Sept. 23, 1952 L. M. HEINEMAN 2,611,830

TRANSDUCER

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Fig. 1

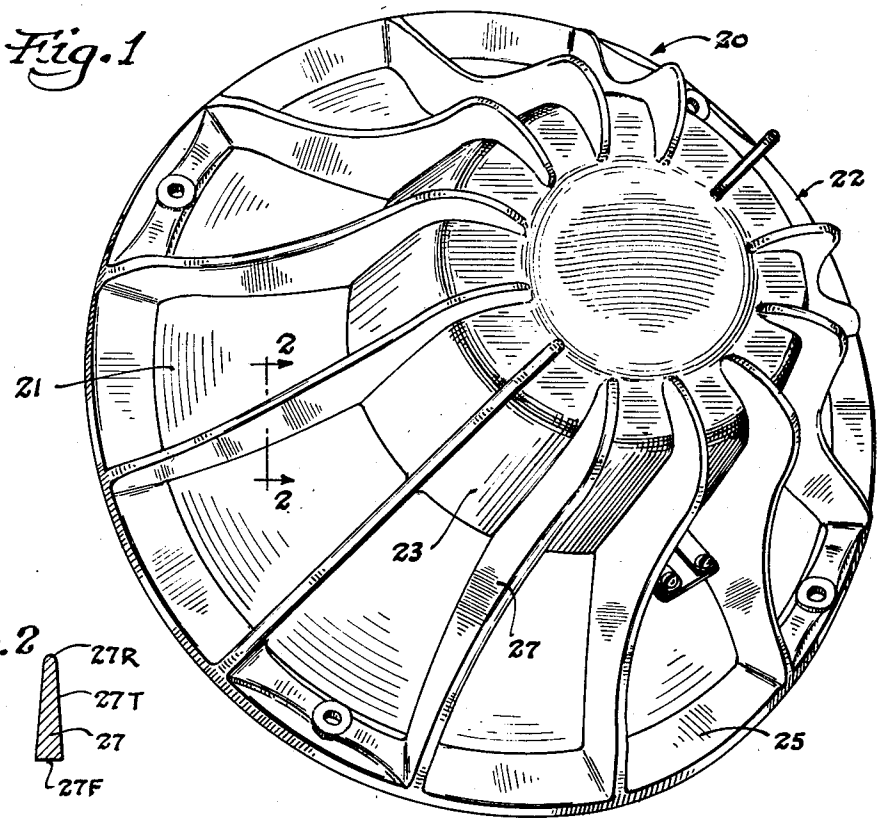


Fig. 2

Fig. 3

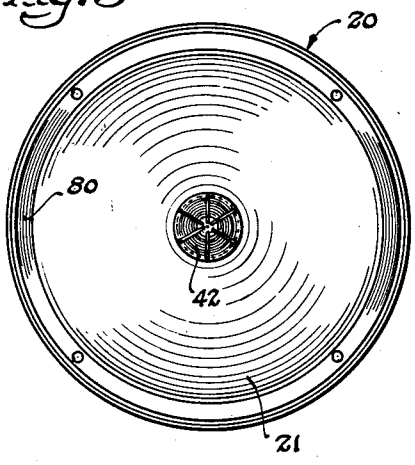
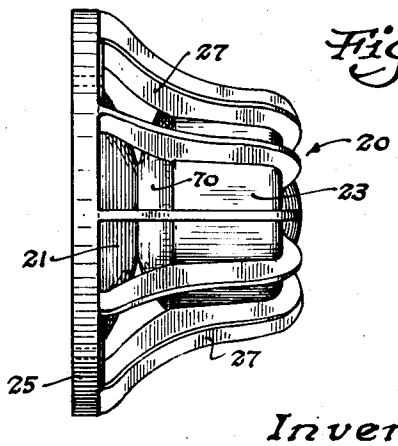


