

Sept. 26, 1939.

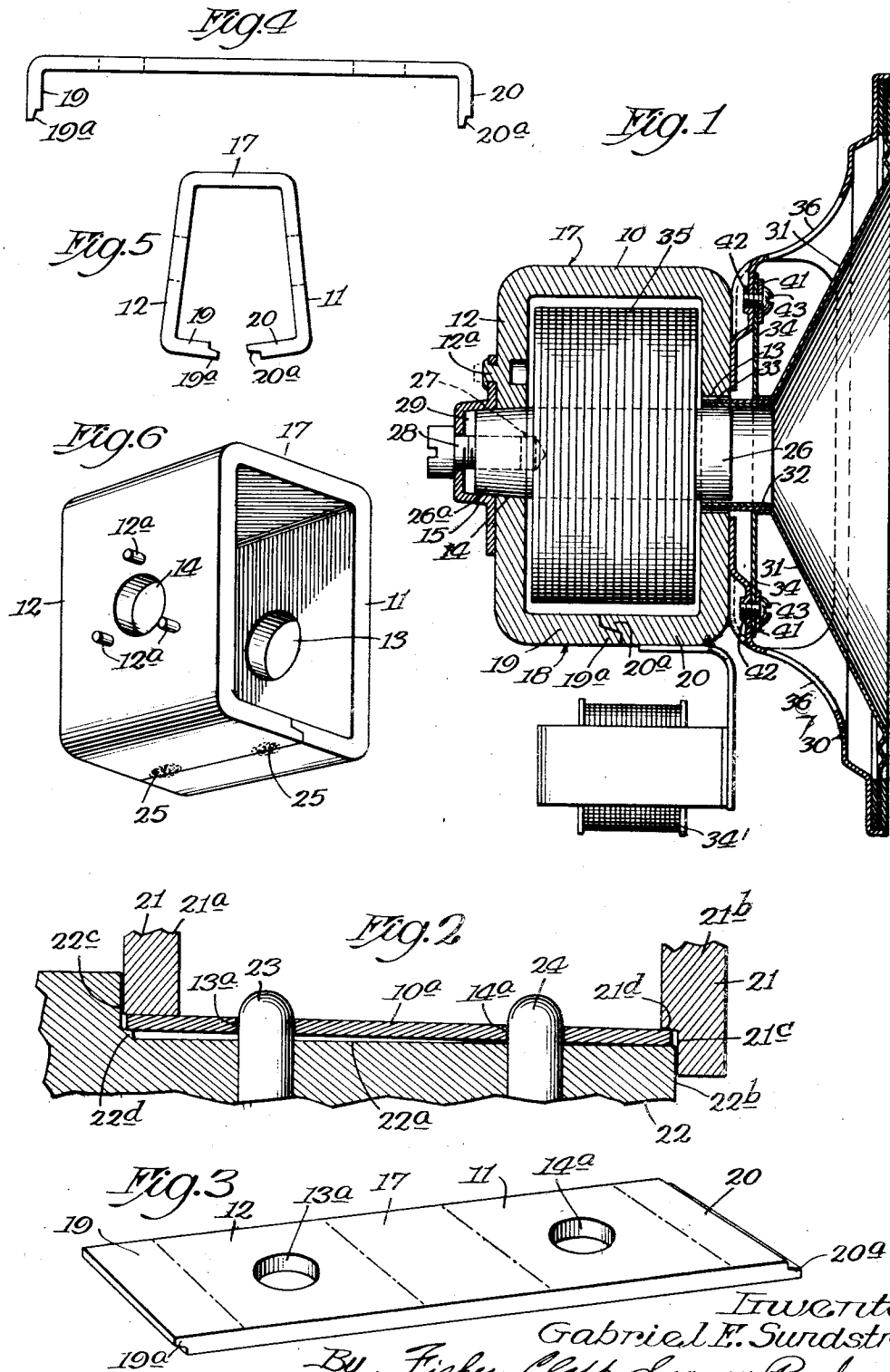
G. E. SUNDSTROM

2,174,355

LOUDSPEAKER AND METHOD OF MAKING SAME

Filed Feb. 1, 1936

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 7

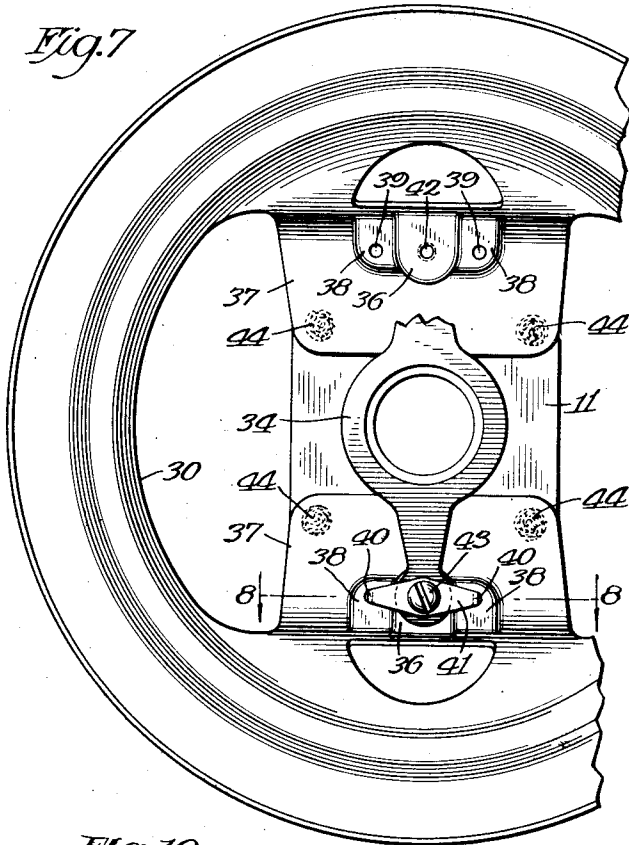


Fig. 8

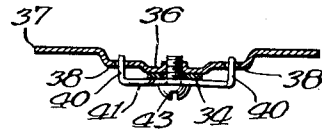


Fig. 9

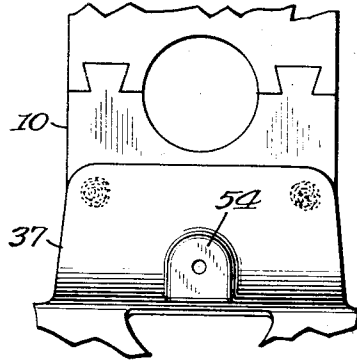


Fig. 10

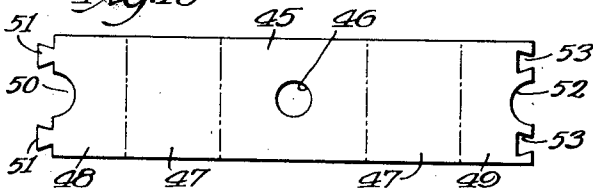


Fig. 13

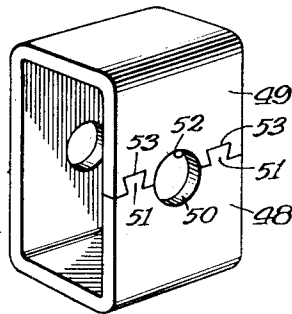


Fig. 11

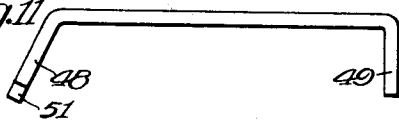
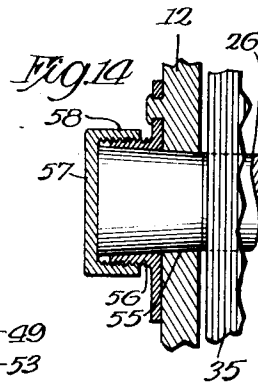
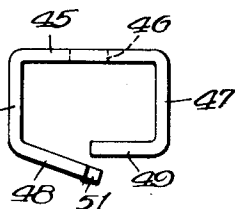


Fig. 12



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UNITED STATES PATENT OFFICE

2,174,355

LOUDSPEAKER AND METHOD OF MAKING SAME

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Application February 1, 1936, Serial No. 61,883

7 Claims. (Cl. 179-115.5)

This invention relates to loud speakers of the general type now more or less commonly used in connection with radio receiving apparatus and for other sound amplification purposes.

