Sept. 23, 1947. D. EKLÖV 2,427,844

VIBRATORY UNIT FOR ELECTRODYNAMIC LOUDSPEAKERS

Filed April 12, 1944

FIG. 1.

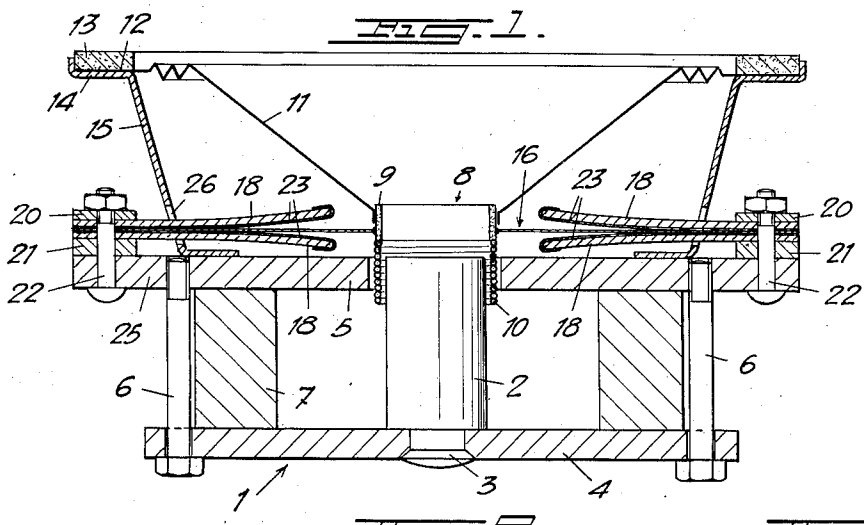


FIG. 2.

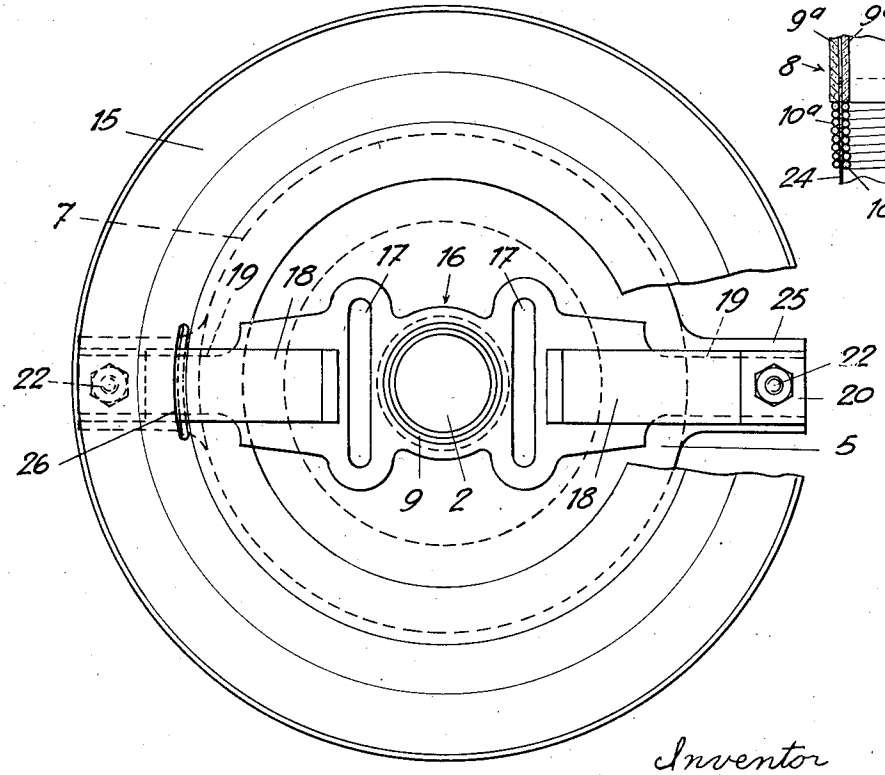


FIG. 3.

