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(54) Abstract Title
Forming and optical source and receiver pair

(57) A method is provided for forming an optical source/receiver pair in which an optical source is placed on a lead frame 42 such that, in a powered condition, optical power from the source is directed perpendicularly to the plane of the lead frame 42. The frame is provided with alignment holes 50 oriented in relation to the optical source. An optical fiber 26 is positioned in an optical fiber carrier 14 having a front face 28 such that a free end of the optical fiber 26 is substantially even with the front face 28, the optical fiber carrier 14 having alignment holes 32 receiving pins 34. The fiber optical carrier 14 is located in juxtaposition to the lead frame 42 such that the pins 34 are in mating engagement with the alignment holes 50 to thereby align the optical fiber 26 with the optical source. Preferably the alignment means are a pin and hole pair.

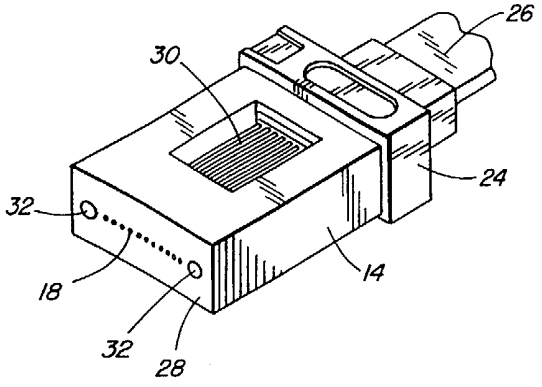

FIG. 2

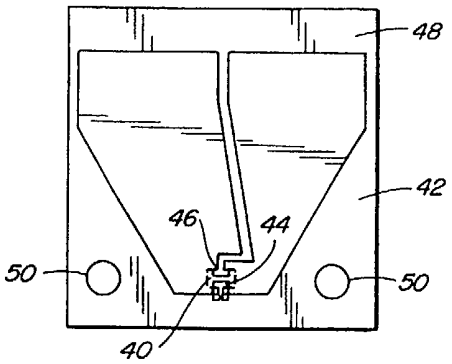

FIG. 3

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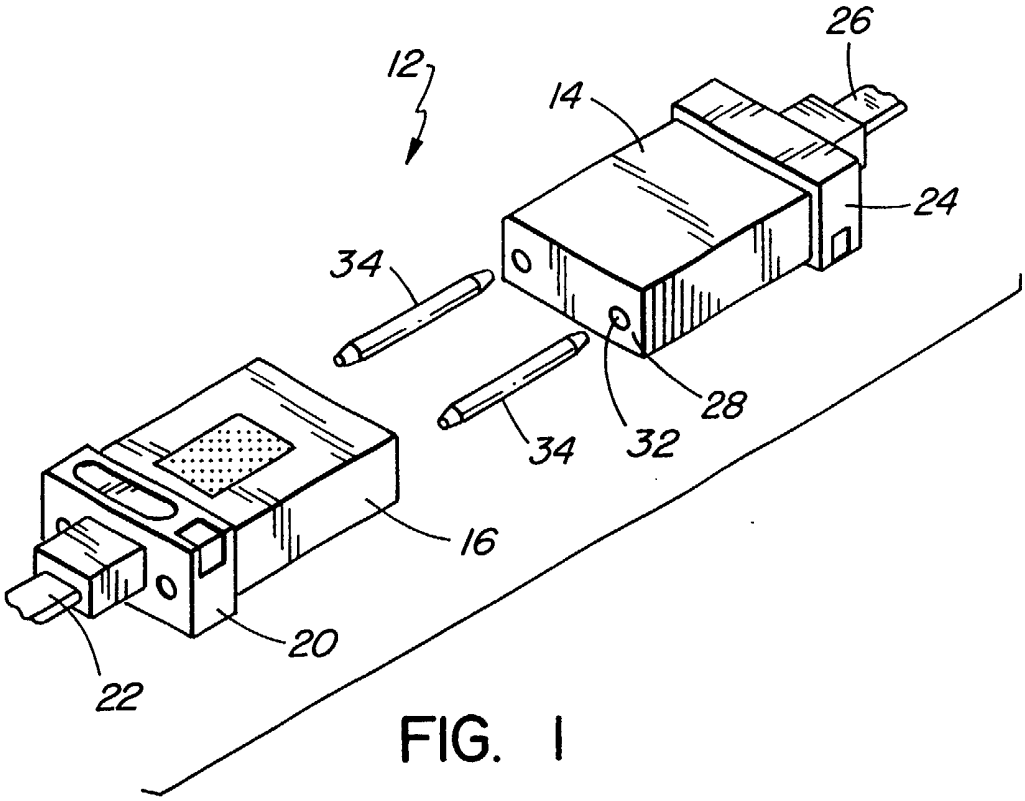

