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(54) **OPTOELECTRONIC PACKAGING ASSEMBLY**

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(57) **ABSTRACT**

Optoelectronic packaging assemblies for optically and electrically interfacing an electro-optical device to an optical fiber and to external circuitry. An optoelectronic packaging assembly includes a submount for holding an optical bench with an electro-optical device. Electrically conductive pins provide electrical contact to the electro-optical device. The optoelectronic packaging assembly includes an optical input receptacle for receiving an optical ferrule and an optical fiber. The optical input receptacle assists optical coupling of the electro-optical device to the optical fiber. The optoelectronic packaging assembly provides for cooling using a heat-sink or a thermal-electric-cooler. Beneficially, the optoelectronic packaging assembly is sealed using a cover.

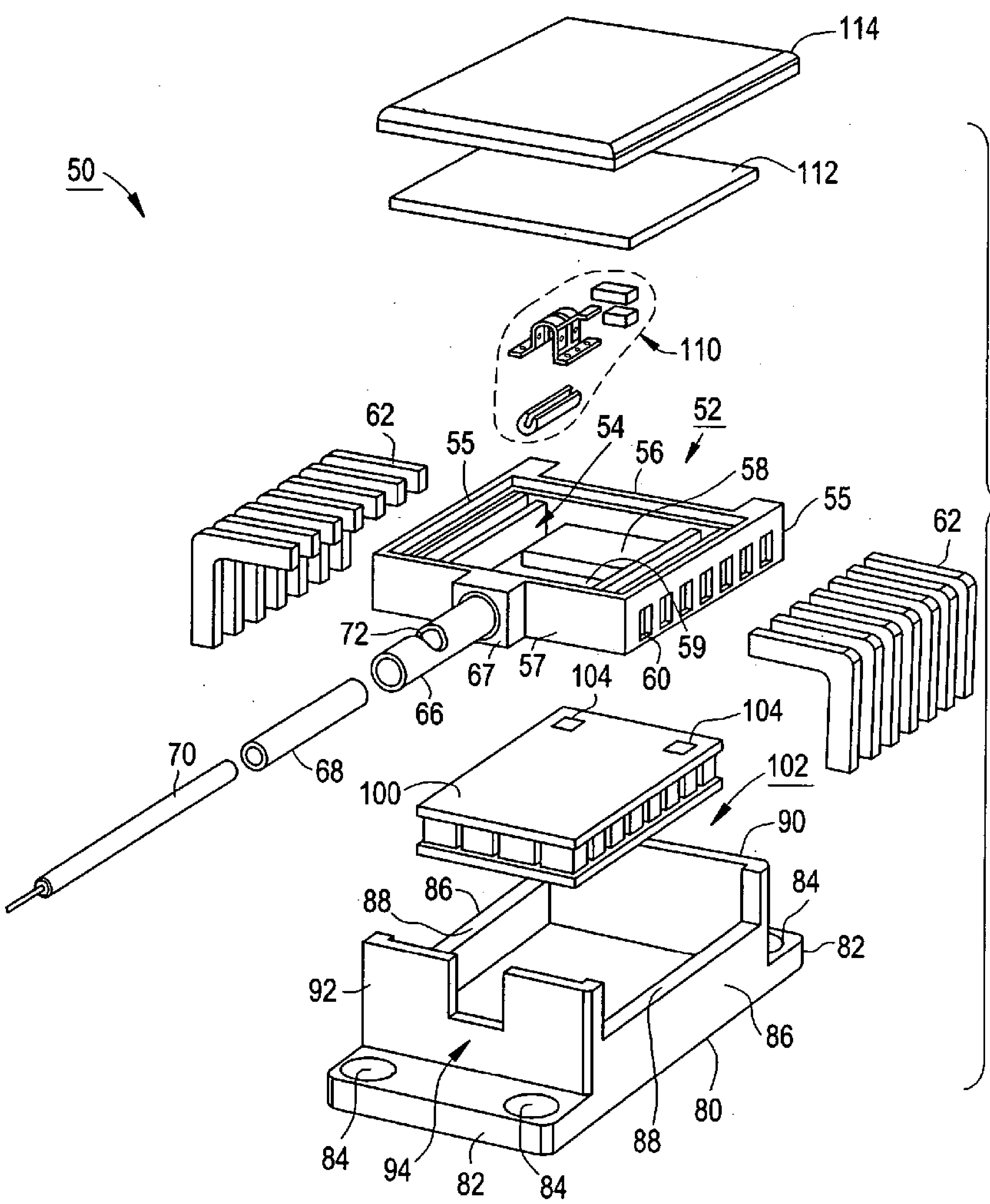


FIG. 1
PRIOR ART

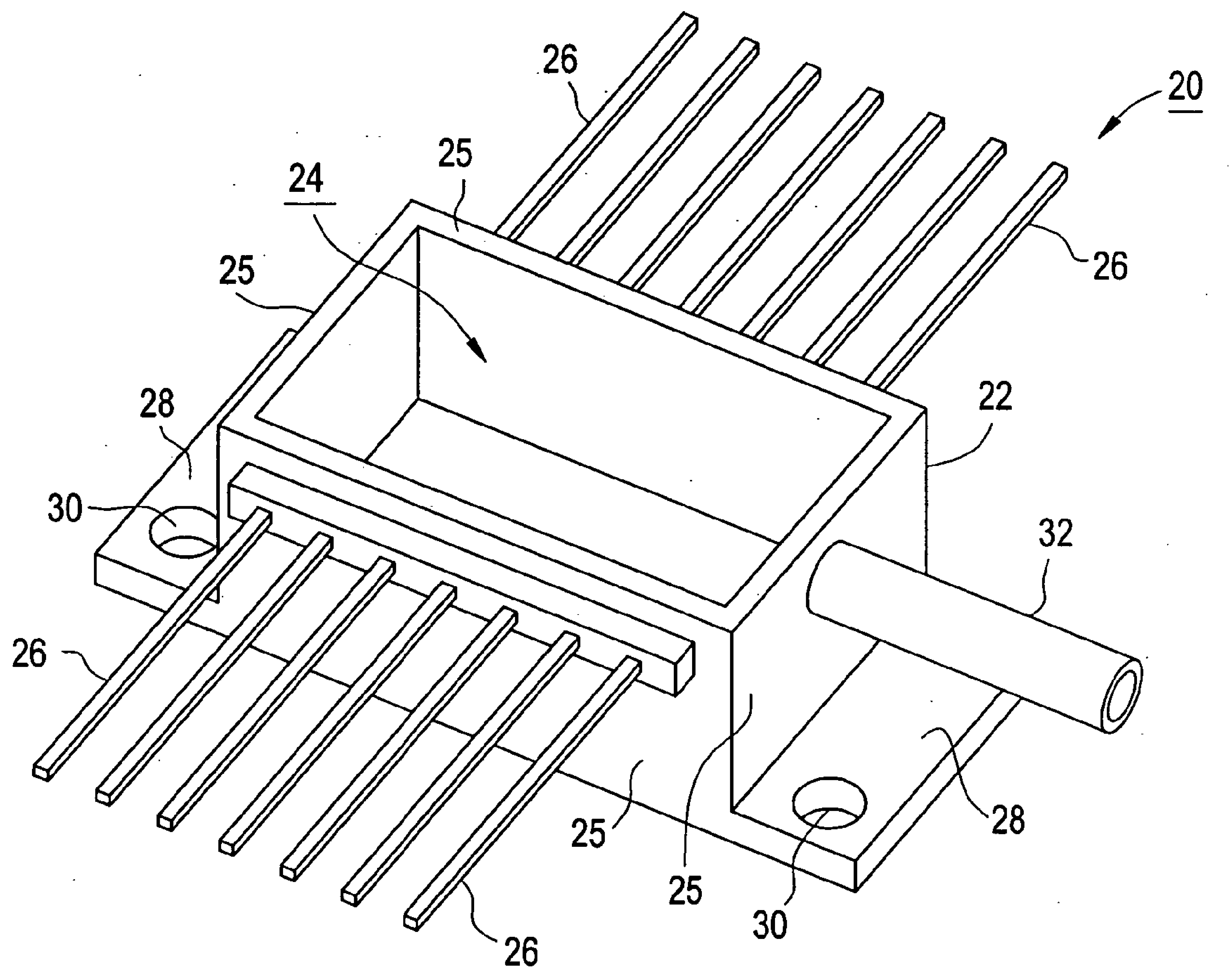
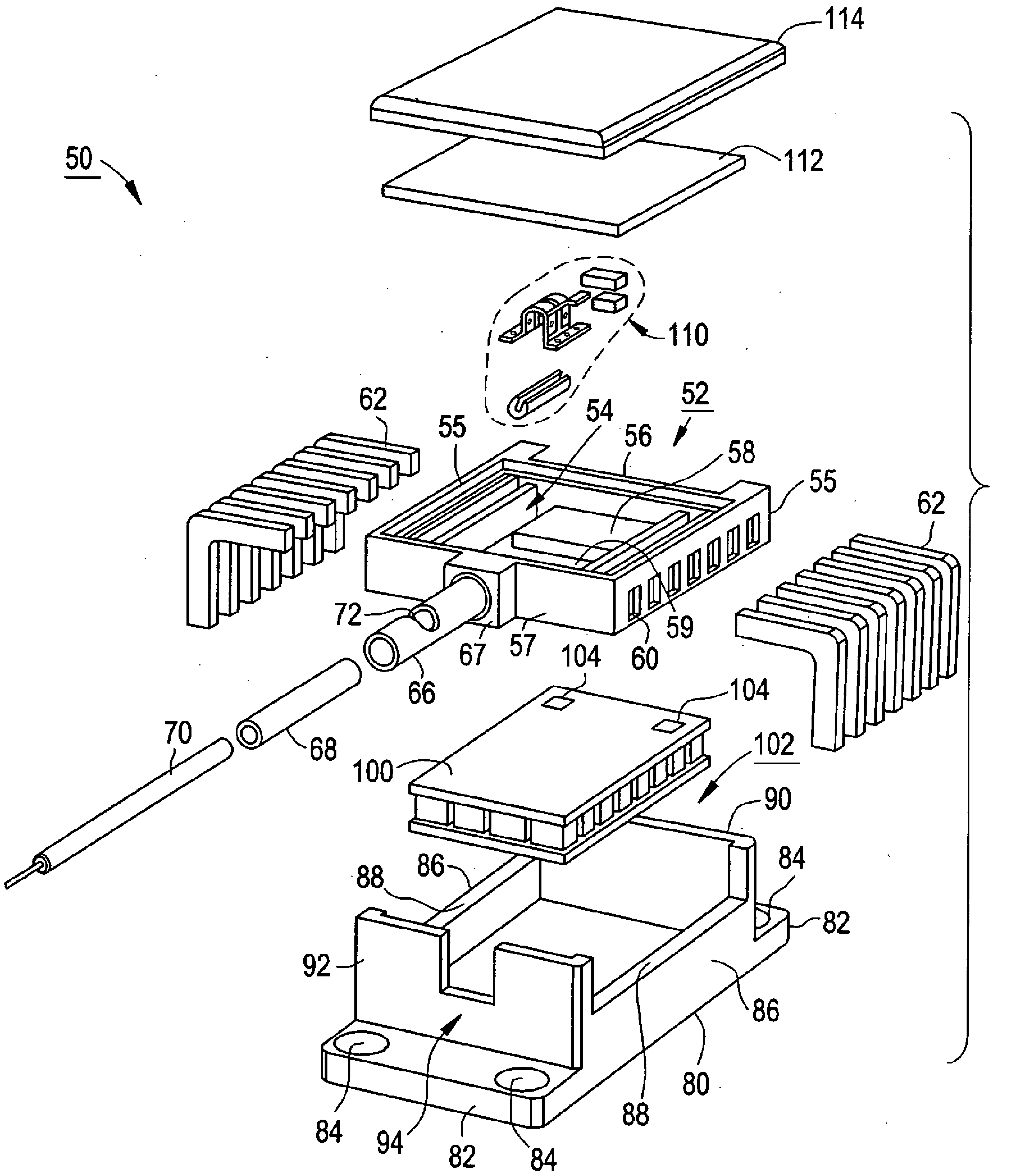


