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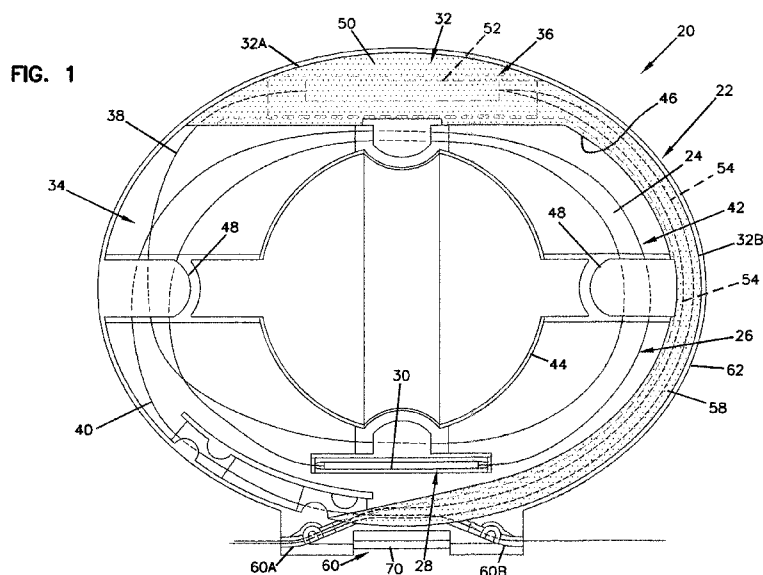
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(54) Title: FIBER MANAGEMENT TRAY WITH RESTRICTED ACCESS REGION



(57) Abstract: A fiber management tray (20) is disclosed. The fiber management tray (20) includes a tray body (22) defining a fiber storage region (24) for storing excess optical fiber length (26). The tray body (22) also includes a splice mount (28) for mounting at least one optical splice (30). The fiber management tray (20) includes a restricted access region (32) and an unrestricted access region (34) on the tray body (22). The splice mount (28) and the fiber storage region (24) are provided at the unrestricted access region (34), and an optical splitter component (36) is provided at the restricted access region (32).



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FIBER MANAGEMENT TRAY WITH RESTRICTED ACCESS REGION**BACKGROUND**

Fiber optic communication systems are becoming prevalent in part because service providers want to deliver high bandwidth communication capabilities (e.g., data and voice) to customers. Fiber optic communication systems employ a network of fiber optic cables to transmit large volumes of data and voice signals over relatively long distances. The ability to effectively manage optical fibers and optical components is an important part of most fiber optic communication systems. Fiber management trays are often used to facilitate managing excess fiber length needed for efficiently providing optical splices between optical fibers. Fiber management trays are also used to support optical components such as optical splitters (e.g., optical power splitters and wavelength division multiplexers (WDM)) and splice sleeves. Example fiber management trays are disclosed by the following International Publication Numbers: WO 98/22842; WO 209/131895; WO 95/25978; WO 95/07480; and WO 2008/033997.

Existing fiber optic systems often use infrastructure technology including organizers having a plurality of fiber management trays pivotally connected to support modules. The support modules can be configured to connect to a frame or profile of a universal mounting system. The fiber management trays can include splice trays dedicated for providing optical splicing functionality, and separate splitter trays for providing optical splitting functionality. Because optical splitters are typically relatively fragile and prone to damage in the field, optical splitter trays can be covered thereby limiting or restricting access to the optical splitters contained therein. In this way, the optical splitters are protected from damage in the field. Splitter input fibers from the splitters of the splitter trays are generally routed to the separate splice trays where field technicians can splice the splitter input fibers to corresponding feeder fibers.

While existing fiber optic systems have proven effective, improvements are needed to provide more compact configurations while maintaining effective fiber management and also maintaining suitable protection of optical components. Improvements are also needed to provide different types of splitting and splicing options in the field to create greater system flexibility for addressing the needs of different applications.

SUMMARY

One aspect of the present disclosure relates to a fiber management tray including a tray body that defines a fiber storage region for storing excess optical fiber length. The tray body also includes a splice mount for mounting at least one optical splice. A fiber management tray includes a restricted access region and an unrestricted access region on the tray body. The splice mount and the fiber storage region are provided at the unrestricted access region. An optical splitter component is provided at the restricted access region. The optical splitter component includes a splitter input fiber and splitter output fibers. This configuration allows both the optical splitter component and the splice location for splicing the splitter input fiber to a feeder fiber to be provided on the same fiber management tray. In this way, it is not necessary for separate splice trays to be dedicated for splicing feeder fibers to splitter input fibers. Instead, splice trays can be dedicated for other applications such as splicing the splitter output fibers to outgoing fibers (e.g., drop fibers) such as fibers routed to subscriber locations. The restricted and unrestricted access regions on the tray body allow field technicians to readily access the splitter input fibers for splicing to the feeder fibers, and also allow the excess length corresponding to the splitter input fiber and the feeder fiber to be effectively managed and stored by field technicians on the tray. At the same time, the restricted access region ensures that the optical splitter component is not disturbed and remains protected. Furthermore, the restricted access region can provide an indication as to whether the optical splitter component has been disturbed for the purpose of verifying warranty claims.

