

- 1 -

WATER PENETRATION DETECTING APPARATUS

The present invention relates to an apparatus for detecting water penetration - for example, in an optical fibre transmission cable.

5

Generally, an optical fibre transmission cable is adversely susceptible to water, and therefore it is conventionally necessary to continuously inject pressurized dry air into it or fill it with a specially prepared jelly. However, to inject pressurized dry air requires an expensive air supply system, and the specially prepared jelly does not provide means for detecting the water penetration into the optical fibre transmission cable and cable connectors. In 1987, H. Sawan and S. Kukita proposed a method of employing the light transmission loss due to a bending of an optical fibre, wherein the water penetration causes a piston or specially prepared thread to bend the optical fibre. However, this method is too complicated to utilize.

10
15

Preferred embodiments of the present invention aim to provide a water penetration-detecting apparatus of a simple structure.

20

According to one aspect of the present invention, there is provided apparatus for detecting water penetration comprising a water penetration detector mounted on a possible water penetration region, an optical fibre for connecting said water penetration detector with a photosensor, and a light source for supplying light through one end of said optical fibre to said water detector, the other end of said optical fibre being connected with said photosensor, wherein the amount of transmission loss of said optical fibre is detected by said photosensor.

25

This Sheet Has Been Replaced

REPLACED SHEETS		SG
☒	Description : paged ¹ to paged ⁵	
☒	Claim(s) : paged ⁴ to paged ⁷	
☐	Drawing(s) : paged to paged	
☒	Abstract : paged ¹ to paged ¹	
DATE OF RECEIPT		

According to another aspect of the present invention, there is provided a water penetration detector for mounting on an optical fibre transmission cable, comprising a housing with a plurality of holes for passing water, a water-absorbent material disposed around the core of said optical fibre
5 transmission cable in said housing, a plurality of grooves formed on the peripheral surface of said core, and an optical fibre wound around said core, wherein said water absorbent material expands volumetrically when wet, so as to apply a pressure to said optical fibre to bend it into said plurality of grooves.

10

Preferably, the number of the loops of the winding of said optical fibre and the number of said plurality of grooves may be adjusted.

15

Preferably, said core may have a properly selected diameter.

Preferably, a tape is wound around said core so as to prevent said water absorbent material from being thrust into said plurality of grooves.

20

The invention extends to an optical fibre transmission cable provided with a water penetration detector according to any of the preceding aspects of the invention.

25

For a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

This Sheet Has Been Replaced



Figure 1 is an exploded perspective view illustrating essential parts of one example of an apparatus for detecting water penetration, according to the present invention;

5 Figure 2 is a cross sectional view of Figure 1; *

Figure 3A and 3B are enlarged views of a part of Figure 2 for showing the operation of the apparatus; and

10 Figure 4 illustrates the apparatus of Figure 1 in use.

Referring to Figure 1, a housing 10 is formed with a plurality of holes 11 for passing water. A water-absorbent material 5 is disposed around the core 1 of an optical fibre transmission cable in the housing 10. A plurality
15 of grooves 3 are formed on the peripheral surface of the core 1. An optical fibre 7 is wound around the core 1. The water absorbent material 5 is made to expand volumetrically so as to apply a pressure to the optical fibre 7 to bend into the plurality of grooves 3. Before winding the optical fibre 7, the core 1 is enclosed with an unwoven fabric tape 4. Then the core 1 is inserted
20 into the housing 10, and the space therebetween is filled with the water absorbent material 5.

The assembled water penetration detector 100 is installed in a cable junction or possible water penetration region of the optical fibre transmission
25 cable, as shown in Figure 4. A light source 22 is connected with one end of an optical fibre cable 20 whose other end is connected via an amplifier 25 to OTDR 30 to output means such as a monitor 35 and printer 38.



