

SPECIFICATION

Interchangeable optical coupling assembly

5 The present invention relates to an interchangeable optical coupling assembly for connecting a light source, for example a light emitting diode to an optical fibre or a system of optical fibres in a removable and interchangeable manner.

10 The problem caused by the connection between a light source, for example a diode and an optical fibre or a system or group of optical fibres into which the light is to be injected is particularly difficult to solve at an industrial level. Thus, despite the very small
15 cross-section of the optical fibres it is necessary for the maximum of light to penetrate them and this requires an extremely precise regulation of the optical fibre with respect to the light source facing the end of the fibre, this applying both to the spacing
20 between the light source and the end of the fibre and for the axial supply between source and fibre.

To solve this problem optical fibres have been produced by extremely accurate machining. These known couplings have the disadvantage of being
25 costly due to the precision machining and are also not interchangeable, that is it is not possible to replace in the case of a given optical fibre coupling the element carrying the light source by another light source element.

30 The present invention proposes to obviate this disadvantage and supply an optical coupling assembly requiring little precision machining, whose cost is reduced and which permits the easy interchangeability of the connector elements
35 without any regulation during use.

According to the present invention an interchangeable optical coupling assembly for connecting a light source to an optical fibre comprises first and second connectors, the first
40 connector including a light emitting transducer and the second connector which is adapted for connection to the first connector carrying an optical fibre which receives light from the transducer, said first connector having a reference surface in the form
45 of a reference shoulder against which an abutment on the second connector is located when the coupling is made, first adjustment means for adjusting the distance between said transducer and the reference shoulder, and second adjustment
50 means for adjusting the lateral alignment between said reference shoulder and said transducer, and said second connector having third adjustment means for adjusting the distance when the coupling is made between the end of the optical fibre and the reference shoulder.
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Preferably the first connector has coupling means provided with a bore in which said reference shoulder is formed, and said second connector has an end fitting adapted to locate in said bore, said end
60 fitting being supported in a housing in which it is axially adjustable and said housing carrying said abutment to engage the reference shoulder.

The end fitting can be screw threaded into said housing, relative rotation thereof permitting relative
65 axial displacement to provide said third adjustment

means, and locking means for retaining the desired relative positions.

In a convenient construction the end fitting is substantially cylindrical and is guided in a bore in the housing, the housing having an internal screw thread which co-operates with an external screw thread on the end fitting and said housing having a connection collar for connecting the housing to the coupling means.

75 Preferably the transducer is provided in a sliding fitting which can be locked in position in the first portion to provide said first adjustment means and said second adjustment means is provided by means for adjusting the lateral position of said
80 coupling means in relation to the light source.

Thus, the first connector can have a base on which the coupling means and sliding fitting are carried, said coupling means being located by screws which pass through oversize openings in the coupling
85 means to allow lateral adjustment thereof when the screws are released.

The invention also includes a coupling connector for use in the interchangeable optical coupling assembly and which is adapted to co-act with said
90 second connector, and which has a light emitting transducer, a reference surface in the form of a reference shoulder against which the abutment on said co-acting connector can locate when the coupling is made, first adjustment means for
95 adjusting the distance between said transducer and the reference shoulder and second adjustment means for adjusting the lateral alignment between said reference and said transducer.

A regulating guage can be included with the coupling assembly which is adapted for use in regulating the assembly prior to coupling the connectors, said guage having a defined length extending from a reference abutment surface and carrying an axially extending central optical fibre,
100 and being adapted for location on the first connector in place of the second connector with said reference abutment surface located against the reference shoulder to determine an optical reference point constituted by the end of the central optical fibre so that the relative positions of the light source and the optical reference point can be axially and laterally
105 adjusted by the first and second adjustment means to ensure maximum injection of light into the fibre of the guage and so that when the guage is removed the first and second connectors can be assemble together.
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The invention also includes the combination of a guage as set forth above with a coupling connector which is adapted to co-act with said second
115 connector.
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The axial distance from the reference shoulder to the end of the optical fibre or fibres on the second portion can be experimentally determined and be such that when the first connector is regulated by
125 means of the guage the fitting of the second connector onto the first permits the passage of the maximum lighting power in the optical fibre or fibres. In certain types of end fittings for connector members or certain types of light sources this distance can be equal to the corresponding axial
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distance on the guage. However, it may also differ and is dependent on the optical and geometrical characteristics of the fibre.

