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R. L. MILLER ET AL

2,993,557

OMNIDIRECTIONAL STEREO SYSTEM

Filed Sept. 22, 1958

FIG. 1

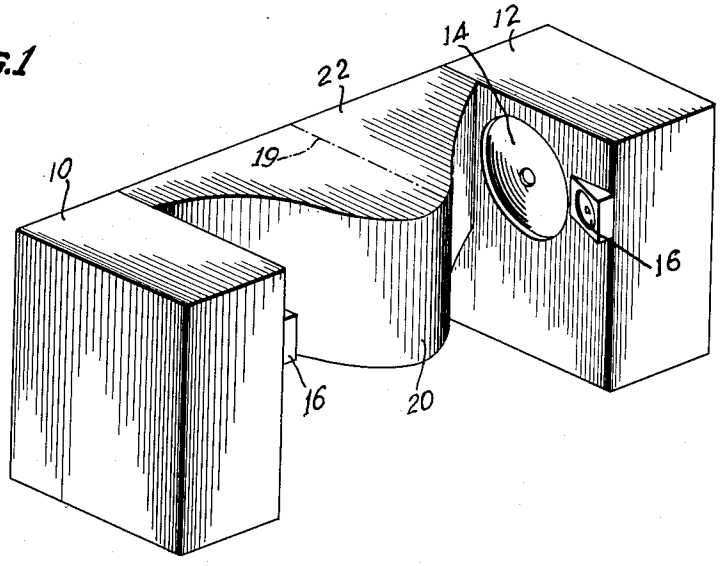


FIG. 2

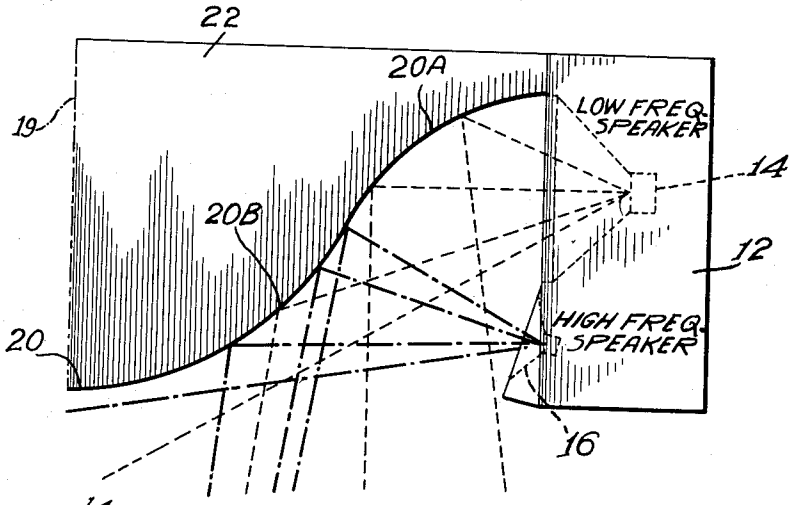
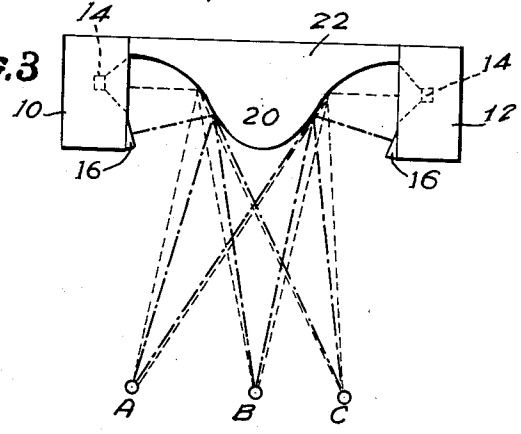


FIG. 3



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OMNIDIRECTIONAL STEREO SYSTEM

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This invention relates to loudspeaker arrangements for obtaining stereophonic effects and, more particularly, to improvements therein.

The presently favored arrangement for obtaining stereophonic effects with loudspeakers is to place two loudspeakers spaced apart from one another and facing toward the listener. These loudspeakers are fed from two separate signal sources which convey the so-called "left and right" audio signal information. One factor that reduces the realism of the resultant stereophonic effect is that due to the directionality of the acoustical output from the speakers the listener must position himself on the center line between the two spaced speakers. Movement from the optimum position causes a loss in stereophonic effect. Since the average livingroom in the home does not lend itself to placing seats for listeners between the two speakers in the optimum position, it will be appreciated that the directionality of the present-day speaker is a limitation and serves to detract from the stereophonic effect.

It is an object of this invention to provide apparatus for obtaining an omnidirectional stereophonic effect from loudspeakers.

It is another object of this invention to provide a novel omnidirectional stereophonic speaker system.

One of the other factors which deteriorate the stereophonic effects obtainable in two speakers is that with such an arrangement there is an effect known as a "hole" in the middle of the sound sources. This comes about because, since two point sources of sound spaced apart are being employed, the effect obtained is that of listening to sound sources from the left and right sides with no sound coming from between the speakers. Where an orchestra is attempted to be reproduced, this effect detracts from the realism of the presentation.

Accordingly, it is a further object of this invention to provide a realistic stereophonic sound system.

Another object of this invention is to provide an arrangement whereby the fixed "point-source-of-sound" effect is eliminated.

