May 14, 1957 E. J. GATELY, JR 2,792,069

LOUD SPEAKER CABINET INCLUDING A HORN

Filed April 21, 1952 3 Sheets-Sheet 1

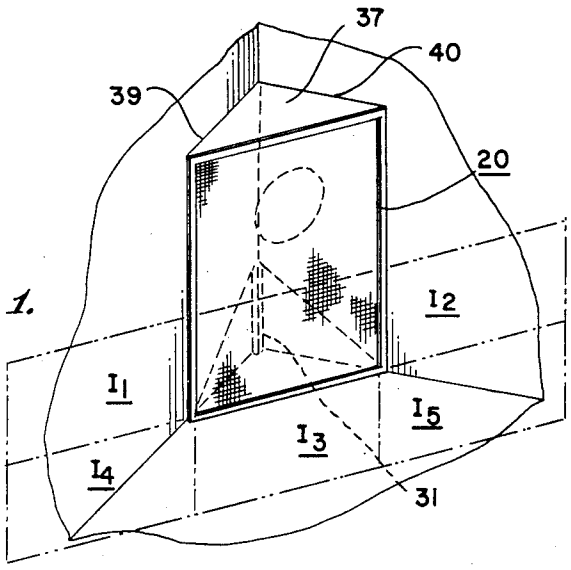


Fig. 1.

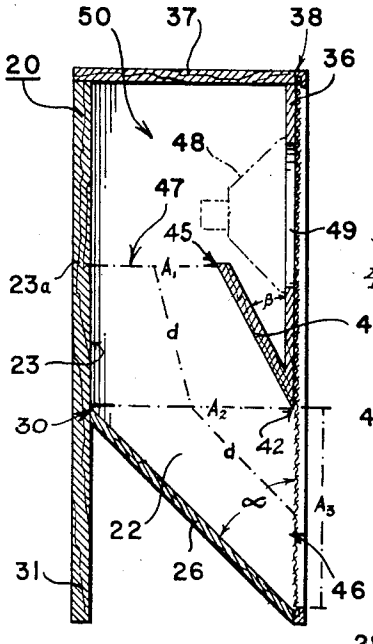


Fig. 3.

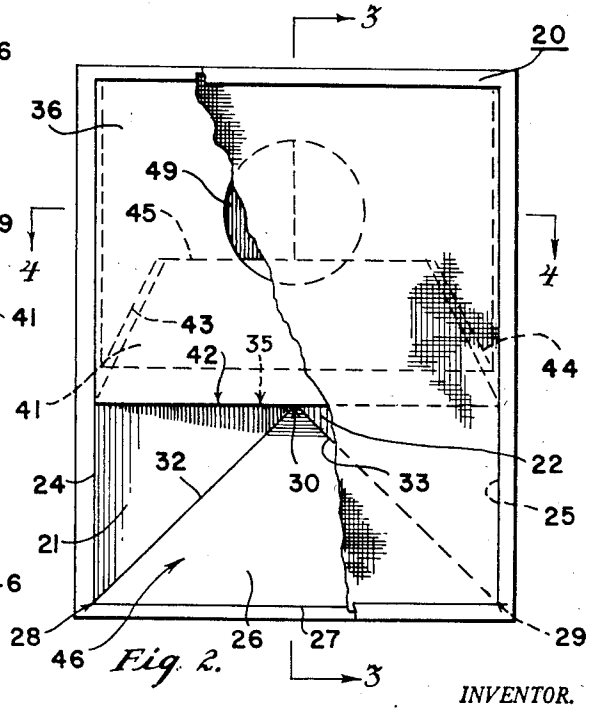


Fig. 2.

