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BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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— *as to the identity of the inventor (Rule 4.17(i))*

Published:

— *with international search report (Art. 21(3))*

(54) **Title:** CARRIER FRAMES

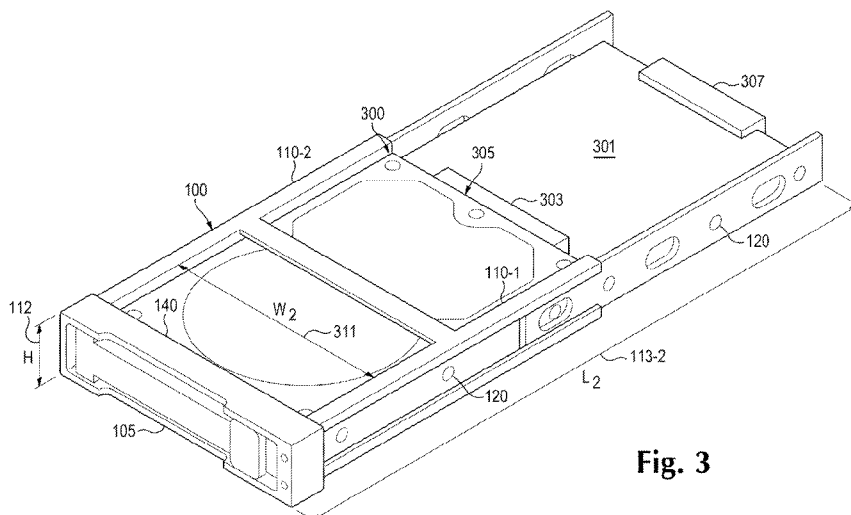


Fig. 3

(57) **Abstract:** In examples provided herein, a carrier frame includes a cross member, a first extendable arm coupled to the cross member to extend to a first variable length to support a first side of an electronic storage device to be supported, and a second extendable arm coupled to the cross member at a distance corresponding to a width of the electronic storage device from the first extendable arm to extend to second variable length to support a second side of the electronic storage device.

CARRIER FRAMES

BACKGROUND

[0001] Data center and cloud computing deployments use large arrays of storage devices. The storage devices can include hard drives (HDs), solid state drives (SSD), and the like.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] FIG. 1 illustrates an example variable carrier frame.

[0003] FIG. 2 illustrates an example variable carrier frame and storage device assembly.

[0004] FIG. 3 illustrates an example variable carrier frame and storage device assembly.

[0005] FIG. 4A illustrates multiple example variable carrier frames inserted in a corresponding carrier cage.

[0006] FIG. 4B illustrates multiple example carrier frames inserted in a corresponding carrier cage.

[0007] FIG. 4B depicts a flowchart of an example method of setting dimensions of a variable carrier frame.

DETAILED DESCRIPTION

[0008] The storage devices may be mounted in carrier frames. The carrier frames are inserted into corresponding carrier cages to mechanically and electrically couple the storage devices to power and data buses. Multiple carrier frames can be inserted into carrier cages to connect multiple storage devices to a storage area network or other data access architecture.

[0009] Various server and cloud computing installations can include large arrays of electronic storage devices. Such arrays can provide computing systems with large data storage and retrieval capabilities. Electronic storage devices, such as hard drives, solid state drives (SSDs), memristor arrays, and the like, come in standard and custom form factors or housings that include various functionality. For example, the housings can include mounting

elements for securing and protecting the subcomponents of the storage devices (e.g., the physical storage/memory media, printed circuit boards, integrated circuits, connectors, power converters, etc.). Some of such subcomponents can provide functionality for accessing data stored on a memory media included therein.

[0010] For example, serial advanced technology attachment (SATA) hard drives and SSDs can be disposed in corresponding housings that include connectors and control logic for retrieving data from specific memory locations in response to requests from a computer system or processing unit. Some electronic storage devices may even include a dedicated controller to execute code that cause the controller to perform various memory specific operations, such as bad sector recovery, indexing, defragmentation, and the like.

[0011] In contrast, some electronic storage devices may be less sophisticated. Such storage devices may include simplified housings and include limited or no specialized storage device functionality. In electronic storage devices with limited or basic internal functionality, various storage device functionality can be handled by an external controller that sends requests and receives responses through physical connections (e.g., connectors, pins, ports, etc.) included in the electronic storage device housing.

[0012] As described, the complexity and functionality of electronic storage devices can vary. Due to the large variety of electronic storage devices the term “electronic storage device” can refer to any of a number of storage devices. Accordingly, for the sake of simplicity and clarity, the term “electronic storage device”, as used herein, can refer to any storage device regardless the memory media technology, form factor, communication protocol, connector type, or level of control logic or functionality included therein.

[0013] To form an array of storage devices and make them available to computer systems and processors, electronic storage devices can be connected to a communication and/or power bus using corresponding connectors. For example, some electronic storage devices include connectors having arrays of pins arranged to mate with corresponding

connectors having arrays of slots. In other implementations, the pins may be connected to the bus, while the slots are included in the electronic storage device. In either case, the connectors of the storage devices are aligned with connectors of the bus and then coupled together.

[0014] To facilitate alignment with mating connectors in a carrier cage, an electronic storage device can be coupled to a variable carrier frame made in accordance with implementations of the present disclosure. In various example implementations, an electronic storage device can be coupled to a variable carrier frame with dimensions that are adjusted to accommodate the dimensions of the electronic storage device, as described herein in reference to the figures.

