

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
11 December 2003 (11.12.2003)

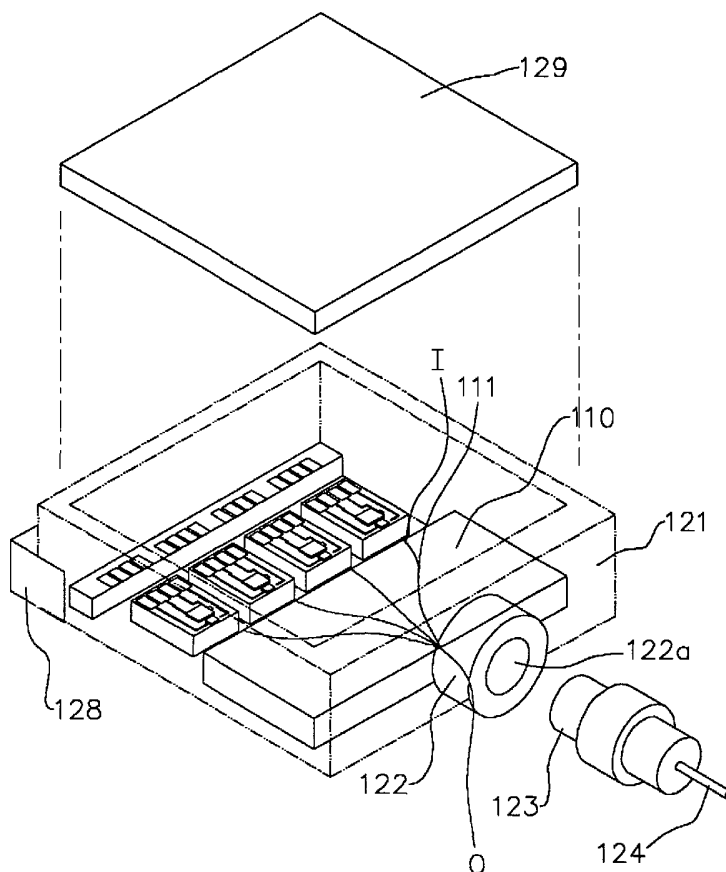
PCT

(10) International Publication Number  
**WO 03/103191 A1**

- (51) International Patent Classification<sup>7</sup>: **H04B 10/02**
- (21) International Application Number: PCT/KR03/01057
- (22) International Filing Date: 29 May 2003 (29.05.2003)
- (25) Filing Language: Korean
- (26) Publication Language: English
- (30) Priority Data:  
10-2002-0031380 4 June 2002 (04.06.2002) KR
- (71) Applicant (for all designated States except US): **ILJIN CORPORATION** [KR/KR]; Iljin Bldg., 50-1 Do-hwa-dong, Mapo-gu, Seoul 121-040 (KR).
- (72) Inventor; and
- (75) Inventor/Applicant (for US only): **SHIN, Ki Chul** [KR/KR]; 1207-2201, Hanyang Mokryun Apt., 1088 Sanbon-dong, Gunpo-shi, Kyunggi-do 435-040 (KR).
- (74) Agent: **HWANG, E-Nam**; 507 New Seoul Bldg., 828-8 Yoksam-dong, Kangnam-gu, Seoul 135-080 (KR).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: OPTICAL MODULE WITH MULTIPORT



(57) Abstract: Disclosed are optical transmitting and receiving modules with multiport. The transmitting module comprises two or more substrates (101) parallelly attached to the bottom of a package; and an optical waveguide (110) including plural unit waveguides (111) having plural optical input terminals (I) formed in the same number as that of light emitting elements (103) and a single optical output terminal (O), wherein the input terminals are disposed in front of emitting portions of the emitting elements (103), and the output terminal is disposed coaxially with an optical fiber (124). The receiving module comprises two or more substrates (131); an optical waveguide (110) including plural unit waveguides (111) having plural optical output terminals (O) and a single optical input terminal (I), wherein the output terminals are disposed in front of receiving portions of the receiving elements (133), and the input terminal is disposed coaxially with an optical fiber (124').

WO 03/103191 A1



**Published:**

— *with international search report*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## OPTICAL MODULE WITH MULTIPORT

## Technical Field

The present invention relates to a optical module  
5 with multiport, and more particularly to a optical  
module with multiport, in which a plurality of  
transmitting modules and a plurality of receiving  
modules are integrated into one package, thereby  
10 reducing the overall size of the modules and  
increasing the optical transmission capacity of the  
modules.

## Background Art

In the course of progress of the information age,  
there have been required optical modules, which can  
15 transmit a large quantity of information. Such optical  
modules must have excellent quality themselves and  
also high reliability for maintaining their excellent  
quality for a long period of time. In order to promote  
the spread of the optical modules for achieving a  
20 FTTH(fiber to the home) system, the optical modules  
should be manufactured at low cost. Particularly,  
since the capacity of an optical transmitting system  
is recently increased, the size of an optical module  
mounted on the optical transmitting system has been  
25 reduced so that the number of the optical modules  
mounted per unit area is increased.

Generally, methods for aligning an optical fiber  
and active elements (for example, a laser diode and a  
photo diode) of an optical module for converting an  
30 electrical signal into an optical signal or an optical  
signal into an electrical signal are divided into two  
types, i.e., an active alignment method and a passive

alignment method.

In case of the active alignment method, an apparatus with resolution of less than  $\mu\text{m}$  is used for aligning the active elements and the optical fiber. This apparatus finely moves to find the precise positions of the active elements and the optical fiber of the optical module in which an optical output is maximum. It takes a long time to use the apparatus in this method, thereby reducing mass production. Furthermore, additional components are required to perform the active alignment method, thus increasing the production cost of the optical module.

In case of the passive alignment method, the active elements and the optical fiber are precisely aligned under the condition that current is not applied to the active elements. The maximum optical output is obtained only when the position of the optical fiber and the active elements are precisely aligned before the optical fiber is substantially aligned.

Since the recent optical modules are manufactured by the active alignment method using an expensive apparatus, which can finely control the alignment in the optical fiber alignment step, it takes a long time to manufacture the optical modules, thereby increasing the cost of the modules and reducing the productivity of the modules.

In order to transmit a larger quantity of information, the number of optical transmitting and receiving modules used in the conventional optical communication system should be continuously increased. However, the increased number of the optical transmitting and receiving modules increases an area occupied by the modules in the system. As a result, due to limitation of area for illustrating the system, it is impossible to continuously increase the number

of the optical transmitting and receiving modules mounted in the system. Accordingly, it is difficult to further increase the transmission capacity of the system.

5                    Disclosure of the Invention

Therefore, the present invention has been made in view of the above problems, and it is an object of the present invention to provide a optical module with multiport, in which a plurality of transmitting  
10 modules and a plurality of receiving modules are integrated into one package, thereby reducing the overall size of the modules and increasing the optical transmission capacity of the modules.

In accordance with one aspect of the present  
15 invention, the above and other objects can be accomplished by the provision of a optical transmitting module with multiport, in which active elements are attached to a substrate at designated positions, and a package includes light collection  
20 means for transferring light emitted from light emitting elements to an optical fiber and electrical connection means formed between the active elements and an external circuit board, comprising: two or more substrates attached in parallel to a bottom surface of  
25 the package; and an optical waveguide including a plurality of unit waveguides provided with a plurality of optical input terminals formed in the same number as that of the light emitting elements formed on the substrates and a single optical output terminal, the  
30 optical waveguide attached to the bottom surface of the package, wherein the optical input terminals are disposed in front of emitting portions of the light emitting elements attached to the substrates, and the optical output terminal is disposed coaxially with the

optical fiber.

Preferably, protuberances with a designated shape may be formed on a bottom surface of a cavity formed in the package, and concavities corresponding to the  
5 protuberances may be formed in bottom surfaces of the substrates and the optical waveguide so that a passive alignment is achieved by coupling the protuberances to the concavities.