Inventor
David Eklöv
by Sommers & Young
Attorneys

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VIBRATORY UNIT FOR ELECTRODYNAMIC LOUD-SPEAKERS

David Eklöv, Stockholm, Sweden, assignor to Aktiebolaget Gylling & Co., Stockholm, Sweden, a Swedish joint-stock company

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11 Claims. (Cl. 179—115.5)

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This invention relates to loudspeakers and has for its general object to provide a loudspeaker operating satisfactorily over a large range of frequencies and presenting superior sound quality.

Another object of the invention is to provide a loudspeaker having high efficiency and thus small dimensions for a predetermined sound volume.

Other objects and advantages of the invention will appear from the following description as read in connection with the accompanying drawing.

On said drawing:

Fig. 1 shows the essential elements of my improved loudspeaker in axial section.

Fig. 2 shows a front view of the loudspeaker with the diaphragm removed, the diaphragm supporting means being partly broken away at the right hand side of said figure.

Fig. 3 shows a fragmentary view on an enlarged scale of the drive coil unit of the loudspeaker .

The electrodynamic loudspeaker as shown on the drawing comprises a magnet generally denoted by 1 and consisting of a central limb 2 riveted at 3 to a base plate 4, and an annular top plate 5, said plates being interconnected by means of bolts 6 and spaced apart at a suitable distance by an annular member 7.

8 represents the drive coil unit of the loudspeaker comprising an annular member 9 supporting the wire-winding 10 situated in the air gap between the opposed surfaces of members 2 and 5.

As may be seen from Fig. 3 the wire winding may comprise two layers 10^a and 10^b secured to an intermediate cylindrical carrier 24 of any suitable insulating material, such as paper or the like clamped at its upper projecting part between two annular members 9^a and 9^b.

Secured to the drive coil unit 8 is a conical diaphragm 11 having a circumferential flange 12 clamped between two annular members 13 and 14, the latter of which is formed integral with an annular bracket 15 spot welded at its base to the top plate 5.

16 denotes a spring member which may be formed of any suitable resilient sheet material for example, from the synthetic plastics now available. At its centre spring member 16 is apertured and secured to the drive coil unit 8.

At opposite sides of the centre aperture spring member 16 is formed with two transverse slots 17 reducing the effective cross sectional area and thereby also the stiffness of spring member 16. The end portions 19 of spring member 16 are each clamped at their outer ends between two guiding plates 18 which extend inwardly thereof a

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major portion of the distances to its center. The end portions of the spring are reduced in width so as to decrease the stiffness of spring member 16 adjacent the clamping zone. At their outer ends guiding plates 18 and spring member 17 are secured to lugs 25 projecting from top plate 5, by means of upper and lower washers 20 and 21 respectively and bolts 22.

As shown in Fig. 1 and at the left hand side of Fig. 2 bracket 15 is provided with apertures 26 through which plates 18 and spring member 16 extend.

Guiding plates 18 are curved so as to diverge successively from guiding spring member 16 as viewed from the clamping zone. Besides guiding plates 18 at the surfaces facing spring member 16 are covered with soft cloth, felt or similar substance 23, preferably thinned off as viewed towards the clamping zone of guiding plates 18.

Although spring member 16 in the foregoing description has been assumed to be secured to the drive coil unit 8 it may obviously as well be secured to diaphragm 11, the essential point being that it partakes in the vibratory movements of the loudspeaker diaphragm so as to control the oscillations thereof in the manner set forth hereunto. Besides, for the single spring member illustrated on the drawing there may obviously be substituted a plurality of spring members partaking in the movements of the diaphragm and clamped between curved guiding plates in the manner set forth hereinbefore.

