

Highly Environmental-resistant Fusion Splicer

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Recently, the installation works of optical fiber cable are shifting from developed countries to BRICs and developing countries where the environment for such works is harsh and the infrastructure is not so advanced. As a result, the market requires a fusion splicer that can maintain high performance even in harsh environment. To meet this market requirement, we have developed a new fusion splicer FSM-60 series.

1. Introduction

In BRICs and developing country where expansion of the Telecom infrastructure is accelerating prosperously, the fusion splice of the optical fiber is performed in large quantities.

Diversifying optical fiber laying work or the extent of the users, the demands for the fusion splicers become emphasized in substantiality of the functional improvement, such as light weighting or reducing the splicing time as well as the rugged construction in any difficult conditions.

FSM-60 series have been developed to meet these demands for resisting shock, dust, and rain.

2. Product overview

The FSM-60S is shown in Fig.1.

A comparison of specifications between the old model and the new model is shown in Table.

3. Features

3.1 Improved shock resistance

The work environment of the splicing procedure in-



Fig.1. Appearance of new fusion splicer.

Table. Specifications for FSM-60 series.

Item	FSM-60S core alignment fusion splicer	FSM-60R12 fixed V-groove fusion splicer
1. Appearance		
Dimensions	136(W) × 161(D) × 143(H) mm	
Weight (With AC adaptor)	2.3 kg	2.1 kg
2. Splicing performance		
Average splice loss	0.02 dB ITU-T G.652	0.05 dB ITU-T G.652
Splice time	9 sec.	20 sec.
Protection sleeve shrinkage time	30 sec.	50 sec.
Number of splice with a fully charged battery	160 splices	90 splices
3. Resistance		
Shock resistance	Drop test from height of 76 cm passes Spec: Telcordia GR-765-CORE	
Dust resistance	Dust resistance test passes Spec: Telcordia TR-NWT-000264	
Water resistance	Rainfall test passes Spec: JIS C 0034	

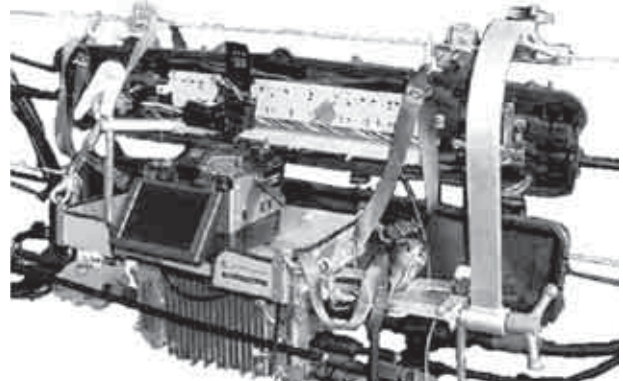


Fig.2. Aerial use of a fusion splicer.

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Fig.3. Splicing on unstable surface.

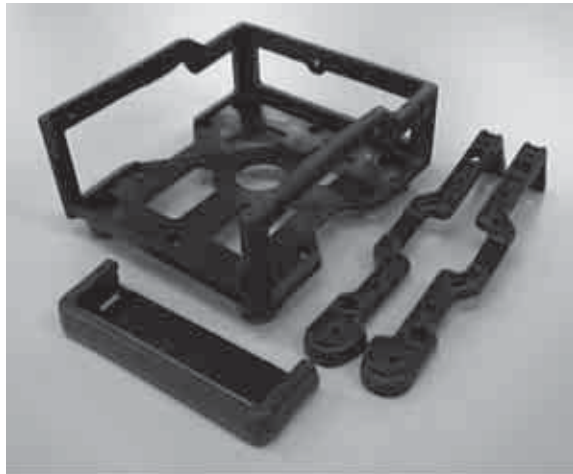


Fig.4. Elastic parts for shock absorption.

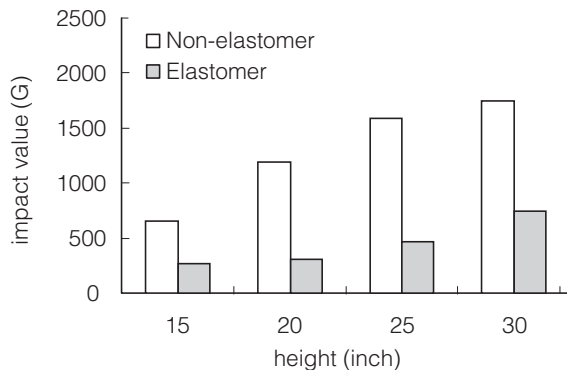


Fig.5. Shock absorption with elastomer.

cludes the telephone pole top or the basement. While carrying in, installing, operating, and carrying out the splicer to these work environments, the operator may give a shock to the splicer, and the splicer may get damaged. (Fig.2, Fig.3)

3.1.1 Installing elastomer covers

As a proper measure against shock, elastomer covers have been arranged around outside of the FSM-60 series. Figure 4 shows elastomer covers.

