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Asahi

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[45] Aug. 5, 1975

[54] DYNAMIC ELECTROACOUSTIC TRANSDUCER

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Jan. 24, 1974 Japan 49-10930

[52] **U.S. Cl. 335/231;** 179/115.5 PV; 179/115.5 ES
[51] **Int. Cl.** **H01f 7/00**
[58] **Field of Search** .... 335/231, 306; 179/115.5 ES, 115.5 PV, 115.5 VC, 115 R, 115.5 ME

[56] **References Cited**

UNITED STATES PATENTS

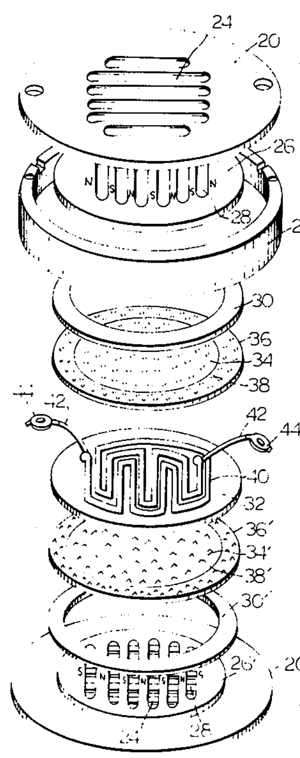
3,013,905	12/1961	Gamzon et al.	179/115.5 PV
3,164,686	1/1965	Tibbetts	335/231 X
3,829,623	8/1974	Willis et al.	179/115.5 PV
3,833,771	9/1974	Collinson	179/115.5 PV

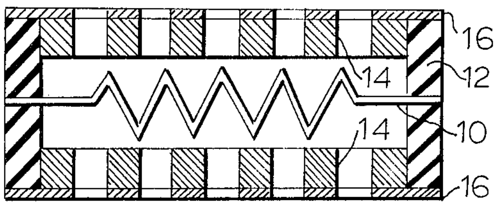
Primary Examiner—G. Harris
Attorney, Agent, or Firm—Wenderoth, Lind & Ponack

[57] **ABSTRACT**

Two slotted discs of permanent magnet disc are disposed in spaced parallel relationship to establish a plurality of aligned magnetic fields of alternate polarity in a gap between them. A main diaphragm with a flatwise coil is maintained flat by two auxiliary diaphragms sandwiching it and disposed in parallel to the discs within the gap with the magnetic fields perpendicularly intersecting the various portions of the coil. Two annular resilient holders clamp the peripheral edges of the main and auxiliary diaphragms between them to give the requisite stiffness to the main diaphragm. Alternatively, a stretching ring may impart the requisite stiffness to the main diaphragm attached to the annular resilient holder.

