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D E C I S I O N
of 11 March 2003

Case Number: T 0449/00 - 3.5.2

Application Number: 94107447.8

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Language of the proceedings: EN

Title of invention:
Electromechanical transducer for vehicle suspension

Applicant:
BOSE CORPORATION

Opponent:
-

Headword:
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Relevant legal provisions:
EPC Art. 56, 84

Keyword:
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Case Number: T 0449/00 - 3.5.2

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 11 march 2003

Appellant: BOSE CORPORATION
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 17 September 1999 refusing European patent application No. 94 107 447.8 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: W. J. L. Wheeler
Members: F. Edlinger
P. Mühlens

Summary of Facts and Submissions

I. The appeal was filed against the decision of the examining division to refuse European patent application No. 94 107 447.8, which had been filed as a divisional application of the earlier application No. 90 309 539.6.

II. The amended claims 1 to 3 on which the decision under appeal is based had been filed with a letter dated 3 February 1998. Claim 1 has the following wording:

"An electromechanical transducer comprising:

a first member (132) electromagnetically coupled to at least a portion of a second member (131), the first member and the second member being relatively slidable along a path between spaced end points, the first member (132) having a winding for producing a magnetic field having a significant component orthogonal to the path and penetrating the second member (131);

the second member (131) including at least one element (142) for interacting with the magnetic field, and

the first (132) and second (131) members being substantially symmetrical about a plane parallel to the path; characterised in that:

the second member (131) is disposed inside the first member and is comprised predominantly of a plurality of contiguous permanent magnets (142) of alternate polarity along the path for establishing a magnetic

field that reacts with the first member magnetic field to produce force along the path, wherein the mass of the second member is substantially that of the contiguous permanent magnets; and

the first member (132) has a plurality of contiguous windings (144) each producing a magnetic field having a significant component orthogonal to the path and penetrating the second member (131)."

Claims 2 and 3 are dependent on claim 1.

III. In the decision under appeal, the examining division found that the application did not meet the requirements of the Convention for several reasons which may be summarised as follows:

At least claim 1 was not clear and not adequately supported by the description. The terms "predominantly", "contiguous" and "substantially" rendered claim 1 unclear because they constituted "fuzzy" terms with no precise meaning and involved subjective judgement. The description of the application did not sufficiently disclose whether "contiguous" meant "touching" or merely "in close proximity". Concerning the arrangement of the permanent magnets, the use of these terms did not clearly define the conditions which had to be satisfied concerning their proximity and the proportion of their mass relative to the mass of the second member. A mass of the second member which was substantially that of the contiguous permanent magnets was not supported by the description because the embodiments comprised additional massive components, such as a magnet holder, bearing rails and a bushing. The application did not

disclose how additional components of negligible weight were formed, nor how the permanent magnets were held in place with sufficient strength and rigidity. The application did not disclose in a manner sufficiently clear and complete how the result specified in claim 3 ("the mass of the second member is as low as practical") could be achieved.

The subject-matter of claim 1 did not involve an inventive step over the prior art disclosed in US-A-4 859 974 (D2). The permanent magnets of the second member in D2, Figure 10B, were arranged in close proximity to each other and held in place by a light-weight supporting structure (D2, column 7, lines 30 to 36). The mass of the second member was therefore substantially that of the permanent magnets in the meaning of present claim 1. The feature of claim 1 specifying that the first member had a plurality of "contiguous windings" constituted the only potential distinguishing feature because the windings in D2 were formed by winding the stator winding around groups of neighbouring teeth (not shown in the figures of D2). However, in a linear motor of this type, it was conventional and thus obvious to arrange the windings in a contiguous manner.

IV. With the statement of grounds of appeal, the appellant requested oral proceedings and presented arguments which may be summarised as follows:

The objected terms of the claims had to be viewed in context and not standing alone. Similar terms had been used extensively in many patent claims, and to suggest that the use of these terms rendered a claim unclear was to set a wholly new precedent in claim

interpretation. The term "contiguous" should be construed in accordance with its primary meaning as meaning "in contact with or touching". It was clear from the description and the drawings, even from simply looking at the views of the transducer, that the volume occupied by the magnets was very much greater than that occupied by the remaining components of the second member and, given that magnetisable material generally had a relatively high density, the mass of the second member would be substantially that of the contiguous permanent magnets.

