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(71) Applicant(s)
Paronne Limited

(Incorporated in Ireland)

Monoclinoe Industrial Estate, Ballysimon Road, Limerick, Ireland

(72) Inventor(s)
Paul Comerford
Declan Brosnan

(74) Agent and/or Address for Service
Marks & Clerk
57-60 Lincoln's Inn Fields, LONDON, WC2A 3LS, United Kingdom

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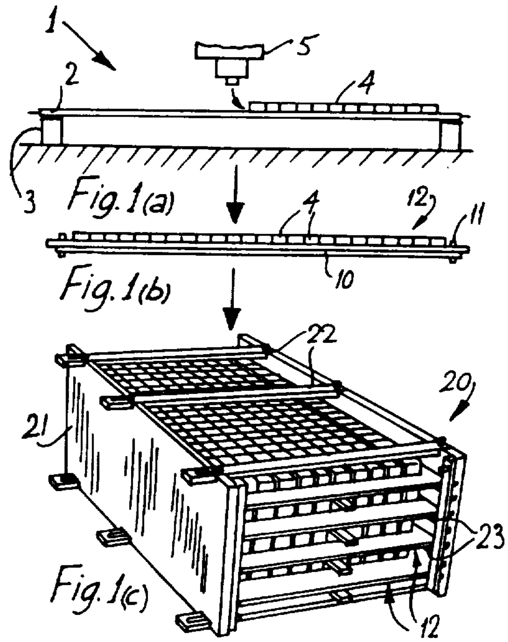
(54) **A process for producing burn-in boards**

(57) Burn-in boards are produced by insertion of sockets (4) into a board (2) of polyimide material having a glass transition temperature of 240°C. A runner (10) is mounted centrally and longitudinally to the lower surface of the board (2) and during soldering, this is used to help ensure that there is uniform application of solder across the width of the board (2). Before application of flux, the assembled board (12) is baked at 110°C for 2 hours for removal of moisture from the board. Before soldering, there is pre-heating by passing over heating plates at a temperature of 175°C. Effective soldering is ensured by use of the runner (10) and the solder composition is 96% Sn/4% Ag to provide reliable joints for the life of the burn-in board. The soldered board is tested by use of a universal test panel having a number of connectors for connection of any desired pair of probes to the board. Each socket (4) is tested in turn and integrity of the socket is ensured as a set of through-holes for the socket is individually connected to an edge connector.



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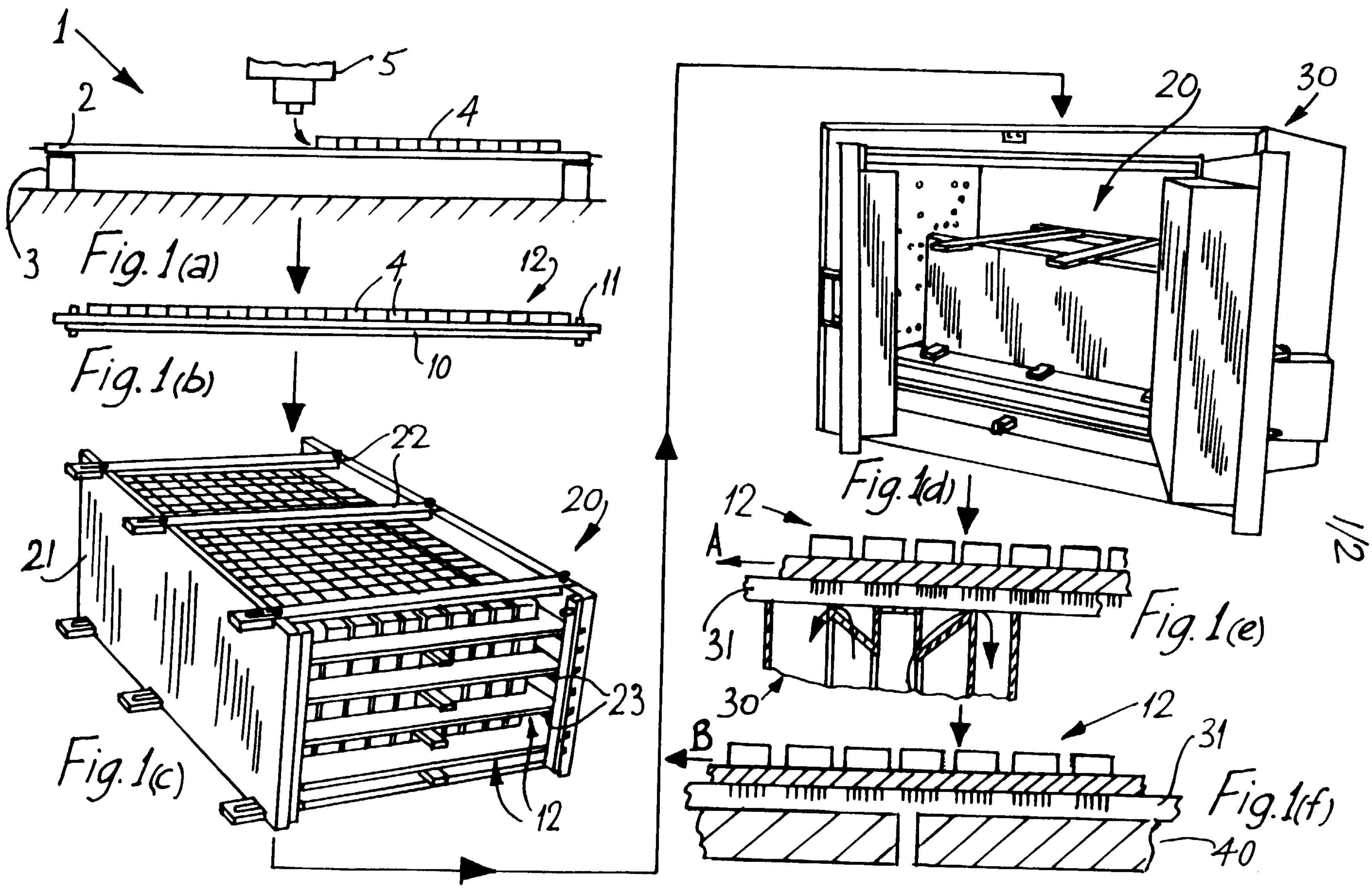