In certain embodiments, the optical splitter component includes a splitter body and splitter output fibers that extend outward from the splitter body. The restricted access region can include a first portion that restricts access to the splitter body and a second portion that restricts access to the splitter output fibers. The second portion can be used to ensure that the splitter output fibers remain routed along a preferred output routing path. In this way, the second portion of the restricted access region prevents the splitter output fibers from being rerouted or otherwise manipulated in the field. In certain embodiments, the second portion of the restricted access region extends along a periphery of the tray body and occupies a relatively small amount of space such that a majority of the tray body is available for

managing and storing the feeder fiber as well as the splitter input fiber at the unrestricted access region.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a top plan view of a fiber management tray in accordance with the principles of the present disclosure, the fiber management tray includes a restricted access region and an unrestricted access region;

Figure 2 shows the fiber management tray of Figure 1 with a cover corresponding to the restricted access region removed to reveal an underlying optical splitter component including a splitter body, a splitter input fiber and splitter output fibers;

Figure 3 is a top, perspective view of the fiber management tray of Figure 1; and

Figure 4 shows the fiber management tray of Figure 1 pivotally connected to a modular mounting plate adapted for connection to a frame or other structure.

DETAILED DESCRIPTION

Aspects of the present disclosure relate to fiber management trays that can be used in fiber optic systems such as fiber-to-the-premises (FTTP) networks and air blown fiber networks. In certain embodiments, the fiber management trays can be used as part of a fiber management system and can be incorporated into various system components that may be used in inside or outside environments. In certain embodiments, the fiber management trays can be used at a central office, at an exchange, at a head end or at a customer premises. In other embodiments, the fiber management trays can be mounted within environmentally sealed enclosures such as street cabinets, splice closures, domes, pedestals, wall boxes or other structures adapted for outside environmental use. The fiber management trays can also be used on structures such as frames, racks, drawers, shelves, panels, closets or other structures.

Figures 1-3 show a fiber management tray 20 in accordance with the principles of the present disclosure. The fiber management tray 20 includes a tray body 22 defining a fiber storage region 24 for storing excess optical fiber length 26. The tray body 22 also includes a splice mount 28 for mounting at least one optical splice 30 (e.g., a splice sleeve). The fiber management tray 20 includes a restricted access region 32 and an unrestricted access region 34 on the tray body 22. The splice mount 28 and the fiber storage region 24 are provided at

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the unrestricted access region 34. An optical splitter component 36 is provided at the restricted access location 32. Referring to Figure 1, an input optical fiber 38 of the optical splitter component 36 extends outwardly from the restricted access region 32 into the unrestricted access region 34. In certain embodiments, the input optical fiber 38 can be routed to the splice mount 28 where the input optical fiber 38 is fusion spliced to a feeder optical fiber 40. It will be appreciated that both the input optical fiber 38 and the feeder optical fiber 40 can have excess optical fiber length 26 that should be effectively managed. As shown as Figure 1, the excess optical fiber length 26 is routed in a fiber loop path 42 defined by the fiber storage region 24. The fiber loop path 42 is defined around a central hub 44 of the tray body 22 and a generally racetrack-shaped boundary 46 that circumscribes the central hub 44. Fiber management tabs 48 overhang the fiber loop path 42 and function to retain/capture the excess optical fiber length 26 within the fiber storage region 24.

As shown at Figure 1, access to the restricted access region 32 is restricted by a top cover 50 secured to the tray body 22. In certain embodiments, the cover 50 is connected to the tray body 22 by means such as a weld (e.g., an ultrasonic weld), an adhesive (e.g., an epoxy), conventional fasteners, security fasteners such as screws that require a unique key or tool to remove such fasteners, or other structures. In certain embodiments, the cover 50 is permanently connected to the tray body 22. By “permanently connected”, it is meant that either the tray body 22 or the cover 50 need be broken or destroyed to remove the cover 50 from the tray body 22, or that a special tool is needed to remove the cover 50 from the tray body 22. In other embodiments, as shown at Figure 3, the fiber management tray 20 can include a tamper indicator 104 (e.g., a seal, tape, etc.) for providing an indication as to whether the cover 50 has been removed. For many applications, unauthorized removal of the cover 50 can be used as a basis for voiding a warranty related to the optical splitter component 36. In still other embodiments, access to the restricted access region 32 can be restricted by embedding or covering the optical splitter component 36 (e.g., a body of the splitter component as well as splitter outputs) in a curable securing medium used to secure the optical splitter component 36 to the tray body 22 such that the curable securing medium itself is a cover.

