PATENT SPECIFICATION (11) 1 569 615

1 569 615

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(54) COUPLING OPTICAL FIBRES

(71) We, STANDARD TELEPHONES AND CABLES LIMITED, a British Company, of 190 Strand, London, W.C.2, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to arrangement for coupling optical fibres, and in particular to optical fibre connectors fitted with lens terminations.

Our co-pending Application No. 04174/76 describes a termination for a coated optical fibre, including a substantially cylindrical transparent plastics body member having a convex lens surface formed integral and coaxial therewith, and having a coaxial guide taper adapted to receive the coated fibre end and leading to a central bore which bore locates the fibre, and in which the central bore and the lens are so arranged that, when a fibre is fitted to the termination, light emitted from the fibre is reflected into a substantially parallel beam by the lens.

According to the present invention there is provided a connector member for a coated optical fibre having a bared end, including a substantially cylindrical ferrule having an axial bore, one end of the bore being fitted with a transparent plastics body having a converging lens surface whose optical principal axis is co-axial with the ferrule axis, and a fibre location guide arranged on the principal axis of the lens, and in which the fibre location guide is dimensional to receive the fibre and to align the bared fibre end coincident with the principal axis of the lens and to position the fibre end at the focus of the lens.

Embodiments of the invention will now be described with reference to Figs. 3*a* to 3*d* of the accompanying drawings and to Figs. 1, 2, 4 and 5 of the drawings accompanying the provisional specification.

Fig. 1 shows a one piece lens termination for an optical fibre connector;

Fig. 2 shows a connector member fitted with a termination of the type of Fig. 1;

Figs. 3*a* to 3*d* show an alternative fibre connector with various preset fibre positioners.

Fig. 4 shows an optical connector member for use with a fibre fitted with a standard jewel termination; and

Fig. 5 is a part schematic diagram of a jig arrangement for preadjusting an optical connector member.

Referring to Fig. 1, the lens termination shown comprises a cylindrical body 11 of plastics, e.g. acrylic, material having one end in the form of a convex lens 12. The other end of the body 11 has a guide taper 13 leading to a coaxial bore 14 for locating the bared fibre end 15 of a plastics coated fibre 16 at the focus of the lens 12. In this way, light emitted from the fibre end is refracted into an expanded parallel beam by the lens.

Fig. 2 shows the termination arrangement of Fig. 1 mounted in a metal ferrule 21 so as to provide a connector member. The body 11 is a push fit in the bore 22 of the ferrule 21 and is coaxial with the outer surface of the ferrule. The ferrule 21 provides a reference surface whereby the termination may be coupled to a similar termination by means of one or more alignment surfaces.

Figs. 3*a* to 3*d* show modifications of the connector arrangement of Figs. 1 and 2. In Figs. 3*a* a ferrule 31 carries a plastics lens insert 32 fitted with a coaxial tube 33 secured to the lens insert 32 with a refractive index matching cement. When the termination is fitted to the prepared end of a coated fibre 16 the tube 33 receives the bored fibre end 15 and that the fibre end is located at the lens focus. The coated fibre 16 is supported in the bore of the termination by a cushioning material 34.

A modification of this tube technique is shown in Fig. 3*b* in which an extended tube 35 containing a fibre stub 36 is employed. The fibre stub 36 is held by the tube 35 at the focus of the lens and couples with a bored fibre end inserted in the open end of the tube.

Figs. 3*c* and 3*d* show two forms of adjustable termination arrangements. Both arrangements employ a lever reduction system to effect adjustment of the fibre end at the lens focus. Fig. 3*c* shows a connector member for terminating a coated fibre 71. The coating is trimmed perpendicular to the fibre axis to expose the fibre end 72 and the prepared fibre is then inserted into a tube 16 mounted along the axis of the ferrule 31. A forward reduced diameter bore portion 73 of the tube 16 receives the bared fibre end and locates it at the focus of the lens 32. The tube 16 is pivoted on a membrane 37 mounted perpendicular to the bore of the ferrule 31.

Angular adjustment of the tube 16 to ensure that the fibre end coincides with the lens focus is effected by screw 74. The lever reduction of movement provided by the relatively long tube 16 permits very fine adjustment of the position of the fibre end.

A similar arrangement is provided in the connector member of Fig. 3*d*, but in this case the supporting membrane 37 is replaced by a ball 38 formed integral with the tube 16 and pivoting within a forward cone portion 39 of the ferrule 31.

