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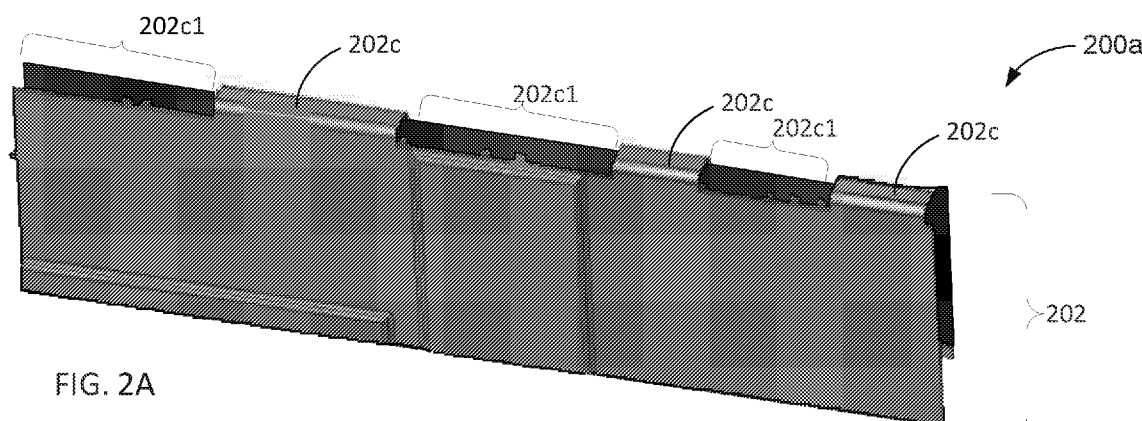


FIG. 2A

(57) Abstract: Embodiments described herein may include apparatuses, systems and/or processes to provide a heatsink to thermally couple with a component such as a memory module. The heat spreader may have a first side, a second side, and a connector that may connect a top edge of the first side and the second side and may provide a compressive force to secure the component between the first side and the second side. Other embodiments may be described and/or claimed.



COMPONENT HEAT SPREADER

Field

Embodiments of the present disclosure generally relate to the fields of heat spreaders for electronic components. More specifically, embodiments of the present disclosure relate to heat spreaders for a memory module.

Background

As computing capacity requirements continue to grow, particularly in the area of server systems, higher-performing central processing units (CPUs) and increased amounts of associated memory are being included in motherboards. As a result, existing components may be positioned closer together. In addition, higher-performing CPUs may call for increased memory, for example, dual-in-line memory modules (DIMMs), to be positioned proximate to the CPU.

Brief Description of the Drawings

Embodiments will be readily understood by the following detailed description in conjunction with the accompanying drawings. To facilitate this description, like reference numerals designate like structural elements. Embodiments are illustrated by way of example and not by way of limitation in the figures of the accompanying drawings.

FIG. 1A illustrates a perspective view of an example implementation of a DIMM heat spreader (HS), in accordance with various embodiments.

FIG. 1B illustrates a perspective view of an example implementation of a HS with a DIMM inserted, in accordance with various embodiments.

FIG. 2A illustrates a perspective view of an example implementation of a HS with portions of the connector removed, in accordance with various embodiments.

FIG. 2B illustrates a perspective view of an example implementation of a HS with portions of the connector removed and with a DIMM inserted, in accordance with various embodiments.

FIG. 3 illustrates a perspective view of an example implementation of a HS including additional heat spreader features, in accordance with various embodiments.

FIG. 4 illustrates a side view of a HS with a DIMM inserted, in accordance with various embodiments.

FIG. 5A illustrates a side view of a HS, in accordance with various embodiments.

FIG. 5B illustrates a side view of a DIMM being inserted into a HS, in accordance with various embodiments.

FIG. 6 depicts an example flow diagram showing a process 600 for inserting a memory module into a HS, according to various embodiments.

FIG. 7 illustrates a perspective view of a DIMM with multiple HSs, in accordance with various embodiments.

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Detailed Description

With increased demand for computing systems with ever greater amounts of memory, memory modules, in particular DIMMs, may be placed closer together, for example, on a motherboard in proximity to one or more CPUs. As a result, issues with respect to heat dissipation for the memory modules as well as the changes in physical dimensions (e.g., functional width) that result from different heat dissipation techniques may be a factor in the density of memory module placement. For example, as the pitch between 2 DIMMs becomes increasingly smaller, thermal dissipation techniques for each DIMM will need to accommodate this change.

In legacy implementations involving DIMMs, in particular high-power DIMMs, heat dissipation may be accomplished using 2 heat spreaders on the front and the back of the DIMM that are held into place with a retention clip. As a result, the clip typically increases the DIMM width by approximately 2 millimeters (mm), thus making it difficult to reduce the pitch between the DIMMs.

In embodiments herein, thermal dissipation for a DIMM may be accomplished with a DIMM heat spreader that does not require a clip, which may allow for a reduced pitch between DIMMs and may allow for increased heat dissipation. It should be noted that the apparatus, processes and techniques described herein with respect to memory modules, in particular DIMMs, may also apply to heat management techniques of other components such as other forms of memory and/or memory modules.

In the following description, various aspects of the illustrative implementations are described using terms commonly employed by those skilled in the art to convey the substance of their work to others skilled in the art. However, it will be apparent to those skilled in the art that embodiments of the present disclosure may be practiced with only some of the described aspects. For purposes of explanation, specific numbers, materials, and configurations are set forth in order to provide a thorough understanding of the illustrative implementations. However, it will be apparent to one skilled in the art that embodiments of the present disclosure may be practiced without the

specific details. In other instances, well-known features are omitted or simplified in order not to obscure the illustrative implementations.

In the following description, reference is made to the accompanying drawings that form a part hereof, wherein like numerals designate like parts throughout, and in which is shown by way of illustration embodiments in which the subject matter of the present disclosure may be practiced. It is to be understood that other embodiments may be utilized and structural or logical changes may be made without departing from the scope of the present disclosure. Therefore, the following detailed description is not to be taken in a limiting sense, and the scope of embodiments is defined by the appended claims and their equivalents.

For the purposes of the present disclosure, the phrase “A and/or B” means (A), (B), or (A and B). For the purposes of the present disclosure, the phrase “A, B, and/or C” means (A), (B), (C), (A and B), (A and C), (B and C), or (A, B, and C).

The description may use perspective-based descriptions such as top/bottom, in/out, over/under, and the like. Such descriptions are merely used to facilitate the discussion and are not intended to restrict the application of embodiments described herein to any particular orientation.

The description may use the phrases “in an embodiment,” or “in embodiments,” which may each refer to one or more of the same or different embodiments. Furthermore, the terms “including,” “having,” and the like, as used with respect to embodiments of the present disclosure, are synonymous.

The terms “coupled with” and “coupled to” and the like may be used herein. “Coupled” may mean one or more of the following. “Coupled” may mean that two or more elements are in direct physical, thermal or electrical contact. However, “coupled” may also mean that two or more elements indirectly contact each other, but yet still cooperate or interact with each other, and may mean that one or more other elements are coupled or connected between the elements that are said to be coupled with each other. By way of example and not limitation, “coupled” may mean two or more elements or devices are coupled by electrical connections on a printed circuit board such as a motherboard, for example. By way of example and not limitation, “coupled” may mean two or more elements or devices are thermally coupled. By way of example and not limitation, “coupled” may mean two or more elements/devices cooperate and/or interact. By way of

example and not limitation, a computing apparatus may include two or more computing devices “coupled” on a motherboard or by one or more network linkages.

FIG. 1A illustrates a perspective view of an example implementation of a DIMM heat spreader (HS), in accordance with various embodiments. Diagram 100a may show a HS 102 that is made up of a first side 102a and a second side 102b that are connected by a connector 102c. In embodiments, the HS 102 may be made out of a single piece of material, for example, from a metal plate or from a plate of some other suitable material. In embodiments, a sheet-metal manufacturing process or some other suitable process may be used to manufacture a HS 102 from the plate.

