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**D E C I S I O N**  
**of 2 July 2002**

**Case Number:** T 0660/99 - 3.5.2

**Application Number:** 95100939.8

**Publication Number:** 0665609

**IPC:** H01R 9/09

**Language of the proceedings:** EN

**Title of invention:**  
Mounting terminal pins in substrates

**Applicant:**  
MOLEX INCORPORATED

**Opponent:**

-

**Headword:**

-

**Relevant legal provisions:**  
EPC Art. 56

**Keyword:**  
"Inventive step - yes"

**Decisions cited:**

-

**Catchword:**

-



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Boards of Appeal

Chambres de recours

**Case Number:** T 0660/99 - 3.5.2

**D E C I S I O N**  
**of the Technical Board of Appeal 3.5.2**  
**of 2 July 2002**

**Appellant:** MOLEX INCORPORATED  
2222 Wellington Court  
Lisle  
Illinois 60532 (US)

**Representative:** Blumbach, Kramer & Partner GbR  
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**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted 22 February 1999  
refusing European patent application  
No. 95 100 939.8 pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** F. Edlinger  
**Members:** J.-M. Cannard  
B. J. Schachenmann

## Summary of Facts and Submissions

I. The Appellant contests the decision of the Examining Division to refuse European patent application No. 95 100 939.8.

II. The following documents:

D1: GB-A-1 142 160,

D3: EP-A-0 303 485, and

D4: US-A-4 970 624,

cited in the search report, remain relevant to the present appeal.

III. Oral proceedings were held on 23 May 2002, in the course of which the appellant filed a new claim 1 worded as follows:

"An electrical or electronical interconnection device (22) for establishing a connection between a generally round terminal pin (24) and a flat flexible circuit (26), comprising:

a flat flexible dielectric substrate (28) having a hole (30) in it;

a ductile conductive film (32) on the substrate (28) in an area at least about said hole (30);

wherein said terminal pin (24) is inserted into the hole (30) in the substrate (28) in contact with the conductive film (32),

characterized in that

i) said flat flexible dielectric substrate (28) is less than 1.27 mm (0.050 inch) thick, said hole (30) in it is generally round and being a prepunched hole of a given diameter;

ii) said terminal pin (24) has a given diameter greater than that of the hole (30);

iii) said electrical or electronical interconnection device establishes an electrical connection directly between the terminal pin (24) and the ductile conductive film (32) without the use of solder or conductive adhesives; and

iv) the difference between the diameter of the pin (24) and the diameter of the hole (30) is a particular difference in the order of 5% to 50% of the diameter of the hole according to the controlled meniscus principle, and a particular interference is established between terminal pin (24) and flat flexible circuit (26)."

Claims 2 to 12 are dependent on claim 1.

IV. The reasons for refusing the present application given in the decision under appeal may be summarised as follows in so far as they apply to the subject-matter of the amended claims:

D3 constituted the closest prior art because it disclosed an interconnection device for directly connecting a terminal pin to a conductive film on a substrate which was initially provided with a

prepunched hole (D3, column 3, lines 31 to 36). Although not explicitly disclosed, such holes had to be considered as "generally round" in the broad meaning of these terms. The terminal pin had a given diameter greater than that of the hole in the substrate (D3, column 6, lines 45 to 48 and Figure 1). The substrate, because of its elasticity (D3, column 6, lines 42 to 53), took a curved bent profile upon insertion of the pin, with normal forces acting on the terminal pin (as with a controlled meniscus principle shown in Figure 2 of the present application). While it was true that the flexible substrate in D3 was mounted on a rigid board, this was not excluded in the present application either. The application as filed did not unambiguously disclose that there was no further support from any adjacent element because there was no positive disclosure of the absence of adjacent elements.

D1 disclosed an electrical interconnection device where a tight fit between a pin and a plurality of circuit boards was obtained with a difference between the diameter of the pin and the diameter of the hole which was in the range of from 2% to 24%. The person skilled in the art would therefore, without exercising inventive skill, have applied an appropriate diameter difference falling within the range as specified in present claim 1.

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

Document D4, which was cited in the application as filed as the starting point of the invention, formed the closest prior art and merely disclosed the features

in the preamble of claim 1.

D3 did not relate to an electrical device for establishing a connection directly between a contact pin and a flat flexible circuit as recited in claim 1 because the circuit board according to D3 comprised as an essential feature a rigid board on a surface of which the flexible dielectric substrate carrying the conductive pads to be connected with the contact pin was always secured. The skilled person thus would not start from D3.

