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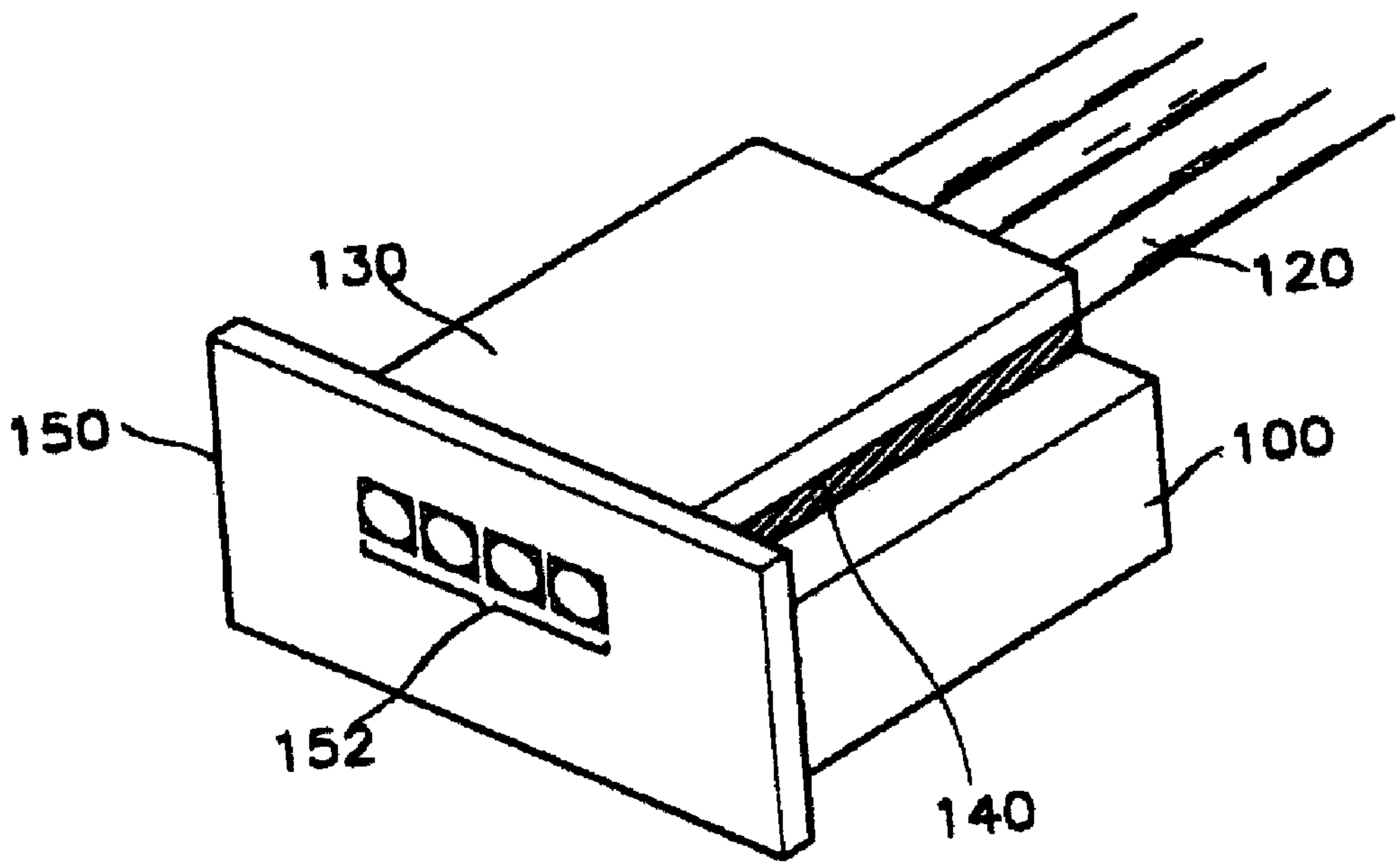
(54) Titre : MODULE DE FAISCEAU DE FIBRES OPTIQUES ENDUIT DE METAL
(54) Title: METAL COATED OPTICAL FIBER ARRAY MODULE



(57) Abrégé/Abstract:
A metal coated optical fiber array module including a metal coated optical fiber array, an arranging substrate having arranging grooves for loading the optical fiber array, wherein a metal is coated on the upper surface including the arranging grooves and the optical fiber array loaded into the arranging grooves is united therewith through the medium of the metal, and a cover for protecting and fixing the optical fiber array loaded into the arranging grooves of the arranging substrate. It is preferable that the optical fiber array module further includes a planar substrate having holes into which the optical fiber array is to be inserted, wherein the optical fiber array loaded on the arranging substrate is inserted into the holes and united with the arranging substrate. After the optical fibers are loaded, the ends thereof are easily polished. When the optical fibers are attached to a waveguide device, the ends of the arrayed optical fibers are enlarged to increase an attachment strength at the contact surface. The axes of the optical fibers are prevented from being tilted, by ultraviolet (UV) irradiation upon loading the optical fibers. Also, when the optical waveguide device is attached to a multi-core optical fiber, a contact surface is widened, thus improving environmental characteristics and reliability of a device package upon connection of the optical fibers.