The invention will be described in greater detail hereafter relative to non-limitative embodiments and with reference to the attached drawings, wherein show:-

Figure 1 shows an axial sectional view of a first connector according to the invention with the guage fitted.

Figure 2 shows an axial sectional view of an interchangeable coupling assembly according to the invention; and

Figure 3 shows an axial sectional view of this assembly for a group of fibres.

As shown in Figures 1 and 2 the optical coupling assembly according to the invention comprises a first connector 1 and a second connector 2. Connector 1 is in the form of a base having for example screw threaded bores 3 for fitting to a random structure. This base has a central bore 4, whose upper opening issues into a recess in the upper face of base. A light source in the form of a light emitting transducer 6 is mounted in the base and comprises a plate 7 which has an emitting diode 8 continued by an optical light conductor bar 9 placed in a substantially cylindrical structure 10. Thus, the light leaves via the upper end face 11 of the bar 9. Structure 10 is mounted in a sleeve 12 penetrating bore 4 and its position can be axially regulated in said bore. Thus, it is possible to regulate at random the level of the upper emitting face 11 of the transducer 10, to provide first adjustment means.

Another screw 19 is provided for bearing against sleeve 12 when the latter is located in the desired axial position, thereby locking sleeve 12 in this position.

The first connector 1 also has coupling means in the form of connector member 13 provided with a precision bore 4 the upper part of which has a reference shoulder 15 constituting a geometrical reference surface. In its lower part the connection member is enlarged by a flange 16 having traversing orifices 17 traversed with a significant clearance by screws into appropriate threads extending from recess 5. Thus, by slightly loosening screws 18 it is possible to move member 13 transversely in all directions perpendicular to the optical axis and when a desired position has to be maintained it is merely necessary to retighten the screws 18, thus providing what is referred to herein as second adjustment means.

The second connector 2 is provided by a support member with a circular cross-section having in its centre an optical fibre 20. This optical fibre is located in the centre of the support member which has an upper end 21, a threaded enlarged portion 22 and a precision formed cylindrical portion 23 which forms an end fitting. This cylindrical portion 23 can have a plurality of grooves 24 if desired. The diameter of the end fitting 23 is slightly less than the diameter of bore 14 so as to permit a gentle sliding introduction. The end 25 of the optical fibre is located in the plane of the end of end fitting 23.

Connector portion 2 has third adjustment means

provided by a substantially cylindrical housing 26 having a first threaded portion 27 in which can be fixed the portion 22 of the support member and a second smaller diameter portion 28 provided with a bore forming an extension of bore 14. This housing 28 has a lower end which provides a reference abutment 29 which can come into contact with reference shoulder 15.

A clamping nut 30 makes it possible to secure housing 26 with respect to end fitting 23. Finally an assembly and connection collar 31 is mounted so as to rotate on housing 26 and has a thread which can be served onto a corresponding thread of the upper portion of connection member 13.

In order to regulate the coupling assembly a guage 32 is provided which has a thicker portion 33 and a thinner cylindrical portion 34 separated by a reference abutment surface provided by a shoulder 35. An optical fibre 36 is positioned precisely in the geometrical centre of cylindrical portion 34. The end 37 of said fibre is precisely level with end 38 of portion 34 of the guage. The axial distance between plate passing through the end 38 of the guage and plane passing through shoulder 35 is precisely determined.

