Sept. 16, 1930. P. E. EDELMAN 1,776,112

LOUD SPEAKER CONDENSER

Filed April 8, 1929 2 Sheets-Sheet 1

Fig. 1.

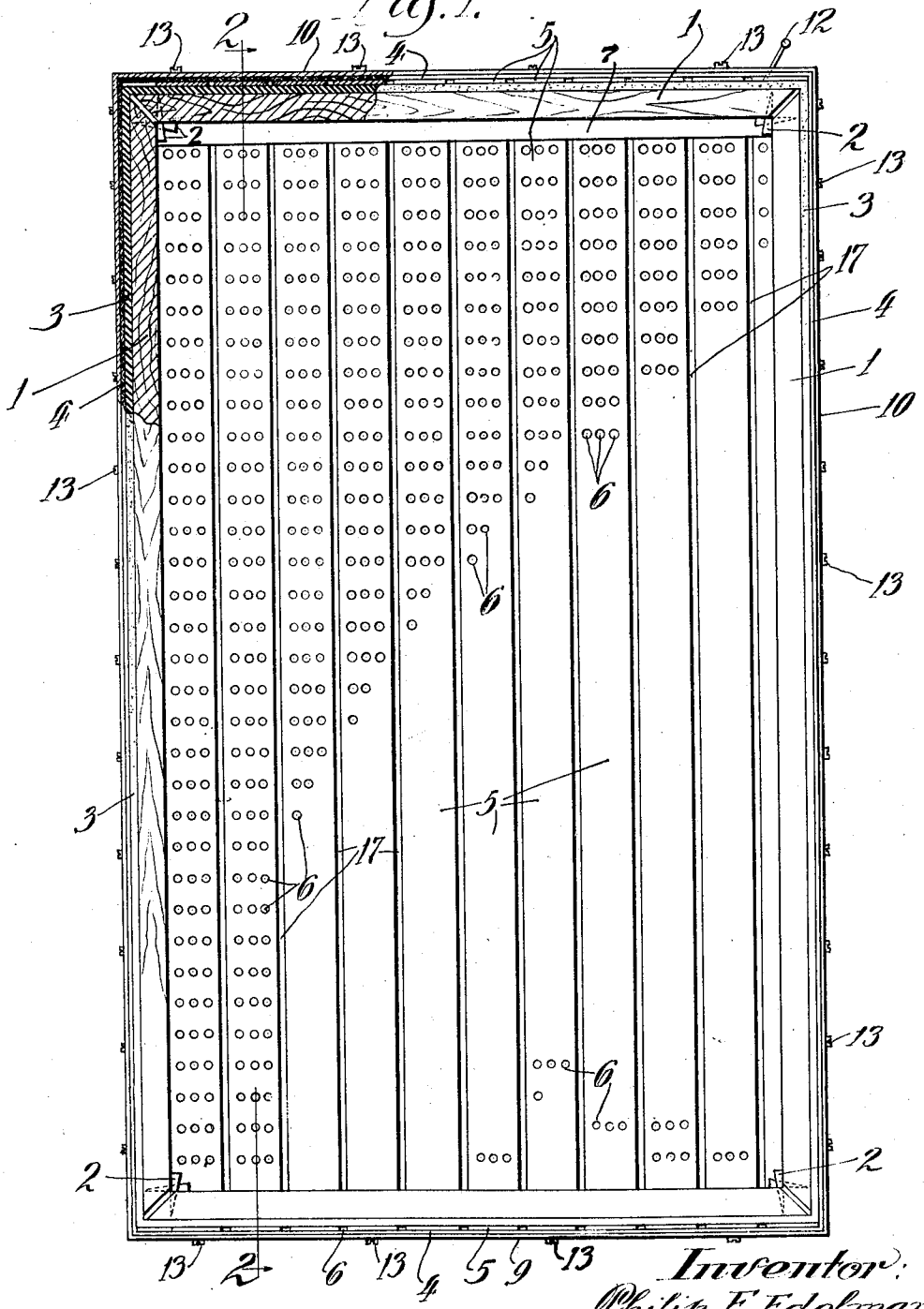

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Fig. 2.

