W. G. ZIEGLER.

SUBMARINE WIRELESS SYSTEM.

APPLICATION FILED JAN. 3, 1920.

1,382,590.

Patented June 21, 1921.

4 SHEETS—SHEET 1.

Fig. 1.

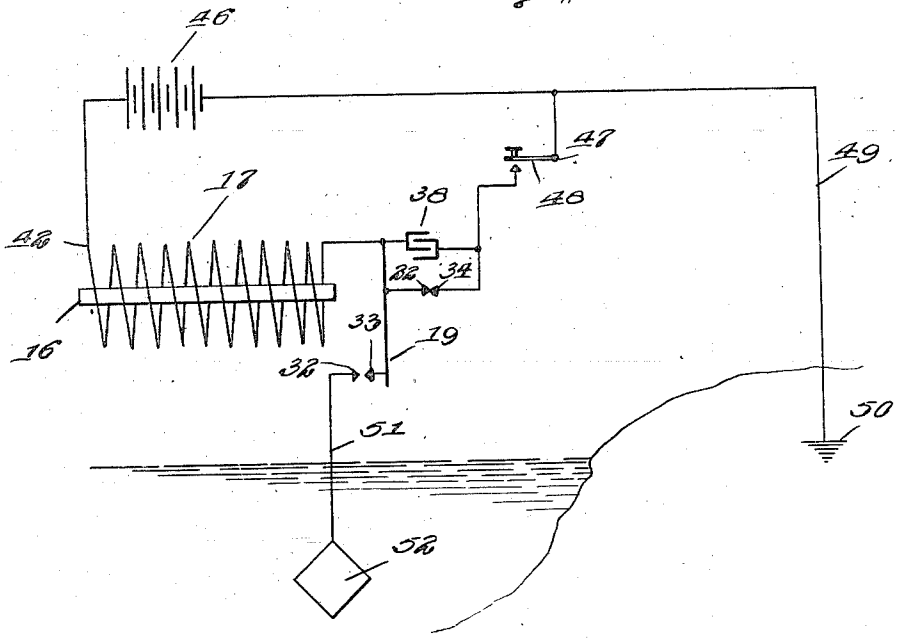
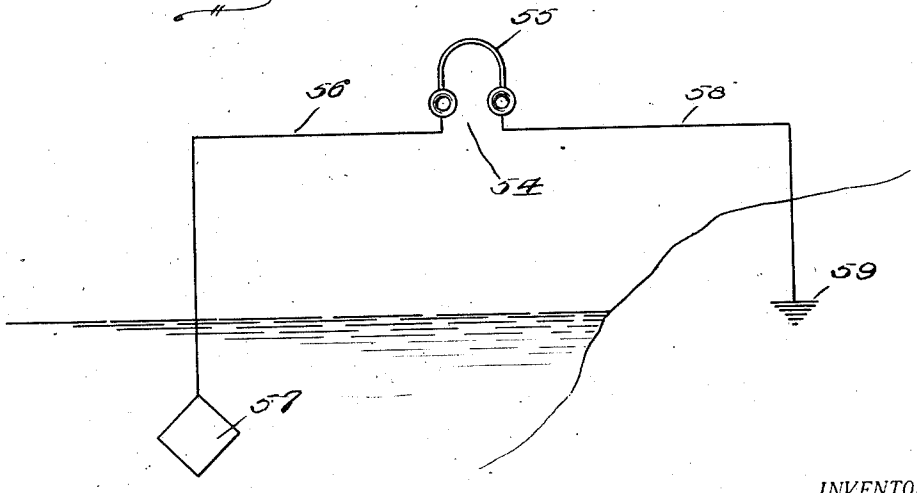


Fig. 3.



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4 SHEETS—SHEET 2.

Fig. 3.

