United States Patent

Nohara et al.

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[54] UNDERGROUND ACOUSTIC DEVICE

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[73] Assignee: **Pioneer Electronic Corporation,** Tokyo, Japan

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** .....**181/31 B,** 181/27 E

[51] **Int. Cl.** **G10k 13/00,** H04r 1/28

[58] **Field of Search** .....181/31.1, 31 A, 27 E

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[57] **ABSTRACT**

An underground acoustic device for radiating sound into the atmosphere has a casing with a folded horn within the same, the casing constituting a tubular member, for example, a cylinder, an inverse truncated cone, a prism, or an inverse truncated pyramid. The hollow tubular casing defines a cavity with a speaker and a folded horn integral therewith supported at the center of the casing bottom to radiate sound upwardly towards the atmosphere. The bottom of the casing is configured to radiate sound upwardly and outwardly through a series of holes in a cover overlying the casing opening. In turn, the center of the cover is provided with a cover with a conical projection facing the speaker hole and acting in conjunction with a cup or cylindrical extension larger in diameter than the speaker horn for reflecting sound downwardly toward the curved reflecting surface of the bottom of the cavity. A drain pipe extends from the inside of the casing to the underground and a net lies intermediate the ends thereof for preventing rats from entering the casing.

9 Claims, 5 Drawing Figures

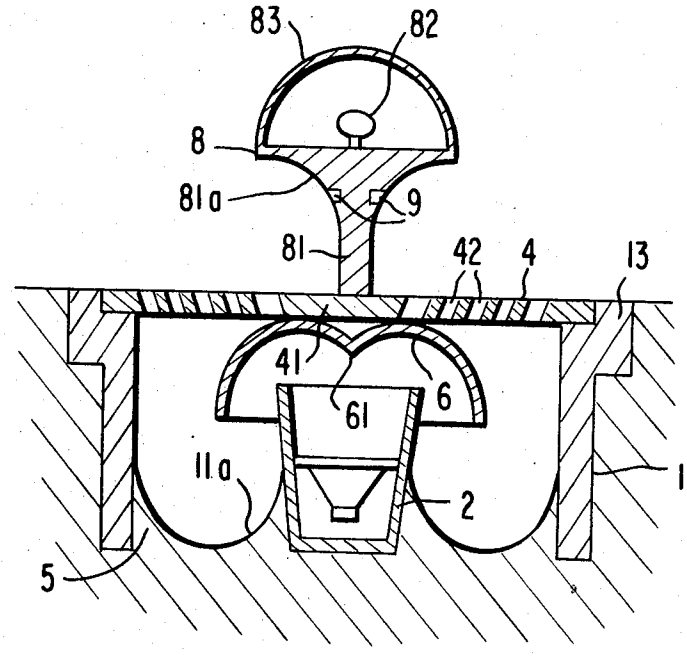


FIG. 1