In operation, if water penetration occurs through the plurality of holes 11 of the housing 10, the water absorbent material 5 expands volumetrically so as to apply a pressure to the optical fibre 7 to bend it into the plurality of grooves 3, as shown in Figure 3B. This causes a loss of the light transmitted through the optical fibre. The tape 4 is to prevent the expanded water absorbent material 5 from being thrust into the plurality of grooves 3.

Practically, when the water penetration detector 100 was connected with an optical fibre cable of 4Km and intentionally soaked in water, the transmission loss of light was detected by the OTDR to be 1.1dB at a wavelength of 1300nm, compared to 0.05dB before soaking. The transmission loss of light varies with the number of the grooves 3 of the core 1 and the number of the loops of the winding of the optical fibre 7.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative

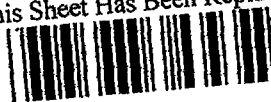


features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

5

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any
10 novel combination, of the steps of any method or process so disclosed.

This Sheet Has Been Replaced





CLAIMS:

1. An apparatus for detecting water penetration comprising a water penetration detector mounted on a possible water penetration region, an optical fibre for connecting said water penetration detector with a photosensor, and a light source for supplying light through one end of said optical fibre to said water detector, the other end of said optical fibre being connected with said photosensor, wherein the amount of transmission loss of said optical fibre is detected by said photosensor.
2. A water penetration detector for mounting on an optical fibre transmission cable, comprising a housing with a plurality of holes for passing water, a water-absorbent material disposed around the core of said optical fibre transmission cable in said housing, a plurality of grooves formed on the peripheral surface of said core, and an optical fibre wound around said core, wherein said water absorbent material expands volumetrically when wet, so as to apply a pressure to said optical fibre to bend it into said plurality of grooves.
3. A water penetration detector as claimed in Claim 2, wherein the number of the loops of the winding of said optical fibre and the number of said plurality of grooves may be adjusted.
4. A water penetration detector as claimed in Claim 2 or 3, wherein said core may have a properly selected diameter.

This Sheet Has Been Replaced





- 7 -

5. A water penetration detector as claimed in Claim 2, 3 or 4, wherein a tape is wound around said core so as to prevent said water absorbent material from being thrust into said plurality of grooves.
- 5 6. A water penetration detector or detecting apparatus substantially as hereinbefore described with reference to the accompanying drawings.
7. An optical fibre transmission cable provided with a water penetration detector according to any of the preceding claims.

This Sheet Has Been Replaced



ABSTRACT

WATER PENETRATION DETECTING APPARATUS

5 An apparatus for detecting water penetration into an optical fibre
transmission cable comprises a housing 10 with a plurality of holes 11 for
passing water, a water-absorbent material 5 disposed around the core 1 of the
optical fibre transmission cable in the housing 10, a plurality of grooves 3
formed on the peripheral surface of the core 1, and an optical fibre 7 wound
10 around the core 1, wherein the water absorbent material 5 expands
volumetrically so as to apply a pressure to the optical fibre 7 to bend it into
the plurality of grooves 3.

