Dec. 29, 1931. A. A. THOMAS 1,839,130

ELECTROSTATIC LOUD SPEAKER

Filed March 7, 1929

FIG. 2.

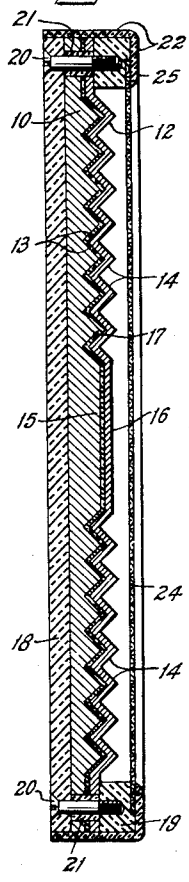


FIG. 1.

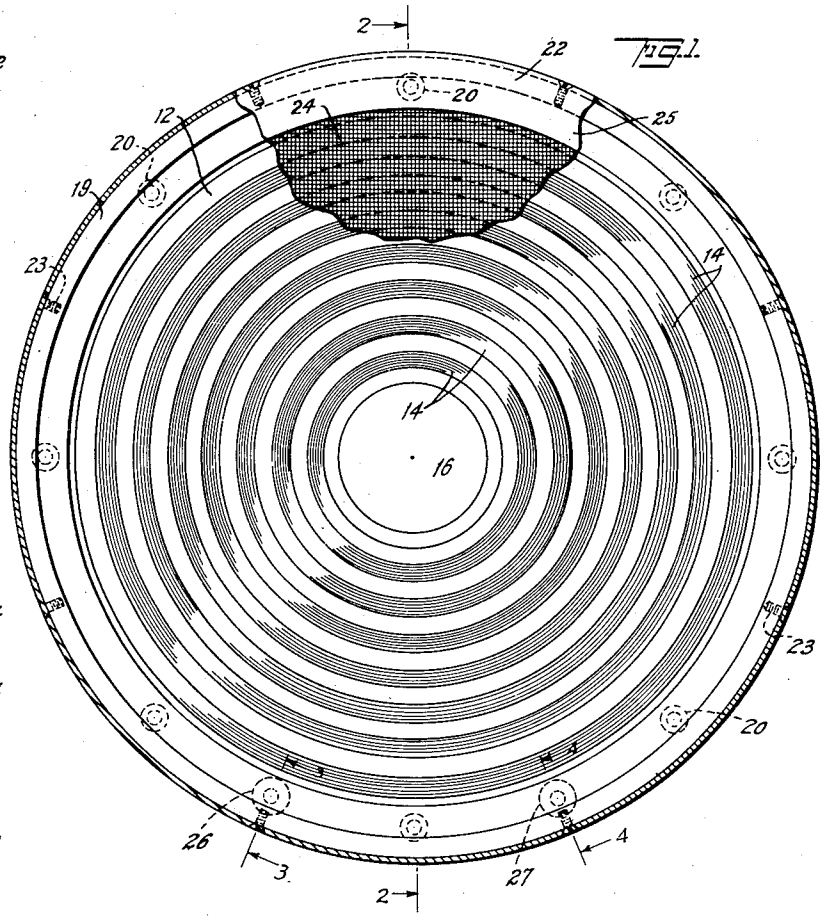


FIG. 3.

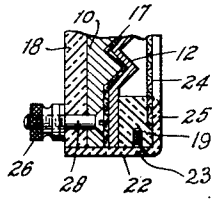
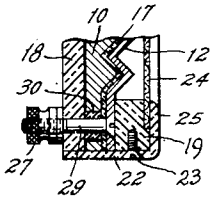


FIG. 4.



INVENTOR

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ELECTROSTATIC LOUD SPEAKER

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My invention is for a loudspeaker of the condenser type, and its characteristic feature is a vibratory electrode in the form of a corrugated diaphragm supported in electrostatic relation to a fixed plate similarly corrugated. If the diaphragm and plate are circular, the corrugations are ring-shaped; if the two electrodes are rectangular, the corrugations run straight and parallel. In either case, the corrugations of the vibratory diaphragm fit into those of the fixed plate, so that the two parts are arranged as closely as possible and separated by elastic dielectric material of substantially uniform thickness. The corrugated structure of the condenser plates possesses several practical advantages, among which the most important are these: First, it increases the electrostatic area of the condenser without increasing the size of the plates, and this means a small instrument of large volume. Secondly, the corrugations in the vibratory diaphragm increase its resiliency and therefore its sensitiveness, whereby the diaphragm responds efficiently to all bands of audible frequencies.

The novel features and advantages of my invention will be understood from a description of the accompanying drawings, in which—

Fig. 1 shows a front view of a preferred form of my new instrument;

Fig. 2 represents a cross-section on line 2—2 of Fig. 1; and

Figs. 3 and 4 are sectional detail views on lines 3—3 and 4—4 of Fig. 1, respectively, to show the binding post connections for the two condenser plates.