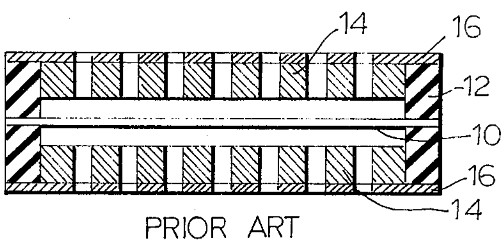
8 Claims, 12 Drawing Figures





PRIOR ART

FIG.1



PRIOR ART

FIG.2

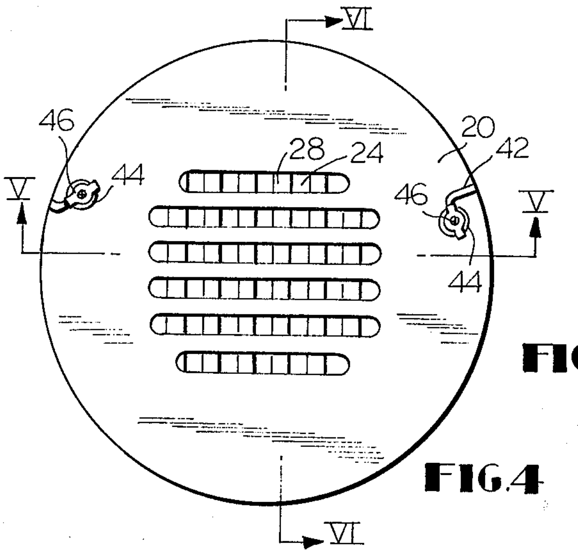


FIG.4

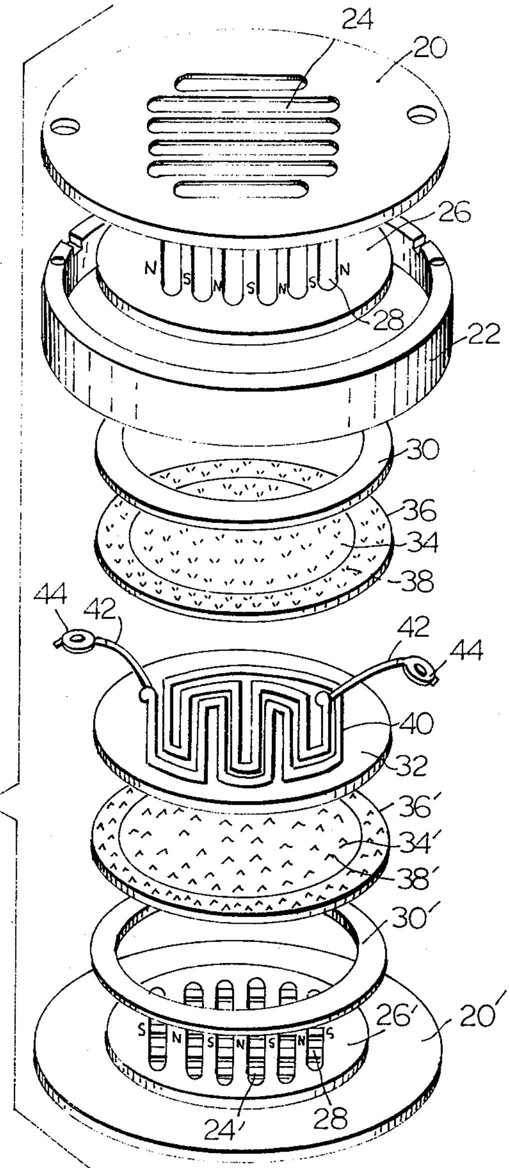


FIG.3

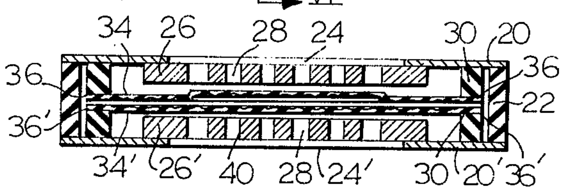


FIG.5

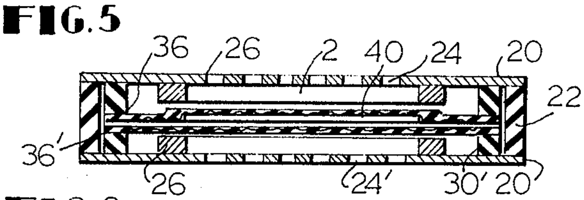


FIG.6

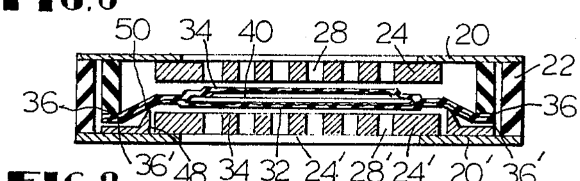


FIG.8

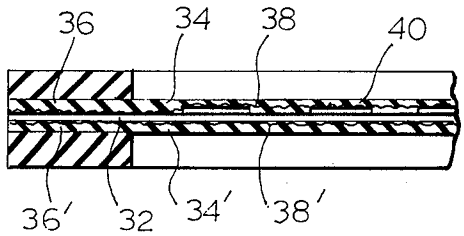


FIG. 7

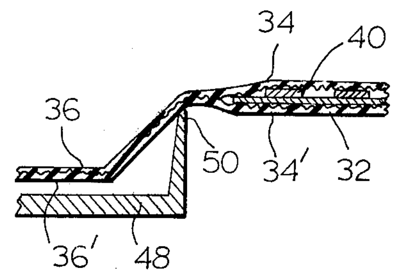


FIG. 9

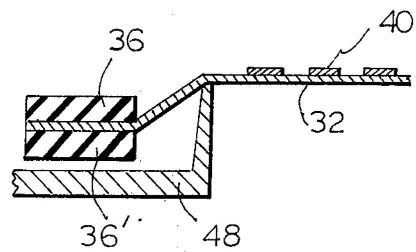


FIG. 10

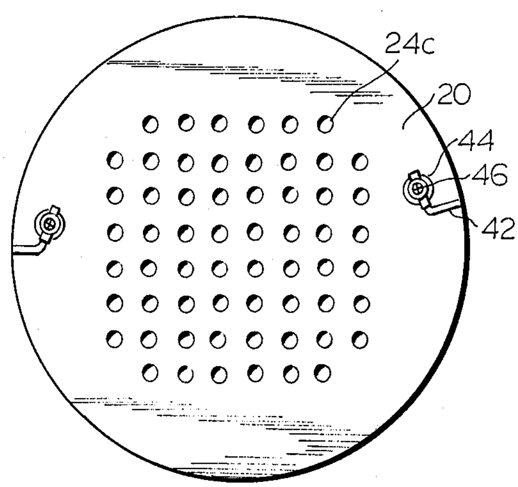


FIG. 11

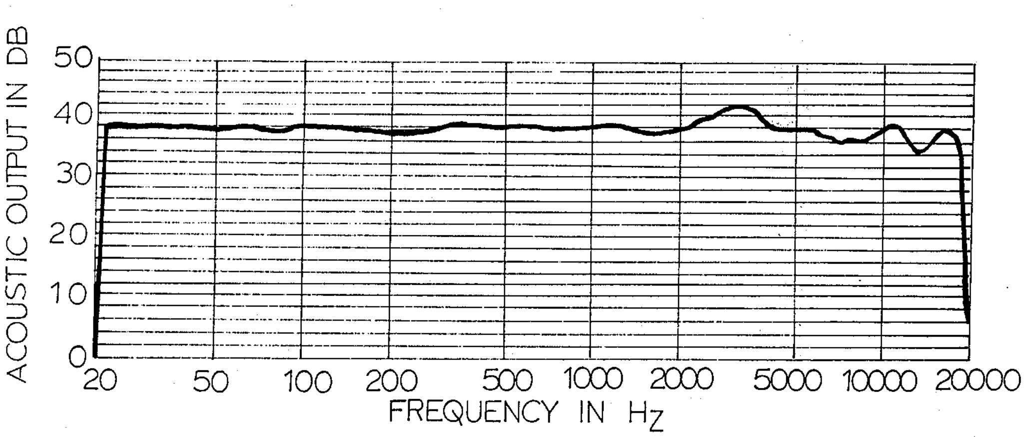


FIG. 12

DYNAMIC ELECTROACOUSTIC TRANSDUCER

BACKGROUND OF THE INVENTION

This invention relates to improvements in dynamic electroacoustic transducers of the type comprising a film-shaped diaphragm having a driving coil printed thereon and permanent magnet means for establishing a plurality of aligned magnetic fields of alternate polarity perpendicularly intersecting the coil.

While the dynamic or moving-coil type of electroacoustic transducers is prevalent at present the electrostatic type of electroacoustic transducers is said to be suitable for the high fidelity reproduction because the diaphragm can vibrate over the substantially entire area as a plane by means of the attraction and repulsion between charges on the diaphragm and the associated stationary electrode disposed in rear thereof. However, as compared with the moving coil type of electroacoustic transducers, the electrostatic type of electroacoustic transducers are inconvenient in use and expensive because the polarization voltage must be applied across the diaphragm and the associated stationary electrode and the transducers are extremely high in impedance resulting in the necessity of connecting the matching transformer with a high step-up ratio to the output of the power amplifier for driving the transducer.

