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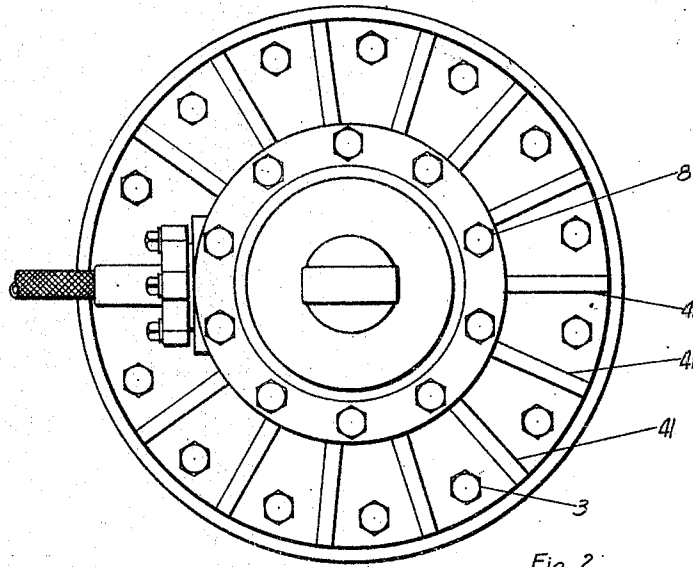
R. L. WILLIAMS

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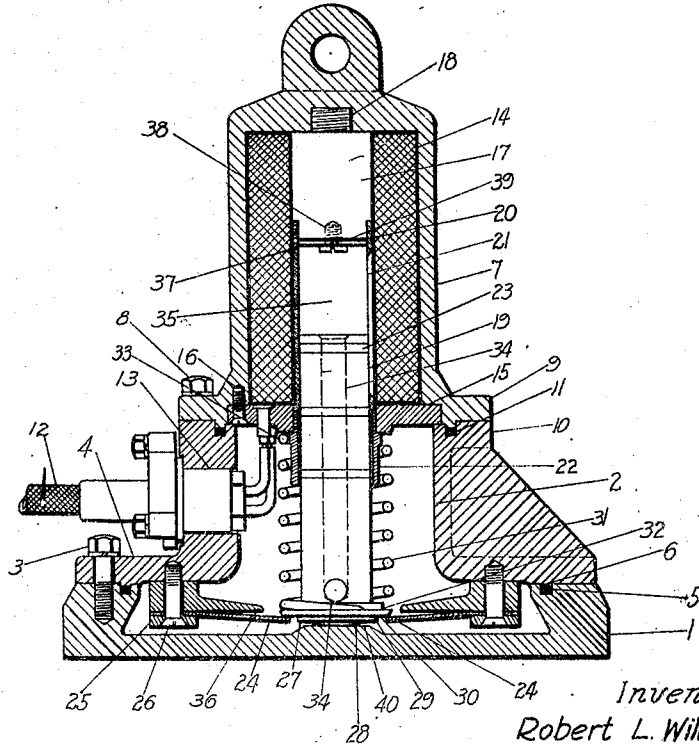
METHOD AND APPARATUS FOR SOUND PRODUCING

Filed Dec. 11, 1924

3 Sheets-Sheet 1



*Strikes
diaphragm*



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Per
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TRANSMISSION

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METHOD AND APPARATUS FOR SOUND PRODUCING