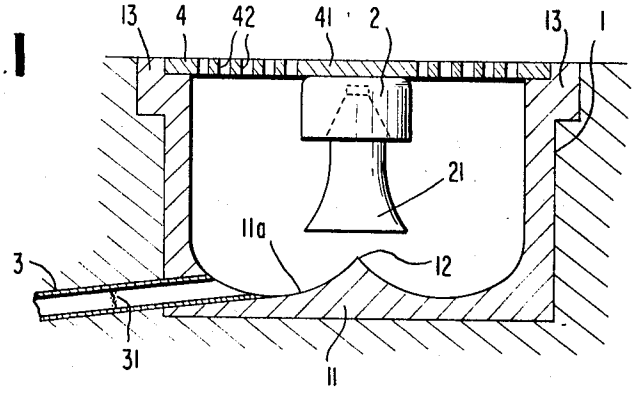


FIG. 2

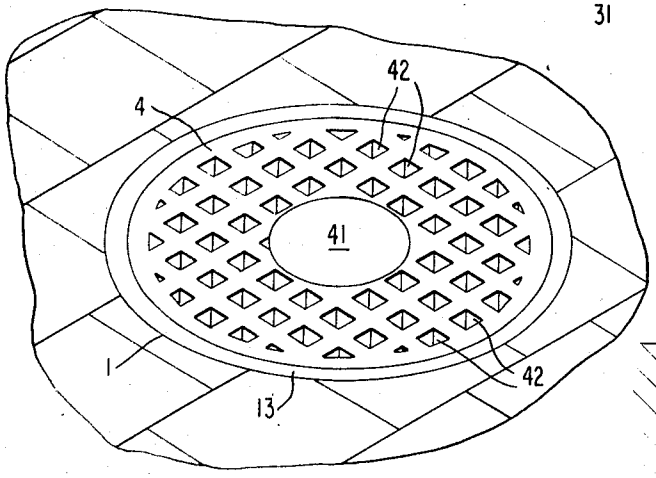


FIG. 3

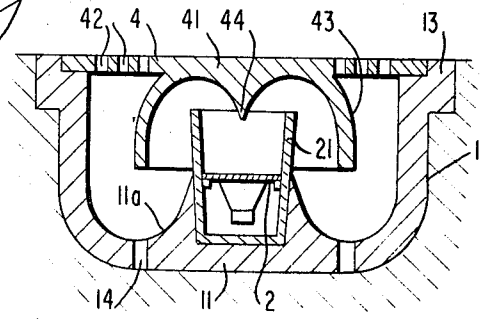


FIG. 4

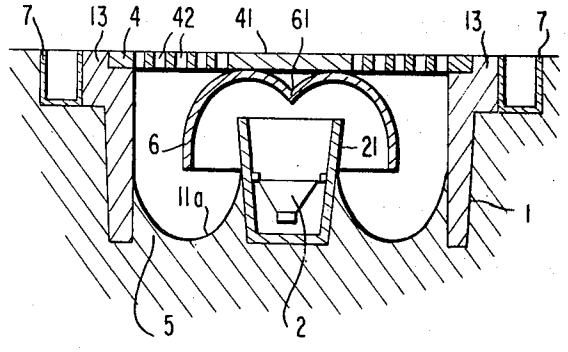
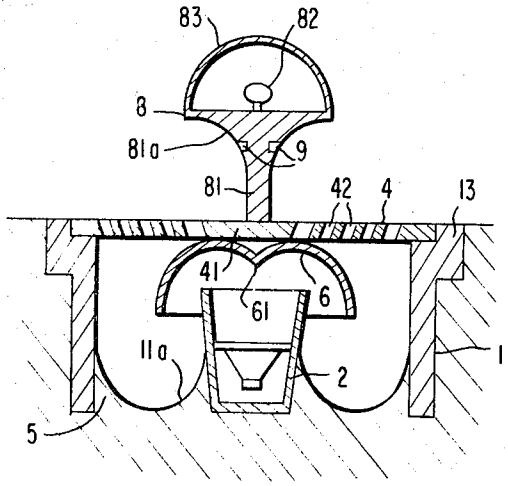


FIG. 5



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UNDERGROUND ACOUSTIC DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an underground acoustic device having a speaker for radiating a sound into the atmosphere.

2. Description of the Prior Art

Heretofore, when the announcements and sound music broadcasting are provided for the street advertisement or as a guide in an outside exhibition, the speaker is attached to a telegraph pole or a tree. This requires not only a pole, but also a cord must be stretched through the atmosphere which spoils the appearance of the place. Particularly for a park or garden, the atmosphere of the place is defiled. Since the broadcasting is done directly from overhead of the persons walking on the street, the walker hears the sound badly. Moreover, as the rain or dew falls directly on the speaker the speaker is corroded even if it is waterproof and this shortens its life.

This invention eliminates the aforementioned disadvantages of conventional speakers and provides an underground acoustic device for radiating sound into the atmosphere from underground to allow the walker to experience a strange sound to increase the advertising affect.

The present invention provides an underground acoustic device in which the acoustic effect may be varied by forming various shapes of the sound passage from the speaker to the surface of the ground.

