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(71) Applicants
The Marconi Company
Limited,
Marconi House, New
Street, Chelmsford, Essex
CM1 1PL

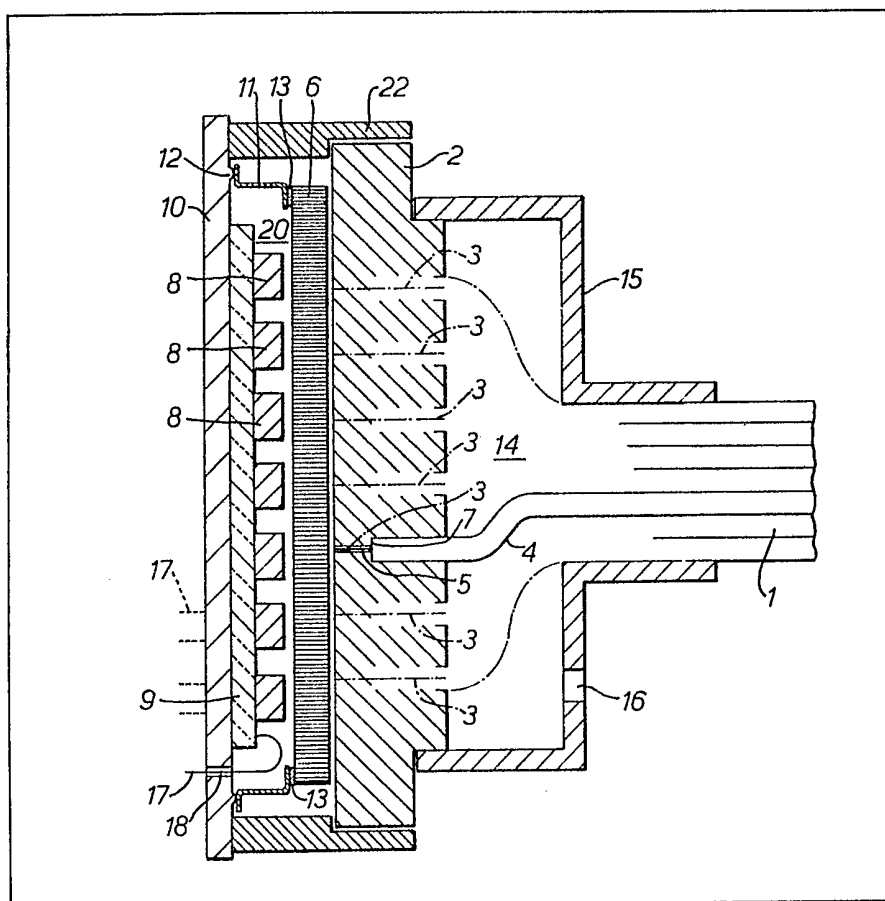
(72) Inventors
Maurice Lionel Apthorp,
Stephen John Millward

(74) Agent
C. F. Hoste,
Marconi House, New
Street, Chelmsford, Essex
CM1 1PL

(54) **Electro-optical terminations**

(57) An electro-optical termination is provided to terminate a fibre optic bundle 1 of individual optical fibres 3. Each termination includes electro-optical converter devices 8 which either receive optical information via the optical fibres 1 and convert them into electrical signals, or the devices receive electrical signals and convert them into optical form for transmission along the optical fibres. The converter devices 8 are mounted

within a hermetically sealed enclosure 20 and are arranged to transmit or receive optical signals via a faceplate 6, which forms part of the wall of the enclosure. The ends of the individual optical fibres 1 terminate in apertures which pass through a rigid plate 2. The construction ensures that the optical fibres 1 are aligned with the converter devices 8, whilst also ensuring adequate protection for the devices themselves. In this way a large number of individual fibres can be coupled to corresponding converter devices.



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SPECIFICATION

Electro-optical terminations

This invention relates to electro-optical terminations and is specifically concerned with the termination of optical fibres. As is known, signals can be transmitted in optical form along thin strands of glass or glass like materials over considerable distances and that in certain circumstances transmission of signals in this way can be advantageous as compared with the conventional transmission of signals in electrical form. At each end of the optical transmission path, the signals are usually handled and processed as necessary in electrical form, and thus at each end of the transmission path it is necessary to convert the signal between its electrical and optical forms by means of suitable electro-optical terminations. This has proved difficult in practice because the very thin optical fibres must be very precisely aligned with associated electro-optical converter devices. In some applications, the optical transmission path comprises many individual optical fibres, each carrying different signals and consequently each fibre must be correctly terminated. The present invention seeks to provide an improved electro-optical termination which is suitable for this purpose.

