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SUBMARINE SOUND TRANSMITTER

Original Filed Feb. 20, 1918

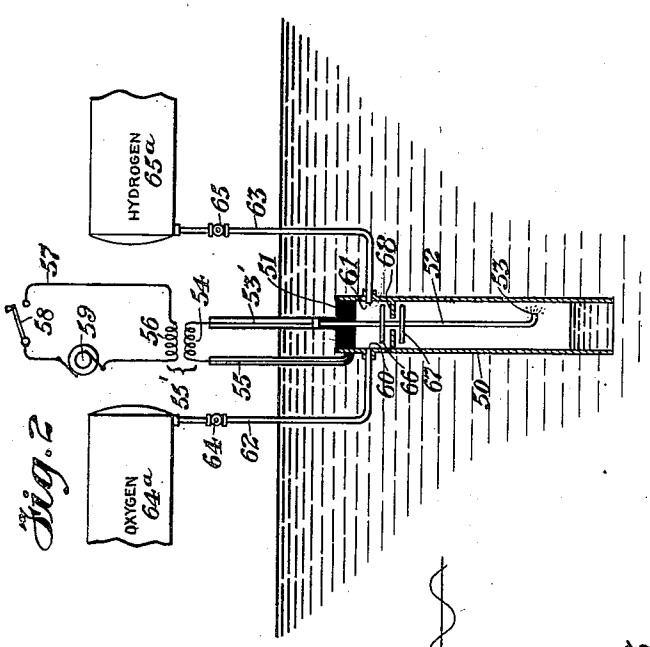


Fig. 2

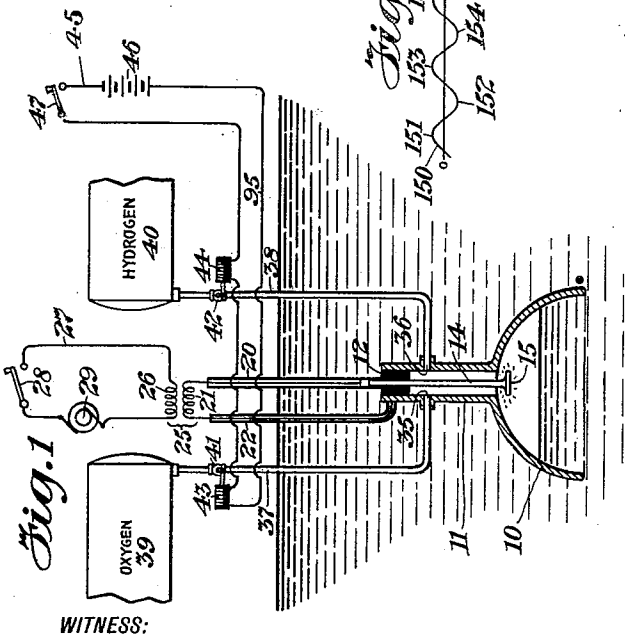


Fig. 1



Fig. 4

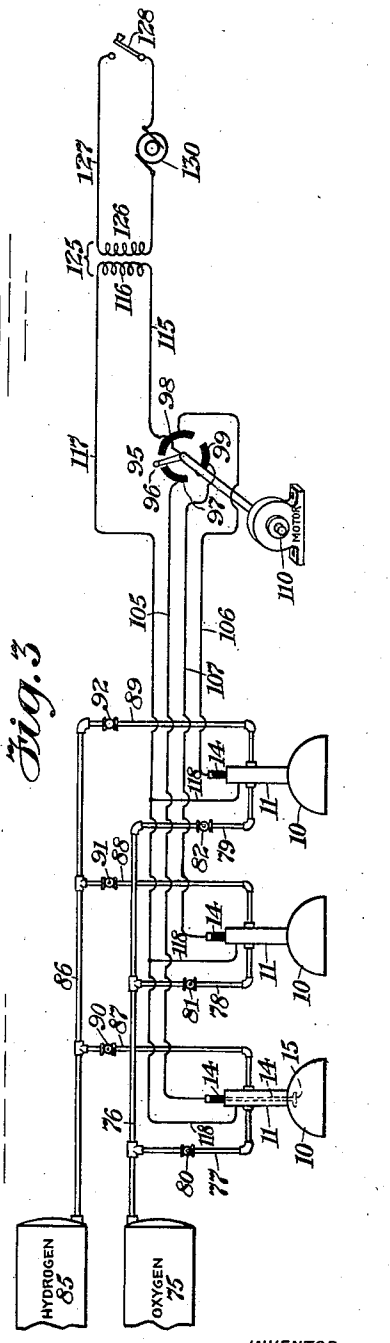


Fig. 3

WITNESS:

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# UNITED STATES PATENT OFFICE.

