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2,566,604

ELECTRODYNAMIC LOUD-SPEAKER ASSEMBLY

Filed March 16, 1948

2 Sheets-Sheet 1

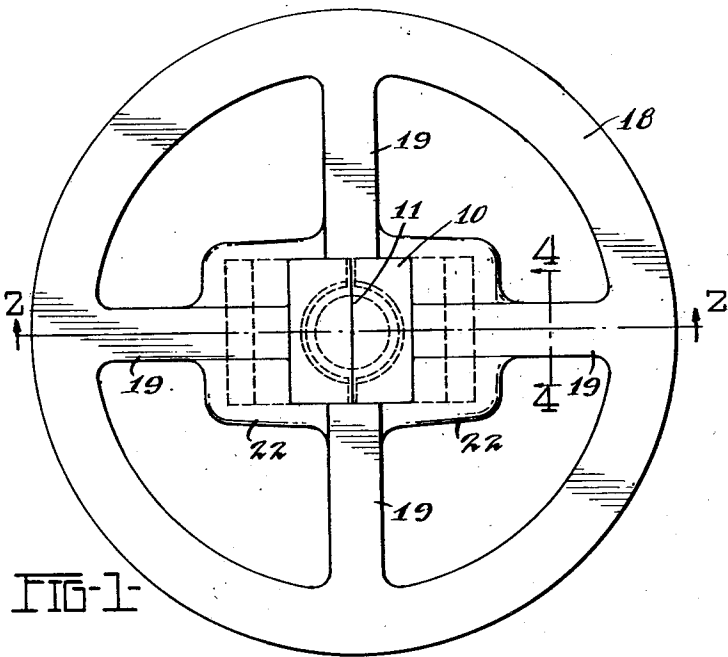


FIG-1-

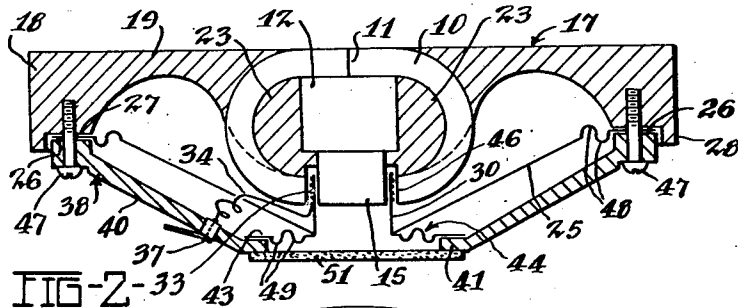


FIG-2-

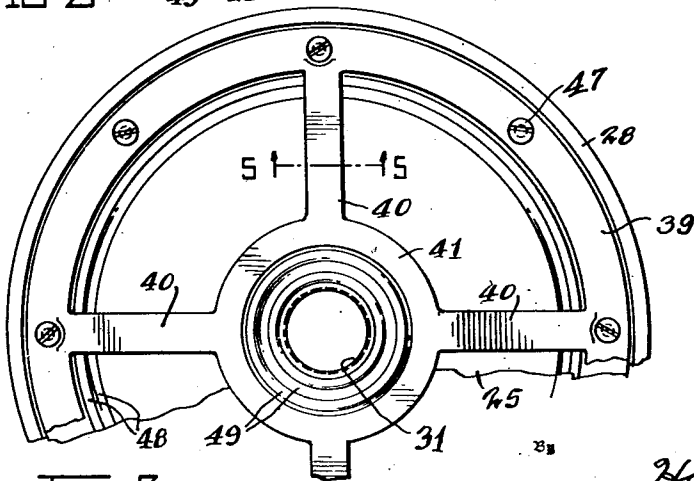


FIG-3-

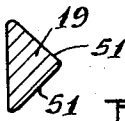


FIG-4-

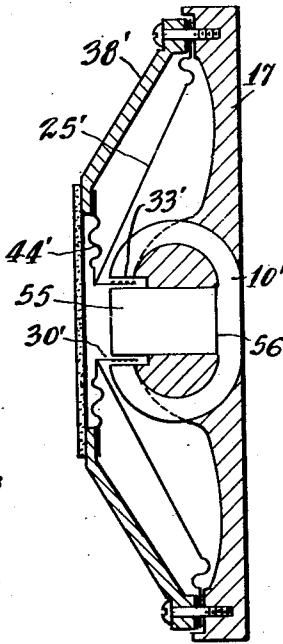


FIG-6-



FIG-5-

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ELECTRODYNAMIC LOUD-SPEAKER ASSEMBLY

