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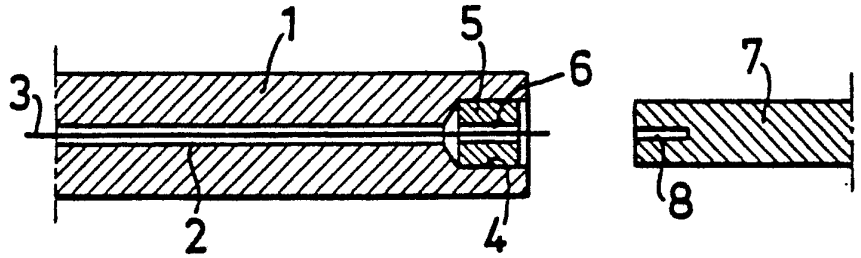
(54) Title: A METHOD FOR OBTAINING AN ACCURATE CONCENTRIC FASTENING OF AN OPTICAL FIBRE IN A CONNECTOR



(57) Abstract

Connector (1) provided with an optical fibre (3) in an axial through-bore (2). The bore (2) has an enlargement (4) in the end of the connector. A solid rod (6) of a non-elastical ductile material is inserted in the recess. An axial force from outside the connector is applied to the rod, thereby expanding the rod radially to fixed position in the recess. A hole (6) is made in the rod with an accurate concentricity relative to the circumference of the connector. The optical fibre is inserted into the hole in the rod. Finally, an axial force from outside the connector is applied to the rod for radial expansion thereof resulting in a reduction of the hole in the rod and thereby obtaining an accurate concentric fastening of the optical fibre.

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A METHOD FOR OBTAINING AN ACCURATE CONCENTRIC FASTENING OF AN OPTICAL FIBRE IN A CONNECTOR

FIELD OF THE INVENTION

The present inventor relates to a connector provided with an optical fibre, which connector is provided with an axial through-hole for the optical fibre and provided with a bushing for concentric fixing of the fibre within the connector. The bushing is arranged to be compressed in axial direction by means of a tool in order to obtain a radial deformation resulting in a centering of the optical fibre within the connector.

BACKGROUND OF THE INVENTION

Such optical connectors are known in several embodiments, for instance as described in the British Patent No. 1 478 135 and in the U.S.Patent No. 4 190 317. In the connector (ferrule) described in the British Patent the bushing is positioned at a considerable distance inside the mouth (end) of the connector and is compressed axially in order to be expanded radially by means of a piston fixed within the connector by varnish, while the end of the optical fibre is after the compression of the bushing resulting in the concentric fastening of the fibre fixed by means of resin in the mouth of the connector. Besides a relatively complicated construction accuracy is with necessity lost by said distance from the mouth of the connector so that in all probability desired low optical damping can not be achieved. Errors in accuracy are also obtained by the method described in said patent by the fact that the free end will wabble during the turning of the surface, so that different thickness of material is obtained in the bushing. The connector assembly described in said U.S. patent is also a relatively complicated construction. The bushing (insert member) is

tapered in order to hold the fibre after a forced insertion of the bushing into a narrow bore, which according to the preferred embodiment is made in a second bushing arranged in a recess in the mouth of the connector. Due to several details errors in accuracy are added resulting in a deteriorated optical damping. During the forced insertion of the tapered body there is also a risk for skew setting or "swelling" meaning deteriorated accuracy.

SUMMARY OF THE INVENTION

The present invention is based in the realization, that the concenctric fastening of the fibre requires for the decisive optical damping in the connector an accuracy in the order of magnitude of a few micrometers. The fastening should accordingly take place immediately at the mouth (end) of the connector. Moreover, as few means as possible enclosing the fibre should be utilized and the bushing be made in non-elastic material in order to keep as close tolerances as possible upon the manufacture of the bore for the fibre. The invention renders an improvement of the optical damping compared with previous technic possible and discloses a simplified method for obtaining the concentric holding of the optical fibre in the connector. This is achieved by the following steps:

a) inserting into the recess a solid rod of a non-elastic ductile material;

b) applying from outside relative to the connector an axial force to the rod for obtaining an expansion thereof in radial direction resulting in a fixing relative to the inner wall of the recess;

c) taking up a hole in the rod with an accurate concentricity relative to the outer surface of the connector;

d) inserting the optical fibre into said hole in the rod being fixed in the recess in the connector;

e) applying from outside relative to the connector an

axial force to the rod for obtaining an expansion thereof in radial direction resulting in a reduction of the hole in the rod, thereby obtaining the accurate concentric fastening of the optical fibre.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1-3 illustrates schematically different manufacturing steps of an optical fibre connector according to the invention.

