Nov. 1, 1932. R. H. LANGLEY 1,886,031

MECHANICAL CONSTRUCTION OF LOUD SPEAKERS

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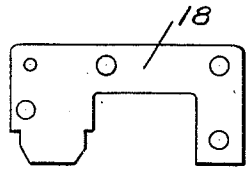


Fig.4.

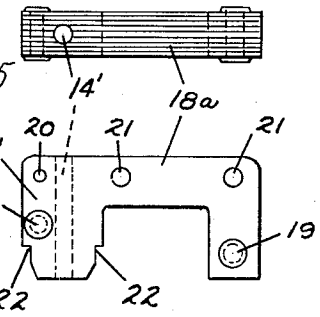


Fig.5.

Fig.6.

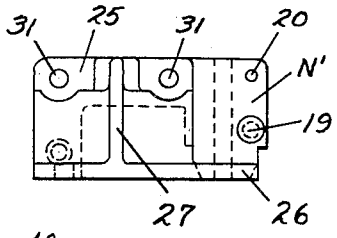


Fig.10.

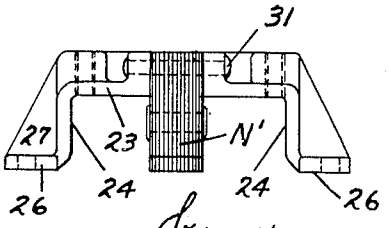


Fig.11.

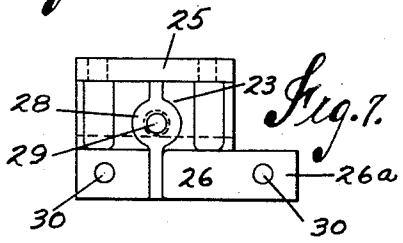


Fig.7.

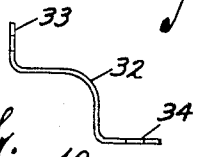


Fig.12.



Fig.13.

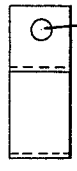


Fig.14.

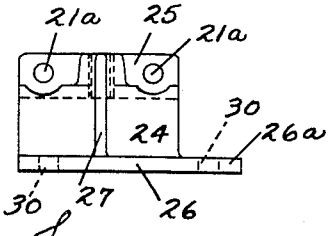


Fig.8.

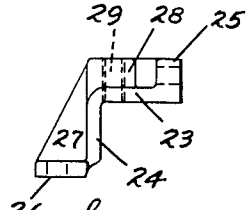


Fig.9.

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MECHANICAL CONSTRUCTION OF LOUD SPEAKERS

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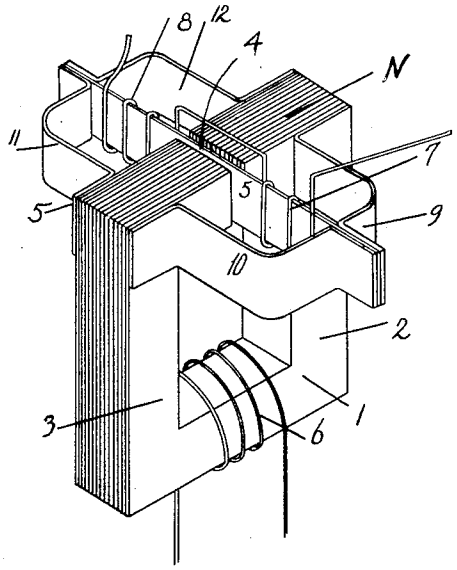


Fig. 1.

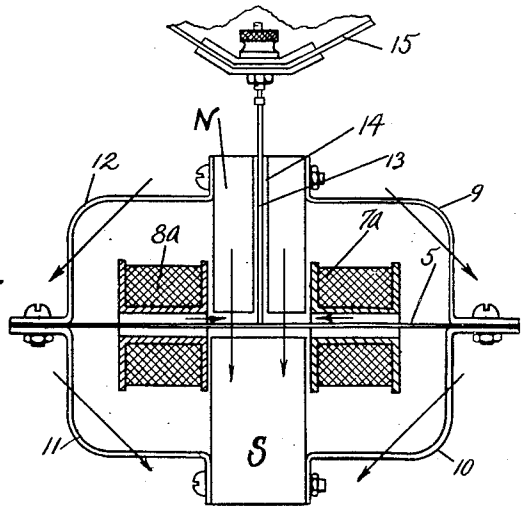


Fig. 2.