Fig.1(a)

Fig.1(b)

Fig.1(c)

Fig.1(d)

Fig.1(e)

Fig.1(f)

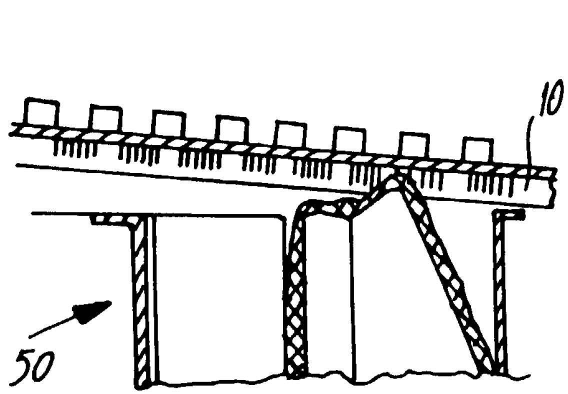

Fig.1(g)

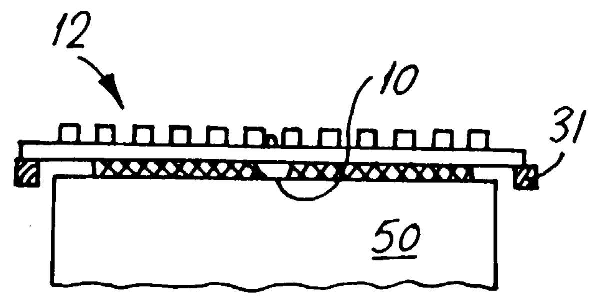

Fig.1(h)