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2 Sheets-Sheet 2

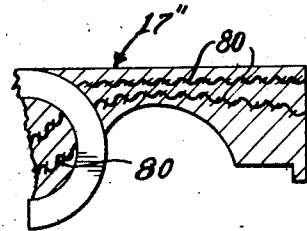
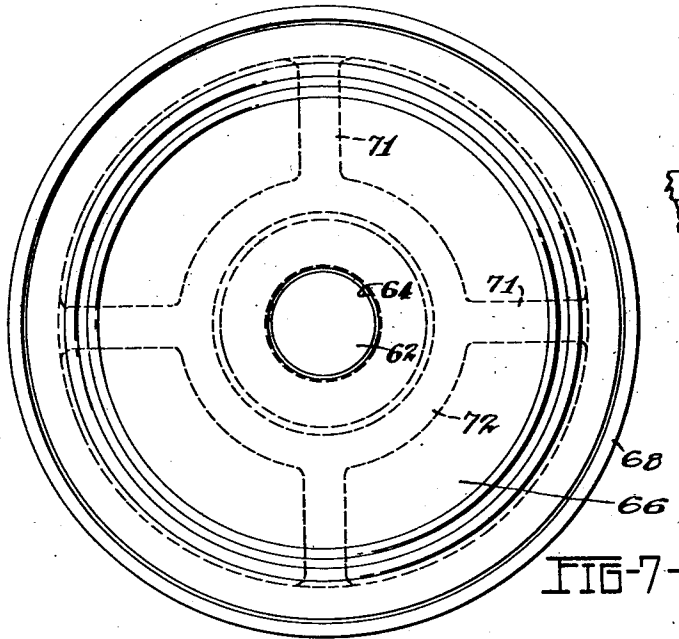


FIG-11-

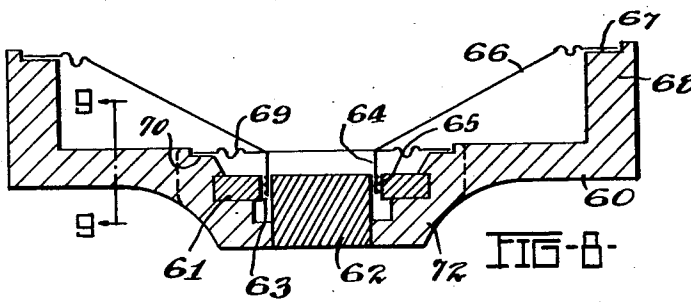


FIG-9-

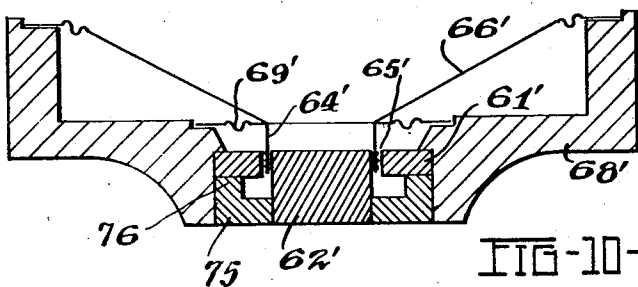


FIG-10-

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ELECTRODYNAMIC LOUD-SPEAKER
ASSEMBLY

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11 Claims. (Cl. 179—115.5)

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This invention relates to means for producing audible sound from electrical impulses and more especially to an electro-dynamic speaker of the moving coil type.

Heretofore loud speakers of the cone-shaped diaphragm type have been supported upon skeleton metal frames with the moving coil and magnet construction arranged rearwardly of the apex of the speaker cone. Prior constructions of this nature are of considerable thickness and the metal frame supporting the cone-shaped diaphragm is subjected to certain resonance that sometimes impairs the quality of speech or tones produced by the diaphragm.

The present invention embraces the provision of a moving coil diaphragm speaker in which the frame construction for mounting the magnet elements and diaphragm is formed or moulded of plastic resin.

Another object of the invention resides in the provision of a sound producing device of the moving coil type wherein the frame construction for supporting the magnet and diaphragm elements is of resinous material and of skeleton formation to minimize interference with the sound waves produced by movement of the diaphragm.

