June 25, 1940. H. C. PYE 2,205,669

SOUND TRANSLATING DEVICE AND METHOD OF MAKING THE SAME

Filed July 22, 1938

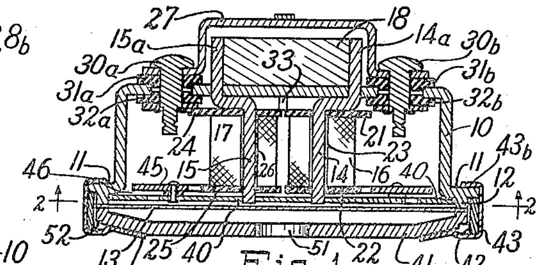

Fig. 1

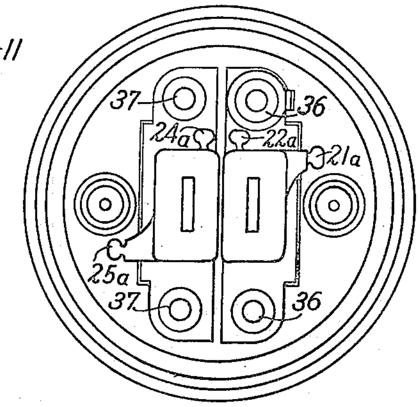

Fig. 2

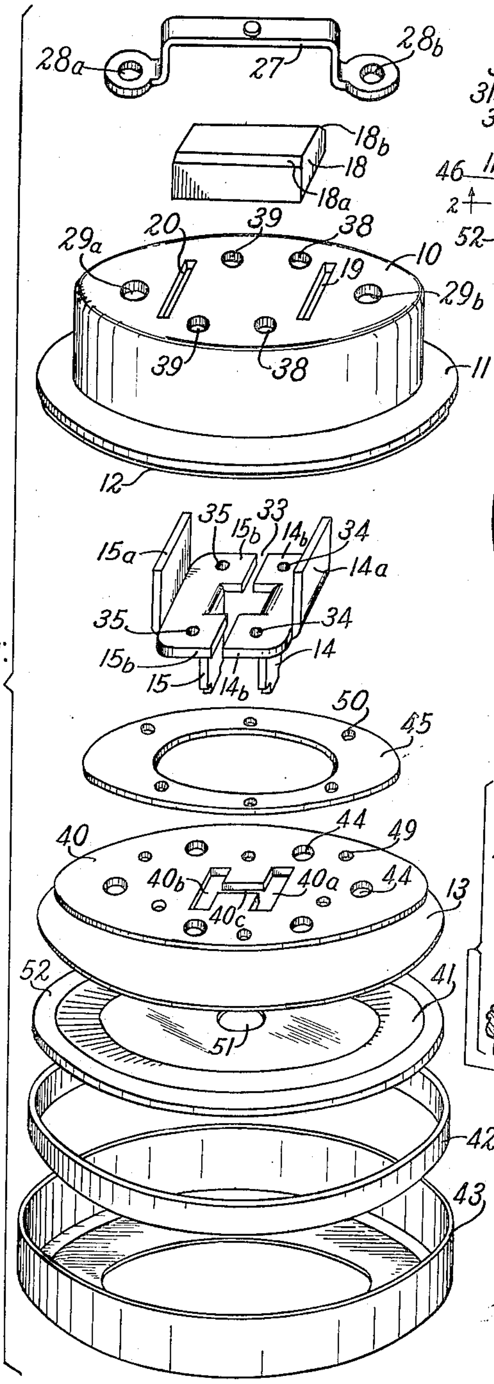

Fig. 3

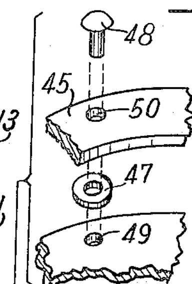

Fig. 4

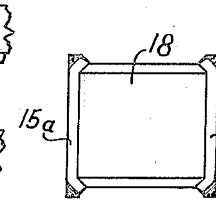

Fig. 5

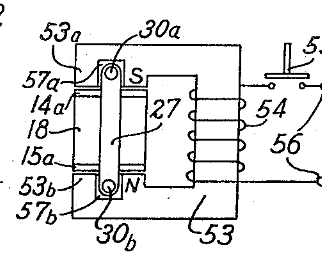

Fig. 6

INVENTOR.
Harold C. Pye
BY Davis, Lindsey, Smith & Shonts
ATTORNEYS.

