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(54) **OPTICAL ENGINE ASSEMBLY AND TRANSCEIVER USING THE SAME**

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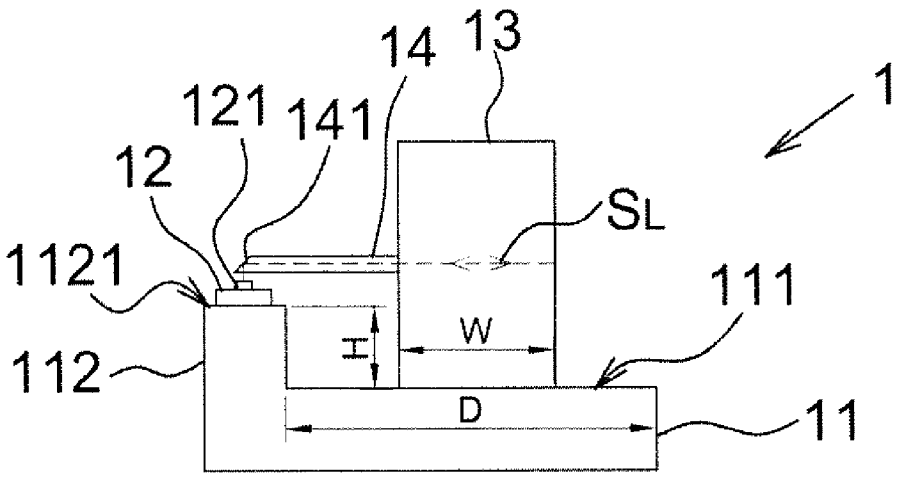
(57) **ABSTRACT**

An optical engine assembly includes a bench, an optoelectronic device, a fixed member and a plurality of fibers. The bench has a bearing surface and an extended sidewall with a predetermined height from the bearing surface. The sidewall has an upper surface parallel to the bearing surface. The optoelectronic device is disposed on the center of the upper surface and includes a plurality of active areas. The fixed member is disposed on the bearing surface and has a plurality of through holes and two pin holes. The fibers respectively pass through the through holes and a 45-degree beveled surface is formed at the front end of each fiber. The 45-degree beveled surfaces are aligned with the active areas, respectively.



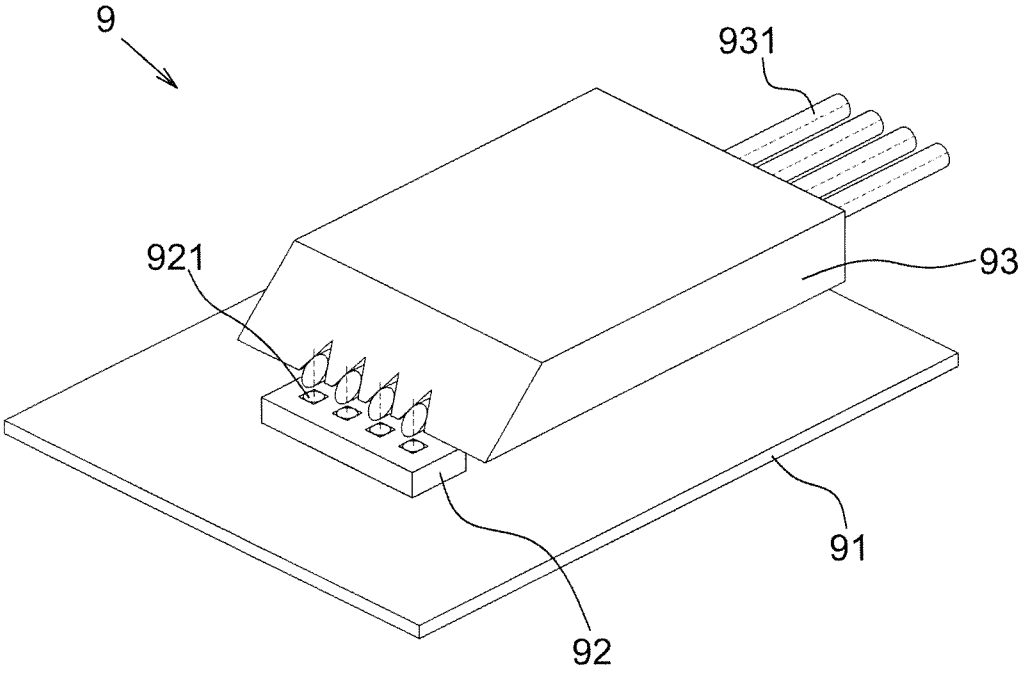


FIG. 1 (Prior Art)

