E. C. WOOD.
SUBMARINE SOUND SIGNALING APPARATUS.
APPLICATION FILED JUNE 20, 1906.

1,035,291. Patented Aug. 13, 1912.

2 SHEETS—SHEET 1.

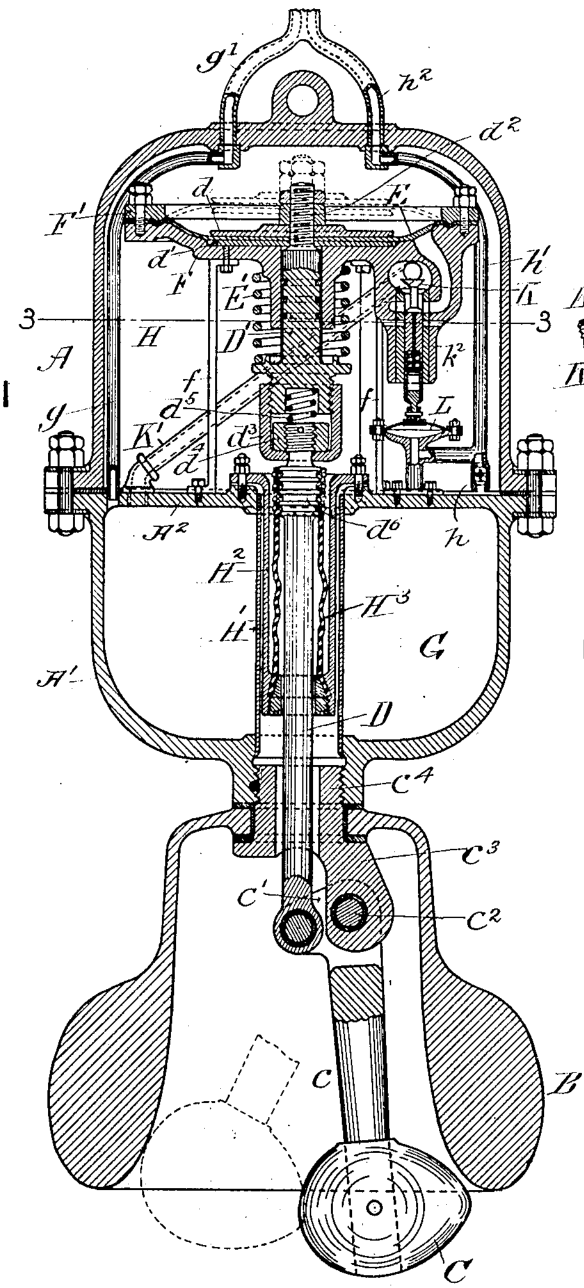

Fig. 1

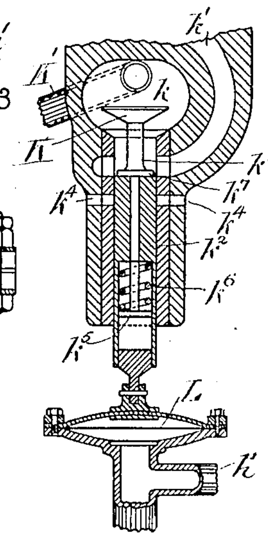

Fig. 2.