Another object of the invention resides in the provision of a moving coil type diaphragm speaker in which the frame member supporting the magnet and a frame member for mounting the coil centering device are formed of resin or other material having substantially non-magnetic and non-current conducting characteristics.

Another object of the invention resides in the provision of a moving coil diaphragm type speaker in which the frame construction embodies inexpensive and readily available material and in which the assembly of elements is greatly simplified.

Further object of the invention resides in a moving coil diaphragm type speaker of a character permitting the use of conventional types and sizes of magnets, magnet assemblies, voice coils, and centering spider in combination with a moulded frame of resinous material.

Still a further object of the invention is the provision of a sound radiating cone and moving coil construction so arranged with respect to the magnetic unit whereby the thickness of such unit over prior devices is greatly reduced.

Further objects and advantages are within the scope of this invention such as relate to the arrangement, operation and function of the related elements of the structure, to various de-

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tails of construction and to combinations of parts, elements per se, and to economies of manufacture and numerous other features as will be apparent from a consideration of the specification and drawing of a form of the invention, which may be preferred, in which:

Figure 1 is a front elevational view of the sound producing means of my invention;

Figure 2 is a sectional view taken substantially on the line 2—2 of Figure 1;

Figure 3 is a rear elevational view of the speaker construction shown in Figure 1;

Figure 4 is a fragmentary detail sectional view taken substantially on the line 4—4 of Figure 1;

Figure 5 is a fragmentary detail sectional view taken substantially on the line 5—5 of Figure 3;

Figure 6 is a sectional view similar to Figure 2 illustrating a modified form of my invention;

Figure 7 is a plan view of a speaker showing another form of my invention;

Figure 8 is a sectional view through the speaker construction shown in Figure 7;

Figure 9 is a fragmentary detail sectional view taken substantially on the line 9—9 of Figure 8;

Figure 10 is a sectional view similar to Figure 8 illustrating a further form of speaker construction, and

Figure 11 is a sectional view showing a portion of a resinous frame construction embodying a reinforcing means.

Referring to the drawings in detail and particularly to the form of the invention shown in Figures 1 through 5 inclusive, the sound producing means or speaker construction of my invention is provided with a magnet assembly including a bar 10 of soft iron or magnetizable metal which is configured into closed contour shown in Figure 2. The ends of the bar 10 are brought into abutting engagement as indicated at 11. The bar 10 is generally ring shaped and provides a metallic path for the magnetic lines of force. While I have illustrated a magnet of the so-called permanently magnetized type, it is to be understood that an electro-magnet or one that is energized by means of current flow through a coil surrounding a portion of the magnet bar may be utilized without departing from the spirit of the invention. Disposed interiorly of the bar 10 is a magnet member 12 in metallic contact with the bar 10 so as to provide a metallic path for magnetic lines of force. Extending from the magnet 12 is a pole piece or magnet pole 15 which is joined to the magnet 12 in a manner to establish a metallic contact between the magnet 12 and the pole piece 15. The elements of the

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magnet construction are mounted upon a suitable skeleton-like frame member 17 which is formed of moldable material such as resin or others of the so-called plastics. I have found that a polystyrene plastic or a material of the phenol formaldehyde group may be used for the frame construction. The main frame 17 is inclusive of an annular portion 18 formed with inwardly extending radially arranged members 19 which join the annular portion of the central portion 22, the latter being molded about portions of the bar 10, magnet 12 and pole piece 15 whereby these elements are held in central position with respect to the annular portion 18. It should be noted that the portion 22 of the molded frame disposed immediately adjacent and exteriorly of the bar 10 are integrally connected together within the interior of the magnet 10 by portions 23, the latter surrounding the cylindrical magnet 12 and the cylindrical pole piece 15.

The loud speaker of my invention is inclusive of cone-shaped diaphragm 25 which provides the sound radiating element of the construction. The peripheral portion 26 of the cone is adapted to rest upon a ledge 27 formed on the peripheral portion 18 of the frame 17. The ledge 27 is bounded by a flange 28 molded as an integral part of the frame 17. Disposed centrally of the diaphragm 25 is a cylindrical member or form 30 constructed of paper, fiber, or other suitable non-magnetic material which is secured by suitable means such as gluing or sewing to the central portion of the cone or diaphragm as at 31. Mounted or wound upon the form 30 is a comparatively few turns of fine wire forming a coil 33. The leads or connections 34 of the coil pass through small openings in the diaphragm and are connected to suitable terminal posts or connectors 37 mounted upon a supplemental frame portion 38 which is also molded of suitable resin in the same manner as the frame portion 17. The leads 34 are extremely flexible so as to minimize interference with the relative axial movement of the diaphragm 25. The coil leads are arranged to be connected to the output or power valve circuit of an audio frequency amplifier (not shown) in the conventional manner.