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SOUND TRANSLATING DEVICE AND METHOD OF MAKING THE SAME

Harold C. Pye, Oak Park, Ill., assignor to Associated Electric Laboratories, Inc., Chicago, Ill., a corporation of Delaware

Application July 22, 1938, Serial No. 220,758

15 Claims. (Cl. 179—114)

The present invention relates to sound translating devices and methods of making the same and more particularly to improvements in telephone receivers of the permanent magnet type and methods of making the same.

In a sound translating device of the type mentioned, a magnetic field structure is provided which conventionally comprises a pair of pole pieces upon which the voice coils are wound and having pole faces disposed adjacent the diaphragm of the device. The magnetic field structure also includes a permanent magnet, usually of the bar type, arranged between the pole pieces to produce a steady magnetic field which links the diaphragm. In the past, it has been the practice to magnetize the bar magnet before it is assembled in the sound translating device and to enclose the magnetic field structure assembly in a housing. The prior method of magnetizing the magnet bar before assembly is open to the criticism that iron or steel filings or other minute magnetic particles may be picked up by the field structure during the assembly operations unless great care is exercised. Such magnetic particles may become embedded in the turns of the voice coils ultimately to cause short circuits or may become lodged between the pole faces and the diaphragm to interfere with the proper response of the diaphragm to signal currents traversing the voice coils. Moreover, when the entire field structure is enclosed within a housing, the only practical method of constructing the device is to magnetize the magnet bar before the assembly operations are started.

It is an object of the present invention to provide an improved sound translating device of the character described which is of extremely simple, economical and rugged construction, is compact in arrangement, and is efficient in operation.

It is another object of the invention to provide a sound translating device of the character described which includes a housing for the windings and diaphragm and wherein the parts of the magnetic field structure are so arranged that the magnet bar may readily be magnetized after the device is fully assembled.

It is a further object of the invention to provide, in a sound translating device which includes a non-magnetic conductive housing electrically coupled with the magnetic circuit of the field structure, an improved field structure which is so arranged that alternating signal currents traversing the field windings are not substantially dissipated as hysteresis and eddy current losses in the housing.

It is a still further object of the invention to provide an improved method of making a sound translating device of the character described, the steps of which are so arranged that the accumulation of foreign magnetic particles upon the field structure is substantially prevented.

In general, the objects as set forth above are in part attained in accordance with the present invention by providing a sound translating device which comprises a substantially non-magnetic conductive frame or housing and a magnetic field structure mounted on the housing so that the magnetic circuit of the structure is coupled to the housing, together with means comprising an auxiliary flux path extending between the pole pieces of the field structure for preventing at least a portion of the alternating component of flux which is developed during operation of the device from linking with the frame or housing. In the arrangement illustrated, the auxiliary flux path comprises projections extending from the pole pieces toward each other and separated by an air gap. More particularly, the housing or frame is provided with a pair of openings extending therethrough and the pole pieces are provided with extensions projecting through the openings to have the permanent magnet of the field structure secured therebetween on the outside of the housing.

In accordance with a further feature of the invention, the device is constructed in accordance with an improved method which comprises the steps of fully assembling the parts of the device before the magnet bar is magnetized and thereafter magnetizing the bar. More particularly, the method of making the device comprises the steps of inserting the pole piece extensions, mentioned above, through the openings provided in the housing so that they project outside the housing; positioning the magnet member between the projected portions of the pole piece extensions; securing the magnet member between the pole piece extensions and the pole pieces to the housing; mounting the diaphragm structure on the housing to provide an enclosed chamber within which the pole pieces and the windings of the field structure are positioned; and thereafter magnetizing the magnet member.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention, both as to its organization and the method of making the same, together with further objects and advantages thereof, will best be understood by reference to the specification taken in connection with the accompanying drawing in which Figure 1 is a side sectional view illustrating a sound translating device having incorporated therein the features of the invention as outlined above, Fig. 2 is an elevational view of the device shown in Fig. 1 with the diaphragm assembly removed therefrom, Fig. 3 is an exploded view illustrating the method of assembling the device shown in Fig. 1, Figs. 4 and 5 are detail views of certain of the elements shown in Figs. 1 and 3, and Fig. 6 diagrammatically illustrates the method of magnetizing the permanent magnet member embodied in the field structure of the device shown in Fig. 1.