FIG. 2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110
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66
104
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84

FIG. 3

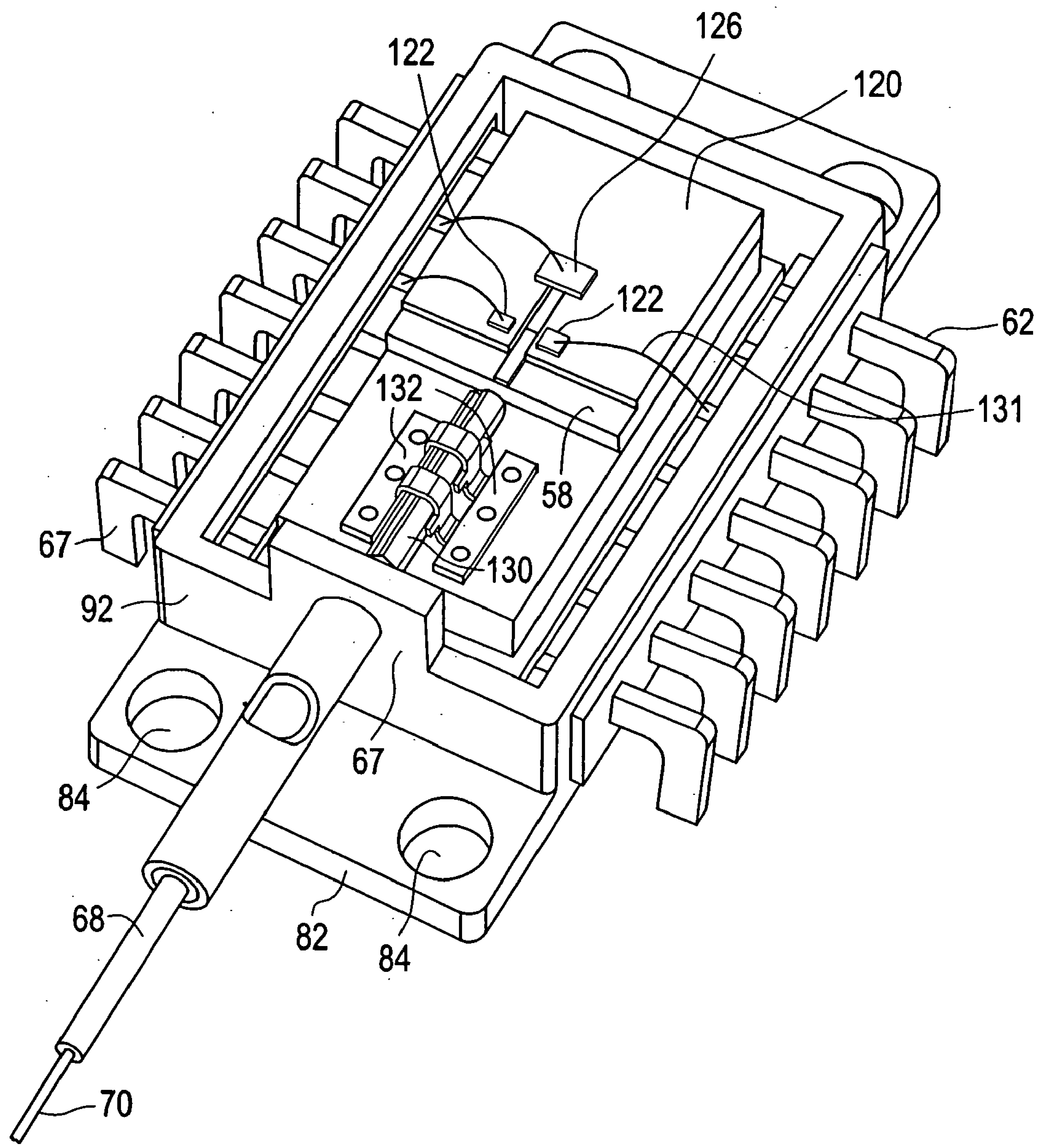


FIG. 4

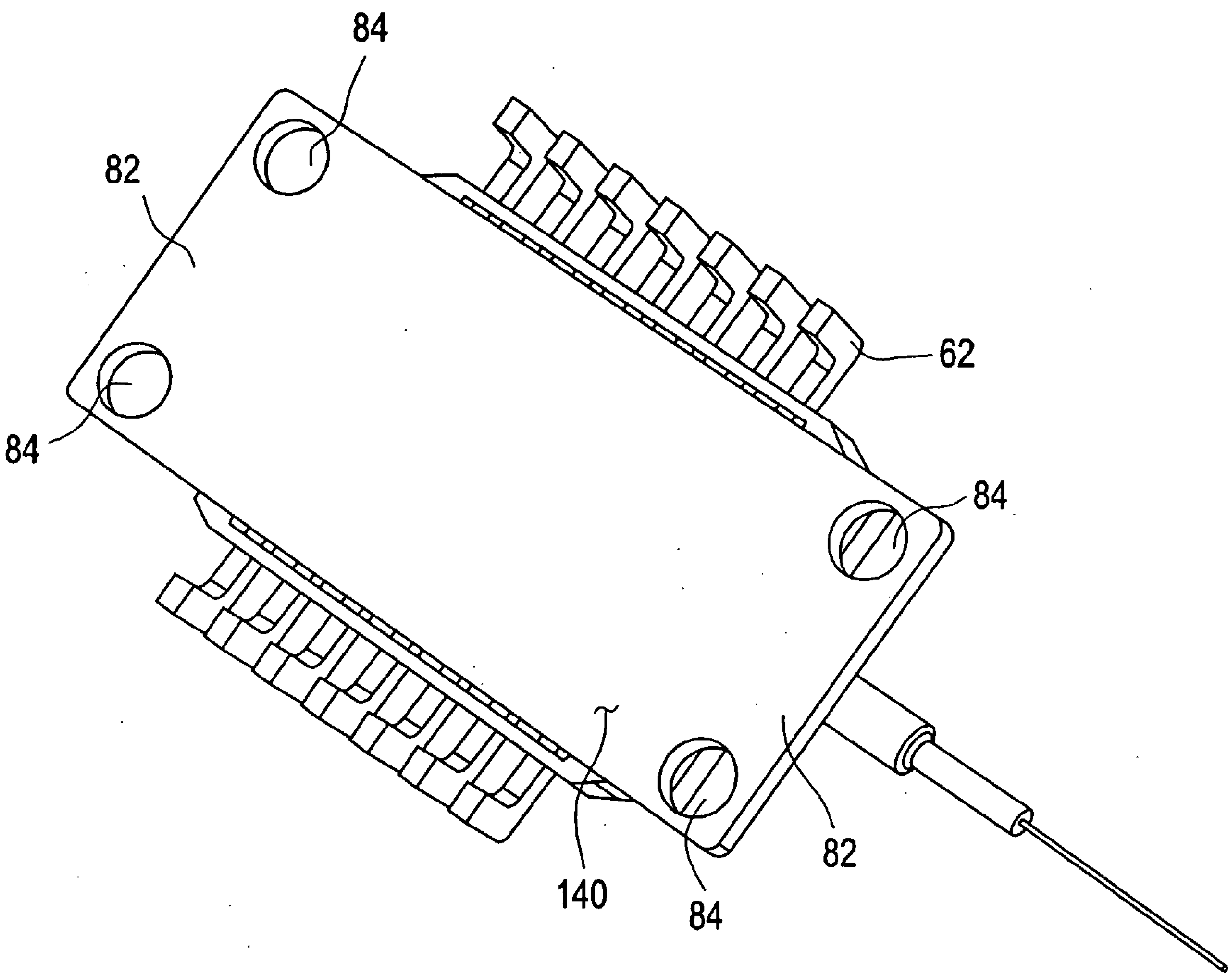


FIG. 5

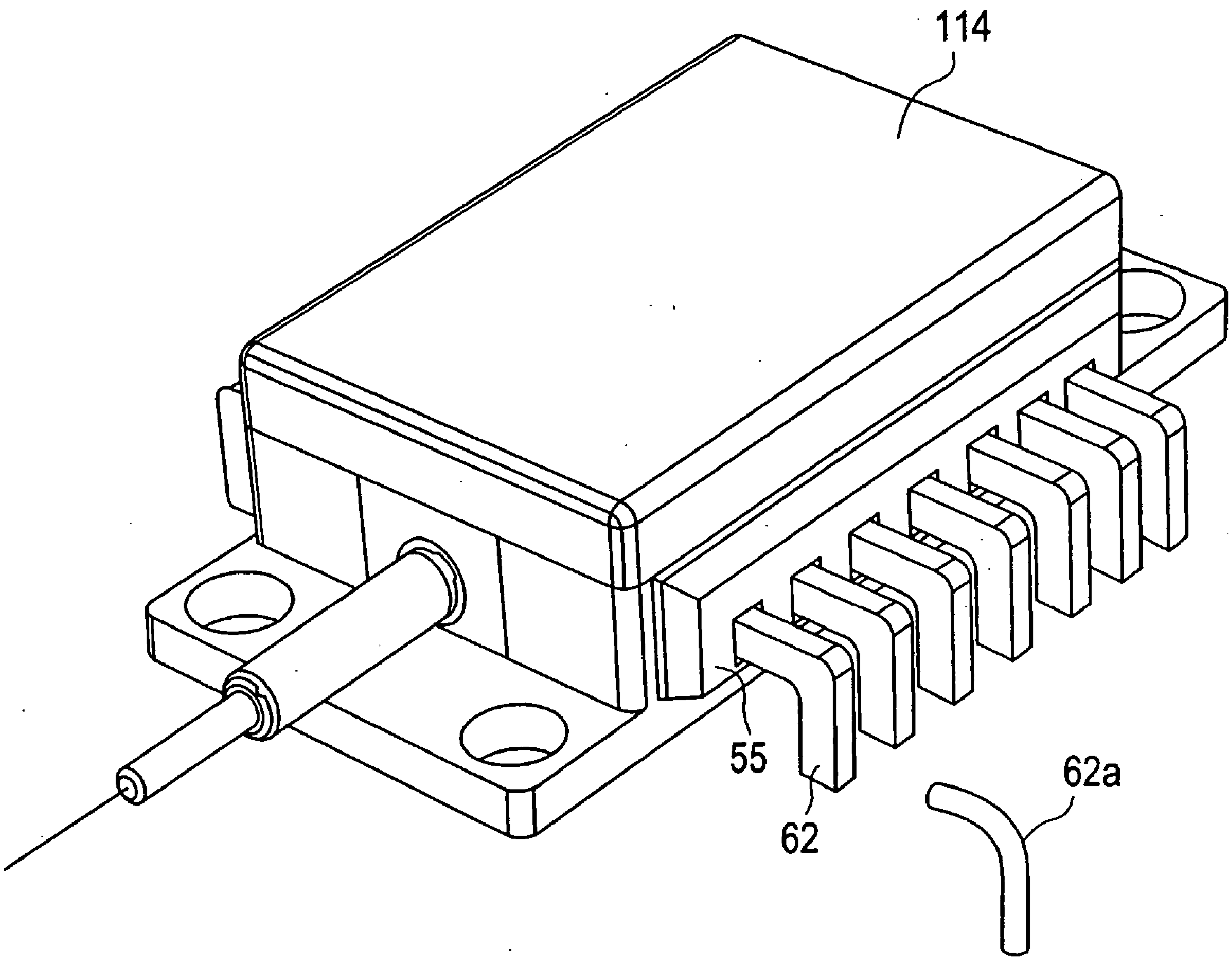
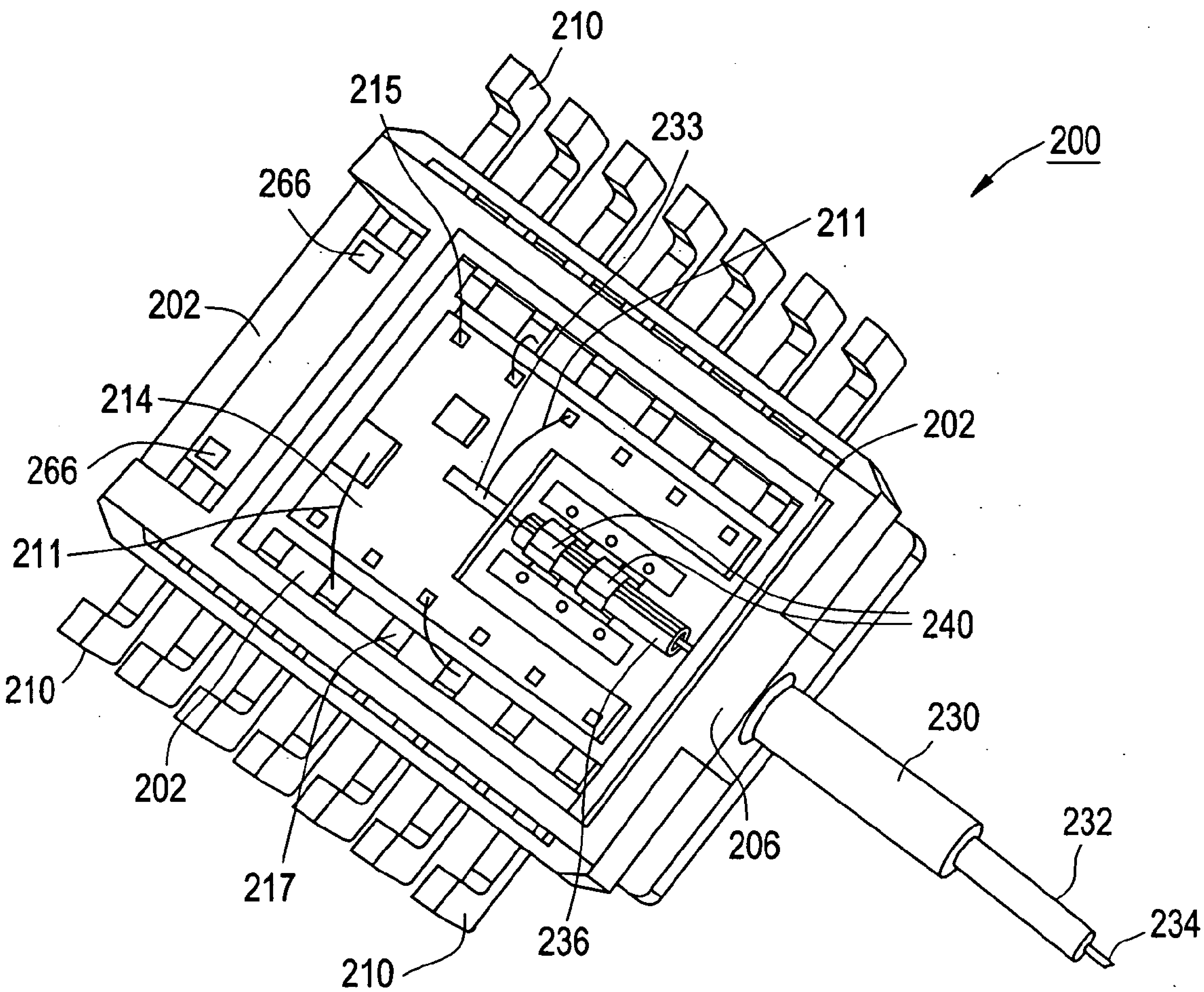