5 The main objects of the invention are to provide a loud speaker construction having a greater electrical and magnetic efficiency; to provide a structure of high efficiency but of simplified construction; to provide an improved construction
10 for certain parts of such a loud speaker; to provide a commercially practicable method of constructing said parts whereby the same may be made economically and at low cost; to provide a structure which will facilitate repair or replacement of certain parts of the device; and in general, it is the object of the invention to provide
15 an improved loud speaker construction of the type referred to.

In the drawings:

20 Fig. 1 is a vertical cross section of a loud speaker embodying the present invention;

Fig. 2 is a sectional illustration of a step in the method of manufacturing a part of the improved loud speaker;

25 Fig. 3 is a perspective illustrating a blank formed by the method illustrated in Fig. 2, and employed in producing a part of the improved loud speaker;

30 Figs. 4 and 5 illustrate successive steps in forming the blank shown in Fig. 3 into a closed loop;

Fig. 6 is a perspective illustrating the completed condition of the blank when in its fully closed loop form;

35 Fig. 7 is a front view of certain parts of the loud speaker;

Fig. 8 is a section on the line 8-8 of Fig. 7;

Fig. 9 is a fragmentary front view similar to a portion of Fig. 7, but showing a modified construction;

40 Figs. 10, 11, 12 and 13 illustrate successive steps in the production of a modified form of field member employed in the loud speaker; and

Fig. 14 is a section corresponding to a portion of Fig. 1, but showing a modified construction.

45 Referring now to the drawings, the loud speaker construction illustrated in Fig. 1 embodies a main element or magnetic field member designated 10 which, in this instance, is formed of sheet metal bent to closed loop form as illustrated. The member 10 is illustrated separately in Fig. 6 from which it will be seen that the magnetic field member is formed from an elongated blank or strap of sheet metal bent to the form indicated.

50 Front and back walls 11 and 12, respectively, of the field member 10 are provided with open-

ings 13 and 14, respectively. The rear opening 14 is preferably tapered rearwardly so that it is of smaller diameter on the outside of the field member than on the inside thereof. The taper need not be great. For instance, it may be approximately two degrees, although it may be either more or less as may be desired. To increase the width of the wall forming the tapered opening 14, a collar or flanged cup element 15
5 may be employed. Such element may be secured to the back part 12 of the field member in any suitable manner, for example by press-forming rivets as indicated at 12a integral with the back 12, positioning said rivets in holes in the flange of the member 15 and heading said rivets over the flange as shown. The described rivet fastening may be replaced by welding or spot-welding, if desired. The cupped member 15 may be of fairly light weight, i. e., thin sheet metal substantially
10 as shown.

The top and bottom or opposite end walls 17 and 18 respectively, of the field member, are in this instance illustrated as being somewhat shorter than the front and back walls 11 and 12. The side wall 17 may be of continuous construction and the opposite wall 18 is formed by abutting end portions 19 and 20, respectively, of the blank from which the member 10 is formed.
15

Instead of employing a simple butt joint, I prefer to provide an overlapping arrangement between the adjoining ends. By overlapping portions of the metal, there appears to be an improvement in the magnetic flux circuit of the field piece 10. Also, by providing an overlapped arrangement, it is more convenient and practicable to permanently connect the ends to prevent separation thereof with resultant impairment of the magnetic flux circuit. Also, by preventing spreading of said front and back walls, a predetermined and practically permanent fitted relationship of the pole piece (presently to be described) with the front wall of the field member may easily be attained.
20

The elongated, rectangular sheet metal blank for forming the field member 10 may be very economically produced by punching and swaging operations. The first step would be to cut or punch a rectangular sheet metal blank to the proper size and punch or bore apertures 13a and 14a (Figs. 2 and 3) therein which subsequently will constitute the apertures 13 and 14 already described. The openings 13a and 14a are initially punched slightly smaller than the finished diameter thereof so as to provide for reaming out of said openings to their proper finished sizes.
25

The elongated, rectangular blank with its punched openings 13a and 14a is designated 10a in Fig. 2. The openings 13a and 14a may be utilized for positioning the blank in swaging apparatus comprising upper and lower dies 21 and 22, respectively. The lower die 22 is provided with upstanding pins 23 and 24 adapted to fit the openings 13a and 14a and to thereby position the blank in the swaging apparatus.