Referring now more particularly to Figs. 1, 2 and 3 of the drawing, there is illustrated a sound translating device in the form of a telephone receiver which comprises a cup-shaped housing 10 constructed of non-magnetic conductive material, such, for example, as aluminum, and having mounted thereon the magnetic field structure of the device. The rim of the housing 10 is provided with a bent-over flanged portion 11 having formed integrally therewith an annular ring 12, the outer surface of which is ground smooth to form a bearing surface for a receiver diaphragm 13. Preferably the diaphragm 13 has a thickness of approximately .008 inch and is constructed of magnetic material, such, for example, as silicon steel, having a high A. C. permeability. The magnetic field structure of the device comprises a pair of pole pieces 14 and 15, upon which the voice coils 16 and 17 of the receiver are wound, and a permanent magnet 18 of the bar type which, in conjunction with the diaphragm 13 and the pole pieces 14 and 15, forms a substantially closed magnetic circuit interrupted only by the narrow air gaps extending between the pole faces of the pieces 14 and 15 and the diaphragm 13. More particularly, the pole pieces 14 and 15 are respectively provided with offset extensions 14_a and 15_a which extend through snugly engaging spaced apart openings 19 and 20 cut in the bottom of the cup-shaped housing 10, and are arranged to receive the magnet member 18 therebetween. For the purpose of retaining the magnet bar 18 within the pole piece extensions 14_a and 15_a, the upper corners, and more particularly the edges, of the magnet 18 are beveled as indicated at 18_a and 18_b, and the upstanding corner portions of the pole piece extensions 14_a and 15_a are bent over to engage the beveled edges of the magnet bar in the manner best illustrated in Fig. 5. Preferably, the length of the bar is just slightly greater than the spacing between the pole piece extensions 14_a and 15_a so that the oppositely disposed faces of the pole piece extensions 14_a and 15_a firmly engage the adjacent faces of the magnet bar to provide a low reluctance connection between the pole pieces and the magnet bar. It will be noted that the mounting arrangement just described serves to restrain the magnet bar 18 against movement in any direction and, thus, this bar is rigidly held in place when the assembly of the device is completed.

The magnet bar 18 is preferably formed of an alloy consisting of twenty-four to twenty-six per cent nickel, eleven to thirteen per cent aluminum and sixty-one to sixty-five per cent iron, such for example as the alloy known as Alnic; while the pole pieces 14 and 15 are formed of an alloy comprising approximately 45 per cent nickel and 55 per cent iron, such, for example, as the alloy known as "Allegheny electric metal." When constructed of the alloy "Alnic" the bar magnet 18, when magnetized, has a coercive force greater than 400 Oersteds and an energy product greater than 1×10^6 ergs per c. c., where the energy product is the maximum product of the remanence measured in Gausses and the coercive force measured in Oersteds.

The magnet winding 16 is wound upon the pole piece 14 between winding heads 21 and 22 constructed of insulating material and is insulated from the pole piece 14 by a layer of insulating material 23 which may, for example, comprise varnish cambric or Empire cloth. The ends of the windings 16 are brought out through slots provided in the inner side walls of the winding heads 21 and 22 to anchoring studs 21_a and 22_a formed integrally with the winding heads 21 and 22, respectively, and projecting therefrom. In a similar manner, the winding 17 is wound upon the pole piece 15 between winding heads 24 and 25 and is insulated from the pole piece 15 by a layer of insulating material 26. The ends of the last-mentioned winding are brought out through slots provided in the inner side walls of the winding heads 24 and 25 to anchor studs 24_a and 25_a formed integrally with and projecting from the winding heads 24 and 25, respectively. In accordance with conventional practice, the two windings 16 and 17 are connected in series by soldering together the ends of the windings terminating at the anchor studs 22_a and 24_a. The remaining two winding terminals are brought out and connected to the connecting terminals of the device which, in the arrangement illustrated, comprises the conductive housing 10 and a U-shaped contact member 27 having its legs straddling the magnet member 18 and secured to the housing 10. More specifically, the ends of the legs of the contact member 27 are bent over and provided with holes 28_a and 28_b therein which register with holes 29_a and 29_b formed in the housing 10. The contact member 27 is mounted upon the housing 10 by rivets 30_a and 30_b extending through the openings 28_a, 29_a and 28_b, 29_b, respectively, and is insulated from the housing 10 by insulating washers 31_a, 31_b, 32_a and 32_b, in the manner illustrated.

