INSTRUCTION MANUAL

ARC FUSION SPLICER

FSM-40S

Read this instruction manual carefully
before operating the equipment.

Adhere to all safety instructions and
warnings contained in this manual.

Keep this manual in a safe place.

Fujikura

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§ 1. Warnings and Cautions for Safe Operation

The FSM-40S has been developed to provide a user-friendly PAS (Profile Alignment System) for use in difficult environmental conditions associated with "field splicing". While the FSM-40S has been design to make such splicing easy to perform, it is recognized that arc fusion splicing does present some dangers. Therefore, this instruction manual includes safety requirements.

- Read this manual carefully and completely before operating the splicer.
- Adhere to all safety instructions and warnings contained in this instruction manual.
- Retain this manual for future reference.

Alert Symbols

This instruction manual indicates warnings and cautions by using alert symbols. It is important to understand the meaning of these symbols.

⚠ **WARNING**
There is a possibility of death or serious injury resulting from improper use by ignoring this indication.

⚠ **CAUTION**
There is a possibility of personal injury or physical loss resulting from improper use by ignoring this indication.

Examples of Alert Symbols

⚠ △ symbol means "Pay Attention."
This example indicates "Pay attention to explosion."

🚫 ◯ symbol means "Must not do."
This example indicates "You must not disassemble."

⬤ ● symbol means "Must do."
This example indicates "You must disconnect the AC power cord from the wall socket (outlet) or the splicer inlet."

⚠ WARNING	
🚫	Never operate the splicer in an environment where flammable liquids or vapors exist. Risk of dangerous fire or explosion may result from the electrical arc in such an environment.
🚫	Do not disassemble or modify the splicer, AC adapter, battery pack, or DC adapter. In particular, do not remove or bypass any electrical or mechanical safety device (e.g., fuse or safety switch) incorporated in this equipment. Modification could cause damage that may result in personal injury, death or electric shock or fire.
⚠ 🚫	Do not touch the electrodes when the splicer is on and power is supplied to the unit, the electrodes generate high voltage and high temperatures that may cause a severe shock or burn. Turn the splicer off, and disconnect the AC power cord, or remove the battery pack when replacing the electrodes. ↪ *Note : Opening the wind protector stops arc discharge.*
🚫	The splicer is designed to splice optical glass fibers designed for the telecommunications industry. Do not attempt to splice any materials other than the optical glass fibers.
🚫	Do not use compressed gas or canned air to clean the splicer. They may contain flammable materials that may ignite during the electrical discharge.
🥽	Safety glasses should always be worn during fiber preparation and splicing operation. Fiber fragments can be extremely dangerous if they come into contact with your eyes or skin.
❗	Use only the AC adapter / battery charger (ADC-07) with FSM-40S. · The proper supply voltage source for the ADC-07 is 100-240 VAC, 50-60Hz. Check the AC power source before use. Using an improper AC power source may cause fuming, electric shock or equipment damage and may result in personal injury, death or fire. ↪ *Note : AC generators commonly produce abnormally high AC output voltage or irregular frequencies. Measure the output AC voltage of generator by a circuit tester before connecting the AC power cord. Such abnormal high voltage or frequency from a generator may cause fuming, electric shock or equipment damage and may result in personal injury, death or fire. Make sure the generator is regularly checked and serviced.*

⚠ WARNING
Use the supplied AC power cord.   Do not place heavy objects on the AC power cord.   Do not pull, heat up or modify the AC power cord. Use of an improper cord or a damaged cord may cause fuming, electric shock or equipment damage and may result in personal injury, death or fire.
Connect the AC power cord properly to the splicer (inlet) and wall socket (outlet).   When inserting the AC plug, make sure there is no dust or dirt on the terminals.   Engage by pressing the female plug into the splicer (inlet) and the male plug into the wall socket (outlet) until both plugs are fully seated.   Incomplete engagement may cause fuming, electric shock or equipment damage and may result in personal injury, death or fire.
The FSM-40S uses a three-prong (core) AC cord that contains an earthed ground safety mechanism.   The splicer MUST be Grounded / Earthed.   Use only the supplied three-prong (core) AC power cord.   NEVER use a two-prong (core) power cord, extension cable or plug.
Use only the approved battery pack with the FSM-40S.   Only the NiMH battery pack (BTR-05) can be used as the approved battery pack.
Use the specified battery charger (ADC-07) and charger cord (DCC-08) to recharge the battery pack (BTR-05).   Using other battery chargers and charger cords may cause fuming or equipment damage and result in personal injury, death or fire.
Use the specified DC adapter (DCA-01) and DC power cord (DCC-01, DCC-04 or DCC-05) to connect an external battery. • Use an external 12 VDC battery with a capacity of 30Ah or less. Using an improper external battery may cause fuming or equipment damage and may result in personal injury, death or fire. • When replacing the DC adapter fuse, use only the specified type (time-lag type, 6.3A).   Using an improper fuse may cause fuming or equipment damage and may result in personal injury, death or fire. • Connect the red positive (+) and black negative (-) terminals of the DC power cord (DCC-05) correctly to the external battery. Improper connection may cause fuming or equipment damage and result in personal injury, death or fire. Read the DCA-01 instruction manual before using the DCA-01.

⚠ WARNING
The splicer inlet is used to disconnect the power cord in the event of a fault. Be sure to position the splicer so that the power cord can be disconnected easily and quickly.
Disconnect the AC or DC power cord from the splicer inlet or the wall socket (outlet) immediately if the splicer or the external battery emits fumes or bad smell, or becomes noisy or hot. Leaving the abnormal condition unattended will cause equipment failure, electric shock or fire and may result in personal injury, death or fire.
Disconnect the AC or DC power cord from the appliance inlet or the wall socket (outlet) if the splicer becomes damaged (e.g., by dropping). Leaving the splicer in a damaged state may cause equipment failure, electric shock or fire and may result in personal injury, death or fire.
Disconnect the AC or DC power cord from the splicer inlet or the wall socket (outlet) immediately if liquid (e.g., water) or foreign matter (e.g., screw) enters the splicer. Leaving the splicer in a damaged state may cause equipment failure, electric shock or fire and may result in personal injury, death or fire.
Do not touch the splicer, AC power cord and AC plug if your hand is wet. Possible electric shock may occur.
Do not operate the splicer if water condensation is present on surface of splicer. Possible electric shock or equipment failure may result.
Do not use the splicer near any hot equipment or in any place of high temperature. Possible equipment failure or fire may result.
Do not discard the battery pack (BTR-05) into an incinerator or fire. Possible explosion may result.
Do not short-circuit the terminals of AC adapter / battery charger (ADC-07), DC adapter (DCA-01) and battery pack (BTR-05). Excessive electrical current will cause personal injury, death or fire.
Before using the shoulder belt of carrying case, inspect the belt and hook for excessive wear or damage. Carrying the case with a damaged belt may cause it to fall and may result in personal injury or equipment damage.

⚠ CAUTION	
🚫	Do not store the splicer in any area where temperature and humidity are extremely high. Possible equipment failure may result.
⚠	Caution should be taken when removing the fiber protection sleeve from the tube heater after the heat shrink cycle is completed. The tube heater and fiber protection sleeve are HOT and should not be touched. Possible burn may result.
🚫	Do not place the splicer in an unstable or unbalanced position. The splicer may shift and lose balance, causing the unit to fall. Possible personal injury or equipment damage may result.
🚫	The splicer is precision adjusted and aligned. Do not allow the unit to receive a strong shock or impact. Possible equipment failure may result. Use the supplied fiber-reinforced plastic (FRP) carrying case to transport and store the splicer. The carrying case protects the splicer from damage, moisture, vibration and shock during storage and transportation.
❗	Keep the splicer free from sand, dust, lubricants and other contaminants. The presence of such substances may degrade the splicing performance and cause equipment failure or damage.
❗	Replace the electrodes properly. • Use only specified electrodes. • Set the new electrodes in the correct position. • Replace the electrodes as a pair. Disregard of the above instructions may cause abnormal arc discharge and result in equipment damage or degradation in splicing performance.
🚫	Do not use any chemical other than alcohol to clean the objective lens, V-groove, mirror, LCD monitor, etc., of the splicer. Otherwise, blurring, discoloration, damage or deterioration may result.
🚫	The splicer requires no lubrication. Oil or grease may degrade the splicing performance and damage the splicer.
❗	The equipment must be repaired or adjusted by a qualified technician or engineer. Incorrect repairs may cause fire or electric shock. Should any problem arise, please contact your nearest sales agency.

Fujikura Ltd. assumes no responsibility for personal injury or physical loss including equipment damage resulting from improper use or modification.

§ 2. Description of Products

§ 2.1. Product Specification

1	Applicable Fiber	Single mode and multi mode silica based optical glass fiber • Cladding diameter : 100 to 150 um • Coating diameter : 0.1 to 1.0 mm
	Cleave Length	• Coating diameter φ 0.25 mm or less : 8 to 16mm • Coating diameters greater than φ 0.25 mm : 16mm (Note 1)
2	Mean Splice Loss (Note 2)	• Single mode fiber : Typ. 0.02 dB • Dispersion shifted fiber : Typ. 0.04 dB • Multi mode fiber : Typ. 0.01 dB
	Mean Splicing Time (Note 3)	Typ. 15 seconds
	Fiber Protection Sleeve Shrinking Time (Note 4)	• 40mm/60mm sleeve : Typ. 90 seconds • Micro sleeve (Note 5) : Typ. 60 seconds
3	Dimensions	172 mm(W) / 186 mm(D) / 180 mm(H)
	Weight	4.9 kg with AC adapter / 5.2 kg with battery pack
4	AC Adapter / Battery Charger	ADC-07 with battery charge function • Input power : 100 to 240 VAC (50 to 60Hz)
	Battery Pack (Option)	BTR-05 NiMH battery • Output power : 12 VDC, 4500mAh • Number of splices made after full charge : Typ. 40 (Note 6) • Battery recharge time using ADC-07 : Typ. 3 hours
	DC Adapter (Option)	DCA-01 • Input power : 12 VDC • External battery capacity: 30Ah max.
5	Proof Test Force	• Standard spec. : Approx. 1.96N (200 gf) • Optional spec. : Approx. 4.41N (450 gf)
6	Automatic Arc Power Compensation	Automatic compensation by atmospheric pressure (maximum altitude : 3500m), temperature and humidity
	Arc Power Calibration	Automatic calibration by observing cladding axis offset surface tensions during arc discharge
	Wind Resistance	Maximum permissible wind velocity: 15 m/s

7	Type of Splice Mode	SM, DS, MM, AUTO and SPECIAL modes SPECIAL mode includes MANUAL (manual splice mode) and AT (attenuation splice mode).
	Number of Splice Modes	· User programmable : 40 modes · Fixed database : 60 modes (Max.)
	Type of Heater Mode	60mm, 40mm, 60Ny8, 40Ny8 and micro sleeves (Note 5)
	Number of Heater Modes	· User programmable : 10 modes · Fixed database : 20 modes (Max.)
	Storage of Splice Results	2000 splice results in internal memory
8	Terminals	· RS-232C serial terminal (D-sub 9-pin) · Video output terminal (RCA type, NTSC output) for maintenance use

Note 1: Coatings between φ 0.25 - 1.0 mm may be spliced with 8 - 16 mm cleave lengths with modification and optional parts (Set Plate B).

Note 2: Mean splice loss;
Data based on splicing same-type fibers having an average quality according to the ITU-T standard.

Note 3: Mean splicing time
· Length of time from the start of operation by pressing ⟨SET⟩ till the end of loss estimation.
· Applies when splicing standard SM, DS and MM fibers in the SM, DS and MM modes, respectively.

Note 4: Fiber protection sleeve shrinking time
· Length of time from the start of heating by pressing ⟨HEAT⟩ till the end of cooling.
· When heating with outside ambient temperature of 25 degrees C, using the AC adapter as power supply.

Note 5: Fujikura micro sleeves available
· FPS01-250-20, FPS01-250-25, FPS01-250-34, etc.
· The last two digits of the part number denote the sleeve length.

Note 6: Number of splices made after full charge
· Capacity based on splicing standard SM fibers, using 60mm long sleeves with a splicing cycle time of 6 minutes.
· Monitor power turn-off feature set at 20 seconds.

§ 2.2. Components of Splicer

Top Cover [TC-03A]

Working Table
[WT-5] (OPTION)
Working Table Support
[WTS-4] (OPTION)
[WTS-5] (OPTION)

J-Plate [JP-03A]
(OPTION)

Monitor Cover
[MC-01]

Arc Fusion Splicer
[FSM-40S]

AC Adapter
/ Battery Charger
[ADC-07]

Battery Pack
[BTR-05]
(OPTION)

Spare Electrodes
1 pair
[ELCT1-25]

AC Power Cord

Battery Charge Cord
[DCC-08]
(OPTION)

DC Power Cord
(OPTION)

[DCC-01]

[DCC-04]

Other Attached Items
• FRP Carrying Case
   [CC-02]
• Instruction Manual

DC Adapter [DCA-01]
(OPTION)

[DCC-05]

"OPTION" are not included as standard.

Fig. 2-1. Components of FSM-40S

§ 2.3. Other Necessary Items for Splice Operation
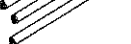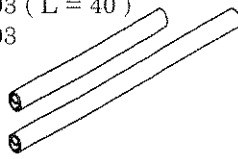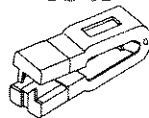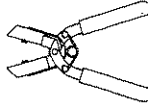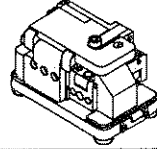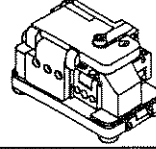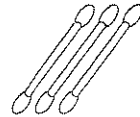
Fiber Type	UV Coating Outer Diameter φ 0.25 mm	Ny Sheath Outer Diameter φ 0.9 mm
Fiber Protection Sleeve	Fiber Protection Sleeve Micro Fiber Protection Sleeve FPS01-250-20 FPS01-250-25 FPS01-250-34	FP-03 (L = 40) FP-03
Fiber Stripping Tool	Primary Coat Stripper PS-02	Jacket Stripper JS-01

Fiber Cleaving Tool	Fiber Cleaver
	
	·CT-04
	  φ 0.25 Cleave Length :
	        6 to 20mm
		·CT-03
		  Cleave Length : 16mm
		·CT-07
		  Cleave Length
		    φ 0.25 : 6 to 20mm
		    φ 0.9 : 10 to 20mm

	Fiber Cleaver
	  Applicable for also Ti fiber
	
	·CT-104
	  φ 0.25 Cleave Length :
	        6~20mm
		·CT-103
		  Cleave Length : 16mm
		·CT-107
		  Cleave Length
		    φ 0.25 : 6 to 20mm
		    φ 0.9 : 10 to 20mm

Fiber Cleaning Tool	Alcohol (Purity : more than 99%) & Dispenser	Lint-free tissue or Gauze Thin Cotton Swab

Fig. 2-2. Other Necessary Items

§ 2.4. Description and Function of Splicer
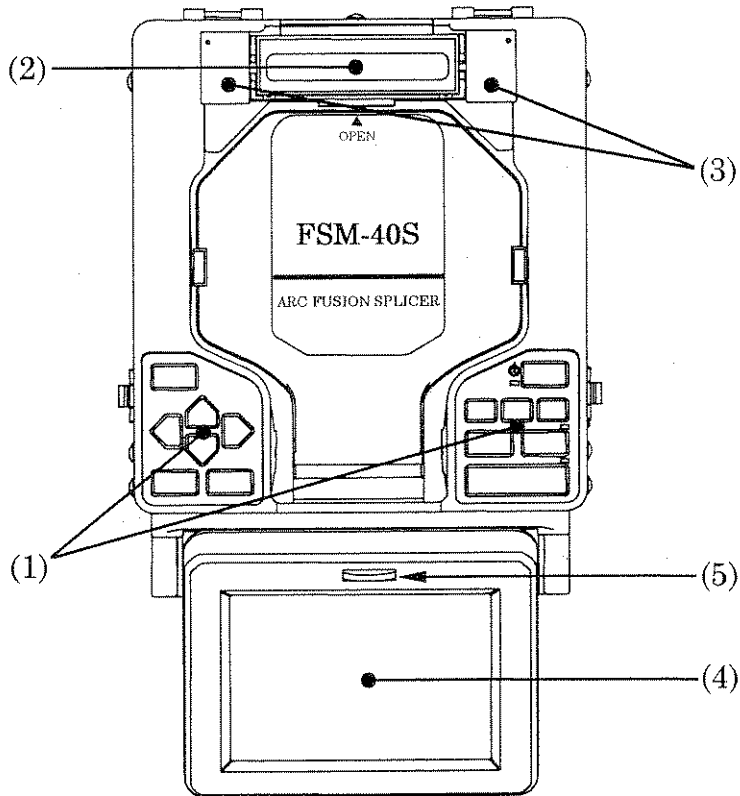
Fig. 2-3. FSM-40S Top View

No	Name	Function
(1)	Panel Keyboard	Switches to operate splicer. For details, refer to Fig. 2-6. Panel Keyboard (Page 17).
(2)	Tube Heater	Heats fiber protection sleeve.
(3)	Tube Heater Clamp	Holds fiber sheath during heating.
(4)	LCD Monitor	Displays fiber image, operating condition, measurement results, etc.
(5)	Brightness Control	Controls brightness of LCD monitor.
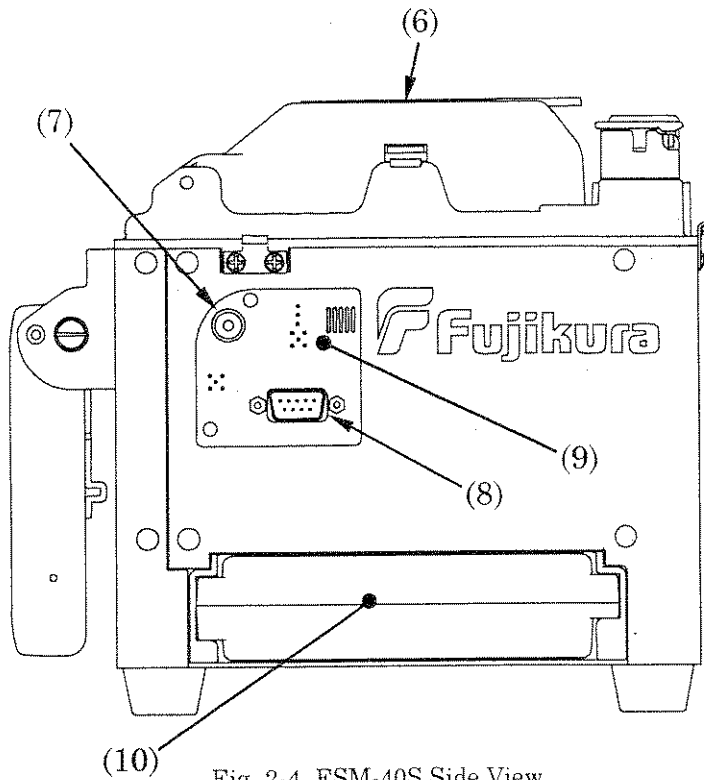
Fig. 2-4. FSM-40S Side View

No	Name	Function
(6)	Wind Protector	Provides protection against abnormal arc discharge due to wind.
(7)	Video Output Terminal	For a maintenance use. Connector is an RCA type, and image signal is NTSC.
(8)	Serial Port	Connects to PC. Connector is a D-Sub 9-pin type, and telecommunication system is RS-232C.
(9)	Sensors	Arc discharge atmospheric compensation provided by temperature, humidity and pressure sensors.
(10)	Power Unit Dock	Area in which to install AC adapter, battery pack or DC adapter.
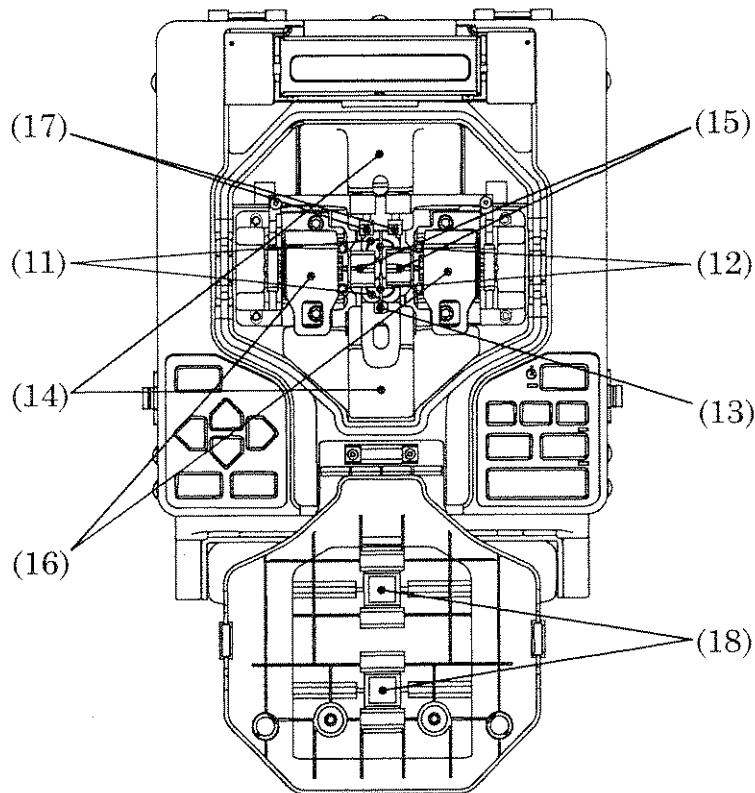
Fig. 2-5. Fiber Splicing Area