In Figure 2, the cover 50 has been removed from the tray body 22 to reveal the underlying optical splitter component 36. As shown at Figure 2, the optical splitter component 36 includes a splitter body 52 and splitter output fibers 54 (e.g., drop fibers) that

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extend outwardly from the splitter body 52. It will be appreciated that the splitter body 52 can include a protective outer casing or sleeve that surrounds and protects an internal optical splitter that provides one-to-many optical splitting between the input optical fiber 38 and the splitter output fibers 54. In certain embodiments, the optical splitter component 36 can provide a 1 x 2 split, a 1 x 4 split, a 1 x 8 split, a 1 x 16 split, a 1 x 32 split, a 1 x 64 split, etc. In certain embodiments, the optical splitter component 36 can include an optical power splitter that evenly splits the power of an optical signal from the input optical fiber 38 to the splitter output fibers 54. In other embodiments, the optical splitter component 36 can include a wavelength division multiplexer that splits optical signals provided from the input optical fiber 38 to the splitter output fibers 54 based on wavelength.

Referring back to Figure 1, the restricted access region 32 includes a first portion 32A that restricts access to the splitter body 52 and a second portion 32B that restricts access to the splitter output fibers 54. The splitter output fibers 54 extend along a fiber routing path 58 that extends a first distance D1 measured from the splitter body 52 to a fiber exit/entrance location 60 of the tray body 22. In certain embodiments, the second portion 32B of the restricted access region 32 extends along a majority of the first distance D1. In a preferred embodiment, the second portion 32B of the restricted access region 32 extends substantially the entire first distance D1 between the splitter body 52 and the fiber exit/entrance location 60. The term “substantially the entire” means all or almost all of the first distance D1.

As shown at Figure 1, the second portion 32A of the restricted access region 32 extends along a peripheral boundary 62 of the tray body 22. The peripheral boundary 62 of the tray body 22 is curved and the second portion 32B of the restricted access region 32 has a curvature that matches the curvature of the peripheral boundary 62. The second portion 32B of the restricted access region 32 is defined between the peripheral boundary 62 of the tray body 22 and a portion of the racetrack-shaped boundary 46 of the fiber loop path 42. It will be appreciated that the second portion 32B of the restricted access region 32 is relatively small compared to the overall size of the fiber storage region 24 such that a relatively large amount of storage area is provided for storing the excess optical fiber length 26 corresponding to the feeder optical fiber 40 and the input optical fiber 38. The second portion 32B of the restricted access region 32 protects the splitter output fibers 54 and ensures that the splitter output fibers 54 remain routed along the preferred fiber routing path 58 that extends from the splitter body 52 of the fiber exit/entrance location 60.

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Referring still to Figure 1, the fiber storage region 24 is positioned between the splice mount 26 and the splitter body 52. It will be appreciated that the splice mount 28 is preferably configured for holding/retaining a conventional splice reinforcing sleeve that is mounted over a conventional splice such as a conventional fusion splice. In certain
5 embodiments, the splice reinforcing sleeve can be snap fit or otherwise secured within the splice mount 28. The splice mount 28 and the splitter body 52 are positioned on opposite sides of the fiber storage region 24 with the splice mount 28 being adjacent to the fiber exit/entrance location 60. The fiber exit/entrance location 60 includes a first passage 60A for routing the splitter output fibers 54 from the second portion 32B of the restricted access
10 region 32 out of the tray body 22. It will be appreciated that the splitter output fibers 54 can be routed from the fiber management tray 20 to another tray where the splitter output fibers 54 can be optically coupled to output optical fibers such as drop fibers or subscriber fibers. The fiber exist/entrance location 60 also includes a second passage 60B for routing the feeder fiber 40 into the tray body 22.

15 In use of the fiber management tray 20, a field technician can route the feeder optical fiber 40 onto the tray body 22 through the second passage 60B of the fiber exit/entrance location 60. From the second passage 60B, the feeder optical fiber 40 can be routed into the fiber storage region 24 and excess length corresponding to the feeder optical fiber 40 can be looped around the fiber loop path 42. After looping the excess length of the feeder optical
20 fiber 40 within the fiber storage region 24, an end of the feeder optical fiber 40 is preferably routed by the field technician to the splice mount 28. The field technician can also store excess length corresponding to the input optical fiber 38 of the optical splitter component 36 along the fiber loop path 42. The field technician preferably splices the end of the input optical fiber 38 to the end of the feeder optical fiber 40 and then mounts the splice within the
25 splice mount 28. The field technician can also route the splitter output fibers 54 out of the tray body 22 through the passage 60A. The splitter output fibers 54 can then be routed to another tray where the splitter output fibers 54 are spliced to corresponding subscriber fibers.

