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Datasheet for the decision of 12 July 2007

Case Number: T 0017/05 - 3.5.03

Application Number: 91104052.5

Publication Number: 0467016

IPC: H04R 9/02

Language of the proceedings: EN

Title of invention:
Magnetic circuit for a speaker

Patentee:
PIONEER ELECTRONIC CORPORATION

Opponent:
Interessengemeinschaft für Rundfunkschutzrechte GmbH Schutzrechtsverwertung & Co. KG

Headword:
Magnetic Circuit/PIONEER

Relevant legal provisions:
EPC Art. 56, 84, 123(2)

Keyword:
"Inventive step - (no)"

Decisions cited:
-

Catchword:
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Case Number: T 0017/05 - 3.5.03

D E C I S I O N
of the Technical Board of Appeal 3.5.03
of 12 July 2007

Appellant: (Patent Proprietor)
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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 3 November 2004 revoking European patent No. 0467016 pursuant to Article 102(1) EPC.

Composition of the Board:

Chairman: R. Moufang
Members: A. Ritzka
D. H. Rees

Summary of Facts and Submissions

I. This appeal is against the decision of the opposition division dated 3 November 2004 to revoke the European patent EP 0 467 016 B. The opposition was based on the grounds of Article 100(a) and (c) EPC. The patent was revoked for lack of inventive step having regard to the disclosure of

D10: GB 501 708 A.

Documents

D9: US 3 953 687 A and
D11: JP 59002500 A

were also discussed in the decision.

II. Notice of appeal was filed and the appeal fee paid on 20 December 2004. The statement of grounds of appeal was filed on 14 March 2005.

The appellant (patentee) requested that the decision under appeal be set aside and the patent maintained on the basis of the claim filed on 14 September 2004 on which the decision under appeal was based. An additional request for oral proceedings was made.

III. In its letter dated 14 February 2005 the respondent (opponent) requested that the appeal be dismissed and made an auxiliary request for oral proceedings. In its letter dated 13 June 2005 the respondent argued that the subject-matter of the claim did not comply with

Articles 123(2), 84 and 56 EPC and that the decision under appeal was therefore correct.

IV. In a communication accompanying the summons to oral proceedings the board raised matters to be discussed during the oral proceedings, in particular with regard to the question of whether the claim fulfilled the requirements of Article 123(2) EPC, to the interpretation of the claim and to the questions of novelty and inventive step.

V. In its letter of 16 May 2007 in response to the board's communication the respondent maintained its request that the appeal be dismissed and announced that it would not be represented at the oral proceedings.

VI. In its letter of 12 June 2007 in response to the board's communication the appellant presented its comments and filed an amended claim for an auxiliary request. The appellant implicitly maintained its main request.

VII. In its letter dated 28 June 2007 the respondent presented comments on the appellant's letter of 12 June 2007, in particular with respect to the auxiliary request, and referred to document

D7: US 4 386 332 A

which was already introduced with the notice of opposition.

VIII. The oral proceedings took place on 12 July 2007 in the absence of the respondent. At the end of the hearing the chairman announced the board's decision.

IX. The only claim of the main request reads as follows

"A magnetic circuit for a speaker having a yoke base (2), a cylindrical pole piece (3) formed on the yoke base (2), an annular magnet (4) mounted on the yoke base (2) and an annular top plate (5) mounted on the magnet (4) so as to form a gap G between the inside wall of the top plate (4) and the opposed outer wall of the cylindrical pole piece (3);
characterized
in that a longitudinal cross-section containing the center line (ℓ) of each of the yoke base (2), the magnet (4) and the top plate (5) has a continuously, outwardly curved periphery (2a, 4a, 5a) in the transition area from the yoke base (2) through the magnet (4) to the top plate (5) on either side of the center line (ℓ), so that the magnetic circuit as a whole has a compressed spherical periphery, compressed in the longitudinal direction of the center line (ℓ)."

The claim of the auxiliary request adds to the claim of the main request that "the yoke base (2) has an annular recess (7) on the inside wall thereof around the cylindrical pole piece (3) which faces the gap G and allows a large axial movement of a voice coil to be inserted in the gap G".

