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EXPERIMENTAL RESEARCH IN MANUFACTURING TEHNOLOGY HIGH POWER AUDIO SPEAKER

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Abstract: *This paper presents a new material and manufacturing technology for high power permanent magnet audio speaker capable of rendering a 10% net increase in speaker efficiency.*
The technology used by the authors pertains to special permanent magnet manufacturing techniques utilizing NdFeB material
Key words: *audio speaker, permanent magnet, air gap.*

1. INRODUCTION

This paper presents a new material and manufacturing technology for high power permanent magnet audio speaker capable of rendering a 10% net increase in speaker efficiency.
The technology used by the authors pertains to special permanent magnet manufacturing techniques utilizing NdFeB material.

Constructive solutions based on information on studies were conducted several sets of simulations in which magnetic material is used NdFeB magnets with different shapes.

For each case was studied and how the magnetic induction depends on the size of the air gap.

2. SIMULATION FOR A MAGNETIC CIRCUIT WITH TOROIDAL MAGNET NdFeB

Figure 1.is a circuit in which the sintered magnet NdFeB has a minimum specific energy $(BH)_{max}$= 40 MGO_e dimensions Φ40x10 mm size and is centrally located.

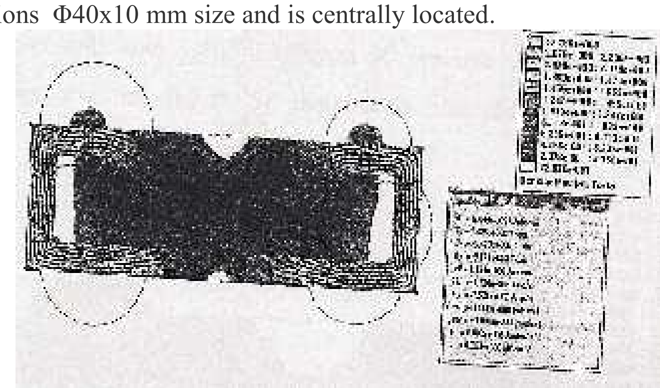

Figure 1 Simulation for a magnetic circuit with a toroidal magnet NdFeB

Considered the air gap is 1.5 mm. At this high induction air gap value obtained is 1.425 T. The circuit model can be considered only theoretically, in it does not allow for dissipation of heat generated greater efficiency in operation. This white areas in center of upper and lower surfaces of the magnet suggests that it can be used to form ring magnet.

Variation of magnetic induction air gap size shows a good uniformity with increasing air gap.

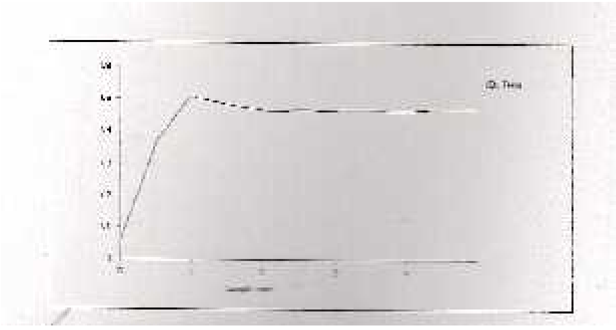

Figure 2.Magnetic flux density dependence of the air gap size

NdFeB magnet is used as the size of donut Φ94x Φ63x7 mm, as in the above case. Magnetic circuit air gap of 1.5 mm was chosen all. For such a case the maximum magnetic induction obtained is 1.408 T. The figure3. shows the distribution of field lines for this configuration and figure size dependence of magnetic induction air gap.

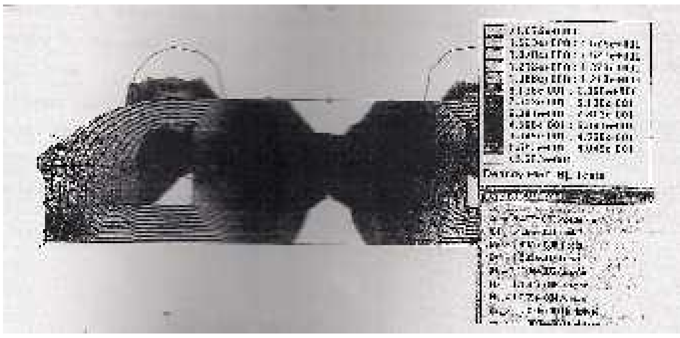

Figure 3.Simulation of a magnetic circuit equipped with a toroidal magnet NdFeB

Constructive solution of the figure3., with large connection range with the upper surface side of the face is passed from the upper polar field lines distribution in the previous circuit in this area. Field lines in this area can be concentrated in the pole piece this way provided that feromangetic material to be fed to a larger magnetic induction.