In embodiments, the first side 102a, the second side 102b, and the connector 102c may be made of separate materials that may be joined together to form a single unit. For example, the first side 102a and the second side 102b may include copper or some other material to provide thermal conductivity. In embodiments, the connector 102c may include steel or some other suitable metal with properties to provide a consistent, strong, resilient compressive force that may be applied to the first side 102a and the second side 102b. Other embodiments may include other suitable materials with such properties. In embodiments, the first side 102a, the connector 102c, and the second side 102b may be coupled by soldering, welding, or some other suitable technique. In embodiments, after coupling, the HS 102 may appear as a whole apparatus with no detachable parts.

FIG. 1B illustrates a perspective view of an example implementation of a HS with a DIMM inserted, in accordance with various embodiments. Diagram 100b may show the HS 102 of FIG. 1A, with a DIMM 104 inserted between the first side 102a and the second side 102b. In embodiments, the DIMM 104 may be inserted so that a top of the DIMM 104 may be adjacent to the connector 102c.

In embodiments, the connector 102c may apply a force, which may be referred to as a compressive force, against the first side 102a and the second side 102b that may cause the sides to press together or clamp against the inserted DIMM 104. In embodiments, this action may cause the DIMM 104 to remain securely seated in the HS 102, and may also provide a thermal connection. While the DIMM 104 is in operation, the thermal connection may allow heat from the DIMM 104 to be transferred, or dissipated, readily to the HS 102. The HS 102 may then dissipate this heat to the ambient air

surrounding the HS 102, or may dissipate the heat to some other cooling process or mechanism.

In embodiments, the first side 102a and the second side 102b may provide about 5 pounds of force on each side of the DIMM 104. In embodiments, other amounts of force may be applied depending on the type of memory module. In embodiments, the connector 102c may be strengthened, for example, by increasing its thickness, changing its chemical composition, through tempering, or through some other suitable process.

In embodiments, one or more of the sides 102a, 102b, of the HS 102 may have one or more cavities 102d, 102e to allow for raised components (not shown) on the DIMM 104. Examples may include a memory controller on the DIMM 104 that may generate heat when in operation and that is to be in physical and thermal contact with the HS 102. This physical and thermal contact may occur while the HS 102 is in physical and thermal contact with other parts of the DIMM 104. In embodiments, the one or more cavities 102d, 102e may be of arbitrary size and/or arbitrary location depending upon the physical layout of additional components (not shown) on the DIMM 104. In embodiments, the one or more cavities 102d, 102e may be created by using a punch process if the HS 102 is made of, for example, sheet metal, or may be created by some other suitable process.

In embodiments, the DIMM 104 inserted into a HS 102 may have a smaller width as compared to legacy implementations. For example, in some embodiments a width of the DIMM 104 inserted into a HS 102 may have a 2.3mm less thickness (5.7 vs. 8.0mm) and therefore may accommodate a narrower pitch. In embodiments, due to the reduced thickness of the DIMM 104 with the HS 102 attached in comparison to legacy implementations, there may be increased airflow between DIMMs, even though the DIMMs may be spaced closer together.

FIG. 2A illustrates a perspective view of an example implementation of a HS with portions of the connector removed, in accordance with various embodiments. Diagram 200a shows a HS 202, which may be similar to the HS 102 of FIG. 1A, where the connector 202c, which may be similar to connector 102c of FIG. 1A, has been cut away in one or more locations to form connector cutaways 202c1. In embodiments, during manufacture of the HS 202, the connector cutaways 202c1 may be portions of the connector 202c that are not added when the sides of the HS 202, which may be similar to sides 102a, 102b of FIG. 1A, were coupled to the connector 202c. In embodiments,

connector cutaways 202c1 may be punched out of a sheet of metal prior to folding, or may be cut away after folding.

FIG. 2B illustrates a perspective view of an example implementation of a HS with portions of the connector removed and with a DIMM inserted, in accordance with various embodiments. Diagram 200b shows a DIMM 204, which may be similar to DIMM 104 of FIG. 1B, inserted into the HS 202. In embodiments, as shown, the connectors 202c may correspond to recesses (hidden by connectors 202c) in the top of the DIMM 204 and, when the DIMM 204 is completely seated, may allow the top of the recesses to be adjacent to the connectors 202c. In embodiments, this may allow the top of the DIMM 204 to be flush with the top of the connectors 202c. In other embodiments, the top of the connectors 202c may be either above or below the top of the DIMM 204.

In embodiments, because there may be less of connector 202c available to apply a compression force to a first side (not shown) and a second side 202b in order to secure the inserted DIMM 204 within the HS 202, the connector 202c may need to be strengthened and/or otherwise altered. In embodiments, this may be accomplished by increasing connector 202c thickness, changing its chemical composition, tempering the connector 202c material, or through some other suitable process.

FIG. 3 illustrates a perspective view of an example implementation of a HS including additional heat spreader features, in accordance with various embodiments. Diagram 300 shows a HS 302, which may be similar to HS 102 of FIG. 1A, which has a first side 302a, a second side 302b, and a connector 302c. Embodiments may include a buildup layer, for example, buildup layer 302f, on the second side 302b, that may have additional thermal dissipation properties due to an increased mass proximate to a heat generation area corresponding to one or more components on a DIMM (not shown) that may be inserted into the HS 302. In embodiments, the heat may dissipate from the buildup layer 302f into the ambient air, or may be removed through some other heat transfer means, for example, by a cold plate or heat pipe that may be thermally coupled to the buildup layer 302f.

FIG. 4 illustrates a side view of a HS with a DIMM inserted, in accordance with various embodiments. Diagram 400 shows a HS 402, which may be similar to the HS 102 of FIG. 1A, that includes a first side 402a and a second side 402b that is connected by a connector 402c. A DIMM 404 is inserted within the HS 402. In embodiments, the DIMM 404 may include a wafer 404a that may have components 404b attached to the side

of the wafer 404a. The components 404b may include controllers, memory modules, capacitors, and the like that may generate heat during operation.

In embodiments, the DIMM 404 may be physically secured after insertion into the HS 402 by pressure exerted on the DIMM 404 by the first side 402a and the
 5 second side 402b. In embodiments, the connector 402c may provide a compression force that is applied to the HS sides 402a, 402b. In embodiments, the HS 402 sides 402a, 402b may be straight (as shown) without any flares at the end edges 402a1, 402b1. In other embodiments, flares may be used to facilitate insertion of a DIMM 404 into the HS 402.

In embodiments, a thermal interface material (TIM) 403 may be applied to
 10 all or part of the inside of a HS side 402a, 402b. In embodiments, the TIM 403 may come into physical and/or thermal contact with the various components 404b that may generate thermal energy to be dissipated. In embodiments, TIM 403 may also be applied to the components 404b either instead of, or in addition to, TIM 403 that may be applied to the inside of a HS side 402a, 402b. In embodiments, the TIM 403 may include epoxies,
 15 silicones, urethanes, acrylates, aluminum oxide, boron nitride, zinc oxide, aluminum nitride, silver compounds and/or other suitable materials for thermal conductivity. In embodiments, the TIM 403 may be applied as a thermal grease, thermal glue, thermal gap filler, thermal pad, and/or thermal adhesive.

FIG. 5A illustrates a side view of a HS, in accordance with various
 20 embodiments. Diagram 500a shows a HS 502, which may be similar to the HS 102 of FIG. 1A, having a first side 502a and a second side 502b that may be connected by a connector 502c. The compression force applied by the connector 502c may cause the first side 502a and the second side 502a to compress together, which may cause the width 505a at the bottom edge of the HS 502 to be smaller than the width 505b at the top edge of the
 25 HS 502.