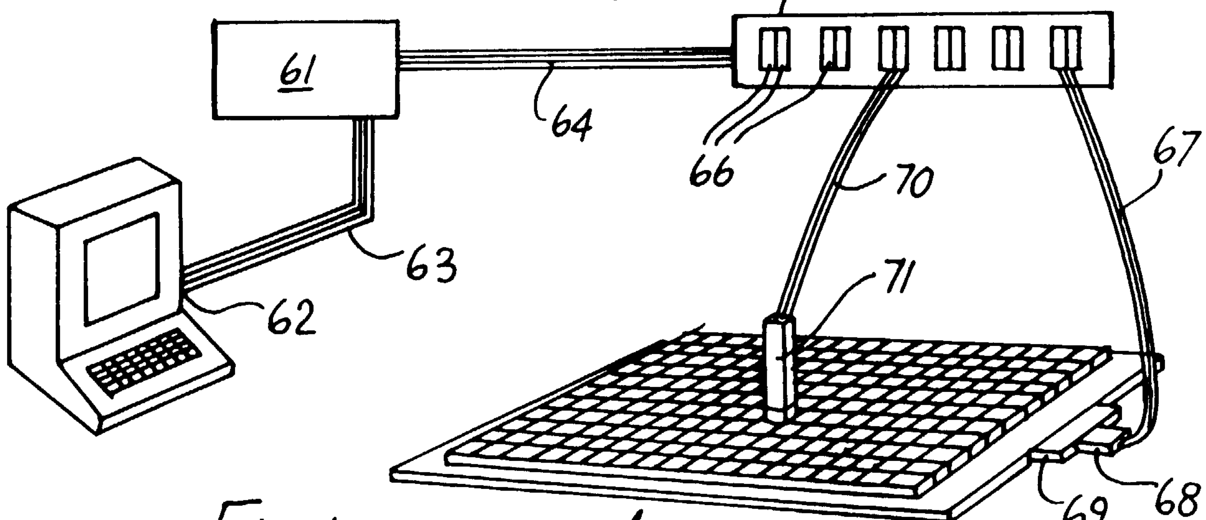

Fig.1(i)

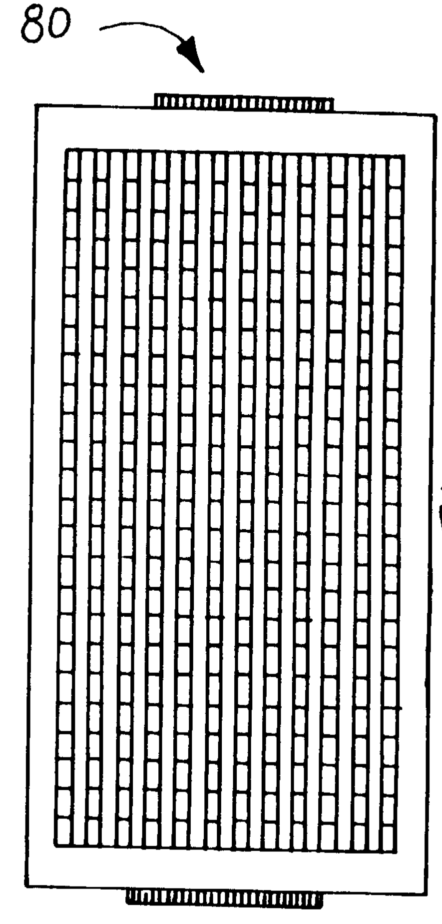

Fig.2

"A process for producing burn-in boards"

The invention relates to a process for producing burn-in boards for use in supporting electronic components during burn-in testing.

More than most other types of boards, burn-in boards are subjected to particularly harsh conditions during use. Further, there is a particularly high reliability expectation of burn-in boards as a single fault may cause a large number of faulty components to be released. In order to achieve this level of quality, the conventional approach to production of burn-in boards has been to use conventional materials for production and after production to carry out extensive testing to ensure quality. This approach has led to a very expensive production process as a considerable amount of highly skilled labour is required for the testing stage and further, because the materials may not be suitable at withstanding the environmental conditions of the burn-in board in use, problems may still arise.

The invention is therefore directed towards providing an improved production process for burn-in boards which produces a board having a higher level of quality with a longer life than has heretofore been the case, and whereby the process is relatively inexpensive to carry out.

According to the invention, there is provided a process for producing a burn-in board, the process comprising the steps of:-

producing a board comprising:-

a substrate of a polymer material having a glass transition temperature in excess of 240°C, a plurality of sets of through-holes, each set being for reception of a socket, and

a board connector connected individually to each set of through-holes;

securing a runner at a position extending substantially centrally and longitudinally at a lower surface of the board, the runner being of a material having a thermal expansion characteristic substantially similar to that of the board;

inserting sockets into the sets of through-holes;

mounting the assembled board in a frame and baking at a temperature in the range of 100°C to 120°C for 1.8 to 2.2 hours;

applying flux to the assembled board lower surface;

pre-heating the assembled board by passing over heating plates at a temperature in the range 160°C to 185°C;

soldering the assembled board by passing over a solder wave device whereby the lower surface of the runner slides on the uppermost edge of the solder wave, the solder being a combination of Sn and Ag and being at a temperature in the range 240°C to 150°C;

visually inspecting the soldered board and carrying out any required manual work; and

testing the soldered board by application of a test socket probe to each socket in turn.

In one embodiment, the board substrate material is polyimide having a glass transition temperature of approximately 260°C. The runner may be of polyimide material. Preferably, the runner is bolted to the board adjacent each end thereof.

In another embodiment, the assembled board is baked for approximately 2 hours at a temperature of approximately 110°C.

In one embodiment, the assembled board is pre-heated by passing over plates at a temperature of approximately 175°C.

