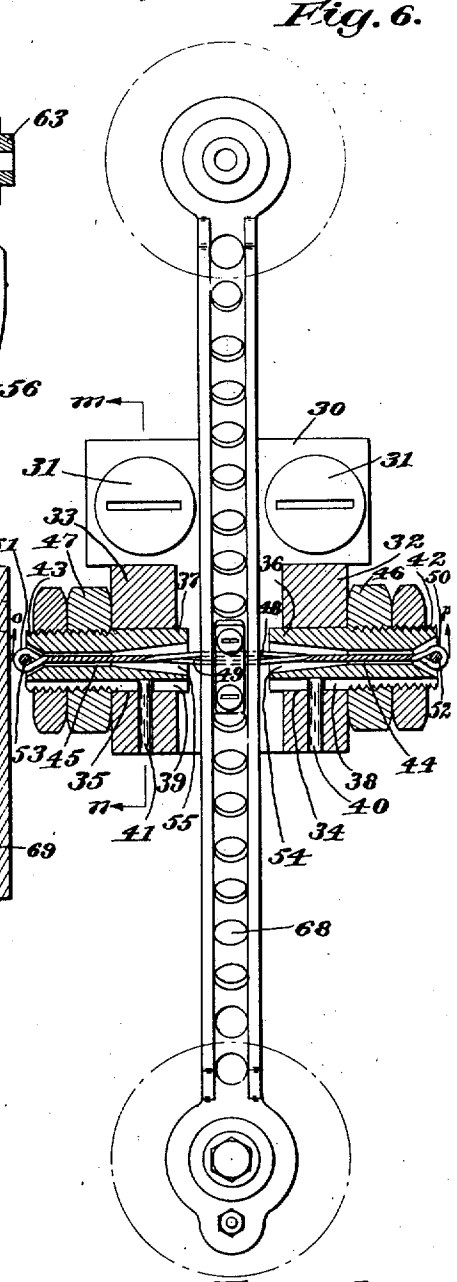


Fig. 6.



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Patented Apr. 27, 1926. 1,582,105

UNITED STATES PATENT OFFICE.

WILLIAM L. WALKER, OF NEW YORK, N. Y., ASSIGNOR TO WALKER SIGNAL AND EQUIPMENT CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

SUBMARINE SIGNALING APPARATUS.

Application filed May 11, 1921. Serial No. 468,611.

To all whom it may concern:

Be it known that I, WILLIAM L. WALKER, citizen of the United States of America, and resident of New York, in the county of New York and State of New York, have invented new and useful Improvements in Submarine Signaling Apparatus, of which the following is a specification.

This invention relates to signaling systems and more particularly to a sound receiving device or "ear" for use in such systems. When a sound receiving device is employed on ship board for receiving sound vibrations propagated through the water it is necessary to locate it at a point well below the water line. The common practice heretofore has been to attach a tank containing water, in which microphones are immersed, to the inner skin of a ship. The sound coming through the water, passes through the skin of the ship, enters the water in the tank and is picked up by the microphones. Such an arrangement is objectionable because the waves and the passage of the ship through the water produce water noises. Further as the tanks contain water, the inner noises of the ship, such as sounds from the engines, are readily transmitted to the microphones, with the result that weak signals which it is desirable to hear, are blanketed or drowned out.

The principal object of the present invention is to overcome the defects incident to the use of sound receiving devices such as previously have been used in connection with the receipt of submarine sounds, and especially to improve those employed on shipboard. To this end it is proposed to so construct the sound receiving box or ear as that one of its sides shall be its receiving diaphragm, the outer surface of which will be substantially flush with the outer skin surface of the plating of a ship's hull. To secure the greatest sensitiveness to weak sound impulses, this diaphragm is made thin and its distortion, due to hydrostatic pressure on its outer surface may be compensated for by air pressure as set forth in my previous application Serial No. 176,299 filed June 22, 1917. In devices of this general character, however, it is not absolutely necessary to provide pressure upon the inner surface of the diaphragm substantially equal to that of the external water pressure upon the outer face thereof to insure its operation, although this method is preferred. As a diaphragm .02 of an inch in thickness constructed in accordance with the present invention will withstand a pressure of sixty pounds per square inch without collapsing, so diaphragms of a thickness sufficient to withstand the external water pressure may readily be provided in cases where compensation by hydrostatic pressure is not desirable.