With transducer 6 in a random position guage 32 is fitted in such a way that its thinner portion 34 fits exactly into bore 14 and its shoulder 35 comes into contact with shoulder 15 of connection member 13. The upper end of optical fibre 36 is connected to a lighting power measuring apparatus. The optical axis of light bar 9 is then aligned with the optical axis of fibre 36 by loosening screws 18 and transversely adjusting connection member 13 until a maximum lighting power is obtained at the outlet of fibre 36. The screws 18 are then tightened with the two optical axes in alignment. Transducer 6 is also axially displaced by sliding member 12 in bore 4 until a maximum lighting power is obtained and under these conditions the distance between end 11 and end 37 is perfectly regulated. Screw 19 is then tightened and under these conditions it is obvious that the position of the source with respect to the reference point constituted by the optical centre of end 37 of fibre 36 is regulated. As a variant the axial position of member 12 can be obtained by abutment on a separate mechanical guage having a shape similar to that of optical guage 32.

Connector 2 is regulated prior to assembling the connectors together by precisely adjusting the axial distance between the ends of end fitting 23, i.e. fibre 25 and reference shoulder 29 of housing 28. If optical fibre 20 has the same characteristics as optical fibre 36 this distance can be equal to the distance between shoulder 35 on the guage and the end 37 of the fibre 36. However, depending on the optical and mechanical characteristics of the fibres and their geometry this distance can be different it being obvious that for a given type of fibre the distance remains the same. This regulation can be carried out very easily on a random guage by screwing end fitting 23 into casing 28 until an appropriate abutment is obtained.

Once the regulation has been carried out the two connectors 1 and 2 are ready for assembly. Figure 2

shows the two connectors assembled together and in this case, after screwing nut 31, reference abutment 29 of casing 28 is in contact with reference shoulder 15 of connection member 13 due to the fact that distance between abutment 29 and fibre end 25 has been adjusted, the end 25 of the optical fibre is located in the optimum position with respect to the end 11 of the light bar. As can be seen in Figure 2 although the reference abutments of the guage and the housing 28 then coincide on the should 15 the position of the fibre ends 25 and 37 are in different positions due to the fact that in this case the optical fibre 20 has a geometry differing from that of optical fibre 36. Referring now to Figure 3 it will be seen that connector 2 no longer has a single central fibre but a group of fibres 39 and in this case the end plane of the fibres when the connector is in the fitted state is again in a different position, which is obviously the same for all the portions having such a group of fibres 39.

In other words all the first connectors are adjusted by using the guage described hereinbefore and both the second connectors are adjusted separately, the distance between the abutment and the fibre end in Figure 3 being regulated separately without any optical measurement.

Thus, it is possible to obtain with a small number of precision members and extremely simple and definitive regulating processes an interchangeable optical coupling assembly at low cost.

CLAIMS

1. An interchangeable optical coupling assembly for connecting a light source to an optical fibre comprising first and second co-acting connectors, the first connector including a light emitting transducer and the second connector which is adapted for connection to the first connector carrying an optical fibre which receives light from the transducer, said first connector having a reference surface in the form of a reference shoulder against which an abutment on the second connector is located when the coupling is made, first adjustment means for adjusting the distance between said transducer and the reference shoulder, and second adjustment means for adjusting the lateral alignment between said reference shoulder and said transducer, and said second connector having third adjustment means for adjusting the distance when the coupling is made between the end of the optical fibre and the reference shoulder.

2. An interchangeable optical coupling assembly as claimed in claim 1 in which the first connector has coupling means provided in which said reference shoulder is formed, and said second connector has an end fitting adapted to locate in said bore, said end fitting being supported in a housing in which it is axially adjustable and said housing carrying said abutment to engage the reference shoulder.

3. An interchangeable optical coupling assembly as claimed in claim 2 in which said end fitting is screw threaded into said housing, relative rotation thereof permitting relative axial displacement to provide said third adjustment means, and locking

means for retaining the desired relative positions.

4. An interchangeable optical coupling assembly as claimed in claim 3 in which the end fitting is substantially cylindrical and is guided in a bore in the housing, the housing having an internal screw thread which co-operates with an external screw thread on the end fitting and said housing having a connection collar for connecting the housing to the coupling means.

5. An interchangeable optical coupling assembly as claimed in claims 1 - 4 in which the transducer is provided in a sliding fitting which can be locked in position in the first connector to provide said first adjustment means and said second adjustment means is provided by means for adjusting the lateral position of said coupling means in relation to the transducer.