The present invention also provides an underground acoustic device which does not have to be set on a pole and which does not need a cord stretched into the atmosphere so as not to spoil the appearance of the street or other place. The invention also provides an underground acoustic device which does not directly receive rain or dew on the speaker so as not to corrode the speaker and lengthens the life of the speaker.

According to one aspect of the present invention, there is provided an underground acoustic speaker for radiating sound into the atmosphere which comprises a casing formed with a folded horn integrally therein. The casing is in the form of a hollow tubular member, for example, a cylinder, an inverse truncated cone, a prism, or an inverse truncated pyramid with a conical projection at the center of the bottom thereof for radiating the sound toward the atmosphere from a speaker attached to the cover thereof. A drain pipe extends underground from the inside of the casing and has a net intermediate its ends for preventing animals from entering the casing. The cover of the casing has multiple holes for passing the sound therethrough except at the center portion to which is attached the speaker.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of an underground acoustic device constructed in accordance with the present invention.

FIG. 2 is a perspective view of the underground acoustic device of FIG. 1 as seen from above ground.

FIG. 3 is a sectional view similar to FIG. 1, but showing another embodiment of the present invention.

FIG. 4 is a sectional view similar to FIG. 1, but showing a further embodiment of the present invention; and

FIG. 5 is a sectional view similar to FIG. 1, but showing still another embodiment thereof.

Reference is now made to the drawings and particularly to FIGS. 1 and 2, which show one embodiment of the underground acoustic device of the present invention. The underground acoustic device comprises a casing 1 made of concrete and formed with a folded horn integrally therein. Casing 1 is in the form of a hollow tubular member, for example, a cylinder as illustrated; but alternately it may be in the form of an inverse truncated cone, a prism, or an inverse truncated pyramid. In this case, it includes an integral bottom 11 which carries a speaker 2, having a horn 21 attached thereto. Casing 1 has a conical projection formed at the center of the bottom 11 for radiating sound from said speaker 2 towards the atmosphere. Said bottom has a reflecting surface 11*a* for

reflecting the sound radiated from the speaker 2. A drain pipe 3 opens at the reflecting surface 11*a* at one end and communicates the inside of the casing 1 to the ground. A net 31 is provided intermediate of the ends of pipe 3 for preventing animals such as a rat or dust from entering into the casing 1. A cover 4 is attached to the stepped opening 13 of the casing 1 and has multiple holes 42 formed within the cover 4 for passing the sound therethrough except at the center portion 41 which couples the speaker 2 on the inside thereof in such a manner that the horn 21 of the speaker 2 faces towards the bottom 11 of the casing 1. The speaker 2 may preferably be a waterproof dome horn speaker in order to obtain good acoustic effects. By forming the casing 1 of the acoustic device as an extension of the horn, the characteristics of the speaker may be improved.

In operation of the underground acoustic device thus constructed, the sound from the speaker 2 is radiated outwardly through the horn 21 and the folded horn defined by the inside of the casing 1 with high efficiency from the ground to the atmosphere. When the rain falls on the underground acoustic device, the water passing into the casing 1 is exhausted through the drain pipe 3 into the surrounding ground.

Referring now to FIG. 3, which shows another embodiment of the underground acoustic device constructed in accordance with the present invention like parts and components are designated by the same reference characters as those shown in FIG. 1. The underground acoustic device comprises a casing 1 made of concrete in the form of a hollow tubular member, for example, a cylinder as shown, or alternatively, an inverse truncated cone, a prism, or an inverse truncated pyramid, the bottom being integral therewith and the outer corner at the bottom being curved, as shown. The bottom 11 has a plurality of drain holes 14 for exhausting water from the casing 1 into the ground. A speaker 2 having a horn 21 attached thereto is attached to the inside surface of the bottom 11 of the casing 1 in such a manner that the horn 21 of the speaker faces the stepped opening 13 of the casing 1. The bottom 11 includes a reflecting surface 11*a* for the sound. A cover 4 is attached to the stepped opening 13 of the casing 1 and has multiple holes 42 formed therein for passing sound therethrough except at the center portion 41. A conical projection 44 is formed at the inside center of the cover and a generally cylindrical sound-reflecting horn 43 extends coaxially around the conical projection 44 for reflecting the sound radiated from the speaker 2.