The connector member shown in Fig. 4 is intended for use with a fibre fitted with a standard jewel ended termination 41 such as that described in our published Specification No. 1,480,445. Terminations of this type employ a watch jewel mounted in a ferrule and whose bore receives and locates the fibre end. The connector ferrule has a guide bore 42 for receiving the jewel ferrule.

The connector members shown in Figs. 1 to 4 may be assembled with the jig arrangement shown schematically in Fig. 5. A rigid mounting plate 61 supports a laser 62 and lens system 63 and has a V groove for positioning a ferrule of a connector member 1 with respect to a parallel light beam produced by the laser and lens system. As shown in Fig. 5 the connector member is of the type shown in Fig. 3*b* but other connector members may also of course be assembled.

A glass tube 64, mounted in a chuck 65 of a micropositioner arrangement, is inserted along the bore of the ferrule until it abuts the plane rear surface of the lens of the connector. A droplet of refractive index matching cement is placed between the tube 64 and the lens. A prepared coated fibre 66 is then inserted down the bore 67 of the chuck 65 so that the bored fibre end 68 enters the bore of the tube 64. The micropositioner is employed to adjust the axial and longitudinal position of the fibre end to obtain maximum light transmission as recorded by a detector 69 disposed at the remote end of the fibre after which the joint is held steady until the cement has set.

Although the connectors described herein have been shown fitted with plano-convex lenses other lens structures may of course be employed. In a particularly advantageous embodiment such a connector employs a cylindrical lens having plane end faces and a graded refractive index. Such lenses are sold under the trade name SELFOC and are made from an optical fibre material constructed so that light travels along the longitudinal axis in a sine wave. A lens made from a quarter wave length of this material has its foci at its plane surfaces. The inward face of such a lens may, in some applications, be provided with an etched pit for locating the ends of the fibre to which the lens is coupled.

In further applications as Fresnel lens, which may be moulded from a plastics material, may also be employed and may similarly be provided with a locating pit for receiving the fibre end so as to ensure alignment of the fibre with the optical axis of the lens.

Both these types of lenses are particularly suitable for the connector shown in Fig. 4 of the accompanying drawings and which is adapted to couple to a fibre termination with a watch jewel.

WHAT WE CLAIM IS:—

1. A connector member for a coated optical fibre having a bared end, including a substantially cylindrical ferrule having an axial bore, one end of the bore being fitted with a transparent plastics body having a converging lens surface whose optical principal axis is co-axial with the ferrule axis, and a fibre location guide arranged on the principal axis of the lens, and in which the fibre location guide is dimensioned to receive the fibre and to align the bared fibre end coincident with the principal axis of the lens and to position the fibre end at the focus of the lens.

2. A connector member as claimed in claim 1, in which the fibre location guide comprises an elongated tube provided with angular adjustment means to effect alignment of the fibre end with the lens focus.

3. A connector member as claimed in claim 2, and in which said fibre location guide is supported by a flexible membrane mounted within a tubular ferrule.

4. A connector member as claimed in claim 1, and in which said fibre location guide includes a fibre stub pre adjusted at the focus of the lens and so arranged as to couple the bared fibre end to the lens focus.

5. An optical fibre connector member substantially as described herein with reference to Figs. 1 and 2 or to Fig. 4 of the drawings accompanying the Provisional Specification, or to any one of Figs. 3*a* to 3*d* of the accompanying drawings.

6. An optical fibre connector assembly including a pair of connector members as claimed in any one of the preceding claims, and means for maintaining the connector members with their lenses or lens systems in optical alignment.

7. A method of terminating a coated optical fibre substantially as described herein with reference to Fig. 5 of the accompanying drawings.

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1569615 PROVISIONAL SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG. 1.

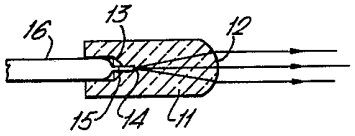


FIG. 2.

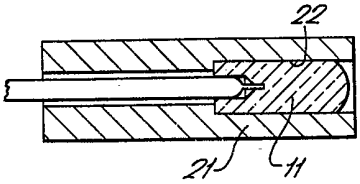


FIG. 4.

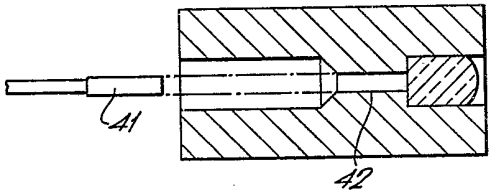


FIG.3a.