According to this invention, an electro-optical termination includes an array of electro-optical converter devices mounted within a hermetically sealed enclosure; a plurality of individual optical fibres, the ends of which are held in a fixed position relative to each other corresponding to said array and which terminate in a common plane; a rigid fibre optic faceplate mounted with one of its major faces adjacent said array and the other of its major faces being adjacent to said plane with the faceplate forming part of the wall of said hermetically sealed enclosure.

The array of converter devices may be arranged along a single line, but preferably they are arranged in a two dimensional pattern. The electro-optical termination may form part of an optical transmitter or an optical receiver, or in certain circumstances it may be used as both a receiver and a transmitter in those cases where light is transmitted in both directions along an optical fibre. In the case of an optical transmitter, the electro-optical converter device comprises light emissive means which generate light in response to an applied electrical signal and this light is transmitted along the associated optical fibres. Conversely, in the case of an electro-optical receiver, the converter devices are light sensitive and generate an electrical signal in response to a light signal which is received via the associated optical fibres. Each optical fibre may be a single strand of glass or similar light transmissive filamentary material, or alternatively each optical fibre may itself comprise a bundle of very fine strands.

Preferably the ends of the individual optical fibres are held in position by means of a rigid opaque plate having a major surface which is

aligned with the adjacent major face of said faceplate, and the individual optical fibres terminating in apertures which pass through the thickness of the rigid plate.

Preferably again the rigid plate is a metal plate of uniform thickness. The individual optical fibres can conveniently be held in position within the metal plate by means of a settable material, which is formed around the fibres at the point where they emerge from the apertures in the metal plate. A suitable settable material is an epoxy resin.

The electro-optical converter devices are preferably supported on a base plate which also forms part of said enclosure. Conveniently a collar is attached to the base plate and extends therefrom to support said faceplate, the collar being of sufficient depth to provide clearance for the height of the electro-optical converter devices and to determine the space of the active surface of these devices from the adjacent surface of said faceplate.

The invention is further described by way of example with reference to the accompanying drawing, which shows a sectional view of an electro-optical termination in accordance with this invention.

Referring to the drawing, a fibre optic bundle of individual optical fibres 1 is held in contact with a brass plate 2. Each optical fibre 1 consists of a thin inner core 3 of light transmissive glass surrounded by an opaque sleeve 4 of a suitable flexible plastics material. The end of each fibre 1 passes through a circular aperture 5 formed in the brass plate 2, and terminates at a flat surface of the plate 2 which is adjacent to a fibre optic faceplate 6. The sleeve 4 does not extend to this surface, but it instead abuts against an internal collar 7 formed in the aperture 5. Only one of these optical fibres 1 is shown in detail, the positions of other fibres being indicated schematically by broken lines. The fibre optic faceplate 6 is a thin parallel sided plate of transparent material, which is formed of a very large number of individual optical fibres compressed together, so that light, which is incident upon one of its major surfaces is transmitted along the optical fibres to the opposite major surface. Faceplates of this kind are now well known and it is not considered necessary to describe their manner of manufacture. However, the cross-sectional area of the individual fibres which together constitute the optical fibre faceplate is extremely small and is preferably less than the cross-sectional area of the core 3 of the optical fibres 1. The inner surface of the optical faceplate 6 is adjacent to a two dimensional array of electro-optical converter devices 8. In the example under consideration, it is assumed that the electro-optical termination is a receiver, and in this case each electro-optical converter device is light sensitive — that is to say, it is able to generate an electrical output signal when light is incident upon it. Typically each converter device is a PIN diode. Although only seven converter devices 8 are shown in the drawing, in practice a large number of such devices would be provided in

a regular two dimensional array. These devices are mounted on and secured to a ceramic substrate 9, which is typically formed of alumina in a manner which is conventional for what are generally
 5 termed hybrid circuits. The substrate 9 is bonded to a base plate 10 formed typically of kovar. The surface of the kovar faceplate is usually nickel plated or gold plated.

In order to protect the converter devices 8, which are relatively fragile and susceptible to contamination, they are mounted within a hermetically sealed enclosure 20. This is achieved by securing the base plate 6 to the faceplate 10 by means of a collar 11, which is bonded to both in a
 10 gas tight manner. The collar 11 is conveniently formed out of a thin sheet of nickel-plated kovar and is attached to the base plate 10 by means of a continuous gas tight weld 12. Its upper surface is attached to the inside of the glass faceplate 6 by means of a glass frit seal 13, the glass frit being
 15 conventional in nature and typically during the manufacture of the electro-optical termination, it is applied in paste form to the periphery of the collar 11, and the faceplate 6 is then brought into contact with the paste. Subsequently, it is fired at
 20 a high temperature and it forms a strong gas tight seal. The enclosure 20 may be evacuated or it may contain an inert gas.