No	Name	Function
(11)	Objective Lens	Lens to observe fibers.
(12)	Electrode	Electrode used with arc discharge. Replacement recommended after 1,000 arc discharges.
(13)	Illumination Lamp	Illuminates vicinity of splice. Light turns on only when wind protector is opened.
(14)	Electrode Cover	Safety cover for electrode fixture. Must be installed.
(15)	V-groove	For X and Y alignments of fibers.
(16)	Sheath Clamp	Holds fiber sheath.
(17)	Fiber Clamp	Secures the bare fiber into bottom of V-groove.
(18)	Wind Protector Mirror	Reflects illumination light to observe the fiber.
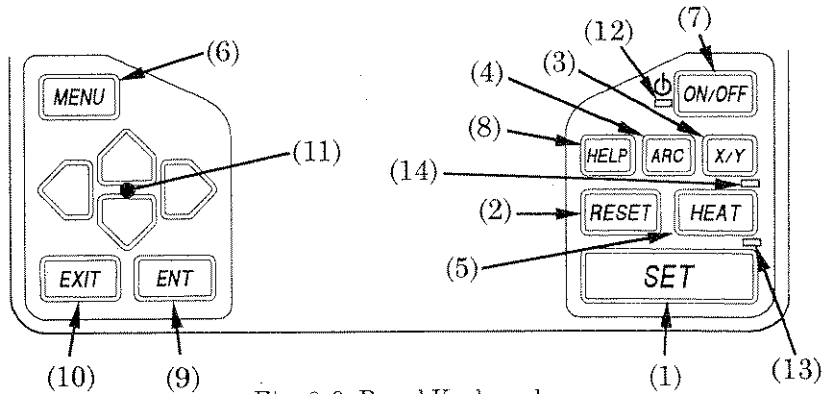
Fig. 2-6. Panel Keyboard

No	Name	Function
(1)	⟨SET⟩	Starts splicing operation. This key is also used to cancel monitor power saving state.
(2)	⟨RESET⟩	Returns system to [READY] state from any state. ⇨ Note : It does not control tube heater.
(3)	⟨X/Y⟩	Selects frame image display, X-direction enlarged, Y-direction enlarged or X-Y direction composite image.
(4)	⟨ARC⟩	Executes re-arc discharge at end of splicing.
(5)	⟨HEAT⟩	Starts tube heater temperature cycle.
(6)	⟨MENU⟩	Opens [Main Menu] screen.
(7)	⟨ON/OFF⟩	Turns power on and off. To turn off power, press and hold key till the LED color will change from green to red.
(8)	⟨HELP⟩	Displays [HELP] screen.
(9)	⟨ENT⟩	Executes or selects command or parameter on menu screen.
(10)	⟨EXIT⟩	Returns system to previous menu screen.
(11)	Direction Keys	⟨▲⟩ ⟨▼⟩ : Used to move cursor or change parameters. ⟨◄⟩ ⟨►⟩ : Used to change pages.
(12)	Power LED	LED illuminates green when power is on, and red when ready to turn off power.
(13)	SET LED	LED illuminates during splicing operation and blinks when monitor is in power saving state.
(14)	HEAT LED	LED illuminates during tube heater heating and blinks during cooling.

§ 3. Outline of Splicing Operation

STEP 1   Inserting Power supply into splicer

- Using AC Power Source
  Insert the AC adapter (ADC-07) into the splicer's power unit dock, and
  connect the AC power cord.
- Using Battery Pack
  Insert the battery pack (BTR-05) into the splicer's power unit dock.
- Using External Battery
  Insert the DC adapter (DCA-01) into the splicer's power unit dock, and
  connect it to the external battery with the DC power cord.

STEP 2   Turn on the splicer power.

Pressing ⟨ON/OFF⟩ turns on the power
to the splicer and displays [Power-On
Menu].
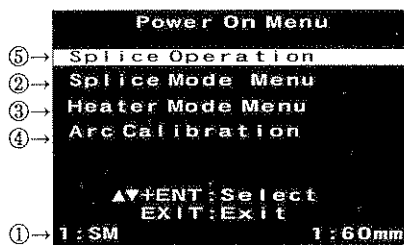
① Current selected modes displayed.
- 1:SM   : [Splice Mode](Fiber Type)
- 1:60mm : [Heater Mode](Sleeve Type)

⑤→ Splice Operation
②→ Splice Mode Menu
③→ Heater Mode Menu
④→ Arc Calibration

▲▼+ENT:Select
EXIT:Exit
①→ 1:SM   1:60mm

Fig. 3-1. Power On Menu

②/③ "Splice Mode" and "Heater Mode"
    menus to select and edit splice and heater modes.

④ Arc calibration command to calibrate the arc power.   To obtain good
    splicing quality, perform the calibration before each splicing session.

⑤ Pressing ⟨ENT⟩ displays [READY] screen.   Pressing ⟨EXIT⟩ or ⟨SET⟩
    on any cursor position also displays [READY] screen.
    ⇨ Note : To select [Power-On Menu] as non-displayable and display
           [READY] screen when the power is turned on, refer to § 6.6.3
           (Page 105).

STEP 3   Fiber stripping
(1) Clean the fiber outer coating approx. 100 mm in length from the fiber
    end with alcohol-impregnated lint-free tissue or gauze.
(2) Pass the fiber through the fiber protection sleeve.
(3) Remove the fiber coating 30-40 mm with a stripping tool.
    ⇨ Check : After this operation, handle the fiber so as not to damage its
           bare glass.

(4) Clean the bare part of the fiber with another alcohol-impregnated lint-free tissue or gauze.
  ⇨ *Check : After this operation, handle the fiber so as not to damage its bare glass.*
  ⇨ *Check : Use a high-quality alcohol, greater than 99% pure.*
  ⇨ *Check : Change lint-free tissue or gauze each time.*
(5) Cleave the fiber with a fiber cleaver.
  ⇨ *Note : The cleave length is 8-16 mm for φ 0.25 mm coated fiber and 16 mm for φ 0.9 mm coated fiber.*
  ⇨ *Note : Do not clean the fiber after cleaving.*

STEP 4   Set the fiber in the splicer.
(1) Gently set the stripped fiber in the V-groove.
  ⇨ *Check : Set the fiber end-face between the V-groove tip and electrode center line.*
(2) Gently close the sheath clamp and then the fiber clamp.
(3) Close the wind protector.

STEP 5   Splicing operation
  Press ⟨SET⟩ to start splicing.   Refer to next page.

STEP 6   Fiber removal
(1) Open the wind protector
(2) Open the left sheath clamp (which also opens the fiber clamp), holding the left fiber in your left hand.   Then, open the right sheath clamp.
(3) Remove the right fiber from the splicer, holding it in your right hand.

STEP 7   Reinforce the splice.
(1) Slide the fiber protection sleeve to the center of the splice and move it to the tube heater.
  ⇨ *Check : Make sure the splice point and fiber protection sleeve are in the center of the tube heater.*
  ⇨ *Check : Make sure the reinforcing material is placed downward.*
  ⇨ *Check : Make sure the fiber is not twisted.*
(2) While applying tension to the fiber, lower the fiber into the tube heater, the left tube heater clamp will close automatically.
(3) With tension still applied to fiber, close the right tube heater clamp with your left hand.
(4) Press ⟨HEAT⟩ to start tube-heating cycle.

Fig. 3-2. Splicing Process (1)

Pause1 : ON

PAUSE1

L:2.1°   R:1.1°

X

Y

HELP:How to Operate

⟨SET⟩

⟨HELP⟩

PAUSE1

SET	Continue
X/Y	View Change
ARC	Arc (No Align)
MENU	Main Menu
RESET	Cancel Splice

1:SM
Standard SM
1:60mm FP-03
Cleave Limit:3.0°

HELP:Show Fiber Image

⟨SET⟩

ALIGNING

Y

1:SM   1:60mm

Pause 2 : ON

PAUSE2

SET	Continue
X/Y	View Change
MENU	Main Menu
RESET	Cancel Splice

1:SM
Standard SM
1:60mm FP-03
Cleave Limit:3.0°

HELP:Show Fiber Image

⟨HELP⟩

PAUSE2

L:2.1°   R:1.1°

X

Y

HELP:How to Operate

⟨SET⟩

⟨SET⟩

ARC ## 158

Y

1:SM   1:60mm

Fig. 3-3. Splicing Process (2)

§ 4. Detail of Splicing Operation

§ 4.1. Preparations before Splicing Operation

Prepare necessary items, referring to Fig. 2-1 & Fig. 2-2 (Page 12).

§ 4.2. Inserting Power Supply into Splicer

Several options exist for supplying power to the FSM-40S, an AC power source (ADC-07), battery pack (BTR-05), or an external battery using the DC adapter (DCA-01) can be used.

⇨ *Warning : Follow safety instructions, refer to the warnings given in § 1 (Page 5) without fail.*

§ 4.2.1. Using AC Power Source

To operate the splicer from an AC power source, use the AC adapter (ADC-07) and the attached AC power cord.

(1) Confirmation before operation

⇨ *Check : Make sure the power source is 100-240 VAC, 50 to 60Hz. When connecting to an AC generator, always check the output voltage of the generator with a circuit tester before connecting the AC power cord.*

⇨ *Check : Make sure the AC power cord is free from damage, etc.*

(2) Inserting the AC adapter

Insert the AC adapter into the power unit dock until it clicks into place.

(3) Connecting the AC power cord to the splicer

Plug the AC power cord into the AC adapter inlet. Make sure plug is fully seated and in the correct position.

(4) Connecting the AC power cord to the AC power source

Plug the AC power cord into the wall socket (outlet). Make sure plug is fully seated and in the correct position. When power is supplied to the AC adapter, the LED illuminates green on the AC adapter.

✐ Note : The FSM-40S can automatically identify the type of power supply being used. When using the AC adapter, the battery indicator will not be displayed on [READY] screen, and the power saving function does not work. For information on how to set the automatic power identification function, battery indicator and power saving function, refer to § 6.6.2 (Page 102).

✐ Note : During extended operation using the AC adapter, the surface of the AC adapter becomes hot. This is not probleme and will not result in any loss of performance.

§ 4.2.2. Removal of Power Supply Unit

(1) Confirmation before operation

✐ Check : Turn off the splicer power.

✐ Check : When the AC adapter is used, remove the AC power cord.

(2) How to remove the power supply unit
① Press and hold the RELEASE button on the rear bottom of the splicer.
② While holding the RELEASE button down, push the EJECT button at the bottom left of the splicer to push out the power supply unit.
③ Remove the power supply unit with your hand.
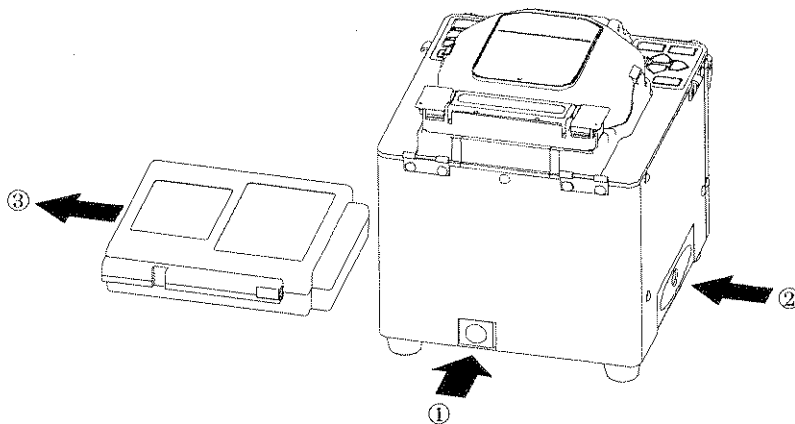
Fig. 4-1. Removing Power Supply Unit

§ 4.2.3. Using Battery Pack

Use of the NiMH battery pack (BTR-05).

(1) Confirmation before operation

⇨ *Check : If battery pack has been in storage for an extended period, discharge and recharge it before operation.*

⇨ *Note : In order to preserve battery life, it is necessary to enable the power saving function.*

(2) Inserting the battery pack

Insert the battery pack into the power unit dock until it clicks into place.

(3) Confirming the remaining battery capacity

Confirm the remaining battery capacity by the battery indicator displayed at the lower left on [READY] screen. The length and color of the bar in the battery mark shows the remaining battery capacity.

Bar Color	Bar Length	Battery State
BLUE	4 / 4	Full
GREEN	3 / 4	Less than 3/4
GREEN	2 / 4	Less than half
YELLOW	1 / 4	Less than 1/4 (Recharge required)

⇨ *Note :The battery indicator does not indicate the true value of remaining capacity, but serves as a reference only.*

⇨ *Note : The FSM-40S automatically identifies the type of power supply being used. When the battery pack is installed, the battery indicator is displayed on [READY] screen, and the power saving function works automatically. For information on how to set the automatic power identification function, battery indicator and power saving function, refer to § 6.6.2 (Page 102).*

(4) Decrease in battery capacity

① When the battery capacity runs low, the error message "Low Battery" is displayed. Turn off the power and replace the battery pack with a new one.

② Before the battery capacity reaches zero, the splicer automatically turns off the power supply.

(5) Charging the battery pack

① Connect the battery pack (BTR-05) and AC adapter / battery charger (ADC-07) with the charger cord (DCC-08).

⇨ Note : The charger cord has two different connecting ends, battery side and charger side, ensure proper connections.

② Plug the AC power cord into the AC adapter inlet fully.

③ Plug the AC power cord into the wall socket (outlet) fully.

④ When power is supplied to the battery charger, the charger's LED illuminates green, and the "charge" LED illuminates orange, indicating the start of charging. Though charging time varies depending upon remaining capacity of the battery pack, it normally takes approximately two hours to complete charging. Upon completion of charging, the "charge" LED turns off.
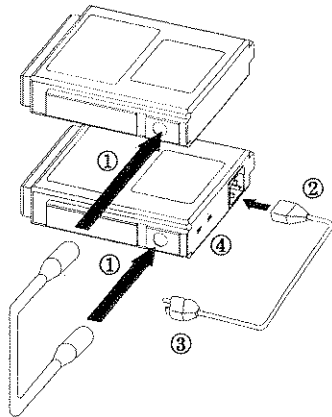
Fig. 4-2. Charging Battery Pack

⇨ Note : When the "CHARGE" lamp blinks, there is a possibility of the battery pack being abnormal or having reached the end of its service life. Replace it with a new one.

⇨ Note : If three hours or more have passed from the start of charging, but charging is not complete or if the "CHARGE" LED does not illuminate, there is a possibility the battery pack may be damaged. Stop charging and contact your nearest sales agency.

⇨ Note : To prevent degradation of the battery pack (due to the memory effect), fully discharge the battery at least once a month. Refer to § 5.2.5 (Page 55).

§ 4.2.4. Using External Battery

Use of the DC adapter (DCA-01) and DC power cord (DCC-01, DCC-04 or DCC-05) to power the splicer by an external battery.

(1) Confirmation before operation

⇨ *Check : Make sure the voltage of the external battery is 12 VDC and the capacity is 30 Ah or less.*

(2) Connection to the external battery

① **Connection to a external battery**

Using the DC power cord (DCC-05), connect the DCA-01 to the external battery as shown below.

RED   BLACK

Battery   DCC-05   DCA-01
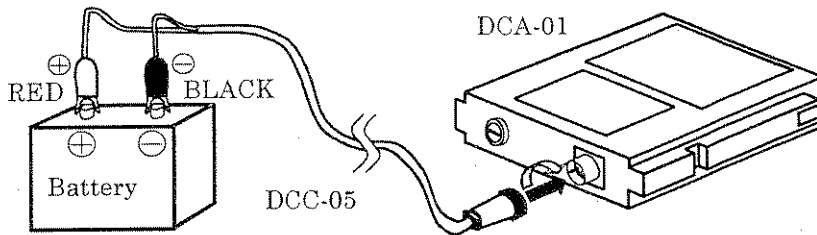
Fig. 4-3. Connecting DCA-01 to External Battery

⇨ *Check : Properly connect the red positive (+) and black negative (-) terminals of the DCC-05 to the external battery. Improper connection may cause fuming or equipment damage and may result in personal injury, death or fire.*

② Connection to a cigarette lighter socket

Using the DC power cord (DCC-04), connect the DCA-01 to the cigarette lighter socket as shown below.
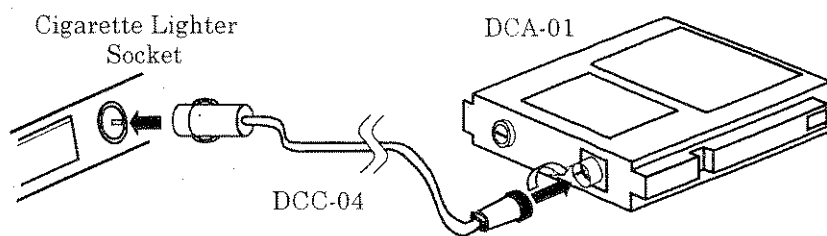
Fig. 4-4. Connecting DCA-01 to Cigarette Lighter Socket

(3) Inserting the DC adapter

Insert the battery pack into the power unit dock until it clicks into place.

(4) Confirming the remaining battery capacity

The battery indicator is calibrated to be use with the internal NiMH (BTR-05) battery. Depending on the type of the external battery connected, indicator reading may become noticeably incorrect. In this case, it may be convenient to use the input voltage display function of the splicer. Refer to § 6.6.1 "Sensor Values" (Page 100).

➪ Note : The FSM-40S automatically identifies the type of power supply being used. When the external battery is installed, the battery indicator is displayed on [READY] screen, and the power saving function works automatically. For information on how to set the automatic power identification function, battery indicator and power saving function, refer to § 6.6.2 (Page 102).

(5) Incorrect Connection

If DC adapter fuse blows, always replace the fuse with the specified type (time lag type, 6.3A). Do not use substitute.

§ 4.3. Turning On Splicer Power

➯ *Check : To obtain a good splicing quality, perform the cleaning and checking procedures before beginning splicing operation. Refer to § 5.1 (Page 42).*

§ 4.3.1. Power-On

Pressing 〈ON/OFF〉 turns on the power and displays [Power-On Menu].

➯ *Check : If condensation is present on the surface of the splicer due to temperature difference between the splicer and the atmosphere, allow the splicer to run for at least 10 minutes.*

➯ *Note : To select [Power-On Menu] as non-displayable and display [READY] screen when the power is turned on, refer to § 6.6.3 (Page 105).*

➯ *Note : Power-on dust check function is available. For information on how to set this function, refer § 6.6.3 (Page 105).*

§ 4.3.2. Power-On Menu

① Current selected modes.
  · 1:SM   : [Splice Mode]
           (Fiber Type)
  · 1:60mm : [Heater Mode]
           (Sleeve Type)
To change the splice mode and the heater mode, proceed to steps ②/③, respectively.

```
        Power On Menu
⑤→  Splice Operation
②→  Splice Mode Menu
③→  Heater Mode Menu
④→  Arc Calibration

    ▲▼+ENT:Select
      EXIT:Exit
①→ 1:SM              1:60mm
```

Fig. 4-5. Power-On Menu

② [Splice Mode Menu] to select and edit splice modes.

➯ *Note : For types of splice modes (including the AUTO mode), refer to § 6.2 (Page 58).*

③ [Heater Mode Menu] to select and edit heater modes.

➯ *Note : For types of heater modes, refer to § 6.3 (Page 88).*

④ [Arc Calibration] command to calibrate the arc power. To obtain good splicing quality, perform the calibration before each splicing session.

➯ *Note : For details of [Arc Calibration], refer to § 5.1.5 (Page 47).*

⑤ Splice operation command. Press 〈ENT〉 or 〈SET〉 when the cursor highlights this position, the splicer proceeds to [READY] screen.