FIG. 1

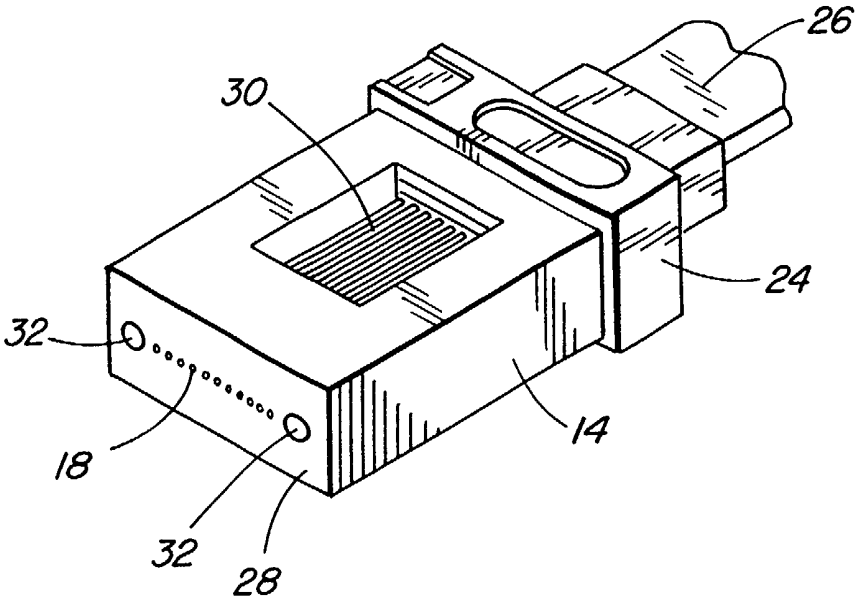

FIG. 2

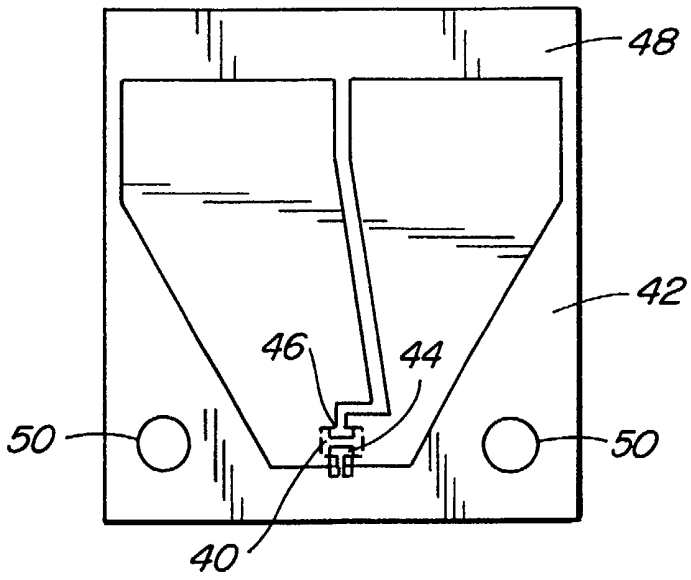

FIG. 3

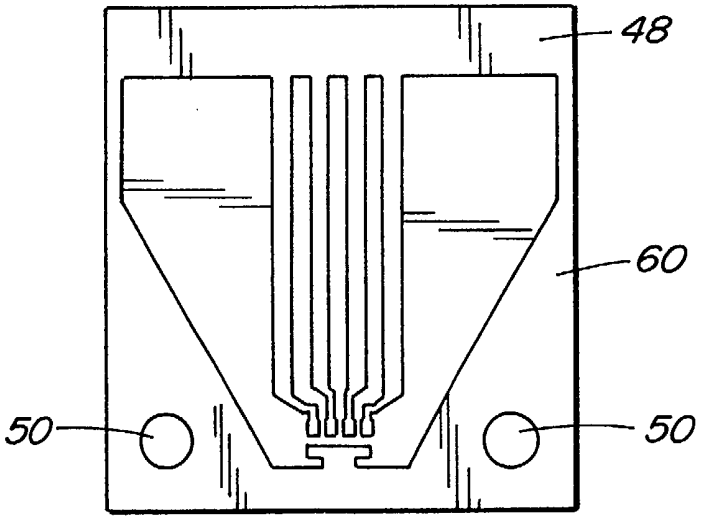

FIG. 4

"Method of Forming Optical Source/Receiver Pair"

