May 5, 1964 S. J. MARES 3,131,783

LOUD-SPEAKER ENCLOSURE

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Fig. 1.

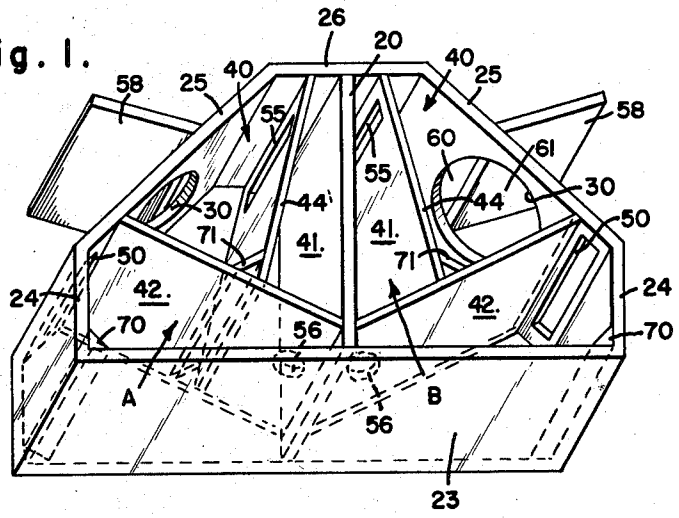
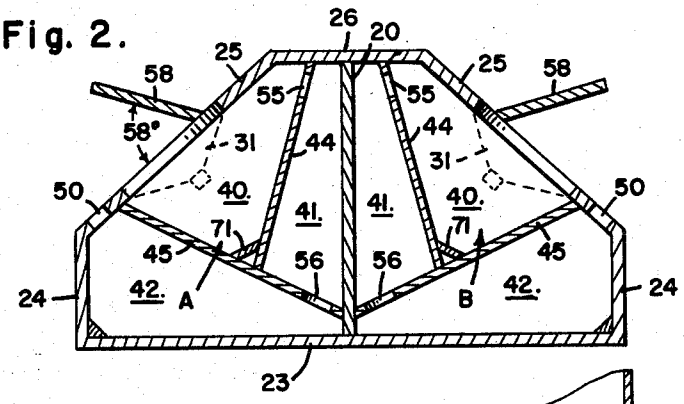


Fig. 2.



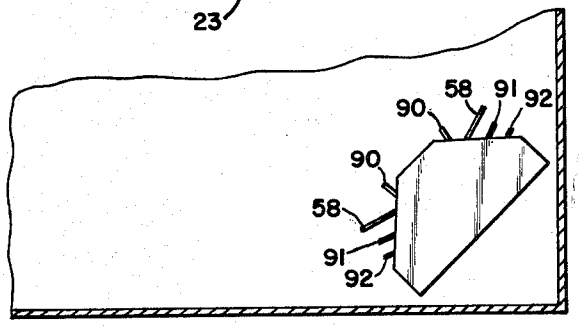


Fig. 5.

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Fig. 3.