§ 4.3.3. READY Screen
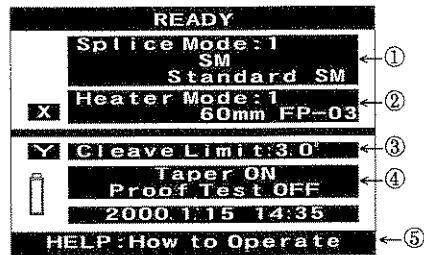
Fig. 4-6. READY Screen

① Currently selected splice mode
   To change the splice mode, press 《MENU》 to open [Main Menu] screen.

② Currently selected heater mode
   To change the heater mode, press 《MENU》 to open [Main Menu] screen.

③ Currently set threshold for cleave angle error

   ⇨ Note : The [Splice Mode Edit] function allows the operator to change the threshold for cleave angle error and the threshold for loss error. Setting these values strictly may improve the splicing quality, however errors are more likely to occur, resulting in a lower splicing yield (probability of success). For information on how to set this function, refer to § 6.2.2 (Page 61).

④ Warning display area
   Section displays critical menu chosen selections. As an example, if the taper function is set to "ON" and the tensile test (proof test) function is "OFF". Fiber breakage may occur due to the taper reducing the fiber-cladding diameter. The no proof test may cause also fibre breakage after the installation.

   ⇨ Note : To change the settings, refer to § 6.6.1 (Page 100) for the proof test, and § 6.2.4 (Page 67) for the taper splice.

⑤ Pressing 《HELP》 displays the instructions for key operation.

   ⇨ Note : Press 《HELP》 when an error has occurred, and a measure or next key operation will be given.

§ 4.4. Fiber Stripping Operation

§ 4.4.1. Cleaning the Outer Coating

Clean the fiber outer coating approx. 100 mm in length from the fiber end with alcohol-impregnated gauze or lint-free tissue. If dust or other impurities on the outer coating enter the fiber protection sleeve, burnout or breaking of fiber may result after completion of installation.

§ 4.4.2. Passing through Fiber Protection Sleeve

Pass one fiber through the fiber protection sleeve.

Pass Fiber

Fiber Protection Sleeve

Fiber   Tension Member
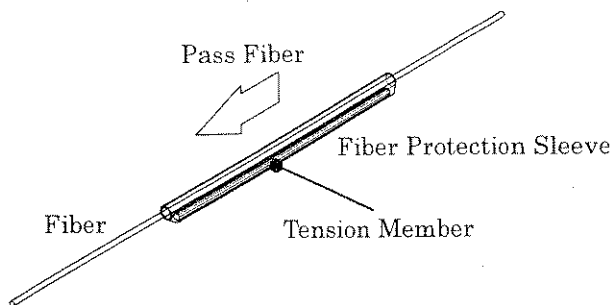
Fig. 4-7. Setting Fiber Protection Sleeve

§ 4.4.3. Stripping and Cleaning

(1) Remove the fiber coating 30-40 mm with a stripping tool.

> ⇨ *Check : After this operation, handle the fiber so as not to damage its bare glass.*

(2) Clean the bare part of the fiber with another alcohol-impregnated gauze or lint-free tissue.

> ⇨ *Check : After this operation, handle the fiber so as not to damage its bare glass.*
> ⇨ *Check : Use a high quality alcohol, greater than 99% pure.*
> ⇨ *Check : Change gauze or lint-free tissue each time.*

§ 4.4.4. Fiber Cleaving

Follow the operating steps listed on the cleaver (① clamp, ② blade unit and ③ cleave button).

(1) Open ① clamp and raise up ③ cleave button.

(2) Slide ② blade unit in the opposite direction as the arrow indicates.

(3) Set the fiber in the adapter.

⇨ Note : The cleave length is 8-16 mm for φ 0.25 mm coated fiber and 16 mm for φ 0.9 mm coated fiber.
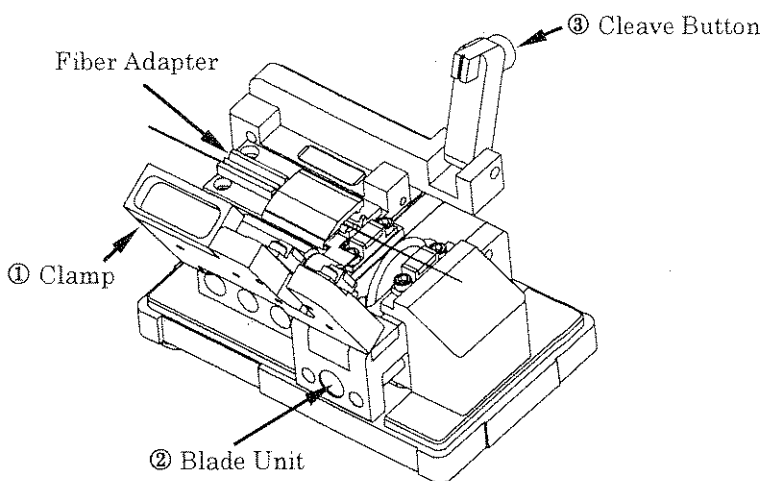
Fig. 4-8. Setting Fiber

(4) Gently close ① clamp until it clicks into place.

(5) Gently move ② blade unit forward and fully in the direction of the arrow, holding it between thumb and index finger.
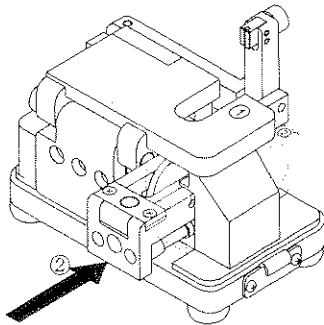
Fig. 4-9. Moving Blade Unit

(6) Lower, then press down ③ cleave button until ① clamp opens.
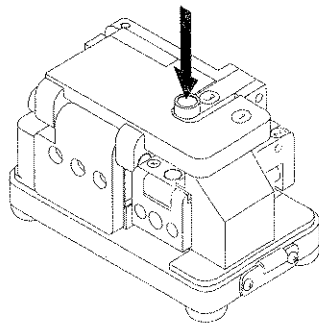
Fig. 4-10. Handling Cleave Button

(7) Raise up ③ cleave button and open ① clamp, then remove the fiber from the adapter.

↪ *Note : Very important to keep fiber end-face extremely clean and defect free. Move fiber immediately to splicing machine and avoid any contact with the fiber end-face.*

(8) Remove and discard fiber fragments and put into a proper disposal container.
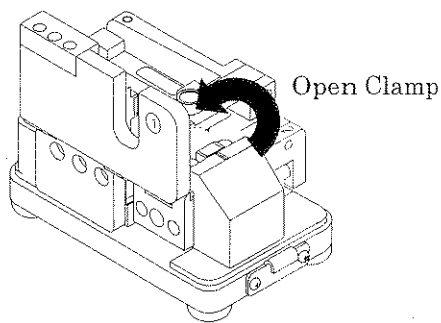
Fig. 4-11. Fiber Removal

§ 4.5. Setting Fibers in Splicer

(1) Open the wind protector.

(2) Open the left and right sheath clamps. Lifting the sheath clamps also opens the fiber clamps.

(3) Place fiber in the V-groove.

⇒ *Check : Make sure the fiber is not twisted when setting it into the splicer.*

⇒ *Check : If the fiber coating has curl memory, or bend memory , load the fiber in such a manner that the crown (curve) of the memory is turn upward.*

⇒ *Check : Care should be taken to prevent damage or contamination of the fiber end-face. Fiber end-face contact on ANY item including V-groove bottom may result in poor quality splices.*
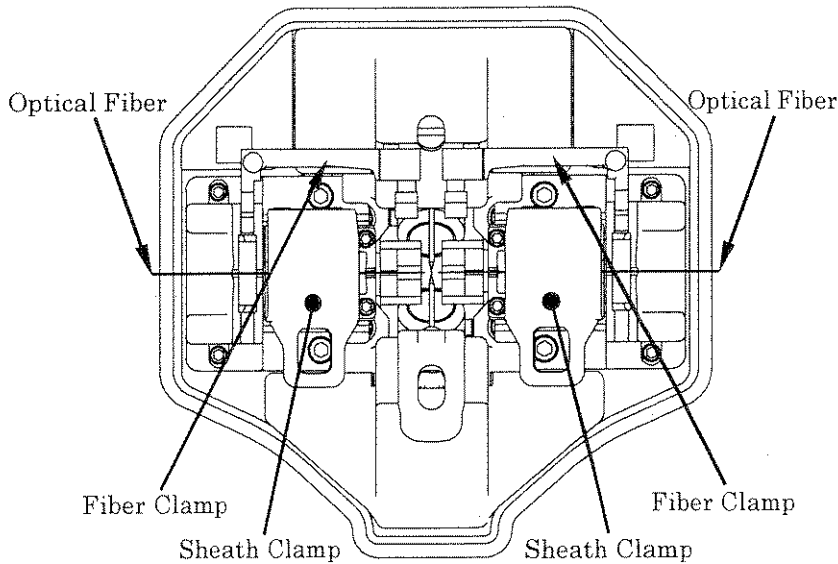
Fig. 4-12. Setting Fibers

(4) Gently close the sheath clamp while holding the fiber.

> ⇨ *Check : Observe fiber setting in the V-groove. The fiber should rest in the bottom of the V-groove. Reload fiber if it does not rest properly.*

> ⇨ *Check : Fiber end-face should rest between the V-groove tip and electrode centerline. It is unnecessary that the fiber end-face be exactly at the midpoint.*

(5) Repeat steps (3) and (4) for second fiber.

(6) Gently close the left and right fiber clamps.

(7) Close the wind protector.

§ 4.6. Splicing Operation

The FSM-40S uses image processing to identify abnormal conditions that sometimes occur during the splicing process. A small portion of these defects sometimes goes undetected and a poor quality splice occurs. Visually inspect the fiber image on the monitor to confirm acceptance or rejection during the various stages of the splicing process.

(1) Start of splicing

Pressing <SET> moves the left and right fibers forward. After completion of cleaning arc discharge, the fibers stop at the predetermined position.

➪ *Note : When the fibers are moving forward and they appear to hop up and down, contamination may be present in the V-grooves or the fiber surface. Clean the V-grooves and redo fiber preparation.*

(2) Cleave angle measurement and alignment operation

The splicer will measure each fiber's cleave angle and aligns the fibers together in the X-axis and the Y-axis.

➪ *Note : In the [Utility Menu] of § 6.6.1 (Page 100),*
PAUSE1-ON: Splicer will pause after cleave angle measurement.
PAUSE2-ON: Splicer will pause after alignment.

Visually examine the condition of the fiber end-face while the splicer is in operation or at a pause.

➪ *Check : Even if no cleave angle error is displayed, press <RESET> and redo fiber preparation if the following cases occur:*
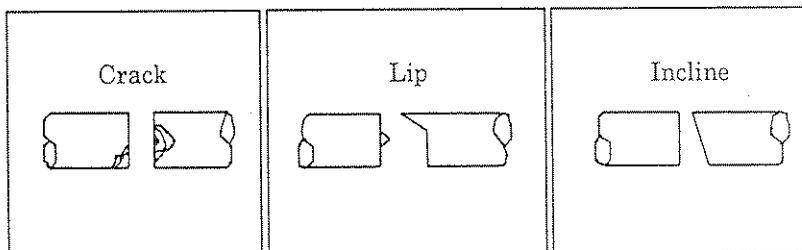
Fig. 4-13. State of Fiber End-face

When the threshold of cleave angle error is exceeded an audible alarm sounds and an error message is displayed.   By pressing 〈HELP〉, confirm the threshold of cleave angle error.

Left Cleave Angle   Right Cleave Angle

Threshold of Cleave Angle Error
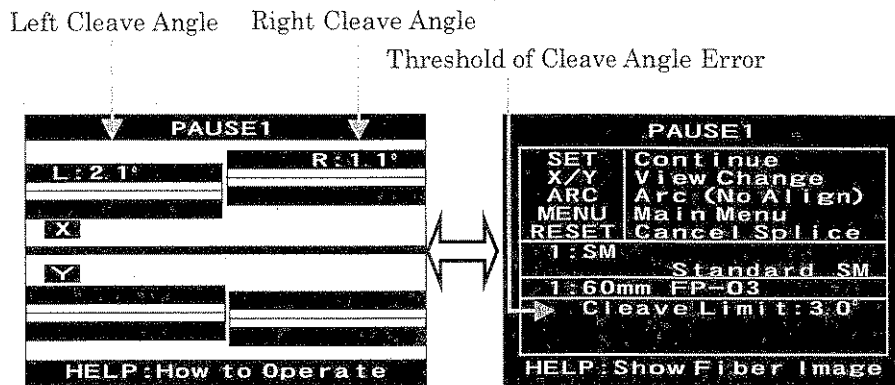
Fig. 4-14. Pause State

If pause feature is enabled, press 〈SET〉 to continue to the next step.

⇨ *Note : To change threshold of cleave angle error, refer to § 6.2.2 (Page 61).*

⇨ *Note : The splicer can continue splicing with the displayed cleave angle error.   To make the splicer unable to do so, refer to § 6.6.3 (Page 105).   A password is required to change this setting.*

⇨ *Note : The cleave angle display may be disabled.   Refer to § 6.6.1 (Page 100).*

⇨ *Note : The clad and core axis offsets display may be enabled.   Refer to § 6.6.1 (Page 100).*

(3) Heating with arc discharge

After aligning the fibers, the splicer will produce a high voltage arc discharge to fuse the fibers together.   During arc discharge, observe the fiber image on the monitor screen.   If some part of the image exhibits an extremely bright glow (hot spot), which is created by burning contaminants located on the surface or end-face of the glass, there is a possibility of the fiber core will be deformed.   Although deformation can be detected by the loss estimation function, a re-splice is recommended.
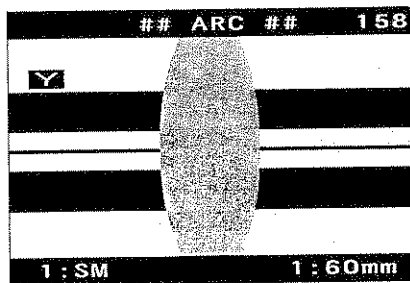
Indicates the number of arc discharges after electrode replacement.

Fig. 4-15. Fibers Being Spliced

(4) Splice Inspection

When the spliced state is abnormal, the splicer displays an error message "FAT," "THIN" or "BUBBLE."   For details of errors and cause, refer to § 8 (Page 119).   In the event a defect occurs and is not detected by the splicer, a re-splice is recommended.
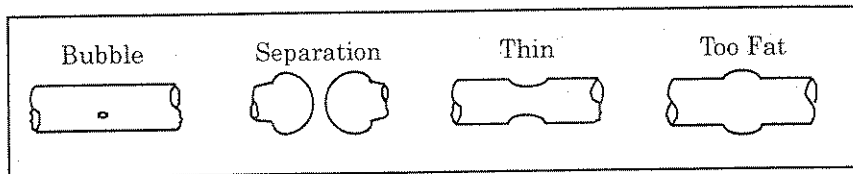
Fig. 4-16. Examples of Incorrect Splicing

⇨ Note : A slightly fat splice is normal.   There is no problem with the splice loss and reliability.

⇨ Note : The splicer can proceed to the next step even with the displayed error "FAT," "THIN" or "BUBBLE."   To make the splicer unable to proceed, refer to § 6.6.3 (Page 105).   A password is required to change this setting.

(5) Splice loss estimating
The estimated splice loss is displayed on the screen.
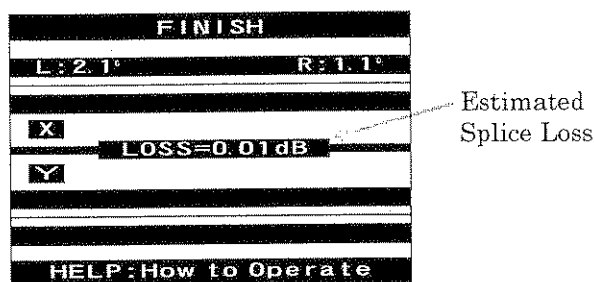
Fig. 4-17. Result of Fiber Splicing

When the threshold of loss error is exceeded, an error message is displayed. The splicer also checks the core angle when using SPECIAL mode, and indicates an error message when the threshold is exceeded.

⇨ *Note : To change the threshold of loss error or core angle error, refer to § 6.2.2 (Page 61) or § 6.2.4 (Page 67).*

⇨ *Note : The splicer can proceed to the next step even with the displayed loss error or core angle error. To make the splicer unable to proceed, refer to § 6.6.3 (Page 105). A password is required to change this setting.*

In some cases the splice loss can be improved with the re-arc feature. Press the ⟨ARC⟩. After re-arc discharge, the splice inspection and loss estimation are repeated.

⇨ *Note : There are cases when the splice loss will deteriorate after re-arc discharge. To disable re-arc discharge or limit the number of repetitions, refer to § 6.6.3 (Page 105). A password is required to change this setting.*

(6) Storing splice result
Press ⟨SET⟩ or open the wind protector and the splicer will automatically perform the proof test and stores the splicing result.

⇨ *Note : To enter a comment in the splice result or cancel the storage, press ⟨ENT⟩ in [FINISH] state. Refer to § 6.5.1 (Page 95).*

§ 4.7. Fiber Removal

(1) Open the wind protector.

⇄ *Check : Heater clamps should be open, ready to receive fiber and splice protector sleeve.*

(2) Open the left sheath clamp (which also opens the fiber clamp), holding the left fiber in your hand.   Then, open the right sheath clamp.

(3) Remove the right fiber from the splicer, holding it in your right hand.

§ 4.8. Reinforcing the Splice

(1) Slide the fiber protection sleeve to the center of the splice and move it to the tube heater.

⇄ *Check : Make sure the splice point and fiber protection sleeve are in the center of the tube heater.*

⇄ *Check : Make sure the reinforcing material (metal rod) is placed downward.*

⇄ *Check: Make sure the fiber is not twisted.*

Center the splice point and the sleeve.

40mm Sleeve   FP-03 (L=40)

60mm Sleeve   FP-03
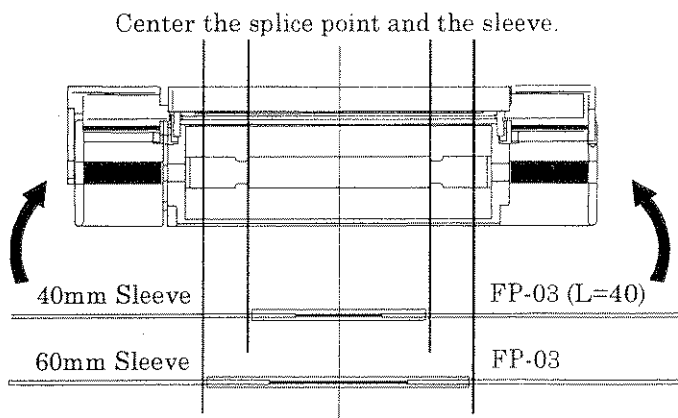
Fig. 4-18. Setting in Tube Heater

(2) While applying tension to the fiber, lower the fiber into the tube heater. The left heater clamp will close automatically.

(3) With tension still applied to fiber, close the right heater clamp with your left hand.

> ⇨ *Check : Check again to see that the splice point and fiber protection sleeve are in the center of the tube heater.*

(4) Press ⟨HEAT⟩ to start a tube-heating cycle. Upon completion of heating, audible alarm sounds and the heater LED turns off.

> ⇨ *Note : To abort the tube heating cycle, press ⟨HEAT⟩. Then, the heater LED will start blinking. By pressing ⟨HEAT⟩ again while the LED is blinking, the tube heating cycle will be aborted.*

(5) Open the left and right heater clamps. While applying tension to the fiber, gently remove the splice reinforcement.

> ⇨ *Note : On occasions the fiber protection sleeve may adhere to the bottom of the tube heater. Simply use a cotton swab or similar soft tip object to gently push the fiber protection sleeve to dislodge.*

(6) Visually check the splice reinforcement for bubbles and impurities.

§ 5. Maintenance of Splicing Quality

§ 5.1. Cleaning and Checking before Splicing

Critical cleaning points and maintenance checks are described below.

§ 5.1.1. Cleaning V-grooves

If contaminants are present in the V-grooves, correct clamping may not occur, resulting in higher splice loss. The V-grooves should be frequently inspected and periodically cleaned during normal operation.

(1) Open the wind protector and fiber clamps.

(2) Clean the bottom of the V-groove with an alcohol-impregnated thin cotton swab as shown in Fig. 5-1. Remove excess alcohol from the V-groove with a clean dry swab.