D2 (in particular Figures 1 to 3) disclosed an arrangement of permanent magnets with a considerable amount of material between them and which were not symmetrical. Moreover, the windings disclosed in D2 were not in the form of individual contiguous windings as specified in present claim 1, but were interwoven with one another through the slots and around groups of teeth (D2, column 6, lines 41 and 42). If contiguous windings were to be used, the person skilled in the art would consider that the moving member in D2 should have greater mass in order to provide larger inertia and smoother movement of the actuator because the magnetic fields generated by contiguous windings did not vary as smoothly as those generated by overlapping windings. The teaching of D2 therefore lead away from the present invention. None of the prior art documents indicated that a member having contiguous permanent magnets could provide a weight saving and might be utilised in a linear motor having contiguous windings.

V. The Board sent out summons to oral proceedings (dated 17 October 2002) accompanied by a communication setting out the Board's provisional view on the significance of

the objected terms and the lack of an inventive step. In response to a request by the appellant, the Board later postponed the date fixed for the oral proceedings to 25 March 2003.

VI. With letter dated 17 February 2003, the appellant advised the Board that they would not be attending the oral proceedings and that the Board should proceed to its deliberations on the basis of the arguments presented with the statement of grounds of appeal. The Board therefore cancelled the oral proceedings.

VII. The appellant contests the decision under appeal in its entirety and requests that the Board review the arguments previously put forward by the applicants and allow the appeal on the basis of its review of the arguments put forward by the applicants to date (page 3, paragraphs 2 and 3 of the statement of grounds of appeal).

Reasons for the Decision

1. The appeal is admissible. The statement of grounds of appeal is sufficiently detailed as to why the appellant considers that the decision under appeal should be set aside and is not merely limited to a review of arguments filed before the examining division (see point IV above). Since no amendments have been filed in the appeal procedure, the Board interprets the appellant's request as meaning that the decision under appeal should be set aside and that a patent should be granted on the basis of the documents on which the decision under appeal was based.

2. *Articles 83 and 84 EPC*

2.1 The decision under appeal refers to terms and features which were considered as being unclear: "predominantly", "substantially", "contiguous magnets", a mass which is "substantially that of the contiguous permanent magnets" and a mass which is "as low as practical".

2.2 All these expressions as far as they concern the second member (131) are related to a general object set out in the divisional application as filed (cf page 5, lines 15 to 25; page 6, lines 11 to 13; page 8, lines 20 to 22) which could be summarized as aiming at establishing a high force-mass relationship by maximizing the mechanical power for a given electrical power input while minimizing the mass of the second member (131). It should be noted that, in the embodiments, the second member disposed inside the first member is the moving element. According to the description (page 4, lines 29 to 33, and page 5, lines 5 to 10), a linear electric motor (32) embodies the transducer which may also function as a generator to convert mechanical work into electrical energy.

2.3 This object is achieved by arranging a plurality of "substantially contiguous permanent magnets" and by providing a second member which is comprised "predominantly" of the permanent magnets and has a mass that is "substantially the same as that of the contiguous permanent magnets". The only passage in the divisional application as filed where the term "contiguous" (instead of "substantially contiguous") is used in the context of permanent magnets is in claim 3, where this term is used as a reference to parts of

claim 1 without further specifying the contiguous arrangement. Page 7, lines 8 to 12, discloses "an array of contiguous permanent magnet elements", but this passage refers to different magnets which are part of a position sensor ("sensor magnet holder 143", "to sense flux changes"). The "contiguous" arrangement of the permanent magnets, as disclosed in its context, thus refers to close proximity of the magnets in view of a high force-mass relationship. To obtain dense packing, it may be desirable to arrange the magnets so that they touch each other. However, there is no disclosure in the application of the magnets being mounted in contact with each other, or of a technical effect achieved by physical contact between the permanent magnets, or of how this could be achieved without requiring mounting or holding material between the magnets.

2.4 The features "the second member (131) ... is comprised predominantly of a plurality of contiguous permanent magnets ... wherein the mass of the second member is substantially that of the contiguous permanent magnets" as specified in claim 1 set out certain minimum requirements for the vicinity of the permanent magnets and the mass composition of the second member to obtain the above object. It goes without saying that the mass of the second member cannot be exactly that of the permanent magnets (alone) because the second member has additional elements, such as a bushing (133), a bearing rail (147), a sensor magnet holder (143), sensor magnets, etc (cf page 6, lines 24 to 29; page 7, lines 8 to 12). Although these features do not clearly define a precise distance and relative mass of the permanent magnets, they may be considered as sufficiently clear and supported by the description (Article 84 EPC) for defining a solution at a general

level to the problem of establishing a high force-mass relationship, and allow a comparison with prior art to be made for judging inventive step.

