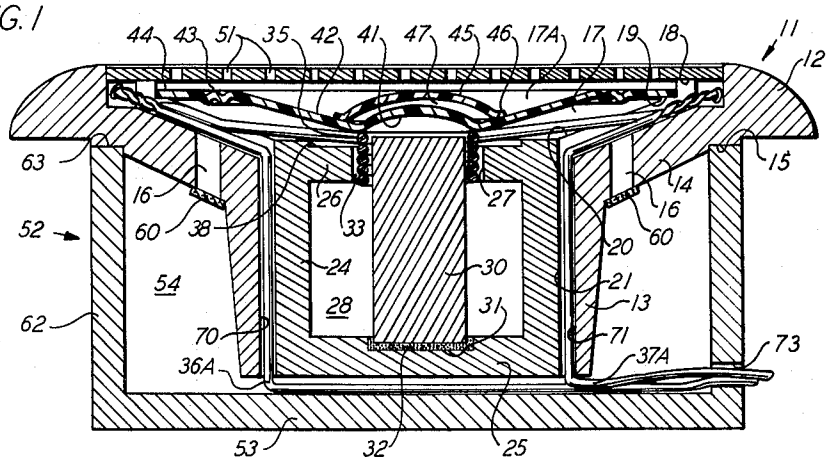
Jan. 18, 1966 D. L. KLIEWER 3,230,319

DYNAMIC EAR PHONE

Filed May 24, 1963

FIG. 1



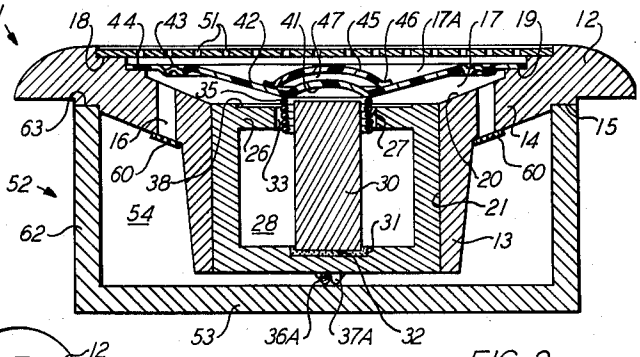




FIG. 2




FIG. 3




FIG. 4

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# DYNAMIC EAR PHONE

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3 Claims. (Cl. 179—115.5)

This invention relates to dynamic ear phones and more particularly to a diaphragm which is provided with a rigid medial auxiliary batten.

One object of the present invention is to eliminate the vibrations of the diaphragm which interfere with the tonal qualities of the diaphragm.

And still another object of the present invention is to have the outer circumferential area of the diaphragm produce low frequency sound waves while the stiffened medial area of the diaphragm produces high frequency sound waves.

In the past the surface of the diaphragm reacted with a wave producing motion so that more than one sound was produced. The secondary or excess sound waves are undesirable because they produce sound waves which interfere with the primary sound wave and thereby interfere with the tonal quality of the primary sound wave.

The present invention overcomes this undesirable condition through a structure which provides a stiff auxiliary membrane attached to the medial area of the diaphragm with entrapped air between the stiff auxiliary membrane and diaphragm.

The prior art discloses a stiff auxiliary membrane inserted into a medial area orifice in the diaphragm. The present construction encompasses a stiff membrane attached in the medial area of the diaphragm and united by means of the peripheral area of the stiff membrane. There is entrapped air between the membrane and diaphragm. The present invention contemplates a primary and a secondary medial diaphragm construction and not a single thick medial diaphragm.

Other objects of the present invention will be pointed out in part and become apparent in part in the following specification and claims.

Referring to the drawings in which similar characters of reference indicate corresponding parts in all the figures:

FIGURE 1 is a vertical medial sectional view through the new and improved dynamic ear phone.

FIGURE 2 is a view similar to FIGURE 1, taken in a vertical plane at right angles to the vertical plane of FIGURE 1.

FIGURE 3 is an exploded perspective view of the construction illustrated in FIGURES 1 and 2.

FIGURE 4 is a perspective view of a detail in construction of the voice coil attached to the diaphragm.

In proceeding with this invention there is provided a circular frame, generally indicated by reference numeral **11**, comprising an outwardly extending circular flange **12**, a circular shell **13**, and a tapered body section **14** provided with a circular band **15** and a plurality of air ports **16**.

Circular flange **12** is provided with a chamber **17** having a stepped wall which provides a guard seat **18**, a diaphragm seat **19** and a sloped side **20** terminating at the axial bore **21** of shell **13**.

A magnetic structure having inner and outer pole pieces is required. One such structure will be described. Any equivalent structure may be substituted.

