New Core Alignment Fusion Splicer

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The telecommunications optical fiber infrastructure market is still growing due to increasing bandwidth demands. One of the most reliable methods for terminating fiber is fusion splicing. In particular, core alignment fusion splicers produce consistent low-loss splices. However, fusion splicing is often seen as a complicated process which requires skilled operators. As a result, the industry demands an easy-to-use splicer that unskilled users can use to successfully complete low-loss splices. Because of the increasing number of fibers to be spliced, the splicer should feature very fast and efficient operation. To meet these expectations, we have developed a new core alignment fusion splicer with quick and simplified operation that is not possible with other splicers.

1. Introduction

In the past, splicing of optical fibers was usually performed by skilled operators who were highly trained concerning fiber optics. However, increasing fiber deployments have driven an increasing need to ensure that fusion splicers are easy to use by unskilled operators. Fusion splicing is seen as a relatively complicated process which requires skilled operators. There are several steps in the splicing process such as opening the wind protector and sheath clamp, and positioning the splice protection sleeve in the correct location so it will properly cover the splice point. A certain level of training and operator attention to detail has been required to properly execute such steps in the splicing process. And, even for trained operators, time is required to ensure proper operation and consistent results. To simplify operations and improve splicing efficiency, we developed new core alignment fusion splicer. By a combination of simplified operations, and close consideration of ergonomics and human factors design, the new fusion splicer offers improved efficiency and reduced splicing cycle time, as well as ease of operation.

2. Purpose of the Development

There were two key areas of focus for improvement that guided the development of this new splicer as compared to previous models:

1. Shorter splicing cycle time
   - Faster release of the wind protector and sheath clamps
2. More efficient splicing operations
   - Preventing unexpected fiber release when the sheath clamps open automatically
   - Simple and intuitive placement of the fiber protection sleeve in the proper location
   - Extended functionality and greater utility of the carrying case

Figure. 1 shows the appearance of the new fusion splicer.

3. Faster release of the wind protector and sheath clamps

Our previous model splicer introduced new automation technology to enable the wind protector and sheath clamps to open automatically. No competitor has such capability. The new fusion splicer has a faster automated release mechanism for the wind protector and sheath clamps compared to the previous splicer. To achieve that, the new fusion splicer releases the wind protector and sheath clamps at the same time. Table 1 shows a comparison of the release operation for the new and the previous splicer. Although both can open the wind protector and sheath

Fig. 1. New Core Alignment Fusion Splicer.

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Table 1. Comparison of wind protector operation.

New Model 90S	Conventional Model 70S
1. Complete splice	1. Complete splice
	2. Move the fiber forwarding motor in reverse direction
2. Release wind protector and sheath clamp	3. Release sheath clamp
	4. Open wind protector

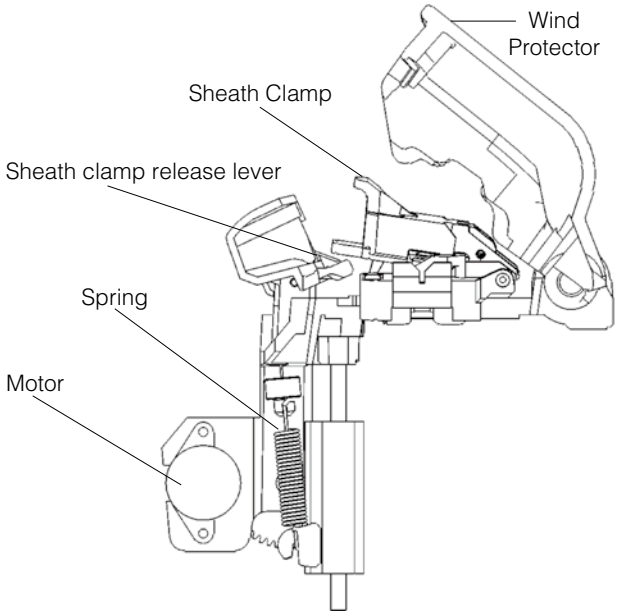

Fig. 2. New opening mechanism for the sheath clamp and the wind protector.

clamps automatically after the splice is completed, with the previous model fusion splicer it was necessary to move the fiber forwarding motors in the backwards direction before releasing the sheath clamps. This was required because the moving the fiber forwarding motor backwards would engage the features that provide the force to automatically release and open the sheath clamps.