15

Figure 1

This Sheet Has Been Replaced



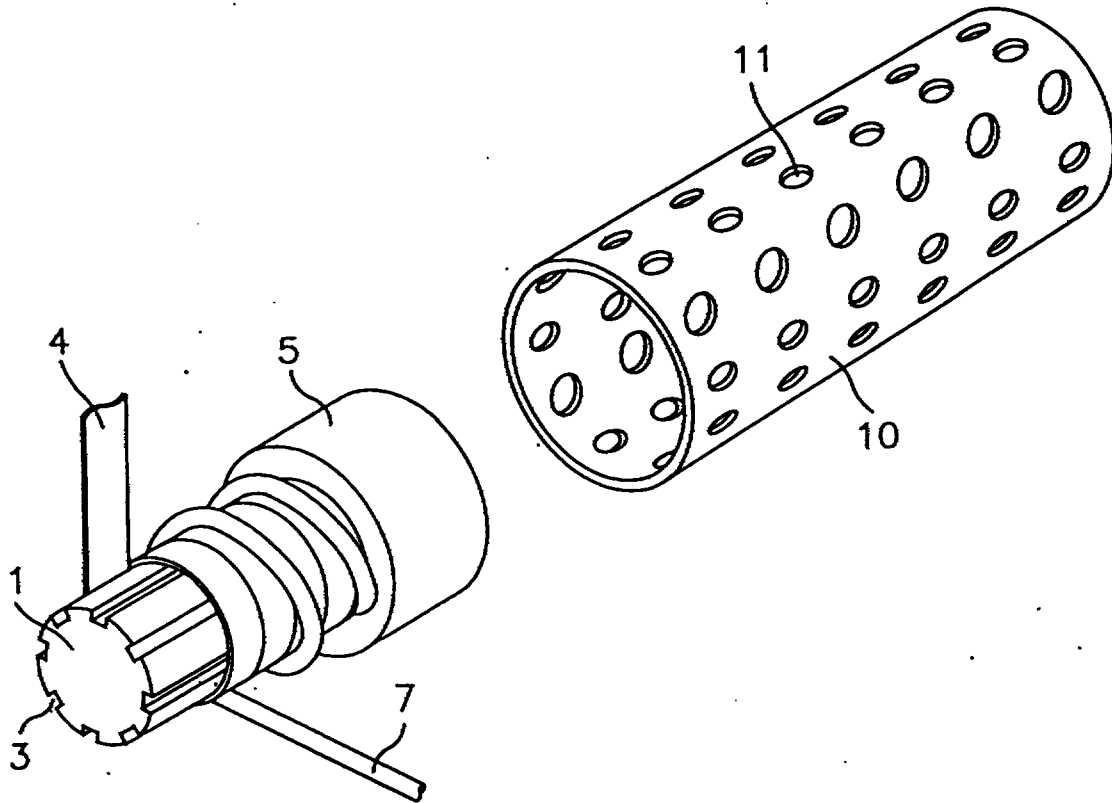


FIG. 1

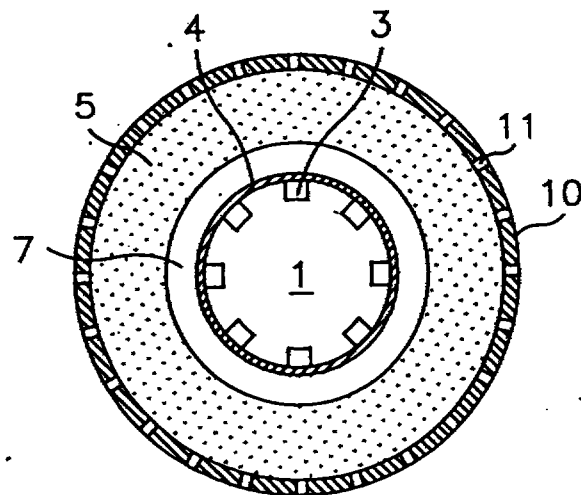


FIG. 2

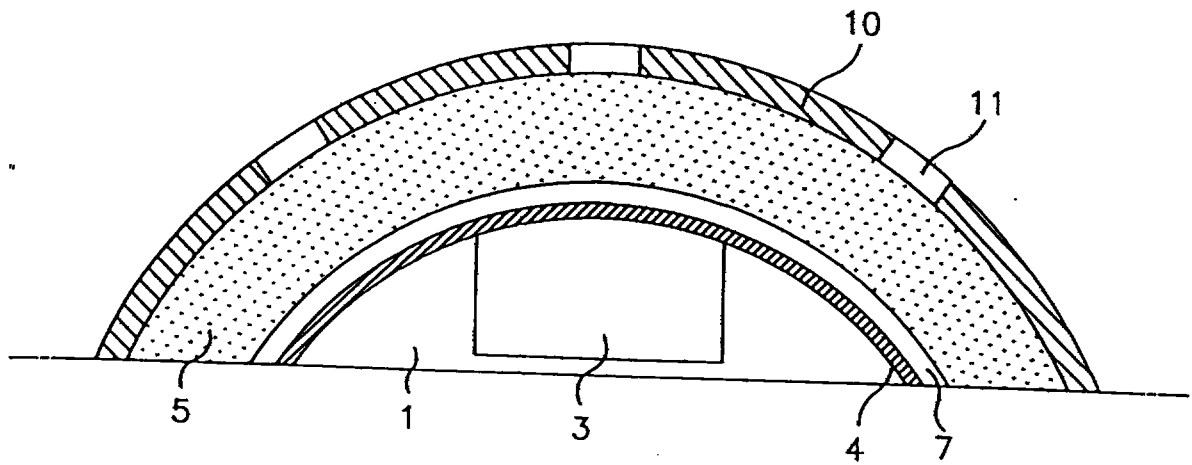


FIG. 3A

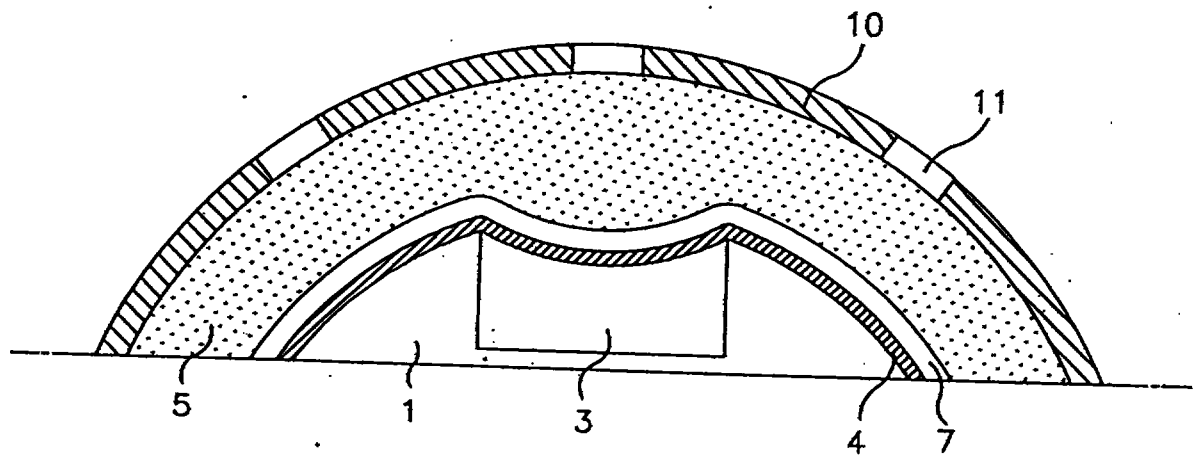


FIG. 3B

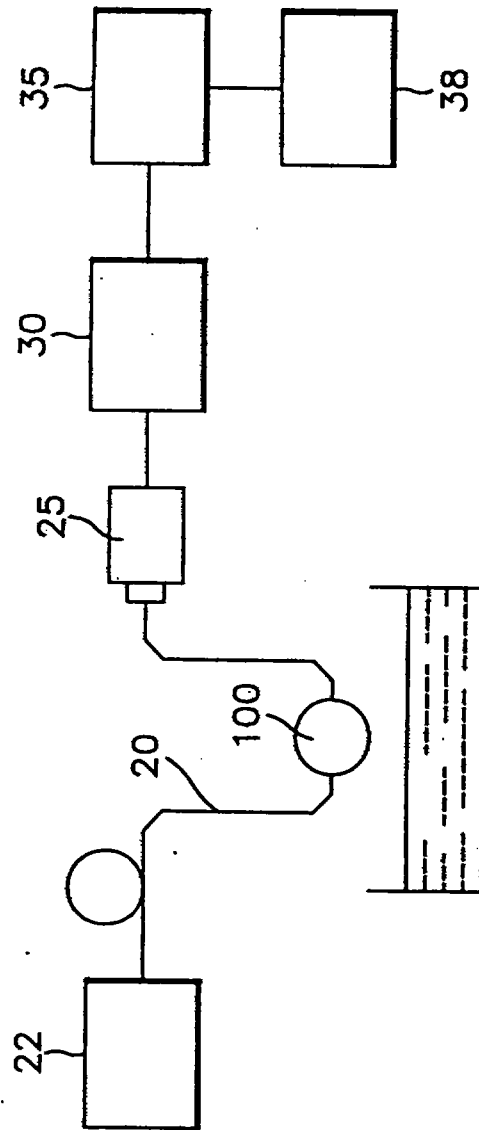


FIG. 4

- 1 -

WATER PENETRATION DETECTING APPARATUS

The present invention relates to an apparatus for detecting water penetration - for example, in an optical fibre transmission cable.

5

Generally, an optical fibre transmission cable is adversely susceptible to water, and therefore it is conventionally necessary to continuously inject pressurized dry air into it or fill it with a specially prepared jelly. However, to inject pressurized dry air requires an expensive air supply system, and the specially prepared jelly does not provide means for detecting the water penetration into the optical fibre transmission cable and cable connectors. In 1987, H. Sawan and S. Kukita proposed a method of employing the light transmission loss due to a bending of an optical fibre, wherein the water penetration causes a piston or specially prepared thread to bend the optical fibre. However, this method is too complicated to utilize.

