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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>(51) International Patent Classification <sup>6</sup> :<br/><b>G06F 1/16, H05K 7/20, B52B 9/00, H01R 23/70, 9/09, 13/11, 23/68, H02G 5/00</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p><b>A1</b></p> | <p>(11) International Publication Number: <b>WO 99/15948</b><br/>(43) International Publication Date: 1 April 1999 (01.04.99)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <p>(21) International Application Number: PCT/US98/14995<br/>(22) International Filing Date: 20 July 1998 (20.07.98)<br/>(30) Priority Data:<br/>08/936,859 24 September 1997 (24.09.97) US<br/>(71) Applicant (for all designated States except US): INTEL CORPORATION [US/US]; 2200 Mission College Boulevard, Santa Clara, CA 95052 (US).<br/>(72) Inventor; and<br/>(75) Inventor/Applicant (for US only): PHAN, Truong [US/US]; 103 N.E. Cory Street, Hillsboro, OR 97124 (US).<br/>(74) Agents: TAYLOR, Edwin, H. et al.; Blakely, Sokoloff, Taylor &amp; Zafman LLP, 7th floor, 12400 Wilshire Boulevard, Los Angeles, CA 90025 (US).</p> |                  | <p>(81) Designated States: AL, AM, AT, AT (Utility model), AU (Petty patent), AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b><br/><i>With international search report.<br/>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p> |
| <p>(54) Title: A COMPUTER SYSTEM INCLUDING A CO-PLANAR PROCESSOR CONNECTOR</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <p>(57) Abstract</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <p>A computer system is formed using a co-planar processor connector to connect a motherboard and a processor package together in a co-planar manner. The co-planar processor connector includes a planar body having an inner cavity defined a number of inner walls extending from one end to the other end, and a number of pins disposed on the inner walls, extending from one end to the other end. The co-planar connector engages the motherboard at one end, and the processor package at the other end. The pins electrically couple the processor package to the motherboard.</p>                                                     |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

## **A Computer System Including A Co-planar Processor Connector**

### **BACKGROUND OF THE INVENTION**

#### **1. Field of the Invention**

The present invention relates to the field of computer systems. More specifically, the present invention relates to the art of coupling a processor to a motherboard of a computer system.

#### **2. Background Information**

Microprocessor based personal computers are known in the art, including personal computers employing low profile form factors. Traditionally, low profile personal computers have employed zero insertion force (ZIF) sockets to couple processors to the motherboards. Historically, the manner in which processors are coupled to the motherboards has not been an issue that needs to be addressed in achieving low profile, as the processors generally have a very low profile. However, recent advances in microprocessor technology have led to certain high performance microprocessors to employ a "cartridge" like approach to packaging, and single edge card connector (SECC) technology to connect the processor packages to the motherboards. Because of the high performance nature of these processors, typically heat sinks with substantial masses have to be employed to dissipate the heat generated by these processors. The first generation SECC processor packages are coupled to the motherboards with the two components occupying orthogonal planes, as a result constraining the low profile that can be achieved. Thus, a new non-

orthogonal approach to coupling these new high performance SECC processor packages and motherboards is desired.

#### SUMMARY OF THE INVENTION

A method for forming a computer system is disclosed. A co-planar processor connector is connected to a motherboard. A processor package is then in turn connected to the co-planar connector with the motherboard and the processor package being co-planar with each other.

A computer system formed using the above disclosed method is disclosed. The computer system includes a motherboard, a co-planar processor connector, and a processor package, interconnected as disclosed. In one embodiment, the computer system further includes a system chassis, and a number of spacers attaching the processor package to a wall of the system chassis.

A co-planar processor connector for use to form the above disclosed computer system is disclosed. The connector includes a planar body having an inner cavity defined by a number of inner walls extending from one end to the other end, and a number of pins disposed on the inner walls, extending from one end to the other end. The processor connector receives a motherboard at one end, and a processor package at the other end, in the above disclosed co-planar manner. The pins electrically couple the processor package to the motherboard.

A method for dissipating heat generated by a processor package is disclosed. The processor package is thermally coupled to a wall of a system chassis. In one embodiment, the wall is parallel to the

processor package, and thermally conductive spacers are used to facilitate the attachment. Heat generated during operation are channeled through the spacers to the chassis for dissipation.

