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G2J JGCA1

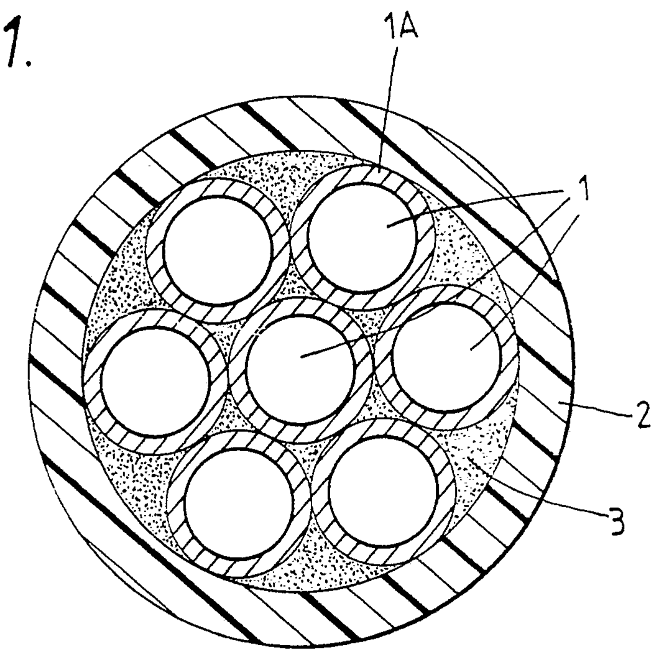
(56) Documents cited
GB 2164198 A GB 2138965 A GB 1506405 A
GB 1501800 A EP 0182538 A1 EP 0157610 A2
US 4037922 A

(58) Field of search
UK CL (Edition J) G2J JGCA1
INT CL⁴ G02B

(54) Optical fibre cable element

(57) A flexible lightweight high capacity cable element comprises a plurality of, e.g. seven, primary coated optical fibres (1) laid in a juxtaposed configuration of a central fibre surrounded by the remaining e.g. six other, fibres; the fibres having a zero angle of lay and the assembly being encapsulated in a plastics sheath (2). It is suitable for installation in ducts using an air blowing technique, or can be used with further such elements in the formation of high capacity cables.

Fig.1.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy

GB 2 215 480 A

Fig.1.

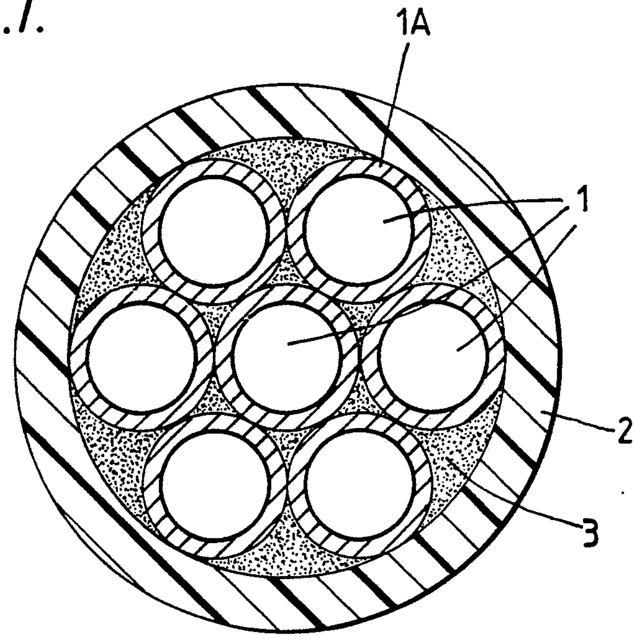


Fig.2.