Fig. 4



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Fig. 5

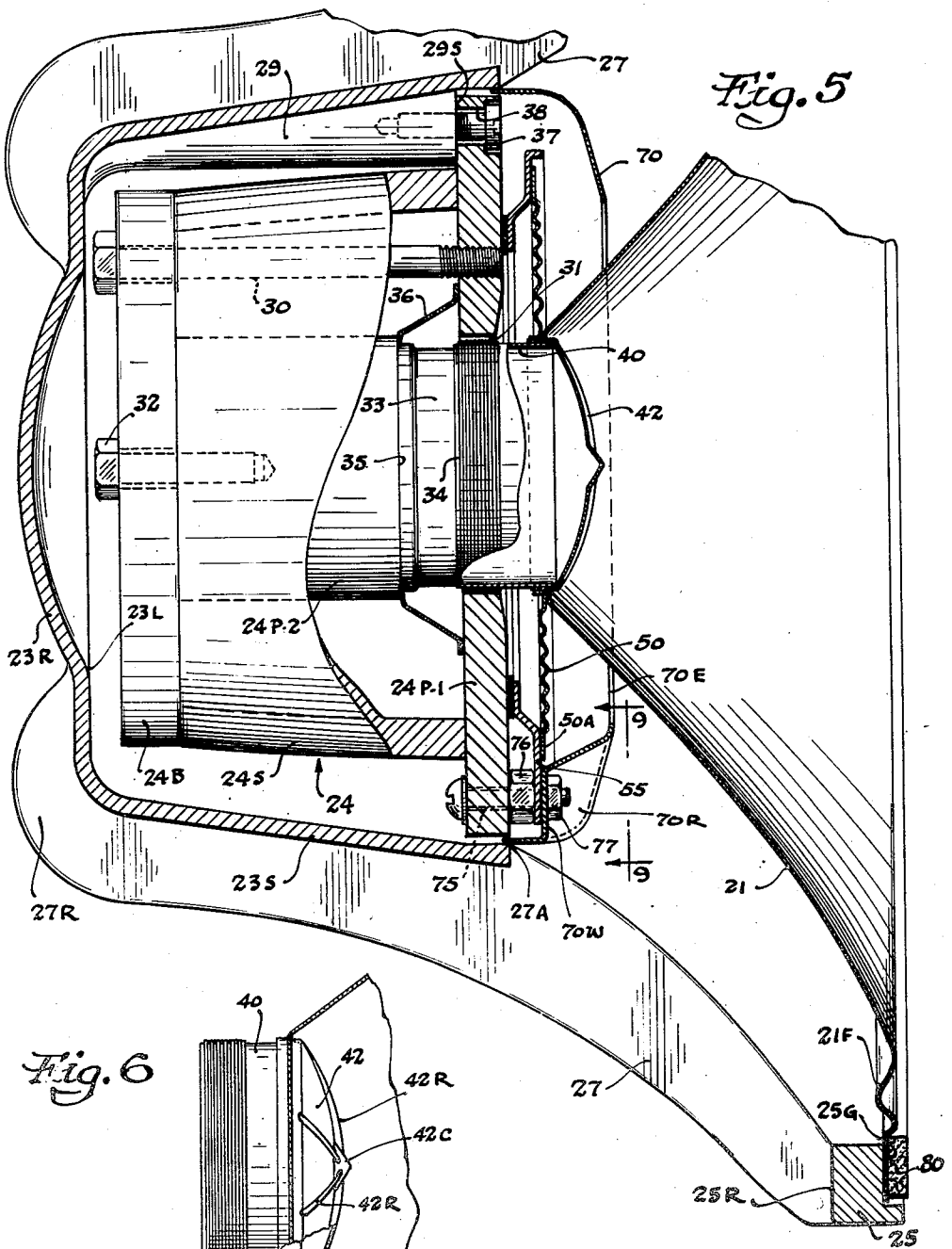


Fig. 6

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Fig. 7

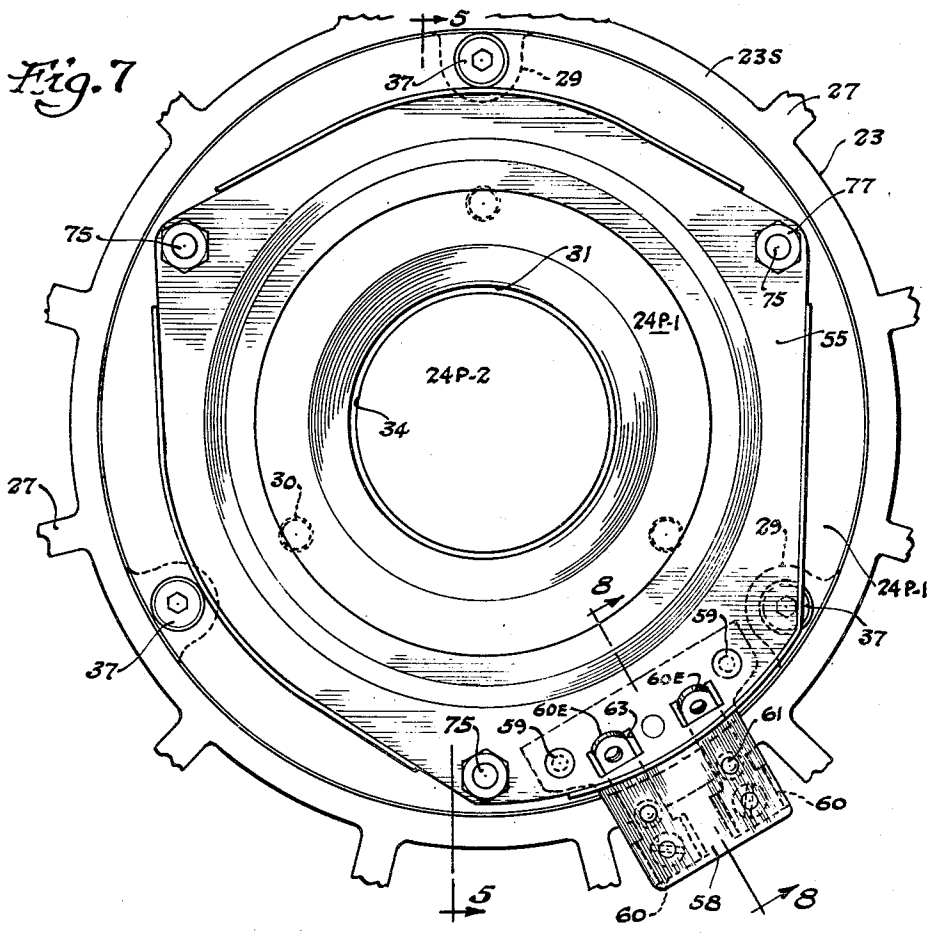


Fig. 8

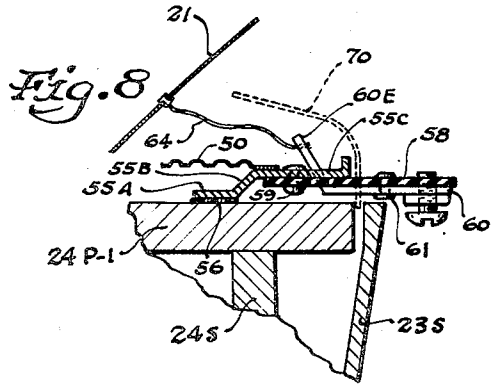
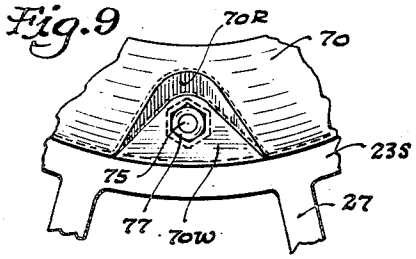


Fig. 9



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UNITED STATES PATENT OFFICE

2,611,830

TRANSDUCER

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Application February 14, 1950, Serial No. 144,179

7 Claims. (Cl. 179—115.5)

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This invention relates to transducers and particularly to loud speakers adapted for use in various kinds of sound reproducing systems.

In loud speakers as heretofore constructed, it has been recognized that fidelity of reproduction was in many instances impaired by excessive back pressure on the rear face of the diaphragm of the loud speaker, and many efforts have been made to reduce this back pressure with a view to obtaining increased fidelity of reproduction. One of the primary factors in the production of objectionable back-pressure on the diaphragms of such prior loud speakers has been the loud speaker frame which has extended from the magnetic yoke of the loud speaker to the outer rim which supports the outermost edge of the diaphragm of the loud speaker, and in most instances this supporting frame has been embodied as a substantially conical sheet metal member that has been perforated in various ways in an endeavor to reduce the objectionable back-pressure. This expedient has, however, been only moderately effective in attaining the desired result, and it is, therefore, an important object of the present invention to obtain a substantial reduction in the back-pressure effective on loud speakers, and to do this by means which afford a rigid and efficient support for the outer rim of the loud speaker diaphragm. More specifically, it is an object of the present invention to eliminate the usual sheet metal supporting frame in loud speakers, and to connect the magnetic yoke supporting means and the outer ring of the loud speaker frame by extremely narrow supporting arms spaced radially from each other and presenting the very minimum of reflective surface directed toward the rear face of the loud speaker diaphragm. A further and related object is to enable the entire supporting frame of a loud speaker to be formed as a casting so that the various supporting surfaces upon which elements of the loud speaker mechanism are to be mounted or supported may be accurately located by processes of machining, thereby to insure greater accuracy in the assembly of the loud speakers as well as to improve the performance of such loud speakers.

Another object of the present invention is to simplify the mounting of the electrical elements and vibrating elements within the frame of the loud speaker, and to enable certain of these elements to be initially put together as sub-assemblies which are thereafter put in place on the loud speaker frame.