FIG. 6



200
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215
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214
266
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240
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FIG. 7

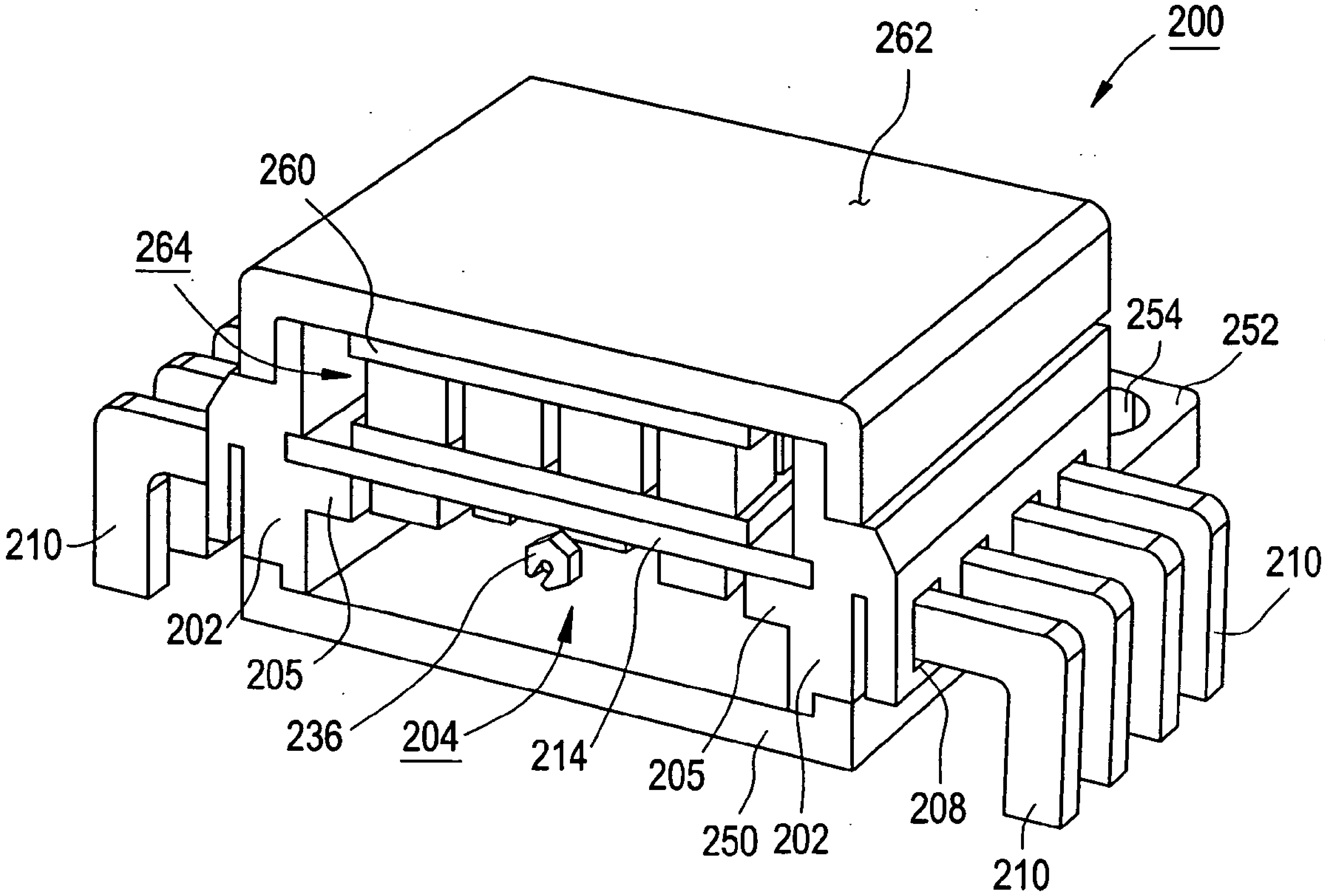
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FIG. 8

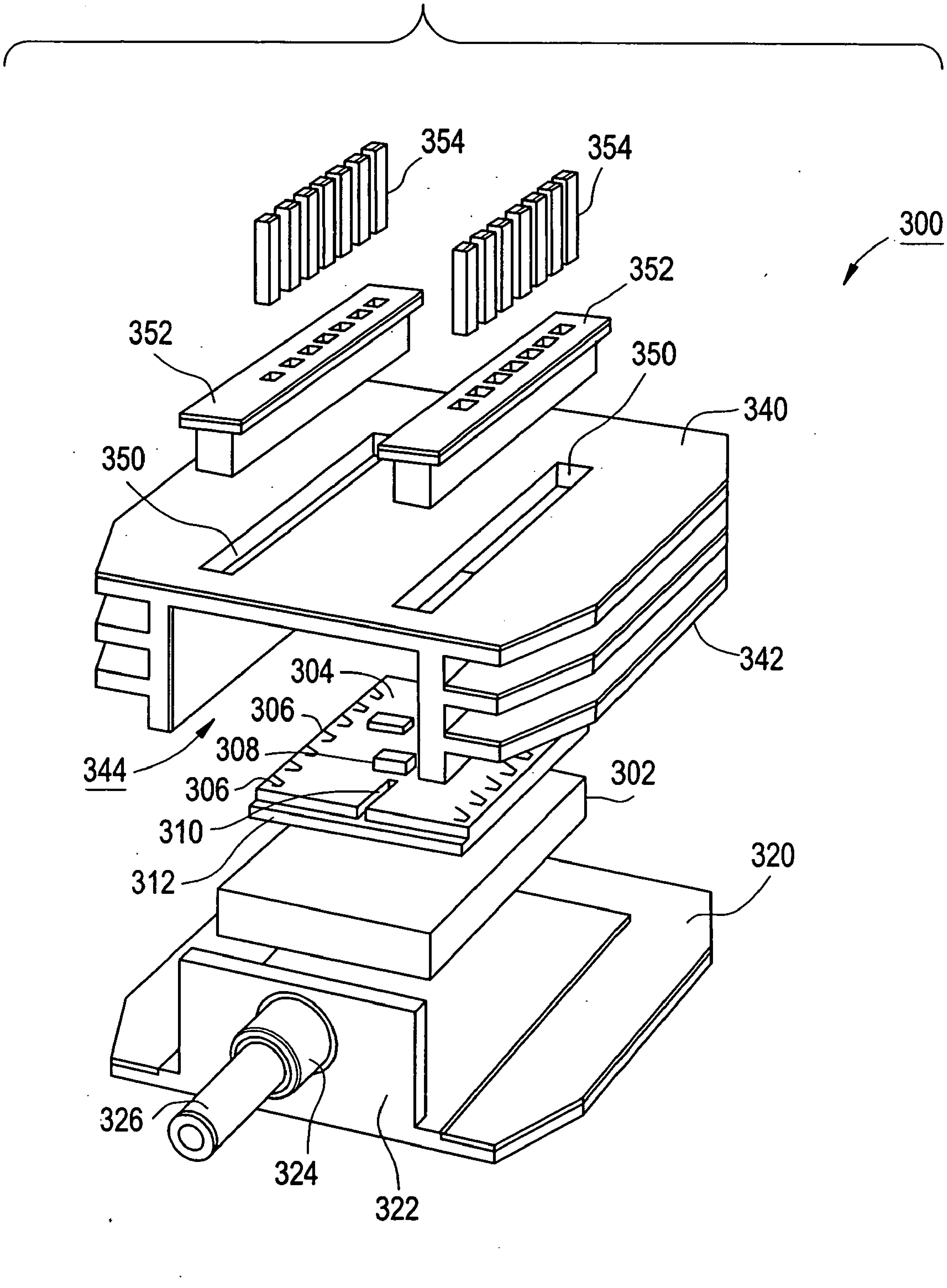
354
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FIG. 9