These and other objects of the invention are achieved in an arrangement wherein the speakers for reproducing the stereophonic sound are positioned spaced apart and facing one another. Interposed between the two loudspeakers is a sound-reflecting surface which has the shape of a curve. This curve is symmetrically disposed about the center line between the two speakers. This reflecting surface extends outward from a base plane extending between the two speakers. The reflecting surface is shaped in order to effectively reflect the output from the one or more loudspeakers on either side thereof substantially at right angles and also to disperse such acoustical output. The listener can move to any desired position in front of the reflecting surface and will still obtain realistic stereophonic acoustical effect nonetheless.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIGURE 1 is an isometric drawing of the embodiment of the invention;

FIGURE 2 is a plan view illustrating the details of the curve of the acoustical reflecting surface employed in the invention; and

FIGURE 3 is a plan view of the invention, illustrating how listeners can obtain stereophonic effects regardless of their location in front of the embodiment of the invention.

Referring now to FIGURE 1, there may be seen an isometric drawing of the embodiment of the invention. This will include a first loudspeaker enclosure **10** and a second loudspeaker enclosure **12**, each of which includes a loudspeaker **14**. The loudspeakers and their enclosures are positioned so that they face toward one another. The loudspeakers **14** are the so-called "woofers," or loudspeakers which reproduce the lower frequencies of the acoustical signal frequency range. The higher frequencies of an acoustical signal range are reproduced by tweeters **16**, which are mounted adjacent the woofers. These may be supported from the same speaker enclosure which supports the low-frequency speakers. The high-frequency speakers are also mounted to be facing toward one another.

Interposed between the loudspeakers is a hard, nonresonant acoustical signal-reflecting surface **20**. This surface has the shape of a curve, which is symmetrical about the center line **19** between the speakers. Effectively, the curve may be said to extend outward between the speakers from a base plane **22**. The high-frequency speakers **16** are mounted at a slight angle in order to face one portion of the curved reflecting surface. The low-frequency speakers face a second portion of the curved reflecting surface.

FIGURE 2 illustrates a plan view of one-half of the curved reflecting surface. The low-frequency speaker **14** faces a concave portion **20A** of the reflecting surface **20**. As indicated by the dotted lines, the acoustical output from the low-frequency speaker will be reflected substantially at right angles from the reflecting surface immediately in front of the loudspeaker. Since, as is well known, low frequencies are not directional, some of the output from the low-frequency speaker will travel to other portions of the reflecting surface **20** than those immediately in front of the low-frequency speaker and will be reflected at other angles than 90° and also a certain portion of the low-frequency output of the low-frequency speaker will manage to avoid the reflecting surface altogether. This, also, is represented by the dotted lines emanating from the low-frequency speaker shown in FIGURE 2.

The high-frequency speaker **16** is aimed at a convex portion **20B** of the reflecting surface **20**. Since, as is well known, the high-frequency sounds emanated by a high-frequency speaker are substantially directional, the convex reflecting surface serves the function of dispersing the high-frequency sound in the manner represented by the dotted lines shown in FIGURE 2.

FIGURE 3 represents an elevation of the embodiment of the invention which illustrates how three listeners, respectively A, B, and C, will receive a stereophonic sound effect from the embodiment of the invention. Listener A will hear the outputs from the loudspeakers mounted in the enclosure **10** by reflection and will hear the sound from the low-frequency loudspeaker mounted in the enclosure **12** directly and from the high-frequency speaker mounted on the enclosure **12** by reflection. The low-frequency acoustical waves are represented by the dash lines, and the high-frequency acoustical waves are represented by the dash-dot lines.

The listener located at the position B directly on the center line between the two speakers will receive acoustical output only by reflection from the curved reflecting surface. The listener at the position C will hear the

sounds provided by the loudspeakers in tne enclosure **12** by reflection and will hear the sound from the low-frequency speaker in the enclosure **10** directly. The high-frequency speaker mounted on the enclosure **10** will be heard by reflection from the reflecting surface **20**.

It has accordingly been shown hereinabove that by this invention an omnidirectional stereophonic effect is obtainable. By virtue of the utilization of the reflecting surface effectively the sound sources move with the listener, so that they effectively are positioned at all times to provide the stereophonic effect. The effect of the reflecting surface in dispersing the sound from the sound sources is to substantially broaden the sound sources so that the "hole" effect is avoided.

There has accordingly been shown and described hereinabove a novel, useful, and unique stereophonic sound system.

We claim:

1. A stereophonic sound system for audio signals comprising a pair of spaced low-frequency speakers for reproducing the lower-frequency portion of the range of said audio signals, means supporting said low-frequency speakers facing toward each other, a pair of spaced high-frequency speakers for reproducing the higher frequency portion of the range of said audio signals, means supporting said high-frequency speakers facing toward each other, and a sound-reflecting surface interposed between said spaced low and high frequency speakers, said sound-reflecting surface having the shape of a curve which is symmetrical about the center line between said spaced loudspeakers, said curve having a concave portion opposite each of said low-frequency speakers and having a convex portion opposite each of said high-frequency speakers.

2. A stereophonic sound system for audio signals comprising a pair of low-frequency speakers for reproducing the lower frequency portion of the range of said audio signals, a pair of high-frequency speakers for reproducing the higher frequency portion of the range of said audio signals, a sound-reflecting surface extending outward from a base plane and having the shape of a curve which is symmetrical about a center plane extending at right angles from said base plane, said sound-reflecting surface having a convex curved portion on either side of said center plane and a concave curved portion between said convex curved portion and said base plane, means for positioning one of said pair of low-frequency speakers on one side and the other on the opposite side of said sound-reflecting surface adjacent said base plane and facing said concave portion of said reflecting surface, and means for positioning one of said pair of high-frequency speakers on one side and the other on the opposite side of said sound-reflecting surface adjacent said low-frequency speakers and facing said convex curved portion of said reflecting surface.

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