The lower die 22 is provided with a main top surface 22a and end surface 22b, an upstanding side wall 22c and a shoulder 22d in the corner between the walls 22a and 22c.

The upper die 21 comprises opposite end members 21a and 21b. The member 21a is of plain configuration, having a flat lower end wall adapted to force the underlying end portion of the blank 10a downwardly to seat on the surface 22a of the lower die. In so doing, the shoulder 22d forces a lower corner portion of the metal in the blank 10a to be displaced outwardly and upwardly so as to form on the blank the lip designated 19a. When the upper die portion 21b descends it similarly displaces an upper corner portion of the metal in the blank 10a downwardly and outwardly to form the lip portion 20a. As indicated in Fig. 2, the length between the side wall 22c of the lower die 22 and the inner wall 21c of the die portion 21b is somewhat greater than the length of the blank 10a so as to provide space between the respective ends of the blank and the said side walls 22c and 21c. Such space receives the metal displaced to form outer end portions of the lips 19a and 20a, and serves to accurately control the length thereof so that when fitted to each other as hereinafter explained, there will be no substantial or seriously objectionable air gap between the meeting ends. The upper die parts may, of course, be formed as parts of a one-piece upper die member and suitable means comprising either a part of the die or an independent element should be provided for holding down the central part of the blank 10a during the swaging operation.

After the blank is provided with end lips as indicated, it is subjected to bending operations, the first of which bends the end portions 19 and 20 of the blank downwardly as indicated in Fig. 4. The end portions 19 and 20 are bent to a position at substantially right angles to the remaining flat body portion of the blank 10a. The next step is to bend the opposite face portions 11 and 12 downwardly at proper points which determine the length of the end wall portion 17 of the field member. Fig. 5 illustrates an intermediate position in the second bending operation. By reference to this figure, it will be noted that when the portions 19 and 20 of the field member approach each other, the adjacent corners of the lips 19a and 20a will clear each other quite freely. This clearance is obtained by making the inner, mutually engaging walls or faces of the lips 19a and 20a slightly inclined to the normal plane of the blank. Such inclination is obtained by forming the upper face of the corner shoulder 22d correspondingly inclined and by making the shoulder 21d of the die member 21b of appropriate inclination. If the inner faces of the lips 19a and 20a were made parallel to the normal plane of the blank 10a, there would be a normal tendency for the adjacent corners of the lips, when approaching each other, to meet and interfere with the completion of the bending operation to close the loop formed

from the blank. By inclining the inner faces of the lips as explained, such difficulty is avoided.

The described interengaging and interfitting arrangement facilitates proper alignment of the portions 19 and 20 of the field member and has the effect of substantially interlocking the parts against displacement. To more securely lock the parts in assembled relation, the lapping lips 19a and 20a may readily be welded or spot-welded together as indicated at 25, 25.

A pole piece 26 of suitable magnetic metal is of generally cylindrical shape, but is provided at its rear end with a tapered portion 26a which is adapted to fit the tapered opening 14 in the rear or back part 12 of the field member. The openings 13 and 14 are preferably simultaneously machined to finished sizes by suitable means such as a reamer which may embody a tapered end portion which will provide the desired taper in the opening 14 and which will ream the opening 13 to predetermined size co-axially aligned with the tapered opening 14. Reamers embodying the necessary two parts for simultaneously reaming the said openings are well known tools and therefore not illustrated.

When the pole piece 26 is inserted, a magnetic coil 35 is also assembled in place. The coil 35 is normally wound on a suitable sleeve element through which the pole piece 26 may be passed. The fit of the pole piece 26 in the sleeve of the coil 35 is preferably a fairly snug but removable fit. The pole piece is inserted, tapered end first, through the voice coil opening 13 until the tapered end seats in the tapered opening 14. When the pole piece is inserted as explained, the tapered rear end of the pole piece fits and is seated in the tapered opening 14 with such accuracy that the front or outer end of the pole piece is incidentally accurately positioned in its predetermined centered relation with the front wall opening 13. The described seating of the pole piece constitutes a self-centering or aligning arrangement for the pole piece which eliminates the otherwise normal requirement that a centering gauge be used on the outer end of the pole piece during its assembly with the field member.