A further object of the invention is to provide a water tight box of sufficient strength to withstand the external water pressure so that in case the diaphragm is ruptured the sea water will be held in the box and not be permitted to enter the vessel. Another object of this invention is to surround the microphones with air and as air is a much poorer conductor of sound than water the microphones are insulated from the ship's internal noises to a considerable extent.

In accordance with the arrangement herein disclosed the listening device comprises an air tight housing secured against the ship's side upon the inside of the hull and enclosing a vibratory arm supporting the current varying microphones with a minimum of frictional resistance and without lost motion, and without supporting the current varying device upon the sound responsive device. This method of supporting the current-varying device permits the utilization of a plurality of such devices in cooperative or in amplifying relationship with a single sound responsive device and is referred to in my previous application Serial No. 202,680, filed Nov. 19, 1917. As such housings are usually of steel or iron, from considerations of durability and low cost, it is evident that sounds transmitted along the hull plating or noises within the ship may seriously interfere with the receipt of desired sounds or signals so a further object of this invention is to overcome these difficulties and one method of accomplishing this object is to insulate the housing from the ship's plating by interposed washers or bushings of sound damping material such as rubber or lead. The housing may also be lined with similar material to cut off noises proceeding from the interior of the vessel.

In order to permit the ready application of

such a device to ships having outer plating of different thicknesses, the device may comprise a box or housing having an outstanding radially disposed attaching flange whose engaging surface is arranged in a plane spaced or predetermined distance from that of the outer surface of the diaphragm. In fitting the device to an opening in a ship's plating, more or less of the thickness of this flange may be cut away, whereby to bring the outer surface of the diaphragm flush with the outer surface of the hull. Thus the device may be made of a stock pattern and interchangeably fitted to any ship as desired. As the diaphragm is in fixed relationship with the body of the housing and with the outwardly projecting flange, all diaphragms will be interchangeable with all ships irrespective of the various thicknesses of ship's plating.

In devices of the class to which this invention relates it has been usual to employ a microphone supported by the sound responsive device for transferring the vibrational motion of the latter into electrical oscillations of an observable character. In employing microphone means for this purpose, however, it is desirable to employ a pair or more of such instruments arranged in cooperative, amplifying, or in other relationship which is readily accomplished by supporting them on a vibratory arm or lever attached to a single sound responsive device. In the use of such a lever great difficulty has been experienced, particularly on ship-board in providing a suitable fulcrum or bearing therefor which while providing the necessary delicacy of poise as to practically eliminate friction and lost motion is able to securely retain the lever in position regardless of heavy shocks or displacements caused by wave action. The elimination of lost motion is particularly important inasmuch as the amplitude of vibration of the parts may be less than one-tenth of a millimeter, and if the lever is free to move on its bearing to the slightest degree there may be sufficient lost motion to affect the microphones. Further any play in the bearing will allow the lever to rise and fall or to rattle, producing corresponding noise in the microphones which may blanket a weak signal. A further object of the present invention is to overcome the difficulties previously experienced in the use of such a microphone lever, as above pointed out. To this end the lever may be supported by securing a taut strand or filament of suitable material fixed at its ends and preferably having those portions lying between the lever and its ends under normally equal torsional strain but in an opposite sense. The lever as thus arranged may be considered as a torsional balance normally in substantially neutral equilibrium and while delicately sensitive to vibrations of the diaphragm, the lever as thus mounted is secured against bodily displacement in a very substantial and effective manner. For practical considerations the filament employed may be double, the two elements thereof passing upon opposite sides of the lever and the twist imparted thereto will in such case cause the two strand elements to be twisted together. To reduce the weight of the lever and therefore its inertia the lever is made of U section and is perforated at intervals in its length. In these perforations small weights may be inserted to change its balance or its period of vibration.