Reasons for the Decision

1. *Main request*

1.1 Claim interpretation

The claim is characterised by the feature that a longitudinal cross-section containing the centre line of each of the yoke base, the magnet and the top plate has a continuously, outwardly curved periphery in the transition area from the yoke base through the magnet to the top plate. The term transition area is further defined beyond its general meaning of an area comprising at least parts of the yoke base, the magnet and the top plate by the limitation "so that the magnetic circuit as a whole has a compressed spherical periphery, compressed in the longitudinal direction of the centre line." Accordingly, the term "transition area" is interpreted as the area comprising the periphery of the magnet and of adjacent parts of the yoke base and the top plate, the extension of the area being such that its outwardly curved periphery determines the extent of the compression of the compressed spherical periphery of the magnetic circuit as a whole.

The term "continuously, outwardly curved periphery" is interpreted as a smooth outwardly curved periphery.

1.2 Novelty and inventive step

The board considers D9 to be the most relevant prior art document.

D9 discloses a magnetic structure for a moving voice coil loudspeaker. A flat annular permanent magnet is arranged in between a rear end plate and a top end plate and around a centre pole piece which abuts on the rear end plate 26 and which forms with the adjacent top end plate 30 a gap in which the voice coil of the loud speaker can move in a direction parallel to the pole piece, see figure 1 and column 2, lines 32 to 52. The magnet is provided with a "slight peripheral radius", i.e. it is outwardly curved, see figure 7 and column 3, lines 49 to 53. The outer edges of the top and rear end plates are tapered or bevelled to the end of the magnet, see column 3, line 68 to column 4, line 6. Providing the magnet with the peripheral radius increases the length of the path of leakage flux between its faces and thereby reduces leakage, see column 3, lines 49 to 53. Tapering or bevelling the edges of the end plates reduces weight while nearly all flux emanating from the magnet faces is channelled into the end plates, see column 3, lines 10 to 15 and column 3, line 68 to column 4, line 6.

D9 at column 3, lines 12 to 20 states that the savings in weight and material costs are significant and that significant savings could be accomplished by utilising only part of those which are theoretically available. The peripheral edges need not taper to absolute zero thickness if mechanical constraints have to be met.

The subject-matter of the claim differs from the magnetic structure disclosed by D9 in that a longitudinal cross-section containing the centre line of each of the yoke base, the magnet and the top plate has an outwardly curved periphery in the transition

area from the yoke base through the magnet to the top plate. Thus, it is novel.

The appellant stated that starting from D9 the problem underlying the claim was that of providing for a magnetic circuit with improved weight, cost and homogeneity of the magnetic flux. An increased reduction of weight was achievable by using an outwardly curved periphery rather than an inwardly curved periphery as known from D9. Moreover, the outwardly curved periphery according to the claim would provide for an improved homogeneity of the magnetic flux.

The board notes that a plurality of embodiments of magnetic circuits are disclosed in the patent specification. Embodiments of the magnetic circuit with a continuously, outwardly curved periphery in the transition area are disclosed referring to figures 1 to 3, embodiments with a discontinuously, outwardly curved periphery are disclosed with reference to figures 6, 7a and 7b and embodiments with an inwardly curved cross-section of the yoke base and plate are disclosed with reference to figures 8 to 10 and 13 to 19. Referring to figures 4, 11 and 5 lines of magnetic force generated in a magnetic circuit with a continuously, outwardly curved periphery, in a magnetic circuit with inwardly curved yoke base and plate and in a magnetic circuit according to the acknowledged prior art, respectively, are shown.

According to column 1, lines 47 to 53 of the patent the object underlying the claimed magnetic circuit is to increase its magnetic efficiency and to reduce its

weight and cost of manufacturing. According to column 4, line 3 the embodiment shown in figure 9 has a most preferable tapered surface. The board notes that the patent specification does not include any hint of different problems underlying the various embodiments disclosed. Neither can different problems be inferred from the description.

