July 5, 1949. J. P. QUAM 2,475,516

SUPPORT CLAMP FOR ELECTRODYNAMIC LOUD-SPEAKERS

Filed July 10, 1944

Fig. 1.

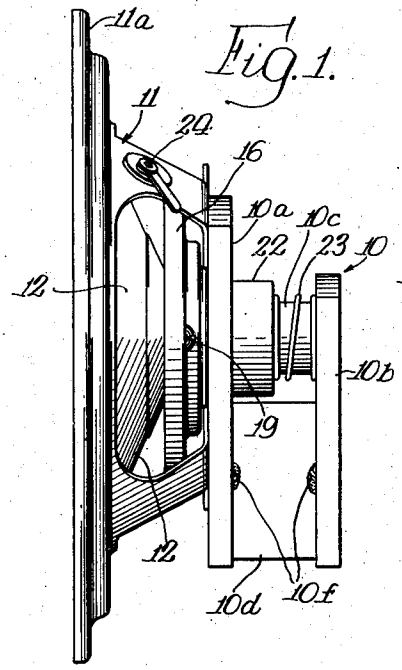


Fig. 4.

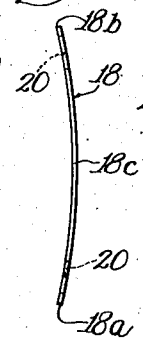


Fig. 2.

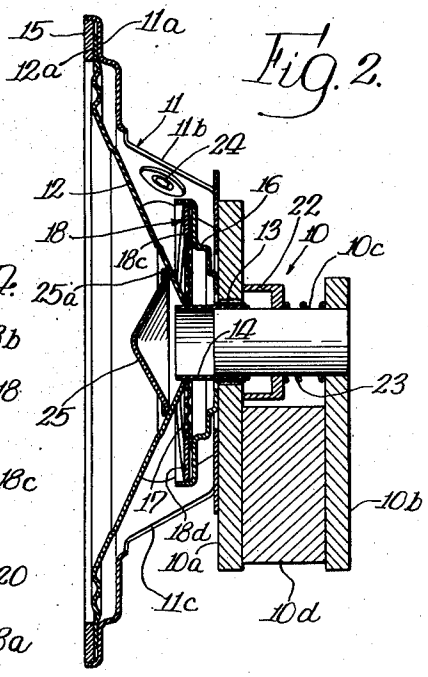
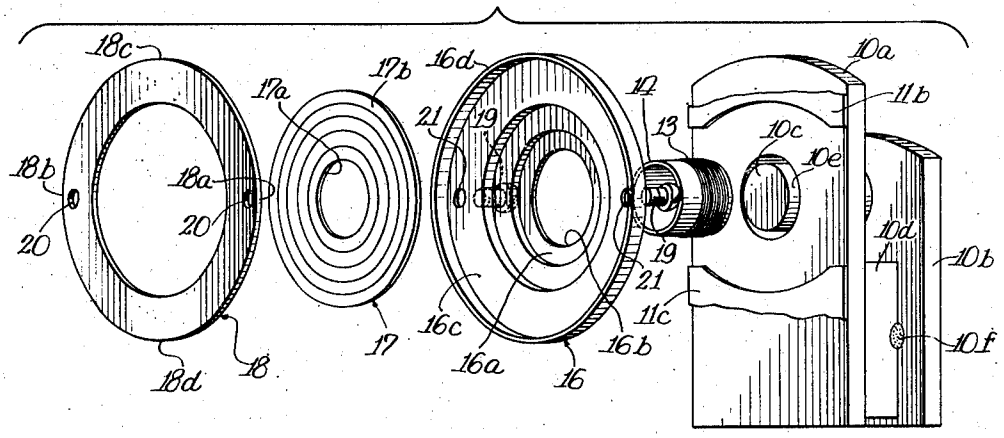


Fig. 3.



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Patented July 5, 1949

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UNITED STATES PATENT OFFICE

2,475,516

SUPPORT CLAMP FOR ELECTRODYNAMIC LOUD-SPEAKERS

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Application July 10, 1944, Serial No. 544,182

4 Claims. (Cl. 179—115.5)

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The present invention relates to sound translating devices and more particularly to improvements in loud-speakers of the dynamic type.

Loud-speakers of the character mentioned conventionally comprise a conical diaphragm which supports a voice or a driving coil at the base thereof for movement within the air gap of an associated magnetic field structure. In order to obtain efficient operation of a speaker of this character it is desirable to make the air gap as small as possible, which in turn complicates the problem of accurately centering the driving coil in the air gap and of maintaining the coil in its centered position after this position is established. Moreover, the small clearances between the driving coil assembly and the adjacent pole pieces of the field structure give rise to the problem of effectively preventing dust and other foreign matter from entering the air gap to interfere with relative movement between the coil assembly and the field structure. Various expedients have been proposed for solving these problems, all of which either lack effectiveness in performing their assigned functions or unduly complicate the speaker assembly operations. Equally important, conventional coil centering and dust excluding arrangements do not permit recentering of the voice coil in the field structure air gap or cleaning of the air gap without destruction or disassembly of at least a part of the speaker structure.