FIG. 5B illustrates a side view of a DIMM being inserted into a HS, in accordance with various embodiments. Diagram 500b shows an embodiment of a tool 507 that may be used to spread apart the bottom edge of the first side 502a1 and the bottom edge of the second side 502b1 to a width 505c. In embodiments, the width 505c may be
 30 greater than the width of the DIMM 504. At this point, the DIMM 504 may be inserted into the HS 502. Upon insertion, the tool 507 may be relaxed, allowing the first side 502a and the second side 502b to physically press against, clamp, and/or thermally couple to the DIMM 504.

In embodiments, prior to the DIMM 504 insertion, TIM 503, which may be similar to TIM 403 of FIG. 4, may be applied to the inner sides of the first side 502a and/or the second side 502b.

5 In embodiments, once the DIMM 504 is inserted into the HS 502, to remove the DIMM 504, the tool 507 may be used to spread apart a bottom edge of the first side 502a1 and a bottom edge of the second side 502b to a width 505c that is greater than the width of the DIMM 504, after which the DIMM 504 may be removed.

FIG. 6 depicts an example flow diagram showing a process 600 for inserting a memory module into a HS, according to various embodiments.

10 At block 602, the process may include spreading apart a bottom edge of a first side of the HS and a bottom edge of a second side of a HS, wherein a top edge of the first side and a top edge of the second side are coupled with a connector to provide a compressive force to the first side and the second side. In embodiments, the HS may refer to HS 102 of FIG. 1A, with the first side of the HS 102a, the second side of the HS 102b, and the connector 102c. In embodiments, the HS may refer to HS 202 of FIG. 2A, HS 302 of FIG. 3, HS 402 of FIG. 4, or of HS 502 of FIG. 5A-5B.

20 In embodiments, spreading apart may be accomplished by using tool 507 of FIG. 5B to spread apart a bottom edge of the first side and of the second side of the HS to a width 505c that may be wide enough to allow the insertion of DIMM 504. This may be referred to above in the detailed description section relating to FIG. 5B.

At block 604, the process may include inserting the memory module between the first side of the HS and the second side of the HS. In embodiments, the memory module may refer to DIMM 104 of FIG. 1B, 204 of FIG. 2B, 304 of FIG. 3, 404 of FIG. 4, and/or 504 of FIG. 5B. In embodiments, insertion may include inserting a DIMM 104 into an HS 102 so that it is tangent to the connector 102c. In embodiments, insertion may include inserting a DIMM 204 into an HS 202 such that a top portion of the DIMM 204 may be at or above the level of the connector 202c.

30 At block 606, the process may include releasing the bottom edge of the first side and the bottom edge of the second side to allow the first and the second side of the HS to press against the memory module. In embodiments, this may include releasing the tool 507 of FIG. 5B to allow the first bottom side 502a1 and the second bottom side 502b1 of the HS 502 to spring back and to apply compressive force against the DIMM 504 and to hold it securely within the HS 502.

FIG. 7 illustrates a perspective view of a DIMM with multiple HSs, in accordance with various embodiments. Diagram 700 shows a DIMM 704, which may be similar to DIMM 104 of FIG. 1A, that may be inserted into multiple HS 730, 732, 734. In embodiments, HS 730 and HS 734 may be similar to HS 202 of FIG. 2B, and HS 732 may
5 be similar to HS 102 of FIG. 1A. In embodiments, multiple HS 730, 732, 734 may be used for accommodating varying dimensional and/or thermal requirements for a DIMM 704, or to facilitate different TIM (not shown) thicknesses among varying components of the DIMM 704, for example, wafer 404a and components 404b of FIG. 4.

Various operations are described as multiple discrete operations in turn, in
10 a manner that is most helpful in understanding the claimed subject matter. However, the order of description should not be construed as to imply that these operations are necessarily order dependent.

EXAMPLES

Example 1 may be a heat spreader (HS) comprising: a first side to couple
15 with a first side of a component; a second side to couple with a second side of the component; and a connector that connects a top edge of the first side of the HS and a top edge of the second side of the HS to provide a compressive force to secure the component between the first side of the HS and the second side of the HS to thermally couple the HS with the component.

20 Example 2 may include the subject matter of example 1, wherein the component is a memory module, a dual-in-line memory module, or a full dual-in-line memory module (DIMM).

Example 3 may include the subject matter of example 1, wherein the first
25 side of the HS includes a recess to facilitate a thermal couple between the first side of the HS and a raised portion on the component that is proximate to the recess when the component is secured by the HS.

Example 4 may include the subject matter of example 3, wherein the raised portion is a memory module controller.

Example 5 may include the subject matter of example 3, further
30 comprising a thermal interface material (TIM) on the recess to facilitate thermal conductivity when the component is secured by the HS.

Example 6 may include any one of examples 1-5, wherein the first side of the HS includes a buildup of material to facilitate heat dissipation from a portion of the component proximate to the buildup of the material.

5 Example 7 may include any one of examples 1-5, wherein one or more portions of the connector are removed to allow the HS, after the component is secured in the HS, to be at or below a top edge of the component.

Example 8 may include any one of examples 1-5, wherein the first side, the second side, and the connector are made from a single piece of material.

10 Example 9 may include any one of examples 1-5, wherein the first side and the second side include copper.

Example 10 may include any one of examples 1-5, wherein the connector includes steel.

Example 11 may be a system comprising: a memory module; and a heat spreader (HS) comprising: a first side of the HS to couple with a first side of the memory
15 module; a second side of the HS to couple with a second side of the memory module; and a connector coupled with a top edge of the first side of the HS and a top edge of the second side of the HS to provide a compressive force to the first side and the second side of the memory module, wherein the memory module is secured between the first side of the HS and the second side of the HS and is thermally coupled to the HS.

20 Example 12 may include the subject matter of example 11, wherein the memory module is a dual-in-line memory module or a full dual-in-line memory module.

Example 13 may include the subject matter of example 11, wherein the first side of the HS includes a recess to facilitate a thermal couple between the first side of the HS and a raised portion on the memory module proximate to the recess when the
25 memory module is secured by the HS.

Example 14 may include the subject matter of example 13, wherein the raised portion is a memory module controller.

Example 15 may include the subject matter of example 13, wherein the HS further comprises a thermal interface material (TIM) on the recess to facilitate thermal
30 conductivity.

Example 16 may include the subject matter of any one of examples 11-15, wherein the first side of the HS includes a buildup of material to facilitate heat dissipation from a portion of the memory module proximate to the buildup.

5 Example 17 may include the subject matter of any one of examples 11-15, wherein portions of the connector are removed to allow the HS to be at or below a top edge of the memory module.

Example 18 may include the subject matter of any one of examples 11-15, wherein the first side of the HS, the second side of the HS, and the connector are made from a single piece of material.

10 Example 19 may include the subject matter of any one of examples 11-15, wherein the first side of the HS and the second side of the HS include copper.

Example 20 may include the subject matter of any one of examples 11-15, wherein the connector includes steel.

15 Example 21 may be a method for inserting a memory module into a heat spreader (HS) comprising: spreading apart a bottom edge of a first side of the HS and a bottom edge of a second side of a HS, wherein a top edge of the first side and a top edge of the second side are coupled with a connector to provide a compressive force to the first side and the second side; inserting the memory module between the first side of the HS and the second side of the HS; and releasing the bottom edge of the first side and the
20 bottom edge of the second side to allow the first side and the second side of the HS to press against the memory module.

Example 22 may include the subject matter of example 21, wherein a spreader tool is used to spread apart a bottom edge of the first side of the HS and the bottom edge of the second side of the HS .

25 Example 23 may include the subject matter of example 21, wherein when the HS presses against the memory module the HS thermally couples with the memory module.

Example 24 may include the subject matter of example 21, wherein inserting the memory module further includes inserting the memory module so that a top
30 portion of the memory module is adjacent to the connector.

Example 25 may include the subject matter of example 21, wherein the memory module is a dual-in-line memory module or a full dual-in-line memory module.

Example 26 may be a heat spreader (HS) comprising: a first side to thermally couple with a first side of a component; a second side to thermally couple with a second side of the component; and means for providing a compressive force to secure the component between the first side of the HS and the second side of the HS.

