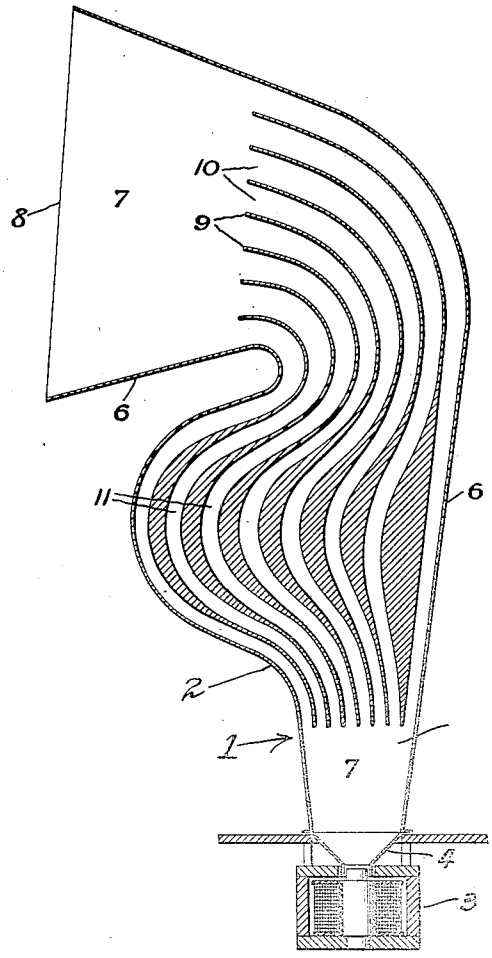
March 15, 1932. E. W. KELLOGG 1,849,840

HORN FOR AUDITORIUM SOUND REPRODUCTION

Filed April 18, 1930



Inventor:
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UNITED STATES PATENT OFFICE

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HORN FOR AUDITORIUM SOUND REPRODUCTION

Application filed April 18, 1930. Serial No. 445,487.

My invention relates to horns for loud speakers, particularly to acoustic horns as used in large loud speakers for sound reproduction in auditoriums, and has for its object the provision of an improved loud speaker horn of the large curved or coiled type.

It is well known that horns which are bent or curved give inferior sound reproduction as compared with horns with straight axes and with equivalent lengths and cross sections. This distortion effect is least if the horn is bent or curved near its small end, at which point the cross section of the sound wave passage is small, or the walls of the passage are close together. The distortion effect is greatest if the bend occurs close to the bell of the horn, the cross section of the sound wave passage at this point being large and the walls of the passage far apart. It is necessary, however, that the curvature of the horn occur close to the large end, or bell portion, in order to comply with the requirement of limited space frequently encountered in loud speaker installations.

In the straight axis horn the wave front expands continuously without encountering any obstructions or reflecting surfaces, and the various portions of the advancing wave front expand approximately equally. In the case of a bend in the sound passage, on the other hand, one edge of the wave front is released by the receding wall while the other edge is obstructed by the obliquely placed surface. If the two walls are close together, or less than about a half wave length apart, the two effects largely cancel and the wave front takes the new direction with little disturbance. But if the walls are farther apart there is no such neutralization, and the various portions of the wave front experience reflections in various directions and phases, with the result that the waves cross and recross the passage, wasting energy and finally emerging in such directions as to give an erratic sound distribution in front of the loud speaker.

While it is principally the short waves which are broken up by a bend in the manner just described, the long waves are adversely affected in a different way by bending the horn near the bell. The effect of such a bend is, in effect, to provide a sound passage vented on the side instead of at the end. The pressure release for long waves occurs when the wave front reaches the lower edge of the opening, which is considerably before it has travelled fully the axial length of the horn. The bending thus shortens the effective length of the horn which reduces its efficiency and causes resonance to occur.

My invention provides means for obviating both of the detrimental effects just described, and secures the acoustic equivalent of a straight axis horn, while permitting bends to be made wherever desired to meet space requirements even though this may mean placing a bend close to the mouth of the horn.

Attempts have been made heretofore to comply with the condition of small wall separation of the sound wave passage at that point where the curvature of the horn takes place. In these prior constructions, however, objectionable distortion of the sound waves still remained, the resulting designs were expensive to manufacture, and further, it was not possible to form the bend within less than a considerable distance from the mouth of the bell.

