BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:
(A) [ ] Publication in OJ
(B) [x] To Chairmen and Members
(C) [ ] To Chairmen

D E C I S I O N
of 8 December 1999

Case Number: T 0962/94 - 3.4.3

Application Number: 89119422.7

Publication Number: 0365007

IPC: H01L 23/051

Language of the proceedings: EN

Title of invention:
Crimp-type semiconductor device having non-alloy structure

Applicant:
Kabushiki Kaisha Toshiba

Opponent:
-

Headword:
Pressure-contact semiconductor device/KABUSHIKI KAISHA TOSHIBA

Relevant legal provisions:
EPC Art. 52(1), 56
EPC R. 86(3)

Keyword:
"Inventive step (denied) - no common problem which the distinguishing features cooperate to solve"
"Late filed amendments (not admitted) - not clearly allowable"

Decisions cited:
T 0092/93, T 0644/89

Catchword:

-

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0962/94 - 3.4.3

D E C I S I O N
of the Technical Board of Appeal 3.4.3
of 8 December 1999

Appellant: Kabushiki Kaisha Toshiba
72, Horikawa-cho
Saiwai-ku
Kawasaki-shi
Kanagawa-ken 210-8572 (JP)

Representative: Lehn, Werner, Dipl.-Ing.
Hoffmann Eitle
Patent- und Rechtsanwälte
Postfach 81 04 20
81904 München (DE)

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 1 August 1994 refusing European patent application No. 89 119 422.7 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: R. K. Shukla
Members: E. Wolff
A. C. G. Lindqvist

Summary of Facts and Submissions

I. The appeal lies against the decision of the examining division, dated 1 August 1994, refusing the European patent application No. 89 119 422.7 for lack of inventive step.

The following prior art documents were considered in the decision appealed against:

D1: EP-A-0 285 074

D2: DE-A-3 308 661

D3: EP-A-0 098 175

The appeal was filed on 30 September 1994 and the appeal fee was paid on the same day. The statement of grounds was filed on 2 December 1994.

II. At the oral proceedings before the Board, the applicant submitted a revised set of claims, of which claim 1 reads as follows:

"1. A crimp-type semiconductor device comprising

a semiconductor pellet (60) having first and second major surfaces and having first and second main electrodes (70, 82) formed on said first and second major surfaces respectively, and a control electrode (72) formed on said first major surface, said first main electrode (70) and said control electrode (72) being arranged on one of said major surfaces so as to

be alternately staggered with each other;

first and second electrode members (78, 84) each having first and second opposing surfaces, said first opposing surfaces being arranged to oppose said first and second major surfaces, respectively; and

first and second electrode posts (80, 86) arranged to oppose respective second opposing surfaces of said first and second electrode members (78, 84) for crimping said main electrode (70, 82) formed on said first and second major surfaces via said respective first and second electrode members (78, 84);

characterized in that

said first and second electrode members (78, 84) are arranged such that said first opposing surfaces thereof are not bonded to but crimped in contact with said first and second major surfaces, respectively, and said second opposing surfaces thereof are not bonded to but crimped in contact with said first and second electrode posts (80, 86), respectively,

said first opposing surfaces being formed to cover the entire surfaces of said main electrodes (70, 82), respectively, and said second opposing surfaces being formed to cover the entire surfaces of said first and second electrode posts (80, 86) wherein

an outer diameter of said first and second electrode members (78, 84) is larger than that of said corresponding main electrode (70, 82), respectively;

an outer diameter of said first and second main electrodes (70, 82) is larger than an outer diameter of said corresponding first and second electrode posts (80, 86), respectively; and

the outer diameters each of said first and second main electrodes (70, 82), each of said first and second electrode members (78, 84), and each of said first and second electrode posts (80, 86) are formed equal to each other, respectively;

positioning guide means (96, 88) are arranged close to at least one of said first and second electrode members (78, 84) and at least one of said first and second electrode posts (80, 86), for positioning at least one of said first and second electrode members (78, 84) with respect to at least one of said first and second electrode posts (80, 86) to be crimped against said electrode members (78, 84); and;

emitter regions (68, 62) are formed in said first and second major surfaces close to said main electrodes (70, 82) such that said emitter regions through which a main current substantially flows in said semiconductor pellet (60) are covered with said electrode members (78, 84), respectively."

III. The applicant further requested during the oral proceedings that as an auxiliary request a new set of claims be admitted into the proceedings. Claim 1 of this auxiliary request differed from the existing claim 1 in that it required in addition that:

(A) said first electrode (70) and said first electrode

member (78) each have a central recess accommodating a gate lead (92) connected to said control electrode (72) which is arranged coaxially to said central recess,

and that:

(B) at said central recess, an inner diameter of said first electrode member (78) is smaller than an inner diameter of said corresponding first main electrode (70).