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## SUBMARINE SOUND TRANSMITTER.

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*To all whom it may concern:*

Be it known that I, JOHN HAYS HAMMOND, JR., a citizen of the United States, residing in Gloucester, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Submarine Sound Transmitters, of which the following is a specification.

Some of the objects of this invention are to provide improved means for generating submarine compressional waves; to provide means whereby a series of compressional waves having a predetermined frequency may be transmitted through long distances; and to provide other improvements as will appear hereinafter.

In the accompanying drawings, Fig. 1 is a fragmentary diagrammatic side elevation partly in vertical central section of a submarine sound transmitter constructed in accordance with this invention; Fig. 2 is a similar view of a modified form of this invention; Fig. 3 is a fragmentary side elevation of a further modified form of this invention; and Fig. 4 is a diagram explanatory of the operation of the system shown in Fig. 3.

One form of this invention, as shown in Fig. 1, comprises a submarine bell 10 made of metal or other suitable material and provided with a cylindrical, tubular extension 11 integral therewith and projecting centrally and radially therefrom. The inner end of this extension 11 communicates with the bell 10 and the outer end of this extension 11 is closed by a plug 12 made of insulating material fixedly secured therein. Extending snugly and axially through the plug 12 is a stem 14 of electrically conducting material which is held in a fixed position by the plug 12 and which is provided upon its inner end with a disk 15 integral therewith and arranged within the bell 10 adjacent the opening into the extension 11.

For generating a series of sparks having a predetermined frequency within the bell and between the disk 15 and the bell 10, the outer end of the stem 14 is connected by a conductor 20 to one end of a coil 21, the other end of which is connected by a conductor 22 to the tubular extension 11. The conductors 20 and 22 are covered with waterproof insulating material and the portion of the stem 14 which extends outside of the plug 12 is also covered with waterproof insulating material. The coil 21 forms the secondary of a transformer 25 which has a primary coil 26 which forms a part of a circuit 27 which is controlled by a key 28 and which is arranged to be energized by an alternating current generator 29 or other source of alternating electric current. When the key 28 is closed, alternating electric oscillations are caused to flow through the primary coil 26 which causes corresponding oscillations of higher voltage in the secondary coil 21 and these latter oscillations cause a series of sparks to be set up between the disk 15 and the bell 10, the sparks occurring in regular sequence and having a frequency equal to twice the frequency of the alternator 29. The alternator 29 may be so operated to produce any desired frequency, for instance, a frequency of 60 cycles per second, which when the key 28 is closed would produce one hundred twenty sparks per second between the disk 15 and the bell 10. For producing a series of explosions within the bell 10 the tubular extension 11 is provided with two diametrically opposed inlets 35 and 36 which are arranged to communicate respectively through two pipes 37 and 38 with two stationary tanks 39 and 40 which contain respectively oxygen and hydrogen under a high pressure, for instance of 2000 lbs. per square inch, the flow through the pipes 37 and 38 being controlled respectively by two adjustable valves 41 and 42 of any suitable construction. The valves may be in the form of electric valves controlled respectively by two solenoids 43 and 44 arranged in series in a circuit 45 energized by a battery 46 and controlled by a key or switch 47.