A hollow cylindrical member, serving the function of a pole piece, is generally indicated by reference numeral **23** and comprises a cylindrical wall **24** having a bottom plate **25** and a top plate **26** provided with a central opening **27**. The hollow area of cylindrical member **23** is



indicated by reference numeral **28**. Top plate **26** provides the outer pole piece for the magnetic structure and may have a circular recess **38**.

Hollow cylindrical member or pole piece **23** is fastened in circular shell **13** by means of a tight fit in axial bore **21**.

A solid cylindrical magnet **30** is centrally disposed within hollow cylindrical member **23** and is fastened to bottom plate **25** by means of an electrically insulating cement **32**. Bottom plate **25** may be provided with a circular recess **31** for the purpose of holding the insulating cement **32** and to permit the cylindrical magnet **30** to be embedded therein. Magnet **30** projects through central opening **27** with an air gap **33** between cylindrical magnet **30** and the side of central opening **27**. The magnet **30** may be termed the inner pole piece.

A diaphragm, generally indicated by reference numeral **40** is preferably fabricated from a membrane of polyethylene terephthalate or a co-polymer of polyvinylidine chloride. One aspect of the former is known commercially as Mylar and the latter as Saran-Wrap.

Diaphragm **40** is of a shape illustrated in the drawing and consists of a general conical shape having a raised central portion or medial dome **41** and a tapering outwardly extending circular side portion **42** having a circular crimped area **43** which terminates in a flat rim **44**. A plastic, dome-shaped stiff auxiliary membrane **45** having a circular band **46** is placed over medial dome **41** with the circular band **46** fastened to said circular side portion **42** by means of a heat seal or an adhesive. An air pocket **47** is formed between dome **41** and stiff auxiliary membrane **45**. Flat rim **44** is secured to diaphragm seat **19** by means of an adhesive.

The tapering outwardly extending circular side portion **42** is the area of the diaphragm which produces the low frequency sound waves. The plastic, dome-shaped stiff auxiliary membrane **45** in cooperation with medial dome **41** produce the high frequency sound waves.

A voice coil **35** having terminal ends **36**, **37** is fastened to diaphragm **40** by means of an adhesive **39**. Medial dome **41** assists in locating the convolutions of the voice coil in exact medial position on the diaphragm **40**. The exact locating of the voice coil on the diaphragm is necessary for the proper location of the voice coil in air gap **33** and the proper functioning of the voice coil and diaphragm.

Voice coil **35** is placed in central opening **27** surrounding cylindrical magnet **30** and within air gap **33**.

A guard plate, generally indicated by reference numeral **50**, is provided with a plurality of perforations or air spaces **51**. Guard plate is preferably fabricated from metal such as aluminum and is fastened to guard seat **18** by means of a press fit.

The structure described supra provides a new and improved dynamic ear phone having superior tonal qualities. However, it has been found that the additional structure about to be described further adds to the tonal qualities of the ear phone.

A cover, generally indicated by reference numeral **52**, comprises a base **53**, and an integrally formed circular side wall **62** provided with a peripheral edge **63** which is fastened to circular band **15**. A cavity **54** is formed between cover **52** and circular frame **11**.

Silk in the form of disks **60** or any other air porous material is fastened by means of an adhesive over the ends of air ports **16** and to tapered body section **14** on cavity **54** side of air ports **16**. Porous material disks **60** filter the air which passes from chamber **17** to cavity **54** through air ports **16**. Cavity **54** is provided for back loading as will hereinafter appear.

Diaphragm **40** divides chamber **17** into two sections. Inner or rear section **17** and outer or front section **17A**.

Lead wires **36A**, **37A** are provided as extensions to

terminal ends **36**, **37** respectively. Body section **14** is provided with two channels **70**, **71**. Cover **52** is provided with an opening **73**. Lead wires **36A**, **37A** are passed through opening **73** and channels **70**, **71** respectively and are united, as by twisting, to ends **36**, **37** respectively.

In operation, lead wires **36A**, **37A** are attached to a sound source (not shown) which provides the electrical energy to vibrate the voice coil and diaphragm.

A D.C. magnetic field exists between magnet **30** and top plate **26** across central opening **27**. The vibration of the voice coil **35** in the D.C. magnetic field creates a vibration frequency in the diaphragm **40**. The shape of pole piece **23** provides a path for the harnessing of the magnetic lines of force inherent in magnet **30**.

Opening **73** is just large enough to accommodate lead wires **36A**, **37A**. Chamber **54** is filled with atmospheric pressure air. As diaphragm **40** vibrates it moves air in front section **17A** through air spaces **51** to produce sound waves. Diaphragm **40** also moves the air in rear section **17** through ports **16** into air filled chamber **54**. Porous disks **60** provide a resistance to the movement of air through ports **16**. Chamber **54** provides back pressure to the movement of air from ports **16** into chamber **54**. In this manner, the air in rear section **17** impedes the vibration of diaphragm **40** and thereby the frequency response and tonal quality of diaphragm **40**.