In accordance with another aspect of the present  
10 invention, there is provided a optical receiving module with multiport, in which a light receiving element is attached to a substrate at a designated position, and a package includes light collection means for  
15 transferring light emitted from an optical fiber to the light receiving element and electrical connection means formed between the light receiving element and an external circuit board, comprising: two or more  
20 substrates attached in parallel to a bottom surface of the package; and an optical waveguide including a plurality of unit waveguides provided with a plurality of optical output terminals formed in the same number  
25 as that of the light receiving elements formed on the substrates and a single optical input terminal, the optical waveguide attached to the bottom surface of the package, wherein the optical output terminals are  
disposed in front of receiving portions of the light receiving elements attached to the substrates, and the optical input terminal is disposed coaxially with the optical fiber.

30 Preferably, protuberances with a designated shape may be formed on a bottom surface of a cavity formed in the package, and concavities corresponding to the protuberances may be formed in bottom surfaces of the  
35 substrates and the optical waveguide so that a passive alignment is achieved by coupling the protuberances to the concavities.

## Brief Description of the Drawings

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1a is a schematic perspective view of an optical transmitting module after active elements are attached thereto;

Fig. 1b is a schematic perspective view of the optical transmitting module before active elements are attached thereto;

Fig. 1c is a bottom view of a substrate of the optical transmitting module;

Fig. 2a is a perspective view of a flat optical waveguide provided with a plurality of channels;

Fig. 2b is a bottom view of the optical waveguide;

Fig. 3a is a schematic perspective view of an optical transmitting module in accordance with the present invention after active elements are attached thereto;

Fig. 3b is a schematic perspective view of the optical transmitting module in accordance with the present invention before active elements are attached thereto;

Fig. 4a is a schematic perspective view of an optical receiving module after active elements are attached thereto;

Fig. 4b is a schematic perspective view of the optical receiving module before active elements are attached thereto;

Fig. 4c is a bottom view of a substrate of the optical receiving module;

Fig. 5a is a schematic perspective view of an optical receiving module in accordance with the present invention after active elements are attached thereto;

5 Fig. 5b is a schematic perspective view of the optical receiving module in accordance with the present invention before active elements are attached thereto;

10 Fig. 6 is a schematic perspective view of a first embodiment of electrical connection means in accordance with the present invention;

Fig. 7 is a schematic perspective view of a second embodiment of electrical connection means in accordance with the present invention; and

15 Fig. 8 is a schematic perspective view of a third embodiment of electrical connection means in accordance with the present invention.

#### Best Mode for Carrying Out the Invention

20 Now, preferred embodiments of the present invention will be described in detail with reference to the annexed drawings.

As shown in Figs. 1a to 3b, in accordance with one preferred embodiment of the present invention, a optical transmitting module with multiport comprises a package 121 for an integrated module, at least two substrates 101, an optical waveguide 110, and electrical connection means 128. The package 121 is provided with a light collection means formed on the front surface of the package 121. The substrates 101 are attached to the bottom surface of a cavity formed in the package 121. The optical waveguide 110 is attached to the bottom surface of the package 121 in front of the substrates 101. The electrical connection means 128 is formed at the rear portion of the package

121.

The light collection means of this embodiment includes a lens insertion hole (not shown) formed in the front surface of the package 121, a transmitting lens (not shown), and a transmitting guide pipe 122 connected to the lens insertion hole and provided with a hollow 122a for receiving a transmitting ferrule 123.

Generally, a ball lens is used as the transmitting lens. The transmitting lens is fixedly installed in the lens insertion hole at a position calculated in advance so that light emitted from an output terminal (O) is concentrated on a core of an optical fiber 124.

The transmitting guide pipe 122 is provided with the hollow 122a for receiving the transmitting ferrule 123 including the optical fiber 124 installed therein. The ferrule 123 is not limited in terms of its shape. However, preferably, the ferrule 123 is formed to have a cylindrical shape. In this case, an inner diameter of the hollow 122a substantially coincides with an outer diameter of the ferrule 123. Accordingly, even if the ferrule 123 is inserted into the hollow 122a in any direction, the light is precisely concentrated on the core of the optical fiber 124.

The package 121 is not limited in terms of its material. Generally, the package 121 may be made of materials such as ceramic, metal (including alloy), resin, or their equivalents. Preferably, protuberances 126a and a protuberance 126b having a designated shape are formed on the bottom surface of the cavity of the package 121 so as to fix the substrate 101 and the optical waveguide 110, and an opening for receiving the substrate 101 and a cover 129 are provided on the upper surface of the package 121.

The protuberances 126a formed on the bottom surface of the cavity of the package 121 serve as means for precisely fixing the substrates 101 at a height and

a position determined in advance so that the light emitted from a light emitting element 103 at the optimum position is incident on an input terminal (I) of a unit waveguide 111.

5           The protuberance 126b serves as means for precisely fixing the optical waveguide 110 at a height and a position determined in advance so that the light emitted from the output terminal (O) at the optimum position is incident on the optical fiber 124 via the  
10 transmitting lens.

          The protuberances 126a and 126b are not limited in terms of their shapes. Accordingly, the protuberances 126a and 126b may be formed to have a shape of a V-groove or a MESA structure provided with a side wall  
15 slanted at a designated angle so that the substrate 101 is easily attached to the protuberances 126a and 126b.

          Preferably, the substrate 101 is made of a semiconductor material, for example silicon. The light emitting element 103 is attached, using solder 105, to  
20 the front area of the upper surface 101a of the substrate 101 at a constant height determined in advance so that the light is incident on the transmitting lens from an optimal angle. A light receiving element 104 for a monitor in order to sense  
25 the strength of the light irradiated from the rear surface of the light emitting element 103 is attached, using the solder 106, to the rear area of the upper surface 101a of the substrate 101. A light reflective groove 102 with a designated shape is formed in the  
30 substrate 101 under the light receiving element 104. The light reflective groove 102 serves to reflect the light irradiated from the rear surface of the light emitting element 103 and then to allow the reflected

light to be incident on the surface of the light receiving element 104. Preferably, the light reflective groove 102 is a V-shaped groove with a certain width and a depth, which are determined by the orientation of crystals of the substrate 101. However, the shape of the light reflective groove 102 is not limited thereto.

Patterns 108 with designated shapes are formed on the substrate 101 so that the light emitting element 103 and the light receiving element 104 are connected to the electrical connection means (here, the electrical connection means serves to electrically connect internal active elements to an external circuit board and will be described later). The above active elements, i.e., the light emitting element 103 and the light receiving element 104, are connected to the patterns 108 via a gold wire 107.

A laser diode is generally used as the light emitting element 103. Preferably, an uneven structure (not shown) with a height and a size designated in advance by the orientation determined by the crystalline characteristics of single crystals may be formed on the bottom surface of the laser diode. In this case, another uneven structure with a height and a size designated in advance is formed at a constant position on the substrate 101 to which the light emitting element 103 is attached so that the uneven structure of the substrate 101 is engaged with the uneven structure of the laser diode, thereby allowing the light emitting element 103 to be mounted at a precise position on the substrate 101 without performing any alignment procedure.

A photo diode is generally used as the light receiving element 104 for a monitor. The light

receiving element 104 serves to control the strength of the light irradiated from the front surface of the light emitting element 103 by sensing the strength of the light incident on the surface of the light receiving element 104. Here, a control circuit for controlling the light receiving element 104 may be formed on an external electronic circuit board (not shown), and the detailed description thereof will thus be omitted because it is considered to be obvious to those skilled in the art.

Concavities 109 are formed in the bottom surface 101b of the substrates 101 so that a shape and a size of the concavity 109 correspond to those of the protuberance 126a formed on the bottom surface of the cavity of the package 121.

The optical waveguide 110 for focusing the light emitted from the light emitting element 103 is attached to the bottom surface of the package 121. The optical waveguide 110 is a multi channel type, which includes a plurality of unit waveguides 111, a plurality of input terminals (I) formed in the same number as that of the light emitting elements 103, and a single output terminal (O).

The input terminals (I) are disposed in front of an emitting portion of the light emitting element 103 attached to the plural substrates 101, and the output terminal (O) is coaxial with the optical fiber 124.