In the operation of the form of this invention shown in Fig. 1, oxygen from the tank 39 and hydrogen from the tank 40 are permitted to flow into the tubular extension 11 in such proportions as to form an explosive mixture which, when exploded, will produce water. This mixture of gases flows downwardly through the extension 11

and into the upper portion of the bell 10 and forces the water downwardly through the open end of the bell. When the key 28 which is normally left open is now closed, a series of sparks having a predetermined frequency will be set up between the disk 15 and the bell 10 and will cause the oxygen and hydrogen to combine chemically within the bell to form water each time a spark is generated, and consequently a series of explosions or detonations are produced in the bell 10 having a frequency of twice the frequency of that of the alternator 29. These explosions will produce powerful series of submarine sound waves or compressional waves having twice the frequency of the explosions and which may be received by any suitable receiving apparatus which may be located a considerable distance from the transmitter.

In the modified form of this invention as shown in Fig. 2, the hereinbefore described bell 10 is omitted and the system comprises a cylindrical tube 50 of metal or any other suitable material, which is open at one end and which is closed at its other end by a plug 51 of insulating material fixedly secured therein. Extending snugly and axially through the plug 51 is a stem 52 of conducting material. This stem 52 extends longitudinally of the tube 50 and the inner end of the stem is turned towards the inner surface of the tube 50 to provide a terminal 53 which is held in a fixed position with respect to the tube 50 and spaced a suitable distance away from the inner surface of the tube.

For generating a series of sparks having a predetermined frequency between the terminal 53 and the tube 50, the outer end of the stem 52 is connected by a conductor 53′ to one end of a coil 54, the other end of which is connected by a conductor 55 to the tube 50. The two conductors 53′ and 55 and the outer portion of the stem 52 are covered with insulating material. The coil 54 forms the secondary of a transformer 55′ which includes a primary coil 56 which is arranged in a circuit 57 controlled by a key 58 and arranged to be energized by an alternating current generator 59.

For generating a series of explosions within the tube 50, the tube 50 is provided adjacent its inner end with two diametrically opposed inlets 60 and 61 which are arranged to communicate respectively through pipes 62 and 63 with two tanks 64 and 65 containing respectively oxygen and hydrogen under pressure, the pipes 62 and 63 being controlled by two valves $64^a$ and $65^a$ of any suitable construction. One or more circular baffle plates 66 and 67 may be rigidly secured to the stem 52 and spaced upon opposite sides respectively of an annular plate 68 surrounding and spaced from the stem 52 and rigidly secured to the tube 50 to cause the oxygen and hydrogen to be thoroughly mixed within the tube 50.

In the operation of the form of this invention shown in Fig. 2, oxygen and hydrogen are permitted to flow in suitable proportions through the pipes 62 and 63 and into the inner end of the tube 50, thus forcing the water outwardly through the open end of the tube 50 until the water has been cleared from the terminal 53. The switch 58, which is normally left open, is now closed and a series of electric sparks having a predetermined frequency will consequently be produced between the terminal 53 and the tube 50 so long as key 58 is kept closed, and this will cause the oxygen and hydrogen to unite in a series of explosions to produce a corresponding series of submarine sound waves or compressional waves having a frequency twice the frequency of the alternator 59, and these submarine waves may be received upon any suitable receiving apparatus. The intensity of the submarine waves may be varied by varying the rate at which the gases flow into the exploding chamber since each spark explodes all the explosive mixture in the chamber at that instant.

In the modified form of this invention shown in Fig. 3 a plurality of submarine bells 10, constructed as hereinbefore described, are each provided with a tubular extension 11 and a stem 14. The tubular extensions 11 are arranged to be supplied with oxygen from a tank 75 through a main pipe 76 and branch pipes 77, 78 and 79 respectively, these branch pipes being controlled by suitable valves 80, 81, 82. The tubular extensions 11 are also arranged to be supplied with hydrogen from a tank 85 through a main pipe 86 and branch pipes 87, 88 and 89, these branch pipes being controlled by suitable valves 90, 91 and 92.

For producing electric sparks successively in the three submarine bells 10, a commutator 95 is provided, which includes a switch-arm 96 which is arranged to be rotated about a fixed axis, and three fixed segmental conducting plates 97, 98 and 99 which are arranged to be engaged successively by the free end of the switch-arm 96 and which are connected respectively by conductors 105, 106 and 107 to the outer ends of the three stems 14 of the three bells 10. The switch-arm 96 is arranged to be rotated at any predetermined rate by means of an electric motor 110 or by any other suitable means and is connected by a conductor 115 with one end of a coil 116, the other end of which is connected by a conductor 117 and branch conductors 118 to the three tubular extensions 11 of the three bells 10. The coil 116 forms the secondary of a transformer 125 which has a primary coil 126 which is in a circuit 127 controlled by a key 128 and arranged to

be energized by an alternating current generator 130. The switch-arm 96 is preferably arranged to be rotated in synchronism with the alternator 130.