Due to the fact that the spring member for guiding the loudspeaker diaphragm is clamped between curved plates which preferably also are elastic or resilient the result is obtained that the larger the deflections of the diaphragm in either direction are the smaller is the part of the diaphragm that can move freely in the direction of movement. From this it follows that the elasticity of the guiding spring will be very great at normal deflections of the diaphragm but that the deflections when tending to reach abnormally large values will be restricted by the decrease of the effective length of the guiding spring member and the diaphragm thus rapidly returned to its normal position of rest. Thus, by this means the resonance frequency of the diaphragm suspending device may be chosen very low without incurring the risk of abnormally large deflections of the diaphragm at resonance and high input power. Moreover, the resonance of the suspending device will be suppressed to some extent due to the fact that the effective length of the guiding

spring member continuously varies with the deflection of the diaphragm.

One might imagine that disturbing noise would arise when the guiding spring member engages the curved faces of the clamping plates but practical tests have proved that this is not the case provided the curved faces are correctly shaped in that the guiding spring member then performs a rolling movement on said faces and thus does not directly strike thereagainst. If the curved faces as described are covered with a soft substance then the movements of the guiding spring will become softer and by varying the thickness of the soft material as used also the time of reverberation for the lower frequencies may be properly controlled. Any general form for the curved faces cannot be given in that the shape depends on the size and shape of the guiding spring member as well as on the deflection of the diaphragm that can be permitted in each particular case.

One of the advantages obtained by my invention resides therein that the resonance frequency of the device suspending the loud speaker diaphragm can be reduced to a value within the range of frequencies in which the sensitivity of the ear is low, that is below about 60 cycles per second.

Another advantage of the invention resides therein that the efficiency of the loud speaker will be high at lower frequencies in that the diaphragm can oscillate or vibrate very freely at normal deflections or amplitudes whereby a predetermined sound volume may be obtained by a loudspeaker of small dimensions.

From the foregoing it follows that my invention renders it possible to manufacture a loudspeaker by using relatively simple means and at low costs having a large range of frequencies, perfect stability and superior sound quality.

I do not wish to be limited as to details of construction as these may be modified in many particular respects without departing from the spirit of my invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. An electrodynamic loudspeaker comprising a diaphragm, a drive coil unit member for vibrating said diaphragm, means for controlling the vibrations of said diaphragm, said controlling means comprising at least one relatively soft spring member of substantial length secured to said drive coil unit, and plate members clamping said spring member at its outer ends and extending inwardly a major part of the distances to its center, the surface of said plate members facing said spring member being curved so as to progressively diverge from said spring member inwardly from the outer ends of said spring member for controlling said spring member.

2. An electrodynamic loudspeaker comprising a diaphragm, a drive coil unit for vibrating said diaphragm, means for controlling the vibrations of said diaphragm, said controlling means comprising at least one relatively soft spring member of substantial length secured to said diaphragm adjacent the center portion thereof, and plate members clamping said spring member at its outer ends and extending inwardly a major part of the distances to its center, the surface of said plate members facing said spring member being curved so as to progressively diverge from said spring member inwardly from the outer ends of said spring member for controlling said spring member.

3. An electrodynamic loudspeaker comprising a diaphragm, a drive coil unit for vibrating said diaphragm, means for controlling the vibrations of said diaphragm, said controlling means comprising at least one relatively soft spring member of substantial length partaking in the vibratory movements of said diaphragm, and plate members clamping said spring member and controlling the movements thereof, the surface of said plate members facing said spring member being curved so as to diverge successively from said spring member as viewed from the clamping zone and covered with a soft substance.

4. An electrodynamic loudspeaker comprising a diaphragm, a drive coil unit for vibrating said diaphragm, means for controlling the vibrations of said diaphragm, said controlling means comprising at least one relatively soft spring member of substantial length partaking in the vibratory movements of said diaphragm, and plate members for clamping said spring member and controlling the movements thereof, the surface of said plate members facing said spring member being curved so as to diverge successively from said spring member as viewed from the clamping zone and provided with a covering of soft substance thinned off towards the clamping zone.