The microphones are connected in series or parallel so that their effects may be averaged and matched with similarly connected microphones in ears on the opposite side of the ship. Furthermore, with this arrangement, if one microphone fails to function properly, the system will not become unoperative.

As a preferred embodiment of means for carrying the above objects into effect that illustrated in the accompanying drawings may be employed and wherein

Fig. 1 is a vertical cross section showing the device as applied to the side of a ship, the section being taken substantially on the line *a—b* of Fig. 3 and showing a portion of the ship's plating;

Fig. 2 is a substantially horizontal cross section of the device of Fig. 1, taken on a line such as *c—d* of Fig. 3;

Fig. 3 is a vertical cross section substantially at right angles to the section of Fig. 1;

Fig. 4 is a fragmentary cross section on the line *e—f* of Fig. 3;

Fig. 5 is a fragmentary vertical cross section to larger scale on a line such as *g—h* of Fig. 3;

Fig. 6 is a front elevation partly in cross section of the devices shown in Fig. 5;

Fig. 7 is a cross section on a line such as *m—n* of Fig. 6;

Fig. 8 is a plan view of certain of the devices shown in Figs. 5 and 6, portions thereof being in section; and

Fig. 9 is a diagrammatic elevation illustrating the arrangement of several listening devices in a single housing.

Referring to the drawings, a portion of the ship's outer plating or skin is indicated at 1, such plating having an opening of suitable size for the reception of the diaphragm housing 2. This housing is preferably of generally cylindrical form and is provided with a radial attaching flange 3. This flange has a series of openings or slots 4 therein for the reception of attaching bolts 5, by means of which the housing is secured to the ship's plating at a point below the water line and upon the inside of the ship's hull. The outer face 6 of the housing presents a substantially plain surface and is intended to lie flush with the outer surface of

the ship's hull. In the commercial manufacture of devices of the class herein disclosed the flange 3 will be made of standard thickness with the surface 7 thereof at a predetermined distance from the plane of the surface 6. This distance is such that when the housing is inserted within an opening in the hull of a vessel having light or thin plating, the surface 6 will be positioned in the plane of the outer surface of such plating, space being left, however, for the interposition of a suitable washer or gasket 8 for forming a tight joint. When the device is to be applied to a ship having thicker plating it is merely necessary to cut away some of the material of the flange 3 from the surface 7, thus increasing the distance between such surface and the surface 6. The latter surface may thus be located in the plane of the outer surface of the plating regardless of the thickness of the latter. In applying the device to an opening in a ship's plating, such opening will preferably be of a diameter somewhat greater than the cylindrical portion of the housing and a bushing 1b of lead or other suitable material will be interposed between the ship's plating and the housing.

Inwardly of the flange 3 the housing is provided with a second flange 9 and to this flange may be secured a cover plate 10 by means of bolts such as 11. In order to prevent leakage beneath the cover plate 10 a gasket 12 of lead or other suitable material may be interposed between the same and the flange 9. The housing is provided with a chamber 13, and in order to prevent or obstruct the passage of sounds from the interior of the ship into such chamber a block of insulating material 14 may be placed immediately within the plate 10. Such plate may be of lead or any other material having sound deadening qualities. If desired, more or less of the surface of the side walls of the chamber 13 may also be insulated against the passage of sounds as by means of the insertion of a lead lining 15 therein or in any other desired manner. At one side of the housing 2 there extends from the cylindrical portion a hollow boss 16 providing an extension 17 of the chamber 13 for a purpose to be hereinafter described. Threaded openings 18, 19 may be formed in the walls of the housing for the attachment of a pressure regulating device, if such be employed, and for the insertion of a plug or other suitable device through which pass the electric conductors leading to the interior of the housing.