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3 Sheets-Sheet 2

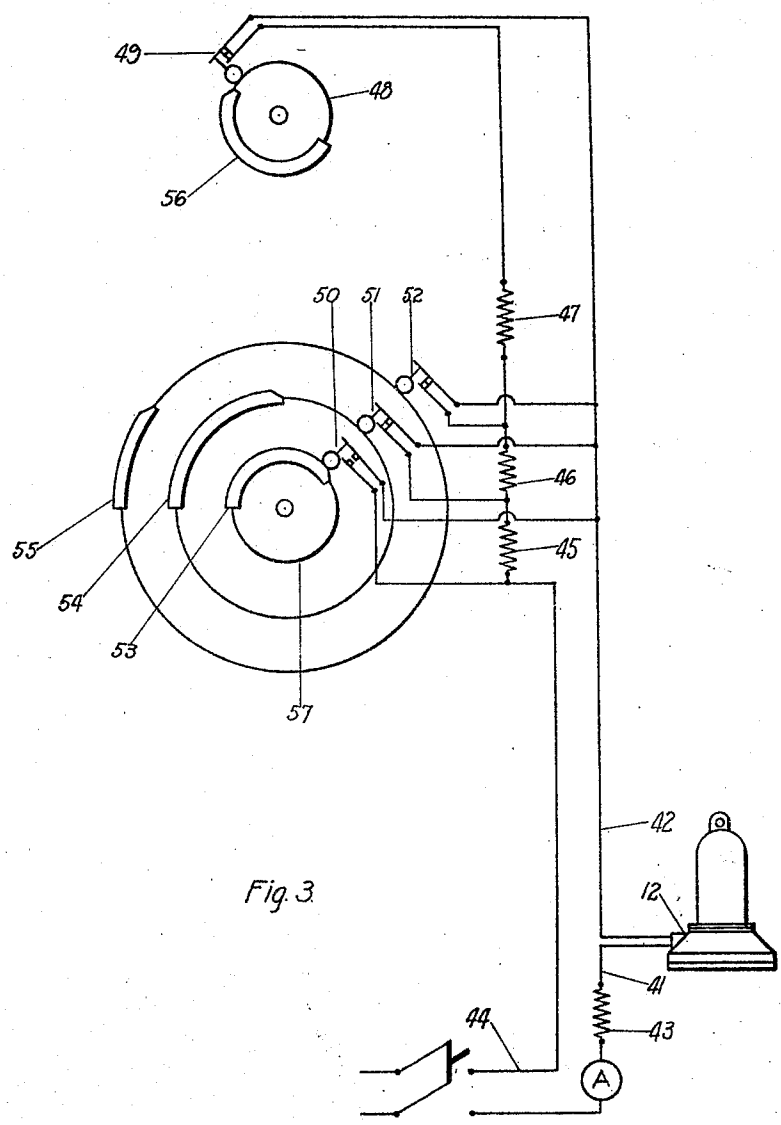


Fig. 3

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METHOD AND APPARATUS FOR SOUND PRODUCING