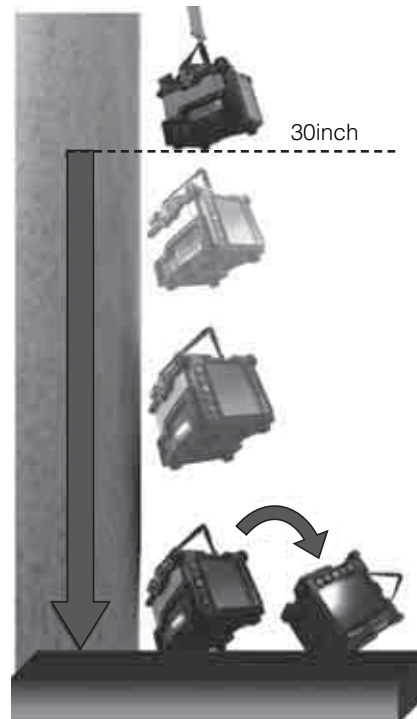


Fig.6. Vertical drop test.

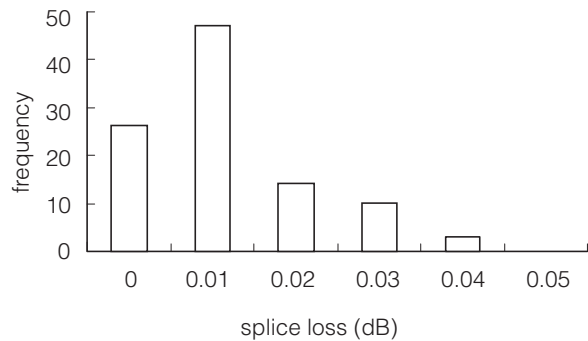


Fig.7. Shock absorption with elastomer.

The comparison results of shock absorption with and without elastomer covers are shown in Fig.5.

It becomes possible to reduce to half the shock added to the splicer by equipping it with an elastomer to absorb the shock compared with the equipment with no elastomer. However, it is insufficient to bear a 76 cm (30 inch) fall shock (Fig.6) by just equipping it with the elastomer. Shock resistance will be secured by the drive parts' weight saving shown in the following clause. The splice test result is shown in the Fig.7.

3.1.2 Weight saving of drive part

The drive part is the portion with a difficult measure against a shock. For the shock resistant measure, reducing the number of screws is not adequate to manage so the review of the inside structure was taken to reduce the weight. This makes a light weight solution to the whole body, and it appears to be an effective measure.

In this part, the weight saving of focus alignment unit in core alignment splicer is explained. The focus alignment unit is the system for observing a core image in optical fibers and focuses on a core in optical fibers back and forth. In the FSM-60S, we have succeeded in reducing weight to conventional 30 %. Figure 8 shows the exterior of focus alignment unit for conventional model and new model.

Figure 9 shows the result of camera offset after dropping from the height of 76 cm. The amount of camera offset was enabled to press down to one fifth of the conventional models as compared, and the structure proved its strength against a shock-resistance.

3.1.3 Measures for the carrying handle

In the conventional fusion splicer, as shown in Fig. 10, the metal carrying handle was used.

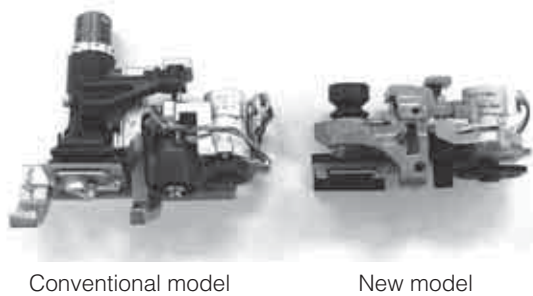


Fig.8. Weight reduction of focus alignment unit.