At its outer portion the cavity within the housing is provided with an annular seat 20 with which engages a flange 22 formed upon a diaphragm unit or cell 21. This diaphragm unit is preferably provided with an inwardly extending flange 23 for engagement by a suitable tool for removing the unit from its seat when desired. For retaining the diaphragm unit or cell in position against its seat a collar 26 may be provided, such collar being externally screw-threaded for engaging screw threads 27 upon the interior of the housing. Interposed between the collar 26 and the diaphragm unit 21 may be a gasket 29 of rubber or other suitable material. To permit the ready turning of the collar 26 in screwing the same into place, it is provided with angularly disposed faces 28, so arranged as readily to be engaged by a wrench of suitable form. The diaphragm units, constructed as described, are interchangeable and while particularly intended for use in the manner and for the purpose described may be found useful in other situations.

The diaphragm unit or cell 21 is in the form of a ring of substantial thickness and some suitable material such as steel, and the diaphragm 24 which extends across and closes such ring is preferably formed integrally therewith. This diaphragm may be made of proper thickness to withstand any hydrostatic pressure to which it may be subjected in normal use without the necessity of counterbalancing such pressure upon the inner side thereof, although pressure preferably will be maintained within the housing sufficient to relieve the diaphragm from the effects of unbalanced pressure upon its opposite faces. At its center the diaphragm is provided with a boss 25 for a purpose to be hereinafter described.

Secured upon the interior of the housing and within the chamber 13 is a bracket 30, such bracket being attached to the housing as by means of screws 31. Outstanding from the bracket 30 are a pair of spaced supporting members 32, 33, such members being provided with aligned openings 34, 35, respectively. Within the openings 34, 35 are arranged a pair of substantially cylindrical plugs 36, 37, respectively, such plugs each having a longitudinal slot, as 38, 39. Engaging the slots 38, 39 are pins 40, 41 fixed within the supports 32, 33, respectively, and serving to prevent rotation of the plugs within the openings in such supports, but permitting longitudinal adjustment of the same. The plugs 36, 37 are externally screw-threaded at their outer portions, as indicated at 42, 43, and are provided with axial bores 44, 45 extending therethrough. Adjusting nuts 46, 47 engage the screw threads 42, 43, respectively, such nuts also engaging the outer surfaces of the supports 32, 33. By means of the nuts the plugs may be adjusted within the openings in the supports. Lock nuts may also be provided if desired for retaining the plugs in adjusted position.

Passing through the bores in the plugs 36, 37 are a pair of filaments 48, 49. These

filaments may be, and preferably are, of steel, such for example as piano wire, although it is contemplated that other materials might be employed as circumstances might warrant. While these filaments may be entirely independent one to the other, as shown herein, they are so connected as to form a substantially continuous band, such band being doubled together whereby to form the looped portions 50, 51. Passing through the looped portions of the band are pins 52, 53, respectively, such pins extending across the bores in the plugs and thus serving in a convenient manner to prevent the withdrawal of the filaments from the bores in the plugs. In the preferred arrangement the bores in the plugs may be enlarged at their inner ends as indicated at 54, 55, in order to avoid contact of the filaments with the side walls of the bore.

56 is a lever device herein shown as comprising the web member 56^a and a pair of parallel flange members 56^b, 56^c (Fig. 8) respectively, the lever being thus of substantially channel section. At a point near the center of length of the lever the flanges 56^b, 56^c are provided with aligned openings substantially in the plane of the adjacent surface of the web member 56^a and through such openings passes one of the filaments as 49. The other filament 48 lies in engagement with the other surface of the web member 56^a and for securing such filaments to the lever member clamping plates 57, 58 are employed, such plates being secured to the lever by means of screws or bolts 59. With this arrangement it is evident that the filaments pass on opposite sides of the web member of the lever and transversely of the axis thereof, the central portions of the filaments being securely clamped to the lever. The filaments constitute the fulcrum or pivot for the lever, and by suitably adjusting the nuts 46, 47 the filaments may be put under heavy tension whereby the lever member is properly suported and prevented from accidental bodily displacement. In the preferred arrangement, as indicated in Fig. 6, the end portions of the filaments, that is those portions lying at either side of the lever 56, are twisted together but in opposite directions, and thus when placed under tension the individual strands constituting the doubled filament are placed under a considerable torsional strain. As the strain is in opposite directions, however, at the opposite sides of the lever, and as the amount of twist is substanially equal, all tendency to turn the lever in one or the other direction is eliminated and thus tbe lever may be considered normally to occupy a position of neutral equilibrium.

