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R. L. WILLIAMS
MEANS FOR PRODUCING SOUND

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2 Sheets-Sheet 1

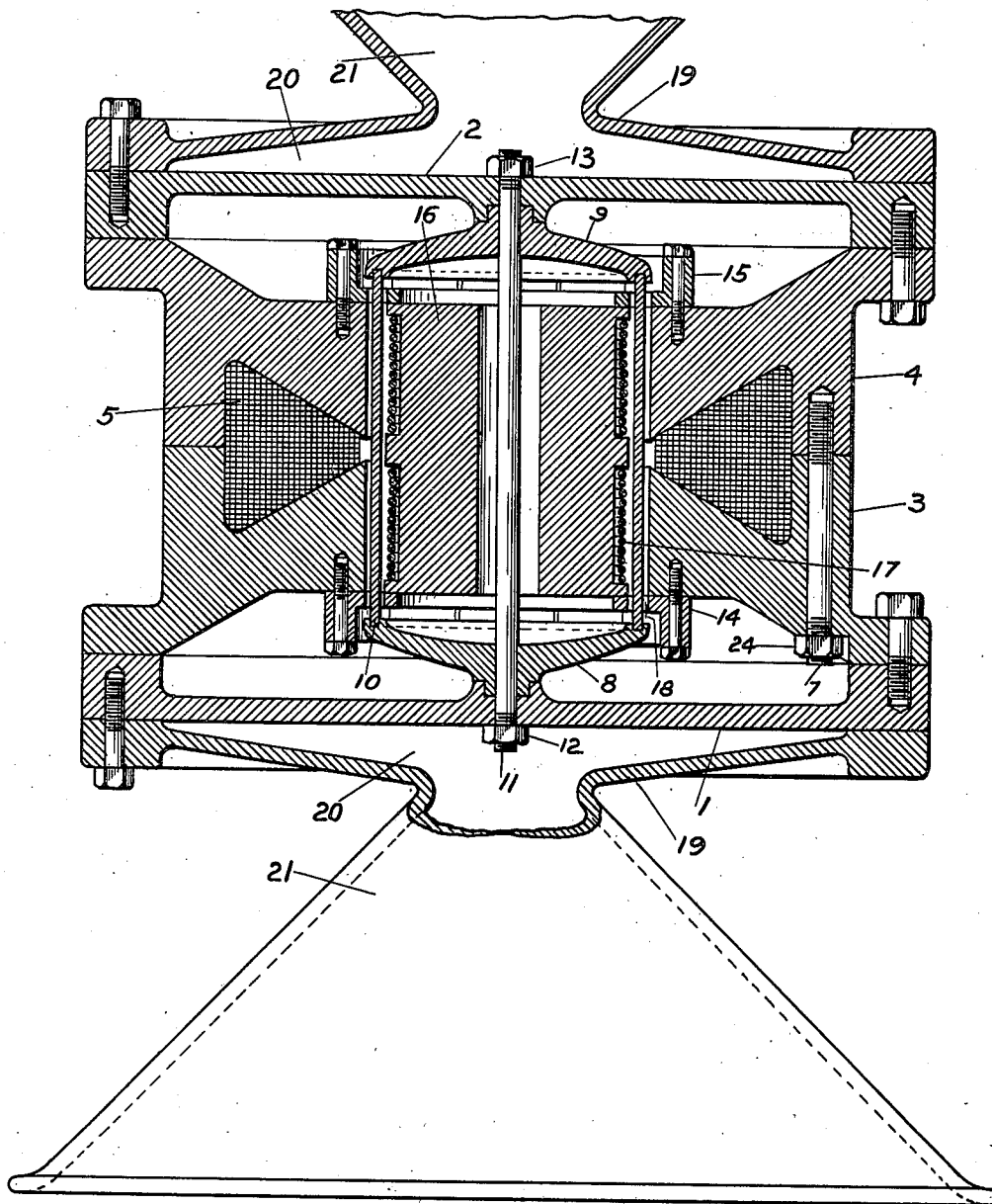


Fig. 1

INVENTOR

Robert L. Williams.

