Dec. 3, 1957 W. L. HARTSFIELD 2,815,086

CONVERTIBLE LOUDSPEAKER SYSTEM

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Fig. 1

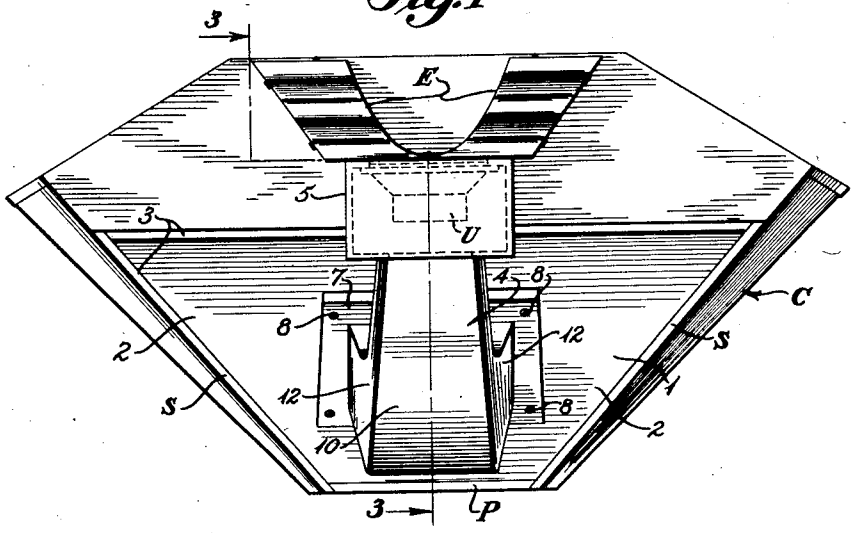
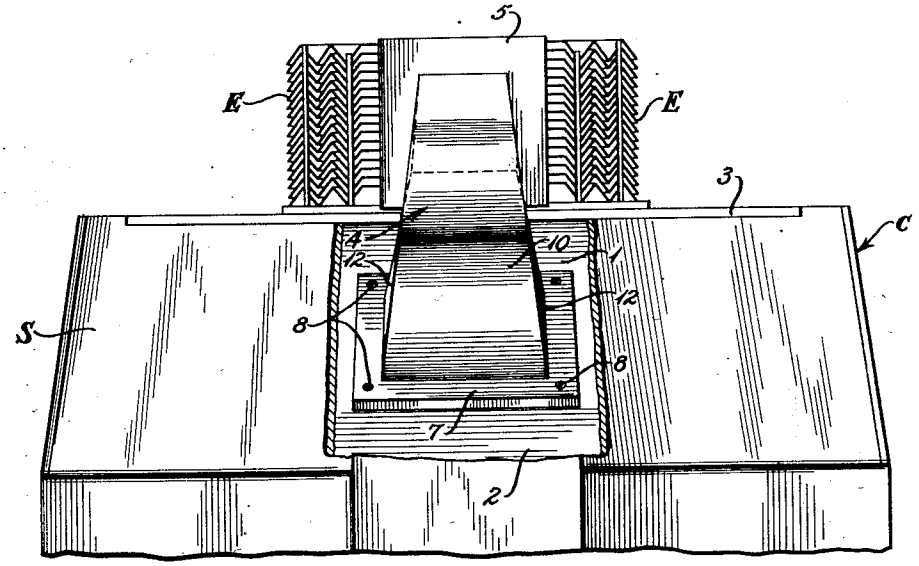