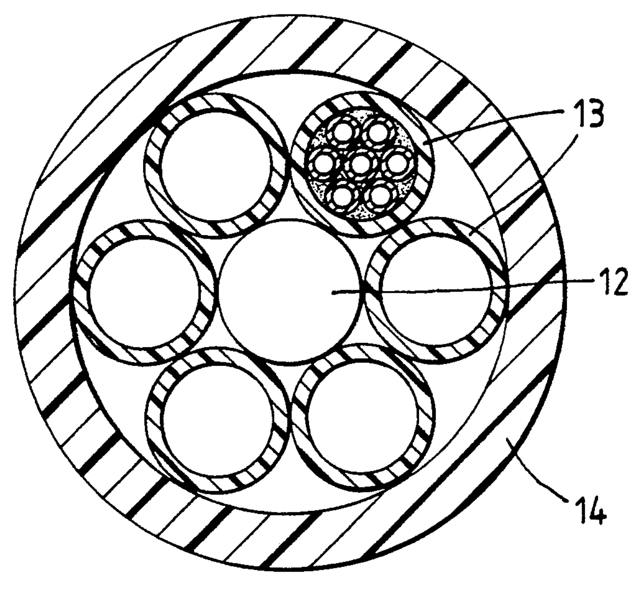


Fig.3.

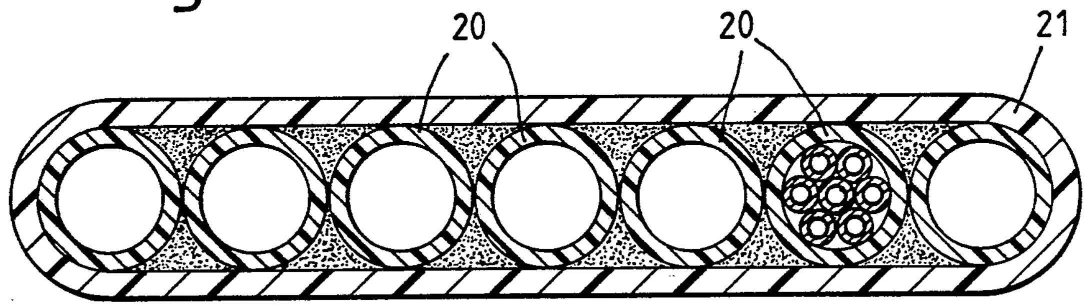


Fig.4.

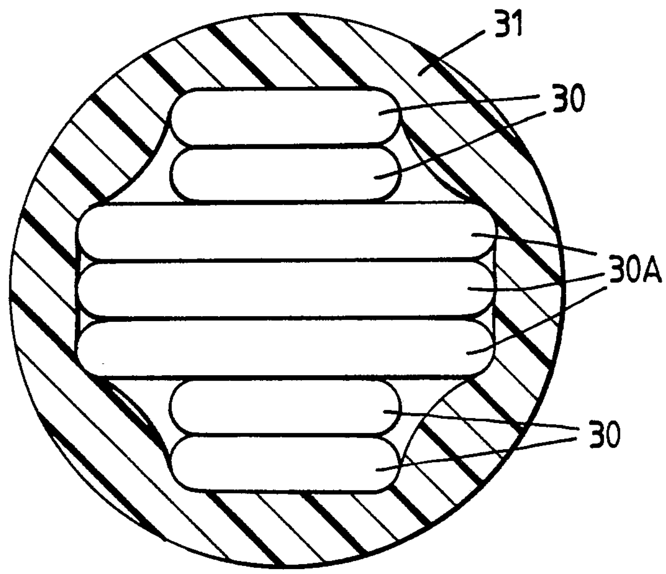
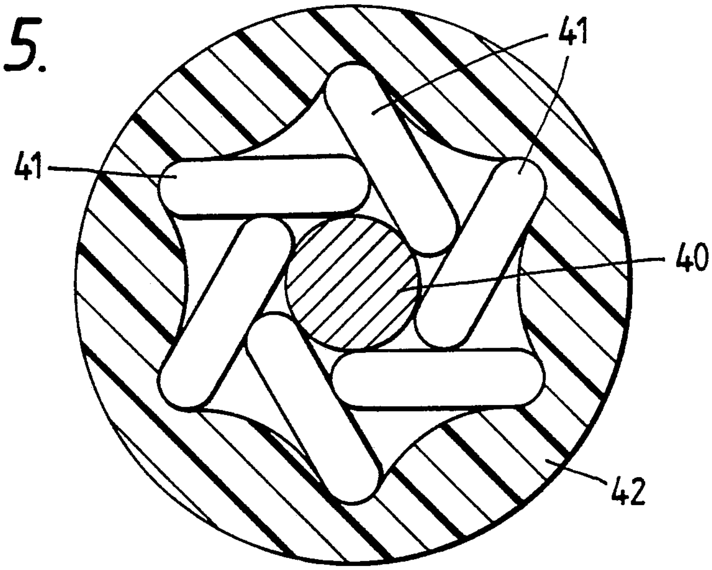


