March 15, 1932. C. D. HAIGIS 1,849,486

MULTIPLE UNIT SOUND AMPLIFIER

Filed April 6, 1927

Fig. 1.

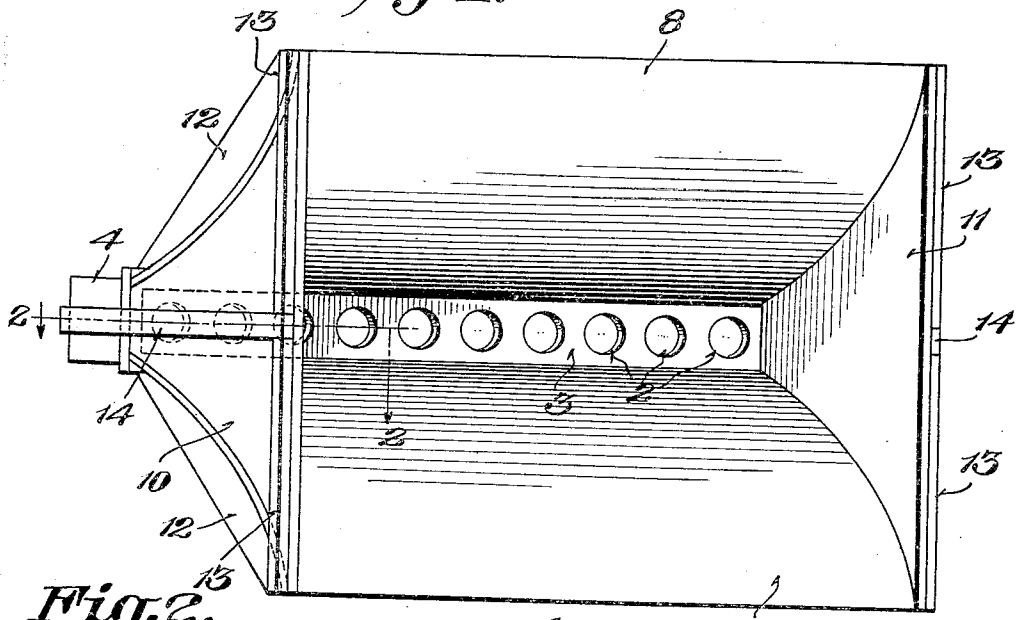


Fig. 2.

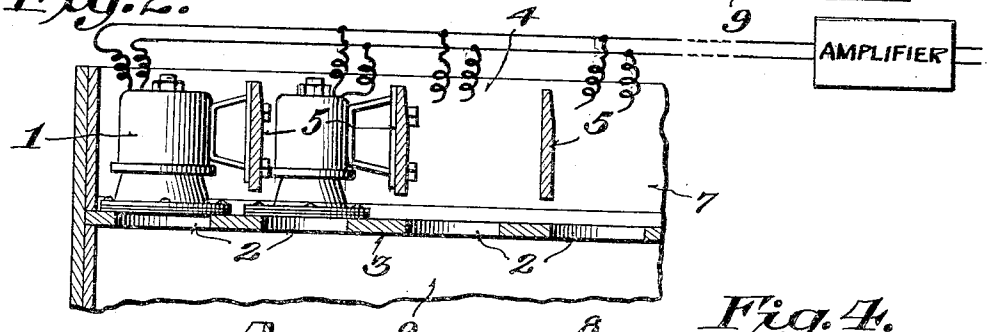


Fig. 3.

