



FUJIKURA ODYSSEY

<http://www.fujikura.co.jp/eng/rd/odyssey/index.html>

"Optical Fiber Fusion Splicer" Development Story

As the optical fiber network continues to spread on a global scale at a rate unsurpassed, Fujikura has played the leading role in the area of various optical-related devices, including optical fiber. In particular, as with the "fusion splicer" essential for connecting optical fibers, the Company maintains the No. 1 market position with its share exceeding 50%. Our efforts toward the development of the "fusion splicer" started at almost the same time as research & development of optical fibers and was truly a decision symbolizing the challenging spirit of Fujikura. While the trials to create from zero an unprecedented device presented an incessant series of hardships, we at last completed a machine that could be called an invention of Fujikura. Here, we would like to trace the challenges in the Company's survival ... going back to a time before Fujikura achieved the No. 1 world market share.

Phase.1 Foresight

Now, we boast the top share in the world market. Fujikura's fusion splicer business maintains a position that could be called the de facto standard. In the beginning, however, we faced a series of hardships.

The initial fusion splicer was for multi-mode optical fibers having a thick diameter core (50 μ) and was easily connected. The shift to the L optical fiber for a single mode (core diameter of 10 μ or less) started in 1980.

This was the time when the true hardships began.

Fujikura's "Optical Fiber Fusion Splicer," now widely used in countries all over the world, truly lives up to its name as the global standard. The needs for more sophisticated optical fibers and higher quality connection require further technological development, and thus their possibilities as targets of business are expanding.

The current fusion splicer business of Fujikura involves distributors as strategic partners in 60 countries around the world, and has an established and carefully-crafted sales &

after-service network. In addition, the Company maintains a position as a top manufacturer by constantly reinforcing its unrivaled research & development system, manufacturing lines with extreme cost performance, and its sales operation system that supports marketing strategies. Fujikura promotes a dynamic business aimed at the global market based on the integrated action between our development, manufacturing and sales workforces. The fusion splicer business is thriving and now showing overwhelming strength but this was not without a period of continual hardships in the initial stage of the development project.

To start with, when the optical fiber-based transmitter first appeared, it seemed like a dreamlike transmitter with such advantages as being light, able to transmit a large volume and with less waste to reach further. However, there was a critical problem. That is the difficulty in connecting optical fibers to one another. Fujikura, however, found a business opportunity in this very issue. "The solution to this problem would be big business!" was what initially motivated research & development. Indeed, the idea was wonderful, but it was not so easy to materialize. We started research activities with only three members. It was 1976.

The development of optical fibers per se at that time was still in the course of trial and error, and in addition to unstable structure and a lack of strength, we had no analytic approach to measure transmission loss. A succession of wearisome experiments ensued. There was uncertainty about the future. At times, we just couldn't see how we would ever achieve a breakthrough. Not surprisingly, there was mounting frustration. It was the next year that we finally saw a glimmer of hope when the structure of original optical fibers became more stable with considerably increased strength. Experiments were carried out using two approaches: the "V groove method"-a method to place an optical fiber on the precise V groove, apply drops of matching oil and press; and the "Fusion splicing method"-a method to place optical fiber in midair and heat-seal it by arc discharging. Owing to its superior properties and workability, the development soon became the "Fusion splicing method." Consequently, the first model of the practical multi-mode fusion splicer was complete in October 1977. Later, in 1979, this equipment was sent to an exhibition attached to



The first splicer "FR-1" to be developed

the Optical Symposium in Washington D.C. It was just a small space in a corner of the exhibition hall, but our exhibition was noticeable by the crowds of visitors in front of our booth. Back then, there was no demand for what we had created and we were unable to make it a profitable business. This event, however, marked our world debut and later brought us to progress and to creating an epoch-making technology that has led Fujikura win the No.1 share in the world market.

Phase.2 Drama in Development

We made a world debut with our multi-mode fusion splicer. We took the lead from the start with our single fiber fusion splicer with profile alignment system. After an epoch-making discovery and top-secret development, the masterpiece "FSM-20" was born. The initial fusion splicer was for multi-mode optical fibers having a thick diameter core (50μ) and was easily connected. The shift to the L optical fiber for a single mode (core diameter of 10μ or less) started in 1980. This was the time when the true hardships began. The issue that needed to be cleared first was the connection of the core section. Initially, we considered using the "phase-contrast microscope" or "polarized-light microscope" to make a "visible core section" as a guide based on the difference in refractive index. However, both seemed difficult to introduce to fusion splicers used at laying sites since they require equipment that is too large in size. This was a big obstacle. Under such circumstances, we received a phone call from the laboratory of the then Nippon Telegraph and Telephone Public Corporation: "We are using an ordinary microscope, but we see something like a core of optical fiber. Would you please examine it?" At the beginning, it was like this: "We see nothing." "Yes, we sure do." "No, we don't." This could be compared to an astronomical observation. You cannot see subtle existence in the first place, but once you capture the substance, it will easily catch your eyes. When we slightly displaced the focus of the microscope, we could without a doubt detect a shade that appeared to be the core section. We then further analyzed it and found it was indeed a core. The research laboratory was full of excitement after we noticed that an ordinary compact microscope could be mounted on fusion splicers. We immediately made a pilot model using the method and tested it at the Ocean Communication Laboratory, where it proved usable. This great discovery acted like a trigger for Fujikura to achieve the top share in the world market and amazing breakthrough points. Fujikura continued development in absolute secrecy. Dedicated researchers were in the experimental laboratory for about a year, spending day and night engaging in improvement and algorithm development. In February 1985, we succeeded in practical application of the single fiber fusion splicer with profile alignment system "FSM-20". That single year launched Fujikura ahead of others to establish an unrivaled position.