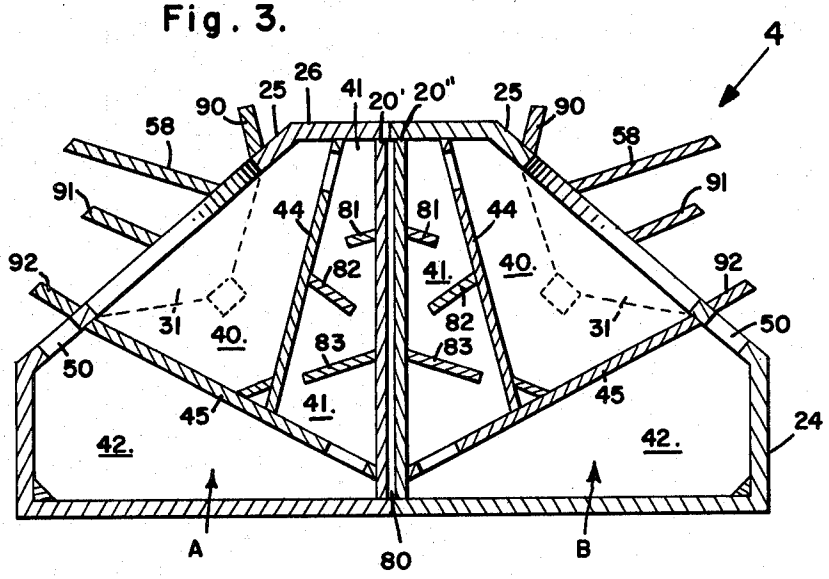
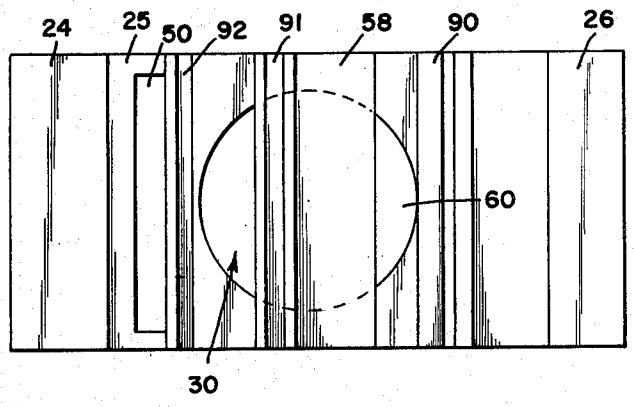


Fig. 4.



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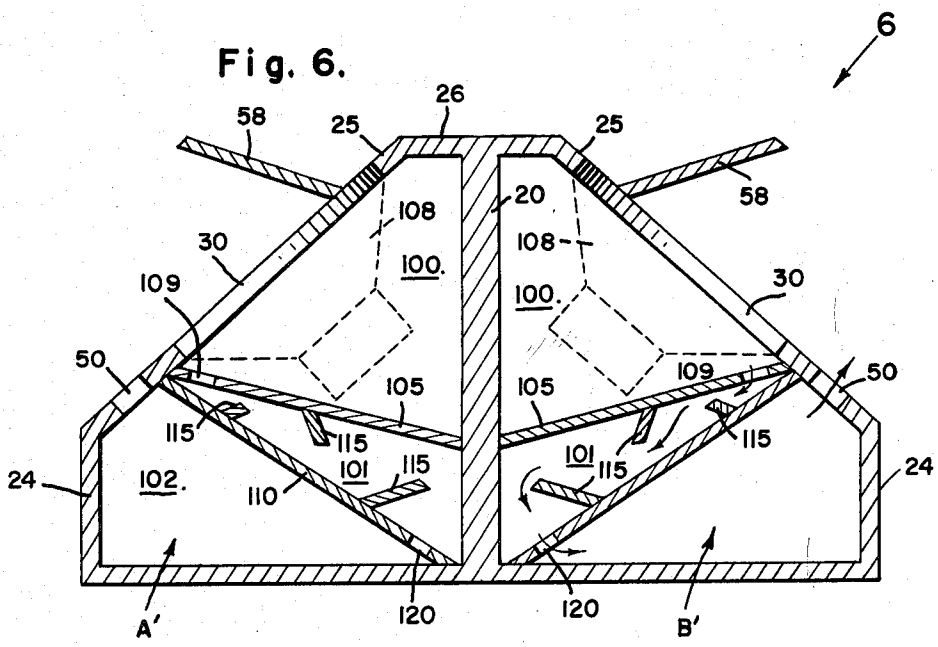
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LOUD-SPEAKER ENCLOSURE

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Fig. 6.