[0015] On particular example variable carrier frame 100 is depicted in FIG. 1. As shown in FIG. 1, the variable carrier frame 100 can include dimensions and mounting elements. In various implementations, the dimensions and configuration of the components of variable carrier frame 100 can be variable or adjustable based on the dimensions of electronic storage device or carrier cage with which it will be used. In one implementations, the dimensions, such as the width and height H 112 of the cross member 105 and/or extendable arms 110 can correspond to the dimensions of the carrier cage into which the carrier frame 100 is to be inserted. In addition, the width W 111 between the extendable arms 110 and the length L 113 to which the extendable arms 110 are extended can correspond to dimensions of a particular electronic storage device and/or the carrier cage with which the carrier frame 100 is to be used.

[0016] As shown, the carrier frame 100 can include extendable arms 110 coupled to a cross member 105 at a distance W 111 from one another. As described herein, the distance W 111 can correspond to a dimension (e.g., the outer width) of a housing of the electronic storage device. Accordingly, in various implementations, the width W 111 can be variable so that it can be adjusted to the dimension of the intended electronic storage device. In such implementations, the extendable arms 110 can be positioned relative to one another to accommodate the width of a particular electronic storage device. To that end, the extendable arms 110 can each include a movable coupling element that match a coupling element in the cross member 105. The

coupling elements, while not shown in FIG. 1A, can include T-shaped or L-shaped elements on the extendable arms 110 that couple into correspondingly shaped slots or rails in the back surface of the cross member 105 that allow for movement of the extendable arms 110 along the longitudinal axis of the cross member 105.

[0017] In various example implementations, extendable arms 110 can include multiple elements that move (e.g. slide) relative to one another to vary the length L 113 to match a dimension of a particular electronic storage device and/or to position mounting elements 120 relative to mounting elements disposed in the electronic storage device. In the particular example shown in FIG. 1A, the extendable arms 110 include two sliding elements 121. One of the sliding elements 121 can include a track or rail 121-1 into which another sliding element 121-2 can be inserted. By adjusting the relative positions of the sliding elements 121, the variable length L 113 can be varied in the direction 115. In some implementations, the variable length L 113 is continuously adjustable from a minimum length to a maximum length. In other implementations, the variable length L 113 can be adjusted to one of several predetermined or incremented intermediate lengths from a minimum length to a maximum length.

[0018] The minimum length, the maximum length, and the intermediate lengths can correspond to standard or customized dimensions of electronic storage devices with which the carrier frame 100 is to be used. In addition, the minimum length, the maximum length, and the intermediate lengths can be defined by spaced catches, notches, or incrementally positioned mounting elements in the sliding elements 121. As such, the length L 113 of the extendable arms can be set to a predefined length by setting the relative positions of the sliding elements by engaging or snapping-into a particular incrementally positioned mounting element.

[0019] When the variable length L 113 of the extendable arms 110 are set, the positions of the sliding elements 121 of the extendable arms 110 can be fixed by using the mounting elements 120 mated to mounting elements included in the intended corresponding electronic storage device. For example, in some implementations, mounting elements 120 can include

through holes that match up with threaded holes in the electronic storage device through which screws can be disposed. Accordingly, in such implementations the screws disposed in the through holes couple the carrier frame 100 to the electronic storage device and set the variable length L 113. In other implementations, the mounting elements 120 can include clips, slots, rivets, catches, and the like to couple the variable carrier frame 100 to the intended electronic storage device.

[0020] FIG. 1B is an expanded view of the example variable carrier frame 100 that illustrates the sliding elements 121. While only two sliding elements 121-1 and 121-2 are depicted in FIG. 1B, other implementations of the present disclosure may include more sliding elements 121. In such implementations, the sliding elements 121 can include multiple nesting sliding elements that can provide for shorter minimum variable lengths L 113.

[0021] FIG. 2 depicts an expanded view of an example assembly that includes the example carrier frame 100 and corresponding electronic storage device 200. As described herein, electronic storage device 200 can include a hard drive, and SSD, or any other housing containing electronic storage media and/or associated control logic. In the particular example shown, the electronic storage device 200 can include a housing having specific dimensions. For example, the housing of electronic storage device can have a length L' 213, a height H' 212, and width W' 211. To couple the variable carrier frame 100 to the electronic storage device 200, the length L₁ 113-1 and/or the width W 111 can be set to correspond to length L' 213 and/or width W' 211. The electronic storage device 200 can then be disposed in between the extendable arms 110. With the length L 113 and width W 111 set to match the length L' 213 and width W' 211, the mounting elements 120 in the extendable arms 110 and mounting elements 210 in the housing of electronic storage device 200 can be aligned to couple electronic storage device 200 to the variable carrier frame 100.

[0022] As described herein, the through holes 120 in the extendable arms 110 can match up with threaded holes 210 in the housing of the electronic storage device 200 so that screws may be inserted to secure the carrier frame to the housing. As depicted in FIG. 2, the length L₁ 113-1 can correspond to

the minimum length of the variable carrier frame 100 that corresponds to the dimension L' 213 of the shortest compatible electronic storage device 200. However, as described herein, the variable carrier frame can be expanded to accommodate electronic storage devices having different lengths and/or widths. For example, in implementations in which the electronic storage device comprises a serial advanced technology attachment (SATA) device that uses a SATA-to-serial attached small computer interface (SAS) bridge, or SATA-to-SAS bridge, device to communicate with an information bus in a carrier cage, the extendable arms 110 can be extended to accommodate the additional length. In such implementations, the bridge device 301 can include control logic, circuitry, hardware, and/or executable code to convert commands between an information bus and the electronic storage device 305.