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LOUD SPEAKER CABINET INCLUDING A HORN

Filed April 21, 1952 3 Sheets-Sheet 2

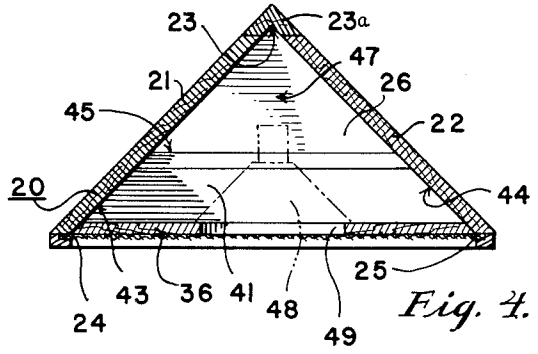


Fig. 4.

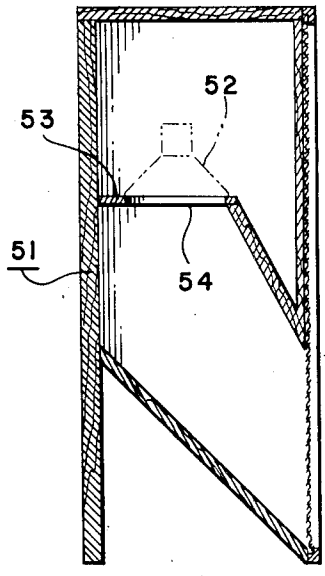


Fig. 5.

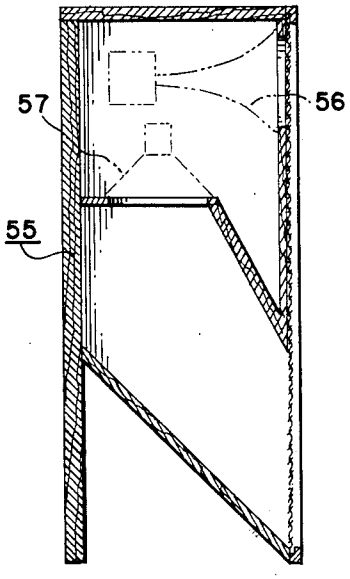


Fig. 6.

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Fig. 7.

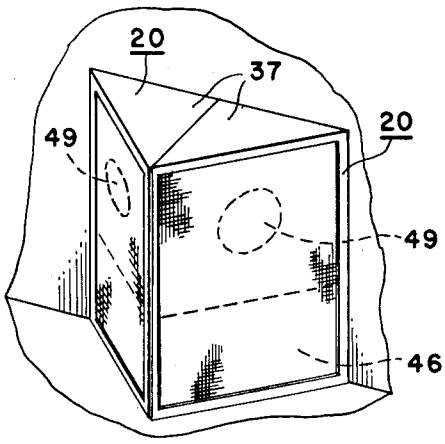
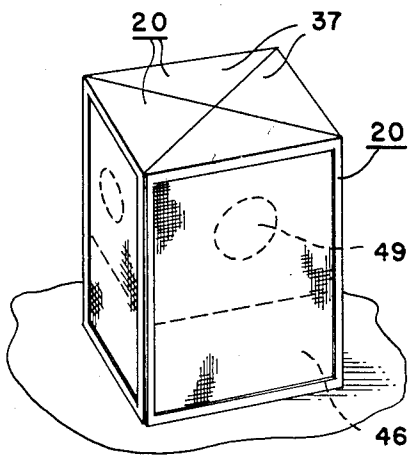


Fig. 8a.



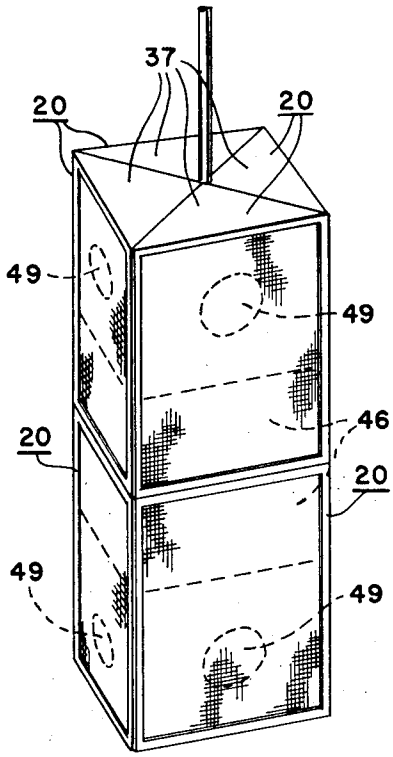


Fig. 9.

