Jan. 27, 1942. E. H. SCOTT 2,271,100

SOUND EQUALIZER REPRODUCER SYSTEM

Filed Dec. 24, 1940

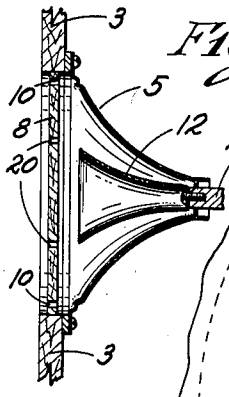


Fig. 3

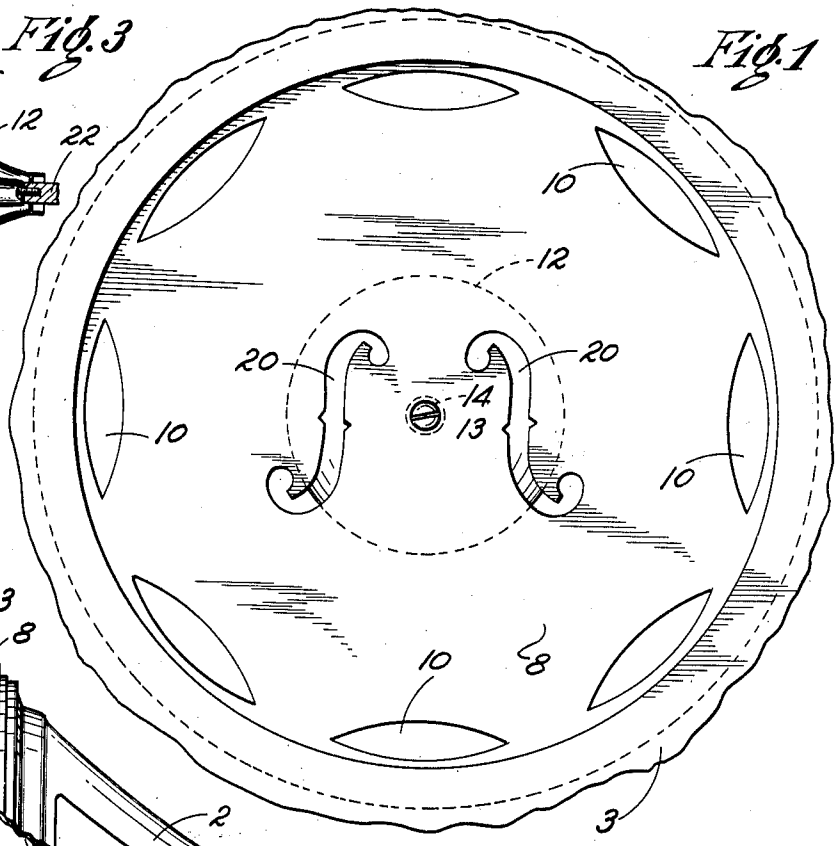


Fig. 1

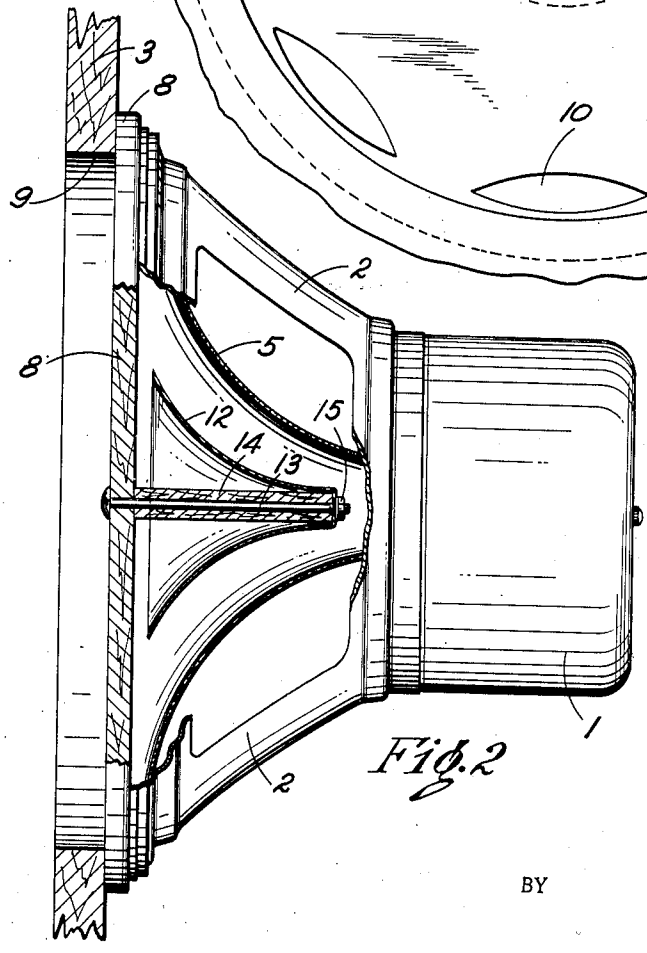


Fig. 2

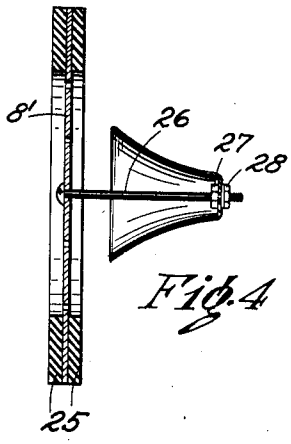


Fig. 4

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Patented Jan. 27, 1942 2,271,100

UNITED STATES PATENT OFFICE

2,271,100

SOUND EQUALIZER-REPRODUCER SYSTEM

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Application December 24, 1940, Serial No. 371,550

11 Claims. (Cl. 181—31)

This invention relates to sound reproducing systems, and more particularly to an improved loud speaker and sound diffuser therefor.

It has long been known that sound reproduced in loud speaker systems has directional characteristics. This is particularly true in the higher frequencies, and the higher the frequency of the sound, the more pronounced are its directional characteristics. Prior to comparatively recent years, this phenomenon was of no particular concern, since the average reproducer very seldom reproduced sounds over 3000 cycles. In more recent years, however, with the advent of high fidelity, the directional characteristics of high frequency sound has become one of the problems for the acoustical engineer. With the modern frequency modulation stations putting signals on the air from 30 to 15000 cycles, it has become necessary to construct a sound system that will faithfully reproduce these signals.

Although the full range of frequencies may be reproduced, the full benefits therefrom are not always realized because of the before-mentioned directional characteristics to the sound. That is, although the low audio frequency sounds are heard in nearly all parts of the room, the high frequency components of the sound are not heard in all parts because of the fact that they are projected in a beam only directly in line with the speaker and all concentrated in a relatively small area. This not only prevents them from being heard at points to one side of the loud speaker, but increases the intensity in the one area so that the sounds are too intense or are brassy in character. There are, therefore, only a very small number of places where one can sit in relation to the speaker and realize the full benefits of the high fidelity reproduction.

By the present invention this high intensity area of high frequency sound is broken up. The high frequencies are distributed, after leaving the speaker, so that the full fidelity range and benefits of the sound system are realized in substantially all parts of the room and there are none of the brassy characteristics before mentioned.

