Application for a Standard Patent or
A Standard Patent of Addition

We, INTERNATIONAL STANDARD ELECTRIC CORPORATION
of 320 Park Avenue, New York 22, State of New York, United States of America, hereby apply for the grant of a standard patent for an invention, entitled

"OPTICAL FIBRE ARRANGEMENT"

which is described in the accompanying complete specification.

Details of basic application(s) -

Number of basic application 429,954
Name of Convention country in which basic application was filed United States of America
Date of basic application 30 September, 1982

Our address for service is:

PATENT DEPARTMENT,
STANDARD TELEPHONES AND CABLES PTY. LIMITED,
252-280 BOTANY ROAD,
ALEXANDRIA, N.S.W. 2015.
AUSTRALIA.

Dated this Twenty-Second day of September 1983

INTERNATIONAL STANDARD ELECTRIC CORPORATION

Authorized Signatory

To: The Commissioners of Patents

This invention relates to optical fibre and, more particularly, to optical fibre having a concentric core arrangement whereby signals can be transmitted through both cores.
In support of the convention application made for a patent of addition for
an invention entitled

"OPTICAL FIBRE ARRANGEMENT"

1. PATRICK MICHAEL CONRICK,
of Standard Telephones and Cables Pty. Limited, 252-280 Botany Road, Alexandria,2015, N.S.W., Australia, do solemnly and sincerely declare as follows:—

1. I am authorised by INTERNATIONAL STANDARD ELECTRIC CORPORATION
the applicant for the patent of addition to make this declaration on its behalf.
2. The basic application as defined by Section 141 of the Act was made
in United States of America
on 30th September, 1982
by RICHMOND CHARLES BEECHER.
3. RICHMOND CHARLES BEECHER, of 274 Bullard Street,
Holden, Maryland 01520, United States of America,

is the actual inventor of the invention, and the facts upon which the Applicant
is entitled to make the application are as follows:—

INTERNATIONAL STANDARD ELECTRIC CORPORATION is the Assignee of
INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION who
is the Assignee of THE SAID INVENTOR.

4. The basic application referred to in paragraph 2 of this Declaration was made
the first application in a Convention country in respect of the invention the subject
of the application.

Declared at Sydney this 22nd day of September 1983

INTERNATIONAL STANDARD ELECTRIC CORPORATION

Declarant

To: The Commissioner of Patents

thereof, taken in conjunction with the figures of the

Claim

1. An optical fibre having an inner core for transmitting a light signal and a concentric outer core for transmitting another light signal, said cores being separated from each other by a cladding layer, said cladding layer including a relatively thin ring for trapping any light transmitted from one core toward the other.
COMMONWEALTH OF AUSTRALIA
PATENTS ACT 1952-1969

COMPLETE SPECIFICATION FOR THE INVENTION ENTITLED

"OPTICAL FIBRE ARRANGEMENT"

The following statement is a full description of this invention, including the best method of performing it known to us:-
This invention relates to optical fibre and, more particularly, to optical fibre having a concentric core arrangement whereby signals can be transmitted through both cores.

Concentric core optical fibres include a central or inner core surrounded by a cladding which, in turn, is surrounded by a concentric outer core which, in turn, is surrounded by an outer cladding layer. By properly relating the indices of refraction between the different cores and claddings, both cores can transmit an optical signal via the principles of total internal reflection. Such fibres have found usage, for example, in military applications wherein the inner core carries an information signal and the outer core carries a jamming signal to prevent unauthorized access to the information signal.

A problem with concentric core fibres is the crosstalk between the cores, that is, the light signal from one core mixing with the signal from the other core so that the signal in the other core is distorted. Crosstalk occurs as a result of scattered light which is present due to improper signal injection, microbends in the fibre and/or perturbations in the fibre.

According to the present invention there is provided an optical fibre having an inner core for transmitting a light signal and a concentric outer core for transmitting another light signal, said cores being separated from each other by a cladding layer, said cladding layer including a relatively thin ring for trapping any light transmitted from one core toward the other.

Preferably the index of refraction of the cores is higher than that of the cladding layer and the index of refraction of the relatively thin portion is also higher than that of the cladding layer, preferably at least as high as that of the cores.

It is also preferable to provide a light absorbing material in the relatively thin ring portion. With such material, light trapped in the ring is not transmitted through the fibre.

For a better understanding of the invention, references made to the following description of a preferred embodiment
thereof, taken in conjunction with the figures of the accompanying drawing, in which:

Fig. 1 is a cross-sectional view of an optical fibre in accordance with this invention; and,

Fig. 2 is a graphic representation of the variation of the refractive index along the cross-section of the fibre shown in Fig. 1.