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3 Sheets-Sheet 3

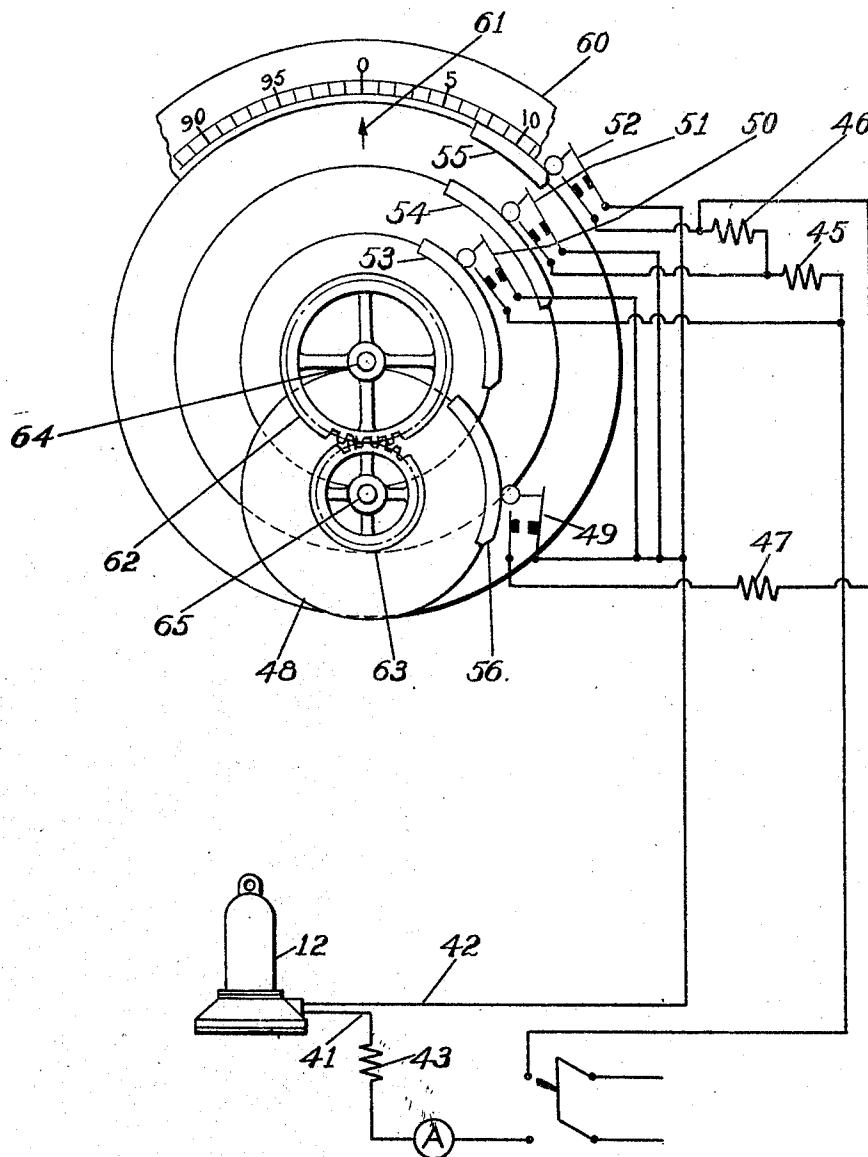


Fig. 4

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Patented Oct. 30, 1928.

1,689,574

UNITED STATES PATENT OFFICE.

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METHOD AND APPARATUS FOR SOUND PRODUCING.

Application filed December 11, 1924. Serial No. 755,291.

The present invention is concerned in particular with the production of sound waves in water or other compressional medium in which it is desirable to impart into the water a sound impulse of high power.

In the present case I accomplish the desired result with an electromagnetic sound impact device in which the energy is stored over a comparatively longer period of time than the time necessary for imparting the energy to the sound radiating means.

In the particular embodiment described below an electromagnetic solenoid works against the action of a spring which, in its normal position, exerts no pressure at all. When the solenoid draws the striker against the pressure of the spring a definite amount of energy is converted into potential energy in the spring which is transformed into kinetic energy so that it may be imparted in a very short space of time into the water.

The purpose of the present invention is to obtain a device which will transmit a great amount of energy into the medium with a small power source.

A further purpose is to obtain a sound producer capable of producing a short note.

A further purpose is to obtain a sound producer capable of operating either under a direct or alternating current source.

It is moreover also the object of the present invention to operate the sounding device with a minimum amount of sparking at the contact. The operation of the device may also be synchronized with a definite position of an indicator so that the sound is emitted at a predetermined definite time.

Further purposes and objects of the present invention will be learned from the following description and drawing in which:

Figure 1 represents a cross section of the sounder.

Figure 2 a plan view of the device as shown in Figure 1, and Figure 3 shows diagrammatically the method of operating the sounder.

Figure 4 shows a diagrammatic representation of the circuit and method of operating

the sounder synchronously with the timing device.

In Figure 1 a diaphragm 1 is bolted to a casing 2 by means of the bolts 3 extending around the outer flange 4. In the circumference within the bolt circle are packing means consisting of a groove 5 filled with packing and an embossed rim 6 fitting into the groove 5.

The casing is divided into two portions, the lower part 2 and the upper part 7 which forms the cover of the device.