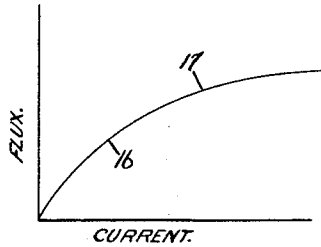


Fig. 3.

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MECHANICAL CONSTRUCTION OF LOUD SPEAKERS

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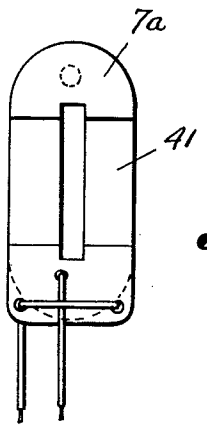


Fig. 15.

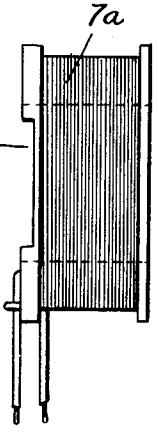


Fig. 16.

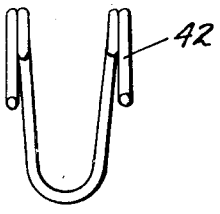


Fig. 17.

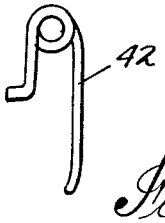


Fig. 18.

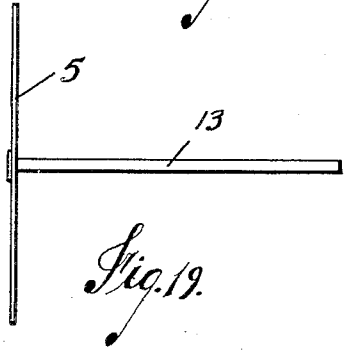


Fig. 19.

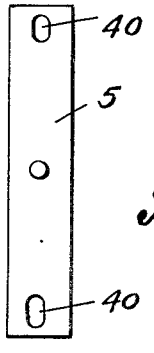


Fig. 20.

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MECHANICAL CONSTRUCTION OF LOUD SPEAKERS

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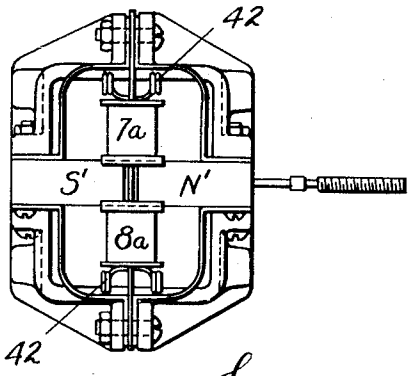


Fig. 21.

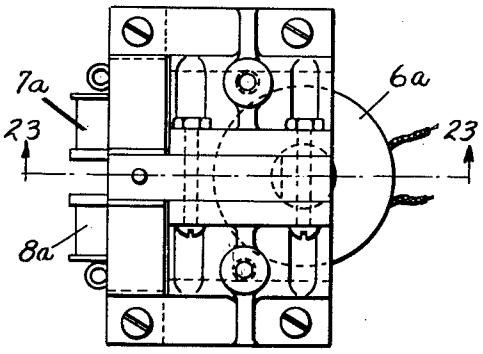


Fig. 22.

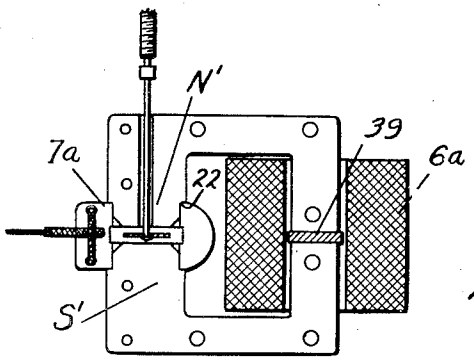


Fig. 23.

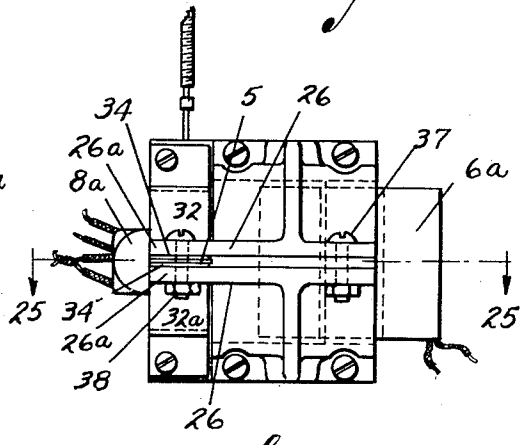


Fig. 24.