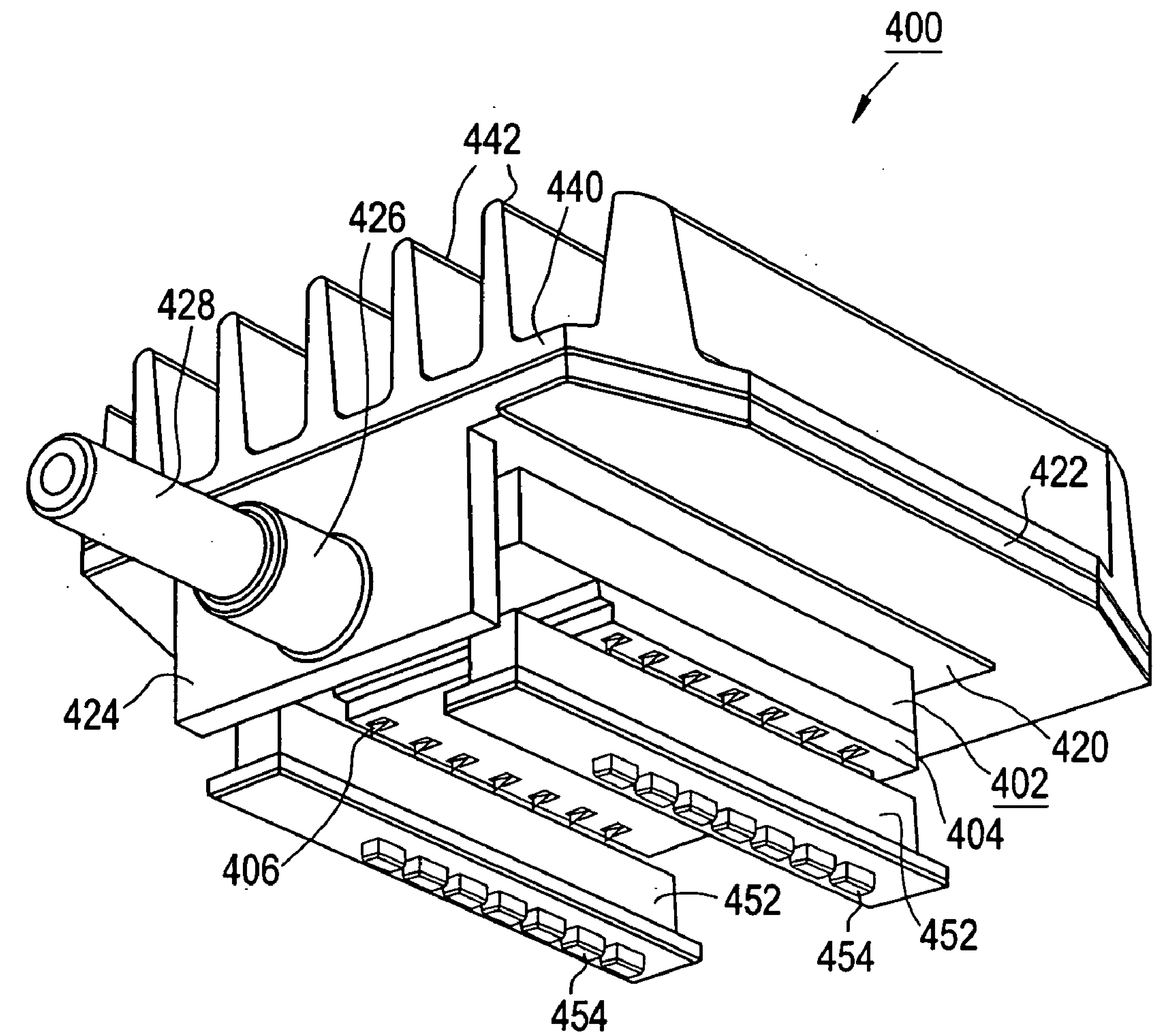
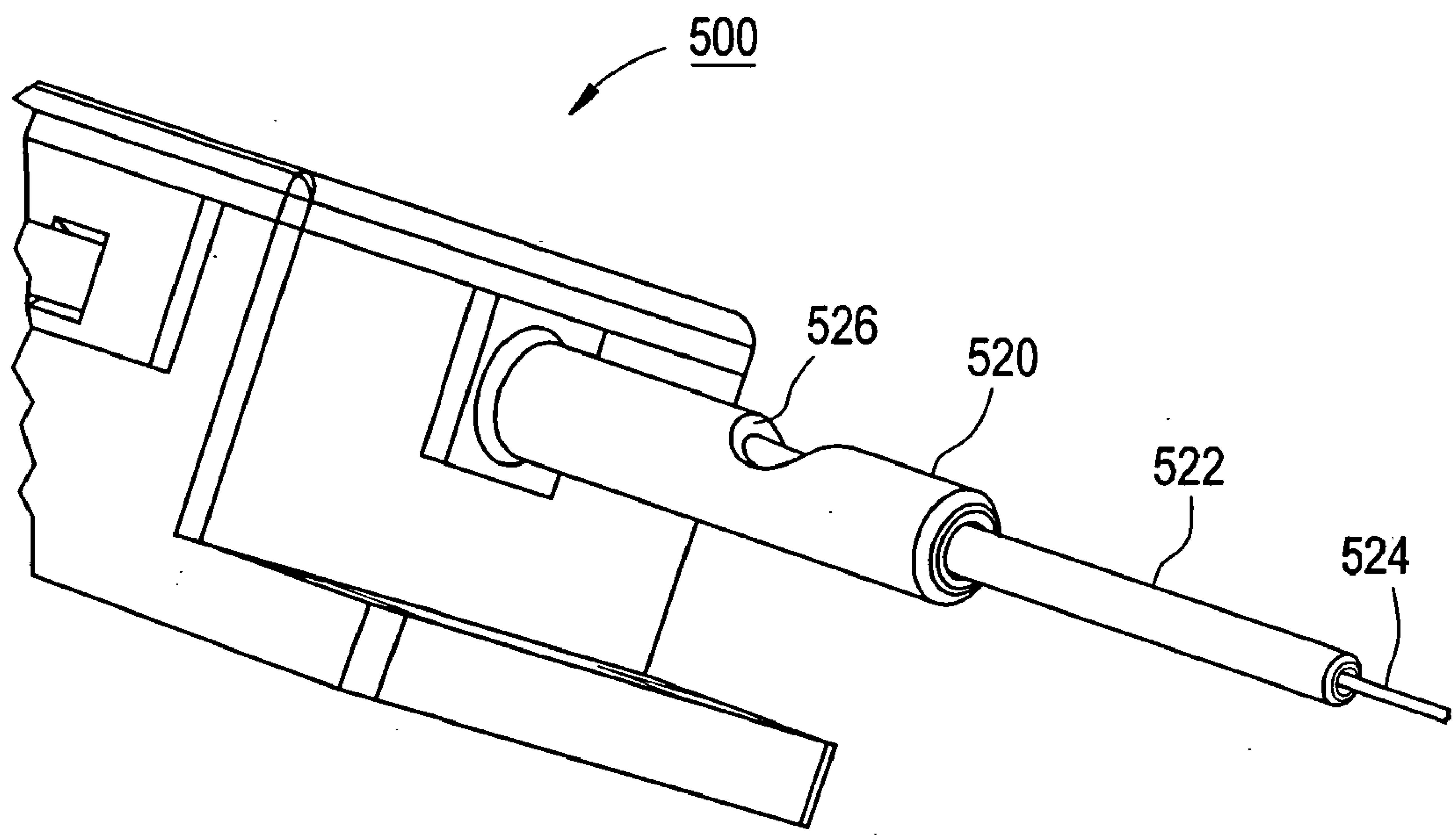


FIG. 10



OPTOELECTRONIC PACKAGING ASSEMBLY

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates to packaging assemblies for optoelectronic devices. More particularly, the present invention relates to optoelectronic packaging assemblies that provide for optical coupling to an optical fiber and for electrically connections to external components.

[0003] 2. Discussion of the Related Art

[0004] Modern optoelectronic applications frequently involve analog or digital signal communication through optical fibers. Such applications typically include optoelectronic devices, such as laser diodes, LEDs, photodiodes, and phototransistors, as primary components. When using such optoelectronic devices it is often necessary to provide for optical coupling with an optical fiber and to provide for electrical connections to external components. For reliability, sealed packaging assemblies are usually used to mount the optoelectronic device, to protect them, and to assist implementation of the optical coupling and electrical connections.