→ *Check : Use a high quality alcohol, greater than 99% pure.*

→ *Check : Use care not to contact the electrode tips.*

→ *Check : Do not use excessive force when cleaning the V-groove. The V-groove arm may be damaged.*
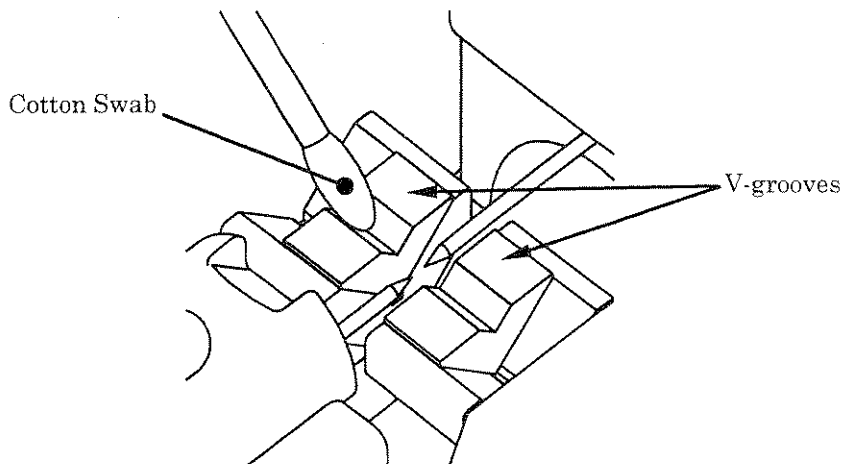
Fig. 5-1. Cleaning V-grooves with Cotton Swab

(3) If the contaminants in V-groove cannot be removed with an alcohol-impregnated thin cotton swab, use a cleaved fiber end-face to dislodge contaminants from V-groove bottom.   Repeat step (2) after this procedure.

Cleaved Fiber
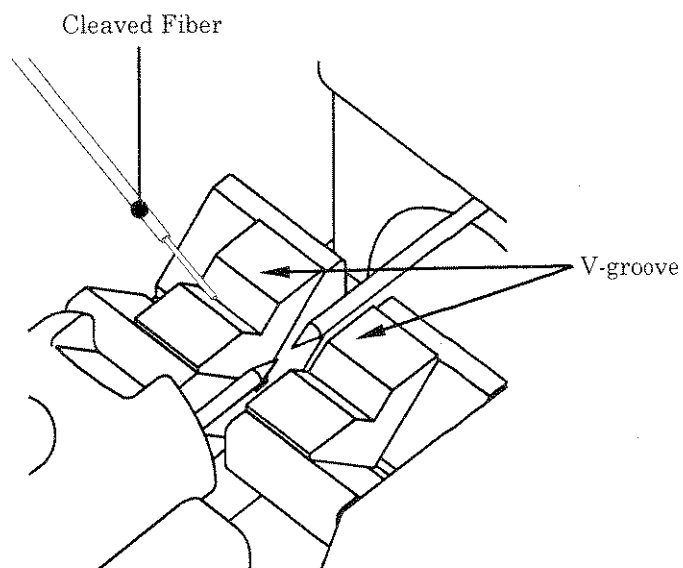
V-groove

Fig. 5-2. Cleaning V-grooves with Cleaved Fiber

§ 5.1.2. Cleaning Fiber Clamp Chips

If contaminants are present on the clamp chips, correct clamping may not occur, resulting in poor quality splices. The fiber clamp chips should be frequently inspected and periodically cleaned during normal operation.

(1) Lift up the fiber clamps.

(2) Clean the surface of the chip clamp with an alcohol-impregnated thin cotton swab as shown in Fig. 5-3. Remove excess alcohol from the clip clamp with a clean dry swab.

⇨ *Check : Use a high quality alcohol, greater than 99% pure.*
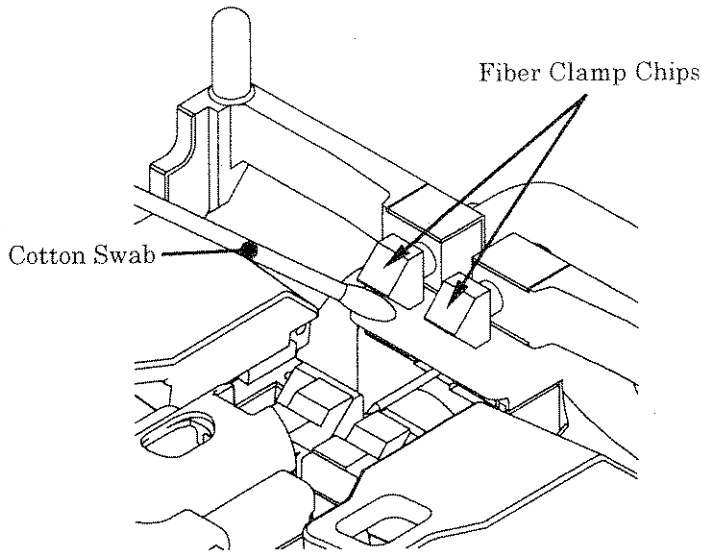
Fig. 5-3. Cleaning Fiber Clamp Chips

§ 5.1.3. Cleaning Wind Protector Mirrors

If the wind protector mirrors become dirty, the core position may be incorrect due to decreased optical path clarity, resulting in higher splice loss.

(1) Clean the mirror surface with an alcohol-impregnated thin cotton swab as shown in Fig. 5-4. Remove excess alcohol from the mirror surface with a clean dry swab.

　⇨ Check : Use a high quality alcohol, greater than 99% pure.

(2) Mirror should be clean and smudge free.

Cotton Swab

Wind Protector Mirror
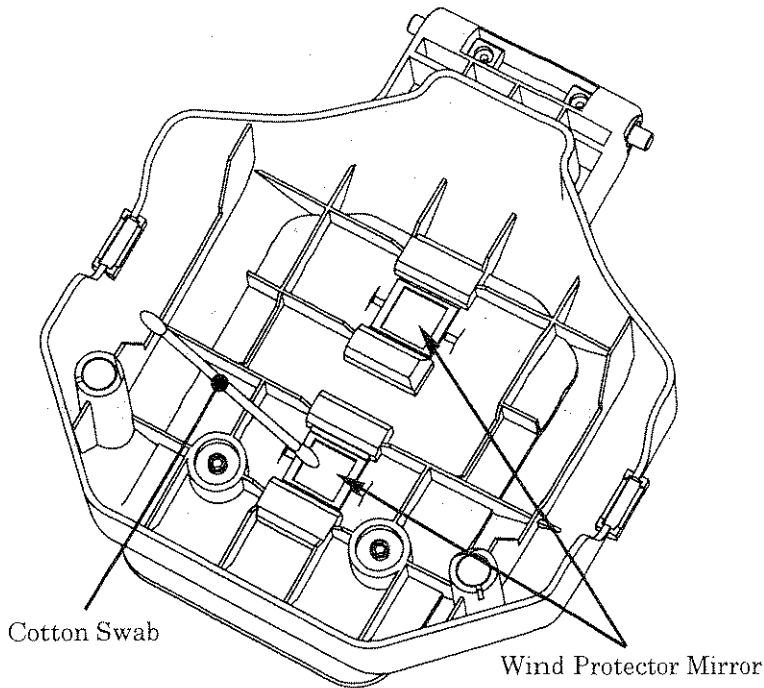
Fig. 5-4. Cleaning Wind Protector Mirrors

§ 5.1.4. Cleaning Fiber Cleaver

If the cleave blade, clamp pads or cleave button anvil of the fiber cleaver becomes contaminated, cleaving quality could possibly degrade, and the fiber surface or end-face may become contaminated resulting in higher splice loss. Clean the cleave blade, clamp pads or cleave button anvil with an alcohol-impregnated thin cotton swab as shown in Fig. 5-5.

Clamp Rubber   Cleave Button Anvil

Blade   Clamp Rubber
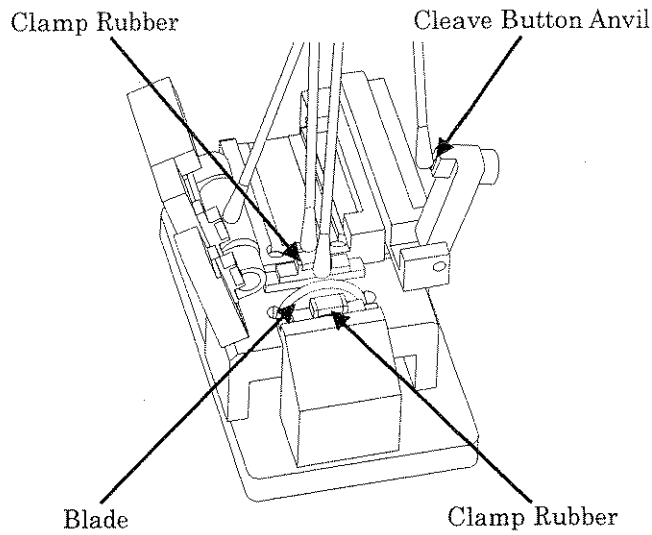
Fig. 5-5. Cleaning Fiber Cleaver

§ 5.1.5. Arc Power Calibration

Atmospheric conditions such as temperature, humidity, and pressure are constantly changing which create variability in the arc temperature. The splicer contains a temperature, humidity, and pressure sensors that are used in a constant feedback monitoring control system to regulate the arc power at a constant level.

Changes in arc power due to electrode wear and glass adhesion cannot be corrected automatically. Also, the center position of arc discharge sometimes shifts to the left or right. In this case, the fiber splicing position has to be shifted in relation to the arc discharge center. It is necessary to perform an arc power calibration to eliminate both of these issues.

⇨ *Note : Performing the [Arc Calibration] function changes the arc power "factor" value. The factor value is use in the algorithm program for all splicing. The arc power value will not change in the splice modes. As a example, set value of arc power will remain unchanged at 20 bits after calibration.*

⇨ *Note : The result of arc power calibration affects all of the 40 splice modes provided, i.e., it does not affect the currently selected mode only.*

⇨ *Note : If arc power has been changed intentionally in a special mode, the set value will not return to the standard value (20 bits) by the arc power calibration.*

Operation Procedure

⇨ Check : For arc calibration, use a normal SM or DS fiber. Using a
special or multi-mode fiber produces an error in the splicing
result.

(1) Press ⟨▲⟩ or ⟨▼⟩ to move the
cursor to [Arc Calibration] in the
[Power-On Menu] or [Main Menu].
Pressing ⟨ENT⟩ displays the screen
shown right.
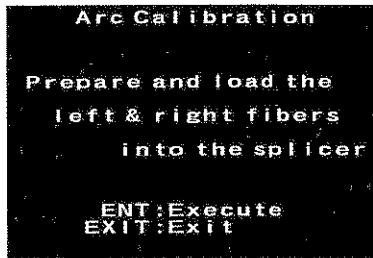
(2) Set the cleaved fibers into the
splicer.

Fig. 5-6. Arc Calibration 1

⇨ Note : Dust adhesion to the fiber
surface may produce incorrect arc calibration result. When
dust exists on the fiber surface, prepare and set the fibers again.

⇨ Note : The threshold of cleave angle error does not link with that set
in the currently selected splice mode cleave setting. A special
threshold of cleave angle error is used just for the arc calibration
function. To change the special threshold, refer to § 6.6.3 (Page
105). A password is required to make this change.

(3) Pressing ⟨ENT⟩ executes the following sequence:

① The splicer generates arc discharges before fibers enter display. By
measuring center position of arc discharge, the splicer calibrates the
fiber splicing position.

② Fibers are spliced together with extreme axial offsets intentionally,
preparing for arc power calibration.

③ Multiple re-arcs occur as splicer measures axial offset change by
surface tension movement.

(4) Upon completion of measurements, the following result is displayed on the screen.

"Test Finish" message

This message indicates that the calibration of arc power and splicing position has been completed successfully.

Fig. 5-7. Arc Calibration 2

《EXIT》 : Ends this function.

"Test Again" message
This message informs that the calibration of arc power and splicing position has been finished, but due to excessive change between before and after factor value numbers, arc calibration should be repeated.

Fig. 5-8. Arc Calibration 3

《EXIT》 : Ends this function.
《ENT》 : Repeats arc calibration.

⇨ *Note : Depending on the environmental conditions or the electrode condition, it may become necessary to repeat arc calibration until the "Test Finish" message appears. In some cases, it is allowable to judge the arc power to have been calibrated correctly by three repetitions of arc calibration. To set the splicer so as to give the "Test Finish" message when the set number of arc discharges is exceeded, refer to to § 6.6.3 (Page 105). A password is required to change the setting.*

⇨ *Note : Though the term "calibration" is employed here, the splicer is not Calibratable Item. Measuring instruments such as OTDRs and Power meters are Calibratable Items. The splicer does not require periodical factory calibration. However, the splicer is recommended to have periodic Service and Routine Maintenance for optimum performance.*
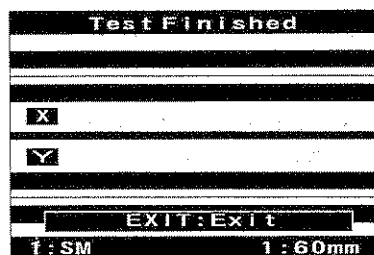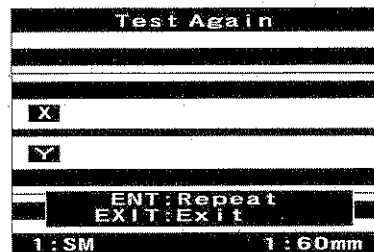
§ 5.2. Periodical Checking and Cleaning

In order to maintain the splicing quality of the splicer, the points of periodical inspection and cleaning are recommended.

§ 5.2.1. Electrode Replacement

Electrodes wear with use and also must be cleaned periodically due to silica oxide buildup. It is recommended that the electrodes should be replaced after 1,000 arc discharges. When the number of arc discharges reaches a count of 1,000, a message prompting to replace the electrodes is displayed immediately after turning on the power. Using the electrodes without a replacement will result in greater splice loss and reduced splice strength.

> ⇨ *Note : Arc discharge count alarm for electrode replacement may be changed. Refer to § 6.6.3 (Page 105). A password is required to make this change.*

Replacement Procedure

(1) Execute [Electrode Replacement] in [Maintenance Menu].

(2) Instruction messages will appear on the screen to turn off the power. Press and hold ⟨ON/OFF⟩ till the LED color changes from green to red.

(3) Remove the old electrodes. For the method of replacement, refer to Fig. 5-9.

(4) Clean the new electrodes with alcohol-impregnated clean gauze or lint-free tissue and install them to the splicer.

> ⇨ *Check : Use approved electrodes ELCT1-25 for FSM-40S. Always replace them as a pair.*

> ⇨ *Check : Be careful not to damage the electrode shaft or tips when cleaning and installing in the splicer. Any damaged electrodes should be discarded.*

> ⇨ *Check : When installing the electrodes, tighten screws no more than finger tight while pushing the electrode collars against the electrode fixtures. Incorrect installation of the electrodes may result in greater splice loss or damage to the discharge circuit.*
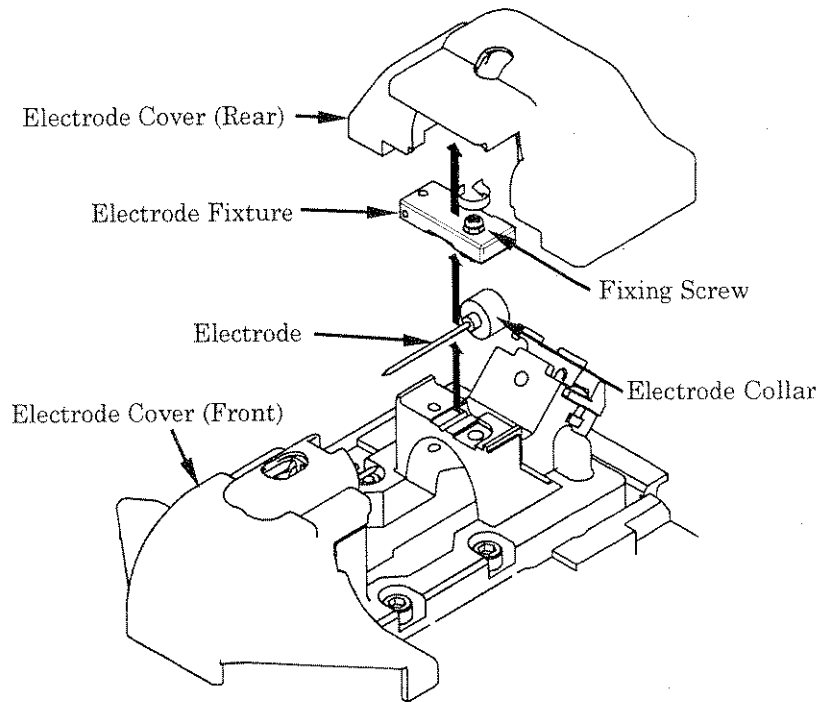
Fig. 5-9. Replacing Electrodes

(5) Turn on the power, prepare and load fibers into the splicer and press
⟨ENT⟩. After executing the arc calibration, the splicer will repeat arc
discharge 30 times in succession to stabilize the electrodes.

☞ *Note : When the fibers melt back as a result of repeated arc discharge,
the splicer will pause. Set new cleaved fibers into the splicer to
complete the electrode stabilization process. Press ⟨ENT⟩ to
restart continuous arc discharge.*

(6) Upon completion of repeated arc discharge, the splicer executes arc
calibration again. Operator should repeat arc calibration until the
"Test Finish" message appears. For details of the arc calibration, refer
to § 5.1.5 (Page 47).

§ 5.2.2. Rotating Cleave Blade

If the cleave blade is worn or damaged, the fiber end-face quality will degrade even if the blade is cleaned. The blade should be rotated to next unworn position.

On the side of the cleave blade, a label is affixed to the cleaver which identifies the twelve different blade sections. The new cleaver when shipped is set at the No. 1 section. It is recommended the operator use the blade section in series from 1,2,3, etc. When all of the 12 sections have been used, replace the blade with a new one. The blade is capable of cleaving approximately one thousand times per section, for a total of twelve thousands cleaves. It is recommendable that the blade rotation occur at the same interval as electrode replacement.

Rotating Procedure

(1) Loosen the fixing screw of the blade unit using a precision flat-head screwdriver. The width of the screwdriver should be no greater than 2.5mm.
(2) Rotate the blade to the next highest number. Then, re-tighten the fixing screw securely.
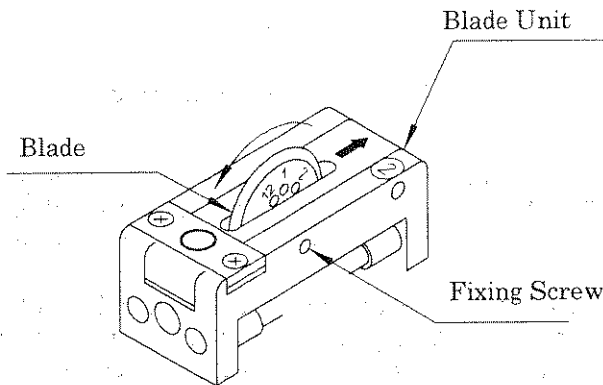
Fig. 5-10. Rotating Blade

➪ *Check : When rotating the blade, do not touch the cutting edge. Move the blade with a thin cotton swab, for easy and safe rotation.*

§ 5.2.3. Diagnostic Test

The FSM-40S has a built in diagnostic test feature that allows the operator to perform a simple one step evaluation of splicer performance covering several different critical variables.
➪ *Note : Perform this function in the event of trouble in the splicer operation.*

Operation Procedure
(1) Change the screen from [Main Menu] to [Maintenance Menu] and execute [Diagnostic Test].   The following checks will be made.

	Check Item	Description
1	LED Check	Measures and adjusts the brightness of the illumination LED.
2	Motor Check	Checks for operation of each motor.
3	Dust Check	Checks the optical path for dust or dirt and judges whether they disturb fiber observation. If contamination exists, this function indicates location.
4	Stuff Check	Measures fiber-stuffing distance during splicing and adjusts the motor rpm.
5	Arc Calibration	Automatically calibrates the arc power factor and fiber splicing position.
6	I/O Port Check	Checks for normal operation of the input and output terminals of the internal circuit.
7	Memory Check	Checks the memory of the internal circuit.

➪ *Check : Before the start of the test, remove fibers from the splicer.*
➪ *Note : When item 3 (dust check) is completed, prepare and load fibers into splicer and press ⟨ENT⟩.*

(2) Upon completion of all checks and adjustments, a list of results is displayed.
① If the dust check result is not good, clean the objective lenses, refer to § 5.2.4 (Page 54).   Clean wind protector mirrors, refer to § 5.1.3 (Page 45).   In case contamination cannot be eliminated by lens cleaning, there is a possibility the contamination may have entered the inside of the optical path.   Please contact your nearest sales agency.
② The dust check and stuff check functions exist as independent instructions in [Maintenance Menu]. It is possible to execute them independently.

§ 5.2.4. Cleaning Objective Lenses

If the surfaces of the objective lenses become dirty, normal observation of the core position may be incorrect, resulting in higher splice loss or poor splicer operation. Therefore, clean them at regular intervals. Otherwise, dirt may accumulate and become impossible to remove.