Fig.5.



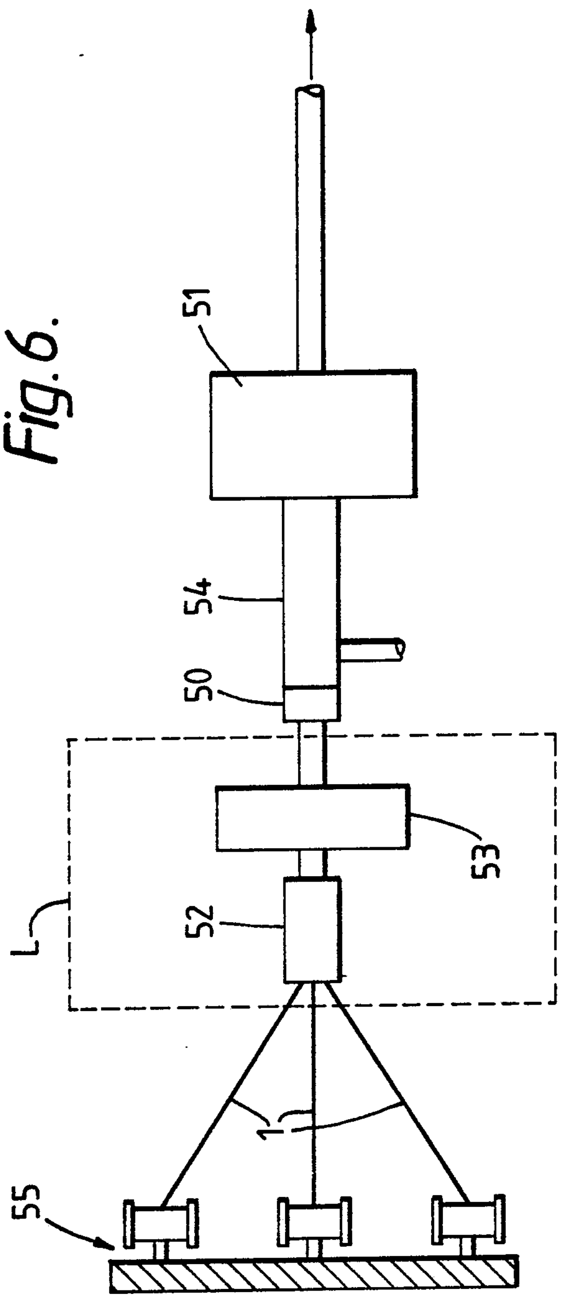


Fig.6.