As indicated above, the housing 10 through which the pole piece extensions 14_a and 15_a extend is closely coupled with the magnetic circuit of the field structure and effectively constitutes a short-circuited conductor encircling each of the two pole pieces 14 and 15. The close inductive couplings between the housing and the magnetic circuit of the field structure results from the fact that the side walls of the openings 19 and 20 closely embrace the pole piece extensions 14_a and 15_a to provide support for the field structure and to prevent the entrance of dirt and moisture within the housing 10. With this arrangement, alternating or undulating flux traversing the pole pieces 14 and 15 and the magnet bar 18 necessarily caused induced voltages to be set up in the conductive housing 10 so that a portion of the alternating current energy producing the alternating flux is necessarily dissipated as hysteresis and eddy current losses in the housing. In order to prevent alternating flux developed during operation of the device from linking with the housing 10, there is provided within the housing an auxiliary flux path extending between the two pole pieces. This auxiliary flux path comprises projections 14_b and 15_b formed integrally with the pole pieces 14 and 15, respectively, and extending toward each other. The adjacent ends of the projections 14_b and 15_b are separated by an air gap 33 which is so proportioned that the magnet bar 18 is not effectively short-circuited and a substantial amount of the steady state flux produced by the magnet 18 is caused to traverse the diaphragm 13. Preferably, this air gap is of the order of .0625 inch. The pole pieces 14 and 15 are preferably stamped from flat stock and during the stamping operation there are cut in the projecting portions 14_b and 15_b thereof a plurality of openings 34 and 35, which are utilized in securing the pole pieces to the housing 10. More particularly, the pole pieces 14 and 15 are mounted upon the housing 10 by means of rivets or bolts 36 and 37 extending through the openings 34 and 35, respectively, and through openings 38 and 39 formed in the bottom portion of the housing 10 and spaced to register with the openings 34 and 35.

The diaphragm assembly comprises, in addition to the diaphragm 13, an inner plate 40, an ear piece 41, an annular supporting ring 42, and an assembly ring 43. As disclosed and claimed in co-pending application Serial No. 220,759, filed July 22, 1938, Harold C. Pye, the inner plate 40, in conjunction with the diaphragm 13 and the annular ring 12, defines a damping chamber adjacent the inner surface of the diaphragm 13, while the ear piece 41, in conjunction with the diaphragm 13, defines a resonating chamber adjacent the outer surface of the diaphragm. The dimensions of the damping chamber and of the restricted passages communicating therewith are so proportioned that the peak in the response characteristic of the device caused by the natural period of vibration of the diaphragm 13 is substantially reduced to flatten the over-all frequency-response characteristic of the device. More particularly, the inner plate 40 which is constructed of non-magnetic material, such, for example, as aluminum, is provided with six openings 44 and has mounted thereon in spaced apart relation a flat annular ring 45 which defines a relatively long, narrow, restricted and annular passage 46 communicating between the interior of the housing 10 and the chamber formed between the plate 40 and the diaphragm 13. By suitably proportioning the size of the holes 44, and the length and width of the restricted passage 46, the acoustical impedance of the chamber adjacent the inner surface of the diaphragm 13 may be properly proportioned to achieve the desired maximum damping effect over the band of frequencies within which the natural period of vibration of the diaphragm 13 is most effective to cause distortion of the over-all response characteristic. Also the layer of air in this chamber serves artificially to enhance the stiffness of the diaphragm 13, thereby to improve the fidelity of reproduction of the device. Although given by way of example only, the following specifications for the parts defining the dimensions of the damping chamber and the passages communicating therewith have been found to be highly satisfactory in practice:

	Inches
Diameter of chamber	1.683
Depth of chamber	0.030
Diameter of holes 44	0.076
Depth of passage 46	0.0030–0.0040
Width of ring 45	.319
Outer diameter of ring 44	1.444

As best shown in Fig. 4, the annular ring 45 is separated from the inner plate 40 by means of thin washers 47 and is mounted upon the plate 40 by means of rivets 48 extending through the washers and registering openings 49 and 50 respectively provided in the plate 40 and the ring 45. As best shown in Fig. 3, the openings 49 and 50, through which the mounting rivets 48 extend, are staggered so that the assembly comprising the plate 40 and the ring 45 is prevented from buckling. The plate 40 has formed therein a pair of slots 40_a and 40_b through which the pole face ends of the pole pieces 14 and 15 extend. A cross slot 40_c connecting the two slots 40_a and 40_b is also provided for preventing the circulation of eddy currents in the plate 40. The dimensions of the slots 40_a and 40_b are substantially greater than the cross-sectional dimensions of the pole face ends of the pole pieces 14 and 15 so that relatively large air gaps are provided between the adjacent surfaces of the pole pieces and the plate 40. By virtue of this arrangement, the coupling between the magnetic circuit of the magnetic field structure and the plate 40 is extremely loose and the production of eddy currents in the plate is substantially prevented.

The ear piece 41, which, in conjunction with the diaphragm 13, defines a resonating chamber adjacent the outer surface of the diaphragm, is provided with a centrally disposed opening 51 through which sound waves are transmitted from the resonating chamber to the exterior of the device. The ear piece 41 is also provided with a projecting annular portion 52 having a smooth upper surface which is adapted to cooperate with the oppositely disposed lower surface of the annular ring portion 12 of the housing 10 to clamp the peripheral edge of the diaphragm 13 therebetween. The clamping surfaces of the two annular portions 12 and 52 are so formed that the peripheral edge of the diaphragm 13 is clamped therebetween with uniform pressure at all points around the outer circumference of the diaphragm. Preferably, the dimensions of the outer resonating chamber and of the passage 51 are so proportioned that the natural period of vibration of the chamber occurs at approximately 2,700 cycles per second, whereby the response of the moving system is materially enhanced at frequencies lying within the band extending from 2,400 to 2,800 cycles per second. To achieve this greater response in the frequency band indicated, it has been found that the following dimensions for the resonating chamber and the passage 51 are satisfactory:

	Inches
Outer diameter of chamber adjacent diaphragm	1.688
Maximum depth of chamber	0.033
Diameter of passage 51	0.250
Depth of passage 51	0.051

In constructing the device described above, the terminal member 27 is first mounted upon the housing 10 in the manner explained previously, and the extensions 14_a and 15_a of the pole pieces 14 and 15 are inserted through the openings 19 and 20, respectively. The last-mentioned operation is performed with the windings 16 and 17 fully assembled on the pole pieces 14 and 15. After the pole piece extensions 14_a and 15_a have been inserted through the openings 19 and 20, the magnet member 18, which is at this time demagnetized, is forced between the adjacent opposite side surfaces of the pole piece extensions, and the extensions are pressed toward each other to bring the inner surfaces thereof into firm engagement with the pole faces of the magnet member 18. Simultaneously, the projections 14_b