Plastic dome-shaped stiff auxiliary membrane **45** stiffens diaphragm **40** in the medial area whereby the frequency response of the medial area is also impeded.

It is the control of the frequency response of the medial area of the diaphragm **40** through stiff auxiliary membrane **45** and the control of the frequency response of the entire diaphragm **40** through the impedance of air in rear section **17** which provides the present structure with the ability to produce both low and high frequency responses and primary sound waves unfettered with secondary sound waves. Secondary sound waves are produced by the uncontrolled vibrations of a diaphragm.

Applicant has produced a diaphragm which is both a "tweeter" and a "woofer."

Having shown and described a preferred embodiment of the present invention by way of example, it should be realized that structural changes could be made and other examples given without departing from either the spirit or scope of this invention.

What I claim is:

**1.** A dynamic ear phone comprising a frame having a shell provided with an axial bore, a tapered body section provided with a plurality of air ports, and a chamber having a wall provided with a diaphragm seat, a movable diaphragm of a general conical shape having a medial area and a tapering outwardly extending circular side portion, stiff auxiliary membrane, means fastening said stiff auxiliary membrane to said diaphragm at said medial area with an air space between said medial area and said stiff auxiliary membrane, a voice coil, means fastening said voice coil to said diaphragm at said medial area, a magnetic structure having inner and outer pole pieces provided with an air gap therebetween, means fastening said movable diaphragm in said diaphragm seat with said voice coil disposed within said air gap, said diaphragm being located in said chamber and dividing said chamber into two sections, means fastening said magnetic structure in said axial bore, a cover provided with a cavity, and means fastening said cover to said frame to provide back pressure on said diaphragm through one of said two sections, said plurality of air ports and said cavity.

**2.** A dynamic ear phone comprising a frame having a shell provided with an axial bore, a tapered body section provided with a plurality of air ports, and a chamber having a wall provided with a diaphragm seat, a movable diaphragm fabricated from a membrane of polyethylene terephthalate or a membrane of a co-polymer polyvinylidine chloride, and having a generally conical shape provided with a medial area and a tapering outwardly extending circular side portion having a circular crimped area and a flat rim, a dome-shaped stiff auxiliary membrane fabricated from plastic material, means fastening said dome-shaped stiff auxiliary membrane to said diaphragm at said medial area with an air space between said medial area and said dome-shaped stiff auxiliary membrane, a voice coil having terminal ends adapted to extend beyond said frame, means fastening said voice coil to said diaphragm at said medial area, a magnetic structure having inner and outer pole pieces provided with an air gap therebetween, means fastening said movable diaphragm through said flat rim in said diaphragm seat with said voice coil disposed within said air gap, said diaphragm being located in said chamber, thereby dividing said chamber into a front section and a rear section, means fastening said magnetic structure in said axial bore, a cover provided with a cavity, and means fastening said cover to said frame to provide back pressure on said diaphragm through said rear section, said plurality of air ports and said cavity.

**3.** A dynamic ear phone consisting of a circular frame having a circular shell provided with an axial bore, a tapered body section provided with a circular band and a plurality of air ports, and a chamber having a stepped wall providing a guard seat, a diaphragm seat and a sloping side terminating at said axial bore, a hollow cylindrical member pole piece comprising a cylindrical wall having a bottom plate and a top plate provided with a central opening, means fastening said hollow cylindrical member pole piece in said axial bore, a cylindrical magnet, electrically insulating means fastening said cylindrical magnet to said bottom plate with one end of said cylindrical magnet located in said central opening, a diaphragm comprising a general conical shape having a medial dome, a tapering outwardly extending circular side portion provided with a circular crimped area and a flat rim, a dome-shaped stiff auxiliary membrane means fastening said dome-shaped stiff auxiliary membrane over said medial dome and to said tapering outwardly extending circular side portion, means fastening said flat rim to said diaphragm seat, an air pocket located between said medial dome and said stiff auxiliary membrane, a voice coil provided with terminal ends, means fastening said voice coil to said diaphragm, said voice coil being located in said central opening and around said cylindrical magnet, a guard plate provided with a plurality of air pockets, means fastening said guard plate in said guard seat, a plurality of air porous disks, means fastening said plurality of air porous disks over said plurality of air ports, a cover provided with a base and a circular side wall having a peripheral edge, and means fastening said peripheral edge to said circular band to form a chamber around said shell and hollow cylindrical member pole piece.


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