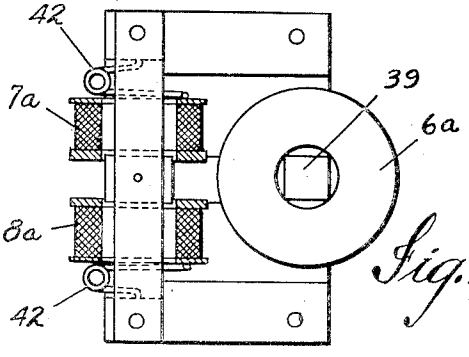


Fig. 25.

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Patented Nov. 1, 1932 1,886,031

UNITED STATES PATENT OFFICE

RALPH H. LANGLEY, OF CINCINNATI, OHIO, ASSIGNOR TO THE CROSLEY RADIO CORPORATION, OF CINCINNATI, OHIO, A CORPORATION OF OHIO

MECHANICAL CONSTRUCTION OF LOUD SPEAKERS

Application filed January 19, 1931. Serial No. 509,555.

My invention relates to improved types of loud speaker motors, and while it is applicable to motors in which the field flux is furnished by a permanent magnet or magnetic system, the specific embodiment which I shall describe in making a disclosure of my invention, will be a type of motor in which the field is electro-magnetic.

The elements of a loud speaker motor embodying the principles which I shall hereinafter set forth comprise the invention of Theodore A. Hunter and Ronald J. Rockwell, and have been set forth and described in a co-pending application in their names, Ser. No. 511,152, filed Jan. 26, 1931, in which application also, in order to make an exemplary showing of a commercial loud speaker embodying their invention, they have described a speaker having the construction of the exemplary speaker which I shall herein describe. My invention has to do with the mechanical construction of this speaker; that is to say, the mechanical embodiment, form, assembly, and construction of the parts, together with a method of fitting and assembling the same, as distinguished from the operative elements of the said speaker which may be embodied in the said construction. As will be pointed out hereinafter, certain phases of my invention will be applicable to other types of motors. The inherent novelty in my invention I have set forth in the appended claims. In making a disclosure of my invention in a specific embodiment I shall describe the construction described by the said Hunter and Rockwell, and in order that the operativeness of my specific embodiment may be more readily understood I have also explained hereinafter the operation of the said specific embodiment.

It has been one of my objects to simplify the construction and decrease the cost of loud speaker motors, and I have succeeded in constructing a motor in accordance with the following disclosure at a commercial cost materially beneath the cost of any other commercial loud speaker of which I am aware.

It is another of the objects of my invention to provide a mechanical construction which greatly simplifies the assembly of the motor, and which is variable to the extent of permitting the motor to be used with various elements and with varying numbers of elements, as will be set forth hereinafter more fully in connection with a description of the operation of the exemplary motor to which my invention has been applied in the ensuing disclosure.

The objects of my invention will be set forth in detail hereinafter, or will be entirely apparent to one skilled in the art upon reading these specifications, and reference is now made to the drawings, in which:—

Figure 1 is a diagrammatic perspective representation of the parts of the speaker embodying my invention.

Figure 2 is also a diagrammatic representation showing the relationship of the armature and the magnetic bridge portions to the poles of my field structure.

Figure 3 is a diagram in which magnetic flux is plotted against current to show the approach to a condition of magnetic saturation.

Figure 4 is a scale drawing showing in plan one of the laminations of a field element.

Figure 5 is an edgewise view of an assembled field element.

Figure 6 is an elevation thereof.

Figure 7 is a plan view of one of my supporting brackets.

Figure 8 is a side elevation thereof.

Figure 9 is an end elevation of the same bracket.

Figure 10 is a side elevation of an assembly of my brackets and the field element of Figs. 5 and 6.

Figure 11 is an end elevation of the same structure.

Figures 12, 13 and 14, are respectively side and end elevations and a top plan view of one of the elements forming the return magnetic path or magnetic bridge circuit of my apparatus.

Figure 15 is an end elevation.

Figure 16 is a side elevation of one of my voice coil structures.

Figure 17 is a side elevation.

Figure 18 is an end elevation of one of

my spring retaining devices for the voice coils.