Referring again to Figure 1, the tray body 22 includes a hinge location 70 positioned adjacent to the fiber exit/entrance location 60. The hinge location 70 is depicted as a hinge
30 pin. As shown at Figure 4, the hinge location 70 can be used to pivotally connect the fiber management tray to a corresponding modular mounting plate 80 (e.g., a mounting base, a mounting member, a groove plate, etc.). The modular mounting plate 80 can be configured

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to be attached to a mounting system (e.g., a universal mounting system) including a frame or other structure having a predetermined connection interface that corresponds to the mounting plate 80. It will be appreciated that the modular mounting plate 80 is configured to receive a plurality of the fiber management trays 20 within each of the fiber management trays being pivotally movable relative to the modular mounting plate 80. For example, each of the fiber management trays 20 can be free to pivot about its own independent pivot axis 82 (see Fig. 1) defined by the hinge location 70. In certain embodiments, both fiber management trays 20 of the type described herein and dedicated splice trays not equipped with splitters can be mounted to the modular mounting plate 80.

Referring to Figure 2, the tray body 22 has an oblong shape when viewed in plan view. The tray body 22 defines a major dimension M1 that extends along a major axis 100 of the tray body 22 and a minor dimension M2 that extends along a minor axis 102 of the tray body 22. The major and minor axes 100, 102 are perpendicular relative to one another. The splitter body 52 and the splice mount 28 are positioned on opposite sides of the major axis 100 and are bisected by the minor axis 102. The passages 60A, 60B are defined at oblique angles relative to the minor axis 102.

In general, the present disclosure relates to a fiber management tray having both an optical splitter component and an optical splice component provided thereon. The fiber management tray is provided with structure that provides a clear demarcation boundary between the splitter component and the remainder of the fiber management tray. In this way, a field technician is provided with a clear indication that the splice component should not be accessed. The tray can also include a barrier that prevents the splitter component from being accessed in the field. Thus, field access is limited to the remainder of the fiber management tray which includes the splice location and a fiber storage and management region. The integrated configuration of the fiber management tray provides dual functions on one tray while still providing protection for the splitter component.

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PARTS LIST

	Fiber management tray	20
	Tray body	22
	Fiber storage region	24
5	Excess optical fiber length	26
	Splice mount	28
	Optical splice	30
	Restricted access region	32
	First portion of restricted access region	32A
10	Second portion of restricted access region	32B
	Optical splitter component	36
	Input optical fiber	38
	Feeder optical fiber	40
	Fiber loop path	42
15	Central hub	44
	Racetrack-shaped boundary	46
	Fiber management tabs	48
	Top cover	50
	Splitter body	52
20	Splitter output fibers	54
	Fiber routing path	58
	First distance	D1
	Fiber exit/entrance location	60
	First passage	60A
25	Second passage	60B

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Peripheral boundary 62

Hinge location 70

Modular mounting plate 80

Pivot axis 82

5 Major dimension M1

Major axis 100

Minor dimension M2

Minor axis 102

Tamper indicator 104

CLAIMS:

1. A fiber management tray (20) comprising a tray body (22) defining a fiber storage region (24) for storing excess optical fiber length (26), the tray body (22) also including a splice mount (28) for mounting at least one optical splice (30), characterized in that the fiber management tray (20) includes a restricted access region (32) and an unrestricted access region (34) on the tray body (22), the splice mount (28) and the fiber storage region (24) being provided at the unrestricted access region (34), and an optical splitter component (36) being provided at the restricted access region (32).
2. The fiber management tray (20) of claim 1, wherein an input optical fiber (38) of the optical splitter component (36) extends outwardly from the restricted access region (32) into the unrestricted access region (34).
3. The fiber management tray (20) of claims 1 or 2, wherein the optical splitter component (36) includes a splitter body (52) and splitter output fibers (54) that extend outwardly from the splitter body (52), and wherein the restricted access region (32) includes a first portion (32A) that restricts access to the splitter body (52) and a second portion (32B) that restricts access to the splitter output fibers (54).
4. The fiber management tray (20) of claim 3, wherein the tray body (22) includes a fiber exit/entrance location (60), wherein the splitter output fibers (54) extend along a fiber routing path (58) that extends a first distance (D1) measured from the splitter body (52) to the fiber exit/entrance location (60), and wherein the second portion (32B) of the restricted access region (32) extends along a majority of the first distance (D1).
5. The fiber management tray (20) of claim 4, wherein the second portion (32B) of the restricted access region (32) extends substantially the entire first distance (D1) between the splitter body (52) and the fiber exit/entrance location (60).