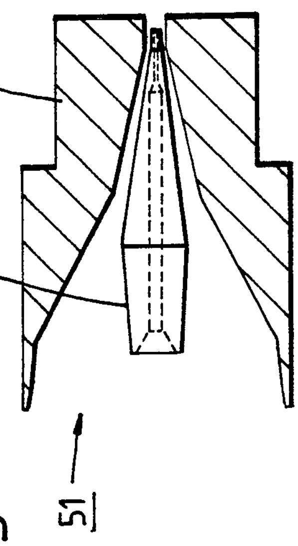
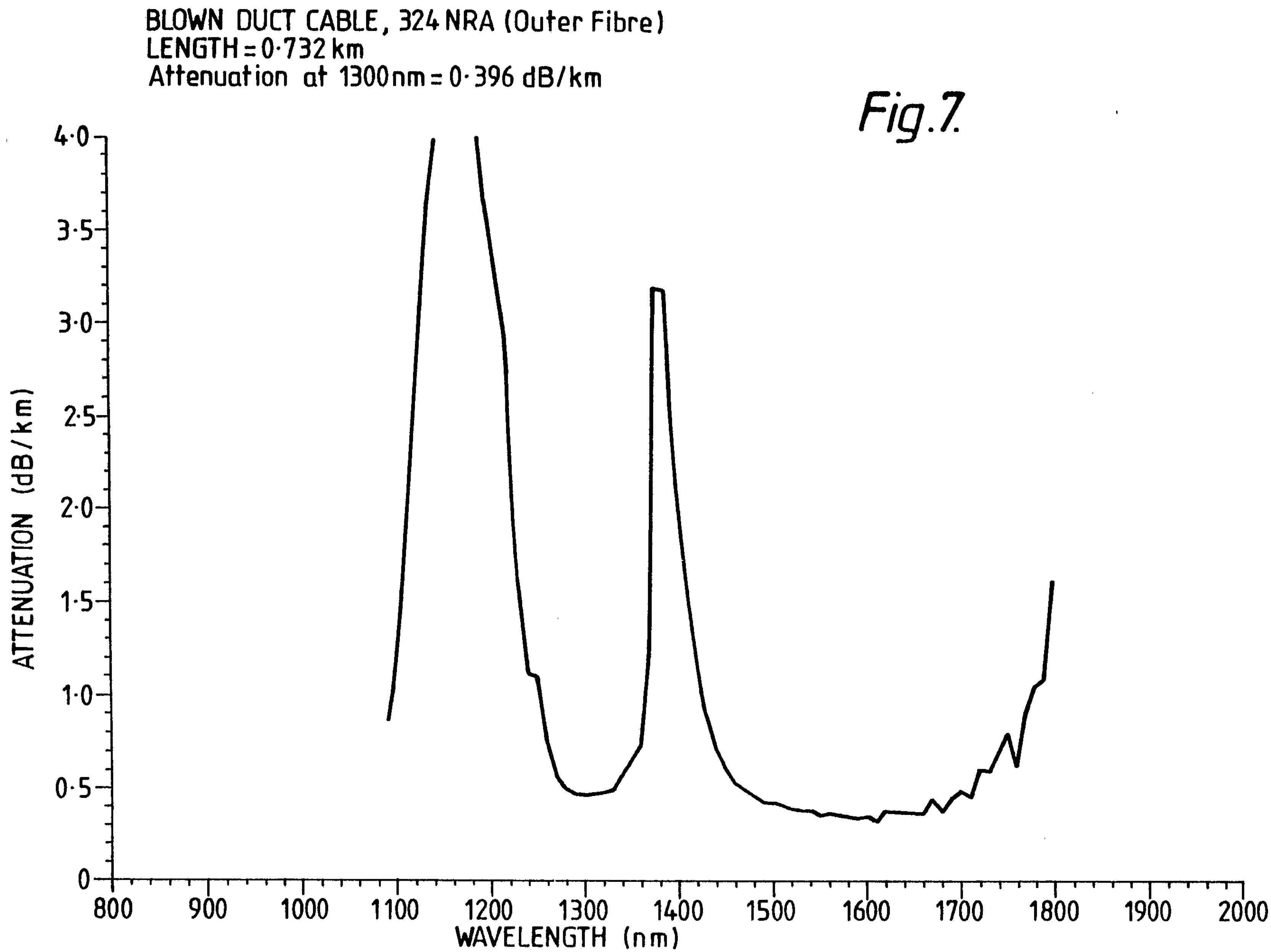


Fig.6A.

