

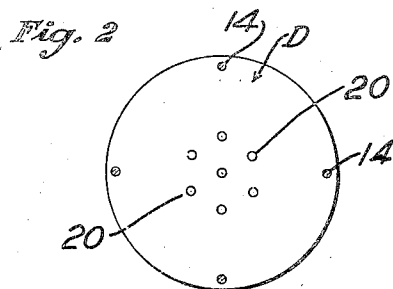
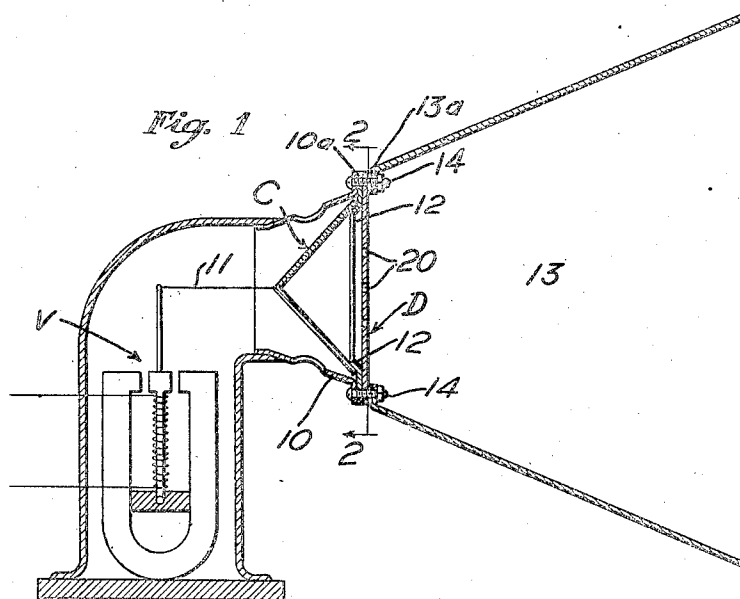
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R. J. POMEROY

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SPEAKER

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## UNITED STATES PATENT OFFICE

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## SPEAKER

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This invention has to do with vibratory sound producing apparatus; and its general object, as will become apparent from the following description, is to improve the quality of sound production in such apparatus and also to make possible the production of sound in larger volume than has heretofore been practical.

The invention, its objects and accomplishments, can best be illustrated by reference to cone speakers. Such speakers may be taken as typical of sound-producing apparatus in which a diaphragm vibrates bodily instead of vibrating by flexure; and although the invention is not necessarily limited specifically to use in connection with a cone diaphragm, its objects and accomplishments, and its general nature, can best be explained in that connection.

Such cone diaphragm, sometimes referred to as free edge cones, are commonly mounted at their peripheral edge by a flexible annular element secured to the cone and also secured to some annular support, as the annular edge of an enclosing casing. Such a cone is supposed to be, and within certain limits is substantially, free to vibrate as a whole; but when the vibration reaches an unusual amplitude and a large sound volume is being produced, the flexible supporting element may become so displaced from its normal position that it no longer flexes freely, but imposes some considerable opposition to diaphragm movement. Also, as such cone speakers are commonly built, the cone, or parts connected therewith, may come into vibratory contact with a fixed part of the support or casing when the vibration amplitude is much increased. Furthermore, as the amplitude increases the inertia of the moving parts becomes a very important factor, even though the cone may not strike and though the flexible cone support may still be within its range of relatively free movement. The result in any such circumstance is the introduction of foreign noises, or at least the distortion of the sounds finally produced.

My invention has two characteristic results. It improves the quality of sound production of such a speaker throughout its

range of amplitude; and it allows such a speaker to be used at a high volume range heretofore impossible with a true sound production.