There have been already proposed dynamic electroacoustic transducers including the diaphragm adapted to vibrate over the substantially entire area resembling the movement of pistons. For example, a corrugated film-shaped diaphragm having disposed thereon a flatwise coil has been located between a pair of opposite permanent magnets. This measure has inevitably caused an increase in a gap between the diaphragm and each of the permanent magnets and accordingly a decrease in the efficiency of sound reproduction. Also in the case where a flat film-shaped diaphragm is used to decrease a gap between the same and each of the associated permanent magnets, the diaphragm has been required to be relatively thick in order to make it difficult to elongate the diaphragm due to its secular change. This increase in the thickness has caused the diaphragm to increase in both stiffness and weight leading to a decrease in the efficiency of sound reproduction and also the deterioration of the wide-band reproduction.

SUMMARY OF THE INVENTION

Accordingly it is an object of the present invention to eliminate the disadvantages of the prior art practice as above described by the provision of a new and improved dynamic electroacoustic transducer including a flat diaphragm with a driving coil prevented from being deformed during long service.

It is another object of the present invention to provide a new and improved dynamic electroacoustic transducer including a flat diaphragm with a driving coil compensated for an elongation due to the secular change thereof by maintaining the diaphragm under a predetermined tensioned state.

The present invention accomplishes these objects by the provision of a dynamic electroacoustic transducer comprising permanent magnet means for establishing a plurality of aligned magnetic fields of alternate polarity in parallel thereto, a diaphragm unit and including a main diaphragm in the form of a thin flat film having disposed thereon a flatwise coil and, a pair of opposite auxiliary diaphragms in the form of thin films for carrying the main diaphragm therebetween to maintain the latter flat, and annular holder means of resilient material for clamping the peripheral edge of the diaphragm unit to impart a predetermined stiffness to the main diaphragm, the diaphragm unit being disposed in the aligned magnetic fields so that the flatwise coil intersects perpendicularly the magnetic fields.

