

OPTICAL FIBRE DISTRIBUTION ARRANGEMENT

This invention relates to optical fibre distribution, and in particular to optical fibre distribution in branched networks for optical telecommunications.

5 Presently, optical fibres are utilised in trunk lines for telecommunications, but it is desirable to have optical transmission with other points in a network, such as in branches between an exchange and a subscriber. Elements in such branches need to be reliable under the extremes of
10 ambient temperature, and to permit broad spectrum transmission over the range of wavelengths utilised, usually 1300 to 1550 nm. It is also necessary to ensure that minimum losses occur due to microbending as optical fibres emerge from branching elements such as couplers.

15 The present invention provides an optical fibre distribution arrangement comprising a coupler array and a plurality of splice organisers, a respective splice organiser being associated with each input line and with each output line of the coupler array, at least one splice being
20 associated with each splice organiser, and the splice organisers being mounted on a support frame so as to be capable of limited relative movement with respect to one another so as to permit access to the splices stored therein.

Advantageously, the coupler array comprises eight
25 wavelength-independent two-by-two couplers arranged as a four-by-eight coupler. The splice organisers may be pivotally or slidably mounted on the support frame.

Preferably, optical fibres extending from the coupler array pass into a manifold block provided with a respective
30 capillary tube for conducting each fibre to a splice organiser.

In a preferred embodiment, the coupler array comprises a plurality of independent couplers interconnected by splices, and wherein formers are provided to control the minimum bend
35 radius of fibres extending from the couplers, the formers being located such that alternative winding patterns are

available to permit different lengths of fibre to be accommodated.

There may be a central former and two outer formers, in which case the coupler array may comprise eight two-by-two
5 couplers located in bundles of four on opposite sides of the central former. Conveniently, the couplers are stacked in layers.

Preferably, each splice organiser comprises a tray having a groove for retaining a splice and a recess for confining
10 loops of optical fibre under their own natural resilience.

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a side view of an optical fibre distribution point constructed in accordance with the invention;

15 Figure 2 is a schematic plan view of elements of Figure 1;

Figure 3 is a view of part of the distribution point of Figure 1;

Figure 4 is a diagram showing the fibre connections of
20 the coupler array forming part of the distribution point of Figure 1;

Figure 5 is a plan view of the coupler array; and

Figure 6 is a plan view of a splice organiser forming part of the distribution point of Figure 1.

25 Referring to the drawings, Figures 1 to 3 show a distribution point for an optical fibre network, the distribution point comprising a four-by-eight coupler array 1 and a plurality of splice organisers 2 mounted on a support frame 3. The support frame 3 has a triangular section in plan
30 with the coupler array 1 mounted on one side and one of the long edges of each of the splice organisers 2 being pivotally mounted to one of the other two sides. Other frame configurations are possible, for example square or rectangular, the one shown being illustrative only. The
35 coupler array 1, which is described in more detail later, has four input lines 4 and eight output lines 5 (only one of each of which is shown in Figures 2 and 3), each input line being coupled to each output line in the arrangement shown in Figure

4. It will be realised that, in two-way communication, the input and output lines 4 and 5 operate in both directions. Throughout this specification, the term 'input' should be taken to mean that side of a branching arrangement closer to the exchange or trunk line, and the term 'output' should be taken to mean that side further away from the exchange. Generally speaking the input side will have fewer lines than the output side.

A fibre splice connection is made between each of the input lines 4 to the coupler array 1 and the incoming line from the previous stage of the distribution network, and these splices are stored in respective ones of the splice organisers 2. Each of the output lines 5 from the coupler array 1 is (or may be) spliced to an outgoing line to the next subsequent stage in the distribution network (such as an individual subscriber line), and these splices are also stored in respective ones of the splice organisers 2. Individual access to each splice is possible, without disturbing the other lines, by pivoting the splice organisers 2 apart at an appropriate point to provide access to the organiser containing the splice to be accessed. Likewise, individual access to the splice between the previous distribution stage fibre and the input to the coupler array 1 is possible. Instead of a pivoted arrangement, it is envisaged that the edges of the splice organisers 2 could be held in a channel permitting sliding, or both sliding and pivoting.

The fibres from the previous and subsequent distribution stages enter the distribution point in reinforcement tubes 6 (see Figure 1) which may conveniently extend inside the frame 3. At the top of the frame 3, these fibres enter transfer capillaries 7 held in a manifold block 8, the capillaries conducting the fibres to the splice organisers 2 where they are connected to their respective input or output fibres that extend from the coupler array 1.

