New Core Alignment Fusion Splicer

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The number of telecom infrastructure construction has still been on the increase in developing countries. Fusion splicing is a high-reliability method for high-quality optical fiber connection. However, due to multiple optical fiber preparation steps in the splicing process, an operator needs to be traine to master the process. A fusion splicer for an inexperienced operator has thus been a common request from the market. In addition, a reduction in splicing time is also demanded at installation sites where numbers of fibers need to be connected. We have developed a new core alignment fusion splicer to fulfill these requirements.

1. Introduction

A high-efficiency fusion splicer for an inexperienced operator has been a common request from the market. In the previous model, an operator has to open and close the wind protector, sheath clamps and tube heater manually. These functions of the new machine is automatically operated. In addition, reduction in heating time, which occupies the most of splicing time, is also desired to improve the operation efficiency.

The new splicer offers shorter heating time. Furthermore, we improved the carrying case so that the operator does not have to remove the splicer from the carrying case.

2. Product Overview

Figure 1 shows the new model. Table 1 shows a comparison of specifications between the new and the previous model.

3. Features

This section describes two features of the new model. We have focused on the following features to achieve.

Fig. 1. New Core Alignment Fusion Splicer.

(1) Simple method
  (a) Automatic mechanism to open/close each part
  (b) Improved carrying case ready for splicing upon opening
(2) Shortening of operation time
  (a) Shortening of heating time
  (b) Improved carrying case ready for splicing without arranging preparation tools

Three improvements: automatic open/close mechanism, tube heater structure, and carrying case.

3.1. Automation of each open-close function

The new model's open/close operation is automated. A reduction in operation procedures improves work efficiency.

Table 1. Specifications.

	New model 70S	Previous model FSM-60S
1. Appearance		
Dimensions	146 mm width 159 mm depth 150 mm hight	136 mm width 161 mm depth 143 mm hight
Weight with AC Adapter	2.5 kg	2.3 kg
2. Splicing Performance		
Average Splice Loss	0.02 dB ITU-T G652	0.02 dB ITU-T G652
Splicing Time	7 seconds	9 seconds
Heating Time of protection sleeve	14 seconds 60 mm sleeve	30 seconds 60 mm sleeve
Number of splices with a fully charged battery	200 splices with protection sleeve heating	160 splices with protection sleeve heating
3. Reliability		
Shock resistance	Drop test from height of 76 cm passes Specification: Telcordia GR-765-CORE	
	6 directions	5 directions except top surface
Mine dust resistance	Alumina powder No. 325 Telcordia TR-NWT-000264	
Waterproofing	Rain 10 mm/h 10 minutes JIS C 0034	

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In the previous model, an operator has to perform open/close operation of various parts and it causes a complicated splice process. The new model has an automatic open/close mechanism of the wind protector, sheath clamp and tube heater.

Table 2 shows the comparison of operation procedures between new and previous models. In the previous model, it requires 9 processes from the start of fusion splicing to the completion of heating reinforcement. In the new model, only three processes are necessary: that can reduce more than half processes.

The automation of functions is useful especially for an inexperienced operator. Furthermore, the new model allow operators time for preparation of the next splicing while the automatic process is in progress. That has successfully resulted in an increase in splicing efficiency.

3.1.1 Wind protector Mechanism

A wind protector seals off a splicer, to prevent fluctuations of are discharge due to the wind. Figure 2 shows the wind protector of the previous model. The previous model is of a single piece and require manual open/close operation.

In the new model, its wind protector opens and closes automatically. Figure 3 shows the new design. The wind protector consists of the front part and rear part. These front and rear wind protectors open automatically with the aid of a motorized assembly. The operator does not have to open or close it manually.

3.1.2 Automatic opening mechanism of sheath clamp

A sheath clamp holds optical fibers set in a splicer. The new model automatically opens the sheath clamp lid when the splicer automatically opens the wind protector.

Figure 4 shows the structure of the automatic sheath clamp mechanism. There are magnets on the rear wind protector. The sheath clamp lids are pulled up by the magnets.