Within the chamber 13 are arranged a pair of microphones 60, 61 one of such microphones being placed in the cylindrical portion of the chamber and the other in the extension 17 thereof. These microphones are oppositely disposed and are located upon opposite sides of lever 56 and substantially at the ends thereof. The vibrator elements of the microphones are adjustably connected to the lever 56 as by means of the screws 62 engaging with the internally threaded sleeves 63 mounted in suitable openings in the respective ends of the lever 56. That end of the lever 56 adjacent the microphone 60 is provided with an opening for the reception of a rod 64, such rod being attached at its opposite end to the boss 25 of the diaphragm 24. Nuts 65, 66 are provided whereby the connection of the rod 64 to the lever 56 may be suitably adjusted.

In order to decrease the weight of the lever 56 the latter is provided with a series of openings 67 spaced apart longitudinally thereof. These openings also serve as sockets for the reception of weights such as 68, these weights serving to permit the initial balancing of the lever and also if desired by the addition of more or less weights upon opposite sides of the fulcrum serving to change the period of oscillation of the lever about such fulcrum. Secured to the outer ends of the supports 32, 33 is a plate 69, such plate serving as a convenient support for the terminals of electrical connections, which may be introduced into the casing through one of the openings 18 or 19.

In the arrangement for a plurality of instruments shown in Fig. 9 as viewed from the inside with cover removed and before assembling parts the housing 70 is indicated as of elongated rectangular form, and provided with a series of openings for the reception of the diaphragm holders such as 71, 72, and 73, such holders being seated within independent chambers in the housing. With this arrangement several listening devices or ears may be applied simultaneously to the ship's hull at a relatively short distance apart, and this may be found desirable under certain circumstances. It is contemplated, however, that under ordinary circumstances the listening devices or ears comprising housings 2 with the associated parts and such as hereinbefore described will be located at separated points on the ship and that the electrical conducting wires leading therefrom will converge to a common station.

In the operation of the device, it being understood that the housing has been applied to a suitable opening in the ship's hull below the water line and that the diaphragm 24 lies in the plane of the outer surface of the ship's hull, any sound vibration transmitted through the water and impinging upon the diaphragm, will immediately set the latter in motion and through the lever 56 will actuate the microphones 60, 61. By

the employment of a rigid lever for connecting the microphones there is substantially no loss of vibrational intensity therebetween, and by mounting the vibration-transmitting lever in the manner hereinabove described, it is evident that it is extremely sensitive to all vibrations imparted by the diaphragm, while at the same time it is substantially impossible for heavy shock or rolling of the ship to cause bodily displacement of the lever from its bearing, the filamentous support therefor retaining the same in normal position under all conditions. By making the diaphragm integral with its cell or unit it is possible to secure the desired resiliency of the same, while at the same time providing the necessary strength.

It may be found under certain circumstances that the amplitude of the vibrations received by the diaphragm is so small that no appreciable oscillation of the lever 56 about its fulcrum will be imparted thereto, but with the arrangement described it is found that even under such circumstances the vibrations are impressed upon and are transmitted along the lever to the microphones. Thus whether or not the lever actually oscillates about its pivot the desired results are obtained.