Abstract of the Disclosure

A metal coated optical fiber array module including a metal coated optical fiber array, an arranging substrate having arranging grooves for loading the optical fiber array, wherein a metal is coated on the upper surface including the arranging grooves and the optical fiber array loaded into the arranging grooves is united therewith through the medium of the metal, and a cover for protecting and fixing the optical fiber array loaded into the arranging grooves of the arranging substrate. It is preferable that the optical fiber array module further includes a planar substrate having holes into which the optical fiber array is to be inserted, wherein the optical fiber array loaded on the arranging substrate is inserted into the holes and united with the arranging substrate. After the optical fibers are loaded, the ends thereof are easily polished. When the optical fibers are attached to a waveguide device, the ends of the arrayed optical fibers are enlarged to increase an attachment strength at the contact surface. The axes of the optical fibers are prevented from being tilted, by ultraviolet (UV) irradiation upon loading the optical fibers. Also, when the optical waveguide device is attached to a multi-core optical fiber, a contact surface is widened, thus improving environmental characteristics and reliability of a device package upon connection of the optical fibers.

METAL COATED OPTICAL FIBER ARRAY MODULE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an optical fiber array module, and more particularly, to a metal coated optical fiber array module.

2. Description of the Related Art

Roughly three technologies are required to manufacture optical waveguide devices on various planar substrates using planar waveguide technology: waveguide design, waveguide fabrication, and packaging. Here, the packaging technology is the key to obtaining the best optical properties of the optical waveguide device. Particularly in manual devices, the connection between an optical fiber and an optical waveguide is an important factor in producing low-priced optical devices.

As for optical waveguide devices, waveguides can be arrayed at accurate intervals by exposure and etching, but it is very difficult to accurately arrange single-core and multi-core optical fibers when the optical fibers are attached to the waveguides. In general, when the optical fibers are arranged and arrayed, uniform holes for receiving the optical fibers are formed in a silicon substrate or metal substrate, and used to fix the optical fibers.

An accurate process is required to form a device for fixing the optical fibers. Also, when the ends of the optical fibers are polished after the optical fibers are loaded, careful attention is needed because the optical fibers are thin. Furthermore, since the thin optical fibers have a small surface area, they have only a small contact surface when attached to the waveguide device, leading to weak attachment. These problems deteriorate the overall performance of the waveguide device. Also, in a general optical fiber array module, optical fibers and grooves for fixing the optical fibers are damaged during polishing.

SUMMARY OF THE INVENTION

To solve the above problem, it is an objective of the present invention to provide an optical fiber array module using metal coated optical fibers, which can improve the attachment strength at a contact surface of the optical fibers by enlarging the cross sections of the arrayed fibers when attached to a waveguide device, prevent the axes of the optical fibers from being tilted due to ultraviolet irradiation upon loading the optical fibers, and increase the total performance of the waveguide device in the respect of packaging the optical waveguide device.

Accordingly, to achieve the above objective, there is provided a metal coated optical fiber array module using a metal coated optical fiber array, comprising: a metal coated optical fiber array; an arranging substrate having arranging grooves for loading the optical fiber array, wherein a metal is coated on the upper surface including the arranging grooves and the optical fiber array loaded into the arranging grooves is united therewith through the medium of the metal; and a cover for protecting and fixing the optical fiber array loaded into the arranging grooves of the arranging substrate.

It is preferable that the metal coated optical fiber array module further comprises a planar substrate having holes into which the optical fiber array is to be inserted, wherein the optical fiber array loaded on the arranging substrate is inserted into the holes and united with the arranging substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

The above objective and advantages of the present invention will become more apparent by describing in detail a preferred embodiment thereof with reference to the attached drawings in which:

FIG. 1 shows an optical fiber array module formed by molding using a sealing agent and polishing a horizontal cross-section after arraying optical fibers along holes formed in a metal-coated arranging substrate;

FIG. 2 shows an optical fiber array module formed by molding using a sealing agent and polishing a horizontal cross-section after attaching a planar substrate having processed holes to an arranging substrate on which the optical fibers shown in FIG. 1 are arrayed;

FIG. 3 is a cross-section of a metal coated optical fiber;

FIG. 4 is a cross-section of a metal coated optical fiber arranging substrate on which arranging grooves are formed;

FIG. 5 shows a planar substrate having processed holes into which optical fibers are to be inserted;

FIG. 6 is a perspective view of the optical array module of FIG. 1 in which a surface to contact an optical waveguide device is polished at an angle of θ; and

FIG. 7 is a perspective view of the optical array module of FIG. 2 in which a surface to contact an optical waveguide device is polished at an angle of θ.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, an optical fiber array module according to a preferred embodiment of the present invention is comprised of an optical fiber array 120, an arranging substrate 100, and a cover 130. The optical fiber array 120 is coated with a weldable or solderable metal as shown in FIG. 3. The optical fiber array 120 can use single optical fibers or ribbon optical fibers. In FIG. 3, reference numeral 160 is an optical fiber core, reference numeral 170 is an optical fiber cladding, and reference numeral 180 is a metal coating film.

The arranging substrate 100 has arranging grooves 110 for loading the optical fiber array 120. The arranging grooves 110 are V- or U-shaped and arrange the optical fiber array 120. FIG. 4 shows a cross-section of the metal coated arranging substrate 100. As shown in FIG. 4, a weldable metal (e.g., copper) is coated to a consistent thickness on the upper surface of the arranging substrate 100 including the arranging grooves 110, thus forming a metal coating film 180. The arranging grooves 110 are attached to the optical fiber array 120 loaded in the arranging grooves 110 through the medium of the metal. The attachment is accomplished by laser welding or soldering. The cover 130 protects and fixes the optical fiber array loaded in the arranging grooves 110 of the arranging substrate 100.