The appellant argued that the magnetic circuit according to claim 1 can be produced with reduced weight compared to the magnetic structure disclosed in D9 as the outwardly curved periphery leads to a mechanically more stable structure which can be designed with a smaller height in the direction of the centre line adjacent to the pole. This argument has not convinced the board, since the diameter of the ring adjacent to the periphery is much bigger than that of the ring adjacent to the pole and thus the reduction of volume due to the reduced height adjacent to the pole is less important than the increase in volume due to an increased height adjacent to the periphery as a consequence of the outwardly instead of inwardly curved periphery.

Moreover, D9 states at column 3, lines 10 to 20 and column 5, lines 19 to 36 that significant savings in weight and material costs are achievable by using end plates of which the axial thicknesses of the radially outer portions is reduced and that mechanical constraints might limit the minimum thickness of the end plates. The skilled person would understand that although the savings in weight and material costs are most significant when using end plates with edges tapered to zero thickness, a benefit is still achieved

when there is less reduction in thickness of the peripheral edges. In the board's view, neither the patent specification nor the prior art documents or common general knowledge provide any support for the proposition that the claimed magnetic circuit solves the problem of reducing weight and material costs compared to the magnetic structure disclosed in D9.

Turning to the appellant's argument that the skilled person would understand from figures 4 and 11 of the patent specification that the magnetic flux in a magnetic circuit with outwardly, continuously curved periphery would have an improved homogeneity of the magnetic flux compared to a magnetic circuit with inwardly curved tapered edges, the board notes that the equal magnetic flux density contours L1 to L4 are very similar in both of the figures 4 and 11, in particular the distance between adjacent equal magnetic flux density contours in the area of the gap G are comparably small which, in the board's view, shows that the loss of magnetic flux in the area of the gap is small and independent of the different shaping of the adjacent end plate in the two cases. Thus, the skilled person gathers from figures 4 and 11 that the different shapes of the end plate and the yoke base in the two examples on which figures 4 and 11 are based do not have a significant influence on the resulting magnetic flux within the gap. Only the magnetic field within the gap is important for the functioning of the loudspeaker.

The magnetic circuit which generates the magnetic flux lines shown in figure 11 has a yoke base and a top plate with inwardly curved surfaces and an annular

magnet with a constant outer radius as shown in figure 9 of the patent specification. The embodiment shown in figure 9 of the patent specification differs from the magnetic structure disclosed in figure 7 of D9 in that the annular magnet of figure 7 of D9 has a slight peripheral radius. The skilled person would understand that the magnetic circuit disclosed with reference to figure 7 of D9 is improved with the respect to the leakage of magnetic flux compared to the embodiment of figure 9 of the patent specification as the slight peripheral radius of the annular magnet increases the length of the path of leakage flux between its surfaces.

Thus, the board considers that the magnetic lines shown in figure 11 correspond to a rough, pessimistic estimate of the magnetic lines that could be expected for the magnetic circuit of figure 7 of D9. In other words, the magnetic lines for the magnetic circuit of figure 7 of D9 can be expected to be similar to or even better than those disclosed in figure 11 of the patent specification. As stated above, the board does not find any significant differences between the magnetic lines shown in figure 4 and 11 with respect to the magnetic flux in the gap G, thus, an improvement of the homogeneity of the magnetic flux already accomplished by the magnetic circuit shown in figure 7 of D9 does not appear to be achieved. The appellant did not present evidence, e.g. measurement reports or the like, supporting that the claimed magnetic circuit results in an improved homogeneity of the magnetic flux in the gap.

The appellant argued that the patent specification was based on two different priority applications, the embodiments disclosed referring to figures 1 to 7b going back to one of the priority applications, the embodiments disclosed referring to figures 8 to 19 going back to the other priority application, and that the comment in column 4, line 3 that figure 9 shows the most preferable tapered surface did not relate to all of the embodiments. However, this does not affect the fact that the patent specification does not give any information supporting the alleged reduced weight and cost and improved homogeneity of the magnetic flux of the embodiments shown in figures 1 to 3, compared to the closest prior art represented by figure 7 of D9.

As no basis can be found in the specification that the claimed magnetic circuit solves the technical problem allegedly underlying the claim and the appellant did not present further evidence, the board comes to the conclusion that it has not been persuasively shown that the claimed magnetic circuit solves this problem.

The board therefore considers that the claimed subject-matter has to be regarded as an arbitrary obvious modification of the magnetic circuit of the closest prior art.

