May 5, 1931. R. C. BENDER 1,804,306

ACOUSTIC DEVICE

Filed March 4, 1930 3 Sheets-Sheet 1

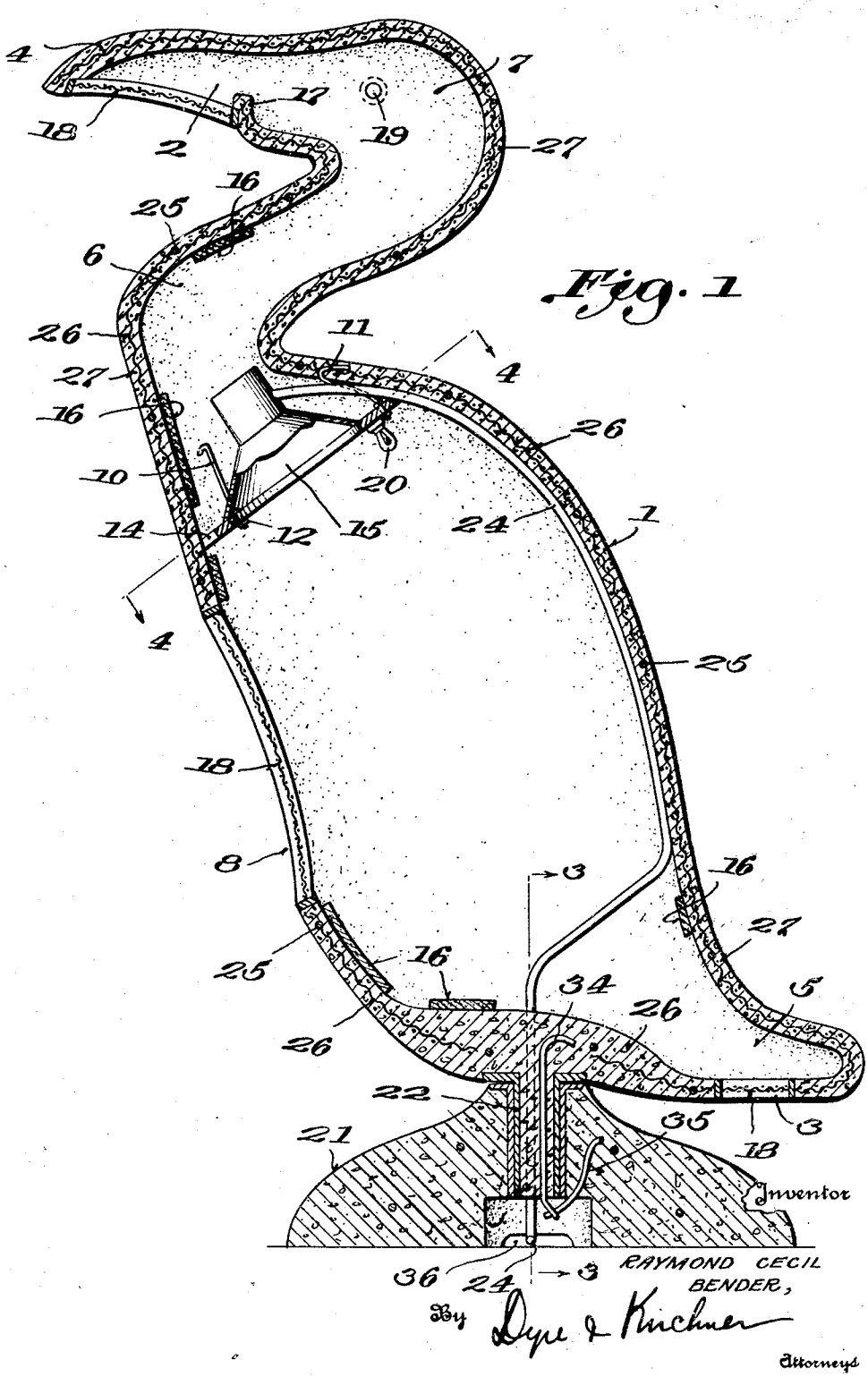


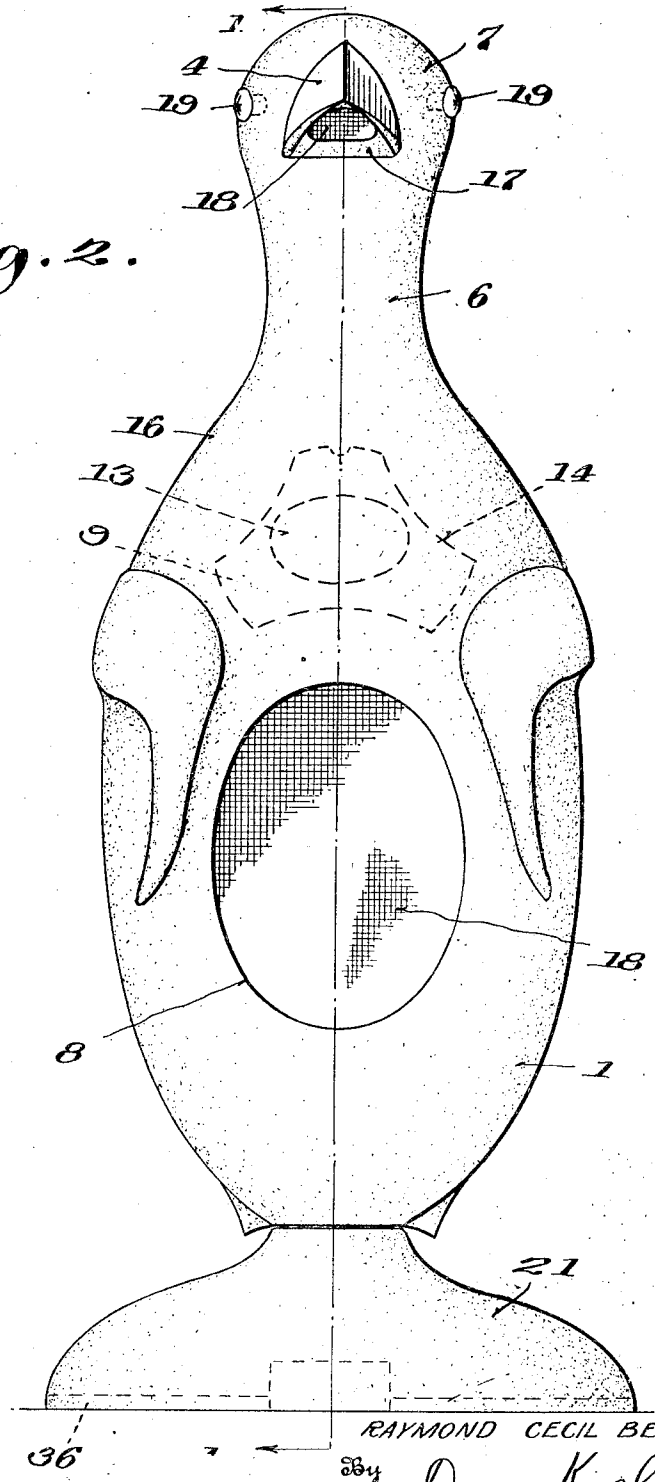
Fig. 1