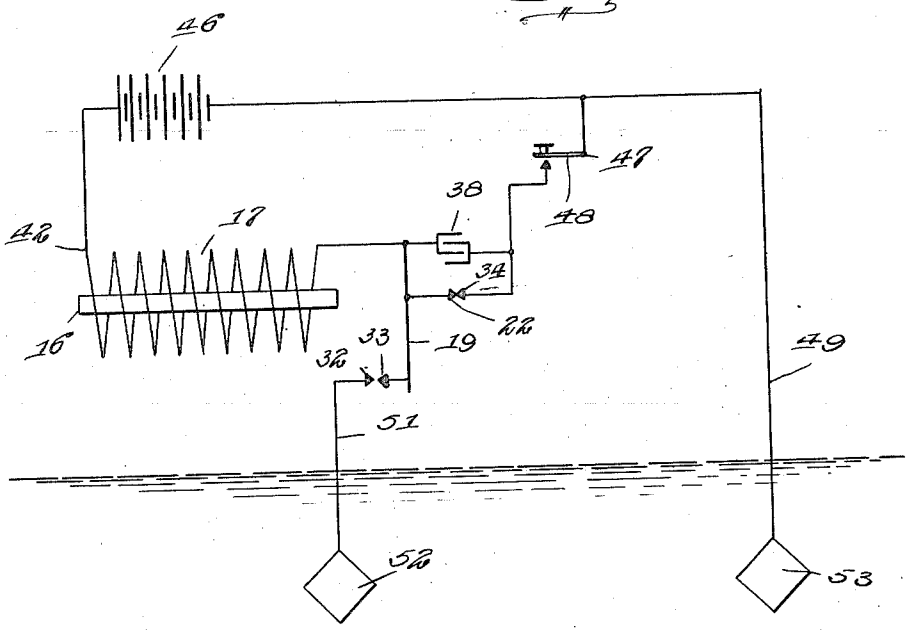
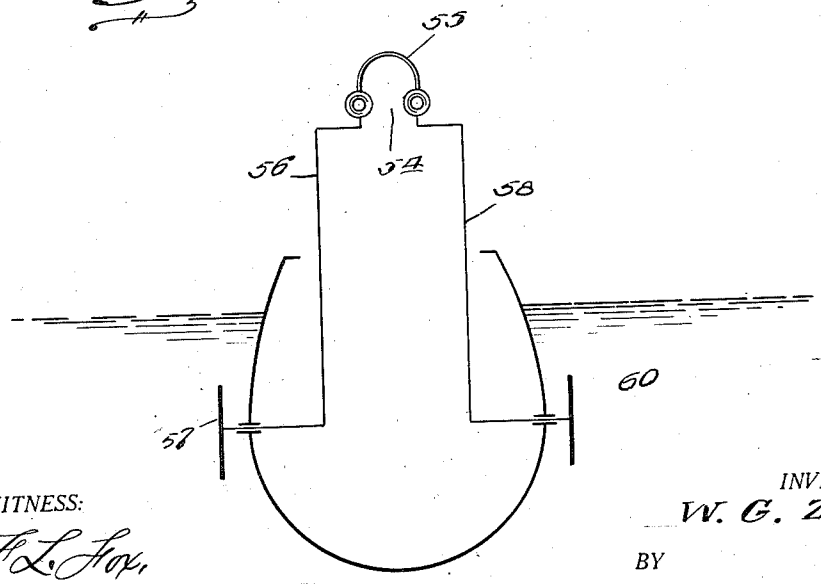


Fig. 4.



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4 SHEETS—SHEET 3.

Fig. 5.