To lock the pole piece in assembled relation with its front end centered as explained, the pole piece is provided at its rear end with a suitably tapped opening 27 adapted to receive a screw 28. The cupped member 15 is of such depth as to provide space 29 into which the rear end of the pole piece may be pulled when the screw 28 is tightened to pull the pole piece tightly to its seat on the tapered wall of the opening 14 and the cupped member 15.

To complete the loud speaker, a suitable more or less cone-shaped, sheet metal frame 30 is spot-welded or otherwise attached to the front wall 11 of the field member and the more or less conventional loud speaker cone or tympanum 31 is suitably secured to the rim of the frame 30. The inner portion or apex of the tympanum 31 is provided with a cylindrical extension 32 which carries the usual so-called voice coil 33. The voice coil 33 is supplied with the varying voice currents through the agency of a transformer 34 which is carried by a suitable bracket also secured to the field member 10 by welding or otherwise.

The inner or apex end of the tympanum 31 is desirably supported by a spider 34. The spider 34 is of generally elongated shape and is mounted at its ends on seats such as indicated at 36, 36, formed in the leg portions 37, 37 of the frame or basket 30. The seats 36, 36 are formed by stamp-

ing portions of the legs 37, 37, forwardly or outwardly as clearly shown in Figs. 7 and 8, and on opposite sides of the seats 36 auxiliary seats or rest portions 38, 38 are provided. The auxiliary portions 38 are provided with openings as indicated at 39 for receiving tapered end portions 40 of spider clamping members 41. The members 41 are also formed of sheet metal and may be very inexpensively punched out and stamped to the illustrated form. The seats 36 are provided with tapped openings 42 for receiving fastening screws 43 which securely clamp the member 41 and underlying end portion of the spider 34 to the respective seats 36. The clamping member 41 being anchored against rotation by the entrance of its end portions in the openings 39 serves to prevent transmission of the rotary movement of the screw to the spider 34. In this manner there is no tendency to strain or distort the spider as an incident to tightening the screw 43. It is preferable that the ends 40 of the clamping member 41 be somewhat tapered across their widths and of such width relative to the openings 39 that the clamping member will be supported at its ends to provide adequate space between the clamping member and the underlying seat 36. When the screw 43 is tightened, the clamping member 41 is adapted to flex sufficiently to permit the same to be tightly clamped against the spider.

The legs 40, 40 of the bridge-like clamping member are, as already indicated, preferably of sufficient length to support the clamping member in such spaced relation to the seat 36 that the underlying spider portion will not be contacted by the clamping member until the flat under side of the clamping screw head is in full flat engagement with the top of the clamping member and has been tightened sufficiently to flex the clamping member to some extent. The clamping member will not normally yield to the pressure of the screw until after the screw has said full contact with the clamping member. In assembling these parts, the clamping member may, in some instances, assume a tilted or angular position in which one of its side edges is nearer the spider than the other. However, the described arrangement insures the straightening up of the clamping member before any portion thereof will engage the spider. Hence, accidental cutting or damaging of the spider by engagement therewith of said clamping member, will not readily occur. If desired, this protective effect may be somewhat amplified by forming in the clamping member, a boss-like seat pressed from the clamping member toward the spider. Such a boss-like seat would also serve to definitely limit the metallic contact area between the clamping member and spider as is effected by the boss-like seat 36 already referred to.

The central portion of the spider 34 embodies an enlarged aperture portion which snugly receives the voice coil portion of the tympanum in the conventional manner.

As indicated at 44 in Fig. 7, the legs 37, 37 of the frame 30 are spot-welded to the front wall 11 of the field member.

In Fig. 9, the field member is shown as of slightly different construction from that above described, as is also the seat for receiving an end of the spider.

In the arrangement shown in Fig. 9, the field member 10 is formed of a sheet metal blank which is initially stamped out in the form illustrated in Fig. 10. As shown in Fig. 10, the blank embodies a back wall portion designated 45, provided with a

punched in opening 46, end walls 47, 47 and end sections 48 and 49 respectively, which together constitute the front wall of the field member. As indicated, the end portion 48 is provided with a semi-circular recess 50 disposed centrally of the end of the blank and a pair of dove-tail shaped tongues 51, 51. The opposite end of the blank is also provided with a semi-circular recess 52 disposed centrally of the width of the blank and a pair of dove-tail shaped recesses 53, 53, respectively, disposed on opposite sides of the recess 52. The recesses 50, and the tongues 51, 51, are respectively complementary to the recesses 52 and 53, 53.