The upper and lower portions are bolted together by bolts 8, arranged about a circle, which clamp the flanged portions 9 and 10 tightly with proper watertight packing as indicated by 11 within the groove. The electrical conducting cable 12 enters the casing through a proper stuffing box 13 as shown in Figure 1.

In the upper portion of the interior of the casing is a solenoid coil 14 which is held firmly in place by a plate 15 of magnetic material by means of machine screws 16. To the upper part of the casing is screwed a cylindrical iron piece 17 by means of the threaded portion 18, which screws into a tap in the top of the casing.

The plunger 19 works within the solenoid coil 14 in a sleeve 20 of composition which is slotted at 21 vertically to keep down eddy currents in the sleeve itself. One end of the sleeve rests against a shoulder of the cylindrical piece 17 and makes a close fit about that piece while the opposite end of the sleeve has a collar 22 of magnetic material fitting closely about it and supported by a press fit in the piece 15. In the plunger 19 are grooves 23 which are filled with felt soaked in oil to lubricate the plunger in its movement in the sleeve. The plunger as shown in Figure 1 is in the position when no current is flowing through the solenoid. In this position the plunger rests against spring fingers 24 which are supported by a ring 25, the latter ring being fastened to the casing 4 by screws 26. The lower part of the plunger 19 has a boss 27 which is slightly convex on its striking

surface 28, and which forms a shoulder 29 upon which rests the bearing plate 30 for the spring 31 to rest upon. The end of the spring 31 is tapered to compensate for the pitch so that it rests fairly snugly in the corner 32 of the bearing plate 30. The upper part of the spring 31 passes outside the collar 22 and rests in a corner 33 formed by a boss in the plate 15 and a slight enlargement in the collar 22.

An air passage communicates through the plunger 19 as shown by 34 from the air space in the lower part of the striker into the air space 35 above the plunger. When the plunger is drawn upwards this air has a chance to escape into the lower chamber and when the plunger travels downward this space is again filled with air through the passage 34.

The protector 36 above the spring fingers 24 which is fastened to the casing by the screws 26 serves both to dampen the spring and to limit its upward motion.

An explanation of the operation of the sounding device is given in the following:

When direct or alternating current is sent through the leads 12 into the solenoid coil 14 a force is exerted upon the plunger 19 tending to make it include as many lines of force as possible. The magnetic path of the flux threads through the center of the coil, the lower plate 15, the cylindrical part of the outside casing 7, the top of the casing 7 through the cylindrical piece 17 which may be called a stop, through the center of the coil thus completing the path. The plunger will be drawn upwards if sufficient current is supplied to the coil so that the path of the flux is practically entirely through magnetic material in this latter position. The plunger will strike against the leather washer 37 attached by the machine screw 38 to the surface 39 of the piece 17. Through this action the spring 31 is compressed and energy is stored in the spring. When the current is broken the force of the spring drives the plunger downward transforming the energy stored up into the kinetic energy of the moving mass. The plunger bears down upon the spring fingers 24 which have little effect in retarding the plunger and imparts a tremendous impact to the diaphragm 1 as it strikes the raised center part 40 of the diaphragm. At the end of the stroke the spring is entirely expanded so that the only pressure exerted upon the plunger is the rebound of the diaphragm 1 and the pressure due to the spring fingers 24. The spring fingers 24 are designed to aid in raising the plunger clear from the diaphragm so that the latter may be allowed to vibrate at its own natural period and also to prevent the plunger from striking the diaphragm upon the rebound so that only one impact is given to the diaphragm.

In the plan view shown in Figure 2 the cas-

ing is shown reinforced by ribs 41 thus furnishing a rigid surface against which the diaphragm is clamped.