IV. In support of the inventive step of the invention the applicant argued essentially as follows:

(a) The invention aims to provide a crimp-type semiconductor device with enhanced performance and stability as compared to devices in which the claimed dimensional relationships are not observed.

(b) To achieve this aim, the invention as claimed requires

(i) that the diameters of the main electrodes, the electrode members and the electrode posts are dimensioned such that the electrode member interposed between the respective main electrode and its associated electrode post has a larger diameter than either that post or that electrode, and that the main electrode has a larger diameter than its associated electrode post;

and

(ii) that there is pairwise symmetry with respect to the diameters of the main electrodes, the electrode members and the electrode posts.

(c) There is also a synergistic effect in that the pairwise symmetry of the components leads to simplifications in manufacture.

(d) Document D1 neither teaches the pairwise symmetry of the invention as claimed, nor discloses all of the claimed relationships between the outer diameters of the main electrodes, the electrode members and the electrode posts.

(e) A layer of fusible metal on the anode side of the device in D1 is not an electrode and that therefore, contrary to the specific requirement in claim 1, the heat buffer plate corresponding to one of the electrode members of claim 1 concerned is not in contact with an electrode of the device.

(f) Document D2, while showing a symmetrical contact arrangement, relates to a different kind of semiconductor device and hence is not relevant to the problem addressed by the present invention as claimed.

V. With regard to the admissibility of the auxiliary request, it was submitted by the appellant that the amendments (A) and (B) to claim 1 of the auxiliary request were disclosed respectively in the claims as filed and in the original description. Moreover, the

features as in amendment (B) were not disclosed in any of the prior art documents, so that the claim so amended involved an inventive step.

Reasons for the Decision

1. The appeal is admissible.

2. *Inventive step*

2.1 Document D1 can be regarded as the closest prior art. It relates to a pressure contact semiconductor device, that is, a semiconductor device in which electrical connection to the device is provided by a pair of opposing external electrodes (8, 9) pressing against respective main electrodes (6.1, ...; 12) on opposite sides of a semiconductor element (2). On each side of the semiconductor element, a conducting plate (10, 13) is placed between the element and the external electrode. Each of the conducting plates is larger in diameter than both the end of the conducting post and the main electrode, respectively, which are in contact with that conducting plate. Base electrodes (7-1, ...), corresponding to the control electrode of the device according to claim 1, are arranged on a major surface of the semiconductor element so as to interdigitate with one of the main electrodes (6.1, ...).

Regarding the layer of fusible metal (12) on the anode side of the device in D1, the Board cannot accept the applicant's argument that the metal layer cannot be regarded as an electrode. The layer concerned covers the semiconductor material of the device, and

electrical connection between the electrode post and the semiconductor material is made, via the heat buffer plate, through that metal layer. Although the metal layer is disclosed to be of a fusible metal such as solder, so that its primary function is apparently for bonding the heat buffer plate (13) to the semiconductor element, the Board is of the view that, whether designated as such or not, the metal layer also performs the same function as an electrode, and therefore can be considered to be an electrode.

Consequently, and contrary to the argument put forward by the applicant, there was an electrode member (13) which is in contact with both an electrode of the device and its associated electrode post and which has a larger diameter than either.

2.2 The subject matter of claim 1 is thus distinguished from the closest prior art in that:

(i) the second electrode member (84) is in pressure contact with its associated main electrode (82) and is not bonded thereto;

(ii) the outer diameters of each of the pairs of the first and second main electrodes, the first and second electrode members and the first and second electrode posts, are equal;

(iii) the outer diameter of the main electrode(s) is greater than the outer diameter of the associated electrode post(s);

(iv) the positioning guide means (96, 98) are provided

adjacent to at least one of the electrode members and at least one of the electrode posts for positioning the electrode member with respect to the electrode post, and

(v) emitter regions (68, 62) are formed in first and second major surfaces of the semiconductor element such that the emitter regions are covered by the electrode members.

2.3 The object of the invention as stated in the application as filed is to provide a pressure type semiconductor device in which excessive local crimp pressure and stress on the semiconductor pellet is avoided, in which satisfactory heat transfer from the device can be obtained and in which there is even current flow across the device to improve its ability to withstand excess currents and voltages (cf. page 7, lines 14 to 23). As explained in detail with the aid of Figures 7 and 8, it is the use of an electrode member that has a larger diameter than the adjoining electrode and electrode post, which results in a uniformly stressed device as well as providing for a more even heat transfer and current flow across the device.

It is, on the other hand, not derivable from the description of the invention that the complete symmetry of the electrodes, electrode members and electrode posts as in feature (ii) or the relative dimensions of the electrodes and electrode posts as in feature (iii) either alone or in combination with the other features, contributes anything towards achieving the uniform stress distribution aimed at by the present invention (see, in particular, page 5, line 2 to page 6, line 22;

page 13, line 30 to page 15, line 17 and Figures 2, 3, 4A, 4B, 7A, 7B and 8).