Fig.7.


BLOWN DUCT CABLE, 324 NRA (Outer Fibre)
LENGTH = 0·732 km
Attenuation at 1300 nm = 0·396 dB/km
ATTENUATION (dB/km)
4·0
3·5
3·0
2·5
2·0
1·5
1·0
0·5
0
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
WAVELENGTH (nm)

BLOWN DUCT CABLE, 324 NRA (Central Fibre)
LENTH = 0·732 km
Attenuation at 1300 nm = 0·671 dB/km

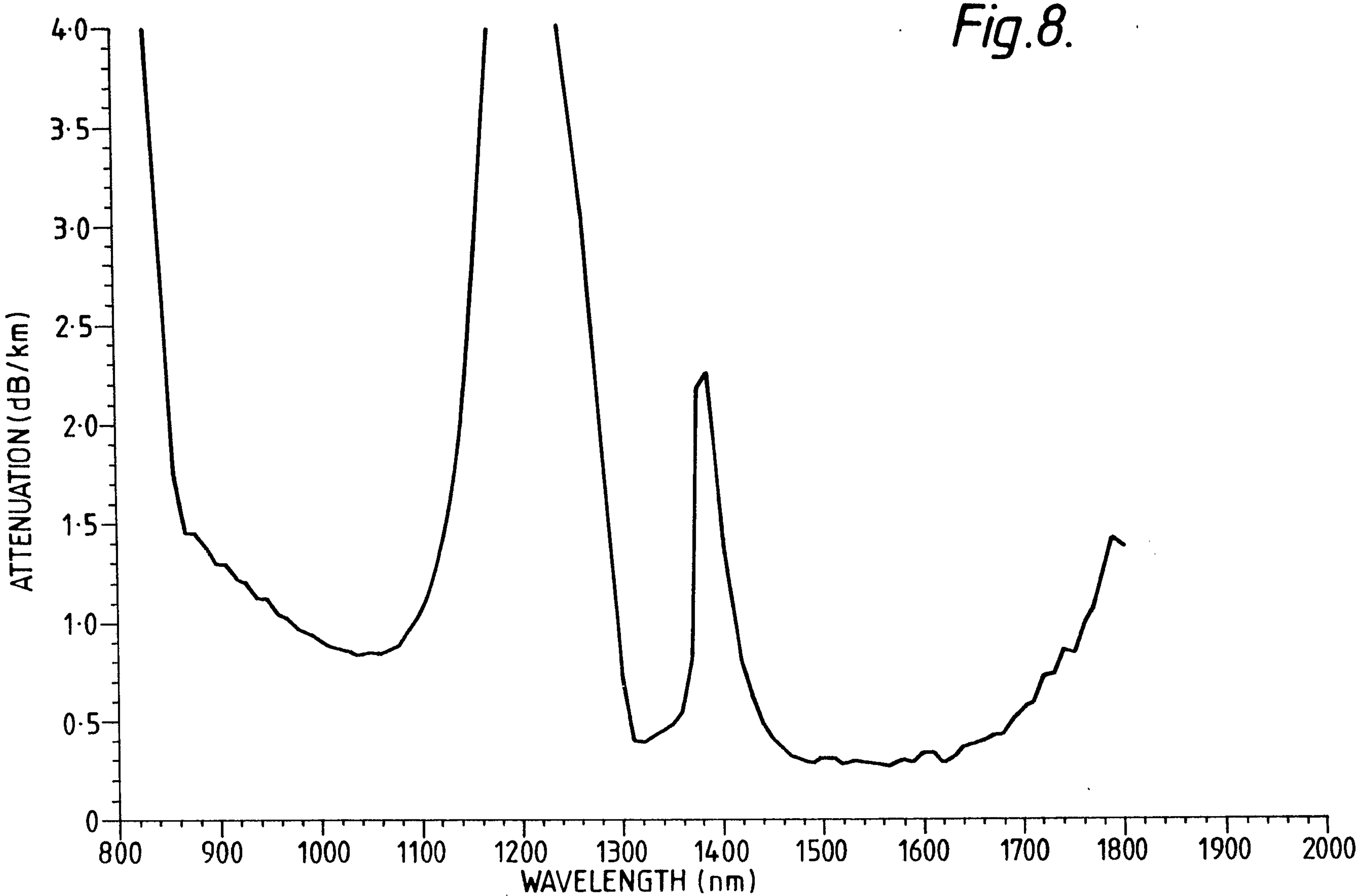


Fig.8.

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OPTICAL FIBRE CABLE ELEMENT

This invention relates to an optical fibre cable particularly, but not exclusively, for use as a blown duct unit for a high capacity local area network and domestic rural subscriber link.

A low loss light density optical cable with nylon extruded fibre units has been disclosed by K. Ishihara in Electronics Letters Volume 17 No. 2, 22 January 1981. The basic unit was constructed by stranding six fibres around a buffer coated steel wire. Each fibre had an outside diameter of 125 um, having double silicone on-line coatings (0.2 to 0.4 mm thick). The stranded unit was sheathed in nylon.

The disadvantage of such a construction is that a precise lay length of fibres has to be established to avoid excessive cabling increments through microbending. Furthermore, single on-line coated fibres (125 um fibres on-line coated to 230 um with silicon resin or epoxy acrylate resin) cannot be successfully used in this construction, to achieve low loss increments through stranding.

It is an object of the present invention to provide a miniature, lightweight, cheap and easily manufacturable multi-fibre cable element for a number of applications.

According to the present invention there is provided an optical fibre cable element comprising a plurality of primary-coated optical fibres encapsulated in a plastics sheath in a juxtaposed configuration of a central fibre surrounded by the remaining fibres, the fibres having a zero angle of lay.