In the operation of the modified system shown in Fig. 3, oxygen and hydrogen are permitted to flow into the three tubular extensions 11 in suitable proportions to produce the explosions, and the key 128, which is normally open, is now closed and a plurality of series of sparks will then be produced in the three bells 10 in the succession determined by the commutator 95. By thus producing the explosions in the bells successively a series of submarine waves will be produced having a wave frequency equal to twice the frequency of the electrical oscillations produced by the alternator 130. Moreover by thus causing the bells to act in succession, any danger of over heating the disk 15 or stem 14 of any particular bell is obviated.

By the use of a plurality of bells 10, as shown in Fig. 3, compressional waves may be produced having frequencies higher than the frequencies which may be produced by a single bell system such as is shown in Figure 1. In the system shown in Figure 3 the gases are continually flowing into the three bells 10, and the sparks are produced so rapidly that sufficient gas does not flow into any one of the bells between two succeeding sparks to produce a heavy explosion. While one bell 10 is being exploded the other bells 10, 10 are being filled with the explosive mixture. In Fig. 4 the full curved line 150 represents the alternating current wave, and the points 151, 152, 153, 154, 155, etc., at the crest of the waves are the points on which the bells 10 would be exploded. The arm 96 of the commutator 95 is rotated in synchronism with the alternator 130 and at such a rate that the arm will be in the centre of one of the segments 97, 98 or 99 when the alternating current in the circuit controlling the bells 10 is either at the crest of a positive wave or at the crest of a negative wave; for instance, either at one of the positive crests 151, 153, 155, etc., or at one of the negative crests 152, 154, etc., and so that when the arm 96 is on the next succeeding segment the wave will be at the next crest, either positive or negative. For instance, when the arm 96 is at the centre of the segment 97, and the alternating current in the circuit controlling the bells 10 is at a corresponding positive peak, for instance, at the point 151 of the curve 150, then an explosion would occur in the corresponding extreme left hand bell 10, and as the arm 96 is rotated in a clockwise direction, when the arm reaches the centre of the next segment 98, the alternating current would be at the peak of the succeeding negative crest, and an explosion would occur at the point 152 in the extreme right hand bell 10, and when the arm 96 reaches the centre of the third segment 99, an explosion would occur in the central bell 10 at the point 154 of the next negative crest of the wave, and the cycle of explosions would then be repeated at the peaks of succeeding half cycles of the wave 150, giving each bell sufficient time between explosions (the time of 1½ cycles of the waves produced by the generator 130) in which to be filled with an explosive mixture of fresh gases.

Although only a few of the many forms have been shown in which this invention may be embodied, it is to be understood that the invention is not limited to any specific construction, but might be embodied in various forms without departing from the spirit of the invention or the scope of the appended claims.

Having thus fully described this invention, I claim:

1. The combination with a hollow submarine device provided with an outlet, of means for continuously supplying the interior of said device with an explosive mixture, and means for exploding said mixture within said device periodically.

2. The combination with a hollow submarine device provided with an outlet, of means for continuously supplying the interior of said device with an explosive gaseous mixture, and means for exploding said mixture within said device periodically.

3. The combination with a hollow submarine device provided with an outlet, of means for continuously supplying the interior of said device with an explosive gaseous mixture, and means for exploding said mixture within said device periodically and at a predetermined frequency.

4. The combination with a hollow submarine device provided with an outlet which is always open and through which said device may communicate freely at all times with the surrounding water when submerged, of means for supplying an explosive mixture of oxygen and hydrogen within said device in the region in free communication with said outlet, and means for exploding said mixture within said region to produce compressional waves in the water surrounding said device.

