

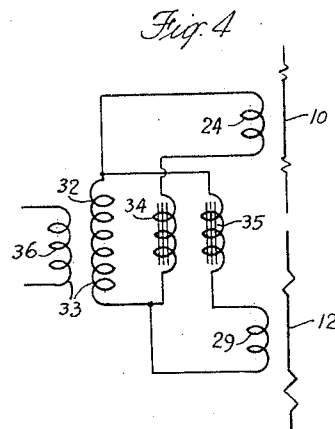
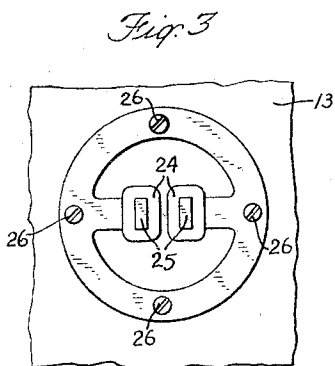
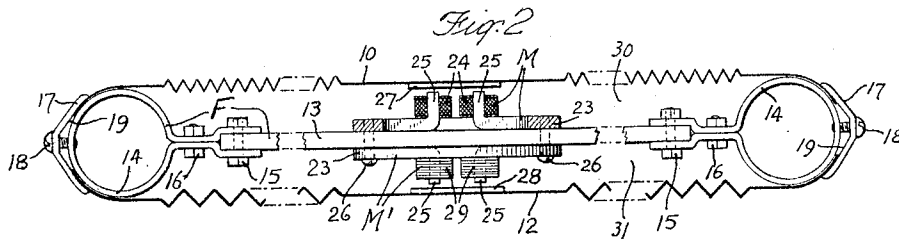
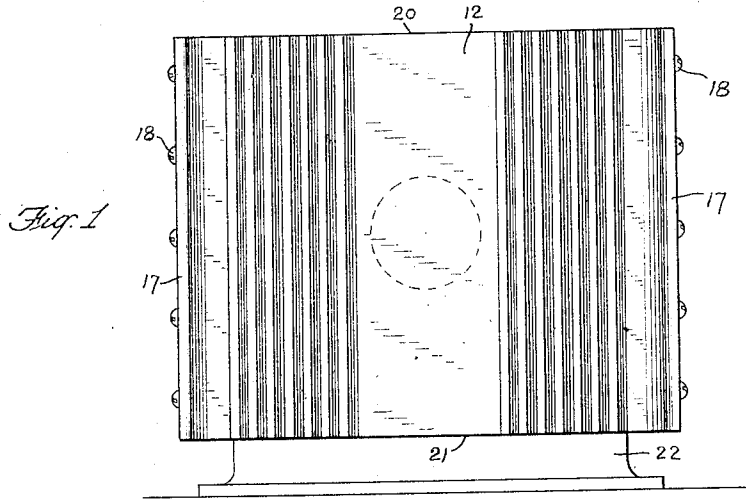
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LOUD SPEAKER

Original Filed Feb. 1, 1927



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LOUD SPEAKER

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This invention is for a loudspeaking unit comprising at least two diaphragms adapted to accentuate different bands of frequencies, so as to encompass practically the entire range of audible sound. In a preferred form of my invention, these diaphragms are tensioned sheets mounted in parallel relation on a flat frame. One diaphragm is subjected to electric impulses of low frequencies, while the other diaphragm is operated by electric impulses of high frequencies. These diaphragms may have substantially the same natural frequencies. The novel features and practical advantages of my invention will be understood from a description of the accompanying drawing, in which—

Fig. 1 is a face view of one form of my new loudspeaker;

Fig. 2 is a plan of the loudspeaker on a larger scale than Fig. 1;

Fig. 3 shows a face view of the electromagnet forming part of the driving units for the diaphragms; and

Fig. 4 is a simplified diagram of circuit connections for the coils of the driving units.

A pair of loudspeaking diaphragms 10 and 12 are stretched on opposite sides of a flat rectangular frame F, which in the present instance consists of a board or panel 13 carrying a pair of tubular side pieces 14. These side pieces may conveniently be formed from sheet metal and secured to the board 13 by suitable fastening devices 15, which may be screws, bolts, rivets, or the like. If desired, the flanged end portions of the side pieces 14 may be secured together by members 16 to increase their rigidity. The diaphragms 10 and 12 are secured to the side pieces 14 by resilient clamping strips 17 which are attached to the side pieces by screws 18 or otherwise. The clamping strips 17 are preferably formed with roughened engaging surfaces 19, adapted to grip the ends of the diaphragms against all possibility of slipping. Any other practical means may be employed for securing the diaphragms 10 and 12 to the frame F. The diaphragms 10 and 12 are made of elastic sheet material and are preferably corrugated so as to be held under constant tension of the required degree. In other words, the dia-

phragms are stretched across the frame F with such tautness that they vibrate properly with substantially equal amplitude over their acoustic surfaces. This free vibration of the diaphragms is due to the fact that they are attached at two edges only, leaving the opposite edges 20 and 21 free or floating. The board or panel 13 is mounted on a suitable base 22.