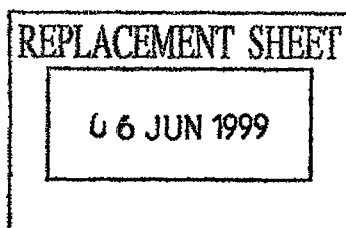
15

Preferred embodiments of the present invention aim to provide a water penetration-detecting apparatus of a simple structure.

20

According to the present invention, there is provided a water penetration detector comprising a water-permeable housing, an elongate core and a water-absorbent material, disposed around the core, within the housing, one or more elongate grooves formed on the peripheral surface of the core and an optical fibre wound around the core so as to cross the groove or grooves at a plurality of points, wherein the water absorbent material expands volumetrically when wet, so as to apply a pressure to the optical fibre to bend it into the groove or grooves.

25



REPLACEMENT SHEETS	SG
☒ Description	: paged ... to paged ...
☒ Claim(s)	: paged ... to paged ...
☐ Drawing(s)	: paged ... to paged ...
☒ Abstract	: paged ... to paged ...
DATE OF RECEIPT 6/6/99	

The housing may include a plurality of holes for passage of water.

The core may be the core of an optical fibre transmission cable.

5 Preferably, a plurality of grooves are formed on the peripheral surface of the core.

Preferably, a tape is wound around the core so as to prevent the water absorbent material from being thrust into the plurality of grooves.

10

The present invention also extends to an optical fibre transmission cable provided with a water penetration detector according to the invention.

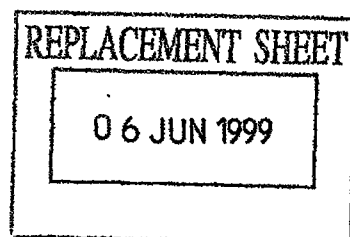
For a better understanding of the invention, and to show how the same
15 may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

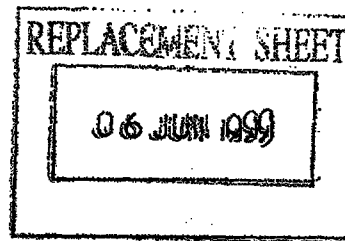
Figure 1 is an exploded perspective view illustrating essential parts of one example of an apparatus for detecting water penetration, according to the
20 present invention;

Figure 2 is a cross sectional view of Figure 1;

Figure 3A and 3B are enlarged views of a part of Figure 2 for showing
25 the operation of the apparatus; and

Figure 4 illustrates the apparatus of Figure 1 in use.