(1) Before cleaning the objective lenses, always turn off the splicer.

(2) Remove the front and rear electrode covers.

(3) Gently clean the lens surface with an alcohol-impregnated thin cotton swab as shown in Fig. 5-11. Using a cotton swab, starting in the center of the lens, move the swab in a circular motion until you spiral to the edge of the lens surface. Remove excess alcohol from the mirror surface with a clean dry swab.
    Check : Use a high quality alcohol, greater than 99% pure.
    Check : Be careful not to bend the electrodes.
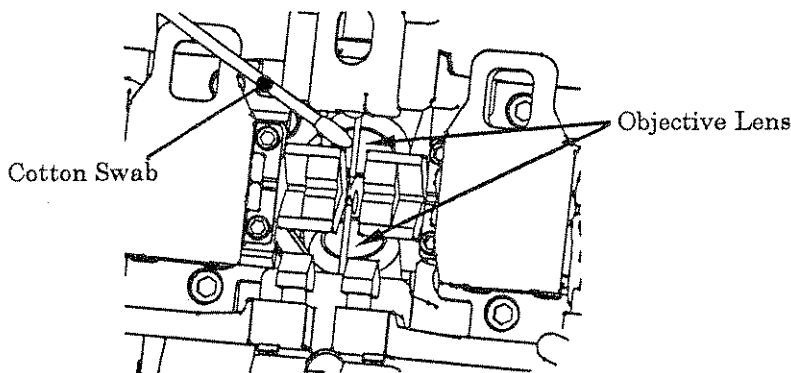
Fig. 5-11. Cleaning Objective Lenses

(4) The lens surface should be clean and smudge free.

(5) Reinstall the front and rear electrode covers.

(6) Turn on the power and make sure no smudges or streaks are visible on the monitor screen. Press ⟨X/Y⟩ to change the screen and check the state of the lens surface on both the X- and Y-screens. Perform dust check as well.

§ 5.2.5. Complete Discharge of Battery Pack

The battery pack (BTR-05) uses NiMH cells. If the battery pack were recharged repeatedly even though a sufficient capacity still remains, a memory effect would make it seem as if the battery capacity has decreased. If such a phenomenon occurs, execute [Battery Discharge] to reduce the remaining capacity to zero. Then, recharge the battery pack to restore the capacity. It is recommended that complete discharge of the battery pack should be performed every month.

> ☞ *Note : If the splicer is left in the normal power-on state, the splicer will shutdown before the battery is discharged completely. Therefore, it is necessary to use the [Battery Discharge] function to discharge the battery pack completely.*

Operation Procedure

(1) Insert the battery pack inside the splicer that is intended to discharge completely, and turn on the power.

(2) Change the screen from [Main Menu] to [Maintenance Menu] and execute [Battery Discharge].

(3) The [Battery Discharge] screen is displayed, and the remaining battery voltage is indicated.

Fig. 5-12. Complete Discharge of Battery Pack

> ☞ *Note : The power saving function turns off automatically.*
> ☞ *Note : Press ⟨EXIT⟩ to stop discharging.*

(4) Upon completion of full discharge, the buzzer sounds and the power turns off.

> ☞ *Note : If the battery pack is near full charged, it will take approximately three hours to discharge it completely.*

(5) Recharge the battery pack.

§ 6. Menu Commands

§ 6.1. Menu Commands Tree

See § 5.1.5 (Page 47).

See § 6.5 (Page 94).

See § 6.6 (Page 100).

Fig. 6-1. Menu Commands Tree (1)

See § 6.2.1 (Page 58).

See § 6.2.2 (Page 59).

See § 6.2.4 (Page 65).

See § 6.3.1 (Page 88).

See § 6.3.2 (Page 90).

See § 6.7 (Page 112).
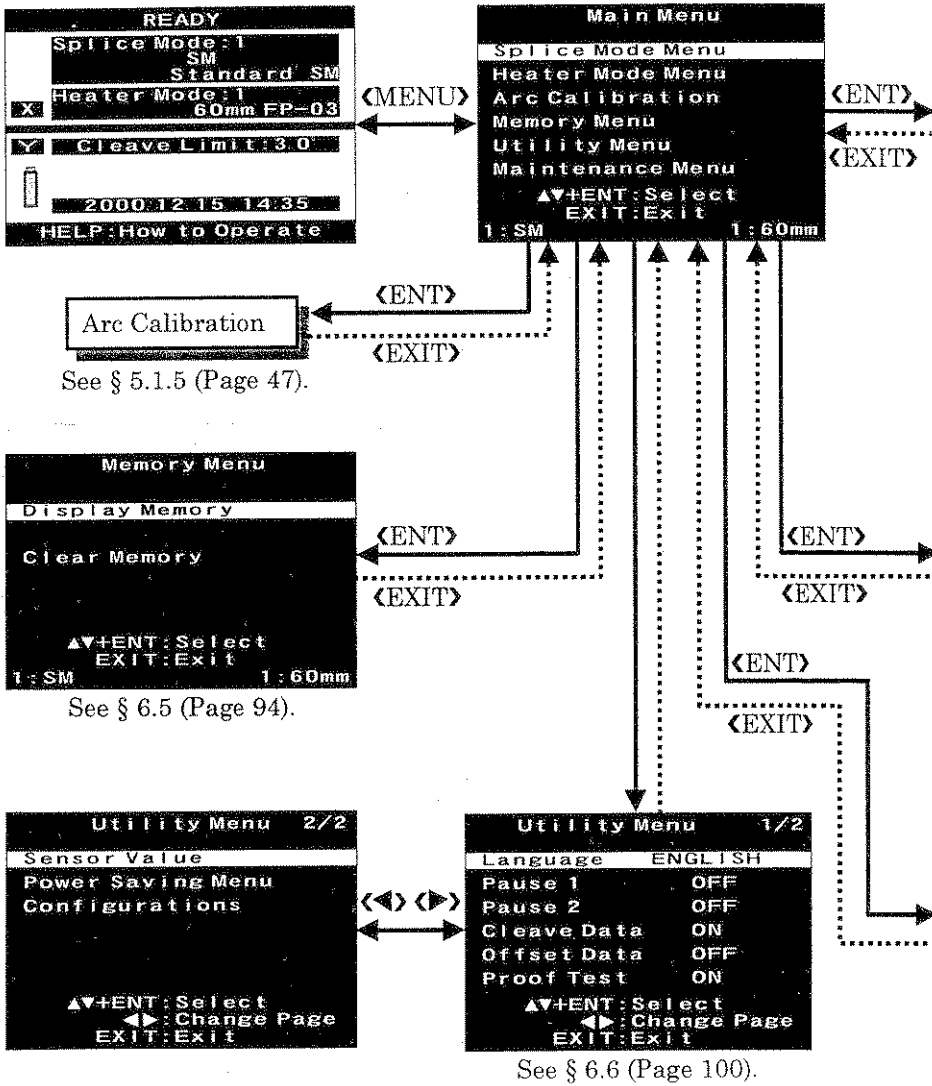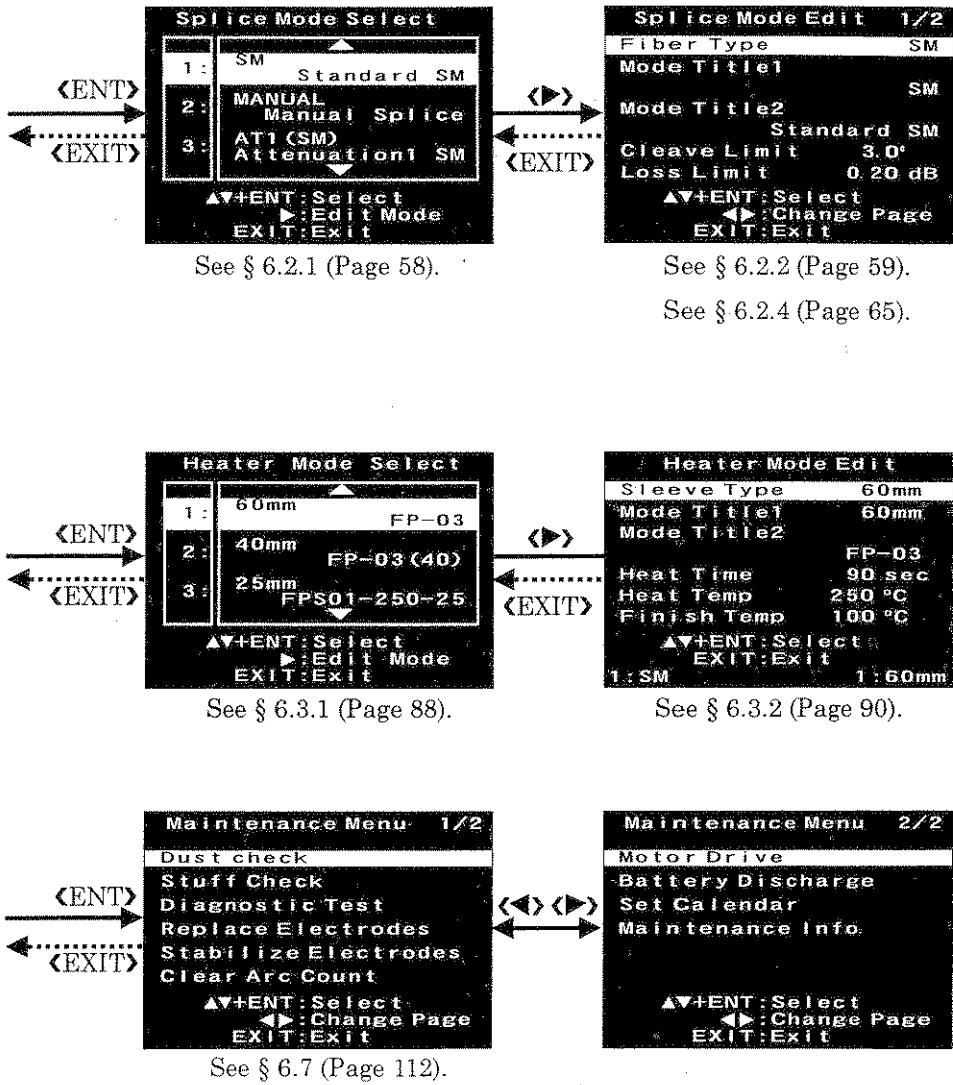
Fig. 6-2. Menu Commands Tree (2)

§ 6.2. Splice Mode

The splicer has 40 splice modes whose settings can be changed. Before splicing, select the most appropriate splice mode for the fiber that is going to be spliced.

(1) In each of the 40 splice modes, the following settings are stored:
- Setting to control the arc discharge
- Setting to calculate estimated loss
- Setting to control aligning and splicing operations
- Threshold at which an error occurs

These settings finely control the aligning and splicing operations.

(2) The splice mode settings need to be optimized according to the types of fibers. Some expertise may be necessary for optimization. Therefore, pre-install settings for typical fibers optimized by Fujikura are stored inside the splicer at factory before shipping. The optimized splice modes stored are as follows:

Splice Mode	Description
SM	Used to splice standard Single Mode fibers: MFD : 9 - 10 um; Wavelength : around 1310nm.
DS	Used to splice Dispersion Shifted fibers: MFD : 7 - 9 um; Wavelength : around 1550nm. Also used to splice WDM fibers.
MM	Used to splice Multi Mode fibers: Core Diameter : 50.0 - 62.5 um.
AUTO	Automatically identifies the type of fibers to be spliced by observing the core profile, and automatically selects the most appropriate one out of the SM, DS and MM splice modes. Refer to § 6.2.3 (Page 66).
SPECIAL	A set of splice modes for special fibers, including the attenuation splice mode and the manual splice mode.

Fig. 6-3. Types of Splice Modes

(3) The SM, DS, MM, AUTO and SPECIAL modes are stored in the "Database Area" as shown in Fig. 6-4. The splice modes stored in this "Database Area" cannot be changed. Alternatively, the above-mentioned 40 splice modes are stored in the "User Programmable Area" that enables the user to change them freely. At the time of shipping from factory, the SM, DS, MM and AUTO modes in the "Database Area" are copied onto the "User Programmable Area".

User Programmable
Area (40 modes)

1:	SM 　　　Standard SM
2:	DS 　　　Standard DS
3:	MM 　　　Standard MM
4:	AUTO 　　　SM/DS/MM
5:	SM 　　　Standard SM
	⋮
39:	MM 　　　Standard MM
40:	AUTO 　　　SM/DS/MM

Database Area
(4 modes)

1:	SM 　　　Standard SM
2:	DS 　　　Standard DS
3:	MM 　　　Standard MM
4:	AUTO 　　　SM/DS/MM

Read-out only

COPY

Database Area
for SPECIAL mode

SPECIAL modes See § 6.2.4 (Page 65)

Read-out only

COPY
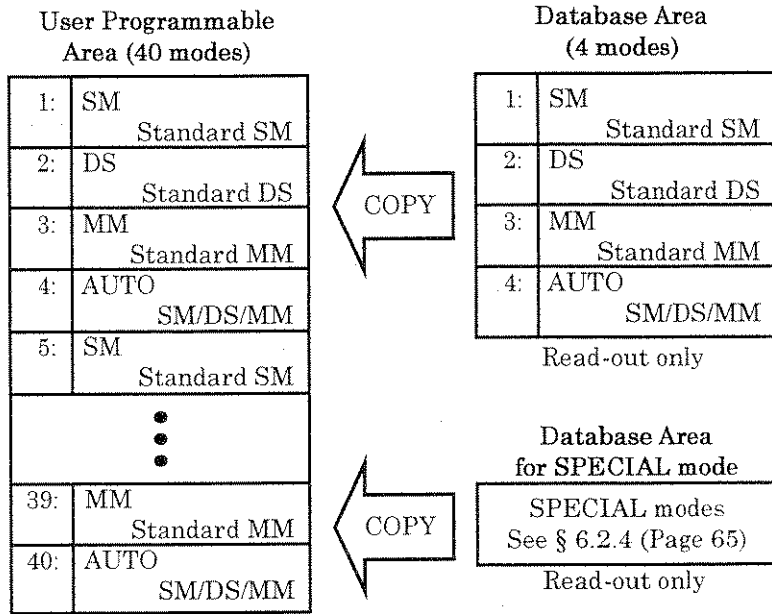
Fig. 6-4. User Programmable Area & Database Area

For descriptions of the splice modes, refer to the following:

§ 6.2.1. Splice Mode Selection

Select the most appropriate splice mode for the fiber to be spliced.

(1) Move the cursor to the [Splice Mode Menu] in the [Main Menu] (or [Power-On Menu]) and press <ENT>.

(2) The [Splice Mode Select] screen is displayed. Press <▲> or <▼> to move the cursor to the splice, and press <ENT>.

(3) The splice mode currently selected is displayed at the lower left of the [Main Menu] (or [Power-On Menu]). Make sure your selection is right.

[Main Menu] or [Power-On Menu]

[Main Menu] or [Power-On Menu]
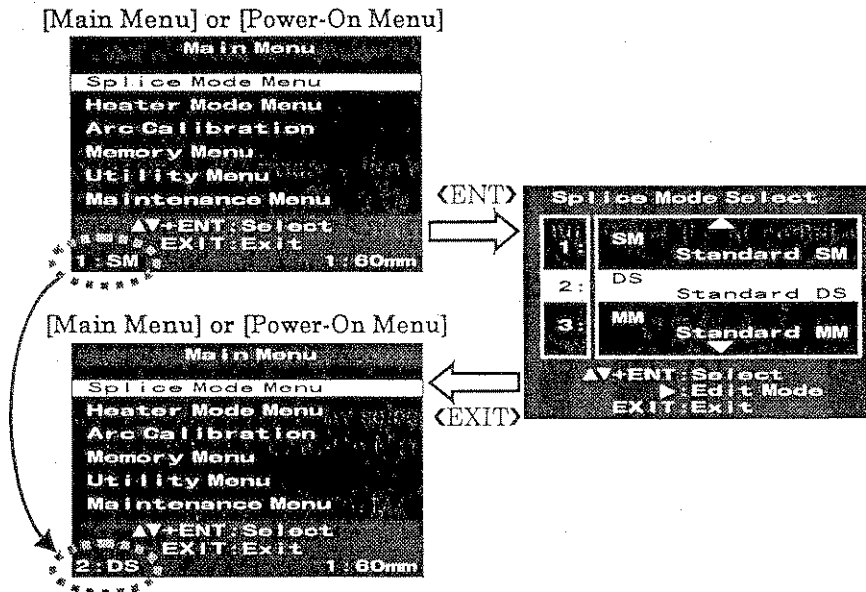
Fig. 6-5. Splice Mode Selection

⇨ Note : To initialize the splice modes or rearrange them so as to be easily visible, refer to § 6.2.9 (Page 86).

⇨ Note : To add a SPECIAL mode for splicing special fibers from the "Database Area" to the [Splice Mode Selection] list, refer to § 6.2.4 (Page 67).

§ 6.2.2. Editing SM, DS, MM and AUTO Modes

The settings stored in the splice modes are changed in the following ways:

(1) Open the [Splice Mode Select] screen. Press ⟨▲⟩ or ⟨▼⟩ to move the cursor to the splice mode to edited, and press ⟨▶⟩.

(2) The [Splice Mode Edit] screen is displayed. Press ⟨▲⟩ or ⟨▼⟩ to move the cursor to the parameter whose setting you want to change, and press ⟨ENT⟩. For details of parameters, refer to next page. How to change numerical values is displayed in the lower section of the screen.

(3) After changing the setting, press ⟨EXIT⟩ to return to the [Splice Mode Select] screen.
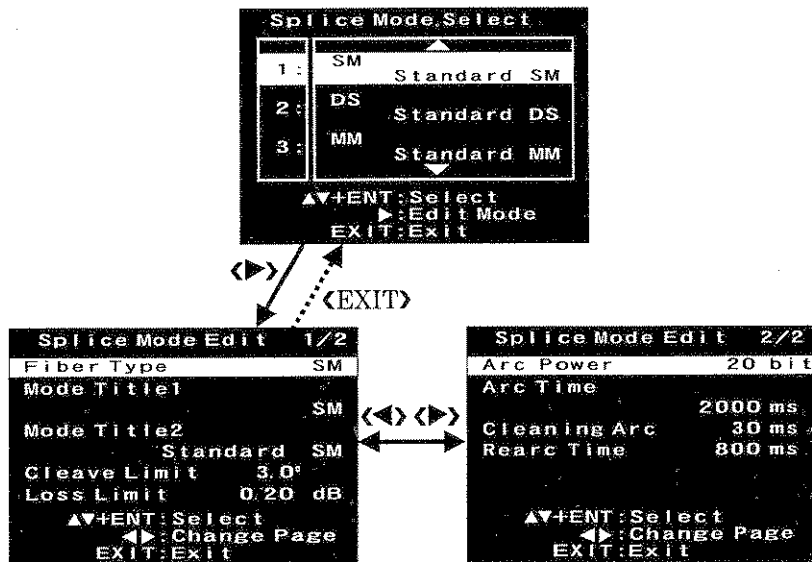
Fig. 6-6. Editing Splice Mode
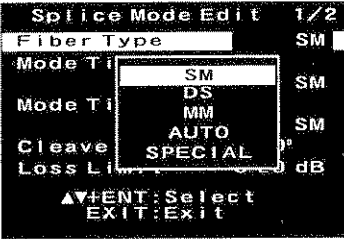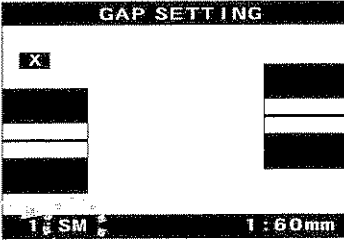
Parameter	Description
Fiber Type	· Select an appropriate fiber type out of those in the SM / DS / MM / AUTO mode, referring to Fig. 6-3 (Page 58). · When the [Fiber Type] is changed, all settings in the splice mode being edited are initialized. When initializing a new fiber type, the splice mode stored in the "Database Area" of Fig. 6-4 (Page 59) is overwritten on the splice mode being edited. Always set the [Fiber Type] before attempting to change other settings. · For details of splice mode initializing or rearrangement, refer to § 6.2.9 (Page 86).
Mode Title1	· The characters entered in this field are displayed as the name of splice mode at the lower left of the screen of the splicing operation being in progress. · Maximum number of characters : 7 (SM / DS / MM mode) 4 (AUTO mode) Mode Title1

Fig. 6-7. SM / DS / MM / AUTO Mode (1)
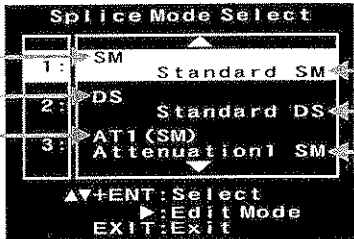
Parameter	Description
Mode Title2	• The characters entered in this field are displayed on the [Splice Mode Select] screen. • Maximum number of characters : 15 **Splice Mode Select** Mode Title1 → 1: SM Standard SM ← Mode Title2 Mode Title1 → 2: DS Standard DS ← Mode Title2 Mode Title1 → 3: AT1 (SM) Attenuation1 SM ← Mode Title2 ▲▼+ENT:Select ▶:Edit Mode EXIT:Exit
Cleave Limit	• Sets the threshold of cleave angle error. When both or one of the left and right cleave angles measured exceeds the threshold, an error message is displayed. • Setting Range : 0.0 (OFF) - 10.0 °, Step : 0.1 ° Initial Setting : SM 3.0 °, DS 2.0 °, MM 5.0 °, AUTO : 3.0 ° "OFF" : Does not make judgment on cleave angle. • The threshold of cleave angle error is an important parameter that governs the splicing quality. The initial setting is a value set rather high with consideration to the worst performance of the fiber cleaver and the splicing yield. To select as low a value as the cleaver performance and splicing yield permit (less than 2.0 °) is recommended. • Even if a cleave angle error occurs, pressing ⟨SET⟩ enables the splicer to perform splicing in disregard of the displayed error. To make the splicer unable to do so, refer to § 6.6.3 (Page 105). • The threshold of cleave angle error set herein has no connection with that in the [Arc Calibration]. To change the threshold for the [Arc Calibration], refer to § 5.1.5 (Page 47).