Another and related object is to simplify the mounting of the loud speaker suspension in the frame, and to enable this to be done in such a way that a protecting housing may be afforded about the suspension so as to assure long life of such suspension. Another object is to improve

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the fidelity of reproduction in such loud speakers through the provision of a relatively rigid dust cap at the center of the diaphragm and over the end of the voice coil support.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show a preferred embodiment of the present invention and the principles thereof and what I now consider to be the best mode in which I have contemplated applying those principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

Fig. 1 is a perspective view showing the rear side of a loud speaker embodying the features of the invention;

Fig. 2 is a sectional view taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is a front elevational view of the loud speaker at a reduced scale;

Fig. 4 is a side elevational view;

Fig. 5 is a fragmentary vertical sectional view taken through the axis of the speaker, the view being taken substantially along the line 5—5 of Fig. 7;

Fig. 6 is an enlarged sectional view showing details of assembly of the diaphragm and dust cap;

Figure 7 is a fragmentary front elevational view showing the speaker in a partially assembled relation;

Fig. 8 is a fragmentary sectional view taken substantially along the line 8—8 of Fig. 7; and

Fig. 9 is a fragmentary plan view showing a portion of the structure illustrated in Fig. 8.

For purposes of disclosure, the invention is herein illustrated as embodied in a loud speaker 20 wherein a cone-shaped sound producing diaphragm 21 is supported in a rigid frame 22. This rigid frame 22 embodies a housing 23 in which the electrical elements of the speaker, including a magnetic yoke 24, are supported and mounted, as will hereinafter be described. The rigid frame 22 of the speaker embodies a forward annular mounting ring 25 that serves as a support for the outer or larger edge of the sound producing diaphragm 21, and under and in accordance with the present invention, this mounting ring 25 is rigidly related to the housing 23 by integrally formed means that are of such a character that the desired rigidity is afforded while at the same time effecting an extremely great reduction in the back-pressure on the diaphragm 21. Thus, as will be evident in Figs. 1 to 4 and 5,

the housing 23 and the mounting ring 25 are rigidly interconnected by arms 27 that are generally rectangular in cross-sectional form as indicated in Fig. 2, and which are disposed in such a way that a narrow edge of each such arm 27 is disposed so as to face toward the rear surface of the diaphragm 21. As will be evident in Figs. 1 and 7, the arms 27 are equally spaced about the axis of the housing 23, such housing 23 being generally cup-shaped in form to afford a bottom or rear wall 23R and side walls 23S. The bottom wall 23R is, in the present case, arranged so that the outer border portion thereof lies in a common plane, while the central portion thereof is doomed outwardly so that the domed portion and the flat portion meet along an annular line 23L that is indicated in Fig. 5 of the drawings. The side walls 23S of the housing 23 are tapered slightly outwardly, as will be evident in Fig. 5 of the drawings, and along inner surfaces of the side walls, three longitudinally extending mounting ribs 29 are formed which terminate in outer end surfaces or shoulders 29S. The shoulders 29S are spaced inwardly from the outer ends or edges of the side walls 23S, as will be evident in Fig. 5, and the shoulders 29S afford mounting surfaces against which elements of the magnetic yoke 24 may be disposed and secured to thereby accurately locate the magnetic yoke 24 within the housing 23.

The arms 27 are preferably formed, in cross section, so that they have a narrow and flat inner surface 27F, as shown in Fig. 2, and these arms taper to a gradually smaller dimension at the outer edge thereof, as indicated at 27T, the outer edge being rounded as at 27R.

The housing 23, the ring 25 and the arms 27 are, under the present invention, formed by processes of casting from a suitable metal, preferably one of the lighter metals such as aluminum, and the several arms 27 are arranged so as to be connected to the rear face 25R of the ring 25. The arms 27 are so disposed as to lie in planes that pass through the common axis of the housing 23 and the ring 25, and the inner edge surfaces of the arm 27 are formed so that these surfaces meet the inner edge of the side wall 23S, as indicated at 27A in Fig. 5 of the drawings. From this general location, the arms 27 extend along the sides 23S of the housing 23 in the form of radially disposed ribs, and at the rear ends of the side walls 23S, the arms 27 are extended around the housing as at 27R so as to extend along the flat rear surface of the rear wall 23R and substantially to the line 23L that is defined by the juncture of the domed portion and the flat portion of the wall 23R. It will be evident, of course, that through this arrangement of the arms 27, the structure of the housing 23 is reinforced by a larger number of relatively high and narrow ribs that extend along the sides thereof, and these ribs, that are formed as portions of the arms 27, extend as flat portions of such arms so as to be connected with the mounting ring 25. Thus, when the casting has been completed, the ring 25 and the housing 23 are rigidly related one to the other by the arms 27, and the mounting surfaces with which other parts or elements are to be associated may then be machined so as to bear a predetermined or accurate relationship to each other. For example, the shoulders 27 may be turned to the proper relationship, while the frame 22 is mounted in a suitable lathe or the like, while the frame is thus mounted in the machine, the mounting ring 25 may be machined in its outer or forward face to afford a rabbeted mounting groove 25G that is to receive the outer edge of the diaphragm 21, as will hereinafter be described.