It is an object of the present invention, therefore, to provide improved and exceedingly simple facilities for effectively preventing dirt, dust and other foreign matter from entering the air gap of a loud-speaker and for fixedly anchoring the diaphragm driving coil of the speaker in a centered position within the air gap.

According to another object of the invention, the driving coil centering facilities are so arranged that the coil may be quickly and easily recentered in the air gap without destruction or disassembly of any of the speaker parts.

In accordance with a still further object of the invention, the air gap sealing facilities are arranged in an improved manner which permits the air gap to be opened at will for the purpose of cleaning the gap.

It is a still further object of the invention to provide in a field structure for a sound translating device, improved facilities for closing one end of an air gap provided between two of the pole pieces of the structure.

More generally stated, it is an object of the present invention to provide an improved sound

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translating device which is simple in arrangement, is easy to manufacture and assemble and yet is efficient and entirely reliable in operation.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the specification taken in connection with the accompanying drawing, in which:

Fig. 1 is a side view in perspective of a loud-speaker characterized by the features of the present invention;

Fig. 2 is a side sectional view of the speaker shown in Fig. 1;

Fig. 3 is an explosion view illustrating the positional relationship of certain of the speaker parts; and

Fig. 4 is an edge view of one of the elements included in the speaker structure.

Referring now more particularly to the drawing, the invention is disclosed in its embodiment in a loud-speaker of the well-known dynamic type, which comprises a field structure indicated generally at **10**; a diaphragm supporting frame or basket **11** fixedly mounted upon one of the pole pieces of the field structure; a conical diaphragm **12** clamped at its outer edge **12***a* to a stepped portion **11***a* of the frame **11** by means of a clamping ring **15**; and a driving coil assembly which includes a tubular coil support **14** cemented or otherwise rigidly secured to the apertured apex of the diaphragm **12**, and a coil **13** wound upon the coil support **14** for movement within an air gap **10***e* of the field structure **10**. The terminal conductors of the coil **13** are brought out between the coil support **14** and the adjacent edge of the diaphragm **12** to extend through sealed openings in the diaphragm to terminals **24** carried by the leg **11***b* of the frame **11**. These terminals are insulated from the frame **11** in any conventional manner.

More specifically considered, the field structure **10** comprises three pole pieces or members with two parallel extending pole plates **10***a* and **10***b* which are held in spaced-apart relationship by means of a bar magnet **10***d* preferably formed of Alnico or like permanent magnetic material. The first, or inner pole plate **10***a*, is provided with a circular opening for receiving the end of the solid cylindrical pole piece **10***c* fixedly carried by the second, or outer pole plate **10***b*. With this arrangement, an air gap **10***e* of annular form is provided between the spaced-apart pole faces of the two pole plates **10***a* and **10***c* to receive the voice coil **13** and the enclosed portion of the

tubular coil support 14 therewithin. Preferably, the relative diameters of the pole piece 10c and opening within the piece 10a are such that only very small clearances are provided between the driving coil assembly of the adjacent surfaces and the two identified pole piece members. This permits an air gap 10e of exceedingly small cross-section to be utilized with a resulting increase in the flux density within the gap for a magnet 10d of given strength.

For the purpose of accurately supporting the driving coil assembly within the air gap 10e to eliminate the possibility of frictional engagement between the parts thereof and the adjacent pole faces of the field structure during vibration of the diaphragm 12, and for the additional purpose of partially sealing the air gap against the entrance of dirt, dust or other foreign matter thereinto, a combination centering and sealing structure is provided which includes a flexible dust impervious spider 17 radiating from the axis of longitudinal movement of the coil support 14, and clamping parts 16, 18 and 19 for uniformally clamping all segments of the spider edge against movement transversely of the coil support 14. More in detail, the spider supporting part 16 is in the form of a cup-shaped metal member having a bottom wall which is spot welded to the inner pole plate 10a and is apertured to receive the driving coil assembly. This member is of stepped cross-sectional configuration, having a last step 16c which defines a substantially flat annular clamping surface against which the marginal edges of the spider 17 may be clamped by the washer-like clamping member 18. A flange 16d extending normal to the step 16c is utilized to restrain the clamping washer 18 against movement transversely of the member 16 during assembly of the parts.