Each of the auxiliary diaphragms may preferably include a multiplicity of protrusions abutting against the adjacent surface of the main diaphragm.

The annular holder means may advantageously include a stretching ring member provided on the inner edge with an annular projecting flange for pushing the diaphragm unit to maintain the main diaphragm in a predetermined tensioned state.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more readily apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIGS. 1 and 2 are longitudinal sectional views of two different dynamic electroacoustic transducers constructed in accordance with the principles of the prior art;

FIG. 3 is an exploded perspective view of a dynamic electroacoustic transducer constructed in accordance with the principles of the present invention;

FIG. 4 is a plan view of the transducer shown in FIG. 3 after having been assembled;

FIG. 5 is a longitudinal sectional view as taken along the line V—V of FIG. 4;

FIG. 6 is a longitudinal sectional view as taken along the line VI—VI of FIG. 4;

FIG. 7 is an enlarged view of one portion of the arrangement shown in FIG. 5;

FIG. 8 is a view similar to FIG. 5 but illustrating a modification of the present invention;

FIG. 9 is a fragmental longitudinal section view, in an enlarged scale of one portion of the arrangement shown in FIG. 8;

FIG. 10 is a view similar to FIG. 9 but illustrating another modification of the present invention;

FIG. 11 is a plan view of a modification of the back plate shown in FIGS. 3 and 4; and

FIG. 12 is a graph illustrating the frequency response characteristic of a transducer constructed in accordance with the principles of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1 of the drawings, there is illustrated a conventional dynamic electroacoustic transducer. The arrangement illustrated comprises a corrugated diaphragm 10 having a driving coil (not shown) disposed on one surface thereof, a pair of annular holders 12, disposed in opposite relationship to clamp the periphery of the corrugated diaphragm 10 therebetween, and a pair of slotted permanent magnets 14 in the form of plates disposed in spaced opposite relationship to form a gap between the diaphragm 10 and each of the permanent magnets 14, the diaphragm 10 being disposed in parallel relationship with the permanent magnets 14 within the gap. Each of the permanent magnets 14 is encircled with one annular holder member 12 and fixed on that surface thereof remote from the diaphragm 10 to one slotted back plate 16 of magnetic material having a peripheral portion fixedly secured to the associated holder member **12**.

In the arrangement of FIG. **1**, a stiffness or compliance has been imparted to the diaphragm **10** by corrugating the latter. This has resulted in the necessity of increasing a spacing between the permanent magnets **14** which has inevitably decreased the efficiency of sound reproduction.

In order to decrease the spacing between the opposite permanent magnets, there have been already proposed dynamic electroacoustic transducers of the type as shown in FIG. **2** wherein like reference numerals designate the components identical or corresponding to those illustrated in FIG. **1**. As shown in FIG. **2** the diaphragm **10** is flat. In other respects, the arrangement is identical to that shown in FIG. **1**.

The arrangement of FIG. **2** has been advantageous in that the spacing between the opposite permanent magnets **14** is narrow to cause an increase in a magnetic flux effective for driving the diaphragm **10**. The diaphragm **10**, however, might be elongated due to its secular change. This has resulted in a change in a sound pressure produced by the diaphragm **10** and also in an increased distortion of a reproduced sound pressure. In order to avoid these objections, the diaphragm **10** has been generally formed of a thick film relatively difficult to be elongated. This measure has caused the diaphragm to increase in both stiffness and weight thereby to decrease in the efficiency of sound reproduction while deteriorating the wideband reproduction.

The present invention contemplates to eliminate the disadvantages of the prior art practice as above described.

Referring now to FIGS. **3** through **6**, there is illustrated a dynamic electroacoustic transducer constructed in accordance with the principles of the present invention. As best shown in FIGS. **5** and **6**, a pair of upper and lower back plates **20** and **20'** of any suitable magnetic material in the form of discs are disposed in spaced opposite relationship to define a circular space with a hollow short cylindrical member **22** having both ends fixed to the peripheral edges of the back discs **20** and **20'**. As best shown in FIG. **4**, the back disc **20** includes a plurality of spaced slots **24** running in parallel to one diameter thereof for the purpose as will be apparent hereinafter. This is true in the case of the lower back disc **20'**. The slots of the disc **20'** are designated by the reference numeral **24'**.

