United States Patent [19]

Dodge

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[54] **SOUND SIGNALING SYSTEM HAVING ADJUSTABLE HORIZONTAL DIRECTIVITY**

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[21] Appl. No.: **124,033**

[52] **U.S. Cl.** .....**116/137,** 181/31 B, 340/384

[51] **Int. Cl.** **B06b 3/00**

[58] **Field of Search** .....116/137, 137 A, 142, 116/142 FP; 181/31 B; 340/384 R, 384 E

[56] **References Cited**

UNITED STATES PATENTS

987,038	3/1911	Berrenberg	116/137
3,138,667	6/1964	Avedon	181/31 B X
3,153,783	10/1964	Whitehead	340/384 R
3,179,202	4/1965	Cole et al	181/31 B
3,214,753	10/1965	Dodge	340/384 E
3,229,448	1/1966	Jacke	116/137 A X
3,517,390	6/1970	Whitehead	340/384 R

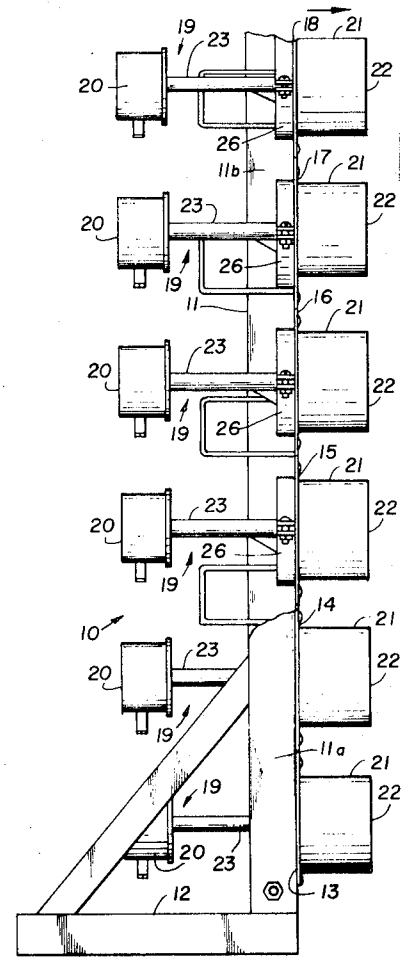
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Attorney—Hyer, Eickenroht, Thompson & Turner

[57] **ABSTRACT**

A sound signaling system is disclosed which includes a vertical frame having a plurality of sound baffles mounted on the frame in vertical alignment, and a plurality of sound transmitters each mounted on one of said baffles to form a vertical array of sound transmitters. Each of the sound transmitters is mounted on its respective baffle by a mounting means which permits the mouth of the sound generator to be adjusted with respect to the baffle from a first position in which the vertical array emits sound signals in a relatively narrow horizontal pattern to a second position in which the array emits such signals in a relatively broader horizontal pattern.