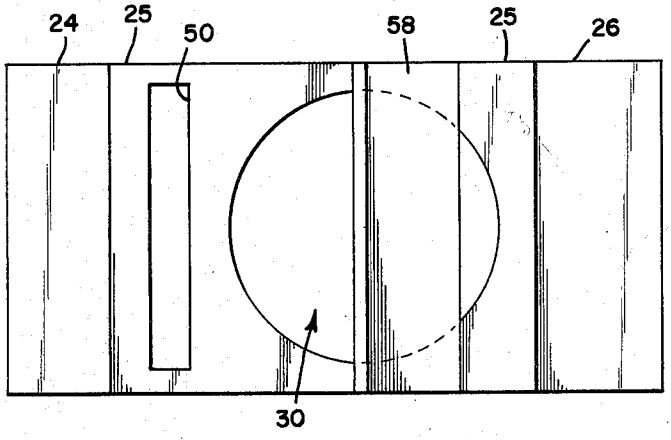


Fig. 7.

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LOUD-SPEAKER ENCLOSURE

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8 Claims. (Cl. 181—31)

This invention relates to a novel loud-speaker enclosure which will allow a directional sound dispersion which is particularly useful in stereophonic sound reproduction.

In the reproduction of stereophonic sound it is necessary that there be two sound transducers, each transducer being fed with a signal which is reproduced from separate input sources spaced apart relative to a given sound producing media. The spacial effect of the simultaneous but different rendition from the same source creates an effect similar to the effect normally observed in hearing the direct rendition of the sound wherein each of the human ears observes a somewhat different rendition of the same sound source.

In order to achieve the true stereo effect it is necessary that the sound transducers be spaced apart a considerable distance in order to give the true spacial effect. If the transducers are located too close together the sound from each of the transducers merges and the spacial effect is lost.

The same spacial effect, however, can be obtained by the formation of specially designed loud-speaker cabinets which through baffles and the like direct the sound from speakers contained within the cabinet in a directional pattern. In this type of device the audio energy is dispersed at an angular relationship which spaces the sound from each of the transducers so as to provide a spacial effect similar to that obtained by actual physical separation or spacing of the transducers.

The principal object of this inventoin is to provide a novel speaker baffle system which will allow two loud-speakers to be contained within a single enclosure and which will furthermore direct the sound waves emanating from each of the speakers in opposite directions to obtain the spacial effect necessary for the proper reproduction of stereophonic or binaural audio sound.

Another important object of this invention is to provide a novel speaker baffle which contains in its interior a configuration of baffles in horn like chambers arranged in a pattern that creates loading of the speaker and a folded horn like arrangement which assists in the generation and emanation of the lower frequencies. Because of the unique baffle construction of the speaker system the actual cabinetry of this speaker occupies a substantially small area while allowing extremely efficient bass frequency attenuation.

A feature and advantage of this invention is that the unique baffle configuration of the speaker enclosure provides a clear bass attenuation without noticeable harmonic resonate distortion quite frequently occurring in speaker enclosures.

A further object of this invention is to provide a speaker enclosure having a highly directionalized audio output in such a way that both the bass and the high frequencies are directed to extend uni-directionally from the housing or enclosure. It is by the combination of two such similar elements directing the sound dispersion in opposite directions from one another that a true stereo or binaural spacial effect is created.

Still another object of this invention is to provide a relatively small or compact speaker housing capable of dispersing sound uni-directionally from each of two sound transducers and with the further provision of a base reflex folded horn baffle network contained within the housing arranged to attenuate the base to provide a smooth base attenuation similarly directed in uni-directional sound radiation patterns.

A still further object of this invention is to provide in such a single enclosure a baffle and sound deflecting network which will allow the device to be satisfactorily operated in a corner position in a room and still obtain the required spacial sound effect required for true stereophonic or binaural reproduction.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings in which similar characters of reference represent corresponding parts in each of the several views.

In the drawings:

FIG. 1 is a perspective view showing the speaker enclosure of this invention.

FIG. 2 is a cross-sectional view taken through the middle of the enclosure and showing the position of loud-speakers in dotted lines.

FIG. 3 is a top plan view taken through the middle of a modification of the speaker cabinet particularly adaptable for corner installation.