Preferably, the solder temperature is approximately 245°C. The solder may be a combination of 96% Sn and 4% Ag.

In one embodiment, the soldered board is tested by connecting a board probe between the board connector and a connector on a universal interface having a plurality of test connectors and by connecting the socket probe between another connector of the universal interface and each socket in turn.

The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only, with reference to the accompanying drawings, in which:-

Figs. 1(a) to 1(i) are together a flow chart illustrating a production process of the invention; and

Fig. 2 is a diagrammatic plan view showing a burn-in board produced by the process.

Referring to the drawings, there is shown a production process 1 for the production of burn-in boards. The preliminary stages of the production process involve receiving data on components which a customer wishes to test using the burn-in board to be produced. Using this data, a board layout is designed to provide maximum component density on the board. Full colour penplots are supplied to the customer for design approval.

A board is then produced according to the design. The substrate material is a polymer having a glass transition temperature in excess of 240°C. Polyimide having a glass transition temperature of approximately 260°C has been found to be particularly suitable. The board has either two, four or six layers and has an edge connector of 0.8 μm Au on 5.0 μm Ni, the edge connector being connected by conductors within the multilayer structure to sets of through-holes. Each set of through-holes is for reception of an individual socket and is individually connected to the edge connector. The substrate thickness is 1.6 mm.

In Fig. 1(a), the board is indicated by the numeral 2 and is shown temporarily resting on supports 3 as sockets 4 are inserted in the sets of through holes by an applicator head 5. The applicator head 5 may be of an suitable type. This step may alternatively be performed manually. As shown in Fig. 1(b), a runner 10 is secured to the underside of the board 2. The runner is also of polyimide material and is of elongate shape and is mounted substantially centrally and longitudinally along the length of the board 2. The runner 10 is secured in place adjacent each end of the board 2 by miniature bolts 11. While in the drawings insertion of the sockets 4 is illustrated before connection of the runner 10, it is envisaged that the runner 10 may be connected before insertion of the sockets, depending on the nature of the structures 3 and their ability to accommodate the runner 10. The assembled board after insertion of the sockets 4 and connection of the runner 10 is indicated generally by the numeral 12.

As shown in Fig. 1(c), a number of the assembled boards 12 are mounted in a frame 20 having a pair of side walls 21 interconnected by cross-members 22. The inner surfaces of the side walls 21 have elongate grooves 23 which receive the side edges of the assembled boards 12. The vertical separations of the grooves 30 is sufficient to accommodate the full height of the assembled board, including the runner and socket legs.

Referring to Fig. 1(d), the set of assembled boards 12 in the frame 20 is then baked in an oven 30 at a temperature in the range of 100°C to 120°C for a time duration in the range of 1.8 to 2.2 hours. The temperature and duration are preferably 110°C and 2 hours, respectively. It has been found that these values are particularly suitable for removal of moisture, particularly as polyimide is prone to absorbing moisture in the air. The baking step helps to avoid "blow-holes" arising in the board during soldering.

As shown in Fig. 1(e), the assembled board 12 is conveyed over a flux applicator 30 by a pair of rails 31 moving in the direction of the arrow A. As shown in Fig. 1(f), the rails 31 convey the board 12 in the direction of the arrow B over a pair of heating plates 40 at a temperature in the range of 160°C to 185°C, and preferably 175°C. This pre-heating step is important at avoiding thermal shock during the subsequent soldering of the assembled board 12.

Soldering of the assembled board 12 is illustrated in Figs. 1(g) and 1(h). Fig. 1(g) is a side view of the soldering operation, while Fig. 1(h) is a rear view which illustrates the manner in which the assembled board 12 is supported during soldering. A wave solder device 50 is used to apply molten solder at a temperature in the range of 240 to 250°C, and preferably 245°C. The composition of the solder is 96% Sn and 4% Ag. It has been found that this tin/silver eutectic alloy is particularly suitable at withstanding the temperatures to which the burn-in board will be subjected during its use. As the assembled board 12 is conveyed, the runner 10 slides on the upper edge of the wave solder device 50. The rails 31 are located to convey the assembled board 12 at a height above the wave solder device 50 which is the same as the depth of the runner 10. Accordingly, sliding of the runner 10 on the device 50 ensures that the board 12 remains flat across its width while being soldered. This is an extremely simple and effective way of ensuring that the board does not sag during soldering, thus avoiding uneven application of solder and possible problems downstream. A very important aspect of the soldering operation is that sag is avoided in a very simple, effective and reliable manner.