The coupler array 1 is positioned with fibre entry and exit ports pointing downwards, as shown schematically in Figure 3. A curved former 9 is provided close to the ports, either as an extension of the housing of the coupler array 1

or secured to the support frame 3. The fibres extending from the ports pass around the former 9 to the inside of the support frame 3, where they pass upwardly, through the manifold block 8, each fibre then passing into a respective capillary 7 which guides it to the associated splice organiser 2 where it is spliced as described above. In order to minimise the space requirement, the fibres pass over the former 9 laterally (as viewed in Figure 3) and cross over so that they are then threaded through the manifold block 8 on the opposite hand to which they left the coupler array 1. Thus, for each input line 4 and each output line 5 there are two capillaries 7 extending over the top of the distribution point for the fibres on each side of the associated splice. The loops are made sufficiently slack to accommodate movement of the splice organisers 2 for access. In this regard, it will be noted that the pivoting arrangement enables a large movement for comparatively little extension; and, in order further to minimise extension, the connection points of the capillaries 7 to the manifold block 8 may be made closer to the organiser pivots, for example by modification of the shape of the support frame 3, or the manifold block location.

For provision of telecommunication channels, it is only necessary to have one input line and a plurality of output lines (in the present instance one input line and eight output lines) for diversification. The coupler array 1 illustrated has four input lines, each of which is split to each of the eight output lines; and, with such an arrangement, the other three input lines are connected to, or reserved for, additional services or maintenance channels, such as television or OTDR.

The splice organisers 2 may be of any convenient form, or may be replaced by connectors in some instances when loss is not a prime factor or when connectors of suitable low transmission loss are available. Preferably, however, each splice organiser 2 is double-sided, with one splice located on each side, but alternative arrangements are envisaged where the splice organiser stores associated spare fibre loops relating to a single splice on opposite sides of the

organiser. In the arrangement shown in Figure 2, the right-hand side (as viewed) of the support frame 3 has three splice organisers 2, each of which is double-sided to receive six (i.e. half) of the splices in the 4 input and 8 output line arrangement. The left-hand side (as viewed) of the support frame 3 has six splice organisers 2, each of which stores only a single splice, and so has the respective fibres from each side of the splice stored on its opposite sides. It will be observed that the space saved by having double splice storage on each splice organiser 2 would facilitate a more compact arrangement.

Figure 5 is a plan view of the four-by-eight coupler array 1. In order to be of a convenient overall size, the housing for the coupler array 1 is of the order of 158mm x 85mm x 16mm. One of the disadvantages of existing coupler arrays is the inflexibility of the internal arrangements to splicing errors, since the location of the coupling elements, the fibre tails and the splices is strictly controlled with little storage space for spare lengths of fibre. Consequently, a splice failure can render the components useless, unless a splice location requiring a shorter length of fibre to reach it is still available. The coupler array 1 has guides for spare fibre tail lengths, the guides providing alternative winding paths so that, in the event of a splice failure, the fibre tail lengths may be wound round a shorter route, and the fibre shortened for a subsequent splicing attempt.

Referring to Figure 5, the housing for the coupler array 1 comprises a tray 9 which has recesses on each side for retaining a bundle of four two-by-two couplers 10, a raised circular central former 11 and a pair of raised curved end formers 12. The couplers 10 are each wavelength-independent two-by-two couplers, and are connected in the scheme shown in Figure 4. In order to accommodate the couplers 10 in the limited space, they are arranged side-by-side in pairs on opposite sides of the central former 11, and two layers deep. A fibre tail from one of the couplers 10 is wound first around the outside of the curved former 12 on the side of the coupler

or secured to the support frame 3. The fibres extending from the ports pass around the former 9 to the inside of the support frame 3, where they pass upwardly, through the manifold block 8, each fibre then passing into a respective
5 capillary 7 which guides it to the associated splice organiser 2 where it is spliced as described above. In order to minimise the space requirement, the fibres pass over the former 9 laterally (as viewed in Figure 3) and cross over so that they are then threaded through the manifold block 8 on
10 the opposite hand to which they left the coupler array 1. Thus, for each input line 4 and each output line 5 there are two capillaries 7 extending over the top of the distribution point for the fibres on each side of the associated splice. The loops are made sufficiently slack to accommodate movement
15 of the splice organisers 2 for access. In this regard, it will be noted that the pivoting arrangement enables a large movement for comparatively little extension; and, in order further to minimise extension, the connection points of the capillaries 7 to the manifold block 8 may be made closer to
20 the organiser pivots, for example by modification of the shape of the support frame 3, or the manifold block location.

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25 lines) for diversification. The coupler array 1 illustrated has four input lines, each of which is split to each of the eight output lines; and, with such an arrangement, the other three input lines are connected to, or reserved for, additional services or maintenance channels, such as
30 television or OTDR.