and 15_b of the pole pieces 14 and 15 are pressed against the bottom wall of the housing 10. While the above-mentioned forces are acting upon the pole pieces 14 and 15, the rivets 36 and 37 are inserted through the openings provided in the housing 10 and the pole pieces, and the ends thereof are flattened in the usual manner, thereby rigidly to mount the field structure upon the housing 10. Also, while the above-mentioned forces are being exerted upon the pole pieces 14 and 15, the upstanding corner portions of the pole piece extensions 14_a and 15_a are bent over against the beveled corners 18_a and 18_b of the magnet member 18. After the field structure assembly is completed in the manner just described, the diaphragm assembly is mounted upon the rim of the cup-shaped housing 10. To this end, the inner plate 40 is forced within the snugly engaging side walls of the annular ring 12 to abut against the ledge formed by the lower surface of the housing flange 11. This operation is performed with the flat annular ring 45 mounted upon the plate 40, and during the performance thereof the pole face ends of the pole pieces 14 and 15 pass through the slots 40_a and 40_b provided in the plate 40. The inner plate 40 is rigidly held within the annular portion 12 of the housing 10 by staking the inner surface of the ring portion 12 at spaced points around the circumference thereof in a well-known manner. Also, a sealed joint is provided between the plate 40 and the pole face ends of the pole pieces 14 and 15 by pouring an insulating compound, such, for example, as Bakelite cement, through the spaces between the side walls of the slots 40_a and 40_b and the side surfaces of the pole pieces 14 and 15, thereby to insure that the damping chamber shall only be connected with the interior of the housing 10 by way of the restricted passage 46 described above. The next step in the construction of the device is to clamp the diaphragm 13 between the clamping surfaces of the two ring portions 12 and 52 projecting respectively from the housing 10 and the ear piece 41. While the diaphragm is clamped in position, the retaining ring 43 with the annular ring 42 inserted therein is telescoped over the ear piece 41 until the flanged portion 43_a thereof engages the tapered surface of the ear piece 41, following which the rim of the retaining ring 43 is bent over as indicated at 43_b to engage the underside of the flanged portion 11 of the housing 10.

The final step in the construction of the device is that of magnetizing the magnet member 18. To this end, and as best shown in Fig. 6, the assembled device is positioned so that the magnet member 18 lies between the poles 53_a and 53_b of an electromagnet 53 having its winding 54 connected through the contacts of a circuit breaker 55 to a direct current source, not shown, but having its positive and negative terminals connected to the terminals 56. In order to expedite the magnetizing operation, the poles 53_a and 53_b of the magnet 53 are provided with cut-away portions 57_a and 57_b within which the legs of the U-shaped contact member 27 and the heads of the rivets 30_a and 30_b are adapted to extend. By this arrangement, the pole piece extensions 14_a and 15_a may be brought into close proximity with the pole faces of the poles 53_b and 53_a, respectively, so that a minimum flux leakage occurs. When the magnet member 18 is fully magnetized, the last step in the construction of the device is completed and the device is ready for use.

In the operation of the device constructed and arranged in the manner set forth above, an attractive force is normally exerted upon the diaphragm 13 by virtue of the flux produced in the magnetic field structure by the magnet member 18. Due to the length of the air gap 33, the magnet member 18 is not short-circuited and a substantial portion of the flux traverses the diaphragm 13. When incoming signal currents traverse the voice coil windings 16 and 17, the steady state flux is increased and decreased in the usual manner in accordance with the undulations of the signal currents. The change in the flux traversing the pole pieces 14 and 15 causes induced voltages to be developed in the closely coupled conductive housing 10 and the resulting circulating currents cause back electromotive forces to be developed which oppose the flux changes in the usual manner. Thus, the reluctance of the portion of the magnetic circuit comprising the permanent magnet 18 and the pole piece extensions 14_a and 15_a is effectively increased so that the greater portion of the alternating component of the flux traverses the auxiliary path described above and comprising the pole piece projections 14_b and 15_b and does not link with the housing 10. As a result, only a small portion of the signal current energy is dissipated as hysteresis and eddy current losses in the housing 10. The variations in the flux traversing the diaphragm 13 causes this diaphragm to vibrate in the usual manner so that sound waves are transmitted by way of the opening 51 to the exterior of the ear piece 41 and the provision of the inner damping chamber defined by the plate 40 prevents an excessive response of the diaphragm 13 at frequencies approaching the natural frequency of vibration of the diaphragm. Also, the provision of the resonating chamber defined by the ear piece 41 enhances the response of the moving system at frequencies in the upper portion of the operating range. Thus, a substantially flat response characteristic typifying good fidelity of reproduction is obtained.