Fig. 6-8. SM / DS / MM / AUTO Mode (2)

Parameter	Description
Loss Limit	• Sets the threshold of estimated loss error.　When the estimated loss is higher than the threshold, an error message is displayed. • Setting Range : 0.00 (OFF) - 1.00 dB,　Step : 0.01 dB Initial Setting : 0.20dB "OFF" : Does not make judgment on estimated loss. • Even if an estimated loss error occurs, pressing ⟨SET⟩ enables the splicer to perform splicing in disregard of the displayed error.　To make the splicer unable to do so, refer to § 6.6.3 (Page 105).
Arc Power	• In the SM / DS / MM / AUTO mode, the [Arc Power] is fixed at 20 bits.　Changing the arc power may improve the splice loss temporarily, but will worsen the long-term mean splice loss in most cases.　Therefore, the [Arc Power] is fixed and is not changeable. • In case the arc power has varied due to degradation of electrodes, it can be corrected to an appropriate level by [Arc Calibration].　We recommend to perform [Arc Calibration] before splicing.　Refer to § 5.1.5 (Page 47). • When the [Arc Power] needs to be changed to splice special fibers, use the SPECIAL mode.　Refer to § 6.2.4 (Page 67).
Arc Time	• In the SM or DS mode, the [Arc Time] is fixed at 2000 ms. In the MM mode, it is fixed at 3000ms.　Changing the [Arc Time] may improve the splice loss temporarily, but will worsen the long-term mean splice loss, in most cases. Therefore, the [Arc Time] is fixed and is not changeable. • When the [Arc Time] needs to be changed to splice special fibers, use the SPECIAL mode.　Refer to § 6.2.4 (Page 67).

Fig. 6-9. SM / DS / MM / AUTO Mode (3)

Parameter	Description
Cleaning Arc	• When setting the end-face gap between fibers, short arc discharge is performed to remove fine dust from the fiber surfaces. The time to perform cleaning arc discharge is set in this field. • Setting Range : 0 (OFF) - 1000 ms, Step : 10 ms Initial Setting : 30 ms "OFF" : Does not perform [Cleaning Arc] discharge. • In the case of carbon coated fibers, set the parameter at 100 ms to remove carbon from the fiber surfaces.
Rearc Time	• A high splice loss after splicing can be decreased by re-arc discharge, in some cases. The re-arc time is set in this field. • By pressing ⟨ARC⟩ on the [FINISH] screen, the splicer performs re-arc discharge. • Setting Range : 0 (OFF) - 30000 ms, Step : 100 ms Initial Setting : 800 ms "OFF" : Does not perform re-arc discharge. • There are cases in which the splice loss worsens by re-arc discharge. To limit the number of re-arc discharges or disable re-arc discharge, refer to § 6.6.3 (Page 105).

Fig. 6-10. SM / DS / MM / AUTO Mode   #4

§ 6.2.3. AUTO Mode

The AUTO mode automatically identifies the type of fibers to be spliced by observing the core profile, and automatically selects the appropriate program from the SM, DS and MM modes. The AUTO mode is effective in cases where the type of fibers to be spliced is not always identical. It can prevent mis-splicing of different splice mode.

Fiber identification can be confirmed as follows:

(1) The result is displayed at the lower left of the screen during the splicing operation.
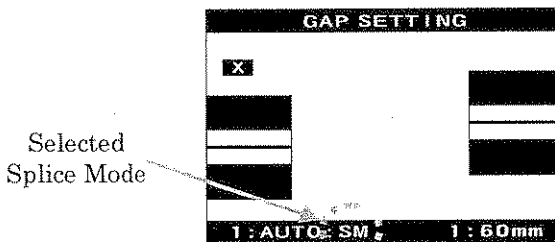
Fig. 6-11. Auto Fiber Type Discrimination

(2) Pressing ⟨HELP⟩ with the splicer in the [PAUSE] state displays the result.

Note the following conditions and restrictions:

(1) Only standard SM, DS and MM fibers can be identified with this mode. In the case of special fibers having an intermediate core profile, do not use the AUTO mode because misjudgment may result.

(2) The splicer identifies the left and right fibers independently. If they are dissimilar, the splice mode can not be selected. In this case, the splicer displays an error message.

(3) Extremely dirty fibers may lead to misjudgment.

(4) Using the AUTO mode makes the splice time longer than normal because the time required for identification.

§ 6.2.4. SPECIAL Mode

(1) In the SPECIAL mode, many splice parameters can be set as compared with the SM, DS and MM mode. Concerning the arc discharge, the following parameters can be controlled.
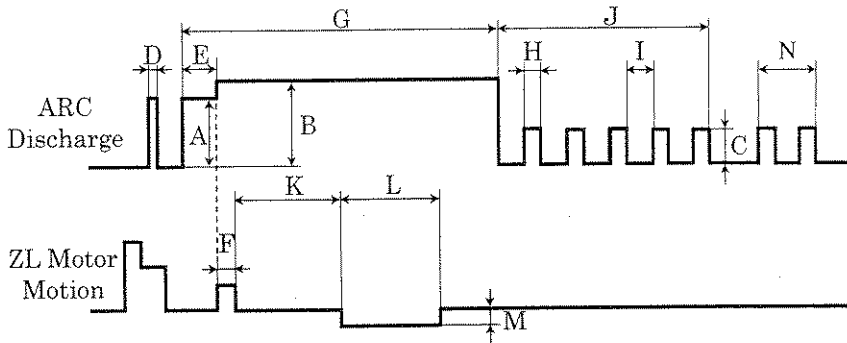
A: Prefuse Power, B: Arc1 Power, C: Arc2 Power,
D: Cleaning Arc, E: Prefuse Time,
F: Forward Time related to Overlap, G: Arc1 Time,
H: Arc2 ON Time, I: Arc2 OFF Time, J: Arc2 Time,
K: Taper Wait Time, L: Taper Time, M: Taper Speed,
N: Rearc Time

Fig. 6-12. Arc Discharge Parameters in SPECIAL Mode

(2) To select a SPECIAL mode, set the [Fiber Type] to "SPECIAL" on the [Splice Mode Edit] screen.
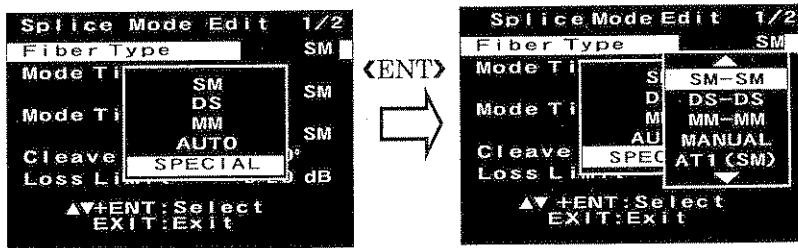
Fig. 6-13. Change to SPECIAL Mode

The splice modes stored in the "Database Area" for the SPECIAL mode are displayed. Select an appropriate mode and copy it into the "User Programmable Area". If the splice mode that is necessary is absent, copy a similar splice mode and optimize it using the edit function.

User Programmable Area (40 modes)	Database Area for SPECIAL mode
1: SM — Standard SM	1: SM-SM — Standard SM
2: DS — Standard DS	2: DS-DS — Standard DS
3: MM — Standard MM	3: MM-MM — Standard MM
4: AUTO — SM/DS/MM	4: MANUAL — Manual Splice
5: SM — Standard SM	5: AT1(SM) — Attenuation1 SM
⋮	6: AT1(DS) — Attenuation1 DS
	7: AT2(SM) — Attenu2 SM 3dB
39: MM — Standard MM	8: AT2(DS) — Attenu2 DS 3dB
40: AUTO — SM/DS/MM	9: AT2(MM) — Attenuation2 MM
	10: LF-LF — LEAF

COPY
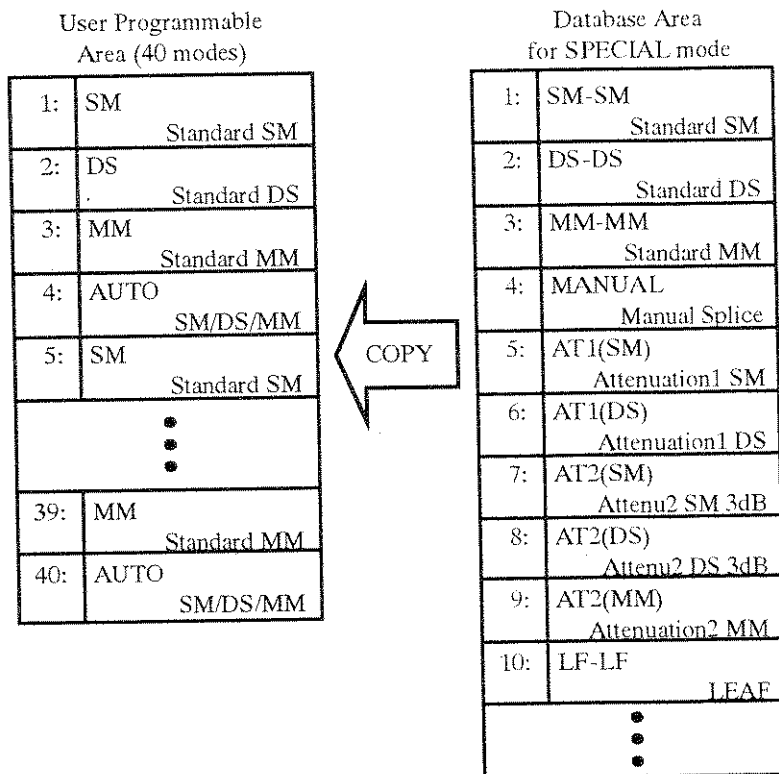
Fig. 6-14. Database Area for SPECIAL Mode

🖙 *Note : Item 4 "MANUAL" in the above "Database Area" is the manual splice mode. For details, refer to § 6.2.7 (Page 80). Items 5 – 9 "AT1" and "AT2" are the attenuation splice modes. Settable parameters are different, so refer to § 6.2.8 (Page 82).*

🖙 *Note : Using the SPECIAL mode makes the splice time longer than normal because the time required to estimate the splice loss becomes longer.*

```
Splice Mode Edit   1/7
Fiber Type        SPECIAL
Mode Title1
                  SM-SM
Mode Title2
              Standard  SM

▲▼+ENT:Select
   ◄►:Change Page
   EXIT:Exit
```

```
Splice Mode Edit   5/7
Arc1 Power        20 bit
Arc1 Time         2000 ms
Arc2 Power        20 bit
Arc2 Time         OFF
Arc2 ON-Time      180 ms
Arc2 OFF-Time     50 ms
Rearc Time        800 ms
▲▼+ENT:Select
     ◄►:Change Page
   EXIT:Exit
```

```
Splice Mode Edit   2/7
Align             Core
Focus             Auto
ECF               0.35
Auto Power        ON



▲▼+ENT:Select
     ◄►:Change Page
   EXIT:Exit
```

```
Splice Mode Edit   6/7
Taper Splice      OFF
Taper Wait        400 ms
Taper Speed       100 bit
Taper Time        100 ms



▲▼+ENT:Select
     ◄►:Change Page
   EXIT:Exit
```

```
Splice Mode Edit   3/7
Cleave Limit      3.0°
Loss Limit        0.20 dB
Core Angle Limit
                  1.0°



▲▼+ENT:Select
   ◄►:Change Page
   EXIT:Exit
```

```
Splice Mode Edit   7/7
Est.Mode          Clad
MFD-L             9.5 μm
MFD-R             9.5 μm
Minimum Loss      0.00 dB
Core Step         100
Core Curve        100
MFD Mismatch      100
▲▼+ENT:Select
     ◄►:Change Page
   EXIT:Exit
```

```
Splice Mode Edit   4/7
Cleaning Arc      30 ms
Gap               15 μm
Gapset Pos.       CENTER
Prefuse Power     20 bit
Prefuse Time      180 ms
Overlap           20 μm

▲▼+ENT:Select
   ◄►:Change Page
   EXIT:Exit
```

Fig. 6-15. Editing SPECIAL Mode

Parameter	Description
Fiber Type	• When the [Fiber Type] is set to "SPECIAL," the splice modes stored in the "Database Area" of SPECIAL mode are displayed. If the splice mode that is necessary is absent, copy a similar splice mode and optimize it using the edit function. • When the [Fiber Type] is changed, all settings of the splice mode being edited are initialized. When initializing a new fiber type, the splice mode stored in the "Database Area" of Fig. 6-14 (Page 68) is overwritten on the splice mode being edited. Always set the [Fiber Type] before attempting to change other settings. • For details of splice mode initializing and rearrangement, refer to§ 6.2.9 (Page 86).
Mode Title1 Mode Title2	• Same as in case of the SM / DS / MM / AUTO mode. For details of [Mode Title1], refer to Fig. 6-7 (Page 62). For details of [Mode Title2], refer to Fig. 6-8 (Page 63).

Align	• Sets the aligning method for fibers.
	
	• Selection items:
	"Core" / "Clad" / "Manual" / "AT1" / "AT2" / "AT2-MM"
	   "Core" : Aligns fibers by core position.
	   "Clad" : Aligns fibers by cladding center position.
	   "Manual" : Aligns fibers manually.
	   "AT1" / "AT2" / "AT2-MM" : Performs attenuation splice.
	
	• Selecting "AT1" / "AT2" / "AT2-MM" changes the types of arc parameters and the [Splice Mode Edit] screen to the special attenuation splice. For the setting method, refer to§ 6.2.8 (Page 82).
	
	• Selecting "Manual" automatically fixes the [ECF] and [Auto Power] functions to "OFF."
	
	• Selecting "Clad" automatically fixes the [Focus] function to "Edge." And, it also fixes [ECF] and [Auto Power] functions to "OFF."

Fig. 6-16. SPECIAL Mode (1)

Parameter	Description
Focus	· Sets the focal point during fiber observation. · Setting Range : Auto - 0.10 - 0.50 - Edge, Step : 0.01 · The focal plane moves near the core with an increase in numerical value and moves away from the core with a decrease in numerical value. This value is difficult to optimize, it is recommended to usually set this function to "Auto." In the case of "AUTO," the left and right fibers will be focused independently, so optimal focusing is possible even when splicing dissimilar fibers. When entering a fixed value, use "0.23" as standard. · For such fibers whose core cannot be observed (e.g., MM fiber), set this function to "Edge" (cladding focus). Setting to "Edge" automatically fixes the [Align] and [Est. Mode] to "CLAD" and the [ECF] and [Auto Power] functions to "OFF."
ECF	· Sets the axial offset ratio when aligning fibers using the ECF. For details of ECF, refer to § 6.2.6 (Page79). · Setting Range : OFF - 0.05 - 0.60, Step : 0.01 "OFF": Does not use ECF for aligning. · The axial offset ratio becomes greater with an increase in numerical value and smaller with a decrease in numerical value. As the value is difficult to optimize, it is recommendable to usually set it at "0.35." In the case of splicing with [Arc Time] of 5 seconds or more, it is recommendable to set this function to "OFF." · ECF is not applicable when the [Align] function is set to "CLAD" or "MANUAL." Therefore, this function is automatically fixed to "OFF." · Selecting [ECF] to "OFF" automatically fixes [Auto Power] to "OFF".
Auto Power	· Used to optimize arc power according to core eccentricity. It is used in combination with ECF.

Fig. 6-17. SPECIAL Mode (2)

Parameter	Description
Cleave Limit Loss Limit	• Same as in case of the SM / DS / MM / AUTO mode. For details of the [Loss Limit], refer to Fig. 6-9 (Page 64). For details of the [Cleave Limit], refer to Fig. 6-8 (Page 63).
Core Angle Limit	• Displays an error message when the bend angle of the two fibers spliced exceeds the threshold set in this field. • Setting Range : 0.0 (OFF) - 10.0 °, Step : 0.1 ° "OFF": Does not make judgment on core angle. • Usually set this parameter at about 1.0 °. • Even if a core angle error occurs, pressing ⟨SET⟩ enables the splicer to perform splicing in disregard of the displayed error. To make the splicer unable to do so, refer to § 6.6.3 (Page 105).
Cleaning Arc	• Same as in case of the SM / DS / MM / AUTO mode. Refer to Fig. 6-10 (Page 65). • The arc power of [Cleaning Arc] is the power set in the field [Prefuse Power].
Gap	• Sets the end-face gap between the left and right fibers at the time of aligning and prefusion discharge. • Setting Range : 10 - 30 um, Step : 1 um. • Usually set the gap at 15 um. • When splicing fibers of small outside diameter, fusing by prefusion discharge can be reduced by diminishing this gap. Adjusting the prefuse power and prefuse time is usually an easier method.

Fig. 6-18. SPECIAL Mode (3)

Parameter	Description
Gapset Pos	• Sets the position at which to splice fibers with respect to the center of arc discharge. • Setting Range : Left 30 um - Center - Right 30um Step : 1 um • In case the left and right fibers are significantly different in MFD, splicing them with an arc time of 5 seconds or more can enhance MFD matching by heating small MFD fiber more than the large MFD fiber. The splice loss can be improved by shifting the gap-setting position from the center of arc discharge toward the large MFD fiber to heat the small MFD fiber more. • Set the gap-setting position at "Center" for a normal splice.
Prefuse Power	• Sets the prefuse power from the start of arc discharge till the start of fiber stuffing. • Setting Range : 0 - 100 bit, Step : 1 bit • Usually set the [Prefuse Power] at 20 bits. • Before stuffing the fibers together they are heated, which softens the fiber end-faces to prevent axial offset from occurring by the impact of fiber stuffing. If prefuse setting is low, axial offset occurs if the end-face angle is not good. If prefuse is set too high, the end-faces are fused excessively and become rounded, causing sudden worsening of the splice loss.
Prefuse Time	• Sets the prefuse time from the start of arc discharge till the start of fiber stuffing. • Setting Range : 0 (OFF) - 1000 ms, Step : 10 ms • Usually set the [Prefuse Time] at 180 ms. • Longer [Prefuse Time] is synonymous with the higher [Prefuse Power].

Fig. 6-19. SPECIAL Mode (4)

Parameter	Description
Overlap	• Sets the overlap amount of fibers at fiber stuffing. • Setting Range : 1 - 50 um, Step : 1 um • Usually set the [Overlap] at 20 um. • Set the [Overlap] rather small when the [Prefuse Power] is weak or the [Prefuse Time] is short, and rather large when the power is strong and the time is long.
Arc1 Power	• The main arc discharge can be controlled in two stages. The first stage of arc discharge is Arc1, and the second is Arc2. The Arc1 power is set in this field. • Setting Range : 0 - 100 bit, Step : 1 bit • Usually set the [Arc1 Power] at 20 bits.
Arc1 Time	• Sets the Arc1 time. • Setting Range : 0.0 (OFF) - 30000 ms, Step : 100 ms "OFF" : Does not perform Arc1 discharge. • Usually set the [Arc1 Time] at 2000 ms. • If the [Arc1 Time] is set at less than 1 second when splicing with Arc1 discharge only (Arc2: OFF), the probability of the splice passing the proof test becomes low. It is recommendable to usually set the time at 1 second or more.
Arc2 Power	• Arc2 is the second stage of main arc discharge. The Arc2 power is set in this field. The setting range is the same as Arc1.

