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File Number: T 607/90 - 3.4.1

Application No.: 84 308 970.7

Publication No.: 0 158 749

Title of invention: Semiconductor device having pressure loaded members

Classification: H01L 23/48

DECISION
of 6 March 1991

Applicant: Mitsubishi Denki Kabushiki Kaisha

Headword:

EPC Art. 56

Keyword: "Inventive step (no)"
"Field of the solution determining the competent skilled person"
"No evidence for the general validity of an alleged prejudice"

Headnote



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Boards of Appeal

Chambres de recours

Case Number : T 607/90 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 6 March 1991

Appellant : Mitsubishi Denki Kabushiki Kaisha
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Decision under appeal : Decision of Examining Division of the European
Patent Office dated 22 February 1990 refusing
European patent application No. 84 308 970.7
pursuant to Article 97(1) EPC.

Composition of the Board :

Chairman : G.D. Paterson
Members : H.J. Reich
Y. van Henden

Summary of Facts and Submissions

I. European patent application 84 308 970.7 (publication number 0 158 749) was refused by a Decision of the Examining Division in respect of Claim 1 filed on 11 January 1989.

II. The reason given for the refusal was that Claim 1 did not satisfy Articles 52(1) and 56 EPC with regard to documents:

D1: Japanese patent No. 57-62562 (62562/82),

D2: US-A-3 992 717,

and the generally known state of the art concerning coned disc springs. It would be obvious to a skilled person to make use of a per se known coned disc spring in adapting the spring housing within a cavity of a conductive block known from document D2 to the semiconductor device known from document D1 in order to provide good electrical contact to its ring-shaped control electrode.

III. The Appellant lodged an appeal against this decision.

IV. In a communication preparing oral proceedings, the Board drew the Appellant's attention, inter alia, additionally to document:

D3: Tochtermann/Bodenstein: "Konstruktionselemente des Maschinenbaues", Teil 1, Springer-Verlag Berlin, 1979, pages 189 to 192

as evidence that coned disc springs are known to solve the technical problem put forward in the grounds of appeal, i.e. to balance manufacturing tolerances. In reply to

this communication the Appellant filed on 6 February 1991 main, first and second auxiliary requests, and document "International Conference on Power Electronics and Variable-Speed Drives", 1-4 May 1984, issued by the Institution of Electrical Engineers, London, as exemplary evidence showing that GTO (gate-turn-off) thyristors have larger control electrode currents than typical semiconductor devices.

V. Claim 1 of the main request reads as follows:

"1. A semiconductor device suitable for use with large control electrode currents, the device comprising a semiconductor component (13), a ring-shaped control electrode (11) formed on a surface of said semiconductor component (13), a first main electrode (12b) also formed on said surface of said semiconductor component (13) and disposed within said control electrode (11), a second main electrode (12a) formed on said surface of said semiconductor component (13) so as to surround said control electrode (11), a control electrode plate (15) pushed onto said control electrode (11) to be in contact therewith, an insulating plate (17) on said control electrode plate (15), main electrode plate means (16a, 16b) pushed onto said first and second main electrodes (12a, 12b) to be in contact therewith, and a conductive block (19) applying pressure to said control electrode plate (15) via said insulating plate (17) and to said main electrode plate means (16a, 16b) characterised in that:

said conductive block (19) has a concave portion housing resilient means (23) for exerting pressure on either said insulating plate (17) or said main electrode plate means (16a, 16b), and further characterised in that

said resilient means (23) is a coned disc spring for exerting pressure over a ring-shaped area."

Claims 1 of the auxiliary requests correspond to Claim 1 of the main request wherein the starting words "A semiconductor device suitable for use with large control electrode currents, the device ..." are replaced:

in the first auxiliary request (alternative Submission A) by the words:

"A semiconductor device constituting a GTO, the device..."

and in the second auxiliary request (alternative Submission B) by the words:

"A semiconductor device constituting a GTO suitable for use with large control electrode currents, the device..."

Claims 2 to 14 of the main, first and second auxiliary requests are identically worded and dependent on the respective Claim 1.

VI. Oral proceedings were held before the Board at the end of which the Appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the main, first or second auxiliary requests filed on 6 February 1991.

VII. In support of his requests the Appellant argued essentially as follows:

(a) The spring arrangement known from document D2 is not suited for producing a uniform pressure on a large area and therefore does not work in a GTO thyristor according to the present application, which is

disclosed to have an enlarged current capacity; see the original description page 2, lines 11 to 14.

- (b) There is a prejudice against the use of springs in high current devices as evidenced by the fact that no such document is on file.

- (c) The skilled person qualified in the present case is a semiconductor expert, who has no knowledge in mechanics and, in particular, does not know that coned disc springs exist and provide a uniform pressure. A semiconductor specialist will only after several steps arrive at the claimed coned disc spring, which is only one of a host of solutions: other solutions would for instance be a different manufacturing technique, a different material for the insulating ring or a shim.

Reasons for the decision

- 1. The appeal is admissible.

- 2. **Inventive step**

- 2.1 From document D1 a semiconductor device is known, which has all the features defined by the pre-characterising parts of Claims 1 of the main and first and secondary auxiliary requests.