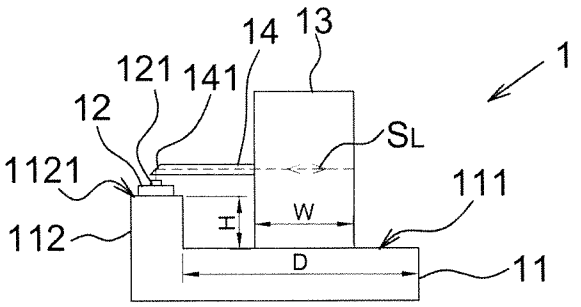


FIG. 2

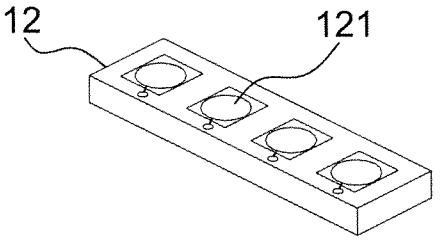


FIG. 3A

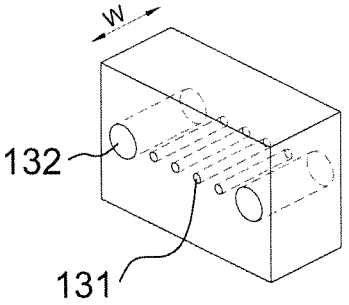


FIG. 3B

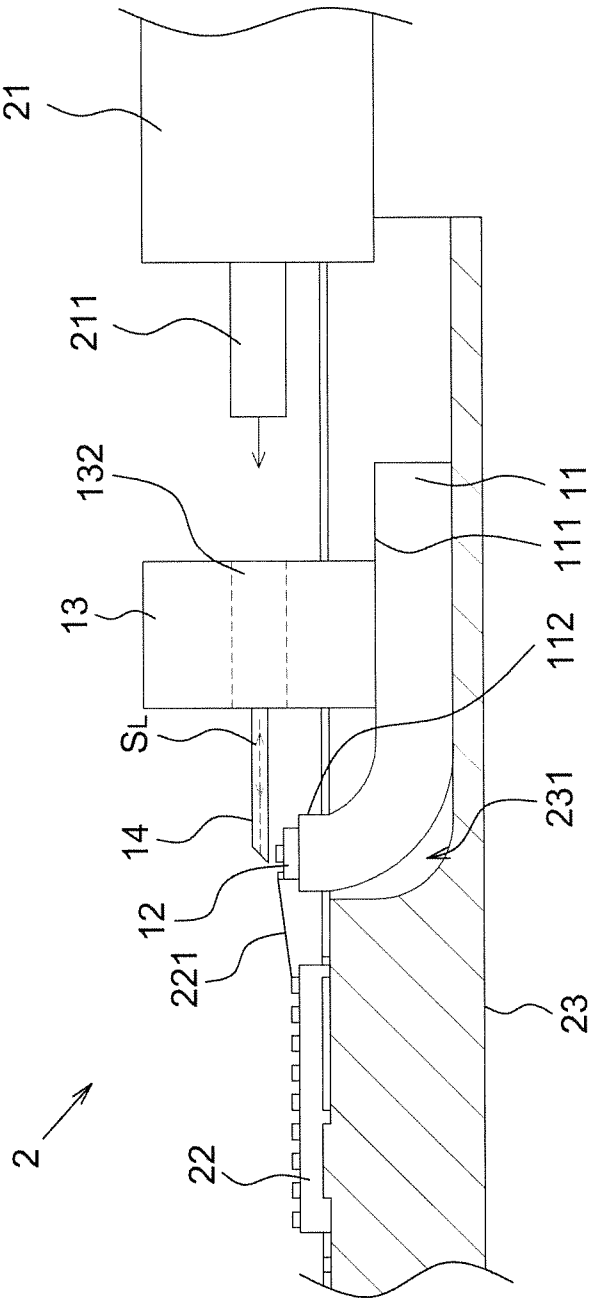


FIG. 4A

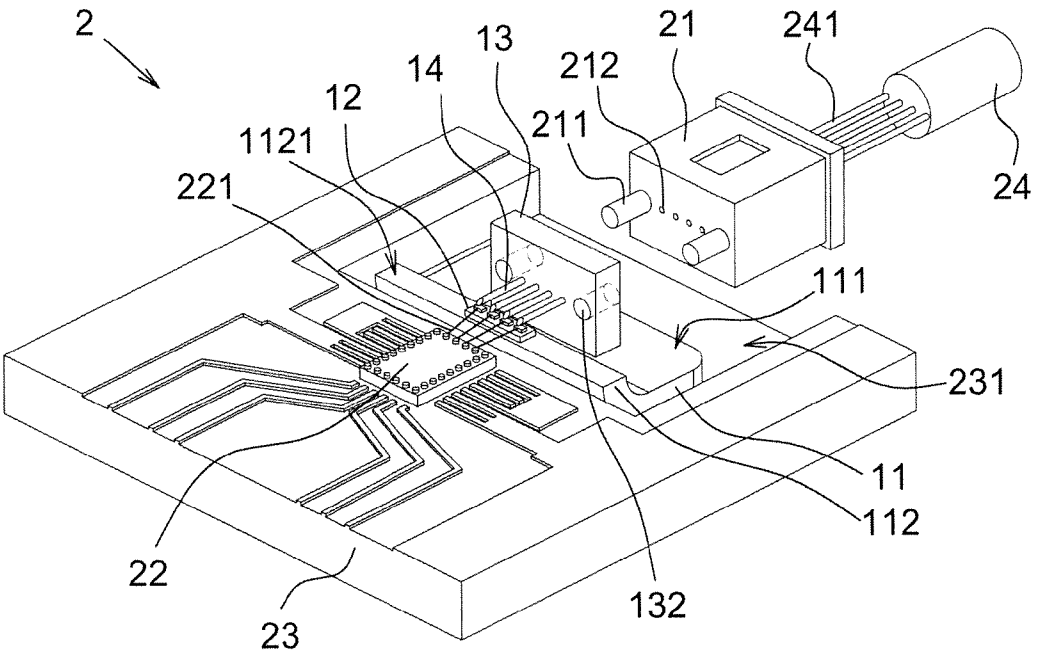

2
13
21
241
14
212
12
211
1121
221
24
111
231
11
112
22
23
132

FIG. 4B

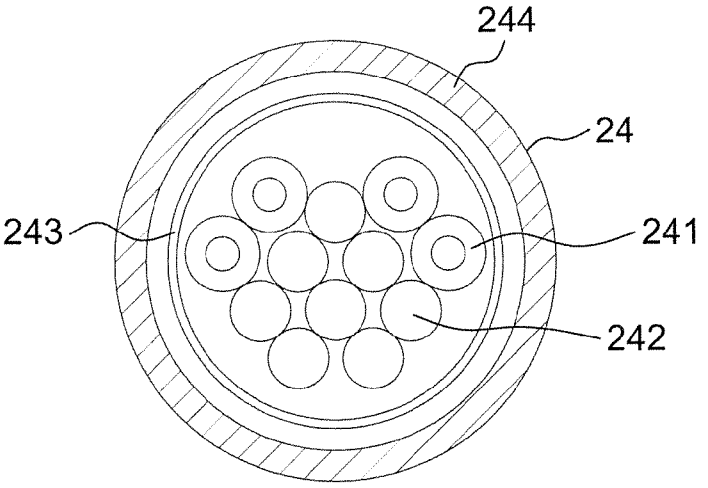

244
24
243
241
242

FIG. 5

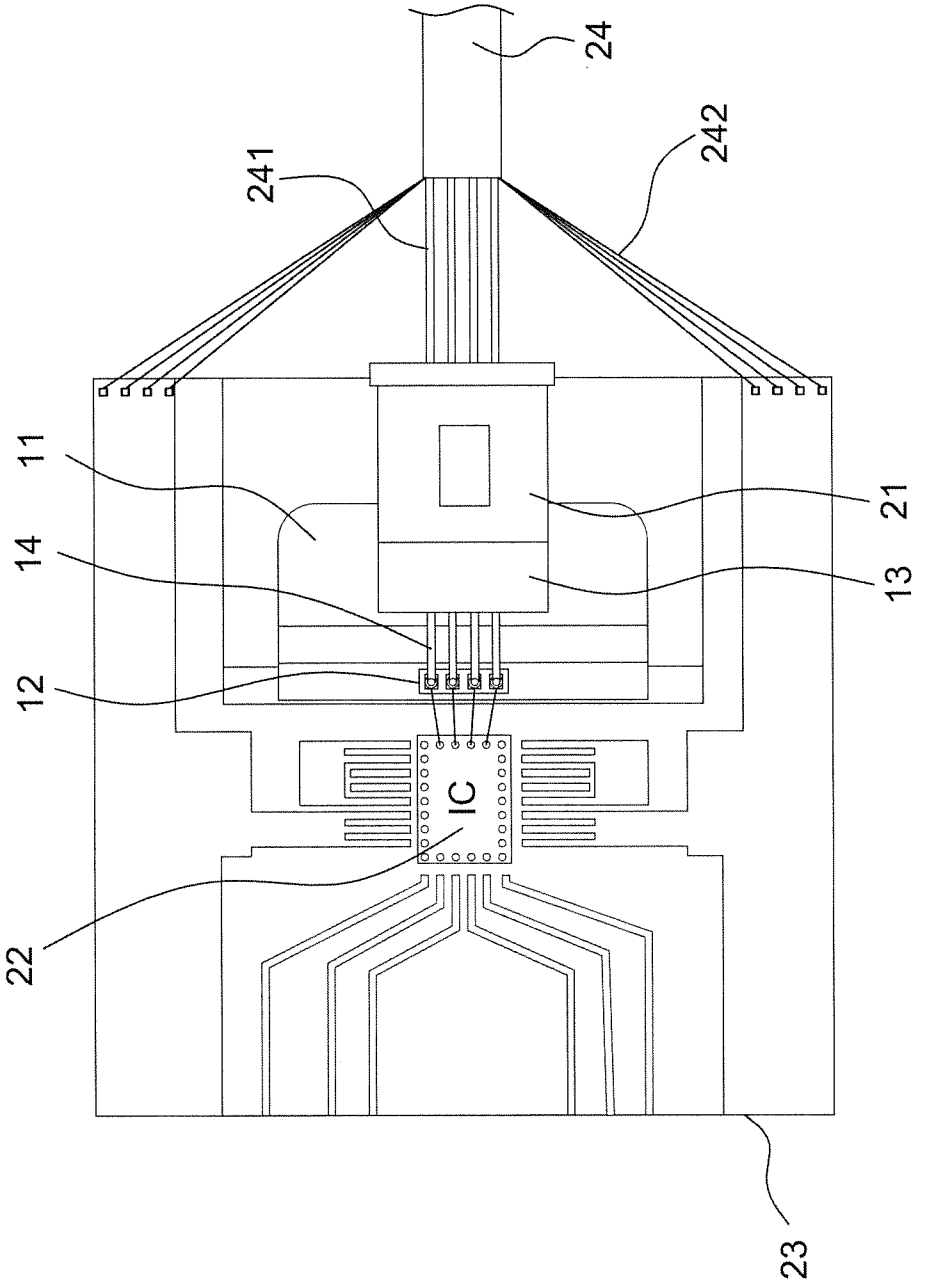


FIG. 6

OPTICAL ENGINE ASSEMBLY AND TRANSCEIVER USING THE SAME

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority benefit of Taiwan Patent Application Serial Number 101138171, filed on Oct. 16, 2012, the full disclosure of which is incorporated herein by reference.

BACKGROUND

[0002] 1. Field of the Disclosure