BY *Ezekiel Wolf*
ATTORNEY

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2 Sheets-Sheet 2

Fig. 2

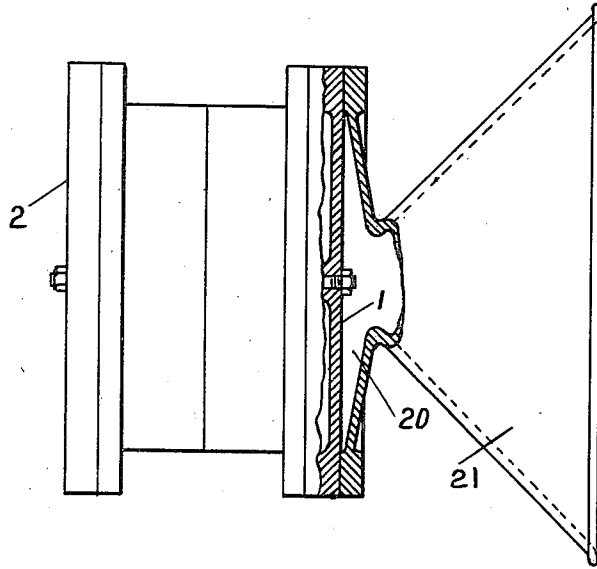
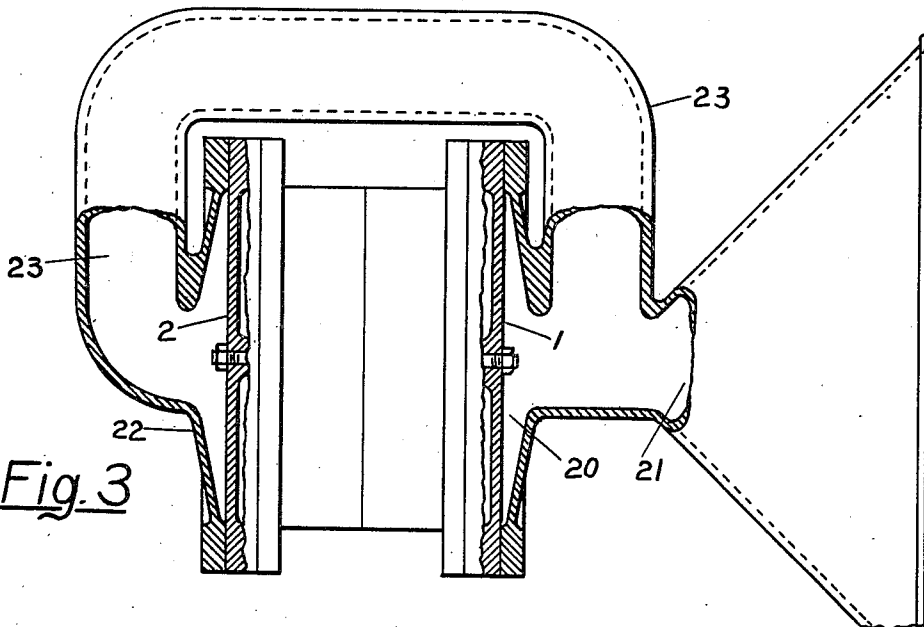


Fig. 3



INVENTOR

Robert L. Williams.

BY

Ezekiel Wolf

ATTORNEY

UNITED STATES PATENT OFFICE

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MEANS FOR PRODUCING SOUND

Robert Longfellow Williams, Newton, Mass., assignor to Submarine Signal Company, Boston, Mass., a Corporation of Maine

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4 Claims. (Cl. 177—7)

This invention relates to air signaling devices, particularly to the class of air signaling devices having a relatively large sound output such as is used for fog signaling from ships, lightvessels, shore stations, etc., or for fire alarm signaling, or for any purpose where a large sound output is required.

The object of the invention is to produce a sound signaling device having a particularly large sound output.

