Oct. 10, 1939. J. P. QUAM 2,175,994

LOUDSPEAKER AND METHOD OF MAKING THE SAME

Filed June 23, 1938

Fig. 1.

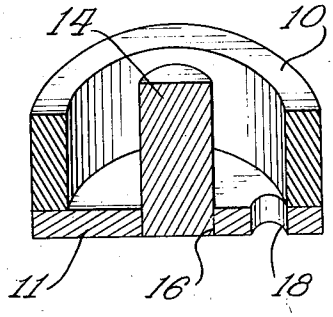



Fig. 2.

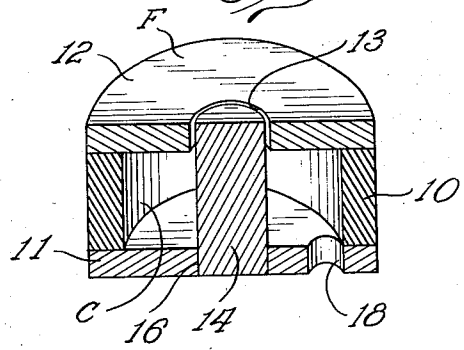



Fig. 3.

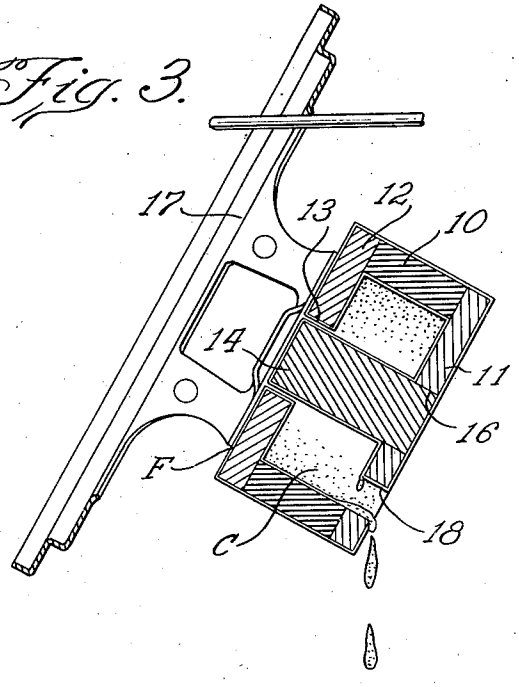
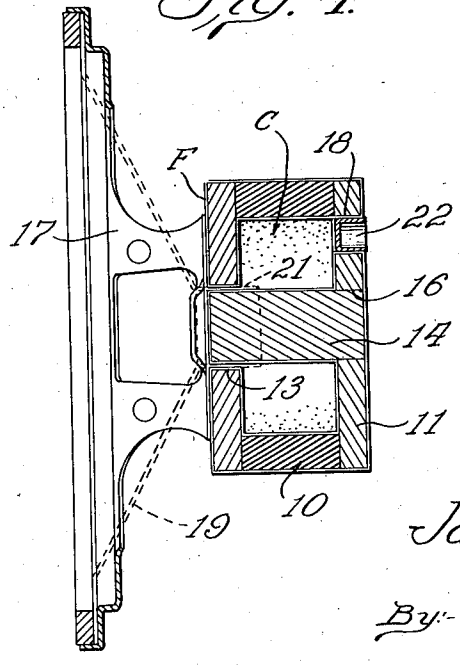



Fig. 4.




Inventor:
James P. Quam
By: Norman P. Mueller
Atty.

Patented Oct. 10, 1939

2,175,994

# UNITED STATES PATENT OFFICE

2,175,994

## LOUDSPEAKER AND METHOD OF MAKING THE SAME

James P. Quam, Chicago, Ill., assignor to Quam-Nichols Company, Chicago, Ill., a corporation of Missouri

Application June 23, 1938, Serial No. 215,484

7 Claims. (Cl. 179—117)

My invention relates in general to loudspeakers and more in particular to a dynamic-type loudspeaker employing a hollow but substantially entirely closed permanent magnet structure, and to a method for manufacturing a loudspeaker of this type and general construction.