[0023] FIG. 3 depicts an example assembly that uses the variable carrier frame 100 in an extended configuration to accommodate and couple to an electronic storage assembly 300 that includes a housing of electronic storage device 305 of a particular length and a bridge device 301 of a particular length. Accordingly, when the electronic storage device 305 is coupled to a bridge device 301 by a coupler 303, the overall length of the electronic storage assembly 300 is a composite of the lengths of the housing of electronic storage device 305, the coupler 303, the bridge device 301, and the coupler 307. The composite length of the electronic storage assembly 300 can correspond to the depth of a corresponding carrier cage in which the electronic storage assembly 300 is to be inserted.

[0024] For example, to accommodate the additional length of the electronic storage assembly 300 attributed to the dimensions of the bridge device 301, the extendable arms 110 of the variable carrier frame 100 can be extended to a length L_2 113-2. Once positioned, mounting elements 120 can be used to secure the variable carrier frame 100 to the electronic storage assembly 300. As such, the variable carrier frame 100 can be coupled to the housing of electronic storage device 305 with or without the bridge device 301. Accordingly, implementations of the variable carrier frame 100 can be used as a universal carrier frame usable to mount electronic storage devices

or assemblies having different lengths in carrier cage is having corresponding depths.

[0025] FIG. 4A depicts an example storage array 400 that includes a carrier cage 401 and multiple variable carrier frames 100. In such implementations, the carrier cage 401 can include internal tracks for accepting the variable carrier frames 100 and connections that align with connectors on the mounted electronic storage devices 200. The variable carrier frame 100 with extendable arms 110 configured to have a length L_1 113 corresponding to a depth D_1 413 of the carrier cage 401 and/or the length L' 213 of the electronic storage device 200 can be inserted into the carrier cage 400 so that the electronic storage device 200 is properly aligned with a particular slot of the carrier cage 401. For example, by inserting the variable carrier frame into a particular track of the carrier cage 401, the connectors of the electronic storage device 200 are automatically aligned with connectors in the carrier cage 401 that provide power and/or communication connections to the electronic storage device 200.

[0026] As shown, the carrier cage 401 can be dimensioned to accommodate multiple carrier frames 100 and the electronic storage devices 200. For example, dimension X_1 411 can be dimensioned to accommodate an integer number of carrier frames 100 having a particular height H 112. The dimension Y_1 412 can be dimensioned to accommodate the overall width of the variable carrier frame 100 and/or cross member 105.

[0027] Similar to the example storage array 400, the example storage array 402 depicted in FIG. 4B can include a carrier cage 403 and multiple variable carrier frames 100. In the example implementation depicted in FIG. 4B, the carrier cage 403 has a depth D_2 423 dimensioned to accommodate an extended length of an electronic storage assembly. For example, depth D_2 423 can correspond to the extended length L_2 113-2 of the electronic storage assembly 300 that includes both electronic storage device 305 and bridge device 301. In such implementations, the extendable arms 110 of the variable carrier frame 100 can be extended to a length corresponding to the extended length L_2 113-2 to couple to the electronic storage assembly 300. The variable carrier frame 100 and the electronic storage assembly 300 can then be

inserted into the carrier cage 403. Upon insertion into the carrier cage 403, the backend coupler 307 of the bridge device 301 can be aligned and mated with a corresponding coupler or connector in the back of the carrier cage 403.

[0028] As with the dimensions of the carrier cage 401, the dimensions of carrier cage 403 can correspond to the dimensions of the carrier frames 100 and/or the electronic storage assemblies 300. For instance, the dimension Y_2 422 can correspond to the overall width of variable carrier frame 100 and the dimension X_2 421 can correspond to an integer number of the height H 112 of the variable carrier frame 100.

[0029] These and other variations, modifications, additions, and improvements may fall within the scope of the appended claims(s). As used in the description herein and throughout the claims that follow, "a", "an", and "the" includes plural references unless the context clearly dictates otherwise. All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the elements of any example so disclosed, may be combined in any combination, except combinations where at least some of such features and/or elements are mutually exclusive.