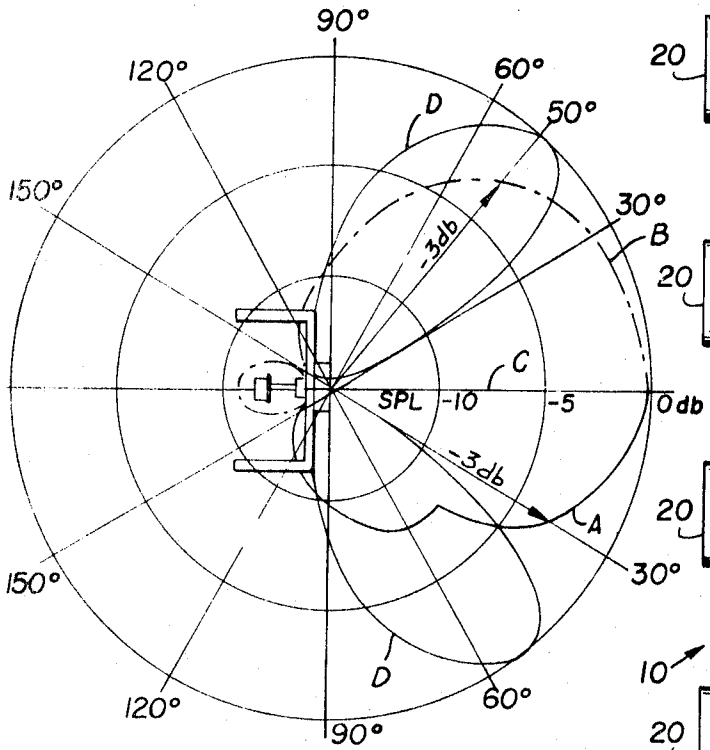
3 Claims, 7 Drawing Figures



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SHEET 1 OF 2



HORIZONTAL DIRECTIVITY

Fig. 7

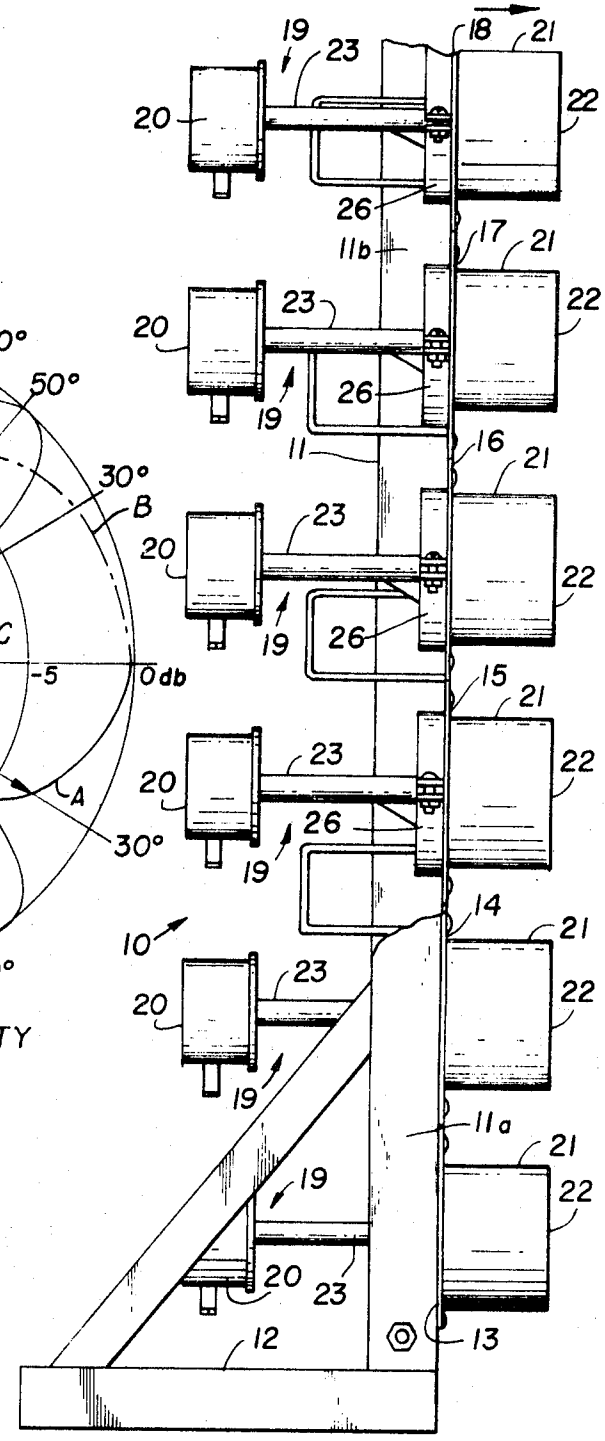


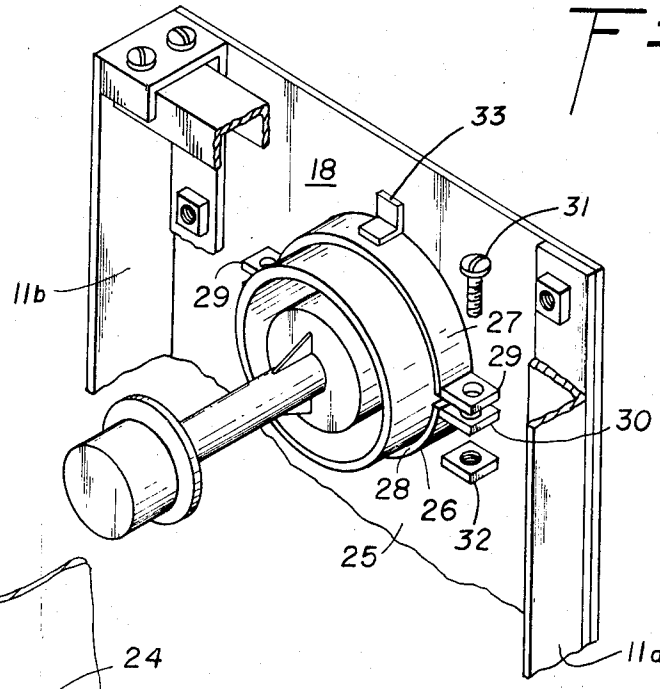
Fig. 1

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Fig. 2



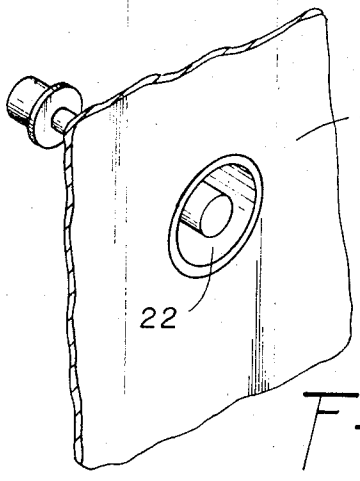


Fig. 6

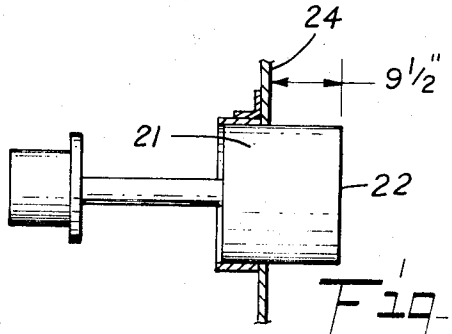


Fig. 3

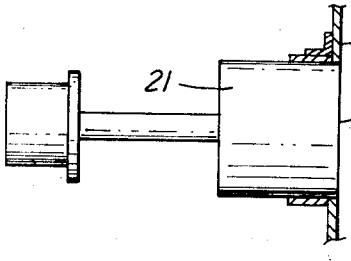


Fig. 4

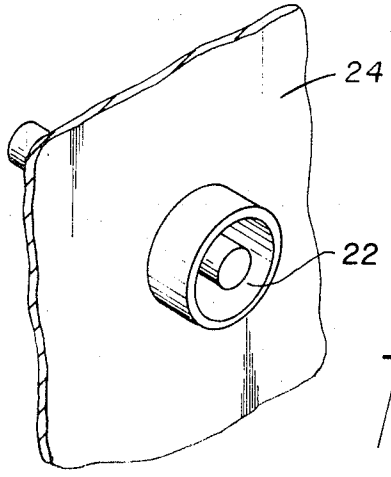


Fig. 5

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SOUND SIGNALING SYSTEM HAVING ADJUSTABLE HORIZONTAL DIRECTIVITY

This invention relates to a sound signaling system in which the horizontal directivity of the emitted sound is adjustable.

It is often desirable to control the horizontal sound radiation pattern of a sound warning signal, such as a fog warning system, in order to concentrate the sound in a certain direction, or to broaden the horizontal angle of coverage of the radiated sound. A narrow horizontal pattern of radiation provides a more efficient use of the available energy so that less energy is required to achieve a desired sound level, and this is a particular advantage where the fog signals are battery powered and at remote locations. It is also desirable at times to concentrate the sound in certain directions to reduce possible annoyance or interference.