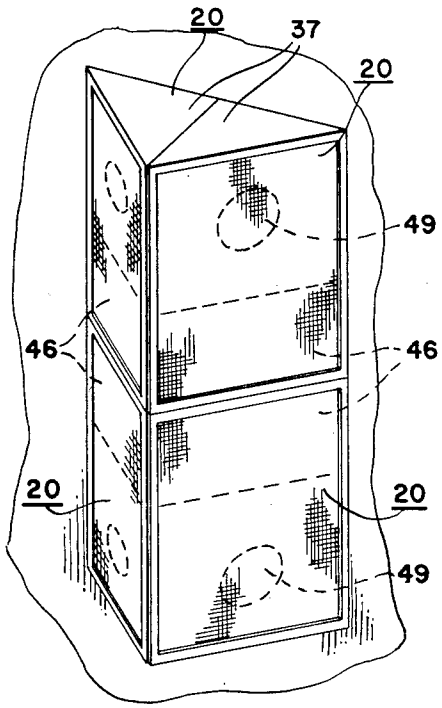


Fig. 8b.

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United States Patent Office

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LOUD SPEAKER CABINET INCLUDING A HORN

Edward J. Gately, Jr., Philadelphia, Pa.

Application April 21, 1952, Serial No. 283,400

7 Claims. (Cl. 181—31)

The present invention relates to acoustic devices and more particularly to horns used in conjunction with loud speakers for amplifying the low-frequency notes generated by a loud speaker.

An object of the present invention is to provide a compact exponential horn.

Another object of the present invention is to provide a compact exponential horn for use with three adjacent surfaces, such as the corner of a room.

Another object of the present invention is to provide a compact acoustic amplifier for low-frequency notes.

Another object of the present invention is to provide a compact inexpensive horn for reproducing, with great fidelity, notes of low frequencies, for example below 600 C. P. S.

Further objects will be apparent by reference to the appended specification, claims and drawings.

For the purpose of illustrating the invention, there are shown in the accompanying drawings forms thereof which are at present preferred, although it is to be understood that the various instrumentalities of which the invention consists can be variously arranged and organized and that the invention is not limited to the precise arrangements and organizations of the instrumentalities as herein shown and described.

In the drawings wherein like reference characters represent like parts:

Figure 1 represents a perspective view of the acoustic device of the present invention at the intersection of three planar surfaces.

Figure 2 represents a front plan view, partly in section, of one embodiment of the present invention.

Figure 3 represents a vertical cross-sectional view along line 3—3 of Figure 2.

Figure 4 represents a horizontal cross-sectional view along line 4—4 of Figure 2.

Figure 5 represents a vertical cross-sectional view similar to Figure 3, of a second embodiment of the present invention.

Figure 6 represents a vertical cross-sectional view similar to Figure 3, of yet another embodiment of the present invention.

Figure 7 represents a perspective view of two of the acoustic devices of the present invention in operative juxtaposition at the intersection of two planar surfaces.

Figure 8–*a* represents a perspective view of four of the acoustic devices of the present invention in operative juxtaposition on a single horizontal planar surface.

Figure 8–*b* represents a perspective view of four of the acoustic devices of the present invention in operative juxtaposition on a single vertical planar surface.

Figure 9 represents a perspective view of eight of the acoustic devices of the present invention, supported in mid-air, as an outdoor arena or the like.

The horn-and-cabinet **20** which is one embodiment of the present invention illustrated in Figures 1 to 4 inclusive includes side panels **21** and **22** joined (as by the corner-post **23**–*a*) at the corner **23**, with the respective

edges **24** and **25** spaced from each other. A generally triangular panel **26** interconnects the side panels **21** and **22**; the edge **27** of the triangular panel **26** interconnecting the corners **28** and **29**, respectively of the panels **21** and **22** and the corner **30** spaced from the end **31** of the corner-post **23**–*a*. The edges **32** and **33** of the panel **26** are in contact with the panels **21** and **22**, respectively.