Claims

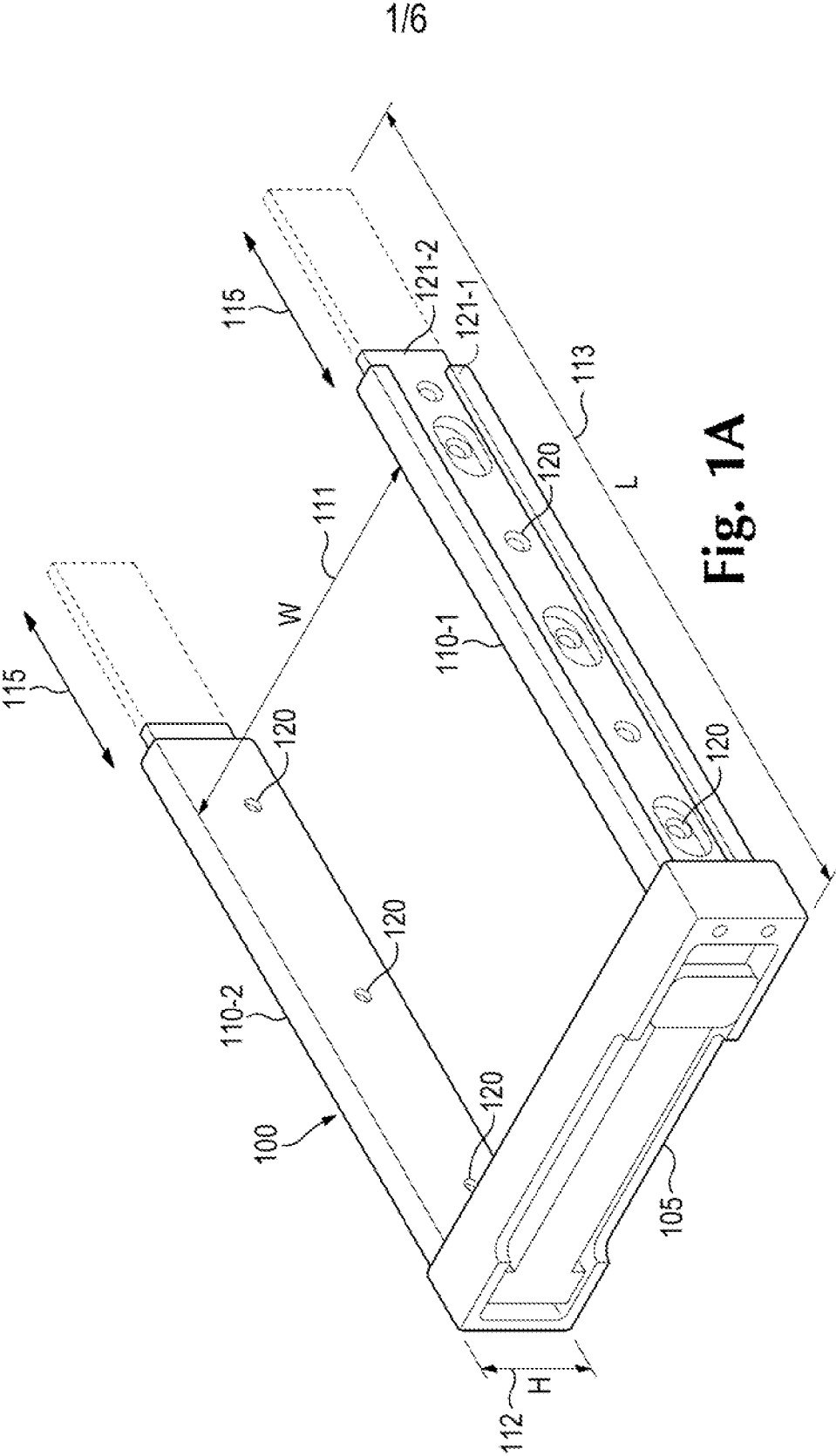
What is claimed is:

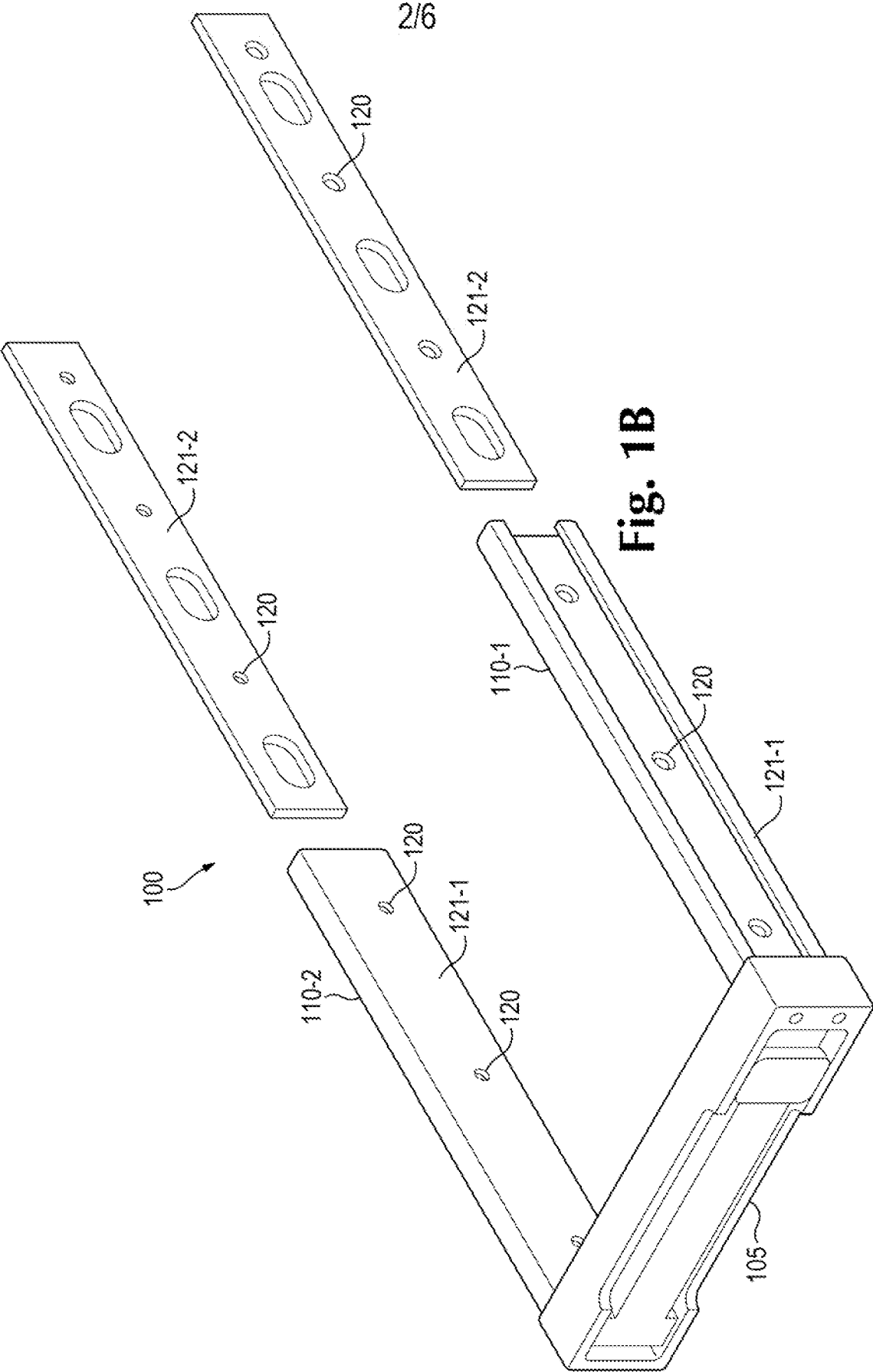
1. A carrier frame comprising:
 - a cross member;
 - a first extendable arm coupled to the cross member to extend to a first variable length to support a first side of an electronic storage device to be supported; and
 - a second extendable arm coupled to the cross member at a distance corresponding to a width of the electronic storage device from the first extendable arm to extend to second variable length to support a second side of the electronic storage device.
2. The carrier frame of claim 1 wherein the first extendable arm and the second extendable arm comprise mounting elements corresponding to mounting elements on the electronic storage device and a second electronic storage device.
3. The carrier frame of claim 1 wherein the first extendable arm is extendable to a third variable length to support the first side of the electronic storage device and a first side of a bridge device, and the second extendable arm is extendable to a fourth variable length to support the second side of the electronic device and a second side of the bridge device.
4. The carrier frame of claim 1 wherein the first variable length and the second variable length correspond to standardized storage device dimensions.
5. The carrier frame of claim 1 wherein the first variable length and the second variable length correspond to custom storage device dimensions.