This invention relates to a method of forming an optical source/receiver pair.

Optical sources such as laser diodes are commonly used for communication links over fiberoptic cables. The alignment of the fiberoptic thread-like transmission medium to a laser diode for the efficient transfer of optical power requires accurate positioning and alignment fixtures. The process is even more complex when an array of several sources and optical fibers are involved.

One of the prior art techniques has been to utilize silicon substrates and to etch, utilizing photolithographic alignment techniques, grooves in the substrate in order to accurately locate the optical fibers in relation to edge-emitting laser diodes.

Since testing of edge-emitting laser diodes prior to assembly is unreliable, it is not uncommon for arrays to be assembled only to fine that the lasers do not meet wavelength or power output requirements. This results in low assembly yields which in turn increases the module costs.

Recent developments in surface-emitting laser diode technology has meant that more traditional and well-proven processing techniques can be utilized in the fabrication of laser arrays. This has resulted in devices having metalization configurations applicable to flip-chip bonding, thereby eliminating assembly problems associated with wire bonding.

It is an object of the present invention to provide an efficient method of forming an optical source/receiver pair in which the optical source is accurately aligned in relation to an optical fiber.

According to the present invention, there is provided a method of forming an optical source/receiver pair comprising the steps of:

placing an optical source on a lead frame such that, in a powered condition, optical power from said source is directed perpendicularly to the plane of said lead frame, said lead frame being provided with a first alignment means oriented in relation to said optical source;

positioning an optical fiber in an optical fiber carrier having a front face such that a free end of said optical fiber is substantially even with said front face, said optical fiber carrier having second alignment means which are complementary to said first alignment means; and

locating said fiber optical carrier in juxtaposition to said lead frame such that said alignment means are in mating engagement to thereby align said optical fiber to said optical source.

In accordance with a preferred embodiment of the present invention, a plurality of optical sources, such as surface-emitting lasers, are fixed in a predetermined arrangement to said lead frame and a plurality of optical fibers are positioned in said optical fiber carrier in the same arrangement as said optical sources whereby each of said optical sources has a mating optical fiber end. The first and second alignment means may comprise a complementary pin and hole pair.

Reference is also made to British Patent Application No. from which the present application is divided.

In order that the invention may be more fully understood a preferred method in accordance with the invention will now be described, by way of example, with reference to the attached drawings, wherein:

Figure 1 is a perspective view of the source/detector pair;

Figure 2 is an enlarged view of the fiberoptic array;

Figure 3 is a plan view of a lead frame for receiving a single laser diode; and

Figure 4 is a plan view of a lead frame for receiving a laser array.

As shown in Figure 1 the module 12 according to the present invention includes fiberoptic ferrule 14 and laser array housing 16. Housing 16 includes cable attachment means 20 for supporting electrical cable 22 which provides electrical power to the laser array as will be discussed hereinafter. Optical fiber ferrule 14 includes cable harness 24 for supporting fiber optic cable 26 which in turn transfers optical signals received on individual optical fibers to downstream receivers such as discreet photo diodes (not shown).

Front face 28 of ferrule 14 has exposed end faces 18 of individual optical fibers 30 as best seen in Figure 2. The end face of each fiber is polished as is well-known for receiving an optical signal thereon. End face 28 of ferrule 14 is also provided with alignment holes 32 which, in a preferred embodiment, are configured to receive pins 34. Pins 34 may be either permanently secured in holes 32 or they may be removable as shown in Figure 1. It is to be understood, however, that pins 34 when inserted in holes 32 are firmly held therein to ensure proper alignment as will be discussed later.

As shown in Figure 2 optical fibers 30 extend from front face 28 through to the cable 26 for transferring

optical signals to appropriate receivers downstream. While Figure 2 shows an array of optical fibers it is to be understood that the unit may have only one fiber.