My invention will be better understood from the following description when considered in connection with the accompanying drawing, and its scope will be set forth in the appended claims.

Referring to the drawing, the single figure thereof illustrates a loud speaker having a horn in which my invention is embodied. The figure shows a loud speaker 1, which comprises an acoustic horn 2 and an electro-responsive device 3 for translating electric waves into sound waves. This latter device may be of any preferred form and in the embodiment shown is of the electro-dynamic type actuating a cone diaphragm 4 mounted adjacent the small end of the horn. The walls 6 of horn 2 enclose the air column or passage 7 for sound waves proceeding from the diaphragm. In the embodiment of my invention illustrated in the drawing the horn is shown as curved; for example as having a right angle bend therein at a point relatively

close to the large end 8 of the horn, that is, close to the mouth of the bell portion thereof.

In accordance with my invention, in order to prevent the interference effects and reflection losses above described as occurring when the horn is bent or curved, at least a portion of the air column or sound wave passage 7 is divided by a series of substantially parallel partitions into a plurality of air columns or sound wave passages, each of which is of relatively small wall separation throughout its length, measured along the radius of curvature. The dimensions of the passages measured perpendicular to the plane of cross section are not necessarily small since there is no curvature of the passages except in planes parallel to the cross section. The principal requirement in regard to the passage width, measured perpendicular to the section shown in the drawing, is that expansion of the passage in that direction be continuous and not involve rapid expansion followed by slow expansion. The wall separation throughout the passages is sufficiently small with relation to wave length to avoid reflection effects at the bends of the passages. In order to construct the respective parallel passages 10 of approximately equal length loops 11 are introduced into those passages which would otherwise be too short. Loops 11 may be formed, as shown in the figure, by increasing the thickness of the partitions 9 to the desired degree throughout that portion of the sound passage 7 in which the loops are required.

In operation of the loud speaker comprising the above described means for dividing the horn passages 7 into a plurality of passages 10, sound waves from diaphragm 4 proceed through the latter passages without distortion by reason of the comparatively small wall separation in these passages. Further, the sound waves in the individual passages arrive at the large or bell end of the horn in phase, by reason of the looping of certain of the passages in such a manner that all of the passages have the same total length. The sound waves on emerging from the several narrow passages unite to form a single wave front travelling in a direction normal to the mouth 8 of the horn.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a curved acoustic horn, means to divide a portion of the air column therein into a plurality of sound wave passages of substantially equal length, said first-named portion including that portion of said air column which extends through the curved portion of said horn.

2. In an acoustic horn having a bend formed therein adjacent the bell portion thereof, means to divide a portion of the air column within said horn into a plurality of sound wave passages of substantially equivalent length, said portion of said air column including that portion of the air column within said horn which lies within said bend.

3. In an acoustic horn having a bend formed therein, means including a plurality of partitions mounted within said horn and extending within said bend, said partitions forming a plurality of sound passages of substantially equal length to prevent distortion of sound waves at said bend.

4. In a curved acoustic horn, a plurality of partitions mounted therein and extending into the curved portion thereof to divide a portion of the air column within said horn into a plurality of substantially parallel passages of substantially equal length each having a relatively small wall separation.

5. In an acoustic horn having a bend formed therein, means to divide the air column therein through a portion of its length into a plurality of sound wave passages throughout said portion of said length of said air column, one of said passages throughout a portion of said length of said air column being substantially straight and at least one of said passages being looped.

6. In a curved acoustic horn a plurality of partitions mounted therein to divide the air column within said horn through a portion of its length into a plurality of sound wave passages, said partitions being increased in thickness throughout part of their length to form loops in said passages.

It witness whereof, I have hereunto set my hand this 15th day of April, 1930.

EDWARD W. KELLOGG.

CERTIFICATE OF CORRECTION.

Patent No. 1,849,840. Granted March 15, 1932, to

EDWARD W. KELLOGG.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, lines 87 and 88, strike out the words "throughout said portion of said length of said air column" and insert the same to follow the word "passages" in line 91, same page and claim; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 17th day of May, A. D. 1932.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.