2.5 The feature of claim 3 specifying that "the mass of the second member is as low as practical" does not substantially change this solution. In the given circumstances, the Board need not decide whether claim 3 complies with Article 83 EPC.

2.6 Concerning the term "contiguous windings", claim 1 (repeated on page 2, lines 3 to 22) as filed with the divisional application is the only place where a plurality of "substantially contiguous" windings was disclosed. The description only refers to "coils, such as 144", which are said to be illustrated in Figures 5 to 7 (see page 6, lines 20 to 33). Figure 7 shows (six) compartments for coils (144) which appear to be separated by spacers (not mentioned in the description). The electrical circuit of Figure 4 shows three phase currents I_a, I_b, I_c, from which it might be concluded that six coils (or coil sides) forming three phase windings are intended to be arranged in the adjacent compartments of Figure 7. Therefore, the description does not clearly support any arrangement of (individual, eg concentrated) "windings" which are "contiguous" in the meaning of touching or in contact with each other. Since no structural details of the windings (or coils) and their "substantially contiguous" arrangement are disclosed in the present application, this feature can only be taken as meaning that the windings are arranged in any conventional manner and in close proximity concerning the adjacent coils (or coil sides), to provide a suitable space distribution of field flux for embodying a linear

electric motor.

3. *Inventive step (Article 56 EPC)*

3.1 It has not been contested by the appellant that D2, Figures 8, 9, 10A to 10D, discloses an electromechanical transducer comprising the features of the preamble of claim 1 (cf point II.3.1 of the decision under appeal). The second member in D2 (moving element 75', 200) is disposed inside the first member (stator 90, 95) and has permanent magnets (50, 230) of alternate polarity along the path (D2, column 7, lines 25 to 33) for establishing a magnetic field that reacts with the first member magnetic field to produce force along the path (D2, column 8, lines 63 to 68: "linear electromagnetic actuator").

3.2 It can be seen from Figures 10A to 10C that the permanent magnets (230) of this embodiment are arranged substantially symmetrical about a plane parallel to the path of relative motion (side rails 65 and 70 move in channels 125 and 120; cf D2, Figure 8 and column 6, lines 10 to 13), so that core symmetry and a neutral bearing force would also be achieved by this arrangement (cf page 8, lines 4 to 8, of the present application). The second member (200) is comprised "predominantly" of a plurality of "contiguous" permanent magnets (230) in that the magnets occupy the largest part of the volume of the second member and the magnets are arranged in close proximity (D2, Figures 10A and 10B; cf points 2.3 and 2.4 above). The ladder structure (205) holding the magnets may be punched from light-weight material, such as aluminum (D2, column 7, lines 33 to 36) and additional components (eg side rails 65, 70) in D2 do not take up

noticeably more space than corresponding parts in Figures 5 to 8 of the present application. Moreover, a similar object of achieving a high force-mass relationship ("high force levels with respect to the volume occupied") is explicitly stated in D2 (column 1, lines 52 to 57; column 9, lines 4 to 10). Although D2 is silent on the relative mass composition of the second member, making the mass of the second member substantially that of the contiguous permanent magnets would constitute an obvious embodiment in view of the structure disclosed in D2 and the common general knowledge in the art that magnetisable material is generally of a relatively high density. The appellant's argument that the person skilled in the art would be led away from providing contiguous magnets and windings as claimed cannot be accepted. Neither does claim 1 specify a clearly distinguishable closer arrangement of the permanent magnets, nor does it set out features which contribute to make the magnetic fields generated by contiguous windings vary more smoothly so that the windings and permanent magnets could be brought in closer proximity.

3.3 In accordance with the disclosure of D2 (Figure 8, 8A, 9 and column 7, lines 15 to 18), the first member (stator 90, 95) would be as described for the other embodiments. Windings are thus arranged in a plurality of stator slots (130), in a conventional manner, and constitute a plurality of "contiguous windings" in the meaning of present claim 1 (see point 2.6 above). The appellant's argument that the plurality of contiguous windings of the first member as specified in present claim 1 are different because they are not interwoven (as may be the case in D2) must fail because such a difference is not specified in claim 1 (and is not

supported by a clear and complete disclosure in the application).

3.4 The subject-matter of claim 1 is therefore obvious to a person skilled in the art in view of the prior art disclosed in D2, and the present application does not meet the requirements of Article 52(1) and 56 EPC in combination.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Sauter W. J. L. Wheeler