# United States Patent [19]

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[11] **3,766,334**

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[54] **DOUBLE VOICE COIL LOUDSPEAKER**


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[52] **U.S. Cl.** ..... **179/115.5 DV,** 179/115.5 R

[51] **Int. Cl.** ..... **H04r 9/06**

[58] **Field of Search** ..... 179/115.5 R, 115.5 VC, 179/115.5 DV, 116, 1 D



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,266,669 | 12/1941 | Wengel | 179/1 D |
| 2,897,291 | 7/1959 | Burke | 179/118.5 R |
| 2,922,849 | 1/1960 | Uchida | 179/115.5 DV |



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[57] **ABSTRACT**

The present invention relates to sound reproducers or loud-speakers of the electro-dynamic or moving-coil type and to a new series-parallel circuit provided with resistance to increase the cycle range and improve the timbre of the sound.


**3 Claims, 4 Drawing Figures**

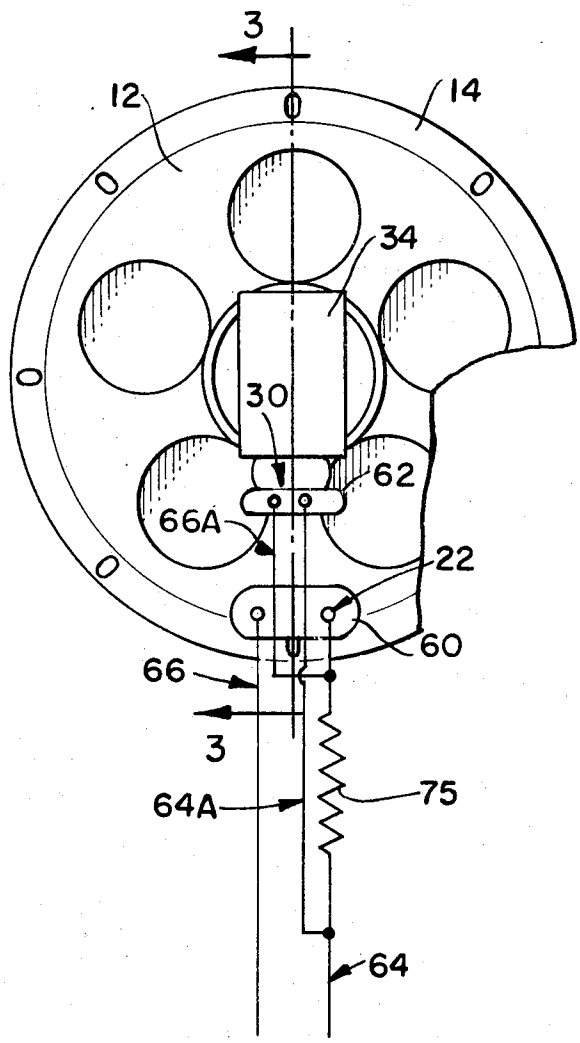


FIG. 1.

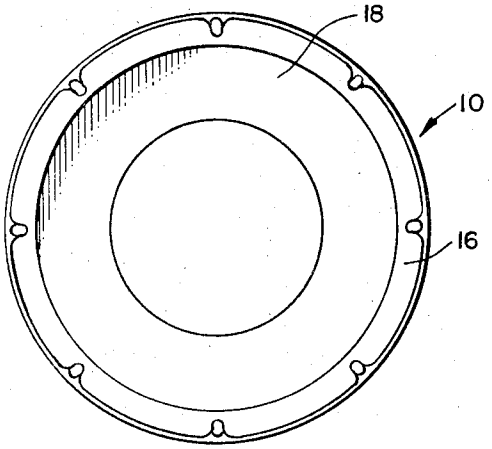



FIG. 2.