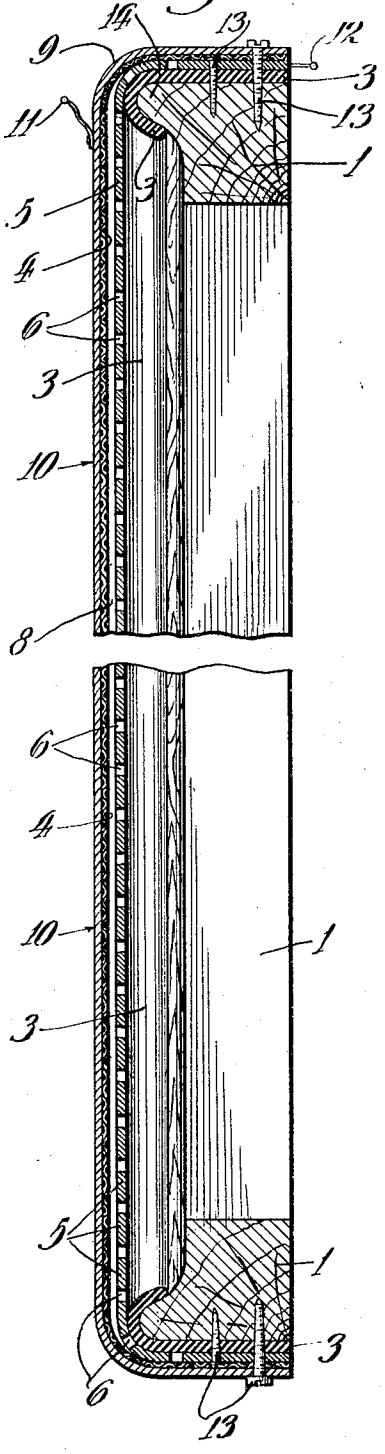
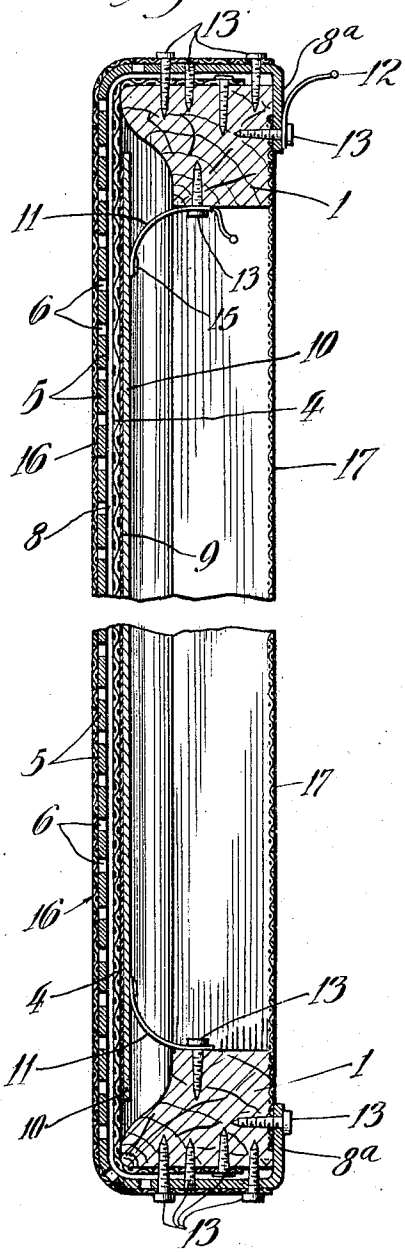


Fig. 3.



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Patented Sept. 16, 1930 1,776,112

UNITED STATES PATENT OFFICE

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LOUD-SPEAKER CONDENSER

Application filed April 8, 1929. Serial No. 353,562.

My present invention relates to condenser reproducers and improvements in a loud speaker condenser of this type.

An object is to obtain far greater volume of response over the entire musical range of the speaker for a given input energy thereto. Various other objects will presently appear.

Heretofore, a limitation to the use of condenser type reproducers has been imposed by relatively poor volume response thereof in comparison with electrodynamic type reproducers. I have conceived and proved that this problem of securing greater volume of response can be solved by improved and novel structure for the speaker diaphragms. I illustrate, by way of example, a suitable embodiment of my invention which I have constructed and satisfactorily tested.