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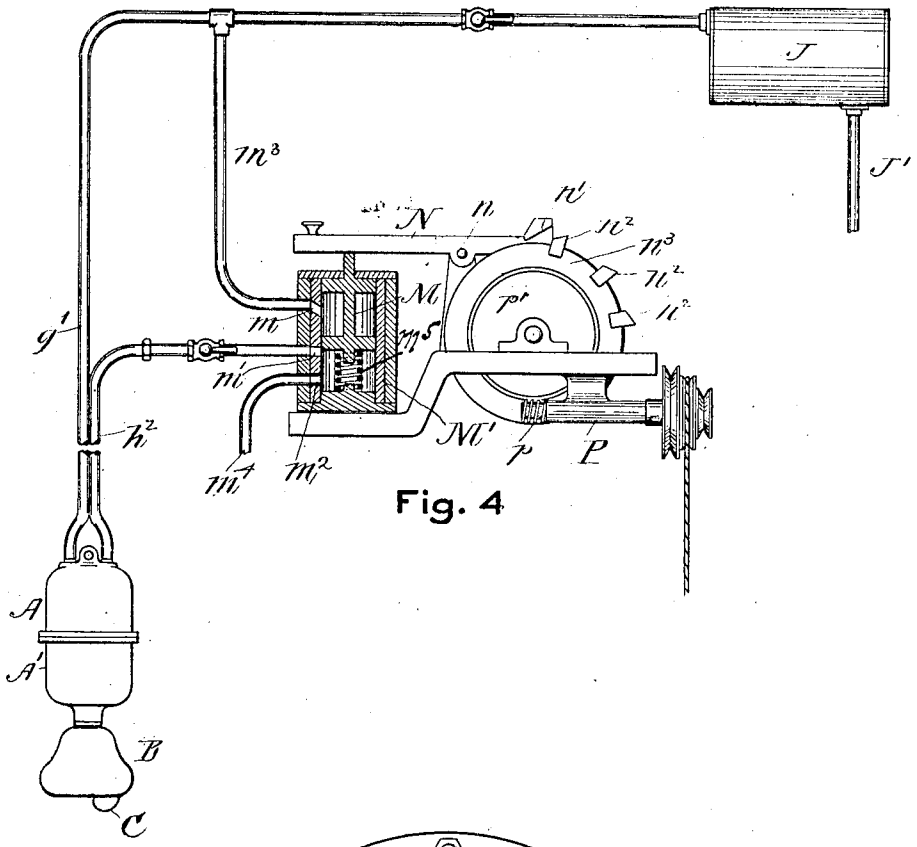

Fig. 4

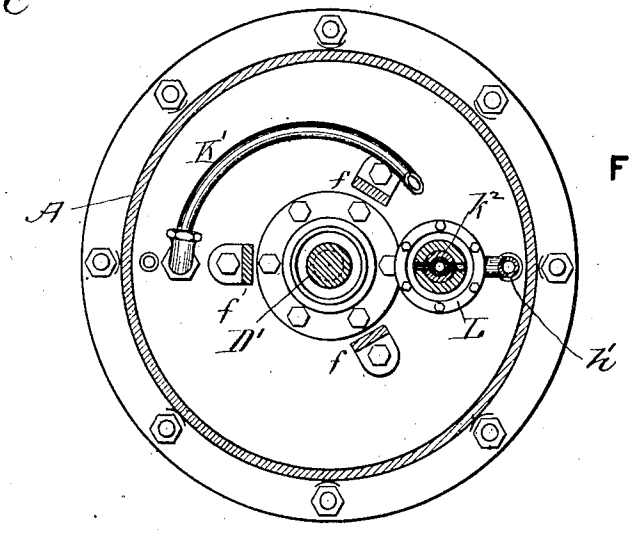

Fig. 3

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UNITED STATES PATENT OFFICE.

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SUBMARINE SOUND-SIGNALING APPARATUS.

1,035,291. Specification of Letters Patent. Patented Aug. 13, 1912.

Application filed June 20, 1906. Serial No. 322,603.

To all whom it may concern:

Be it known that I, EDWARD C. WOOD, of Somerville, in the county of Middlesex and State of Massachusetts, a citizen of the United States, have invented a new and useful Improvement in Submarine Sound-Signaling Apparatus, of which the following is a specification.

My invention relates to an apparatus for producing submarine sound signals such as is used for giving warning and directing signals to ships approaching the coast and for signaling between ships at sea; and it relates especially to that class of submarine signaling apparatus in which the sound is produced by blows delivered by a striker upon a submerged resonating body, for example,—a bell.

The object of my invention is to produce a simple and reliable, self-contained apparatus of this class suitable to be suspended in the water from a light-ship or other structure and which can be maintained permanently submerged without injury and which can be operated automatically or by hand from a distant point, for example, from the deck of a ship or from the shore, so as to sound code signals.