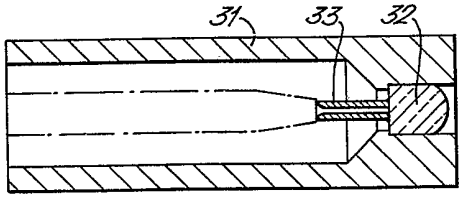


FIG.3b.

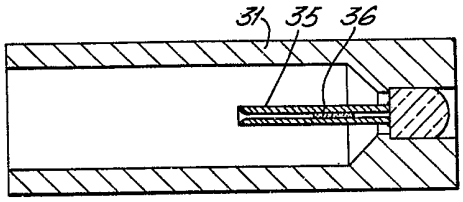


FIG.3c.

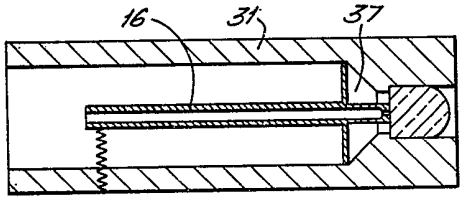
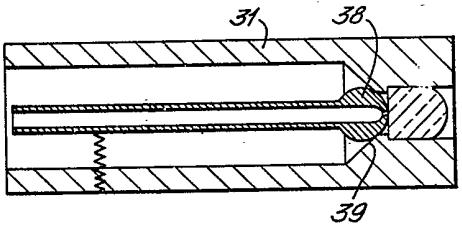


FIG.3d.



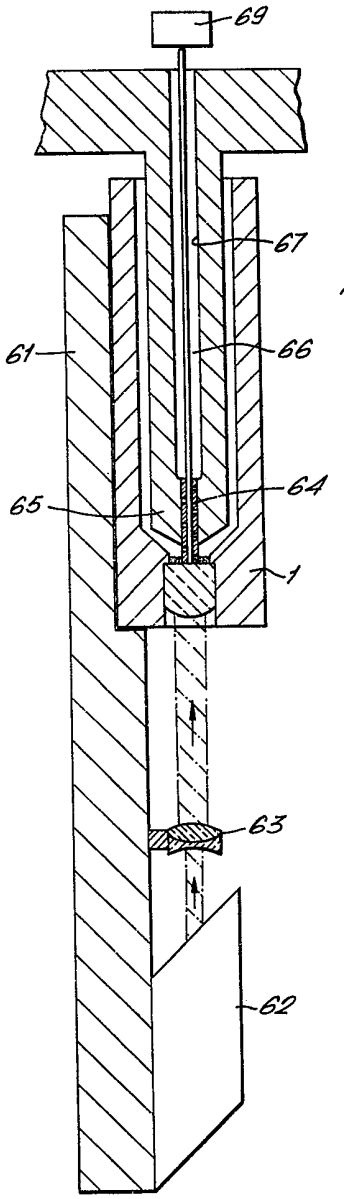


FIG.5.

1569615 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale

FIG.3a.

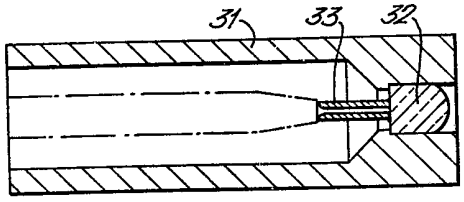


FIG.3b.

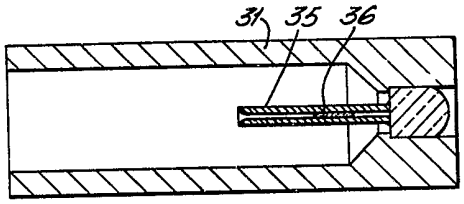


FIG.3c.

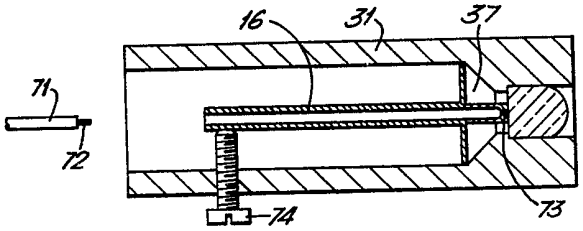


FIG.3d.