As particularly shown in Figures 2 and 3 the frame member 38 has an annular peripheral portion 39 and radially arranged spokes or ribs 40 which integrally join the peripheral portion with a central circular ledge 41. Glued or otherwise secured to the inner side of the ledge 41 is an annular portion 43 of a spider or member 44, the latter serving the purpose of properly centering the moving or voice coil 33 with respect to the pole piece 15. The spider 44 is secured to a peripheral edge of the coil form 30 by gluing the elements together or by other suitable means. The portion of the bar member 10 adjacent the sound radiating cone 25 is provided with a cylindrical opening 45 to receive and accommodate the form 30 and the coil 33. The clearance spaces between the coil and the pole piece 15 and between the coil and the wall of the opening 46 in member 10 are only a few thousandths of an inch. A minimum of clearance is necessary in order to obtain a high efficiency for the loud speaker.

The cone-shaped diaphragm 25 is preferably formed of paper, fiber or other suitable material and is configured with annular convolutions 48 to facilitate axial movement of the body of the diaphragm 25, form 30 and the voice coil 33. The centering spider 44, fabricated of suitable ma-

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terial such as paper, fiber or the like, is also configured with annularly arranged convolutions 49 to facilitate axial movement of the form 30 and coil 33. The spider 44 serves to guide and maintain the form 30 and coil 33 in the annular space between the pole piece 15 and the member 10. The frame portion 38 may be secured to the frame member 17 in any suitable manner as by means of screws 47 threaded into spaced openings provided in the peripheral portion 18 of the frame member 17. A disc 51 of felt or other suitable material is cemented or glued to the exterior portion of ledge 41 on the supplemental frame member 38 to provide a dust excluding means for the interior of the chamber formed by the coil form 30 and the centering spider 44.

While the speaker may be positioned so that the radiation of sound may be emitted from either side of the diaphragm 25, I have found it preferable in use to dispose the speaker with the frame 17 forwardly of the diaphragm. In order that the radial portions or arms 19 and 40 forming integral parts of the frames 17 and 38 respectively have a minimum of effect upon the sound waves, I preferably form these radial arms as shown in Figures 4 and 5. In cross section they are generally triangular in configuration so that the surfaces 51 and 52 facing the diaphragm 25 are angularly arranged or canted so that sound waves engaging the arms are angularly reflected from the canted surfaces, thus presenting a minimum of interference with the passage of sound waves radiated from the diaphragm.

In the construction of speaker hereinbefore described, the moving coil and magnet construction are disposed substantially within the concave or frusto-conical formation of the diaphragm 25 in contradistinction to conventional type speakers wherein the magnet and moving coil are disposed on the opposite side of the diaphragm. Thus by my construction there is produced an extremely compact unit occupying a comparatively small space as this arrangement secures a minimum thickness of speaker assembly. Furthermore the use of a frame construction formed of moldable resinous material which is non-magnetic and when formed as illustrated is substantially non-resonant, there is provided a speaker unit which may be inexpensively manufactured and which functions very efficiently. The elements such as the cone-shaped diaphragm, the coil and its supporting form and magnets are of conventional design and dimension so that the frame structures 17 and 38 may be readily molded or formed to support and secure the several elements in cooperative relationship.

A modified form of the speaker of my invention is illustrated in Figure 6. In this form of the invention the member 10' is provided with a pole stem 55 which is secured to and has metallic contact with the ring-shaped member 10' as at 56. The frame structure 17' and 38' are similar to the frame 17 and 38 hereinbefore described. This type of speaker embodies a cone-shaped diaphragm of sound radiating member 25'. The form 30, voice coil 33', and a centering spider 44' are the same construction as disclosed in the form shown in Figure 2 of the drawings. The speaker of the type shown in Figure 6 may be constructed to provide a comparatively thin unit by reason of the employment of a one-piece pole stem or magnet 55 as this element may be of lesser length than the combined lengths of the cylindrical magnet 12 and the pole piece 15 of the construction shown in Figure 2. I have found that a

speaker of this character functions very efficiently and provides an inexpensive unit where the space factor is of paramount importance.