The second step in forming a field member from the blank illustrated in Fig. 10 is to bend down the end portion 49 to substantially right angles to the main body portion of the blank and the end portion 48 to an angle somewhat less than 90 degrees, substantially as illustrated in Fig. 11. A third step is illustrated in Fig. 12, where the end portions 47, 47 are bent to right angular relation to the central portion 45. A final step consists in further bending the end portion 48 of the blank into co-planar relation with the end portion 49, in which position the dovetail shaped tongues 51 will enter and lock with the dovetail shaped recesses 53. The dovetail tongues and slots are made of such relative proportions that when they are interengaged, as shown in Fig. 13, the meeting ends are more or less jammed into one another so that there is tight, intimate engagement between the ends of the walls.

The hole 46 may be employed for guiding purposes as indicated in connection with Fig. 2, during any of the forming operations where such use is feasible, and it will of course be evident that the procedure may be inverted, i. e., the blank ends bent upwardly instead of downwardly, to meet practical considerations in press maintenance and operation.

Suitable punch-press squaring operations may be employed for insuring the desired squareness of the field member when formed either in the manner illustrated in Figs. 2 to 6 inclusive, or Figs. 10 to 13 inclusive.

Because of the increased area of contact between the meeting ends of the blanks, incident to the described end connections, certain desirable electrical effects are obtained. It also will be apparent that by effectively interlocking the meeting ends of the blanks as described, the practicability of forming accurately, co-axially aligned core and voice coil openings in the front and back of the field member is enhanced.

As shown in Fig. 9, a seat 54 is pressed outwardly from the leg 37 of the tympanum supporting frame, the seat in this instance being of substantially the same shape as that illustrated in Fig. 7, but without the auxiliary seats on its opposite sides. This form is all that is required when the spider element 34 is secured in a conventional manner which does not contemplate a non-rotating clamping element such as that above described.

In Fig. 14, a magnetic core 26 is illustrated as being mounted in the back wall 12 of a field member so that the core may be removed rearwardly from the loud speaker, instead of forwardly therefrom as in the arrangement shown in Fig. 1. According to the construction shown in Fig. 14, the rear wall of the field member 12 is provided with a forwardly tapered opening 55, the width of which is extended by means of a flange member 56. Because of the relatively slight taper re-

quired, the member 56 and also the member 15 above described may be made of relatively thin sheet metal without materially impairing the strength of the cylindrical flange portion of the member at its outer end. In the arrangement shown in Fig. 14, the core member 26 has its rear end provided with a forwardly tapered portion which is designed to fit the tapered opening 55 and its extension and to be inserted therein by passing the core element forwardly through the opening 55. A cap 57 provided with an internally screwthreaded flange 58 engages screwthreading provided on the outer surface of the cylindrical flange part of the member 56. By tightening the cap 57 on the member 56, the core element 26 is of course held tightly to its seat. The latter seat is of course formed in coaxial alignment with the voice coil opening in the front wall of the field member so that the rear end seating of the core will serve to maintain the front end in proper coaxial relationship to the voice coil opening.

The described structure is especially advantageous first, in that the manufacturing operations, especially in respect of the production of the field member 10 are very simple and inexpensive to perform, secondly the structure is advantageous in that the field member provides an efficient magnetic flux circuit, thereby adding to the efficiency of the loud speaker. The efficiency of the magnetic flux circuit is due in considerable measure to the adequate connection between the meeting ends of the blank when formed into the closed loop as illustrated. Another advantage of the described structure is that the pole piece 26 may be readily removed by a repair man in the field so as to avoid the usual requirement of taking the loud speaker into a shop or factory for repair or replacement of such a part as the field coil 35. By facilitating the removal of the pole piece in the manner explained, a repair man in the field may very readily replace the coil 35. Other advantages of the described structure will also be apparent to those skilled in the art.

The specific form of the invention illustrated in Figs. 9 to 13 inclusive which employs interlocking dove-tail tongues and recesses on the opposite ends of the field magnet blank is not specifically claimed in this application, but forms the subject matter of a later application filed by me October 17, 1936, Serial No. 106,093, and forming a continuation in part of this application.