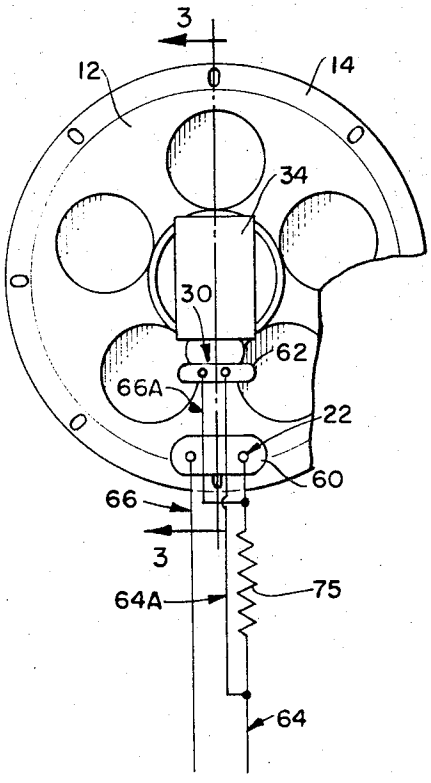



FIG. 3.

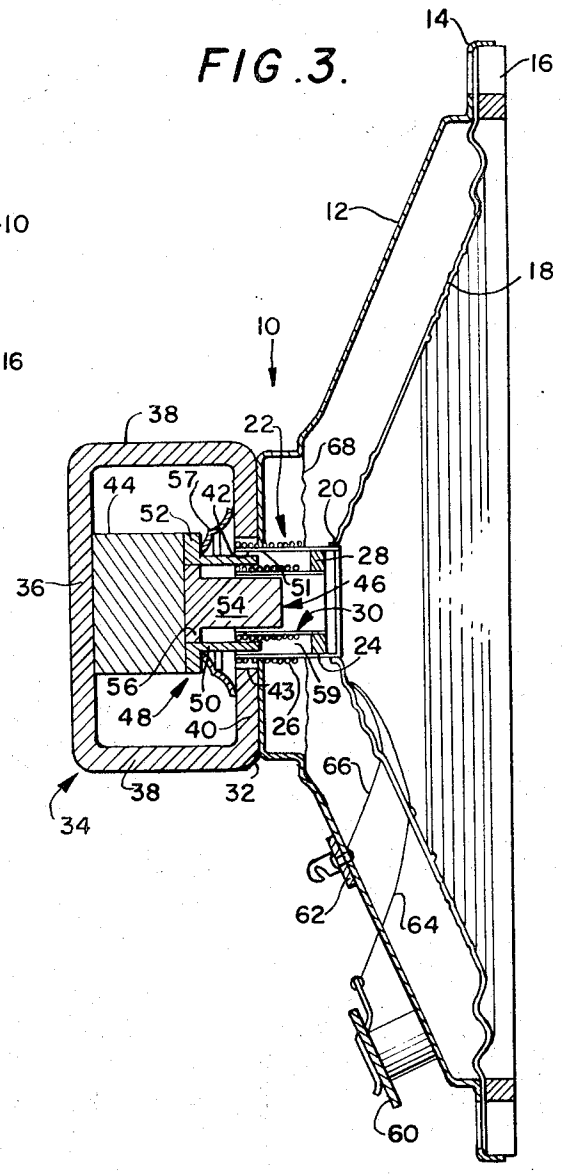
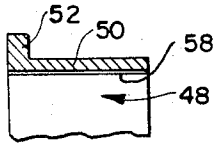



FIG. 4.

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# DOUBLE VOICE COIL LOUDSPEAKER

This invention relates to sound reproducers and more particularly, to loudspeakers of the electro-dynamic or moving-coil type and more specifically to improving the cycle range and sound qualities.

A primary object of the present invention is the provision in the circuit structure of a loudspeaker of resistance which will supply more harmonics or overtones than heretofore, increase the cycle range and improve the timbre of the sound, thereby providing sound which, in effect, appears to be more three dimensional in scope and less flat than sound reproduced by conventional speakers heretofore utilized.

Another object of the present invention is the provision of a loudspeaker capable of utilizing a greater output from a transformer while at the same time producing sharp and distinct tones.

Still another object of the present invention is the provision of a speaker which has virtually no resonant frequency such as usually caused by cone vibration, and which smooths out and reduces the gain or such caused by an audio frequency.

A further object is the provision of a speaker which is exceedingly effective at low frequencies, down to 30 cycles, and to frequencies as high as 1,500 cycles.