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Fig. 2.



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Fig. 3.

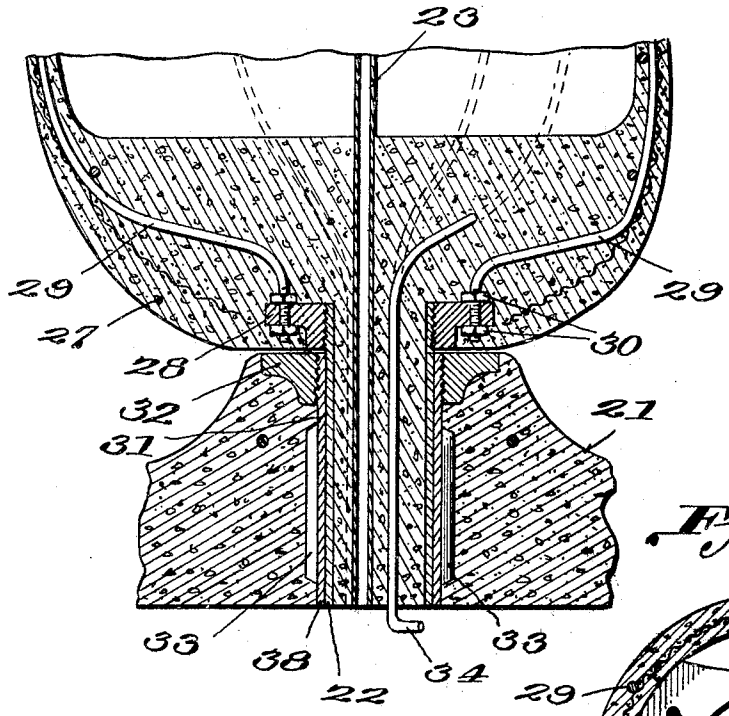


Fig. 4.