A further object is to produce a device of this type having increased range and increased efficiency over devices previously used for this purpose.

Sound producers which produce sound by the periodic motion of a diaphragm are often termed oscillators. Oscillators of both the electromagnetic and electrodynamic types have for some time been employed for signaling under water. For signaling in air, however, the electromagnetic type has chiefly been used. The electromagnetic oscillator is particularly well adapted for signaling under water. In this case, on account of the incompressibility of the water, the radiating element or diaphragm can only have an extremely small amplitude, even smaller than it is practical to make the air gap between the electromagnet and the armature. The electromagnetic oscillator has inherently a small vibration amplitude, since, for best efficiency the air gap between the armature and the magnet poles must be kept small. Therefore, in signaling under water, good efficiency is not prevented by any restriction in the smallness of size of the air gap.

In air, however, a large amplitude of motion of the diaphragm is required. It is evident, therefore, that the electromagnetic type of oscillator is distinctly limited in output for air signaling by the armature striking the pole faces. The air gap between the two cannot be increased, since it must be kept small in order to obtain good efficiency.

In order to avoid this limitation inherent in electromagnetic oscillators, I employ an electrodynamic type of oscillator wherein the maximum diaphragm amplitude is limited only by the elasticity of the diaphragm. I furthermore employ two diaphragms whose centers are rigidly connected together and which vibrate in unison. I also tune the driving element, which is directly connected and vibrates in unison with the diaphragms, to a very high pitch relative to the diaphragm, or in other words, I make the driving element as rigid as possible.

The details of operation and construction of my invention will be apparent from the description below, together with the drawings in which Figure 1 shows a cross-section of my invention in detail;

Figure 2 shows a modification of the device shown in Figure 1; and

Figure 3 shows a further modification.

Figure 1 shows my air signaling device in detail. Two circular diaphragms 1, 2, are rigidly connected together at their peripheries by the field magnets 3, 4, which are excited by a coil 5, energized by direct current. The field magnets 3, 4, are held together by the studs 7 and the nuts 24. Into a boss on each diaphragm is fitted a conical or cupped disc 8, 9 made of aluminum alloy, such as duralumin, the discs being tuned to a very high frequency relative to the diaphragms.

A copper tube 10 is mounted between the discs, fitting into grooves or mounted in some other suitable manner at the peripheries of the discs. The diaphragms 1, 2, are also connected at their centers by a tie-rod 11 which passes through the axis of the copper tube, through the centers of the discs 8, 9, and the diaphragms 1, 2, and is secured to the latter by means of the nuts 12, 13.

Two brass rings 14, 15, fastened to the field magnets, support the steel core 16 within the copper tube. On the core is wound the alternating current winding 17. The brass rings have slots 18 through which pass ears cut in the edges of the copper tube 10, the tube being, therefore, free to move independently of the field magnets and core.

A horn 19, secured to the outer face of the diaphragm, forms a resonating chamber 20 and the horn chamber 21. The resonating chamber and the horn chamber are designed to transfer the vibratory energy of the diaphragm to the outside atmosphere. The diaphragms, resonating chambers and horns are all tuned in the manner best adapted to transfer the sound energy to the atmosphere with the best transmission efficiency. For example, the mechanical oscillating system comprising the two diaphragms, the connecting discs and the copper tube may be tuned as a whole to have a natural frequency equal to the signaling frequency. The resonating chamber with the horn may likewise be tuned to the signaling frequency.

The field magnet 3 forms the north pole and magnet 4 the south pole. The magnetic flux due to coil 5 flows from magnet 3 through the

air gap in which the tube 10 is situated, to the core 16, through the second air gap to magnet 4, and thus back to magnet 3.

Coil 17 forms the primary of a transformer of which the tube 10 is the secondary. Since the tube is situated in an intense magnetic field, the alternating current induced in the tube by the alternating flux due to the current in winding 17 causes the tube to move back and forth in the direction of its axis at the frequency of the current traversing the winding 17.