FIG. 2 shows an optical fiber array module constituted by further providing a planar substrate 150, having holes into which the optical fiber array is to be inserted, to the optical fiber array module shown in FIG. 1. As shown in FIG. 2, the holes of the planar substrate 150 have the same spacing as the arranging grooves 110 of the arranging substrate 100. The holes can be accurately formed in the planar substrate 150 using a solution or reactive vapor by mechanical processing, laser or semiconductor exposure and dry or wet etching. The holes are large enough for the metal coated optical fibers to be inserted therethrough. Also, the holes of the planar substrate may have cross-sections in the shape of a polygon, including a triangle and a rectangle, a circle, or an oval. A solderable or weldable metal can be entirely or partially coated on the planar substrate.

Meanwhile, when the optical fiber array 120 is loaded into the arranging grooves 110 of the arranging substrate 100 and fixed by soldering, it protrudes past the edge of the arranging substrate 100 to be inserted through the holes of the planar substrate 150. Thereafter, the optical fibers protruding past the edge of the arranging substrate 100 are inserted into the holes of the planar substrate, and covered and protected by a cover. Then, the resultant structure is fixed by molding using a filling compound 140 (e.g., epoxy molding compound).

According to needs, several planar substrates 150 having holes may be stacked and united. After molding, protrusions of the optical fibers through the holes are polished to thereby form an optical fiber array capable of being accurately attached to an optical waveguide device. However, when a pre-polished substrate such as a silicon wafer is used, the polishing process can be omitted. As occasion demands, a substrate portion with holes for the manufactured optical fiber array module is polished at a vertical or horizontal arbitrary angle θ (θ=0° to 20°) to reduce reflection loss. When angled polishing for reducing the reflection loss is not needed, the polishing process can be omitted by using the pre-polished substrate. Meanwhile, in the optical fiber array module having no planar substrate as shown in FIG. 1, the cross-section of the optical fiber array module to be coupled to the optical waveguide device is polished at a horizontal or vertical arbitrary angle θ (θ=0° to 20°), as needed, to thus reduce reflection loss. FIG. 7 shows the optical fiber array module shown in FIG. 2 in which a surface contacting the optical waveguide device is polished at an angle θ, and a stacked planar substrate 150 is used. FIG. 7 shows the optical fiber array module shown in FIG. 2 in which a surface contacting the optical waveguide device is polished at an angle θ.

According to the present invention, after optical fibers are loaded, the ends thereof are easily polished. When the optical fibers are attached to a waveguide device, the ends of the arrayed optical fibers are enlarged, leading to an improved attachment strength at the contact surface. The entire performance of the waveguide device is also improved in the respect of packaging of the optical waveguide device.

When an optical fiber array module is manufactured, the axes of the optical fibers are prevented from being tilted, by UV irradiation upon loading the optical fibers, thereby increasing the reliability of the optical fiber array module. Also, when the optical waveguide device is attached to a multi-core optical fiber, a contact surface is widened, thus improving environmental characteristics and reliability of a device package upon connection of the optical fibers.

The attachment of the optical fibers to the arranging substrate is accomplished by a reliable method such as laser welding. When the grooves on the arranging substrate are minutely twisted from the optical axis, a substrate having accurate holes for compensating for the twist is used, so that the accuracy of the optical axis increases.

CLAIMS:

1. A metal coated optical fiber array module using a metal coated optical fiber array, comprising:

a metal coated optical fiber array;

an arranging substrate having arranging grooves for loading the optical fiber array, wherein a metal is coated on the upper surface including the arranging grooves and the optical fiber array being loaded into the arranging grooves is united therewith through the medium of the metal;

a cover for protecting and fixing the optical fiber array loaded into the arranging grooves of the arranging substrate; and

a planar substrate having holes into which the optical fiber array is to be inserted, wherein the optical fiber array loaded on the arranging substrate is inserted into the holes and united with the arranging substrate.

2. The metal coated optical fiber array module as claimed in claim 1, wherein the optical fiber array comprises a plurality of single optical fibers or ribbon optical fibers.

3. The metal coated optical fiber array module as claimed in claim 1 or 2, wherein a solderable or weldable metal is coated on a portion of the upper surface of the arranging substrate including the arranging grooves.

4. The metal coated optical fiber array module as claimed in claim 2, wherein a solderable or weldable metal is coated on the entire or part of the surface of the planar substrate.

5. The metal coated optical fiber array module as claimed in claim 2, wherein the planar substrate comprises a plurality of stacked planar substrates.

6. The metal coated optical fiber array module as claimed in claim 2, wherein the holes through the planar substrate are formed by mechanical processing, light sensitive exposure, etching, a solution or reactive vapor.

7. The metal coated optical fiber array module as claimed in claim 2, wherein the holes through the planar substrate have cross-sections in the shape of a polygon, including a triangle and a rectangle, a circle, or an oval.

8. The metal coated optical fiber array module as claimed in claim 1 or 2, wherein the optical fiber array is protected and fixed by the cover by molding using a filling compound to minimize the exposure of the metal surface.

9. The metal coated optical fiber array module as claimed in claim 1, wherein the end of the optical fiber array module to be connected to an optical waveguide device is polished at a vertical angle of 0° to 20°.

10. The metal coated optical fiber array module as claimed in claim 1, wherein the end of the optical fiber array module to be connected to an optical waveguide device is polished at a horizontal angle of 0° to 20°.

11. The metal coated optical fiber array module as claimed in claim 2, wherein the end of the planar substrate of the optical fiber array module to be connected to an optical waveguide device is polished at a vertical angle of 0° to 20°.