To eliminate the time for the backwards motor movement, the new fusion splicer has new mechanism to generate the necessary power for sheath clamp release. Figure. 2 shows the structure. There is a spring to generate the clamp release power. The power of the spring is generated during fiber splicing by motor movement. After splice operation, the power is retained in the spring because it is linked to the wind protector and is therefore latched in the closed condition until the wind protector opens. When the wind protector is opened, the sheath clamp release lever, which is part of the rear wind protector section, unlatches the sheath clamp. That enables the spring to

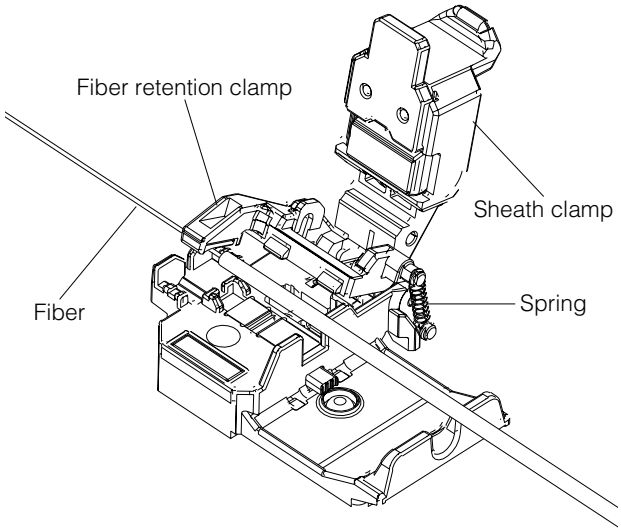

Fig. 3. Structure of the fiber retention clamp.

flip the sheath clamp open immediately. By use of the new mechanism, the new fusion splicer reduces the release time from 6 seconds to 1 second.

4. Preventing unexpected fiber release when the sheath clamps open automatically

The new fusion splicer has newly added fiber retention clamps to improve the usefulness and splicing efficiency when the automated sheath clamp release function is enabled.

When an operator uses the previous model fusion splicer, which has the automated sheath clamp release function but does not have fiber retention clamps, the operator has to hold one side of fiber by hand to prevent the fiber from jumping loose in an uncontrolled manner. As an alternative, the automated sheath clamp release function can be disabled, or at least disabled for the sheath clamp on one side. So, either there is the possibility of the fiber jumping loose in an uncontrolled fashion, or the automated sheath clamp release cannot be fully utilized, resulting in slower and less efficient splicing because the operator must manually open at least one of the sheath clamps.

The new fiber retention clamps enable the full time savings benefits of automated opening of both sheath clamps, without an extra operation step by the operator, and without risk of the fiber jumping. Figure. 3 shows the new fiber retention clamp mechanism. These fiber retention clamps are independent from the conventional sheath clamps. After the sheath clamps are released automatically, the fiber retention clamps still hold the fiber in place. And, unlike to the sheath clamps, the retention clamps hold the fiber with minimal force by use of a small spring. That force is easily overcome and the fiber is easily released when an operator picks the spliced fiber up. In

addition, there is a switch to enable / disable the function for operators who do not wish to use it.

By the addition of the fiber retention clamps, the new fusion splicer enables the full benefits of the automated sheath clamp release function to be utilized. Therefore faster, easier, and more efficient splicer operation is possible compared to the previous splicer.

5. Simplified positioning operation for the fiber protection sleeve

The new fusion splicer has an ergonomically designed structure that enables easy splice protection sleeve positioning. The splice sleeve can be placed into the proper position with a simple operation and reduced operation time.

To set the splice protection sleeve to the proper position with a conventional splicer, a few steps are required. First, the operator slides the splice fiber protection sleeve to a position roughly around the splice point after the fusion splice is completed. This may be done after the fiber has been released from both sheath clamps. The operator then moves the spliced fiber with sleeve to a position shown in Figure. 4 where there is a splice sleeve positioning groove built into the structure of the tube heater. When the sleeve is lowered into this positioning groove, the operator can control the fiber splice position precisely within the sleeve because the fiber can be moved right or left while the positioning groove ensures that the sleeve is held in a stationary position. In order to do this, the operator must use the right and left hand to move the fiber to the left or right as required to ensure that the bare glass splice region is at the center of the splice sleeve. As described, this two-step splice sleeve positioning process requires the operator to use the proper method and also to carefully observe and establish the proper position of the splice location at the center of the splice sleeve. Therefore, the quality of splice protection is affected by the operator's skill and habits. This operation is also slow and not simple or easy.