In Figure 3 is shown the method of operating the sounder in connection with a synchronizing device. The cable 12 from the sounder comprises leads 41 and 42. Lead 41 connects the one potential of a source of current through a resistance 43 and an ammeter A. The other potential lead 44 has resistances 45, 46, 47 in series connecting to one side of a switch 49 operated by a rotating cam 56. Shunted across the leads 42 to 44 are switches 50, 51, 52; 50 before resistance 45; 51 before resistance 46; 52 before resistance 47; in such a manner that when closed, 50 will cut out all the above three resistances, 51 resistances 46 and 47, and 52 resistance 47. The lead 42 connects to the switch 49 so that when all three switches 50, 51, and 52 are open and also 49, the current to the device is broken.

The closing of the current is accomplished when the cam 53 relieves the switch blade of switch 50. The current then flowing through the solenoid raises the plunger. The first contact to be opened is 50 by the cam 53 which thereby cuts resistance 45 in series with the solenoid and thereby decreases the current. When cam 54 opens contact 51 the current is cut down still further by resistance 46. A similar reduction in current takes place when resistance 47 is thrown in circuit by the opening of switch 52 by the action of the cam 55. Since the current is now decreased to a minimum, there will be very little energy in the magnetic field which must be absorbed to break the circuit. In this way the break can be made to take place at just the time it is desired, since there will be very little arcing thus insuring that the break is practically instantaneous.

At the time cam 55 comes under switch 52 all the switches but 49 are open. The cam 56 which opens the switch 49 travels on the disc 48 which makes ten revolutions to one of the larger cam wheel 57. The disc 48 is synchronized with the desired mechanism in conjunction with which it is to operate with the result that sometime during the interval when cam 55 holds open switch 52 the current is suddenly broken and the plunger is released. Since the disc 48 revolves faster than the other cam wheel the timing of the opening of the circuit may be accurately regulated. If the disc 48 is run in synchronism with a time recording device so that the opening of the switch 49 occurs at the zero point of the timing device, then the circuit will only be broken at the time when switch 49 and all the other switches are open. In this way an accurate synchronism of the sounder with the timing device is obtained.

Figure 4 shows the method of synchronizing the operation of the sounder with the timing device, as mentioned above. The indi-

5 cating mark 61 on the cam wheel 55, shown
 in the figure, points to the zero of the scale 60.
 The cams 53, 54 and 55 are shown in the posi-
 tion of maintaining open the contacts 50, 51
 10 and 52 respectively. The cam 56 is shown
 opening the contacts 49 so that, as shown in
 the figure, the sounder 12 is being operated.
 The cams 53, 54 and 55 are fixed rigidly on
 the shaft 64, which also carries a gear 62
 15 meshing with gear 63, which is carried on the
 shaft 65 and which operates the cam wheel
 48. As mentioned above the ratio of the
 synchronizing mechanism is ten to one, so
 20 that the shaft 65 makes ten revolutions to
 one of the shaft 64. As the arrow 61 comes
 to the zero of the scale the cam 56 opens
 rapidly the contacts 49, thus completing the
 opening of the sounder circuit, since the con-
 25 tacts 50, 51 and 52 are already open. In this
 manner the position of the arrow 61 can be
 accurately synchronized with the sounding
 of the sounder 12, since the contacts 49 are
 opened so much more rapidly than the other
 contacts on the slower cams.

30 While it has always been desirable to use
 a device such as is described in the present ap-
 plication for submarine sounding, yet it has
 been found difficult to operate such a sounder
 successfully because of the inherent inaccu-
 35 racy in trying to operate the sounder syn-
 chronously with a timing device. The pres-
 ent method and apparatus employed have
 been found successful in operating the im-
 pact sounder, due to the very slight amount
 40 of current which is broken by the last cam,
 here cam 49, and also because of the rapidity
 with which the current is broken.

