

INSTRUCTION MANUAL

ARC FUSION SPLICER

FSM-20CS

CS06E

 **Fujikura**

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1. GENERAL

1.1 Outline of FSM-20CS Optical Fiber Fusion Splicer

The FSM-20CS Arc Fusion Splicer is used for splicing SM (Single Mode) optical fiber and MM (Multi Mode) optical fiber.

Mutual aligning of both SM and MM optical fibers is performed automatically by the image processing microcomputer built into the splicer.

The power source applicable for this system is AC85-265V (50/60Hz) or DC10-15V. The AC voltage selection is automatic.

The Type FSM-20CS Arc Fusion Splicer is shown below.

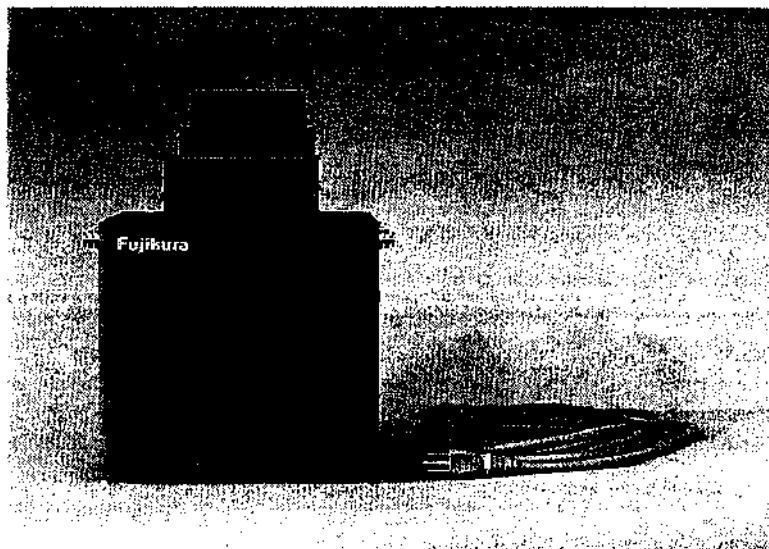


Fig.1.1 Type FSM-20CS Arc Fusion Splicer

CAUTION

NEVER USE a cleaning spray on the machine. Spray that includes FREON gas causes abnormally strong discharges. This reduces the life time of the electrodes and may cause damage to the mirrors and lens.

1.2 Construction

The components comprising the FSM-20CS Arc Fusion Splicer are shown in Table 1.1 and the accessories in Table 1.2 below.

Table 1.1 Components of FSM-20CS Arc Fusion Splicer

No.	Name	Quantity
1	Arc Fusion Splicer Main Body	1
2	Power Cord (AC/DC)	1 pair
3	Carrying case	1

Table 1.2 Accessories and Spares

Name	Quantity	Comment
Spare Electrode	1 pair	
Spare Fuse	1 set	DC6.3A/AC3.15A *1 (20 mm long)
Spare Mirror	1	
Hexagonal Wrench	1	*2
Tweezers	1	*2
Instruction Manual	2	

*1 AC250V 3.15A Time Lag Fuse (Slow-Blow).

*2 Used especially for "Up/Down" mirror replacement.

1.3 Parts and Functions

The following table gives descriptions of the parts and functions of the splicer. The locations of the items are given in Fig. 1.2.

Table 1.3 Items and Functions of Splicer

No.	Name	Function
①	Keyboard Panel	This is used to operate the splicer (See Section 2.1).
②	Monitor	Displays the fiber image, the operation state and estimated loss.
③	"Bright"	Adjusts the brightness of the LCD monitor.
④	Input Voltage Indicator	Indicates whether the input DC voltage is in the appropriate range. Green=good : Red=Too high or too low
⑤	AC Fuse Holder	3.15A fuse is used.
⑥	DC Fuse Holder	6.3A fuse is used.
⑦	POWER Switch	3 position switch. DC ON - OFF - AC ON.
⑧	DC IN Terminal	Connection for a DC power source, such as a battery. Turn the power switch to the DC-side.
⑨	SER.PORT Terminal	This terminal is used to input and output data when using a portable computer.
⑩	VIDEO OUT Terminal	This terminal is used to connect the video cord of an external monitor. Video signals are NTSC composite signals.
⑪	AC IN Terminal	This terminal is used for the AC power source (AC 85-265V, 50/60 Hz).
⑫	GND Terminal	This terminal may be used to ground the splicer.
⑬	Top Cover	This cover is used to protect the splicer when not in use.

No.	Name	Function
⑭	Wind Protector	Prevents abnormal arcing caused by the wind during discharge. By opening and closing the wind protector, the illumination lamp is turned off and on. When it is opened, the mirror is moved up to allow the fibers to be set. It also functions as a safety switch and prevents arc discharges while open.
⑮	Terminals for Working Table	These terminals are used to fix the working table (option).
⑯	Terminal for Tripod	This terminal is used to fix the splicer on the tripod (option).
⑰	Holder	The optical fiber sheath is set on this plate.
⑱	Optical Fiber Guide Unit (V-groove)	This guide unit is used to hold the optical fiber and to align the fiber pair to be spliced.
⑲	Discharge Electrodes	These discharge electrodes fuse the optical fiber pair to be spliced.
⑳	Illumination Lamp	This lamp is used to illuminate the optical fiber for the imaging system. When the wind protector is closed, the illumination is turned ON; when it is opened, the illumination is turned OFF.
㉑	Electrode Cover	Designed for the insulation of the high voltage electrode. DO NOT attempt arc discharges when the cover is disengaged for safety purposes.
㉒	Objective Lens	This lens is for magnification of the fiber image.
㉓	Fiber Clamp	This clamp is used to keep the optical fiber on the optical fiber guide unit.
㉔	Sheath Clamp	This clamp is used to hold the optical fiber sheath.
㉕	Mirror	This mirror is used to guide the illumination light to the objective lens to observe the fiber images. It can be set or reset (down or up).
㉖	Electrode Fixture	This secures the discharge electrode at the specified position.
㉗	Heater (option)	This is used to heat the heat-shrink sleeve.
㉘	Heat Indicator Lamp	Indicates that the heat-shrink sleeve is being heated.

2. OPERATION

2.1 Keyboard Panel

This section gives the key functions of the FSM-20CS. Fig.2.1 shows the key layout on the top panel of the splicer. Table 2.1 shows their respective functions.

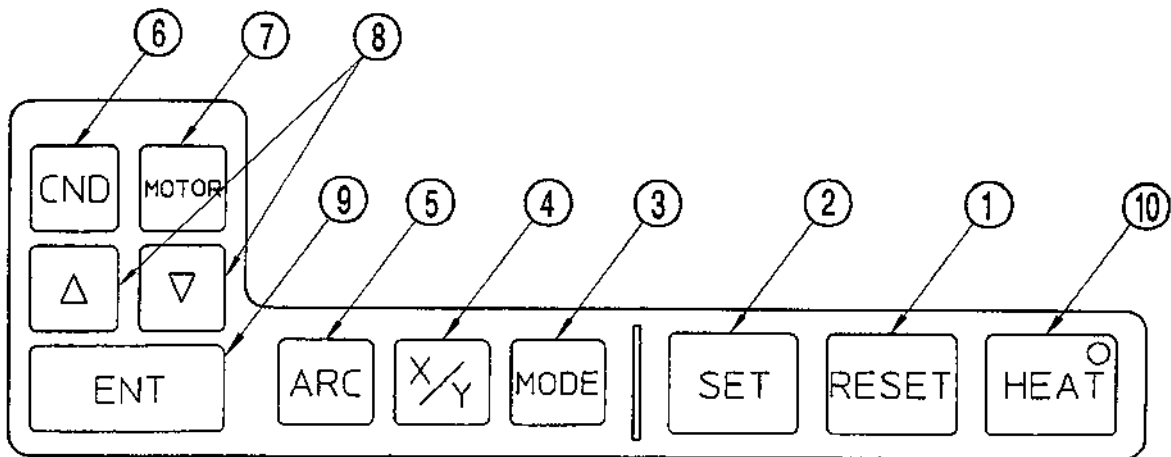


Fig. 2.1 Keyboard Layout

Table 2.1 Functions of Keys

No.	Name	Function
①	RESET Key	When the RESET switch is pressed, the system stops in any step of operation and the fibers move back to Z axis home position. The splicer accepts the RESET with a beeping sound and displays "RESET" on the monitor. After the reset operation is completed, "READY" is displayed on the monitor.
②	SET Key	This is used to initiate the gap setting of two fiber end faces and automatic alignment of the fibers. The instructions "GAP SET", "FIBER OK?" and "ALIGNING" are displayed on the monitor at each stage.

No.	Name	Function
③	MODE Key	<p>The FSM-20CS can be preset to 20 different modes for various fibers (SM1 – SM10, MM1 – MM10). This key is used to select the mode.</p> <p>In SM mode, core axis alignment is performed automatically and in the MM mode, fiber axis alignment is performed.</p>
④	X/Y Key	<p>This is used for the automatic field change operation. When the X/Y key is pressed, the fiber image is changed from (X) to (Y) or (Y) to (X). If this is done after a gap set operation, the fibers are adjusted to the center of the monitor and focused automatically.</p>
⑤	ARC Key	<p>This is used to perform an arc but it will not function while the system is in its automatic splicing operation.</p> <p>No fiber stuffing occurs if this key is operated from the "READY" state or if an arc has already occurred. "***ARC**" is displayed on the monitor just before the discharge is produced.</p> <p>If gap setting has been done, loss estimation automatically follows the discharge operation (SM only).</p> <p>This function may be used to re-arc a splice after the automatic process has finished.</p>
⑥	CND Key	<p>This is used to select the menu options.</p>
⑦	MOTOR Key	<p>This is used for controlling the splicer motors manually.</p>
⑧	<p>△ (up) Key</p> <p>▽ (down) Key</p>	<p>These are used for moving the '*' cursor wherever applicable in the menus and options. This symbol will change to a '#' symbol when a selection is made by pressing the "ENT" key.</p> <p>When manual motor control is selected, these keys act as "Backward" and "Forward" direction controls.</p>
⑨	ENT Key	<p>This is used to select a menu option for discharge conditions or select a motor control.</p> <p>It also changes the "*" cursor to "#", indicating that a parameter may be changed.</p>
⑩	HEAT Key	<p>This is used to start the heater process. The heat indicator lamp lights during heating.</p>

2.1.1 Selecting Splice Mode

The FSM-20CS can be preset for 20 different splicing modes (10 settings for SM fibers and 10 settings for MM fibers). This allows various fiber types to be spliced. Each mode consists of 6 parameters (ARC POWER, ARC TIME, FORWARD, PREFUSE, GAP, ECF). See Section 2.1.2. For SM1-SM10, core axis alignment and splice loss estimation are performed automatically. For MM1-MM10, fiber cladding alignment is performed automatically.

Operation

- (1) Make sure that the splicer is in its "READY" state or that the splicing sequence is paused or finished.
- (2) Press the MODE key. 10 splice modes are displayed on the monitor as shown in Fig. 2.2. The cursor "*" on the left side of the mode shows the present splice mode selected.
- (3) The cursor is moved up or down by the Δ (up) or ∇ (down) keys. Move it to the splice mode you wish to select.
- (4) If the ∇ (down) key is pressed when the cursor is beside SM10, then the MM modes are displayed as shown in Fig. 2.3.
- (5) To escape from this state, press any key except MODE, Δ (up) or ∇ (down).