For operating my apparatus I prefer to use compressed air though other fluids might be employed; and for the resonating body I prefer to use a bell provided with an internal tongue or striker.

In submarine signaling apparatus of this class pistons have been employed to actuate the striker and to avoid serious losses from friction, from the weight or leakage of the piston it has been found necessary to give it a relatively long stroke. This requires that the bell-crank on which the striker is suspended carry a horizontal arm so long that the attached piston rod must pass through a hole at one side of the crown of the bell; and this construction not only weakens the bell, but prevents its being turned around from time to time so as to bring a new surface to be struck by the striker as could be done if the piston rod were passed up through a hole in the center of the crown of the bell.

In order to bring a new surface into service whenever the striking point becomes worn and to obtain the further advantage of a moving piece of light weight and large diameter operatable by compressed air at comparatively low pressure, I have invented a structure in which the striker is actuated by a central actuating rod, operated by a flexible diaphragm operable by compressed air at comparatively low compression, thus obviating losses by leakage of the working fluid, and in combination with this I have devised special mechanism for varying the pressure upon the diaphragm controllable from a distant point either by hand or automatic means.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a vertical section of the bell and striking apparatus. Fig. 2 is a sectional detail, enlarged, illustrating more clearly the main valve and the auxiliary diaphragm for shifting it. Fig. 3 is a horizontal section on line 3—3 of Fig. 1, and Fig. 4 is a diagram illustrating the auxiliary valve, the code mechanism, and their connection with the apparatus shown in the other figures.

A, A^1 is the case of the apparatus on the lower end of which is rigidly mounted the bell B.

C is the striker which is carried on the lower end of the long arm c of a bell-crank lever, the short arm c^1 of which is pivotally connected to the bottom of the pull-rod D. The bell-crank lever is pivoted at c^2 to a lug c^3 hanging from the coupling c^4 by which the bell is connected with the lower portion A^1 of the case.

E is the main diaphragm which is circular in form and is made of rubber, leather or similar flexible material. The diaphragm is clamped at its outer edge between the metal plate F and the ring F^1. At its center it is clamped between the plates d and d^1 which are mounted on the diaphragm rod D^1. For this purpose the upper end of the diaphragm rod is reduced in diameter and threaded. A shoulder is thus formed upon which the under plate d^1 rests and against which both plates and the diaphragm are clamped by nuts d^2. The diaphragm rod D^1 is connected with the pull-rod D by means of a coupling comprising a cup-shaped nut d^3 perforated at the bottom to fit over the end of the pull-rod D and slide thereon. It is prevented from being pulled off the pull-rod by a nut d^4. The

nut d^3 is threaded on its interior at its open end to engage the threaded exterior of the bottom of the diaphragm rod D^1. A spring d^5 lies within this coupling between the lower end of the diaphragm rod D^1 and the upper end of the pull-rod and keeps these two parts normally separated, but allows a slight back lash to the pull-rod so that after it has pulled the striker C into contact with the bell B the striker may have a slight rebound to prevent its deadening the vibrations of the bell. The plate F as shown is supported on rods f mounted upon the partition A^2 which divides the chamber within the casing A, A^1 into two chambers G and H. The result of this construction above described is that when the flexible diaphragm E is moved it moves the pull-rod and gives the striker a corresponding stroke, the position of the diaphragm changing from that shown in full lines in Fig. 1 to that shown in dotted lines therein.

The chamber G in the lower part A^1 of the case is kept supplied with compressed air through the pipe g which may be connected with a source of compressed air J by means of a flexible tube g^1, such for example, as a rubber hose. The chamber H is connected through an outwardly-opening check-valve h with the pipe h^1 which serves as an escape or exhaust for the air from the chamber H and may be connected through a flexible tube h^2 with the atmosphere or with an air reservoir at low pressure. This chamber H is also connected with the chamber upon the open side of the diaphragm. As a matter of convenience the two tubes may be fastened together except at their ends. The chamber H and the chamber above the diaphragm are always connected.