#### **BRIEF DESCRIPTION OF DRAWINGS**

The present invention will be described by way of exemplary embodiments, but not limitations, illustrated in the accompanying drawings in which like references denote similar elements, and in which:

**Figures 1a – 1b** illustrate a side view and a top view of an exemplary motherboard having a processor package attached thereto in accordance with the teachings of the present invention;

**Figure 2** illustrates how the interconnected components can be placed into a chassis to form a low profile computer system in accordance with one embodiment of the present invention; and

**Figures 3 - 5** illustrate one embodiment of the co-planar processor connector of the present invention.

#### **DETAILED DESCRIPTION OF THE INVENTION**

In the following description, various aspects of the present invention will be described. Those skilled in the art will also appreciate that the present invention may be practiced with only some or all aspects of the present invention. For purposes of explanation, specific numbers, materials and configurations are set forth in order to provide a thorough understanding of the present invention. However, it will also be apparent to one skilled in the art that the present invention may be practiced without the specific

details. In other instances, well known features are omitted or simplified in order not to obscure the present invention.

Referring now to **Figures 1a – 1b**, wherein a side view and a top view of an exemplary motherboard having a processor package attached to it in accordance with the teachings of the present invention are shown. As illustrated, in accordance with the teachings of the present invention, processor package **208** is attached to motherboard **202** employing co-planar processor connector **402** of the present invention. Processor package **208** is a cartridge like package employing SECC technology. An example of processor package **208** is disclosed in co-pending U.S. Patent Application, Number 08/739,815, filed on October 30, 1996, entitled A Processor Card Assembly.

Co-planar processor connector **402** is first attached to motherboard **202** co-planar with motherboard **202**. Processor package **208** is then attached to co-planar processor connector **402** with processor package **208** and motherboard **202** also co-planar to each other.

In addition to processor package **208**, motherboard **202** also has a number of other components attached to it, such as memory modules **212**, I/O ports **220**, and add-on card **216**. For the illustrated embodiment, add-on card **216** is attached to motherboard **202** using right angle add-on card connector **214**. Examples of memory modules **212** includes single in-line memory modules (SIMM) or dual in-line memory modules (DIMM), whereas examples of I/O ports **220** include keyboard, mouse, serial and parallel ports. An example of add-on card **216** is a Peripheral Component Interconnect (PCI) add-on card with a PCI agent disposed thereon. The

PCI agent is to be coupled to a PCI bus disposed on motherboard 202, and having to meet the high performance PCI signal requirements. Right angle add-on card connector 214 is first attached to motherboard 202 in a direction orthogonal to motherboard 202. Add-on card 216 is then attached to right angle add-on card connector 214 with add-on card 216 and motherboard 202 occupying parallel planes. Right angle add-on card connector 214 is the subject of U.S. Patent Application, number <to be assigned>, filed contemporaneously, entitled A Computer System Including Right Angle Processor and Add-On Card Connectors, which is hereby fully incorporated by reference.

For the illustrated embodiment, motherboard 202 including the above described elements is attached to riser card 102. Attached also to riser card 102 is power supply 204, fixed drive 206, and optionally, diskette drive 224. For the illustrated embodiment, power supply 204 spans the entire length of motherboard 202, and having receptacle 222 disposed at the other end to receive external AC power. In a preferred embodiment, riser card 102 includes a number of inter-component cabling elimination features disposed on its rear (interior facing) surface and its front (exterior facing) surface. The features disposed on the interior facing surface includes motherboard connector 108, power supply connector 110, fixed drive connector 112 and diskette drive connector 114 for directly connecting motherboard 202, power supply 204, fixed drive 206 and diskette drive 224 to riser card 102, without employing cabling. The features disposed on the exterior facing surface includes a power on/off button for powering the host computer system on/off, a number of I/O ports for coupling external I/O devices to the host computer system, visual indicators and display area for providing visual indicators and messages to

a user of the host computer system. Riser card **102** is the subject of U.S. Patent Application, number <to be assigned>, filed contemporaneously, entitled A Computer System Including A Riser Card With Multiple Inter-Component Cabling Elimination Features, as well as the subject of U.S. Patent Application, number <to be assigned>, filed contemporaneously, entitled A Computer System Including A Riser Card And A Chassis With Serviceability Features, which are both hereby fully incorporated by reference.