6. The carrier frame of claim 1, wherein the first extendable arm and the second extendable arm comprise mounting elements compatible with multiple corresponding carrier cages.
7. A storage array housing comprising:
 - a carrier cage;
 - a plurality of carrier frames disposed in the carrier cage, wherein each of the carrier frames comprises:
 - a cross member;
 - a first extendable arm coupled to the cross member to extend to a first variable length to couple to a first side of a corresponding electronic storage device to be supported; and
 - a second extendable arm coupled to the cross member at a distance corresponding to a width of the corresponding electronic storage device from the first extendable arm to extend to second variable length to couple to a second side of the corresponding electronic storage device.
8. The storage array housing of claim 7, wherein the first variable length and the second variable length correspond to dimensions of the carrier cage and dimensions of the corresponding electronic storage device to be supported.
9. The storage array housing of claim 7, wherein the first extendable arm and the second extendable arm comprises mounting elements compatible with the corresponding electronic storage device and another electronic storage device.
10. The storage array housing of claim 7, wherein the corresponding storage device comprises serial advanced technology attachment (SATA) device and a SATA-to-serial attached small computer interface (SAS) bridge device.
11. A carrier frame comprising:
 - a first adjustable arm comprising mounting elements extendable to multiple lengths to couple to multiple types of memory modules; and

a second adjustable arm comprising mounting elements extendable to multiple lengths to couple to the multiple types of memory modules.

12. The carrier frame of claim 11, wherein first and second adjustable arms are dimensioned to couple to multiple types of carrier cages.
13. The carrier frame of claim 11, further comprising a structural cross element adjustably coupled to the first and the second adjustable arms to position the first and the second adjustable arms at a distance from one another corresponding to widths of the multiple types of memory devices.
14. The carrier frame of claim 11, wherein the multiple types of memory devices comprise a composite memory device type having serial advanced technology attachment (SATA) device and an SATA-to-serial attached small computer interface (SAS) bridge device.
15. The carrier frame of claim 11, wherein the multiple lengths correspond to predefined positions set by mechanical catches.





