

Internal distribution code:

- (A) [] Publication in OJ
(B) [] To Chairmen and Members
(C) [X] To Chairmen
(D) [] No distribution

D E C I S I O N
of 28 June 2001

Case Number: T 0926/96 - 3.4.3

Application Number: 91115551.3

Publication Number: 0475432

IPC: H01L 21/66

Language of the proceedings: EN

Title of invention:
Wire bonding inspection equipment

Applicant:
KABUSHIKI KAISHA TOSHIBA

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (no)"
"Obvious combination of known features"

Decisions cited:

T 0363/94

Catchword:

-



**Europäisches
Patentamt**

**European
Patent Office**

**Office européen
des brevets**

Beschwerdekammern

Boards of Appeal

Chambres de recours

Case Number: T 0926/96 - 3.4.3

D E C I S I O N
of the Technical Board of Appeal 3.4.3
of 28 June 2001

Appellant:
(Opponent)

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
D-81904 München (DE)

Decision under appeal:

**Decision of the Examining Division of the
European Patent Office posted 15 May 1996
refusing European application No. 91 115 551.3
pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: R. K. Shukla
Members: V. L. P. Frank
J. H. P. Willems

Summary of Facts and Submissions

I. The appeal lies from a decision of the examining division, dated 15 May 1996 to refuse European patent application No. 91 115 551.3 for lack of an inventive step. The decision mentions inter alia the following prior art documents

D1: Patent Abstracts of Japan, vol. 11, No. 257
(E-534), 20 August 1987 & JP-A-62 067 830

D2: US-A-4 255 851

II. The appellant (applicant) lodged an appeal on 15 July 1996. The appeal fee was paid the same day. The statement setting out the grounds of appeal was filed on 25 September 1996.

III. During the oral proceedings held on the 28 June 2001 the appellant submitted claim 1 of a main request and each of the auxiliary requests 1 to 3.

IV. Independent claim 1 of the main and first auxiliary request reads as follows:

Main request:

"1. A wire bonding inspection equipment for use in a wire bonding step for wire bonding a semiconductor device (3) to a surrounding member (2), and in a sealing step for sealing the semiconductor device, comprising:

judging means (7) for judging whether or not the wire bonding is acceptable and for producing a defect signal for the semiconductor device whose wire bonding is judged defective; and

breaking means, responsive to said defect signal, for breaking wires of the semiconductor device whose wire bonding is judged defective, characterized by:

defective mark applying means (13) for applying a defect mark on the combined defective semiconductor device and lead frame in response to the defective signal, said defect mark applying means being arranged to apply said defect mark on an area of the combined defective semiconductor and lead frame other than an area designated to be covered with a sealing material."

1st auxiliary request:

"1. A method of operating a wire bonding inspection equipment for use in a wire bonding step for wire bonding each of a plurality of semiconductor devices (3) to a surrounding member (2), and in a sealing step for sealing the semiconductor device, the equipment comprising:

judging means (7) for judging whether or not the wire bonding of each of the semiconductor devices is acceptable and for producing a defect signal for any semiconductor device whose wire bonding is judged defective;

breaking means, responsive to said defect signal, for breaking wires of the semiconductor device whose wire bonding is judged defective; and

defect mark applying means (13) for applying a defect mark on the combined defective semiconductor devices and lead frame in response to the defective signal, said defect mark applying means being arranged to apply said defect mark on an area of the combined semiconductor devices and lead frame other than an area designated to be covered with a sealing material,

said method comprising the steps of:

using the inspection equipment to inspect the wire

bonding of all the semiconductor devices on the surrounding member (2) and to break the wires of, and apply a defect mark for, the or each semiconductor device whose wire bonding is judged to be defective; and

returning the inspected surrounding member (2) to a supply magazine (1) from which it was previously taken prior to inspection."

Claim 1 of the 2nd auxiliary request differs from claim 1 of the main request in that it further specifies that the breaking means comprises a pressing plate member (11) for breaking all bonded wires of said defective semiconductor device, and means (10) for moving said pressing plate member relative to the semiconductor device.

Claim 1 of the 3rd auxiliary request differs from claim 1 of the 1st auxiliary request in that the breaking means are as specified in claim 1 of the 2nd auxiliary request.

V. The arguments presented by the appellant can be summarised as follows:

- (i) Document D1, which is the closest prior art, discloses an equipment comprising a wire bonding testing station and a wire breaking station. The wire breaking station breaks the wires of the devices found to be defective by the testing station. The problem addressed by the invention having regard to the disclosure in document D1 was to improve the reliability of the operation of the wire bonding inspection equipment, and in particular, of the identification of the

defective devices. There were, however, a multitude of options that a skilled person would consider for solving this problem. Although, the application of a visible mark on the defective devices was an available option (e.g. document D2), there was no reason why a skilled person would select this last option which entailed the use of an additional expensive and complicated marking means.