- 3 -

Referring to Figure 1, a housing 10 is formed with a plurality of holes 11 for passing water. A water-absorbent material 5 is disposed around the core 1 of an optical fibre transmission cable in the housing 10. A plurality of grooves 3 are formed on the peripheral surface of the core 1. An optical fibre 7 is wound around the core 1. The water absorbent material 5 is made to expand volumetrically so as to apply a pressure to the optical fibre 7 to bend into the plurality of grooves 3. Before winding the optical fibre 7, the core 1 is enclosed with an unwoven fabric tape 4. Then the core 1 is inserted into the housing 10, and the space therebetween is filled with the water absorbent material 5.

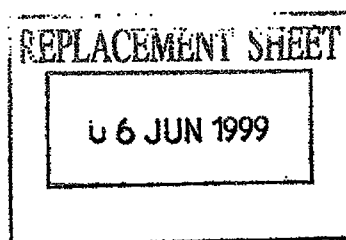
The assembled water penetration detector 100 is installed in a cable junction or possible water penetration region of the optical fibre transmission cable, as shown in Figure 4. A light source 22 is connected with one end of an optical fibre cable 20 whose other end is connected via an amplifier 25 to OTDR 30 to output means such as a monitor 35 and printer 38.

In operation, if water penetration occurs through the plurality of holes 11 of the housing 10, the water absorbent material 5 expands volumetrically so as to apply a pressure to the optical fibre 7 to bend it into the plurality of grooves 3, as shown in Figure 3B. This causes a loss of the light transmitted through the optical fibre. The tape 4 is to prevent the expanded water absorbent material 5 from being thrust into the plurality of grooves 3.

Practically, when the water penetration detector 100 was connected with an optical fibre cable of 4Km and intentionally soaked in water, the transmission loss of light was detected by the OTDR to be 1.1dB at a wavelength of 1300nm, compared to 0.05dB before soaking. The transmission

- 4 -

loss of light varies with the number of the grooves 3 of the core 1 and the number of the loops of the winding of the optical fibre 7.

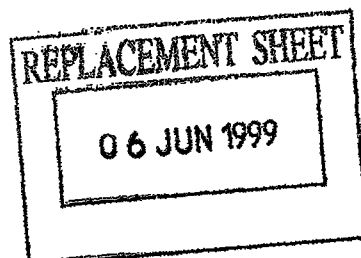




- 5 -

CLAIMS

1. A water penetration detector comprising a water-permeable housing, an elongate core and a water-absorbent material, disposed around the core, within
5 the housing, one or more elongate grooves formed on the peripheral surface of the core and an optical fibre wound around the core so as to cross the groove or grooves at a plurality of points, wherein the water absorbent material expands volumetrically when wet, so as to apply a pressure to the optical fibre to bend it into the groove or grooves.
- 10 2. A detector according to claim 1 in which the housing includes a plurality of holes for passage of water.
3. A detector according to claim 1 or claim 2 in which the core is the core
15 of an optical fibre transmission cable.
4. A detector according to any one of claims 1-3 in which a plurality of grooves are formed on the peripheral surface of the core.
- 20 5. A detector according to any preceding claim in which a tape is wound around the core so as to prevent the water absorbent material from being thrust into the plurality of grooves.
6. An optical fibre transmission cable provided with a
25 water penetration detector according to any preceding claim.



ABSTRACT

WATER PENETRATION DETECTING APPARATUS

5 An apparatus for detecting water penetration into an optical fibre
transmission cable comprises a housing 10 with a plurality of holes 11 for
passing water, a water-absorbent material 5 disposed around the core 1 of the
optical fibre transmission cable in the housing 10, a plurality of grooves 3
formed on the peripheral surface of the core 1, and an optical fibre 7 wound
10 around the core 1, wherein the water absorbent material 5 expands
volumetrically so as to apply a pressure to the optical fibre 7 to bend it into
the plurality of grooves 3.

15

Figure 1