The magnetic yoke 24 as herein shown is constructed so as to be particularly adapted for mounting in the housing 23. Thus, as shown in detail in Fig. 5 of the drawings, the magnetic yoke 24 comprises a generally cylindrical but somewhat tapered annular side walls 24S that is made from a magnetic material and which, in the finished speaker, is magnetized so as to constitute a permanent magnet in the magnetic circuit. At the rear end of the side wall 24S, this being the smaller end of the side wall, a back plate or bottom wall 24B is engaged with the rear edge surfaces of the side wall 24S, this back plate 24B being formed from a soft iron material. An outer pole piece or plate 24P–1 is afforded by a relatively flat soft iron plate and is engaged with the forward edge surfaces of the side walls 24S, it being noted that the plate 24P–1 extends outwardly for a substantial distance beyond the side wall 24S so that edge portions of this plate may be engaged with and secured to the shoulders 29S in the mounting operation, as will hereinafter be described. The plates 24B and 24P–1 are held against opposite ends of the side walls 24S by a plurality of tie bolts 30 that are extended at circumferentially spaced points through the back plate 24B and are threaded at their forward ends into the pole plate 24P–1.

The outer pole piece 24P–1 is formed with a circular opening 31, and this opening 31 cooperates with a central pole stem 24P–2 to afford an annular magnetic gap. The central pole piece 24P–2 is generally cylindrical in form and has its rear end abutted against the back plate 24B and is held in this position by a cap screw 32 that extends axially through the back plate 24B and is threaded into the pole piece 24P–2. Near its forward end, the pole piece 24P–2 is reduced at 33, and forwardly of the reduced portion 33, a somewhat enlarged cylindrical portion 34 is afforded that serves as the inner boundary of the magnetic gap. Just rearwardly of the reduced portion 33, a shoulder 35 is afforded that faces forwardly, and a dust guard 36 in the form of a somewhat resilient annular metal member 36 is extended between the shoulder 35 and the rear face of the pole piece 24P–1 to prevent foreign matter that may be present within the side wall 24S from reaching the magnetic gap.

The projecting outer edges of the pole piece 24P–1 are arranged so that they may be abutted against the several mounting shoulders 29S, and cap screws 37 are extended through openings 38 in the pole piece 24P–1, and are threaded into the forward ends of the positioning ribs 29, thus to securely mount the magnetic yoke 24 in the desired relationship within the housing 23.

It will be observed that the diaphragm 21 has an outer mounting portion that is secured as by adhesive to the forwardly facing surface of the mounting groove 25G, and inwardly of this attaching portion, the diaphragm 21 is provided with an annularly corrugated flexing portion 21F. Inwardly of this flexing portion, the diaphragm 21 extends in a gradually reducing and generally conical shape and terminates at its inner or smaller end in a flange 21A, such flange being cylindrical as shown in Fig. 6 of the drawings. This flange 21A is utilized in mounting a cylindrical voice coil support 40, this voice coil support being formed preferably from a molded

paper material and being inserted through the flange 21A so as to project slightly in a forward direction from the flange 21A. Rearwardly of the flange 21A, a voice coil winding 41 is formed on the outer surface of the voice coil support. The forwardly projecting portion of the voice coil support 40 serves as a mounting and centering means for a domed dust cap 42 which has a cylindrical flange 42F thereon extending in a rearward direction about its outer edge. This flange 42F surrounds the projecting portion of the voice coil support 40, and the voice coil support 40 is secured to the flanges 21A and 42F by an adhesive.

The dust cap 42, in accordance with the present invention, is made relatively light in weight, and yet is endowed with unusual rigidity by forming the same from an extremely thin gage aluminum stock and by forming radial ribs 42R therein which extend from the edge of the flange 42F to a central conical projection 42C that is formed in the dust cap 42.

