

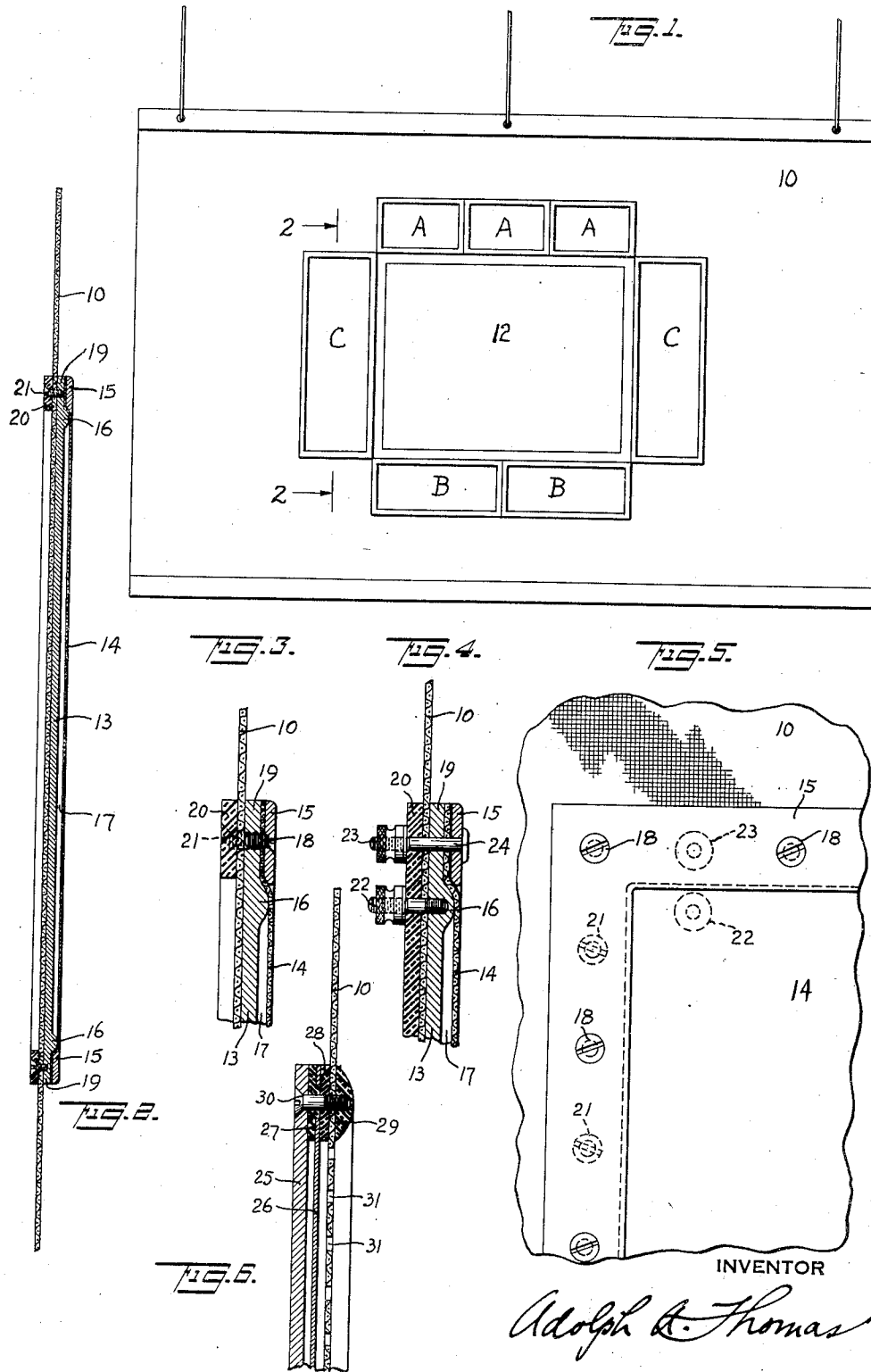
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ELECTROSTATIC LOUD SPEAKER

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ELECTROSTATIC LOUD-SPEAKER

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My invention is for a novel construction of electric loudspeaker apparatus particularly adapted for talking movies to improve the reproduction of sound. As far as I am aware, the only type of loudspeaker used at the present time in theaters exhibiting talking movies is the old-fashioned horn. Usually more than one horn is used, these horns being arranged in proximity to the screen. Since the horns must be concealed from the audience, they have to be covered in some way and that tends to muffle the sound. But aside from that, owing to the large volume of sound required in theaters, the loudspeaker horns must be of great size; and it is a matter of experience that big horns with necessarily long sound passages give a rumbling unnatural reproduction, often lacking in clearness. In some talking movies it is sometimes impossible to distinguish between men's voices and women's voices, and between the various instruments of an orchestra. Unless the speech and music (particularly the dialogue) accompanying a motion picture are reproduced in a clear and natural manner, an audience finds no enjoyment in the story of the picture. There are, indeed, many people who object to talking movies on that account and avoid them.

