BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Publication in the Official Journal Yes / No

File Number: T 3/90 - 3.4.1

Application No.: 82 303 716.3

Publication No.: 0 007 691

Title of invention: Tape for tape-automated-bonding of integrated circuits and method of producing the tape

Classification: H01L 23/48

DECISION
of 24 April 1991

Proprietor of the patent: British Telecommunications PLC

Opponent: Deutsche ITT Industries GmbH

Headword:

EPC Art. 116(1)

Keyword: "Oral proceeding; withdrawal of request by non-representation"

Headnote

If oral proceedings are appointed as a result of a party's request for such proceedings on an auxiliary basis, and if that party subsequently states that it will not be represented at the oral proceedings, such a statement should normally be treated as equivalent to a withdrawal of the request for oral proceedings.

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Headword:

EPC Art. 56, 116(1)

Keyword: "Inventive step (yes); Different problem to be solved"

Headnote follows

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 3/90 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 24 April 1991

Appellant : (Opponent)	Deutsche ITT Industries GmbH Hans-Bunte-Strasse 19 Postfach 840 7800 Freiburg i. Br. (DE)
Respondent : (Proprietor of the patent)	British Telecommunications PLC 81 Newgate Street London EC1A 7AJ (GB)
Representative :	Roberts, Simon Christopher British Telecom Intellectual Property Unit 13th Floor 151, Gower Street London, WC1E 6BA (GB)
Decision under appeal :	**Decision of Opposition Division of the European Patent Office dated** 9 November 1989 **rejecting the opposition filed against European patent No.** 0 070 691 **pursuant to Article** 102(2) EPC.

Composition of the Board :

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

Summary of Facts and Submissions

I. The Respondent is owner of European patent No. 0 070 691.

The independent claims for the Contracting States AT, BE, CH, IT, LI, NL and SE read as follows:

"1. A tape for use in tape-automated-bonding of integrated circuits, the tape being provided along its length with a series of interconnection arrays, each array comprising a plurality of interconnection beams (3) for bonding with interconnection pads (7) of an integrated circuit (8), a terminal (6) being provided on each interconnection beam for making a bond between that beam and a respective interconnection pad of an integrated circuit, characterised in that each terminal is formed entirely of deposited material, and in that each terminal comprises at least an outer layer of a conductive material having a Vickers hardness number of 55 or less to render the terminal compliant.

6. A method of producing a tape as claimed in claim 1, the method including the step of depositing the material or materials, for forming the terminals, only at locations on the tape which correspond to interconnection pads of the integrated circuit."

The independent claims for the Contracting States DE, FR and GB have the following wording:

"1. A tape for use in tape-automated-bonding of integrated circuits, the tape being provided along its length with a series of interconnection arrays, each array comprising a plurality of interconnection beams (3) for bonding with interconnection pads (7) of an integrated circuit (8), a terminal (6) being provided on each interconnection beam

for making a bond between that beam and a respective interconnection pad of an integrated circuit, the terminals being formed entirely of deposited material, wherein each material comprises at least an outer layer of a conductive material having a Vickers hardness number of 55 or less to render the terminal compliant, the terminal having been grown on its respective interconnection beam.

6. A method of producing a tape as claimed in claim 1, the method including the step of depositing the material or materials, for forming the terminals, only at locations on the tape which correspond to interconnection pads of the integrated circuit."

Claims 2 to 5 are dependent on Claim 1 and Claims 7 and 8 are dependent on Claim 6 respectively in both sets of claims.

The claims for DE, FR and GB include the feature of "the terminal having been grown on its respective interconnection beam" in order to avoid loss of novelty under Article 54(3) EPC in view of document D1 below, which is acknowledged in the description of the patent in suit.

II. This patent was opposed by the Appellant in particular on the grounds of lack of novelty and inventive step in view of the prior art which can be derived from documents:

D1: EP-A-0 061 863 (lack of novelty of the claims for DE, FR and GB, under Article 54(3) EPC only);

D2: "Electronics International" Vol. 53, No. 27, December 1980, pages 100 to 105;

D3: "29th Electronic Components Conference" Cherry Hill, N.J., 14-16 May 1979, pages 94 to 98;

D4: "BTAB The Exclusive Success, Proceedings of the ISHM

International Microelectronics Symposium", New York, 1980, pages 238 to 244; and late-filed document

D6: "Solid State Technology", March 1977, pages 33 and 34.

During the procedure before the Opposition Division the Respondent filed the following document in support of his case:

D5: "IEEE Transactions on Components, Hybrids, and Manufacturing Technology" Vol. CHMT-2, No. 3, September 1979, pages 301 to 308.

III. The Opposition Division rejected the opposition, as regards inventive step on the ground that none of the documents cited above hinted to the skilled person to specify by technical terms the hardness of the outer layer of conductive material of a terminal, i.e. of a "bump" to be formed on an interconnection beam of a tape. The claims for DE, FR and GB were also held to be novel over document D1.