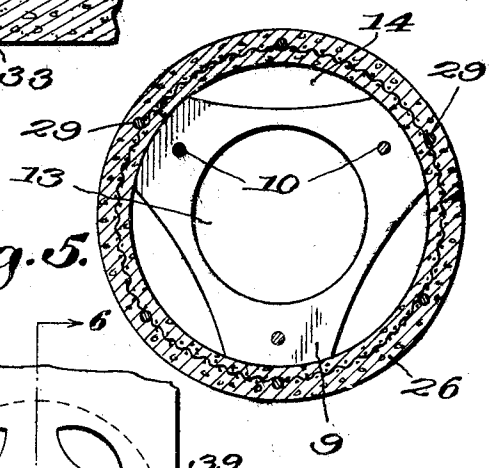


Fig. 6.

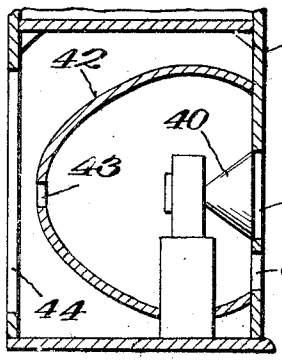
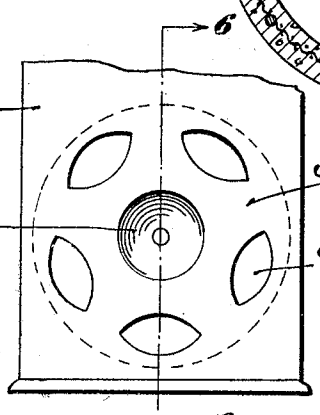


Fig. 5.



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UNITED STATES PATENT OFFICE

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ACOUSTIC DEVICE

Application filed March 4, 1930. Serial No. 433,077.

My invention relates to acoustic devices, and more especially to acoustic amplifiers for coupling a sound translating device, such as a sound emitting or sound responsive element, with the surrounding atmosphere, with particular reference to an amplifier or sound chamber for use with a sound emitting element of the type embodying an electromagnetically driven cone, to be used for the reproduction of radio broadcast signals, or electrical sound reproduction in general.

Among the objects of the invention are the following:

To generally improve the quality of sound reproduction in a device of the above type especially through the elimination of the harshness of tone and the added drumming sounds prevalent in the usual baffle board cone speaker or large exponential horn;

To provide a loud speaker having a horn or amplifying chamber of a shape operative to enhance the quality of reproduction and at the same time adaptable to embodiment in various decorative forms such as birds, mammals and other objects, without wide departure from its functional form;

To provide a novel arrangement of cone speaker and baffle board mounting whereby the sound waves emitted from the rear of the speaker may be utilized to reinforce those emitted from the front;

To provide a loud speaker adapted to outdoor use as in a garden or court without protection against weather, insects, small birds and the like.

Other objects and advantages of the invention will be apparent from the following specification and drawings accompanying the same.

In the drawings:

Figure 1 is a longitudinal cross sectional elevation taken on the line 1—1 of Fig. 2;

Fig. 2 is a front elevation;

Fig. 6 is an enlarged fragmentary cross section on the line 3—3 of Fig. 1;

Fig. 4 is a section on the line 4—4 of Fig. 1;

Fig. 5 is a fragmentary front elevation of a radio receiving set with baffle board speaker embodying the main feature of the invention; and

Fig. 6 is a section on the line 6—6 of Fig. 5.

Referring to the drawings in particular, the resonator or sound amplifying chamber 1 is generally egg-shaped in form and everywhere oval in section with continuously varying area of cross section throughout. This feature enables the device as a whole to be embodied in various different shapes such as that of birds, mammals, houses or other objects without departing from its required general form, the present embodiment of the device being in the form of a great auk. Because the dimensions preferably bear a given ratio to the wave length of the lowest tone to be transmitted the device is relatively large compared to the usual loud speaker, a device in the form here shown and actually built and operated being approximately eight feet in height.