6. An interchangeable optical coupling assembly as claimed in claim 5 in which the first connector has a base on which the coupling means and sliding fitting are carried, said coupling means being located by screws which pass through oversize openings in the coupling means to allow lateral adjustment thereof when the screws are released.

7. An interchangeable coupling assembly as claimed in any one of the preceding claims in which the transducer comprises a diode with an optical bar.

8. An interchangeable optical coupling assembly substantially as described hereinbefore with reference to and as shown in Figures 2 and 3 of the accompanying drawings.

9. A coupling connector for use in the interchangeable optical coupling assembly set forth in claim 1 and adapted to co-act with said second connector, having a light emitting transducer, a reference surface in the form of a reference shoulder against which the abutment on said co-acting connector can locate when the coupling is made, first adjustment means for adjusting the distance between said transducer and the reference shoulder and second adjustment means for adjusting the lateral alignment between said reference shoulder and said transducer.

10. A coupling connector as claimed in claim 9 having a coupling means provided with a bore in which said reference shoulder is formed.

11. A coupling connector as claimed in claim 10 in which the transducer is provided in a sliding fitting which can be locked in position to provide said first adjustment means and said second adjustment means is provided by means for adjusting the lateral position of said coupling means in relation to the transducer.

12. A coupling connector as claimed in claim 11 including a base on which the coupling means and sliding fitting are carried, said coupling means being located by screws which pass through one size openings in the coupling means to allow lateral adjustment thereof when the screws are released.

13. A coupling connector as claimed in any one of the preceding claims 9-12 in which the transducer comprises a diode with an optical bar.

14. A coupling connector as claimed in claim 9 and substantially as described herein with reference to and as shown in the accompanying drawings.



shows the two connectors assembled together and in this case, after screwing nut 31, reference abutment 29 of casing 28 is in contact with reference shoulder 15 of connection member 13 due to the fact that distance between abutment 29 and fibre end 25 has been adjusted, the end 25 of the optical fibre is located in the optimum position with respect to the end 11 of the light bar. As can be seen in Figure 2 although the reference abutments of the guage and the housing 28 then coincide on the should 15 the position of the fibre ends 25 and 37 are in different positions due to the fact that in this case the optical fibre 20 has a geometry differing from that of optical fibre 36. Referring now to Figure 3 it will be seen that connector 2 no longer has a single central fibre but a group of fibres 39 and in this case the end plane of the fibres when the connector is in the fitted state is again in a different position, which is obviously the same for all the portions having such a group of fibres 39.

In other words all the first connectors are adjusted by using the guage described hereinbefore and both the second connectors are adjusted separately, the distance between the abutment and the fibre end in Figure 3 being regulated separately without any optical measurement.

Thus, it is possible to obtain with a small number of precision members and extremely simple and definitive regulating processes an interchangeable optical coupling assembly at low cost.

CLAIMS

1. An interchangeable optical coupling assembly for connecting a light source to an optical fibre comprising first and second co-acting connectors, the first connector including a light emitting transducer and the second connector which is adapted for connection to the first connector carrying an optical fibre which receives light from the transducer, said first connector having a reference surface in the form of a reference shoulder against which an abutment on the second connector is located when the coupling is made, first adjustment means for adjusting the distance between said transducer and the reference shoulder, and second adjustment means for adjusting the lateral alignment between said reference shoulder and said transducer, and said second connector having third adjustment means for adjusting the distance when the coupling is made between the end of the optical fibre and the reference shoulder.

2. An interchangeable optical coupling assembly as claimed in claim 1 in which the first connector has coupling means provided in which said reference shoulder is formed, and said second connector has an end fitting adapted to locate in said bore, said end fitting being supported in a housing in which it is axially adjustable and said housing carrying said abutment to engage the reference shoulder.

3. An interchangeable optical coupling assembly as claimed in claim 2 in which said end fitting is screw threaded into said housing, relative rotation thereof permitting relative axial displacement to provide said third adjustment means, and locking

means for retaining the desired relative positions.