Fig. 2



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Fig. 3

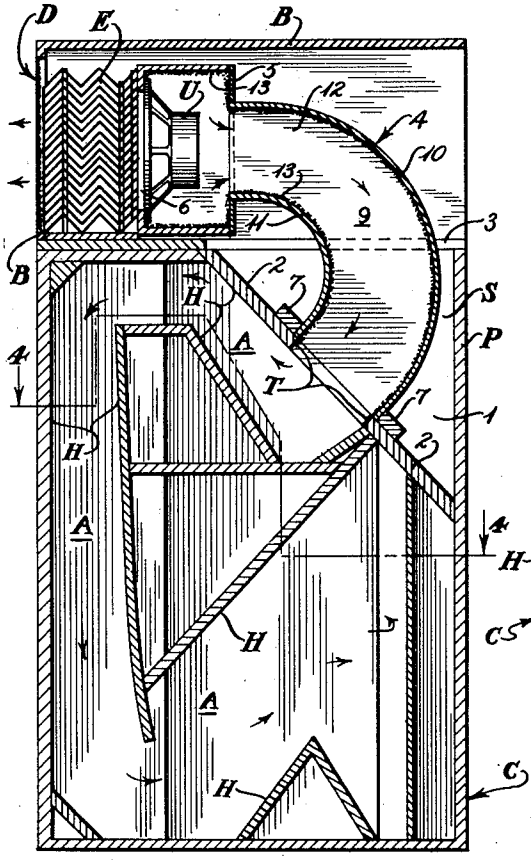
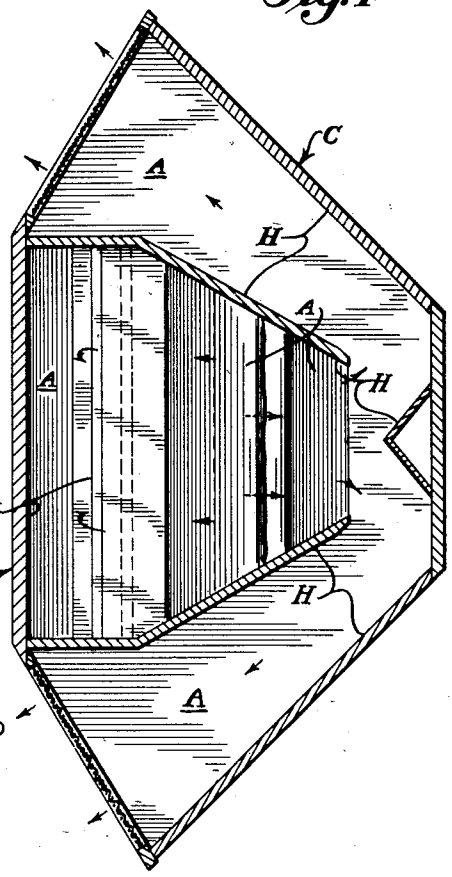


Fig. 4



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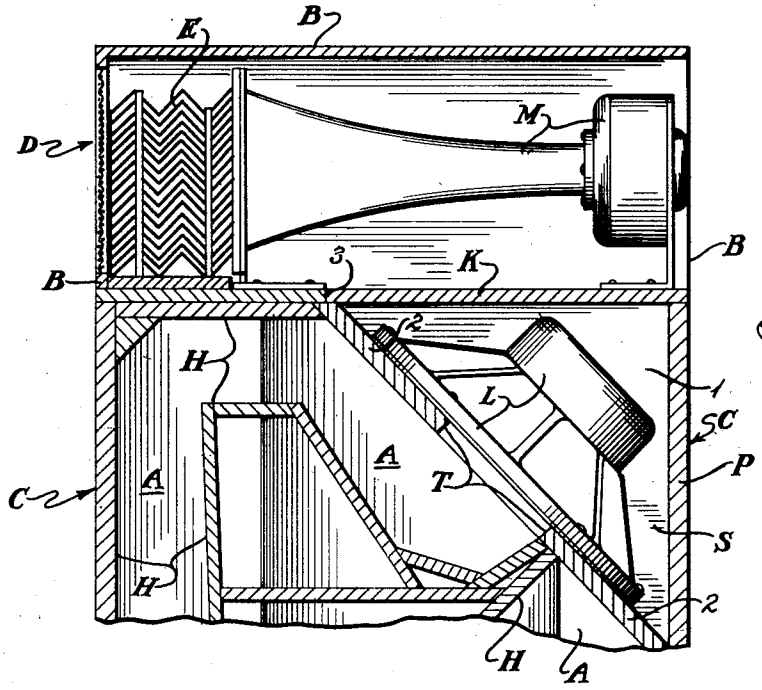