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6. The fiber management tray (20) of claims 4 or 5, wherein the second portion (32B) of the restricted access region (32) extends along a peripheral boundary (62) of the tray body (22).

5 7. The fiber management tray (20) of claim 6, wherein the second portion (32B) of the restricted access region (32) is position between the peripheral boundary (62) of the tray (22) and the fiber storage region (24).

8. The fiber management tray (20) of claims 3-7, wherein the second portion (32B) of
10 the restricted access region (32) is curved.

9. The fiber management tray (20) of claims 1-8, wherein the fiber storage region (24) defines a fiber loop path (42).

15 10. The fiber management tray (20) of claims 3-9, wherein the fiber storage region (24) is positioned between the splice mount (28) and the splitter body (52).

11. The fiber management tray (20) of claims 4-10, wherein the splice mount (28) is positioned adjacent to the fiber exit/entrance location (60).

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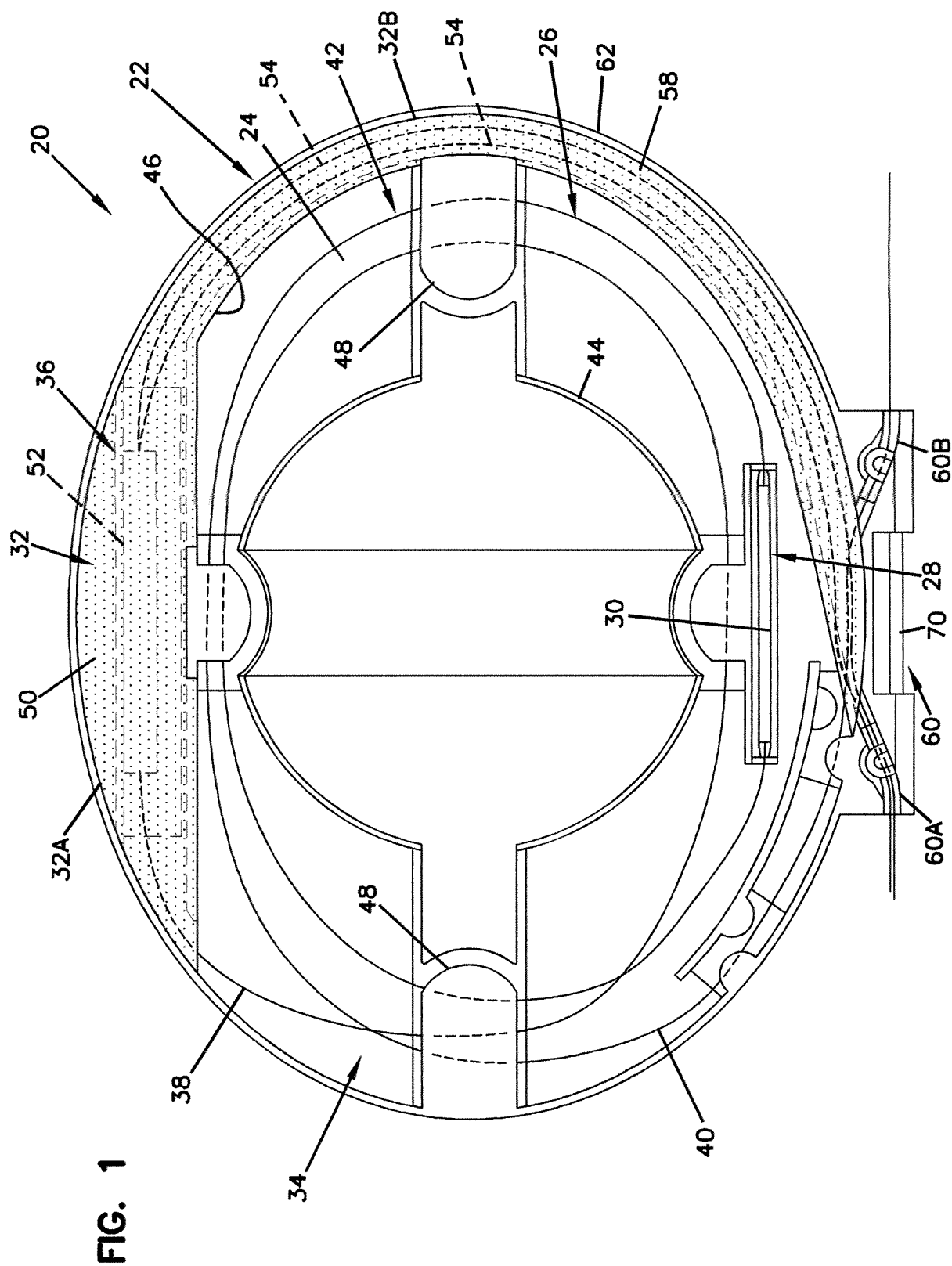
12. The fiber management tray (20) of claims 4-11, wherein the tray body (22) includes a hinge location (70) at which the tray body (22) pivotally connects to a tray mounting plate (80), wherein the hinge location (70) is positioned adjacent to the fiber exit/entrance location (60), wherein the tray body (22) has an obround shape when viewed in plan view, wherein
25 the tray body (22) defines a major dimension (M1) that extends along a major axis (100) of the tray body (22) and a minor dimension (M2) that extends along a minor axis (102) of the tray body (22), wherein the major and minor axes (100, 102) are perpendicular relative to one another, and wherein the splitter body (52) and the splice mount (28) are positioned on opposite sides of the major axis (100) and are bisected by the minor axis (102).