According to another aspect of the present invention there is provided a method of making an optical fibre cable element, comprising feeding a plurality of primary-coated optical fibres towards a guide which guides them into a juxtaposed configuration of a central fibre surrounded by the remaining fibres with a zero angle of lay, and feeding the juxtaposed fibres into an encapsulating stage in which an encapsulation is applied around the juxtaposed fibres.

The fibres can each have either a single or double primary coating such as an acrylate or silicone coating. By primary coating is meant a protective coating applied on-line when the fibre was drawn, in order to protect the fibre surface.

Preferably the sheathing material is a thermoplastic polyester, for example one sold under the trade name 'HYTREL'. An overall sheathing diameter in the range 1.5 to 2 mm outside diameter is preferable.

Such a cable element can be installed into ducts using an air blowing technique such as described in British Patent Specification 0108590. In addition, a plurality of such units can be stranded around a central strength member and finally sheathed to provide a very high fibre count, high capacity, subscriber or LAN unit. A plurality of such units can also be sheathed to provide a flat cable. Such flat cables can be used either singly or stacked up in multi-layers and re-sheathed to again provide higher capacity links. Such flat links are useful for domestic and office under-carpet telephone and computer links.

In order that the invention can be more clearly understood, reference will now be made to the accompanying drawings, in which:-

Fig. 1 shows in cross-section a cable element according to an embodiment of the present invention;

Fig. 2 shows in cross-section a cable incorporating cable elements of Fig. 1;

Fig. 3 is a cross-section of a flat cable incorporating cable elements of Fig. 1;

Fig. 4 is a cross-section of a high capacity cable using flat cables as shown in Fig. 3,

Fig. 5 shows a high capacity cable incorporating flat cables of Fig. 3 in a stranded configuration.

Fig. 6 shows schematically apparatus for making the cable element of Fig. 1 and Figs. 7 and 8 show attenuation curves for two cable elements as shown in Fig. 1.