**Figure 2** illustrates in further detail how the interconnected components are placed into a chassis to form a low profile computer system in accordance with one embodiment of the present invention. The illustration is presented from a perspective view of the exemplary system. As illustrated, the interconnected elements, including motherboard **202**, coplanar processor connector **402**, processor package **208**, etc., are placed into chassis **302** to form exemplary computer system **400**. The interconnected elements are placed into chassis **302** in a manner such that riser card **102** is disposed directly behind the front wall of chassis **302**. For the illustrated embodiment, a number of thermally conductive spacers **211** (see **Fig. 1**) are employed to thermally couple the processor package to the bottom wall of system chassis **302**. In other words, for the illustrated embodiment, system chassis **302** also functions as a heat sink for processor package **208**.

Additionally, for the illustrated embodiment, chassis **302** also includes corresponding openings **310** disposed on the front wall to externalize the cabling elimination features disposed on the exterior facing surface of riser card **102**. Furthermore, chassis **302** includes hinged top

cover 304 and back panel 306, which when assembled, render chassis 302 effectively sealed. An effectively sealed chassis is a chassis that requires special tool and/or extraordinary effort on the part of a user to open the chassis. However, sealed chassis 302 includes covered opening 308 with sliding cover 318, which can be slid in one direction to temporally uncover opening 308 to provide access to servicing components located proximately adjacent to opening 308, without requiring chassis 302 to be unsealed. Chassis 302 is the subject of the above identified incorporated by reference co-pending U.S. Patent Application, number <to be assigned>.

As a result, exemplary computer system 400 can achieve a low profile, notwithstanding the fact that processor package 208 is a cartridge like package that employs SECC technology, such as the processor package disclosed in the above identified co-pending U.S. Patent Application, number 08/739,815, which otherwise requires a very large heat sink to remove the heat generated by processor package 208 during operation.

Figure 3 - 5 illustrates one embodiment of co-planar processor connector 402 in further detail. Figure 3 is a perspective view of connector 402. Figures 4 - 5 are cross sectional views of connector 402 taken at two different axes, A-A and B-B respectively. As shown, for the illustrated embodiment, co-planar processor connector 402 includes two-part main body 408 having a motherboard end (the end that engages with motherboard 202) and a processor end (the end that engages with processor package 208). For the illustrated embodiment, the two parts are snapped together using guides 414 (see Fig. 4, which is the cross

sectional view taken along axis A-A with the motherboard end of the two part main body removed).

Main body **408** has inner cavity **410** defined by a number of inner walls, extending from the processor end to the motherboard end. Main body **408** also includes a number of pins **412** disposed along the inner walls, extending from the processor end to the motherboard end. For ease of illustration, only one pair of pins **412** is illustrated in the cross sectional view of **Figure 4**. Those skilled in the art will appreciate that there are many more pins involved. However, the precise number of the pins involved is application dependent, that is, depending on the type of motherboard and processor package being coupled together.

Co-planar processor connector **402** receives processor package **208** at the processor end, with processor package **208** and motherboard **202** occupying the same plane (see **Fig. 2** and **Fig. 5**, which is the cross sectional view taken along axes B-B). Processor package **208** is electrically coupled to motherboard **202** by pins **412** disposed on the inner walls of main body **408**. As illustrated in **Fig. 5**, pins **412** electrically engage fingers **203** and **209** of motherboard **202** and processor package **208** respectively.

Those skilled in the art will appreciate that the disclosed invention may be practiced with modifications and alterations within the spirit and scope of the appended claims. Accordingly, the above description is to be regarded as illustrative but not restrictive of the present invention.

Thus, a computer system including a co-planar processor connector has been disclosed.

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## CLAIMS

What is claimed is:

1. A processor connector for coupling a processor package to a motherboard in a low profile manner, comprising:
  - a) a planar main body, having an inner cavity defined by a plurality of inner walls extending from a first end to a second end, to engage the motherboard at the first end and the processor package at the second end, with the processor package and the motherboard being co-planar with each other; and
  - b) a plurality of pins disposed along the inner walls of the inner cavity extending from the first end to the second end to electrically couple the processor package to the motherboard.
2. The processor connector as set forth in claim 1, wherein the planar main body comprises of two parts snapped together.
3. The processor connector as set forth in claim 2, wherein at least one part of the two part planar main body comprises a plurality of guides for facilitating snapping the two parts of the main body together.
4. A computer system with a low profile, comprising:
  - a) a motherboard;
  - b) a processor package;
  - c) a processor connector having
    - c.1) a planar main body, including a first inner cavity defined by a first plurality of inner walls extending from a first end to a second end, engaging the motherboard at the first end and the





processor package at the second end with the motherboard and the processor package being co-planar with each other,

c.2) a first plurality of pins disposed on the first inner walls of the first inner cavity, extending from the first end through the second end, to electrically couple the motherboard and the processor package.