SPlice MODE		
* SM1	FUJIKURA	125um
SM2	FUJIKURA	125um
SM3	FUJIKURA	125um
SM4	FUJIKURA	125um
SM5	FUJIKURA	125um
SM6	FUJIKURA	125um
SM7	FUJIKURA	125um
SM8	FUJIKURA	125um
SM9	FUJIKURA	125um
SM10	FUJIKURA	125um
READY	SM1	(X)

Fig. 2.2 Splice Modes for SM Fiber

SPlice MODE		
* MM1	FUJIKURA	125um
MM2	FUJIKURA	125um
MM3	FUJIKURA	125um
MM4	FUJIKURA	125um
MM5	FUJIKURA	125um
MM6	FUJIKURA	125um
MM7	FUJIKURA	125um
MM8	FUJIKURA	125um
MM9	FUJIKURA	125um
MM10	FUJIKURA	125um
READY	MM1	(X)

Fig. 2.3 Splice Modes for MM Fiber

2.1.2 Changing Discharge Conditions

This section gives the procedures necessary to change the programme parameters (ARC POWER, ARC TIME, FORWARD, PREFUSE, GAP, ECF).

Note: Dip Switch 5 Bit 8 (DATA CHANGE PROTECT) must be OFF for this procedure. The splicer is shipped from the factory with this switch off.

Operation

- (1) Make sure that the splicer is in its "READY" state or that the splicing sequence is paused or finished.
- (2) Press the "CND" key. The menu is displayed on the monitor as shown in Fig. 2.4. The cursor '*' on the left hand side shows the function to be selected.
- (3) Move the cursor '*' to '1 CONDITION SET'
- (4) Press the "ENT" key. The current settings for the programmes are displayed on the monitor as shown in Fig. 2.5. The cursor '*' on the left hand side shows the selected parameter.
- (5) The cursor '*' is moved up or down by the Δ (up) or ∇ (down) key. Move it to the parameter you want to change.
- (6) Press the "ENT" key. The '*' changes to a '#'.
- (7) The value of the selected parameter may be increased or decreased by pressing the Δ (up) or ∇ (down) key. The value changes while the key is held down. When the key is released, it stops.
- (8) Press the "ENT" key again. The '#' changes back to a '*'. Another parameter may now be changed by moving the cursor up or down.
- (9) To escape from this state, press any key except "CND", "ENT", Δ (up) or ∇ (down).

Note: The FSM-20CS has a sensor to measure the atmospheric pressure. When operating the splicer at a different altitude or under different weather conditions from which it was calibrated, the arc power is automatically adjusted to maintain splice quality.

If it is required to change the arc power for some other reason, see Appendices AP2.2 and AP7, set it using the above procedure. The new arc power becomes standard, again with automatic adjustment.

* 1	CONDITION SET
2	COMMENT SET
3	OPTION SET
READY SM1 (X)	

Fig. 2.4 Menu Display

SM1	FUJIKURA	125um
* 1	ARC POWER	12
2	ARC TIME	2000msec
3	FORWARD	40msec
4	PREFUSE	180msec
5	GAP	8line
6	ECF	0.40
READY		SM1 (X)

Fig. 2.5 Splicing Parameters

Table 2.2 Details of Splicing Parameters

Monitor display	Description	Step	Range
1 ARC POWER	Arc (discharge) power	1	0 - 31 *1
2 ARC TIME	Arc (discharge) time	0.1 sec	0 - 65 sec
3 FORWARD	Stuffing time during fusion splice	5 msec	0 - 1 sec
4 PREFUSE	Prefusion time during fusion splice	10 msec	0 - 1 sec
5 GAP	Gap between end faces of fiber	2 line	6 - 32 line *2
6 ECF	ECF factor	0.05	0 - 0.9 *3

*1 The discharge current is approximately $10.0+0.3 \times \text{DATA}$ (mA).

*2 1 line = 2 μm

*3 See Appendix AP6.

2.1.3 Setting Comments

When the "MODE" key is pressed, 10 splice modes and comments are displayed on the monitor as shown in Figs. 2.2 or 2.3. Move the cursor to the comment that is to be changed using the Δ (up) or ∇ (down) keys.

Note: Dip Switch 5 Bit 8 (DATA CHANGE PROTECT) must be OFF for this procedure. The splicer is shipped from the factory with this switch off.

Operation

- (1) Make sure that the splicer is in its "READY" state or that the splicing sequence is paused or finished.
- (2) Press the "CND" key. The menu is displayed on the monitor as shown in Fig. 2.4. The cursor '*' on the left hand side shows the programme to be selected.
- (3) Move the cursor '*' to '2 COMMENT SET'
- (4) Press the "ENT" key. The current comment for the programme is displayed on the monitor as shown in Fig. 2.6. The cursor '*' shows the selected character.
- (5) The cursor '*' is moved left or right by the Δ (up) or ∇ (down) key.
Move it to the character you want to change.
- (6) Press the "ENT" key. The '*' changes to a '#'.
Move it to the character you want to change.
- (7) The character may now be changed by pressing the Δ (up) or ∇ (down) key. It changes while the key is held down. When the key is released, it stops.
- (8) Press the "ENT" key again. The '#' changes back to a '*'. Another character may now be changed by moving the cursor left or right.
- (9) To escape from this state, press any key except "CND", "ENT", Δ (up) or ∇ (down).

2.1.4 Setting Optional Functions

This splicer has some optional functions, DATA DISPLAY, PAUSE, etc., as shown in Table 2.3. These are common to all splice programmes. To set these options, off or on, proceed as follows.

Note: Dip Switch 5 Bit 8 (DATA CHANGE PROTECT) must be OFF for this procedure. The splicer is shipped from the factory with this switch off.

Operation

- (1) Make sure that the splicer is in its "READY" state or that the splicing sequence is paused or finished.
- (2) Press the "CND" key. The menu is displayed on the monitor as shown in Fig. 2.4. The cursor '*' on the left hand side shows the programme to be selected.
- (3) Move the cursor '*' to '2 OPTION SET'
- (4) Press the "ENT" key. The current settings for the options are displayed on the monitor as shown in Fig. 2.7. The cursor '*' shows the selected option.
- (5) The cursor '*' is moved up or down by the Δ (up) or ∇ (down) key. Move it to the option you want to change.
- (6) Press the "ENT" key to turn ON or OFF.
- (7) To escape from this state, press any key except "CND", "ENT", Δ (up) or ∇ (down).

```

SM1
FUJIKURA 125um
*
READY SM1 (X)

```

Fig. 2.6 Comment Display

```

OPTION SET
* 1 DATA DISPLAY OFF
2 PAUSE OFF
3 ECF ON
4 CLEANING ARC ON
5 CLEAVE ANGLE ON
READY SM1 (X)

```

Fig. 2.7 Optional Functions

Table 2.3 Details of Optional Functions

Monitor display	Description
DATA DISPLAY	Display data such as axis offset etc. on the monitor (See Appendix AP7).
PAUSE	Stop splice procedure after fibers are gapset (Press "SET" key to restart).
ECF	See Appendix AP6.
CLEANING ARC	A discharge is produced to remove dust on the fiber surface just after GAP SET has started.
CLEAVE ANGLE	The cleaved fiber end faces are checked and the cleaved angles are displayed on the monitor. ERROR 7 is displayed when either angle is more than five degrees.

2.1.5 Manual Motor Operation

Note: Dip Switch 5 Bit 8 (DATA CHANGE PROTECT) must be OFF for this procedure. The splicer is shipped from the factory with this switch off.

Operation

- (1) Make sure that the splicer is in its "READY" state or that the splicing sequence is paused or finished.
- (2) Press the "MOTOR" key. The motor select state is displayed on the monitor as shown in Fig. 2.8. The second line shows which motor is selected.
- (3) The selected motor is changed by using the Δ (up) or ∇ (down) keys.
- (4) Press the "ENT" key when the required motor is selected. The state changes to the manual motor operation state as shown in Fig. 2.9.
- (5) The Δ (up) and ∇ (down) keys control the direction of the motor. The motor runs while the key is pressed.
- (6) To return to the motor select state, press the "ENT" key.
- (7) To escape from this state, press any key except "CND", "ENT", Δ (up) or ∇ (down).

