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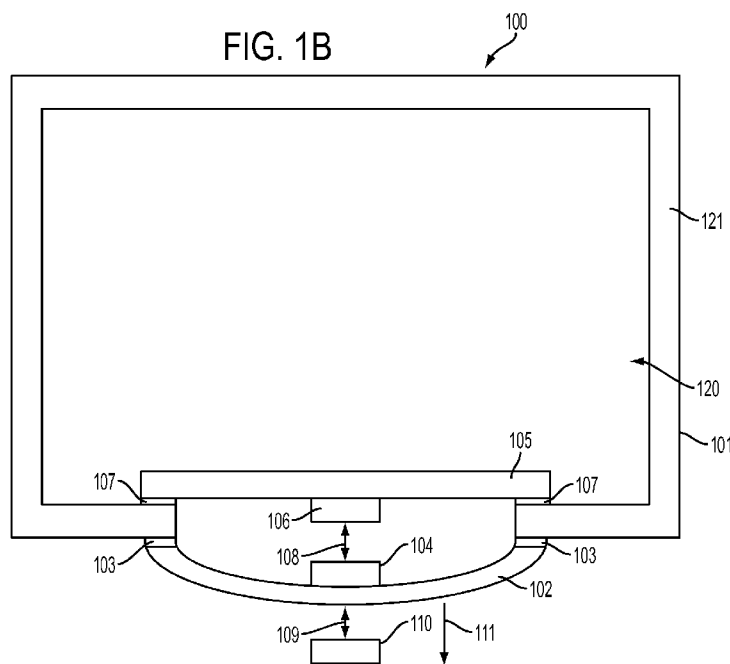
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Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

[Continued on next page]

(54) Title: MAGNETIC PRELOADING OF JOINTS



(57) Abstract: A first component (105) is coupled to a second component (102) by one or more joints (103;107). Magnetic force between at least a first magnetic (106) and second magnetic unit (104) preloads the joint by placing the joint in compression. The first and second magnetic units (106; 104) may be respectively coupled to the first and second components (105; 102). The magnetic force acts as a retentive force between coupled components and/or the joint and operates to resist one or more tensile and/or other opposing forces. In some cases, the first magnetic unit may be a shield, such as a direct current shield, that protects one or more components from a magnetic field of the second magnetic unit.



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- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
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MAGNETIC PRELOADING OF JOINTS

Cross-Reference to Related Application

[0001] This Patent Cooperation Treaty patent application claims priority to U.S. non-provisional application No. 14/262,455, filed April 25, 2014, and titled "Magnetic Preloading of Joints," the contents of which are incorporated herein by reference in their entirety.

Technical Field

[0002] This disclosure relates generally to joints, and more specifically to magnetic preloading of joints.

Background

[0003] Electronic devices and other apparatuses frequently utilize joints to couple components together. For example, joints may be utilized to couple an interface surface to a housing, a main logic board to a housing, a main logic board to an interface surface, and/or other various components to other various components. Such joints may be adhesive joints, welds, solder joints, bolted joints, and/or any other kind of technique utilized to couple components.

[0004] Components joined by such a joint may be subject to various tensile forces. Such tensile forces may be forces exerted on the components and/or joint that, if sufficient, may tear the components and/or the joint apart. If such tensile forces exceed the tensile strength of the joint, the joint may fail. This may cause the joint and/or the components to partially or fully separate.

Summary

[0005] The present disclosure discloses systems, apparatuses, and methods for magnetic preloading of joints. A first component may be coupled to a second component by one or more joints. Magnetic force between at least a first magnetic and second magnetic unit may preload the joint by placing the joint in compression. In some cases, the first and second magnetic units may be respectively coupled to the first and second components. Thus, the magnetic force may be a retentive force between coupled components and/or the joint.

[0006] In some implementations, the first and second component, the first and second magnetic units, and the joint may be incorporated into an apparatus such as an electronic device. Such an electronic device may be connectible to another electronic device via one or more third magnetic units that attract the second magnetic unit. In such cases, the

second component may be an interface surface for connecting the two electronic devices and the attraction between the second and third magnetic units that occurs when the two apparatuses are connected may exert tensile and/or other opposing forces on the first component, second component, and/or the joint.

- 5 **[0007]** In various cases, the first and/or second magnetic unit may be a shield. Such a shield, such as a direct current shield, may shield one or more components from the first and/or second magnetic unit. In some cases, the first and/or second magnetic unit may include one or more ferromagnetic materials, permanent magnets, electromagnets, and/or other such magnetic materials. The first and/or the second component may be formed of
10 one or more rigid materials such as metal, glass, ceramic, plastic, crystal, ferromagnetic material, and/or other such materials.

- [0008]** In some implementations, a system for magnetic preloading of joints includes a first component, a second component, at least one joint that couples the first component and the second component, and at least a first magnetic unit and a second magnetic unit. Magnetic
15 force between the first magnetic unit and the second magnetic unit preloads the at least one joint by placing the at least one joint in compression.

- [0009]** In various implementations, an apparatus includes a first component, a second component, at least one joint that couples the first component and the second component, and at least a first magnetic unit coupled to the first component and a second magnetic unit
20 coupled to the second component. Magnetic force between the first magnetic unit and the second magnetic unit preloads the at least one joint by placing the at least one joint in compression.