The two diaphragms 10 and 12 may be duplicates of each other and have substantially the same natural frequency, but at the present time I prefer to construct the diaphragms so as to accentuate different bands of frequencies. That is to say, one diaphragm is adapted to operate most efficiently in the upper register, while the other diaphragm operates with best results in the lower register, so that the entire range of audible frequencies is reproduced with equal fidelity, or as nearly so as mechanical and electrical conditions permit. By way of example, I have assumed that the diaphragm 10 accentuates the upper register and the diaphragm 12 the lower register. For convenience I shall therefore refer to diaphragm 10 as the high diaphragm, and the diaphragm 12 I shall call the low diaphragm. These diaphragms may be made of the same material, but of such dimensions or weight as to have different acoustic capacities. Among materials suitable for the construction of these diaphragms, I may mention steel, iron, duralumin (an aluminum alloy), copper, bronze, celluloid, paper, wood, parchment, and others along the same line. The diaphragm 10, for example, may be of elastic sheet metal having a high natural frequency and capable of correctly reproducing the higher notes of the piccolo and violin, and the diaphragm 12 may consist of a non-metallic sheet having a low natural frequency and capable of reproducing the deepest organ tones. The acoustic area of the diaphragms is such that the resultant reproduction has loudspeaker volume of requisite degree.

In the broad aspect of my invention, the loudspeaking diaphragms 10 and 12 are operated in any practical way, usually by elec-

trical means. In the present instance, I have selected electromagnetic driving units mounted on opposite sides of the board 13. These driving units, which are indicated as a whole by M and M' in Fig. 2, may be of any practical construction. By way of example and not as a limitation, I have shown a driving unit consisting of a permanent magnet 23 having a coil or coils 24 mounted on pole pieces 25. As shown in Fig. 2, the magnets 23 of the driving units are mounted in alignment on opposite sides of the board 13, so that the same screws or bolts 26 hold both magnets in position. The diaphragm 10 is provided with an armature 27 adjacent the polar ends of the associated magnet. Similarly, the other diaphragm 12 has an armature 28 in operative relation to the pole pieces of its driving unit. If the diaphragms 10 and 12 are of magnetic material, no separate armatures are necessary. Instead of having a magnetic connection between the diaphragms and their driving unit, the construction of the latter may be such as to require a mechanical connection between the diaphragms and the vibratory armature of the unit. Such driving units are well known in the art and need not be illustrated. It will therefore be understood that the driving units M and M' shown in the drawing are to be regarded as broadly representing any practical form of mechanism for operating the diaphragms in accordance with electric impulses transmitted by the output circuit of the amplifying system to which the speaker is connected. For convenience, I shall call the windings 24 of unit M as the controlling coil of diaphragm 10, and the windings 29 of unit M' will be referred to as the controlling coil of diaphragm 12.

The board 13 of the loudspeaking mechanism is preferably solid so as to separate the diaphragms 10 and 12 acoustically. These diaphragms form a pair of shallow sound chambers 30 and 31, which are freely open to the outer air at the top and bottom, or at least at one end. During the operation of the diaphragms, the air columns in sound chambers 30 and 31 are set in vibration, whereby the sound produced by the diaphragms is augmented in volume. Since the sound chambers 30 and 31 are separated by the board or panel 13, there is no interference between the vibrations produced behind the diaphragms. The board 13, which is substantially free of vibration, may be of light rigid metal, such as aluminum or aluminum alloy, or it may be of non-metallic material, such as wood, hard rubber, bakelite and similar materials adapted for this purpose.

Any practical system may be employed for amplifying and transmitting electric impulses to the operating mechanism of the diaphragms. An example of such an amplifying transmission system is diagrammatically

illustrated in Fig. 4. The operating coils 24 and 29 of the loudspeaking mechanism are connected in parallel to the secondary winding 32 of an audio-frequency transformer 33. In the circuit of coil 24 is a variable inductance 34, and in the circuit of coil 29 is a variable inductance 35. These inductances are so adjusted in value as to cause the diaphragms 10 and 12 to give the best acoustic results. It has been previously assumed that diaphragm 10 operates most efficiently on high notes, and that diaphragm 12 is best on low notes. In that case, the inductance value of the circuit of coil 29, which operates the low diaphragm 12, should preferably be greater than the inductance value of the circuit of coil 24, which operates the high diaphragm 10. The relative inductance values of the circuits of loudspeaker coils 24 and 29 are adjusted by means of the variable inductance windings 34 and 35, as will be clear to those who are familiar with this branch of electrical engineering. The primary coil 36 of transformer 33 is connected in the output circuit of an amplifying system, which may include one or more vacuum tubes, as will be understood without further explanation.

My new double diaphragm loudspeaker may be used for radio reproduction, and in other connections where loudspeaking reproduction is desired.

Although I have shown and described a certain construction, I want it understood that my invention is not limited to the details set forth. The specific embodiment illustrated in the drawing is to be regarded merely as a practical example of my invention, which may be constructed in other ways than herein described without departing from the scope of the appended claims.

This case is a division of my copending application, Serial Number 165,052, filed February 1, 1927.