Another object of the present invention is the provision of a loudspeaker which, although simple in construction, is nevertheless highly efficient and sensitive in operation.

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:

FIG. 1 is a front elevation of a loudspeaker embodying the instant invention;

FIG. 2 is a rear elevation thereof, partly broken away;

FIG. 3 is an enlarged section taken on line 3—3 of FIG. 2; and

FIG. 4 is a detail section, partly broken away, of the outer armature utilized in the present invention.

The conventional electrodynamic loudspeaker or sound reproducer as heretofore utilized, has worked on the principle of a moving voice coil, which, when excited, usually by magnetic means, imparts vibration to the speaker cone thereby producing sound. More specifically, the moving voice coil is usually wound on a cardboard bobbin or the like which in turn is secured to the speaker cone. A magnetic field is provided proximate to said voice coil and the electrodynamic action which results between the flux produced by current passing through the wires of said coil and the magnetic lines of force creates a mechanical upward and downward pulling action. This force causes the voice coil to move up and down, which in turn makes the speaker cone vibrate and produce sound. The volume from the speaker is determined by the strength of the magnetic field, the number of turns in the voice coil, and the amount of current passing there through.

It has been found that the above-described speaker operation can be greatly improved by the use of double voice coils, concentrically disposed. By setting up the two coils so that they coact with separate and independent magnetic fields and function in unison, the sound output is more sharp and distinct, at lower frequencies as well as the higher ones.



Referring to the drawings, a loudspeaker constructed in accordance with the instant invention is shown generally at **10.** Speaker **10** comprises a metallic conical shell **12** having a peripheral flange portion **14.** Secured to flange **14,** as by a fiber clamping ring **16** or the like, is a paper speaker cone or diaphragm **18** of conventional construction. The truncated end **20** of cone **18** has secured thereto by any desirable means, such as cementing, an outer voice coil bobbin **22** comprising a cardboard or aluminum cylinder **24** having windings **26** therearound. A cork or composition ring **28** is secured to the inner surface of the cylinder **24** and acts as both spacing and insulating means between outer coil bobbin **22** and an inner voice coil bobbin **30,** likewise comprising a cardboard or aluminum cylinder having windings therearound. It will be understood that the inner voice coil bobbin **30** is secured to the spacer **28** and is maintained solely thereby in concentric relation with respect to outer voice coil bobbin **22.** It will further be understood that the bobbins **22** and **30,** other than the former's connection to speaker cone **18,** are not anchored in any way and hence are free to move axially whereby to impart vibration to the speaker cone **18.**

Secured to the truncated end of shell **12** by any desirable means, as at **32,** is a metallic rectangular supporting strap **34.** Supporting strap **34** comprises a rear wall **36,** side walls **38** and a front wall **40** having therein a centrally disposed aperture **42,** the inner surface **43** of which comprises a pole face. Mounted on the inner surface of rear wall **36,** as by cementing or the like, is a permanent magnet **44,** although it will be understood that other forms and types of magnets, such as an electromagnet, for example, could well be utilized. Magnet **44** at its free end forward surface engages inner and outer poles **46** and **48,** respectively, now to be described. It will be understood that poles **46** and **48** are each contructed of magnetic steel and hence, due to their contact with magnet **44,** provide their respective magnetic fields. The outer pole **48** comprises a tubular body portion **50,** the outer diameter of which extends through the aperture **42** in spaced relation to pole face **43** thereof, whereby to provide a gap **51.** Pole **48** further comprises an outwardly extending peripheral flange **52** which is in contact with magnet **44.** Inner pole **46** comprises a core portion **54,** and likewise is provided with an outwardly extended flange **56.** As will be noted, inner pole **46** is mounted concentrically within outer pole **48** by virtue of the fact that flange **56** is a press-fit therein. A circular spacer ring **57** of nonmagnetic material, such as brass, maintains outer pole **48** against longitudinal movement, and also maintains poles **46** and **48** centered with respect to the aperture **42.**

In operation and use, outer voice coil bobbin **22** surrounds outer pole **48** in very close proximity thereto and extends into gap **51,** while inner voice coil bobbin **30** is disposed intermediate core **54** of the inner pole and tubular portion **50** of the outer pole. As will be noted clearly in FIG. **3,** tubular portion **50** does not extend inwardly of gap **51,** thereby leaving uncovered a substantial portion of the windings of bobbin **30.** As will hereinafter become apparent, this relation is important in that it enables vibrations from one bobbin to be imparted to the other, whereas if such tubular portion extended in appreciably farther, it would tend to isolate the two bobbins with respect to each other.