Heretofore various apparatus to cause diffusion has been used. Although this apparatus may have been to some extent effective, it had its disadvantage in that it was very cumbersome requiring a considerable amount of space for installation. This was undesirable from the standpoint of home use since the users of radios do not want their radios to take up too much space and often sacrifice better reproduction for a device that is smaller and blends better with the general scheme of their other furniture. The present invention affords all of the advantages of the more cumbersome apparatus, and still lends itself to the general scheme of the home decorations. In fact, with the present device the general appearance of the radio is so improved as to make it more desirable than the conventional type of radio console.

It is therefore an object of my invention to provide a reproducing system having high fidelity characteristics.

It is another object of my invention to provide a speaker system that eliminates areas of high intensity sound.

It is still another object of my invention to provide a speaker system that furnishes even distribution and diffusion of high frequency sounds throughout a larger area.

Still another object of the invention is to provide a mechanism for accomplishing the foregoing objects and still not detract from the aesthetic beauty of the receiver or reproducer in which the apparatus is used.

Still other objects of the invention, and the invention itself, will become more apparent from the following description of an embodiment thereof, which description is illustrated by the accompanying drawing and forms a part of this specification. In the specification I have discussed to some extent what I believe to be the mode of operation. However, it is to be understood that this is theoretical, and that although definitely improved results are afforded by the apparatus claimed as determined by actual listening tests, the theory of the operation is not intended as a limitation upon the invention since other theories may later be set forth in accordance with a future better understanding of the particular art.

In the drawing:

Fig. 1 is a front elevational view showing a fragment of the baffle board and the sound board with certain elements behind the sound board being shown by dash lines;

Fig. 2 is a side elevational view with certain parts being broken away and shown in section;

Fig. 3 is a fragmentary section of a modifying form of the invention; and

Fig. 4 is another section of a third modification.

Throughout the drawing, like parts have been designated by like reference characters.

The loud speaker should be one capable of producing a high range of frequencies, and may comprise a pot 1 containing a winding, which pot is

supported by a frame 2. The frame is in turn adapted to be connected to a baffle board 3 which may comprise the front of the receiver console. The speaker is provided with the usual cone 5 flexibly supported at its periphery and carrying a voice coil, not shown, all as is common practice.