Figure 19 is an elevation of my armature and the attached driving rod.

Figure 20 is a plan view of my armature.

Figure 21 is an end elevation of a completed motor.

Figure 22 is a top plan view of a completed motor.

Figure 23 is a sectional view of a motor taken along the lines 23, 23 of Fig. 22.

Figure 24 is a side elevation of my completed motor.

Figure 25 is a sectional view of my motor taken along the lines 25, 25 of Fig. 24.

One of the objects of my invention has been to produce in a magnetic armature type speaker, an economical construction in which a return path is provided for the alternating or fluctuating flux in the armature, which path is not co-extensive with the path of the flux in the field structure. Accordingly, I have devised, as will fully be explained, a structure in which the return path for the armature flux is in a structure lying essentially in a plane transverse to the plane of the main field structure. As has been understood by investigators in this field, one of the disadvantages of the magnetic type of loud speaker has been the permeation of the field structure by the alternating flux produced in the armature.

Another well known disadvantage of the magnetic type speaker has been the saturation of the armature with the magnetic flux produced by the field, and it has been another object of my invention to provide an adequate and economical construction in a magnetic type speaker in which the armature is practically free of magnetic saturation due to the field.

Due in part to the foregoing disadvantage, viz., the saturation of the armature by the field flux, but also affected by other factors, the armature of magnetic type speakers has been less readily able to give satisfactory reproduction of impressed signals because it is in a state of relative unbalance upon movement; that is to say, the closer the armature approaches either pole of the field, the more strongly it is attracted to the said pole and so great is the increase in this attraction upon movement that the motion-response to the variations in the armature actuation current is no longer true. The response of such a motor is essentially non-rectilinear; and it is an object of my invention to produce, and I have succeeded in producing a motor the response of which is much more nearly rectilinear.

The essential features of the exemplary motor to which my invention is applied are set forth diagrammatically in Figure 1, wherein I have shown a field structure comprising a core of essentially C shape, and having a back portion 1, side portions or legs 2 and 3, and opposite portions on the opposite ends of these legs which are essentially pole pieces, and may conveniently be called N and S since they will be referred to in this way in Figure 2 in connection with an explanation of the operation of this motor. The pole pieces N and S are separated by a space 4, which is an air-gap in which an armature 5 of strip form may move. It will be understood that this armature is mounted in suitable supports at its ends and is free to vibrate in its central portion, which is the portion located between the pole pieces N and S. A field coil 6 has been indicated diagrammatically as situated upon the back portion of the field core structure. When this coil is energized by direct current, the field core structure will be magnetized and permeated by a constant flux. It may be so magnetized that the pole pieces marked N and S will be respectively the north and south poles of the magnetic structure, the flux across the air-gap 4 passing through the central portion of the armature 5. I have indicated diagrammatically voice coils 7 and 8 upon the portions of my armature 5 which extend beyond the air-gap. These coils are connected in series, but are wound in the opposite direction so as to have an opposite magnetic effect upon the central portion of the armature. These coils are intended, of course, to be energized by a voice current of fluctuating or alternating character. The passage of this current in one direction will tend to magnetize the armature with a north pole at its center, while the passage of the current in the opposite direction will tend to magnetize the armature with a south pole at its center. A loud speaker motor constructed merely as just described would be operative, but its efficiency would be relatively low because there would not be any closed magnetic circuit for the alternating flux set up in the armature. A feature of the construction is the provision of means for completing the magnetic circuit for the armature flux, and in the preferred embodiment illustrated in Figure 1, I have shown magnetic bridge arms or by-pass path constructions 9, 10, 11 and 12. These arms connect the pole pieces N and S with the outer ends respectively, of the armature. Their function will now be explained more in detail.

I have shown in Figure 2 the pole pieces N and S with the armature 5 lying in the air-gap 4 between them. The armature is connected by a suitable drive rod 13, passing through a perforation 14 in the pole piece N and connecting the armature either directly or through a suitable motion transmitting or converting mechanism to a vibratile device, such as a cone 15. The magnetic arms 9 to 12 inclusive, are shown in eleva-