[0003] This disclosure generally relates to a communication device and, more particularly, to an optical engine assembly and a transceiver using the same.

[0004] 2. Description of the Related Art

[0005] Referring to FIG. **1**, it shows a schematic diagram of a transmitter **9** in the conventional optical communication system, and the transmitter **9** includes a printed circuit board **91**, an optoelectronic device **92** and a deflection device **93**.

[0006] The optoelectronic device **92** is disposed on the printed circuit board **91** and electrically connected to a chip (not drawn herein) so as to convert the electric signals from the chip to optical signals and then emit the optical signal upward perpendicular to the printed circuit board **91**. The deflection device **93** includes a plurality of optical fibers **931** whose front ends are formed with metal sputtered 45-degree beveled surfaces to reflect the optical signals from vertical to horizontal. The horizontal optical signals may be transmitted to an external transmission line via a connector (not drawn herein).

[0007] In the art, how to align the 45-degree beveled surfaces of the optical fibers **931** with the laser chips **921** of the optoelectronic device **92** is an important issue; and an accurate alignment can reduce the coupling loss such that the optical signals can have a better quality. However, as the printed circuit board **91** does not have good flatness (e.g. 100 μm normally), it is difficult to precisely align the optoelectronic device **92**, which is directly disposed on the printed circuit board **91**, in the following manufacturing process.