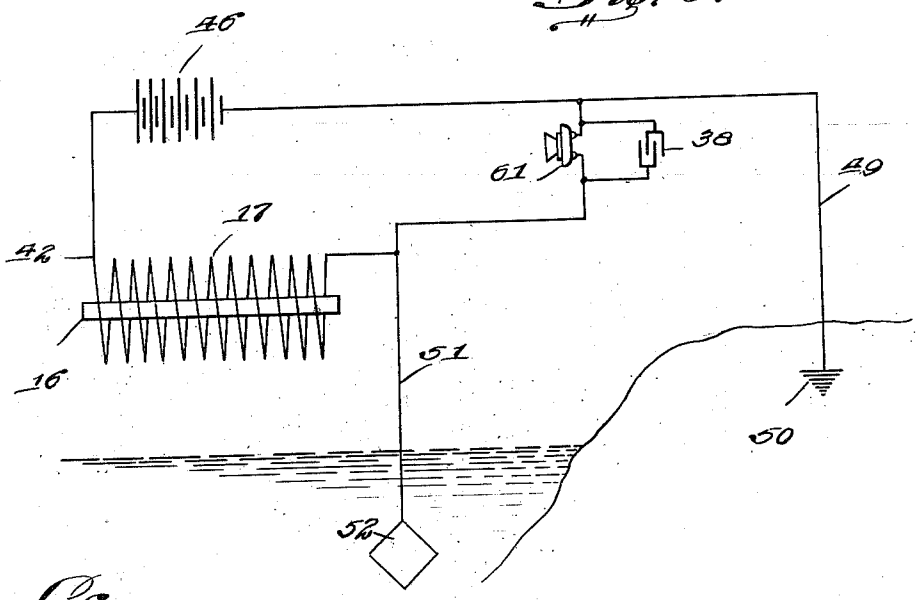
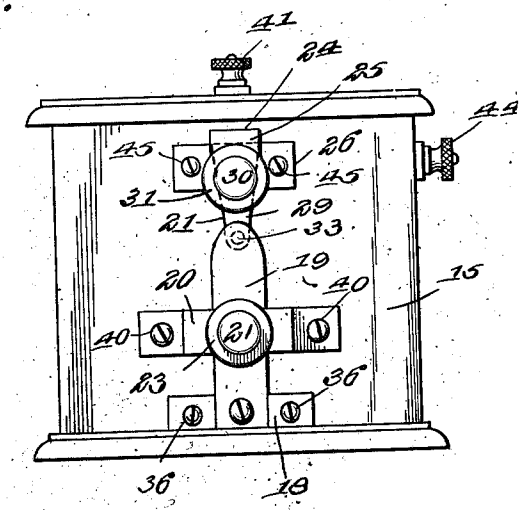


Fig. 8.



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4 SHEETS—SHEET 4.

Fig. 6.

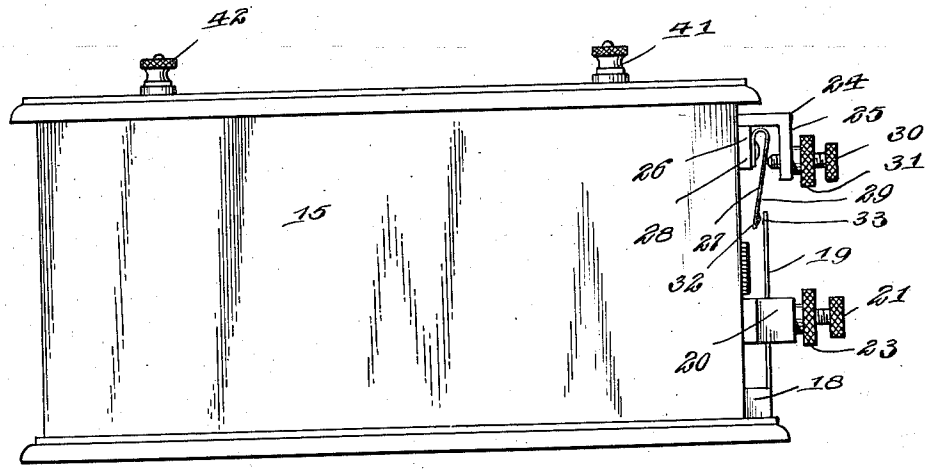
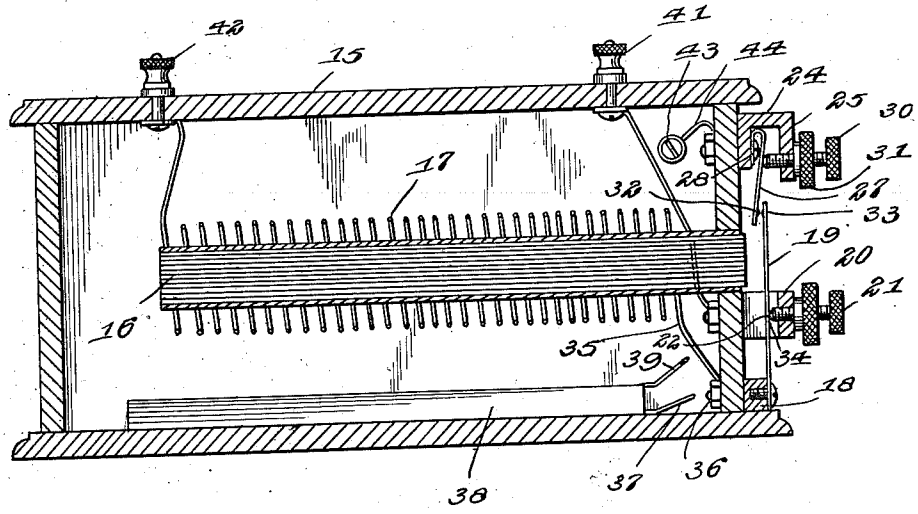