[0005] Unfortunately, optoelectronic packaging has proven to be a demanding, difficult, and costly manufacturing task. One significant problem is coupling an optical fiber to an optoelectronic device with the required alignment accuracy and in such a way that the optical alignment is stable over both time and temperature. Manually aligning optical components is time consuming and costly. To assist optical alignment it is common to insert an optical-coupling ferrule between the optoelectronic component and the optical fiber. But, optical alignment remains a serious problem.

[0006] Another problem with optoelectronic packaging is the difficulty of removing heat from a packaged high-power optoelectronic device. For example, a laser diode can produce a significant amount of heat that must be removed quickly and efficiently to protect the laser diode.

[0007] Because of the foregoing, optoelectronic packaging assemblies generally have been relatively large, at least in comparison to non-opto semiconductor device packages. Furthermore, automated fabrication processes for use with optoelectronic packaging assemblies have been limited.

[0008] One optoelectronic package assembly that has been relatively successful is the so-called butterfly package. That package provides for input/output electrical connections along two sides, a high frequency circuit board for mounting an optoelectronic device and its associated components, and a tube for receiving an optical fiber. The tube enables an optical fiber and an optical ferrule to be located near the optoelectronic device, while the input/output lines enable electrical interconnections. Furthermore, additional mechanical components are required, for example, brackets that retain the optical fiber and ferrule in position.

[0009] While generally successful, the butterfly package is characterized by a large number of mechanical parts that must be assembled to a high degree of accuracy in a package that provides for poor access to internal components. Additionally, traditional butterfly packages are costly and inflexible to changes in their structure or configuration. Reference **FIG. 1** and the associated detailed description that is proved subsequently.

[0010] Therefore, an optoelectronic packaging assembly that provides for input/output electrical connections, for easy mounting of an optoelectronic device and its associated components, for relatively simple, accurate and stable optical alignment, and for good thermal cooling would be beneficial.

SUMMARY OF THE INVENTION

[0011] The principles of the present invention provide for an optoelectronic packaging assembly with input/output electrical connections, easy mounting of an optoelectronic device, relatively simple, accurate and stable optical alignment between the optoelectronic device and an optical fiber, and good thermal cooling.

[0012] A first embodiment optoelectronic packaging assembly that is in accord with the principles of the present invention includes a submount having a cavity defined by a floor, sidewalls, a back wall, and a front wall. The sidewalls retain pins, while the front wall includes a protruding optical input receptacle. The submount fits on sidewalls of a base that includes a front wall with a slot. The base is configured such that the submount extends over the base sidewalls, and such that the optical input receptacle extends from the slot. An external cover fits over the submount.

[0013] A second embodiment optoelectronic packaging assembly that is in accord with the principles of the present invention includes a submount having sidewalls, a front wall, pins, protrusions, and an optical input receptacle. The protrusions are dimensioned to receive a printed circuit board. The front wall and the sidewalls define a cavity, and the sidewalls retain the pins. The optical input receptacle extends from the front wall. A bottom cover includes walls configured to receive the submount such that the submount and the bottom cover form an enclosed bottom cavity. Furthermore, the optical input receptacle extends from the bottom cavity. Additionally, a top cover is received on the submount. The top cover and the submount are configured such that the submount and the top cover form an enclosed top cavity.

[0014] A third embodiment optoelectronic packaging assembly that is in accordance with the principles of the present invention includes a base having a bottom wall and a front wall with a protruding optical input receptacle. A submount is attached to the bottom wall. Furthermore, a heat-sink mates with the base to form an enclosed volume. The heat-sink includes a top surface with a slot. An insert is in the slot. That insert includes pins that extend into the enclosed volume.

[0015] A fourth embodiment optoelectronic packaging assembly that is in accord with the principles of the present invention includes a base having a plate and a front wall with an optical input receptacle. A submount is attached to the plate. A printed circuit board having electrical contacts is on the submount. A heat-sink is in thermal communication with the plate. Pins of an insert electrically connect to the electrical contacts.

[0016] Additional features and advantages of the invention will be set forth in the description that follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

BRIEF DESCRIPTION OF THE DRAWING

[0017] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate various embodiments of the invention and together with the descriptions of the embodiments serve to explain the principles of the invention. In the drawings:

[0018] **FIG. 1** is a simplified schematic view of a prior art butterfly optoelectronic packaging assembly;

[0019] **FIG. 2** is a blow-up of a first embodiment optoelectronic packaging assembly that is in accord with the principles of the present invention;

[0020] **FIG. 3** is a schematic perspective view of a partially assembled first embodiment optoelectronic packaging assembly with the cover removed;

[0021] **FIG. 4** is a bottom view of the first embodiment optoelectronic packaging assembly;

[0022] **FIG. 5** is a schematic perspective view of a fully assembled first embodiment optoelectronic packaging assembly;

[0023] **FIG. 6** is a bottom perspective view of a second embodiment optoelectronic packaging assembly that is in accord with the principles of the present invention, but without a bottom plate;

[0024] **FIG. 7** is a cut-away perspective view of the second embodiment optoelectronic packaging assembly;

[0025] **FIG. 8** is a blow-up of a third embodiment optoelectronic packaging assembly that is in accordance with the principles of the present invention;

[0026] **FIG. 9** is a blow-up of a fourth embodiment optoelectronic packaging assembly that is in accord with the principles of the present invention; and

[0027] **FIG. 10** is a perspective view of a retaining feature this is beneficially included in the first through fourth embodiment optoelectronic packaging assemblies.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

[0028] References will now be made in detail to illustrated embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[0029] **FIG. 1** is a simplified schematic view of a prior art butterfly optoelectronic packaging assembly **20**. As shown, that prior art package includes a body **22** having a cavity **24** that is defined between walls **25**. The body **22** is typically comprised of KOVAR. The cavity **24** is dimensioned to receive an optoelectronic component or assembly, which is not shown. A plurality of pins **26** for making electrical connections between external electronics and a received optoelectronic component or assembly extends from two sides of the body **22**. The body **22** further includes a mounting flange **28** having mounting holes **30**. The mounting flange and holes are used to mount the optoelectronic packaging assembly **20** to an external structure. The body **22** also includes a fiber input receptacle **32** for receiving an optical fiber. Finally, while not shown for clarity, the optoelectronic packaging assembly **20** beneficially includes a cover for sealing the cavity **24**.

[0030] The optoelectronic packaging assembly **20** typically takes the form of a standardized package. Among other factors, the pins **26** are formed into a standard footprint, and the mounting holes **30** and the receptacle **32** are located and dimensioned according to a predetermined configuration. This enables system designers to efficiently incorporate the optoelectronic packaging assembly **20** into their designs. Furthermore, a standard footprint enables the use of standardized optoelectronic workbenches and assembly machines to mount optoelectronic components or assemblies into the optoelectronic packaging assembly **20**, to align an optical fiber with the mounted optoelectronic components or assemblies, and to electrically interconnect the optoelectronic components or assemblies to the pins **26**.

[0031] While the optoelectronic packaging assembly **20** is generally functional, it suffers from at least four significant limitations. First, such optoelectronic packaging assemblies generally have poor heat dissipation characteristics. Second, the walls tend to be relatively high, thus increasing the difficulty of mounting and then electrically and optically interconnecting a contained optoelectronic component or assembly. Third, with such optoelectronic packaging assemblies it can be very difficult to optically align a contained optoelectronic component with an optical fiber in three dimensions. Furthermore, these packages are very costly.

[0032] **FIG. 2** illustrates a first embodiment optoelectronic packaging assembly **50** that addresses limitations of the prior art optoelectronic packaging assembly **20**. As shown in **FIG. 2**, the optoelectronic packaging assembly **50** includes a submount **52** having a cavity **54** defined between (a) sidewalls **55**, (b) a back wall **56**, (c) a front wall **57**, and (d) a floor **59**. The sidewalls **55** each include a plurality of openings **60** for a plurality of pins **62**. Typically, the submount **52** is molded from a liquid. crystal polymer (such as VECTRA) but may also contain plating such as gold, nickel or aluminum for shielding or sealing. Furthermore, as shown in **FIG. 2**, the openings **60** and pins **62** have rectangular cross-sections.

[0033] Inside the cavity **54** is a raised mount **58**. The raised mount **58** is configured to receive an optoelectronic device or assembly (shown in **FIG. 2** in miscellaneous components **110**, and subsequently described in more detail). Beneficially, the pins **62** are insert molded in the submount **52**, or are pushed into the openings **60**. If pushed into the openings **60**, the openings can be beneficially sealed with a sealant. In any event, the pins **62** assist electrical connections between external electronics and the internal optoelectronic component or assembly. Furthermore, the pins **62** are beneficially formed into a "standard footprint" such that the optoelectronic packaging assembly **50** can mount interchangeably with the optoelectronic packaging assembly **20**.