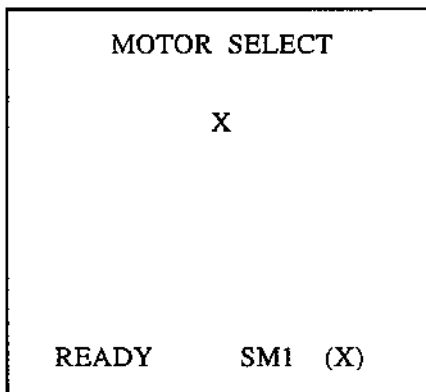


Fig. 2.8 Motor Select State

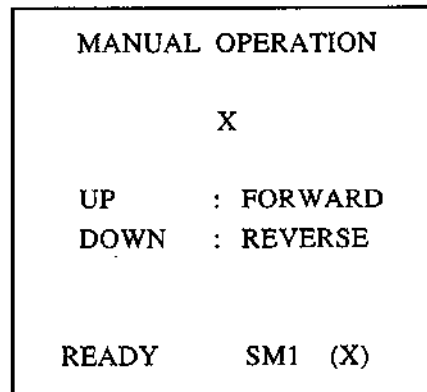
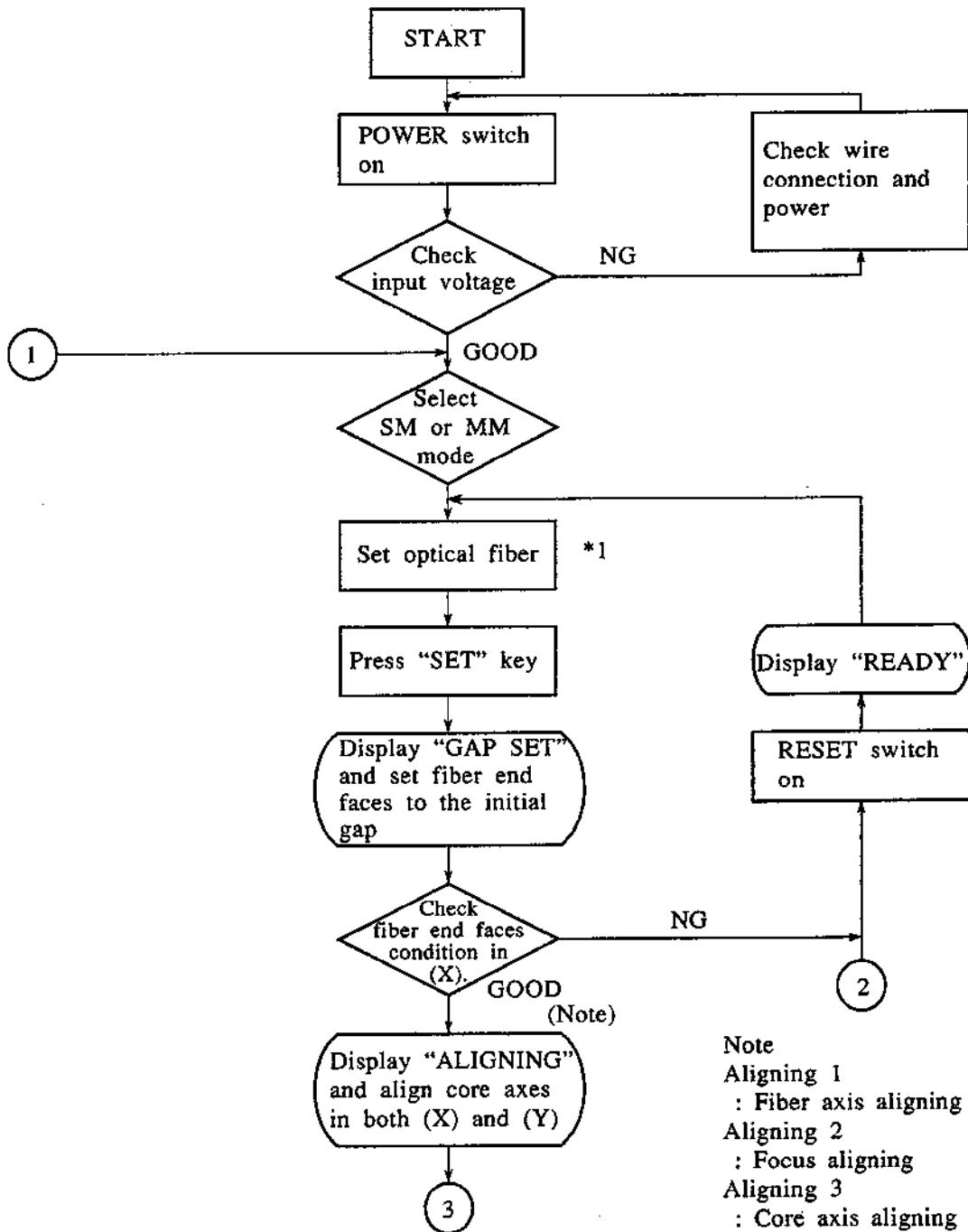
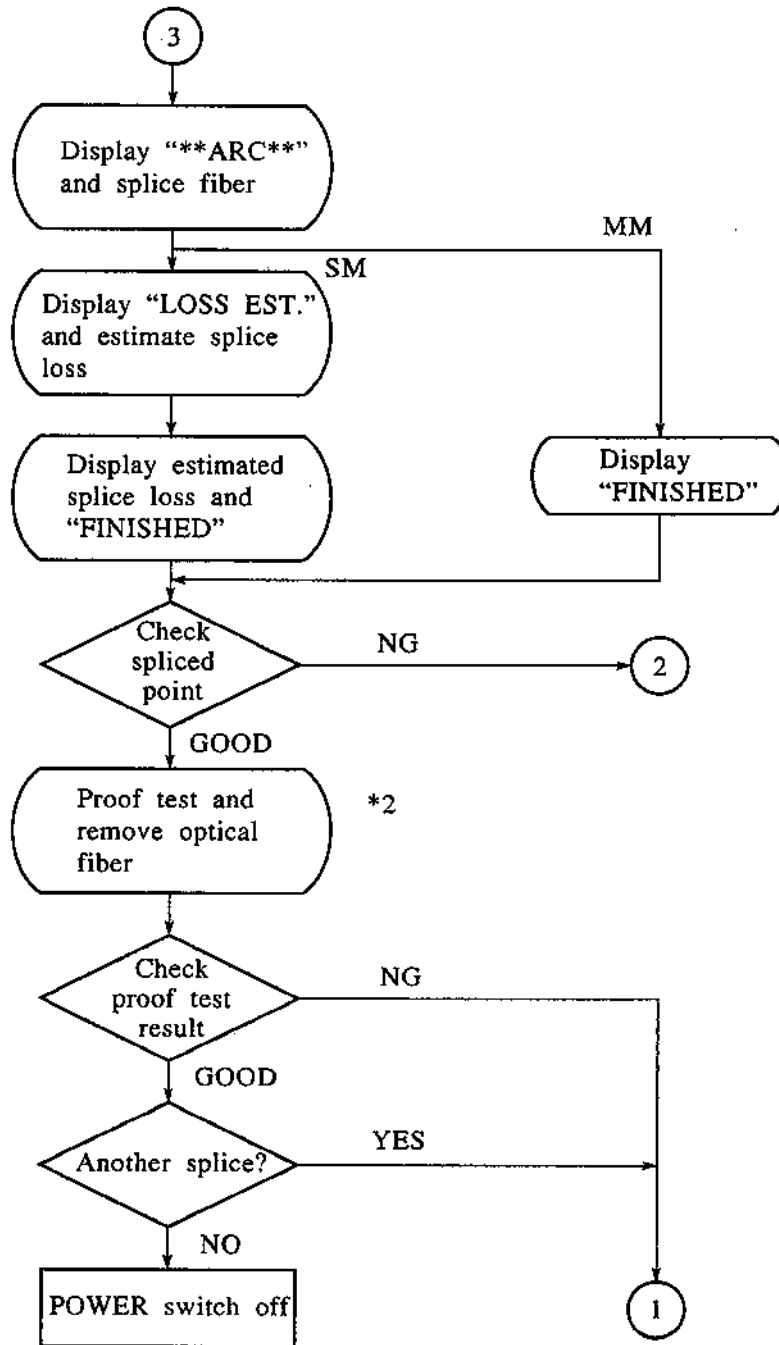


Fig. 2.9 Manual Operation State

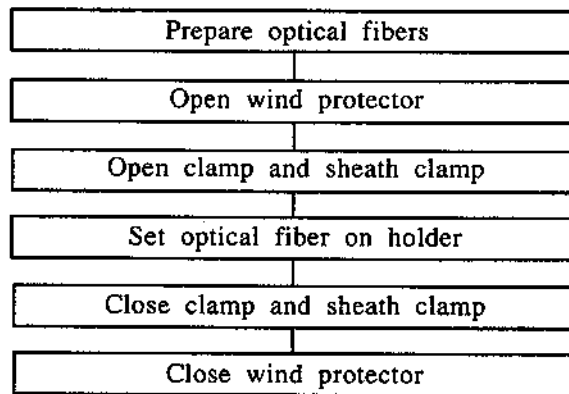
2.2 Operating Flow Chart

: Manual
 : Automatic

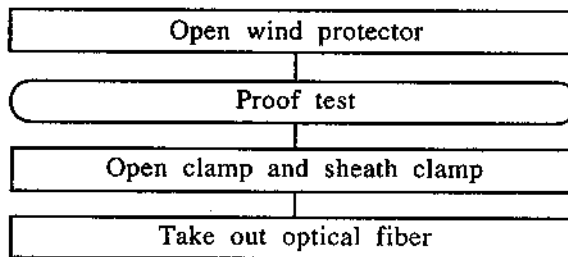




*1 Flow Chart for Setting Fibers



*2 Flow Chart for Proof Test and Fiber Removal



2.3 Connecting the Power Cord and Operational Check

Ensure the POWER switch is OFF. Firmly connect the AC power cord to the AC IN terminal. Connect the AC power source; AC85-265V (50/60Hz). The FSM-20CS automatically adjusts to the correct voltage range and frequency.

Refer to Section 4 when you use a DC power source.

FOR SAFETY PURPOSES, THE SPLICER MUST ALWAYS BE EARTHED EITHER THROUGH THE MAINS CONNECTOR OR THE GND TERMINAL.

Turn the Power switch ON and check whether the input voltage indicator points to green area ("appropriate"). When the input voltage is in the red area ("too high or low"), check the power supplies.

Ensure that "READY" is displayed on the monitor.

2.4 Splicing SM Type Optical Fiber

2.4.1 Selecting Splice Mode

Confirm "READY" is displayed on the monitor and select SM mode (See Section 2.1.1).

2.4.2 Setting Optical Fibers

- (1) Strip, clean and cleave the optical fibers.
- (2) Open the wind protector.
- (3) Lift the fiber clamps and the sheath clamps.
- (4) Place the optical fiber in the V-grooves, as shown below.

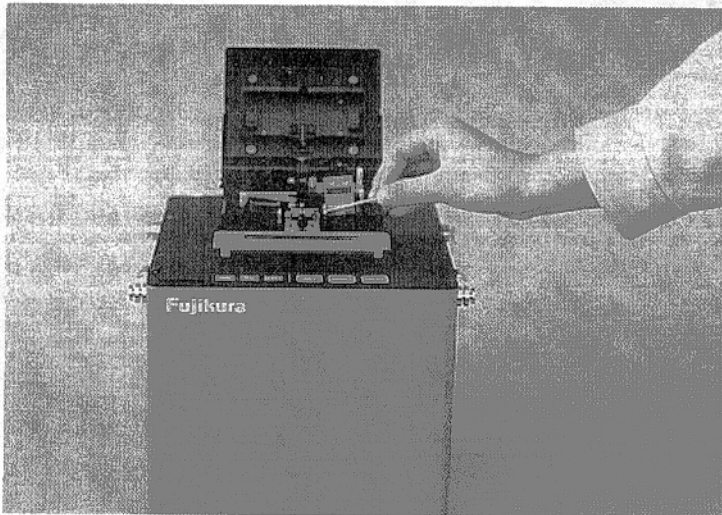


Fig. 2.9 Setting the Optical Fiber

- (4) Carefully close the sheath clamp until it clicks. (See Fig. 2.10 (a) below)

Check that the bare fiber is seated at the bottom of the V-groove. Ensure the fiber end face is positioned between the V-groove and the discharge electrodes as illustrated in Fig. 2.10 (b) below.

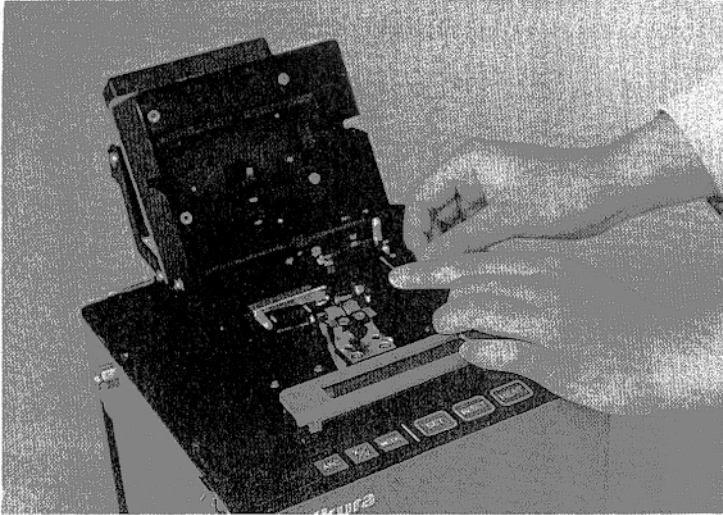
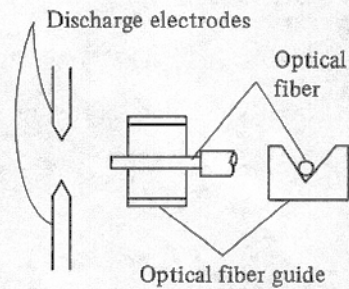


Fig. 2.10(a) Close the Sheath Clamp



(b) Fiber Position in V-groove

- (5) Repeat for the other fiber.
(6) Carefully close the fiber clamps and then the wind protector.
(7) Press the "SET" key.

The mirror is set, "GAP SET" is displayed and the optical fibers move forward to their initial gap.

If the CLEANING ARC function is ON, (See Section 2.1.4), a short discharge now occurs to remove dust from the fiber surface. Press "RESET" and prepare the fibers again if any dust remains after cleaning.

If the CLEAVE ANGLE function is ON, the end face angles are checked and an error occurs if either is more than 5 degrees.

Now, the splicer either continues with the splice procedure, or, if the PAUSE function is ON, it stops to allow operator inspection of the fiber images. "FIBER OK?" is displayed and a beep is sounded. Press "SET" to continue the splice procedure.