Fig. 5

Fig. 6

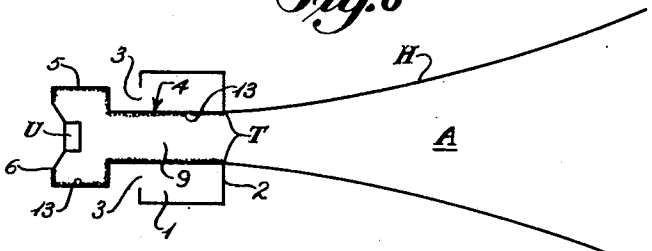
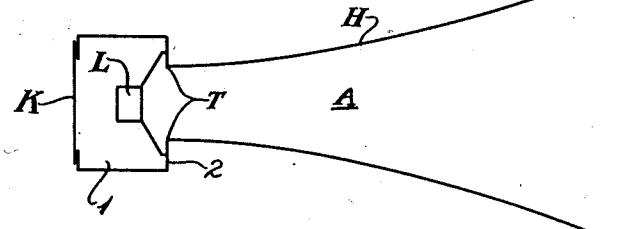


Fig. 7



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CONVERTIBLE LOUDSPEAKER SYSTEM

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Application February 18, 1954, Serial No. 411,133

18 Claims. (Cl. 181—31)

My invention relates to high-fidelity audio loud-speaker horns, and more particularly relates to a convertible system of loud-speaker horns whereby the same speaker cabinet may be used to house either a complete high-fidelity system including a low-frequency driver operating into a low-frequency horn in the bottom of the cabinet and including a high-frequency driver in the upper part of the cabinet; or alternatively to house an adapter in the upper part of the same cabinet, the adapter housing a relatively smaller loud-speaker unit in its upper end, which unit faces forwardly of the cabinet to directly radiate the high-frequency audio components therefrom, the back radiation of the loud-speaker unit being coupled to the upper end of the air column of the adapter the lower end of which couples smoothly into the throat of the folded low-frequency horn.

This convertible audio horn system was invented to meet a very important economic need in the present high-fidelity audio equipment market, the need growing out of the fact that the prospective purchaser of a high-fidelity audio system, having limited funds at his disposal, has heretofore been faced with two unsatisfactory alternatives. Either he must purchase a complete high-fidelity system including not only the folded horn cabinet but also including the extremely costly separate high- and low-frequency drivers and cross-over networks, or else he must purchase a much less expensive single loud-speaker unit and a different cabinet for use therewith, which cabinet and speaker unit will be a total loss to him when he wishes to graduate from the less expensive system to the more costly complete high-fidelity system.

Therefore, the principal object of my invention is to provide a cabinet having a low-frequency horn therein designed to match a full-size low-frequency driver, and to provide an adapter for use in conjunction therewith, which adapter will house a relatively smaller loud-speaker unit for directly radiating the high-frequency components and for driving by its back-radiation through the adapter the low-frequency horn, the adapter replacing the said low-frequency driver until the purchaser can afford to trade in the adapter and smaller loud-speaker unit on high-fidelity high- and low-frequency drivers and cross-over networks.

Another important object of my invention is to provide in the cabinet a back cavity adapted to be closed by a lid when a low-freqency driver is used, said lid being omitted when the adapter and smaller speaker unit are used so that the adapter will enter the back cavity and couple to the throat of the low-frequency horn and become, in effect, a continuation of the air column thereof.

Still another object of my invention is to provide a top cover which will fit and overlie the lower horn portion of the cabinet and become the upper portion of the cabinet wherein is located either the high-frequency driver, or, alternatively, the adapter and smaller loud-speaker unit. In either case, the top cover has an opening in the front thereof to permit radiation of the high-frequency audio components, and is so designed that a high-frequency audio lens may be installed between the speaker unit, or the high-frequency driver, and said opening to spread the high-frequency audio components to cause them to radiate over a predetermined pattern.

A more specific object of my invention is to provide a cabinet and adapter of the type described wherein the adapter has a tapered characteristic which when coupled to the throat of the horn forms therewith a composite air column having a continuous taper.