3/6

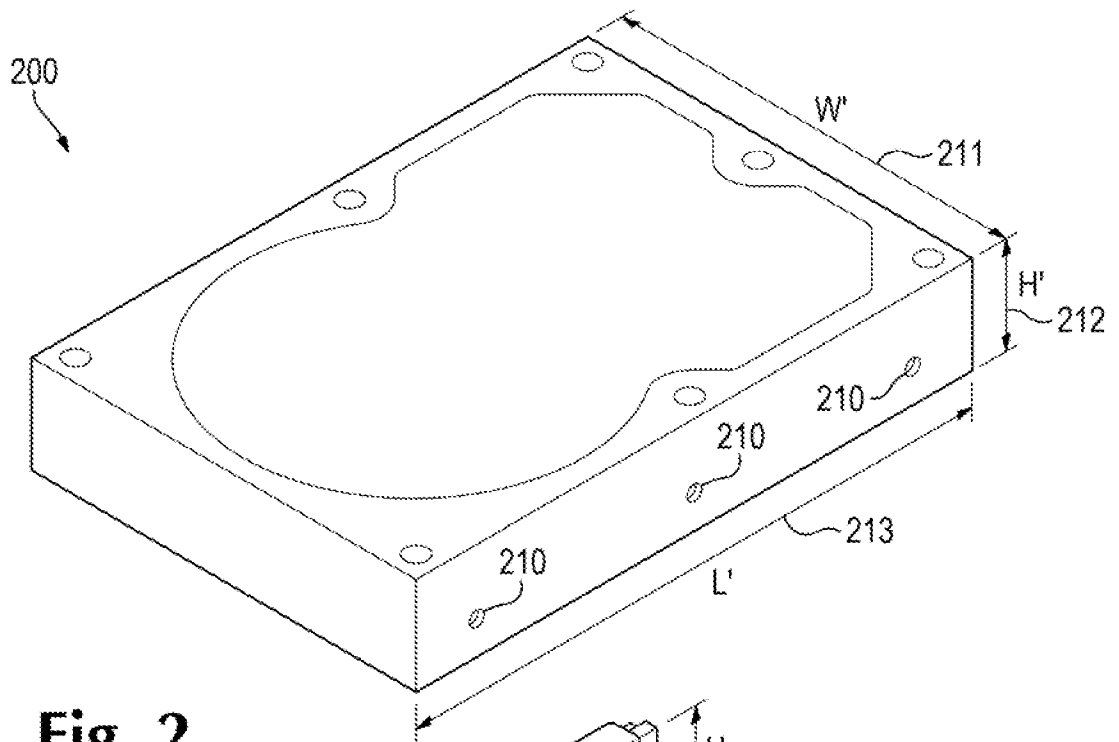
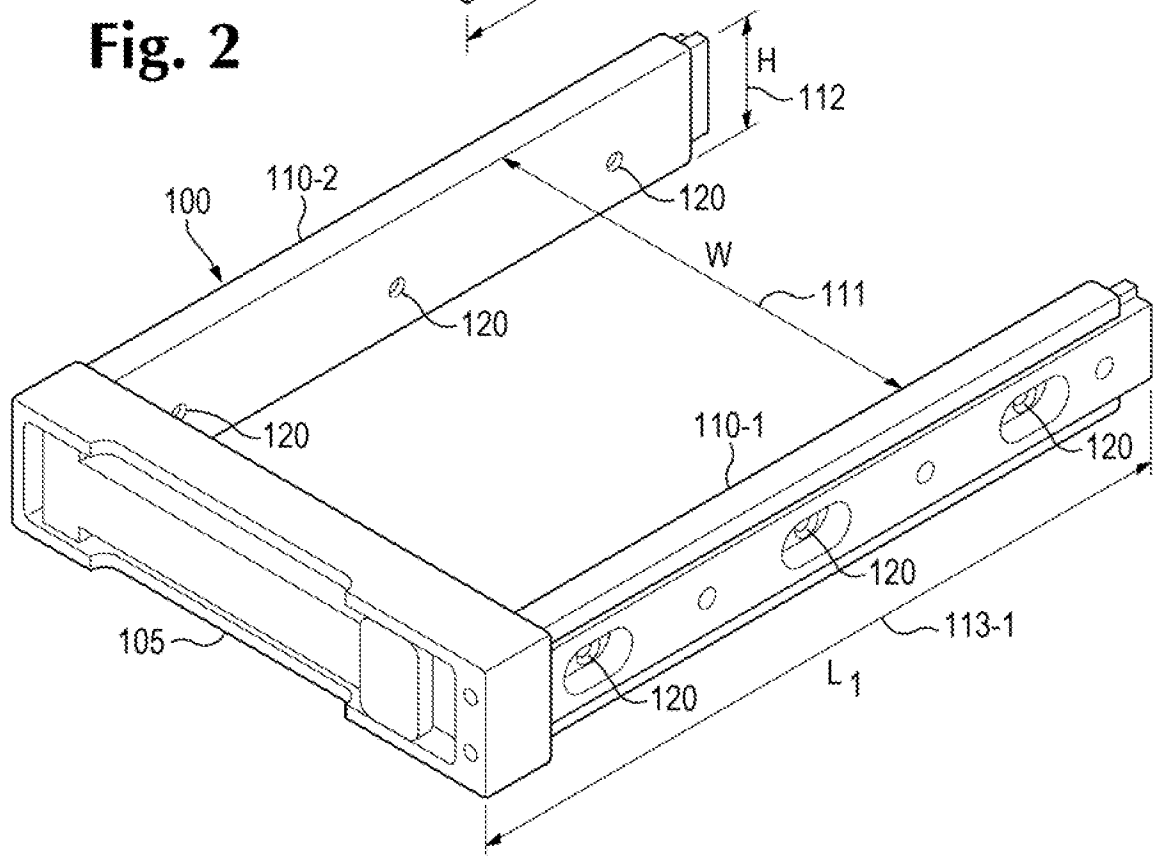
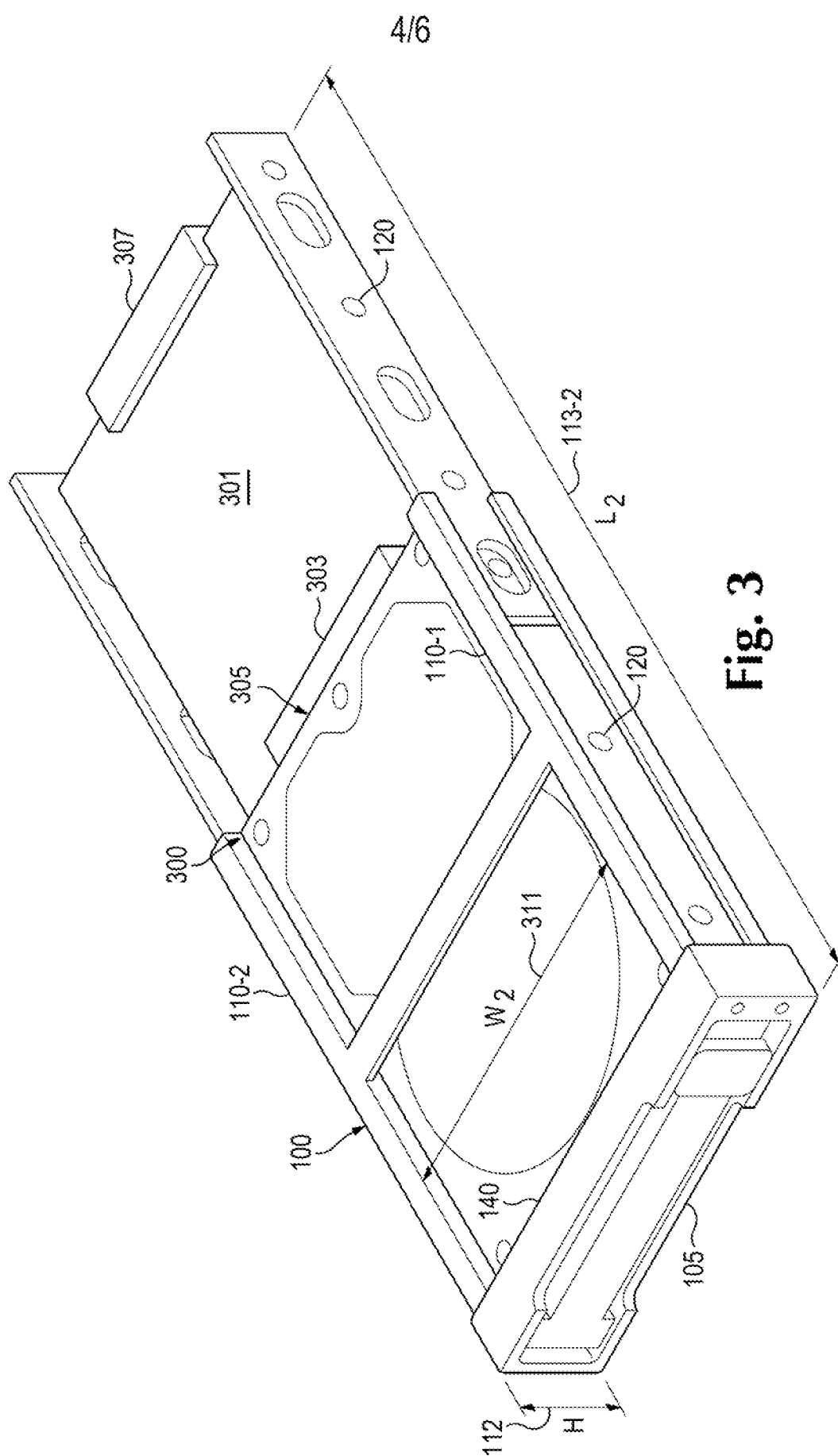