Fig. 7.



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UNITED STATES PATENT OFFICE.

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SUBMARINE WIRELESS SYSTEM.

1,382,590. Specification of Letters Patent. Patented June 21, 1921.

Application filed January 3, 1920. Serial No. 349,166.

To all whom it may concern:

Be it known that I, WILLIAM G. ZEIGLER, a citizen of the United States of America, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Submarine Wireless Systems, of which the following is a specification.

This invention relates to wireless systems for the transmission of messages and has for its object the provision of an apparatus and system whereby the wireless waves are transmitted through water and the earth instead of through the air and earth as in the ordinary systems, the device being particularly adaptable for use between shore stations and surface and submarine ships or between ships at sea, the advantage of this system being that the elevated aerials are eliminated, spark gaps, secondary and high frequency transformers are also eliminated, and the posibility of interception of messages by the ordinary wireless system and apparatus is prevented.

An important object is the provision of a system of this character which operates upon a closed circuit and which is therefore more sensitive to the reception of wireless waves, the device being adapted for telephonic as well as telegraphic communication.

Another object is the provision of a system and apparatus of this character which operates upon the following principle: The earth and the water are two solids of different densities and one will transmit a given vibration differently from the other. These two solids of different densities are influenced by a positive vibration of electricity in one and a negative vibration in the other, these vibrations traveling indefinitely through the two solids respectively. The vibrations are effected by the self-induced electro-motive force in a helix having an interrupter associated therewith.

A further object is the provision in a wireless system of this character of a specially constructed vibrator coil which is provided with means for the discharge of electro-motive force induced within the coil, the vibrator arrangement being so constructed and adjusted that the device may be tuned or adjusted for different wave lengths.

An additional object is the provision of a system and apparatus of this character which will be comparatively simple and inexpensive in manufacture and installation, highly efficient and positive in action, durable in service, and a general improvement in the art.

With the above and other objects and advantages in view, the invention consists in the details of construction to be hereinafter more fully described and claimed, and illustrated in the accompanying drawings in which—

Figure 1 is a diagram of the transmitting apparatus for a land station and showing the parts arranged for wireless telegraphy,

Fig. 2 is a similar view showing the arrangement of parts of a transmitting apparatus for use at sea,

Fig. 3 is a diagrammatic view of a receiving apparatus for a land station,

Fig. 4 is a diagram showing the receiving station at sea,

Fig. 5 is a diagrammatic view, similar to Fig. 1, showing the parts arranged for wireless telephony,

Fig. 6 is a side elevation of the coil and vibrator,

Fig. 7 is a longitudinal sectional view therethrough,

Fig. 8 is an end elevation.

Referring more particularly to the drawings, it will be seen that I make use of a coil and vibrator comprising a casing 15 within which is mounted the coil which is formed of a core 16 formed preferably as a bundle of soft iron wires covered with the usual insulation, such as fiber, paper, or the like, and then covered with many coils of wire forming a helix 17, this helix together with the core, constituting an electro-magnet. The winding of the helix should be so judged that the maximum strength of the magnetic field around the magnet may be secured without offering too great a resistance to the flow of current through the helix. Experimentation will determine the proper size of wire and the proper number of turns thereof to secure the best results. The core 16 is so mounted within the casing 15 that one end will project beyond the end wall of the casing, as clearly shown.