D3 did not disclose a dielectric substrate having in it a prepunched hole of a given diameter since the substrate and the conductive pads were initially pierced by means of a punching pin to form the holes. The holes produced by piercing had irregular torn edges which exercised on the contact pin to be connected irregular forces smaller than those produced by the edges of the prepunched hole according to claim 1. Under these circumstances, neither the particular difference of the order of 5% to 50% of the diameter of the pin and the diameter of the hole, nor the particular interference according to the controlled meniscus principle established between the pin and the flat flexible circuit according to claim 1 were disclosed or suggested by D3. D3 recommended the use of solder for providing a permanent connection.

D1 merely related to a method of making electrical connection to a terminal conductive pad situated on one of a stack of a plurality of flexible printed circuits wherein a rigid conductor passed through the stack was joined to the pad by means of solder. Even if the substrate had prepunched holes which were undersized in

respect of the diameter of the conductor by 2% to 24%, it was not derivable from the teaching of D1 that this undersizing could establish good electrical connections directly between the rigid conductor and the conductive pad without the use of solder.

- VI. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the documents filed at the oral proceedings and the agreed amendments on pages 3, 7 and 8 of the description.
- VII. At the end of the oral proceedings the chairman declared the closure of the debate and that a decision would be taken in writing when the appellant had filed fair copies of the documents filed in the oral proceedings and further amendments of the description as agreed by the appellant.
- VIII. With letter dated 24 May 2002, the appellant filed fair copies of claims 1 to 12 and pages 1, 2, 2a, 3 and 7 of the description. A fair copy of page 8 of the description was filed with fax of 29 May 2002.

### **Reasons for the Decision**

1. The appeal is admissible.
2. Claim 1 of the present single request essentially includes the features of claim 1 of the main request on which the decision under appeal was based and comprises additional features specifying the interference action based on a particular difference of the pin and hole diameters and the controlled meniscus principle, to

establish direct electrical connection. These features are disclosed on page 2, paragraph 2, and page 7, paragraph 3, of the application as filed.

3. *Closest prior art*

3.1 The present invention is concerned with mounting electronic devices, such as terminal pins, in flat flexible circuitry and the reduction of time and expense of the secondary operations necessary to establish good electrical and mechanical connections between a terminal pin and a flat conductor on the flat flexible circuitry (application as published, page 1, lines 23 to 35). Reducing the time and expense in manufacturing operations are objectives which usually occur within the framework of industrial mass production methods. As specified in claim 1, these objectives are achieved by establishing a particular interference between the terminal pin and the flat flexible circuit and selecting a particular difference of the diameter of the pin and the diameter of the hole according to a controlled meniscus principle, to establish an electrical connection directly between the pin and a conductive film on the substrate without the use of solder or conductive adhesives.

3.2. D4 relates to an electrical or electronic device (10) for establishing a connection between a generally round terminal pin (20) and a flat flexible circuit and discloses the features recited in the preamble of claim 1, namely a flat flexible dielectric substrate (sheet 12) having a hole (Figures 1A, 1B: 26) in it, a ductile conductive film (14) on the substrate around said hole, wherein said terminal pin is inserted into the hole in the substrate in contact with the



conductive film (see Figure 1; column 3, line 32 to column 4, line 23). In the embodiment shown in Figure 1, the substrate (12) is not supported by a rigid board and thus has to be sufficiently flexible to deform, but also sufficiently rigid to compress the conductive adhesive in areas where electrical contact has to be established (D4, column 4, lines 12 to 21; column 5, line 62 to column 6, line 4). The flexible substrate is punctured to produce holes in the form of slits (Figures 1A, 1B) and conductive adhesives are used to establish conductivity between the pin and the film. The problem of reducing the costs and time required for establishing electrical connections is mentioned in D4 (column 2, lines 1 to 4). The device (10) is thus suitable for mass production.