The horizontal angle of coverage of a sound transmitter depends in part on the dimension of the mouth of the horn with respect to the wavelength of the fundamental tone. Sound warning signals generally employ low frequencies in the range of 300 to 500 Hz as these are the most effective frequency ranges for the range of signaling required, for example, from 2 to 5 miles. The wavelengths of such sound signals are generally from about 2 to 4 feet. A typical vertical array for such applications is illustrated in my prior patent U.S. Letters Pat. No. 3,214,753 entitled "Sound Signal System" issued Oct. 26, 1965. However, the mouth dimension of a practical transmitter in such a vertical array is usually small compared with these wavelengths and the radiation pattern will generally cover large horizontal angles of plus or minus 60° or greater with a sound intensity of −3 db.

In order to increase the efficiency of the sound in such arrays and reduce the angle of radiation, baffles are often used in conjunction with the sound transmitters. However, in the past sound transmitters have been mounted on such baffles in a manner so that the only possible way of adjusting the horizontal directivity of the sound pattern was to change the baffle. Thus, no simple and efficient device has been provided for providing adjustment of a sound transmitter on its particular baffle to permit a vertical array of sound transmitters to emit signals in a sound radiation pattern having a relatively wide horizontal angle of, for example, plus or minus 60° at a sound intensity of −3 db, while permitting the same vertical array to emit, when desired, sound signals in a sound radiation pattern having a relatively narrower sound pattern such as plus or minus 30° a sound intensity of −3 db. It is the primary object of this invention to provide such a device.

Another object of this invention is to provide an adjustable sound signaling system in which a single vertical array of sound transmitters may emit sound in such relatively narrow and relatively broad horizontal patterns without the necessity of changing baffles.

Another object of this invention is to provide a simple baffle and horn mounting arrangement which permits such adjustment.

Another object of this invention is to provide such a baffle and sound generator mounting arrangement which readily permits such adjustment in the field.

Another object of this invention is to provide a single vertical array of sound transmitters which can be used to provide sound signals in a plurality of different sound patterns without the need of a different such array for each desired sound pattern.

These and other objects of this invention are provided, in the preferred embodiment illustrated, by providing a sound signaling system which includes a vertical array of sound transmitters each of which is mounted on a baffle. Mounting means, such as an adjustable clamp, is provided for mounting each sound transmitter in its respective baffle to permit adjustment of the sound transmitters from a first position in which the vertical array emits sound signals in a relatively narrow horizontal sound radiation pattern to a second position in which the array emits such signals in a relatively broader horizontal sound radiation pattern.

In the drawings, wherein is described a preferred embodiment of this invention and wherein like reference numerals are used throughout to designate like parts,

FIG. **1** is an elevational view of a vertical array utilizing this invention;

FIG. **2** is a perspective view showing the mounting of one of the sound transmitters of FIG. **1** on its baffle;

FIG. **3** is a side view in partial section showing one mounting position of the sound transmitters of FIG. **2**;

FIG. **4** is a side view in partial section showing another mounting position of the sound transmitter of FIG. **2**;

FIG. **5** is a partial perspective view of the front of the apparatus of FIG. **2** showing the sound transmitters in mounting position of FIG. **3**;

FIG. **6** is a partial perspective view of the front of the apparatus of FIG. **2** showing the sound transmitter in the mounting position of FIG. **4**; and

FIG. **7** is a graph illustrating the relative horizontal directivity of the sound patterns emitted by the vertical array of FIG. **1.**

In the drawings, FIG. **1** illustrates a vertical array **10** which includes a vertical frame **11** mounted in a vertical position on a suitable base plate **12.** Vertical frame **11** is made of two spaced-apart vertically extending angle beams **11***a* and **11***b* and suitable cross bracing and, of course, can be of any suitable arrangement which permits the mounting of a plurality of sound transmitters in a suitable array. The illustrated array **10** is particularly useful as a fog horn for mounting on offshore structures, such as an offshore drilling platform.