When the diaphragm 21 is mounted in position on the speaker frame, the voice coil is accurately positioned in an axial sense in the magnetic gap by a corrugated voice coil suspension member 50 that is formed from a molded paper stock in accordance with usual practice. At its inner edge this voice coil suspension member 50 has a flange 50F that is cylindrical in form and which surrounds and is adhesively secured to the flange 21A, as shown in detail in Fig. 6 of the drawings. At its outer edge, the suspension member 50 has a flat portion 50A that is adhesively secured to one surface of a mounting ring 55. This mounting ring 55 has an inner flange 55A that has a suitable felt washer 56 secured adhesively thereto on what may be termed the rear surface of such flange. This flange 55A is flat and is adapted to bear through the washer 56 against the outer or forward face of the pole piece 24P–1. Just outwardly of the flange 55A, the mounting member 55 is offset forwardly as at 55B, and this offset portion 55B is connected to an outer flange portion 55C which is parallel to the flange 55A, but which is arranged to be spaced from the forward face of the pole piece 24P–1 when the mounting member is in the position shown in Figs. 5 and 8. The flange 50A of the suspension member 50 is adhesively secured to the flange 55C so that the suspension member 50 extends inwardly to its point of connection with the voice coil in substantially parallel relationship with respect to the pole piece 24P–1. The mounting ring 55 is utilized under the present invention to carry a terminal block 58 which is secured to the lower face of the flange 55C by means of rivets 59, as shown in Figs. 7 and 8. The terminal block 58 is made from an insulating material and extends outwardly for a considerable distance beyond the outer edge of the mounting ring 55, and a pair of metallic terminal strips 60 are secured in spaced relation to each other and to the lower surface of the terminal block 58 by means of rivets 61. At their inner ends, the terminal strips 60 extend through suitable openings in the terminal block 58 and in the mounting ring 55C, as indicated at 63 in Fig. 7 of the drawings, and these extensions 60E may thus be utilized for electrical connection of the leads 64 that extend from the voice coil 41 and along and through the diaphragm 21, as indicated in Fig. 8 of the drawings.

The mounting ring 55 and the suspension 50 are partially enclosed by a metallic protecting

shield 70, as shown in Figs. 5, 7, 8 and 9, this shield 70 having side walls that extend downwardly or rearwardly for a slight distance into the space between the side wall 23S and the outer edge of the pole piece 24P–1. The shield 70 then extends inwardly in a forwardly spaced relationship with respect to the suspension member 50, and the shield terminates in an inner edge 70E that is spaced from the diaphragm 21 in an amount sufficient to allow maximum vibration of the diaphragm in the operation of the speaker.

The present invention provides for securing the mounting member 55 and the shield 70 in place at the same time, and by the same means, this being done after a preliminary or sub-assembly operation in which these elements are operatively associated with the diaphragm 21 and the suspension 50. Thus, the shield 70 is formed with depressed clearance recesses 70R, which afford wall portions 70W that are in a parallel plane and may be engaged with the outer or forward face of the flange 55C. In securing these parts to the magnetic yoke 24, the pole piece 24P–1 has three mounting screws 75 that are extended forwardly through the projecting edge portions of the pole piece 24P–1. At the forward ends of these screws 75, a spacing nut 76 is put in position, and the thickness of these nuts 76 is such that when the mounting ring 55 is in position, the rear face of the flange 55C will bear against the forward faces of the spacing nuts 76. Then, when the sub-assembly that includes the ring 55 and the shield 70 is put in place, the projecting ends of the bolts 75 extend through aligned openings in the flange 55C and the walls 70W. The parts may then be secured together by nuts 77 threaded onto the projecting ends of the poles 75 so as to engage the walls 70W.

In the assembly of the speaker, the assembled magnetic yoke 24S is put in place by means of the cap screws 37, and a sub-assembly is made up which comprises the diaphragm 21, the mounting ring 55 and the suspension member 50, the dust cap 42 at this time being withheld from the sub-assembly so as to facilitate centering of the voice coil in the magnetic gap, as will be later described. In making the sub-assembly, the diaphragm 21 is rested on its large end resting on a work bench, and the shield 70 is placed over the small end of the diaphragm so that the inner edge of the shield rests temporarily on the diaphragm. The ring 55, with the suspension 50 fixed thereto, is then put in place over the shield 70 and the inner flange 50F of the suspension is moved into and then fixed adhesively in position in the relation shown in Fig. 6. The leads 64 are then connected as by soldering to the terminal extensions 60E, thereby completing the sub-assembly. The sub-assembly is then transferred to the position of Fig. 5, and after centering the voice coil in the magnetic gap in the usual manner by means of shims inserted through the then open forward end of the voice coil support 40, the nuts 77 are put in place and tightened. The dust cap 42 is then secured in position by adhesive, and the outer edge of the diaphragm 21 is adhesively secured to the ring 25, a protecting fibre ring 80 preferably being adhesively secured over such edge to prevent damage to the diaphragm when the speaker is mounted in its position of use.

From the foregoing description it will be evident that the present invention enables a substantial reduction to be effected in the back-pressure encountered in loud speakers, and enables this to be accomplished by means which afford a

rigid and efficient support for the outer rim of the loud speaker diaphragm. Moreover, the present invention enables the usual sheet metal supporting frame in loud speakers to be eliminated, and enables the magnetic yoke supporting means and the outer ring of the loud speaker frame to be rigidly connected by extremely narrow supporting arms spaced radially from each other and presenting the very minimum of reflective surface directed toward the rear face of the loud speaker diaphragm.