FIG. 4 is a side elevational view of the embodiment of FIG. 3 taken from the position indicated by the arrow 4 in FIG. 3.

FIG. 5 is a top plan view of the speaker enclosure of FIGS. 3 and 4 shown installed in the corner of a room.

FIG. 6 is a top plan view of a modification of the speaker cabinet particularly adapted for larger speakers.

FIG. 7 is a side elevational view of the embodiment of FIG. 6 taken from the subject indicated by arrow 6.

The speaker enclosure of FIGS. 1 and 2 is formed by an enclosed cabinet divided in the middle by a partition 20 separating the enclosure into A and B sound chambers.

The exterior formation of the enclosure is formed by a straight back panel 23 having at its ends two side panels 24 extending at right angles from back panel 23.

The forward or front portion of the cabinet is formed by two converging front panels 25 and a front face plate 26 which caps the two converging front panels 25 forming a truncated front face for the cabinet.

Partition 20 bisects the interior portion of the cabinet being mounted midway between the ends of front face plate 26 and back panel 23 so as to provide an equal spacial area in each of the sound chambers A and B.

Loud-speaker openings indicated at 30 are formed in converging front panels 25. The two panels 25 are positioned at a 90° angle relative to each other so that the two speaker openings will carry speakers such as indicated at 31 disposed at a 90° relationship to each other.

The interior of each of the sound chambers A and B is divided into three sound control areas indicated at 40, 41 and 42 by two baffle members 44 and 45.

Baffle member 45 extends from the inside face of converging front panel 25 to the face of the dividing partition 20. The position of joinder of baffle member 45 to partition 20 is located a short distance, in the order of approximately two inches, from the inside face of back panel 23. The opposite end of baffle member 45 is located a sufficient distance away from the joinder between side panel 24 and converging front panel 25 to allow for the formation of a base frequency output port 50, in converging front panel 25 between baffle member 45 and side panel 24. This allows bass frequency output port 50 to be on the same plane as speaker outlet opening 30.

Baffle member 44 is mounted on the inside face of front face plate 26 and the base of baffle 45. The forward end of baffle 44 is mounted substantially midway between the dividing partition 20 and the juncture of converging front panel 25 and front face plate 26 and extends rearwardly from front face plate 26 at an angle of approximately 75° relative to front face plate 26 to mate with baffle 45 at a position somewhat closer to dividing par-

tition 20 than to converging front panel 25. Baffle 44 is positioned so that sound control area 40 provides a sufficient cubic air space within the chamber to provide satisfactory back loading for speaker 31. The forward end of baffle 44 is provided with an air port 55 which allows air communication between chambers 40 and 41.

Baffle 45 is provided with a relatively small aperture 56 opening close to partition 20. It can thus be seen that the air path from sound control area 40 is allowed to go through aperture 55 wherein there is a rectangular cross section horn like configuration in sound control area 41 for the passage of air to and through aperture 56. Thence the air passage is in another rectangular cross section horn like area 42 terminating in bass frequency output port 50. Area 40 therefore functions to provide the back loading for the speaker and sound control areas 41 and 42 function in a folded horn like arrangement to cause the attenuation of the bass frequency.

The top and bottom of the enclosure, of course, is provided with a cap so that each of the sound control areas is sealed from the other and to atmosphere in substantially air tight relationship except for the ports and passageways 30, 50, 55 and 56. These passageways provide the sole communicating passageways between the compartments and the compartments and atmosphere.

The exterior of converging front panel 25 is provided with sound deflecting board 58 which extends at an angle of 58° outwardly from the outer face of the two converging front panels 25. Board 58 extends the entire height of converging front panel 25 and passes over speaker opening 30 at a position about three-fourths the distance between the midway point of the speaker opening and the extreme forward end. The precise positioning of the interior end of board 58 is limited to the particular design of loud-speaker 31 employed.

