R. A. FESSENDEN.

SOUND SIGNALING.

APPLICATION FILED MAR. 22, 1917.

1,384,029.

Patented July 5, 1921.

3 SHEETS—SHEET 1.

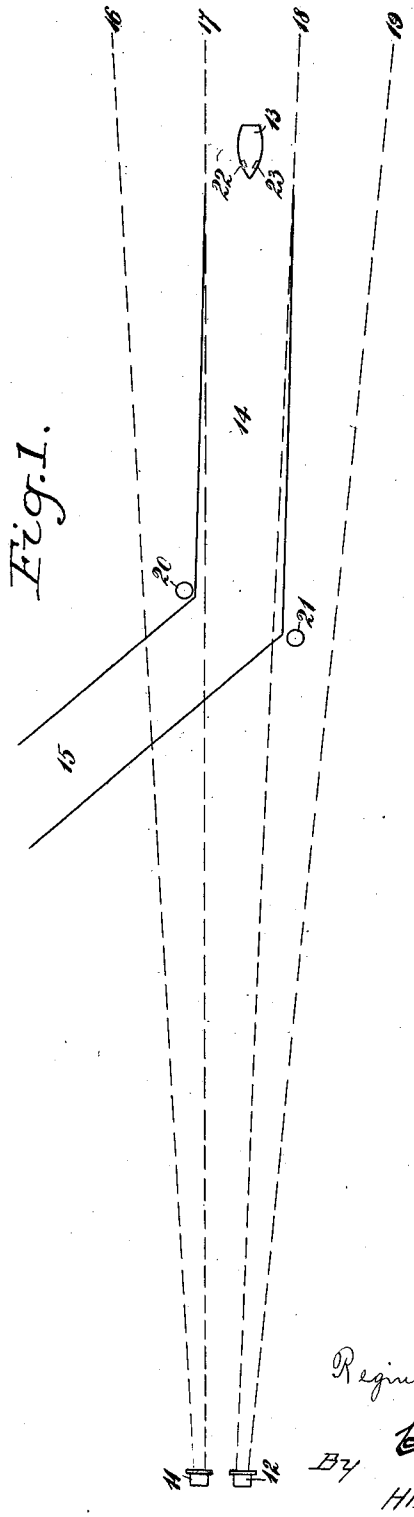

Fig. 1.

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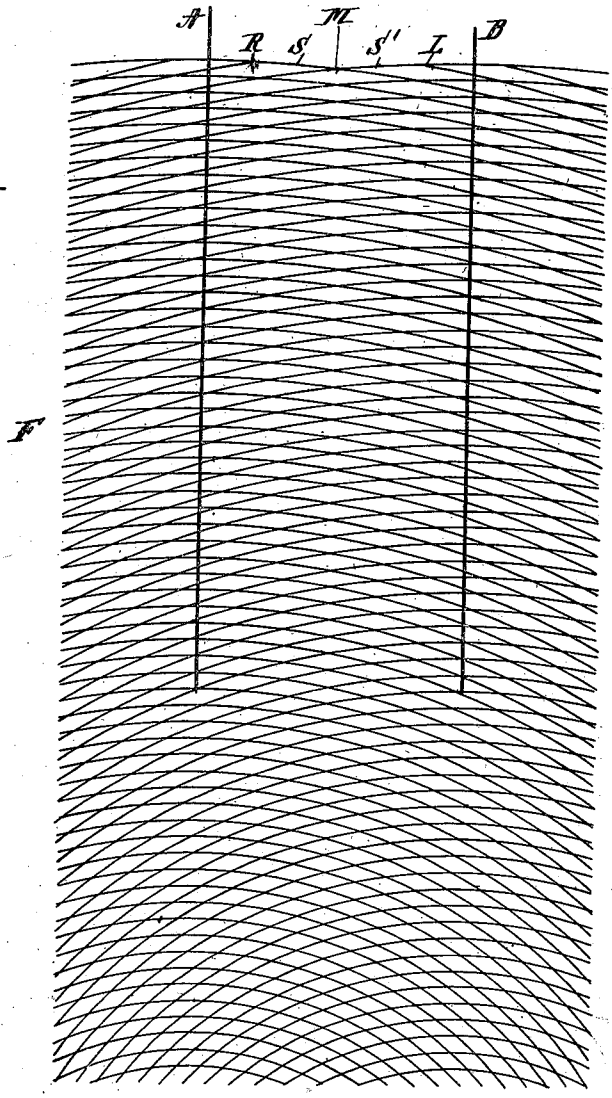
3 SHEETS—SHEET 2.