5 Example 27 may include the subject matter of example 26, wherein the component is a memory module, a dual-in-line memory module, or a full dual-in-line memory module (DIMM).

 Example 28 may include the subject matter of example 26, wherein the first side of the HS includes a recess to facilitate a thermal couple between the first side of
10 the HS and a raised portion on the component proximate to the recess when the component is secured by the HS.

 Example 29 may include the subject matter of example 28, wherein the raised portion is a memory module controller.

 Example 30 may include the subject matter of example 28, further
15 comprising a thermal interface material (TIM) on the recess to facilitate thermal conductivity when the component is secured by the HS.

 Example 31 may include the subject matter of any one of examples 26-30, wherein the first side of the HS includes a buildup of material to facilitate heat dissipation from a portion of the component proximate to the buildup of material.

20 Example 32 may include the subject matter of any one of examples 26-30, wherein portions of the means for providing a compressive force are removed to allow the HS, after the component is secured in the HS, to be at or below a top edge of the means for providing a compressive force.

 Example 33 may include any one of examples 26-30, wherein the first
25 side, the second side, and the means for providing a compressive force are made from a single piece of material.

 Example 34 may include the subject matter of any one of examples 26-30, wherein the first side and the second side include copper.

 Example 35 may include the subject matter of any one of examples 26-30,
30 wherein the means for providing a compressive force includes steel.

The foregoing description of one or more implementations provides illustration and description, but is not intended to be exhaustive or to limit the scope of the embodiments to the precise form disclosed or claimed herein. Modifications and variations are possible in light of the above teachings or may be acquired from practice of various
5 implementations of the various embodiments. Future improvements, enhancements, or changes to particular components, methods, or means described in the various embodiments are contemplated to be within the scope of the claims and embodiments described herein, as would readily be understood by a person having ordinary skill in the art.

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Claims

What is claimed is:

1. A heat spreader (HS) comprising:
a first side to couple with a first side of a component;
5 a second side to couple with a second side of the component; and
a connector that connects a top edge of the first side of the HS and a top edge of
the second side of the HS to provide a compressive force to secure the component between
the first side of the HS and the second side of the HS to thermally couple the HS with the
component.
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2. The HS of claim 1, wherein the component is a memory module, a dual-in-line
memory module, or a full dual-in-line memory module (DIMM).
3. The HS of claim 1, wherein the first side of the HS includes a recess to facilitate
15 a thermal couple between the first side of the HS and a raised portion on the component
that is proximate to the recess when the component is secured by the HS.
4. The HS of claim 3, wherein the raised portion is a memory module controller.
- 20 5. The HS of claim 3, further comprising a thermal interface material (TIM) on the
recess to facilitate thermal conductivity when the component is secured by the HS.
6. The HS of any one of claims 1-5, wherein the first side of the HS includes a
buildup of material to facilitate heat dissipation from a portion of the component
25 proximate to the buildup of the material.
7. The HS of any one of claims 1-5, wherein one or more portions of the connector
are removed to allow the HS, after the component is secured in the HS, to be at or below a
top edge of the component.
30
8. The HS of any one of claims 1-5, wherein the first side, the second side, and the
connector are made from a single piece of material.

9. The HS of any one of claims 1-5, wherein the first side and the second side include copper.
10. The HS of any one of claims 1-5, wherein the connector includes steel.
- 5 11. A system comprising:
a memory module; and
a heat spreader (HS) comprising:
a first side of the HS to couple with a first side of the memory module;
a second side of the HS to couple with a second side of the memory
10 module; and
a connector coupled with a top edge of the first side of the HS and a top edge of the second side of the HS to provide a compressive force to the first side and the second side of the memory module,
wherein the memory module is secured between the first side of the HS and the
15 second side of the HS and is thermally coupled to the HS.
12. The system of claim 11, wherein the memory module is a dual-in-line memory module or a full dual-in-line memory module.
- 20 13. The system of claim 11, wherein the first side of the HS includes a recess to facilitate a thermal couple between the first side of the HS and a raised portion on the memory module proximate to the recess when the memory module is secured by the HS.
14. The system of claim 13, wherein the raised portion is a memory module
25 controller.
15. The system of claim 13, wherein the HS further comprises a thermal interface material (TIM) on the recess to facilitate thermal conductivity.
- 30 16. The system of any one of claims 11-15, wherein the first side of the HS includes a buildup of material to facilitate heat dissipation from a portion of the memory module proximate to the buildup.

17. The system of any one of claims 11-15, wherein portions of the connector are removed to allow the HS to be at or below a top edge of the memory module.

18. The system of any one of claims 11-15, wherein the first side of the HS, the
5 second side of the HS, and the connector are made from a single piece of material.

19. The system of any one of claims 11-15, wherein the first side of the HS and the second side of the HS include copper.

10 20. The system of any one of claims 11-15, wherein the connector includes steel.

21. A method for inserting a memory module into a heat spreader (HS) comprising:

15 spreading apart a bottom edge of a first side of the HS and a bottom edge of a second side of a HS, wherein a top edge of the first side and a top edge of the second side are coupled with a connector to provide a compressive force to the first side and the second side;

inserting the memory module between the first side of the HS and the second side of the HS; and