45 From the above description it will be
 noticed that the switch 49 opens ten times to
 each time the other switches open but that
 there will be only one operation of the
 sounder among these ten openings of switch
 50 49. Therefore, it is evident that with the
 present device the more rapid operating syn-
 chronizing switch controls the sounding de-
 vice but only once in every ten times of its
 operation. Due to the fact that the switch 49
 55 operates so much quicker than the other
 switches the error of operation due to the
 back lash of the gears in a slow system is
 avoided while the rapid action on account of
 the speed of the disc wheel 48, and other fea-
 tures cause the timing of the opening of the
 contacts and the operation of the sounder to
 be very accurate.

Having now described my invention I
 claim:

1. In an electromagnetic sounding system,
 an electromagnetic sound generator of the
 60 impact type, an electrical source of energy,
 a switching mechanism controlling the trans-
 fer of energy from the electrical source to the
 generator, comprising a switching means,
 means controlled by said switching means for

65 reducing the current supplied to the sound
 generator, and a second switching means for
 breaking the current at a time when the cur-
 rent has been reduced.

2. In an electromagnetic sounding system,
 a switching system for controlling the oper-
 70 ation of a sound generator comprising switch-
 ing means operating at a comparatively slow
 period to open one branch of a shunt circuit, a
 second switching means operating at a more
 rapid period than the first to complete the
 75 opening of the circuit, whereby the more
 rapidly operating switching means controls
 the operation of the system at times when the
 first branch of the shunt circuit is open.

3. In an electromagnetic sounding system, 80
 an electromagnetic sound generator of the
 impact type, an electrical source of energy, a
 switching mechanism controlling the transfer
 of energy from the electrical source to the
 generator, comprising a switching means, 85
 means for operating said switching means
 periodically, means controlled by said switch-
 ing means for reducing the current supplied
 to the sound generator, a second switching 90
 means, and means for operating said second
 switching means periodically, but at a more
 rapid rate than said first switching means for
 breaking the current at a time when the cur-
 rent has been reduced.

4. An electric sound generating system of 95
 the impact type comprising an electric sound
 generator, a scale, an indicator adapted to
 move with reference to the scale and means
 for producing the sound when the indicator
 has reached a desired position with reference 100
 to the scale, comprising means for energizing
 the sound producing mechanism prior to the
 production of the sound, means for reducing
 the energy so supplied, whereby the sounding 105
 mechanism is ready to operate for the produc-
 tion of the sound, and means including in
 part said energizing means for releasing the
 sounding mechanism for the production of
 the sound, said means accurately synchron- 110
 ized with the desired position of said indi-
 cator.

5. A sound generating system of the impact 115
 type comprising a scale, an indicator adapted
 to move with reference to the scale, and means
 for producing the sound when the indicator
 has reached a desired position with reference
 to the scale, comprising means for energizing
 and restraining the sound producing mecha-
 nism until said mechanism is completely ener- 120
 gized, means for reducing the energy supplied
 to said means to the point where the mecha-
 nism is just restrained and means, including
 in part said energizing means, for releasing
 suddenly the restraining means at the mo- 125
 ment when the indicator has reached the de-
 sired position with reference to the scale.

6. An electric sound generating system of
 the impact type comprising an impact mem-

ber, a diaphragm on which said impact member operates, a restraining spring and electromagnetic means for retracting said impact member against said restraining means and
5 means for controlling the supply of current to said electromagnetic means including means for decreasing the current supplied to said electromagnetic means after said impact member is in its retracted position and
10 means for breaking the current and releasing said impact member after it has been reduced.
7. An electric sound generating system comprising a scale, an indicator adapted to move with reference to the scale and a sound
15 producer of the impact type comprising an

impact member, a diaphragm on which said impact member operates, a restraining spring and electromagnetic means for retracting said impact member against said restraining means, means for controlling the supply of
20 current to said electromagnetic means including means for decreasing the current supplied to said electromagnetic means after said impact member is in its retracted position and
25 means for breaking the current and releasing said impact member after it has been reduced and when said indicator has reached a desired position with reference to the scale.

In testimony whereof I affix my signature.
ROBERT LONGFELLOW WILLIAMS.