To prevent leakage from the chamber G to the chamber H around the pull-rod, I provide a metal tube H^1 which is connected with the bottom of the casing A^1 and with the partition A^2 and within this tube I provide also a cylindrical casing H^2 which extends down into the chamber in the tube H^1 and surrounds the pull-rod D. A rubber tube H^3 is wired into grooves d^6 in the pull-rod D, its lower end being clamped by a conical threaded plug into the bottom of the casing H^2. All the joints in the casing are suitably packed to prevent leakage from one chamber to the other.

The lower chamber G within the casing is a compressed air reservoir, being as is shown above, connected at all times with a compressed air tank J or other source of pressure, and the pull-rod is given an upward vertical stroke to give the signal by the introduction of compressed air from this chamber under the diaphragm E and then exhausting the air therefrom so that the parts may resume their original position.

To control the air pressure beneath the diaphragm E I have provided a valve K normally resting upon a seat in the bottom of the valve chamber k. This valve chamber is connected with the reservoir G by means of the tube K^1. Below the valve seat is a passage k^1 so directed that it will discharge air beneath the diaphragm E so as to lift the diaphragm. When the valve is off its seat, as shown in both Figs. 1 and 2, it will be seen that the compressed air can pass directly from the reservoir G to the valve chamber k, from thence around the valve and into the passage k^1 to the under side of the diaphragm and, if the pressure is sufficient, the diaphragm will be lifted, thus lifting the pull-rod and causing the striker to strike the bell. When the valve is in its lower position, however, this is impossible for the connection between the valve chamber k which is always connected with the reservoir G and the passage k^1 will be closed. To lift the valve I provide a diaphragm L of ordinary construction on which is mounted a slide-rod k^2 the upper end of which engages a collar k^7 carried by the valve stem k^3, connected with the pipe k^1 so that as impulses of compressed air are sent from the air tank J through this pipe the diaphragm will be lifted, thus lifting the valve K. I prefer to have an extensible joint between the diaphragm and the valve in order to avoid such re-adjustment from time to time as might be necessary if the parts were rigidly connected. The compressed air after it is exhausted from under the diaphragm E passes on into the exhaust chamber H. The ports k^4 are closed by the slide-rod k^2 when the valve itself is off its seat and open when the valve is closed, thus allowing the air to pass from the passage k^1 around the valve stem k^3 which is reduced for the purpose and out through the ports k^4 into the exhaust chamber H. An extension of this valve stem passing through the slide-rod carries a head k^5 between which and the bottom of the slide rod is a spring k^6 which insures the closing of the valve when the diaphragm recedes. When the pressure in this exhaust chamber is sufficient it will open the check-valve h and allow the escape of air backward through the pipe h^1 and tube h^2 to the exhaust in the shore apparatus whatever that may be so that the same pipe or tube serves to convey the impulses of compressed air by which the apparatus is operated and also as the exhaust for the air by which motor power is supplied to sound the bell. As a means of operating this bell to give code signals I have shown an apparatus in Fig. 4 which is satisfactory for the purpose. It comprises in addition to the air tank J and the pipes which have already been described a slide valve M sliding in a cylinder M^1 having ports m, m^1 and m^2. The port m is the

inlet and connects directly with the tank J through the tube m^3 and tube g^1. The port m^1 connects directly with the tube h^2, and the port m^2 connects with the tube m^4 which is the exhaust. When the valve is in the position shown in Fig. 4 the exhaust chamber of the signaling apparatus is connected (provided there is enough pressure therein to open the check-valve h) through the port m^1 and port m^2 with the atmosphere so that the pressure therein may be reduced according to the pressure at which the check-valve is set. When the valve M, however, is at the other end of its stroke it will be seen that the tank J is connected through the port m and port m^1 and tube h^2 and pipe h^1 with the under side of the diaphragm L so that the diaphragm is lifted and lifts the valve K, thus allowing the air to pass from the air reservoir G to the valve chamber k, and out through the passage k^1 to the under side of the diaphragm E lifting the diaphragm and causing the pull-rod to operate the striker to strike the bell. A spring as shown at m^5 or any other convenient means may be employed to operate the valve M so that after being moved from its position shown in Fig. 4 to its lowest position it will return to the position shown in Fig. 4. Its stroke should be momentary and the instant it has returned the air below the diaphragm E will exhaust as above described and the parts will all resume their normal positions.