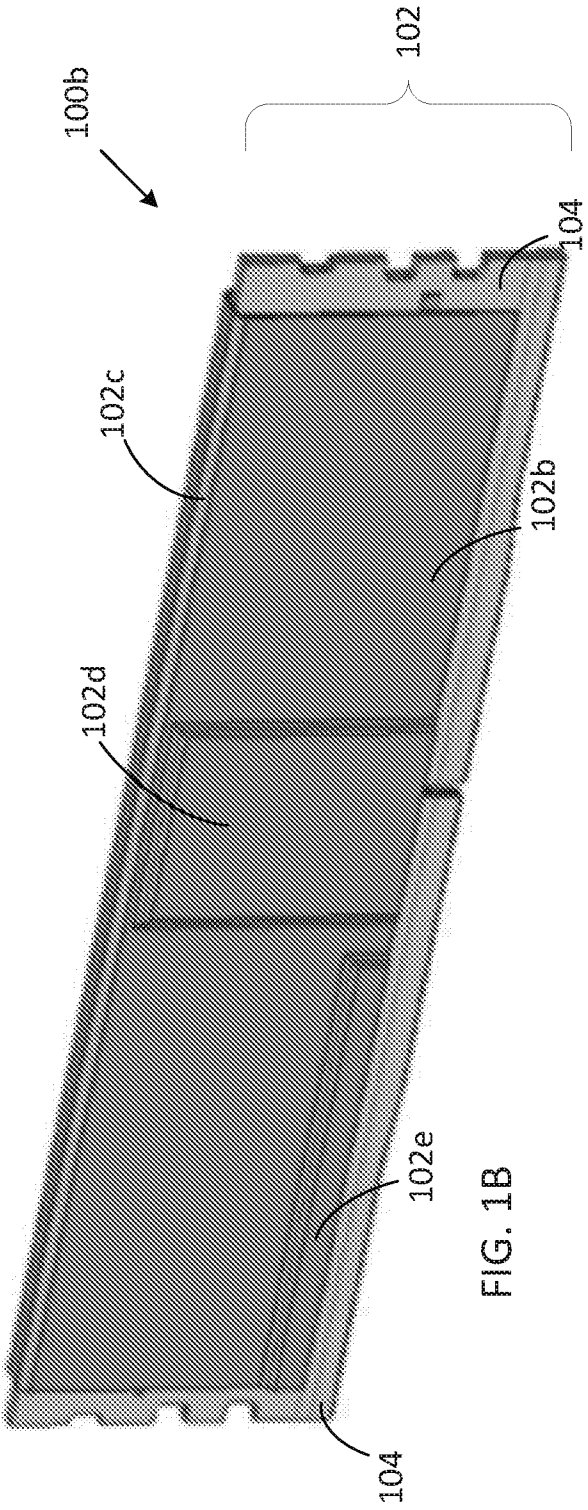
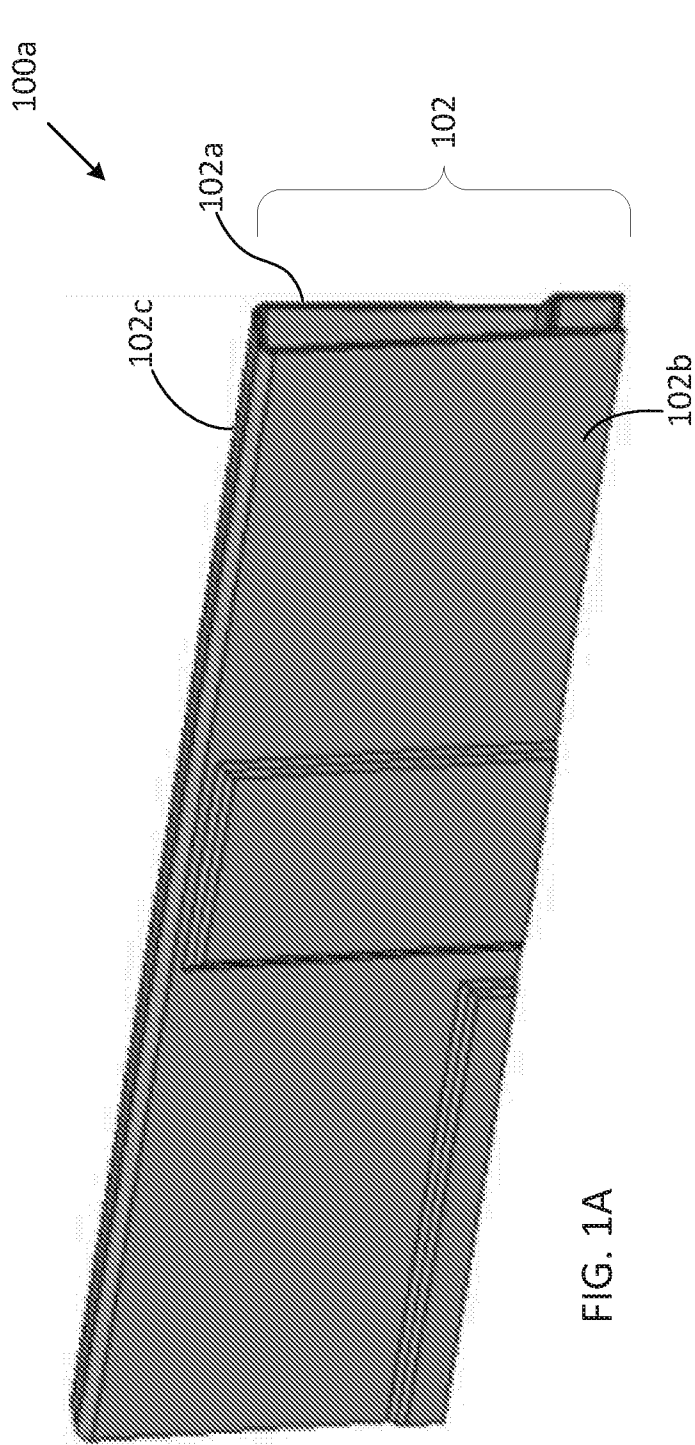
20 releasing the bottom edge of the first side and the bottom edge of the second side to allow the first side and the second side of the HS to press against the memory module.

22. The method of claim 21, wherein a spreader tool is used to spread apart a
25 bottom edge of the first side of the HS and the bottom edge of the second side of the HS .

23. The method of claim 21, wherein when the HS presses against the memory module the HS thermally couples with the memory module.

24. The method of claim 21, wherein inserting the memory module further
30 includes inserting the memory module so that a top portion of the memory module is adjacent to the connector.

25. The method of claim 21, wherein the memory module is a dual-in-line memory module or a full dual-in-line memory module.