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

I claim:

1. A sound translating device comprising a substantially non-magnetic and electrically conductive frame, a magnetic field structure mounted on said frame, said frame being inductively coupled to the magnetic circuit of said structure, and means comprising said frame for preventing at least a portion of the alternating component of flux which is developed during operation of said device from linking with said frame.

2. A sound translating device comprising a non-magnetic and electrically conductive frame, a magnetic field structure mounted upon said frame and comprising a magnetic circuit including two paths, one of said paths including a permanent magnet, said frame being inductively coupled to the magnetic circuit of said structure, and means comprising said frame for causing the predominant portion of the alternating component of flux which is developed during operation of said device to traverse the other of said paths.

3. A sound translating device comprising a substantially non-magnetic and electrically conduc-

tive frame, a diaphragm, a magnetic field structure mounted on said frame and comprising a pair of pole pieces arranged to cooperate with said diaphragm to provide a substantially closed magnetic circuit, said frame being arranged to encircle at least one of said pole pieces, thereby to affect a short-circuited conductor inductively coupled to said magnetic circuit, and means comprising said frame and a relatively low-reluctance auxiliary flux path extending between said pole pieces for preventing at least a portion of the alternating component of flux which is developed during operation of said device from linking with said frame.

4. A sound translating device comprising a substantially non-magnetic and electrically conductive frame, a diaphragm, a magnetic field structure mounted on said frame and comprising a pair of pole pieces arranged to cooperate with said diaphragm to provide a substantially closed magnetic circuit, said frame being arranged to encircle at least one of said pole pieces, thereby to affect a short-circuited conductor inductively coupled to said magnetic circuit, said pole pieces having projections extending toward each other and separated by an air gap to provide an auxiliary flux path between said pole pieces, and means comprising said frame and said auxiliary flux path for preventing at least a portion of the alternating component of flux which is developed during operation of said device from linking with said frame.

5. A sound translating device comprising a substantially non-magnetic and electrically conductive frame having a pair of openings therein, a magnetic field structure mounted on said frame and comprising pole pieces having extensions projecting through said openings and a permanent magnet secured between said extensions on one side of said frame, a diaphragm positioned on the other side of said frame, said pole pieces and said permanent magnet being arranged to cooperate with said diaphragm to provide a substantially closed magnetic circuit which is inductively coupled to said frame, and means comprising said frame and a relatively low-reluctance auxiliary flux path extending between said pole pieces on said other side of said frame for preventing at least a portion of the alternating component of flux which is developed during operation of said device from linking with said frame.

6. A sound translating device comprising a substantially non-magnetic and electrically conductive frame having a pair of openings therein, a magnetic field structure mounted on said frame and comprising pole pieces having extensions projecting through said openings and a permanent magnet secured between said extensions on one side of said frame, a diaphragm positioned on the other side of said frame, said pole pieces and said permanent magnet being arranged to cooperate with said diaphragm to provide a substantially closed magnetic circuit which is inductively coupled to said frame, said pole pieces having projections extending toward each other and separated by an air gap to provide an auxiliary flux path between said pole pieces on said other side of said frame, and means comprising said frame and said auxiliary flux path for preventing at least a portion of the alternating component of flux which is developed during operation of said device from linking with said frame.

7. A sound translating device comprising a substantially non-magnetic and electrically conductive frame having a pair of openings therein, a magnetic field structure mounted on said frame and comprising pole pieces having extensions projecting through said openings and a permanent magnet secured between said extensions on one side of said frame, a diaphragm positioned on the other side of said frame, said pole pieces and said permanent magnet being arranged to cooperate with said diaphragm to provide a substantially closed magnetic circuit which is inductively coupled to said frame, said pole pieces having projections extending toward each other and separated by an air gap to provide an auxiliary flux path between said pole pieces on said other side of said frame, the length of said air gap being so proportioned that a substantial amount of the steady state flux traversing said magnetic circuit and produced by said magnet traverses said diaphragm, and means comprising said frame and said auxiliary flux path for shunting a portion of the alternating component of flux which is developed during operation of said device away from said pole piece extensions and said magnet.