The optical waveguide 111 of this preferred embodiment of the present invention is a flat four-channel wavelength division multiplexing (CWDM) filter, which is designed so that light with different wavelengths is transmitted via the plural channels. This type of the optical waveguide 111 is manufactured by already known methods, that is, by a process for producing a silica-based PLC (planar lightwave circuit), for example by flame hydrolysis

deposition(FHD), photolithography, or reactive ion etching(RIE) (Refer to Y. Inoue, M. Oguma, T. Kitoh, M. Ishii, T. Shibata, and Y. Hibino, OFC 2002 conference, p. 75).

5 Preferably, the optical waveguide 110 includes a concavity 112, formed on the bottom surface, with a shape and a size to correspond to those of the protuberance 126b formed on the bottom surface of the cavity of the package 121.

10 The concavities 109 and 112 are not limited in terms of their forming method, but may be formed by all of conventionally known etching methods means.

The passive alignment is simply achieved by coupling the concavities 109 and 112 of the substrates 15 101 with the protuberances 126a and 126b of the package 121. That is, since the final position of the light emitting element 103 is disposed coaxially with the input terminals (I) so that the light is incident on the input terminals (I) of the unit waveguide 111 from 20 an optimal angle, and obtained by a method controlled in advance so that the light from the output terminal (O) is concentrated on the core of the optical fiber 124 in the ferrule 123, the passive alignment can be simply achieved by a single step for fixedly inserting 25 the ferrule 123 into the package 121.

Hereinafter, a optical receiving module with multiport in accordance with another preferred embodiment of the present invention will be described in detail with reference to Figs. 4a to 5b.

30 In accordance with another preferred embodiment of the present invention, the optical receiving module with multiport comprises a package 121' for an integrated module, at least two substrates 131, the optical waveguide 110, and the electrical connection means 128. 35 The package 121' is provided with a light collection means formed on the front surface of the

package 121'. The substrates 131 are attached to the bottom surface of a cavity formed in the package 121'. The optical waveguide 110 is attached to the bottom surface of the package 121' in front of the substrates 131. The electrical connection means 128 is formed at the rear portion of the package 121'.

The light collection means of this embodiment includes a lens insertion hole (not shown) formed in the front surface of the package 121', a receiving lens (not shown), and a receiving guide pipe 122' connected to the lens insertion hole and provided with a hollow 122a' for receiving a receiving ferrule 123'.

Generally, a ball lens is used as the receiving lens. The receiving lens is fixedly installed in the lens insertion hole at a position calculated in advance so that light emitted from an optical fiber 124' is concentrated on input terminals (I) of the optical waveguide 110.

The receiving guide pipe 122' is provided with the hollow 122a' for receiving the receiving ferrule 123' including the optical fiber 124' installed therein. The ferrule 123' is not limited in terms of its shape. However, preferably, the ferrule 123' is formed to have a cylindrical shape. In this case, an inner diameter of the hollow 122a' substantially coincides with an outer diameter of the ferrule 123'. Accordingly, even if the ferrule 123' is inserted into the hollow 122a' in any direction, the light is precisely concentrated on the acceptance core of a light receiving element 133.

Protuberances 146a and 146b having a designated shape are formed on the bottom surface of the cavity of the package 121' so as to fix the substrates 131 and the optical waveguide 110, and an opening for receiving

the substrates 131 and a cover 129' are provided on the upper surface of the package 121'.

5 The protuberances 146a formed on the bottom surface of the cavity of the package 121' serve as means for precisely fixing the substrates 131 at a height and a position determined in advance so that the light emitted from the output terminal (O) of the unit waveguide 111 is concentrated on the acceptance of the light receiving element 133.

10 The protuberance 146b serves as means for precisely fixing the optical waveguide 110 at a height and a position determined in advance so that the light emitted from the optical fiber 124' inserted into the ferrule 123' at the optimum position is incident on the input terminal (I) of the unit waveguide 111.

15 The protuberances 146a and 146b are not limited in terms of their shapes. Accordingly, the protuberances 146a and 146b may be formed to have a shape of a V-groove or a MESA structure provided with a side wall slanted at a designated angle so that the substrates 131 are easily attached to the protuberances 146a and 146b.

20 The substrate 131 is not limited in terms of its material, but may be made of a ceramic material. A metal pattern 134 for a N-electrode and a metal pattern 136 for a P-electrode are formed on the front surface 131a of the substrate 131. The light receiving element 133 is attached on the metal pattern 134. Here, the light receiving element 133 is attached on the metal pattern 134 via a solder 135 coated in advance, and then connected to the metal pattern 136 via a gold wire 137.

25 A photo diode is preferably used as the light receiving element 133. The light receiving element 133 is fixedly located at a designated position on the substrate 131 so that the light receiving element 133

and a central axis of the output terminal (O) of the optical waveguide 110 are arranged in a straight line.

Concavity 138 is formed in the bottom surface 131b of the substrate 131 so that a shape and a size of the concavity 138 correspond to those of the protuberance 146a formed on the bottom surface of the cavity of the package 121'. The concavity 138 is not limited in terms of its forming method, but may be formed by means of a mold in manufacturing the substrate 131 or by a separate cutting step.

The constitution of the optical waveguide 110 of the optical receiving module in this embodiment is the same as that of the above-described optical transmitting module, and the detailed description thereof will thus be omitted. However, in the optical waveguide 110 of this embodiment, light from the single input terminal (I) is multiplexed into different plural wavelengths and then transmitted to respective output terminals (O).

The passive alignment is simply achieved by coupling the concavities 138 of the substrates 131 with the protuberances 146a of the package 121. That is, since the light receiving element 133 is fixed to the front surface of the substrate 131 by a method controlled in advance so that the light emitted from the output terminal (O) of the optical waveguide 110 is concentrated on the acceptance core of the light receiving element 133 and the light irradiated from the optical fiber 124' in the ferrule 123' is concentrated on the input terminal (I) of the optical waveguide 110, the passive alignment can be simply achieved by a single step for fixedly inserting the ferrule 123' into the package 121'.

The electrical connection means serves as an interface for electrically connecting the internal active elements of the package 121' to an external

circuit board, may include a conventional pin structure and a preferred structured described below.

A first embodiment of the electrical connection means is formed to have a structure of a connector 128 integrally formed with the package 121 as shown in Fig. 6. The connector 128 includes contact points C and C' formed on both terminals of the connector 128 in order to electrically connect the internal active elements 103 and 104 and an external circuit board 152, and preferably a matching circuit 143 for achieving impedance matching with the active elements 103 located between the contact points C and C'. The contact points C' to be connected to the external circuit board 152 are horizontally protruded from one surface of the package 121 so that the contact points C' are easily connected to the external circuit board 152.

The matching circuit 143 may be formed on a substrate 142 with a designated dielectric constant (here, a non-described reference numbers 141 and 144 individually represents upper and lower insulating plates). Preferably, a protection circuit for minimizing signal interference may be formed together with the matching circuit 143 on the substrate 142. The detailed constitution of the matching circuit 143 may be selected from various types by those skilled in the art according to required characteristics (for example, the constitution of the matching circuit 143 may be determined by the dielectric constant of the substrate 142), but does not constitute the subject matter of the present invention.

Of course, the matching circuit 143 and/or the protection circuit may have a multi-layered structure. This structure minimizes a signal loss and interference between signals, thus allowing the optical module to be used as an element, which is operable at high speeds more than 2.5 Gbps.

A second embodiment of the electrical connection means is formed to have a structure of a socket 128' integrally formed with the package 121 as shown in Fig. 7. The socket 128' includes contact points C and C' formed on both terminals of the connector 128 in order to electrically connect the internal active elements 103 and 104 and an external circuit board 152, and preferably a matching circuit 143 for achieving impedance matching with the active elements 103 located between the contact points C and C'. The contact points C' to be connected to the external circuit board 152 are horizontally protruded from one surface of the package 121 so that insertion portions 153 of the external circuit board 152 are easily inserted into concavities of the socket 128'.

In the above-described connector-type or socket-type electrical connection means, the contact points C and C' and the matching circuit 143 may be formed on the upper or lower surface of the connector 128 or the socket 128', or both the upper and lower surfaces of the connector 128 or the socket 128'.