2.4 In the Board's view, therefore, the problem as stated in the application itself must be taken to have been solved by the semiconductor device of document D1, since that device has conducting plates, i.e., electrode members which are interposed between the main electrodes and their respective electrode posts and which have

(a) a larger diameter than the associated electrode, and

(b) a larger diameter than that portion of the electrode post through which the contact pressure is applied.

2.5 The objective technical problem addressed by the claimed invention must therefore be redefined having regard to the features (i) to (v) by which the claimed invention is distinguished from the nearest prior art. In this context it is apparent from the description of the invention that there is no further common problem which features (i) to (v) cooperate to solve; instead, each feature addresses a separate aspect of a pressure-contact type semiconductor device such as disclosed in D1, as explained in the following:

2.5.1 The pairwise symmetry of the electrode arrangement as in feature (ii), it was submitted by the applicant, simplifies the production of the device. Feature (iv), in the Board's view, has a similar function in that the provision of guide means facilitates the assembly of

the device.

Document D2 relates to a pressure contact semiconductor device in which the pressure contact structure, including conducting plates (9, 31) interposed between the posts (32, 35), is largely symmetrical about the major plane of the device. Although the pairwise symmetry for the **main electrodes** is not disclosed in document D2, the skilled person would regard this as a normal design possibility given that the electrode posts and the electrode members are symmetrical. The pressure-contact semiconductor device of document D2 is also provided with positioning guides which hold the components in alignment during the assembly of the device.

It is the considered opinion of the Board that in view of the teachings of document D2 it would be obvious for a person skilled in the art, who is concerned with the problem of simplifying the device manufacture and assembly of the device, to incorporate features (ii) and (iv) in the device of document D1.

2.5.2 Feature (iii) concerns the relative dimension (the outer diameter) of the main electrode. No technical effect is, in the Board's opinion, derivable for this feature from the application as filed (see in particular Figures 7A and 8 of the application in suit), so that this feature has to be regarded as an alternative to the known relative dimension of the main electrode in document D1. In the Board's view, therefore, this was one of the normal design possibilities which would have been obvious to the skilled person.

2.5.3 Similarly, the requirement that the second electrode member is in pressure contact with the associated main electrode (feature (i)), does not appear to have any technical significance in achieving uniform stress distribution or current distribution, and merely provides an alternative way of forming contact between the electrode member and the main electrode. The pressure-contact, in the Board's view, would be regarded as one of the known alternatives, since, as acknowledged in the application as filed, both types of contacts are known in the art.

2.5.4 The provision of emitter regions as in feature (v) merely implies a specific type of device (i.e., a double gate GTO thyristor), which is per se known in the art. Feature (v) also requires that the emitter regions be covered by the electrode members, so that all of the device current flowing through the emitter regions flows through the electrode members. It is known from document D1 to cover the electrodes fully by their respective electrode members, which results in substantially all of the device current flowing through the electrode members. The use of pressure contacts for a known device, as in feature (v), therefore, was obvious.

2.5.5 For the foregoing reasons, in the Board's judgement, the subject matter of claim 1 does not involve an inventive step within the meaning of Article 56 EPC.

3. *Auxiliary request - Admissibility*

3.1 According to the established case law of the boards of appeal, the admissibility of new requests containing

amendments filed before or during the oral proceedings depends upon whether or not the amended claims forming the new request are clearly allowable in the sense that they clearly do not give rise to new objections under the EPC and clearly meet the outstanding objections under the EPC including the objection under Article 52(1) EPC (see, e.g., T 92/93, T 644/89).

In the present case, claim 1 of the auxiliary request which was filed during the oral proceedings after the discussion of the patentability of claim 1 of the main request, contained amended features (A) and (B) mentioned in item III above. From document D2 there is known a centrally located contact arrangement for connection to the gate electrode as well as means to position at least one of the electrode members with respect to its associated electrode post as stated in feature (A). The same features are known also from the prior art device described and discussed with the aid of drawings in the patent application itself.

Regarding feature (B), it is apparent that in the embodiment of the invention as shown in Figure 6, the inner diameter of the first electrode member is **not** smaller than that of the corresponding first main electrode. Thus, the embodiment as shown in Figure 6 is inconsistent with the amendments as in feature (B)

It follows from the foregoing that claim 1 of the (proposed) auxiliary request is not clearly allowable since it is not clear that the embodiment as shown in Figure 6 is consistent with the amended claim and that the requirement of inventive step is met. In the exercise of the Board's discretion under Rule 86(3)

EPC, the auxiliary request is therefore not admitted into the proceedings.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Spigarelli R. K. Shukla