Figure 5 shows the side view of automatic opening mechanism of the sheath clamp lid. After the proof test of an optical fiber after splicing, the lift up pin lifts the sheath clamp lid and separate the clamp magnet from the sheath clamp. The Rear wind protector magnet pulls up the iron lid of the sheath clamp, to open the sheath clamps.

The software can control to enable or disable the sheath clamp opening function on each side individually. An operator can select the sheath clamp operating modes on the software from “Enabling the automatic function on both sides”, “Enabling the automatic

Table 2. Comparison of operation procedures.

New splicer 70S	Previous splicer FSM-60S
1. Set an optical fiber on the left.	1. Set an optical fiber on the left.
2. Set an optical fiber on the right.	2. Set an optical fiber on the right.
3. Take out the optical fiber and adjust the protection sleeve position and set it into the tube heater.	3. Close the wind protector.
	4. Open the wind protector.
	5. After splicing, open the left side sheath clamp.
	6. Open the right side sheath clamp.
	7. Take out the optical fiber and adjust the protection sleeve position and set it into the tube heater.
	8. After heating, open the tube heater lid.
4. Remove the optical fiber.	9. Remove the optical fiber.

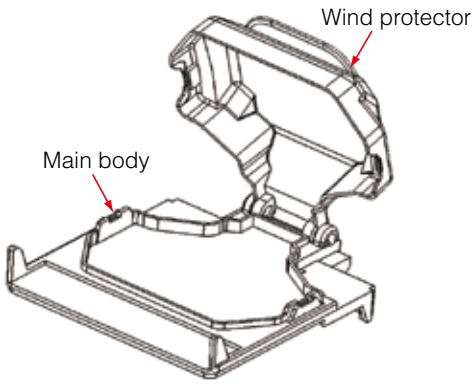

Fig. 2. Wind protector of previous splicer.

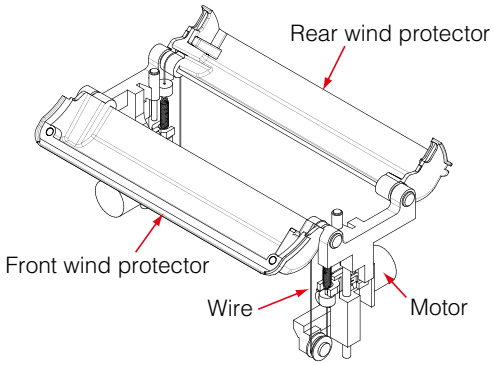

Fig. 3. New motorized wind protector.

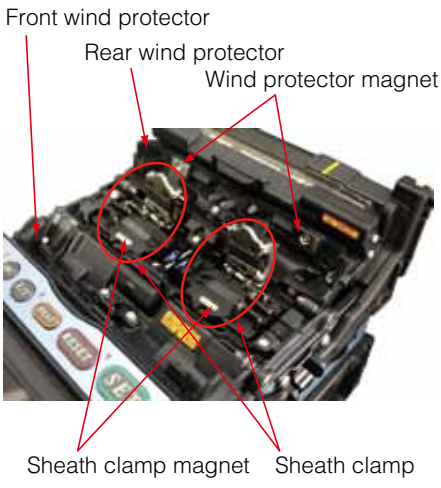

Fig. 4. Sheath clamp in open position.

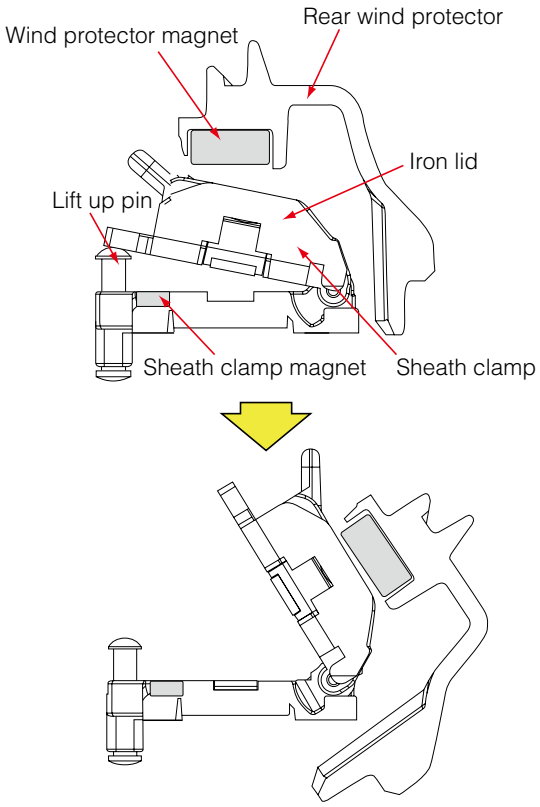

Fig. 5. Automatic opening mechanism of sheath clamp.