The spider 17 is preferably formed of a treated porous cloth, and is provided with circular corrugations around the center thereof to permit transverse flexing and yet prevent stretching. The degree of porosity of this spider is sufficient to permit air to move freely in and out of the chamber in which the air gap and driving coil are enclosed without permitting dust particles of any substantial size to enter this chamber. At its inner peripheral edge, the spider is cemented or otherwise fixedly secured to the diaphragm 12 adjacent the connection between the diaphragm and the coil support 14.

As indicated above, one of the problems involved in anchoring the driving coil 13 in a centered position within the air gap 10b is that of fixedly clamping all segments of the marginal edge of the spider against movement in directions transversely of the voice coil supporting tube 14. Heretofore clamping or securing means have been of such construction that only localized clamping pressure is exerted upon a small edge portion of the spider. This has resulted in incomplete securing, at best, and the possibility of displacement of the voice coil 13 within the air gap. Of greater importance, however, is the fact that prior means for securing a spider to the speaker frame structure has prevented ready adjustment of the spider and hence coil relative to the air gap to center the coil, and in general all former commercially practical spider securing means have required that the diaphragm and coil assembly be torn down and replaced when the speaker was completely assembled and the voice coil was not centered in the air gap.

In accordance with the present invention this

difficulty has been obviated by utilizing a clamping member or washer 18 of the configuration shown in Fig. 4 of the drawings. As there illustrated, the washer 18 is curved or dished so that the opposed low points 18c and 18d thereof contact the seated edge portion of the spider 17 midway between the opposed high points 18b and 18a of the washer, when this washer is assembled within the flange 16d of the member 16 to overlie the spider 17. Clamping screws 19 which extend through openings 21 in the stepped portion 16c of the member 16 and are threadable into threaded openings 20 disposed adjacent the high points 18a and 18b of the washer are utilized to draw the high points of the washer toward the step 16c of the member 16, thereby progressively to clamp an increasing part of the spider edge portion to the surface of the step 16. With this arrangement in a yielding washer, all edge portions of the spider 17 are fixedly clamped to the surface of the step 16c when the screws 19 are threaded into the openings 21 to bring the high points of the washer into engagement with the adjacent edge portions of the spider, or in other words, to bring the washer to a flat shape conforming to the spider supporting face of the cup 16.

From the above explanation, it will be understood that the two parts 16 and 17 serve partially to enclose the air gap 10b and the voice coil assembly. Such enclosure is further effected by providing a cap 25 of conical shape, the edges of which are cemented to the diaphragm 12 so that the left end of the tubular coil support 14 is closed. Further to this end, a spring pressed ring 22 formed of brass or other non-magnetic metal and embracing the center pole piece 10c for engagement with the underside of the inner pole plate 10a, is provided for closing the end of the air gap 10e which opens at this side of the pole piece 10a. More specifically the ring 22 is counterbored or formed to provide a small annular chamber adjacent the end of the air gap which opens at the underside of the pole plate 10a, and is held in tensioned engagement with this side of the pole plate by means of a compression spring 23 embracing the pole piece 10c and tensioned between the ring 22 and the outer pole plate 10b.

In the manufacture and assembly of the structure described above, the field structure 10 is constructed by grinding the pole face ends of the bar magnet 10d to establish a parallel relationship therebetween. The basket 11 is spot-welded to the inner pole plate 10a, and the cup 16 is likewise spot-welded to the plate 10a in a centered position relative to the hole. Another sub-assembly is made by driving the pole piece 10c into the corresponding aperture in the outer pole plate 10b. Then, while centering the pole piece 10c in the opening for the inner pole plate 10a, the magnet 10d is mounted between the pole plates. Meanwhile, the ring 22 and compression spring 23 was slipped over the pole piece 10c, as can be understood from the drawings. With all of these elements in a jig or fixture and the pole piece centered, the magnet is secured to the two pole plates 10a and 10b by arc welding.

The final assembly step is that of mounting the diaphragm 12 and its associated coil assembly within the frame 11. A positioning jig may be utilized for the purpose of accurately positioning the preassembled unit with the connected parts 12, 14 and 17 relative to the field structure 10 in a manner such that the coil 13 and enclosed portion of the tube 14 are very accurately supported

centrally of the air gap 10e. With these relative positions established, the ring 15 may be clamped to the portion 11a of the frame 11 by means of cement to fixedly secure the outer edge of the diaphragm 12 against movement relative to the other parts of the structure. Also, the screws 19 may be threaded into the openings 20 for the purpose of fixedly clamping the edge portion of the spider 17 to the step 16c of the member 16 in the manner explained above.