Reference is made to the accompanying drawings, in which—

Figure 1 is a rear view elevation of the condenser assembly;

Fig. 2 is a sectional view or a part of the condenser assembly showing the relation of the plurality of diaphragm elements used; and

Fig. 3 shows a modified construction similar to Fig. 2 with the addition thereto of a vibration controlling fabric.

In other applications for Letters Patent of the United States, I have disclosed the preferred circuits for operating a condenser speaker of this type. My present invention is characterized by a condenser structure in which a dielectric diaphragm, such as empire cloth, stretched over a supporting frame and carrying a conductive electrode coating, is placed closely adjacent not only to one co-operating flexible porous electrode as heretofore practiced, but to a plurality of adjacently disposed and freely mounted metallic perforated ribbons, each of which serves as an electrode and sound reproducer, thereby greatly multiplying the volume of response of the condenser speaker for a given input excitation energy therefor.

In Fig. 1, the expansible frame 1 may be expanded by means of corner wedges 2 and carries a soft rubber fabric gasket 3 over which the condenser diaphragms 4 and 5 are stretched. Each ribbon electrode 5 mounted back of dielectric diaphragm 4, for example, consists preferably of a perforated ribbon of soft zinc or lead foil about .02″ thick, containing a multiplicity of perforated holes 6 of about $\frac{3}{32}$″ diameter disposed ¼ inch apart in the width of strip 5, and ½″ apart in the length of metal strip 5. Each adjacently disposed strip 5 is separated from the next strip by an air gap 17 of about ⅛ inch, so as to be free to flex, twist and stretch independently of the next adjacent strips 5.

A cross connector ribbon of metal 7 interconnects the strips 5 electrically for parallel electrical operation thereof, permitting independent mechanical performance of each strip 5. A twisting action of strips 5, not possible if air gap 17 were omitted, is thereby attained, affording a far greater volume of response than heretofore considered possible in this art. In stretching strips 5 on frame 1, each strip 5 also becomes slightly contoured or curved on one surface, facilitating the aforesaid crosswise twisting action combined with lengthwise flexing under the influence of electrical stresses applied thereto in use. The strips 5 are overlapped on one end of frame 1 at 8 to facilitate electrical connection through the connector strip 7 to terminal 12.

The strips 5 must be made of relatively soft metal, such as zinc or lead, which are substantially nonelastic and which hence add no artificial resonance to the reproduced sound. The order of sound reproduction thereby attained in comparison to the best previously known constructions for the flexible electrode connected by terminal 12 is at least 400 per cent greater for a given input energy to the condenser carried on frame 1 with full brilliancy of reproduction, including all tones and overtones within the range of audible frequencies.

A suitable size for frame 1 is 16″ by 30″, though any other desired size may be used, larger or smaller than this. As shown, in Fig. 2, diaphragms 5, as well as dielectric diaphragm 4, are fastened to frame 1 by tacks 13. The ribbon diaphragms 5 are first stretched over frame 1, after which a dielec-

tric diaphragm 4 made, for example, of empire cloth .005" thick, or varnished fabric impregnated with oxidized linseed oil, is stretched thereover. The frame 1 is expanded to draw member 4 and members 5 closely adjacent, but separated by a thin air gap or space 8 which may be of very minute dimensions.

Perforations 6 in the metal strips 5 permit the free flow of air from the air gap 8 through the flexible electrode diaphragms 5. The dielectric diaphragm 4 is coated with japan varnish size 9 on the top side thereof, and carries a thin covering or electrode 10 of metal foil, such as aluminum foil .0002 inch thick. A tinsel or flexible metal strip connector 11 is fastened to the electrode 10 carried by the diaphragm 4. A connector terminal 12 is fastened to all of the adjacently disposed diaphragm ribbons 5. Frame 1 has a projecting portion 14 to insure that diaphragms 4 and 5 will be drawn closely together when frame 1 is expanded by means of wedges, shown in Fig. 1. The gasket 3 of soft rubber fabric tends to hold the diaphragms 4 and 5 taut during use thereof.

In Fig. 3 is shown a reversed modified assembly for the elements of Fig. 2, with the addition of a dampening fabric covering 16 in lieu of gasket 3 of Fig. 2. This fabric covering 16 is stretched over flexible electrode strips 5 and made of a stretchable textile fabric of porous characteristics, such as monk cloth or crash.