In Figures 7, 8 and 9 of the drawings there is illustrated a further form of speaker construction of my invention embodying an annular or ring type magnet disposed with its axis coincidental with the axis of the pole piece. In this form, the frame 59 is of molded plastic and embedded in the frame is an annular magnet 61 of the so-called permanent magnetic type. Centrally disposed with respect to the annular magnet 61 is a pole piece or magnet 62 also of the permanent magnetic type. An annular space 63 is provided between the inner wall of the magnet 61 and the exterior cylindrical surface of the pole piece 62 in which space is disposed a coil form 64 supporting convolutions of wire forming a voice coil 65. The coil supporting form 64 is connected to a cone-shaped diaphragm 66 which is secured at its periphery at 67 by means of glue or cement to a peripheral flange 68 formed on the molded frame 60. The coil supporting form 64 is properly positioned by means of a centering spider 69 which is glued or cemented to a ledge 70 molded into the frame 60. In this form of the invention, the diaphragm and coil centering spider are supported upon the frame member 60. In this construction the radial arms 71 which integrally join the peripheral flange 68 of the frame structure to the central annular portion 72 are configured in cross section as shown in Figure 9. Through the use of this particular shape of radial arm, a minimum of interference is provided for the sound waves emanating from the cone-shaped diaphragm 66.

The form of the invention shown in Figure 10 is similar to that shown in Figure 8 wherein the frame 68' supports an annularly-shaped permanent magnet 61' which surrounds a centrally disposed pole piece 62'. This form of the invention is inclusive of a sound radiating cone or diaphragm 66', a coil supporting form 64', a voice coil 65' and coil centering spider 69' of similar construction to that shown in the form of the invention of Figure 8. In the construction shown in Figure 10, there is provided an additional metallic path for the magnetic lines of force or flux, said added metallic path being in the form of a disc 75 of soft iron, the innermost portion of which is in metallic contact with a central pole piece 62'. The disc 75 of soft iron is formed with an axially projecting flange portion 76 which is in metallic contact with the annular permanent magnet 61'. The soft iron disc 75 is molded into the frame 68' so as to be permanently held in contact with the annular magnet 61' and the pole piece 62'. The disc 75 provides a metallic path to facilitate movement of the lines of force through the magnet elements.

There is shown in Figure 11 a fragmentary view of a portion of a molded speaker frame 17' in which a reinforcement is embedded. Thus the plastic frame may incorporate a fabric or fibrous reinforcement 80 to lend strength to the molded frame. The reinforcement may consist of a thin metal member embedded in the molded material to enhance the strength of the frame construction.

From the foregoing description it will be obvious that I have provided an inexpensive construction of loud speaker for radios or electronic devices which occupies a minimum of space and which may be fabricated from magnet coil and diaphragm elements of conventional design.

In producing the speaker constructions of my invention, suitable molding dies or molds (not shown) may be utilized. The magnet elements or assembly may be placed in the molds and the resin, in moldable or plastic condition, may be injected into the dies by conventional methods whereby the frame in finished form has the magnet elements securely and permanently embedded therein.

It is apparent that, within the scope of the invention, modifications and different arrangements may be made other than is herein disclosed, and the present disclosure is illustrative merely, the invention comprehending all variations thereof.

What I claim is:

1. In combination, a speaker including a base frame formed of resinous molded material; a magnet permanently embedded in the molded resinous frame; a cylindrically-shaped pole piece associated with said magnet and forming therein an annular space; a coil disposed in said annular space; a cylindrical sleeve of nonmetallic material supporting said coil; a frusto-conically shaped diaphragm connected to said coil supporting means; the peripheral portion of said diaphragm being secured to the frame, and a centering spider of nonmetallic material connected to said coil supported means and adapted to maintain the coil in said annular space out of engagement with said magnet and pole piece.

2. In combination, a sound radiating means including a frame formed of resinous material; a magnet and pole piece assembly carried by said frame; a coil operatively associated with said pole piece and magnet assembly; a member supporting said coil; a diaphragm connected to said coil supporting member; the peripheral portion of said diaphragm being secured to said frame; and means associated with said diaphragm and carried by said frame for centering said coil supporting member with respect to the pole piece.