Disposed within the circular space defined by the opposite back discs **20** and **20'** and the hollow cylindrical member **22** are a pair of upper and lower permanent magnets **26** and **26'** in the form of slotted discs abutting against the internal surfaces of the adjacent back discs **20** and **20'** respectively. Each of the permanent magnets **26** or **26'** includes a plurality of spaced slots **28** or **28'** running in parallel to one diameter thereof for the purpose as will be apparent later. The permanent magnets **26** and **26'** are encircled with respective annular holders **30** and **30'** of any suitable resilient material such as a foamed rubber to form annular narrow gaps therebetween. The resilient holders **30** and **30'** have one end face abutting against the internal surfaces of the adjacent back discs **20** and **20'** and the other end faces resiliently clamping a diaphragm unit including a main flat diaphragm **32** and a pair of opposite auxiliary diaphragms **34** and **34'** one for each side. More specifically, the other or opposite end faces of the resilient holders **30** and **30'** resiliently clamp therebetween the peripheral edges of the main diaphragm **32** and auxiliary diaphragms **34** and **34'** through a pair of reinforcement annuli **36** and **36'** fixed to the peripheral edges of the auxiliary diaphragms **34** and **34'** respectively.

As exaggeratedly shown in FIG. **7**, each of the auxiliary diaphragms **34** and **34'** is provided on that surface facing the main diaphragm **32** with a multiplicity of protrusions **38** or **38'** extending toward the main diaphragm **32** to substantially abut against the latter. The protrusions **38** or **38'** function to prevent each of the auxiliary diaphragms **34** or **34'** from directly contacting the main diaphragm **32** to generate parasitic sounds independent of the particular input signal applied to a driving coil (which will be described hereinafter) on the main diaphragm **32.** However, the auxiliary diaphragms **34** and **34'** are permitted to be moved along with the main diaphragms **32.**

In order to prevent the auxiliary diaphragms **34** and **34'** from directly contacting the main diaphragm **32,** the auxiliary diaphragms may be corrugated or creased. Alternatively, each of the auxiliary diaphragms may be provided with a multiplicity of raised portions disposed in a regular or an irregular pattern. The term "protrusion" used herein and in the claims means what protrudes from the auxiliary diaphragm to prevent direct contacting of the main and auxiliary diaphragms. The protrusions on each of the auxiliary diaphragms **34** and **34'** may change in arrangement and/or the number per unit area to control the vibrational mode, and range of vibrating frequencies of the diaphragm unit.

The diaphragm unit including the main diaphragm **32** and auxiliary diaphragms **34** and **34'** is resiliently maintained substantially in the central plane within a circular gap defined by the opposite permanent magnets **26** and **26'** by having the peripheral edge resiliently clampled between opposite annular resilient holders **30** and **30'** to be given the requisite stiffness. Further the auxiliary diaphragms **34** and **34'** serves to prevent dust, moisture etc. from sticking to the main diaphragm **32** and resulting in noise.

The back disc **20** and **20'** provides means permitting a magnetic flux from the adjacent permanent magnet **26** or **26'** to flow therethrough and is formed of a soft magnetic iron sheet having a suitable thickness. The back disc may be thin enough to be magnetically saturated and, for example, 0.3 mm thick. However the back disc should have a mechanical strength sufficient to form each end surface of the transducer while enforcing the associated magnet.

It has been found that the back disc preferably has a thickness of 0.5 mm.

The parallel slots **24** or **24'** of each of the back discs **20** or **20'** cooperate with slots **28** or **28'** cut in the adjacent permanent magnet **26** or **26'** to transmit a sound pressure produced by the main diaphragm **32** to the front or rear of the transducer therethrough. Also air within a space formed between each back disc **20** or **20'** and the diaphragm unit **32–34–34'** serves to damp the diaphragm unit. It has been found that the slots **24** or **24'** are preferably 3 mm wide. If desired, the each back disc may be provided with a plurality of circular apertures (see **24***c* in FIG. **11**) having a diameter of, for example, 3 mm instead of the slots.

As above described, each of the permanent magnets **26** or **26'** includes a plurality in the example illustrated, six of spaced slots **28** or **28'** running in parallel to one diameter thereof and having the width of 3 mm for example. In the assembled position, the slots **28** or **28'** of the permanent magnet **26** or **26'** are preferably disposed substantially perpendicularly to the slots **24** or **24'** of the adjacent back disc **20** or **20'** as best shown in FIG. **4.** This is because the sound pressure from the vibrating diaphragm **32** is effectively transmitted to the exterior of the transducer through the intersections of the slots **24** and **28** or **24'** and **28.** It is noted that, in the assembled position, the slots **28** of the permanent magnet **26** are aligned with the respective slots **28'** of the permanent magnet **26'**. This is true in the case of the back discs **20** and **20'**.