To eliminate this operation complexity, the new fusion splicer has new positioning structure as shown in Figure. 5. New structure incorporates a finger guide position for grasping the spliced fiber just to the outside of the sheath clamps. The distance from the center of the splice point and the point where the operator can grasp the fiber with thumb and forefinger is designed to be 30 mm, which is half the length of a standard 60 mm splice protection sleeve. The operator can easily grasp the fiber on one side at the finger guide position just after the sheath clamp has been opened. By tilting the fiber upwards on the other side, the splice sleeve will naturally slide down until it has covered the splice point and the end of the sleeve is in contact with the operators thumb and forefinger that are grasping the spliced fiber as shown in Figure. 6. This enables the splice sleeve to be set to the proper position for heating very easily and with a very fast operation. With the new fusion splicer, precise splice sleeve position control is not dependent on the operator skill or habits, and the total splicing process is faster.

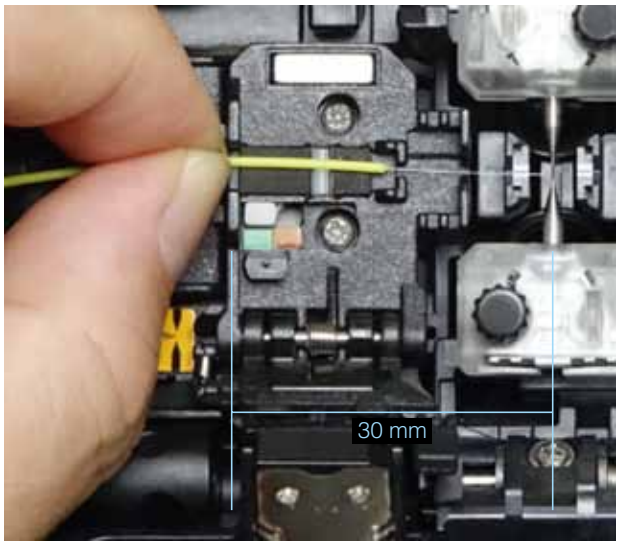

Fig. 5. New splice sleeve positioning structure.

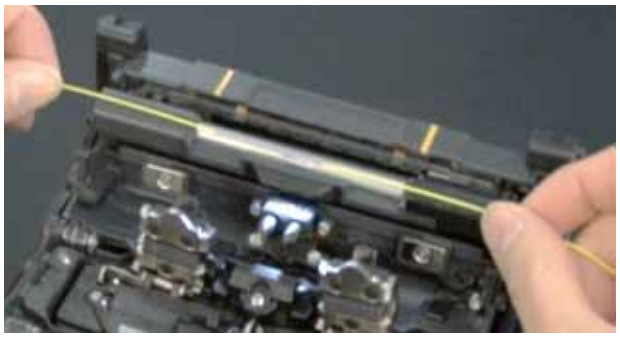

Fig. 4. Conventional splice sleeve positioning groove.

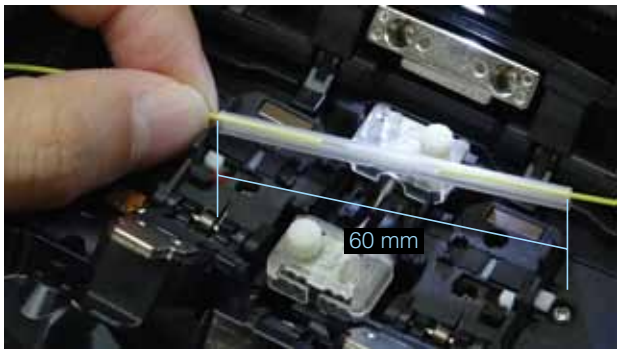

Fig. 6. Splice protection sleeve at proper position.

Fig. 7. Opened carrying case (with work tray inside enabling splicing operation).

6 Extended functionality and utility of the carrying case

The newly developed carrying case also enables better and more efficient use of the new fusion splicer. It has larger storage and has better functionality relative to previous versions. Figure. 7 shows the opened carrying case. When just opened, the splice tray contained within the case ensures that the splicer is ready to be used in a user-friendly splicing environment. In addition, the newly designed work tray can be removed from the carrying case, and it can be configured in many different ways to suit the preference of the operator as well as the size of the available working space. As shown in Figure. 7, the work tray can be separated into two pieces. Fig. 8 (a) shows an example for large a work space in which both of the work tray pieces are combined for using the full capability and working area of the work tray. And Fig. 8 (b) shows an example for narrow or restricted work space in which the operator uses only one half of the work tray.

In addition, we also added two storage drawers into the work tray. All typical items that may be required for splicing operations may be stored in these drawers, such as an extra battery, stripping tools, fiber cleaver, and so on. The storage drawers are designed so they will stay closed until the operator wants to open them.

Fig. 8. Usage examples for the removable work tray: (a) combined mode, (b) separate mode.

7. Conclusion

We have developed a new core alignment splicer for fast and efficient operation. It offers both simplified operation and reduced splicing operation time, and it is especially beneficial for un-skilled operators.