In operation of the underground acoustic device thus constructed, the sound radiated from the speaker 2 is reflected through the second horn 43 formed by the generally cylindrical sound-reflecting member 43 so that the thus reflected sound is again reflected to the third horn 11*a* defined by a position of the bottom 11 of the casing 1. The sound then passes through holes 42 of the cover 4 from the underground into the atmosphere with high efficiency. When the rain falls on the underground acoustic device, the water passing into the casing 1 is exhausted through the drain holes 14 formed in the bottom 11 of the casing 1 and passes into the ground.

Reference is now made to FIG. 4, which shows a further embodiment of the underground acoustic device of the invention. The underground acoustic device comprises a casing or cylinder 1 made of concrete in the form of a hollow tubular member, for example, a cylinder as shown, or alternatively, an inverse truncated cone, a prism, or an inverse truncated pyramid, and forming in this case with the ground 5, a cylindrical cavity with the ground acting as a bottom thereof. A speaker 2 having a horn 21 attached thereto is attached to the ground 5 in such a manner that the horn 21 of the speaker 2 faces the opening 13 of the cylinder 1. The bottom of ground 5 is preformed into a reflecting surface 11*a* for the sound. A cover 4 is attached to the stepped opening 13 of the cylinder 1 and has multiple holes 42 formed therein for passing the sound therethrough except at the center portion 41. A conical projection 61 is formed at the center of the cup-shaped, generally cylindrical sound reflecting horn 6 formed coaxially around

the conical projection 61 to the inside thereof for reflecting sound radiated from the speaker 2. A drain channel 7 is formed around the cover 4 at the edge of the stepped opening 13.

Salt is mixed into the ground 5 if the ground 5 is soft, and a proper hardness to the ground 5 is thus obtained. Any desired hardness may be obtained for the ground 5 so that various qualities of sound are radiated from the speaker 2. Particularly if high sound is desired, it is preferable that the ground 5 provides a hard reflecting surface.

The speaker 2 may be attached to the cup-shaped generally cylindrical sound-reflecting horn 6 or hung therefrom, and, an acoustic reflector formed by plates may be provided on the cover 4 so as to optionally vary the direction of the sound radiated from the acoustic device.

In operation of the underground acoustic device thus constructed, the sound radiated from the speaker 2 is reflected by the cup-shaped generally cylindrical sound-reflecting horn 6 so that the thus reflected sound is again reflected by the third horn formed by the ground 5 to finally pass through holes 42 of the cover 4 and from underground into the atmosphere with good efficiency. When the rain falls on the underground acoustic device, the water passing into the cylinder 1 is directly absorbed by the ground 5.

Referring now to FIG. 5, which shows still another embodiment of the underground acoustic device, the acoustic device comprises a cylinder 1 made of concrete and in the form of a hollow tubular member, for example, a cylinder as shown, or alternatively, an inverse truncated cone, a prism, or an inverse truncated pyramid, and forming in this case with the ground 5, a cylindrical cavity with the ground acting as the bottom of the cavity. A woofer speaker 2 has a horn 21 attached thereto and is attached to the ground 5 in such a manner that the horn 21 of the speaker 2 faces the opening 13 of cylinder 1. The bottom of ground 5 forms reflecting surface 11*a* for the sound. A cover 4 is attached to the stepped opening 13 of cylinder 1 and has multiple holes 42 for passing the sound therethrough except at the center portion 41 thereof to which is attached a conical projection 61 lying at the inside center of a cup-shaped, generally cylindrical sound-reflecting horn 6 extending coaxially around the conical projection 61 for reflecting the sound radiated from the speaker 2. An illumination lamp 8 such as, for example, mercury-arc lamp stands on the center portion 41 of the cover 4 and has a base 81 provided with a reflecting surface 81*a*. This reflects the woofer sound radiated from the woofer speaker 2 and a plurality of waterproof tweeter speakers 9 provided within the reflecting surface 81*a*. The mercury-arc lamp 8 has an illumination portion 82 and a cover 83 formed of acryl resin which is provided on the lamp 8. The tweeter speakers 9 may preferably be selected so as to provide a proper directivity of the sound radiated therefrom.