The permanent magnets **26** and **26'** can be preferably formed of a sintered barium ferrite either isotropic or anisotropic and not required to be very thick. It has been found that the optimum thickness of the permanent magnets is of 2 mm from the view point of the mechanical strength and the manufacturing. the thickness of the magnet just specified makes it relatively difficult to break the magnet during assembling and in operation.

Each of the permanent magnets **26** or **26'** is magnetized in the direction of thickness thereof with a surface density of magnetic flux of from 650 to 1,200 gausses so that those portions of the disc located on both sides of each slot **28** thereon are opposite in the direction of magnetization to each other. In FIG. **3,** for example, the outer portion of the upper disc **20** on the outside of the rightmost slot **28** is shown as having an N magnetic pole on the upper surface thereof, that portion located between the rightmost and next slots **28** is shown as having an S magnetic pole on the upper surface thereof, and so on. The outer portion of the disc **20** on the outside of the leftmost slot **28,** has an N magnetic pole. This is true in the case of the lower magnet disc **20'**. That portion of each permanent magnet disposed between adjacent slots **28** or **28'** thereon is preferably equal in width to the slots **28** and **28'**. For example it may be 3 mm wide.

Thus it will be appreciated that, in the narrow gap formed between the upper and lower permanent magnets **26** and **26'** in the assembled position, each of those portions of the gap facing the aligned slots **28** and **28'** has a magnetic flux flowing therethrough in substantially parallel to the planes of both parallel permanent magnets **26** and **26'** but substantially perpendicularly to the axis of the slot and opposite in the direction of flow to that flowing through the gap formed between the next aligned slots **28** and **28'**. In other words, a plurality of aligned magnetic fields of alternate polarity are established in the gap between the permanent magnets **26** and **26'**.

Permanent magnets formed of a sintered barium ferrite are possible to have the magnetic flux density equal to from 1.2 to 1.5 times that provided by flexible magnets including rubbers or plastics. An increase in the flux density is advantageous in that it contributes to an increase in the sensitivity of the resulting transducer.

The permanent magnets **26** and **26'** may be formed of a strontium ferrite advantageous in that it is easily available with a low cost.

As above described, a main flat diaphragm **32** is centrally positioned in the narrow gap defined by the upper and lower permanent magnets **26** and **26'** to be parallel thereto. The main diaphragm **32** may be formed of a thin film of polyimide, polyester or polypropyrene. In order to facilitate the vibration of the main diaphragm **32** and to improve the high frequency characteristic thereof, it is desirable to render the main diaphragm thin and light. It has been found that the main diaphragm **32** has a thickness of 2.5 microns with the satisfactory results.

The main diaphragm **32** can have a driving coil in the form of a flatwide coil disposed on either one or each of the opposite surfaces thereof. The flatwise coil **40** is exaggeratedly shown in FIG. **3** as including one pair of straight portions running in close parallel relationship and in one direction between each pair of aligned slots **28** and **28'** of the permanent magnet discs **26** and **26'** and respectively connected to a pair of straight portions facing the next part of aligned slots **28** and **28'** but running in the opposite direction to form a pair of serpentine coil sections. Each of the coil sections has both ends positioned between the outermost pairs of aligned slots **28** and **26** adjacent one end thereof on the same side. One of the coil sections is serially connected at one end to the other coil section at that end remote from the said one end. The remaining ends of the coil sections are connected through flexible leads **42** to terminals **44** respectively as shown in FIG. **3.** In the assembled position, the terminals **44** are insulatingly fixed to the back plate **20** by setscrews **46** as shown in FIG. **4.**

If desired, any number of the straight portions may face each pair of slots **28** and **28'** to form a corresponding number of coil sections which are, in turn, serially interconnected in the similar manner as above described.

Onet set of the straight coil portions disposed between each pair of aligned slots **28** and **28'** substantially perpendicularly intersect a magnetic flux resulting from one pair of magnetic poles disposed on both sides of that pair of aligned slots **28** and **28'**. Also a driving current is adapted to flow through alternate ones of the sets of close parallel coil portions in one direction while it flows through the remaining sets thereof in the opposite direction. The flatwise coil **40** is, therefore, responsive to a flow of driving current flowing therethrough to swing the main diaphragm **32** along with the auxiliary diaphragms **34** and **34'** as a whole toward the upper or lower permanent magnet **26** or **26'** as determined by the instantaneous polarity of the current to produce a sound pressure.