5. The combination with a hollow submarine device provided with an outlet which is always open and through which the device may communicate freely at all times with the surrounding water when submerged, of means for supplying the interior of said device with a mixture of hydrogen and oxygen in such proportions that when ignited the hydrogen and oxygen will combine to form water in the region in free communication with said outlet, and means for exploding said mixture in said region periodically to

produce compressional waves in the water surrounding said device.

6. The combination with a hollow submarine device provided with an outlet which is always open and through which the device may communicate freely at all times with the surrounding water when submerged, of means for supplying the interior of said device with a mixture of hydrogen and oxygen in such proportions that when ignited the oxygen and hydrogen will combine to form water in the region in free communication with said outlet, and means for exploding said mixture in said region periodically and at a predetermined frequency to produce compressional waves in the water surrounding said device.

7. The combination with a hollow submarine device provided with an outlet through which said device may communicate freely with the surrounding water when submerged, of means for continuously supplying a mixture of oxygen and hydrogen to the interior of said device in the region in free communication with said outlet and in such proportions that when said mixture is ignited substantially all of said oxygen and said hydrogen will combine to form water, and means for exploding said mixture in said region periodically to produce compressional waves in the water surrounding said device.

8. The combination with a hollow submarine device provided with an outlet through which said device may communicate freely with the surrounding water when submerged, of means for continuously supplying a mixture of oxygen and hydrogen to the interior of said device in the region in free communication with said outlet and in such proportions that when said mixture is ignited substantially all of said oxygen and said hydrogen will combine to form water, and means for exploding said mixture in said region periodically and at a predetermined frequency to produce compressional waves in the water surrounding said device.

9. The combination with a plurality of hollow submarine devices, of means for supplying the interior of said devices with an explosive mixture, and means operative to explode said mixture in said devices in succession to produce compressional waves in the water surrounding said devices when submerged, each of said devices being provided with an outlet which is at all times open and through which said devices communicate at all times with the surrounding water.

10. The combination with a plurality of hollow submarine devices each provided with an outlet through which said devices may communicate freely respectively with the water surrounding said devices when said devices are submerged, of means for continuously supplying each of said devices with an explosive mixture, and means automatically operative to explode the said mixtures successively in the said devices.

11. The combination with a plurality of hollow submarine devices each provided with an outlet through which said devices may communicate freely respectively with the water surrounding said devices when said devices are submerged, of means for continuously supplying each of said devices with an explosive gaseous mixture, and means automatically operative to explode the said mixtures successively in the said devices.

12. The combination with a plurality of hollow submarine devices each provided with an outlet through which said devices may communicate freely respectively with the water surrounding said devices when said devices are submerged, of means for continuously supplying each of said devices with an explosive mixture, and means automatically operative to explode the said mixtures successively in the said devices and at a predetermined rate of succession.

13. The combination with a plurality of hollow submarine devices each provided with an outlet through which said devices may communicate freely respectively with the water surrounding said devices when said devices are submerged, of means for continuously supplying each of said devices with an explosive gaseous mixture, and means automatically operative to explode the said mixtures successively in the said devices and at a predetermined rate of succession.

14. The combination with a plurality of hollow open ended submarine devices, of means for supplying said devices with an explosive mixture, and means automatically operative to produce a spark in one of said devices to cause an explosion of said mixture in said device and then to produce a spark in another of said devices to cause an explosion in said second mentioned device, said devices being thus caused to operate in a predetermined order to produce compressional waves in the water surrounding said devices.

15. The combination with a plurality of hollow submarine devices, of means for supplying said devices with an explosive gaseous mixture, and means automatically operative to produce a spark in one of said devices to cause an explosion of said mixture in said device and then to produce a spark in another of said devices to cause an explosion in said second mentioned device, said devices being thus caused to operate in a predetermined order to produce compressional waves in the water surrounding said devices.

16. The combination with a hollow sub-

marine device provided with outlet, of means for continuously supplying the interior of said device with an explosive gas mixture and an ignition circuit for exploding said mixture within said device.

17. The combination with a hollow submarine device provided with an outlet, of means for continuously supplying the interior of said device with an explosive gaseous mixture and an ignition circuit including a source of alternating current for exploding said mixture within said device periodically.

Signed at New York in the county of New York and State of New York this 4th day of February A. D. 1918.

JOHN HAYS HAMMOND, Jr.