- [0010]** In some implementations, a method for magnetic preloading of joints includes: coupling a first component and a second component to form at least one joint therebetween;
25 positioning at least a first magnetic unit and a second magnetic unit, at least one of the first magnetic unit or the second magnetic unit operationally affixed to one of the first component or the second component; and preloading the at least one joint by placing the at least one joint in compression as a result of magnetic force between the first magnetic unit and the second magnetic unit.

- 30 **[0011]** It is to be understood that both the foregoing general description and the following detailed description are for purposes of example and explanation and do not necessarily limit the present disclosure. The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate subject matter of the disclosure. Together, the descriptions and the drawings serve to explain the principles of the disclosure.

Brief Description of the Drawings

[0012] FIG. 1A is a side view of a first example system for magnetic preloading of joints.

[0013] FIG. 1B illustrates the system of FIG. 1A with the addition of a third magnetic unit.

[0014] FIG. 2 is a side view of a second example system for magnetic preloading of joints.

5 **[0015]** FIG. 3 is a side view of a third example system for magnetic preloading of joints.

[0016] FIG. 4 is a flow chart illustrating an example method for magnetic preloading of joints. This example method may be performed by the example systems of FIG. 1A-B, FIG.2, and/or FIG.3.

Detailed Description

10 **[0017]** The description that follows includes sample systems, methods, and apparatuses that embody various elements of the present disclosure. However, it should be understood that the described disclosure may be practiced in a variety of forms in addition to those described herein.

15 **[0018]** The present disclosure discloses systems, apparatuses, and methods for magnetic preloading of joints. A first component may be coupled to a second component by one or more joints. Magnetic force between at least a first magnetic and second magnetic unit (which may be respectively coupled to the first and second components and/or may be the respective first and second components) may preload the joint by placing the joint in compression. Thus, the magnetic force may be a retentive force between coupled
20 components and/or the joint. As a result of such preloading, the joint and/or coupled components may resist tensile and/or other opposing forces greater than would otherwise be possible.

25 **[0019]** In some cases, the first and second component, the first and second magnetic units, and the joint may be incorporated into an apparatus such as an electronic device. Such an apparatus may be connectible to another electronic device via one or more third magnetic units that attract the second magnetic unit. In such cases, the second component may be an interface surface for connecting the two apparatuses and the tensile and/or other opposing forces may be the attraction between the second and third magnetic units that occurs when the two apparatuses are connected.

30 **[0020]** In various cases, the first and/or second magnetic unit may be a shield. Such a shield, such as a direct current shield, may shield one or more components (such as

electronic components) from the first and/or second magnetic unit. In some cases, the first and/or second magnetic unit may include one or more ferromagnetic materials (such as iron cobalt), permanent magnets, electromagnets, and/or other such magnetic materials. The first and/or the second component may be formed of one or more rigid materials such as metal, glass, plastic, ceramic, crystal, ferromagnetic material, and/or other such materials.

[0021] FIG. 1A is a side view of a first example system 100 for magnetic preloading of joints. As illustrated, the system may include an apparatus 101 that includes may include a housing 121, an internal space 120, a first component 105 coupled to the housing by joints 107, and a second component 102 coupled to the housing by joints 103.

[0022] The joints 107 may be adhesive joints, welds, solder joints, bolted joints, and/or any other technique utilized to couple components such as the first component 105 and the housing 121. Similarly, the joints 103 may involve any technique utilized to couple components such as the housing 121 and the second component 102.

[0023] In some embodiment, the first component 105 may be formed of one or more rigid materials such as glass, plastic, metal, crystal, ceramic, ferromagnetic material, and/or any other such rigid material. Similarly, the second component may be formed of one or more rigid materials in some embodiments, such as those listed above.

[0024] As also illustrated in FIG. 1A, the apparatus 101 may include at least a first magnetic unit 106 and a second magnetic unit 104, each of which may be formed of one or more ferromagnetic materials, permanent magnets, electromagnets, soft magnetic materials (ferromagnetic and/or other materials that magnetize in the presence of a magnetic field and demagnetize when that magnetic field is removed), and/or other such magnetic materials. The first and second magnetic units may be configured such that they are attracted to each other by a magnetic force 108.

[0025] This magnetic force 108 between the first and second magnetic units 106 and 104 may preload the joints 107 and/or 103 by placing the joints in compression. When tension is applied to the joints as a separating force, the compressive preload may resist a certain amount of that tension, thus essentially negating that tension. Only when the tension exceeds the compression may the joints experience tension. Absent tension, the joints may not separate. As such, a retentive force may exist between the joints and/or the first and second components 105 and 102. This retentive force may resist an opposing or tensile force which may tend to separate the joints and/or the first and second components 105 and 102. This retentive force may also resist one or more shear and/or other forces exerted upon the first component, second component, and or the joints.

5 [0026] As a result of this retentive force, the joints 107 and/or 103 may have a higher tensile strength than that of the joints in the absence of the magnetic force 108. This may enable different joining techniques than would otherwise have sufficient tensile strength to withstand tensile and/or other forces that may be exerted on the joints and/or the first and/or second components 105 and 102.

10 [0027] For example, FIG. 1B illustrates the system 100 of FIG. 1A with the addition of a third magnetic unit 110. The third magnetic unit may be configured to attract the second magnetic unit with an additional magnetic force 109. This additional magnetic force may pull the second component 102 and/or the joints 103 in the direction 111, opposing the magnetic force 108 and thus being an opposing force. As such, the additional magnetic force may be a tensile force on the second component and/or the joints.