The motion of the tube is communicated to the diaphragms by means of the conical or cup-shaped discs 8, 9. Since these are made of a material of great rigidity, even though of light weight, practically no bending takes place in them, but the motion is directly transmitted to the diaphragms. The whole mechanical oscillating structure can therefore be made very light in weight. However, the mass of the copper tube plus the conical discs is as large as or larger than the effective mass of the diaphragms, whereby the diaphragms will have a motion as large as or larger than that of the copper tube. Furthermore, since the diaphragms are rigidly connected at their centers by the rod 11, they must move in unison and with the same frequency as the copper tube 10. The sound waves produced by one diaphragm are, therefore, 180° out of phase with the sound waves produced by the other, since the first produces a rarefaction of the air, while the second is producing a condensation.

The manner in which my invention is constructed produces a relatively light oscillating structure, whereby I am able to radiate with good efficiency large amounts of power, i. e., of the order of several kilowatts. My oscillator in actual test has been heard for great distances and in competition with other sound producing devices has proven superior in carrying power.

As shown in Figure 1, a resonating chamber 20 and horn 21 are attached to each diaphragm whereby sound is radiated in all directions.

For signaling in one direction only, such as is often desirable, as for instance in fog signaling from shore stations, the arrangement shown in Figure 3 may be employed. In this case a resonator 22 is mounted on the second diaphragm. From this resonator, a sound conducting tube 23 leads to the resonator 20 on the first diaphragm, the sound being then passed to the horn 21 and out to the atmosphere. The sound tube 23 must, however, be of a length equal to one-half a wave length of the sound produced, in order that the sound from this diaphragm will be in phase with the sound from the first diaphragm by the time it reaches the resonator 20. The sound wave produced by the two diaphragms will therefore be additive.

If desirable, the resonator and horn may be omitted from one diaphragm, as illustrated in Figure 2. In this case, the diaphragm on which

the resonator is mounted has the greater load and radiates the greater amount of acoustic energy, the sound output of the second diaphragm being extremely small.

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

What I claim is:

1. An electrodynamic sound producer comprising a plurality of parallel spaced diaphragms, an electrodynamic driving mechanism including a tube adapted to move by the action of the electrical force arranged between and perpendicularly to the said diaphragms, a pair of substantially rigid cup-shaped elements having their edges positioned at and fitting over the ends of the said tube, said diaphragms being positioned on the other side of said elements contacting at the center thereof, and means rigidly securing said diaphragms, elements and moving tube as one unit.

2. An electrodynamic sound producer comprising a plurality of parallel spaced diaphragms, an electrodynamic driving mechanism including a longitudinally oscillating tube arranged between and perpendicularly to the said diaphragms, a pair of dished substantially rigid plate elements having a groove near the outer edge on one side fitting said tube and a boss on the center on the other side fitting into a recess at the center of the diaphragm, and a rod passing through said center from one diaphragm through the other forming a rigid unit.

3. An electrodynamic sound producer comprising a plurality of parallel spaced diaphragms, means for clamping said diaphragms at the periphery thereof, an electrodynamic driving mechanism including a longitudinally oscillatory driving tube arranged between and perpendicularly to the said diaphragms, a pair of substantially rigid cup-shaped elements positioned at and fitting over the ends of the said tubes, said diaphragms being positioned on the other side of said elements contacting at the center thereof, and means passing through said diaphragms for securing the moving elements as a single unit.

4. An electrodynamic sound producer comprising a plurality of parallel spaced tuned diaphragms, means for clamping said diaphragms at the periphery thereof, an electrodynamic driving mechanism including a longitudinally oscillatory driving tube arranged between and perpendicularly to the said diaphragms, a pair of dished rigid plate elements, having a tuning substantially ultra audible positioned at and fitting over the ends of the said tubes, said diaphragms being positioned on the other side, of said elements contacting at the center thereof and means passing through said diaphragms for securing the moving elements as a single unit.

ROBERT LONGFELLOW WILLIAMS.