

FERRULE FOR CONNECTORS

This invention is related to a ferrule for connectors, especially for connectors of optical fibres, comprising a body which is traversed by a hole allowing to receive an optical fibre.

Such a device is already known. The reversible connection of optical fibres, used for the transmission of luminous signals, is achieved by means of connectors of different kinds. The perfect alignment of the two ends of the fibres to be connected is the omnipresent objective in the realisation of connectors for optical fibres. The mechanical workpiece on which the result of the connection depends the most and which reduces the intensity loss of a signal to a minimum, is the ferrule.

The ferrule is essentially a cylindrically shaped body having a diameter in the range of from 1.3 to 3.17 mm and a length of from 3 to 16 mm, depending on the nature of the connector to be used. The ferrule must have a lengthwise traversing hole for receiving the optical fibre which is typically cemented therein. The diameter of the ferrule holes may vary from 0.124 mm to 0.150 mm according to the type of fibre to be introduced. At the time of assembling, the play between the ferrule hole and the optical fibre should be as small as possible in order to avoid alignment errors that would bring about intensity losses of the luminous signal; usual values of this play are inferior to 1 μm for monomodal connections and smaller than 3 to 4 μm for multimodal connections.

The position of the capillary hole is also very important for the results to be obtained when the two ferrules, having received the two ends of the fibre to be connected, are mechanically aligned by means of a resilient ferrule aligning sleeve which acts on their outer diameter. The concentricity deviation between the axis of the capillary hole and the axis of the ferrule itself should be as small as possible, ideally inferior to 1 to 1.4 μm for monomodal connections, and inferior to 3 to 4 μm for multimodal connections.

Still other properties of the ferrule may influence the quality of the connection, namely the thermal, chemical or mechanical stability of the material used and the degree of surface finishing, more particularly of the contact surface of the ferrule and of its outer diameter.

There are several types of connectors commercially available. The connectors which are most widely used are those which comprise a ceramic single block ferrule of zirconium oxide, ZrO_2 . This material permits to obtain good performances as to material stability, and an optimal, nearly spectacular surface finishing which is the result of special polishing techniques. The material which is used for the manufacture of ceramic ferrules is a fritted "raw" body whose shape depends on the technique that is applied for moulding the body prior to the fritting treatment. There are two principal methods of manufacture: extrusion and injection moulding.

The extrusion method allows to obtain circular cylindrical bars having a capillary hole. It is not possible to obtain more complex shapes. The hardness of the material does not

allow to remove material, excepted by special methods such as grinding with diamond fitted abrasive wheels or by polishing, always using abrasives on diamond basis.

Therefore, it is important to avoid such expensive

- 5 operations regarding the type of equipment that must be used and the fact that these operations must be carried out rather slowly in order not to damage the piece under machining and the tool.

- 10 The method of injection moulding allows to obtain more complex shapes and thus a "raw" body whose shape is closer to that of the finished product by integrating shapes required for the final product. A major problem of this technique, however, is the difficulty of correctly managing,
- 15 within the interior of the matrix, the filament that will produce the capillary hole. The pressure exerted by the flux of the molten ceramic material unavoidably causes a curving of the filament and a displacement from its axis with respect to the mould opening that shapes the outer
- 20 diameter of the ferrule. As a result, the best values of the concentricity that can presently be obtained in industrial manufacture, are between 20 and 40 μm . This fact implies that, for obtaining the required values on the finished product, excess material must be removed from the
- 25 outer diameter by grinding in various manners and with a mechanical effect on the capillary hole. To that end, it is required that the hole traverses the ferrule over its entire length with a constant diameter.

- 30 The length of the ferrule hole is a parameter that may influence the performances of the connector. The length which must guide the fibre within the ferrule must not be inferior to about 1.5 mm in order to avoid an angular

misalignment of the fibre with respect to the ferrule. The length of the guiding hole in the ferrule, presently about 10 mm, is considered to be greatly exaggerated as to the functionality of the connector. This length is due to
5 ferrule manufacturing considerations and aspects.

The objective of the invention is to provide a ferrule which can easily and cheaply be manufactured and which guarantees a safe and reliable connection.

10

This objective is achieved by the new ferrule according to the present invention; the body of the ferrule comprises a first guiding portion for the fibre, this portion being shaped in such a manner that the circumference of the cross
15 section of the hole is a closed, non-circular line that surrounds a virtual circle whose diameter is a function of the fibre diameter, said closed line touching said virtual circle at least once, and the body comprises a second, additional fibre guiding portion having a circular cross
20 section whose diameter corresponds to said virtual circle, determined by the fibre within the first guiding portion.