15 [0028] However, due to the constant compression of the joints 103 by the magnetic force 108, the magnetic force may resist the additional magnetic force 109. This may prevent separation of the joint 103 and/or the second component 102 from the housing 121 and/or the first component 105.

20 [0029] In some cases, the strength of the magnetic force 108 between the first magnetic unit 106 and the second magnetic unit 104 may be related to various factors such as the individual strengths of the first and/or second magnetic units, distance between the first and second magnetic units, shapes of the first and second magnetic units, components utilized to focus magnetic flux of the first and/or second magnetic units, and/or other such factors. One or more such factors may be tuned in design of the apparatus 101 in order to have the constant compression of the joints 103 and/or 107 meet or exceed various opposing forces acting on the joints.

25 [0030] For example, in implementations where the apparatus 101 is configured to be connected to another apparatus by the third magnetic unit 110, the various factors influencing the strength of the magnetic force 108 between the first magnetic unit 106 and the second magnetic unit 104 may be tuned such that the strength will meet or exceed the additional magnetic force 109 so that the first component 104, second component 102, and/or joints 103 and/or 107 do not partially or fully separate when the two apparatuses are
30 connected and/or disconnected.

[0031] As illustrated, the first magnetic unit 106 is coupled to the first component 105 and the second magnetic unit 104 is coupled to the second component 106. However, it is understood that this is an example. In various implementations, other configurations are possible.

[0032] For example, the first and/or second magnetic unit 106 and 104 may be a plurality of magnetic units without departing from the scope of the present disclosure. In some cases, the first and second magnetic units may be made up of a different number of magnetic units.

5 **[0033]** In another example, the first and/or second magnetic unit may be coupled to one or more intermediate components. The intermediate component may then be coupled to the first and/or second component 105 and 102 without departing from the scope of the present disclosure. Such intermediate components may be one or more mounting members and/or any other such intermediate structure.

10 **[0034]** In still another example, the first and/or second component 105 and 102 may themselves be the first or second magnetic units 106 and 104. In one example of such a case, the first and/or second component may be formed of a ferromagnetic material such as iron cobalt. As such, the first and/or second component may be magnetic and therefore have a magnetic attraction 108 to each other without requiring additional separate first and/or second magnetic units.

15 **[0035]** In various implementations, the apparatus 101 may be an electronic device. In such implementations, the electronic device may be any kind of electronic device such as a laptop computer, a tablet computer, a smart phone, a wearable device, a cellular telephone, a mobile computer, a digital media player, a desktop computer, a display device, a docking station, a charging device, a network device, an accessory device, a printer, and/or any
20 other electronic device.

[0036] In such implementations, the electronic device may include one or more components that are not shown, such as one or more processing units, one or more non-transitory storage media (which may take the form of, but is not limited to, a magnetic storage medium; optical storage medium; magneto-optical storage medium; read only memory; random
25 access memory; erasable programmable memory; flash memory; and so on), one or more communication components, one or more user interface components, and/or other such components. In some implementations, such components may be located in the internal space 120.

30 **[0037]** In various implementations where the apparatus 101 is an electronic device, the third magnetic unit 110 may be incorporated into an additional electronic device (which may be any electronic device such as any of the examples listed above) that is connectible to the electronic device. In such an implementation, the second component 102 may be an interface surface (which may be configured to mate and/or otherwise connect with one or

more interface surfaces of the additional electronic device) and the second magnetic unit 104 and the third magnetic unit may operate to couple the two electronic devices.

5 **[0038]** In some implementations where the apparatus 101 is an electronic device and one or more components are located in the internal space 120, the first magnetic unit 106 may be a shield that shields such components from the magnetic flux of the second magnetic unit 104. Such a shield may be a direct current shield, which may be formed of a ferromagnetic material such as iron cobalt.

10 **[0039]** In various implementations, the first component 105 itself may be a component that is protected from a magnetic field of the second magnetic unit 104 by the first magnetic unit 106 functioning as a shield. For example, the apparatus 101 may be an electronic device and the first component may be a component of the electronic device such as a main logic board or other such component. In such a case, the first magnetic unit may be mounted to the main logic board in such a way that the first magnetic unit shields the main logic board and/or other elements of the main logic board from the magnetic field of the second
15 magnetic unit.

[0040] Although the apparatus 101 is illustrated as having the first component 105 coupled to the housing 120 by joints 107 and the second component 102 coupled to the housing by joints 103, it is understood that this is an example. In various cases, the first component may be directly coupled to the second component by one or more joints.

20 **[0041]** FIG. 2 is a side view of a second example system 200 for magnetic preloading of joints. By way of contrast with FIGs. 1A and 1B, the system 200 illustrates a first housing component 201 of an apparatus coupled to a second housing component 202 by joints 203. Magnetic force 206 between first and second pairs of magnetic units 204 and 205 operates as a retentive force opposing and/or resisting any force exerted on the second housing
25 component and/or the joints in the direction 207 (or upon the first housing component in the opposite direction), i.e. a tensile force. Such magnetic force may also resist one or more shear forces exerted on the first and/or second housing components and/or the joints.

30 **[0042]** For example, the first housing component 201 may be a main case for an electronic device and the second housing component 202 may be a cover glass. In such an example, the magnetic force 206 between the first and second pairs of magnetic units 204 and 205 may operate as a retentive force to prevent separation of the cover glass from the main case, the main case from the joints 203, and/or the cover glass from the joints when forces are exerted upon the cover glass (such as when a screen protector that is adhesively attached to the cover glass is removed) and/or the main case.