Fig. 2





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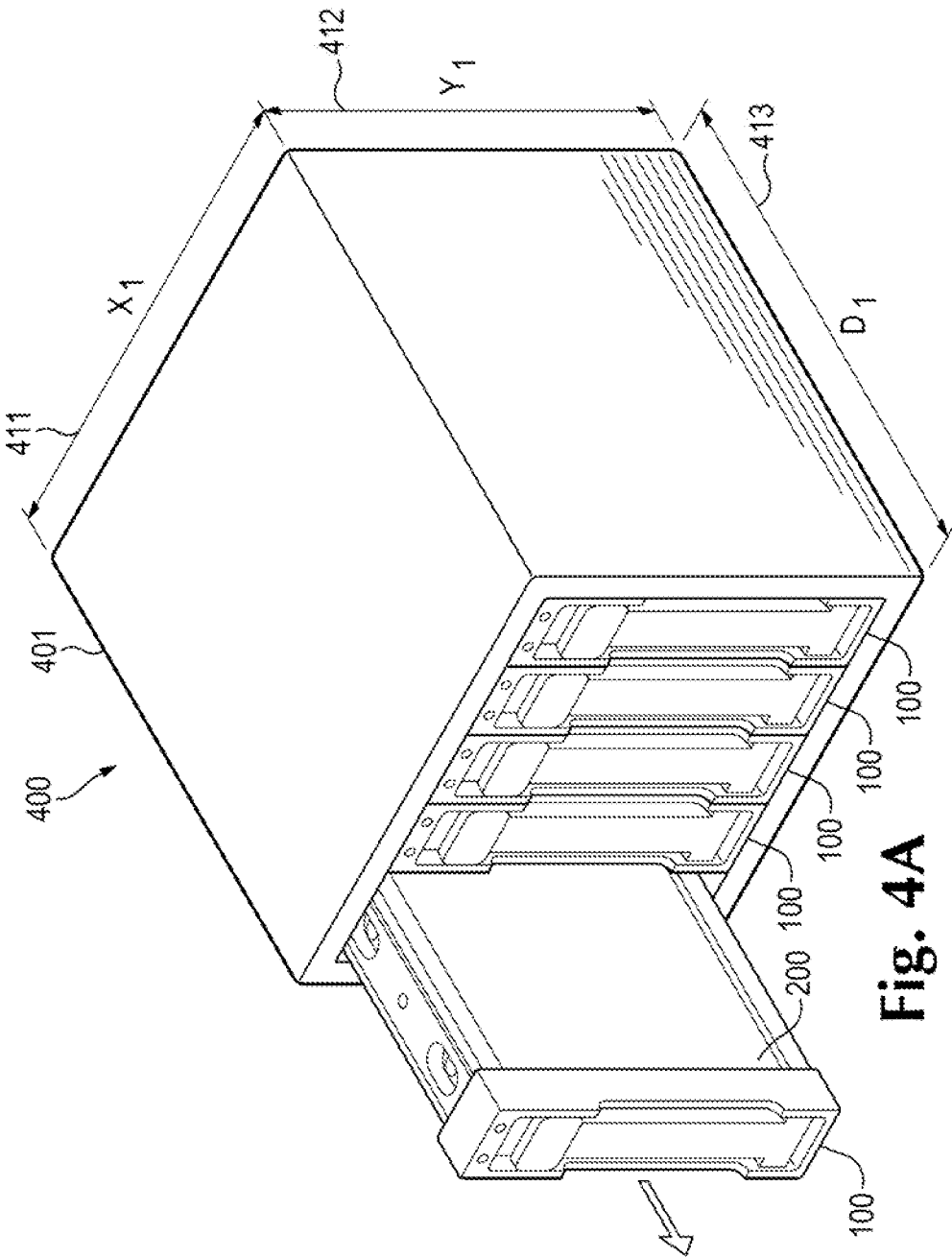