The constitution of the matching circuit 143 of the socket 128' is the same as that of the above-described connector 128, and the detailed description thereof will thus be omitted.

A third embodiment of the electrical connection means is formed to have a structure of pins 145 electrically connecting the internal active elements 103 and 104 and an external circuit board 152 as shown in Fig. 8. Generally, the pins 145 are made of a lead frame. Differently from conventional pins arranged perpendicularly to the surface of the package, the pins 145 are arranged horizontally with the bottom surface of the package 121.

In the third embodiment shown in Fig. 8, the pins 145 are attached to a lower insulating plate 142

provided with the same matching circuit as that of the first embodiment shown in Fig. 6 by a brazing method and an upper insulating plate 141 is stacked on the lower insulating plate 142.

5            Preferably, the number of the pins 145 is minimized according to intended use, thus reducing the total dimensions of the package 121. In this embodiment of the present invention, the number of the pins 145 on the substrate is at least four (in case of  
10 the optical receiving module, two), thereby remarkably reducing the dimensions of the package 121. Further, the pins 145 are protruded from the rear surface of the package 121 in a horizontal direction, thereby allowing the package 121 to be easily mounted on a  
15 contact area 154 on an external circuit board.

Hereinafter, a process for manufacturing the above optical transmitting module will be described in detail. The optical receiving module is manufactured by the same process, and the detailed description thereof  
20 will thus be omitted.

The package 121 for an integrated module is seated on a stage (not shown). The silicon substrate 101 provided with the laser diode 103 and the photo diode 104 for a monitor, and the optical waveguide are  
25 picked up, and then mounted in the cavity of the package 121 for an integrated module. Here, the silicon substrate 101 and the optical waveguide 110 are aligned at precise positions on the bottom surface of the package 121 by the concavities 109 and 112  
30 provided with the slanted side wall formed in the bottom surfaces of the silicon substrate 101 and the optical waveguide 110 and the flat bottom surfaces with rectangular shapes, and the MESA structures 126a and 126b provided with the slanted side wall formed on  
35 the bottom surface of the cavity of the package 121 so that the shapes and sizes of the concavities 109 and

112 correspond to those of the MESA structures 126a and 126b. Solder having a designated melting point is coated on the upper surfaces of the MESA structures 126a and 126b.

5           The stage is heated so that the solder (not shown) coated on the upper surfaces of the MESA structures 126a and 126b is melted, thus fixing the silicon substrates 101 for transmitting light and the optical waveguide 110 at precise positions in the package 121.

10           The contact points C of the connector 128 are connected to the metal patterns 108 formed on the silicon substrates 101 via a gold wire.

          After the silicon substrates 101 for transmitting light and the optical waveguide 110 are fixed in the package 121, the cover 129 is fixed to the upper surface of the package 121 by electric welding under a nitrogen atmosphere.

15           After the mounting of the silicon substrates 101 for transmitting light in the cavity of the package 121 is completed, the transmitting ferrule 123 provided with the transmitting optical fiber 124 is inserted into the hollow 122a of the transmitting guide pipes 122 attached to the front surface of the package 121, and then fixed to the hollow 122a by laser welding, or etc.

25           Here, the optical fiber 124 is connected to the package 121 in a receptacle or pigtail form.

#### Industrial Applicability

30           As apparent from the above description, the present invention provides a optical module with multiport, in which a plurality of transmitting modules and a plurality of receiving modules are integrated into one package, thereby reducing the overall size of the modules and increasing the optical

transmission capacity of the modules. Further, the passive alignment is achieved without the operation of a light emitting or receiving element. Moreover, since the optical module is manufactured under the condition  
5 that the inner components are aligned in advance, it is possible to reduce the time taken in aligning the components.

Although the preferred embodiments of the present invention have been disclosed for illustrative  
10 purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

15

## Claims:

1. A optical transmitting module with multiport, in which active elements are attached to a substrate at designated positions, and a package includes light collection means for transferring light emitted from light emitting elements to an optical fiber and electrical connection means formed between the active elements and an external circuit board, comprising:
- 5
- two or more substrates attached in parallel to a bottom surface of the package; and
- 10
- an optical waveguide including a plurality of unit waveguides provided with a plurality of optical input terminals formed in the same number as that of the light emitting elements formed on the substrates and a single optical output terminal, said optical waveguide attached to the bottom surface of the package,
- 15
- wherein the optical input terminals are disposed in front of emitting portions of the light emitting elements attached to the substrates, and the optical output terminal is disposed coaxially with the optical fiber.
- 20
2. The optical transmitting module with multiport as set forth in claim 1, wherein protuberances with a designated shape are formed on a bottom surface of a cavity formed in the package, and concavities corresponding to the protuberances are formed in bottom surfaces of the substrates and the optical waveguide so that a passive alignment is achieved by coupling the protuberances to the concavities.
- 25
- 30
3. The optical transmitting module with multiport as set forth in claim 2, wherein each of the protuberances formed on the bottom surface of the

cavity of the package has a MESA structure provided with a side wall slanted at a designated angle.

4. The optical transmitting module with multipoint as set forth in claim 1, wherein the package is made  
5 of a material selected from the group consisting of ceramic, metal, resin, and their equivalents.

5. The optical transmitting module with multipoint as set forth in claim 1, wherein a guide pipe of the light collection means has an inner diameter the same  
10 as an outer diameter of a ferrule so that the ferrule is fixedly inserted into the guide pipe.

6. The optical transmitting module with multipoint as set forth in claim 1, wherein the electrical connection means is formed to have a connector or  
15 socket structure including contact points formed on both terminals of the structure for electrically connecting the active elements and the external circuit board, and a matching circuit formed between the contact points for achieving impedance matching with  
20 the active elements, said contact points to be connected to the external circuit board being horizontally protruded from one surface of the package.

7. The optical transmitting module with multipoint as set forth in claim 1, wherein the electrical  
25 connection means is formed to have a pin structure including contact points formed on both terminals of the structure for electrically connecting the active elements and pins, and a matching circuit formed between the contact points for achieving impedance  
30 matching with the active elements, said pins being horizontally protruded from one surface of the package and attached to the contact points.

8. The optical transmitting module with multiport as set forth in claim 6 or 7, wherein the matching circuit is formed on a substrate with a designated dielectric constant.

5           9. The optical transmitting module with multiport as set forth in claim 6 or 7, wherein the matching circuit has a multi-layered structure.

10           10. A optical receiving module with multiport, in which a light receiving element is attached to a substrate at a designated position, and a package includes light collection means for transferring light emitted from an optical fiber to the light receiving element and electrical connection means formed between the light receiving element and an external circuit board, comprising:

15           two or more substrates attached in parallel to a bottom surface of the package; and

20           an optical waveguide including a plurality of unit waveguides provided with a plurality of optical output terminals formed in the same number as that of the light receiving elements formed on the substrates and a single optical input terminal, said optical waveguide attached to the bottom surface of the package,

25           wherein the optical output terminals are disposed in front of receiving portions of the light receiving elements attached to the substrates, and the optical input terminal is disposed coaxially with the optical fiber.

30           11. The optical receiving module with multiport as set forth in claim 10, wherein protuberances with a designated shape are formed on a bottom surface of a

cavity formed in the package, and concavities corresponding to the protuberances are formed in bottom surfaces of the substrates and the optical waveguide so that a passive alignment is achieved by  
5 coupling the protuberances to the concavities.

12. The optical receiving module with multiport as set forth in claim 11, wherein each of the protuberances formed on the bottom surface of the cavity of the package has a MESA structure provided  
10 with a side wall slanted at a designated angle.

13. The optical receiving module with multiport as set forth in claim 10, wherein the package is made of a material selected from the group consisting of ceramic, metal, resin, and their equivalents.

14. The optical receiving module with multiport  
15 as set forth in claim 10, wherein a guide pipe of the light collection means has an inner diameter the same as an outer diameter of a ferrule so that the ferrule is fixedly inserted into the guide pipe.

15. The optical receiving module with multiport  
20 as set forth in claim 10, wherein the electrical connection means is formed to have a connector or socket structure including contact points formed on both terminals of the structure for electrically  
25 connecting the light receiving elements and the external circuit board, and a matching circuit formed between the contact points for achieving impedance matching with the light receiving elements, said contact points to be connected to the external circuit  
30 board being horizontally protruded from one surface of the package.