[0043] By way of another example, the first housing component 201 may be a container and the second housing component 202 may be a handle for the container. In such an example, the magnetic force 206 between the first and second pairs of magnetic units 204 and 205 may operate as a retentive force to prevent separation of the handle from the container
5 when the container is picked up by the handle.

[0044] In yet another example, the first housing component 201 may be a pressurized canister and the second housing component 202 may be a lid for the pressurized canister. When pressure inside the pressurized canister exceeds that of an external environment, the pressure inside the pressurized canister may exert tensile and/or other force tending to
10 separate the pressurized canister from the lid, the lid from the joints 203, and/or the pressurized canister from the joints. In such an example, the magnetic force 206 between the first and second pairs of magnetic units 204 and 205 may operate as a retentive force to prevent separation of the lid, pressurized canister, and/or joints as a result of such tensile and/or other force.

[0045] In still another example, the second housing component 202 may be a railing and the first housing component 201 may be a mounting bracket that couples the railing to a surface such as a wall. In such an example, the magnetic force 206 between the first and second pairs of magnetic units 204 and 205 may operate as a retentive force to prevent separation of the railing from the mounting bracket, the railing from the joint 203, and/or the joint from
20 the mounting bracket when a user supports himself using the railing and/or otherwise exerts force upon the railing.

[0046] FIG. 3 is a side view of a third example system 300 for magnetic preloading of joints. By way of contrast with FIGs. 1A and 1B, the second magnetic unit 304 of the system 300 may be coupled to the second component 302 by a tray member 313. Such a tray member
25 may be formed of a material such as plastic and may include one or more side shields 311 and 312, which may be one or more direct current shields.

[0047] To further contrast with the system 100 illustrated in FIG. 1B, the tray member 313 of the system 300 may position the second magnetic unit 304 further from the first magnetic unit 306, though closer to the third magnetic unit 310. This may result in a weaker magnetic
30 force 309 between the second and third magnetic units and a stronger magnetic force 308 between the first and second magnetic units than in the system 100 of FIG. 1B.

[0048] As a result, design of the system 300 may have more options available than the system 100 with respect to the factors influencing the magnetic force 308 between the first and second magnetic units 306 and 304, though fewer options available with respect to the

factors influencing the magnetic force between the second magnetic unit and the third magnetic units 310.

5 **[0049]** Although the system 300 is illustrated and described as utilizing a tray member 313 to couple the second magnetic unit 304 to the second component 302, it is understood that this is an example. In various implementations, a variety of different coupling mechanisms may be utilized to couple the second magnetic unit to the second component and/or the first magnetic unit 306 to the first component 305.

10 **[0050]** FIG. 4 is a flow chart illustrating an example method 400 for magnetic preloading of joints. This example method may be performed by the example systems of FIG. 1A-B, FIG.2, and/or FIG.3.

[0051] The flow begins at block 401 and proceeds to block 402 where at least first and second components may be coupled to form at least one joint therebetween. Such components may be any components that are coupleable by one or more joints. Further, such a joint may be any kind of joint used to couple two or more components.

15 **[0052]** The flow then proceeds to block 403 where at least first and second magnetic units are positioned. Such positioning may include operationally affixing at least one of the first magnetic unit to the first component or the second magnetic unit to the second component. Further, such positioning may result in a magnetic force between the first and second magnetic units attracting each other.

20 **[0053]** Next, the flow may proceed to block 404 where the joint is preloaded by placing the joint in compression. The joint may be placed in compression as a result of the magnetic force between the first and second components. Such preloading may resist one or more tensile forces on the components or joint, shear forces on the components or joint, and/or other such forces.

25 **[0054]** The flow may then proceed to block 405 and end.

[0055] Although the example method 400 is illustrated and described as including particular operations performed in a particular order, it is understood that this is an example. In various implementations various configurations of the same, similar, and/or different operations may be performed without departing from the scope of the present disclosure.

30 **[0056]** For example, FIG. 4 illustrates blocks 403 and 404 of the example method 400 as separate operations performed in a linear order. However, in various implementations blocks 403 and 404 may be performed simultaneously.

[0057] By way of a second example, FIG. 4 illustrates blocks 402 and 403 of the example method 400 as separate operations performed in a linear order. However, in various implementations blocks 402 and 403 may be performed together, such as when performed as part of construction of an apparatus.

5 **[0058]** In the present disclosure, the methods disclosed may be implemented as sets of instructions or software readable by a device. Further, it is understood that the specific order or hierarchy of steps in the methods disclosed are examples of sample approaches. In other embodiments, the specific order or hierarchy of steps in the method can be rearranged while remaining within the disclosed subject matter. The accompanying method claims present
10 elements of the various steps in a sample order, and are not necessarily meant to be limited to the specific order or hierarchy presented.

[0059] Methods utilizing techniques described in the present disclosure may be provided as a computer program product, or software, that may include a non-transitory machine-readable medium having stored thereon instructions, which may be used to program a
15 computer system (or other electronic devices) to perform a process according to the present disclosure. A non-transitory machine-readable medium includes any mechanism for storing information in a form (e.g., software, processing application) readable by a machine (e.g., a computer). The non-transitory machine-readable medium may take the form of, but is not limited to, a magnetic storage medium (e.g., floppy diskette, video cassette, and so on);
20 optical storage medium (e.g., CD-ROM); magneto-optical storage medium; read only memory (ROM); random access memory (RAM); erasable programmable memory (e.g., EPROM and EEPROM); flash memory; and so on.