The vibrator structure includes a support 18 secured externally at one end of the casing 15 and having secured thereon a spring armature 19 which is vertically disposed and which extends through a bridge piece 20 having extending therethrough an adjusting screw 21 provided preferably with plati-

num point 22 engaging the armature 19. A suitable lock nut 23 is provided for locking the screw 21 in its desired adjusted position. Secured upon the upper portion of the end of the casing 15 is a support 24 which has a depending portion 25 spaced from the end of the casing and which includes a plate portion 26 secured to the casing. Secured upon this plate portion 26 is a spring contact 27 which is formed preferably from a single sheet of spring metal bent to provide an attaching portion 28 secured against the plate portion 26 and a tongue 29 which extends downwardly. An adjusting screw 30 extends through the offset portion 25 of the support and engages the tongue 29 and this screw 30 carries a suitable lock nut 31. The upper end of the armature 19 carries a contact 33 engaging a contact 32 mounted on the lower end of the tongue 29 and it is of course preferable that these two contacts be formed of platinum or other material which will stand sparking without deterioration. The armature 19 is also provided with a contact 34 engaged by the contact 22 on the end of the screw 21. Tuning of the vibrator is effected by adjustment of the screw 21. The purpose of the contacts 32 and 33 is to permit the discharge of self-induced electro-motive force within the helix 17 at the break of the magnetic field. Owing to the flexibility of the spring tongue 29, it will be seen that this tongue will adjust itself to a great extent to the tuning effected by movement of the armature 19 under the influence of the screw 21.

The connections of this vibrator coil above described are as follows: One terminal 35 of the helix 17 is connected with one of the screws 36 which hold the support 18 and the other screw 36 holding this support is connected by a wire 37 with a condenser 38 located preferably within the bottom portion of the casing 15. The other terminal 39 of the condenser is connected with one of the screws 40 which hold the bridge piece 20 in position. The other screw 40 holding the bridge piece in place is connected with a terminal 41 mounted on the casing 15. The other end of the helix 17 is connected with a terminal 42 mounted on the casing. Mounted on one side of the casing 15 is another terminal 43 to which is connected a wire 44 connected with the screws 45 which hold the support 26 in position. After the internal connections are made within the casing 15 it is preferable that the casing be filled with some suitable insulating material which may conveniently be sealing wax.

In carrying out my system the transmitting station on land includes a source of current 46 which has one pole, the positive, connected with the terminal 42 which is connected with one end of the helix 17. The negative pole of the source of current is connected with one terminal 47 of the telegraph key 48, the other terminal of which is connected with the terminal 41 on the casing 15. Also connected with the terminal 47 of the telegraph key 48 is a wire 49 which is grounded, as shown at 50. The contact or terminal 43 of the coil structure has connected therewith a wire 51 which is connected with a metal plate 52 which is submerged in the water and which performs the function of an aerial.

The operation of this transmitting station is as follows:

When the telegraph key 48 is depressed, the circuit is closed from the source of current through the coil and current flows from the positive pole of the source of current 46, through the helix, through the armature 19, which is at this time negative as the spring effect has not yet been overcome by the magnetic field around the electro-magnet formed by the helix 17 and its cores, through the contacts 22 and 34, screw 21, bridge piece 20, terminal 41 through the telegraph key 48, back to the source 46. The magnetic field produced about the helix by the flow of electricity therethrough will attract the armature 19 toward the core of the helix, breaking the circuit between the contacts 22 and 34, whereupon the contacts 32 and 33 will instantly engage. The result of this action is a weak flow of current from the positive pole of the source of current 46, through the helix, through the vibrator armature 19, through the contacts 32 and 33, through the terminal 43, through the wire 51 and to the submerged aerial 52, by electrolysis to the ground, and from the ground 50 through the wire 49, through the terminal 47 of the telegraph key, and back to the negative pole of the source 46. The purpose of the coil is to produce by self-induction, an electro-motive force greater than that used to excite the magnetic field. When the magnetic field is caused by the flow of current through the helix, the magnetic lines of force in the core are expanded, and the greater the current or the greater the number of turns of wire up to the maximum limits, the larger will be the number of lines of force that are expanded. This action takes place during the "make" of the magnetic field. When the flow of current is stopped by the action of the vibrator armature 19, the "break" occurs and the magnetic lines of force suddenly readjust themselves by contracting into the core. The sudden rush of the lines of force cutting across the windings of the helix induces within the coil or helix an electro-motive force of peculiar intensity and volume, which is stronger than that employed to make the magnetic field. The energy thus induced naturally seeks an exit and a portion flows into the condenser 38, shunted across the contacts 22 and 34 and