It has been found that much improved sound characteristics are achieved in my specific structural arrangement by providing a non-magnetic coating **58** on the inner surface of tubular portion **50.** It will be understood that this coating may be of any material which is incapable of being magnetized or attracted by a magnet, some examples of such material being so-called white metal, brass, aluminum, copper, etc.

Another important feature of the instant invention resides in the fact that the space **59** between voice coil bobbins **22** and **30** acts, in effect, as a sound-compression chamber. In other words, the sound vibration waves which emanate from the outer bobbin **22** will be carried across the chamber **59** and imparted to the inner bobbin **30** and vice versa. Hence, in effect, each voice coil bobbin cooperates with the other to produce more pronounced vibration of the speaker cone. In this respect it might be pointed out that the windings on either bobbin **22** or **30** could be eliminated, and the loudspeaker would still function in improved fashion. More specifically, if, for example, the windings **26** of outer bobbin **22** were eliminated, the vibrations emanating from inner bobbin **30** would still move across chamber **59** and be imparted to the cylinder **24,** thereby causing the latter to aid in vibrating the speaker cone.

Conventional terminals **60** and **62** and wiring **64** and **66** are provided for the energization of the voice coils. Also, a conventional spider **68** may be utilized, if desired, to help maintain the voice coils in proper position and also to act as a dust shield.

FIG. **2** is a wiring diagram showing outer voice coil bobbin terminal **22** and inner voice coil bobbin terminal **30.** A first electrical conduit **66** (which may be considered to be negative or ground) is connected on one end to outer voice coil bobbin terminal **22** and on the other end it may be connected to an amplifier (not shown). A second electrical conduit **64** (which may be considered to be positive) is connected on one end to outer voice coil bobbin terminal **22** and on the other end to the amplifier (not shown). A first auxiliary electrical conduit **66A** connects inner voice coil bobbin terminal **30** with second electrical conduit **64.** A second auxiliary electrical conduit **64A** connects inner voice coil bobbin terminal **30** with second electrical conduit **64.** An electrical resistance, which may take any known form, is illustrated as a resistor **75** intermediate the connections of conduits **64A** and **66A** with conduit **64.** In this manner by way of example an 8 ampere current from the amplifier will flow through electrical conduit **66** and outer coil **22** to the parallel circuit of resistor **75** and inner coil **30.** 4 amperes will flow through resistor **75** and 4 amperes will flow through coil **30** (assuming equal resistances), whereby reactants are created which are fed back to electrical conduit **64.** This feedback assists the frequencies to thereby increase the cycle range to thirty cycles on the low end of the scale to 15,000 cycles on the high end of the scale. The timbre of the music is thereby greatly enhanced.

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 loudspeaker of the electrodynamic type, comprising dual voice coils driving a substantially frustroconical speaker cone, whose sound output is monaural and whose sound intensity is equal and audible at each ear, said dual voice coils comprising, an outer voice coil bobbin, an inner voice coil bobbin, mounted concentrically with respect to each other, means securing one of said voice coil bobbins to said speaker cone in axially extending relation therefrom, means comprising an insulating and spacing collar attached to said outer voice coil bobbin and attached to and supporting said inner voice coil bobbin in spaced relation and defining therebetween an annular sound compression chamber, means for creating a magnetic field in juxtaposition to each of said bobbins, said magnetic means comprising a first pole having a core portion extending within the inner voice coil bobbin, a second pole comprising a tubular portion extending into said sound compression chamber, and pole faces disposed adjacent the outer surface of the outer voice coil bobbin and cooperating with said second pole to form a gap, said second pole tubular portion having on the inner surface a non-magnetic metallic coating to isolate the magnetic field of said second pole from the magnetic field of said first pole, a first electrical conduit attachable to an amplifier, and to said outer voice coil bobbin, a second electrical conduit attachable to an amplifier and to said outer voice coil bobbin, a first auxiliary electrical conduit connected to said inner voice coil bobbin and to said second electrical conduit, a second auxiliary electrical conduit connected to said inner voice coil bobbin and to said second electrical conduit and resistance means interposed in said second electrical conduit intermediate said first auxiliary electrical conduit and said second auxiliary electrical conduit said electrical conduits and auxiliary electrical coduits and voice coils being arranged in inphase relation.