Changes in the construction may be made without departing from the spirit of the invention, the scope of which should be determined by reference to the following claims, the same being construed as broadly as possible consistent with the state of the art.

I claim:

1. In a loud speaker, a magnetic field member having spaced front and back parts provided with substantially co-axially aligned apertures one of which is tapered, a pole piece disposed substantially co-axial with said apertures and having one end thereof tapered to fit and seated in said tapered aperture and its other end positioned in the other aperture in spaced relation to the wall of the latter, removable means for forcing the tapered end of said pole piece to a tight fit in said tapered aperture and said tight fit forming the sole support of said pole piece, and a magnet winding removably mounted on said pole piece between said front and back parts, the arrangement being such that when said forcing means is removed the pole piece may be withdrawn

through said other aperture to thereby facilitate removal of said winding.

2. In a loud speaker, a magnetic field member having spaced front and back parts connected at both ends and provided with substantially co-axially aligned apertures, the aperture in said back part being tapered rearwardly, a pole piece disposed substantially co-axial with said apertures and having its rear end tapered rearwardly to fit and seated in said tapered aperture and its front end positioned in the opening of said front part in spaced relation to the wall thereof, removable means for forcing the tapered end of said pole piece to a tight fit in said tapered aperture and said tight fit forming the sole support of said pole piece, and a magnet winding removably mounted on said pole piece between said front and back parts, said aperture in the front part of the field member being of such size that the pole piece may be inserted and withdrawn therethrough to and from its seat in the tapered aperture, whereby removal of said winding from the field member is facilitated.

3. In a loud speaker, a magnetic field member having relatively spaced, integrally connected front and back parts provided with substantially co-axially aligned apertures, the aperture in said back part being tapered rearwardly, a pole piece disposed substantially co-axially with said apertures and having its rear end tapered and seated on the wall of said tapered opening and its front end positioned in the opening of said front part in spaced relation to the wall thereof, a cupped washer overlying the rear end of said pole piece in spaced relation thereto and having a marginal portion bearing on said back part, a screw extending through said washer and threaded into said pole piece for pulling and holding the latter to its seated position in said tapered opening, and a magnet winding removably positioned around said pole piece between said front and back parts of said magnetic field member, the opening in said front part being large enough to permit said pole piece to be withdrawn therethrough so as to facilitate removal of said winding.

4. In a dynamic loud speaker, a field magnet structure comprising a strip bent into the form of a continuous rectangular loop open at each side, said strip having two round openings which are in alignment when the strip is formed into said loop, and a pole mounted in one of said openings in the loop and having a free end within the other opening in the loop to provide space for a voice coil, said bent strip being provided with abutting inter-fitting stepped ends autogenously secured together by spot welds to constitute the loop, the welded joint being located at an intermediate position at one of the sides of the rectangular loop.

5. In a dynamic loud speaker, a field magnet structure comprising a strip bent into the form of a continuous rectangular loop open at each side, said strip having a pair of openings which are in pre-determined alignment when the strip is formed into said loop, and a pole mounted in one of said openings in the loop and having a free end within the other opening in the loop to provide space for a voice coil, said bent strip being provided with abutting, inter-fitting stepped ends autogenously joined to constitute the loop, the joint being located at an intermediate position at one of the sides of the rectangular loop.

6. In a dynamic loud speaker, a field magnet structure comprising a strip bent into the form of

a continuous, rectangular loop open at each side, said strip having a pair of openings which are in pre-determined alignment when the strip is formed into said loop, said bent strip being provided with abutting, inter-fitting stepped ends autogenously joined to constitute the loop, the joint being located at an intermediate position at one of the sides of the rectangular loop.

7. In a loud speaker, a magnetic field member having spaced front and back parts provided with substantially co-axially aligned apertures, one of which is tapered, a pole piece disposed substantially co-axial with said apertures and having

one end thereof tapered to fit, and seated in, said tapered aperture and its other end positioned in the other aperture in spaced relation to the wall of the latter, removable means for forcing the tapered end of said pole piece to a tight fit in said tapered aperture and said tight fit forming the sole support of said pole piece between said front and back parts, the arrangement being such that when said forcing means is removed the pole piece may be withdrawn to thereby facilitate removal of said winding.

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