IV. An appeal against this decision specifically in relation to the issue of inventive step was lodged by the Opponent, who put forward arguments for lack of inventive step which were additionally based on the following newly cited documents:

D7: "Solid State Technology", September 1978, pages 79 to 81; and

D8: US-A-3 838 984.

In his response to the statement of grounds of appeal, the Respondent (Patentee) supported his counter-arguments inter alia by documents:

D9: US-A-3 440 027;

D10: C.R. Draper: "The Production of Printed Circuits and Electronics Assemblies", Robert Draper Ltd., Teddington, 1969, pages 207 to 211; and

D11: J. Fischer and D.E. Weimer: "Precious Metal Plating", Robert Draper Ltd., Teddington, 1964, pages 56, 57, 149, 150.

V. Both parties requested oral proceedings on an auxiliary basis. In a communication annexed to a summons to oral proceedings the Board informed the parties of its provisional view that the teachings of more relevant documents D3 and D4 might be regarded as giving no hint to increase the adherence of a terminal (bump) to the surface to be bonded by rendering the bump compliant, and that the late cited documents D6 and D8 appeared to have no influence on the decision to be taken and might therefore be disregarded under Article 114(2) EPC.

In response to this communication of the Board, the Appellant contested in writing the Board's opinion, citing additionally the document:

D12: "Solid State Technology", March 1978, page 44.

Furthermore, he stated that "no representative would be sent to the oral proceedings". The Registrar of the Board confirmed with the Appellant that this statement was equivalent to a withdrawal of his request for oral proceedings. Subsequently, the scheduled oral proceedings were cancelled by the Board.

VI. The Appellant requested that the decision under appeal be set aside and that the patent be revoked.

VII. The Respondent requested:

(a) that the appeal be dismissed and the patent be maintained in unamended form (main request);
(b) that the matter be referred back to the Opposition Division in the event that document D8 is taken into consideration by the Board (first auxiliary request);
(c) that the patent be maintained in amended form on the basis of a subsidiary set of claims filed on 14 September 1990 with letter dated 11 September 1990 in the event that the matter is not remitted to the Opposition Division and document D8 is considered to be relevant (second auxiliary request); and
(d) that oral proceedings be held in the event that the Board intends to revoke the patent (third auxiliary request).

VIII. In support of his request, the Appellant argued essentially as follows:

(a) Nothing inventive can be seen in depositing an outer terminal layer, i.e. a bump, not on the chip contacts but on the beams of a tape. As derivable from document D7, only these two possibilities exist. Moreover, in the electrical contacts described in document D3 the bumps are not provided on the contacts of a chip but on those of a printed circuit. Also in document D8 bumps are grown by electroplating directly on their respective interconnection beam.

(b) It is generally known to the semiconductor expert that the hardness of the bump material is of importance in bonding contacts. Document D3, page 96, describes experiments in which the gold bump hardness

is varied. Document D4, page 241, chapter 3, mentions the effect of the local hardness of a bump on insuring a uniform and repeatable thermocompression bonding which would implicitly include an appropriate adhesion. Also document D12, page 44, paragraph 5, explicitly states that a reliable thermocompression bond is a function of the hardness of the bumps.

(c) In view of the above prior art, the claimed Vickers hardness number of 55 or less for the bump material would only be the result of an obvious selection on the basis of routine experiments.

IX. The above arguments were contested by the Respondent who made essentially the following submissions:

(a) Document D3 only describes the classical gold to gold TAB (tape automated bonding) with the bumps on the chip rather than BTAB (bumped tape automated bonding) with the bumps on the tape. However, the fact that TAB and BTAB are known as alternatives has always been accepted by the patentee.

(b) Document D8 solves the problem of unwanted contacts between neighbouring beam leads by providing insulating frame members which inter alia surround the bumps and thus prevent their necessary deformation during bonding. Hence, the problem of improving the reliability of a bond has not been addressed in document D8. Furthermore, documents D3 and D4 would clearly demonstrate that bump hardness was not considered to be an important property in solving the problem of poor bonding performance of BTAB.

(c) The limit of 55 Vickers is in practice very low, particularly for electrodeposited material, and would not routinely be achieved other than through deliberate choice and careful process selection and control.

Reasons for the Decision

1. Procedural matters - oral proceedings

As set out in paragraph V above, both parties originally requested oral proceedings on an auxiliary basis; according to the established practice of the Boards of Appeal, this is interpreted as a request for oral proceedings unless the Board intends to decide the case in favour of the requesting party. The Board then issued a communication under Article 11(2) of the Rules of Procedure of the Boards of Appeal, in which it indicated as a preliminary view that it was likely to decide in favour of the Respondent. Oral proceedings were therefore appointed because of the Appellant's request for such proceedings. The Appellant then stated inter alia that it would not be represented at the oral proceedings. In such circumstances, such a statement is clearly equivalent to a withdrawal of the Appellant's earlier request for oral proceedings on an auxiliary basis. (This was in fact confirmed on the telephone by the Registrar in the present case, although such confirmation was not really necessary).

After the Board had considered the Appellant's observations in reply to its communication and had internally confirmed its intention to decide the case in favour of the Respondent's main request, the oral proceedings were therefore duly cancelled by the Board.