12. The metal coated optical fiber array module as claimed in claim 2, wherein the end of the planar substrate of the optical fiber array module to be connected to an optical waveguide device is polished at a horizontal angle of 0° to 20°.

13. The metal coated optical fiber array module as claimed in claim 1 or 2, wherein the union of the optical fiber array with the arranging grooves of the arranging substrate is accomplished by welding or soldering.

14. The metal coated optical fiber array module as claimed in claim 1 or 2, wherein the grooves of the arranging substrate are V- or U-shaped.

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FIG. 1

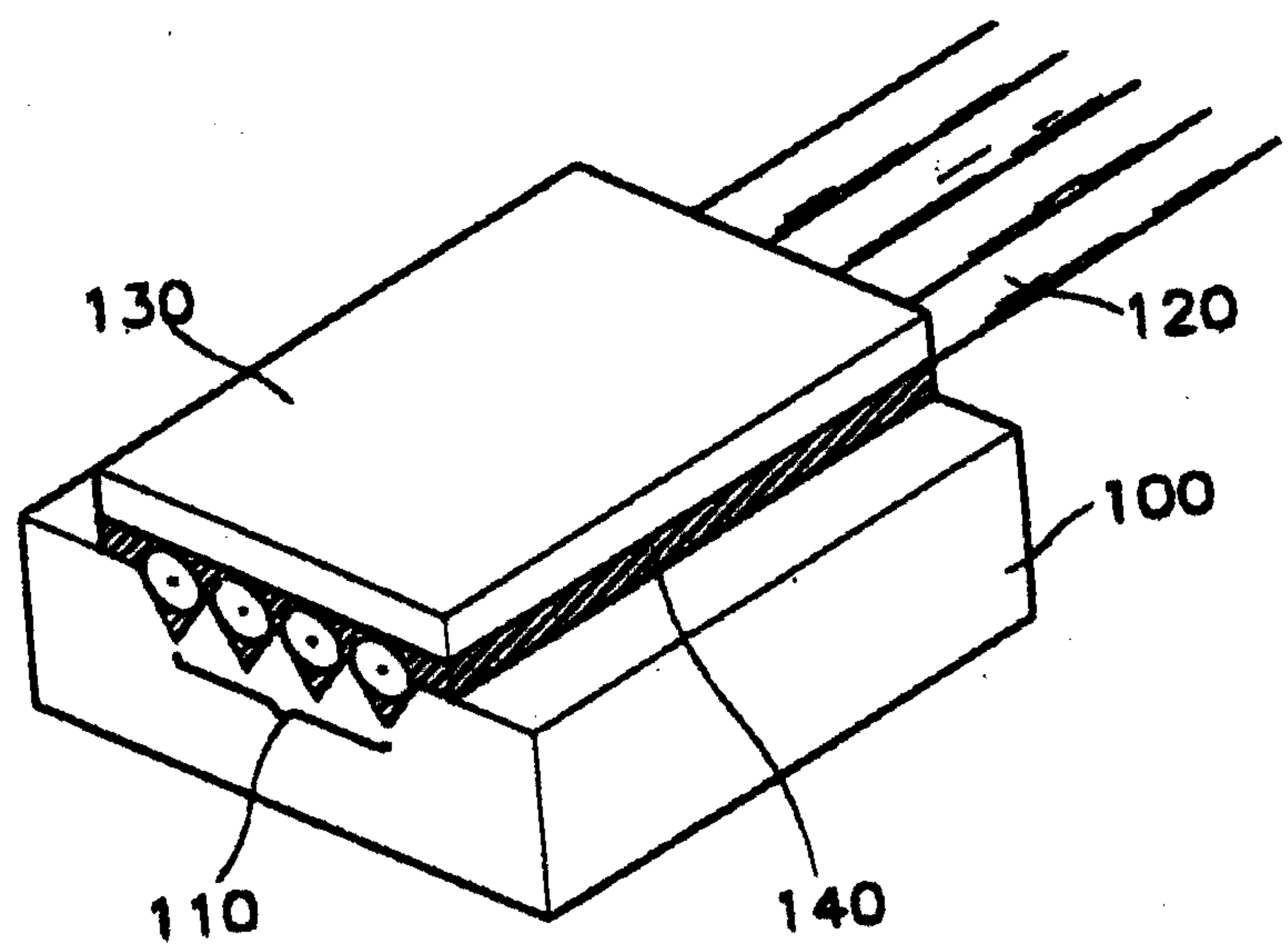


FIG. 2

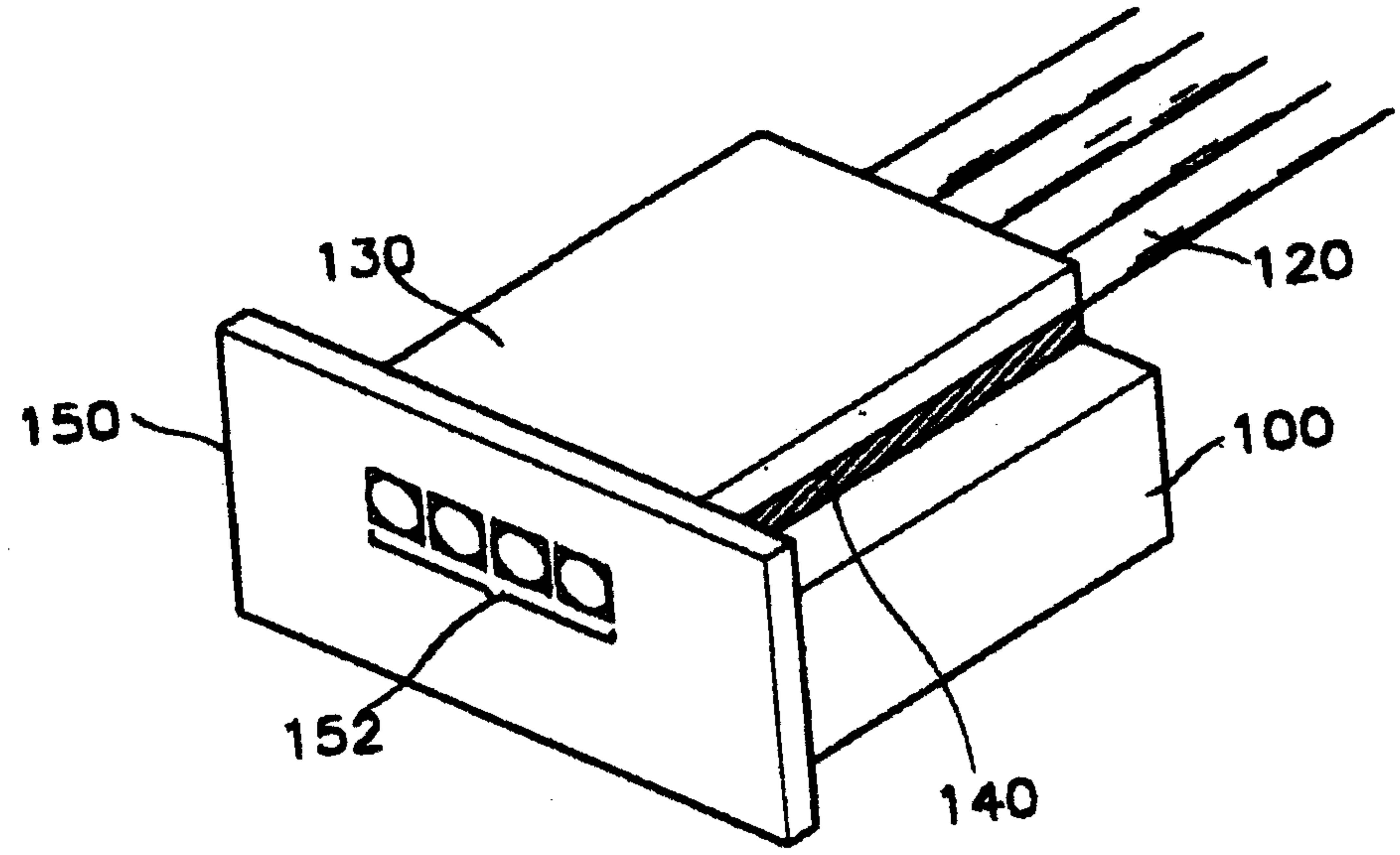


FIG. 3

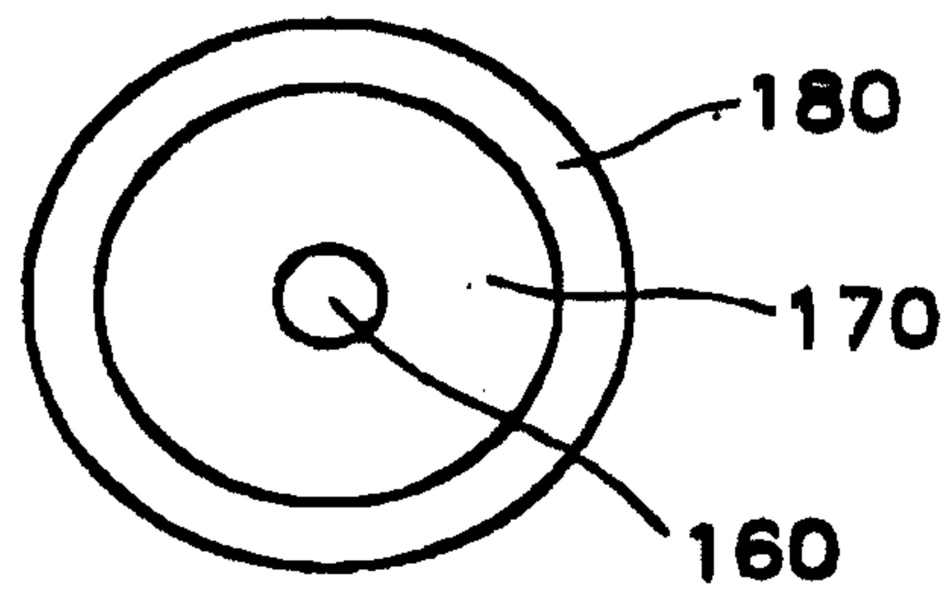


FIG. 4

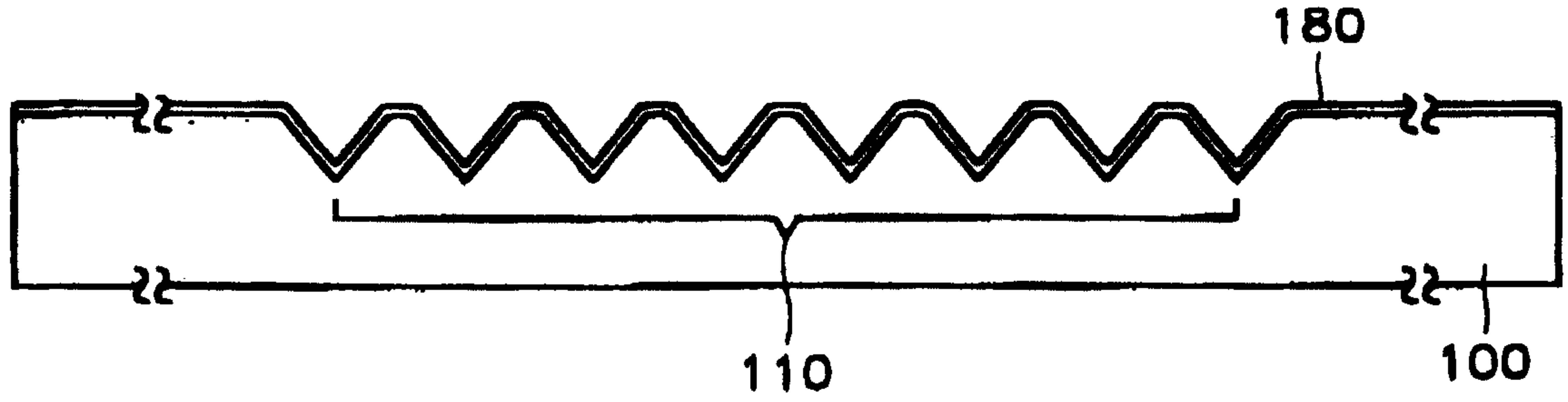


FIG. 5