The invention accomplishes these things characteristically by reducing the vibration amplitude of the cone without reducing or dissipating the sound energy; and it does this by transferring part of the vibratory energy to an auxiliary diaphragm. In a preferred and illustrative construction, I place across the opening of a free edge cone a tensed or stretched diaphragm of some suitable material, preferably a material that is not resiliently vibratory. Such materials as fabric or leather—materials that are substantially non-resilient—I find suitable to the purpose. Such a diaphragm encloses within the cone an air chamber and, through the alternate compression and rarefaction of the enclosed air, takes on a part of the vibration, causing the vibratory amplitude of the cone diaphragm to be relatively decreased, and keeping the cone within that amplitude range wherein it vibrates freely in true consonance with the sound vibrations imposed upon it. At the same time, the auxiliary diaphragm has further effects upon the cone, hereinafter spoken of; and the total result is to improve the quality of sound produced and to allow much more sound energy to be put into the speaker, with a much larger sound volume produced, without any distortion or introduction of foreign noises.

All of this will be best understood from the following detailed description, wherein I set forth a preferred and illustrative construction, reference for this purpose being had to the accompanying drawings, in which—

Fig. 1 is a vertical central section showing a typical construction embodying my invention, and

Fig. 2 is a cross-section on line 2—2 of Fig. 1.

In the drawings I have made no attempt to illustrate to any degree the details of a cone speaker, merely showing the cone and its vibratory apparatus in more or less diagrammatic form. The cone is shown at C mounted in a casing 10. An electromagnetic vibrator

is indicated at V, its vibrating armature being connected by element 11 with the rear center of the cone. Such a vibrating apparatus may positively move the cone in each of two opposite directions, or only in one direction. My invention is applicable in either case.

Such a cone may typically be mounted through the medium of a flexible annular mounting element 12 secured to the cone around its annular edge and secured to and supported by some annular supporting member, as for instance the front edge of casing 10. In the diagrammatic illustration I have shown the flexible mounting element 12 as being clamped between the casing flange 10<sup>a</sup> and the edge of auxiliary diaphragm D, the flange 13<sup>a</sup> of horn 13 being clamped down over diaphragm D, and all the parts being held together by bolts or screws 14. Mounted in the manner described, it will be seen that auxiliary diaphragm D encloses a chamber within the cone, and the vibration of the cone bodily will cause alternate compression and rarefaction of the enclosed air. Such alternate compression and rarefaction has the immediate effect of decreasing or limiting the vibratory amplitude of the cone; and, through that alternating compression and rarefaction, vibrations are impressed upon diaphragm D, causing that diaphragm to vibrate. Through the vibration of diaphragm D, sound vibrations are finally transmitted to atmosphere. Diaphragm D is preferably of a material that has little or no inherent vibratory period—preferably a material that is substantially non-resilient, but relatively highly flexible as regards transverse bending. Instances of suitable materials are various fabrics or soft leather. The diaphragm made of such material is stretched across the cone opening; not tightly enough to give it an audible vibration periodicity of its own, but merely tightly enough to hold it flat and to insure its return to its normal plane condition after being displaced.

Preferably I also provide some means of limited air escape from the chamber thus enclosed; and this may be most easily provided by perforating diaphragm D with a few small perforations 20. When cone C is moved forward under vibratory impulse, the enclosed air is compressed and the diaphragm D immediately moves outwardly. At the same time a limited amount of air escapes through the perforations. Then upon rearward movement of the cone and the consequent rarefaction of the enclosed air, diaphragm D is drawn rearwardly and a limited amount of air is drawn in through perforations 20. The energy expended in vibrating diaphragm D and in moving air through the perforations is not lost to sound production; but that energy, distributed in that way, reacts upon cone C to materially

decrease its amplitude of vibration. Thus a comparatively large amount of sound energy may be put through the speaker without giving the cone too large a vibratory amplitude.