tion, and the voice coils have been indicated at 7*a* and 8*a*. When the field structure is actuated by a suitable direct current, there will be a flux in the pole pieces N and S and across the air-gap 4 in the direction of the arrows in Figure 2. The arms 9 to 12 are magnetic arms, and as respects the field flux, the arms 9 and 10 upon the one side and the arms 12 and 11 upon the other act as magnetic by-pass paths for the field flux, and they will be saturated with a magnetic flux in the direction of the arrows. It is desirable to have them saturated as aforesaid, and for this reason they are made of relatively light magnetic material. They may be made of thick material, but the operation of my speaker will not be entirely the same as that which I shall presently describe; and although good speakers may be made this way, the relationship of parts is very much more exact and hard to obtain than if the paths are made relatively light and are kept substantially saturated. In Figure 3 I have, by way of example, plotted flux against current to produce a curve 16, showing the degree of magnetic saturation in one of the arms. It has been found preferable so to proportion the size of the arms with relation to the size of the field structure and the flux therein, that the arms will be operated at some point high up on the saturation curve, such as the point 17.

In considering the operation of this speaker, the arms 10 and 11 may be first considered. If the coils 7*a* and 8*a* are magnetized by a current which tends to produce a north pole at the center of the armature, the direction of the flux in the armature will be that of the small arrows within the ends thereof. A flux flowing inwardly in the left hand end of the armature must take as its return path, the pole piece S and the arm 11. The arm 11 is saturated in the direction of the arrow, and therefore is a very low reluctance path. Flux flowing inwardly in the right hand end of the armature must take a path embracing the arm 10 and the pole piece S. The arm 10 is saturated in the direction of the arrow; but the direction of the flux in the armature is opposite to this and therefore can flow in the arm 10 over a relatively low reluctance path opposite in direction to the direction of saturation therein. Thus a magnetic circuit for the armature flux is presented by the right hand end of the armature, the pole piece S and the arm 10. The central portion of the armature is more strongly magnetized as a north pole, and is repelled from the pole piece N and attracted to the pole piece S.

If there were in Figure 2 no arms 10 and 12, it is clear that the armature would be permeated and perhaps saturated by the field flux, since there would be a magnetic circuit between the pole pieces N and S comprising in sequence, the arm 9, the armature, and the arm 11. A magnetic speaker of some efficiency can be made in this way, and its operation is vastly improved over that which results when no return paths are provided for the armature flux. The situation which has been described for one direction of the alternating voice coil current will, of course, be reversed for the other alternation; and if the direction of the current in the voice coils 7*a* and 8*a* tends to magnetize the armature with a south pole at its center, there will be presented to the armature flux a high reluctance path comprising the arm 11, and a high reluctance path comprising the arm 10.

Now, when there is added to this system the arms 10 and 12 several results are accomplished. Since the arms 9 and 10 on the one side and the arms 12 and 11 on the other form magnetic by-pass paths for that portion of the field flux which they can carry up to their point of saturation, and since the armature is connected between these by-pass paths, there is produced a balanced magnetic bridge circuit, in which the armature is substantially unsaturated by the field flux, in which the production of an alternating flux in the armature is not modified by any substantially resident magnetic permeation in the armature, and at which magnetic circuit return paths for the alternating flux in both ends of the armature are provided. It will be noted also, that the magnetic circuit or circuits for carrying the alternating flux of the armature are in a plane different from the plane of the field core, and that there is substantially no tendency for the field core to carry the alternating flux produced in the armature.

Let it be supposed that the action of the coils 7*a* and 8*a* is to produce a north pole at the center of the armature 5 in Figure 2. In accordance with the foregoing explanation, it will be clear that there will be presented to this flux relatively high reluctance return paths comprising arms 9 and 12, and relatively low reluctance return paths comprising arms 10 and 11. Upon the passage of the current in the opposite direction, i. e. so as to magnetize the armature with a south pole at its center, the paths embracing the arms 9 and 12 will be low reluctance paths, and the paths embracing the arms 10 and 11 will be high reluctance paths. Since the flux flows in the low reluctance paths essentially by bucking a saturation flux therein, it will be clear that this construction provides shifting balance points for the armature, lying out upon the several arms. The function of the return paths in strengthening the armature flux will be apparent, and the repulsive and attractive forces acting upon the armature at its central portion will, of course, produce in it the vibrations which are transmitted by the drive rod 13 to the vibratile device 15 in