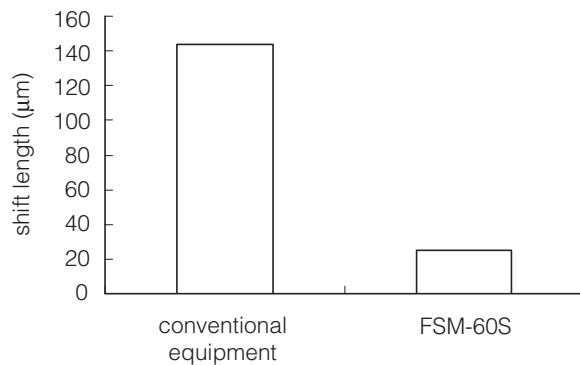


Fig.9. Camera offset after drop.

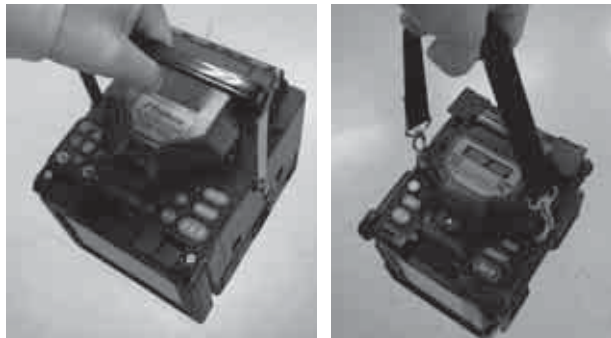


Fig.10. Types of carrying handle.

However, if a shock is added to a handle by dropping the equipment, distortion of a micron unit will occur on the main body. Therefore, in the FSM-60 series, the handle on the belt was changed from metal to cloth and this alternative gave a reduction of a shock to reach the main body.

3.1.4 Measures for the LCD monitor

The LCD monitor is not damaged by a fall, but a monitor is broken when there is a foreign object on the ground. When a protuberance hits liquid crystal during transportation of the fusion splice machine, damage occurs. Therefore, as shown in Fig. 11, we installed a transparent protection plate of thickness 3 mm so that a monitor was not broken by a shock from the outside. Figure 12 shows the protection test result of the plate by dropping 500 iron balls from 200 mm high. 3 mm-thick protection plate was not damaged that proved the tolerance improvement.

3.2 Improved dust resistance

The splicing procedure is often operated outdoors, so particles of sand or dust sometimes put into inside of the splicer. If these coarse particles adhere to a gear or bearing, a defect of splicing procedure will occur. The FSM-60 series employ a structure so that dust or sand can hardly get inside when the wind protector is closed. Figure 13 shows the appearance of the splicer after dust test.



Fig.11. Appearance of monitor protection plate.

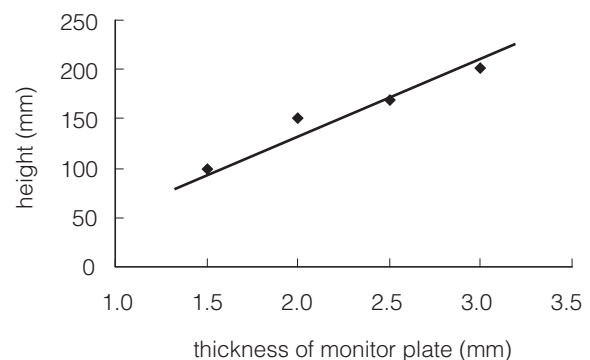


Fig.12. Monitor durability after impact.



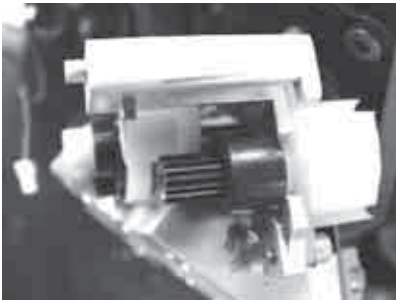
Fig.13. Appearance after dust test.



Fig.15. Appearance after rain test.



Conventional model



New model of FSM-60S

Fig.14. Internal gear condition after dust test.

Figure 14 shows the pictures of the gear part of conventional model and the FSM-60 series. The invasion of dust or sand is controlled by reviewing the part structure as compared with the conventional model.

3.3 Improved water resistance

The FSM-60 series achieved remarkable water-resistance structure so that water does not go inside the splicer when the wind protector is closed. Figure15 shows the rain test results. It is confirmed that the splicer inside does not have invasion of the water after having rainfall in more than rain strength $R=10 \text{ mm/h}$ for 10 minutes.

4. Conclusion

The new product FSM-60 series succeeded in achieving the improvement of shock, dust and rain resistance as compared with the conventional splicers.