At one hand, the above defined profile of the first guiding portion for the fibre allows the use of a reinforced matrix
25 core during manufacture, and this fact greatly reduces the necessary grinding operations after manufacture, improves the concentricity of the hole with respect to the outer diameter, and facilitates the washing of the hole, all in maintaining the precise guidance of the fibre. On the other
30 hand, the ferrule according to the present invention reduces the difficulties of the fibre insertion, thus improving the automation possibilities of the process, and generates a space into which any cement excess may enter and find an

increased contact surface which improves the fixation of the fibre at the connection site. The second, additional guiding portion for the fibre still improves its guidance and provides an extremity of the ferrule that is virtually
5 free from any cement deposit.

The means which are defined in the dependent claims allow to implement the invention according to preferred embodiments.

10 Now, an embodiment of the device according to the invention will be described as a non-limiting example. Reference will be made to the drawing wherein:

FIG. 1 shows a partially sectioned side elevation view of
15 the ferrule,

FIG. 2 shows a sectional view according to the plane A-A in FIG. 1,

FIG. 3 is an enlarged sectional view of the central portion of the ferrule, and

20

FIG. 4 shows a sectional view according to the plane B-B in FIG. 3.

FIG. 1 shows a partly sectioned side elevation view of the
25 ferrule for connectors according to the invention, and FIG. 2 is a sectional view in the plane A-A of FIG. 1. The ferrule comprises a body 1 which is essentially cylindrical or prismatic and which is traversed right through by a hole intended to receive an optical fibre. The body 1 is thus a
30 tubular one. The cross section of the hole is not circular over the entire length of the body 1. The latter has a guiding portion 2 for the fibre. This portion 2 is shaped in such a manner that the circumference of the cross section

of the hole (see FIG. 2) forms a non-circular closed line 3 that surrounds and touches a virtual circle 4 (see FIG. 4) whose diameter is a function of the fibre diameter. In the shown Example, line 3 is a closed curve which extends around
5 the axis of the hole and has a varying radius whose value is never inferior to a minimum value which depends on the fibre radius. Since the radius of the fibre is known, this minimum value (that is of course half the diameter of circle 4) corresponds to the fibre radius plus a play value which
10 is necessary for the introduction of the fibre into the ferrule. As an example, for a fibre having a thickness of 0.127 mm, this play value is in the order of + 0.004 mm. The maximum value of the varying radius of the closed curve is preferably at least twice the minimum value. This allows
15 the use of a reinforced matrix core during manufacture and reduces the required grinding operations.

The term "cross section" of the hole means the section of this hole in a plane that is perpendicular to the central
20 hole axis 5. This axis 5 is thus a symmetry axis of the body 1. The circumference of the cross section of the hole can be any closed line whatsoever which surrounds the virtual circle 4 and touches its circumference at least once at a point or at a portion of this circumference.
25 Preferably, line 3 that delimits the cross section of the hole within the guiding portion 2 touches the virtual circle 4, determined by the fibre, at least three times in such a manner that every time a contact point or a contact zone for the fibre is established (the contact points or contact
30 zones being discontinuous, i.e. separated by non-contact zones). Each contact point is part of a longitudinal contact line (which is also a generating line of the hole where the hole is prismatic or cylindrical and non-

circular). For assembling the fibre, it is cemented into the ferrule, and the cement will be deposited within the play zone around the fibre and within the spaces created by the shape of the hole (which is for example prismatic or cylindrical and non-circular; in this case, line 3 is the directrix). Thus, the precise guidance of the fibre within the ferrule is guaranteed.

FIG. 3 shows an enlarged longitudinal section of the central portion of the ferrule, and FIG. 4 is a cross-sectional view according to plane B-B in FIG. 3 (and which corresponds to the plane A-A in FIG. 1). In the shown example, the body 1 is shaped in such a manner that the cross section of the hole within the guiding portion 2 is like a four-leaf clover. This construction shape has proven to be advantageous regarding the manufacturing precision of the ferrule, the assembling ease, and the safe and reliable fastening of the fibre in the ferrule.

The body 1 further comprises a second, additional guiding portion 6 for the fibre; this portion 6 has a circular cross section. The diameter of the circular cross section of this additional guiding portion 6 corresponds to that of the virtual circle 4, determined by the fibre within the first guiding portion 2 (i.e. the desired nominal diameter of a ferrule hole: fibre diameter plus play). According to the present example, the additional guiding portion 6 guides the fibre by a length of about 0.3 mm whereas the first guiding portion 2 guides the fibre by a length of about 1.3 mm, the total length of both guiding portions thus being about 1.6 mm. This guiding length is sufficient for avoiding an angular misalignment of the fibre with respect to the ferrule. The ferrule according to the invention has thus a

length of the guiding hole for the fibre which is reduced to a minimum.