After soldering, the soldered board is visually inspected and any re-work and trimming is carried out manually. There is then a quality control visual check to locate any cosmetic or functional imperfections and any required repair work is carried out. The runner 10 is removed during this stage.

Finally, the soldered board 60 is tested by application of test signals generated by a test controller 61. The controller 61 is connected to a display and interface assembly 62 by a loom 63. The controller 61 is also connected by a loom 64 to a universal test panel 65. The test panel 65 has a set of connectors, the set of connectors including all possible connectors which will be required for a board to be produced. One of the connectors 66 is connected by a lead 67 to a connector 68 which is connected to the edge connector 69 of the board 60. A probe lead 70 is connected to another connector 66, the probe lead 70 terminating in a movable probe head 71. The probe head 71 is configured for connection to the type of socket 4 which is soldered in the board 60. The test operator moves the probe head 71 to each socket in turn. At every socket 4, the test controller 61 transmits signals via the test panel 65, the lead 67, the connectors 68 and 69, and conductors within the board 61 to the particular socket 4. The return signals on the return path are then logged for verification.

It has been found that this method of testing helps to ensure that a wide variety of different boards may be produced in a simple manner without the need to design test fixtures such as those of the "bed-of-nails" type. Again, the testing method is very simple, but has been found to be very effective for both comprehensiveness of testing and efficiency. A burn-in board end product is indicated generally by the numeral 80 in Fig. 2.

It will be appreciated that the process of the invention provides a high quality burn-in board because of the materials, the assembled boards being baked, pre-heated, soldered using an Sn 96%/Au 4% euthetic alloy with sliding action of the runner on the wave solder, and by testing using the universal test panel 65 directing test signals directly to each socket in turn. The temperature and time values which are used have been found to be particularly effective for the material composition of the burn-in board. It will also be appreciated that the method is efficient because of the simple manner in which these steps are carried out.

The invention is not limited to the embodiments hereinbefore described, but may be varied in construction and detail.

CLAIMS

1. A process for producing a burn-in board, the process comprising the steps of:-

producing a board comprising:-

a substrate of a polymer material having a glass transition temperature in excess of 240°C,

a plurality of sets of through-holes, each set being for reception of a socket, and

a board connector connected individually to each set of through-holes;

securing a runner at a position extending substantially centrally and longitudinally at a lower surface of the board, the runner being of a material having a thermal expansion characteristic substantially similar to that of the board;

inserting sockets into the sets of through-holes;

mounting the assembled board in a frame and baking at a temperature in the range of 100°C to 120°C for 1.8 to 2.2 hours;

applying flux to the assembled board lower surface;

pre-heating the assembled board by passing over heating plates at a temperature in the range 160°C to 185°C;

soldering the assembled board by passing over a solder wave device whereby the lower surface of the runner slides on the uppermost edge of the solder wave, the solder being a combination of Sn and Ag and being at a temperature in the range 240°C to 250°C;

visually inspecting the soldered board and carrying out any required manual work; and

testing the soldered board by application of a test socket probe to each socket in turn.

2. A process as claimed in claim 1 wherein the board substrate material is polyimide having a glass transition temperature of approximately 260°C.

3. A process as claimed in claim 2, wherein the runner is of polyimide material.

4. A process as claimed in any preceding claim wherein the runner is bolted to the board adjacent each end thereof.

5. A process as claimed in any preceding claim wherein the assembled board is baked for approximately 2 hours at a temperature of approximately 110°C.

6. A process as claimed in any preceding claim wherein the assembled board is pre-heated before soldering by passing over plates at a temperature of approximately 175°C.

7. A process as claimed in any preceding claim wherein the solder is a combination of 96% Sn and 4% Ag.

8. A process as claimed in claim 7 wherein the solder temperature is approximately 245°C.

9. A process as claimed in any preceding claim wherein the soldered board is tested by connecting a board probe between the board connector and a connector on a universal interface having a plurality of test connectors and by connecting the socket probe between another connector of the universal interface and each socket in turn.

10. A process substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

11. A burn-in board whenever produced by a process as claimed in any preceding claim.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

12

Application number GB 9525154.2	

Relevant Technical Fields

(i) UK Cl (Ed.O) H1K (KMA, KRX); H2E (EAHM)

(ii) Int Cl (Ed.6) G01R 31/26, 1/04

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE: WPI

Search Examiner
R C HRADSKY

Date of completion of Search
7 FEBRUARY 1996

Documents considered relevant following a search in respect of Claims :-
1-11

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

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E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
A	US 5387861 (INCAL)	1
A	US 4926117 (MICRON)	1

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