Interposed between the front edge of the speaker and the baffle board is a sounding board 8. Although in the drawing this sounding board is shown as interposed between the speaker and the baffle board; this is a matter of convenience since the speaker could be mounted directly on the baffle board and the sounding board disposed in the circular hole 9.

The sounding board is relatively thin compared to the baffle board and is of generally circular form. It is provided with a series of generally elliptical openings 10 extending in a circle adjacent its periphery. The holes are disposed inside of, but adjacent, the peripheral edge of the speaker cone. These openings can be varied in size and shape. For instance, they may be in the form of arcuate slots, or be a series of circular openings. They can also vary in number, but I have found from extensive listening tests that the type shown give very satisfactory results and still do not detract from the general design appearance.

A diffusion cone 12 is provided and comprises a generally conical member shaped to conform to the inner surface of the speaker cone and held in coaxial spaced relation therefrom by a bolt 13. The bolt 13 extends through the front and center of the sound board 8 and has a bushing 14 telescoped thereunder. The bushing extends into the closed end of the diffuser which is adjacent the voice coil end of the speaker cone, and the bolt 13 extends through the bushing and end of the speaker, and all are held securely in place by a nut 15.

Very obviously, the diffuser could be held in place by other means such as a screw extending from the closed end through the bushing and into the sound board. Or they all could be held in place by suitable cements. As best shown in Fig. 1 the center area of the sound board is provided with a pair of openings 20. These openings may take the form of the conventional *f* holes such as are present in violins. It is to be noted, however, that the relative positions of the diffuser and *f* holes is such that the diffuser substantially covers the *f* holes, and also that the free edge of the diffuser is spaced from the sound board approximately three-quarters of the distance of the thickness of the board, and that the edges of the diffuser are free to vibrate.

In Fig. 3 I have shown a modified form of the invention where the loud speaker is connected to the baffle board 3 in the usual manner and the sound board 8 disposed in the opening of the baffle board, as previously described. The diffuser cone 12 is, in this instance however, connected to the pole piece 22 of the loud speaker instead of being supported by the baffle board.

In Fig. 4 I have shown another modification where the sound board 8' is formed of a relatively thin sheet of aluminum or other metal capable of vibration when struck by sound waves, which board may be supported between blocks 25 of wood, or even sponge rubber, to permit a more ready vibration of the board. The diffuser comprises the usual generally conical member secured to the center of the board by a bolt 26, nuts 27 and 28 holding the diffuser in the desired adjusted position.

What I believe to be the operation of the apparatus is as follows: Complex sound waves are reproduced by the speaker cone. These include waves of high and low frequencies varying from 30 to 12,000 cycles and upwards. The high frequencies sounds are not free to travel forward since they are guided outwardly by the diffuser to the circumferential openings, only a portion escaping through the *f* holes. At the same time the sound board which is relatively thin, sets up vibrations under control of these waves, which vibrations are in turn transmitted through the sound board and its connection to the diffuser, where it again acts on the air column affording still further diffusion. Because the air column's general direction is toward the sides or laterally of the speaker, a considerable spread of sound is obtained. At the same time, since the sound board itself is vibrating, the column of air in front of the sound board is also agitated to transmit the complex sound waves forward. The high intensity beam is thus eliminated and there is not this usual tendency to set up room reflections which have undesirable effects upon the sounds.

By actual testing I have found that without this arrangement, the beam effect of the high frequencies in the neighborhood of 9000 cycles is very pronounced, and that the high frequencies cannot be heard to any great extent except in one place, i. e., directly in front of the speaker. With the arrangement shown, however, the beam effect is completely eliminated and the high frequencies are evenly distributed over a large area in a more normal manner. That is, the intensity of the high frequencies is less because of the diffusing, whereas in the prior devices the beam was a concentration of all the high frequencies in one small area.

Various designs in the shape of the *f* openings are also apparent, but I have found that the design shown is very effective and does not detract from the appearance.

Having thus described my invention, I am aware that numerous and extensive departures may be made therefrom, and will be apparent to those versed in the art, without departing from the spirit or scope of the invention.

I claim:

1. An apparatus of the class described including a baffle board, a loud speaker disposed adjacent to the baffle board and having a sound producing cone, said baffle board being formed with an opening opposite said loud speaker cone, a sound board disposed in front of said cone and formed with sound openings adjacent the edge thereof, a diffuser supported by the sound board inside of the cone, said diffuser being spaced from and supported by the sound board and said sound board being formed with openings opposite the diffuser.

2. An apparatus of the class described including a baffle board, a loud speaker disposed adjacent to the baffle board and having a sound producing cone, said baffle board being formed with an opening opposite said loud speaker cone, a sound board disposed in front of said cone and formed with sound openings adjacent the edge thereof, a diffuser having a shape complementary to the cone supported by the sound board inside of the cone, said diffuser being spaced from the speaker cone and said board and supported by the

sound board, said sound board being formed with openings opposite the diffuser.