In order to impart to the coil **40** a flexibility as high as the main diaphragm **32,** it is desirable that the flatwise coil **40** is less in thickness than the main diaphragm **32.** For example, with the main diaphragm **32** having a thickness of 25 microns, a thickness of **18** microns of the coil **40** has given the satisfactory results.

The flatwise coil **40** is in the form of a printed circuit and may be formed on the main diaphragm **32** of any suitable, high, electrically conductive material such as copper or aluminum according to photolithographic and masking techniques well known in the art. For example, copper or aluminum may be uniformly disposed into at thin film on one surface of the main diaphragm **32** over the entire area and the resulting film is selectively etched into a predetermined pattern such as shown in FIG. **3** to form the flatwise coil **40** on the diaphragm **32.**

With the coil **40** having the serpentive pattern as shown in FIG. **3,** the same may be preferably formed of a fine conductor having a width of 0.15 mm with the central distance of 0.30 mm maintained between each pair of close parallel conductor portions. Such a coil was low in inductance and smooth in impedance characteristic resulting in a high quality of reproduction. A diaphragm of polyimide having a copper coil as above described disposed thereon had the effective vibrational mass in the order of 0.2 g. Such diaphragms are suitable for producing high audio energies. Also diaphragms of polyester having the aluminum coil as above described had the effective vibrational mass in the order of 0.1 g. The latter diaphragms are particularly suitable for handling low acoustic energies. Thus they can be effectively used as headphones or the like.

The auxiliary diaphragm 34 or 34′ should be light in weight and generate no parasitic sound. The disphragm 34 and 34′ is preferably formed of a very thin film of polyester low in elongation and extremely small in deterioration of properties during long service. It has been found that, with satisfactory results, the auxiliary diaphragm is of a transparent polyester film 6 microns thick and includes the protrusions 38 or 38′ as shown in FIG. 3 or 7 and has attached to the peripheral edge thereof the reinforcement annulus 36 or 36′ of Bakelite (trademark) 0.5 mm thick. If desired, the annulus may be formed of any suitable plastic other than Bakelite.

The annular resilient holder 30 or 30′ is preferably formed of a foamed urethane including a multiplicity of independent minute air-cells. Such a foamed urethan is stable in elastic modulus and extremely small in deformation during long service. As an example, the resilient holders 30 and 30′ having a thickness of 3 mm were formed of such a urethane and compressed to a thickness of 1.5 mm with the main auxiliary diaphragms clamped therebetween. Under these circumstances, the main diaphragm was maintained in such a tensioned state that it had the requisite stiffness while the resilient holders exhibited no permanent compression.

The hollow cylindrical member 22 is preferably formed of an acrylonitrile-butadiene-styrene copolymer because it is high and in both mechanical strength and electrically insulating property.

Referring now to FIGS. 8 and 9 wherein like reference numerals designate the components identical or similar to those shown in FIGS. 3, 5 and 6, there is illustrated a modification of the present invention. As best shown in FIG. 8, the diaphragm unit including the main diaphragm 32 and the auxiliary diaphragms 34 and 34′ has the peripheral edge reinforced by a pair of reinforcement annuli 36 and 36′ attached to both sides thereof. Then the diaphragm unit is fixedly secured at the peripheral edge to the upper resilient annulus 30 through the upper reinforcement annulus 36 and maintained in the requisite tensioned state by a stretching ring 48 disposed on the lower back disc 20′. More specifically the stretching ring 48 includes an annular edge 50 directed toward the upper back disc 20 adjacent the outside of the lower magnet disc 26′ to force the diaphragm unit 32–34–34′ in its tensioned state toward the upper permanent magnet 26. In other respects, the arrangement is identical to that shown in FIGS. 3 through 6.

In FIG. 10 wherein like reference numerals designate the component identical or similar to those illustrated in FIGS. 8 and 9, there is illustrated an arrangement similar to that shown in FIGS. 8 and 9 except for the omission of the auxiliary diaphragms 34 and 34′.

While the single annular resilient holder 30 is shown in FIG. 8, it is to be understood that two or more holders may be used. As above described, a resilience exerted by the annular holder or holders may be charged to control the tension of the diaphragm 32.

In the arrangement as shown in FIGS. 8 and 9 and in FIG. 10, the requisite tension is imparted to the diaphragm 32 by engaging the latter with the annulus edge 58 of the stretching ring 48. Therefore the diaphragm 32 can be formed of a thin light film having a relatively high elongation without increasing a gap between the diaphragm and each of the permanent magnets 26 or 26′.