In Fig. 3 the dielectric diaphragm 4 with its electrode coating 10 is first stretched over frame 1, and held by tacks 13 thereon. Next the perforated metal ribbons 5 are stretched over diaphragm 4, and fastened to frame 1 by tacks 13. Then vibration controlling fabric 16 is tacked to frame 1 over electrode diaphragms 5. Terminal 12 is fastened to the extending portion 8 of strips 5 by a tack 13. Connector terminals 11 of flexible metallic ribbon is secured to electrode 10 at 15, and attached to wood frame 1 by tack 13.

This assembly has the advantage of limiting the amplitude of response of ribbon electrode diaphragms 5 on very large electrostatic energy input thereto to prevent generation of undesired stationary waves, thereby under the influence of powerful excitation. This modified assembly also affords protection for the delicate foil electrode 10, as the frame 1 projects beyond the surface of the covering 10. A muslin fabric screen 17 may be tacked over frame 1 to assist this aforesaid mechanical protection feature if desired.

While I have shown and described but a few embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made which do not depart from the spirit and scope of the invention as disclosed in the appended claims.

I claim:

1. An acoustic condenser comprising, in combination, a stretched dielectric diaphragm, an electrode coating attached on one surface thereof, and a plurality of cooperating flexible electrode strips spaced from each other and mounted adjacent to said dielectric diaphragm.

2. An acoustic condenser comprising, in combination, a flexible electrode impermeable to air flow, a dielectric diaphragm carrying said electrode, and a plurality of parallel electrically connected freely separated flexible metallic ribbon electrodes mounted closely adjacent to said dielectric diaphragm.

3. An acoustic condenser comprising, in combination, a sheet of stretched fabric impregnated with an insulating compound and coated on one surface with an adhesive varnish, a thin layer of metal foil carried on said varnish coating, and a plurality of cooperating independently spaced perforated soft metal ribbon electrodes disposed closely adjacent to the surface of said impregnated fabric which is not coated with adhesive varnish.

4. An acoustic condenser comprising, in combination, an expansible frame, a plurality of perforated flexible metal ribbons stretched thereover, a dielectric diaphragm stretched over said ribbons and supported by said frame, and a metallic coating on said dielectric diaphragm.

5. An acoustic condenser comprising, in combination, a frame, a soft yielding gasket thereon, a plurality of thin flexible perforated metal ribbons independently mounted over said gasket and held on said frame, an impregnated fabric diaphragm stretched adjacent to said metal ribbons, and a co-operating electrode coating carried on said fabric diaphragm.

6. An acoustic condenser comprising, in combination, a supporting frame, a dielectric diaphragm stretched thereover and fastened thereto, an electrode coating carried by said diaphragm, a plurality of independently mounted perforated electrode metal ribbons stretched closely over said diaphragm with very small air gaps between said ribbons and said diaphragm, and means to control the amplitude of vibration of said ribbons.

7. An acoustic condenser comprising, in combination, a frame, a diaphragm carried thereby, an electrode on said diaphragm, a plurality of independently spaced perforated soft metal ribbons mounted closely over said diaphragm and separated therefrom by a thin layer of air, and a sheet of porous fabric stretched adjacent and in contact with said metal ribbons to control the amplitude of vibrations thereof.

8. An acoustic condenser comprising, in combination, a frame, a dielectric diaphragm stretched thereon, an electrode coating carried on said diaphragm, a plurality of perforated soft metal flexible ribbons stretched closely near to said diaphragm and mounted independently from each other of said ribbons on said frame, and a co-operating fabric covering carried on said frame to limit the amplitude of response of said ribbons when same are connected to a source of electrical excitation in electrical circuit with the electrode coating on said diaphragm.

9. An acoustic condenser comprising a mounting frame carrying protecting fabric screens at the front and back side of said frame, and an electrostatic condenser reproducer mounted on said frame, characterized by the fact that one of said fabric screens is stretched substantially in contact with said electrostatic condenser reproducer to control the amplitude of vibration response thereof.

10. In an acoustic condenser, a dielectric diaphragm, an electrode coating carried thereby, and a plurality of independently mounted co-operating perforated electrodes placed with respect thereto free to twist as well as flex under the action of electrical excitation.

In testimony whereof I have hereunto set my hand this 4th day of April, 1929.

PHILIP E. EDELMAN.