In the manufacture of permanent magnet dynamic-type speakers wherein the permanent magnet is of a box-like construction which is hollow and substantially closed, a great deal of difficulty has been encountered in cleaning out metal particles, core sand, and similar foreign matter from the permanent magnet cavity. As a result, such undesired matter often lodges in the voice coil aperture after the complete assembly of the speaker in a manner to impede or distort the movement of the voice coil therein. Efforts have been made to dislodge and remove such accumulation of foreign matter from within the cavity in the permanent magnet by means of a blast of compressed air, or by means of air suction applied at the voice coil aperture. Such cleaning methods, however, usually result in only a partial removal of the foreign matter because some of the metal and dirt particles, and the like, merely whirl around in the cavity, and particularly in the corners thereof, while the pressure is on, but settle back into the cavity when the pressure is removed. The metal or dirt particles which are not removed from the permanent magnet cavity normally subsequently fall into the voice coil aperture or become lodged therein during the final assembly operations and testing of the speakers in the factory, or after the speakers have been installed in a receiver and have gone into service. Such particles in the voice coil aperture interfere with or stop the movement of the voice coil in its air gap, and normally the voice coil and diaphragm have to be removed before the particles can be removed. A new diaphragm and voice coil have to be substituted because the original members are torn in removing. This is very costly when it has to be done in the factory, and much more costly when the trouble becomes apparent out in the field.

Some of these difficulties are overcome by providing a relatively large air gap at the voice coil aperture. This is extremely undesirable, however, because the larger the air gap the smaller the magnetic forces at the air gap, and hence the weaker the magnetic force available for moving the voice coil in such air gap. It is understood, of course, that the ideal construction for a speaker from the standpoint of operation includes a voice coil air gap just wide enough to permit the movement of a voice coil therein without rubbing on either the magnet pole piece, or the inside surface of the aperture in the end plate of the magnet forming the air gap. However, with such a small air gap the danger of interference arises from even the smallest foreign particles.

It is an object of my invention to provide an improved dynamic-loudspeaker employing a substantially closed but hollow permanent magnet.

A further object of my invention is to provide a method for the manufacture of speakers of the above described construction so that metal and dirt particles and similar foreign matter can be effectively removed from the permanent magnet structure after the assembly thereof, or if not entirely removed, can be positively sealed onto the inside wall of the permanent magnet so that it cannot become dislodged to fall or be attracted into the voice coil air gap in the permanent magnet.

It is also an object of my invention to produce better speakers of this general construction at a materially lower cost.

A still further object of my invention is to provide a speaker of the construction described having a voice coil effectively operating in a relatively small voice coil aperture or air gap.

Another object is to provide a method for washing metal and dirt particles from a substantially closed, hollow space in a manufactured article and simultaneously sealing any such particle which are not removed, onto the wall of such hollow space.

Other objects and advantages of my invention will be apparent from the following description, taken with the drawing, in which:

Fig. 1 is a cross-sectional view of a portion of the complete permanent magnet for the loudspeaker in one of the preliminary stages of assembly.

Fig. 2 is a similar view of the permanent magnet structure in a subsequent step in the process of manufacture.

Fig. 3 is a cross-sectional view of the speaker with the metallic portions assembled, and illustrating a subsequent step in the process of manufacture of the speaker.

Fig. 4 is a cross-sectional view of a complete speaker embodying my invention and completed in accordance with the method of my invention.

In practicing my invention, an annular magnet portion 10 is provided with a pair of end plates 11 and 12 welded thereto to provide a box-

like structure hollow on the inside. The end plate 12 is provided with an aperture 13 centrally thereof to receive a core or pole piece 14 of magnetic material which may be driven into a corresponding aperture 16 in the end plate 11 with a rigid driving fit. The core 14 may be assembled onto the end plate 11 in an appropriate jig before the end plate 11 is assembled onto the ring 10, or the end plates 11 and 12 may be originally assembled on the ring as described above, and the core then driven into the aperture 16 while being centered in the voice coil aperture 13 of the plate 12.

A stamped-out diaphragm frame 17 known as a "basket" in the art, is centered with respect to the voice coil aperture 13 and then welded to the outside face F of the plate 12. This latter assembly can likewise be accomplished in either one of two different orders, viz., the basket 17 may be first welded to the plate 12 and then the latter with the basket thereon, welded to the annular ring 10, or as previously mentioned, the basket may be welded to the plate 12 after the latter has been welded to the annular ring 10.