As it can be seen with the board in position, as indicated, there is a small opening of the loud-speaker opening 30 indicated at 60 located on the forward portion of deflecting board 58 and a substantially larger opening 61 located to the rear of deflecting board 58. The front portion of board 58 terminates at a position overlying opening 30 at a position approximately equal to the inboard spacing of board 58 from the center of speaker opening 30, but, of course, in the opposite side of the opening.

Most loud-speakers are characterized by the fact that the high frequency generating region of the speaker is located in the central portion of the speaker and the lower or lower and middle frequency ranges are generated at the ends or at least through the entire diaphragm of the speaker. Opening 60 should therefore be at a position located outwardly from the area of the speaker responsible for the generation of the higher frequency ranges so that the opening 60 is facing only the lower low frequency generating region of the speaker.

It has been found in this system that deflecting boards 58 disperse the mid-range and higher frequencies in a substantially unidirectional pattern outwardly from the speaker cabinet so that the sound emanating from sound chambers A and B is emanated at substantially 90° angles relative to each other.

Small opening 60 allows a small amount of direct forward sound radiation particularly in the lower load areas. This effect creates a pleasing effect in that it tends to reduce the characteristic commonly referred to as the "hole in the middle" which is the effect that is created when two speakers are spaced apart and the sound appears to be void in the area between the speakers. This is undesirable in that for ideal stereo reproduction the sound should appear to be coming from inbetween the two loud speakers but yet there should be the stereo separation required to obtain the spacial effect of stereo.

The two ports 50 emanate the bass in a bass reflex action through sound control areas 41 and 42 contained within the enclosure. It is noted that these ports are dispersed at 45° angles relative to each other and in such a way that there is a definite directional characteristic also given to the lower directional regions. It is also noted that the two ports are located on the same plane as loud-speaker opening 30 so that the loud-speaker and the reflex port or bass frequency output port 50 are emanating from the same plane.

The connecting members of the cabinet are held together by brace members such as indicated at 70 and 71 to add greater rigidity to the cabinet. In addition insulating materials can be placed on one or more walls of one of the chambers to dampen any resonant effect that might exist within the respective chambers. The purpose of the insulation which may be Fiberglas or other cotton mat or other material conventionally used for this purpose is to dampen resonance that might exist.

The embodiment of FIG. 3 is identical in its general construction to the embodiments of FIGS. 1 and 2 and bear identical reference numerals.

The embodiment of FIG. 3, however, is provided with additional baffles and sound deflecting channels. In addition dividing partition 20 is formed in two pieces 20′ and 20″ spaced apart by an air space 80.

The interior of sound control area 41 is provided with three air deflectors 81, 82 and 83. Deflectors 81 and 83 are mounted on the two pieces 20′ and 20″ and extend inwardly and rearwardly at an angle of about 70° relative to the connected wall. Air deflector 82 is mounted between air deflectors 81 and 83 on baffle member 44 and extends inwardly and rearwardly also at an angle of about 70°.

Air deflectors 81, 82 and 83 all define deflectors or air generators which control and smooth out the flow of air pressure through baffle member 41. The spacing between divider partition 20 and 20′ facilitates the installation of deflectors 81 and 83 and also provide a superior separation between the A and B sound deck generating sections of the enclosure.

The exterior of the speaker system of the embodiments of FIGS. 3, 4 and 5 is provided with three additional exterior deflecting or baffle boards 90, 91 and 92 in addition to board 58.

Deflector boards 90, 91 and 92 function to improve directionality of the enclosure which makes the enclosure particularly suitable for corner installations as indicated in FIG. 5 wherein the corner there is a greater requirement that the sound be separated due to the effect of the corner tending to cause the sound emanating from the A and B chambers of the cabinet to be directed between walls of the room inwardly to a central point. The purpose of deflector boards 90, 91 and 92 is to cause the sounds to ride along the wall of the room rather than be deflected outwardly to a central point in the room area.