The condenser parts of my new speaker comprise a fixed plate 10 and a vibratory plate 12, both consisting of a suitable metal having good conductivity, such as aluminum and its alloys, brass, bronze, steel, and others along the same line. The fixed plate 10 is formed with corrugations 13, and the vibratory plate 12 has similar corrugations 14. In the embodiment illustrated, the plates are circular and the corrugations are in the form of concentric rings. The central portions 15 and 16 of the two plates may be left flat. The plate 10 may be a casting of aluminum, which is light and strong, and the vibratory plate 12 is easily stamped from sheet metal, like duralumin. The corrugations of the two plates fit into each other and are separated by elastic dielectric material 17, which may be a thin sheet of rubber, a layer of rubber cement, a piece of fabric like silk, cheesecloth or netting, asbestos fibers, chamois skin and other insulating materials having sufficient elasticity to permit vibration of the disk 12 as an acoustic diaphragm. The dielectric 17 need not be a continuous sheet or layer, for it may consist of rings laid in the trough-shaped corrugations of either plate, or the dielectric may be in the form of radial strips. The simplest way, however, to separate the condenser plates is by means of a single sheet, which is easily put in place. To make the drawings clear, the diaphragm 12 and dielectric sheet 17 are shown much thicker than in the actual instrument.

The condenser plates 10 and 12 are held in operative relation by a suitable frame, which in the present instance comprises a back plate 18 and a front ring 19, both of insulating material like wood, fiber, bakelite, compressed pulp, hard rubber, and perhaps others. Screws or bolts 20 clamp the edges of the condenser disks 10 and 12 between the insulating members 18 and 19. The bolts 20 pass through insulating sleeves or bushings 21 in the metal plates 10 and 12, so that the latter remain properly insulated. A casing 22 of insulating material may be placed over the supporting frame 18—19 and held in place by screws 23 or otherwise. A suitable screen 24 conceals the charged electrode 12, and at the same time guards it against human contact. This screen may simply be a piece of gauze, perhaps appropriately colored and ornamented, or it may be a grille of insulating material. In any event, the screen 24 should be sufficiently open to permit the free passage of sound generated by the vibratory diaphragm 12. A convenient way to hold the screen 24 in place is by providing the casing 22 with an inturned shoulder 25 arranged to engage the periphery of the screen. If the latter is a piece of gauze,

it may be directly attached to the shoulder 25, as by glue or cement.

The condenser plates 10 and 12 are electrically connected to a pair of binding posts 26 and 27. The binding post 26 includes a screw or bolt 28 projecting rearwardly from the fixed plate 10, as shown in Fig. 3. The binding post 27 is connected to the vibratory diaphragm 12 by a screw or bolt 29, which is insulated from the plate 10 by a sleeve or bushing 30 of insulating material. Any other practical means may be employed for establishing electrical connection between the condenser plates 10 and 12 and a pair of terminals easily accessible.

When the condenser plates are subjected to variable differences of potential, the thin plate 12 vibrates relatively to the fixed plate 10 and operates as a loudspeaking diaphragm. The corrugations 14 impart such elasticity or resiliency to diaphragm 12 that it responds to the slightest variations in potential and operates efficiently over the entire audible range of frequencies. If the diaphragm 12 is a very thin sheet of elastic metal, the corrugations 14 have the effect of producing a plurality of independently vibratory surfaces which increase the sensitiveness of the instrument. The diaphragm 12 may also be made sufficiently stiff to vibrate as a single member, being resiliently suspended around the edges. In either case, the diaphragm 12 should be so light that it has no appreciable inertia, whereby the sensitiveness and efficiency of the instrument are a maximum. In some instances it is possible that the annular corrugations 14 may act like circular elastic hinges about which the enclosed area vibrates, this area varying at different frequencies. The mounting of diaphragm 12 may be such that the elastic dielectric 17 is maintained under pressure, so that the whole area of the diaphragm is cushioned. Incidentally, the dielectric also serves to damp or eliminate parasitic vibrations of the diaphragm.

Another practical advantage of the corrugations in the condenser plates 10 and 12 is increased electrostatic area, and that means correspondingly increased volume of reproduction. In other words, the corrugations 13 and 14 of the condenser plates provide maximum operative surface in an instrument of minimum dimensions. The entire structure is so flat that it can be hung on a wall like a picture. A supporting base may be attached to the bottom of the outer casing 22 for setting up the instrument on a table. The parts are few and rugged, being cheap to make and easy to assemble, and there is nothing to get out of order after the instrument has been completed and tested. The condenser plates 10 and 12 may also be made rectangular, in which event the corrugations run parallel and the vibratory sheet 12 is supported at two opposite ends only. This will be clear without additional illustration. If it shall be found in some cases that the reproduction is too sharp or metallic, the outer face of the diaphragm can be covered with silk, paper, or other sound-softening material.