A plurality of baffle plates **13, 14, 15, 16, 17** and **18** are mounted in vertical alignment, i.e., one above the other, across array **10** and between parallel extending beams **11**a and **11**b. A plurality of sound transmitters **19** are mounted in array **10,** and each of transmitters **19** is mounted on one of the baffles **13** through **18,** as illustrated in FIG. **1** and as hereafter described. Each of sound transmitters **19** includes an acoustical driver **20** and a horn portion **21** open at its end to form a horn mouth **22** through which sound is emitted. In the preferred embodiment illustrated, horns **21** are cylindrical in cross section and the length and diameter of horns **21** are dependent on the frequency of the emitted sound signal. Of course, other shapes and configurations of horn portion **21** could be utilized with this invention.

Each of sound transmitters **19** also includes a tubular member **23** acoustically coupling the sound drivers **20** to horns **21.** Acoustical drivers **20** convert electrical energy into acoustical energy, and each of drivers **20** is connected to a suitable electronic source (not shown) of electrical driving signals in the audio frequency

range, for example, 200 to 500 Hz to provide the necessary driving signals.

FIG. 2 illustrates the mounting of one of the sound transmitters **19** on, for example, baffle plate **18**; it being understood that each of these sound transmitters is mounted on its respective baffle plate in similar fashion. Each of baffle plates **13** through **18** includes a circular opening through it slightly larger than the outside diameter of horn portion **21**, a forward wall **24** illustrated in FIGS. **5** and **6** and a rearward wall **25**, as illustrated in FIG. **2.** Baffles **13** through **18** may be made of aluminum or other suitable material for reflecting sound. As illustrated by the arrows in FIGS. **1** and **2**, the forward wall of each of baffles **13** through **18** faces in the direction in which sound is emitted from vertical array **10**, and each of sound transmitters **19** extends through the circular openings in one of baffles **13** through **18**, so that sound is emitted from its mouth in this forward direction.

An important feature of this invention is the mounting of each of transmitters **19** to permit positioning of their mouth **22** with respect to forward wall **24** to provide adjustment of the horizontal directivity of the sound radiation pattern of the vertical array **10.** To permit such mounting, an adjustable clamp **26** is provided for mounting each of sound transmitters **19** on its respective baffle **13** through **18.** Clamp **26** includes two semicircular portions **27** and **28**, and clamping ears **29** and **30**, respectively, extending laterally from each of portions **27** and **28.** Each of semicircular portions **27** and **28** are mounted about horn portion **21** on the rearward wall **25** side of the respective baffle plate, illustrated as plate **18** in FIG. **2.** Semicircular portions **27** and **28** are mounted so that ears **29** and **30** are aligned opposite each other and spaced apart, and bolts **31** pass through suitable openings in ears **29** and **30**, and are screwed into nuts **32.** When nuts **32** are tight, horn **21** is securely mounted in baffle **18** at a selected position, for example, the position illustrated in FIGS. **3** and **5** when mouth **22** is at a fixed distance such as 9½ inches from wall **24.** However, when these nuts are loosened sufficiently, horn **21** can be moved in baffle **25** to another position, such as the position illustrated in FIGS. **4** and **6**, where mouth **22** is substantially flush with wall **24** of baffle **18.** To ensure that clamp **26** mounts horn **21** securely in baffle **18**, one of clamp portions **27** and **28** can be rigidly secured to back wall **25** by an L-shaped member **32** by bolts or welding (not shown).

As noted, in the preferred embodiment illustrated, horn mouth **22** may be extended beyond wall **24** of baffle **18** by a distance of some 9½ inches, as shown in FIGS. **3** and **5.** The resulting sound radiation pattern for this position is shown in FIG. **7** as ±30° to −3db, by the line indicated by the letter A. When mouth **22** is withdrawn to a flush position, now illustrated in FIGS. **4** and **6**, the horizontal coverage is increased to ±50°, which is shown by the line indicated by the letter B. It should also be noted that with the horn mouth in the extended position of FIGS. **3** and **5** and with the narrower horizontal radiation pattern, sound radiated at 0°, or on axis C in FIG. **7**, is increased in intensity by 3db. This is an increase of **2** times the radiated sound power on axis C for the same power input. On the other hand, the broader sound pattern B provides less radiated energy at 0° but a wider area of effective coverage.