The elements of this preassembly, viz., the annular ring 10, the end plates 11 and 12, the core 14, and the basket 17, are all cast, stamped-out, or machined members, and the original production of the same, (except, of course, the casting of the ring 10) as well as the welded assembly thereof is normally accomplished in the machine shop portion of the factory. As a result, there is normally some core sand, slivers of steel, and other metal and dirt particles, on the preassembly and within the magnet cavity represented by the reference character C in Fig. 2. In this connection it is understood, of course, that other configurations for the permanent magnet may be provided resulting in a box-like structure with an internal cavity, all within the concept of the present invention. As stated above, the generally accepted procedure in the manufacture of loudspeakers of this general construction prior to my invention was to direct a stream of compressed air from a high-pressure nozzle into the cavity C through the voice coil aperture 13 after the preassembly to the extent illustrated in Fig. 4 has been completed, or apply a suction at the aperture. However, as further explained, this has been insufficient to remove all foreign material from the cavity, and as a result a goodly number of speakers have had to be torn down after assembly, removing the diaphragm and voice coil so that particles which had become lodged in the voice coil aperture could be removed by blowing or the like. Even this was not a complete insurance against failure in the field, because some of the material which lodged in the voice coil aperture might be blown back into the cavity C again, escape detection in the factory and then drop into the voice coil aperture after the speaker had been put into use.

These difficulties have been substantially completely eliminated in the commercial practice of my invention which includes providing a drain opening 18 at one side of the end plate 11 in such a position that it will be coextensive with the inside surface of the annular ring 10 as shown clearly in Figs. 1, 2 and 3, inclusive. After the assembly of the magnet structure and the diaphragm frame 17 as described above, and with the drain 18 open, the entire unit is dipped into a paint tank. The paint completely covers the outside of the unit and flows into the cavity C through the voice coil aperture 13 and the drain opening 18 until the cavity C is entirely filled. This operation, of course, requires only a second or two. The unit as illustrated in Fig. 3 is then suspended from a rack or the like over a suitable drain pan in a position such that the opening 18 is at the lowest point in the cavity C so that the paint in the cavity will drain out completely. Relatively light paint is preferably employed, aluminum paint being quite satisfactory, and this flows readily out of the voice coil aperture 13, into the cavity C, and out of such cavity through the opening 18, so that only a very thin film of paint remains over the entire structure. With the unit suspended as shown in Fig. 3, the last drop of paint, in draining, accumulates and dries, if at all, at the drain opening 18. This does not affect the operation of the speaker in any manner, and with the paint draining in the direction noted, the film at the voice coil aperture 13 is so thin that it will not impede the movement of the voice coil therein even though the air gap intermediate the pole piece and aperture wall is very narrow.

As the paint drains from the inside of the cavity C, the objectionable metal and dirt particles are effectively carried with the paint and removed from the unit. If any such particles remain, these are sealed onto the surface of the magnet, inside and out, during the drying operation so that they cannot fall into the air gap at the voice coil aperture 13 to cause trouble. The thin film of paint is illustrated on the magnet in Figs. 3 and 4 at the cross-section portion as a narrow border over the entire inside of the cavity C, the voice coil aperture 13, and over the outside of the magnet structure. The border, of course, does not indicate the thickness of the coating on the unit. The paint also covers the basket 17. After the paint has drained from the preassembled unit, the unit is placed in a baking oven at approximately 450° F., and dried for approximately thirty minutes. The time and temperature for the drying, of course, will vary with the paint used for the cleaning and sealing operation. After the drying operation, a hard clean surface is provided over the entire magnet structure and basket.

The painting and drying steps are normally carried on in a paint shop separate from the machine shop wherein the original assembly is completed, and after the drying operation, the painted unit is carried directly to the assembly lines which are normally comparatively free from dust and metal particles. In the assembly line the diaphragm 19 and voice coil 21, shown in dotted lines in Fig. 4, are mounted upon the basket 17 with the voice coil centered in the air gap at the voice coil aperture 13. The speaker is then substantially complete, and as a final precaution an air blast is applied to the aperture 18 which is still open and any slight dust that there might be in the voice coil aperture 13 is blown outwardly from the magnet structure. A metal plug 22 of soft material is then forced into the aperture 18 with a suitable punch and the cavity C is sealed completely except, of course, for the voice coil aperture 13. The magnets are then magnetized, and the speakers tested and made ready for shipment.

In the commercial practice of this invention, it has been found that rejects due to the accumulation of foreign matter in the voice coil aperture, and the failure of speakers in the field due to this cause have been reduced substantially to nothing. In addition to thus materially re-

ducing the cost of production, the practice of my invention has made possible an improved speaker of dynamic type utilizing an enclosed permanent magnet. This improvement has resulted from a smaller voice coil aperture made possible by freedom from dirt and the like, and in addition the magnet structure of the speaker is protected on the inside and out against corrosion, rust, or the like, due to a moisture accumulation thereon.