A further important object of my invention is to provide acoustical padding in the loud-speaker housing and in the air-column portion of the adapter, said padding attenuating the high-frequency audio components of the back-radiation of the loud-speaker unit to prevent their entry into the horn section of the cabinet, said padding serving to prevent reflections against the back of the diaphragm of the loud-speaker unit in the adapter, and the distribution of the padding in the adapter providing means for adjusting the characteristic of the front- and back-radiation of the loud-speaker unit in the adapter so as to balance the over-all radiation of the system and provide a smooth cross-over.

Other objects and advantages of my invention will become apparent during the following discussion of the drawings, wherein:

Figure 1 is a plan view of my cabinet showing the adapter connected to the throat of a folded low-frequency horn at the back cavity, and showing a high-frequency audio lens mounted in front of the loud-speaker unit, the top cover of the cabinet being removed in this view.

Fig. 2 is a rear elevation corresponding to Fig. 1, the rear panel of the cabinet being partially broken away to show the lower portion of the adapter attached to the low-frequency driver mounting-board of the cabinet.

Fig. 3 is a side elevation in section along line 3—3 of Fig. 1 of the cabinet and top cover showing the adapter and high-frequency audio lens therein.

Fig. 4 is a section view taken along line 4—4 of Fig. 3.

Fig. 5 is an enlarged partial side elevation in section showing the cabinet, including the top cover, equipped with a low-frequency driver in the back cavity and with a high-frequency driver under the top cover and behind the high-frequency audio lens, the drivers in this figure replacing the adapter and smaller loud-speaker unit shown in Fig. 3.

Fig. 6 is a schematic diagram of the adapter and speaker system shown in Fig. 3, and

Fig. 7 is a schematic diagram of the low-frequency portion of the high-fidelity system as shown in partial elevation in Fig. 5.

Referring now to the drawings, I shall describe in more detail the particular embodiment of my invention shown therein.

Figs. 1, 2, 3, and 5 show a cabinet C having a folded low-frequency horn H defining an air column A which terminates in a throat T. The cabinet C has a top cover B with an opening D adapted to pass the high-frequency audio components for radiation thereof outside of the cabinet, a high-frequency lens E being included, if desired, as shown in Figs. 1, 2, 3 and 5. These elements are shown only generally and their particular structure forms no part of the present invention.

These figures further show that the cabinet is provided with a back cavity 1 separated from the folded horn H by a speaker mounting-board 2 through which the throat T of the horn passes, the back cavity 1 being further enclosed by a back panel P and by side panels S. The top of the back cavity 1 has an opening 3, Figs. 3 and 6, which may be closed by a lid K, Figs. 5 and 7. When the lid K is omitted, the back cavity communicates

into that portion of the cabinet C enclosed by the top cover B, for the purpose hereinafter stated.

When the cabinet is to house a full high-fidelity audio system, a low-frequency driver L will be housed within the back cavity 1 and secured to the mounting-board 2 at the throat T, as shown in Figs. 5 and 7, in which event the lid K will close the back cavity 1. In the upper part of the cabinet C beneath the top cover B will be mounted a high-frequency driver M, Fig. 5, oriented to radiate outwardly through the top cover opening D and through the lens E, if used. These drivers L and M may be of any high quality type and will be driven by power from a suitable amplifier (not shown) delivered through a suitable cross-over network (not shown).

However, when the cabinet is to house a lower-cost system, the low-frequency driver L and the high-frequency driver M and the lid K will not be used, but instead an adapter 4 and a smaller loud-speaker unit U will serve both to provide high-frequency audio through the top cover opening D and to drive the low-frequency horn H through the adapter 4, Figs. 1, 2, 3 and 6.

The adapter 4 includes a housing 5 in which is mounted the loud-speaker unit U opposite an opening 6 through which the high-frequency audio directly radiates from the front of the loud-speaker cone. As stated above, this front-radiation may or may not pass through a lens E.

The back-radiation of the loud-speaker unit U is coupled to the adapter 4 which has at its lower end a flange 7 serving to mount the adapter 4 to the mounting-board 2 by any suitable securing means, such as screws 8, Figs. 1 and 2.