3. An apparatus of the class described including a baffle board, a loud speaker secured to the baffle board and having a movable sound producing cone, said baffle board being formed with an opening coaxial with said cone, a sound board disposed in front of said cone and formed with sound openings adjacent the edge of the cone, a diffuser supported by the sound board coaxial with the cone and having a conformation complementary to the inner surface of the cone, said diffuser being spaced from the sound board and said sound board being formed with sound openings opposite the diffuser, said diffuser being interposed between the loud speaker cone and the last said openings and substantially covering said last mentioned openings.

4. An apparatus of the class described comprising a baffle board, a loud speaker secured to the baffle board and provided with a movable sound producing cone, said baffle board being formed with an opening coaxial with said cone and covered thereby, a sound board disposed in front of said cone and closing said opening in the sound board and formed with sound openings adjacent the edge of the cone, a diffuser supported by the sound board coaxial with the cone and having an outer surface shaped to provide a surface complementary to the inner surface of the cone, said diffuser being spaced from the speaker cone and the sound board, said sound board being formed with sound openings opposite the diffuser, said diffuser being interposed between the loud speaker cone and the last said openings and having an area at its end adjacent the sound board sufficient to cover said last mentioned openings.

5. A sound reproducing system including a baffle board, a loud speaker supported juxtaposed to the baffle board, said baffle board being formed with an opening in front of the loud speaker, said loud speaker having a sound producing cone, a diffuser member disposed within the cone, a sound board disposed in front of the speaker and closing the opening in the baffle board, said sound board having a plurality of openings adjacent the edge of the cone.

6. A sound reproducing system including a baffle board, a loud speaker supported juxtaposed to the baffle board, said baffle board being formed with an opening in front of the loud speaker, said loud speaker having a sound producing cone, a diffuser member disposed within the cone, a sound board disposed in front of the speaker and closing the opening in the baffle board, said sound board having a plurality of openings adjacent the edge of the cone, and a pair of openings of small area in front of the diffuser.

7. A sound reproducing system including a baffle board formed with and opening therein and a loud speaker disposed over said opening, a sound board of a material capable of vibrating in response to sound from the loud speaker closing the opening in the baffle board and formed with openings adjacent the periphery of the cone, a diffuser disposed between the sound board and the center of the cone to intercept sound waves and distribute them toward said peripheral openings.

8. A sound reproducing system including a baffle board formed with an opening therein, a loud speaker disposed over said opening, a sound board of a material capable of vibrating in response to sound from the loud speaker closing the opening in the baffle board and formed with openings adjacent the periphery of the cone, a diffused disposed between the sound board and the center of the cone to intercept sound waves and distribute them toward said peripheral openings, said sound board having small area openings opposite the diffuser and in alignment therewith.

9. A sound reproducing system comprising a baffle board formed with a circular opening therein, a loud speaker having a sound reproducing cone supported with the cone over the opening in the baffle board, a pole piece for said speaker, a sound board closing the opening in the baffle board and formed with a series of sound openings spaced from the periphery of said cone, a generally conical diffuser having the small end connected to said speaker pole piece and having the large end extending toward but spaced from the sound board, said sound board having openings opposite the diffuser and substantially covered thereby against sound from the cone.

10. An apparatus of the class described, a baffle board and a loud speaker juxtaposed to said baffle board, an opening in said baffle board coaxial with the loud speaker cone, a sound board for said opening and closing said opening, said sound board being formed of a material capable of vibrating in response to sound waves from the loud speaker and having openings formed therethrough adjacent the edge of the cone, a diffuser supported by said sound board coaxial with the cone and extending into the cone in spaced parallel concentric relation thereto, said connection between the diffuser and sound board transmitting vibrations from the sound board to the diffuser and said diffuser, and openings formed in the center of the sound board substantially covered by the diffuser and of relatively small area as compared with the first mentioned openings.

11. An apparatus of the class described, a baffle board and a loud speaker juxtaposed to said baffle board, an opening in said baffle board coaxial with the loud speaker cone, a sound board for said opening closing said opening and supported inside of said opening, said sound board being formed of a material capable of vibrating in response to sound waves from the loud speaker and having openings formed therethrough adjacent the edge of the cone and spaced inside of the cone periphery, a diffuser supported by said sound board coaxial with the cone and extending into the cone in spaced parallel concentric relation thereto, said connection between the diffuser and sound board transmitting vibrations from the sound board to the diffuser and said diffuser and openings formed in the center of the sound board substantially covered by the diffuser and of relatively small area as compared with the first mentioned openings, said sound board between the central openings and the outer openings being imperforate.

ERNEST H. SCOTT.