Deflecting board 90 is located at an approximately 62° angle forwardly extending of the end of speaker opening 30. This causes a greater directional control in opening 60 of speaker opening 30. Deflecting board 91 is mounted at approximately 63° angle rearwardly of the panel 25 and is located at a position approximately in line with the termination of the end of deflecting board 58. This adds a further directional channel in the rearward area of the speaker and also provides a horn like channel between deflecting ports 91 and 58 which still further improves the directional characteristics of the sound emanating from the speaker.

Deflecting board 92 is mounted at a rearwardly extending 70° angle on converging front panel 25 slightly forward of bass frequency output port 50. This adds directional control to the sound output from port 50 and also forms a channel between deflecting boards 92 and 91 still adding further to the directional characteristics of the sound emanating directly from speaker 31. Deflecting board 91 is about half the length of deflecting board 58 and deflecting boards 90 and 92 are slightly shorter than deflecting board 91.

In FIG. 6 and FIG. 7 there is provided another embodi-

ment of the invention which is particularly adapted for carrying larger size loud-speakers or particularly loud-speakers having an extended depth.

The structure of FIGS. 6 and 7 includes an outer housing which is identical to the housing of the embodiment of FIGS. 1 and 2 and bearing identical reference numerals for all parts contained therein.

Each of the sections of the cabinet are indicated at A' and B'. The interior of both sections are identical except formed of basically opposite configurations as are the embodiments of the other modification.

The interiors of each of the sections A' and B' include a speaker compression chamber **100** opening to a horn chamber **101** which in turn opens to the final horn chamber **102**.

Compression chamber **100** is formed by a baffle wall **105** which extends from panel **25** to the partition **20**. Wall **105** is mounted in the division between loud-speaker opening **30** and base frequency outlet port **50** and extends angularly to partition **20** at an angle to allow a loud-speaker, such as indicated in dotted lines at **108**, to be installed within the cabinet without making contact with the speaker.

An aperture **109** is formed in wall **105** which forms the air opening into horn chamber **101**. Horn chamber **101** is defined by baffle wall **105** and another partition **110**. Partition **110** extends from a point immediately adjacent the connection of wall **105** to side wall **25** to a position adjacent the corner of partition **20** and straight back panel **23**. The two walls **105** and **110** thus are angularly disposed so that the distance between the two walls increases toward partition **20**. Thus the two walls form a horn like configuration.

Air deflectors **115** can be installed in the interior of horn chamber **101** in the same manner and for the same purpose as described in the embodiments shown in FIGS. 3 and 4.

Partition **110** is provided with an aperture **120** at a point slightly disposed from partition **20**. This opening opens in the beginning of a substantially horn like area **102** which is defined by partition **110** and straight back panel **23** of the enclosure.

Thus in operation speaker **108** creates audio vibrations against the back loading effect of the area within compression chamber **100**. The vibrations are emitted through aperture **109** into the apex of partition **110** and thereafter pass through aperture **120** into the apex of horn chamber **102**. The sound is then dispersed through bass frequency output port **50**.

It can thus be seen that the structure in the interior of the cabinet forms the two section folded horn supported by the loading area immediately behind the speaker.

It is believed that an essential element of the invention is the provision of the folded horn contained within the enclosure together with the combination of the compression chamber immediately to the rear of the speaker.

Another important feature of this invention is the provision of the bass reflex outlet and the front opening of the speaker on identical planes with the concurrent provision of the deflecting boards which cause the deflection of the emitted audio vibrations on an axis of approximately 180° from each other.

Although the foregoing invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it is to be understood that certain changes and modifications may be practiced within the spirit of the invention as limited only by the scope of the appended claims.