reproducing sound. The armature is substantially not permeated by the field flux, and its response to fluctuations of the armature current is not only true, but powerful. Hereinabove I have described a motor of the Hunter and Rockwell type as operating with what I have termed a strip form armature, with either a pair of magnetic arms connecting the ends of the armature respectively with the pole pieces N and S, or with a plurality of magnetic arms completing the magnetic circuits, as shown in Figure 2. There is another modification which has been found to give excellent results, and which has an economical advantage. In this modification instead of employing a strip form armature, there is employed what may be called a reed form armature, i. e. an armature which is mounted at one end only, the other end being free to vibrate. Such a construction may be understood from Fig. 2 if, for example, the magnetic arms 9 and 10 are eliminated, the voice coil 7*a* taken away, and the armature 4 cut off, say, close to the right end edges of the pole pieces N and S. The armature will then be in the form of a reed mounted at its left-hand end between the magnetic arms 11 and 12. It will be magnetized by the voice coil 8, as has been described, and the operation of this modification will be essentially the same as that which has been described for other modifications. A return path for each of the magnetic paths produced by the fluctuations of the alternating current will comprise respectively the armature, the magnetic arm 12, and the pole piece N for one path, and the armature, the magnetic arm 11, and the pole piece S for the other path. There is greater necessity in this modification for careful proportioning of the armature, and it will be advisable to provide an armature, where possible, the natural period of which it outside the audible range. In speakers of the reed type constructed in this way, I have secured very excellent results and very true reproduction.

I will proceed now to the construction of the exemplary commercial speaker embodying my invention in its several parts. I have shown in Figure 4 a stamping forming a lamination of my core. For convenience in assembling my motor, as hereinafter to be described, I make my core in two pieces, which are afterward put together to form my completed core. The laminations 18 of Figure 4 are provided with suitable holes and are put together to form the core members 18*a* of Figures 5 and 6. The laminations may be assembled by means of rivets 19. The front portion N′ of my core members 18*a* may conveniently be made a little wider than the rear portion, as shown, and the perforation 14′ may be made therein for the passage of the drive rod. The core member may also be provided with perforations 20 and 21 for purposes presently to be described. For each motor I make up two of these core pieces, only one of which, however, need have the perforation 14′. I also provide in the portion marked N′, shoulders 22 to hold the voice coils.

As shown in Figures 7, 8, and 9, I provide bracket members of non-magnetic material adapted to be attached respectively to my core pieces 18*a*, and to each other. These brackets I have been making of cast aluminum, but other non-magnetic materials will serve. They comprise a body portion having parts 23 and 24 extending at right angles. The part 23 has a flange portion 25, and the part 24 has another flange portion 26. The flange portion 25 may be provided with perforations 21*a*, whereby it may be fastened to one of my core members. A reinforcing rib structure 27 may join the flanges 25 and 26 across the body of my bracket, and this rib structure may be provided with a boss 28 perforated and threaded as at 29 for the reception of a screw in holding my motor to a suitable support. The flange member 26 has a projection 26*a* upon one end to hold the armature in the magnetic arms. The flange may have perforations 30 for the reception of bolts in assembling my motor. A pair of these brackets is assembled with a core member 18*a* in such a way that the flange 25 is attached by means of rivets 31, passing through the perforations 21*a* in the flange and 21 in the core member, the portion N′ extending beyond the bracket, as shown in Figure 10, and the flange portions 26*a* extending out opposite the portion N′ and lying in a plane at right angles to the plane of my core piece. I can take the assembly shown in elevation in Figure 11 and grind it, or otherwise dress it, until the faces of the flanges 26 and the ends of my core piece lie in the same plane. In building up my motor, I take two of the assemblies shown in Figure 11 and fasten them together, with the respective flanges 26 contiguous and parallel, and it will be clear that by introducing spacers between the flanges 26, I can space my core members to the extent of producing an air-gap of the desired width.

I have shown in Figures 12, 13 and 14, one of the magnetic arm members, it has a body portion 32, and flange portions 33 and 34, one of which is provided with notches 35, and the other with an attachment perforation 36.

In assembling my motor, I position two of the assemblies of Figure 11 in opposite relationship, as aforesaid. This is illustrated in the side elevation of Figure 24 where the opposed flanges 26 are shown attached together, as by bolts 37 and 38. The extensions 26*a* are shown in opposed relationship, and between them is the armature 5, and the flanges 34 of arms corresponding to the arms 9 and

10 of Figure 2 and indicated by their body portions 32 and 32*a*. Where fastened by the bolt 38, the flange portions 26*a* are placed apart by three thicknesses of metal, namely the thickness of the armature and the thickness of the flanges 34 of my magnetic arms lying on either side of the armature. Where the armature passes between the pole pieces N′ and S′ of my core structure, there will be a space on either side of the armature, determined by the thickness of the flanges 34 between the flanges 26*a* of my brackets. Thus by grinding true the faces of the assemblies shown in Figure 11, I secure my pole spacing with a great degree of accuracy by the simple method just described; and I secure a similar space at the rear end of my core structure by inserting between the two parts, the blocks 39 shown in Figures 23 and 25. It is thought that the general assembly of my motor will be clear from a consideration of the several figures.