CAUTION: The "RESET" key may be pressed at any time to terminate the splice procedure. However, if this is done when the fiber image is not correctly focused or positioned on the monitor, then the image may not be recognized on the next GAP SET. This may lead to collision of the fibers and require them to be prepared again. If the operator is any doubt as to when the "RESET" key was pressed, lift the wind protector and press the "SET" key. Error 3 "TOO DARK" will result and the field and focus motors will move to their correct positions. Lower the wind protector and proceed as normal.

2.4.3 Observation of Fiber End Faces

Check the fiber end face condition on the monitor twice, first after gap setting the fiber and second after automatic field exchange. If the end face condition is NOT good, (See Fig. 2.11), press the 'RESET' key and try again.

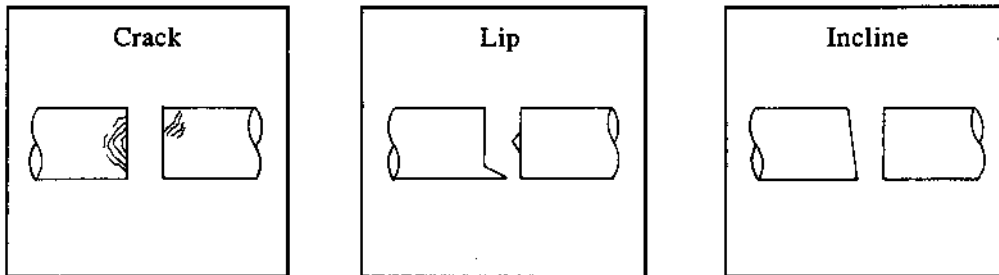


Fig. 2.11 End Face View of Optical Fiber

2.4.4 Automatic Splicing

(1) Mutual aligning of fibers

("ALIGNING" is displayed on the monitor)

At first, the splicer aligns the fibers in (X) field as follows.

Step	Aligning mode	Display on the monitor
First step	Fiber axes aligning in (X) field	ALIGNING 1
Second step	Focus aligning in (X) field *1	ALIGNING 2
Third step	Core axes aligning in (X) field *2	ALIGNING 3
Fourth step	Core axes aligning in (Y) field	ALIGNING 3

*1: Fiber axes aligning in (Y) direction using difference of focus position between both fibers.

*2: In MM mode, "ALIGNING" is started from the third step but using fiber axes alignment.

The symbol "*" appears on the monitor while the X or Y motor is driven for align

(2) Arc Discharge.

("**ARC**" is displayed on the monitor)

The splicer resets the mirror and splices fibers by discharging.

The number of discharges is indicated on the monitor.

The accumulated number of discharges is increased whenever an arc is produced (does not include CLEANING ARC discharges). To clear the number of discharges, refer to Appendix AP2.

(3) Estimation of the spliced loss (SM Mode only)

"LOSS EST." is displayed on the monitor.

The splicer measures the core axis offset by image processing and estimates splice loss.

(4) Display of estimated loss (SM Mode only)

The splicer displays the estimated loss and "FINISHED" on the monitor.

2.4.5 Observation of Spliced Point

After splicing, if the splice image appears as shown below, the steps described in Table 2.5 should be taken.

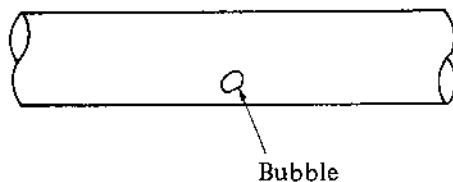


Fig. 2.12 Appearance of Bubble

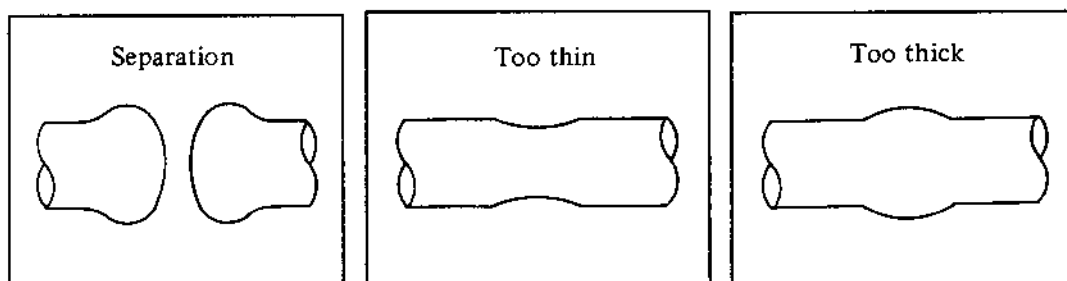


Fig. 2.13 Defective Spliced Results

Table 2.5 Treatment of Defective Spliced Results

<ul style="list-style-type: none"> • Appearance of bubble 	<ul style="list-style-type: none"> • Improper cleaving of optical fiber • Dust on fiber end faces 	Cleave the fiber again or change the cleaver
<ul style="list-style-type: none"> • Becomes too thin 	<ul style="list-style-type: none"> • Abnormal discharge • Malfunction of fusion splicer main body 	Adjust the splice programme parameters (ARC POWER, etc.)
<ul style="list-style-type: none"> • Becomes too thick 	<ul style="list-style-type: none"> • Malfunction of fusion splicer main body 	Adjust the splice programme parameters

2.4.6 Proof Test and Fiber Removal

- (1) Open the wind protector and proof testing is started.
- (2) Open the fiber and sheath clamps.
- (3) Remove the optical fiber from the holders.

2.5 Splicing MM Type Optical Fiber

2.5.1 Selecting Splice Mode

Confirm "READY" is displayed on the monitor and select MM mode (See Section 2.1.1).

2.5.2 Other Procedures

Other procedures from this step, except for loss estimation, are completely the same as described in "2.4 Splicing SM Type Optical Fiber".

Refer to sections 2.4.2-2.4.6

2.6 Tube Heater (option)

Use Fujikura FP-3M Heat-Shrink Sleeves.

- (1) Slide the heat-shrink sleeve, through which the fibers are already inserted, to the center of the spliced portion.

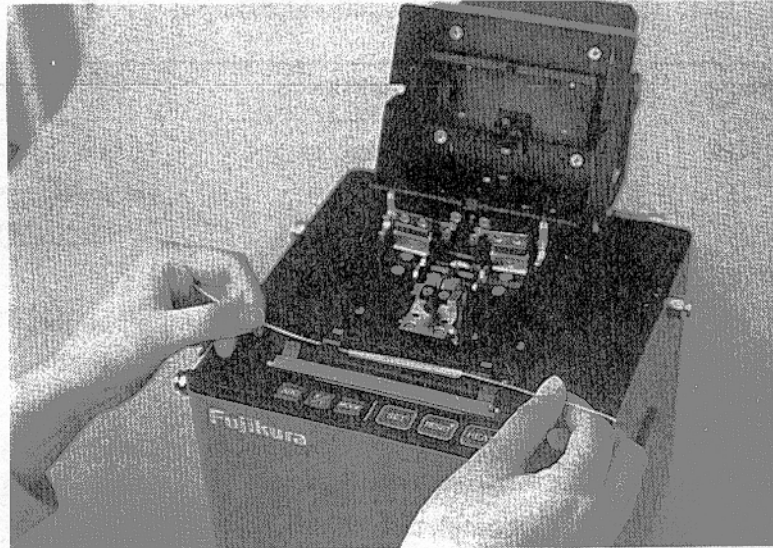


Fig. 2.14 Setting the Heat-Shrink Sleeve

- (2) Open the heater cover.
- (3) Keep the reinforcing material (steel rod) position downward inside the heat-shrink sleeve. Close the heater cover.
- (4) Press the "HEAT" key and check that the heat indicator lamp is lit.
- (5) When the sleeve is shrunk completely, the heat indicator lamp is turned off and a beep is sounded. Reinforcing takes approximately 2 and half minutes.

3. ALARM INDICATION

When any abnormal operating condition occurs, a warning beep is sounded for about 2 seconds and the monitor displays the following messages.

Table 3.1 Abnormal Conditions

Message	Reason	Remedy
OVER RUN XF XR YF YR	<ul style="list-style-type: none"> • There is dust on the V-groove. • A fiber is detached from its V-groove. • The primary coating of the fiber is not completely removed. 	<p>Clean the V-groove according to section 5. MAINTENANCE.</p> <p>Place the fiber again on the V-groove.</p> <p>Cut the fiber again and repeat the entire procedure.</p>
OVER RUN FOCUS NEAR FOCUS FAR FIELD UP FIELD DOWN	<ul style="list-style-type: none"> • A fiber is not set properly in its V-groove. 	<p>The focus point and position of fiber image are returned to their correct positions automatically.</p> <p>Place the fiber in the V-groove, then start again from the gap setting.</p>
OVER RUN ZLF ZRF	<ul style="list-style-type: none"> • A fiber is cleaved too short. • The fiber is detached from V-groove 	<p>Cleave the fibers properly. *1</p> <p>Place the fiber again on the V-groove.</p>
OVER RUN ZLR ZRR	<ul style="list-style-type: none"> • During manual motor operation, the fiber moves back until the limit switch is hit. 	<p>Automatically returns to the "READY" state.</p>

*1: The proper length of the cleaved fiber is 16+/-1mm for 0.9mm diameter coated fiber.

For ERROR 1-9, check the cause among those listed below. Press the "RESET" key and take the remedy in the right column.

For ERROR 2, 3 or 4, wait for about 15 seconds until the monitor displays "READY". The splicer is returning motors to home position during this time.

Table 3.2 ERROR Messages

Message	Reason and Remedy
ERROR 1 GAP SET ERROR	<ul style="list-style-type: none"> • Gap is not set correctly. Place the optical fibers on the V-grooves again and press the "SET" key.
ERROR 2 SET ERROR	<ul style="list-style-type: none"> • Fibers are cleaved too long. Cleave the optical fibers again to the proper length 16 +/- 1mm (for 0.9mm diameter fiber). • Dusty mirror/lens. Clean the mirrors and objective lens. • Discharge electrode is seen on the monitor. The field is returned to correct position automatically.
ERROR 3 TOO DARK	<ul style="list-style-type: none"> • Wind protector is opened. Close the wind protector and press the "SET" key. • Dusty mirror/lens. Clean the mirrors and objective lens. • Lamp is dark. Consult the manufacturer.
ERROR 4 FOCUS ERROR	<ul style="list-style-type: none"> • Focus/field of fiber image is not proper. This error occurs when there is a problem with the automatic field exchange operation. Consult the manufacturer.

Message	Reason and Remedy
ERROR 5 TOO DUSTY FIBER	<ul style="list-style-type: none"> • Dusty fiber surface. Remove the coating of the fibers, clean the fiber surface thoroughly and cleave them again. • Check CLEANING ARC is ON. • Wrong mirror angle inside the wind protector. Consult the manufacturer.
ERROR 6 FIELD EXCHANGE ERROR	<ul style="list-style-type: none"> • This error occurs when the automatic field exchange operation does not work well. Consult the manufacturer.
ERROR 7 TOO BAD CLEAVE	<ul style="list-style-type: none"> • Large cleaved angle (more than 5 degrees). Reset and try cleaving again or press the "SET" key to override.
ERROR 8 MIRROR TROUBLE	<ul style="list-style-type: none"> • Mirror limit switch broken. Consult the manufacturer.
ERROR 9 Z TROUBLE	<ul style="list-style-type: none"> • Backward limit switch of Z direction is broken or not struck. Consult the manufacturer.

Note: When the fiber image position or focus is not correct, bad splicer operation may occur. Lift the wind protector and press the "SET" key. ERROR 3 "TOO DARK" occurs, and the motors move to their correct home positions.

4. OPERATION BY DC POWER SOURCE

If a DC Power Source is used for the splicer, check the output voltage is in the range 10-15 V.