This adjustment of the sound pattern results from the adjustment of the position of mouth **22** in front of baffle **18.** The sound is radiated from mouth **22** or slightly in front of mouth **22**, in the preferred embodiment shown. By adjusting the position of this apparent source with respect to the baffle face, the horizontal directivity can be changed. The pattern is influenced by the direct radiation from the mouth and by the radiation which originates at the source and travels to the baffle, and hence, reflected from the baffle. By adjusting the source to baffle distance, the phasing of the direct and reflected waves may be controlled. For example, when the baffle to mouth distance is adjusted so that the reflected wave at 0° travels a total distance equal to one wave length, or multiples of one wave length, greater than that of the direct wave radiation at 0°, the waves add so as to reinforce the total sound radiated at 0°. Sound radiated at other than 0° is decreased, and the directivity pattern is narrowed.

Other directivity patterns may be obtained by different adjustments of the mouth to baffle distance. For example, when the 0° path (axis C) difference is equal to a one-half wave length, a cancellation of the sound radiated at 0° results. The major radiation will occur at angles of approximately ±60° as shown in FIG. **7** by the two lobes on each side of axis C indicated by the letter D. Such a radiation pattern is useful for signaling by a fog signal up and down a channel or river. It should be noted that even though the horn mouth could be fixed in the baffle at the desired position at the time of manufacturing to provide a desired pattern, the feature of adjustability provided by this invention permits field adjustment of the sound pattern; also, only one model of a vertical array need be manufactured rather than a multitude of models required for different sound patterns.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. A directional sound signaling system, comprising, in combination: a vertical frame; at least one sound baffle mounted on said frame in vertical alignment; a plurality of sound transmitters each mounted on at least said one sound baffle to form a vertical array, each of said sound transmitters including a sound driver and a horn acoustically coupled to the sound driver, said horn extending through said baffle and including a mouth opening to emit sound forward of the baffle; and mounting means for so mounting each of said sound transmitters in at least said one baffle to permit adjustment of each of said sound transmitters from a first position with respect to such baffle in which said vertical array emits sound signals in a relatively narrow horizontal pattern to a second such position wherein said array emits such signals in a relatively broader horizon-

tal pattern, said mounting means adapted to mount said horn to permit adjustment of the horn from one of said positions with the opening in said mouth substantially flush with said forward wall of said baffle, to the other of said positions with said opening at a distance forward of said wall.

2. The sound signaling system of claim **1** wherein said horn is cylindrical and said mounting means is a split clamp encircling said horn and including a semicircular first section mounted on said baffle and a semicircular second section connected to said first semicircular section, and means so connecting said first and second semicircular sections to permit movement of one of said sections with respect to the other for tightly engaging said horn in said clamp to permit said horn to be secured at one of said first or second positions, and for loosely mounting said horn in said clamp to permit movement of said horn through said baffle to the other of said first and second positions.

3. Sound transmitting apparatus for emitting sound in a plurality of sound patterns comprising, in combination: a baffle including an opening therein and having a forward wall facing the direction in which sound is to be emitted; a sound transmitter including a cylindrical horn portion extending through said opening, said horn portion having a mouth opening to emit sound in said direction, and mounting means for mounting said horn position in said opening to permit adjustment of the position of said mouth opening with respect to said forward wall, said mounting means being a split clamp encircling said horn and including a semicircular first section mounted on said baffle and a semi-circular second section connected to said first semicircular section, and including means so connecting said first and second semicircular sections to permit movement of one of said sections with respect to the other for tightly engaging said horn in said clamp to permit said horn to be secured in said clamp and for loosely mounting said horn in said clamp.

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