function on the left or the right side only", or "Disabling automatic function."

3.1.3 Automatic open-close mechanism of tube heater

To perform a heating process after splicing, a splicer needs to be equipped with the following parts:

(1) Heater lid to keep heating temperature inside the tube heater
(2) Heater sheath clamp to prevent an optical fiber from bend during heating

In the new model, the heater lid and heater sheath clamp open and close automatically. Figure 6 shows the automatic operation. The motor opens and closes them by an eccentric cam. Figure 7 shows the mechanism inside the tube heater. To heat the protection sleeve, the operator only sets an optical fiber into the tube heater. The splicer closes the heater lid and starts heating. After the predefined heating time, the heater lid and heater sheath clamp open automatically.

3.2 Shortening of the heating time

The new model reduces the operation time: for both splicing and heating. Figure 8 shows operation time of the previous and new models. The operation time of the new model is 21 seconds in total. That is reduction by 46% of that of the previous model: 18 seconds shorter than the previous model.

This new model reduced the splicing time by 2 seconds by the improvement of the optical fiber alignment algorithm. As a result, 7seconds of splicing was

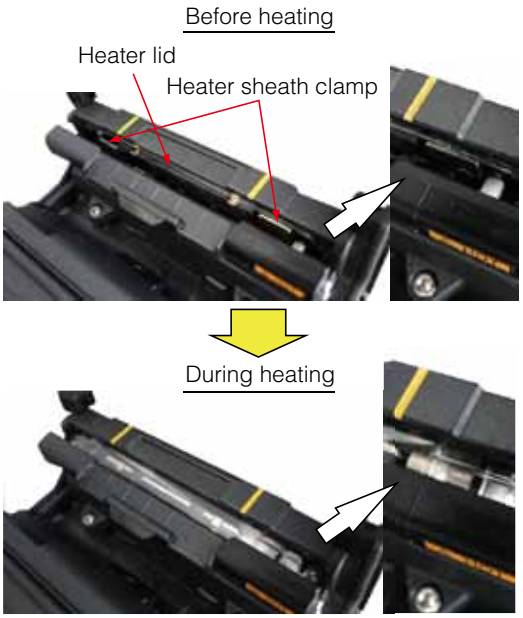

Fig. 6. Automatic open-close function of tube heater.

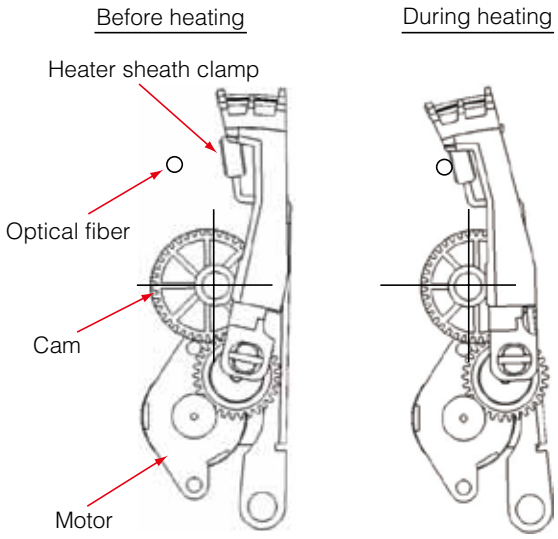

Fig. 7. Automatic open-close mechanism of tube heater.