[0008] Accordingly, the present disclosure provides an optical engine assembly and a transceiver using the same in which the optoelectronic device is disposed on a metal bench having a simple structure thereby simplifying the manufacturing process and a good flatness thereby improving the alignment accuracy. The manufacturing cost is also reduced.

SUMMARY

[0009] The present disclosure provides an optical engine assembly and a transceiver using the same that may reduce the manufacturing cost, improve the manufacturing efficiency and improve the optical coupling efficiency.

[0010] The present disclosure further provides an optical engine assembly and a transceiver using the same that use a metal bench to bear optoelectronic devices thereby having high heat dissipation efficiency.

[0011] The present disclosure further provides an optical engine assembly and a transceiver using the same that use a metal bench having a simple structure to bear optoelectronic devices so as to simplify the manufacturing procedure.

[0012] The present disclosure further provides a transceiver that may transmit and receive optical signals and electrical signals simultaneously.

[0013] The present disclosure provides an optical engine assembly including a bench, an optoelectronic device, a fixed member and a plurality of optical fibers. The bench has a bearing surface and an extended sidewall with a predetermined height from an edge of the bearing surface. The extended sidewall has an upper surface parallel to the bearing surface. The optoelectronic device is disposed on a center of the upper surface and includes a plurality of active areas. The fixed member is disposed on the bearing surface and has a plurality of through holes and two pin holes. The optical fibers respectively pass through the through holes and a 45-degree beveled surface is formed at a front end of each of the optical fibers. The 45-degree beveled surfaces are aligned with the active areas, respectively.

[0014] The present disclosure further provides a transceiver including an optical engine assembly, a connector, a control chip, a substrate and a transmission line. The bench has a bearing surface and an extended sidewall with a predetermined height from an edge of the bearing surface. The extended sidewall has an upper surface parallel to the bearing surface. The optoelectronic device is disposed on a center of the upper surface and includes a plurality of active areas. The fixed member is disposed on the bearing surface and has a plurality of through holes and two pin holes. A plurality of optical fibers pass through the through holes respectively and a 45-degree beveled surface is formed at a front end of each of the optical fibers. The 45-degree beveled surfaces are aligned with the active areas, respectively. The connector is disposed on the bearing surface and has two dowel pins configured to insert into the two pin holes of the fixed member. The control chip is coupled to the optoelectronic device. The optical engine assembly and the control chip are disposed on the substrate. The transmission line has a plurality of transmission fibers and a plurality of copper wires. The transmission fibers are respectively optically coupled to the optical fibers of the optical engine assembly via the connector and the copper wires are electrically connected to a circuit layout on the substrate.

[0015] The present disclosure further provides a transceiver including a printed circuit board, a control chip, an optical engine assembly and a transmission line. The control chip is disposed on the printed circuit board and is configured to generate or receive electrical signals. The optical engine assembly is disposed on the printed circuit board and coupled to the control chip and is configured to generate or receive optical signals. The transmission line is coupled to the optical engine assembly and the printed circuit board and includes 4 transmission fibers and 7 copper wires, wherein the 4 transmission fibers are configured to transmit the optical signals with transition minimized differential signaling (TMDS) data and the 7 copper wires are configured to transmit the electrical signals.

[0016] In an embodiment, the bench is made of metal materials such as zinc alloy or copper alloy.

[0017] In an embodiment, the connector is a standard MT connector.

[0018] In the optical engine assembly and the transceiver using the same according to the present disclosure, the number of optical fibers included by the optical engine assembly and the transmission line is determined according to the data format to be transmitted, e.g. 4 optical fibers may be included for transmitting TMDS data when high-definition multimedia interface (HDMI) data is transmitted. In other embodiments, one optical fiber may be used to transmit TMDS data.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Other objects, advantages, and novel features of the present disclosure will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

[0020] FIG. **1** shows a schematic diagram of the transmitter of the conventional optical fiber communication system.

[0021] FIG. **2** shows a side view of the optical engine assembly according to an embodiment of the present disclosure.

[0022] FIG. **3**A shows a perspective view of the optoelectronic device of the optical engine assembly according to the embodiment of the present disclosure.

[0023] FIG. **3**B shows a perspective view of the fixed member of the optical engine assembly according to the embodiment of the present disclosure.

[0024] FIG. **4**A shows a side view of the transceiver according to an embodiment of the present disclosure.

[0025] FIG. **4**B shows a perspective view of the transceiver according to an embodiment of the present disclosure.