It will also be apparent that the present invention enables the entire supporting frame of a loud speaker to be formed as a casting so that the various supporting surfaces upon which elements of the loud speaker mechanism are to be mounted or supported may be accurately located by processes of machining, thereby to minimize costs and insure greater accuracy in the assembly of the loud speakers while at the same time improving the performance of such loud speakers.

It will also be evident that the present invention simplifies the mounting of the electrical elements and vibrating elements within the frame of the loud speaker, and enables certain of these elements to be initially put together as sub-assemblies which are thereafter put in place on the loud speaker frame. From the foregoing description it will also be apparent that the present invention simplifies the mounting of the loud speaker suspension in the frame, and enables this to be done in such a way that a protecting housing may be afforded about the suspension so as to assure long life of such suspension. Furthermore, it will be clear that this invention improves the fidelity of reproduction in such loud speakers through the provision of an improved and relatively rigid dust cap at the center of the diaphragm and over the end of the voice coil support.

Thus, while I have illustrated and described the preferred embodiment of my invention, it is to be understood that this is capable of variation and modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. In a loud speaker, a frame comprising a cup-shaped housing having rear and side walls and with said side walls defining an open end, means on the inner surfaces of said side walls defining mounting shoulders spaced from the front edge of said side walls and affording forwardly facing mounting surfaces at circumferentially spaced points about said side walls, a mounting ring of a diameter larger than said housing and disposed forwardly of said open end and coaxially with respect to said housing, a plurality of narrow arms fixed at their opposite ends to said ring and said housing and disposed in equally spaced relation about the axis of said ring and housing, magnetic yoke means disposed within said housing and having elements thereof positioned against and secured to the respective mounting shoulders of said housing to locate and support said yoke within said housing, a diaphragm having an outer edge portion fixed to said ring, and means adjacent the central portion of the diaphragm electrically associating said diaphragm with said magnetic yoke.

2. In a loud speaker, a frame comprising a cup-shaped housing having rear and side walls and with said side walls defining an open forward end, means on the inner surfaces of said side walls defining mounting shoulders spaced from the front edge of said side walls and affording forwardly facing mounting surfaces at circumferentially spaced points about said side walls, a mounting ring of a diameter larger than said housing and disposed forwardly of said open end and coaxially with respect to said housing, a plurality of narrow arms fixed at their opposite ends to said ring and said housing and disposed in equally spaced relation about the axis of said ring and housing, magnetic yoke means disposed within said housing and having elements thereof positioned against and secured to the respective mounting shoulders of said housing to locate and support said yoke within said housing, a diaphragm having an outer edge portion fixed to said ring, means including a voice coil and a voice coil support on and adjacent the central portion of the diaphragm and electrically associating said diaphragm with said magnetic yoke, an annular suspension-mounting ring mounted on the forward side of said yoke means, a terminal block carried on said suspension mounting ring, a voice coil suspension extended between said last mentioned ring and said voice coil support to center the same, an annular shield disposed over a portion of said suspension and engaging outer portions of said suspension mounting ring, and common means securing said last mentioned ring and said shield to said yoke means.

3. In a loud speaker, a frame comprising a cup-shaped housing having rear and side walls and with said side walls defining an open forward end, means on the inner surfaces of said side walls defining mounting shoulders spaced from the front edge of said side walls and affording forwardly facing mounting surfaces at circumferentially spaced points about said side walls, a mounting ring of a diameter larger than said housing and disposed forwardly of said open end and coaxially with respect to said housing, a plurality of narrow arms fixed at their opposite ends to said ring and said housing and disposed in equally spaced relation about the axis of said ring and housing, magnetic yoke means disposed within said housing and having elements thereof positioned against and secured to the respective mounting shoulders of said housing to locate and support said yoke within said housing, a diaphragm having an outer edge portion fixed to said ring, means including a voice coil and a voice coil support on and adjacent the central portion of the diaphragm and electrically associating said diaphragm with said magnetic yoke, an annular suspension-mounting ring mounted on the forward side of said yoke means, a voice coil suspension extended between said last mentioned ring and said voice coil support to center the same, an annular shield disposed over a portion of said suspension and engaging outer portions of said suspension mounting ring, and common means securing said last mentioned ring and said shield to said yoke means.