Figs. 4 and 5 show a coupling device for two connectors in a section along the line IV-IV in Fig. 5 and a section along the line V-V in Fig. 4, respectively.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The connector 1 shown in Fig. 1 has an axially bore 2 for an optical fibre 3. The bore is in the forward end or the coupling end enlarged to a recess 4 and a bushing 5 having a hole 6 in alignment with the extension of the bore 2 is inserted in the recess 4. Fig. 1 also shows the front end of a punch 7 having a hole 8 for receiving the optical fibre 3.

The bushing 5 is made of a soft metallic material, preferably a tin alloy, and the punch 7 is arranged for compressing the bushing in axial direction for obtaining a radial deformation. Fig. 2 illustrates the shape of the conductor and the bushing after performed compression and Fig. 3 shows the final shape of the conductor after grinding the coupling end.

By a method as described above and using a bushing of a soft metallic material, a non-elastic and with maximum accuracy determined concentric fixing of an optical fibre is made possible. Since the concentricity is coun-

ted relative to the outer surface of the conductor 1, the bushing 5 may preferably be manufactured in such a way, that the solid rod is inserted into the recess 4 and is fixed therein by a limited compression by means of a suitable tool, whereupon the axial hole 6 is bored in the rod.

Due to the obtained accurate centering an optical fibre in a connector can definitely guaranteed be lined up with another connector in an optical coupling device. An appropriate embodiment of such a coupling device is shown in Figs. 4 and 5.

The coupling device 10 shown in Figs. 4 and 5 consists of a middle sleeve 11 having a central through-hole 12, in which a rod 13 is fixed. A longitudinal groove 14 with walls 15 is formed in the rod 13 for obtaining an inwardly decreasing cross-section of the groove. The hole 12 has above the groove 14 a portion 16 being somewhat enlarged and extending along the groove, said portion 16 being concentrically formed relative to a connector 1 inserted into the groove. The sleeve 11 is at the ends provided with projecting flanges 17 having external thread 18 and internal tapered surface 19. The threads 18 are arranged for co-operation with nuts 20 having internal threads 21 and the tapered surfaces 19 are arranged for co-operation with annular tapered wedge elements 22, which preferably have an axial slit.

When coupling two connectors 1 together by means of the coupling device 10 shown in Figs. 4 and 5, the connectors are inserted from the ends of the groove 14 to the abutment shown in Fig. 5. The nuts 20 are positioned so far outwardly, that wedge effect does not exist between the wedge elements 22 and the surfaces co-operating with the elements in order to allow the insertion of the connector. The nuts are thereafter screwed

upon the threads 18 and the wedge elements are wedged up between the tapered surfaces 9 of the sleeve 11 and the outer surface of the connector 1 faced to the portion 16 and the roll 13.

An extraordinarily rigid coupling of the connectors 1 with high accuracy concerning the up-lining of the fibre ends relative each other is obtained by means of a coupling device 10. Moreover, the construction is simple in manufacture and allows a simple and rapid handling.

I CLAIM:

A method for obtaining an accurate concentric fastening of an optical fibre in a connector, wherein a ductile bushing is arranged to surround the fibre in a recess in the end of the connector, c h a r a c t e r i z e d in the following steps:

(a) inserting into the recess (4) a solid rod (5) of a non-elastic ductile material;

(b) applying from outside relative to the connector (1) an axial force to the rod for obtaining an expansion thereof in radial direction resulting in a fixing relative to the inner wall of the recess;

(c) taking up a hole (6) in the rod with an accurate concentricity relative to the outer surface of the connector;

(d) inserting the optical fibre (3) into said hole in the rod being fixed in the recess in the connector;

(e) applying from outside relative to the connector an axial force to the rod for obtaining an expansion thereof in radial direction resulting in a reduction of the hole in the rod, thereby obtaining the accurate concentric fastening of the optical fibre.