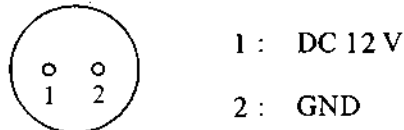


Fig. 4.1 DC Power Cord

4.1 Optional DC Outlet Box, Type OB-3P/3PT

- (1) Ensure the splicer power switch is off. Connect the DC power cord between the outlet box and DC IN terminal. Connect the outlet box to the battery pack ensuring the polarity is as shown above.
- (2) Turn the power switch to DC and check the voltage indicator, on the side of the splicer, is acceptable (Green area). If the voltage is lower (left side RED area), charge the battery pack. If higher (right side RED area), check the battery.

4.2 Using a DC Power Cord Directly Connected to a Battery

Prepare the cable so that the WHITE wire connects to the positive (+) terminal and the BLACK wire to the negative (-) terminal.

Confirmation of operation is the same as in Section 4.1 above, but obviously, without the DC outlet box.

5. MAINTENANCE

5.1 Cleaning the Optical Fiber Guide Unit (V-groove)

When the V-groove of the optical fiber guide unit becomes dirty, it causes axial offset of the optical fiber.

Ensure the splicer is switched off. Lift the fiber clamp and wipe the V-groove with a cotton stick dipped in alcohol. Alternatively, scour the V-groove with the end face of a cleaved fiber as shown below.

After cleaning, discharge a few times (See Section 6.1 Note 3).

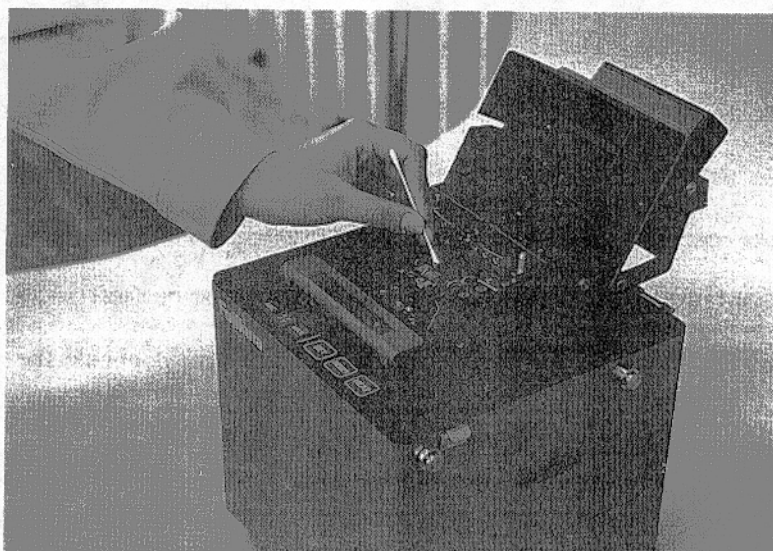


Fig. 5.1 Cleaning with Cotton Stick

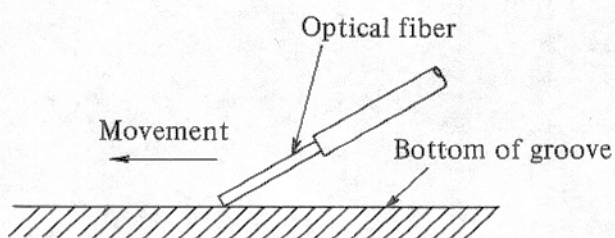


Fig. 5.2 Cleaning with Optical Fiber

5.2 Cleaning the Objective Lens

If the objective lens is dirty, a bad image may be seen on the monitor and cause abnormal operation of the splicer.

Ensure the splicer is switched off. Remove the electrode cover, loosen the electrode screws and move the electrode towards the back of the splicer (take care not to damage the tip through any unintentional contact). Wipe the objective lens with a cotton stick dipped in alcohol. Move the electrode back, keeping it firmly pressed into place while tightening the screws lightly.

After cleaning, discharge a few times (See Section 6.1 Note 3).

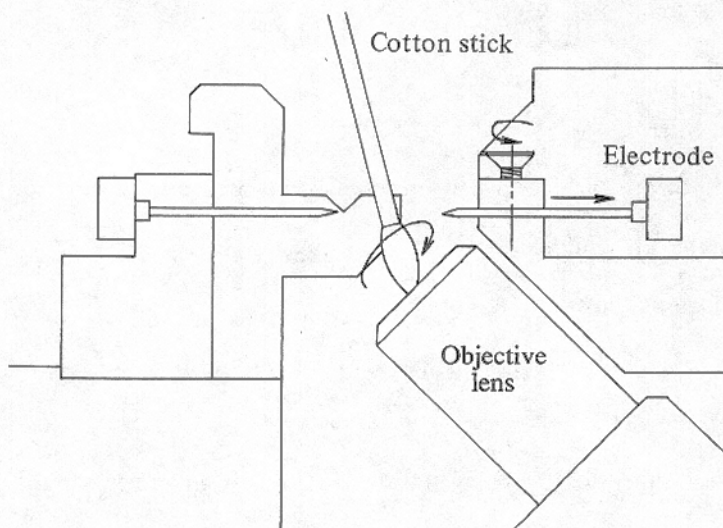


Fig. 5.3 Cleaning the Objective Lens

5.3 Cleaning the Mirrors

When either of the mirrors is dirty, a bad image may be seen on the monitor and cause abnormal operation of the splicer.

Cleaning procedure is as follows.

- (1) Open the wind protector (the Up/Down mirror is reset automatically) and turn off the splicer.
- (2) Wipe the mirrors inside the wind protector and in front of the V-grooves with a cotton stick dipped in alcohol.

If the mirror has large visible dust, like sand, on its surface, blow it away before wiping (DO NOT use an aerosol gas cleaner for this).

5.4 Replacing the UP/Down Mirror

If the mirror has scratches on its surface, a bad image may be seen on the monitor and cause abnormal operation of the splicer.

Replacement procedure is as follows (See Fig. 5.4).

Note: Use the hexagonal wrench, tweezers and spare mirror provided in the splicer carrying case.

- (1) Press the "SET" key to set the mirror. Press the "RESET" key and turn off the splicer.
- (2) Open the wind protector, loosen the screws ("D") fixing the electrodes and remove the electrodes carefully.
- (3) Remove the screws ("A") on the mirror attachment using the hexagonal wrench. Remove the mirror attachment ("B") with the tweezers. Take care not to drop the screw or the mirror attachment inside the splicer.
- (4) Push the new mirror firmly against the holder ("C") while tightening the screw. Confirm that no gap is visible between the mirror attachment and the holder.
- (5) Push both electrodes until the flanges touch the electrode fixture and lightly tighten screws ("D").

- Ⓐ: Mirror Attachment Screw
- Ⓑ: Mirror Attachment
- Ⓒ: Mirror Holder
- Ⓓ: Electrode Fixing Screws

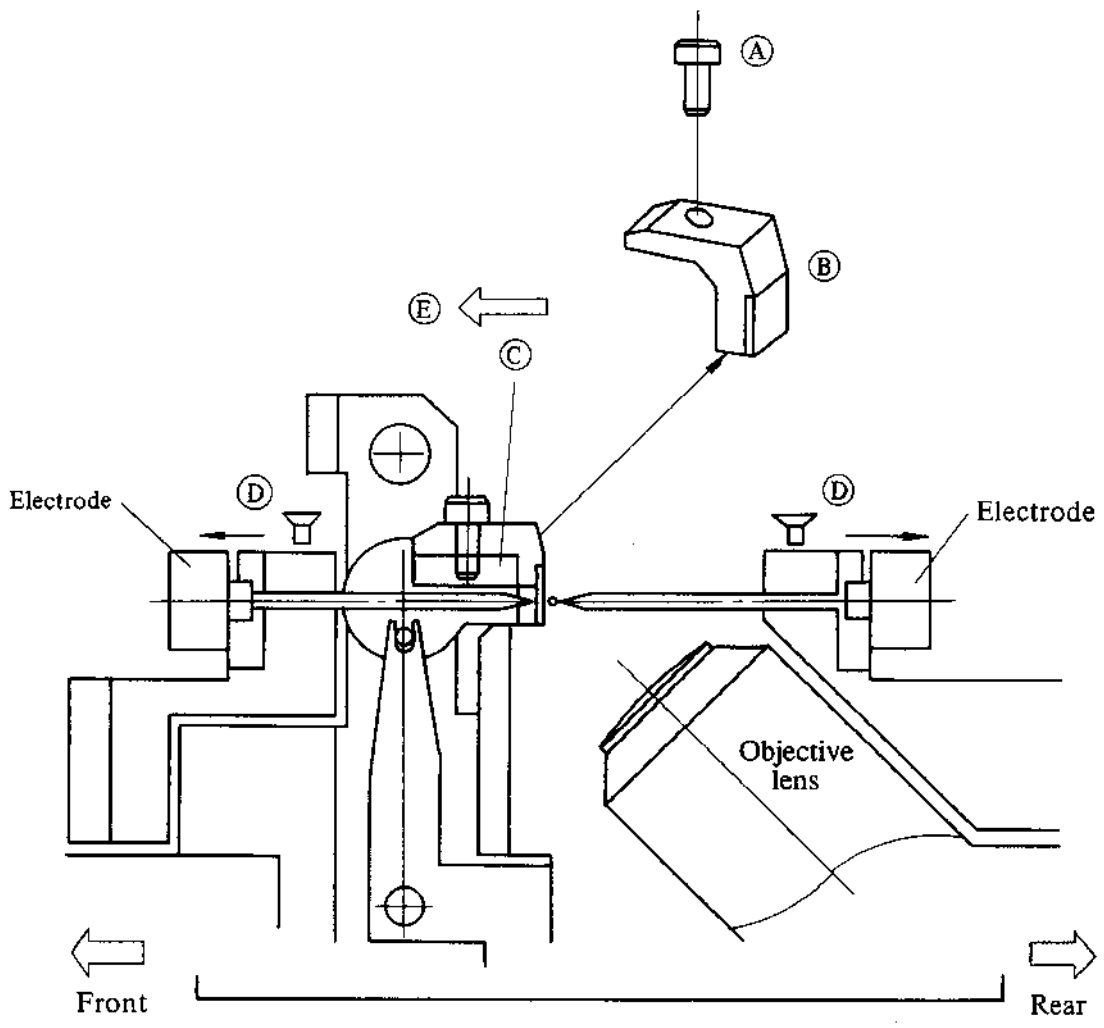


Fig. 5.4 Replacing the Up/Down Mirror

5.5 Replacing of Discharge Electrodes

Worn electrodes may cause increased splice loss and visibly bad splices.

Ensure the splicer is switched off. Remove the electrode cover, loosen the electrode fixing screws and remove the electrodes (See Fig. 5.5 below). Replace with new electrodes, keeping them firmly pressed into place while tightening the screws lightly. Take care not to damage the electrode tips through any unintentional contact. Always replace electrodes as a pair. After replacement, perform about twenty discharges to wear them in.