5. The computer system as set forth in claim 4, wherein the planar main body of the processor connector comprises of two parts snapped together.

6. The computer system as set forth in claim 5, wherein at least one part of the two part planar main body of the processor connector comprises a plurality of guides for facilitating snapping the two parts of the main body of the processor connector together.

7. The computer system as set forth in claim 4, wherein the computer system further comprises:

d) a chassis having a plurality of chassis walls;  
e) a plurality of thermally conductive spacers attached to the processor package and one of the chassis walls to secure the processor package, and to facilitate employment of the chassis as a heat sink for the processor package to dissipate heat generated by the processor package during operation.

8. The computer system as set forth in claim 7, wherein the spacers attach the processor package to a base wall of the chassis.





9. The computer system as set forth in claim 4, wherein the computer system further comprises:

d) an add-on card connector having

d.1) an L-shaped main body, including a second inner cavity defined by a second plurality of inner walls extending from a third end to a fourth end, to be mechanically attached upside down to the motherboard with the upside down L-shaped main body and the motherboard being orthogonal to each other,

d.2) a second plurality of pins disposed on the second inner walls of the second inner cavity extending from the third end through the fourth end to be electrically connected to the motherboard, and

e) an add-on card mechanically engaged with the second inner cavity at the third end of the add-on card connector with the add-on card and the motherboard occupying parallel planes, and electrically coupled to the motherboard through the second plurality of pins.

10. The computer system as set forth in claim 9, wherein the L-shaped main body of the add-on card connector is augmented at its sides with mounting steps to facilitate said upside down mechanical attachment to the motherboard.

11. The computer system as set forth in claim 9, wherein the upside down L-shaped main body including the augmented mounting steps in conjunction with the motherboard define an exterior cavity having a height sufficient to accommodate a predetermined number of components attached to the motherboard.





12. The computer system as set forth in claim 9, wherein the add-on card connector is a PCI add-on card connector, and the add-on card comprises a PCI agent that is to be electrically located within a predetermined distance from the motherboard to be connected to a PCI bus disposed on the motherboard.

13. A method for forming a computer system, comprising:

- a) attaching a processor connector having a planar body including an inner cavity defined by a plurality of inner walls extending from a first end to a second end, to a motherboard; and
- b) attaching a processor package to the processor connector, co-planar with the motherboard, the processor connector further having a plurality of pins extending from the first end to the second end to electrically couple the processor package to the motherboard.

14. The method of claim 13 further comprising:

- c) attaching the processor package to a wall of a computer chassis using a plurality of thermally conductive spacers.

15. The method of claim 14 wherein step (c) comprises attaching the processor package to a base wall of a computer chassis using the plurality of thermally conductive spacers.

16. A method for dissipating heat generated by a processor package during operation, comprising:

- a) mechanically attaching the processor package to a motherboard in a co-planar manner;

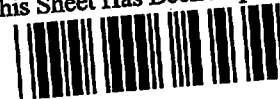




b) thermally attaching the processor package to a wall of a chassis, allowing the heat generated by the processor package during operation to be channeled to the chassis for dissipation.

17. The method of claim 16 wherein the wall and the processor package occupy parallel planes, and step (b) comprises employing thermally conductive spacers to mechanically and thermally attach the processor package to the wall.

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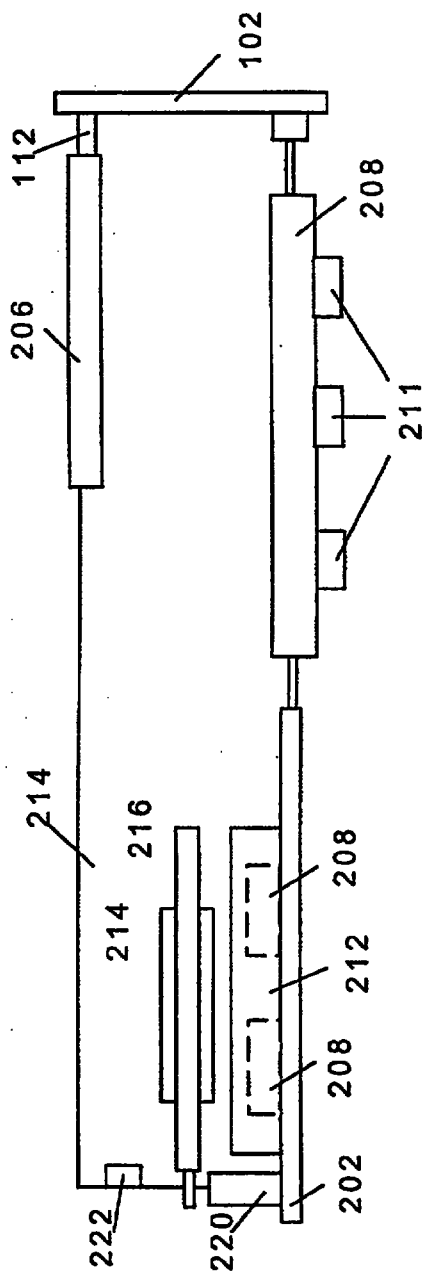


