Commonwealth of Australia

Patents Act 1952

CONVENTION APPLICATION FOR A STANDARD PATENT

We, N.V. PHILIPS' GLOeilAMPENFABRIKEN, a limited liability company, organized under the laws of the Kingdom of the Netherlands and carrying on business at Groenewoudseweg 1, Eindhoven, The Netherlands,

hereby apply for the grant of a Standard Patent for an invention entitled:

"Connector for the detachable connection of light conducting fibres".

which is described in the accompanying complete specification. This application is made under the provisions of Part XVI of the Patents Act 1952 and is based on the following application or applications for a patent or patents or similar protection made in the following country or countries on the following date or dates:

- in The Netherlands, appl. No. 8601855, filed July 16, 1986
- in , appl. No. , filed
- in , appl. No. , filed

Our address for service is:

Philips Industries Holdings Ltd,
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Dated this 2nd June 1987

N.V. PHILIPS' GLOeilAMPENFABRIKEN

I.M. Lerner.

To: THE COMMISSIONER OF PATENTS.
The coupling element 1 shown in Figures 1 to 3 comprises an envelope having a rear part 3 and a front part 5. These two parts are cylindrical and the diameter of the front part 5 is smaller than that of the rear part 3. A fibre holder 7 in which end parts of, for example, five light conductor fibres 9 are placed parallel beside each other is connected in the front part 5. The fibre holder 7 has substantially the shape of a rectangular parallelepiped which consists of two plates which are placed against each other and of which at least one comprises parallel grooves for receiving the end parts of the fibres 9. The protective synthetic resin layer 11 of which has been removed. Examples of such fibre holders are described, for example, in EP-A-0,109,648 and the prior Netherlands Patent Application 8503409 (PHN 11,579). The fibre holder 7 with the end parts of the fibres 9 connected therein has been inserted, for example, from the rear side (on the right in Figure 1) into the envelope 3, 5 and is bonded there. The rear part 3 of the envelope through which the fibres 9 extend to the exterior is filled with a moulding mass 13 of a suitable synthetic resin.

The light conducting fibres 9 on their front side (on the left in Figure 1) have end faces 15 the centres of which are situated on a straight line 17 (see Figure 2) in the end face 19 of the coupling element 1. The end faces 15 together with said end face are polished in such a manner that the assembly has the form of a cylindrical surface with
a comparatively large radius of curvature the axis of which is parallel to the line 17. The cylindrical outer surface 20 of the front part 5 of the envelope of the coupling element 1 has then been finished, for example, according to the method described in US-A-4,289,374 (PHN 9235) so that the axis of said cylindrical surface coincides accurately with the axis of the light conductive core of the central one of the five fibre end parts. If the number of fibre end parts should be even (for example, four or six) there is no central fibre end part. In that case the axis of the cylindrical outer surface 20 is preferably made to coincide with the axis of the light conductive core of one of the two fibre ends which are situated immediately beside the centre of the row of fibre ends.

1. A connector for the detachable connection of pairs of light conducting fibres, comprising two coupling elements in each of which end parts of at least two light conducting fibres are secured beside each other so as to be mutually in parallel in such a manner that the centres of their end faces are situated on one line in an end face of the coupling element, as well as a connector housing for receiving the two coupling elements in such a manner that their end faces engage each other, the coupling elements and the connector housing comprising aligning means to ensure that the end parts of the fibres becoming located two-by-two in the elongation of each other, characterized in that the aligning means consist of the combination of the following measures:
   a) each coupling element comprises a cylindrical outer surface the axis of which coincides with the axis of the light conducting core of one of the fibre end parts secured in the said coupling element and which can cooperate with a centring member of the connector housing so as to centre the coupling elements in the connector housing in such a manner that the two cylindrical outer surfaces are located with their axes in the elongation of each other;
   b) each coupling element comprises an orientation element which is capable of cooperating with an orientation member of the connector housing so as to orient the coupling elements in the connector housing in such a manner that the lines on which the centres of the fibre end faces are located are mutually parallel.
COMPLETE SPECIFICATION FOR THE INVENTION ENTITLED:

"Connector for the detachable connection of light conducting fibres".

The following statement is a full description of this invention, including the best method of performing it known to me:-
"Connector for the detachable connection of light conducting fibres"

The invention relates to a connector for the detachable connection of pairs of light conducting fibres, comprising two coupling elements in each of which end parts of at least two light conducting fibres are secured beside each other so as to be mutually in parallel in such a manner that the centre of their end faces are situated on one line in an end face of the coupling element, as well as a connector housing for receiving the two coupling elements in such a manner that their end faces engage each other, the coupling elements and the connector housing comprising aligning means to ensure that the end parts of the fibres become located two by two in the elongation of each other.