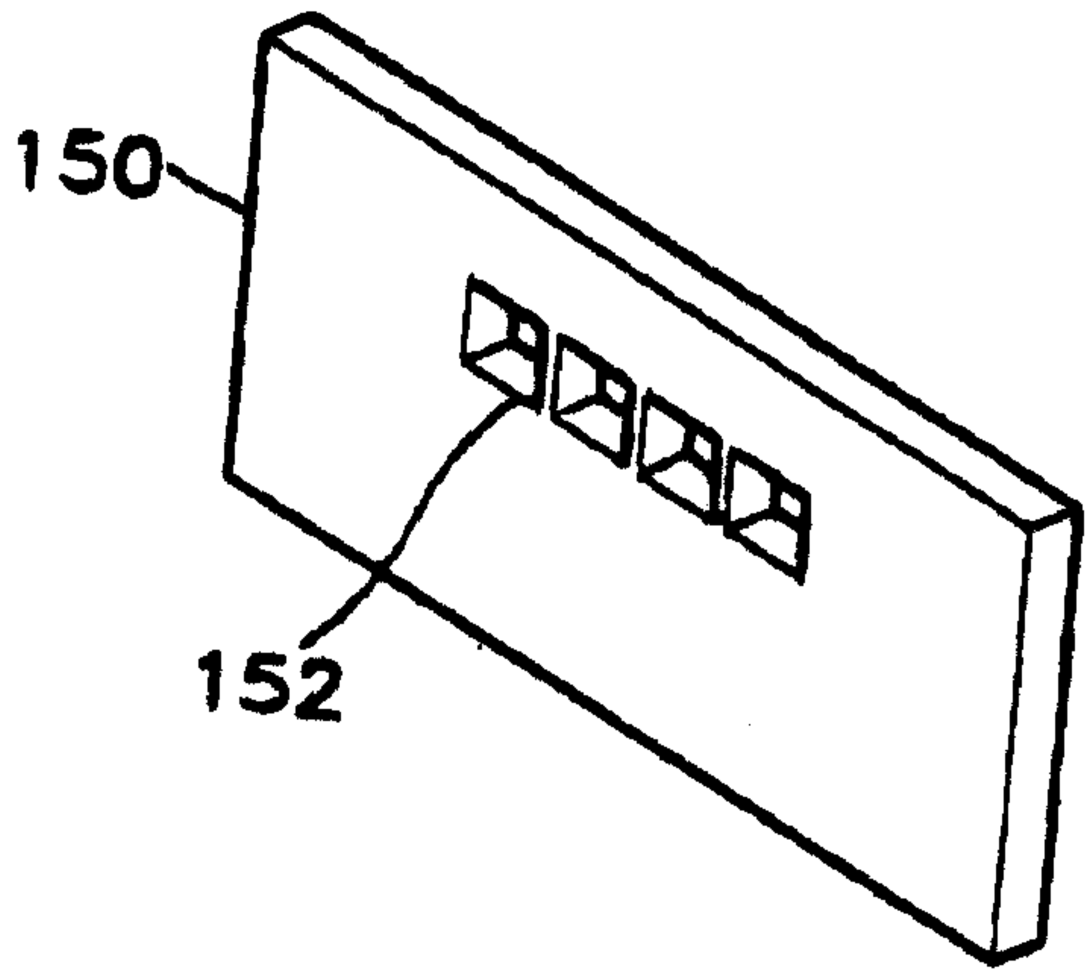


FIG. 6

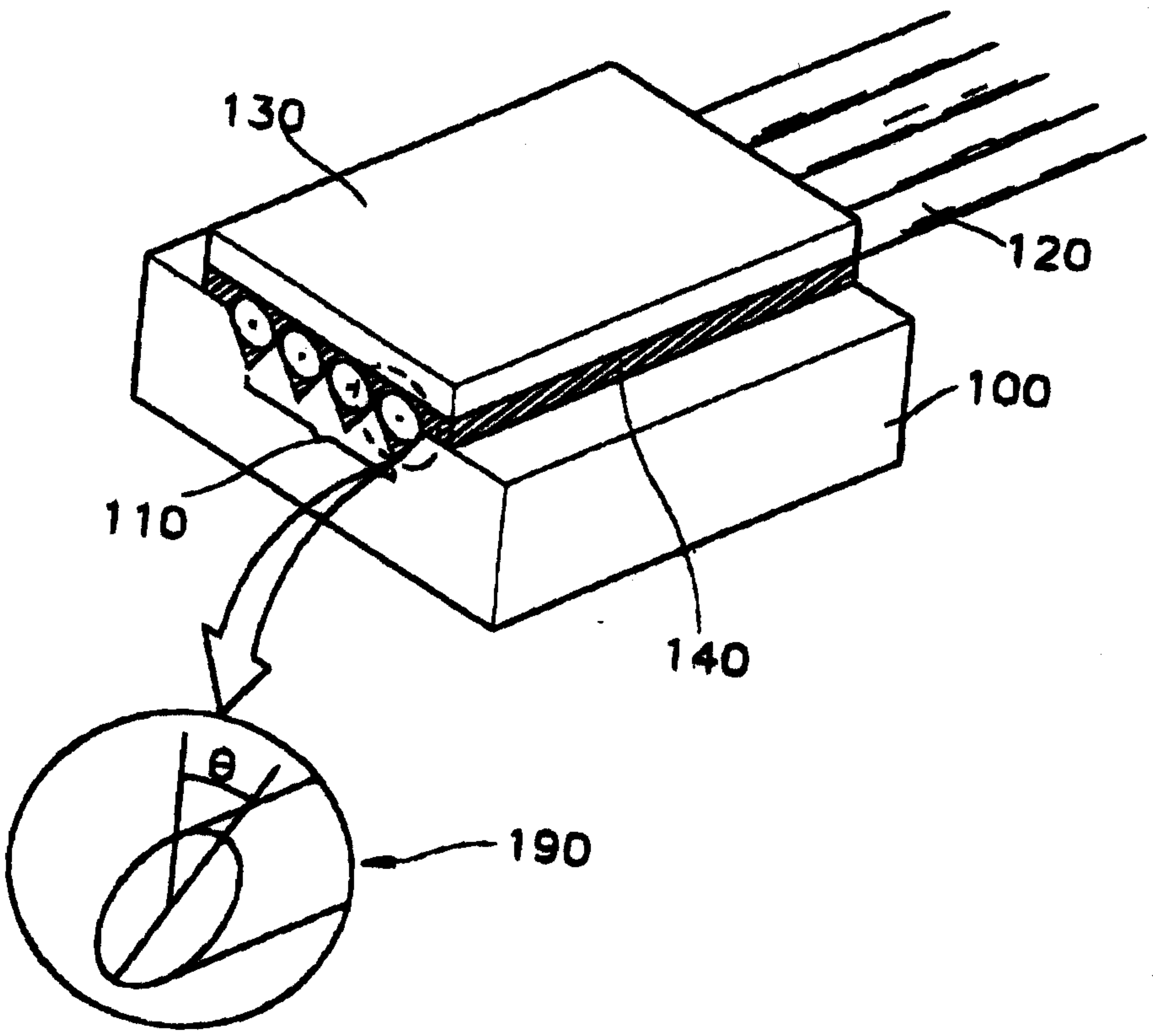
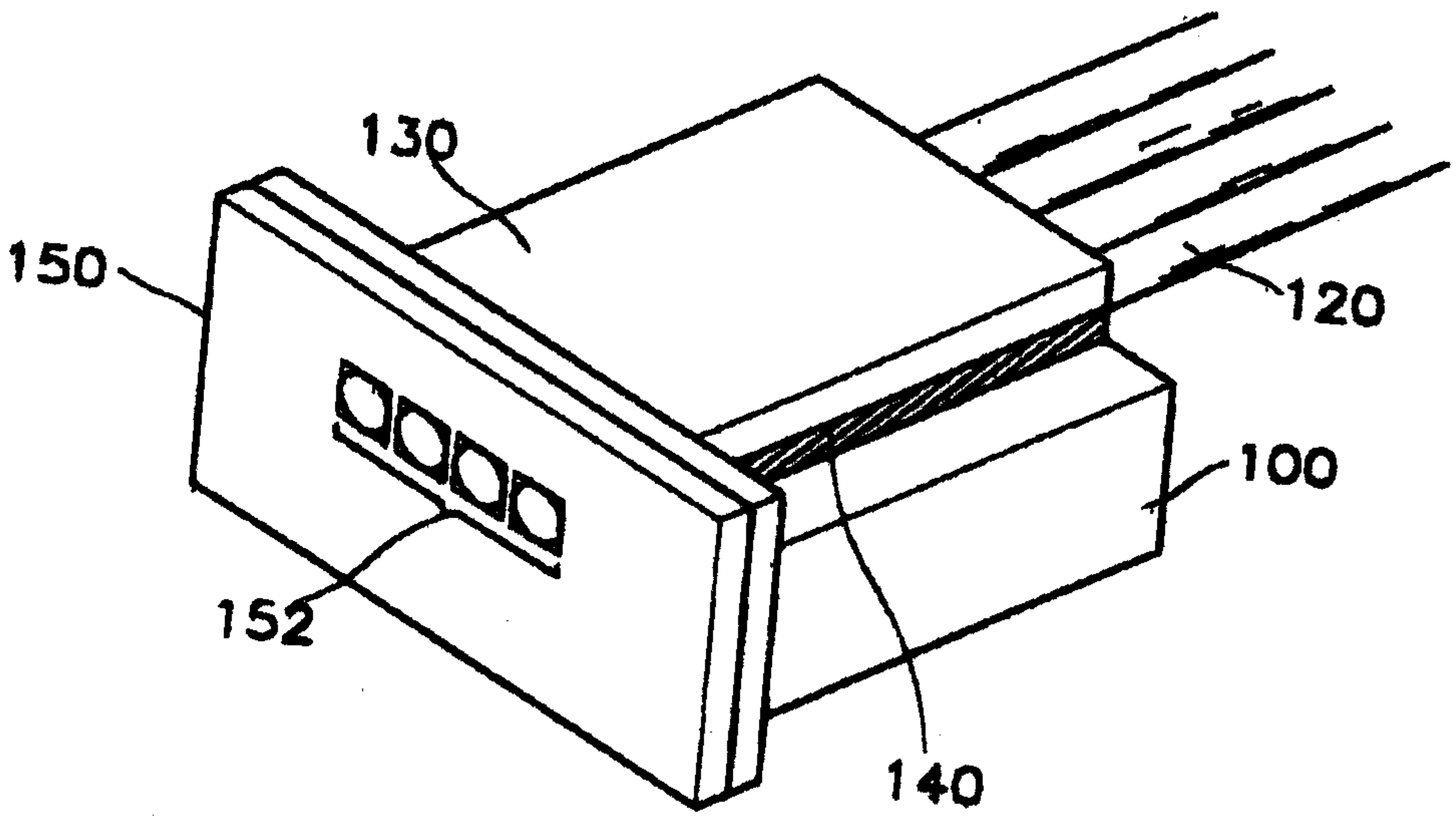
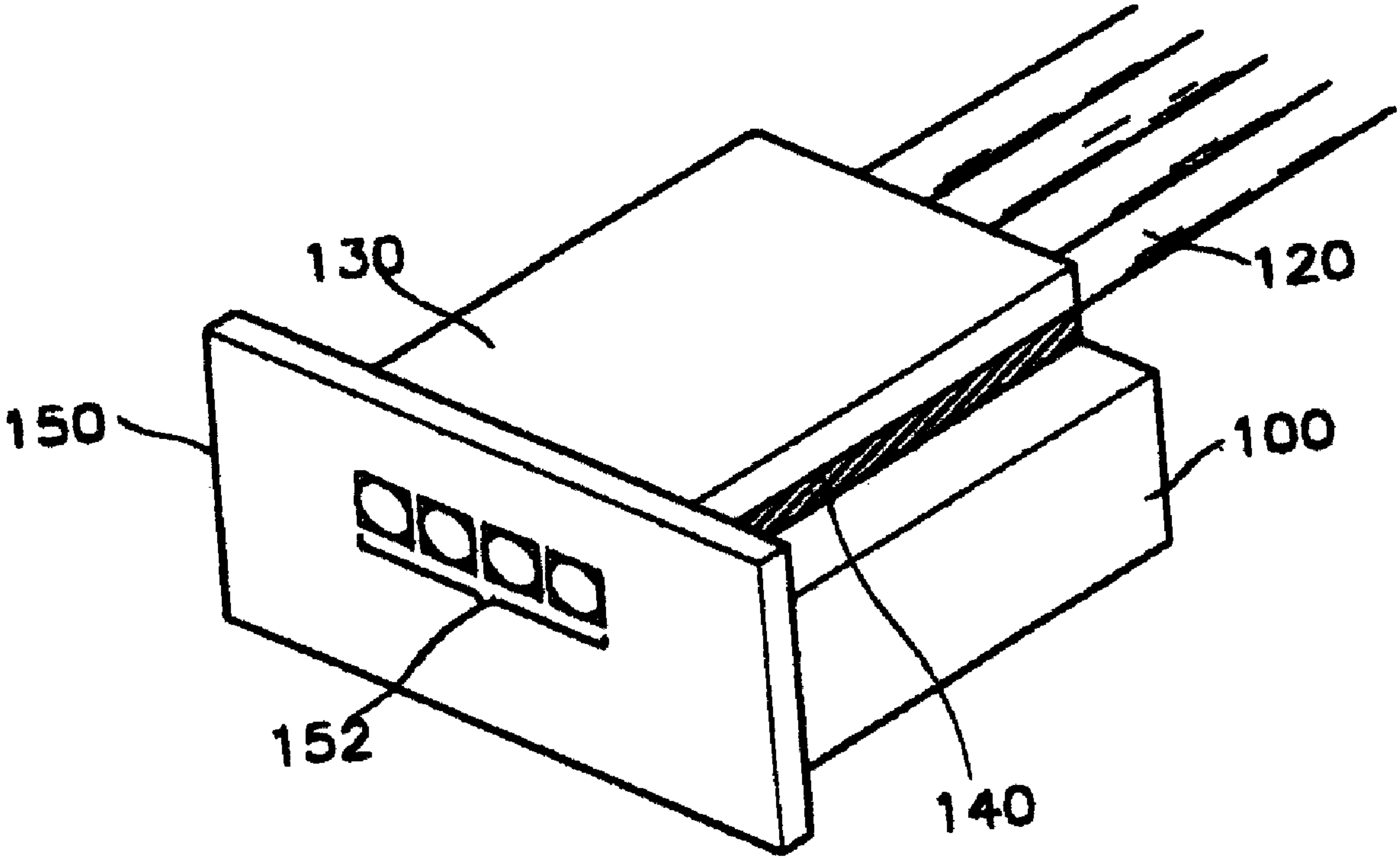


FIG. 7

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