[0034] The submount **52** also includes a protruding optical input receptacle **66**, which extends from a block structure **67** of the front wall **57**. The optical input receptacle **66** is for receiving an optical ferrule **68** that mates with an optical fiber **70**. The optical ferrule surrounds the optical fiber and assist alignment of that fiber. The optical input receptacle **66** includes a "half-moon" shaped slot **72** that is described in more detail with respect to **FIG. 10**.

[0035] The submount **52** is dimensioned to fit onto a base **80**. The base **80** includes mounting flanges **82** having mounting holes **84** for mounting the optoelectronic packaging assembly **50** to an external structure. The base **80** further includes "low boy" sidewalls **86** having top surfaces **88**, a back wall **90**, and a front wall **92** with a slot **94**. The sidewalls **86** are dimensioned to receive the submount **52** on the surfaces **88** such that the sidewalls protrude from the base. Furthermore, the slot **94** is dimensioned to receive the block structure **67**. Typically, the base **80** is molded from a liquid crystal polymer (such as VECTRA). Furthermore, the mounting holes **84** are beneficially formed with a "standard footprint" such that the optoelectronic packaging assembly **50** mounts interchangeably with the optoelectronic packaging assembly **20**. Of course, other footprints are also possible.

[0036] Still referring to **FIG. 2**, an optional thermal-electric-cooler **100** (TEC), which beneficially includes a Peltier element, can cool the optoelectronic device or assembly. In such cases the base **80** includes a cavity **102** dimensioned to receive the thermal-electric-cooler **100**. That cooler includes connectors **104** for receiving power. Those connectors are electrically connected to pins **62** such that external power can be applied to the thermal-electric-cooler **100**.

[0037] Still referring to **FIG. 2**, the optoelectronic packaging assembly **50** also includes miscellaneous components **110** (including an optoelectronic component or assembly) that are described in more detail subsequently. Additionally, a lower cover **112** fits inside the submount **52**, and an external cover **114** fits over the remainder of the optoelectronic packaging assembly **50**.

[0038] **FIG. 2** illustrates an advantage of the optoelectronic packaging assembly **50**. Such assemblies can include a thermal-electric-cooler **100** (TEC) that can significantly improve heat dissipation.

[0039] **FIG. 3** illustrates a partially assembled first embodiment optoelectronic packaging assembly **50**. As shown, the pins **62** fit into the submount **52** (via the openings **60**), and the submount is fitted to the base **80** such that the block structure **67** fits into the slot **94** (reference **FIG. 2**). An optical bench (or substrate) **120** is located on the raised mount **58**. The optical bench **120**, which is beneficially comprised of a ceramic, silicon, or diamond, includes components **122** (such as resistors or capacitors) and an electro-optic device **126** (such as a laser diode or LED). The electro-optic device could be either an emitter or detector and of either a vertical or an edge type. The optical ferrule **68** inserts through the optical fiber input receptacle **66**, while the optical fiber **70** inserts into the optical ferrule **68**.

[0040] Still referring to **FIG. 3**, the optical ferrule **68** is optically aligned with the electro-optic device **126** such that an efficient optical coupling is made between the electro-optic device **126** and the optical fiber **70**. Assisting the optical alignment is an optical spacer **130**. The optical spacer is configured to retain and hold the optical ferrule such that optical ferrule is located on the same plane as the electro-optic device **126**. The optoelectronic package **50** further includes clamps **132** for retaining the optical spacer **130** in place. Finally, wire bonded conductors **131** electrically interconnect the pins **62**, the components **122**, and the electro-optic device **126**. The optical bench (substrate) **120**, the components **122**, the electro-optic device **126**, the optical spacer **130**, the conductors **131**, and the clamps **132** are part of the miscellaneous components **110** shown in **FIG. 2**.

[0041] **FIG. 3** illustrates advantages of the optoelectronic packaging assembly **50**. First, the "low boy" sidewalls **86** enable ready access to the internal structures and components. This simplifies the mounting of the optical bench **120** and the interconnecting of that board and its components to the pins **62**. Furthermore, the raised mount **58** and optical spacer **130** assist alignment of the optical ferrule with the electro-optic device **126**.

[0042] Turn now to **FIG. 4** for a bottom view of the optoelectronic package **50**. As shown, the base **80** and its mounting flanges **82** provide a flat bottom surface **140**. The bottom can also be of a different structure incorporating details to increase surface area for increased thermal efficiency. This enables efficient heat transfer to an external structure, something that is particularly important if a TEC **100** is not used. Again, the footprint of the optoelectronic packaging assembly **50**, including that of the pins **62** and mounting holes **64**, is beneficially the same as that of the optoelectronic packaging assembly **20**.

[0043] **FIG. 5** shows a schematic perspective view of a fully assembled optoelectronic packaging assembly **50**. As shown the external cover **114** mates with the remainder of the optoelectronic packaging assembly **50** so as to form a protected, sealed package. **FIG. 5** also shows a sidewall **55** protruding from the remained of the package. The sidewall could be integrated to the package or added as a secondary piece. While the pins **62** are shown with square cross-sections, in optoelectronic packaging assemblies produced at high speed it may be beneficial to use round openings and round pins **62***a*.

[0044] The optoelectronic packaging assembly **50** illustrated in **FIGS. 2 through 5** is beneficial in addressing various limitations of the optoelectronic packaging assembly **20**. However, the optoelectronic packaging assembly **50** may not be optimal in all applications. For example, in some applications might be beneficial to arrange for heat transfer through that top of the optoelectronic packaging assembly. One such optoelectronic packaging assembly is a second embodiment optoelectronic packaging assembly **200** illustrated in **FIGS. 6 and 7**. Such optoelectronic packaging assemblies are inverted structures in which heat flow is predominately through the top of the assembly.

[0045] **FIG. 6** illustrates a bottom view of the second embodiment optoelectronic packaging assembly **200** with a bottom cover removed, while **FIG. 7** illustrates a cut-away view. In this embodiment, the device is inverted, or flipped over to increase thermal efficiency by allowing the heat to be evacuated through the top. As shown in those figures, the optoelectronic packaging assembly **200** includes a submount **202** having a cavity **204** that is partially defined by a front wall **206** (not shown in **FIG. 7**). Inside the cavity **204** are protrusions **205** (see **FIG. 7**). The submount **202** also includes a plurality of openings **208** for receiving a plurality of pins **210**. Typically, the submount **202** is molded from a liquid crystal polymer (such as VECTRA), but may also contain plating such as gold, nickel or aluminum for shielding or sealing.

[0046] Furthermore, as shown in **FIGS. 6 and 7**, the openings **208** and the pins **210** have rectangular cross-sections (round cross-sections are an alternative). Beneficially, the pins **210** are insert molded into the submount **202**, or are pushed into the openings **208**. If the pins are pushed into the openings, the openings **208** are beneficially sealed with a sealant. In any event, the pins **210** are used to make electrical connections between external electronics and an internal optoelectronic component or assembly. Referring now to **FIG. 6**, to this end electrical conductors **211** are bonded between the pins **210** and the optoelectronic component or assembly. Furthermore, the pins **210** are beneficially formed into a "standard footprint" such that they can mount in the same location as the pins of the optoelectronic packaging assembly **20**.

[**0047**] An optical bench (or substrate or printed circuit board) **214** holding an electro-optic device is mounted on the protrusions **205**. Beneficially, the optical bench **214** includes contacts **215** to which the electrical conductors bond. Electrical connections are formed between the contacts **215** and exposed portions **217** of the pins **210**. This enables electrical connections between external circuitry and components on the optical bench **214**. Typically, the optical bench **214** is comprised of aluminum silicon carbide, copper tungsten, or a ceramic.

[**0048**] Referring now specifically to **FIG. 6**, the submount **202** includes an optical input receptacle **230** for receiving an optical ferrule **232** that mates with an optical fiber **234**. The input receptacle **230** includes a "half-moon" shaped slot as described in more detail with respect to **FIG. 10**. The optical ferrule **232** is inserted through the input receptacle **230**, while the optical fiber **234** is inserted into the optical ferrule. The optical ferrule **232** is optically aligned with the electro-optic device **233** such that an efficient optical transition is made between the electro-optic device **233** and the optical fiber **234**. Assisting the optical alignment is an optical spacer **236**. The optical spacer is configured to retain and hold the optical ferrule such that optical ferrule is located in the same plane as the electro-optic device. The optoelectronic packaging assembly **200** further includes clamps **240** for retaining the optical spacer **236**.