4. An interchangeable optical coupling assembly as claimed in claim 3 in which the end fitting is substantially cylindrical and is guided in a bore in the housing, the housing having an internal screw thread which co-operates with an external screw thread on the end fitting and said housing having a connection collar for connecting the housing to the coupling means.

5. An interchangeable optical coupling assembly as claimed in claims 1 - 4 in which the transducer is provided in a sliding fitting which can be locked in position in the first connector to provide said first adjustment means and said second adjustment means is provided by means for adjusting the lateral position of said coupling means in relation to the transducer.

6. An interchangeable optical coupling assembly as claimed in claim 5 in which the first connector has a base on which the coupling means and sliding fitting are carried, said coupling means being located by screws which pass through oversize openings in the coupling means to allow lateral adjustment thereof when the screws are released.

7. An interchangeable coupling assembly as claimed in any one of the preceding claims in which the transducer comprises a diode with an optical bar.

8. An interchangeable optical coupling assembly substantially as described hereinbefore with reference to and as shown in Figures 2 and 3 of the accompanying drawings.

9. A coupling connector for use in the interchangeable optical coupling assembly set forth in claim 1 and adapted to co-act with said second connector, having a light emitting transducer, a reference surface in the form of a reference shoulder against which the abutment on said co-acting connector can locate when the coupling is made, first adjustment means for adjusting the distance between said transducer and the reference shoulder and second adjustment means for adjusting the lateral alignment between said reference shoulder and said transducer.

10. A coupling connector as claimed in claim 9 having a coupling means provided with a bore in which said reference shoulder is formed.

11. A coupling connector as claimed in claim 10 in which the transducer is provided in a sliding fitting which can be locked in position to provide said first adjustment means and said second adjustment means is provided by means for adjusting the lateral position of said coupling means in relation to the transducer.

12. A coupling connector as claimed in claim 11 including a base on which the coupling means and sliding fitting are carried, said coupling means being located by screws which pass through one size openings in the coupling means to allow lateral adjustment thereof when the screws are released.

13. A coupling connector as claimed in any one of the preceding claims 9-12 in which the transducer comprises a diode with an optical bar.

14. A coupling connector as claimed in claim 9 and substantially as described herein with reference to and as shown in the accompanying drawings.

15. An interchangeable optical coupling assembly as claimed in any one of the preceding claims 1-8 in combination with a regulating guage which is adapted for use in regulating the assembly prior to coupling the connectors, said guage having a defined length extending from a reference abutment surface and carrying an axially extending optical fibre, and being adapted for location on the first connection, in place of the second connector, with said reference abutment surface located against said reference shoulder to determine an optical reference point constituted by the aid of the central optical fibre so that the relative positions of the light source and the optical reference point can be axially and laterally adjusted by the first and second adjustment means to ensure maximum injection of light into the fibre of the guage so that when the guage is removed the first and second connectors can be assembled together.
16. An interchangeable optical coupling assembly as claimed in claim 15 in which the axial distance from the reference abutment surface to the end of the optical fibre of the guage is used to adjust the corresponding distance between the end of the optical fibre or fibres and the reference shoulder on the second connector prior to assembly.
17. An interchangeable optical coupling assembly in combination with a regulating guage as claimed in claim 15 substantially as described herein with reference to and as shown in Figure 1 of the accompanying drawings.
18. A coupling connector as claimed in any one of the preceding claims 9-14 in combination with a regulating guage which is adapted for use therewith for regulating the connector prior to assembly with a co-acting second connector, said guage having a defined length extending from a reference abutment surface and carrying an axially extending optical fibre, and being adapted for location on the first connector with said reference abutment surface located against said reference shoulder to determine an optical reference point constituted by the end of the central optical fibre so that the relative positions of the light source and the optical reference point can be axially and laterally adjusted by the first and second adjustment means to ensure maximum injection of light into the fibre of the guage.
19. A coupling connector in combination with a regulating guage as claimed in claim 18 substantially as described herein with reference to and as shown in Figure 1 of the accompanying drawings.