Intervening between the edges **24** and **25** of the panels **21** and **22**, is a generally rectangular panel **36** with its edge **42** in spaced relation to the edge **27** of the panel **26**. A cover **37**, triangular in shape, interconnects the edges **38** of the panel **36** and the edges **39** and **40**, respectively, of the panels **21** and **22**.

The angle α between the plane of the panel **26** and the plane in which the panel **36** lies is, for example, 45° although this angle may vary, as will be hereinafter shown.

Behind the panel **36** is a panel **41**, generally trapezoidal in shape, with its edge **35** in abutment with the edge **42** of the panel **36** and with its side edges **43** and **44** in contact with the side panels **21** and **22**, respectively, and with the edge **45** in spaced relation to the corner **23**.

The panels **21**, **22**, **26**, **36**, **37** and **41** form a combined cabinet-and-horn which is generally wedge-shaped (substantially a right triangular prism). The wedge may be truncated slightly (i. e., the corner-post **23** may form a flat surface between the panels **21** and **22**) without adversely affecting horn-operation.

An exponential horn is formed by the panels **26**, **21**, **41** and **22**; said horn having a mouth-opening **46** defined by the panel edges **42**, **24**, **27** and **25**, and having a throat-opening **47** which is defined by the panels **21** and **22** and the edge **45** of the panel **41**.

The panel **41** is disposed at an angle β to the front panel **36**; the angles α and β being so related to each other that the horn (between the throat **47** and the mouth **46**) is exponential in character; i. e., its sectional area varies exponentially with its length. For instance, the area A_3 (across the mouth **46**; see Figure 3) is twice the area A_2 and is four times the area A_1 (across the throat **47**); d being the distance within which the area doubles.

As is shown in Figures 2, 3 and 4, a speaker **48** may be mounted on the panel **36** behind an opening **49** therein with the concave side of the speaker facing toward the opening **49**. Thus, the higher frequency notes are radiated into the room directly through the opening **49**.

The low frequency notes below 600 cycles are radiated from the convex side of the speaker-cone **48** through the chamber **50** and enter the horn through the throat **47** and are radiated into the room through the mouth **46**.

When the horn of the present invention is disposed in a room-corner (at the juncture of three intersecting plane surfaces) the effective mouth area is six times the actual mouth-area; the walls or surfaces adjacent the mouth **46** acting as reflectors to create virtual image I_1, I_2, I_3, I_4 and I_5 around the actual mouth.

As is illustrated in the embodiment **51** shown in Figure 5, a speaker **52** may be mounted across the throat **47** (on a separate triangular-shaped panel **53** having the aperture **54** therein) so that the notes to be amplified are radiated directly from the concave side of the speaker **52** into the throat **47**.

In the embodiment **55** illustrated in Figure 6 a pair of speakers is used; a high-frequency speaker or "tweeter" **56** is mounted across the aperture **49** in the panel **36** and a low frequency speaker or "woofer" **57** is mounted across the throat **47** on the panel **53**.

In an exponential horn the actual taper or rate of flare (the distance in which the area doubles) should be a function of the desired cutoff frequency; the relationship being approximately

$$\text{Distance (in feet)} = \frac{62.5}{\text{frequency (cycles/sec.)}}$$

Moreover, the effective mouth area should have an area which is approximately equal to the area of a circle whose diameter is

$$\frac{1}{\pi}$$

times the wave length (in feet) of the desired cutoff frequency.

For instance, an exponential horn having an 80 cycle cutoff should have a taper of

$$\frac{62.6}{80}$$

or .78 feet and the effective mouth area should be

$$\frac{\pi}{4}\left(\frac{1100\times 12}{80\times\pi}\right)^2$$

or 2110 square inches. An actual specimen of the present invention illustrated in Figures 1–4 inclusive built for 80 cycle cutoff, had a throat area of approximately 72 square inches with the horn section doubling in area every 9.35 inches with the mouth approximately 18.7 inches from the throat and having an approximate area of 292 square inches (or an effective mouth-area of approximately 1752 square inches).