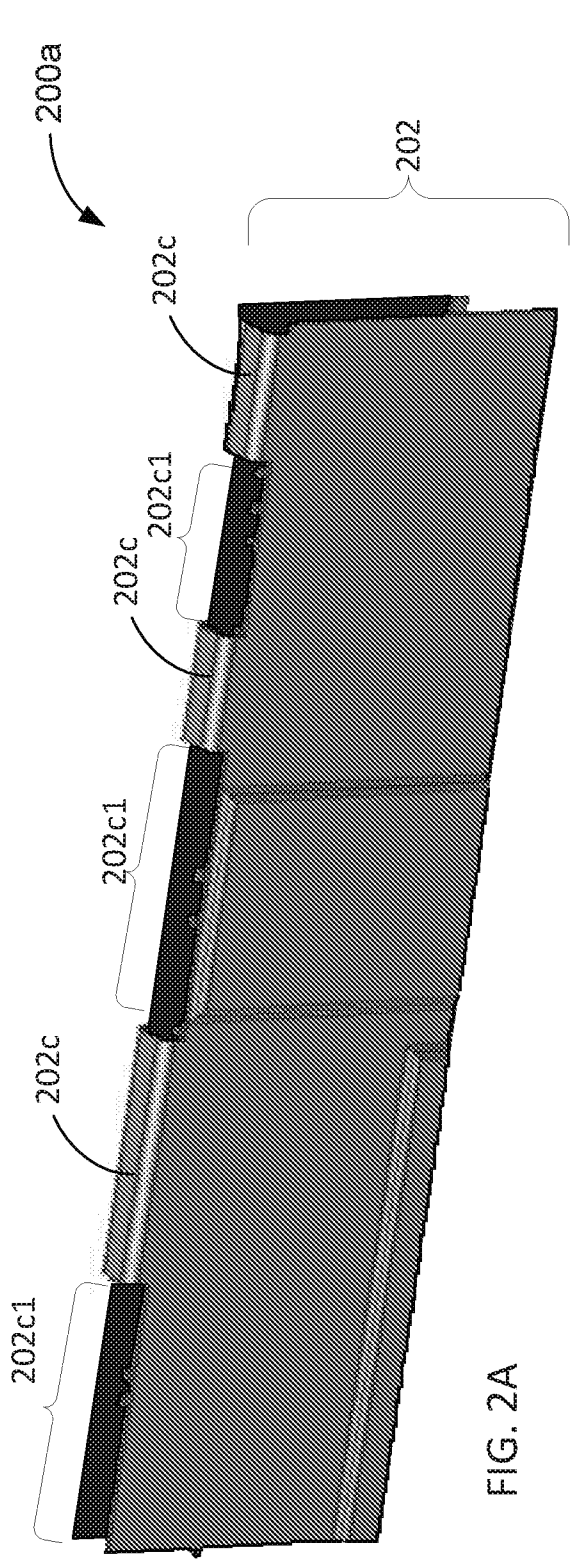


FIG. 2A

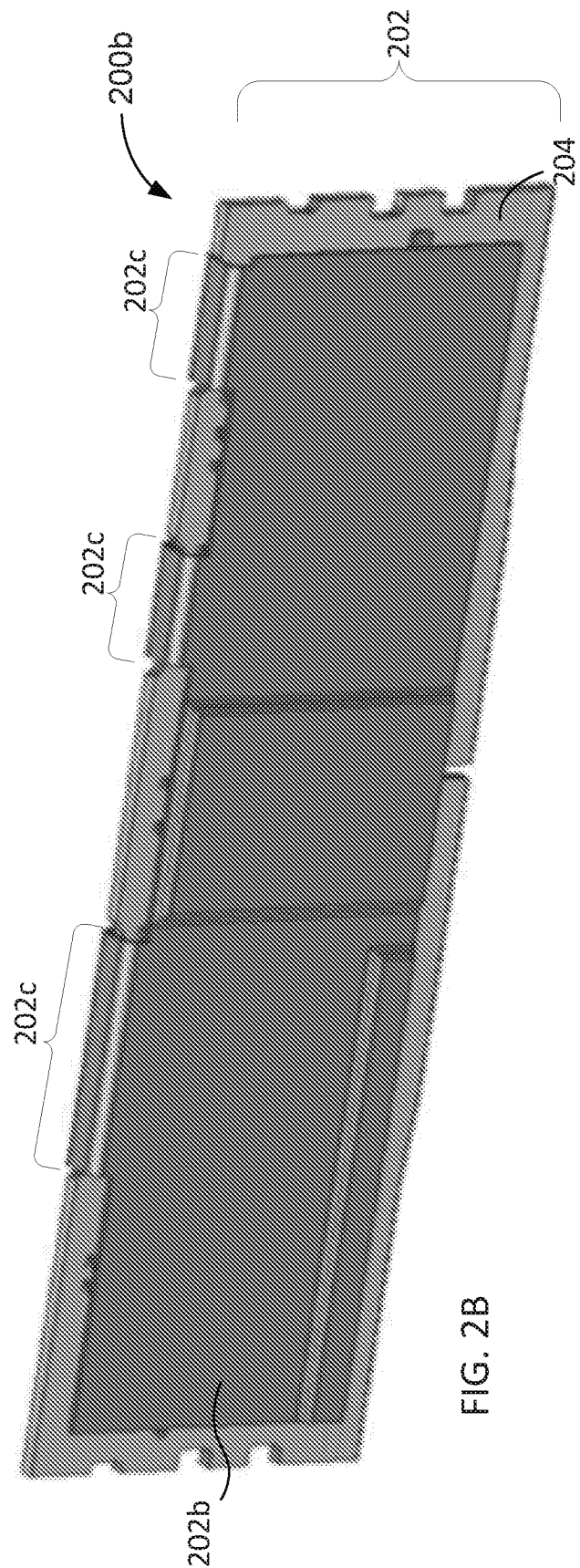


FIG. 2B

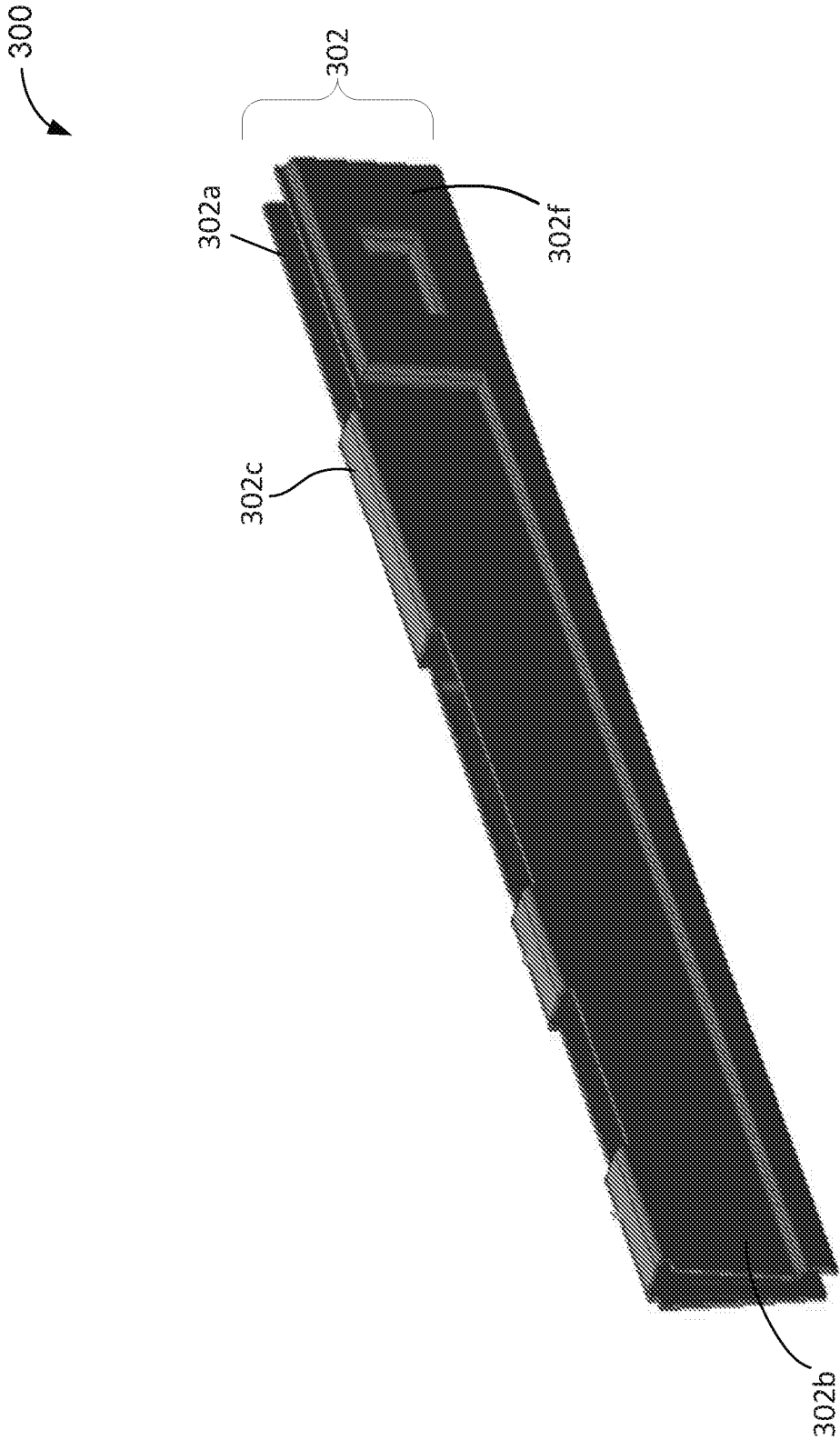