The adapter 4, as stated in the objects of this invention, includes a tapered tube 9 defining an adapter air column, and the tube 9 including an upper curved wall 10, a lower curved wall 11 and symmetrically disposed side walls 12, the tube 9 becoming a matching continuation of the tapered air cloumn A of the folded horn H, as best illustrated in Fig. 6.

Within the housing 5 and the adapter 4, I provide acoustical padding 13 for the purpose of absorbing the high-frequency audio components of the back-radiation of loud-speaker unit U, and to prevent reflections of the back-radiation. By laboratory measurements I have found that for the purpose of adequately absorbing the high-frequency components of the back-radiation while providing a smooth cross-over characteristic, the padding 13 should not line the entire inside of the housing 5 but should be used only on the upper wall 10 and lower wall 11 of the adapter 4, the side walls 12 being unpadded.

While I have illustrated only one practical embodiment of my invention, showing a particular form of cabinet containing a folded low-frequency horn, and an adapter having a curved air column portion to mechanically fit the particular structure of the illustrated cabinet, it is to be understood that changes in the structure of the illustrated cabinet and adapter are possible without deviating from the spirit of my invention as set forth in the following claims.

I claim:

1. For use with a cabinet having a low-frequency horn defining a tapered air-column communicating with the atmosphere at one end and having at the other end a mounting board with a throat therethrough and adapted to be coupled to a relatively large low-frequency driver, an adapter to be coupled to said horn at the mounting board in place of said driver to permit said horn to be driven by a relatively smaller loud-speaker unit, said adapter comprising a tapered wall tube defining an adapter air-column said tube having a larger end of the same area as said throat, and said tube reducing in cross-section along a taper designed to couple with the taper of said horn and terminating in a smaller end; a mounting flange fixed to the tube at its larger end for supporting the tube when secured to the mounting board at the

throat; and a housing coupled to said smaller end and having an aperture therein communicating with the atmosphere, said loud-speaker unit being mounted in said housing and facing outwardly through said aperture, whereby the front-radiation of said unit will radiate directly and the back-radiation will drive said horn through the adapter.

2. In a device as set forth in claim 1, the tube being curved so as to orient the aperture in substantially the same direction as the end of the horn which communicates with the atmosphere.

3. In a device as set forth in claim 1, the inner surfaces of the housing and the tube being at least partially lined with acoustical padding to absorb high-frequency audio components of the back-radiation and to prevent audio reflections.

4. For use with a cabinet having a low-frequency horn defining a tapered air-column communicating with the atmosphere at one end and having at the other end a mounting board with a throat therethrough and adapted to be coupled to a low-frequency driver, an adapter to be coupled to said horn at the mounting board in place of said driver to permit said horn to be driven by a loud-speaker unit, said adapter comprising an elongated tube defining an adapter air column having one end of the same area as said throat; detachable coupling means on said one end of said tube for supporting the latter by connecting it to said horn at the throat; and a housing coupled to the other end of the air-column and having an aperture there opposite communicating with the atmosphere, said loud-speaker unit being mounted in said housing and facing outwardly through said aperture, whereby the front-radiation of said unit will radiate directly and the back-radiation will drive said horn through the adapter.

5. In a device as set forth in claim 4, the tube being curved so as to orient the aperture in substantially the same direction as the end of the horn which communicates with the atmosphere.

6. In a device as set forth in claim 4, the inner surfaces of the housing and the tube being at least partially lined with acoustical padding to absorb high-frequency audio components of the back-radiation and to prevent audio reflections.

7. For use with a high-fidelity audio cabinet having a lower portion including a tapered low-frequency horn communicating with the atmosphere and having a throat communicating with a back cavity in the cabinet, said cabinet having an upper portion with an opening communicating with the atmosphere and said back cavity being adjacent said upper portion and normally separated therefrom by a lid, and said cabinet normally having a low-frequency driver in said back cavity and a high-frequency driver in said upper portion at said opening; an adapter for replacing said low-frequency driver, said high-frequency driver and said lid with a single loud-speaker unit, said adapter comprising a tapered wall tube defining an adapter air-column having a larger end of the same area as said throat; coupling means on said tube to couple the latter to said horn at the throat; said tube being tapered to accoustically couple to said horn and terminating in a smaller end; and a housing in said upper portion and coupled to said smaller end and having an aperture therein, said aperture being aligned with said opening whereby when said loud-speaker unit is mounted in said housing facing outwardly through said aperture the front-radiation of said unit will radiate directly and the back-radiation will drive said horn through the adapter.