I have shown in Figures 19 and 20 an assembly of my armature 5 and the drive rod 13. My armature has perforations 40 at its ends for the passage of the bolts 38. A field coil structure 6*a* is shown in the several figures positioned on the rear portion of my core structure. The voice coils are indicated at 7*a* and 8*a*, and are illustrated on an enlarged scale in Figures 15 and 16, where it will be seen that in the end flange I produce a groove 41. In my construction, the voice coils are held spaced apart by the pole pieces N′ and S′ in a horizontal direction, and in order that they may not shift in my construction, there is an engagement of the ends of the pole pieces in the notches 41, and the shoulders 22 of my pole pieces engage the flanges of my coils so as to hold them rigidly against motion. This will be clear from a consideration of Figure 23.

Referring again to Figure 2, I have shown my voice coils 7*a* and 8*a* positioned very close to the pole pieces N and S, and separated some distance from the point of attachment of the arms 9 to 12 to the ends of my armature. This construction not only facilitates the rigid holding of my voice coils as just described, but it is also advisable from an operating standpoint to prevent the return of flux through the air-gap between the coils and the adjacent arms, whereby the efficiency of my motor might be cut down. To hold my coils against my pole pieces for this reason, and secure the positive engagement aforesaid, I have provided the spring members 42 shown in Figures 17 and 18, which do not need special description. Their use is illustrated clearly in Figures 21 and 25.

I have thus described in connection with a motor of the Hunter and Rockwell type my novel mechanical construction. It will be clear that this construction may be employed to produce operative motors in accordance with any of the several modifications of the Hunter and Rockwell device. For example, one or more of the magnetic arms may be eliminated, while the armature mounting remains the same, and for spacing a smaller piece of metal may be placed against the armature at the point where it is clamped between brackets 26*a* in place of the end of the magnetic arm. For the reed type of motor, two of the magnetic arms, both being upon the same side of the pole pieces, may be eliminated, a reed type of armature employed, and spacing secured by a block of metal between the clamping portions 26*a* of the brackets on the opposite side of the motor from the side at which the reed armature is mounted. In this type of motor however, it is convenient and less expensive to eliminate entirely the bracket members upon the one side of the field structure. The construction of my bracket members and their rigidity is such that two of the brackets is sufficient to give a satisfactorily rigid and operative structure. My construction may be employed in cases where there are no magnetic arms providing return paths for the alternating current flux in the armature. It will be clear also that modifications in my invention may be made to adapt it to different types of motors than the one which has been employed herein as an exemplary embodiment of my invention.

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

1. In a loud speaker motor, a field core structure comprising interspaced pole pieces, a pair of brackets attached at interspaced points to said field core structure, said brackets having clamping members arranged to engage and hold an armature in a plane such that it will extend between the said pole pieces.

2. In a loud speaker motor, a field core structure in two parts, and bracket members attached to each of said parts, said bracket members having clamping faces extending at an angle to the plane of said field core structure and adapted to engage an armature and hold a portion of said armature between interspaced portions of said field core structure. said faces adapted to be interspaced by said armature, and additional thicknesses of material therebetween so as to interspace said parts of said field core structure.

3. In a loud speaker motor, a field core structure in two parts, a pair of angle brackets attached in opposed position to each of said parts, said angle brackets having faces substantially coplanar with faces of said field core portions, whereby said field core portions and the attached brackets may be individually worked to make said faces and portions exactly coplanar, said faces adapted to

receive in clamping engagement an interposed armature, and said faces adapted to be interspaced to control the clearance of said armature between parts of said field core portions forming interspaced pole pieces.

4. In a loud speaker motor, a field core structure in two parts adapted to be placed in opposed relationship, bracket members attached to said parts to hold said parts in opposed relationship, said brackets arranged to be attached together, faces on said brackets adapted to clamp an armature between parts of said opposed field core structures, additional material between said clamping faces to give clearance to said armature between said parts, and means comprising a spacing member between other opposed parts of said field core structure to produce a corresponding interspacing therebetween.