Having thus described the invention in a preferred embodiment of the same, what I claim and desire to secure by Letters Patent of the United States is:—

1. A submarine ear comprising a casing having a seat therein and a threaded portion adjacent the seat, a diaphragm cell engaging said seat, a threaded collar engaging the threaded portion of the casing for retaining said cell in engagement with said seat, a resilient washer interposed between said cell and collar, a microphone within the casing spaced from and supported independently of the diaphragm, and means for transmitting vibrations from the diaphragm to the microphone.

2. A sound receiving device comprising a water-tight housing having a diaphragm constituting a portion of its wall, a microphone within the housing spaced from the diaphragm and supported independently of the latter, and means for transmitting vibrations of the diaphragm to the microphone comprising an elongate rigid rod perpendicular to the plane of the diaphragm.

3. A sound receiving device comprising a water-tight housing having a diaphragm constituting a portion of one of its walls, a plurality of microphones disposed within the housing and supported independently of the diaphragm, and means for transmitting vibrations from the diaphragm to the microphones comprising an elongate member of small transverse section said member being perpendicular to the plane of the diaphragm.

4. A sound receiving device comprising a heavy thick walled casing, a diaphragm forming a portion of one wall of the casing, a microphone supported within the casing independently of the diaphragm, means including a pivoted lever for transmitting movement from the diaphragm to the microphone, and sound deadening means for guarding the microphone from vibrations other than those transmitted from the diaphragm.

5. A submarine ear comprising a housing having a chamber therein, a sound receiving diaphragm for closing one side of said chamber, the walls of the housing being thick as compared with the diaphragm, sound actuated instrumentalities within said chamber, and a thick block of sound deadening material within said chamber and extending substantially across that side of the chamber opposite the diaphragm.

6. A device of the class described comprising a thick walled housing provided with a chamber, a thin diaphragm for closing one end of said chamber, a thick block of sound deadening material within said chamber and spaced from said diaphragm, sound actuated instrumentalities interposed between said diaphragm and block, and sound deadening means lining other portions of the walls of the chamber.

7. A sound receiving device comprising a water tight housing, a diaphragm forming one wall of the housing, a plurality of microphones in spaced relation within the housing, a rigid member extending between said microphones for transmitting vibrations thereto, and means for connecting said member with the diaphragm.

8. A device of the class described comprising a water tight housing, a diaphragm forming one wall of the housing, a pair of oppositely disposed microphones spaced within the housing laterally one from the other, a rigid bar extending from one of the microphones to the other and having them disposed respectively upon its opposite sides, and means for connecting said bar to said diaphragm.

9. A sound receiving device comprising a water tight housing having a chamber, a diaphragm extending across the same, a microphone device within said chamber, and a rigid member for transmitting vibrations of said diaphragm to said microphone.

10. A submarine ear comprising a water tight housing, a diaphragm forming one wall of the housing, a plurality of microphones spaced apart and in opposed relation, a substantially rigid member having its opposite ends in vibration transmitting relation to the respective microphones, and means for transmitting vibrations from the diaphragm to said lever.

11. In combination in a listening device,

a pair of microphones spaced laterally one from the other, a pivoted lever member for transmitting vibrations to the said microphones, and means whereby the period of oscilation of such lever may be varied.

12. In a submarine ear, in combination, a centrally pivoted rigid lever member, microphones disposed respectively upon opposite sides of said lever adjacent to its ends and in vibration receiving relationship thereto, and means whereby said lever may be balanced about its pivot point.

13. A microphone connecting lever for use in a sound receiving device comprising an elongated substantially rigid member having a plurality of socket openings spaced longitudinally thereof, and a weight for selective engagement with said openings.

14. A device of the class described, comprising a lever member, a filament arranged at substantially right angles adjacent its center, a clamp device for securing said filament to said lever member, and adjustable means for tensioning said filament.

15. In a device of the class described, in combination, a microphone connecting lever, and means providing a fulcrum therefor, said means comprising a filament fixedly secured to said lever and extending transversely thereof, and means engaging the opposite ends of said filament for holding it in taut condition.