[0060] It is believed that the present disclosure and many of its attendant advantages will be understood by the foregoing description, and it will be apparent that various changes may be
25 made in the form, construction and arrangement of the components without departing from the disclosed subject matter or without sacrificing all of its material advantages. The form described is merely explanatory, and it is the intention of the following claims to encompass and include such changes.

[0061] While the present disclosure has been described with reference to various
30 embodiments, it will be understood that these embodiments are illustrative and that the scope of the disclosure is not limited to them. Many variations, modifications, additions, and improvements are possible. More generally, embodiments in accordance with the present disclosure have been described in the context or particular embodiments. Functionality may be separated or combined in blocks differently in various embodiments of the disclosure or
35 described with different terminology. These and other variations, modifications, additions,

and improvements may fall within the scope of the disclosure as defined in the claims that follow.

CLAIMS

We claim:

1. A system for magnetic preloading of joints, comprising:
a first component;
a second component;
at least one joint that couples the first component and the second component; and
5 at least a first magnetic unit and a second magnetic unit;
wherein magnetic force between the first magnetic unit and the second magnetic unit preloads the at least one joint by placing the at least one joint in compression.
2. The system of claim 1, wherein the at least one joint in compression resists an opposing force exerted on the at least one joint.
3. The system of claim 2, wherein the opposing force comprises an additional magnetic force between at least a third magnetic unit and the second magnetic unit.
4. The system of claim 3, wherein the first component, second component, the at least one joint, the first magnetic unit, and the second component are incorporated into a first electronic device and the third magnetic unit is incorporated into a second electronic device.
5. The system of claim 4, wherein the first electronic device and second electronic device are coupleable utilizing at least the second magnetic unit and the third magnetic unit.
6. The system of claim 1, wherein the first magnetic unit is coupled to the first component and the second magnetic unit is coupled to the second component.
7. The system of claim 6, wherein the second magnetic unit comprises an interface surface.
8. The system of claim 7, wherein the second magnetic unit is coupled to the interface surface utilizing at least one tray.
9. The system of claim 8, wherein the at least one tray comprises plastic and includes at least one shield mounted to a side of the second magnetic unit.
10. The system of claim 1, wherein the first magnetic unit comprises a shield that shields one or more components of an electronic device from the second magnetic unit.

11. The system of claim 1, wherein the first magnetic unit comprises at least one ferromagnetic material and the second magnetic unit comprises a permanent magnet.

12. The system of claim 1, wherein at least one of the first magnetic unit is the first component or the second magnetic unit is the second component.

13. The system of claim 1, wherein at least one of the first component or the second component is composed of at least one ferromagnetic material.

14. The system of claim 1, wherein at least one of the first magnetic unit or the second magnetic unit comprises a plurality of magnetic units.

15. The system of claim 1, wherein the at least one joint comprises at least one of an adhesive joint, a weld, a solder joint, or a bolted joint.

16. The system of claim 1, wherein at least one of the first component or the second component comprises a rigid material.

17. The system of claim 1, wherein the magnetic force between the first magnetic unit and the second magnetic unit is a retention force between the first and second components at the at least one joint.

18. The system of claim 1, wherein magnetic force between the first magnetic unit and the second magnetic unit resists at least one tensile force at the at least one joint.

19. An apparatus, comprising:

a first component;

a second component;

at least one joint that couples the first component and the second component; and

5 at least a first magnetic unit coupled to the first component and a second magnetic unit coupled to the second component;

wherein magnetic force between the first magnetic unit and the second magnetic unit preloads the at least one joint by placing the at least one joint in compression.

20. A method for magnetic preloading of joints, the method comprising:

coupling a first component and a second component to form at least one joint therebetween;

5 positioning at least a first magnetic unit and a second magnetic unit, at least one of the first magnetic unit or the second magnetic unit operationally affixed to one of the first component or the second component; and

preloading the at least one joint by placing the at least one joint in compression as a result of magnetic force between the first magnetic unit and the second magnetic unit.