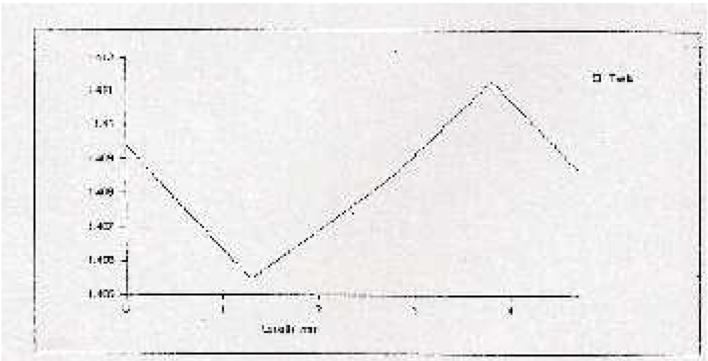

Figure 4. Magnetic flux density dependence of the air gap size

The analysis of simulation in Figure 3 results a very importance conclusion for constructive solutions. Central area of the magnetic circuit is unnecessary, the extremely low magnetic flux.

It is recommended that this area be occupied by air, which will help dissipate the heat generated better functioning electrodynamics audio device. This will create a higher density of magnetic flux in the air gap, there is growth potential in this area magnetic induction. Air gap magnetic flux density dependence of size (Fig.4) suggests that the circuit would work with a rotten air gap greater than 1.5 mm. This would help to release additional heat, but it would rot and carrying coils allow new constructive solutions.

3. MAGNETIC CIRCUIT SIMULATION FOR BEVELED EDGES

It has been made a simulation for the magnetic circuit where the edges are out at the bottom to try to eliminate non-uniform local magnetic field. The result was an increase in the magnetic induction in air gap at 1.438 T then by 2.1% higher. The figure 5 and 6 shows the results of these simulations**.**

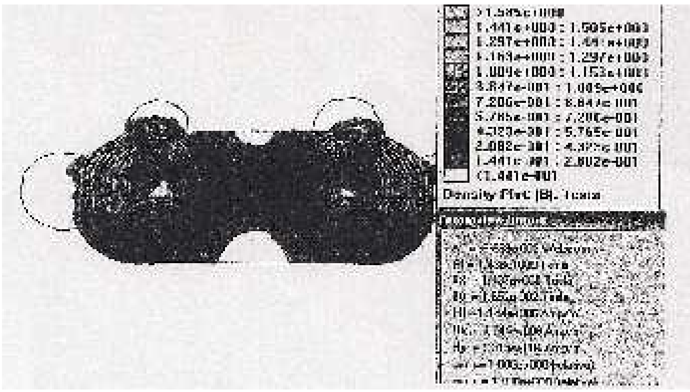

Figure 5.Magnetic circuit with bevelled edges

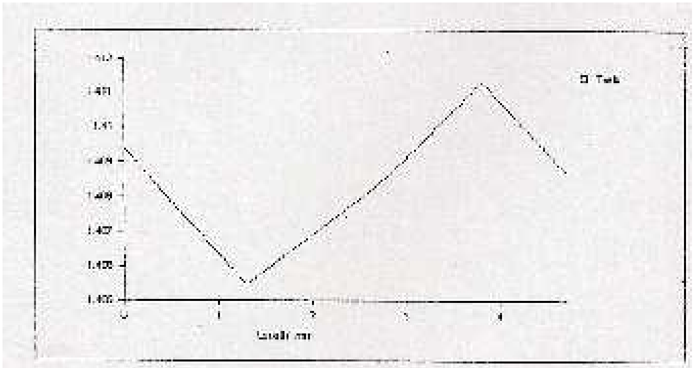

Figure 6.Variation of magnetic induction in air gap magnetic circuit

The results of these simulations show that in such a dimensional version of the circuit are close to maximum performance that can be obtained**.**

In these conditions has been studied where the magnetic circuiotul above (magnetic circuit with outgoing edges) were schimabte size magnet, a magnet that was introduced with Φ120x Φ63x7 mm, keeping the magnetic characteristics of the magnet ((BH) max = 40 MGOe) and air gap size. Simulation results are presented in figures. Maximum magnetic induction in air gap is in the latter case the 1,818 T.