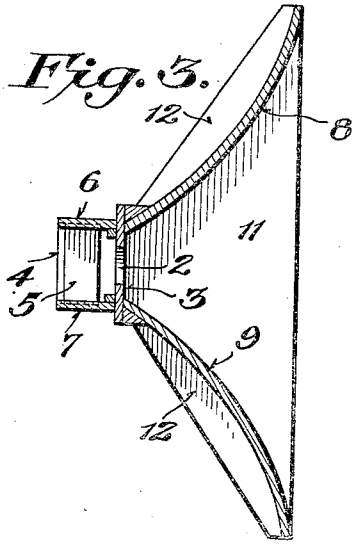
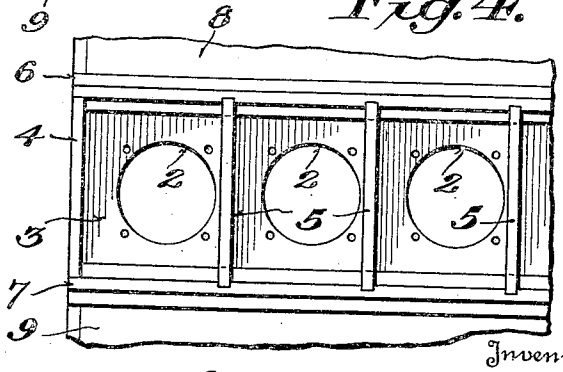


Fig. 4.



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UNITED STATES PATENT OFFICE

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MULTIPLE UNIT SOUND AMPLIFIER

Application filed April 6, 1927. Serial No. 181,486.

This invention relates to the amplification of sound, particularly to means for producing relatively large volumes of sound, as in auditorium and field work, although certain features of the invention are applicable to the amplification of sound in volume suitable for the rooms of dwellings and the like.

It is an object of this invention to provide improved means for producing and efficiently amplifying sound without overloading the sound producing mechanism and without substantial distortion of the produced sound.

Another object of this invention is to provide improved means for amplifying sound, particularly relatively large volumes of sound, which is also directive in character so that it may be used in such a way as to minimize or eliminate the disadvantageous consequences of adjacent sound reflecting surfaces.

Other objects will appear as the description of the invention proceeds.

The invention is capable of receiving a variety of mechanical expressions, one of which has been shown on the accompanying drawings, but it is to be expressly understood that the drawings are for purposes of illustration only and are not to be construed as a definition of the limits of the invention, reference being had to the appended claims for that purpose.

Referring in detail to the drawings, wherein the same reference characters are employed to designate corresponding parts in the several figures,

Fig. 1 is a perspective of an embodiment of the present invention;

Fig. 2 is a fragmentary section, on an enlarged scale, on the line 2—2 of Fig. 1;

Fig. 3 is a section of Fig. 1 taken at right angles to the section of Fig. 2; and

Fig. 4 is a fragmentary rear elevation on the scale of Fig. 2.

When relatively large volumes of sound are required, as in auditorium or field work, a sound producing unit, such as a loud speaker or electro-magnetic receiver, of conventional size, cannot be supplied with sufficient energy to produce the desired volume of sound without overloading the unit and producing the distortions attendant on such overloading. Nor can the size of such a sound producing unit be increased indefinitely, in order to produce large volumes of sound, without introducing distortions by reason of the mass and inertia effects which are attendant on the use of large vibratory elements.

In conformity with the present invention the desired volume of sound is obtained by connecting a plurality of electro-magetic receiver or loud speaker units, preferably in series, each of said units being of suitable size and construction to generate sound waves with a minimum distortion, and each of said units being supplied with only so much energy as can be properly handled without danger of distortion. Having determined the quantity of sound energy which can be properly generated from a given unit without substantial distortion, as many units are employed as may be necessary to bring the total sound energy up to the desired amount, and the number of units employed will thus vary with the use to which the device is to be put. The number of units to be used having been determined sound amplifying and directing means in conformity with the present invention are provided therefor, as illustrated on the drawings, wherein the invention is shown as applied to the amplification of sound from a plurality of sound producting units.