Fig. 2.



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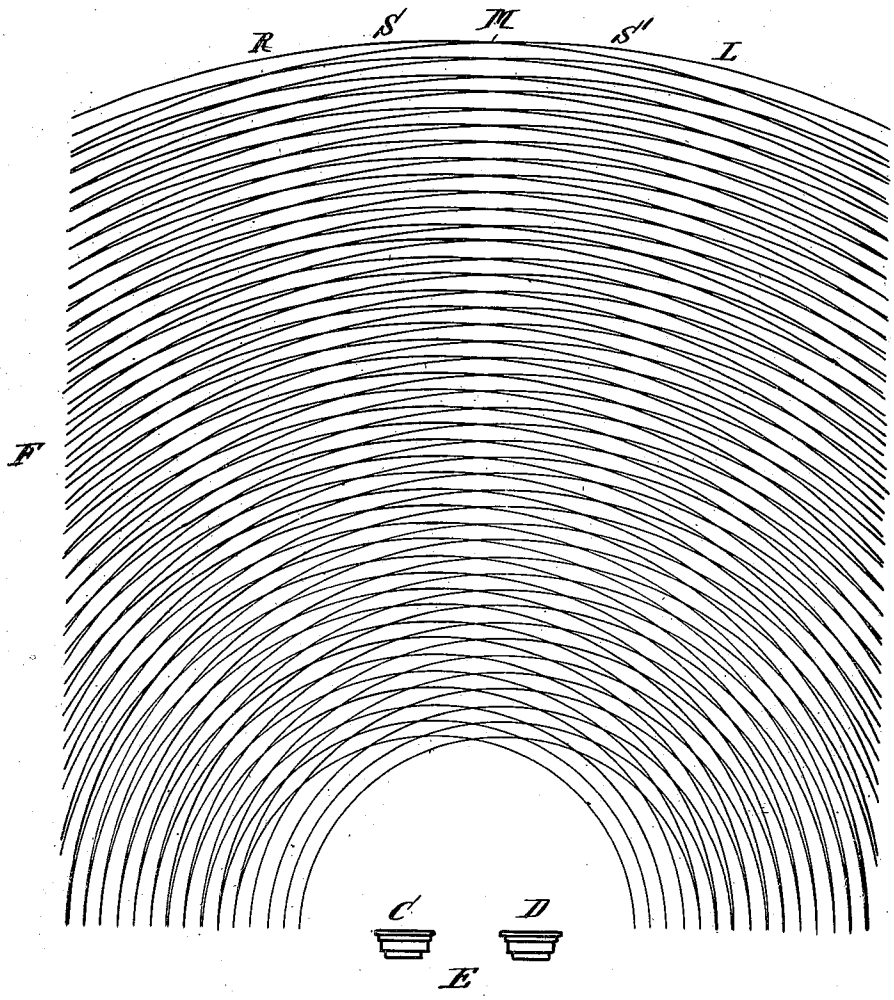
3 SHEETS—SHEET 3.

Fig. 3.



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UNITED STATES PATENT OFFICE.

REGINALD A. FESSENDEN, OF BROOKLINE, MASSACHUSETTS, ASSIGNOR TO SUBMARINE SIGNAL COMPANY, OF PORTLAND, MAINE, A CORPORATION OF MAINE.

SOUND-SIGNALING.

1,384,029. Specification of Letters Patent. Patented July 5, 1921.

Application filed March 22, 1917. Serial No. 156,718.

To all whom it may concern:

Be it known that I, REGINALD A. FESSENDEN, of Brookline, in the county of Norfolk and State of Massachusetts, a citizen of the United States, have invented a new and useful Improvement in Sound-Signaling, of which the following is a specification.

My invention relates to signaling by means of sound, and more particularly to submarine signaling, and still more particularly to submarine signaling by the use of interference fringes of sound waves for piloting ships through channels.

The object of my invention is to produce localized sound signals and more particularly to produce localized sound signals in the shape of interference fringes *i. e.*, spaces where the sound is more concentrated than in other spaces, and to utilize sound spaces or sound paths of different intensities to guide ships along channels, and for other purposes for which my invention may be adapted.

In the accompanying drawing, forming a part of this disclosure, Figure 1 shows diagrammatically a suitable method for carrying out my invention.

Figs. 2 and 3 show diagrammatically the interaction of the sound waves.

14 is a channel having a bend marked by the buoys 20 and 21 and thereafter continuing at an angle as shown at 15.