Figure 1a

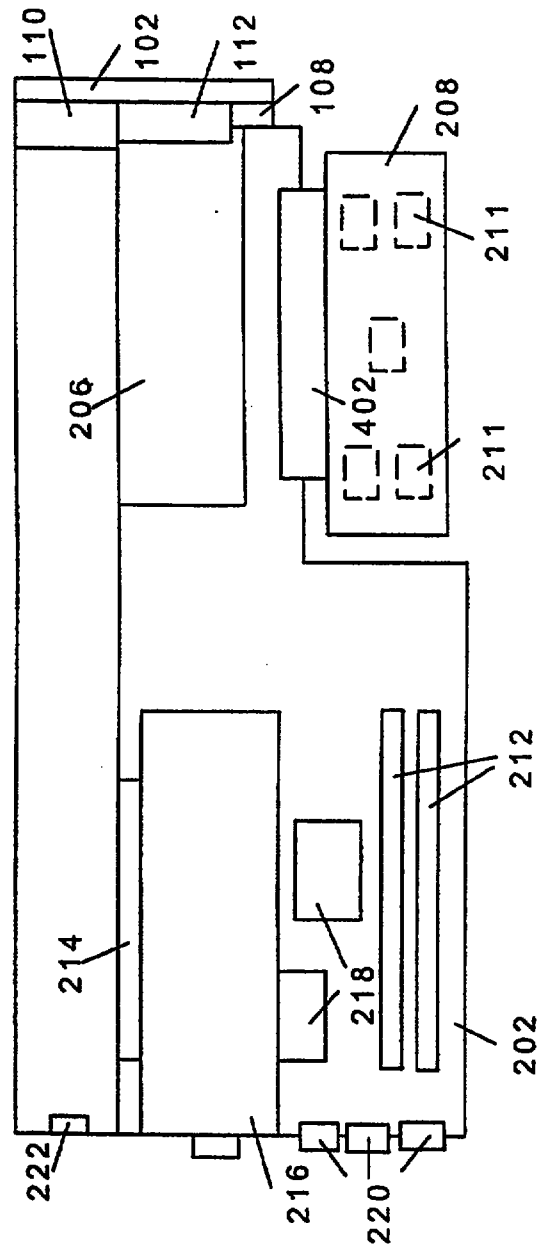


Figure 1b

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