5. An electrodynamic loudspeaker comprising a diaphragm, a drive coil unit for vibrating said diaphragm, means for controlling the vibrations of said diaphragm, said controlling means comprising at least one relatively soft spring member of substantial length connected with the diaphragm and partaking in the vibratory movements thereof, and resilient plate members clamping said spring member at its outer ends and extending inwardly a major part of the distances to its center, the surface of said plate members facing said spring member being curved so as to progressively diverge from said spring member inwardly from the outer ends of said spring member for controlling said spring member.

6. An electrodynamic loudspeaker comprising a diaphragm, a drive coil unit for vibrating said diaphragm, means for controlling the vibrations of said diaphragm, said controlling means comprising at least one relatively soft sheet material spring member of substantial length connected with the diaphragm and partaking in the vibratory movements thereof, and plate members clamping said spring member at its outer ends and extending inwardly a major part of the distances to its center, the surface of said plate members facing said spring member being curved so as to progressively diverge from said spring member inwardly from the outer ends of said spring member for controlling said spring member.

7. An electrodynamic loudspeaker comprising a diaphragm, a drive coil unit for vibrating said diaphragm, means for controlling the vibrations of said diaphragm, said controlling means comprising at least one relatively soft synthetic plastic flat spring member of substantial length connected with the diaphragm and partaking in the vibratory movements thereof, and plate members clamping said spring member at its outer ends and extending inwardly a major part of the distances to its center, the surface of said plate members facing said spring member being curved so as to progressively diverge from said spring member inwardly from the outer ends of said spring member for controlling said spring member.

8. An electrodynamic loudspeaker comprising a diaphragm, a drive coil unit for vibrating said diaphragm, means for controlling the vibrations

of said diaphragm, said controlling means comprising at elast one relatively soft sheet material spring member of substantial length secured intermediate its ends to said drive coil unit, and plate members for clamping said spring member at the opposite ends thereof and extending inwardly major parts of the distances to its center, the surfaces of said plate members facing said spring member being curved from said spring member inwardly from the outer ends of said spring member for controlling said spring member.

9. An electrodynamic loudspeaker comprising a diaphragm, a drive coil unit member for vibrating said diaphragm, means for controlling the vibrations of said diaphragm, said controlling means comprising at least one spring member of substantial length connected with the diaphragm and partaking the vibratory movement thereof, and plate members clamping said spring member, said spring member having two soft portions, one located near the drive coil unit and the other located near the outer end portions, and a stiff portion located between said soft portions, said plate members having surfaces facing said stiff portions of said spring member along the major parts of their lengths, said surfaces being curved so as to diverge progressively from said stiff regions of said spring member inwardly from the outer ends of said spring member for controlling said spring member.

10. An electrodynamic loudspeaker comprising a diaphragm, a drive coil unit for vibrating said diaphragm, means for controlling the vibrations of said diaphragm, said controlling means comprising at least one relatively soft sheet material spring member of substantial length secured intermediate its ends to said drive coil unit and provided with transverse slots at opposite sides of said drive coil unit, and plate members for

clamping said spring member at the opposite ends thereof and extending inwardly major parts of the distances to its center, the surfaces of said plate members facing said spring member being curved so as to diverge progressively from said spring member inwardly from the respective outer ends of the spring.

11. An electrodynamic loudspeaker comprising a diaphragm, a drive coil unit for vibrating said diaphragm, means for controlling the vibrations of said diaphragm, said controlling means comprising at least one relatively soft sheet material spring member of substantial length secured intermediate its ends to said drive coil unit provided with transverse slots at opposite sides of said drive coil unit and having end portions reduced in width, and plate members for clamping said spring member at the opposite ends thereof and extending inwardly major parts of the distances to its center, the surfaces of said plate members facing said spring member being curved so as to progressively diverge from said spring member inwardly from the respective outer ends of said spring member for controlling said spring member.

DAVID EKLÖV.

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