It is the purpose of this invention to improve the reproduction of sound in talking movies by the use of electrostatic loudspeakers arranged close to the screen and directly open to the auditorium. Where the screen is on a curtain adapted to be raised and lowered, as in large theaters having a stage, I support one or more condenser speakers on the curtain itself in permanent relation to the screen. This arrangement has the practical advantage that the loudspeakers do not have to be handled at all, for they move out of the way when the screen is raised. In one embodiment of my invention, I use several condenser speakers surrounding the screen and constructed to accentuate different bands of frequencies. This enables me to reproduce the entire musical scale with substantially uniform efficiency and fidelity. Owing to their flat construction, these loudspeakers

can be supported in full view of the audience without their presence being detected.

The novel features and practical advantages of my loudspeaking apparatus will be understood from a description of the accompanying drawing, in which—

Fig. 1 shows a theater curtain carrying a set of electrostatic loudspeakers of different sizes arranged around a motion picture screen;

Fig. 2 represents a vertical section on line 2—2 of Fig. 1 on a larger scale to show the construction of one of the loudspeakers;

Figs. 3 and 4 are fragmentary section views on an exaggerated scale to show the mounting of certain parts in the structure of Fig. 2;

Fig. 5 is a partial front view of the loudspeaker construction illustrated in Figs. 2-4; and

Fig. 6 shows a side section of a modified form of condenser speaker in which the vibratory electrode is behind a perforated section of the curtain.

A theater curtain 10 carries a motion picture screen 12 of any approved construction. These screens are usually an integral part of the curtain itself, but sometimes they consist of special material attached to the curtain. The particular construction of screen 12 and its mounting on curtain 10 are immaterial in reference to the scope of my invention. The curtain 10 carries loudspeaker mechanism of the electrostatic type adjacent to screen 12. In the particular embodiment illustrated in Fig. 1, this loudspeaker mechanism comprises a plurality of condenser speakers, marked A, B and C, surrounding the screen 12. These loudspeaker units have vibratory electrodes of different size to accentuate correspondingly different bands of frequencies. For example, the three upper speaker units A have diaphragms for accentuating high notes, the two lower speakers B are adapted to emphasize the middle register, and the two side speakers C, which are the largest, are intended to bring out the low notes. In this way, all the frequencies are brought out with substantially uniform efficiency and fidelity over the entire musical scale within practical limits.

In the broad aspect of my invention, the condenser speakers may be of any approved construction, and by way of example I have illustrated a simple form of speaker which is so flat that its presence on the curtain would hardly be noticed by the audience. Referring to Figs. 2-5, there is a rigid condenser plate 13 and a vibratory electrode 14, which is a tensioned sheet adapted to operate as a loudspeaking diaphragm. The plate 13 is a rectangular piece of sheet metal, preferably aluminum, which is light and stiff, although other metals may be used, such as brass, iron, and the like. In the present instance, the diaphragm 14 is mounted directly on the fixed plate 13 by a frame 15, which may be of insulating material or a light strip of metal. The rigid plate 13 is provided with ribs 16 which serve to tension the diaphragm 14 and at the same time hold it spaced from the fixed electrode 13. The ribs 16 may be arranged in the outline of a rectangle to engage the tensioned diaphragm sheet all around, or they may be provided at only two opposite edges of plate 13, in which case the diaphragm will be entirely free at two edges.

The diaphragm 14 may be a thin sheet of flexible metal, such as duralumin, steel, nickel, invar (an alloy of steel and nickel), brass, and so on; or it may consist of an insulating sheet, like fabric, rubber, celluloid, etc., covered on the outside with a coating or other suitable metallic surface. If the diaphragm sheet 14 is of metal, it will have to be insulated from the metal plate 13 in any practical way. The space 17 between the condenser elements 13 and 14 may be filled with elastic dielectric material adapted to permit free and full vibration of the diaphragm. Screws 18 or other fastening devices hold the edge of diaphragm 14 clamped between the frame 15 and the outer flanges 19 of plate 13. A second frame 20, preferably of insulating material, is mounted on the back of curtain 10 and holds the condenser speaker rigidly attached to the front side of the curtain. Screws or like members 21 hold the frame 20 and condenser plate 13 rigidly connected on opposite sides of curtain 10. Two binding posts 22 and 23 project from the rear frame 20 for conveniently connecting the condenser elements 13 and 14 in a circuit of variable potential. The binding post 22 is electrically connected to the fixed plate 13, while the binding post 23 is in metallic contact with diaphragm 14 by means of a screw or bolt 24. It is here assumed that the clamping frame 15 is of metal and in electrical contact with diaphragm 14 over a wide area.

In the modification of Fig. 6, the condenser speaker comprises a fixed plate 25 and a vibratory electrode 26, which constitutes a loudspeaking diaphragm. What has been said about the diaphragm 14 of Figs. 2-5 may be considered applicable to diaphragm 26 with-

out the need of repetition. The edge of diaphragm 26 is clamped between a pair of insulating frames 27 and 28, which are secured to the rigid plate 25 in any practical way, as by screws, bolts or rivets (not shown). In this construction the condenser unit is mounted on the back side of curtain 10 and is held in place by an insulating frame 29, which is arranged on the front side of the curtain and connected to the condenser unit by screws 30 or otherwise. The curtain 10 is perforated at 31 to permit free passage of sound into the open air.