FIG.1

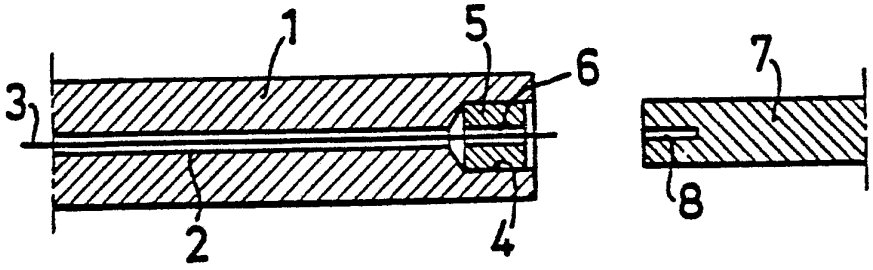


FIG.2b

FIG.2a

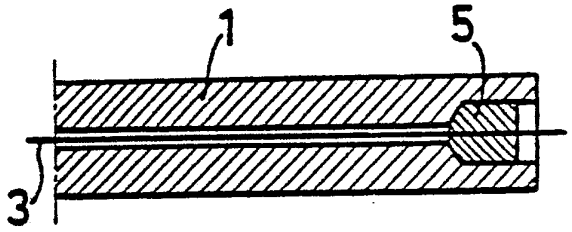


FIG.3

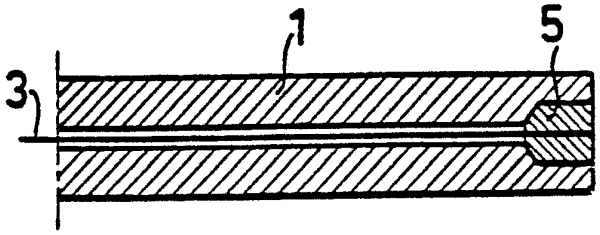


FIG.5

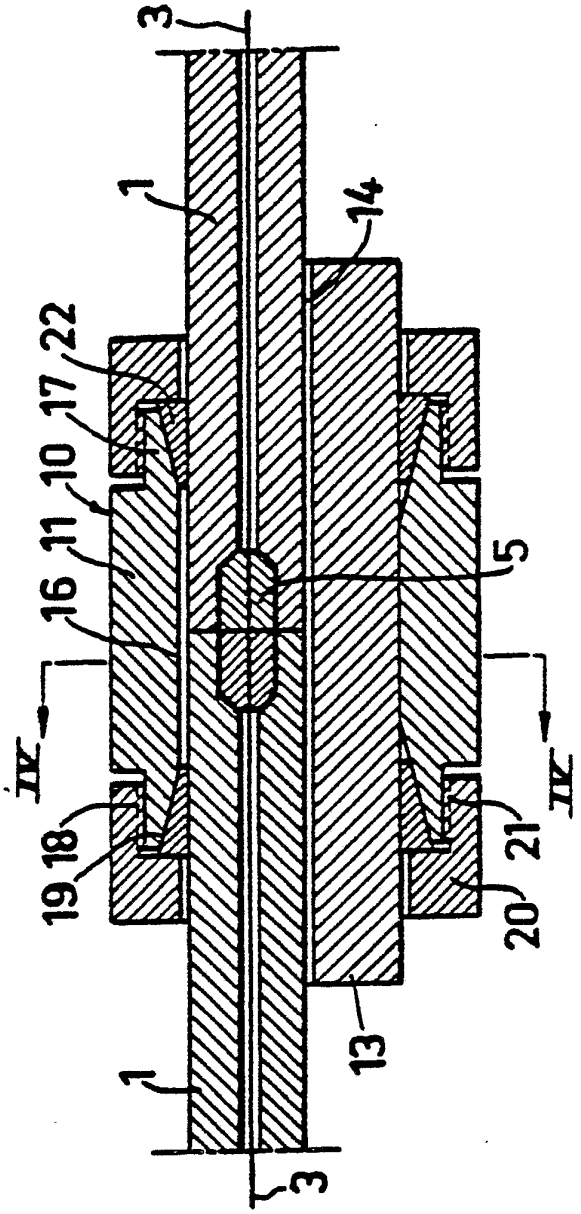
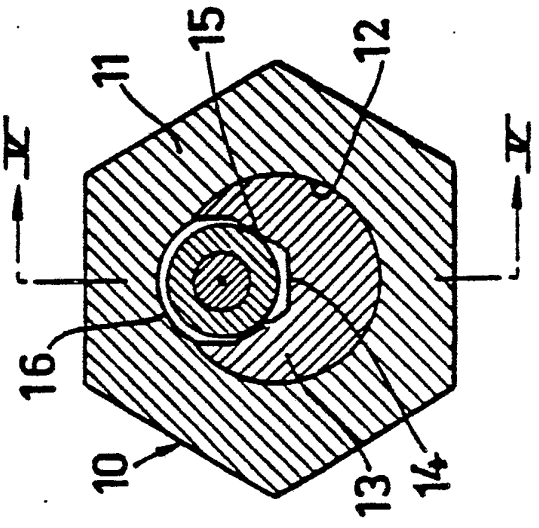


FIG.4



INTERNATIONAL SEARCH REPORT

International Application No PCT/SE81/00270

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC 3

G 02 B 7/26

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
IPC 3	G 02 B 5/14, 7/26
US Cl	350:96, 96.10, 96.15, 96.20, 96.21, 96.23, 96.34

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
A	US, A, 4 190 317 (MAKUCH) 26 February 1980	
A	US, A, 4 153 331 (CROSS) 8 May 1979	
A	GB, A, 1 478 135 (THOMSON-CSF) 29 June 1977	

* Special categories of cited documents: [15]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
1981-12-29	1982 -01- 04
International Searching Authority [1]	**Signature of Authorized Officer [20]**
Swedish Patent Office	Kristina Brandell