To depress the valve M at the proper times any convenient form of code mechanism may be used. I have shown a lever N pivoted at n and having at its other end a cam surface n^1 which engages with the projections n^2 on the code wheel n^3. This code wheel n^3 is rotated by means of a shaft P operated from any suitable source of power and having a worm p at one end adapted to engage a gear p^1 formed upon or connected with the code wheel n^3.

The tubes h^2 and g^1 may each be provided with suitable stop-cocks to shut off the air when the apparatus is out of commission, and the tank J is connected with a suitable air compressor by means of the pipe J^1.

It is unnecessary to describe the operation of the apparatus in view of the description of the details of the mechanism above given.

The apparatus as a whole may be suspended by a chain or in any other desirable way either from a buoy or a light-ship. In the former case the tank and apparatus for supplying compressed air are preferably located at the shore station near by. In the latter case they may be located on the light-ship.

I prefer to provide a spring E^1 located between the under side of the plate F and the upper side of a collar on the end of the diaphragm rod D^1 which spring will be compressed as the pull-rod is raised by the diaphragm and will assist in returning the pull-rod and hence the diaphragm to its original and hence inactive position.

It is obvious that changes in the details of construction may be made without departing from the spirit of my invention as set forth in the claims.

What I claim as my invention is:—

1. An apparatus of the character described comprising a motor having a pressure chamber, an exhaust chamber, a fluid pressure operated controlling valve, an escape pipe, leading from said exhaust chamber, and also communicating with said valve, and means permitting the passage of fluid pressure through said pipe to said valve without entering said exhaust chamber, whereby said escape pipe serves also as means for transmitting fluid pressure impulses to said valve.

2. An apparatus of the character described comprising a motor having a pressure chamber adapted to confine an elastic fluid, an exhaust chamber, a flexible diaphragm having the space upon its side constantly in communication with the exhaust chamber, a main valve adapted to connect the other side alternately with the pressure chamber and with the exhaust chamber, an escape pipe leading from said exhaust chamber, a check-valve opening outward from the exhaust chamber into said escape-pipe, a shifting device for the main valve communicating with the said escape pipe, and means for intermittently raising the pressure in the escape pipe for actuating the shifting device.

3. A motor comprising in combination a diaphragm, a pressure chamber, an exhaust chamber, means for connecting said chambers alternately with one side of said diaphragm comprising a valve and a diaphragm connected thereto, a source of supply of compressed fluid permanently connected to said pressure chamber, and means connecting the under side of said valve-controlling diaphragm with said compressed fluid supply comprising a tube containing a check-valve located in said exhaust chamber, whereby when said check-valve is under pressure it will complete the connection between said compressed fluid supply and the under side of said valve-controlling diaphragm and when it is opened it will make possible the escape of fluid from said exhaust chamber.

4. A motor comprising in combination a diaphragm suitably mounted, a pressure chamber, an exhaust chamber, means for connecting said chambers alternately with one side of said diaphragm comprising a valve and a diaphragm connected thereto, a source of compressed fluid permanently connected to said pressure chamber, and means connecting the under side of said valve-con-

trolling diaphragm with said compressed fluid supply comprising a tube containing a check-valve located normally to connect said tube with said exhaust chamber and adapted to be closed by an increase of pressure in said tube whereby said valve diaphragm will be operated to open said valve and connect said compressed fluid chamber with one side of said diaphragm, as described.

EDWARD C. WOOD.

In the presence of—
JOHN E. R. HAYES.
M. E. FLAHERTY.