16. The optical receiving module with multiport  
as set forth in claim 10, wherein the electrical  
connection means is formed to have a pin structure  
including contact points formed on both terminals of  
5 the structure for electrically connecting the light  
receiving elements and pins, and a matching circuit  
formed between the contact points for achieving  
impedance matching with the light receiving elements,  
said pins being horizontally protruded from one surface  
10 of the package and attached to the contact points.

17. The optical receiving module with multiport  
as set forth in claim 15 or 16, wherein the matching  
circuit is formed on a substrate with a designated  
dielectric constant.

18. The optical receiving module with multiport  
15 as set forth in claim 15 or 16, wherein the matching  
circuit has a multi-layered structure.

FIG. 1a

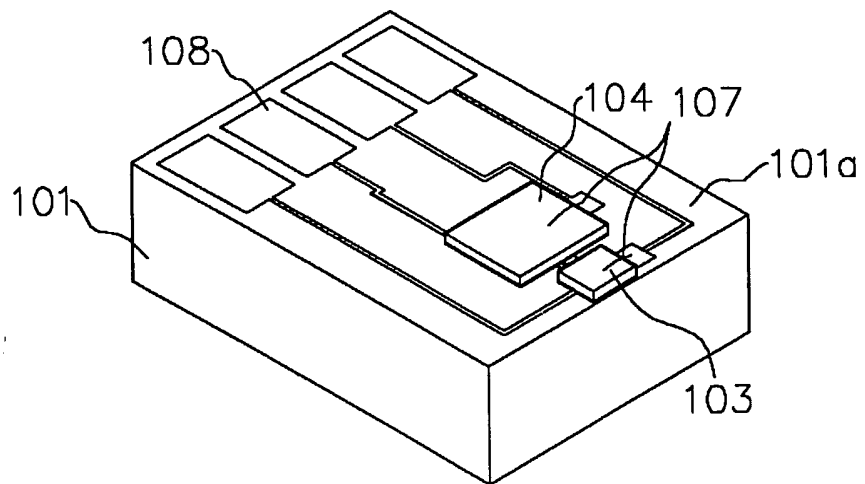


FIG. 1b

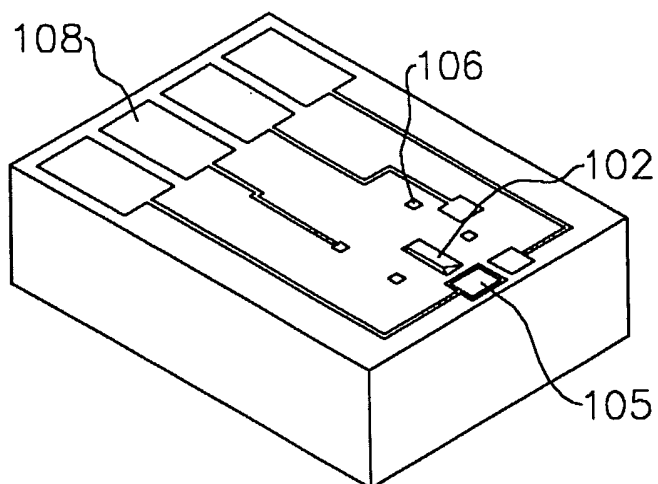


FIG. 1c

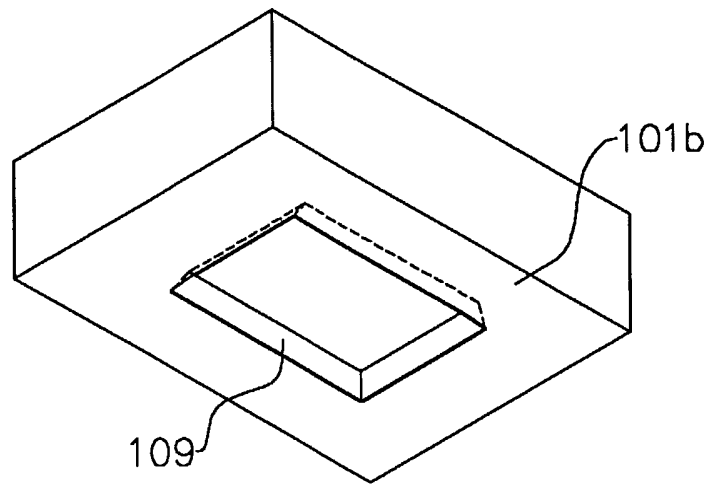


FIG. 2a

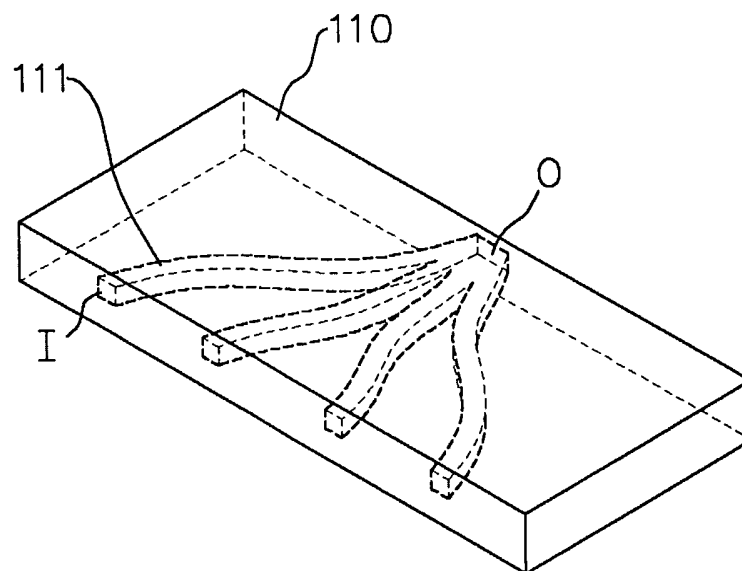


FIG. 2b

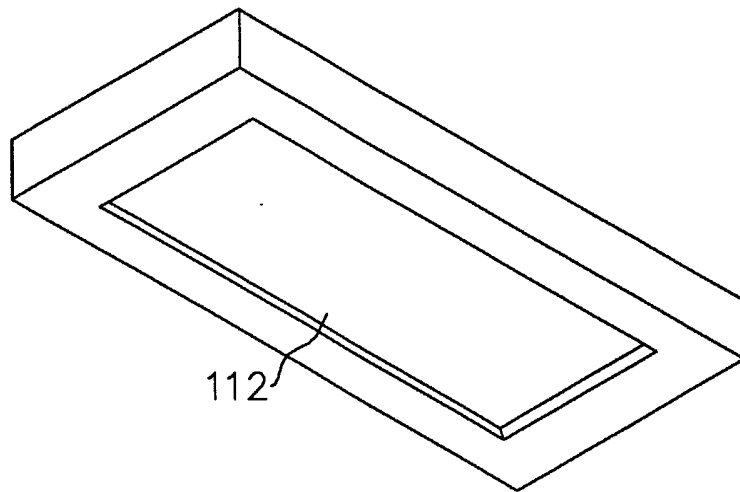


FIG. 3a

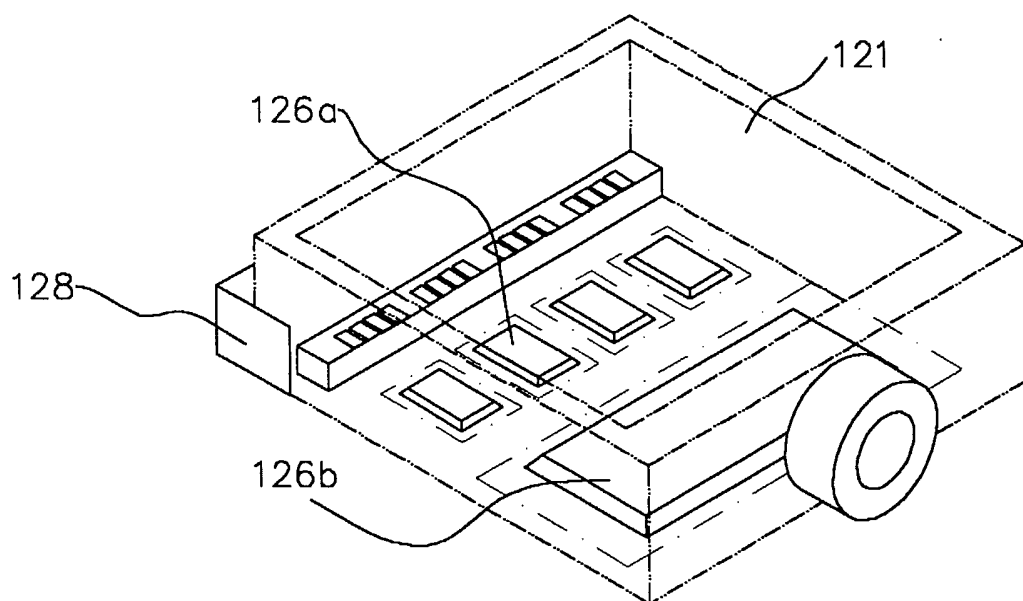


FIG. 3b

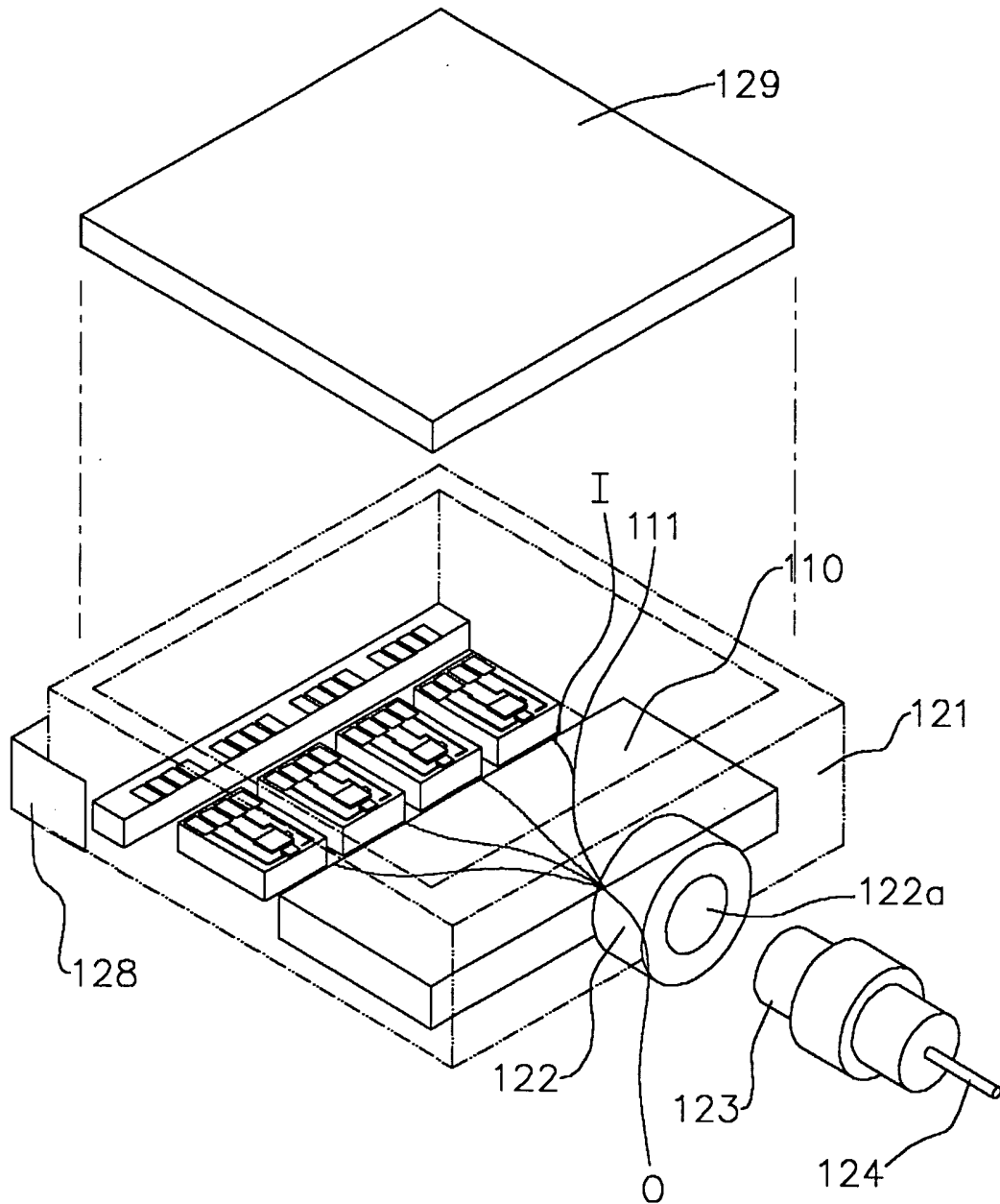


FIG. 4a

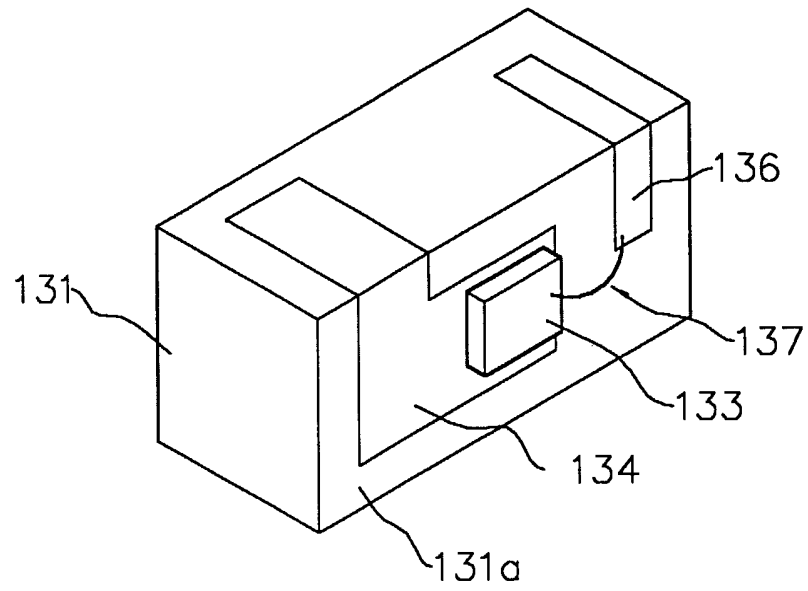


FIG. 4b

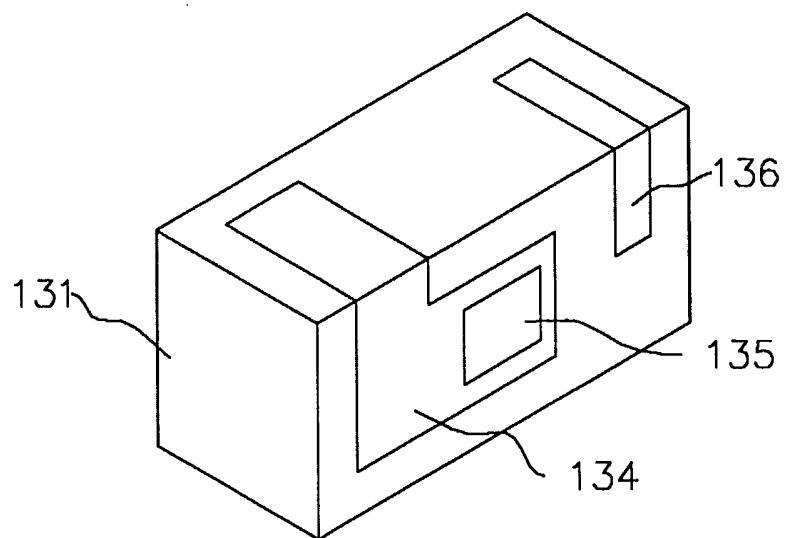


FIG. 4c

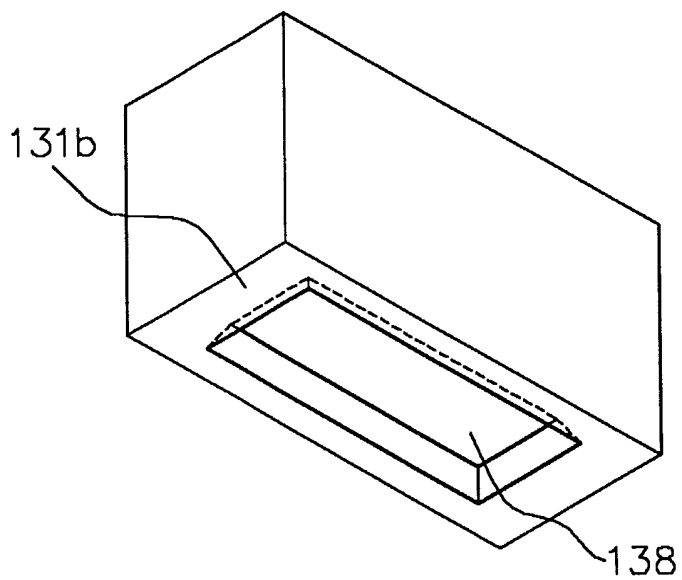


FIG. 5a

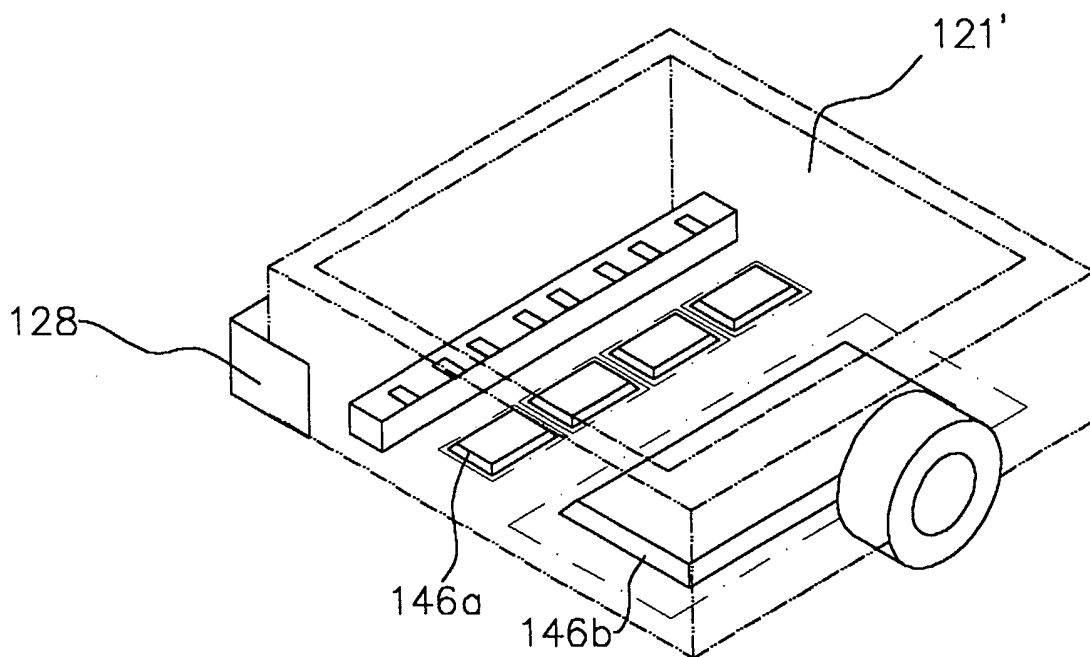


FIG. 5b

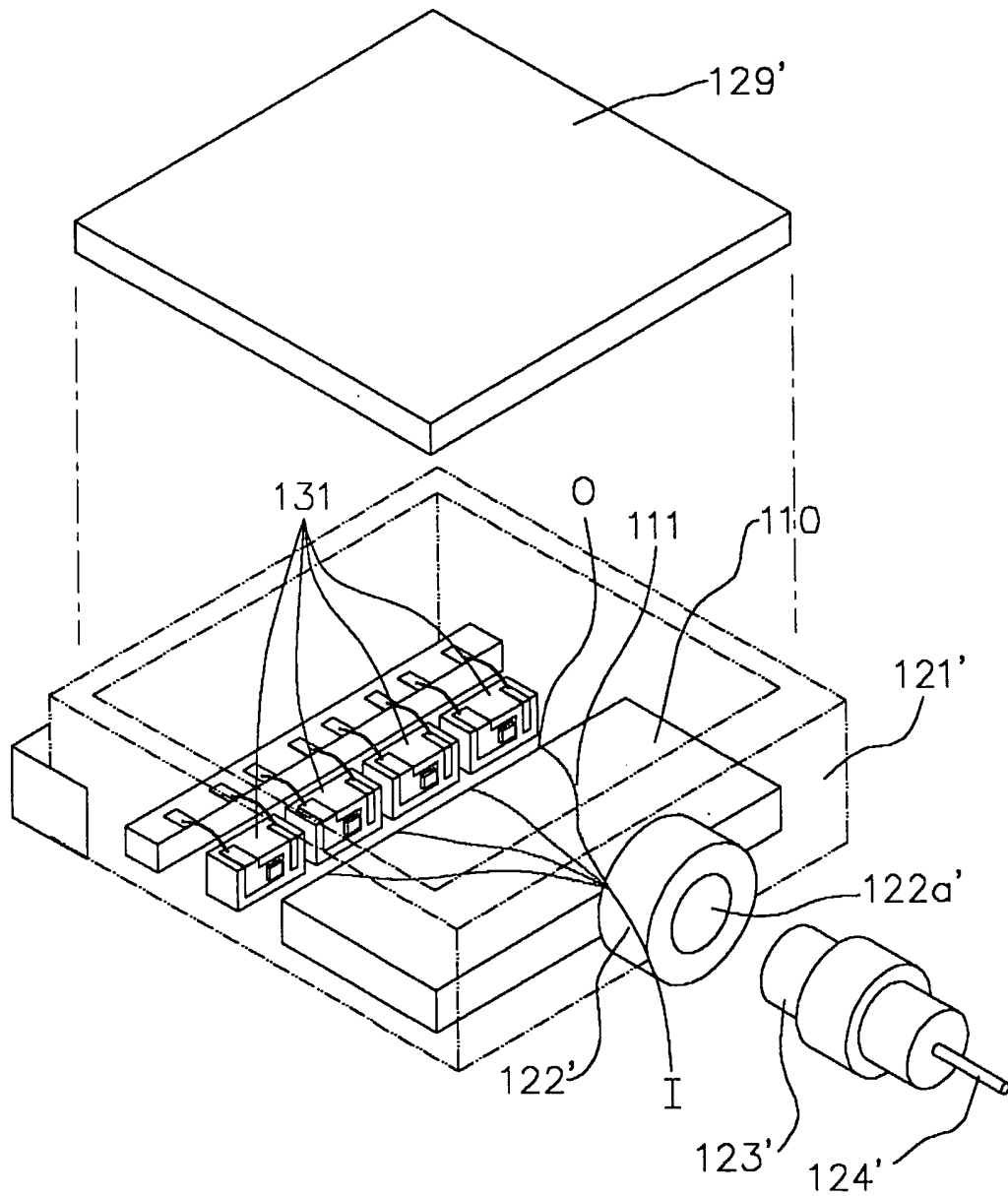


FIG. 6

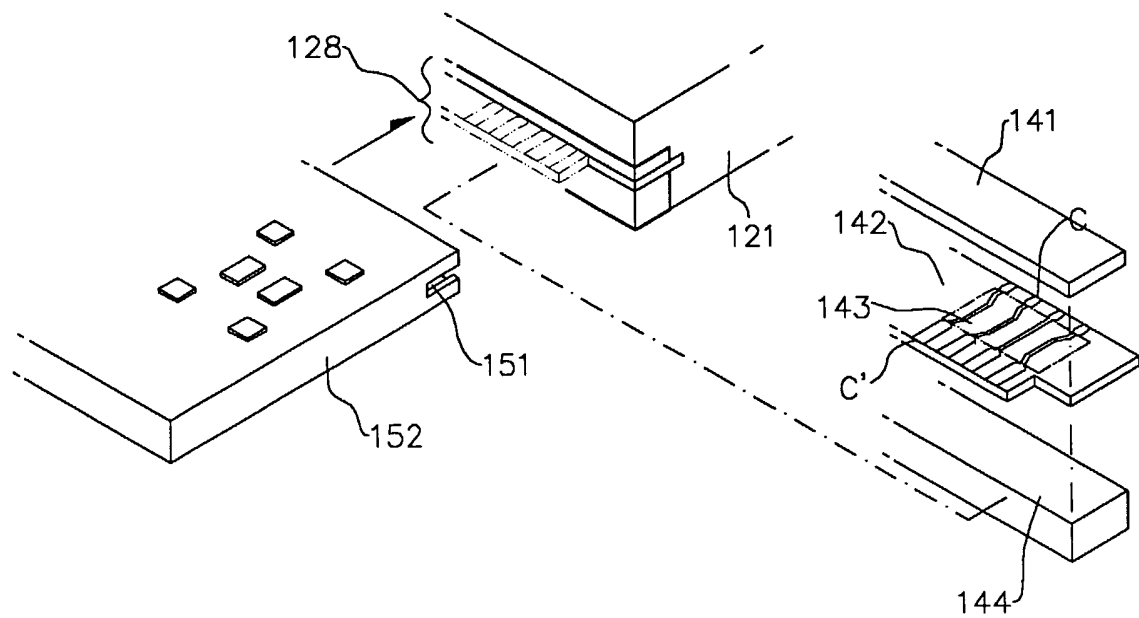


FIG. 7

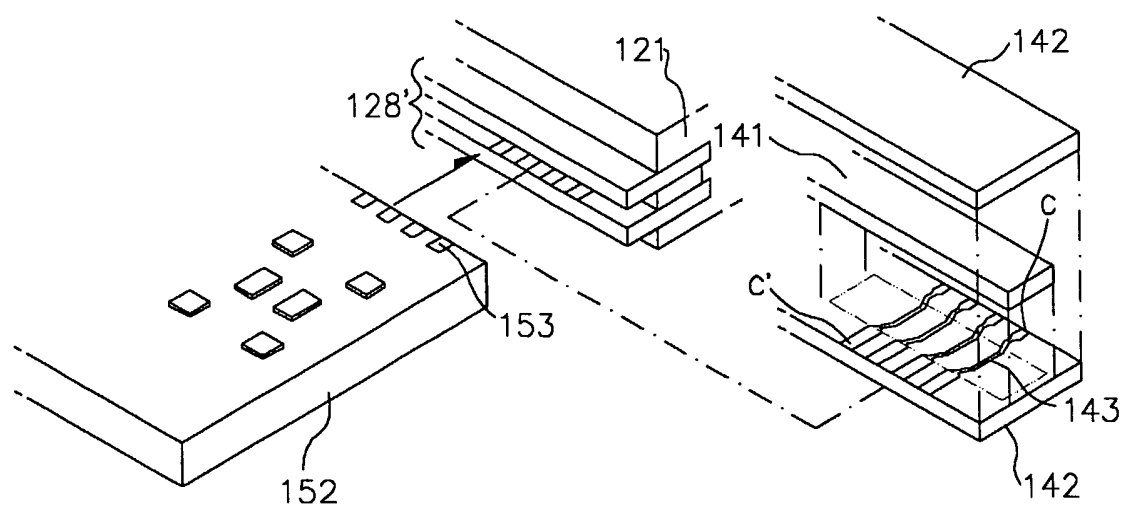
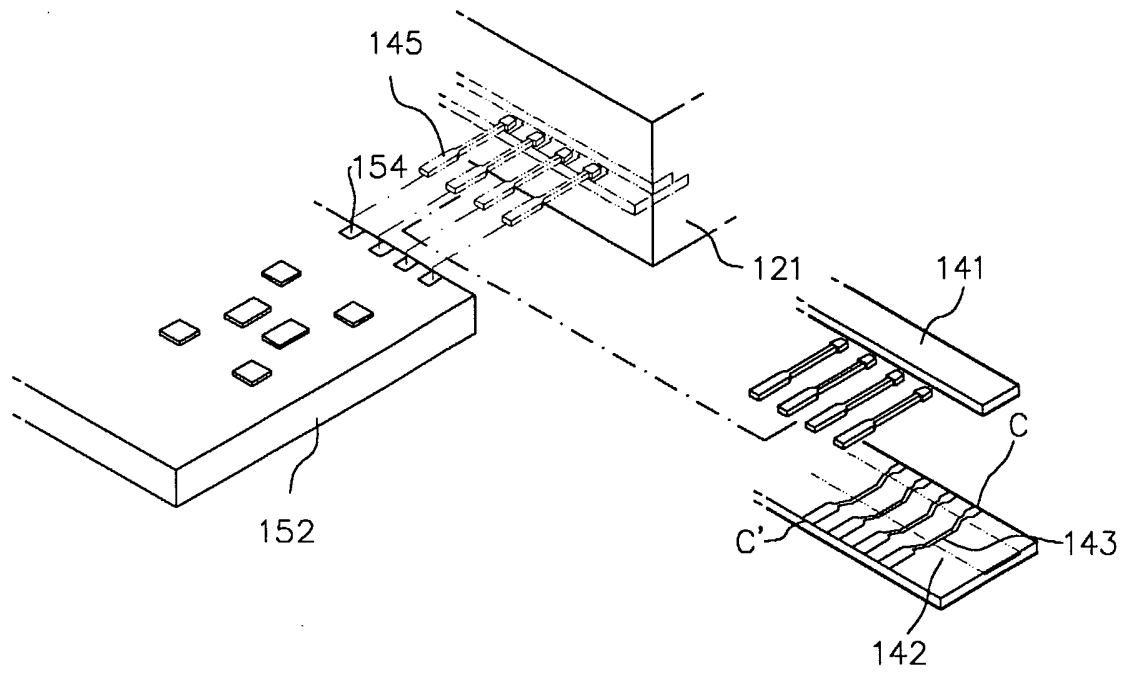


FIG. 8