Such a connector is known, for example, from US-A-4,272,154. In order to minimise the light losses in the connector it is of importance that the light conducting cores of the end parts of each pair of fibres to be coupled together should become located exactly in the elongation of each other. For this purpose it is necessary for the centres of the end faces of the fibres in each of the coupling elements to be situated on one line with equal mutual distances. A second condition for a low-loss coupling is that the lines on which the centres of the fibre end faces in the two coupling elements are located, become located exactly parallel in the connector housing and that the mutual positions of at least one pair of fibre end parts to be coupled together are good. The positions of the other fibre end parts then are automatically good. In the known connector the light-conducting fibres are situated on a flat surface in the coupling element and their position is determined by grooves in a cover plate placed on said surface. A part of the flat surface not covered by the cover plate and a side face of the cover plate together with two reference faces in
the connector housing constitute the aligning means. The grooves and the side faces of the cover plates of two coupling elements to be secured together must be made together in one operation so as to ensure the desired accuracy. It is, therefore, not readily possible to secure together any pair of coupling elements from a store of coupling elements without loss of accuracy. Consequently, the known connector is not so suitable for use in large numbers.

It is an object of the invention to improve a connector of the type mentioned in the opening paragraph in such a manner that it is possible to manufacture coupling elements independently of each other and to secure any pair of said coupling elements together with a very great accuracy, so that an optimum pairwise coupling between the light conducting fibres is automatically ensured after the two coupling elements have been connected in the connector housing.

For that purpose the connector according to the invention is characterized in that the aligning means consist of the combination of the following measures:

a) each coupling element comprises a cylindrical outer surface the axis of which coincides with the axis of the light conducting core of one of the fibre end parts secured in said coupling element and which can cooperate with a centring member of the connector housing so as to centre the coupling elements in the connector housing in such a manner that the two cylindrical outer surfaces are situated with their axes in the elongation of each other;

b) each coupling elements comprises an orientation element which is capable of cooperating with an orientation member of the connector housing so as to orient the coupling elements in the connector housing in such a manner that the lines on which the centres of the fibre end faces are located are mutually parallel.

The cylindrical outer surface constitutes a reference face the position of which is directly determined by the place of the light conducting core of one of the fibre
end parts and does not depend, in contrast with the known connector, on the place of the corresponding reference face of another coupling element. When the two coupling elements are connected in the connector housing it is ensured that at least one pair of fibres is coupled optimally. Due to the orientation element and the orientation member it is also ensured that the lines on which the centres of the fibre end faces are located are accurately mutually in parallel so that all fibre pairs are coupled optimally. The two coupling elements are hence oriented with respect to each other in a system of cylinder coordinates, orientations according to the two coordinates being established independently of each other. In the known connector said orientations take place in combination in a system of rectangular coordinates.

A very reliable and simple method to form a cylindrical outer surface the axis of which coincides with the axis of the light conducting core of a fibre end part is described in US-A-4,289,374 (PHN 9235). For using this method it is favourable when the axis of the cylindrical outer surface of the coupling element, in the case of an odd number of pairs of fibres to be connected, coincides with the axis of the light conducting core of the central one of the fibre end parts secured in the coupling element and, in the case of an even number, coincides with the axis of the light conducting core of one of the two fibre end parts which are located immediately beside the centre of the row of fibre end parts secured in the coupling element.

A further embodiment of the connector according to the invention is characterized in that the orientation element is formed by a radial projection of the coupling element and the orientation member is formed by an axial slot in a wall of the connector housing. The projection may be provided on a ring which is placed around the coupling element and is rotated until the projection is, for example, accurately perpendicular to the line on which the centres of the fibre end faces are located. In this position the ring may be locked.
The invention will now be described in greater detail with reference to the drawing, in which:

Figure 1 is a longitudinal sectional view of an embodiment of a coupling element for a connector according to the invention,

Figure 2 is an elevation of the end face of the coupling element shown in Figure 1,

Figure 3 is a perspective view of the coupling element,

Figure 4 is a longitudinal sectional view on a reduced scale of an embodiment of a connector according to the invention, and

Figure 5 is a plan view of the connector shown in Figure 4.

The coupling element 1 shown in Figures 1 to 3 comprises an envelope having a rear part 3 and a front part 5. These two parts are cylindrical and the diameter of the front part 5 is smaller than that of the rear part 3. A fibre holder 7 in which end parts of, for example, five light conductor fibres 9 are placed parallel beside each other is connected in the front part 5. The fibre holder 7 has substantially the shape of a rectangular parallelepiped which consists of two plates which are placed against each other and of which at least one comprises parallel grooves for receiving the end parts of the fibres 9 the protective synthetic resin layer 11 of which has been removed. Examples of such fibre holders are described, for example, in EP-A-0,109,648 and the prior Netherlands Patent Application 8503409 (PHN 11.579). The fibre holder 7 with the end parts of the fibres 9 connected therein has been inserted, for example, from the rear side (on the right in Figure 1) into the envelope 3, 5 and is bonded there. The rear part 3 of the envelope through which the fibres 9 extend to the exterior is filled with a moulding mass 13 of a suitable synthetic resin.