[0026] FIG. **5** shows a cross-sectional view of the transmission line coupled to the transceiver according to the embodiment of the present disclosure.

[0027] FIG. **6** shows a top view of the transceiver according to an embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE EMBODIMENT

[0028] It should be noted that, wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0029] Referring to FIG. **2**, it shows a schematic diagram of the optical engine assembly according to an embodiment of the present disclosure. The optical engine assembly **1** is connected to a transmission line via a standard multi-terminal (MT) connector (described later) so as to send optical signals to the transmission line or receive optical signals from the transmission line. The optical engine assembly **1** includes a bench **11**, an optoelectronic device **12**, a fixed member **13** and a plurality of optical fibers **14**.

[0030] The bench **11** is configured to bear the optoelectronic device **12** and the fixed member **13**. The bench **11** includes a bearing surface **111** and an extended sidewall **112** with a predetermined height H from an edge (e.g. the left edge shown in the figure) of the bearing surface **111**. The sidewall **112** has an upper surface **1121** parallel to the bearing surface **111**. In this embodiment, the bench **11** is made of metal materials such as zinc alloy or copper alloy. For example, the bench **11** may be manufactured by compression molding or metal injection molding so as to obtain high flatness (within 10 μm).

[0031] The optoelectronic device **12** is disposed on a center of the upper surface **1121** of the extended sidewall **112** and includes a plurality of active areas **121** (as shown in FIG. **3**A), and the active areas **121** may be laser chips configured to convert electrical signals to optical signals or photodetectors configured to detect optical signals and convert the optical signals to electrical signals. The number of the active areas **121** is determined according to the number of channels needed by the communication system, e.g. 4 channels shown herein. In an embodiment, a part of the plurality of optoelectronic devices **12** may be photodetectors and the others may be laser chips so as to form a transceiver of the communication system.

[0032] The fixed member **13** is disposed on the bearing surface **111** and includes a plurality of through holes **131** and two pin holes **132**. An extended direction of the fixed member **13** is preferably parallel to the bearing surface **111** and has a width W (as shown in FIG. **3**B); wherein the plurality of through holes **131** are configured to fix the optical fibers **14** therein and the two pin holes **132** are configured to be inserted by two dowel pins (described later) of a standard MT connector so as to combine with the standard MT connector. In this embodiment, a pitch of the plurality of through holes **131** is, for example, 250 μm to match the standard MT connector. The prescribed pitch may be customized according to different applications. In an embodiment, the fixed member **13** may be manufactured by injection molding, and the through holes **131** and the two pin holes **132** are corresponding to the standard MT connector. In another embodiment, the fixed member **13** may be a part of the standard MT connector (e.g. made by cleaving the standard MT connector) such that the through holes **131** and the two pin holes **132** correspond to the standard MT connector. Similarly, the number of the through holes **131** is determined according to the number of the required channels.

[0033] In an embodiment, a depth D of the bearing surface **111** from the sidewall **112** is preferably larger than the width W of the fixed member **13**, e.g. about 1 mm difference, so as to be convenient for assembling.

[0034] The optical fibers **14**, for example, may be bare fibers; each of the optical fibers **14** passes through the through holes **131** and an front end of each of the optical fibers **14** forms a 45-degree beveled surface **141** configured to deflect optical signals S_L. Therefore, the 45-degree beveled surfaces **141** are aligned with the active areas **121** respectively. In addition, for improving a reflection coefficient of the 45-degree beveled surfaces **141**, one or a plurality of layers of metal or dielectric film(s) may be coated thereon.

[0035] Referring to FIG. **4**A and FIG. **4**B, FIG. **4**A shows a side view of the transceiver according to an embodiment of the present disclosure; FIG. **4**B shows a perspective view of the transceiver according to an embodiment of the present disclosure. The transceiver **2** according to this embodiment is configured to transmit the optical signals S_L generated by the optical engine assembly **1** shown in FIG. **2** to a transmission line via a standard MT connector or receive the optical signals S_L from the transmission line to the optical engine assembly **1** via the standard MT connector.

[0036] The transceiver **2** includes the optical engine assembly **1**, a connector **21**, a control chip **22**, a substrate **23** and a transmission line **24**; wherein the optical engine assembly **1** and the control chip **22** are disposed on the substrate **23**. The substrate **23** may be a printed circuit board (PCB) and a circuit layout if formed thereon according to operating requirements. As shown in FIG. **2**, the optical engine assembly I includes the bench **11**, the optoelectronic device **12**, the fixed member **13** and the optical fibers **14**, and thus redundant explanation is omitted herein. In addition, the substrate **23** preferably includes a recess **231** configured to accommodate the optical engine assembly **1** so as to shorten a distance between the optoelectronic device **12** and the control chip **22** thereby shortening the wire bonding length. However, the

recess **231** may not be implemented according to different applications. In an embodiment, the recess **231** is made by mechanical work.