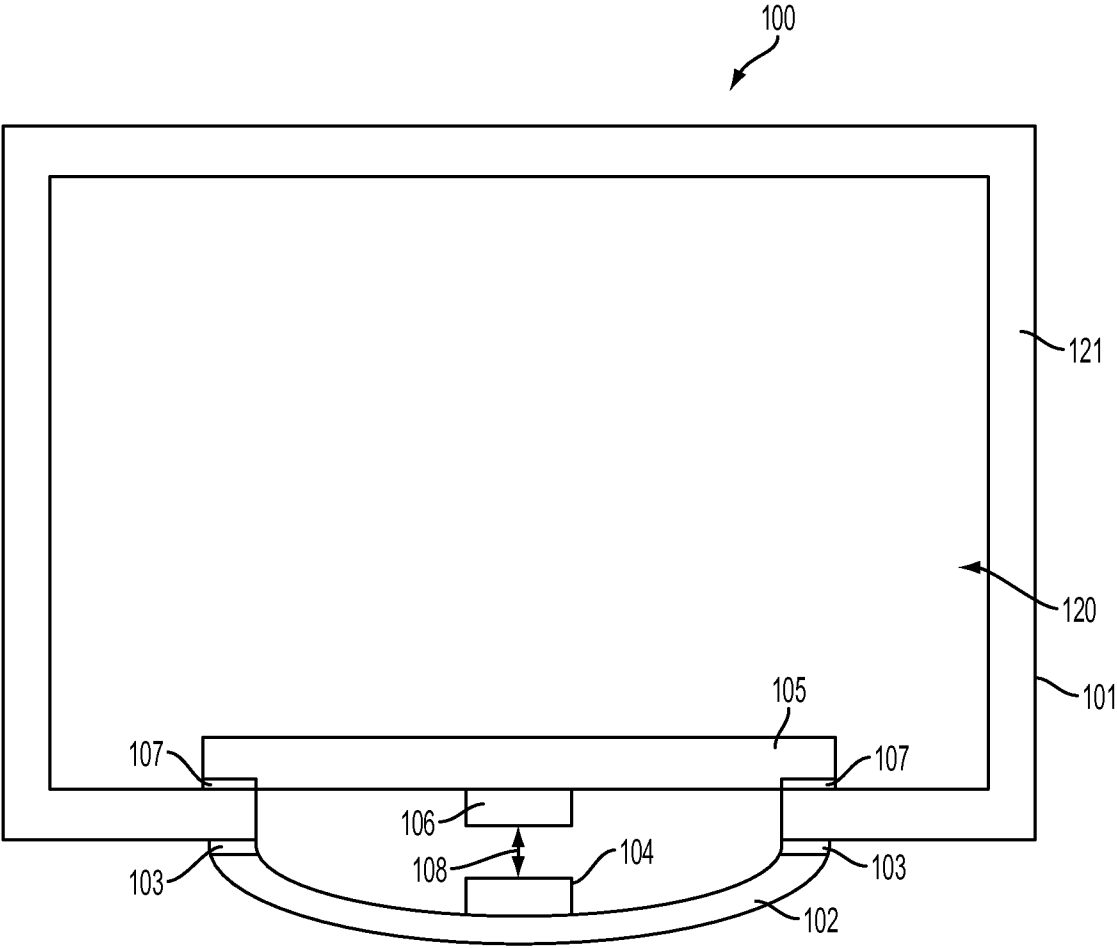


FIG. 1A

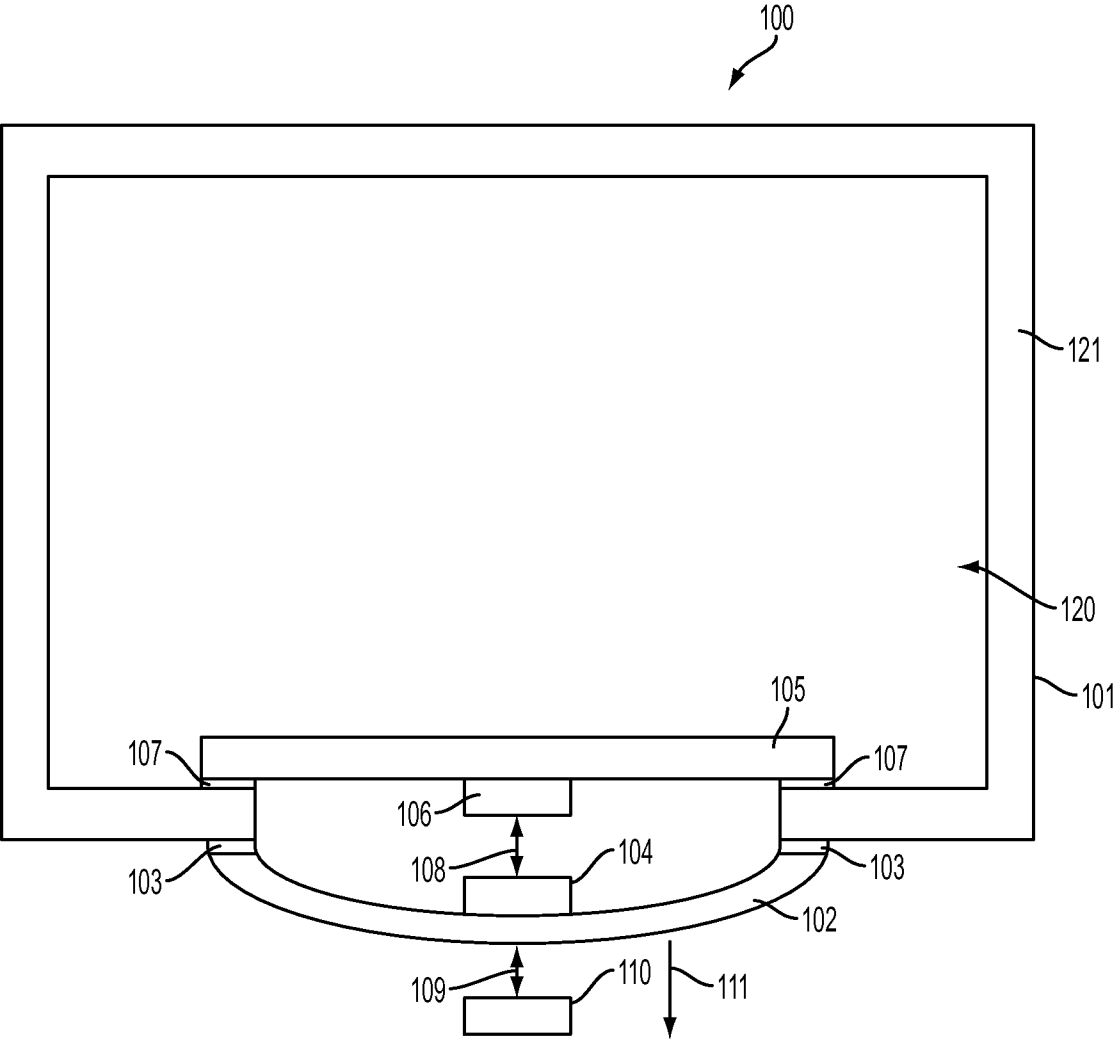


FIG. 1B

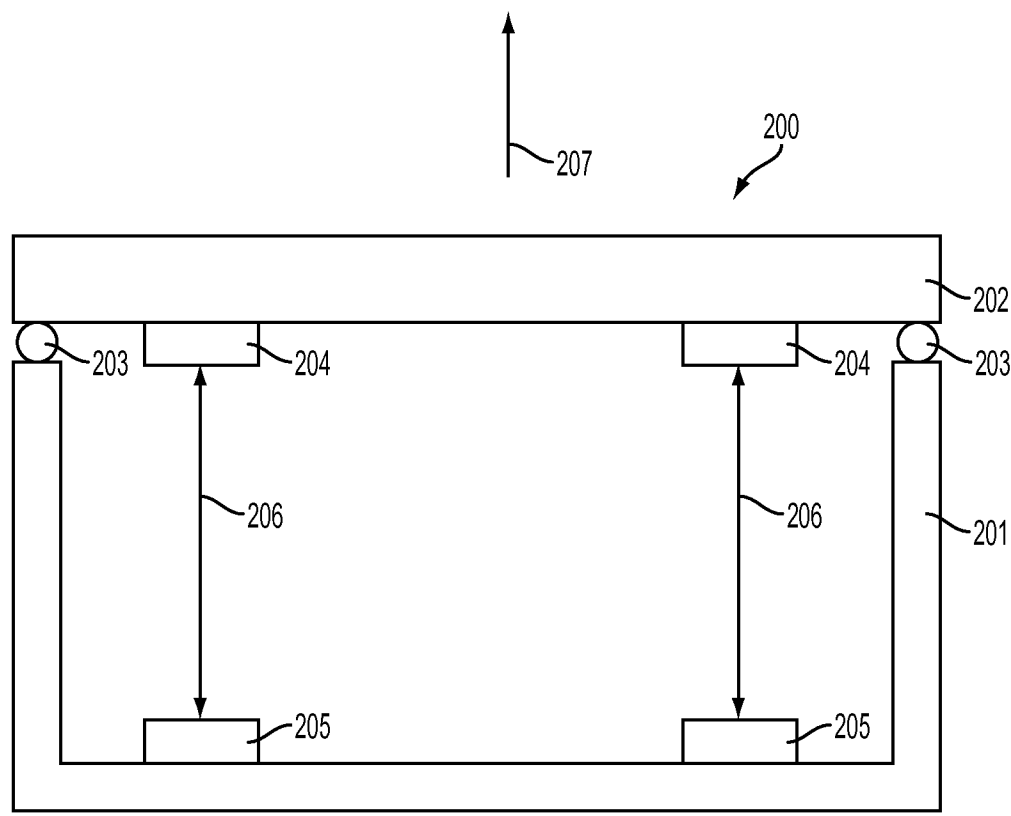


FIG. 2

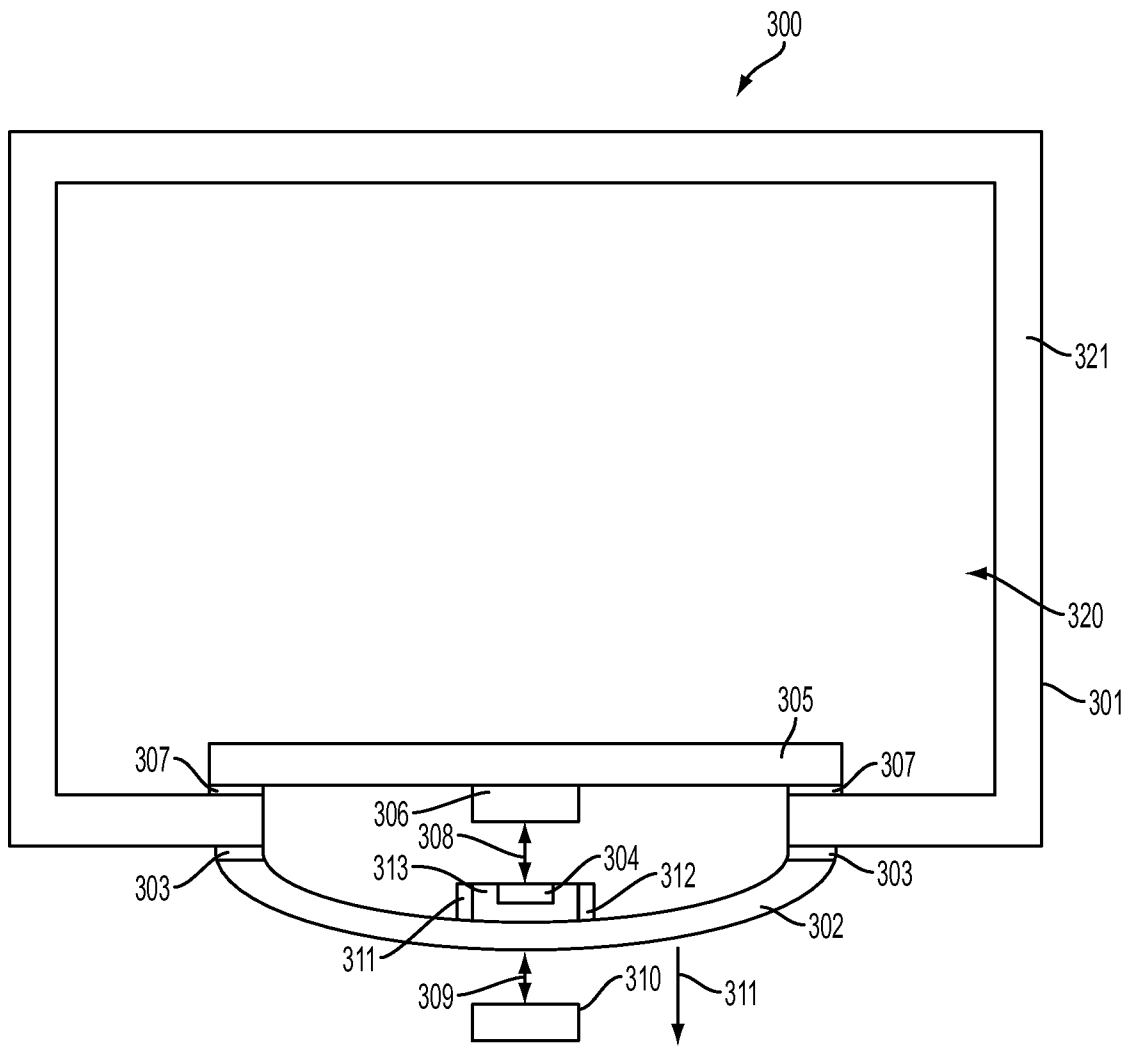


FIG. 3

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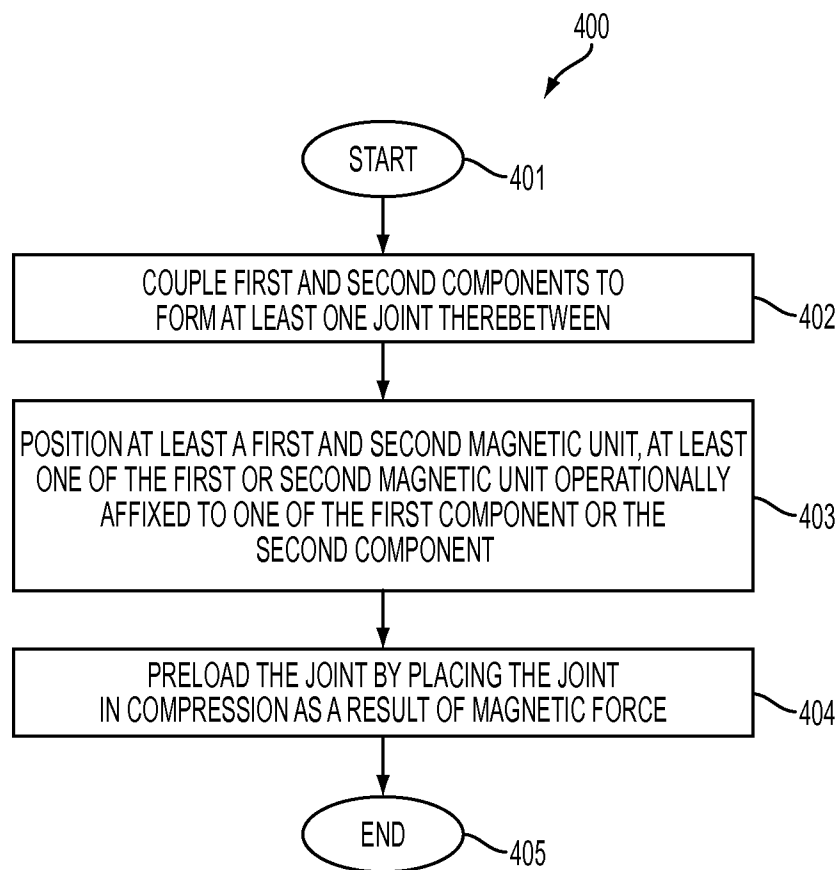


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/021305

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16B1/00
ADD.

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)
F16B

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014/105682 A1 (CHEN SHENG-CHI [TW]) 17 April 2014 (2014-04-17) paragraphs [0023], [0029] - [0033]; figures 1,2 paragraphs [0034] - [0036]; figure 3 -----	1-20
X	DE 10 2006 053415 B3 (EPLAX GMBH [DE]) 6 December 2007 (2007-12-06)	1,2,6-20
A	paragraph [0048] - paragraph [0054]; figures 2-4 paragraph [0057] - paragraph [0067]; figures 5-10 -----	3-5
X	US 2005/155308 A1 (KOWALSKI CHARLES J [US] ET AL) 21 July 2005 (2005-07-21) paragraph [0021] - paragraph [0035]; figures 1-6 -----	1,6-8, 11,14, 16-20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

12 June 2015

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2015/021305

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2014105682 A1	17-04-2014	TW 201416569 A US 2014105682 A1	01-05-2014 17-04-2014
DE 102006053415 B3	06-12-2007	NONE	
US 2005155308 A1	21-07-2005	NONE	