FIG. 3

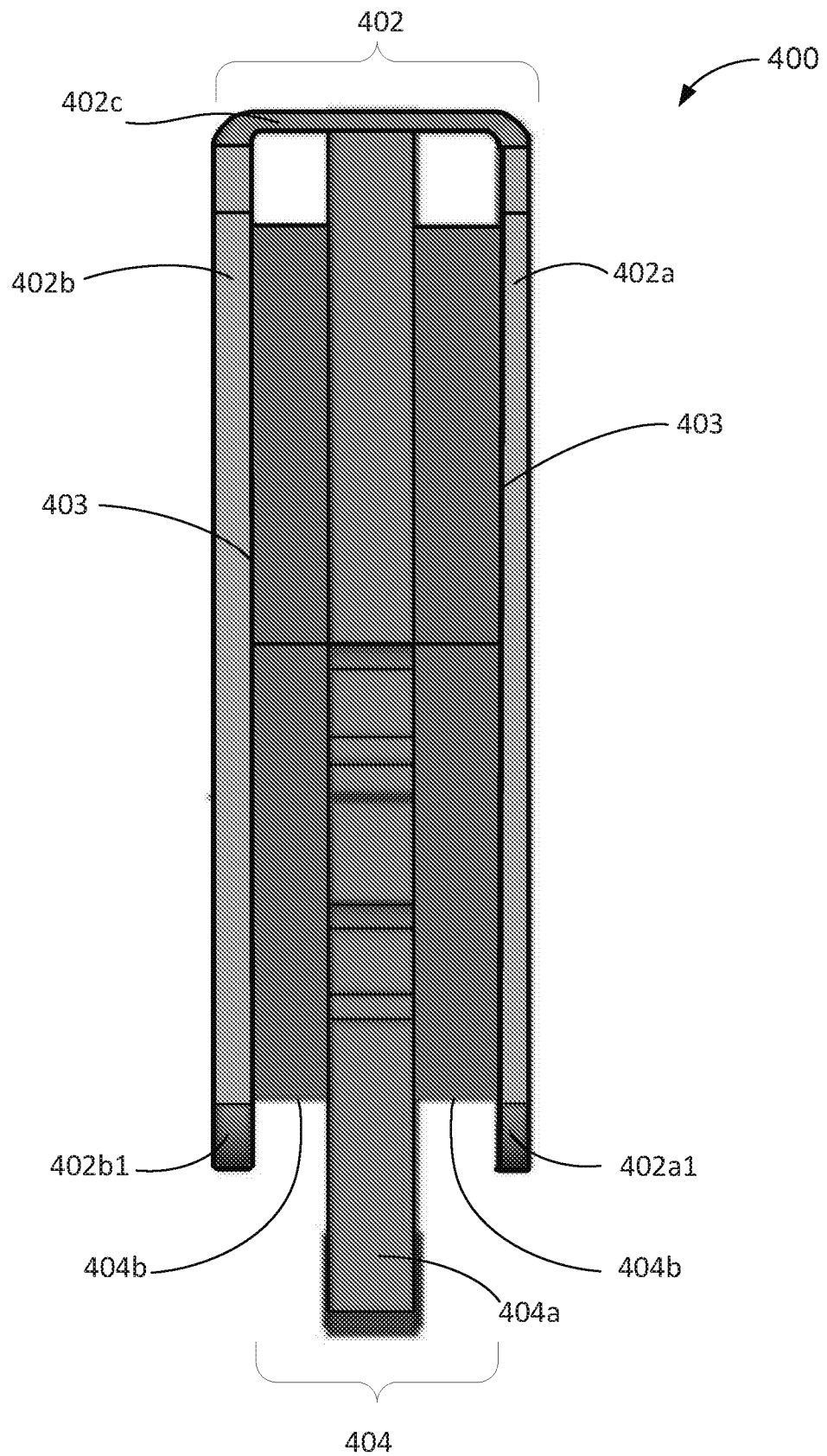
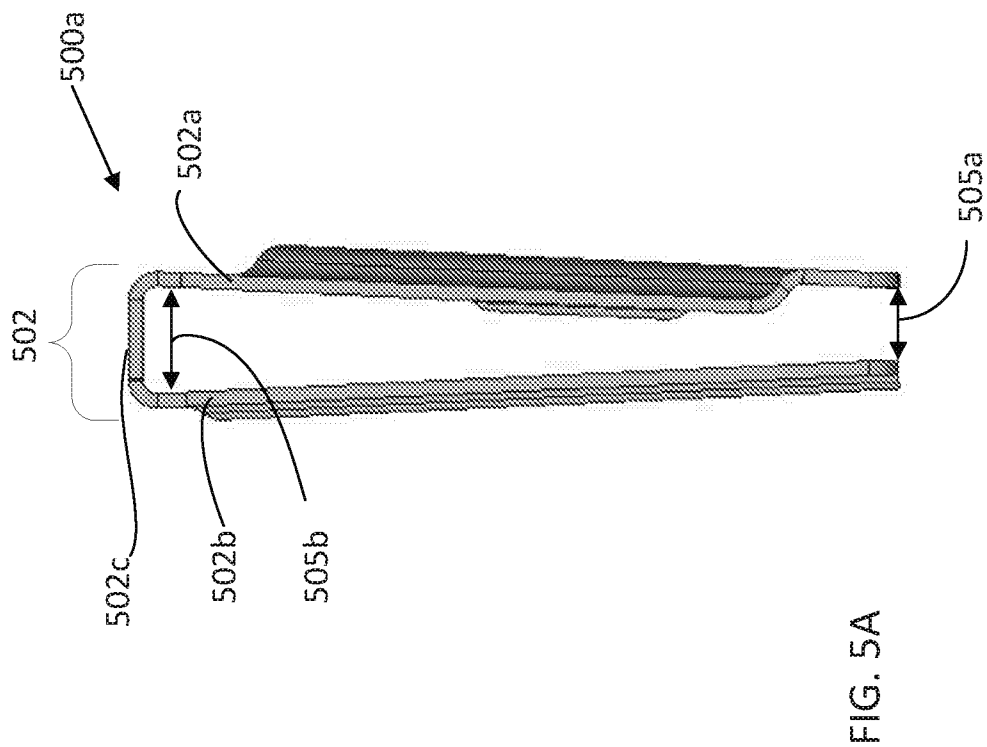
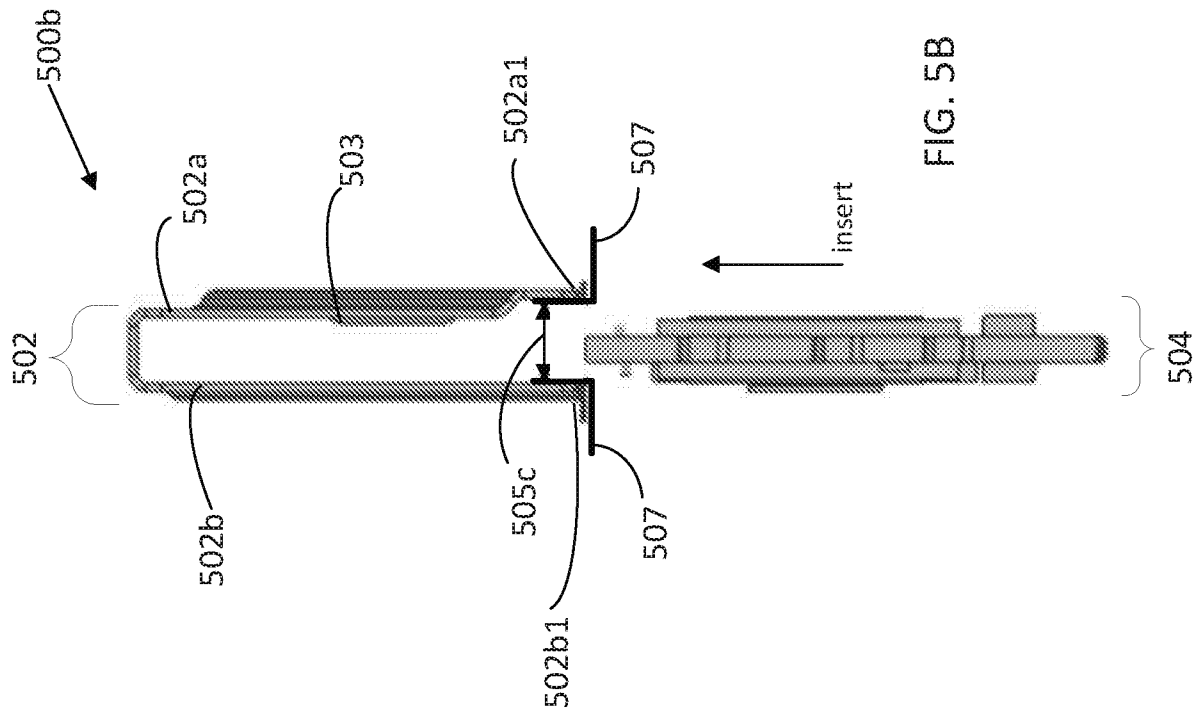