- 3.3 D3 discloses rigid circuit boards which are especially suitable for use in the manufacture of prototype circuits, the users modifying the pattern on the board by removal of appropriate portions of the conductive strips or pads. D3 is more specifically concerned with improvements to this type of circuit boards to make them suitable for design and assembly by a user of standard and non-standard items (column 1, lines 15 to 50). To this effect, at least one separately formed flexible sheet (4) is secured to a rigid board (eg by means of self-adhesive tapes 6). A direct electrical connection between a terminal pin (C) and a conductive strip or pad (8) is provided without the use of solder or conductive adhesives. A particular thickness of the conductive strips or pads carried on the surface of the sheets is considered as essential to achieve this effect (see D3, claim 1). According to Figure 1 of D3, the flexible sheet (4) and the conductive strips or pads (8) thereupon are pierced by the contact pin (C)

to establish the direct connection between the pin (C) and the conductive strip (column 6, lines 39 to 53). In an alternative embodiment (column 3, lines 31 to 36; column 6, line 60 to column 7, line 1), "a special punching pin or pins may be used initially to form a hole or holes in an electrically conductive strip and/or pad" and "each selected copper strip or pad 8 and the underlying flexible sheet 4 may be initially pierced by means of a special punching pin which is removed prior to insertion of the or a contact pin of the surface mounted component". The holes thus formed by a special punching pin or pins are not necessarily round holes of a predetermined diameter, but merely have to be such that a terminal pin piercing the strip or pad establishes a direct electrical contact therewith in a prototype rigid board interconnection device. "In all cases, where an electrical connection between a contact pin and an electrically conductive strip or pad is to be permanent, a permanent electrical connection may be effected by soldering the contact pin to the pierced electrically conductive strip or pad" (D3, column 3, lines 43 to 48). The disclosure of D3 does not take account of a particular interference between a terminal pin and a flat flexible circuit for establishing a permanent direct electrical connection which would be suitable for mass production. In particular, D3 does not disclose a particular difference between the diameter of the pin and the diameter of the hole of the order of 5% to 50% of the diameter of the hole, but only refers to a suitable thickness of the strip or pad and sufficient flexibility of the sheet (D3, claim 1; column 6, lines 39 to 53). The disclosure in D3 of a kit of parts to be used for assembly of the circuit boards and which may include etch-resistant inks, solvents, thinners and

cleaners (column 5, lines 5 to 46) and the indication that a permanent connection may be effected by soldering confirm that the circuit boards disclosed in D3 are designed for use in the manufacture of prototype circuits and not for mass production. Since in all the embodiments of D3 the flexible sheets are secured to the rigid board, the conflicting requirements of sufficient rigidity and flexibility of the flat flexible sheet do not arise in the same way as described in D4 (see point 3.2 above) and in the present application.

3.4 Accordingly, on an objective analysis and without hindsight of the present application, the Board considers that D4 reflects the closest prior art because the mechanical and electrical constraints as well as the manufacturing requirements for mass production of electronic devices mounted in flat flexible circuitry are quite different from those which arise in the manufacture of prototypes of rigid circuit boards.

4. *Inventive step*

4.1 Starting from D4, the objective problem of the present invention can be seen as that of further reducing the time and the expense of the operations necessary for establishing an electrical connection between the terminal pin and the flat conductor on the flat flexible substrate, as put forward by the appellant. This corresponds to the technical problem identified in the application as filed (see published application, page 2, lines 23 to 30).

4.2 Since D3 does not disclose a particular interference

between a terminal pin and a flat flexible circuit and since it is concerned with a different problem (see point 3.3 above), it does not give any hint at solving this problem as specified in present claim 1.

4.3 D1 is concerned with an interconnection device between a tube (17) and a plurality of flexible printed circuit boards forming a stack, wherein each board has a prepunched hole of a given diameter (19) smaller than the diameter of the tube, the difference in diameters being of the order of 2% to 24% (page 1, lines 63 to 80). However, the electrical connection in D1 is always obtained by the use of solder and the reason for having a diameter of the pin greater than that of the hole, which results from the necessity of firmly holding the tube (17) in position in the stack of boards while making the joints, is a mechanical one. The electrical connection is not a main concern of D1, which merely mentions that the difference in diameter between the hole and the tube "is variable within wide limits without impairing the metal-to metal contact between the tube and the pads" (page 2, lines 94 to 106).

5. For the foregoing reasons, in the Board's judgement, the subject-matter of claim 1 according to the present request is considered to be new and involve an inventive step within the meaning of Articles 54 and 56 EPC and the application as amended meets the requirements of the EPC.

## Order

### For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to grant a patent in the following version:

#### **Claims:**

No. 1 to 12 as filed with letter dated 24 May 2002

#### **Description:**

page 1, 2, 2a, 3, 7 as filed with letter dated  
24 May 2002

page 8 as filed per fax on 29 May 2002

pages 4 to 6 as originally filed

#### **Drawings:**

sheet 1/1 as originally filed.

The Registrar:

The Chairman:

M. Hörnell

F. Edlinger