8. A sound translating device comprising a substantially non-magnetic and electrically conductive housing having a pair of openings therein, a magnetic field structure mounted on said housing and comprising pole pieces having extensions projecting through said openings and inductively coupled to said housing, a permanent magnet mounted between said pole piece extensions on the outside of said housing, and means comprising said housing for preventing at least a portion of the alternating component of flux which is developed during operation of said device from linking with said permanent magnet.

9. A sound translating device comprising a substantially non-magnetic and electrically conductive housing having a pair of openings therein, a magnetic field structure mounted on said housing and comprising pole pieces having extensions projecting through said openings and inductively coupled to said housing, said pole pieces having projections extending toward each other and separated by a gap to provide an auxiliary flux path between said pole pieces within said housing, a permanent magnet mounted between said pole piece extensions on the outside of said housing, and means comprising said housing and said auxiliary flux path for preventing at least a portion of the alternating component of flux which is developed during operation of said device from linking with said permanent magnet.

10. A sound translating device comprising a substantially non-magnetic and electrically conductive housing having a pair of openings therein, a magnetic field structure comprising pole pieces having extensions projecting through said openings and inductively coupled to said housing, said pole pieces having projections extending toward each other and separated by a gap to provide an auxiliary flux path between said pole pieces within said housing, means securing said pole piece projections to said housing to provide a rigid assembly, a permanent magnet mounted between said pole piece extensions on the outside of said housing, and means comprising said housing and said auxiliary flux path for preventing at least a portion of the alternating component of flux which is developed during operation of said device from linking with said permanent magnet.

11. A sound translating device comprising a substantially non-magnetic housing having a pair of openings therein, a magnetic field structure mounted on said housing and comprising pole

pieces having extensions projecting through said openings, a permanent magnet having beveled corners, and means comprising portions of said pole piece extensions bent over to engage the beveled corners of said permanent magnet for rigidly mounting said permanent magnet between said pole piece extensions on the outside of said housing.

12. A sound translating device comprising a substantially non-magnetic housing having a pair of openings therein, a magnetic field structure mounted on said housing and comprising pole pieces having extensions projecting through said openings, a permanent magnet having beveled corners, means comprising portions of said pole piece extensions bent over to engage the beveled corners of said permanent magnet for rigidly mounting said permanent magnet between said pole piece extensions on the outside of said housing, and a substantially U-shaped contact member having legs straddling said permanent magnet and secured to said housing on the outside thereof.

13. A sound translating device comprising a substantially non-magnetic housing having a pair of openings therein, a magnetic field structure mounted on said housing and comprising pole pieces having extensions projecting through said openings, a permanent magnet mounted between said pole piece extensions on the outside of said housing, and a substantially U-shaped contact member having legs straddling said magnet and secured to said housing on the outside thereof.

14. In the construction of a sound translating device of the form comprising a magnetic field structure including a permanent magnet member and pole pieces at least one of which is provided with a winding, a housing for said winding and said pole pieces, and a diaphragm structure; the method of making said device which comprises the steps of arranging said field structure on said housing with said magnet member disposed exteriorly of said housing and with said winding and said pole pieces disposed interiorly of said housing, arranging said diaphragm structure on said housing to provide a substantially sealed chamber enclosing said winding and said pole pieces, all before said magnet member is magnetized, thereby to prevent magnetic particles from being attracted to said field structure during the foregoing steps, and then introducing said magnet member in a magnetic field, thereby to magnetize said magnet member.

15. In the construction of a sound translating device of the form comprising a magnetic field structure including pole pieces having windings thereon and provided with extensions adapted to receive a permanent magnet member therebetween, a cup-shaped housing provided with openings for receiving said pole piece extensions, and a diaphragm structure; the method of making said device which comprises the steps of inserting said pole piece extensions through said openings so that they project exteriorly of said housing, positioning said magnet member exteriorly of said housing and between said pole piece extensions, securing said magnet member between said pole piece extensions, securing said pole pieces to said housing, arranging said diaphragm structure on said housing to provide a substantially sealed chamber enclosing said windings and said pole pieces, all before said magnet member is magnetized, thereby to prevent magnetic particles from being attracted to said field structure during the foregoing steps, and then introducing said magnet member in a magnetic field, thereby to magnetize said magnet member.

HAROLD C. PYE.