The egg-shaped amplifying chamber is positioned with the smaller portion at the top and the larger portion at the bottom. A pair of relatively small sound openings 2 and 3 is provided at the ends of the chamber, one at the top or smaller end situated in the bottom of the beak 4 of the bird-shaped chamber, and the other at the bottom of the chamber in the bottom of the tail portion. The bottom small opening communicates with the main chamber 1 through a cone shaped extension 5 of the main chamber, forming the tail of the bird, while the top small opening 2 communicates with the main chamber through extended portions 6, 7 and 4 of the main chamber forming the neck, head and beak of the bird.

Intermediate the ends the chamber 1 is provided with a relatively large sound opening 8. Near the upper or smaller end of the amplifier chamber 1, intermediate the large opening 8 and the top small opening, is mounted a baffle board 9 by means of threaded rods or bolts 10 anchored in the walls of the chamber as indicated at 11 and secured to the baffle board by nuts 12. As shown in Fig. 4 the baffle board 9 is provided with the usual central sound opening 13, and in addition to this is formed to provide a series of sound openings or passages 14 surrounding the main opening. It will be obvious that in-

stead of providing these passages in the form of reentrant portions in the periphery of the board, they may take the form of openings of similar area within the periphery around the main central opening. A cone speaker or sound emitting device 15 preferably of the dynamic cone type is mounted on the baffle board on the top side thereof within the smaller end of the chamber so as to direct the sound waves emitted from the front or concave surface of the cone through the opening 13 downwardly toward the small opening in the inverted cone shaped extension 5 at the large end of the amplifying chamber, while the sound waves emitted from the back or convex side of the cone are directed into the smaller, upper portion of the amplifying chamber. This upper portion of the chamber, including its extension into the neck and head portions, being of general tapering form terminating at a relatively small opening 2, forms in effect a partial air impedance operating to pass a large portion of the higher tones which emerge through the opening at the beak, while reflecting or cushioning back a portion of the sound waves which pass down through the side openings in the baffle board into the lower or large portion of the chamber reinforcing those emitted from the front of the cone. I have found that the tone quality is greatly improved by making the length of this rear air impedance reflector, that is, the distance from the baffle board to the opening 2, at least one half the wave length of the lowest note which it is desired to reproduce. Also a large portion of the sound directed against the sides of the chamber from the back of the cone is reflected down through the side openings in the board to further reinforce the sound waves from the front of the cone.

At the bottom of the amplifying chamber, the inverted cone shaped extension 5 acts as an air impedance to reflect or cushion back a large portion of the lower components, permitting a large portion of the higher components to pass out through the lower small opening 3. Substantially all the lower components issue out of the main opening 8 and as this opening is in the side of the chamber in a plane parallel to the direction of propagation of the incident waves from the cone, only a relatively small amount of the waves pass directly from the dynamic speaker into the open air, the greater portion being permitted to build up within the chamber to the desirable point of sound efficiency. To this end it is preferable to make the distance from the cone speaker element to the lower small opening 3, not less than one half the wave length of the lowest note desired to be reproduced.

To enable this building up to take place without undue reverberation, I place within the chamber several absorption pads 16, at the places indicated, to effect the desired amount of damping. This application of the absorption pads together with the peculiar shape of the resonating or amplifying chamber, results in the elimination of the harsh resonance, drumming sound, and barrel tones prevalent in the usual dynamic speaker with baffle board, exponential horns and the like.

By arranging the upper opening 2 under the beak 4 and providing the short vertical water baffle wall 17 at the back of the beak, the upper opening to the atmosphere is shielded against the weather. To camouflage the several openings, especially the large opening 8, these are all covered with suitable screening material 18, which also enhances the tone effect and protects the interior of the device against insects and small birds and animals. For decorative effect electric light bulbs 19 are used for the eyes of the bird figure, and another light 20 is mounted within the amplifying chamber near the speaker, the lights 19 giving light to the beak opening and eyes, and the light 20 giving light to the body interior.

To enable the device to be positioned with the main opening 8 facing in any desired direction, it is mounted on the base 21 by means of a swivel connection 22 through which passes a conduit 23 for the admission of a suitable multiple conductor cable 24 for conveying current to the speaker element and electric light bulbs.