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/KR03/01057**A. CLASSIFICATION OF SUBJECT MATTER****IPC7 H04B 10/02**

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)

IPC H04B, G02B, H01S

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)

KIPONET

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 06-102437 A (FUJISU LTD.) 15 APRIL 1994 See Abstract ; Figures 1~3	1, 10
----		-----
Y		2-9, 11-18
Y	US 5,450,431 A (AT & T Corp.) 12 SEPT. 1995 See column 1 line 5 ~ column 3 line 59; Figures 1 & 2.	1-18
Y	EP 0 864 893 A2 (NIPPON TELEGRAPH AND TELEPHONE CORP.) 16 SEPT. 1998 See page 24 line 1 ~ page 25 line 44; page 26 line 40 ~ page 29 line 24	2-9, 11-18
A	US 5,351,262 A (BELL COMM. RESEARCH, INC.) 27 SEPT. 1994 See the whole document	1, 10

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"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
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

08 SEPTEMBER 2003 (08.09.2003)

Date of mailing of the international search report

08 SEPTEMBER 2003 (08.09.2003)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office  
920 Dunsan-dong, Seo-gu, Daejeon 302-701,  
Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

PARK, Hyung Sik

Telephone No. 82-42-481-5702



**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

PCT/KR03/01057

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 06-102437 A	15-04-1994	NONE	
US 5,450,431 A	12-09-1995	CA 2154018 EP 0700135 JP 8083953 DE 69500953	03-03-1996 06-03-1996 06-03-1996 05-03-1998
EP 0 864 893 A2	16-09-1998	US 6222967	24-04-2001
US 5,351,262 A	27-09-1994	CA 2143944 WO 9406181 EP 0663109 JP 8501187 JP 2757235 DE 69329713	27-09-1994 17-03-1994 17-03-1994 19-07-1995 25-05-1998 31-05-2001