What is claimed:

1. A loudspeaker enclosure particularly adapted to create binaural audio reproduction comprising: enclosure box means forming a pair of complementary sealed chambers; each said chamber having a first vertical side wall relatively mounted in a substantially 90° relationship to the first side wall of the other chamber; each said first side wall forming a loudspeaker receiving aperture of complementary size to allow a loudspeaker to be mounted within the chamber over the aperture; a vertical deflector plate extending outward at a rearward angle from said first side wall to cover less than all of the speaker aperture; an air outlet port formed by each said first side wall spaced from said loudspeaker receiving aperture; partition means dividing each said chamber into a compression area immediately adjacent the loudspeaker receiving aperture; a first rectangular horn area, and a second rectangular horn area; said partition means being angularly disposed to provide a wider area at the second end of each horn area than at the first end of each horn area; a passageway formed by said partition means to form an air communication port between said compression area and the first end of said first horn area; and a second passageway formed by said partition means forming an air communication port between said first and second horn areas located adjacent the second end of said first horn area and the first end of said second horn area; said air outlet port formed by said first side walls being located adjacent and opening into the second end of said second horn area.

2. A loudspeaker according to claim 1 and wherein said first passageway is an elongated aperture and said second passageway is a circular aperture.

3. A loudspeaker enclosure particularly adapted to create the spacial effect of binaural audio reproduction comprising: a loudspeaker enclosure cabinet means forming a pair of complementary sealed chambers; each said chamber having a first vertical side wall relatively mounted in a substantially 90° relationship to the first side wall of the opposite chamber with the walls being positioned so that extended imaginary planes of said walls intersect along a vertical line at the front of the cabinet of the enclosure; each said side wall forming a loudspeaker receiving aperture of complementary dimension to allow a loudspeaker to be mounted over the opening in the interior of said chamber; a vertical air outlet port formed by said first side wall spaced rearwardly from said loudspeaker receiving aperture; vertical partition means in the interior of each said chamber dividing the chamber into a compression area immediately adjacent the speaker receiving aperture and a first and second serially connected folded horn means, the second of said horn means opening through said air outlet port; a passageway formed by said partition means to form an air communication port between said compression area and the first end of said first horn means; and a vertical deflector plate mounted on the exterior of each said first side walls extending outwardly from said side walls at a position rearwardly of the forward end of the speaker receiving aperture and forwardly of the center point of the speaker receiving aperture; said deflector plates extending to a position rearwardly of the center point of said speaker receiving aperture.

4. A loudspeaker enclosure particularly adapted to create the spacial effect of binaural audio reproduction comprising: a loudspeaker enclosure cabinet means forming a pair of complementary sealed chambers; each said chamber having a first vertical side wall relatively mounted in a substantially 90° relationship to the first side wall of the opposite chamber with the walls being positioned so that extended imaginary planes of said walls intersect along a vertical line at the front of the cabinet of the enclosure; each said side wall forming a loudspeaker receiving aperture of complementary dimension to allow a loudspeaker to be mounted over the opening in the interior of said chamber; a vertical air outlet port formed by said first side wall spaced rearwardly from said loudspeaker receiving aperture; vertical partition means in the interior of each said chamber dividing the chamber into a compression area immediately adjacent the speaker receiving aperture, and a first and

second serially connected folded horns, the second of said horns opening through said air outlet port; a passageway formed by said partition means to form an air communication port between said compression area and the first end of said first horn; a first vertical deflector plate mounted on the exterior of each said first side walls at a position rearwardly of the forward end of the speaker opening end and forwardly of the center; said first deflecting plates extending to a position rearwardly of the center point of said speaker receiving aperture; second vertical deflecting plates extending forward from each of said first side walls at a position immediately forward of the forward end of said speaker receiving aperture; third vertical deflecting plates extending angularly rearwardly from a position slightly rearward of the center point of said speaker receiving aperture and extending to a position forward of the rearward extension of said speaker receiving aperture; and fourth vertical deflecting plates connected to each said side plates mounted on said side plate between said speaker receiving aperture and said vertical air outlet port; said fourth vertical deflecting plate extending angularly rearwardly to a position forwardly of the rearward edge of the vertical air outlet port.