The casing or walls of the amplifying chamber and the base 21 may be constructed of any suitable material, preferably of some hard material, the present embodiment being constructed of reinforced concrete or cement. The amplifying chamber 1 of general egg-shaped form modified, in the present instance, to represent the body of a bird, is made by forming a cage work of iron reinforcing rods 25 in the general contour of a bird, covering this frame or cage work with expanded metal lath 26 fastened to the rods 25 of the cage work, and then applying to the metal lath a thickness of one half to three inches of cement, stucco or concrete 27 between and on both inside and outside the lathing and rods to form a smooth solid wall. The swivel elements are molded into the body 1 and base 21, as indicated in Fig. 3 where it will be seen that the swivel spindle element 22 is threaded at the top into a flange 28 in which the lower ends of the reinforcing rods 29 are secured by bolts 30, the flange 28 being invested in the cement 27 along with the rods 29. A socket member 31 for the swivel spindle 22 is embedded in the concrete base member 21. The top of this socket member is provided with a flange 32 which functions as a thrust bearing for the bottom surface of the flange 28, while the sides of the socket member are provided with fins 33 to anchor it in the cement base. The cable conduit 23 extending down through the

tubular swivel spindle 22, is held in place by the cement filling 26, the filling also holding in place an extension 34 of one of the reinforcing rods bent laterally at the lower end so as to engage a fixed stop 35 to limit the turning movement of the swiveled amplifier chamber. As shown at the bottom of Fig. 1, and indicated in dotted lines in Fig. 2, a tunnel 36 is formed in the bottom of the base 21 to house the cable 24 leading away from the device to the usual necessary sources of signal and power current not shown.

Referring to Figs. 5 and 6, these show one of the main features of the invention applied to the usual combination of a cone speaker and baffle board mounted in a radio receiving cabinet 37. Here the outer openings 38 in the baffle board 39 take the form of a series of openings through the board within the periphery of the board and outside the edge of the cone 40 and the main or central opening 41. Mounted within the speaker compartment of the cabinet, and surrounding the back or rear side of the cone 40, is a tone or resonating chamber 42 which, like the small tapered portion 6 of Fig. 1, is tapered away from the cone 40 to form a conical air impedance reflector with a relatively small opening 43 at the back. It has been found that the presence of the apertures or openings 38 in the baffle board greatly reduces the harshness without detracting from the usual amplifying qualities of the baffle board and that the use of the reflector 42 greatly improves the amplifying effect and its quality while the opening 43 in the back of the tone chamber or reflector 42 (corresponding to the opening 2 in the beak in Fig. 1) prevents the drumming sound and sound wave distortion. In this embodiment, as in that of Figs. 1 to 4, the effect of the tone chamber and reflector 42 with its relatively small opening 43 is to reflect or cushion back a large portion of the sound waves emitted from the back of the cone, causing them to be projected through the openings 38 to the front of the board 39 where they reinforce the sound waves eminating from the front of the cone 40 through the main central opening 41. Those sound waves which pass out through the opening 43 are projected into the surrounding atmosphere outside the cabinet by way of the rear cabinet opening 44.

While certain specific embodiments of the invention have been described herein for the sake of disclosure, it will be obvious to those skilled in the art that many modifications and variations thereof may be made without departing from the spirit of the invention and I therefore do not limit myself to what is shown in the drawings, but contemplate all such modifications and variants as fall fairly within the scope of the appended claims.

Having thus described my invention what I claim and desire to secure by Letters Patent is:

1. A loud speaker comprising a sound amplifying chamber of general tapered form having a pair of sound openings one near the larger end and one near the smaller end, and a conical diaphragm sound emitting element mounted within the amplifying chamber between the openings with the concave side of the diaphragm facing in the general direction of the larger end of the chamber and the convex side facing in the general direction of the smaller end.

2. A loud speaker as claimed in claim 1 in which a baffle board having a plurality of openings is mounted partitioning the large and small ends of the chamber and in which the concave side of the diaphragm communicates with the large end of the chamber through one of said openings, another of said openings being arranged to permit communication between said larger and smaller ends of the amplifying chamber.

3. A loud speaker comprising a tapered egg-shaped sound amplifying chamber having sound openings near the large and small ends respectively, a baffle board mounted within the chamber intermediate the ends thereof, an opening in the baffle board, a conical sound emitting diaphragm situated between the baffle board and the small end of the chamber with the concave surface of the diaphragm in communication with the large end of the chamber through the opening in the baffle board, said baffle board being provided with another opening for communication between the large and small ends of the chamber outside the diaphragm.