8. In a device as set forth in claim 7, the tube being curved so as to orient the aperture in substantially the same direction as the end of the horn which communicates with the atmosphere.

9. In a device as set forth in claim 7, the inner surfaces of the housing and the tube being at least partially lined with acoustical padding to absorb high-frequency audio

components of the back-radiation and to prevent audio reflections.

10. For use with a high-fidelity audio cabinet having a lower portion including a low-frequency horn communicating with the atmosphere and having a throat communicating with a back cavity in the cabinet, said cabinet having an upper portion with an opening communicating with the atmosphere and said back cavity being adjacent said upper portion and normally separated therefrom by a lid, and said cabinet normally having a low-frequency driver in said back cavity and a high-frequency driver in said upper portion at said opening; an adapter for replacing said low-frequency driver, said high-frequency driver and said lid with a single loud-speaker unit, said adapter comprising an elongated tube defining an adapter air-column having one end of the same area as said throat coupling means on said tube to couple the latter to said horn at the throat; and a housing in said upper portion and coupled to the other end of said tube and having an aperture therein, said aperture being aligned with said opening whereby when said loud-speaker unit is mounted in said housing facing outwardly through said aperture the front-radiation of said unit will radiate directly and the back-radiation will drive said horn through the adapter.

11. In a device as set forth in claim 10, the tube being curved so as to orient the aperture in substantially the same direction as the end of the horn which communicates with the atmosphere.

12. In a device as set forth in claim 10, the inner surfaces of the housing and the tube being at least partially lined with acoustical padding to absorb high-frequency audio components of the back-radiation and to prevent audio reflections.

13. An adapter for use in substituting for separate drivers a single loud-speaker unit in an audio cabinet having a low-frequency horn with a throat designed to be normally coupled to a low-frequency driver and said cabinet normally housing a separate high-frequency driver, said adapter comprising a tube defining an adapter air-column to be coupled at one end to said horn at its throat; detachable coupling means on said tube for securing the latter to the horn; and a housing coupled to the other end of said tube and having an aperture therein, said loud speaker unit being mounted in said housing to face outwardly through said aperture and to directly radiate high-frequency components of its output, the back-radiation of said unit driving said horn through said adapter air-column, the low-pass characteristics of which are designed to couple with the low-pass characteristics of said horn.

14. In a device as set forth in a claim 13, the tube being curved so as to orient the aperture in substantially the same direction as the end of the horn which communicates with the atmosphere.

15. In a device as set forth in claim 13, the inner surfaces of the housing and the tube being at least partially lined with acoustical padding to absorb high-frequency audio components of the back-radiation and to prevent audio reflections.

16. An adapter for use in substituting for separate drivers a single loud-speaker unit in an audio cabinet having a low-frequency tapered horn with a throat designed to be normally coupled to a low-frequency driver and said cabinet normally housing a separate high-frequency driver, said adapter comprising a tapered wall tube defining an adapter air-column to be coupled at one end to said horn at its throat; detachable coupling means on said tube for securing the latter to the horn at the throat; and a housing coupled to the other end of said tube and having an aperture there opposite, said loud speaker unit being mounted in said housing to face outwardly through said aperture and to directly radiate high-frequency components of its output, the back-radiation of said unit driving said horn through said adapter, and the taper of said tube acoustically coupling with the taper of said horn.

17. In a device as set forth in claim 16, the tube being curved so as to orient the aperture in substantially the same direction as the end of the horn which communicates with the atmosphere.

18. In a device as set forth in claim 16, the inner surfaces of the housing and the tube being at least partially lined with acoustical padding to absorb high-frequency audio components of the back-radiation and to prevent audio reflections.

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