**2.** A loudspeaker of the electrodynamic type, comprising dual voice coils driving a substantially frustroconical speaker cone, whose sound output is monaural and whose sound intensity is equal and audible at each ear, said dual voice coils comprising, inner and outer voice coil bobbins mounted concentrically with respect to each other, means securing said outer voice coil bobbin to speaker cone in axially extended relation therefrom, a spacing collar of magnetic insulating material secured to both said inner and outer voice coil bobbins to rigidly support said bobbins in concentric relationship and to define an annular sound compression chamber therebetween, means for creating a magnetic field in juxtaposition to each of said bobbins, said magnetic means comprising a permanent magnet, a first pole attached to said permanent magnet and provided with a core portion extending within the inner voice coil bobbin, a second pole attached to said permanent magnet and mounted concentrically with respect to said first pole and provided with a tubular portion extending into said sound compression chamber, a gap formed between said first and second poles, said second pole tubular portion having on the inner surface a nonmagnetic metallic coating to control the effective force of the magnetic field of said first pole, a first electrical conduit attachable to an amplifier, and to said outer voice coil bobbin, a second electrical conduit attachable to an amplifier and to said outer voice coil bobbin, a first auxiliary electrical conduit connected to said inner voice coil bobbin and to said second electrical conduit, a second auxiliary electrical conduit connected to said inner voice coil bobbin and to said sec-

ond electrical conduit, and resistance means interposed in said second electrical conduit intermediate said first auxiliary electrical conduit and said second auxiliary electrical conduit said electrical conduits and auxiliary electrical conduits and voice coils being arranged conduits in-phase relation.

3. A loudspeaker of the electrodynamic type, comprising dual voice coils driving a substantially frustroconical speaker cone, whose sound output is monaural and whose sound intensity is equal and audible at each ear, said dual voice coils comprising, inner and outer voice coil bobbins mounted concentrically with respect to each other, means securing said outer voice coil bobbin to said speaker cone in axially extending relation therefrom, a spacing collar of magnetic insulating material secured to both said inner and outer voice coil bobbins to rigidly support said bobbins in concentric relationship and to define an annular sound compression chamber therebetween, means for creating a magnetic field consisting of a circular strap having an axial orifice and open opposite sides, a block formed in the circular strap opposite the axial orifice, said circular strap and block comprising a low loss permanent magnetic circuit, a first pole bar magnet attached to said block and provided with a core portion extending within the inner voice coil bobbin, a second pole attached to said block, mounted concentrically with respect to said first pole and provided with a tubular portion extending into said sound compression chamber and forming part of said low loss magnetic circuit, the forward surface of said second pole forming the other end of said sound compression chamber, said inner and outer voice coil bobbins and said first and second poles extending axially through said axial orifice to form a first gap between said circular strap at said axial orifice and said outer voice coil bobbin, and a second gap formed between said first and second poles, said second pole tubular portion having on the inner surface a non-magnetic metallic coating to control the effective magnetic field between said first pole bar magnetic and said second pole low loss magnetic circuit, a first electrical conduit attachable to an amplifier, and to said outer voice coil bobbin, a second electrical conduit attachable to an amplifier and to said outer voice coil bobbin, a first auxiliary electrical conduit connected to said inner voice coil bobbin and to said second electrical conduit, a second auxiliary electrical conduit connected to said inner voice coil bobbin and to said second electrical conduit, and resistance means interposed in said second electrical conduit intermediate said first auxiliary electrical conduit and said second auxiliary electrical conduit said electrical conduits and auxiliary electrical conduits and voice coils being arranged in in-phase relation.

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