Although I have described my invention in its preferred embodiment, it is understood that the invention is not limited thereto, but changes and modifications may be made therein, all within the scope of the appended claims.

I claim:

1. The method of producing a field magnet for a loudspeaker adapted to have a voice coil moving in an air gap in said magnet and protecting said air gap against the introduction therein of metal and dust particles from the inside of the magnet so as to interfere with the movement of the voice coil in said air gap, which method comprises assembling a multi-piece magnet in a manner to provide a hollow cavity therein with said magnet having an annular opening in one side thereof to provide a voice coil air gap and having an edge aperture in an opposite side, substantially filling said magnet cavity with a liquid, draining said liquid from said cavity at said edge aperture to thereby wash metal and dust particles from within said cavity through said aperture, baking said magnet to dry a covering of said liquid on the inside wall of said cavity to seal any remaining metal and dust particles thereon, and plugging said edge aperture to substantially close said magnet over the entire body thereof except for said annular opening.

2. In a field magnet for a loudspeaker, said field magnet being hollow walled forming a substantially inaccessible cavity having an air gap in one wall of said magnet and an opening in a wall other than the air gap wall, a method for preventing normally loose particles within the substantially inaccessible cavity from entering the air gap in said field magnet, which method includes substantially filling said cavity of said magnet with a liquid, draining said liquid from said cavity through said wall opening to wash said particles from within the cavity and carry the same with the liquid through said opening, and drying the liquid on the inside walls of the cavity to thereby seal any remaining particles within the cavity onto said inside walls in a manner to prevent such particles from entering said air gap.

3. A method for removing loose particles of undesired material from within a substantially closed hollow permanent magnet housing having a substantially inaccessible cavity therein and sealing any remaining particles to the inside wall of said cavity, with said housing having at least two different openings out of said cavity with each opening in a different wall of the housing, which method includes immersing said housing in a liquid bath for a time sufficient to substantially fill the inside of said housing, draining said liquid from one of said openings to wash undesired loose particles from said cavity and carry said particles with said draining liquid, subjecting said housing to a temperature for drying a film of said liquid onto the inside walls of said cavity to retain any remaining loose particles therein and seal said particles onto said walls, and thereafter closing the opening from which the liquid drained.

4. The method of manufacturing a loudspeaker having a walled magnet unit of magnetic material with a voice coil air gap in one wall, a cavity within said walls substantially closed thereby except for said voice coil air gap and a drain opening from said cavity, which method includes the steps of substantially filling said cavity with a liquid, draining said liquid from said cavity through said drain opening to wash particles within the cavity therewith and leaving only a coating of said liquid within said cavity on the walls thereof with any remaining particles carried in the coating, and drying the coating on said cavity walls to seal said remaining particles therein and prevent such particles from entering the voice coil air gap.

5. The method of manufacturing a loudspeaker having a walled magnet unit of magnetic material with a voice coil air gap in one wall, a cavity within said walls substantially closed thereby except for said voice coil air gap and a drain opening from said cavity, and said speaker having a diaphragm support supported on the outside of said unit, which method includes the steps of substantially filling said cavity with a liquid, suspending said unit at said diaphragm frame in a position to drain the liquid from the cavity through said drain opening to wash particles within the cavity therewith during said draining and leaving only a coating of said liquid within said cavity on the walls thereof with any remaining particles carried in the coating, drying the coating on said cavity walls to seal said remaining particles therein and prevent such particles from entering the voice coil air gap, and closing the drain opening.

6. In a loudspeaker having a diaphragm thereon, a walled permanent magnet having an air gap in one wall thereof and having an internal cavity formed by said walls and substantially closed on all sides except for said air gap, and a dry coating of sealing material on the walls of said internal cavity to seal undesired particles therein and prevent said particles from entering into said air gap.

7. In a loudspeaker having a diaphragm, a voice coil secured to said diaphragm, and a diaphragm frame, a magnet unit having walls of magnetic material with a voice coil aperture in one wall, with said walls forming an internal cavity within the unit substantially closed except for the voice coil aperture, a dry covering over the walls of said internal cavity for retaining normally loose particles and preventing such particles from entering said air gap from a point within said cavity, with one of the cavity walls having an opening therein, and a plug in said opening.

JAMES P. QUAM.