3. In combination, a speaker; a base frame formed of resinous material; a magnet embedded in the resinous frame; a pole piece in engagement with said magnet; said magnet having a circular opening formed adjacent said pole piece providing therewith an annular space; a coil disposed in said annular space; means supporting said coil; a diaphragm connected to said coil supporting means, said diaphragm being supported upon said base frame, and a centering spider formed of nonmetallic material connected to said coil supporting means and adapted to maintain the coil in said annular space out of engagement with said magnet and pole piece.

4. In combination, a speaker; a base frame formed of resinous material; a magnet embedded in the resinous frame; a pole piece in engagement with said magnet; said magnet having a circular opening formed adjacent said pole piece providing an annular space; a coil disposed in said annular space; means supporting said coil; a diaphragm connected to said coil supporting means; said diaphragm being supported upon said base frame; a secondary frame formed of resinous material secured to said base frame; and a member secured to said secondary frame and to said coil supporting means for centering the latter about the pole piece.

5. In combination, a sound radiating device including a frame formed of resinous material; a magnet carried by said frame; a pole piece in engagement with said magnet; a coil disposed in cooperative relationship with said pole piece and

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said magnet; a cone-shaped diaphragm having its central portion adapted to support said coil; said frame being formed with a central portion and a peripheral portion; said peripheral portion being integrally joined to a central portion by means of radially arranged arms, said diaphragm being secured to the peripheral portion of said frame; said arms being substantially triangular in cross section for reflecting sound waves emanating from said diaphragm which impinge upon said arms.

6. In combination, a sound radiating device including a frame formed of molded resinous material; a magnet embedded in said molded frame; a cylindrical pole piece in engagement with said magnet; a coil disposed in cooperative relationship with said pole piece and said magnet; a cone-shaped diaphragm having its central portion adapted to support said coil; said frame being formed with a central portion and a peripheral portion; said peripheral portion being integrally joined to a central portion by means of radially arranged arms, the peripheral portion of said diaphragm being secured to the peripheral portion of said frame; said arms being configured for angularly reflecting sound waves impinging thereon.

7. In combination, a sound radiating device including a main frame made of molded non-metallic material; a magnet embedded in said main frame; a pole piece associated with said magnet and supported by said frame; a cylindrical coil form surrounding said pole piece; a coil carried by said form; a cone-shaped diaphragm connected to said coil form for supporting the same, the periphery of said diaphragm being secured to said main frame; a supplemental frame; and a member secured to said supplemental frame and to said coil form for centering the latter about the pole piece.

8. In combination, a sound radiating device including a main frame made of molded resinous material; a magnet embedded in said main frame; a pole piece associated with said magnet and supported by said frame; a cylindrical coil form surrounding said pole piece; a coil carried by said form; a cone-shaped diaphragm connected to said coil form for supporting the same, the periphery of said diaphragm being secured to said main frame; a supplemental frame formed of resinous material; means for securing said supplemental frame to said main frame, and a member secured to said supplemental frame and to said coil form for centering the latter about the pole piece.

9. A speaker including a frame structure; said frame structure having main and supplemental members; means for securing said members together; said frame structure being formed of molded resin; a magnet and pole piece assembly embedded in one of the components of said

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frame; a cone-shaped diaphragm carried by said frame construction; a voice coil unit connected to said diaphragm and disposed in cooperative relationship with said pole piece, and a voice coil centering member secured to the supplemental frame member.

10. A speaker construction including a frame structure; said frame structure having main and supplemental members; means for securing the frame members together; said frame members being formed of molded resin; a magnet and pole piece assembly embedded in one of the components of said frame; a cone-shaped diaphragm carried by said frame construction; a voice coil unit connected to said diaphragm and disposed in cooperative relationship with said pole piece; a voice coil centering member secured to the supplemental components of said frame; said magnet and pole piece assembly being arranged at the concave side of said diaphragm.

11. A speaker including a base frame formed of resinous material; a magnet centrally disposed and embedded in said frame; a pole piece in metallic engagement with said magnet; a cylindrical member of non-magnetic material surrounding said pole piece; a coil mounted upon said cylindrical member movable axially of said pole piece; a cone-shaped diaphragm having its central portion connected to said cylindrical member; the concave configuration of said diaphragm being adjacent said magnet; the periphery of said diaphragm being mounted upon said base frame; a spider connected to said cylindrical member for centering said member and coil adjacent said pole piece; means including a secondary frame secured to said base frame and adapted to support said spider; said base and secondary frames including peripheral portions and radially disposed arms integrally connected with said peripheral portions, the cross sectional configuration of said radial arms being of substantially triangular contour.

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