Encased within housing 16 is a substrate (not shown) for connection to cable 22 in order to provide electrical power to the laser diode 40 shown in dotted line in Figure 3. The carrier or lead frame 42 shown in Figure 3 is connected to the substrate and to laser diode 40 via contact pads 44 and 46. This configuration permits flip-chip bonding of laser diode to the pads while permitting the surface-emitting laser to provide a collimated beam in a direction away from the plane of the contacts. As is known, the end strip 48 is removed after the laser has been attached and the package otherwise completed in order to isolate the two pads 44 and 46.

Lead frame 42 also has holes 50 which are precisely aligned in relation to the bonding pads 44,46.

Figure 4 illustrates an alternate lead frame structure which is intended to accommodate a four-laser diode array. The lead frame design, also, is such that the flip-chip bonding pads results in the accurate placement of the diode devices on the metal frame.

Lead frame 60 of Figure 4 is also provided with holes 50 which as in the single laser embodiment of Figure 3 are accurately positioned with respect to the bonding pad locations. Although the lead frame 60 of Figure 4 shows four discreet bonding pads it will be apparent to one skilled in the art that this method is well-suited to arrays having many more laser devices. Similarly, optical housing 14 can accommodate a large number of optical fibers spaced apart on the same centers as the optical sources.

As indicated previously, guide pins 34 when positioned in holes 32 in the ferrule and holes 50 in the lead frame accurately position the optical sources in relation to the end faces of the optical fibers.

In assembly, one or more laser diodes is attached to the appropriate lead frame by flip-chip bonding techniques. This permits accurate positioning of the devices with respect to the alignment holes. The lead frame is clipped to remove the shorting strip and contacts are made to the power connections by well-known means. Some form of protections such as encapsulation or protection plate will support the laser diode array and protect the surface-emitting lasers. Because surface-emitting lasers emit a collimated beam no optical elements are required in order to

obtain good optical coupling of optical power into the optical fiber.

The optical fiber ferrule having a single fiber or an array of fibers in an arrangement which matches the laser array is then mated with the laser housing such that the guide pins accurately locate one component in relation to the other.

Other securing means to hold the two components in mating engagement may be used if desired.

While particular embodiments of the invention have been disclosed and illustrated, it will be apparent that certain variations can be made to the basic concept. It is intended that such variations will fall within the scope of the present invention as defined by the appended claims.

CLAIMS:

1. A method of forming an optical source/receiver pair comprising the steps of:

placing an optical source on a lead frame such that, in a powered condition, optical power from said source is directed perpendicularly to the plane of said lead frame, said lead frame being provided with a first alignment means oriented in relation to said optical source;

positioning an optical fiber in an optical fiber carrier having a front face such that a free end of said optical fiber is substantially even with said front face, said optical fiber carrier having second alignment means which are complementary to said first alignment means; and

locating said fiber optical carrier in juxtaposition to said lead frame such that said alignment means are in mating engagement to thereby align said optical fiber to said optical source.

2. A method as defined in claim 1, wherein a plurality of optical sources are fixed in a predetermined arrangement to said lead frame and a plurality of optical fibers are positioned in said optical fiber carrier in the same arrangement as said optical sources whereby each of said optical sources has a mating optical fiber end.

3. A method as defined in claim 1 or 2, wherein said first and second alignment means comprise a complementary pin and hole pair.

4. A method as defined in claim 1, 2 or 3, wherein said optical sources are surface-emitting lasers.

5. A method as defined in claim 4, wherein said surface-emitting lasers are attached to said lead frame by flip-chip bonding.

6. A method as defined in claim 1, 2, 3, 4 or 5, wherein a distal end of the or each said optical fiber is coupled to a photodiode.

7. A method of forming an optical source/receiver pair, substantially as hereinbefore described with reference to the accompany drawings.

Application No: GB 0118319.3
Claims searched: 1-7

Examiner: Richard Nicholls
Date of search: 10 October 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): G2J (JGED)

Int Cl (Ed.7): G02B

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	WO 94/28448 A1	(Bandgap) see especially figure 2a	1,2 and 3
X	US 5473716 A	(Motorola) see especially figures 1 and 3 and column 2 lines 33-37	1 and 2

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.