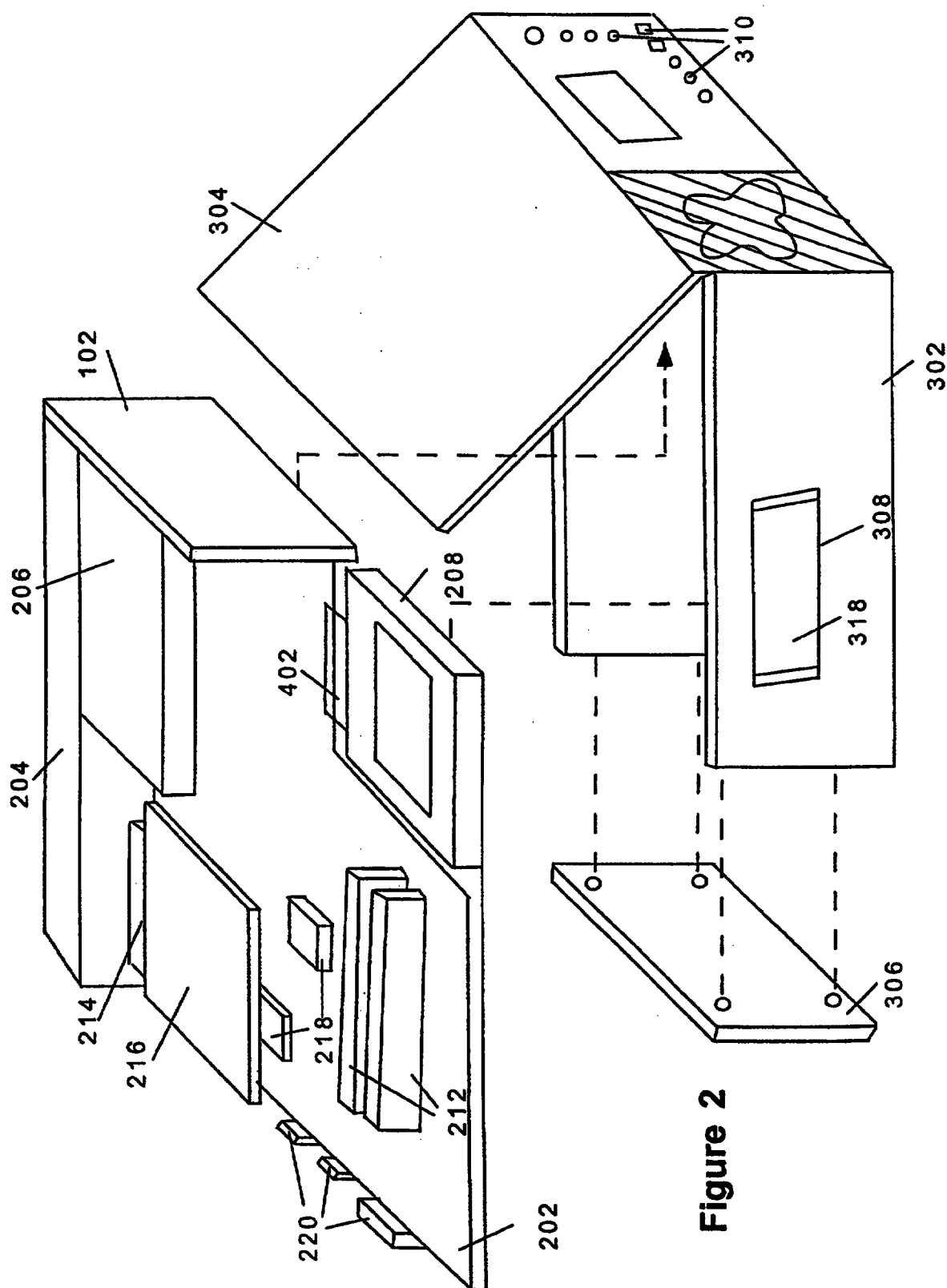


Figure 2

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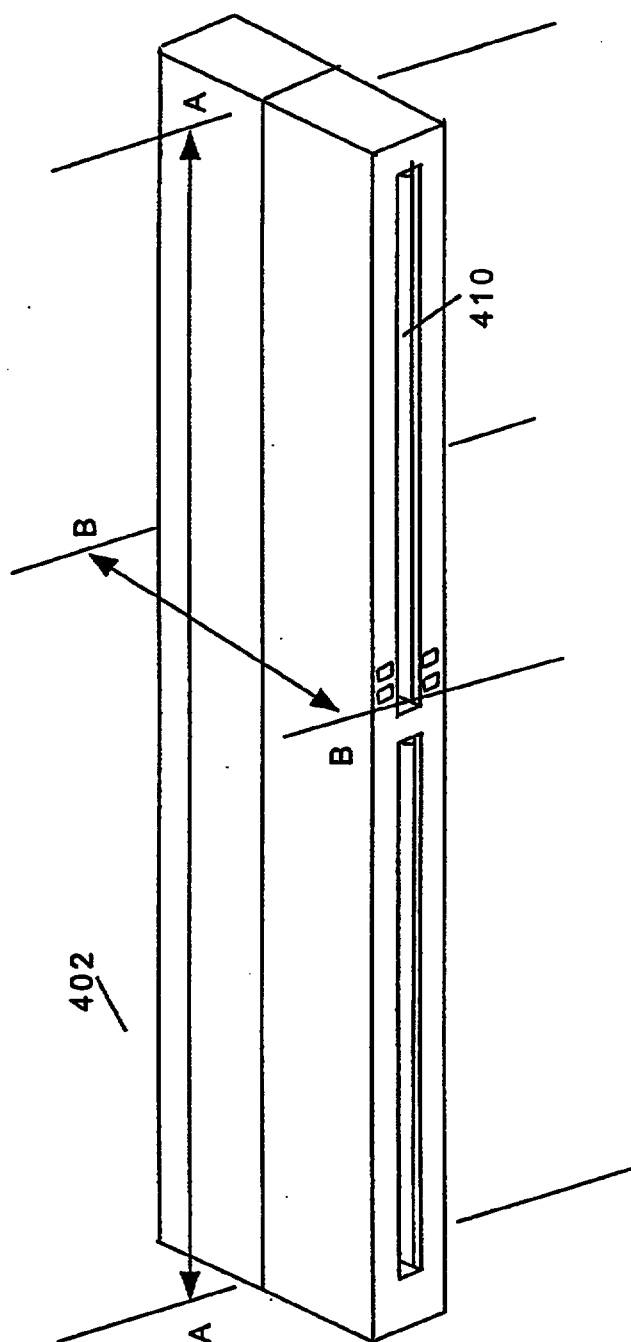