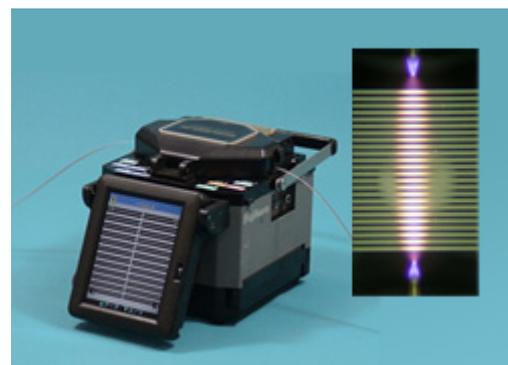
: Single fiber fusion splicer with profile alignment system "FSM-20"

Phase.3 Drama in Sales Operation

Initial reaction to "FSM-20" was clouded with doubt. However, its functional properties soon gained admiration, and within time it was considered the de facto standard.

Development team members, who were convinced of the business success of "FSM-20," started traveling throughout the world, diligently carrying demonstration models. Yes, they took an approach with an eye on the global market from the very beginning. They triumphantly knocked the door of potential customers. But there was doubt with comments like, "You can directly view the core? Unbelievable!"

In addition, we received comments such as: "The main body must not be separated. It should be more compact!" The first year thus passed with continuous hardships. What did work in our favor was that at least potential customers were kind enough to try it. After actually using it, they were gripped with surprise to find it so functional. That surprise gradually grew to admiration. In the United States, Bell Telephone Laboratory introduced a large number of the model. This result became a sort of guarantee and rocketed evaluation to ignite the business. In the United States, in particular, Fujikura's fusion splicer was given the name "PAS (Profile Alignment System)" and it wasn't long before it started to dominate the global market.



Smaller mass fusion splicer up to 12 fiber ribbons

Phase.4 Achieving the No.1 World Market Share

The single-fiber fusion splicer that continued to develop taking over the concepts of "FSM-20", and smaller mass fusion splicer up to 12 fiber ribbons were going to dominate the global market.

"FSM-20" was recognized worldwide as having excellence and was put into mass production. Since then, it has undergone repeated technological progress and five succeeding models were developed, acquiring a sophisticated quality in design duly acceptable in the world along the way. Furthermore, a special function that automatically adjusts itself to any change in the atmospheric pressure under certain weather conditions was added by incorporating a pressure sensor. The mass-production line was constantly improved to achieve extreme cost performance, enhancing maturity to a level that could be called the de facto standard. What triggered Fujikura to win such an overwhelming share was the development of a smaller mass fusion splicer up to 12 fiber ribbons. This model was in particular highly evaluated by U.S. telephone companies, and Fujikura started winning the majority of related contracts in the U.S. market.

Phase.5 And Then, Toward the Future

The future of the fusion splicer business depends on the "challenging & creative spirit" of the next-generation leaders, those who will overtake the achievements of their illustrious predecessors.

In the midst of global computerization, DWDM technology is penetrating. Also, optical fibers along with amplifier technology are still in the course of remarkable progress as those with other advanced functions are being developed. In order to realize optical communication devices of a high performance and high quality, it is also essential to improve the fusion splicing technology. Fujikura has developed the "factory-spec model" specialized in fusion splicing of optical amplifiers and peripheral devices, and is now promoting its diversification. Although it was witnessed a drop following the collapse of the IT bubble, the "factory-spec model" is now being used globally for manufacturing optical communication devices. Moreover, in the future we are expecting to develop a fusion splicing system for optical fiber razor processors and optical fiber sensors.



The use of optical fibers is rapidly diversifying to fields other than communication. So long as optical fibers exist, fusion splicing technology will exist as well. In order to identify further business opportunities, we will never stop incessantly challenging ourselves.

Looking back, the current optical world may well not exist without Fujikura's fusion splicer. This gives us a hint of the extent of the role Fujikura played. Product development of fusion splicer involves three slogans that remain in play to this day:

- 1.Be No.1 in the world! (Developing unrivaled products is the only way for us to survive.)
- 2.Keep up with what you stick to! (Never give up.)
- 3.Do not fear problems! (Challenge something new.)

It is tough to maintain the No.1 market share in the world market for a continued period. Fujikura's success in doing so proves that these three slogans are firmly rooted in the Company spirit.

Fujikura's fusion splicer business—progress is still on its way. What possibilities lie ahead? This will depend on the "challenging & creative spirit" of the next-generation leaders who take over the achievements of their illustrious predecessors.

This is a story made about 15 years ago, but this spirit is still handed down to the present leaders.

Please visit our website and look for the current products you are interested in.
<https://www.fusionsplicer.fujikura.com/>