prevents a welding spark at this point. The greater part of the induced current, however, passes through the contacts 32 and 33, through the wire 44, terminal 43, and wire 51, to the submerged aerial 52. This latter course being the shorter route to a terminal conductor, the positive current naturally leaps for this outlet 52 while the negative current passes through the wire 49, to the ground 50. This of course depends upon the manner in which the polarity of the source of current 46 is connected to the coil, the polarity of the self-induced electro-motive force being the reverse to that of the source of current. The above changes take place at the rate to which the vibrator 19 is tuned, the sound being a buzz lasting the duration of a dot or dash of the Morse code, depending upon the period of depression of the telegraph key 48.

The positive and negative vibrations of the transmitting station are effected by the self-induced electro-motive force as it expends itself into a change. The production of these oscillations, at the positive and negative terminations, are resultants of the electricity contained in the self-induced electro-motive force as their source. These vibrations travel out from the respective plates, in general spherical waves, being longitudinal in character, their speed being increased or decreased according to the density of the solids through which they pass. These vibrations are not confined to the respective solids, but travel through both of them.

In case the sending apparatus or transmitting station is used at sea, the ground connection 50 is replaced by another plate 53 similar to the plate 52 except that the plates 52 and 53 are formed of dissimilar metals.

In further carrying out my system, I provide a receiving station which when used on ground, is arranged as shown in Fig. 3. Referring to this figure, it will be seen that the receiving station includes a pair of wireless receivers 54 of the proper resistance, which are connected with each other by a wire 55 and one of which is connected with a wire 56 leading to a submerged aerial formed as a plate 57. The other receiver 54 is connected by a wire 58 with the ground 59. This receiving station is operated on a closed circuit since the chemical action of the elements in the water on the submerged aerial 57 will produce a flow of current through the receivers 54 to the ground 59.

This particular station operates under a closed circuit, that is, the chemical action (electrolysis) of the elements in natural solution upon the plates 52 and 50 produces an electro-motive force having a definite polarity. This causes an electro tension throughout the immediate vicinity of the component and associated elements. This electro tension causes a certain rate of vibration to occur which is fundamental in the resultant electricity of the closed circuit. It is understood that an electric circuit, regardless of what its condition may be, has similarities between it and another, and so it is that the vibrations of the electro tension of the receiving station, have a peculiarity in rate and quality similar to that effected by the transmitting station. When the wave vibrations from the transmitting station pass through the immediate vicinity of the components and associated elements of the receiving station, an effect is produced in which an acceleration of the chemical action is taking place due to the fact that the electro tension is influenced by the vibrations sent out by the transmitting station. This will cause a buzz in the receivers 54 of a duration equal to the buzz in the transmitting station produced by the length of depression of the telegraph key. In order to strengthen the effect in the receiving station, such devices as audion detectors and amplifiers, such as are used in wireless transmission through air, may be used.

Referring to Fig. 4 it will be seen that the receiving station upon a ship at sea is slightly different. In this form the wire 58 instead of being grounded, as in the previously described form, is connected with a second submerged aerial 60 which should be formed of a different metal from that employed for the plate 57. The operation of the receiving station while at sea, is the same as the previously described form except that the current caused by the electrolysis of the plate 57 will pass into and through the plate 60 instead of to the ground 59, as in the previous form.