Figure 3

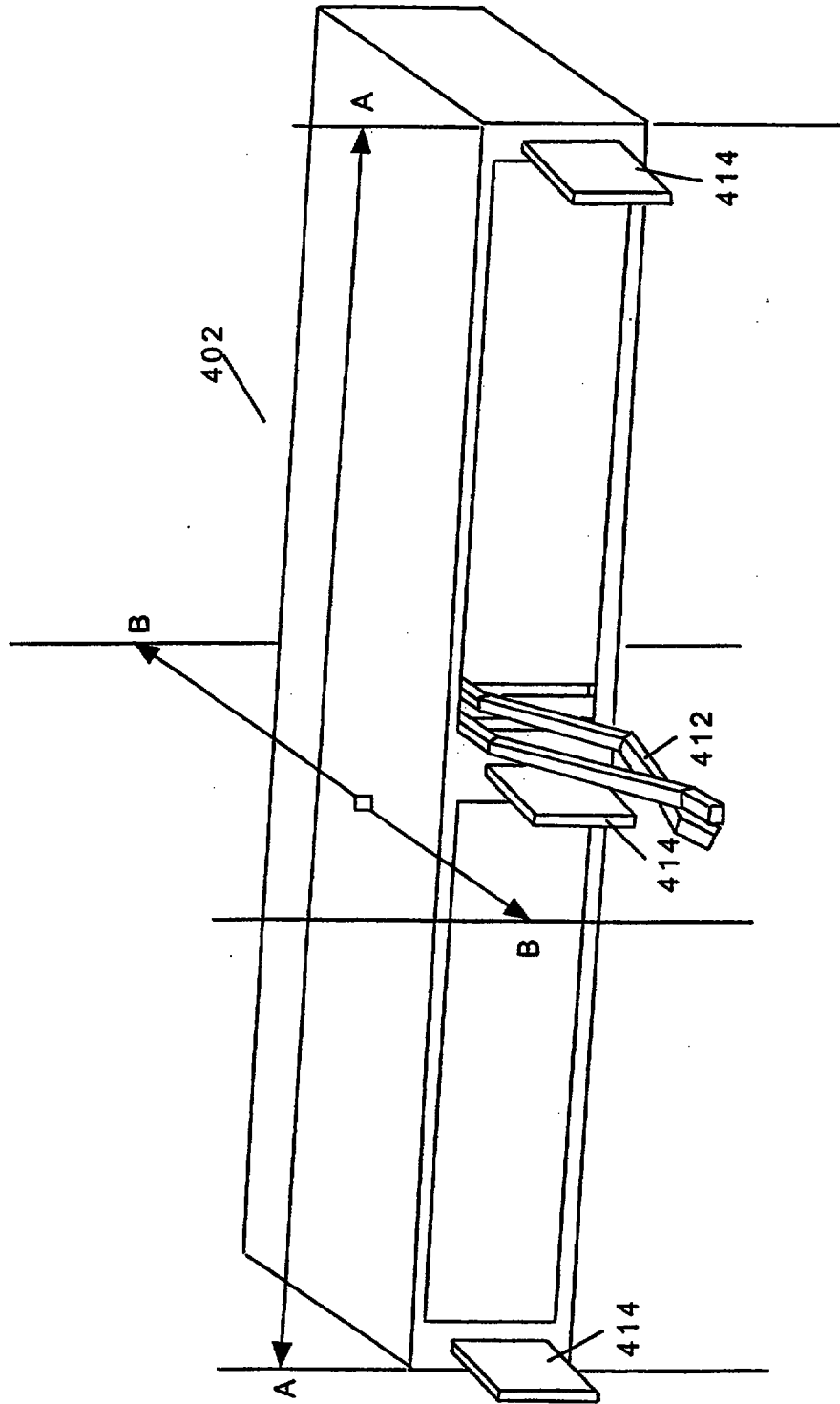


Figure 4