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Figure 5 is a plan view of the four-by-eight coupler array 1. In order to be of a convenient overall size, the housing for the coupler array 1 is of the order of 158mm x 85mm x 16mm. One of the disadvantages of existing coupler arrays is the inflexibility of the internal arrangements to splicing errors, since the location of the coupling elements, the fibre tails and the splices is strictly controlled with little storage space for spare lengths of fibre. Consequently, a splice failure can render the components useless, unless a splice location requiring a shorter length of fibre to reach it is still available. The coupler array 1 has guides for spare fibre tail lengths, the guides providing alternative winding paths so that, in the event of a splice failure, the fibre tail lengths may be wound round a shorter route, and the fibre shortened for a subsequent splicing attempt.

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10 from which the fibre tail extends, and then around the outside of the other curved former 12, and then diagonally over the central circular former 11, where it is spliced to a fibre tail of the other of the couplers 10 to which it is
5 connected. A single fibre track is shown in Figure 5. In the event of a splice failure, the fibre tails associated with the failed splice may be unwound and rewound around the guides in a shorter path, for example by passing the first curve of the fibre tail around the central former 11 rather than around one
10 of the curved formers 12. The fibres may then be shortened, and a new splice made. In this way, at least a second attempt at splicing is enabled. Additional lengths of spare fibre, which could be used to permit a larger number of splice attempts, may also be stored by provision of extra loops or a
15 different winding pattern, (e.g. a figure of 8 may be used).

Grooves for retaining the splices may be provided, or the splices may be glued in position on the central former 11. One advantage of the looped winding around the formers 11 and 12 is that comparatively loose turns may be made, so that the
20 fibres are not pulled into close contact with the edges of the formers, and this enables the loops to accommodate dimensional changes due to thermal expansion without strain. The formers 11 and 12 may be varied in shape. In particular, the central former 11 may be split or elongated. A four-by-four coupler
25 may be made in a similar way by utilising only four couplers 10, and arranging these in a single layer rather than in a two-layer arrangement as is used for the four-by-eight coupler described.

Figure 6 shows a preferred splice organiser which enables
30 a single splice to be stored on one side thereof. This splice organiser comprises a tray 13 having a central raised circular former 14, two raised curved end formers 15, and a splice-retaining groove 16. The splice is positioned in the groove 16, and the fibres pass out of the organiser along a channel
35 17; and, when the splice organiser is in a distribution assembly, into capillaries 7. It is for this latter purpose, that the fibres exit in the same direction. In alternative uses, a similar arrangement (but with separate exit channels)

may be preferred. Spare loops of fibre on each side of the splice are stored in the organiser by forming coils of fibre and placing these (as indicated by the arrows in Figure 6) over the central former 14, with the first bend after the
5 splice being passed around the outer side of one of the curved formers 15. The natural resilience of the fibres will cause the coils to expand outwardly into a configuration of varying diameter elliptical turns. This procedure is then repeated for the fibre on the other side of the splice. Care has to be
10 taken not to coil the fibres over tightly in the first instance. A hinged or clip-on lid may be provided to cover the organiser, or it may be arranged to engage with an adjacent organiser so that the confronting organisers effectively form covers for each other. The reverse side of
15 the organiser preferably has a similar configuration for storing another splice, thereby enabling six organisers independently to store the twelve splices associated with the distribution point described.

CLAIMS

1. An optical fibre distribution arrangement comprising a coupler array and a plurality of splice organisers, a respective splice organiser being associated with each input line and with each output line of the coupler array, at least one splice being associated with each splice organiser, and the splice organisers being mounted on a support frame so as to be capable of limited relative movement with respect to one another so as to permit access to the splices stored therein.
2. An arrangement as claimed in claim 1, wherein the coupler array comprises eight wavelength-independent two-by-two couplers arranged as a four-by-eight coupler.
3. An arrangement as claimed in claim 1 or claim 2, wherein the splice organisers are pivotally mounted on the support frame.
4. An arrangement as claimed in claim 1 or claim 2, wherein the splice organisers are slidingly mounted on the support frame.
5. An arrangement as claimed in any one of claims 1 to 4, wherein optical fibres extending from the coupler array pass into a manifold block provided with a respective capillary tube for conducting each fibre to a splice organiser.
6. An arrangement as claimed in any one of claims 1 to 5, wherein the coupler array comprises a plurality of independent couplers interconnected by splices, and wherein formers are provided to control the minimum bend radius of fibres extending from the couplers, the formers being located such that alternative winding patterns are available to permit different lengths of fibre to be accommodated.
7. An arrangement as claimed in claim 6, wherein there is a central former and two outer formers.



8. An arrangement as claimed in claim 7, wherein the coupler array comprises eight two-by-two couplers located in bundles of four on opposite sides of the central former.

9. An arrangement as claimed in any one of claims 6 to 8, wherein the couplers are stacked in layers.

10. An arrangement as claimed in any one of claims 1 to 9, wherein each splice organiser comprising a tray having a groove for retaining a splice and a recess for confining loops of optical fibre under their own natural resilience.

11. An optical fibre distribution arrangement substantially as hereinbefore described with reference to, and as illustrated by, the accompanying drawings.