Fig. 4A

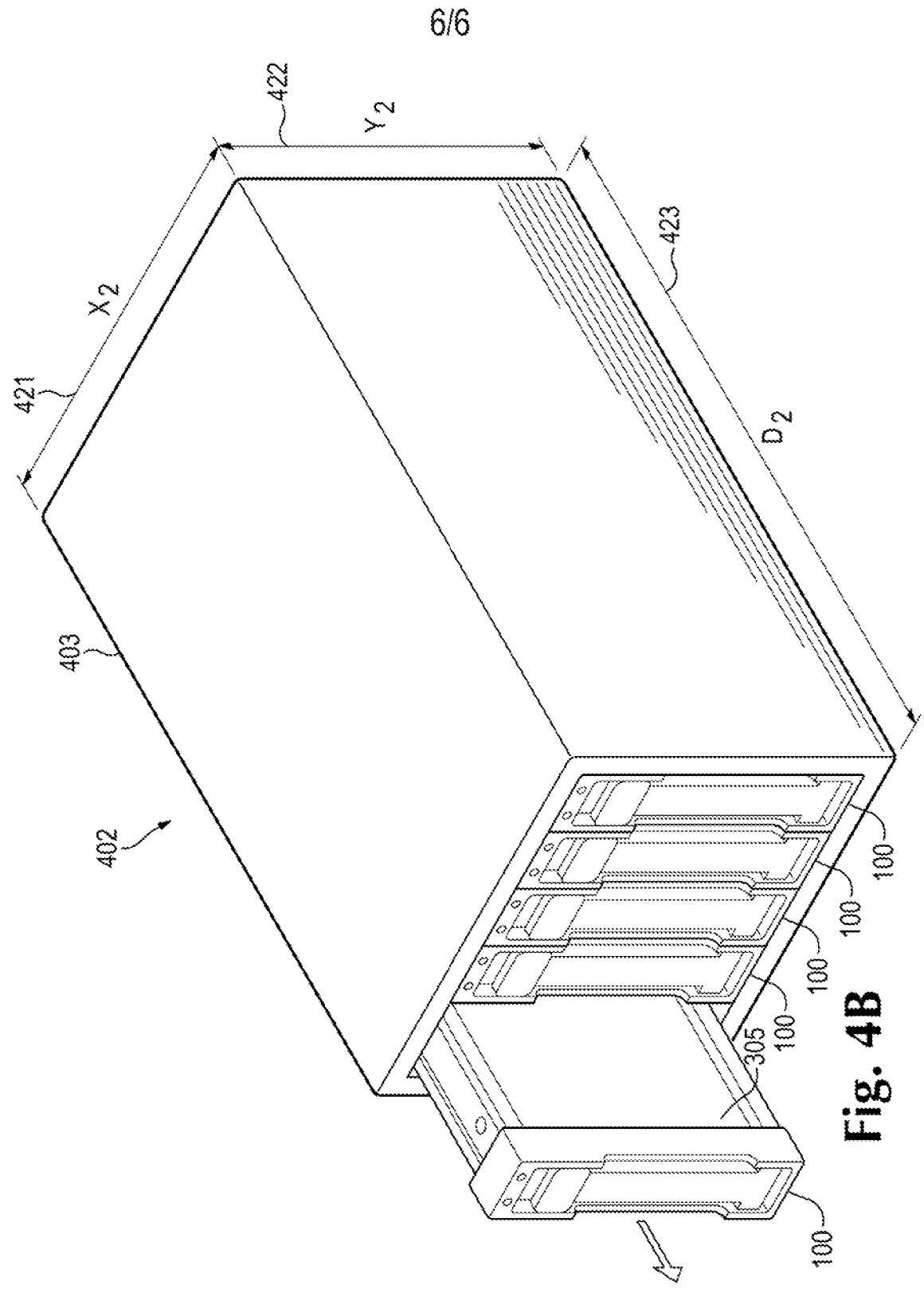


Fig. 4B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/037905**A. CLASSIFICATION OF SUBJECT MATTER****G11B 33/02(2006.01)i, G11B 23/02(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)

G11B 33/02; G11B 15/68; G06F 1/18; G06F 1/16; G11B 23/02

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: carrier frame, cross member, first extendable arm, second extendable arm, electronic storage device, mounting elements, carrier cage, and similar terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015-0022069 A1 (COOLER MASTER DEVELOPMENT CORPORATION) 22 January 2015 See paragraphs [0023]-[0028]; and figures 1-10.	11-12, 14-15
Y		1-10, 13
Y	US 2005-0024819 A1 (WEN-TANG PENG et al.) 03 February 2005 See paragraphs [0016], [0019]; and figure 1.	1-10, 13
A	US 2003-0227708 A1 (ROBERT WESLEY LUFFEL) 11 December 2003 See paragraphs [0029]-[0058]; and figures 4-9.	1-15
A	US 7518822 B1 (JOHN P. KARIDIS et al.) 14 April 2009 See column 7, line 45 - column 9, line 42; and figures 8-11C.	1-15
A	US 2009-0091884 A1 (ROBERT I. WALKER et al.) 09 April 2009 See paragraphs [0030]-[0056]; and figures 1-3.	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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24 March 2016 (24.03.2016)

Date of mailing of the international search report

25 March 2016 (25.03.2016)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/037905

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