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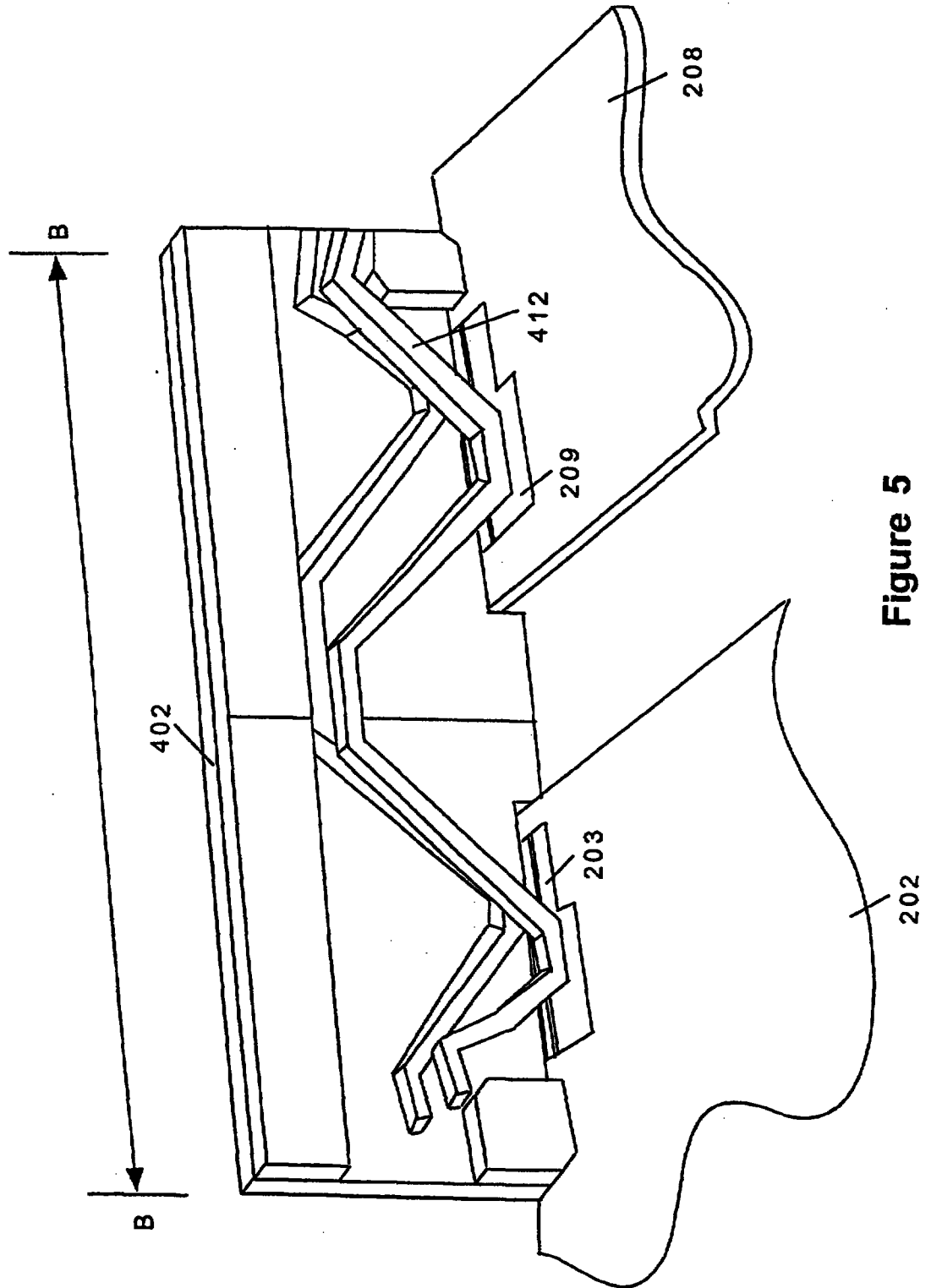


Figure 5