After the diaphragm assembly is thus mounted upon the preassembled frame 11 and field structure 10, the non-magnetic sealing ring 22 may be retracted away from the pole piece 10a and a blast of air projected through all portions of the air gap 10e for the purpose of removing any dust particles or foreign matter admitted thereto during the assembly operations. After the air gap has been thus thoroughly cleaned, the ring 22 may be released to seat against the pole piece 10a under the influence of the spring 23 and thus effectively close off the end of the air gap which opens at the underside of the pole piece 10a. Also, the cap 25 may be cemented at its edges to the diaphragm 12, thereby completely to seal the air gap 10b against the entrance of dust, dirt or other foreign matter thereinto.

As will be evident from the above explanation, the structure is such that recentering of the coil 13 within the air gap 10b may be readily accomplished without disassembly of the speaker or destruction of its parts. The need for this might arise during the final manufacturing and testing step or after the speaker was out in the field. To accomplish the recentering operation it is only necessary that the screws 19 be unscrewed to relieve the clamping pressure exerted upon the marginal edges of the spider 17 by means of the clamping washer 18. In this regard it is noted that the screw receiving openings 21 in the member 16 are disposed adjacent the opposite edges of the pole piece 10a but are displaced outwardly therefrom. As a result, they are readily accessible for actuation by a screw driver and are in no way blocked by the parts of the field structure. After the spider has thus been freed, finger manipulation of the diaphragm assembly and the sense of touch may be relied upon to indicate that the voice coil moves freely in the air gap and thus recenter the coil 13 within the air gap 10e. If more accurate centering is required, the cap 25 may be removed from the diaphragm 12 and a centering gauge employed to establish the desired position of the coil 13 in the center of the air gap 10e. After the centering operation is completed, the screws 19 may be tightened for the purpose of again drawing the high points of the clamping washer 18 into engagement with the adjacent edge portion of the spider 17. Either during the centering operation or after it is completed, or at any other time the non-magnetic sealing ring 22 may obviously be retracted from the pole piece 10a for the purpose of cleaning the air gap 10b in the manner explained above.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein which are within the true spirit and scope of the invention as defined in the appended claims.

I claim:

1. In a loud-speaker which includes a field structure provided with an annular air gap, a diaphragm and a diaphragm driving coil disposed in said air gap; the means for retaining said coil

centered in said air gap which comprises a flexible spider radiating from the axis of said voice coil, a member fixedly mounted with respect to said field structure and provided with a clamping surface for seating the outer edge portion of said spider, a curved resilient clamping member having low points adapted to bear against oppositely disposed segments of the seated-edge portion of said spider and angularly spaced high points out of contact with the seated-edge portion of said spider, and means for drawing the high points of said clamping member toward said seat and said spider-edge portion, thereby progressively to clamp an increasing part of said spider-edge portion to said surface until all segments of said spider-edge portion are fixedly clamped to said surface by the action of said clamping member.

2. In a loud speaker with a field structure having an annular air gap therein and a speaker diaphragm driving coil disposed in said air gap, the means for adjustably centering the driving coil in said air gap and maintaining it centered including in combination, a frame seat on said field structure, a spider surrounding the driving coil and secured thereto having an edge portion supported on one side on said frame seat, circumferentially bowed clamping means on the other side of said spider-edge portion, and means for drawing said clamping means and frame seat together to progressively clamp an increasing part of said spider-edge portion to said frame seat including threaded members acting on said bowed circumference of said clamping means in positions such that said clamping means is progressively flattened circumferentially thereof to a final clamping position.

3. In a loud-speaker with a field structure having an annular air gap therein and a speaker diaphragm driving coil disposed in said air gap, the means for adjustably centering the driving coil in said air gap, and maintaining it centered including in combination, a frame seat on said field structure surrounding said air gap, a spider surrounding said driving coil having an inner edge portion secured to said driving coil and an outer edge portion supported on one side on said frame seat, a circumferentially bowed clamping member on the other side of said outer edge portion, and clamping means for drawing said clamping member toward said frame seat to progressively clamp an increasing part of said outer edge portion to said frame seat, said clamping means acting on said bowed circumference of said clamping member for progressively flattening said clamping member circumferentially thereof to a final clamping position.

4. In a loud-speaker with a field structure having an annular air gap therein and a speaker diaphragm driving coil disposed in said air gap, the means for adjustably centering the driving coil in said air gap, and maintaining it centered including in combination, an annular frame seat on said field structure surrounding said air gap, an annular spider surrounding said driving coil having an inner edge portion secured to said driving coil and an outer edge portion supported on one side on said frame seat, a resilient circumferentially bowed annular clamping member on the other side of said outer edge portion of said spider and having first portions closely adjacent said outer edge portion and second portions bowed away from said outer edge portion, and clamping means engaging said frame seat and said second portions of said clamping member for drawing

said clamping member toward said frame seat to progressively clamp an increasing part of said outer edge portion to said frame seat so that said clamping member is progressively flattened to a final clamping position.

JAMES P. QUAM.

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