Fig. 6-20. SPECIAL Mode (5)

Parameter	Description
Arc2 Time	• Sets the Arc2 time. • Setting Range : 0.0 (OFF) - 1000 sec, Step : 1sec "OFF": Does not perform Arc2 discharge. • Usually set the [Arc2 time] to "OFF." • It is possible to set a very long arc time. However, when the total of the Arc1 time and Arc2 time exceeds 30 seconds, always set the functions [Arc2 ON Time] and [Arc2 OFF Time] to weaken the arc power. Continuous arc discharge over 30 seconds without weakening the arc power may damage the arc discharge unit.
Arc2 ON Time	• During Arc2 discharge, the arc power can be weakened by intermittent discharge. The period in which Arc2 discharge is turned on is set in this field. • Setting Range : 5 - 500 ms, Step : 5 ms Initial Setting : 180 ms • Adjust the Arc2 power by the ratio of [Arc2 ON Time] to [Arc2 OFF Time].
Arc2 OFF Time	• Sets the period in which Arc 2 discharge is turned off. • Setting Range : 0 (OFF) - 500 ms, Step : 5 ms, Initial Setting : "OFF" • When the Arc2 discharge is intermittent, re-arc discharge is also intermittent. When continuous re-arc discharge is necessary, set this parameter to "OFF."

Fig. 6-21. SPECIAL Mode (6)

Parameter	Description
Rearc Time	• Sets the re-arc discharge time. The meaning of re-arc discharge and the setting range are the same as in case of the SM / DS / MM / AUTO mode. Refer to Fig. 6-10 (Page 65). • In the SPECIAL mode, re-arc discharge power is set in the field [Arc2 Power]. • When the Arc2 discharge is intermittent, re-arc discharge is also intermittent.
Taper Splice	• Used to set the taper function to "ON". This function pulls the spliced fibers during heating and makes the splice point thinner. The degree of thinning is set in the following items. With some types of fibers, the splice loss can be improved by the taper function. • Initial Setting : OFF
Taper Wait	• Sets the time from the end of fiber stuffing till the start of pulling. • Setting Range : 0 - 30000 ms, Step : 10 ms Initial Setting : 400 ms
Taper Speed	• Sets the fiber pulling speed. • Setting Range : 0 - 250 bit, Step : 1 bit Initial Setting : 100 bit
Taper Time	• Sets the fiber pulling time. • Setting Range : 0 - 30000 ms, Step : 10 ms Initial Setting : 100 ms

Fig. 6-22. SPECIAL Mode (7)

Parameter	Description

Est. Mode	<u>Before setting the following items, refer to § 6.2.5 (Page 78).</u>
	
	• Select one of the splice loss estimating methods given below:
	  "OFF" : Does not perform splice loss estimating. The splice time is shortened.
	  "Core" : Performs splice loss estimating by measuring the core position.
	  "Clad" : Performs splice loss estimating by measuring the cladding center position.

MFD-L	• Sets the MFD of the left and right fibers as declared by the fiber manufacturer. MFD sometimes changes by arc discharge. It may be necessary to change the MFD settings to maintain the accuracy of the splice loss. • Setting Range : 1.0 - 100.0 um, Step : 0.1 um
MFD-R	• When the MFD settings of the left and right fibers are different, the ratio of the one MFD to another MFD is used for estimating. So normally, the fiber entered in the parameter [MFD-L] can be placed on the left or the right. • If the [Gapset Pos.] is shifted from "Center," the operator may be required to place correct fiber in the specified side. • When splicing left and right fibers having the same MFD, both the parameters [MFD-L] and [MFD-R] must be set to the same value.
Min. Loss	• Sets the minimum value for the estimated loss. When splicing special or dissimilar fibers, a high splice loss may remain even under the optimized arc discharge conditions. To make the actual splice loss agree with the estimated splice loss, set the minimum value of the actual splice loss. • Setting Range : 0.00 - 10.00 dB, Step : 0.01 dB
Core Step Core Curve MFD Mismatch	• Sets the effect the factor "Core Step," "Core Curve" or "MFD Mismatch" has on the splice loss. • Setting Range : 0 (OFF) - 50000, Step : 1

Fig. 6-23. SPECIAL Mode (8)

§ 6.2.5. Splice Loss Estimating Function

The splice loss varies with the following causes. The splicer calculates the estimated loss by observing the state of them.
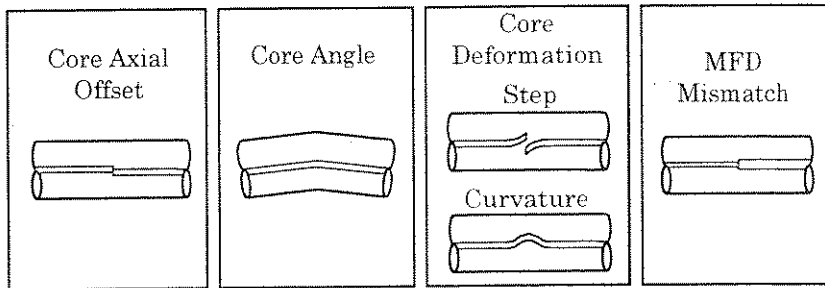
Fig. 6-24. Factors of Splice Loss

(1) Core Axial Offset Factor

The loss due to core axial offset. As the core axial offset loss varies with the fiber MFD, the equation refers to values set in [MFD-L] and [MFD-R].

(2) Core Angle

The loss due to core angle of the two spliced fibers. As the core angle loss varies with the fiber MFD, the equation refers to values set in [MFD-L] and [MFD-R].

(3) Core Deformation

The loss due to core deformation. As the core deformation loss varies with the fiber MFD, the equation refers to values set in [MFD-L] and [MFD-R]. With some types of fibers, the actual splice loss does not agree with the estimated loss when only the MFD value is entered, so the estimated loss should be adjusted by the [Core Step] and [Core Curve] factors. Generally, the splice loss caused by "Core Curve" is much higher than that by "Core Step."

(4) MFD Mismatch

The loss due to the MFD mismatch of the left and right fibers. Use this factor only when the arc discharge time exceeds 5 seconds. The equation refers to values set in [MFD-L] and [MFD-R]. With some types of fibers, the actual splice loss does not agree with the estimated loss when only the MFD value is entered, so the estimated loss should be adjusted by the [MFD Mismatch] factor.

§ 6.2.6. ECF Splice

When fibers with eccentric core are aligned, their outer claddings are offset as shown below. Heating them with arc discharge fuses the fiber surfaces, surface tension are created which causes the outer claddings to align (viscous self-centering). As a result, core axial offset occurs, resulting a high splice loss.

By using ECF (Eccentricity Correct Function) for fiber splicing, it can solve the problem. With this function, the amount by which the outer claddings are restored by surface tension is calculated in advance, and the core axes are offset by the calculated amount after aligning the fibers. Thus, the core axes are aligned after heating with arc discharge. The effect of the core step remains, but the loss due to it is much lower than that due to the core axial offset. A long arc discharge counteracts ECF because surface tensions will eventually create cladding alignment. At that time, set ECF to "OFF".
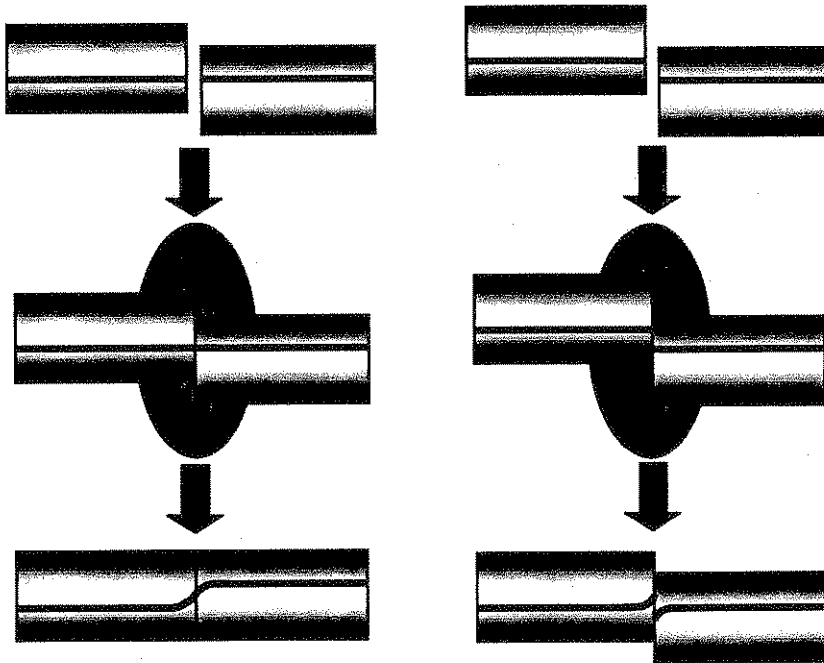
Fig. 6-25. ECF Splice

§ 6.2.7. Manual Splice Mode

Mode used to splice fibers manually. The following two methods can create a manual splice mode on the [Splice Mode Select] list.

Making a new manual mode

(1) Change the [Fiber Type] to "SPECIAL" in [Splice Mode Edit].

(2) Select "MANUAL" from the "Database Area."

Fig. 6-26. Manual Mode Selection (1)

Change to a new manual mode

(1) A manual splice mode can only be made from the SPECIAL mode.

(2) Change the [Align] to "Manual" in [Splice Mode Edit].

(3) The [ECF] and [Auto Power] are automatically set to "OFF."
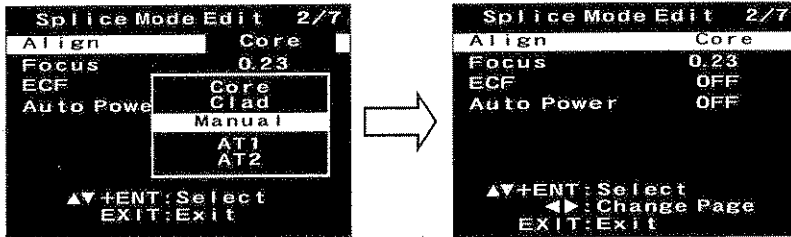
Fig. 6-27 Manual Mode Selection (2)

Splicing in the manual mode

(1) Press 《SET》 and the splicer gap-sets the left and right fibers and pauses.

(2) By pressing 《MENU》, change selection of manually operable motors. The names of the motors are displayed in the upper section of the screen.
By pressing 《ENT》, change the motor speed to either "Fast" or "Slow."

(3) Pressing 《▲》《▼》《◀》《▶》 operates the motor. The motors types and key operations are listed below.

(4) Upon completion of manual aligning, press 《ARC》 to splice fibers.

⇨ Note : When the motor reaches the limit of the operating range, the buzzer sounds and the motor stops. As the motor cannot move further, press the key for reversing the motor.

⇨ Note : By pressing 《HELP》, delete the message on the screen. Pressing it again displays the message.
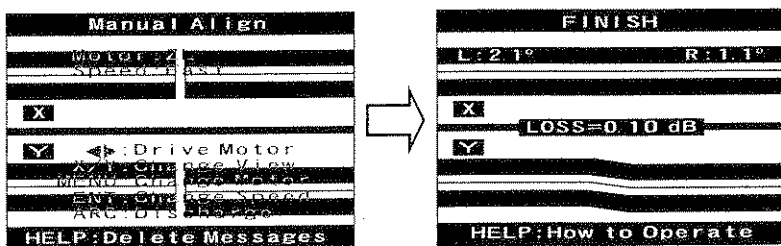
Motor	Z motors:▶, Others: ▲	Z motors:◀, Others: ▼
ZL	Moves left fiber forward.	Moves left fiber backward.
ZR	Moves right fiber backward.	Moves right fiber forward.
X	Moves X-fiber upward.	Moves X-fiber downward.
Y	Moves Y-fiber upward.	Moves Y-fiber downward.
Focus X	X-lens moves nearer fiber.	X-lens moves away from fiber.
Focus Y	Y-lens moves nearer fiber.	Y-lens moves away from fiber.

Fig. 6-28. Manual Mode Operation

§ 6.2.8. Attenuation Splice Mode

The mode to splice fibers with axial offset in order to make an attenuator. There are two types of attenuation splice modes as shown below.

AT1 mode
The splicer automatically makes adequate offset amount of the fibers according to the loss entered in [Target Loss].

AT2 mode
The splicer offsets the fibers, referring to the amount entered in [Start Offset]. Re-arc discharge is automatically repeated until the offset amount reaches the amount entered in [Stop Offset]. The splicer does not estimatethe splice loss in this mode.

The following two methods can create an attenuation splice mode on the [Splice Mode Select] list.

Making a new attenuation mode

(1) Change the [Fiber Type] to"SPECIAL" in [Splice Mode Edit].

(2) Select "AT1(SM)", "AT1(DS)", "AT2(SM)", "AT2(DS)" or "AT2(MM)" from the "Database Area."
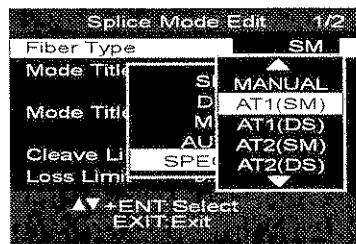
Fig. 6-29. Selection of Attenuation Mode (1)

Change to an attenuation mode

(1) An attenuation splice mode can only be made from the SPECIAL mode.

(2) Change [Align] to either"AT1" , "AT2" , "AT2-MM" in [Splice Mode Edit].
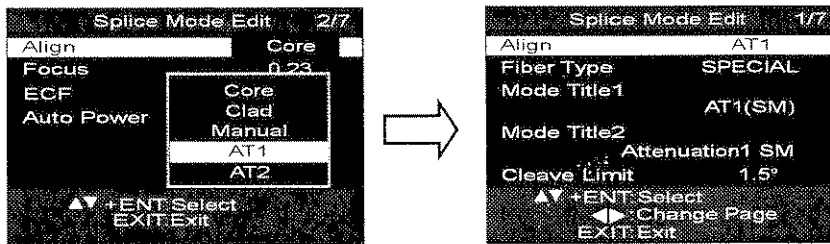
Fig. 6-30. Selection of Attenuation Mode (2)

Editing AT1 mode

Parameter	Description
Target Loss	· Sets the target splice loss. · Setting Range : 0.1 - 15.0 dB,　Step : 0.1 dB
MFD	· Sets the MFD of fibers to be spliced. · Setting Range : 1.0 - 100 um,　Step : 0.1 um
Coefficient	· When the actual loss does not agree with the target loss, adjustment is made using this [Coefficient] parameter. · Setting Range : 0.01 - 2.00,　Step : 0.01 Initial Setting : 1.00 · The splice loss becomes higher with greater [Coefficient] and becomes lower with smaller [Coefficient].
Other Parameters	· Refer to § 6.2.4 (Page 67).

Fig. 6-31. Editing Attenuation1 Mode

Editing AT2 and AT2-MM mode

Parameter	Description
Start Offset	• Sets the axial offset amount before splicing. • Setting Range : 1.0 - 25.0 um, Step : 0.1 um
Stop Offset	• Sets the axial offset amount at which to stop arc discharge. Re-arc discharge is repeated until the axial offset amount set herein is reached. • Setting Range : 0.8 - (80% of [Start Offset]) um, Step : 0.1 um • The axial offset amount set in [Start Offset] decreases by heating with arc discharge. Therefore, 80% of [Start Offset] is the maximum amount of [Stop Offset] setting.
Other Parameters	• Refer to § 6.2.4 (Page 67).

Fig. 6-32. Editing Attenuation2 Mode

✎ Note : The AT1 mode has a splice loss estimating function.   In some cases, the correct value of estimated loss is not displayed due to the characteristics of fibers spliced.   The estimated loss value is used for reference only in the AT1 mode.   So it is recommendable to use a power meter to confirm the splice loss.

✎ Note : If the actual splice loss does not agree with the target loss in the AT1 mode, make correction by adjusting the [Coefficient] parameter.   This parameter can make finer correction than the [Target Loss] and [MFD] parameters.

✎ Note : The AT2 mode has a little higher stability for the attenuated loss than the AT1 mode.   However, some variation can occur inevitably.   To suppress variation, set the cleave limit at a low level (e.g., 1.0 °).

✎ Note : When it is necessary to make an attenuator that is higher in accuracy than that made in the AT1 or AT2 mode, adjust the splice loss by re-arc discharge, observing the attenuated loss with the power meter.

✎ Note : The "AT2-MM" mode is attenuation splice for MM fiber.   The usual "AT2" mode observes the core axial offset.   However the "AT2-MM" mode observes the cladding axial offset.

§ 6.2.9. Splice Mode Initializing / Rearrangement

(1) Splice mode initializing

The initial settings of the splice modes are recorded in the "Database Area" of the splicer as shown on next page. By changing the [Fiber Type] on the [Splice Mode Edit], it is possible to copy the initial settings stored in the "Database Area". Upon completion of copying, the intended splice mode is in the initialized state.

(2) Splice mode rearrangement

By using the function of copying the initial settings in the "Database Area", rearrangement of the splice modes is possible in the "User Programmable Area." It is recommendable to rearrange them in the order of the frequency of use for convenience.

With this rearrangement, the splice modes are initialized. To rearrange them without initializing, it is necessary to use a PC. Copy the contents of the "User Programmable Area" onto the PC and rearrange the splice modes on the PC, not on the splicer. Then, copy them from the PC onto the "User Programmable Area."

⇨ Note : For details of the data transfer to or from the PC, refer to § 7 (Page 118).

⇨ Note : Splice modes are successively added to the "Database Area". The "Database Area" cannot be upgraded even by using the PC. To upgrade it, contact your nearest sales agency.

[Splice Mode Edit]

Database Area
Normal + Special modes

1:	SM Standard SM
2:	DS Standard DS
3:	MM Standard MM
4:	AUTO SM/DS/MM

1:	SM-SM Standard SM
2:	DS-DS Standard DS
3:	MM-MM Standard MM
4:	MANUAL Manual Splice
5:	AT1(SM) Attenuation1 SM
6:	AT1(DS) Attenuation1 DS
7:	AT2(SM) Attenu2 SM 3dB
8:	AT2(DS) Attenu2 DS 3dB
9:	AT2(MM) Attenuation2 MM
10:	LF-LF LEAF
11:	BLANK

COPY

User Programmable Area
40 modes

1:	SM Standard SM
2:	DS Standard DS
3:	MM Standard MM
4:	AUTO SM/DS/MM
5:	SM Standard SM
39:	MM Standard MM
40:	AUTO SM/DS/MM

PC

Fig. 6-33. Splice Mode Arrangement

§ 6.3. Heater Mode

The splicer has 10 heater modes whose settings can be changed. Before starting the splice operation, select the most appropriate heater mode for the fiber protection sleeves to be used.

§ 6.3.1. Heater Mode Selection

(1) Move the cursor to the [Heater Mode Menu] in the [Main Menu] (or [Power-On Menu]) and press ⟨ENT⟩.

(2) The [Heater Mode Select] screen is displayed. Press ⟨▲⟩ or ⟨▼⟩ to move the cursor to the heater mode to be used, and press ⟨ENT⟩. For the types of heater modes, refer to the following.

Heater Mode	Description
60mm	The mode to heat standard 60 mm sleeves. Optimized using the following product: • Product Code : FP-03 or FP-03M, Fujikura Ltd.
60Ny8mm	The mode to heat Ny secondary-coated, 8mm stripped fibers with the above 60mm sleeves. As the Ny coating is not resistant to heat, the heating temperature is set low. Note: Splicing 8mm stripped secondary coated fibers requires the splicer to be fitted with the optional parts (Set Plate B).
40mm	The mode to heat standard 40mm sleeves. Optimized using the following product: • Product Code : FP-03 (L=40), Fujikura Ltd.
40Ny8mm	The mode to heat Ny-coated 8mm stripped fibers with the above 40mm sleeves.
34mm	The mode to heat the following 34mm micro sleeves: • Product Code : FPS01-250-34, Fujikura Ltd.
25mm	The mode to heat the following 25mm micro sleeves: • Product Code : FPS01-250-25, Fujikura Ltd.
20mm	The mode to heat the following 20mm micro sleeves: • Product Code : FPS01-250-20, Fujikura Ltd.

Fig. 6-34. Types of Heater Modes

(3) The heater mode currently selected is displayed at the lower right of the [Main Menu] (or [Power-On Menu]).   Make sure your selection is right.
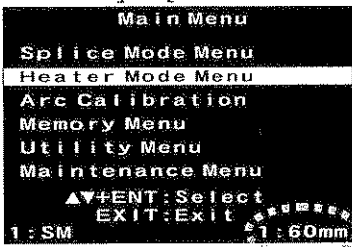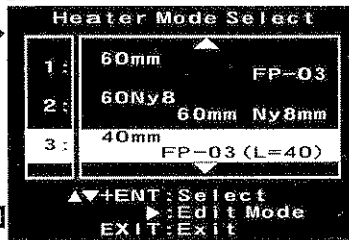
[Main Menu] or [Power-On Menu]
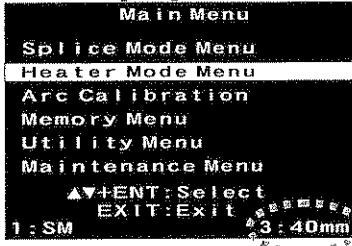
Fig. 6-35. Heater Mode Selection

↪ Note : To initialize the heater modes or rearrange them so as to be easily visible, refer to § 6.3.3 (Page 92).