11 and 12 are two oscillators of the type disclosed in United States Patent No. 1,167,366, dated January 4, 1916.

These oscillators are placed side by side and are so connected as to be in phase with each other.

When this is the case, at all points along the line at right angles to the line joining the centers of the diaphragms of the two oscillators the sound waves from each oscillator will arrive with the same phase, and consequently there will be shown an intense sound proportional to the square of the number of oscillators along this direction, which in the arrangement shown in the diagram passes down the center of the channel 14, while at points to the right and left of this line the waves from the two oscillators will arrive at different phases, and consequently the sound will be less along the lines 17 and 18.

Proceeding outward there will be another pair of loci of minimum audibility, along the lines 16 and 19, etc.

If the two oscillators be arranged to operate 180 degrees in phase, then the direction of minimum audibility will pass down the channel and 17 and 18 will be lines along which the sounds will be of greater audibility as will also be the lines 16 and 19.

Assuming the latter condition, the vessel 13 entering the channel 14 from the channel 15 will receive a minimum amount of sound on the sound receivers 22 and 23, installed on it, as long as it is in the middle of the channel 14. If, however, it moves either to the right or the left the sounds will greatly increase.

This invention is particularly useful in places such as the Panama Canal where vessels have to travel in channels and where on account of the fog the channel marks cannot be seen till close up. In such cases the beam of sound produced by sound interference enables the captain to keep in the middle of the channel until he reaches the place where he can see the buoys marking the point of turning.

An additional advantage of this method is that where the sound waves from a number of sound sources coincide, the intensity of the sound is n^2 times that of the intensity of a single wave. The sound is strongly concentrated along certain lines or at certain points, and in this way the effect is obtained of a much stronger source of sound. For example, four crests coinciding together from four sources of sound gives sixteen times the intensity of a single source, *i. e.*, are equivalent at the point where they coincide to a source of strength 16.

My invention is also applicable to many other uses, wherever it is desired to localize sound at a distance from the source.

Figs. 2 and 3 show diagrammatically the interaction of sound waves proceeding from the oscillators C and D, the oscillators in the one case being placed closer than in the other. It is well known that sound waves from a given source proceed in a manner similar to light waves and in each of these views the sound waves as a whole are lettered F: The sets of sound waves from the two oscillators C and D will interfere. A and B being the sides of the channel, M will be the middle beam of comparative silence

when the waves from each oscillator cross or interfere. R and L are similar silence beams while S and S^1 are sound beams when the waves from one source of sound do not interfere with those from the other. Thus there is an interaction between the two sets of sound waves which provides a well defined course provided by my invention by which a vessel may be directed between the sides of the channel. Such a course may be seen by placing the eye near the point E of the drawing and looking along the surface of the drawing.

What I claim as my invention is:—

1. As a means of producing localized distribution of sound, a plurality of sound sources each located to act as a separate source and means for operating them in a predetermined phase relation with each other and interacting with each other to produce interference fringes of sound.

2. A method of producing localized sound signals which consists in arranging a plurality of sound sources at a predetermined distance apart whereby each will act as a separate source and exciting said sources at a predetermined frequency and with a predetermined phase relation between each other and interacting with each other to produce interference fringes of sound.

3. In a submarine signaling system, the method of guiding ships in channels which consists in throwing, by means of interference fringes produced by a plurality of sound sources located whereby each will act as a separate source, beams of sound of different intensity along the course of the channel.

4. In a submarine signaling system, the method of guiding ships in channels, which consists in exciting a plurality of sound sources arranged at a predetermined distance from each other and at a predetermined distance apart sufficient to cause each to act as a separate source, whereby sound waves having a predetermined frequency and phase relative to each other will be established and will cause interfering fringes at predetermined points along the channel.

5. That method of guiding a ship in its course which consists in exciting a number of sources of sound arranged at a predetermined distance and direction from each other said distance being sufficient to cause each to act as a separate source and excited at a predetermined frequency and phase relatively to each each other, whereby at certain positions the waves will coincide and the sound intensity thereof at such positions will be greatly in excess of the sum of the normal intensities of the separate sources.

6. That method of guiding a ship in its course, which consists in exciting a number of sources of sound arranged at a predetermined distance and direction from each other said distance being sufficient to cause each to act as a separate source and excited at a predetermined frequency and phase relatively to each other, whereby at certain positions the waves will coincide and the sound intensity thereof at such positions will be proportioned to the square of the number of sound sources instead of proportioned to their sum.

REGINALD A. FESSENDEN.