

This Sheet Has Been Replaced



ELECTROSTATIC LOUDSPEAKER

The present invention concerns an electrostatic loudspeaker of the kind described below. The loudspeaker is primarily intended to reproduce music at the highest quality level.

An electrostatic loudspeaker of prior art comprises in principal a thin conductive membrane which is positioned between two electrodes having the shape of perforated plates preferably entirely made from electrically conductive material. A positively charged membrane is made to move by means of a voltage difference between the electrodes which by signal alternate between positive and negative charge. Within the limits of operation the deviation is mainly proportional to the difference of voltage between the electrodes. Another kind of electrostatic loudspeakers is described in US-patent no 3,980,838. The loudspeaker described therein has two membranes positioned on either side of a stator and kept at distance from this by means of distance rings. In order to obtain a sound-reproduction a stepped up signal voltage is supplied to the membranes. In this and other known constructions of electro-static loudspeakers the membrane and stator are charged with different kinds of charges and the loudspeakers operate with both attracting and repelling forces.

With prior art electrostatic loudspeakers it is difficult to obtain a sufficiently high soundpressure with kept up quality, i. e. the available force is too small. The outer dimensions of the loudspeaker which shall include a wide span of low frequencies becomes unwieldy large and electrostatic loudspeakers of prior art can also be a severe load to the amplifier of the sound reproduction equipment. Further as already mentioned this prior art designs make use of both repelling and attracting fields, i. e. charges of different polarity, whereby the breakdown voltage in air will be



comparatively low. The force which it is possible to obtain in the elements will thus be comparatively low in the order of some ten N/m^2 .

The present invention concerns electrostatic loudspeakers in which membrane and stator have charges of the same polarity. It is hereby made possible that great forces can work in the loudspeaker without any risk for sparking between stator and membrane. This means that a very high loudpressure can be obtained while maintaining the quality and with loudspeakers which have much smaller outer dimensions than those of prior art designs. The invention is also for a transformer with a signal return function for operation of loudspeakers of this kind.

The invention will below be described more in detail with reference to the embodiment which is shown in the enclosed figure. This shows a cross-section of a loudspeaker and a transformer unit which is connected to the loudspeaker.

The loudspeaker shown in the figure has two membranes 19, 20, each of which has a corresponding stator 2, 9 shaped as a grid or the like and made from electrically conductive material. The two membranes are parallel to each other and joined together by means of a firm, hard or stiff material 6, which has very low weight per volume. This material has essentially the same cross-section dimension as the membranes, and these are attached to either side of the material. Preferably the membranes are joined to the material over the entire surface or pointwise by points which are evenly distributed over the surface. Suitable materials can be foamed polyurethane or other polymere material having 95-99% air content and a weight per volume which is below 40 kg/m^3 .

Membrane and stator are mounted in a frame 3, so that pairs of stator and membrane have electrically conductive contact with each other while the pairs of membrane-stator are electrically



insulated from each other in the carrying and uniting design. The electrically conductive mounting in the frame 3 by fastener 1 is flexible and airtight so that the loudspeaker can be built into e. g. a box with a solid back side without causing any problems with acoustic short-circuit and blowing sounds caused by soundwaves which pass through the slit 25. The outgoing signal from the amplifier is by wires from a transformer supplied to the loudspeaker at connections 11, 12.

The pairs of membrane 19, 20 and stator 2, 9 always have the same potential and repel each other with a varying force when the potential varies. At an incoming signal all voltages on the right respectively the left side are equally changed. When the voltage increases on the left side it is reduced on the right side and the membranes are displaced to the right.

Thereby that adjacent membrane and stator have the same potential and that membranes of different potential are at a constant and comparatively large distance from each other, high potentials up to about 140 kV may be utilised in the membrane-stator-pair.

In a preferred embodiment of the invention there is between membrane and corresponding stator an inlay of thin, light nets or the like 7, 8, which preferably are made from textile material which is electrically conductive or has been made conductive by a treatment. In the figure only two such nets are shown on the left side of the loudspeaker. However the two sides ought to be made in the same way and the number of nets may vary depending upon the actual application. If for example four nets are used on each side, the space between membrane and stator is split up into five equal parts. The distance between equal charges is reduced to $1/5$ and the force between membrane and stator is thus increased 25-fold.

In the figure there is also shown a transformer unit for the loudspeaker whereby the direction of transmitted signals have



been indicated with arrows. The signal coming in by the lead 16 from an amplifier in the equipment is supplied to a transformer winding which on its corresponding secondary side has a centre connection with a voltage of a constant potential, so called bias 17. The incoming signal is supplied to the loudspeaker-connectors 11, 12 through resistors 13, 14. By means of further transformer windings 21, 22 which are connected in parallel with the resistors 13, 14 one obtains a correcting signal which is the outvoltage from the secondary winding 23, which by the lead 15 as a reconnecting signal is returned to the amplifier preferably to a compensating controlling unit before the final step of the amplifier. This signal sends information about the movements of the membranes to the amplifier, the outsignal of which is corrected. In the figure there is shown two different possibilities 18, 24 for connecting of the secondary winding 23 to earth, whereby the alternative with earth connection at the middle of the secondary winding is used to obtain a balance return connection.



CLAIMS

1. Electrostatic loudspeaker characterised therein that it comprises two stators, one membrane corresponding to each stator whereby the membranes are mechanically connected to each other and thereby at the same time make equal movements under the influence of repelling forces between membrane and stator in respective stator-membrane pair, and each stator and its appurtenant membrane are electrically connected to each other so that they always have the same potential and a controlled varying difference of potential may exist between the two stator-membrane-pairs which are electrically insulated from each other.
2. Electrostatic loudspeaker according to claim 1 characterised therein that the membranes are connected to each other by means of an intermediate body of a firm, hard or stiff material having a low weight per volume and a cross-section which parallel to the planes of the membranes has essentially the same dimensions as the membranes.
3. Electrostatic loudspeaker according to claim 2 characterised therein that the intermediate body has a low weight per volume, preferably less than 40 kg/m^3 .
4. Electrostatic loudspeaker according to any of the proceeding claims characterised therein that between membrane and stator of a pair there is arranged one or more electrically conductive net or the like, by means of which the space between membrane and stator is split up into several essentially equal parts.

This Sheet Has Been Replaced