Referring to Fig. 1, the cable element comprises seven primary coated optical fibres 1 which have been encapsulated in a sheath 2 of a thermoplastic polyester, in particular one sold under the trade name 'HYTREL'. Each of the fibres has a single or double primary coating only, indicated by the reference numeral 1A, in particular a single or double acrylate or silicone on-line coating.

The element has a zero angle of lay for the fibres and each of the six outer fibres which surround the central fibre embrace each other and also embrace the central fibre, i.e. they are in contact.

If required a filler 3 can be provided in the interstices between the fibres during or prior to application of the sheath 2.

The cable element just described is suitable for installation in ducts using an air blowing technique. Alternatively, it can be incorporated into a larger cable, and an example is shown in Fig. 2.

Referring to Fig. 2, a high capacity subscriber link cable or local area network cable is shown, and comprises a central member 12, which can itself consist of an element such as that already described with reference to Fig. 1, or alternatively can be a simple strength member. Around the central member 12 are six elements each the same or similar to that described with reference to Fig. 1. Each unit is designated by the reference numeral 13. These cable elements 13 are sheathed in an outer plastics sheath 14 and are stranded around the central member 12.

Referring now to Fig. 3, there is shown an alternative cable made up of the elements shown in Fig. 1. In Fig. 3 there is shown seven cable elements 20, each element being the same as is shown in Fig. 1, and these are laid side by side and encapsulated in a flat sheath 21 of plastics material which has been extruded around the elements 20. Once again, a filler can be used between the interstices of the elements, or alternatively the extruded sheath 21 can be relied upon to substantially fill the interstices between the adjacent fibre elements 20.

Fig. 4 shows in cross-section a high capacity cable using several flat cables each as described with reference to Fig. 3. Thus referring to Fig. 4, there is a stack of flat cables 30, each as described with reference to Fig. 3, sitting one on top of the other and sheathed in an outer plastic sheath 31. The overall configuration of the cable is shown as circular and for this purpose the flat cables 30 at the top and at the bottom would have fewer units 20 in them so that they are narrower in order to enable a circular overall configuration to be achieved. Thus the middle three flat cables designated 30A would be wider and would contain for example twelve of the cable elements 20, side by side, whereas the upper two and the lower two flat cables would contain only six elements 20 so that they are narrower.

As an alternative arrangement to Fig. 4 there is shown, in Fig. 5, a central strength member 40 surrounded by flat cables each similar to the one shown in Fig. 3 and designated 41 and stranded around the strength member 40.

Around this assembly is provided a plastics sheath 42.

The apparatus of Fig. 6 is used in order to manufacture the element of Fig. 1. Seven primary coated fibres 1 are fed in parallel via a guide bush 50 into the extruder head. The crosshead tooling 51 is used to sheath the fibres to an overall 1.5 to 2.0mm O.D. using for example Hytrel 7246. Figure 6A shows on a larger scale the point 51A and 51B used with the crosshead tooling 51. Both acrylate on-line coated and sylgard on-line coated fibres can be handled by this process to manufacture the basic cable element. The sheath is fairly tight - i.e. the fibres cannot be easily pulled out of the sheath. The extruder has a vacuum length 54 for creating a vacuum to draw down the extruded sheath 2 on to the fibres 1.

If buffering of fibres is required for any specific purpose, then it is possible to carry this out in a single operation as shown schematically in Figure 6 by means of the equipment shown within the broken line L. The fibres are fed through an intermediate applicator 52 which enables a dip coating of u.v. curable silicone resin to be applied and the buffered unit is cured using a u.v. lamp 53, prior to entry into the extruder for sheathing. One could alternatively use a thermally curable resin in which case fibres are fed in a guide to hold fibres in mechanised register into a coating applicator, then the fibres embedded in resin matrix are thermally cured prior to entry into the extruder crosshead. Such a core of fibres embedded in a resin matrix is suitable for insertion into C-section of a submarine cable.