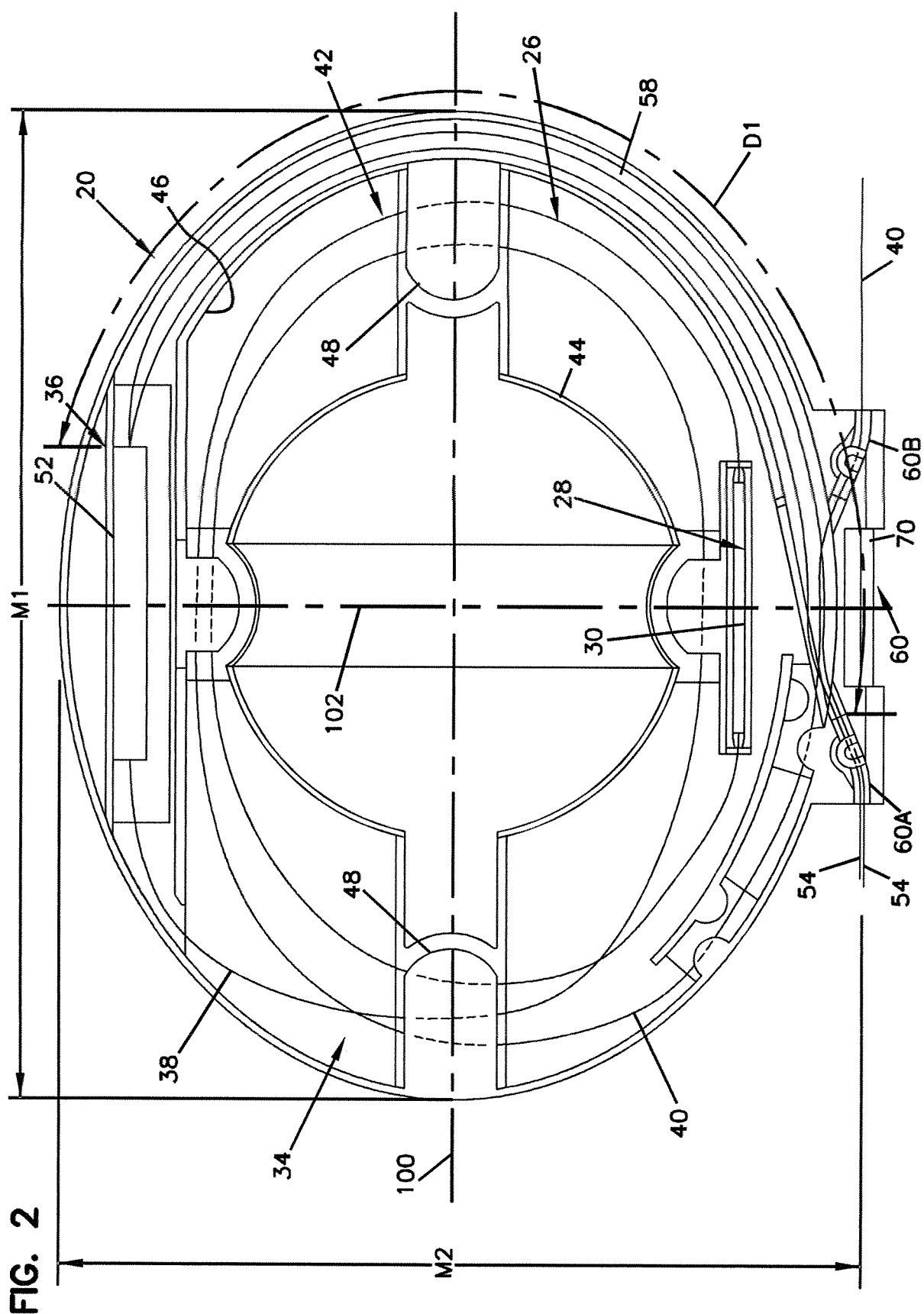
13. The fiber management tray (20) of claims 1-12, wherein the splitter component (36) is an optical power splitter or a wavelength division multiplexer.