In order to provide support for the flexible and relatively weak optical fibres 1, a chamber 14
 30 within a metal cap 15 through which the fibre optic bundle passes contains an epoxy resin. The epoxy resin is poured into the chamber 14 via an entry port 16 and subsequently cures into a rigid mass. This serves to secure the optical fibres 1 in
 35 place. Whilst the epoxy resin is curing the optical fibres 1 are urged into the apertures 5 so that initially the ends of the inner cores 3 of the optical fibre 1 are proud of the inner surface of the brass plate 2. Subsequently, these ends are polished so
 40 as to be flush with this inner surface. By this means the ends of the optical fibres can be very accurately spaced in relation to the individual electro-optical converter devices 8. If necessary, the optical fibres can be aligned with the array of
 45 devices 8 by lateral adjustment movement relative to the faceplate 10 during assembly of the brass plate 2. When they are correctly aligned, the brass plate 2 is permanently clamped to the base plate
 50 10 via a rigid spacer 22.

This form of construction has the advantages that alignment can be achieved very easily; the converter devices 8 are protected by the presence of the faceplate 6 and they operate in a hermetically
 55 sealed enclosure; and the outer surface of the faceplate 6 can easily be cleaned, since it is a smooth optically flat surface.

Although in the drawing an electro-optical receiver is illustrated, it will be understood that by using light emissive devices 8, an electro-optical
 60 transmitter can be produced in which electrical signals applied to the devices 8 generate light signals which are transmitted along the fibre optic bundle of individual optical fibres 1. The electrical
 65 signals can be applied or received from the device

8 in any convenient manner. In the drawing, it is assumed that conductive tracks are formed on the surface of the ceramic plate 9 on which the devices 8 are mounted, with the conductive tracks providing electrical communication between the
 70 devices 8 and external leads 17. These leads 17 are attached to the ceramic substrate 9 and pass through apertures 18 in the base plate 10. The leads 17 are sealed into the base plate 10 by means of a glass bead in order to preserve
 75 electrical insulation and to maintain the hermetic seal.

CLAIMS

1. An electro-optical termination including an
 80 array of electro-optical converter devices mounted within a hermetically sealed enclosure; a plurality of individual optical fibres, the ends of which are held in a fixed position relative to each other corresponding to said array and which terminate
 85 in a common plane; a rigid fibre optical faceplate mounted with one of its major faces adjacent to said array and the other of its major faces being adjacent to said plane with the faceplate forming part of the wall of said hermetically sealed
 90 enclosure.

2. A termination as claimed in claim 1 and wherein the converter devices are arranged in a two dimensional pattern.

3. A termination as claimed in claim 1 or 2 and
 95 wherein the ends of the individual optical fibres are held in position by means of a rigid opaque plate having a major surface which is aligned with the adjacent major face of said faceplate, and the individual optical fibres terminating in apertures
 100 which pass through the thickness of the rigid plate.

4. A termination as claimed in claim 3 and wherein the rigid plate is a metal plate of uniform thickness.

5. A termination as claimed in claim 3 or 4 and wherein the optical fibres terminate in the plane of said major surface of the rigid opaque plate.

6. A termination as claimed in claim 3, 4 or 5 and wherein the individual optical fibres are held
 110 in position within the metal plate by means of a setable material, which is formed around the fibres at the point where they emerge from the apertures in the metal plate.

7. A termination as claimed in claim 6 and wherein said setable material is an epoxy resin.

8. A termination as claimed in any of the preceding claims and wherein the electro-optical converter devices are supported on a base plate which also forms part of said enclosure.

9. A termination as claimed in claim 8 and wherein said converter devices are mounted on a ceramic substrate which in turn is mounted on
 120 said base plate.

10. A termination as claimed in claim 8 or 9 and wherein a collar is attached to the base plate and extends therefrom to support said faceplate, the collar being of sufficient depth to provide clearance for the height of the electro-optical
 125 converter devices and to determine the spacing of

the active surface of these devices from the adjacent surface of said faceplate.

11. A termination as claimed in claim 10 and wherein said collar forms part of the envelope of
5 said hermetically sealed enclosure and is sealed in

a gas tight manner to the base plate and the faceplate.

12. An electro-optical termination substantially as illustrated in and described with reference to the
10 accompanying drawing.