- (ii) Document D2 discloses an equipment in which the integrity of the substrate is tested by an ultrasonic detector and a defect mark is applied on the lead frame if the substrate is found to be defective. A skilled person would not have applied this teaching to the equipment disclosed in document D1 in the way it is done in the application in suit. An obvious combination of documents D1 and D2 results in an equipment comprising wire bonding and substrate testing stations. If the wire bonding was found to be defective then some wires would be broken and if the substrate was found to be defective then a visible mark would be applied on the device. The obvious combination of both teachings results thus in a completely different equipment than the one disclosed in the application in which the wires are broken **and** a mark is applied if the wire bonding is defective.

- (iii) The appellant also pointed out that document D2 is not concerned with increasing the reliability of an identification process, but relates instead to the application of an indelible mark by a safe and relatively inexpensive method which does not

disturb adjacent devices (cf. D2, column 1, lines 61 to 68). There was thus no reason for a skilled person to consider this document when looking for a solution to the problem mentioned above.

Reasons for the Decision

1. The appeal is admissible.
2. *Amendments (Article 123(2) EPC)*

Claim 1 of all the requests have been amended during the appeal proceedings. The Board is satisfied that these amendments do not contravene the requirement of Article 123(2) EPC. Since the claims are not allowable for lack of an inventive step for the reasons which follow, these amendments are not discussed in detail here.

3. *Inventive step (Article 56 EPC)*

The only issue in the appeal is that of inventive step

- 3.1 Main request

- 3.1.1 It is not in dispute that document D1 represents the closest prior art.

The document discloses (cf. Abstract) a wire bonding inspection equipment comprising an inspection and judging unit formed by a television camera (7) and a controller (8), and a wire breaking unit comprising a laser (9). The inspection and judging unit is located

after the wire bonding stage (4) and decides after inspection if the wire bonds are of an acceptable quality. If the wire bonds are judged to be unacceptable a bonding wire of the device is melted down by the laser beam (9a). The corresponding Japanese patent application discloses two further embodiments in which the laser is replaced either by a mechanical cutting apparatus (cf. Figure 2, ref. 9b) or by a pressing plate which is lowered onto the semiconductor device (cf. Figure 3, ref. 9c). This document is silent on the further processing of the defective devices. It is, however, implicit in the disclosed process that at least the devices considered to be acceptable are transferred to a final sealing station, since semiconductor devices are invariably protected by a suitable sealant.

Although, it is stated in the English abstract of document D1 that "**a** bonding wire is melted down" by the laser beam (emphasis added), it is clear that the breaking means disclosed in this document are suitable for breaking more than a single wire of the devices judged to be defective.

3.1.2 The inspection equipment claimed in claim 1 of the application in suit thus differs from this known equipment in that in response to a defect signal indicating a defective wire bonding in a device, a defect mark is applied on an area of the defective device which is not covered by the sealing material.

3.1.3 This feature improves the reliability of the inspection equipment. In document D1, in the event that a wire of a defective device is not completely broken due to a malfunction of the breaking means, it is likely that

the defective device would not be identified as such by the subsequent functional test and would be sealed and classified as being non defective. The provision of a mark on an area not covered by the sealing means allows a visual identification of the defective article even after it has been sealed.

The Board therefore agrees with the finding of the examining division that the objective problem addressed by the application in suit is the improvement of the reliability of the inspection equipment known from document D1. This finding has not been contested by the appellant.

3.1.4 The skilled person in the art, in the present case a quality control engineer, would notice during the routine quality control inspections that some defective devices have not been correctly identified by the inspection equipment and would thus recognize the need of improving its reliability. Consequently, no inventive step can be recognized by the Board in the formulation of the problem.

3.1.5 The appellant has argued that the skilled person would think of several ways of solving this problem; thus, for example, more reliable breaking means could be employed, or a second testing station could be provided after the breaking means which would issue a warning signal if the wires are not properly broken, or the defective devices could be removed from the process line before being sealed, or the reliability of the functional test, which is carried out after the wires have been broken and the device is sealed could be improved. The provision of a defect mark is a further possibility. However, the fact that the present

solution has been chosen from the multitude of possible options is an indication of inventive step, as no pointer towards it is found in the prior art.

However, the Board does not find this argument persuasive, since the mere fact that several ways exist for solving a problem does not impart inventiveness to the selection of one of them. What has to be considered instead is whether the chosen solution was obvious or not to the skilled person in the light of the prior art.

Indeed, the use of an indelible, optical mark for identifying defective devices is known from document D2. This document discloses an apparatus for marking articles during a manufacturing process, in particular, of semiconductor devices. In the apparatus, the ceramic substrate of the semiconductor device is ultrasonically tested for cracks. A mark (26) is applied on the lead frame of the device which is found to be defective on an area lying between two adjacent devices, i.e. an area which is not covered by the sealing material (cf. column 2, lines 37 to 65; column 3, lines 36 to 64; Figures 1 and 2).