The light conducting fibres 9 on their front side (on the left in Figure 1) have end faces 15 the centres of which are situated on a straight line 17 (see Figure 2) in
the end face 19 of the coupling element 1. The end faces 15
together with said end face are polished in such a manner
that the assembly has the form of a cylindrical surface with
a comparatively large radius of curvature the axis of which
is parallel to the line 17. The cylindrical outer surface 20
of the front part 5 of the envelope of the coupling element 1
has then been finished, for example, according to the method
described in US-A-4,289,374 (PHN 9235) so that the axis of
said cylindrical surface coincides accurately with the axis
of the light conductive core of the central one of the five
fibre end parts. If the number of fibre end parts should be
even (for example, four or six) there is no central fibre end
part. In that case the axis of the cylindrical outer surface
20 is preferably made to coincide with the axis of the light
conductive core of one of the two fibre ends which are
situated immediately beside the centre of the row of fibre
ends.

A ring 21 having a radial projection 23 is placed
around the rear part 3 of the envelope of the coupling
element 1. Said ring has been rotated so that the projection
23 is perpendicular to the line 17 and has then been fixed on
the coupling element, for example, by welding it to the rear
part 3, for example by means of a laser. The projection 23
constitutes an orientation element.

Two coupling elements 1 can be placed in a connector
housing 25 with their end faces 19 facing each other (see
Figure 4). The connector housing 25 comprises a centring
member 27 which in this example has the form of a hollow
cylindrical sleeve in which the front parts 5 of the coupling
elements fit accurately so that they become located with
their axes in the elongation of each other. Of course it is
also possible to provide the connector housing 25 with
another centring member, for example a V-shaped groove with
pressure means as described in US-A-4,478,485 (PHN 10 047) or
DE-A-3,208,779 (PHN 82 251), a conical clamping sleeve as
described in US-A-3,982,815 or a sleeve having three leaf
springs as described in EP-A-0,185,413 (PHN 11 245).
The connector housing 25 furthermore comprises two orientation members in the form of axial slots 29 in the wall of the connector housing. When the coupling elements 1 are inserted into the connector housing 25 the slots 29 guide the projections 23 so that the coupling elements are oriented in the connector housing in such a manner that the lines 17 are accurately mutually parallel. Of course it is also possible to orient the coupling elements 1 in the connector housing 25 in a different manner. For example, the orientation elements on each coupling element 1 may be formed by one or more flat side surfaces at the rear part 3 and the orientation member at the connector housing 25 by corresponding flat surfaces at the interior surface of the parts in which in the example described the slots 29 have been provided.

Due to the aligning means formed by the described centring and orientation means, the axes of each pair of coupled fibre end parts become located accurately in the elongation of each other. Due to the fact that the end faces 19 with the fibre end faces 15 have been polished so as to be slightly cylindrical in the manner described, the fibre end faces are located exactly against each other. All this has for its result that each pair of fibres 9 is coupled together optimally (that is to say with very small light losses, for example, 0.5 dB or less).
The claims defining the invention are as follows:

1. A connector for the detachable connection of pairs of light conducting fibres, comprising two coupling elements in each of which end parts of at least two light conducting fibres are secured beside each other so as to be mutually in parallel in such a manner that the centres of their end faces are situated on one line in an end face of the coupling element, as well as a connector housing for receiving the two coupling elements in such a manner that their end faces engage each other, the coupling elements and the connector housing comprising aligning means to ensure that the end parts of the fibres becoming located two-by-two in the elongation of each other, characterized in that the aligning means consist of the combination of the following measures:
   a) each coupling element comprises a cylindrical outer surface the axis of which coincides with the axis of the light conducting core of one of the fibre end parts secured in the said coupling element and which can cooperate with a centring member of the connector housing so as to centre the coupling elements in the connector housing in such a manner that the two cylindrical outer surfaces are located with their axes in the elongation of each other;
   b) each coupling element comprises an orientation element which is capable of cooperating with an orientation member of the connector housing so as to orient the coupling elements in the connector housing in such a manner that the lines on which the centres of the fibre end faces are located are mutually parallel.

2. A connector as claimed in Claim 1 for connecting an odd number of pairs of light conducting fibres, characterized
in that the axis of the cylindrical outer surface of the coupling element coincides with the axis of the light conducting core of the central one of the fibre end part secured in the coupling element.

3. A connector as claimed in Claim 1 for connecting an even number of pairs of light conducting fibres, characterized in that the axis of the cylindrical outer surface of the coupling element coincides with the axis of the light conducting core of one of the two fibre end parts which are located immediately beside the centre of the row of fibre ends secured in the coupling element.

4. A connector as claimed in any of the Claims 1 to 3, characterized in that the orientation element is formed by a radial projection of the coupling element and the orientation member is formed by an axial slot in a wall of the connector housing.

5. A connector as claimed in any of the preceding Claims, characterized in that the end face of each coupling element and the fibre end faces situated in said end face are polished so as to have the form of a cylindrical surface, the axis of which is parallel to the line on which the centres of the fibre end faces are located.

6. A connector substantially as described with reference to the accompanying drawings.

Dated this Fourteenth day of July 1987.

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