5 The body 1 has a third portion 7 where the cross section of the hole is circular and has a diameter greater than the greatest diameter of the guiding portion 2. The guiding length of the two guiding portions 2 and 6 being sufficient, this third portion 7 does not serve as a fibre guide and further renders the assembling easier.

10

The "raw" ferrule body, namely the original piece as such, is manufactured by injection moulding and does not require any removal of material for obtaining the correct hole diameter, nor any grinding of the external diameter of the
15 ferrule; this avoids any detrimental mechanical effect on the inner diameter. The core of the matrix used which is stressed for bending during injection by the flux of the molten material may be reinforced thanks to the profile of the guiding portion 2 and of the third portion 7.

20 Preferably, the ferrule is made of CIM (Ceramic Injection Moulding), of MIM (Metal Injection Moulding), or of suitable thermoplastic materials.

The dimension conditions of the capillary hole as well as
25 the concentricity of the hole with respect to the outer diameter are improved. Moreover, the washing operations for cleaning the capillary hole and for avoiding its obstruction are rendered substantially easier.

30

- - - -



CLAIMS

1. Ferrule for connectors, especially for connectors of optical fibres, comprising a body (1) which is traversed by a hole allowing to receive an optical fibre, characterised in that the body (1) of the ferrule comprises a first guiding portion (2) for the fibre, this portion (2) being shaped in such a manner that the circumference of the cross section of the hole is a closed, non-circular line (3) that surrounds a virtual circle (4) whose diameter is a function of the fibre diameter, said closed line (3) touching said virtual circle (4) at least once, and that the body (1) comprises a second, additional fibre guiding portion (6) having a circular cross section whose diameter corresponds to said virtual circle (4), determined by the fibre within the first guiding portion (2).
2. Ferrule according to claim 1, characterised in that said first guiding portion (2) is shaped in such a manner that the hole is prismatic or cylindrical and non-circular.
3. Ferrule according to claim 1 or 2, characterised in that the line (3) of the first guiding portion (2) which delimits the cross section of the hole, touches at least three times said virtual circle (4) determined by the fibre, in such a manner that each time at least one contact point with the fibre is established.
4. Ferrule according to any one of claims 1 to 3, characterised in that said closed line (3) extends around the axis of the hole and has a varying radius whose minimum value corresponds to the radius of the fibre plus a play value.



5. Ferrule according to claim 4, characterised in that the maximum value of the varying radius of the closed line (3) is at least twice its minimum value.

5 6. Ferrule according to any one of claims 1 to 5, characterised in that the cross section of the hole in the first guiding portion (2) is four-leaf clover shaped.

7. Ferrule according to any one of claims 1 to 6,
10 characterised in that the axis of the hole (5) is a symmetry axis of said body (1).

8. Ferrule according to any one of claims 1 to 7,
characterised in that said first guiding portion (2) and
15 said second, additional guiding portion (6) have a total length of about 1.6 mm.

9. Ferrule according to any one of claims 1 to 8,
characterised in that said body (1) further comprises a
20 third portion (7) wherein the cross section of the hole is circular and has a diameter greater than the greatest diameter of the first guiding portion (2).

10. Ferrule according to any one of claims 1 to 9,
25 characterised in that it is manufactured by injection moulding.

11. Ferrule according to any one of claims 1 to 10,
characterised in that it is made of CIM (Ceramic Injection
30 Moulding), of MIM (Metal Injection Moulding) or of a thermoplastic material.

ABSTRACT OF THE DISCLOSURE

FERRULE FOR CONNECTORS

A ferrule for connectors, especially for optical fibre connectors, comprises a body (1) traversed by a hole for
5 receiving an optical fibre therein. The body (1) has a guiding portion (2) for the fibre wherein the circumference of the cross section of the hole forms a closed, non-circular line (3) which surrounds and locally touches a
10 virtual circle (4) whose diameter depends on the fibre diameter. The shape of the body (1) facilitates the manufacture of the ferrule and improves the locking of the fibre within the ferrule.