5. A loudspeaker enclosure particularly adapted to create the spacial effect of binaural audio reproduction comprising: enclosure box means forming a pair of complementary sealed chambers; each said chamber having a first vertical side wall relatively mounted in a substantially 90° relationship to the first side wall of the other chamber; each said first side wall forming a loudspeaker receiving aperture of complementary size to allow a loudspeaker to be mounted within the chamber over the aperture; vertical deflecting plates extending outward at a rearward angle from said first side wall to vertically project upon less than all of the speaker aperture; an air outlet port formed by each said first side wall spaced from said loudspeaker receiving aperture; partition means dividing each said chamber into a compression area immediately adjacent the loudspeaker receiving aperture; a first horn area, and a second horn area; said partition means being angularly disposed to provide a wider area at the second end of each horn area than at the first end of each horn area; a passageway formed by said partition means to form an air communication port between said compression area and the first end of said first horn area; a second passageway formed by said partition means forming an air communication port between said first and second horn areas located adjacent the widest end of said first horn area and the narrowest end of said second horn area; said air outlet port formed by said first side walls being located adjacent the opening into the widest end of said second horn area; and a plurality of air deflectors mounted on the interior of said first horn area extending inwardly from one wall portion of the partition means and spaced from the other wall portion of the partition means forming the horn area.

6. A loudspeaker enclosure particularly adapted to create the spacial effect of binaural audio reproduction comprising: a loudspeaker enclosure cabinet means forming a pair of complementary sealed chambers; each said chamber having a first vertical side wall relatively mounted in a substantially 90° relationship to the first side wall of the opposite chamber with the walls being positioned so that extended imaginary planes of said walls intersect along a vertical line at the front of the cabinet of the enclosure; each said side wall forming a loudspeaker receiving aperture of complementary dimension to allow a loudspeaker to be mounted over the opening in the interior of said chamber; vertical sound deflecting board extending outward and at a rearward angle from said first vertical side wall from a position between the center and forward edge of said speaker aperture; a vertical air outlet port formed by said first side wall spaced rearwardly from said loudspeaker receiving aperture; first vertical partition means extending from the inside of the first side wall of each of said chambers to the opposite wall of said chamber to form a compression area immediately adjacent the speaker receiving aperture; a second partition means extending from the first side wall to another wall of said cabinet means in each of said chambers angled outwardly relative to said first partition means; said first and second partition means mounted between the vertical air outlet port and the loudspeaker receiving aperture; a vertical aperture formed by the first partition means immediately adjacent said first side walls; and a circular aperture formed in said second partition means on the rearward extension thereof opening into the area carrying the vertical air outlet port opening whereby the partition means form a serially connected pair of folded horns opening to said vertical air outlet port.

7. A loudspeaker enclosure particularly adapted to create the spacial effect of binaural audio reproduction comprising: a loudspeaker enclosure cabinet means forming a pair of complementary sealed chambers; each said chamber having a first vertical side wall relatively mounted in a substantially 90° relationship to the first side wall of the opposite chamber with the walls being positioned so that extended imaginary planes of said walls intersect along a vertical line at the front of the cabinet of the enclosure; each said side wall forming a loudspeaker receiving aperture of complementary dimension to allow a loudspeaker to be mounted over the opening in the interior of said chamber; a vertical air outlet port formed by said first side wall spaced rearwardly from said loudspeaker receiving aperture; partition means mounted within each of said chambers to form a compression area immediately adjacent the loudspeaker receiving aperture and a serially connected folded horn passageway opening to said vertical air outlet port; a passageway formed by said partition means to form an air communication port between said compression area and said folded horn passageway; and vertical deflecting plates mounted on each of said first side walls at a position rearwardly of the forward end of said loudspeaker receiving aperture and forwardly of the center of the loudspeaker receiving aperture; said deflecting plates extending through the entire height of the loudspeaker enclosure cabinet.

8. A device according to claim 7 and wherein each said deflecting plate is mounted on an angle of approximately 58° relative to each of said side walls and is of sufficient length to extend to a position substantially rearward of the middle of said loudspeaker receiving aperture and forward of the rearward end of said loudspeaker receiving aperture.

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