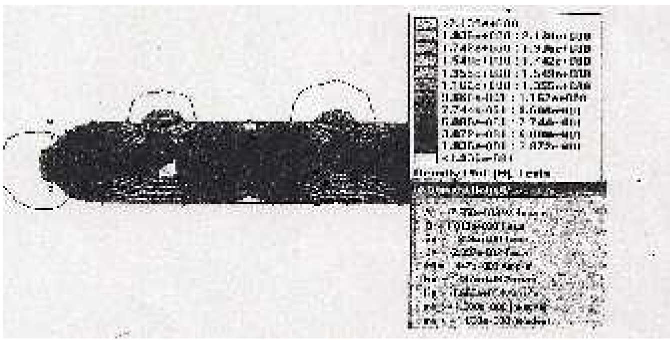

Figure 7. Magnetic circuit with magnet of NdFeB cu Φ120x Φ63x7 mm

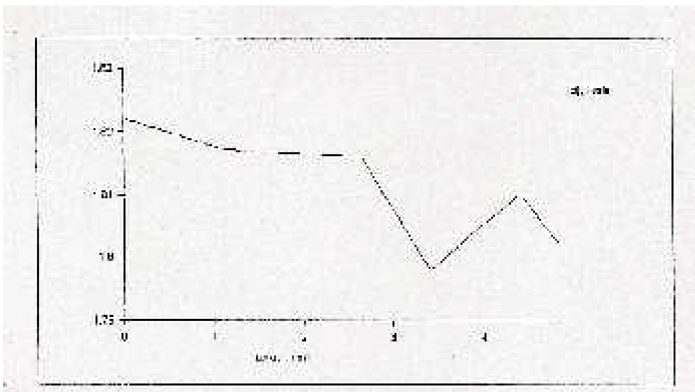

Figure 8. Air gap magnetic flux density dependence on the size of magnetic circuit of Figure 7

So an increase of about twice the volume of magnetic material in relation to the magnetic circuit before induction leads to increased air gap can be obtained in about 26.5%, so a very important result. Such a circuit also has a good uniformity of magnetic induction in air gap to about 2.8 mm air gap size

In these last four simulations was taken into account to achieve magnetric circuit, a high saturation index material (Armco iron).

.A proposal for a magnetic circuit configuration that uses two different magnets, sintered NdFeB and NdFeB crowded, is shown in Figure 9.

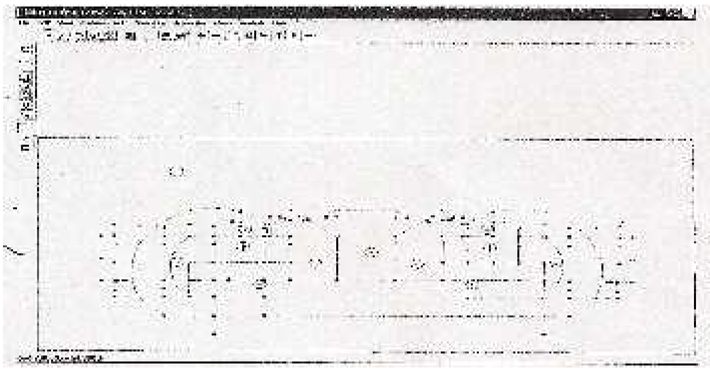

Figure 9. Magnetic circuit configuration with two permanent magnets NdFe B

From a practical perspective this configuration shows the potential of such a magnetic circuit with two different equipment. It can be used as a demonstration model, because the pieces polar raise large technological difficulties. Get maximum magnetic induction obtained ircuit interfierul this distribution is 1.569 T. Magnetic field lines in the circuit is shown in Figure 10.

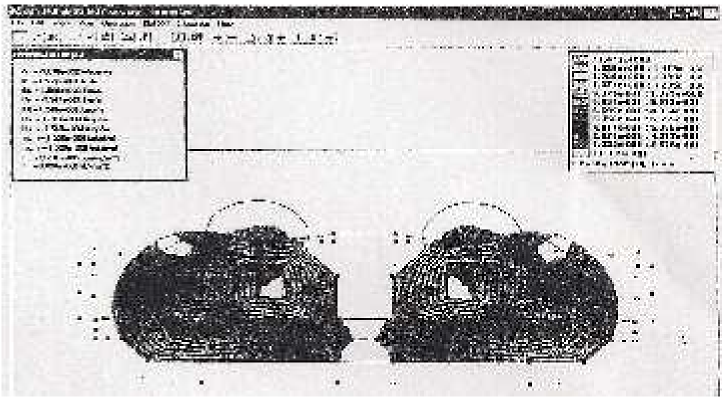

Figure 10. Distribution of field lines in the circuit in Figure 9

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4. INDUCTION VARIATION IN AIR GAP MAGNETIC CIRCUIT

It can be seen that virtually no loss in sides of the flow field. Cancellation of these losses is due to geometric forms of the polar parts, which basically follow the outline field lines. Mounting magnets in concentration led to opposite field lines in the air gap circuit, which has laid the increased induction, as was expected. Figure represents the active air gap detail.