I claim as my invention:

1. A loudspeaker comprising a pair of substantially flat tensioned diaphragm sheets supported at two opposite edges only and adapted to accentuate different bands of frequencies, and means for operating said diaphragm sheets.
2. A loudspeaker comprising a frame, a pair of substantially flat tensioned diaphragms mounted on opposite sides of said frame and adapted to vibrate independently of each other, and means for simultaneously operating said diaphragms.
3. Loudspeaking mechanism comprising a board provided with a pair of side pieces projecting beyond the opposite faces of said board, a pair of tensioned diaphragm sheets secured to said side pieces on opposite sides of said board, whereby said diaphragm sheets are spaced from said board, and means for operating said diaphragm sheets.
4. Loudspeaking mechanism comprising a

flat frame, a pair of diaphragms mounted in parallel relation on opposite sides of said frame, said diaphragms consisting each of a tensioned sheet stretched across the frame and secured thereto along two opposite edges, the other two opposite edges of each diaphragm being free, and means for operating said diaphragms.

5. Loudspeaking mechanism comprising a frame, a pair of diaphragms mounted on said frame in parallel relation and adapted to vibrate independently of each other, each of said diaphragms consisting of a tensioned sheet secured at two opposite edges and free at the other two edges, one of said diaphragms having a high natural frequency and the other diaphragm having a low natural frequency, and means for simultaneously operating said diaphragms.

6. Loudspeaking mechanism comprising a frame, a pair of diaphragms mounted on said frame in parallel relation and adapted to vibrate independently of each other, each of said diaphragms consisting of a tensioned sheet secured at two opposite edges and free at the other two edges, one of said diaphragms being of metal having a high natural frequency and the other diaphragm being of non-metallic material having a low natural frequency, and means for simultaneously operating said diaphragms.

7. Loudspeaking mechanism comprising a board provided with a pair of side pieces projecting beyond the opposite faces of said board, a pair of tensioned diaphragm sheets secured to said side pieces on opposite sides of said board, whereby said diaphragm sheets are spaced from said board and form therewith a pair of sound chambers open to the outer air, and mechanism mounted on said board for operating said diaphragm sheets.

8. A loudspeaker comprising a frame, a pair of loudspeaking diaphragms carried by said frame, said diaphragms consisting of tensioned sheets stretched across said frame and having different natural frequencies, and means for operating said diaphragms.

9. A loudspeaker comprising a flat frame provided with side pieces projecting laterally beyond both faces of the frame, and a pair of tensioned diaphragm sheets secured to said side pieces on opposite sides of said frame, said tensioned sheets operating as loudspeaking diaphragms, and means for operating said diaphragm sheets.

10. A loudspeaker comprising a pair of substantially rectangular sheets supported only at two opposite edges under tension, said sheets constituting loudspeaking diaphragms of different natural frequencies, and means for operating said diaphragms.

11. A loudspeaker having a pair of substantially flat tensioned sheets substantially rectangular and supported at two opposite edges only, said tensioned sheets constituting

loudspeaking diaphragms adapted to vibrate with substantially uniform amplitude over their acoustic areas, and means for simultaneously operating said diaphragms.

12. A loudspeaker comprising a flat frame provided with a pair of side pieces at two opposite edges, said side pieces projecting laterally beyond one face of the frame, and a tensioned diaphragm sheet secured at two opposite edges to said side pieces, the other two edges of said sheet being unsecured, and means for vibrating said tensioned sheet which operates as a loudspeaking diaphragm.

13. A loudspeaker comprising a frame, a pair of substantially flat tensioned diaphragms mounted on opposite sides of said frame, which has a member extending between said diaphragms, and mechanism mounted on said member for actuating said diaphragms.

14. A loudspeaker comprising a board, a pair of tensioned diaphragms secured to said board on opposite sides thereof and spaced from the board for vibratory movement, whereby said diaphragms form with said board a pair of sound chambers open to the outer air, and means for operating said diaphragms.

15. A sound radiator comprising a pair of substantially parallel walls closely spaced to form an acoustic channel open to the outer air, the cross-section of said channel being narrow compared to the surface area of the walls, one of said walls being elastic to operate as a diaphragm, and rigid members arranged to close the two opposite sides of said narrow channel, said members also constituting spacing means for said walls.

16. A sound radiator comprising a pair of substantially parallel walls closely spaced to form an acoustic channel open to the outer air, the cross-section of said channel being narrow compared to the surface area of the walls, one of said walls being an elastic corrugated membrane adapted to operate as a diaphragm.

17. A sound radiator comprising a flat frame having three parallel walls closely spaced to provide two narrow acoustic channels on opposite sides of the central wall which is substantially rigid, at least one of the two outer walls being elastic to operate as a diaphragm, said acoustic channels being open to the outer air.

18. A sound radiator comprising a pair of substantially rectangular walls mounted in closely spaced parallel relation to form an acoustic channel open to the outer air, the cross-section of said channel being narrow compared to the surface area of said walls, one of said walls being a stretched elastic membrane adapted to operate as a diaphragm.

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