The subject-matter of Claims 1 of all said three requests differs from the device of document D1 in the identically worded characterising part, i.e. in that:

- (a) "said conductive block (19) has a concave portion housing resilient means (23) for exerting pressure on

either said insulating plate (17) or said main electrode plate means (16a, 16b);" and in that

b) "said resilient means is a coned disc spring for exerting pressure over a ring-shaped area."

2.2 The remaining documents on file do not come closer to the device claimed in Claim 1. In particular neither document D2 nor any other document cited in the European Search Report disclose a semiconductor device with a ring-shaped control electrode placed in between a first and a second main electrode or with a coned disc spring.

2.3 Starting - in correspondence with the description of the present application - from document D1, the objective problem underlying the present invention is to avoid irregularities in the size of the control electrode plate and its insulating plate as the result of tolerances in the manufacturing process, i.e. to avoid misalignments which may either cause damage to the insulating plate or an insufficient contact pressure between control electrode and semiconductor body; see also the description, page 4, lines 1 to 17 and page 5, lines 16 to 19.

The above deficiencies will be found automatically in practice by a skilled mechanical engineer who is regarded by the Board to be the competent expert for the manufacturing process of the device components outside the semiconductor wafer. Thus, no contribution to inventive step is to be found in the recognition of this problem.

2.4 The above-mentioned problem is solved according to the identical characterising parts of Claims 1 of all three requests by housing a coned disc spring (feature (b) in para. 2.1) in the conductive block for exerting pressure

on the insulating plate or main electrode plate means (feature (a) in paragraph 2.1).

- 2.5 It is known from document D3, in particular page 190, paragraph 2, to balance manufacturing tolerances by a coned disc spring, i.e. by feature (b). The teaching of document D3 is kept quite general and not specified to one particular use. In the Board's view, a solution of a general mechanical problem in a non-specific field must be considered to form part of the general technical knowledge of a mechanical engineer; see also Decision T 195/84, OJ EPO 1986, 121, in particular point 8.4. Hence, no inventive step can be seen in the fact that the same skilled person - a mechanical engineer - who discovers the technical problem, applies his general expert knowledge in order to solve it.

Even if - in view of the Appellant's argument in paragraph VII(c) - a semiconductor specialist became aware of the above problem of manufacturing tolerances, he would nevertheless not be the specialist whose knowledge and ability have to be taken into account in the assessment of whether the solution involves an inventive step. If the problem prompts the person skilled in the art to seek its solution in another technical field, the specialist in that field is the person qualified to solve the problem; see also Decision T 32/81, OJ EPO 1982, 225. Hence, again, the question whether the provision of a coned disc spring implies an inventive step would have to be decided on the knowledge and abilities of the mechanical engineer.

In the Board's view, a mechanical engineer is conscious of the fact that a coned disc spring exerts a uniform pressure along its annular contact area on the basis of

its axial symmetry and will automatically apply it where such uniform pressure has to be realised. The recognition of the necessity for and the advantages of a pressure uniformity for a control contact is held to fall within the general routine capacities of the skilled person. Hence, though there may be a host of other solutions, nothing inventive can be seen in selecting among known technical means a particular one which appears to be the most appropriate for a given purpose on the basis of its well known properties. Thus, nothing inventive can be seen in feature (b) of the characterising part.

2.6 Once having in an obvious way decided to balance unwanted manufacturing tolerances by a coned disc spring, a skilled person will consult the prior art about possibilities for housing spring means in the field of semiconductor devices and take into account document D2, from which feature (a) of the characterising part is known, i.e. a conductive block which has a concave portion housing resilient means for exerting pressure on an insulating plate; see document D2; figure 2. The conversion of the known central circular concave portion into an annular concave portion for housing the selected coned disc spring as well as the realisation of its alternative site "for exerting pressure on said main electrode means" represent, in the Board's view, constructional routine measures of no inventive merit, so that the skilled person would arrive at the subject-matter of Claims 1 of all three requests without exercising an inventive step.

2.7 The Appellant has produced no evidence that a prejudice against the use of coned disc springs - or generally of resilient means - in high current semiconductor devices existed in the art and was generally valid, i.e. that it was a widespread opinion which was generally shared by

all experts in the particular field; see also the Decision T 19/81, OJ EPO 1982, 51. Moreover, in the Board's view, the skilled person can be regarded as able to dimension the conductive block and eventually provide additional cooling means in such a way, that also for high current applications the working temperature within the conductive block stays low and allows the elastic properties of a spring to be maintained. Contrary to the Appellant's view, the lack of a description of this application in a prior art document does not prove the existence of a prejudice, cf. paragraphs VII(a) and (b) above.

- 2.8 For the above reasons, the Board regards it as obvious to make use of a coned disc spring known from document D3 for balancing manufacturing tolerances and to house such a spring in a concave portion of a conductive block in analogy to the teaching of document D2.
3. Therefore, Claims 1 of the main and first and second auxiliary requests are considered to lack an inventive step and not to be allowable with regard to Articles 52(1) and 56 EPC. Claims 2 to 14 of these requests fall because of their dependence on the respective Claim 1.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

M. Beer

G.D. Paterson