16. In combination in a submarine ear, a vibration transmitting lever, and means providing a fulcrum for said lever comprising a filament secured to said lever adjacent the center thereof and extending transversely thereto, the end portions of said filament being normally under substantially equal and opposite torsional strain, and means engaging the opposite extremities of said filament for supporting it in taut condition.

17. A lever device for use in submarine ears, and means providing a pivot for said lever comprising a pair of filamentous strands extending transversely of said lever and secured thereto, the end portions of said strands being twisted together but in opposite directions.

18. In combination with a microphone connecting lever, fulcrum means therefor comprising a pair of filaments arranged respectively upon opposite sides of said lever and secured thereto, the end portions of said filaments being twisted together and in opposite directions, and means engaging the extremities of said filaments for supporting the same in taut condition.

19. In a device of the class described, a lever supporting filament, a member having an opening therein for the passage of the filament, a pin extending transversely across said opening and engaging a loop of said filament whereby to prevent the withdrawal of the filament therefrom, and means for imparting longitudinal movement of said member.

20. In a device of the class described a lever supporting filament and means for imparting tension thereto comprising a cylindrical plug having a longitudinal bore for the passage of the filament, a fixed pin engaging a longitudinal slot in said plug whereby to prevent rotation thereof, means to restrain said filament against withdrawal from the bore, and means for imparting longitudinal movement to the plug.

21. In a listening device, spaced supports having a pair of aligned perforations, plugs slidable in said perforations, said plugs having longitudinal bores extending therethrough and having screw threads upon their exterior surfaces, adjusting nuts engaging said screw threads, a doubled filament passing through the bores in the respective plugs, pins engaging the opposite ends of said filament whereby to prevent withdrawal of the same from the plugs, a lever member extending between said supports and means for clamping a strand of said doubled filament upon either side of the lever.

22. A sound receiving device, including a casing having a chamber and a lateral offset, a diaphragm forming a closure for the chamber, microphones in the chamber and the offset, and operative connections between the microphones and diaphragms for actuation of the form by the latter.

23. A sound receiving device, including a casing having a chamber and a lateral offset, a diaphragm forming a closure for the chamber, microphones in the chamber and the offset, means interconnecting the microphones for simultaneous operation, and operative connections between said means and the diaphragm for actuating the parts.

24. A sound receiving device, including a casing having a chamber and a lateral offset, a diaphragm forming a closure for the chamber, microphones in the chamber and the offset, means interconnecting the microphones for simultaneous operation and operative connections between said means and the diaphragm, said microphone connecting means including an intermediately pivoted lever and the operative connection including a rod extending from lever to diaphragm.

25. A sound ear including spaced sound actuable members and a lever connecting the members, said lever being of U-shape in cross section and having a plurality of longitudinally spaced weight receiving apertures formed therein.

26. A sound receiving device for use on ship board comprising a housing constructed and arranged to be seated in an opening in the ship's plates, a sound deadening

gasket interposed between the housing and the plates of the ship, a diaphragm forming a portion of the outer wall of the housing, sound deadening material lining a portion at least of the interior walls of the housing, a microphone disposed within the housing spaced from and supported independently of the diaphragm, and means for transmitting vibrations of the latter to the microphone.

27. A sound receiving device comprising a water-tight housing, a removable and replaceable diaphragm cell having a diaphram adapted to form one wall of the housing, a plurality of microphones in spaced relation within the housing, a rigid lever member supporting said microphones and adapted to transmit vibration thereto, whereby to set up variable currents in the microphones, and means connecting said lever to the diaphragm.

28. A device of the class described comprising a water-tight housing having a chamber, a diaphragm extending across the same, a plurality of microphone devices within the housing, each of said microphones having a vibrator element, a lever within the housing, and rigid means connecting the lever to the diaphragm and also to the vibrator element of each of the several devices so that the lever transmits vibrations of the diaphragm to the several vibrator elements and thereby produces a variable current in each microphone.

Signed by me at Boston, Massachusetts, this seventeenth day of December, 1920.

WILLIAM L. WALKER.