[0037] The connector **21** may be a standard MT connector, and a part of the connector **21** is mounted on the bearing surface **111** of the optical engine assembly **1**. The connector **21** has two dowel pins **211** configured to insert into the two pin holes **132** of the fixed member **13** for combination. As mentioned above, the connector **21** has a plurality of fixed holes **212** corresponding to the through holes **131** of the fixed member **13** for external fibers **241** to insert therein. When the connector **21** is combined with the fixed member **13** through the two dowel pins **211** and secured on the bearing surface **111**, the above-mentioned external fibers **241** are optically coupled to a side of the optical fibers **14** away from the 45-degree beveled surface **141**. It is appreciated that the fixed member **13** and the connector **21** may be made according to practical applications as long as they are matched to each other; i.e., the connector **21** may not be a standard MT connector.

[0038] The control chip **22** may be coupled to the optoelectronic device **12** via wire bonding or a circuit layout on the substrate **23**. More specifically speaking, the control chip **22** is electrical connected to the active areas **121** of the optoelectronic device **12**. When the active areas **121** are laser chips, the laser chips covert electrical signals from the control chip **22** to optical signals and emit the optical signals to the 45-degree beveled surface **141** of the optical fibers **14** along the direction perpendicular to the bearing surface **111**. When the active areas **121** are photodetectors, the photodetectors convert optical signals from the optical fibers **14** to electrical signals and then send the electrical signals to the control chip **22** for processing.

[0039] Referring to FIG. **5**, it shows a cross-sectional view of the transmission line coupled to the transceiver according to the embodiment of the present disclosure. The transmission line **24** has a plurality of transmission fibers **241** (i.e. the above-mentioned external fibers) and a plurality of copper wires **242**. The transmission fibers **241** may pass through and fix inside the fixed holes **212** of the connector **21** so as to be respectively optically coupled to the optical fibers **14** of the optical engine assembly **1** via the connector **21**. The copper wires **242** are electrically connected to a circuit layout on the substrate **23** (as shown in FIG. **6**) so as to electrically connected to the control chip **22** through the circuit layout. Accordingly, the control chip **22** may send or receive electrical signals via the copper wires **242** and send or receive optical signals via the optical engine assembly **1**, the connector **21** and the transmission fibers **241**. It is appreciated that front ends (the ends facing the fixed member **13**) of the transmission fibers **241** are grinded and polished for optical coupling.

[0040] The number of the transmission fibers **241** and the copper wires **242** included in the transmission line **24** may be arranged according to the communication data transmitted by the transmission system. For example, when the transceiver **2** of this embodiment is configured to transmit and receive high-definition multimedia interface (HDMI) data, the transmission line **24** may include 4 transmission fibers **241** and 7 copper wires **242** (as shown in FIG. **5**), wherein the 4 transmission fibers **241** may transmit the data of TMDS 0, TMDS 1, TMDS 2 and TMDS CLK respectively, and the 7 copper wires **242** may transmit the data except the TMDS signals. In addition, the transmission line **24** may further include a shielding layer configured to shield the electromagnetic interference (EMI) from the copper wires **242** and a protection layer **244** for covering the outmost layer of the transmission line **24**. In addition, the TMDS signals may also be transmitted by using only one transmission fiber **241** according to different modulation methods.

[0041] In other words, when the transceiver **2** of this embodiment is configured to transmit and receive HDMI data, the optical engine assembly **1** and the control chip **2** are both disposed on a printed circuit board; the control chip **2** is configured to generate or receive electrical signals (e.g. the data except the TMDS signals); and the optical engine assembly **1** is coupled to the control chip **22** and configured to generate or receive optical signals (e.g. the TMDS signals). The transmission line **24** is optically coupled to the optical engine assembly **1** and electrically coupled to the printed circuit board **23**. The transmission line **24** includes at least one (e.g. 4 shown herein) transmission fiber configured to transmit optical signals containing the TMDS data and 7 copper wires configured to transmit electrical signals without containing the TMDS data (as shown in FIG. **6**).

[0042] In addition, it is appreciated that the combination between different components according to the embodiment of the present disclosure may be implemented by using glue.