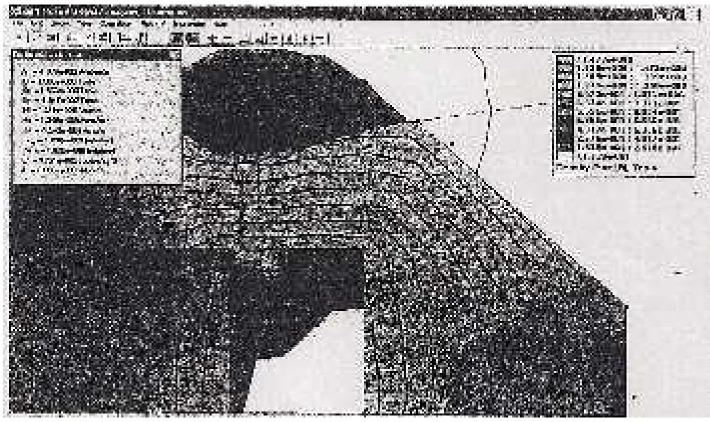

Figure 11. The distribution of air gap field lines in the circuit of Figure 9

It can be seen in figure high degree of concentration in the air gap field lines, which justifies the value of magnetic induction. Magnetic field in air gap also has a very good uniformity, feature and highlighted how variation of magnetic induction by x-axis and y axis as (Fig.12 and 13)

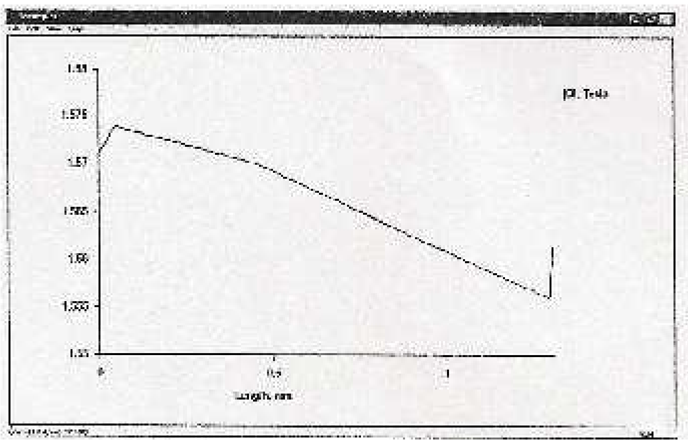

Figure 12.Variation after x-axis of induction in air gap magnetic circuit of Figure 9

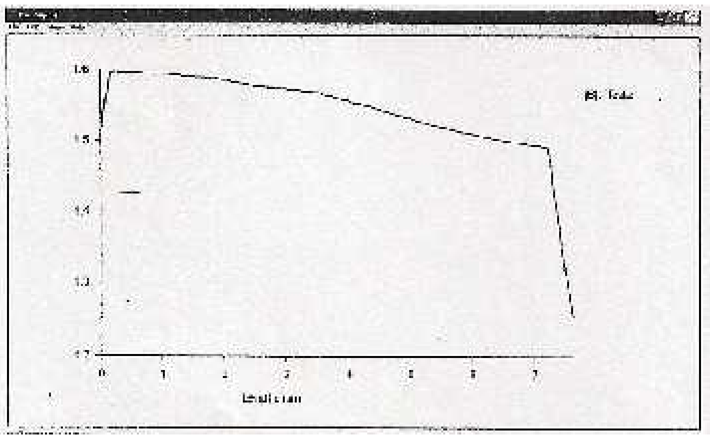

Figure 13. Variation after y-axis of induction in air gap magnetic circuit of Figure 9

Figure shows a good magnetic circuit comportatre for increasing air gap size: doubling the air gap size from 0.5 mm to 1 mm produces a magnetic flux density decreased only by about 1%. Magnetic flux density also decreased after the y-axis (height air gap) is slow: at 7 mm from the center aproxmativ indutia air gap is greater than 1.5 T. ferromagnetic material used in this simulation was Armco iron.

5. CONCLUSIONS

Losses are higher magnetic flux magnetic circuit as the magnetic permeability of soft magnetic materials is reduced and hence their saturation magnetic induction is small. It is very important that the construction of magnetic circuits to be used high magnetic permeability material, to prevent their magnetic saturation. Using probes for the determination of potential internal reluctance permanent magnet, caused by sunlight-readable section of magnetic circuit. Differences between the same parameter values found for the three audio devices provided by the SC. ElCOMP SRL shows that it is very important to apply methods for each individual case.

Computer simulations with FEMM program can permte ciorecta Designing a magnetic circuit in accordance with the application envisaged, but it is important to have a close correlation between the design in terms of electromagnetic nail design mechanically, thermally and acoustically. For example the value of size x length magnet magnetic <camp (20 mm)> in audio devices of high power electro-No. 3 Only 90% can be measured in air gap of 1.5 mm, which means that the magnetic circuit is designed and constructed properly (affects air gap parasitic magnetic materials used have low saturation induction, etc..).

Also it should be noted that achieving a high power electromagnetic audio device equipped with magnetic materials (soft and hard) simulation performance must combine magnetic circuit performance alculator practical implementation of circuits for testing, which would lead a better knowledge technological factors that influences all the condition is in production.

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