- - - -

15

(FIG. 1 and 2)

DRAWINGS

1/2

FIG. 1

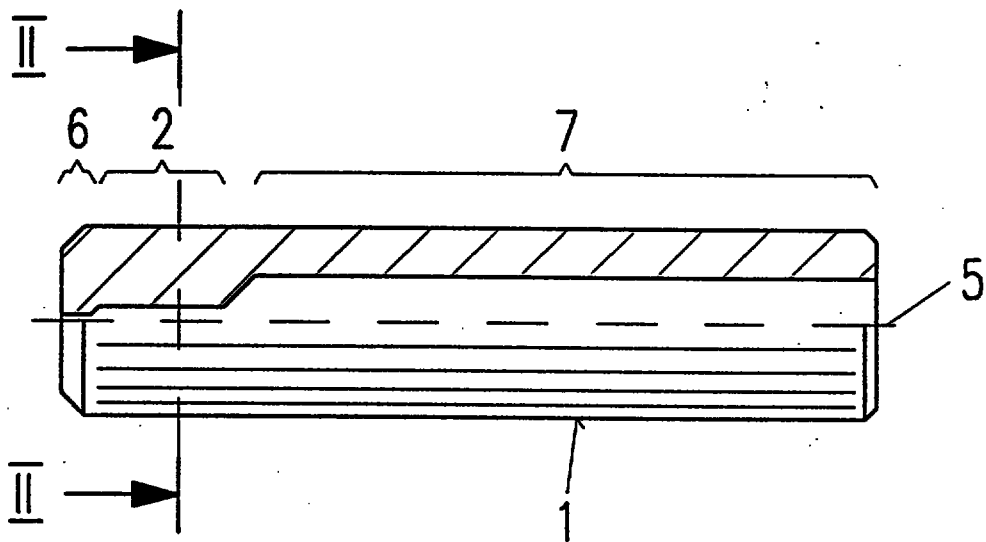
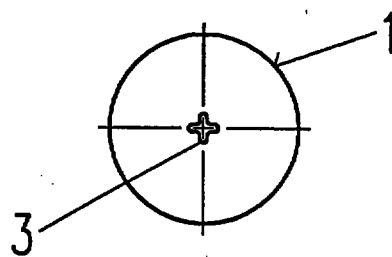


FIG. 2



DRAWINGS

2/2

FIG. 3

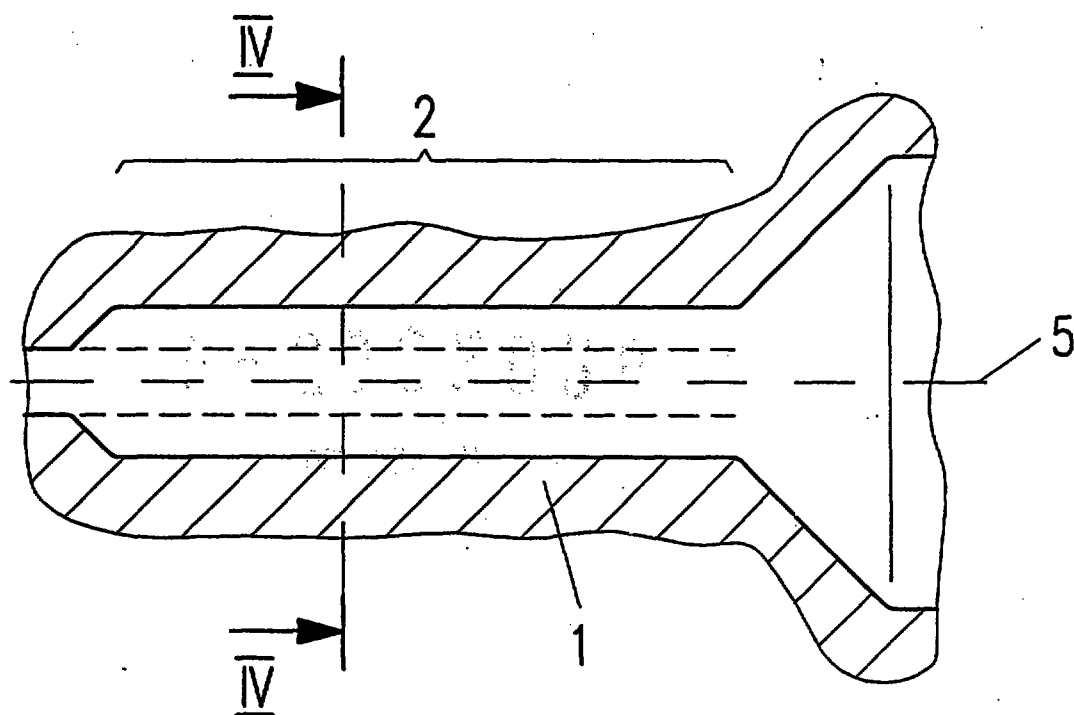


FIG. 4