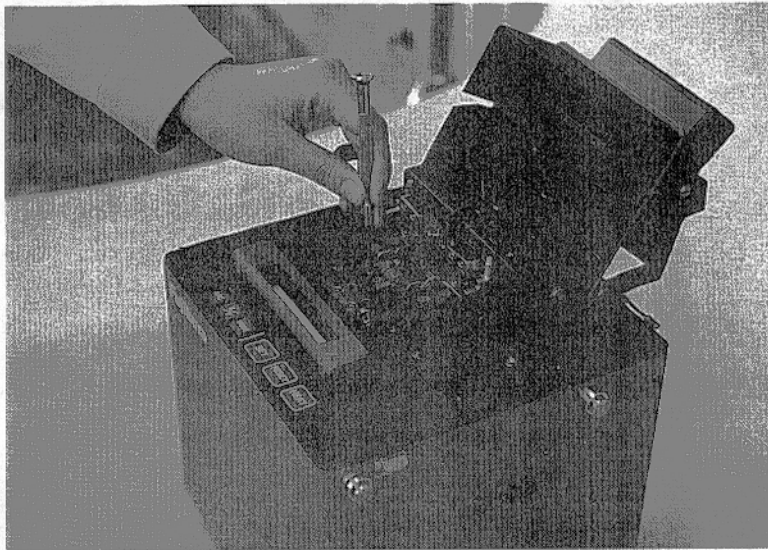


Fig. 5.5 Replacing of Discharge Electrodes

6. CAUTIONS

6.1 Notes on Use

- (1) During discharge, the electrode generates a voltage of about 4,000V. Do not touch it! Make sure to ground the splicer main body during use. If there are drops of water on the splicer main body, dry thoroughly before use.
- (2) Do not discharge while the electrodes are not in place.
- (3) When alcohol, oil (including hand grease), etc. are adhered to the electrodes, abnormal discharge occurs. However, after discharging several times, such liquids will disappear and a normal discharge will be produced.
- (4) Turn the power switch off before plugging or unplugging the power cord from the splicer main body.
- (5) Do not clean the objective lens, switches or panels with any chemical except for alcohol. Such chemicals may cause discoloration or deterioration.
- (6) Be careful not to get dust or sand on the splicer. Specifically, do not rub the V-grooves with a hard material, such as metals, because they are precisely machined.
- (7) No lubrication is needed on the splicer. Lubrication may adversely affect operation.
- (8) Precise adjustments have been made to all parts of the splicer. Do not loosen screws or make any modification (except for mirror, electrode replacement, etc.). If there is something wrong with the splicer, consult the manufacturer.

6.2 Notes on Storage and Transportation

- (1) Always use the carrying case of the splicer to prevent moisture, vibration and impact when storing and transporting the splicer.
- (2) Do not store in a place where high humidity or temperatures can be expected.

APPENDICES

AP1. REVIEW OF DIP SWITCH FUNCTIONS

This splicer has 5 Dip Switches (Dip Sw. as shown below. See Table AP 1.1 for their functions).

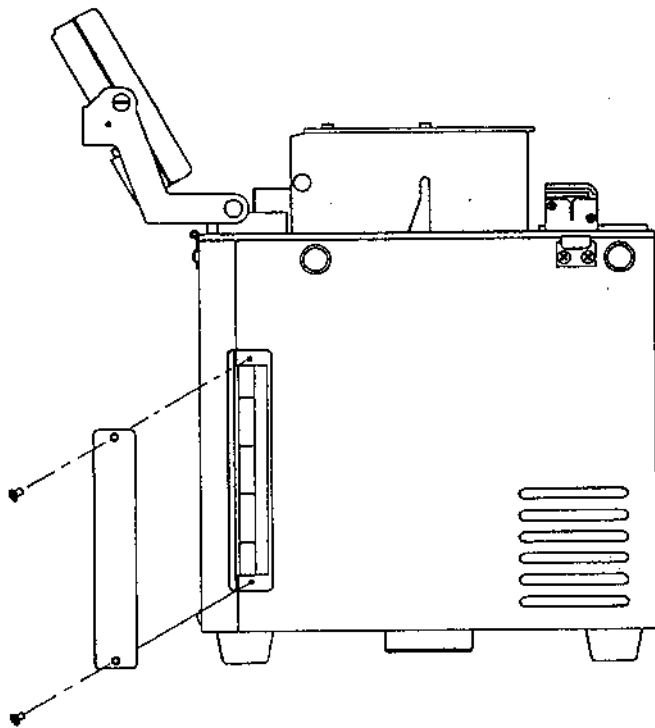


Fig. AP1.1 Dip Sw Location

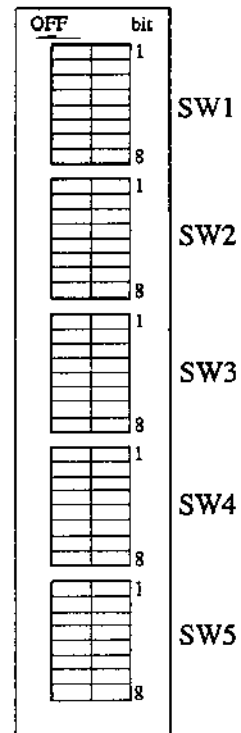


Fig. AP1.2 Dip Sw Key

Table AP1.1 Dip Switch Functions of FSM-20CS Splicer

Switch No.		Bit	Function
Dip Sw 1	LSB	1	Field change before aligning
		2	Discharge in (X) field
		3	Data transmission from splicer
		4	ECF aligning
		5	1550 nm dispersion shifted fiber
	MSB	6	Not used
Dip Sw2		8	Not used
		1	Not used
Dip Sw 3		1	Maintenance mode
		2	Not used
Dip Sw 4		8	Not used
		1	Not used
Dip Sw 5		7	Not used
		8	Data change protect

(1) Field change before aligning Dip Switch 1 Bit 1

OFF: If gap set in (X) field, the cleaved angle is checked (assuming CLEAVE ANGLE function is ON) and the aligning is performed in X. Then, X-Y field exchange occurs and the cleaved angle in Y is checked before completing the alignment.

If gap set in (Y) field, the cleaved angle is checked and then Y-X exchange occurs before continuing as above.

- ON: The procedure is the same as above except that if gap set in X, field exchange occurs, the cleaved angle is checked in Y and then the field returns to X to continue as usual.
- (2) Discharge in (X) field Dip Switch 1 Bit 2
 OFF: Discharge in (Y) field (Discharge not visible)
 ON: Discharge in (X) field (Discharge visible)
- (3) Data transmission from splicer Dip Switch 1 Bit 3
 OFF: No transmission.
 ON: The splicer transmits data (splicer states, estimated splice loss etc.) from the "SER. PORT" terminal (See Appendix AP.3.2).
- (4) ECF aligning (See Appendix AP8) Dip Switch 1 Bit 4
 OFF: Two step aligning
 ON: ECF aligning
- (5) 1550 nm dispersion shifted fiber Dip Switch 1 Bit 5
 OFF: The splicer estimates the spliced loss for a single mode fiber for 1300 nm wavelength.
 ON: The splicer estimates the spliced loss for a single mode fiber which has the zero-dispersion wavelength around 1550 nm. "1.55 um LOSS EST." is displayed on the monitor during the RESET operation.
- (6) Data change protect Dip Switch 5 Bit 8
 OFF: All keys are accepted.
 ON: CND, MOTOR, Δ (up), ∇ (down), ENT keys are not accepted. Discharge conditions cannot be changed.
 Motors cannot be operated manually.

AP2. MAINTENANCE MODE

AP2.1 Selecting Maintenance Menu

- (1) Ensure that the splicer is in its READY state.
- (2) Set Dip Switch 3 Bit 1 to ON. The maintenance menu is displayed on the monitor as shown in Fig. AP2.1 below. The cursor '*' shows the selected function.
- (3) Move the cursor to the required function by using the Δ (up) or ∇ (down) keys.
- (4) To escape from maintenance mode, turn Dip Switch 3 Bit 1 to OFF.

MAINTENANCE MODE	
* 1	ARC POWER TEST
2	ELECTRODE
3	STUFF MEASURE
4	CENTER SHIFT
5	ALL RESET
6	ARC COUNT CLEAR
7	INSPECTION
8	ENCODER
READY	SM1 (X)

Fig. AP2.1 Maintenance Mode Menu

AP2.2 Arc Power Test

The discharge power applied to each fiber can be measured from the melt amount of fiber in the 'ARC POWER TEST' mode. Judgment of the discharge power setting, good or not, is automatically performed.

Note: This is a destructive test and will require the fibers to be prepared again if they are going to be used.

- (1) Set two fibers in the splicer. Take care to get the end face angle as small as possible.
- (2) Select "1 ARC POWER TEST"
- (3) Press the "SET" or "ENT" key to start gap setting. The test is performed in (X) field.

- (4) A long discharge is applied to the fiber and the melt amounts of fibers are measured and displayed on the monitor. 'OK' is displayed when the discharge power setting is judged from the melt amount to be good. When the discharge power is too strong or too weak, "strong" or "weak" is displayed respectively. In this case, change the discharge power setting (See Section 2.1.2).

Table AP2.1 Judgment of the Discharge Power

Display	Melt amount
Strong	more than 80 μm
OK	11-80 μm
Weak	less than 11 μm

Note: The difference in melt amount, between the two fibers, should not be more than about 50 μm .

- (5) Press the "RESET" key to return to the maintenance menu.
Turn Dip Switch 3 Bit 1 OFF to return to the normal splicing mode.

AP2.3 Electrode

This mode is used to adjust the right fiber end face in line with the electrode image on the monitor.

It is for service representatives only.

AP2.4 Stuff Measure

This mode measures the left fiber stuffing amount during discharge.

Procedure is as follows.

- (1) Gap set fibers.
- (2) Select "3 STUFF MEASURE".
- (3) Press the "SET" key to start the measurement.
- (4) The stuffing amount is measured and displayed on the monitor (Factory setting is about 28 μm).

AP2.5 Center Shift

This mode is used to adjust the amount of gap set position shift on (Y) image based on (X) image. It is for service representatives only.

AP2.6 All Reset

This mode is used to return all motors to their home positions.

- (1) Select "5 ALL RESET".
- (2) Press the "SET" key to start ALL RESET mode.
- (3) The following motors move to their home positions.
 1. Focus, field motors
 2. Z axes motors
 3. Mirror motor
 4. X, Y motors.

AP2.7 Arc count clear

This function returns the arc count display to zero.

- (1) Select "6 ARC COUNT CLEAR".
- (2) Press the "ENT" key, and the arc count becomes zero displaying "ARC COUNT=0".

When you exchange the electrode, return the arc count to zero in order to keep a record of the number of discharges.

AP2.8 Inspection

This function is for service representatives only.

AP2.9 Encoder

This function is for service representatives only.

AP3. OPERATING THE EXTERNAL COMPUTER (Option)

The splicer has an RS-232C link ("SER.PORT" on the side panel) for data communication to an external computer.

The following functions are available.

- (1) The splicer transmits signals indicating in which step it is operating and indicating splice loss, etc. (See Appendix AP3.2)
- (2) Motors can be operated from the computer.
- (3) The splicer can store characters and numerals in an 18 x 10 area in the BTRAM (battery backup memory) and display them on the monitor. For example, this could be used to display a message when taking a photograph of a splice. (See Appendix AP3.4).

The optional PC-1600 portable computer is available with software for the above functions.

AP3.1 Data In/Out Terminal (RS232C)

The data In/Out terminal (SER.PORT) is a DIN 8 pin connector (DIN standard No. 45326). The pin assignment and specifications for it are shown below.

Table AP3.1 Pin Assignment of SER.PORT (DIN45326)

No.	Name	Function
1	GND	Signal ground
2	S D	Transmission data
3	R D	Receive data
4	R S	Request to send
5	C S	Clear to send
6	D R	Data set ready
7	E R	Data terminal ready
8	C D	Carrier detection

Table AP3.2 Specification of SER.PORT

Item	Description
Communication mode	Asynchronous
Baud rate	2400
Start bit length	1 bit
Data bit length	8 bit
Stop bit length	1 bit
Parity	None

- Note:
- Pin No. 4-5 and 6-7 are interconnected inside the splicer.
 - Pin No. 8 is not connected (open).