5. In a loud speaker motor, a pair of brackets having faces in planes substantially at right angles to each other, a pair of field structures adapted to be attached to one face of each of said brackets, and an armature structure adapted to be clamped between the other two faces of said brackets, said last mentioned faces being coplanar with faces of said field structure parts.

6. In a loud speaker motor, a pair of U-shaped field core structures adapted to be placed in opposed relationship to form a substantially C-shaped core with interspaced pole piece portions, a bracket attached to each of said U-shaped sections, and having a face substantially in the plane of said U, and a face at substantially right angles thereto, said face being coplanar with the upper ends of the legs of the U-shaped section to which it is attached, portions of said faces adapted to receive and clamp an armature, and additional thicknesses of metal therebetween to space said pole pieces on either side of said armature, and said armature therebetween, and a spacing block between the opposed portions of said field structure remote from said pole pieces.

7. In a loud speaker motor, a pair of U-shaped core sections, brackets on either side of said core sections, said brackets having faces substantially coplanar with the ends of said core sections and at right angles to the general plane of said sections, an armature extending between opposed legs and between opposed faces of said clamps, magnetic arms one end of which lies between said faces on either side of said armature, the other end of which is attached respectively to a leg of said U-shaped section, and means for fastening said faces together.

8. In a loud speaker motor, a pair of U-shaped core sections, brackets on either side of said core sections, said brackets having faces substantially coplanar with the ends of said core sections and at right angles to the general plane of said sections, an armature extending between opposed legs and between opposed faces of said clamps, magnetic arms one end of which lies between said faces on either side of said armature, the other end of which is attached respectively to a leg of said U-shaped section, and means for fastening said faces together, said brackets having mounting means for said motor.

9. In a loud speaker motor, a pair of U-shaped core sections, and an angular bracket attached on either side of said core sections and having a face substantially perpendicular thereto and coplanar with the ends of said sections, said brackets having their angular portions interspaced from the legs of said U-shaped sections, said faces adapted to be clamped together to assemble said core sections, an armature adapted to be clamped between said faces, magnetic arms adapted to be clamped between a face and said armature on one end, and attached to one of said legs on the other, a field coil surrounding an opposed pair of said legs, a spacer block between said legs, and voice coils on said armature between said legs forming pole pieces and said clamping faces.

10. In a loud speaker motor, a pair of U-shaped core sections, and an angular bracket attached on either side of said core sections and having a face substantially perpendicular thereto and coplanar with the ends of said sections, said brackets having their angular portions interspaced from the legs of said U-shaped sections, said faces adapted to be clamped together to assemble said core sections, an armature adapted to be clamped between said faces, magnetic arms adapted to be clamped between a face and said armature on one end, and attached to one of said legs on the other, a field coil surrounding an opposed pair of said legs, a spacer block between said legs, and voice coils on said armature between said legs forming pole pieces and said clamping faces, a pair of said brackets having means for mounting said motor on a support.

11. In a loud speaker motor, a pair of U-shaped core sections, and an angular bracket attached on either side of said core sections and having a face substantially perpendicular thereto and coplanar with the ends of said sections, said brackets having their angular portions interspaced from the legs of said U-shaped sections, said faces adapted to be clamped together to assemble said core sections, an armature adapted to be clamped between said faces, magnetic arms adapted to be clamped between a face and said armature on one end, and attached to one of said legs on the other, a field coil surrounding an opposed pair of said legs, a spacer block between said legs, and voice coils on said armature between said legs forming pole pieces and said clamping faces, a pair of said brackets having means for mounting said motor on a support, and spring means for holding said voice coils adjacent said legs.

12. In a loud speaker motor, a pair of U-shaped core sections, and an angular bracket attached on either side of said core sections and having a face substantially perpendicular thereto and coplanar with the end of said sections, said brackets having their angular portions interspaced from the legs of said U-shaped sections, said faces adapted to be clamped together to assemble said core sections, an armature adapted to be clamped between said faces, magnetic arms adapted to be clamped between a face and said armature on one end, and attached to one of said legs on the other, a field coil surrounding an opposed pair of said legs, a spacer block between said legs, and voice coils on said armature between said legs forming pole pieces and said clamping faces, said voice coils having shoulders defining a channel to receive end portions of said legs for spacing in one direction, said legs having shoulders for spacing said coils in another direction, and resilient means for holding said coils against said legs.

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