A skilled person would recognize that the application of a mark, as is disclosed in document D2, allows the identification of defective devices even after the sealant has been applied and that it reduces, therefore, the possibility that a defective device be wrongly classified. The visible mark would therefore be a backup for the electric, functional testing after the breaking of the wires for the identification of the defective device.

The claimed equipment is an aggregation of wire breaking and marking means as there is no functional interrelationship between these means. The combined effect of these means is not greater than but equal to the sum of their individual effects. The effects achieved by these means are independent of each other (T 363/94).

- 3.1.6 The appellant also argued that the teaching of document D2 is specific in that it discloses the application of a mark to identify only a cracked ceramic substrate and that there is no reference to inspection of wire bonding or to breaking the wires of defective devices. To make a generalization of a very specific teaching and then apply this generalized teaching to a particular case of the invention as claimed, is an unallowable analysis based on hindsight.

The Board cannot follow this argument, since it is clear from the disclosure of document D2 that the testing and marking means are individual, separate units without any synergetic effect. This document relates in general "to a method and apparatus for indelibly marking articles during a manufacturing process" (cf. column 1, lines 8 to 9 and claim 1). The emphasis of the invention is thus clearly on the marking of an article in an indelible manner and not on the particular test carried out on the article. This is further emphasized in the discussion of the background of the invention in which the drawbacks of marking devices by an ink dot or by punching a hole in the lead frame are discussed. Furthermore, the provision of more than a single mark to encode different failure types during multiple testing is specifically mentioned (cf. D2, column 3, line 65 to column 4, line 8). The marking

means can thus be employed with multiple, different testing units and its use is not limited to any specific test or defect as suggested by the appellant. Thus, the teaching of the document is disclosed to be generally applicable.

3.1.7 For the foregoing reasons, in the Board's judgement, the subject-matter of claim 1 according to the main request does not involve an inventive step.

3.2 1st auxiliary request

3.2.1 Claim 1 according to this request relates to a method of operating a wire bonding inspection equipment, the equipment having all the features of the main request. The only difference in substance with respect to claim 1 of the main request is that after its inspection the surrounding member (2) is returned to the supply magazine (1) from which it was previously taken prior to inspection.

The appellant argued that an inventive step lies in this process step, as it allows to reuse the lead frames (i.e. the surrounding members) of the defective devices instead of discarding them.

3.2.2 In this connection, the only reference to this feature is in column 4, lines 3 to 11 of the published application, wherein it is stated that instead of storing the inspected lead frames in a discharge magazine they may be returned to the supply magazine. There is no further discussion of this aspect of the inspection equipment. The appellant interpreted, however, this statement as implying that the semiconductor chips and the wiring were removed from

the lead frames prior to storing them back in the supply magazine, allowing thus the lead frames to be reused. This interpretation contradicts, however, the disclosure of the application, since it is stated therein that the supply magazine contains lead frames with semiconductor devices bonded to them (cf. column 2, lines 44 to 51), and not lead frames without semiconductor chips and wires.

- 3.2.3 In consequence, the additional process step of returning the inspected lead frame to the supply magazine was one of the several alternatives available to the skilled person which he would consider depending upon the circumstances.

For these reasons, in the Board's judgement, the subject-matter of claim 1 according to the 1st auxiliary request does not involve an inventive step.

3.3 2nd auxiliary request

- 3.3.1 Claim 1 according to this request differs from claim 1 of the main request, in that it further specifies that the breaking means comprises a pressing plate member (11) and means (10) for moving the pressing plate with respect to the semiconductor device.

- 3.3.2 According to the embodiment illustrated in Figure 2 of the application, the breaking means comprises a pressing plate used to break all the wires of the defective semiconductor device. The pressing plate is lowered onto the defective semiconductor device until all the wires are broken (cf. column 3, lines 47 to 50). No further details are given in the application. In particular, the shape of the pressing plate is not

specified. It is the Board's view, that a skilled person would find this disclosure sufficiently clear as to enable him to carry out the process.

Document D1, however, shows in Figure 3 (cf. the Japanese patent application) an embodiment of the breaking means (9c) comprising a pressing plate and moving means for moving it with respect to the semiconductor device, as is indicated by the up and down arrows on the right-hand side of the device.

Although it is not derivable from the figure whether the pressing plate is intended for breaking the semiconductor device or the wires or both the wires and the device, the skilled person would consider the use of a pressing plate as shown in the embodiment of Figure 3 for breaking the wires of the device.

3.3.3 The Board therefore comes to the conclusion that the subject-matter of claim 1 according to this request does not involve an inventive step.

3.4 3rd auxiliary request

Claim 1 according to this request is a combination of claim 1 of the 1st and 2nd auxiliary requests, respectively, and its subject-matter does not involve an inventive step for the reasons presented already in relation to these requests.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

L. Martinuzzi

R. K. Shukla