FIG. 4



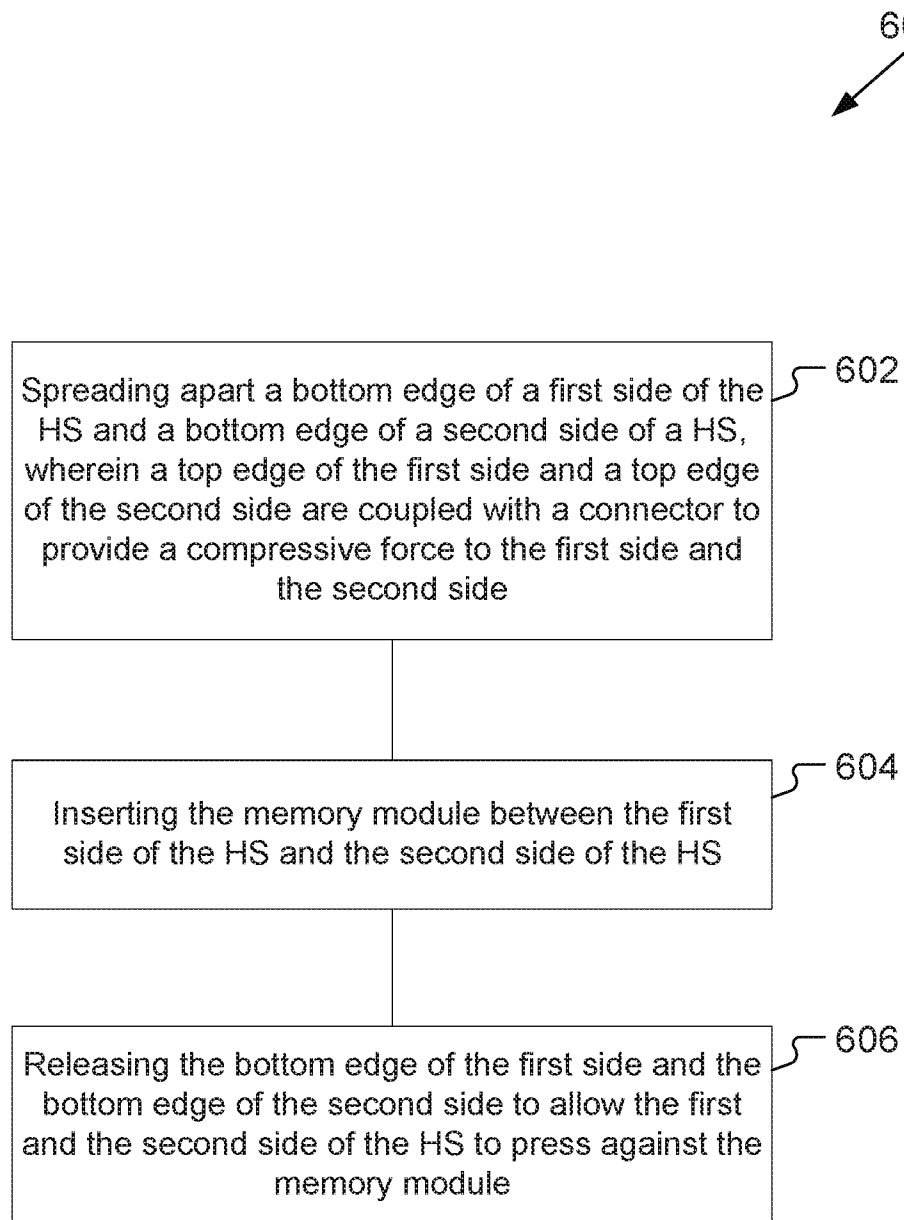


FIG. 6

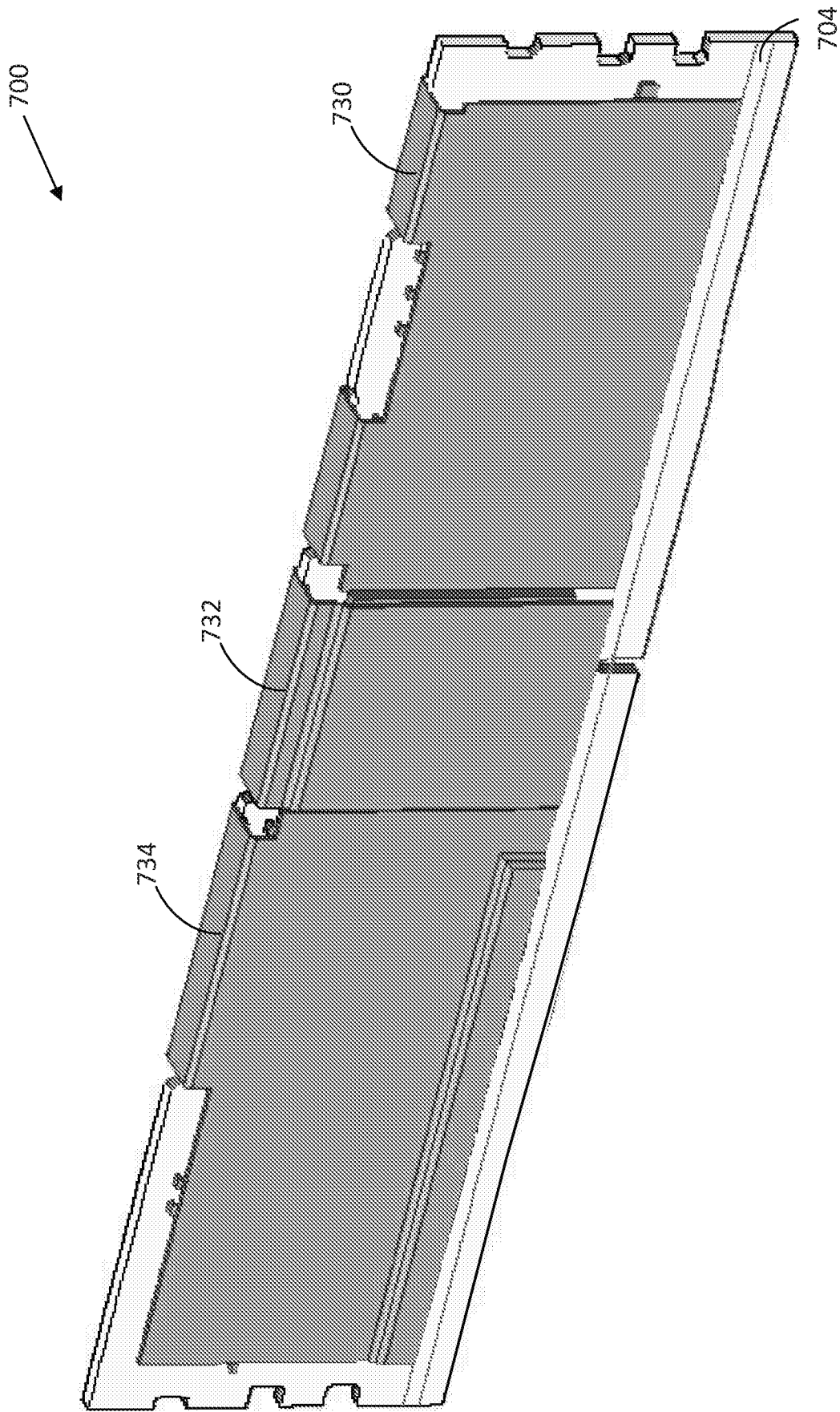


FIG. 7

A. CLASSIFICATION OF SUBJECT MATTER**H01L 23/495(2006.01)i, H05K 7/20(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01L 23/495; F28F 7/00; H05K 7/20

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: DIMM(Dual-In-line-Memory-Module), HS(Heat-Spreader), clip, TIM(Thermal-Interface-Material), recess

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013-0186595 A1 (MING-YANG HSIEH) 25 July 2013	1-2, 8-12, 18-23, 25
Y	See paragraphs [0034]-[0037], [0040]-[0046]; claim 1; and figures 3-6, 9-13.	3-7, 13-17, 24
Y	US 2009-0109613 A1 (ANTON LEGEN et al.) 30 April 2009	3-5, 7, 13-15, 17, 24
	See paragraphs [0050]-[0053]; and figures 2C-2D.	
Y	US 2009-0303681 A1 (SHURONG TIAN et al.) 10 December 2009	6, 16
	See claim 15; and figure 1.	
A	US 2008-0013282 A1 (SHAWN P. HOSS et al.) 17 January 2008	1-25
	See paragraphs [0029]-[0031]; and figures 6a-6d.	
A	US 2007-0070607 A1 (PAUL GOODWIN) 29 March 2007	1-25
	See paragraphs [0018]-[0030]; and figures 1-9.	



Further documents are listed in the continuation of Box C.



See patent family annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search

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Date of mailing of the international search report

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Name and mailing address of the ISA/KR

International Application Division

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2017/038965

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US 2009-0303681 A1	10/12/2009	US 7715197 B2	11/05/2010
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US 2007-0070607 A1	29/03/2007	None	