It may be assumed that the specific constructions of condenser speaker above described are applicable to all the units A, B and C of Fig. 1, although it is not essential in actual practice that the different speakers be constructed exactly alike. If the diaphragms are arranged on the front side of the curtain and directly exposed to view, they may be painted or covered with a material that harmonizes with the design of the supporting curtain 10, so that the presence of the speakers will not be noticed by the audience. Leastwise, the speakers will be regarded as some kind of decoration around the screen 12. Although I have shown seven loudspeaker units in Fig. 1, my invention is not limited to any particular number of speakers nor to any precise arrangement thereof in relation to the screen. It is desirable to mount the speakers as closely to the screen as possible, so as to create the illusion that the sound is coming from the characters in the picture.

The curtain 10 also performs the useful function of an acoustic baffle which prevents the sound generated by the speaker units from passing back of the curtain, so that all sound waves are projected forwardly toward the audience. Since the diaphragms 14 and 26 are directly open to the auditorium, the reproduction is clear and natural. It is assumed, of course, that the loudspeakers are properly connected in circuit. I have not considered it necessary to show or describe any circuit connections, because they will be understood by experts in this art. In large theaters having a stage on which the settings are frequently changed, the curtain 10 will be mounted for raising and lowering, carrying with it the screen 12 and the loudspeakers A, B and C. The latter are therefore always in proper relation to the screen without attention by the stage hands. The curtain 10 may also be a fixed support for the screen and the condenser speakers.

Although I have shown and described certain specific constructions, I want it understood that my invention is not limited to the details set forth. It is to be expected that changes and modifications will occur to those skilled in the art without departing from the

scope of the invention as defined in the appended claims.

I claim as my invention:

1. The combination of a motion picture
5 screen and a plurality of electrostatic loudspeakers arranged around said screen, said loudspeakers being flat structures mounted substantially parallel with said screen and having different natural frequencies to accentuate the entire musical scale within practical limits.

2. In talking movie apparatus, a curtain
15 having a motion picture screen, and an electrostatic loudspeaker mounted on said curtain adjacent said screen, the vibratory electrode of said loudspeaker being open to the free air at the front of said curtain.

3. In talking movie apparatus, a curtain
20 having a motion picture screen, and a plurality of electrostatic loudspeakers mounted on said curtain around said screen, said loudspeakers being arranged to throw the sound in a forward direction.

4. In talking movie apparatus, a curtain
25 having a motion picture screen, and a plurality of electrostatic loudspeakers mounted on said curtain adjacent said screen, said loudspeakers having different natural frequencies to accentuate the entire musical
30 scale within practical limits.

5. In talking movie apparatus, a curtain
having a motion picture screen, and an electrostatic loudspeaker mounted on said curtain adjacent the screen, said loudspeaker
35 having a diaphragm arranged behind the curtain which is perforated in front of the diaphragm to permit the projection of sound in a forward direction.

6. In talking movie apparatus, the combination of a sheet-like support having a
40 surface constructed to operate as a motion picture screen, and an electrostatic loudspeaker mounted on said support near the screen, said loudspeaker comprising a fixed
45 condenser plate of substantially rectangular form provided with ribs near the edge, said plate extending beyond said ribs to form outer flanges, a vibratory electrode mounted on said plate in tensioned condition and
50 held spaced from said plate by said ribs, fastening means for said vibratory electrode engaging said flanges, a frame on one side of said support for holding said condenser unit to the other side of said support,
55 and fastening devices engaging said frame and unit and passing through said sheet-like support, whereby said loudspeaker unit is rigidly mounted on said support.

7. In talking movie apparatus, the combination of a sheet-like support having a
60 surface constructed to operate as a motion picture screen, a flat electrostatic loudspeaker unit mounted on the rear side of said support near the screen, said support in front of said
65 loudspeaker unit being pervious to the pas-

sage of sound generated by said loudspeaker unit.

8. In talking movie apparatus, the combination of a sheet-like support having a surface constructed to operate as a motion picture screen, a flat electrostatic loudspeaker
70 unit mounted on one side of said support near the screen, a member on the other side of said support, and fastening means passing through said member and unit for securing the latter to said support.

9. The combination of a theater curtain,
a motion picture screen on said curtain, and electrostatic loudspeaker mechanism mounted on said curtain near said screen and arranged to throw the sound forward, said
80 mechanism being surrounded by the curtain which thereby acts as an acoustic baffle to direct sound waves forward.

10. An upright flat support having a portion constructed to operate as a motion picture screen, and a plurality of electrostatic
85 loudspeaker units mounted on said support adjacent said screen and arranged to throw the sound forward, said loudspeaker units having different natural frequencies to accentuate the entire musical scale within
90 practical limits.

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