Referring to Fig. 5, I have shown an adaptation of my system for wireless telephony. In this form I make use of a telephone transmitter 61 in place of the telegraph key 48 shown in Fig. 1, and in this form the contacts 32 and 33 and 22 and 34 are eliminated. The condenser in this instance is shunted across the terminals of the transmitter 61. The operation is the same as the operation of the arrangement shown in Fig. 1 except that the operator speaks the message into the transmitter 61 instead of operating the telegraph key and using the Morse code. The action on the receiving station is the same regardless of whether the transmitting station be arranged for telegraph or telephony except that in the latter instance the sounds audible in the receivers 54 will be words instead of merely buzzes.

From the foregoing description and a study of the drawings it will be apparent that I have thus provided a wireless system for the transmission of messages which eliminates static electricity from producing

interference in the transmission and reception of the message, which eliminates long erect aerials, which facilitates communication with ships at sea, which is very sensitive as it operates upon a closed circuit while receiving, and which transmits messages which cannot be received by a Marconi wireless receiving station when such station is awaiting aerial wireless messages. It will also be observed that my system eliminates spark gap and also secondary and high frequency transformers. A further advantage is that the transmission of vibrations is effected through the earth instead of through air and that the operation of sending messages is noiseless.

While I have shown and described the preferred embodiment of my invention, it is of course to be understood that I reserve the right to make such changes in the form, construction, and arrangement of parts as will not depart from the spirit of the invention or the scope of the subjoined claims.

Having thus described my invention, I claim:

1. In a wireless apparatus for the transmission of messages, a source of current, an electro-magnet connected therewith and having a vibratory armature, a circuit closing device connected with said source and with said electro-magnet and further connected with the ground, a secondary vibrator association with said vibratory armature and operated thereby for making and breaking the flow of current caused by self-induction at the make and break of the circuit through the electro-magnet, and a metallic plate connected with said secondary vibratory and submerged within a body of water.

2. In a wireless apparatus for the transmission of messages, a vibrator structure comprising a metallic core, a helix surrounding the core, a vibrator armature acted upon by said core and connected with one end of the helix, a condenser connected with said armature, means for adjusting the position of the armature with respect to the core and serving as the make and break contacts of the vibrator structure, a second vibrator engaged by said armature and adapted to make and break a secondary current caused by self-induction within said helix at the make and break of the armature with its adjusting means, said adjusting means being connected with said condenser, and a terminal plate connected with said secondary vibrator, and a circuit closing device connected with the helix, a source of current and with the ground.

3. In a wireless apparatus for the transmission of messages, a sending apparatus comprising an electro-magnet having a vibratory armature, a circuit closing device connected with said electro-magnet and interposed in circuit with the ground with a source of current, a secondary vibrator associated with the armature and operated automatically thereby for making and breaking the flow of self-induced current at the make and break of the circuit through the magnet, and a metallic terminal plate connected with the secondary vibrator.

4. In a wireless apparatus for the transmission of messages, a sending apparatus comprising an electro-magnet having a vibratory armature, a circuit closing device connected with said electro-magnet and interposed in circuit with the ground and with a source of current, a secondary vibrator associated with the armature and operated automatically thereby for making and breaking the flow of self-induced current at the make and break of the circuit through the magnet, and a metallic terminal plate connected with the secondary vibrator, the secondary vibrator being formed as a resilient contact disposed in the path of travel of the armature.

5. In a wireless apparatus for the transmission of messages, a sending apparatus comprising an electro-magnet having a vibratory armature, a circuit closing device connected with said electro-magnet and interposed in circuit with the ground and with a source of current, a secondary vibrator associated with the armature and operated automatically thereby for making and breaking the flow of self-induced current at the make and break of the circuit through the magnet, a metallic terminal plate connected with the secondary vibrator, the secondary vibrator being formed as a resilient contact disposed in the path of travel of the armature, and means for adjusting the armature vibrator and the secondary vibrator independently.

In testimony whereof I affix my signature.

WILLIAM GEORGE ZEIGLER.