In operation of the underground acoustic device thus constructed, the sounds radiated from both tweeter and woofer speakers 9 and 2 is radiated in such a manner that the woofer sound radiating from the speaker 2 is reflected from the cup-shaped generally cylindrical sound-reflecting horn 6 and thus reflected sound is again reflected by the third horn formed by the ground 5 to pass through the holes 42 of cover 4 from underground into the atmosphere. The sound contacts reflecting surface 81*a* for reflection so as to spread the sound over the ground surface and not to radiate it vertically. The tweeter sound is radiated over the ground surface from the reflecting surface 81*a* directly and accordingly the mixture of woofer and tweeter sounds are spread all over the ground to produce a good acoustic effect with a better quality to the sound. Since the tweeter speakers are provided under the illumination lamp 8, the tweeter speakers 9 are not seen from the outside and this provides a good appearance.

The cover 4 is provided with holes 42 which are inclined to act as a deflector thereby radiating the sound in a broader manner to the atmosphere. The holes 42 are inclined in the direction of the periphery of the cover 4.

It is understood from the foregoing description that the speaker is buried underground within the casing so that the announcement or broadcasting of the music is radiated from the ground with the result that makes a strong impression on the walker for a good advertising effect. A good appearance may be provided and the rain or dew may not fall directly onto the speaker to reduce the life thereof.

It is also understood that since the sound is reflected at the folded structure after being radiated from the speaker good acoustic characteristics are obtained to suit public parks or gardens.

What is claimed is:

1. An underground acoustic device for radiating sound from the ground into the atmosphere comprising: a hollow tubular member positioned within the ground, means including said hollow tubular member defining a cavity with an upper opening, a speaker including a horn coaxially positioned within and fixed to the bottom of said means defining said cavity with the speaker horn facing upwardly towards said opening of said hollow tubular member, the bottom of said cavity being curved to form a path for the sound, a cover overlying the open upper end of said hollow tubular member and carrying multiple holes for passing the sound therethrough except at the center portion thereof, a conical projection beneath and at the center of the cover, a cup-shaped generally cylindrical, sound-reflecting horn concentrically surrounding said conical projection for reflecting the sound radiated from said speaker toward the sound-reflecting curved surface of the cavity bottom, thence outwardly through said multiple holes.

2. An underground acoustic device as set forth in claim 1, wherein said hollow tubular member is of cylindrical prism shape.

3. An underground acoustic device as set forth in claim 1, further comprising a drain channel formed around said cover at the edge thereof.

4. An underground acoustic device as set forth in claim 1, wherein the bottom of said cavity is formed by the ground and said ground includes salt as a component thereof for varying the quality of the sound reflected therefrom.

5. An underground acoustic device as set forth in claim 1, wherein said multiple holes are inclined radially outwards towards the periphery of the cover to control the direction of sound radiated from the acoustic device.

6. An underground acoustic device as set forth in claim 1, wherein said speaker is a woofer.

7. An underground acoustic device as set forth in claim 6, further comprising an illumination lamp standing on the center portion of said cover and having a base formed with a reflecting surface or reflecting the woofer sound radiated from said woofer speaker and a plurality of waterproof tweeter speakers provided on said reflecting surface.

8. An underground acoustic device as set forth in claim 7, wherein said illumination lamp comprises a mercury-arc lamp having a cover formed by acryl resin overlying the same.

9. An underground acoustic device as set forth in claim 7, wherein the holes within said cover are inclined in the direction of the cover periphery to direct the sound as individual acoustic reflectors.

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