[**0049**] Turning now to **FIG. 7**, the submount **202** is dimensioned to fit into a bottom cover **250**. That bottom cover can include optional mounting flanges **252** having mounting holes **254** that are used for mounting the optoelectronic packaging assembly **200** to an external structure. Such optional mounting flanges are shown in **FIG. 7**, but not in **FIG. 6**. The bottom cover **250** is dimensioned to be received on surfaces of the submount **202**. The bottom cover **250** is beneficially molded from a liquid crystal polymer (such as VECTRA) although other materials may be used. Furthermore, if used, the mounting holes **254** can be formed with a "standard footprint" such that the optoelectronic packaging assembly **200** can mount interchangeably with the optoelectronic packaging assembly **20**. If space savings is required the flanges can be reduced in size or even eliminated.

[**0050**] Still referring specifically to **FIG. 7**, an optional thermal-electric-cooler **260** (TEC), that beneficially includes a Peltier element, can cool the optoelectronic device or assembly. In that case, a top cover **262** having a cavity **264** receives the thermal-electric-cooler **260**. That top cover is beneficially comprised of aluminum, copper, or copper tungsten. The thermal-electric-cooler **260** beneficially includes connectors **266** (see **FIG. 6**) for receiving electrical power. Those connectors are electrically connected to pins **210** such that external power can drive the thermal-electric-cooler **260**. If the optional thermal-electric-cooler **260** is not used, the top cover **262** does not have to include the cavity **264**. Furthermore, the top cover **262** can then be brought into direct thermal communication with the electro-optic device to provide heat dissipation.

[**0051**] While the first and second embodiments of the present invention are beneficial, some applications require improved thermal dissipation without a thermal-electric-cooler. Such is provided by a third embodiment optoelectronic packaging assembly **300** illustrated in **FIG. 8**.

[**0052**] As shown in **FIG. 8**, the optoelectronic packaging assembly **300** includes a submount **302** for receiving an optical bench **304** having a plurality of electrical contacts **306**. The optoelectronic packaging assembly **300** is an inverted design, allowing the heat to escape from the top, and it utilizes a flipchip attachment to connect electrical signals between the optical bench **304** and the external final system. At least one optical component **308**, beneficially an electro-optical device, is mounted on the optical bench **304**. Also beneficially, the optical bench includes an alignment slot **310** for assisting optical alignment of the optical component **308** with an optical fiber (not shown in **FIG. 8** for clarity). An optional spacer **312** can be disposed between the optical bench **304** and the submount **302** to assist optical alignment. Typically, the submount **302** is molded from a liquid crystal polymer (such as VECTRA), although other materials can also be used, and may also contain plating such as gold or nickel or aluminum for the purposes of shielding or sealing. The optical bench **304** is beneficially comprised of aluminum silicon carbide, copper tungsten, or a ceramic.

[**0053**] The submount **302** mounts on a base **320**. That base includes a front wall **322** having an optical input receptacle **324**. The optical input receptacle mates with an optical ferrule **326** that, in turn, mates with an optical fiber (not shown). The optical input receptacle **324** beneficially includes a "half-moon" shaped slot as described in more detail with respect to **FIG. 10**.

[**0054**] With the submount **302** fitted onto the base **320**, the optical ferrule **326** is inserted through the input receptacle **324** and into the alignment slot **310** such that the input ferrule optically aligns with the electrical component **308**. An optical spacer and clamps, such as those used in the first and second embodiments, can be used to retain the optical ferrule in position. Furthermore, the base **320** can include optional mounting flanges having mounting holes that can be used for mounting the optoelectronic packaging assembly **300** to an external structure. Such optional mounting flanges are not shown in **FIG. 8**. The base is beneficially molded from a liquid crystal polymer (such as VECTRA).

[**0055**] Still referring to **FIG. 8**, a heat-sink **340** having fins **342** and a cavity **344** is fitted over the base **320** and over the printed circuit board **304**. The heat-sink **340** is beneficially dimensioned to thermally contact the optoelectrical component **308** and/or the optical bench when the optoelectronic packaging assembly **300** is fully assembled. To that end, the heat sink is beneficially comprised of aluminum, copper, aluminum silicon carbide, copper tungsten, or a ceramic. If desired, an optional thermal-electric-cooler (TEC) can be fitted in the cavity **344** to provide additional cooling. In that case, the cavity **344** is fabricated to receive the thermal-electric-cooler. However, **FIG. 8** illustrates an optoelectronic packaging assembly **300** without a TEC.

[**0056**] Still referring to **FIG. 8**, the heat-sink **340** includes slots **350** for receiving molded inserts **352** that retain pins **354**. The pins enable an electrical interface between the optical bench and the external environment. The slots, molded inserts **352** and pins **354** are dimensioned such that the pins **354** contact the electrical contacts **306**. An electrically conductive paste or solder balls can be used to ensure electrical connections between the pins **354** and the electrical contacts **306**. The pins **354** provide an electrical path between external devices and the electrical component **308**.

[**0057**] Another embodiment optoelectronic packaging assembly that provides improved thermal dissipation without a thermal-electric-cooler is a fourth embodiment "flip-chip" optoelectronic packaging assembly **400** illustrated in **FIG. 9**. As shown, the optoelectronic packaging assembly **400** includes a submount **402** for receiving an optical bench **404** having a plurality of electrical contacts **406**. At least one electrical component, beneficially an electro-optical device, is mounted on the optical bench **404**. As shown, the optical bench **304** is "flipped" over to enable better heat flow to the submount **402**. Beneficially, the optical bench is comprised of aluminum silicon oxide, copper tungsten, or a ceramic, while the submount **402** is comprised of a highly thermally conductive material (such as copper, aluminum, or diamond).

[**0058**] The submount **402** mounts onto a plate **420** of a base **422**. The base and the plate are beneficially comprised of a highly thermally conductive material, such as copper, copper tungsten, aluminum, or diamond. The base **422** has a front wall **424** with a protruding optical input receptacle **426**. The optical input receptacle **426** mates with an optical ferrule **428** that, in turn, mates with an optical fiber (not shown). The optical input receptacle **426** beneficially includes a "half-moon" shaped slot as described in more detail with respect to **FIG. 10**.

[**0059**] With the submount **402** on the plate **420**, the optical ferrule **428** is inserted through the optical input receptacle **426** such that the optical ferrule optically aligns with the electrical component. An optical spacer and clamps, such as those used in the first and second embodiments, can be used to retain the optical ferrule in position.

[**0060**] Still referring to **FIG. 9**, a heat-sink **440** having fins **442** mounts over the base **422**. The heat-sink **440** is fabricated to transfer heat from the optoelectronic package **400** to the external environment. Beneficially, the heat sink is comprised of a highly thermally conductive material, such as copper, copper tungsten, aluminum, or diamond. If desired, an optional thermal-electric-cooler (TEC) can be disposed between the heat-sink **440** and the base **422**.

[**0061**] The optoelectronic packaging assembly **400** also includes a bottom cover (which is removed for clarity) that includes slots for receiving molded inserts **452** that retain pins **454**. The bottom cover, slots, molded inserts **452**, and pins **454** are dimensioned such that the pins **454** contact the electrical contacts **406**. An electrically conductive paste or solder balls can be used to ensure electrical connections between the pins **454** and the electrical contacts **406**. The pins provide an electrical path between external devices and the electrical component.

[**0062**] All of the illustrated embodiments include an optical input receptacle that receives an optical ferrule. **FIG. 10** illustrates a generalized optoelectronic packaging assembly **500** that includes an optical input receptacle **520** that receives an optical ferrule **522**. An optical fiber **524** fits into the optical ferrule **522** shown in the exploded view for clarity. Furthermore, the optical input receptacle **520** includes a half-moon shaped slot **526**. This slot enables an assembly operator to seal the optical ferrule **522** in place in the optical input receptacle **520**. This prevents the optical ferrule **522** from moving after assembly that could potentially damage the laser or create signal integrity problems related to misalignment of the fiber. Beneficially, after the optical ferrule is aligned with an electro-optic device within the optoelectronic packaging assembly **500**, an operator places a sealant, such as an epoxy in the moon shaped slot **526**. The sealant then seals the input receptacle **520** while retaining the optical ferrule **522** in position.

[**0063**] It will be apparent to those skilled in the art that various modifications and variation can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

1. An optoelectronic packaging assembly, comprising:

a submount having a cavity defined by a floor, sidewalls, a back wall, and a front wall, wherein at least one of said sidewalls retains pins, said submount further including an optical input receptacle which extends from said front wall;

a base having sidewalls with top surfaces and a front wall with a slot, wherein said base is configured to receive said submount such that said submount extends over said sidewalls of said base and such that said optical input receptacle extends from said slot; and

an external cover over said submount.

2-75. (Cancelled)

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