In Fig. 1, the optical fibre 10 in accordance with this invention is shown as including an inner core 12 of suitable light transmitting material having an index of refraction N₁. Around this core 12 is formed a first cladding layer 14, formed of a suitable material and having an index of refraction N₂ which is lower than the index of refraction N₁. With the indices of refraction between the core 12 and the cladding layer 14, light can be transmitted along the core 12 by the internal reflection thereof at the interface of the core and the cladding.

Around the cladding layer 14 is formed another or outer core 16 also of suitable light transmitting material. The outer core 16 is generally concentric with respect to the inner core 12 and has an index of refraction N₃ which is higher than the index of refraction of the cladding layer 14. Thus, the core 16 is spaced from the inner core 12 by the cladding layer 14.

Around the core 16 is formed another or outer cladding layer 18 formed of a suitable material and having an index of refraction N₄ which is lower than that of the index of refraction N₃ of the core 16. With N₃ being higher than N₂ and N₄, light can be transmitted along the outer core 16 also by the internal reflection thereof at the interfaces.

In accordance with this invention, the inner cladding layer 14 is formed with a relatively thin concentric ring 20 of light transmitting material having an index of refraction N₅ which is higher than the index of refraction of the core layer 14. With this arrangement, the ring 20 separates between the cores 12 and 16 and forms a barrier therebetween that traps any light refracted from the cores into the cladding layer. Preferably, the index of refraction N₅ is at least as high as the index of refraction of the cores 12 and 16. Moreover, the ring 20 should include...
a material for enabling it to absorb, rather than transmit, the light it traps. By so absorbing the light, it is not discharged at the output end of the fibre 10 and minimizes problems associated with coupling the fibre to a receiver.

As can be seen in Fig. 2, the refractive index profile for a particular fibre in accordance with this invention is illustrated. The refractive index profile of the core 12 is the characteristic parabolic profile of a graded index fibre and is shown at $N_1$. The increased index $N_5$ of the ring 12 is outwardly adjacent the parabolic index of the core and outwardly adjacent the index profile of the ring is the index $N_4$ profile of the outer core 16.

In a preferred fibre 10, the cores 12 and 16 are made of a high quality glass such as fused silica or fused silica doped with a suitable material increasing its index of refraction. Such materials are well known in the art and include germania and phosphorus. Similarly, the cladding layers 14 and 18 can be made of fused silica or silica doped with boron or fluorine which elements reduce the index of refraction of the silica. Combinations of variously doped silica layers to provide an optical fibre are well known to those skilled in the art, and a more detailed explanation is not necessary for an understanding of this invention.

The ring 20 is doped to raise its index of refraction, for example, it can be doped with germania. Preferably, the ring additionally is doped with a material that absorbs light at the appropriate wavelength, for example, boron, cobalt or nickel. Such materials should not require irradiation to become absorbent at the desired wavelength.

The fibre 10 can be made in accordance with any conventional manufacturing process. Thus, a modified chemical vapor deposition process (MCVD) or a vapour axial deposition process (VAD) or a rod in tube process can be utilized. If an MCVD process is used, the outer cladding layer 18 could be the substrate tube used in such process or could be surrounded by that tube,
purposes.

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The claims defining this invention are as follows:

1. An optical fibre having an inner core for transmitting a light signal and a concentric outer core for transmitting another light signal, said cores being separated from each other by a cladding layer, said cladding layer including a relatively thin ring for trapping any light transmitted from one core toward the other.

2. An optical fibre as claimed in claim 1, wherein said relatively thin ring includes a light absorbing material for absorbing light trapped therein.

3. An optical fibre as claimed in claim 1 or 2, wherein the index of refraction of said cladding is less than that of said cores.

4. An optical fibre as claimed in claim 3, wherein the index of refraction of said ring is higher than that of said cladding layer.

5. An optical fibre as claimed in claim 4, wherein the index of refraction of said ring is at least as high as that of said cores.

6. An optical fibre as claimed in any one of the preceding claims, wherein said cores and said cladding are made of silica material and wherein said ring is doped with light absorbing material.

7. An optical fibre as claimed in any one of the preceding claims, wherein said ring is doped with an element selected from the group consisting of boron, cobalt and nickel.

8. An optical fibre as claimed in any one of the preceding claims, including an outer cladding layer surrounding said outer core.

9. An optical fibre substantially as herein described with reference to Fig. 1 of the drawings.

DATED THIS TWENTY-SECOND DAY OF SEPTEMBER 1983
INTERNATIONAL STANDARD ELECTRIC CORPORATION