Thus, the subject-matter of the claim does not involve an inventive step.

2. *Auxiliary request*

2.1 Article 123(2) EPC

In view of the board's conclusion with respect to inventive step (see point 2.2 below) the question of whether the addition "in that the yoke base has an annular recess on the inside wall thereof around the cylindrical pole piece which faces the gap G and allows a large axial movement of a voice coil to be inserted in the gap G" complies with the requirements of Article 123(2) EPC need not be decided.

2.2 Inventive step

Document D7 discloses a magnetic circuit for a dynamic speaker which can be manufactured inexpensively without a need of machining, see column 2, lines 10 to 12. Referring to the prior art, a magnetic circuit is disclosed comprising an annularly shaped magnet, a pole yoke having a back plate coupled to one surface of the magnet and a centre pole extending from the central portion of the back plate and passing through a whole in the annularly shaped magnet, and an annularly shaped top plate coupled to the other surface of the magnet, in which an air gap is provided between the centre pole and the top plate, the lower surface of the back plate being flat while a stepped portion is formed in the upper surface of the back plate to determine the position of the magnet, see column 1, lines 6 to 21 and figure 1A. The structure of this magnetic circuit is said to be disadvantageous in that the thickness of the magnet must be increased as the length of the air gap is increased and hence as the circuit is made more

effective. This disadvantage is overcome by a magnetic circuit in which the back plate protrudes downwardly at the base portion of the centre pole and a groove is formed in the back plate along the circumferential direction of the centre pole. In the magnetic circuit thus constructed, the length of the air gap in the moving direction of the voice coil is advantageously increased without increasing the thickness of the magnet. See D7, column 1, lines 16 to 39 and figure 1B.

The appellant argued that the problem underlying the claim of the auxiliary request is to provide for a magnetic circuit with improved weight, material costs and homogeneity of the magnetic flux that can be used in a woofer.

As discussed in point 1.2 above, it is not inventive to modify the magnetic circuit disclosed in D9 such that its longitudinal cross-section has a continuously outwardly curved periphery in the transition area from the yoke base through the magnet to the top plate on either side of the centre line so that the magnetic circuit as a whole has a compressed spherical periphery. A magnetic circuit having a compressed spherical periphery, compressed in the longitudinal direction of the centre line, is similar to the magnetic circuit of figure 1A of D7 in so far as the length of the air gap is limited by the thickness of the magnet. Adapting the magnetic structure for the use in a woofer requires larger movement of the voice coil in the gap and thus increasing the length of the air gap. D7 at column 1, lines 25 to 39 refers to a solution of this problem known from the prior art, namely forming a groove in the back plate along the

circumferential direction of the centre pole so that the length of the air gap is increased.

The appellant argued that combining documents D7 and D9 was a hindsight patchwork argumentation and that the skilled person would not consult D7, as the problem underlying the invention disclosed in D7 related to machining of a given magnetic structure, see D7, column 2, lines 10 to 12. However, the board notes that D7 additionally discloses prior art magnetic circuits and a problem occurring with the prior art magnetic circuit of figure 1A and solved in the prior art magnetic circuit of figure 1B, see figures 1A and 1B and column 1, lines 16 to 39. The magnetic structure of figure 1A is similar to the magnetic structure of D9 and to the magnetic circuit as claimed according to the main request which, in the board's conclusion (see point 1.2 above), is an arbitrary, obvious modification thereof. The problem of an increased length of the air gap discussed with reference to figure 1A of D7 is identical to the additional problem underlying the claim of the auxiliary request. Thus, the skilled person, who is looking for an improvement of the magnetic circuit corresponding to an obvious modification of the magnetic circuit of D9, would consult D7, which addresses the same problem, and increase the length of the air gap in the moving direction of the voice coil by forming a groove in the back plate along the circumferential direction of the centre pole which corresponds to an annular recess on the inside wall of the yoke base around the cylindrical pole piece which faces the gap G and allow a large axial movement of a voice coil to be inserted in the gap G.

Thus, the subject-matter of the claim does not involve an inventive step.

3. There being no other requests, it follows that the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Magliano R. Moufang