Although I have shown and described a specific construction, I want it understood that my invention is not limited to the details set forth. It is to be expected that changes and modificaions will occur to those skilled in the art, without departing from the scope of the invention as defined in the following claims.

I claim as my invention:

1. An electrostatic telephone instrument comprising a pair of plates having permanently interfitting corrugations and separated by an elastic dielectric, at least one of said plates being vibratory to act as an acoustic diaphragm and the stationary plate being imperforate.

2. An electrostatic telephone instrument comprising a pair of circular disks having permanently interfitting annular corrugations and separated by an elastic dielectric, one of said disks being vibratory to act as an acoustic diaphragm and the other disk being a rigid imperforate plate.

3. An electrostatic loudspeaker comprising a fixed condenser plate having corrugations, a vibratory condenser plate having corrugations adapted to fit into the corrugations of said fixed plate, an elastic dielectric separating the two plates, and an insulating frame in which said plates are mounted.

4. An electrostatic loudspeaker comprising a fixed corrugated plate of cast metal, a vibratory corrugated plate of sheet metal adapted to operate as a diaphragm, means for so supporting said plates that the corrugations of one fit into the corrugations of the other, and an elastic dielectric between said plates.

5. An electrostatic loudspeaker comprising a fixed disk of cast metal having annular corrugations, a vibratory disk of sheet metal having annular corrugations adapted to fit into the corrugations of said fixed disk, said vibraory disk operating as a diaphragm, and elastic dielectric material for separating said disks, said material being held under pressure.

6. An electrostatic loudspeaker comprising a fixed disk and a vibratory disk provided each with annular corrugations, said vibratory disk acting as a loudspeaking diaphragm, a circular frame in which said disks are supported in electrostatic relation, the corrugations of one disk fitting into those of the other, and elastic dielectric material separating said disks.

7. An electrostatic loudspeaker comprising a fixed corrugated plate of cast metal, a vi-

bratory corrugated plate of sheet metal adapted to operate as a diaphragm, means for so supporting said plates that the corrugations of one fit into the corrugations of the other, and a corrugated sheet of elastic dielectric arranged between said metal plates and engaged by said supporting means.

8. An electrostatic loudspeaker comprising a fixed disk of cast metal having annular corrugations, a vibratory disk of sheet metal having annular corrugations adapted to fit into the corrugations of said fixed disk, said vibratory disk operating as a diaphragm, a corrugated disk of elastic dielectic material between said metal disks, and means engaging said three disks for supporting them in electrostatic relation.

9. An electrostatic loudspeaker comprising a fixed disk and a vibratory disk provided each with annular corrugations, said vibratory disk acting as a loudspeaking diaphragm, a pair of insulating circular members between which said disks are clamped in electrostatic relation, the corrugations of one disk fitting into those of the other, elastic dielectric material separating said disks, and a pair of insulated binding posts projecting from one of said members and electrically connected to said disks.

10. An electrostatic telephone instrument comprising a pair of electrodes in the form of insulated imperforate metal plates having permanently interfitting corrugations, at least one of said plates being vibratory to act as an acoustic diaphragm.

11. An electrostatic telephone instrument comprising a pair of electrodes in the form of circular imperforate metal disks having permanently interfitting annular corrugations separated by a dielectric, at least one of said plates being vibratory to act as an acoustic diaphragm.

12. An electrostatic loudspeaker comprising a fixed imperforate condenser plate having corrugations, a vibratory condenser plate having permanent corrugations to fit into the corrugations of said fixed plate, a dielectric separating the two plates, and a support for holding said plates in operative relation.

13. An electrostatic loudspeaker comprising a fixed corrugated plate of cast metal, a vibratory corrugated plate of sheet metal adapted to operate as a diaphragm, and means for so supporting said plates that the corrugations of one fit into the corrugations of the other, said plates being insulated from each other.

14. An electrostatic loudspeaker comprising a fixed imperforate disk and a vibratory disk provided each with permanent annular corrugations, said vibratory disk acting as a loudspeaking diaphragm, and a frame in which said disks are supported in electrostatic relation, the corrugations of one disk fitting into those of the other.

15. An electrostatic loudspeaker comprising a fixed electrode in the form of a corrugated plate which is flat at the center, a vibratory electrode in the form of a plate having corrugations adapted to fit into the corrugations of the fixed electrode, said vibratory plate having a flat central portion arranged opposite and closely to the flat central portion of the fixed electrode, and means for holding said electrodes in electrostatic relation.

ADOLPH A. THOMAS.