[0043] As mentioned above, in a transmitter of the conventional optical communication system, optoelectronic devices are directly disposed on a printed circuit board such that the optical coupling efficiency is difficult to be controlled within a satisfactory range due to the poor flatness of the printed circuit board. The present disclosure further provides an optical engine assembly (FIG. **2**) and a transceiver using the same (FIG. **4**B and FIG. **6**) that use a metal bench having a simple structure for bearing the optoelectronic devices so as to simplify the manufacturing procedure and reduce the manufacturing cost. In addition, according to the characteristic of the metal bench, the optical engine assembly and the transceiver using the same of the present disclosure further have high heat dissipation efficiency and good optical coupling efficiency.

[0044] Although the disclosure has been explained in relation to its preferred embodiment, it is not used to limit the disclosure. It is to be understood that many other possible modifications and variations can be made by those skilled in the art without departing from the spirit and scope of the disclosure as hereinafter claimed.

What is claimed is:

1. An optical engine assembly, comprising:

a bench comprising a bearing surface and an extended sidewall with a predetermined height from an edge of the bearing surface, the extended sidewall having an upper surface parallel to the bearing surface;

an optoelectronic device disposed on a center of the upper surface and comprising a plurality of active areas;

a fixed member disposed on the bearing surface and comprising a plurality of through holes and two pin holes; and

a plurality of optical fibers respectively passing through the through holes, a front end of each of the optical fibers forming a 45-degree beveled surface which are respectively aligned with the active areas.

2. The optical engine assembly as claimed in claim **1**, wherein the bench is made of zinc alloy or copper alloy.

3. The optical engine assembly as claimed in claim **1**, wherein the active areas are laser chips or photodetectors.

4. The optical engine assembly as claimed in claim **2**, wherein the active areas are laser chips or photodetectors.

5. The optical engine assembly as claimed in claim **1**, wherein a pitch of the through holes of the fixed member is 250 μm; and the optical fibers are bare fibers.

6. The optical engine assembly as claimed in claim **2**, wherein a pitch of the through holes of the fixed member is 250 μm; and the optical fibers are bare fibers.

7. A transceiver, comprising:

an optical engine assembly, comprising:

a bench comprising a bearing surface and an extended sidewall with a predetermined height from an edge of the bearing surface, the extended sidewall having an upper surface parallel to the bearing surface;

an optoelectronic device disposed on a center of the upper surface and comprising a plurality of active areas;

a fixed member disposed on the bearing surface and comprising a plurality of through holes and two pin holes; and

a plurality of optical fibers respectively passing through the through holes, a front end of each of the optical fibers forming a 45-degree beveled surface which are respectively aligned with the active areas;

a connector disposed on the bearing surface and comprising two dowel pins configured to insert into the two pin holes of the fixed member;

a control chip coupled to the optoelectronic device;

a substrate on which the optical engine assembly and the control chip are disposed; and

a transmission line comprising a plurality of transmission fibers and a plurality of copper wires, the transmission fibers respectively optically coupled to the optical fibers of the optical engine assembly via the connector and the copper wires electrically connected to a circuit layout on the substrate.

8. The transceiver as claimed in claim **7**, wherein the connector is a standard MT connector.

9. The transceiver as claimed in claim **7**, wherein the bench is made of zinc alloy or copper alloy.

10. The transceiver as claimed in claim **7**, wherein the substrate further comprises a recess configured to dispose the optical engine assembly.

11. The transceiver as claimed in claim **7**, wherein the transmission line comprises 4 transmission fibers and 7 copper wires.

12. The transceiver as claimed in claim **8**, wherein the transmission line comprises 4 transmission fibers and 7 copper wires.

13. The transceiver as claimed in claim **9**, wherein the transmission line comprises 4 transmission fibers and 7 copper wires.

14. The transceiver as claimed in claim **10**, wherein the transmission line comprises 4 transmission fibers and 7 copper wires.

15. A transceiver, configured to transmit and receive HDMI data, the transceiver comprising:

a printed circuit board;

a control chip disposed on the printed circuit board and configured to generate or receive electrical signals;

an optical engine assembly disposed on the printed circuit board and coupled to the control chip and configured to generate or receive optical signals; and

a transmission line coupled to the optical engine assembly and the printed circuit board and comprising 4 transmission fibers and 7 copper wires, wherein the 4 transmission fibers are configured to transmit the optical signals comprising TMDS data and the 7 copper wires are configured to transmit the electrical signals.

* * * * *