4. A loud speaker comprising a tapered sound amplifying chamber having a relatively small opening at the large end and another relatively small opening at the small end, and a relatively large opening in the side intermediate the ends, a baffle board partition arranged in the chamber between the small opening at the small and the large opening, said partition having a sound opening therethrough, a sound emitting diaphragm arranged to emit sound waves from one side into the small end of said chamber and from the opposite side into the large end of said chamber through the said opening in said baffle board, said baffle board having another sound opening therethrough arranged to permit the passage of sound waves from the small end of the chamber into the large end.

5. An acoustic device comprising an elongated sound amplifying chamber of irregular cross section having relatively small openings at opposite ends, a baffle board diaphragm situated intermediate the ends of the chamber dividing it into two compartments, one of relatively small area and the other of relatively large area, said chamber being

tapered abruptly from the baffle board toward one end for a distance less than one half the total distance and to an area less than that of the baffle board and continuing on to the opening with an area less than that of the baffle board, and enlarged from the baffle board to substantially the remainder of its extent toward the other end to an area greater than that of the baffle board, said baffle board having an opening, and a conical sound emitting diaphragm mounted with its concave surface toward the opening in the baffle board to emit sound therethrough, said baffle board being provided with another opening or passage to permit sound waves emitted from the convex side of the sound emitting diaphragm to pass from the smaller compartment of the amplifying chamber into the larger compartment.

6. A loud speaker comprising a tapered, egg-shaped sound amplifying chamber having an extension at its larger end in the form of an inverted cone with a relatively small opening near the apex of the cone, said chamber having a relatively large opening intermediate the ends, and a sound emitting element situated intermediate the small end of the chamber and the large opening.

7. A loud speaker as claimed in claim 6 with a baffle board surrounding the sound emitting element and in which the distance between the baffle board and the opening in the cone-shaped extension is not less than one half the wave length of the lowest note to be reproduced.

8. A loud speaker comprising an egg-shaped amplifying chamber having a relatively large opening in the side and relatively small openings, one at each end, respectively, a sound emitting element situated within the chamber intermediate the large opening and the smaller end of the egg-shaped chamber, and absorption pads mounted against portions of the inner walls of said chamber to prevent resonance and reverberation.

9. A loud speaker comprising an amplifying horn of general tapering form from end to end, and a conical sound emitting element situated within and intermediate the ends of the amplifying horn, the axis of the element being substantially parallel to the longitudinal axis of the horn.

10. A loud speaker comprising an egg-shaped sound amplifying chamber mounted with the smaller end above and the larger end below, a baffle board mounted within the chamber extending thereacross near the upper smaller end, said baffle board having a central opening and having another opening constituting a sound passage between the upper and lower ends of the chamber, a cone speaker element mounted on the upper side of the baffle board within the upper smaller portion of the chamber and adapted to direct sound waves downwardly through the central opening in the baffle board into the larger portion of the chamber, and to direct sound waves from the rear side of the cone toward the upper smaller end of the chamber, a sound conduit extending generally upwardly from the smaller end of the chamber and opening laterally, a lip or eave extending over the lateral opening of the said conduit, a water protecting wall extending upwardly from the lower edge of the lateral opening of the said conduit, a hollow cone-shaped extension at the lower, larger end of the chamber forming a downward and lateral extension of the said chamber and provided with a relatively small opening in its lower end, said chamber being also provided with a relatively large opening in the side thereof situated intermediate the baffle board and the lower end of the chamber.

11. A loud speaker comprising a tone chamber varying from a large diameter to a small diameter from end to end and provided at the small end with a relatively small opening, a baffle board mounted in the chamber and forming one end wall of the large end of the tone chamber, said baffle board being provided with a plurality of openings, and a conical sound emitting diaphragm mounted on the baffle board over one of said openings, the concave surface of said diaphragm facing the large end of the chamber and the convex surface of the diaphragm facing the small end of the chamber.

12. An acoustical device comprising a sound emitting element and a baffle board therefor, said baffle board being provided with openings for the transmission of sound waves from the rear of the element past the baffle board to the space in front thereof, in combination with a reflector casing surrounding the back and the front of the element and the baffle board and provided with sound emitting openings in the rear and in the front of the baffle board.

In testimony whereof I affix my signature.

RAYMOND CECIL BENDER.