2. The only substantive issue specifically raised in this appeal is that of inventive step.

3. The Board agrees with the finding of the Opposition Division that the claims for DE, FR and GB are novel over document D1, for the reasons given by the Opposition Division.

4. **Inventive step (Main request)**

4.1 Starting from the Respondent's own prior art statement in the description of the patent under appeal - or from the tapes and methods for producing them described in documents D5 to D8 - the objective problem underlying the present invention in the Board's view stays the same, i.e. to avoid poor adhesion of the surface of the outer layer of the terminals of interconnection beams provided on a tape to the metal surface of the connection pads of an integrated circuit bonded onto the tape; see also the patent under appeal, column 1, lines 52 to 60.

4.2 This problem is solved according to Claims 1 of both sets of claims in that: "each terminal comprises at least an outer layer of a conductive material having a Vickers hardness number of 55 or less to render the terminal compliant". By referring method Claim 6 back to Claim 1 this feature is implicitly comprised in the process parameter of the depositing step claimed in Claims 6 of both sets of claims. However, the additionally claimed feature that each terminal is formed "entirely of deposited material" and the feature "the terminal having been grown on its respective interconnection beam", in the Board's view, do not indispensably take part in solving the above-defined objective problem and, for this reason, are to be disregarded in the judgment on inventive step.

4.3 Thus, the item of inventive step reduces to the question whether a skilled person can be expected to increase the adhesion of a terminal (bump) to a pad by rendering the material of the terminal more compliant, either on the basis of hints given in the prior art or by making use of his normal expert knowledge.

4.4 Document D2 does not mention any properties of the bump material at all. Documents D3 and D4 both teach to avoid damages in the silicon body of an IC (integrated circuit) in a thermocompression bonding step by the use of "soft bumps". There is no statement in these documents concerning the interface problem of adhesion.

The experiments described in particular on page 96 of document D3 investigate the influence of different gold hardnesses of the bonding bump on the formation of cracks in the surface of the silicon IC under the bump.

Document D4 specifies the integral surface effect studied in document D3 to an investigation of the surface topology of the bumps. In the Board's view, a skilled person interprets the influence of the "local" hardness on the quality of the thermocompression bonding as the detrimental influence of surface inhomogeneities, in particular of local hard nodules (stalag bumps). Contrary to the Appellant's view in paragraph VIII(b) above, the Board regards a skilled person as not able to derive from the explicit technical teaching of chapter 3 of document D4, i.e. to avoid inhomogeneities in the surface hardness such as local hard nodules by homogenising the plating current density via rounded edges of bumps prior to plating - any suggestion to decrease the hardness of a complete homogeneous bump surface in order to increase the adhesion of the bump material to the surface to be bonded.

In interpreting the above-mentioned teaching of document D3 and D4 a skilled person would probably design the mechanical plasticity of a bump and its surface homogenity in order not to damage the delicate inactivated semiconductor surface of a chip by the pressure which is necessarily to be exercised in a thermocompression bonding step. Such a teaching in the Board's view gives no suggestion as to how to realise advantageous properties of the interface between pad and bump in the bonded product after the thermocompression step, i.e. how to solve a completely different problem; see also decision T 39/82, OJ EPO 1982, 419.

4.5 Having regard to the skilled person's general abilities, the Board takes the view that any interaction in the interface between bump and pad - such as their mutual adhesion - is a two-dimensional surface problem. Solving this problem via the mechanical bump plasticity, i.e. by a physical material property which determines the three-dimensional volume behaviour of the bump, is not regarded as a result of an obvious logical analogy. For this reason, the Board takes the view that a skilled person, without exercising an inventive step, cannot be expected to relate low Vickers hardness numbers of a material with its good adhesion and to start experiments in order to find out an appropriate upper limit for the hardness number; see also paragraph VIII-(c) above.

4.6 In document D6 a ductile material is used for compensating different heights of bumps which result from their production process. Documents D7 and D8 are silent with regard to the hardness of the applied bump material. Document D12 teaches to adapt the pressure-temperature-time schedule - i.e. the process parameters of the thermocompression step - to the existing bump hardness. Therefore, late-filed documents D6, D7, D8 and D12 have

no influence on the outcome of the decision to be taken and are disregarded under Article 114(2) EPC.

4.7 For the above reasons, the Board finds that the subject-matter of granted Claims 1 and 6 in both sets of claims involves an inventive step within the meaning of Article 56 EPC.

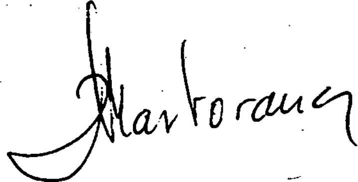
5. Hence, it follows that granted Claims 1 and 6 for the Contracting States AT, BE, IT, LI, NL and SE and granted Claims 1 and 6 for the Contracting States DE, FR and GB are maintained unamended. Dependent Claims 2 to 5, 7 and 8 in each set of claims concern particular embodiments of the tape according to Claim 1 and the method according to Claim 6 respectively and are likewise maintained.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:



P. Martorana G.D. Paterson