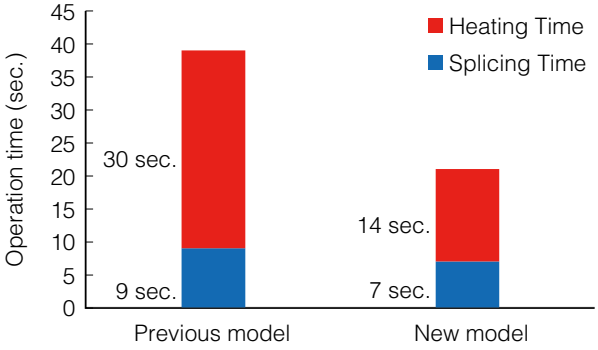

Fig. 8. Reduction of splicing time.

achieved.

More significant reduction in the operation time was achieved by reducing the heating time of protection sleeve. Figure 9 shows the structure of the tube heater. This new tube heater sandwiches the protec-

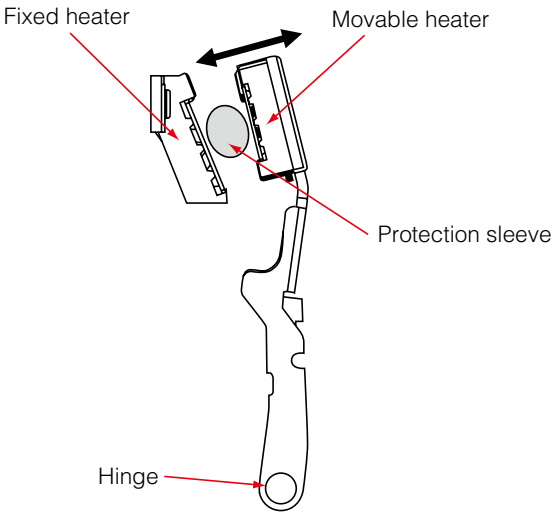

Fig. 9. Tube heater mechanism.

Fig. 10. Appearance of carrying case.

tion sleeve between a movable heater and a fixed heater. The movable heater has continuous contact with the protection sleeve due to the spring force as the protection sleeve shrinks. As a result, the tube heater reduces the heating time by 50 percent, compared to the previous tube heater.

3.3 Improved carrying case

We also developed an improved carrying case that can suit various working environments. This new carrying case can store not only a splicer but also a jacket stripper, bottle of alcohol for optical fiber cleaning, and cleaver. Figure 10 shows the appearance of the carrying case.

Figure 11 shows an opened carrying case. The new carrying case consists of a removable upper lid and an lower case that contains a work table. An operator can start to splice optical fibers immediately by just opening the upper lid. This eliminates the need for an operator to remove the splicer from the carrying case and the need for arranging the preparation tool on the workspace.

An operator can also take out the work table from the under case and build a suitable work environment shown in Figure 12.

Fig. 11. Inside carrying case.

Fig. 12. Various settings with carrying case.

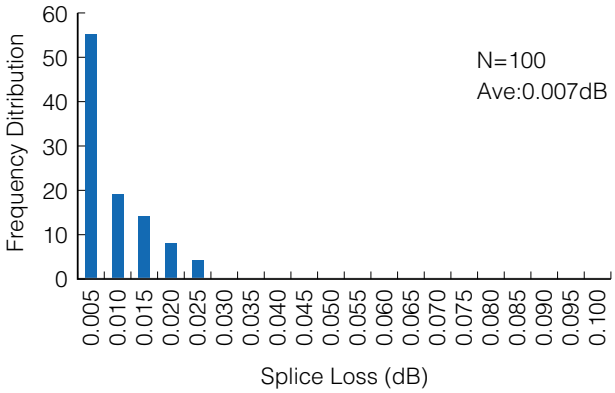

Fig. 13. Splice loss distribution.

4. Splicing performance

The new model can splice with low splice losses. Figure 13 shows distribution of splice losses in splicing SM fiber conforming with ITU-T G 652 standards. The average splice loss is 0.007 dB which is sufficient performance for almost all applications.

5. Conclusion

We have developed a new, high efficiency fusion splicer. The new model reduces operation time by various automatic functions and an improved structure while maintaining high performance. The splicer is useful not only for inexperienced operators, but also for the skilled operators.