Further, in the arrangements as shown in FIGS. 8, 9 and 10, the main diaphragm 32 is carried in its tensioned state by the stretching ring 48. This ensures that any elongation of the main diaphragm 32 is prevented from adversely affecting the driving coil thereon.

FIG. 12 shows typically a frequency response exhibited by an electroacoustic transducer similar to that shown in FIGS. 3 through 6 excepting that the back plates include circular apertures having a diameter of 3 mm as shown in FIG. 11. The back plates had a diameter of 63 mm and each permanent the magnet 3 mm thick and 49 mm in diameter was spaced away from the diaphragm unit as above described by a gap of 0.8 mm. As shown in FIG. 12, the frequency response is substantially uniform within a frequency range of about 20 to 20,000 Hz. Also it has been found that a harmonic distortion has been only of about 0.1 %.

Thus it is seen that the present invention provides wideband dynamic electroacoustic transducers high in both fidelity and efficiency.

While the present invention has been illustrated and described in conjunction with a few preferred embodiments thereof it is to be understood that various changes and modifications may be restorted to without departing from the spirit and scope of the present invention.

What is claimed is: coil

1. A dynamic electroacoustic transducer comprising permanent magnetic means for establishing a plurality of aligned magnetic fields of alternate polarity in parallel thereto, a diaphragm unit including a main diaphragm in the form of a thin flat film having disposed thereon a flatwise coil, and a pair of opposite auxiliary diaphragms in the form of thin film for carrying said main diaphragm therebetween to maintain the latter flat, and annular holder means of resilient material for clamping the peripheral edge of said diaphragm unit to impart a predetermined stiffness to said main diaphragm, said diaphragm unit being disposed in said aligned magnetic fields so that said flatwise coil intersects perpendicularly said magnetic fields.

2. A dynamic electroacoustic transducer as claimed in claim 1 wherein each of said auxiliary diaphragms includes a multiplicity of protrusions abutting against the adjacent surface of said main diaphragm.

3. A dynamic electroacoustic transducer as claimed in claim 1 wherein said annular holder means includes a stretching ring member provided at the inner edge with an annular projecting flange or pushing said diaphragm unit to maintain said main diaphragm in its predetermined tensioned state.

4. A dynamic electroacoustic transducer as claimed in claim 3, wherein said main diaphragm smaller than said auxiliary diaphragms.

5. A dynamic electroacoustic transducer comprising, in combination, a pair of opposite discs of permanent

magnets disposed in spaced parallel relationship to form a circular gap therebetween, each of said discs of permanent magnet including a plurality of spaced parallel slots, that portion thereof located on either side of each of said slots being magnetized in the direction of thickness of said each disc so that each pair of adjacent magnetized portions are opposite in polarity to each other, a pair of back discs of magnetic material including a plurality of openings and backing said discs of permanent magnet respectively, said slots of each of said discs of permanent magnet overlapping said openings of the adjacent back disc, a main diaphragm in the form of a thin flat film having disposed thereon a flatwise coil, a pair of opposite auxiliary diaphragms in the form of thin film provided on one surface with protrusions to carry said main diaphragm between said protrusions on said opposite auxiliary diaphragms to maintain said main diaphragm flat and annular holder means of resilient material for clamping the peripheral edges of said main and auxiliary diaphragms to impart a predetermined stiffness to said main diaphragm, said main auxiliary diaphragms being disposed in parallel relationships with said discs of permanent magnet with said flatwise coil perpendicularly intersecting magnetic fields caused from said magnetized portions of said discs of permanent magnet.

6. A dynamic electroacoustic transducer as claimed in claim **5** wherein said openings of each of said backing plates comprises a plurality of parallel slots perpendicularly intersecting said slots of the adjacent disc of permanent magnet.

7. A dynamic electroacoustic transducer as claimed in claim **4** wherein said openings of each of said back plates comprise a plurality of circular apertures positioned above said slots of the adjacent disc of permanent magnet.

8. A dynamic electroacoustic transducer comprising, in combination, a pair of opposite discs of permanent magnet disposed in spaced parallel relationship to form a circular gap therebetween, each of said discs of permanent magnet including a plurality of spaced parallel slots, that portion thereof on either side of each of said slots being magnetized in the direction of thickness or said each disc so that each pair of adjacent magnetized portions are opposite in polarity to each other, a pair of slotted back discs of magnetic material backing said discs of permanent magnet respectively, said slots of each of said discs of permanent magnet overlapping said openings of the adjacent back disc, a diaphragm in the form of a thin flat film having disposed thereon flatwise coil, annular holder means having attached thereto the peripheral edge of said diaphragm and a stretching ring member disposed in opposite relationship with said annular holder means to tension and diaphragm.

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