5 14. The fiber management tray (20) of claims 1-13, wherein access to the restricted access region (32) is restricted by a cover (50) secured to the tray body (22).

15. The fiber management tray (20) of claim 1-13, wherein access to the restricted access region is restricted by a cover (50) secured to the tray body, and wherein the cover (50) is
10 either permanently connected to the tray body (22) or the fiber management tray (20) includes a tamper indicator (104) for providing an indication as to whether the cover (50) has been removed.

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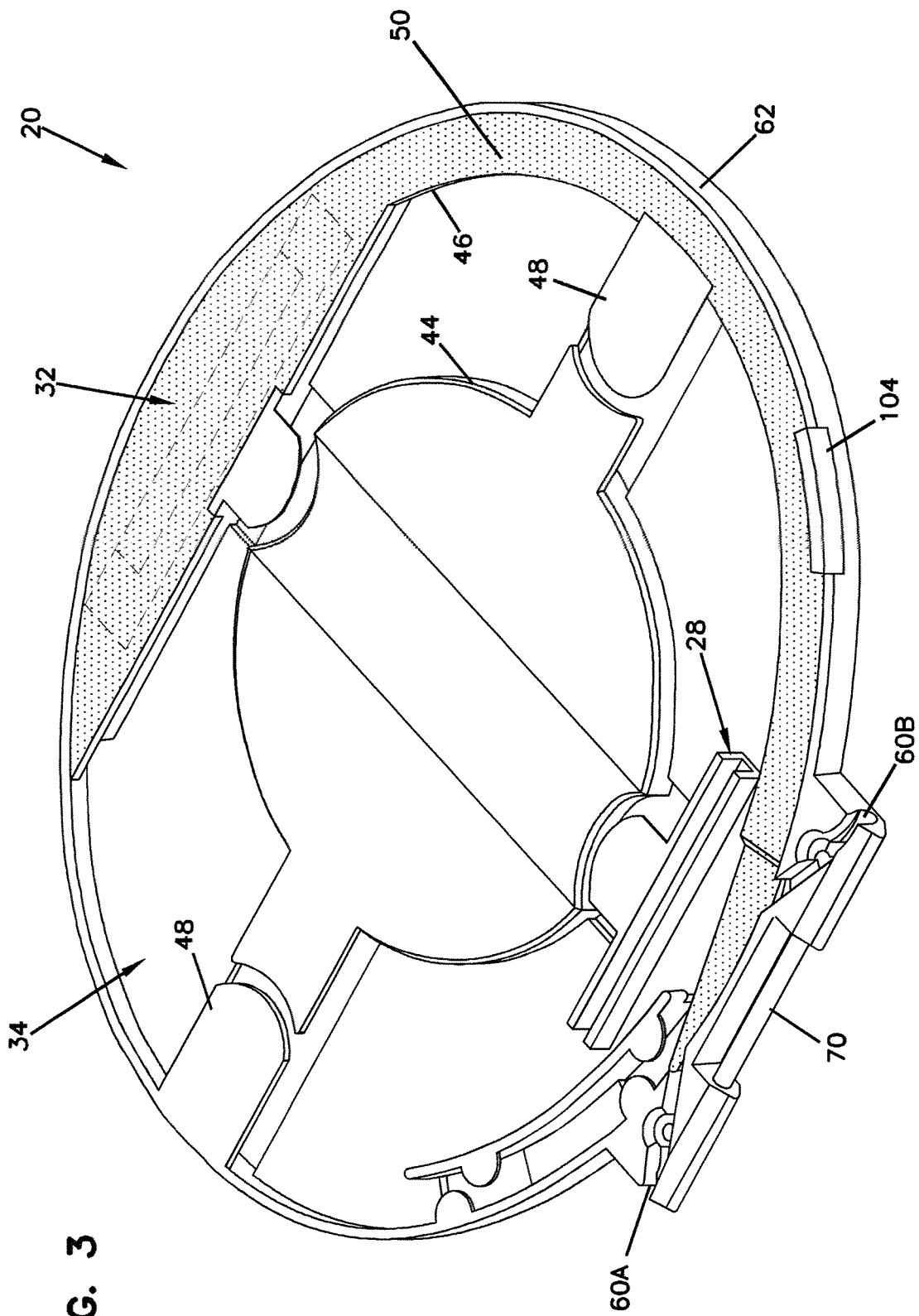
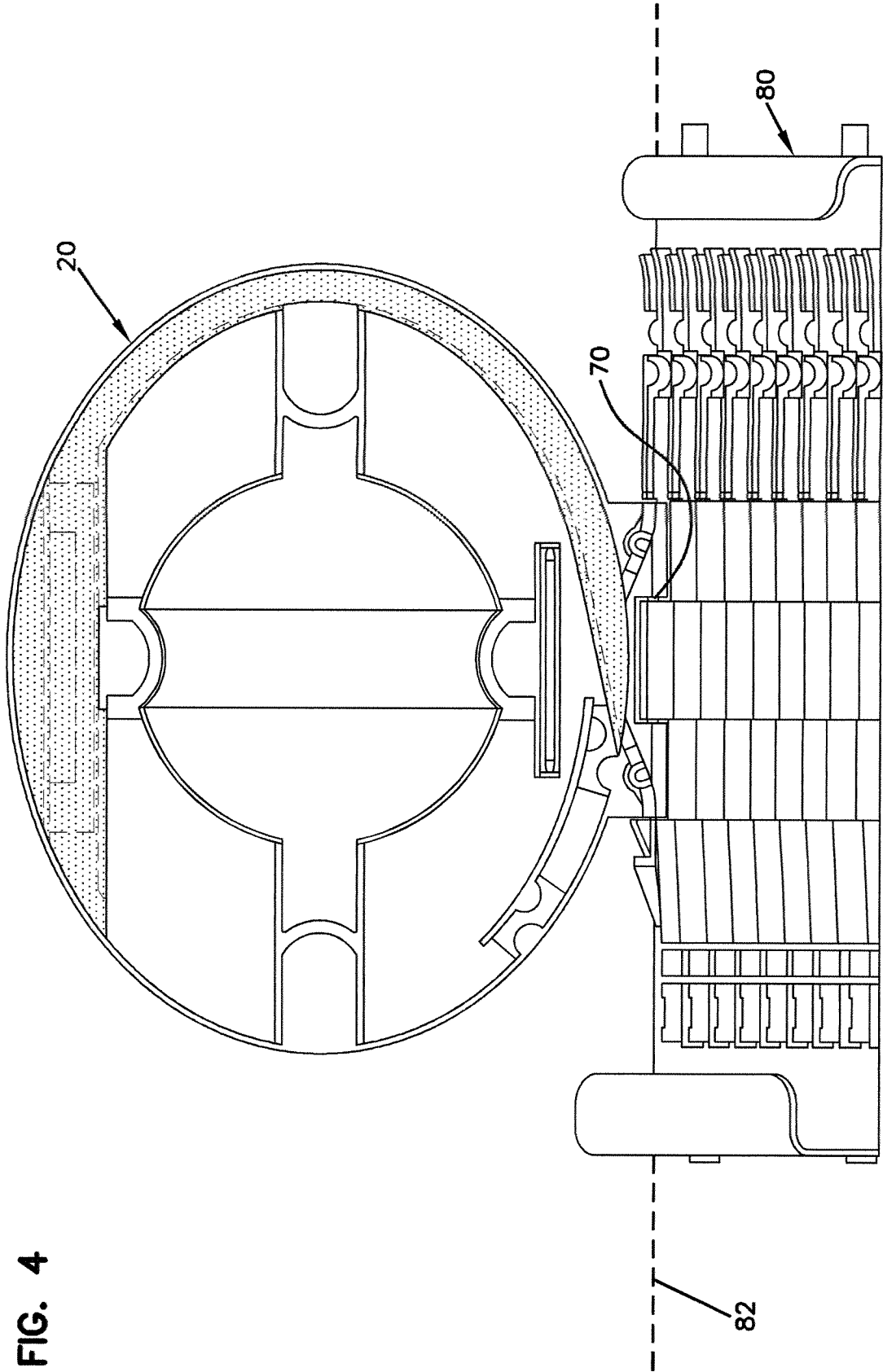


FIG. 3



INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B6/44
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)
G02B

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 5 553 183 A (BECHAMPS RONALD D [US]) 3 September 1996 (1996-09-03) abstract; figures 1-8 -----	1-11,13, 14 12,15
X A	US 5 080 459 A (WETTENGEL PAUL F [GB] ET AL) 14 January 1992 (1992-01-14) abstract; figure 9 column 4, lines 25-50 -----	1,12 2-11, 13-15
X A	EP 0 903 594 A1 (PIRELLI CAVI E SISTEMI SPA [IT]) 24 March 1999 (1999-03-24) abstract; figures 1-8 -----	1 2-15
X A	WO 03/087912 A2 (TYCO ELECTRONICS RAYCHEM NV [BE]; TYCO ELECTRONICS LTD UK [GB]; BELLEK) 23 October 2003 (2003-10-23) abstract; figures 1-13 -----	1,12,14, 15 2-11,13



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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