AP3.2 Data Transmission from the splicer

The splicer transmits the following data from the SER.PORT at the beginning of each step.

Table AP3.3 Data Format Transmitted by the Splicer

Data Format	Meaning
R Cr Lf	Beginning of reset operation
S Cr Lf	Beginning of gap setting
B Cr Lf	Beginning of automatic aligning
A Cr Lf	Beginning of arc fusion splice
I Cr Lf	Beginning of loss estimation
E Cr Lf	End of one splice sequence
L **.**. Cr Lf	Estimated splice loss [dB]
M *.* SP *.* Cr Lf	Core axis offset after alignment in (X) and (Y) image respectively [μm]
N *.* SP *.* Cr Lf	Core axis offset after arc fusion splice in (X) and (Y) image respectively [μm]
O *.* SP *.* Cr Lf	Fiber axis offset after alignment in (X) and (Y) image respectively [μm]
P *.* SP *.* Cr Lf	Fiber axis offset after arc fusion splice in (X) and (Y) image respectively [μm]
Enq Cr Lf (05H 0DH 0AH)	The external computer requests the splicer to resend the signal

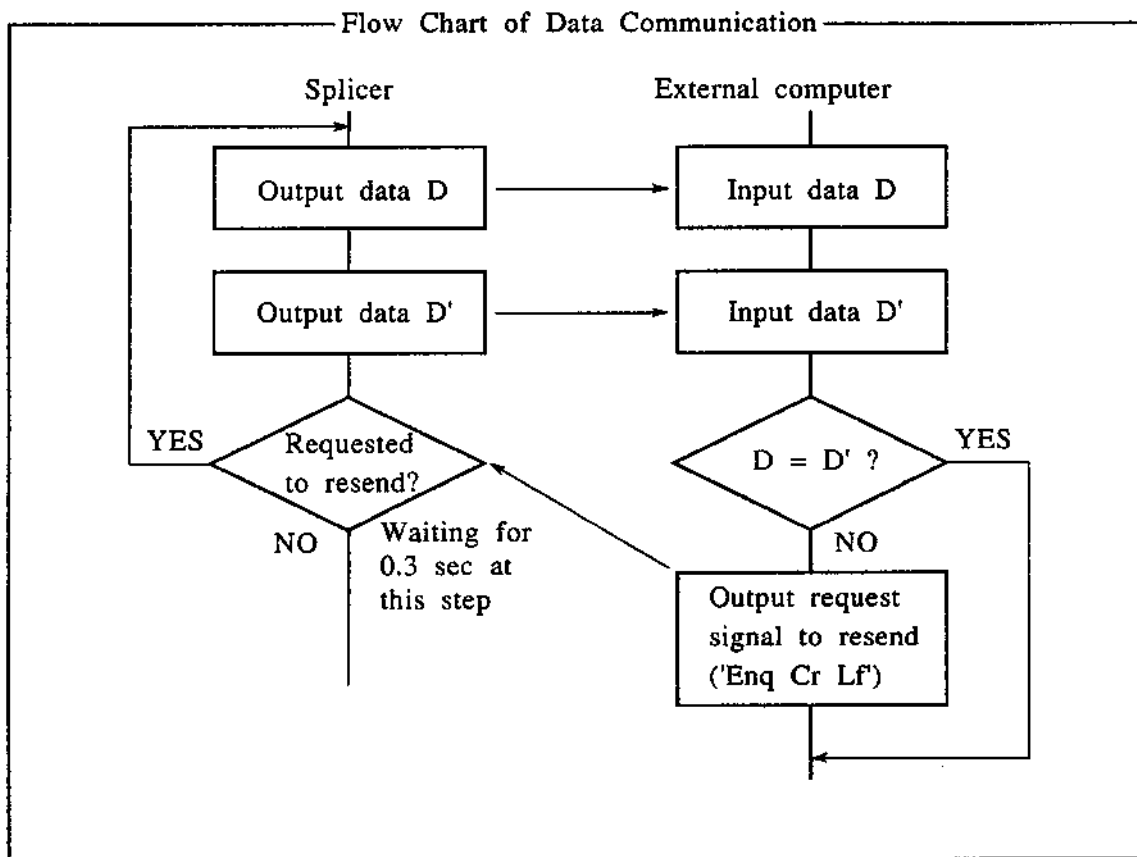
Note: 1. All characters are in the form of ASCII code (American National Standard Character for Information Interchange). *'s denote numerals.

For example,

M 0 1 . 3 SP 2 5 . 7 Cr Lf is equal to
4D 30 31 2E 33 20 32 35 2E 37 0D 0A

in HEX and it means the core axis offset in (X) is 1.3 μm and in (Y) is 25.7 μm .

2. In MM mode, the splicer does not transmit the estimated splice loss, fiber axis offset after arc fusion or core axis offset.
3. One data output of the splicer is completed by sending the same data twice.
So data communication between the splicer and the external computer has the following sequence.



The splicer waits for the request-to-resend signal for 0.3 second after sending the data twice. If the splicer receives the request-to-resend signal ten times, it neglects the signal and goes to the next step.

AP3.3 Driving Motors by External Computer

The motors can be controlled by sending the relevant ASCII commands as follows.

Table AP3.4 Commands for Manual Operation

Motor driving direction				Command characters
Move X	forward	START	X	X 8 Cr LF
		STOP		X 5 Cr Lf
	backward	START		X 2 Cr Lf
		STOP		X 1 Cr Lf
Move Y	forward	START	Y	Y 8 Cr LF
		STOP		Y 5 Cr Lf
	backward	START		Y 2 Cr Lf
		STOP		Y 1 Cr Lf
Move Z Right	forward	START	ZR	K 8 Cr Lf
		STOP		K 5 Cr Lf
	backward	START		K 2 Cr Lf
		STOP		K 1 Cr Lf
Move Z Left	forward	START	ZL	J 8 Cr Lf
		STOP		J 5 Cr Lf
	backward	START		J 2 Cr Lf
		STOP		J 1 Cr Lf
Move Focus	far	START	FOCUS	D 8 Cr LF
		STOP		D 5 Cr Lf
	near	START		D 2 Cr Lf
		STOP		D 1 Cr Lf
Move Field	up	START	FIELD	B 8 Cr LF
		STOP		B 5 Cr Lf
	down	START		B 2 Cr Lf
		STOP		B 1 Cr Lf
Move Mirror	on/off		MIRROR	E Cr Lf *1
'ARC'				A Cr Lf
'SET'				H Cr Lf
'RESET'				Z Cr Lf *2

*1 Mirror is toggled by this command.

*2 This "RESET" command is accepted by the splicer at the following machine states only (ie It is not equal to the "RESET" key).

- 1) "READY" status
- 2) Pause after "GAP SET" of fibers
- 3) After "LOSS ESTIMATION" process

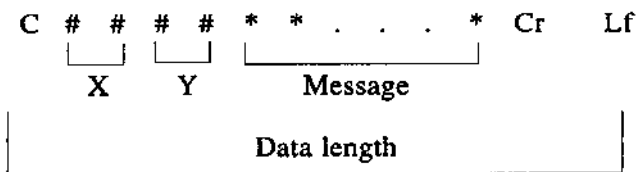
AP3.4 Message Display on the Monitor

The monitor has an 18 × 10 size message display area as shown in Fig. AP3.1.

Message display is done as follows.

- (1) To Write to BTRAM (battery backup memory)

Send data in the following format to the splicer from the external computer.



X: Displaying start address in x axis. (ASCII)

Y: Displaying start address in y axis. (ASCII)

Maximum data length is 27 character. More characters may be displayed by sending multiple messages.

The splicer receives the data only once and does not check it.

- (2) To Display on the monitor

Send "# Cr Lf" to the splicer from the external computer. The splicer displays all characters in the BTRAM display area.

- (3) To Delete the characters from the BTRAM and Monitor

Send "% Cr Lf" to the splicer from the external computer. The splicer fills up the BTRAM area with SP (20H) and displays them on the monitor.

- (4) To blank the display, keeping the message in the BTRAM, press the "RESET" key.

Example: "C0101SPliced BY FUJIKURA CrLf"

"C0503'90 APR 17th CrLf"

"#CrLf"

Produces the following.

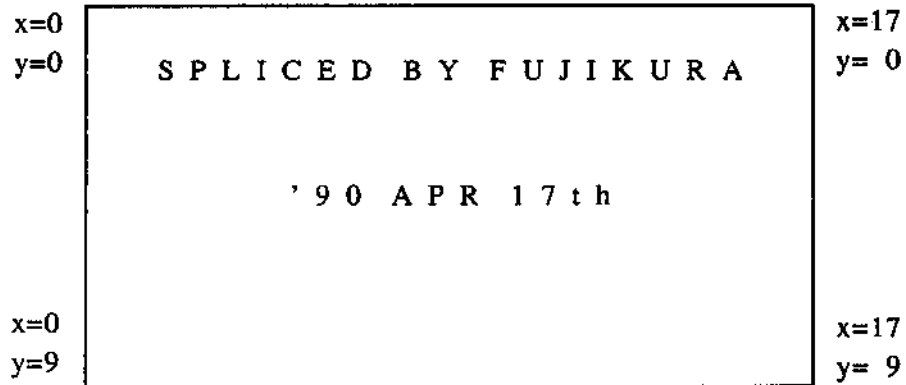


Fig. AP3.1 Message Display on the Monitor

AP4. USING EXTERNAL MONITOR

(5 inch external monitor, option)

The video signal from the VIDEO OUT terminal is NTSC, composite signal [525 scanning lines (H), 49.94Hz(V)]. The PM-580-xxx monitors supplied by Fujikura are compatible with this standard.

The monitor requires an AC power source for operation. 100V, 120V, 220V or 240V models are available on request.

Connect the VIDEO cord between the VIDEO OUT terminal and the monitor, as shown below.

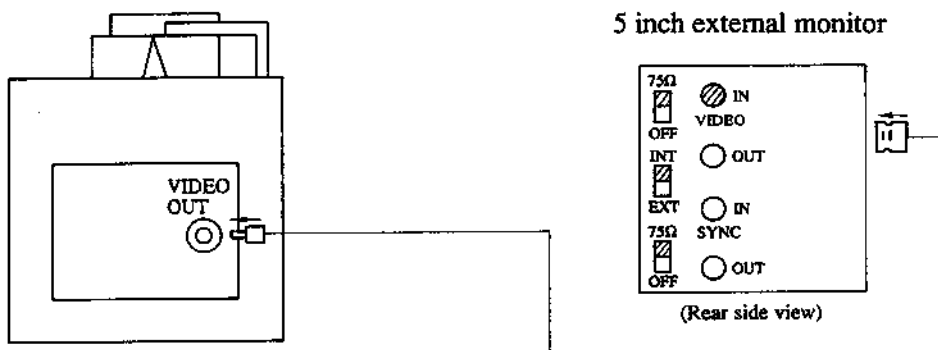


Fig. AP4.1 Connection of 5 inch Monitor to Splicer

Brightness and contrast adjustment is on the front of the monitor.

Note: Please consult the manufacturer for other types of monitors.

**AP5. INSTALLATION OF WORKING TABLE, FRONT ADAPTOR
(for Working Table or Heater), TRAY HOLDER (OPTIONS)**

AP5.1 INSTALLATION OF WORKING TABLE (OPTION)

Hang the working table on the side terminals of the splicer. (See Fig. AP5.1.)