And, furthermore, diaphragm D in its action tends to equalize the vibratory movement of the cone. For many different reasons, herein unnecessary to state in detail, the energy effectively applied to the cone to move it in one direction may not be equal to the energy so effectively applied to move the cone in the opposite direction. The auxiliary diaphragm to a substantial extent tends to equalize the resulting unequal movements of the cone, as explained by the following considerations. Suppose the cone to be at the right-hand end of its travel in Fig. 1. In that position, diaphragm D is also at or near the end of its similar travel, and the enclosed air is most highly compressed. Upon the reverse travel of the cone, the energy stored in the system by the compression of the air and displacement of diaphragm D, tends to expand itself in moving the cone C toward the left. Similarly when the cone C has reached its position to the left, the enclosed air is rarefied and diaphragm D is displaced inwardly; and upon a subsequent movement to the right, energy thus stored expends itself in assisting the cone to move to the right. Thus a certain amount of energy of each cone movement is stored and is expended upon the immediately following opposite movement of the cone; with the result that unequal energies of successive movements are much more nearly equalized. To this fact, together with the fact that a large amount of sound energy is not accompanied by a corresponding large vibration amplitude of the primary diaphragm, I attribute in the main the success of my apparatus.

The small apertures give a certain amount of damping action without any appreciable loss of energy; they prevent the enclosed air body from setting up any appreciable vibrations of its own. These relief apertures may of course be constituted in any suitable manner. They are most easily provided in the auxiliary diaphragm; but they might be provided at any position. And, in providing them in the auxiliary diaphragm they might be provided there by using a more or less air pervious fabric. But I prefer to provide them by perforating an otherwise impervious diaphragm, as they may thereby be made of just the correct size and number to give the best results on any particular speaker.

I claim:

1. In sound producing apparatus, the combination of a primary vibratory diaphragm flexibly supported so that in vibration the diaphragm moves substantially bodily, and an auxiliary vibratory diaphragm enclosing a space at one side of the primary diaphragm.

2. In sound producing apparatus, the combination of a primary vibratory diaphragm flexibly supported at its edge so that in vibration the diaphragm moves substantially

5 bodily, and an auxiliary vibratory perforated diaphragm of flexible material enclosing a space at one side of the primary diaphragm.

3. In sound producing apparatus, the combination of a conical diaphragm flexibly supported at and around its peripheral edge on an annular support and vibratory by movement

10 15 bodily, and an auxiliary vibratory diaphragm of flexible material extending across the opening of the conical diaphragm and peripherally mounted on the same annular support, the auxiliary diaphragm enclosing a space within the conical diaphragm and acting as a damper to limit vibration amplitude of the conical diaphragm.

4. In sound producing apparatus, the combination of a conical diaphragm flexibly supported at and around its peripheral edge on an annular support and vibratory by movement

20 25 30 35 40 45 50 55 60 65 bodily, and an auxiliary diaphragm of substantially non-resilient material tensed across the opening of the conical diaphragm and peripherally mounted on the same annular support, the auxiliary diaphragm enclosing a space within the conical diaphragm and acting as a damper to limit vibration amplitude of the conical diaphragm.

5. In sound producing apparatus, the combination of a conical diaphragm flexibly supported at and around its peripheral edge on an annular support and vibratory by movement

35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995

6. In sound producing apparatus, the combination of a conical diaphragm flexibly supported at and around its peripheral edge on an annular support and vibratory by movement

50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995

7. In sound producing apparatus, the combination of a non-vibratory annular support,

a conical diaphragm, and annular flexible mounting element secured to and around the peripheral edge of the diaphragm and to the annular support, to flexibly support the conical diaphragm and allow it to vibrate

70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995

8. In sound producing apparatus, the combination of a non-vibratory annular support, a conical diaphragm, an annular flexible mounting element secured to and around the peripheral edge of the diaphragm and to the annular support, to flexibly support the conical diaphragm and allow it to vibrate

85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995

9. In sound producing apparatus, the combination of a primary vibratory diaphragm flexibly supported so that in vibration the diaphragm moves substantially

105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995

In witness that I claim the foregoing I have hereunto subscribed my name.

ROY J. POMEROY.

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**CERTIFICATE OF CORRECTION.**

Patent No. 1,761,745.

Granted June 3, 1930, to

**ROY J. POMEROY.**

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, line 3, claim 2, strike out the words "at its edge"; page 3, line 67, claim 7, for "and" read an, and line 78, same claim, for "rearefied" read rarefied; lines 84 and 85, claim 8, for the misspelled word "annnular" read annular; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of October, A. D. 1930.

(Seal)

**M. J. Moore,**  
Acting Commissioner of Patents.