4. In a loud speaker, a frame comprising a member, means on the mounting member defining mounting shoulders affording forwardly facing mounting surfaces at circumferentially spaced points, a mounting ring disposed forwardly of said mounting member, a plurality of narrow arms fixed at their opposite ends to said ring and said mounting member and disposed in equally spaced relation about the axis

of said ring, magnetic yoke means disposed with elements thereof positioned against and secured to the respective mounting shoulders to locate and support said yoke on said mounting member, a diaphragm having an outer edge portion fixed to said ring, means including a voice coil and a voice coil support on and adjacent the central portion of the diaphragm and electrically associating said diaphragm with said magnetic yoke, an annular suspension-mounting ring mounted on the forward side of said yoke means, a voice coil suspension extended between said last mentioned ring and said voice coil support to center the same, an annular shield disposed over a portion of said suspension and engaging outer portions of said suspension mounting ring, and common means securing said last mentioned ring and said shield to said yoke means.

5. In a loud speaker, a frame comprising a cup-shaped housing having rear and side walls and with said side walls defining an open forward end, means on the inner surfaces of said side walls defining mounting shoulders spaced from the front edge of said side walls and affording forwardly facing mounting surfaces at circumferentially spaced points about said side walls, a mounting ring of a diameter larger than said housing and disposed forwardly of said open end and coaxially with respect to said housing, a plurality of rigid narrow arms rigidly fixed at their opposite ends to said ring and said housing and disposed in equally spaced relation about the axis of said ring and housing, magnetic yoke means disposed within said housing and having elements thereof positioned against and secured to the respective mounting shoulders of said housing to locate and support said yoke within said housing, a diaphragm having an outer edge portion fixed to said ring, means including a voice coil and a voice coil support on and adjacent the central portion of the diaphragm and electrically associating said diaphragm with said magnetic yoke, an annular suspension-mounting ring having an inner annular flange engaged with the forward side of said yoke means and having an outer annular flange spaced from said forward side of said yoke means, a terminal block carried on the rear side of said outer flange of said suspension mounting ring, a voice coil suspension extended between said last mentioned ring and said voice coil support to center the same, an annular shield disposed over a portion of said suspension and engaging outer portions of said suspension mounting ring, and common means securing said last mentioned ring and said shield to said yoke means.

6. In a loud speaker, a frame comprising a mounting member, means on said mounting member defining mounting shoulders and affording forwardly facing mounting surfaces at circumferentially spaced points, a mounting ring disposed forwardly of said mounting shoulders, a plurality of narrow arms fixed at their opposite ends to said mounting member and said ring and disposed in equally spaced relation about the axis of said ring, magnetic yoke means disposed on said mounting member and having elements thereof positioned against and secured to the respective mounting shoulders to locate and support said yoke thereon, a diaphragm having an outer edge portion fixed to said ring, means including a voice coil and a voice coil support on and adjacent the central portion of the diaphragm and electrically associating said diaphragm with said magnetic yoke, an annular suspension-mounting ring having an inner annular flange engaged with the forward side of said yoke means and having an outer annular flange spaced from said forward side of said yoke means, a terminal block carried on the rear side of said outer flange of said suspension mounting ring, a voice coil suspension extended between said last mentioned ring and said voice coil support to center the same, an annular shield disposed over a portion of said suspension and engaging outer portions of said suspension mounting ring, and common means securing said last mentioned ring and said shield to said yoke means.

7. In a loud speaker, a frame comprising a cup-shaped housing having rear and side walls and with said side walls defining an open forward end, means on the inner surfaces of said side walls defining mounting shoulders spaced from the front edge of said side walls and affording forwardly facing mounting surfaces at circumferentially spaced points about said side walls, a mounting ring of a diameter larger than said housing and disposed forwardly of said open end and coaxially with respect to said housing, a plurality of narrow arms fixed at their opposite ends to said ring and said housing and disposed in equally spaced relation about the axis of said ring and housing, magnetic yoke means disposed within said housing and having elements thereof positioned against and secured to the respective mounting shoulders of said housing to locate and support said yoke within said housing, a diaphragm having an outer edge portion fixed to said ring, means including a voice coil and a voice coil support on and adjacent the central portion of the diaphragm and electrically associating said diaphragm with said magnetic yoke, an annular suspension-mounting ring having an inner annular flange engaged with the forward side of said yoke means and having an outer annular flange spaced from said forward side of said yoke means, a terminal block carried on the rear side of said outer flange of said suspension mounting ring, terminals carried on the rear surface of said block and extended in insulated relation through said block and said outer flange, a voice coil suspension extended between said outer flange of said last mentioned ring and said voice coil support to center the voice coil support, an annular shield disposed over a portion of said suspension and engaging outer portions of said suspension mounting ring, and common means securing said last mentioned ring and said shield to said yoke means.

LAWRENCE M. HEINEMAN.

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