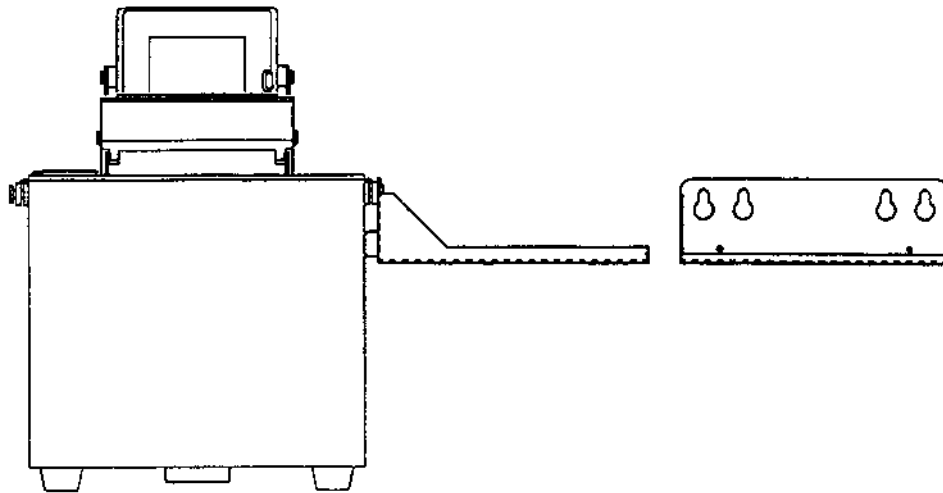


Fig. APS5.1 Installation of Working Table

AP5.2 INSTALLATION OF FRONT ADAPTOR (OPTION)

The working table or the tube heater (SH-4 ; optional accessory) can be installed in front of the splicer by using front adaptor.

Hang the front adaptor on both side terminals of the splicer. (See Fig. AP5.2.)

The working table can be installed on the side of the splicer even if the front adaptor installed.

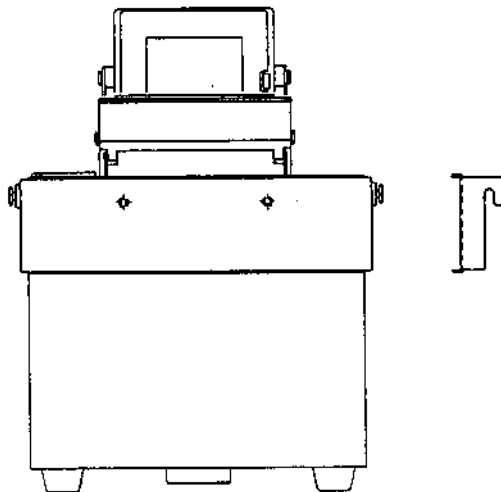


Fig. AP5.2 Installation of Front Adaptor

AP5.3 INSTALLATION OF TRAY HOLDER (OPTION)

You can install the tray holder on the back of the splicer. Tray holder has two sizes. (See Table AP5.1.)

Tray holder is fixed by butterfly screws. (See Fig. AP5.3.)

Table AP5.1 Tray Holder Types

Name	Tray Holder S	Tray Holder M
Type	THS-01	THM-01
Tray Size	85~125mm	85~160mm

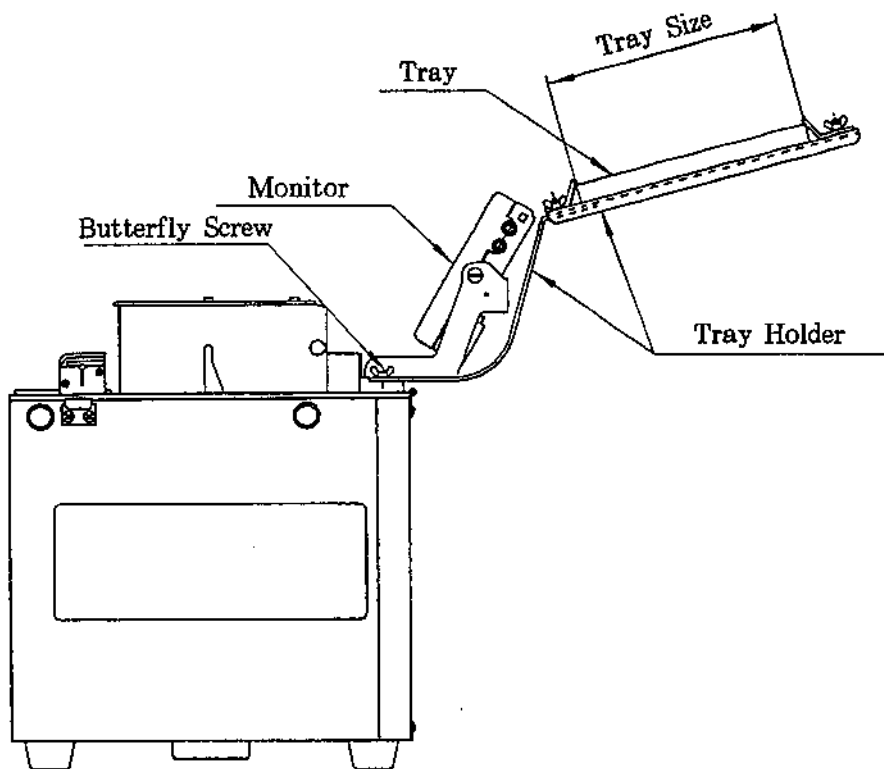
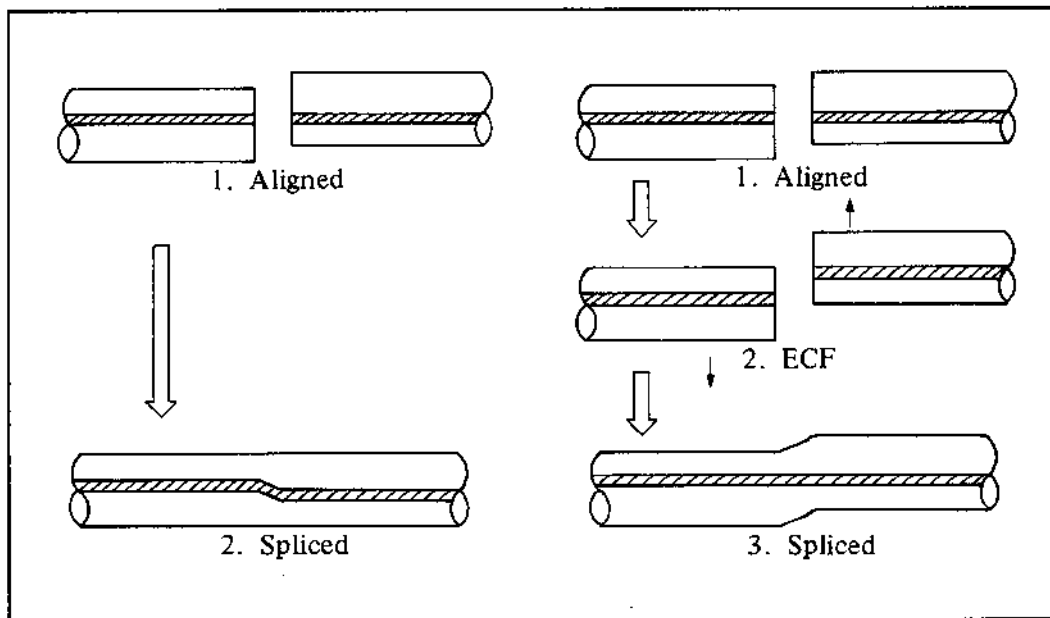


Fig. AP5.3 Installation of Tray Holder

AP6. ECCENTRICITY CORRECTION FUNCTION (ECF)

When the optical fibers are spliced, surface tension moves the fibers during discharge, so that, not the core axes but the fiber axes come to coincide. Therefore, when the fibers have large eccentricity, this produces core axes offset and, hence, large loss.

This splicer can compute the amount of surface tension movement that will occur and correct for it by an intentional offset during the alignment process.



(a) Splice without ECF

(b) Splice with ECF

Fig. Ap6.1 Effect to ECF

AP7. ADJUSTING DISCHARGE POWER

- (1) Select "DATA ON" (See Section 2.1.4) to display data during splicing, as shown below.

A		E	
B		F	
C		G	
D		H	
a_1	a_2	a_3	a_4
a'_1	a'_2	a'_3	a'_4

- A : Core axis offset after aligned in (Y) [line]
 B : Core axis offset after aligned in (X) [line]
 C : Core axis offset after spliced in (Y) [line]
 D : Core axis offset after spliced in (X) [line]
 E : Fiber axis offset after aligned in (Y) [line]
 F : Fiber axis offset after aligned in (X) [line]
 G : Fiber axis offset after spliced in (Y) [line]
 H : Fiber axis offset after spliced in (X) [line]
 $a_1 - a_4$: Eccentricity on each inspection point of left fiber [line]
 $a'_1 - a'_4$: Eccentricity on each inspection point of right fiber [line]

1 [line] = about 0.6 μm

Fig. AP7.1 Data Displayed on the Monitor during Automatic Splice

- (2) Prepare optical fiber having as largest an eccentricity as possible.
 (3) Discharge power is appropriate if the difference between E and G and the difference between F and H is within 1 line after splicing.

Discharge power is too weak if $|G| > |E|$ and $|H| > |F|$.

Discharge power is too strong if $|G| < |E|$ and $|H| < |F|$.

AP8. ECF ALIGNING MODE AND TWO STEP ALIGNING MODE

The FSM-20CS can splice single mode fiber at low loss, regardless of the core eccentricity, by adopting ECF (See Appendix AP6.). There are two ECF modes, as follows.

(1) Two step aligning mode

The fiber core is aligned first and then the fiber axis is offset according to the required ECF factor (See Section 2.1.2).

This is named "Two Step Aligning Mode".

(2) ECF aligning mode

The machine can align the fiber axis directly to the best position including the ECF offset.

Standard setting of the FSM-20CS is in ECF aligning mode.

(3) Mode selection

ECF aligning mode : Dip Switch 1 Bit 4 ON

Two step aligning mode : Dip Switch 1 Bit 4 OFF

(4) Data display on the monitor

Any data displayed on the monitor is not affected by which ECF mode is selected.

- Notes:
1. When ECF is OFF (See Section 2.1.4), the machine works without ECF.
 2. "ECF ALIGNING" is displayed on the monitor during the RESET operation when "ECF Aligning" mode is selected.

AP9. CHARACTER TABLE FOR COMMENT SETTING

△ Key

▽ Key

→

←

	!	"	#	\$	%	&	'	()	*	+	,	-	.	/
0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
P	Q	R	S	T	U	V	W	X	Y	Z	[¥]	^	-
■	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
p	q	r	s	t	u	v	w	x	y	z	←	→	↓	↑	

WARRANTY PERIOD

If your machine fails to function within one year of the date of the original purchase, the defect will be remedied free of charge. Damage due to misuse, abuse or natural causes is not covered by this warranty.

REPAIR & ADJUSTMENT

Defective machines should be returned to one of our factories which are equipped with the precise measurement and calibration equipment necessary for repairs. When shipping a machine for repairs, please include with it a description of the exact nature of the problem and inform us whether you have all necessary accessories.

Enquiries concerning products should be made to one of the following:

Fujikura Europe Ltd.,
CI Tower,
St. George's Square,
High Street,
NEW MALDEN,
Surrey KT3 1LD,
United Kingdom.
Tel. 081-336-1244
Fax. 081-336-2564
Telex 927992 FELLON G.

Alcoa-Fujikura Ltd.,
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Fax. (803) 439-5160.

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