These sound producing units, only one of which is shown at 1, and which may be of any suitable type, size and construction, are preferably mounted in a row with their vibratory elements adapted to propagate sound from a common surface, which may be curved or plane as shown. In the structure illustrated, the units are mounted with their vibratory elements in register with, and preferably conforming substantially with the size of, apertures 2 provided in a baffle 3 supported in any suitable way, as by an elongated box-like structure 4 extending rearwardly of the baffle 3 and having transverse partitions 5 extending between the top 6 and bottom 7 thereof, on which the respective units are mounted in any suitable way.

Extending forwardly of the apertured baffle 3 is a trough-shaped amplifier of any suitable size, construction and material, and

shown as composed of curved side walls 8 and 9 and end walls 10 and 11 which may be either plane or curved. The size of the bottom of the trough or inlet end of the amplifier is determined by the number and mechanical impedance value of the sound producing units employed, it being noted that it is at least as large, and preferably larger, than the area of the vibratory elements; the size of the mouth of the trough or outlet of the amplifier is determined by the intensity of the low-frequencies desired in conformity with principles well understood in the design of amplifiers; the flare of the amplifier between the inlet and the outlet is preferably such that the cross sections vary in conformity with an exponential equation so as to obtain maximum efficiency in the amplification of the sound waves. The amplifier is preferably made of substantially non-vibratory construction, and to this end its side walls 8 and 9 are shown as braced with ribs 12, and its end walls are shown as strengthened by edge strips 13 and ribs 14. It is to be expressly understood, however, that the amplifier and the supporting frame work for the sound producing unit or units may be built up in any suitable way so as to conform with the use to which the amplifier is to be put and to obtain the desired strength and rigidity taking into consideration the materal used, the size of the parts and the manner of support.

A trough-like amplifier of the character illustrated propagates a sound wave having a substantially regular and uninterrupted front which is of generally cylindrical form and therefore highly directive in character. Advantage is preferably taken of this fact in so mounting the amplifier in its relation to adjacent sound reflecting surfaces that may be productive of interferences, dissonances, etc., as to minimize the effect of such surfaces by causing the wave front to expand with the axis of its cylindrical surface at the proper angularity to such sound reflecting surfaces.

A sound amplifying device embodying the present invention inherently possesses many notable advantages, including that it occupies only a relatively small volume of space for a desired amplification and low frequency cut-off; it is relatively simple and inexpensive in construction; it affords a cut-off which is not sharply limited by the length of the device for a common rate of expansion in cross sectional area, whereby the actual cut-off may be many cycles below that apparently characteristic of an amplifier having the outlet area employed; it introduces none of the constructional and acoustic difficulties inherent in the use of bent and angularly related passages; and it affords an amplification that is productive of a very pleasing sound quality, particularly when employed with the sound producing unit having an increasing sound output at the lower frequency; and it provides means which are readily applicable to the amplification of sound under a wide variety of conditions and of a wide variety of volumes.

It will therefore be perceived that sound producing means, capable of handling relatively large volumes of sound energy, have been provided in such a way as to eliminate overloading of the sound producing units and the distortion incident to the use of large sound producing units, while at the same time the desired amplification of the sound generated by the one or more units is effected in a manner which is highly efficient and which assures the propagation of regular and uninterrupted wave fronts. Moreover, the amplifier is of such a character as to be highly directive in character so that the effect of adjacent sound reflecting surfaces may be minimized.

While the embodiment of the invention illustrated on the drawings has been described with considerable particularity, it is to be expressly understood that the invention is not to be restricted thereto, as the same is capable of receiving a variety of mechanical expressions, some of which will now readily suggest themselves to those skilled in the art, while changes may be made in the details of construction, arrangement and proportion of parts, without departing from the spirit of this invention. Reference is therefore to be had to the claims hereto appended for a definition of the limits of the invention.

What is claimed is:

1. In a device of the character described, the combination of a series of sound generating units arranged in a substantially straight line, and a trough-shaped amplifier substantially devoid of interior obstructions for amplifying the sound generated by all of said units.

2. In a device of the character described, a series of loud speaker units arranged to generate sound in a common surface, and common amplifying means substantially devoid of interior obstructions for all of said units.