In addition, the horn of the present invention, though "folded" to reduce its size, does not bend through more than 180° from throat to mouth.

The horn-and-cabinet of the present invention, though most effective when used at the juncture of three planar surfaces, can be used (in groups of two) at the juncture of two planar surfaces, as illustrated in Figure 7, or in groups of four along a single planar surface, as illustrated in Figures 8–*a* and 8–*b*, or, if eight are grouped together as illustrated in Figure 9, can be suspended in space.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and it is therefore desired that the present embodiments be considered in all respects as illustrative and not restrictive, reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention.

Having described my invention what I claim as new and desire to protect by Letters Patent is the following:

1. A cabinet including both a loud-speaker enclosure and a horn having a throat and a mouth, said cabinet comprised of 6 panels, 4 of which are plane panels, each inclined to each other and so disposed in relation to each other as to define, therebetween, a horn, the sectional area of which varies generally exponentially with its length between throat and mouth, the remaining panels so disposed in relation to each other and to three of the aforementioned plane panels as to define therebetween the said speaker enclosure.

2. A cabinet including both a loud-speaker enclosure and a horn having a throat and a mouth, said cabinet comprised of 6 panels, 4 of which are plane panels, each inclined to each other and so disposed in relation to each other as to define, therebetween, a horn, the sectional area of which varies generally exponentially with its length between throat and mouth, the remaining panels so disposed in relation to each other and to three of the aforementioned plane panels as to define therebetween the said speaker enclosure, two of said horn-defining panels being disposed at an angle to each other, each of the other two horn-forming panels being connected to and intervening between each of the first two horn-forming panels.

3. A cabinet including both a loud-speaker enclosure and a horn having a throat and a mouth, said cabinet comprised of 6 panels, 4 of which are plane panels, each inclined to each other and so disposed in relation to each other as to define, therebetween, a horn, the sectional area of which varies generally exponentially with its length between throat and mouth, the remaining panels so disposed in relation to each other and to three of the aforementioned plane panels as to define therebetween the said speaker enclosure, one of said horn-forming panels being generally triangular in shape.

4. A cabinet including both a loud-speaker enclosure and a horn having a throat and a mouth, said cabinet comprised of 6 panels, 4 of which are plane panels, each inclined to each other and so disposed in relation to each other as to define, therebetween, a horn, the sectional area of which varies generally exponentially with its length between throat and mouth, the remaining panels so disposed in relation to each other and to three of the aforementioned plane panels as to define therebetween the said speaker enclosure, one of said horn-forming panels being generally trapezoidal in shape.

5. A cabinet including both a loud-speaker enclosure and a horn having a throat and a mouth, said cabinet comprised of 6 panels, 4 of which are plane panels, each inclined to each other and so disposed in relation to each other as to define, therebetween, a horn, the sectional area of which varies generally exponentially with its length between throat and mouth, the remaining panels so disposed in relation to each other and to three of the aforementioned plane panels as to define therebetween the said speaker enclosure, said throat being generally triangular in shape.

6. A cabinet including both a loud-speaker enclosure and a horn having a throat and a mouth, said cabinet comprised of 6 panels, 4 of which are plane panels, each inclined to each other and so disposed in relation to each other as to define, therebetween, a horn, the sectional area of which varies generally exponentially with its length between throat and mouth, the remaining two panels so disposed in relation to each other and to three of the aforementioned plane panels as to define therebetween the said speaker enclosure, said mouth being rectangular in shape.

7. A cabinet including both a loud-speaker enclosure and a horn having a throat and a mouth, said cabinet comprised of 6 panels, 4 of which are plane panels, each inclined to each other and so disposed in relation to each other as to define, therebetween, a horn, the sectional area of which varies generally exponentially with its length between throat and mouth, the remaining two panels so disposed in relation to each other and to three of the aforementioned plane panels as to define therebetween said speaker enclosure, said horn being operatively connected to said enclosure at its throat.

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