Otherwise the fibres would be fed directly into the guide bush 50 from the fibre pay-off station 55, without buffering and the buffering station is thus shown within the broken line L.

Two separate types of unbuffered cables were made. In the first cable, seven 250um O.D. fibres each having a single hard acrylate on-line coating were used. In the second cable version, seven 230um O.D. fibres having a softer 'Sylgard' (silicone resin) on-line coating were used.

Figures 7 and 8 show one spectral attenuation curve of the first type of sheathed cable element. It is important to note that the bend edge is not encroaching on either of the 1310 or 1550nm wavelength windows of interest for longhaul communication links, i.e. such a cable could be used at both wavelengths. When tight nylon secondary coating is applied to such an acrylate fibre, then one normally sees a fairly sharp bend edge effect.

This cable was temperature cycled between $-20^{\circ}C$ to $+40^{\circ}C$ (6 x 10 hr cycles). One outer fibre and the central fibre were monitored for optical performance. Both fibres showed negligible change in attenuation after temperature cycling.

A 926m length of the second type of cable element was also temperature cycled, and the central fibre showed a slight improvement after cycling.

It is to be understood that the results of the two cable types made are surprising in that such low losses have been achieved in such a simple construction of cable element and although buffering is shown as an option it is believed unlikely this will be necessary except in exceptional circumstances such as e.g. dynamic cables, or for submarine cables. For such dynamic cable applications, however, we prefer on-line buffering of fibres with a 'softer' material such that the fibres are embedded in this material matrix prior to further operation such as on-line extrusion coating or, alternatively, on-line feeding into, for example, the protective tubular structure, e.g. a metal tube, of a submarine cable, which may be a C-section extrusion or longitudinally folded up from flat strip.

CLAIMS:-

1. An optical fibre cable element comprising a plurality of primary-coated optical fibres encapsulated in a plastics sheath in a juxtaposed configuration of a central fibre surrounded by the remaining fibres, the fibres having a zero angle of lay.

2. An element as claimed in claim 1, wherein each optical fibre has a primary coating consisting of a single or double acrylate coating.

3. An element as claimed in claim 1, wherein each fibre has as its primary coating a single silicone coating.

4. An element as claimed in any preceding claim, wherein the encapsulation comprises a plastics sheath of Hytrel.

5. An optical fibre cable comprising a plurality of elements each as claimed in any preceding claim, helically laid up around a central member, and having an outer sheath of plastics material.

6. A cable as claimed in claim 5 wherein the central member comprises a cable element as claimed in any of claims 1-5.

7. An optical fibre cable comprising a plurality of cable elements each as claimed in any of claims 1-5, laid side by side in a flat configuration and encapsulated in a plastics sheath.

8. An optical fibre cable comprising a plurality of cables each as claimed in claim 7, and stacked one on top of the other, said stack being held together by an outer sheath.

9. An optical fibre cable comprising a plurality of flat cables each as claimed in claim 7, helically laid up around a central member to form an assembly, said assembly being encapsulated in an outer sheath.

10. An optical fibre cable element substantially as hereinbefore described with reference to and as illustrated in Fig. 1 of the accompanying drawings.

11. An optical fibre cable substantially as hereinbefore described with reference to and as illustrated in Fig. 2, Fig. 3, Fig. 4 or Fig. 5 of the accompanying drawings.

12. A method of making an optical fibre cable element, comprising feeding a plurality of primary-coated optical fibres towards a guide which guides them into a juxtaposed configuration of a central fibre surrounded by the remaining fibres with a zero angle of lay, and feeding the juxtaposed fibres into an encapsulating stage in which an encapsulation is applied around the juxtaposed fibres.

13. A method as claimed in claim 12, wherein there are seven optical fibres.

14. A method as claimed in claim 12 or 13, wherein the fibres are each provided with a buffering layer between the primary coating and said encapsulation.

15. A method of making an optical fibre cable element substantially as hereinbefore described with reference to the accompanying drawings.

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