3. In a device of the character described, a series of loud-speaker units arranged to generate sound in a common plane, and common amplifying means substantially devoid of interior obstructions for all of said units, the cross sectional area of said common amplifying means being not less than the combined area of all of the vibrating elements of said units.

4. In a device of the character described, the combination of a series of receiver units arranged substantially in a line and adapted to generate sound in a common surface, and a trough-shaped amplifier which flares from said units to the outlet thereof for amplifying sound generated by all of said units, said

amplifier being substantially devoid of interior obstructions.

5. In a device of the character described, the combination of a series of loud speaker units arranged in a substantially straight line and adapted to generate sound in a common plane, and a trough-shaped amplifier substantially devoid of interior obstructions for amplifying the sound generated by all of said units.

6. In a device of the character described, a series of loud-speaker units arranged substantially in a line, a box-like cellular structure for supporting said units and a trough-shaped amplifier substantially devoid of interior obstructions for amplifying the sound generated by all of said units.

7. In a device of the character described, the combination of an apertured baffle, a series of loud-speaker units registered with the apertures of said baffle, and a common amplifier substantially devoid of interior obstructions for all of said units.

8. In a device of the character described, a flat apertured baffle, a series of loud-speaker units registered with the apertures of said baffle, and a common amplifier substantially devoid of interior obstructions for all of said units.

9. In a device of the character described, a baffle having a series of apertures arranged substantially in a line, a series of sound generating units registered with the apertures of said baffle, and a trough-shaped amplifier substantially devoid of interior obstructions extending forwardly of said baffle.

10. In a device of the character described, a flat baffle having a series of apertures arranged in a substantially straight line, a series of sound generating units registered with the apertures of said baffle, and a trough-shaped amplifier substantially devoid of interior obstructions extending forwardly of said baffle.

11. In a device of the character described, the combination of a series of sound-producing units and a trough-shaped amplifier which flares from said units to the outlet thereof for amplifying the sound generated by all of said units, said amplifier being adapted to produce a substantially cylindrical wave front and being substantially devoid of interior obstructions.

12. In a device of the character described, the combination of a series of sound-producing units and a trough-shaped amplifier for amplifying the sound generated by all of said units, said amplifier being adapted to produce a substantially cylindrical wave front, and said amplifier flaring from said units to the outlet thereof to minimize reflection from adjacent sound reflecting surfaces and being substantially devoid of interior obstructions.

13. In combination, a plurality of sound-producing devices linearly disposed and a common amplifier which flares outwardly from said devices for amplifying the sound produced by all of said devices, the interior of said amplifier presenting uninterrupted sound-paths between the sound-producing devices whereby each serves to impose a load on the other devices.

14. Sound amplifying apparatus including a horn flared upon two sides, the rear edges of the two sides being substantially parallel, a spacing strip provided with a plurality of openings therethrough disposed between the parallel edges, a plurality of loud-speakers, one for each opening, said loud-speakers being adapted to be operated simultaneously to produce a wide smooth fan of sound waves.

15. A loudspeaker comprising a member having a nonvibrating plane surface, and a plurality of sound radiating bodies mounted on said member for simultaneous operation.

16. A loudspeaker comprising a member having a nonvibrating surface, and a plurality of sound radiating diaphragms substantially mounted in vertical alignment on said member, said sound radiating diaphragms being positioned so that the direction of motion of each is substantially perpendicular to the line of vertical alignment.

17. A loudspeaker comprising a non vibratory baffle member and a plurality of vibratory elements carried by said member and arranged substantially one above the other, said vibratory elements being positioned to radiate sound waves substantially at right angles to the vertical axis of said baffle member.

18. A loudspeaker comprising a member having a non-vibrating plane surface, and a plurality of sound radiating bodies mounted in a single line on said member for simultaneous operation.

In testimony whereof I have signed this specification.

CARLETON D. HAIGIS.