§ 6.3.2. Editing Heater Mode

The settings of the heating conditions stored in the heater mode can be edited in the following ways:

(1) Open the [Heater Mode Select] screen. Press ⟨▲⟩ or ⟨▼⟩ to move the cursor to the heater mode to be edited, and press ⟨▶⟩.

(2) The [Heater Mode Edit] screen is displayed. Press ⟨▲⟩ or ⟨▼⟩ to move the cursor to the parameter whose setting to be changed, and press ⟨ENT⟩. For details of parameters, refer to next page. How to change numerical values is displayed in the lower section of the screen.

(3) After changing the setting, press ⟨EXIT⟩ to return to the [Heater Mode Select] screen.

Parameter	Description
Sleeve Type	• Select an appropriate sleeve type from Fig. 6-34 (Page 88). • When the [Sleeve Type] is changed, all settings of the heater mode being edited are initialized. When initializing a new sleeve type, the heater mode stored in the "Database Area" Fig. 6-38 (Page 93) is overwritten on the heater mode being edited. Always set the [Sleeve Type] before attempting to change other settings. • For details of heater mode initializing and rearrangement, refer to § 6.3.3 (Page 92).

Fig. 6-36. Heater Mode (1)

Parameter	Description
Mode Title1	• The characters entered in this field are displayed as the name of heating mode at the lower right of the screen when the splicing operation is in progress. • Maximum characters : 5
Mode Title2	• The characters entered in this field are displayed as an explanation of the heater mode on the [Heater Mode Select] screen. • Maximum characters : 13
Heat Time	• Sets the standard heating time from the start of heating by the ⟨HEAT⟩ till the end of heating (end of cooling). • Setting Range : 0 - 240 sec Initial Setting : Depends on the selected heater mode. • As the heating time is automatically corrected according to the outside air temperature, etc., the set heating time is different from the actual heating time.
Heat Temp	• Sets the sleeve heating temperature. • Setting Range : 100 - 250 °C Initial Setting : Depends on the selected heater mode.
Finish Temp	• The temperature at which the buzzer sounds after the end of heating, notifying that you can remove the sleeve now. • Setting Range : 80 - 250 °C Initial Setting : 100 °C • Finish Temp 100 °C • With higher finish temperature, the buzzer sounds before the sleeve is cooled. With temperature above 100 °C the sleeve may deform when removed from tube heater, causing stress for the fiber to remain at the splice point.

Fig. 6-37. Heater Mode (2)

§ 6.3.3. Initializing & Rearrangement of Heater Modes

(1) Initializing Heater Mode

The initial settings of the heater modes are recorded in the "Database Area" of the splicer as shown on next page. By changing the [Sleeve Type] on the [Heater Mode Edit], it is possible to copy the initial settings stored in the "Database Area." Upon completion of copying, the intended heater mode is in the initialized state.

(2) Rearranging Heater Modes

By using the function of copying the initial settings in the "Database Area," it is possible to rearrange the heater modes in the "User Programmable Area." It is recommendable to rearrange them in the order of the frequency of use for convenience.

With this rearrangement, the heater modes are initialized. To rearrange them without initializing, using a PC is necessary. Copy the contents of the "User Programmable Area" onto the PC and rearrange the heater modes on the PC, not on the splicer. Then, copy them from the PC onto the "User Programmable Area."

Note : A new heater mode is added to the "Database Area," in some cases. The database area cannot be upgraded even by using the PC. To upgrade it, contact your nearest sales agency.
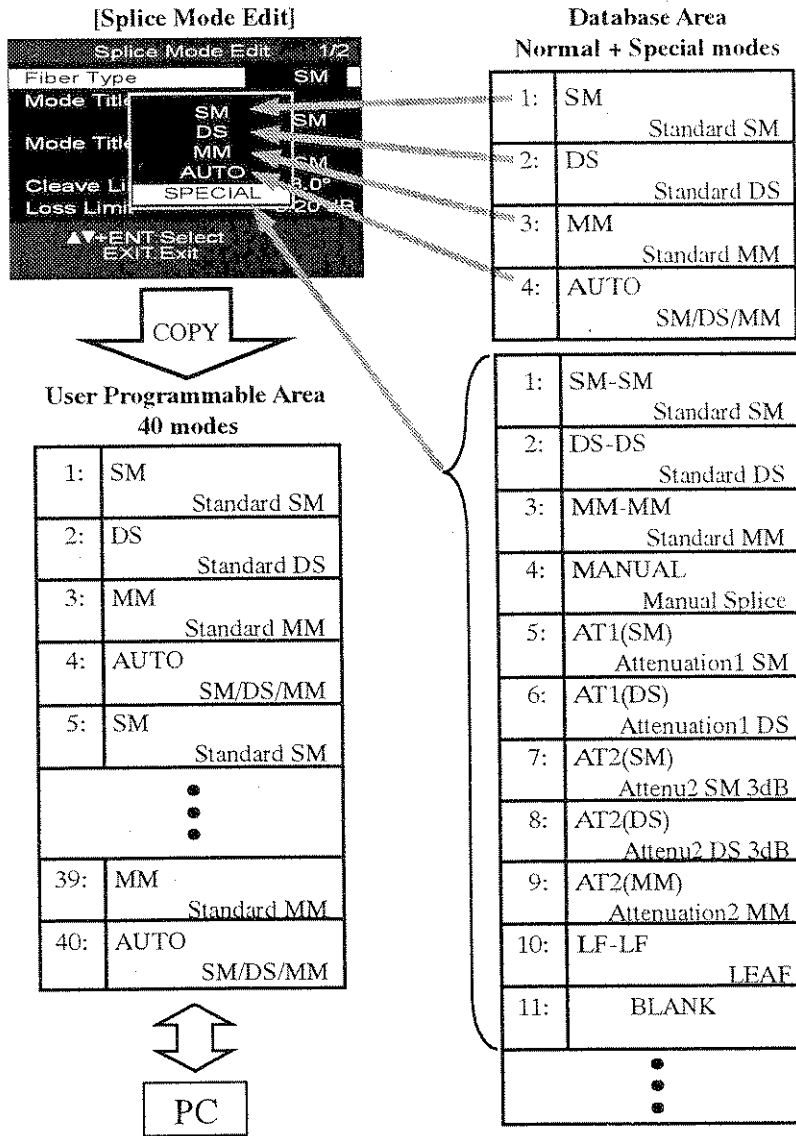
[Heater Mode Edit]

Heater Mode Edit

Sleeve Type   60mm

Mode Title1   ▲
Mode Title2   60mm
                 60Ny8mm
                 40mm
Heat Time   40Ny8mm
Heat Temp   34mm
Finish Temp   ▼

▲▼+ENT:Select
EXIT:Exit
1:SM   1:60mm

COPY

User Programmable Area
10 modes

1:	60mm FP-03
2:	60Ny8mm 60mm Ny8mm
3:	40mm FP-03(L=40)
4:	40Ny8mm 40mm Ny8mm
5:	34mm FPS01-250-34
	● ● ●
9:	60Ny8mm 60mm Ny8mm
10:	40mm FP-03(L=40)

Database Area

1:	60mm FP-03
2:	60Ny8mm 60mm Ny8mm
3:	40mm FP-03(L=40)
4:	40Ny8mm 40mm Ny8mm
5:	34mm FPS01-250-34
6:	25mm FPS01-250-25
7:	20mm FPS01-250-20
8:	Blank
9:	Blank
10:	Blank
	● ● ●

PC

Fig. 6-38. Heater Mode Arrangement

§ 6.4. Arc Calibration

Refer to the description given in § 5.1.5 (Page 47).

§ 6.5. Splice Result Memory

The splicer can store data on 2000 splice results.   The data stored in it are
listed as below.

SM / DS / MM / AUTO mode	SPECIAL mode
Memory No. 1234 1/2 2000. 1. 1 18:00 1 : SM Standard SM LOSS=0.02dB FAT CLV L:1.6 R:0.6 OFS Core:0.7 Clad:0.7 ENT:Input Comment ◀▶:Change Page EXIT:Exit	Memory No. 1235 1/3 2000. 1. 1 18:05 7 : SM-SM Standard SM LOSS=0.02dB BUBBLE CLV L:1.6 R:0.6 OFS Core:0.7 Clad:0.7 ENT:Input Comment ◀▶:Change Page EXIT:Exit
Memory No. 1234 2/2 Cleave Limit 2.0° Loss Limit 0.20 dB Arc Power 20 bit Arc Time 2000 ms ◀▶:Change Page EXIT:Exit	Memory No. 1235 2/3 Cleave Limit 2.0° Loss Limit 0.20 dB Arc Power 20 bit Arc Time 2000 ms ◀▶:Change Page EXIT:Exit
	Memory No. 1235 3/3 Arc2 Power 20 bit Arc2 Time OFF Prefuse Power 20 bit Prefuse Time 180 ms Overlap 20 μm Gap 15 μm Gapset Pos. CENTER ◀▶:Change Page EXIT:Exit

Fig. 6-39. Data Stored in Splicing Result Memory

§ 6.5.1. Storage in Splice Result Memory

```
                    ┌─────────────────────────┐
                    │   "Finish" screen after │
                    │     loss estimation     │
                    └─────────────────────────┘
```

Route 1	Route 2	Route 3
Automatic storage with same comment	Storage with comment input	Storage cancel

```
        Memory Storage Menu          Memory Storage Menu

        Storage/Comment Input        Storage/Comment Input

        Memory Storage Cancel        Memory Storage Cancel


           ▲▼+ENT:Select               ▲▼+ENT:Select
             EXIT:Exit                   EXIT:Exit
        1:SM            1:60mm        1:SM            1:60mm


              Comment Input
          Fiber No:  R123■
          ◄  SPACE    FINISH ►

          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
          0 1 2 3 4 5 6 7 8 9 . @ ¥
          + - * / = ( ) ! ? # $ % &
             ▲▼◄►+ENT:Input
               EXIT:Exit
```

"〈SET〉 or 〈RESET〉 pressed" or "Cover opened"

Data storage	No data storage

Fig. 6-40. Flow of Data Storage

(1) Storing splicing data automatically

Press 〈SET〉 or 〈RESET〉 on the [FINISH] screen or open the wind protector cover and the splice result data are automatically stored in the memory.

· The comment on the last stored splice result data are automatically copied onto the comment area for the splice result data to be next stored. Enter a comment in the last stored splice result data by [Display Memory] function. Refer to § 6.5.2 (next page).

· If a comment is entered and stored in the [FINISH] state at the first splice operation, the same comment will be entered in the succeeding splice result data. Refer to § 6.5.2 (next page).

(2) Storing splicing data with comment entered

Press 〈ENT〉 on the [FINISH] screen and the [Memory Storage Menu] screen opens. Press 〈ENT〉, following the message [Storage/Comment Input]. As the [Comment Input] screen opens, enter a comment. Press 〈SET〉 or 〈RESET〉 on the [FINISH] screen or open the wind protector cover and the splice result data are stored together with the comment.

(3) Not storing splicing data

Press 〈ENT〉 on the [FINISH] screen and the [Memory Storage Menu] screen opens. Press ENT, following the message [Memory Storage Cancel], and you return to the [FINISH] screen. In this case, the splice result data is not stored by pressing 〈SET〉 or 〈RESET〉, or opening the wind protector.

⇨ *Note : It is possible to make the splicer store all splice records by disabling the function [Memory Storage Cancel]. Refer to § 6.6.3 (Page 105). A password is required to change the settings.*

⇨ *Note : The data stored in the splice result memory can be transmitted to the PC. For details of the data transfer to the PC, refer to § 7 (Page 118).*

§ 6.5.2. Display of Splice Result Memory

The function to display the splice result data stored in the memory. With this function, it is possible to enter or edit a comment.

(1) Open the [Memory Menu] from the [Main Menu].

(2) Press ⟨ENT⟩ to select [Display Memory], and open the [Memory Display] screen.

(3) Specify the memory number by either of the following methods:
- Move the cursor to the memory number of the data to be displayed, and press ⟨ENT⟩.
- Press ⟨▶⟩ to open the small window [Jump to]. Specify the memory number and press ⟨ENT⟩ twice.

(4) The splice result data are displayed. To enter or edit a comment, press ⟨ENT⟩. The [Input Comment] screen is displayed.
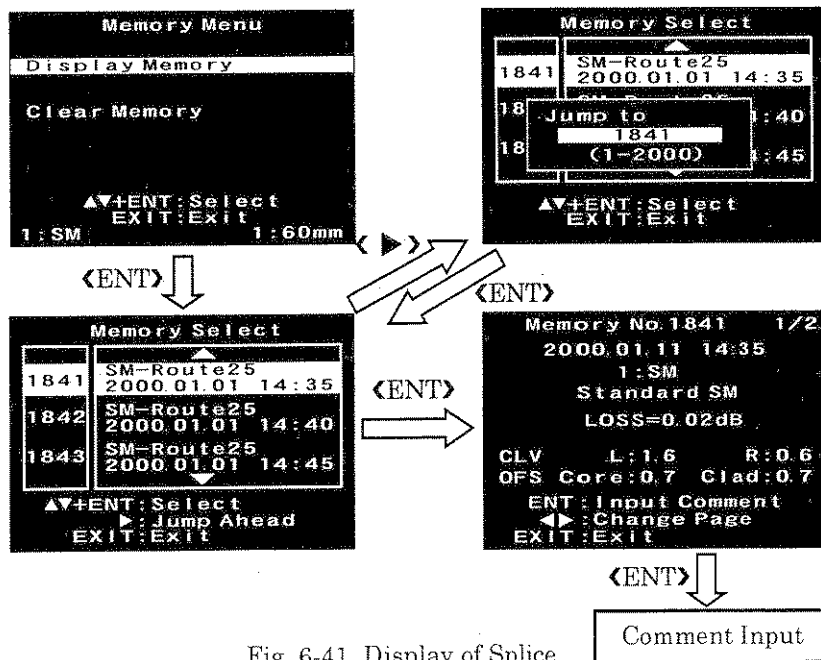
Fig. 6-41. Display of Splice Result Memory

§ 6.5.3. Clearing Splice Result Memory

This function enables to erase part or all of the splice result data stored in the memory.   Use the function to erase any unnecessary data.

> *Note : When splice result data have been written in all areas for 2000 splice results, the next data is stored, at the top (#0001) of the memory.   With the return to the top of the memory, the past data is erased and overwritten with new data.*

Method of clearing partial memory

(1) Move the cursor to [Clear Memory] on the [Memory Menu] screen and press ⟨ENT⟩.   The [Memory Clear] screen opens.

(2) Move the cursor to [Clear Partial Memory] and press ⟨ENT⟩.   The [Partial Memory Clear] screen is displayed.

(3) Enter the memory start and finish numbers in the fields [From] and [to], respectively, and press ⟨ENT⟩.   The selected range is cleared.

> *Note : In the case of partial clearing, the data succeeding the cleared range moves up, filling the blank space left after clearing.*

> *Note : When the [to] (finish) number is smaller than the [From] (start) number, partial clearing is not executed.   In this case, correct the numbers and re-enter.*

Method of clearing all memory

(1) Move the cursor to [Clear Memory] on the [Memory Menu] screen and press ⟨ENT⟩.   The [Memory Clear] screen opens.

(2) Move the cursor to [Clear All Memory] and press ⟨ENT⟩.   The [All Clear Memory] screen opens.

(3) Pressing ⟨ENT⟩ erases all splicing data.
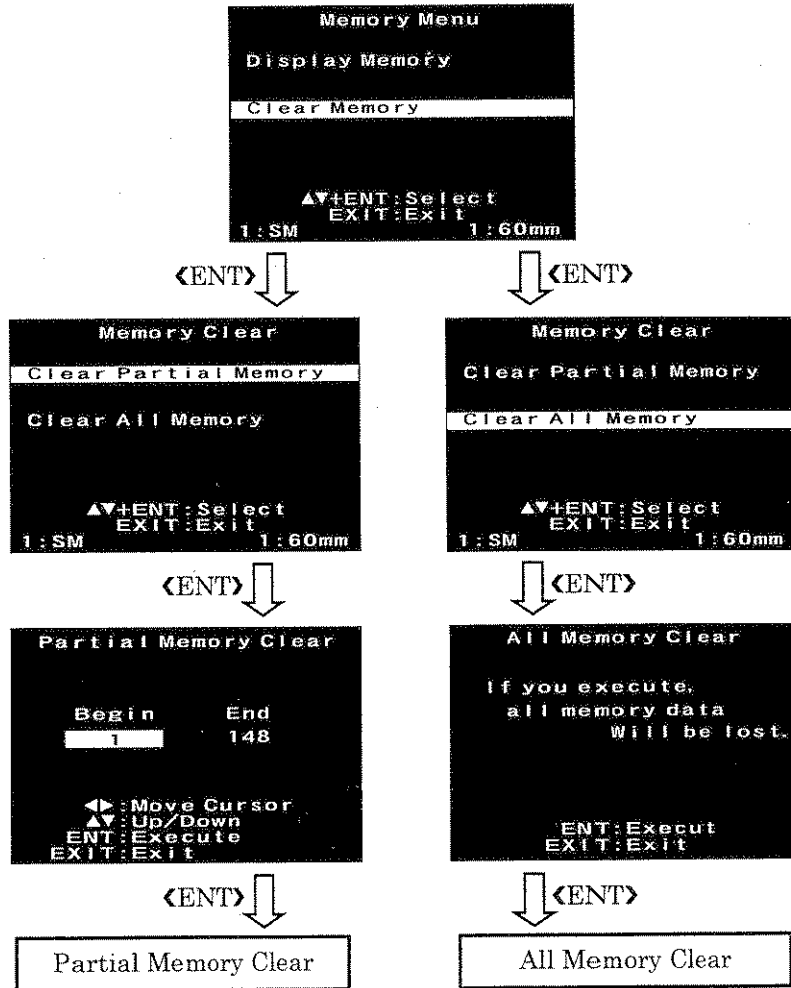
Fig. 6-42. Memory Clearing Method

§ 6.6. Utility Menu

This menu is used to change settings other than the splice and heater modes.

§ 6.6.1. Setting Parameters

Parameter	Description
Language	• Sets the language to be displayed on the screen.
Pause1	• "ON" causes pause after the splicer gap-sets the left and right fibers. Cleave angle measurement is made before the splicer pauses. • For the state of the [Pause] screen, refer to § 3 (page 18). • Initial Setting : OFF
Pause2	• "ON" causes pause after the splicer aligns the left and right fibers. • With ECF on, the cores of the left and right fibers are not aligned even after finishing the alignment process. For details, refer to § 6.2.6 (Page 79). Note that ECF is set to "ON" in the SM and DS modes. In the AUTO mode, ECF is "ON" when the fibers are judged to be of SM or DS type. • Initial Setting : OFF

Fig. 6-43. Utility Menu (1)

Parameter	Description
Cleave Data	• "ON" displays the results of cleave angle measurement of the left and right fibers. In the SPECIAL mode, the results of core angle measurement are displayed additionally. • Initial Setting : ON
Offset Data	• "ON" displays the amount of core axial offset and the amount of cladding axial offset on the screen. • Initial Setting : OFF
Proof Test	• "ON": Performs a proof test after splicing. • Initial Setting : ON
Sensor Value	• Displays the values measured by different sensors. • The value measured by the temperature sensor sometimes is displayed higher than that of the ambient temperature caused by self-heating of the splicer. • The power source type shows the result of identifying the type of the power supply unit installed in the splicer. For details, refer to § 6.6.2 (Next Page).
Power Saving Menu	• Sets the power saving mode. Refer to § 6.6.2 (Next Page).
Configurations	• Used to precisely set various operations of the splicer and when the supervisor restricts its functions. Refer to § 6.6.3 (Page 105).

Fig. 6-44. Utility Menu (2)

§ 6.6.2. Power Saving Menu

Without setting the power saving function when using the battery pack, the number of splice cycles by a battery pack will be decreased. It is important that this function be enabled for energy conservation.

The splicer automatically identifies the type of the power supply unit. In addition, it can program an independent power saving setting. Utilizing these features enables automatic turning on or off of the power saving function after detecting the following types of power supply units:

- AC adapter (ADC-07)
  Automatically turns off the power saving function.

- Battery packs (BTR-05, BTR-04, DCA-01)
  Automatically turn on the power saving function.

Method of changing the power saving settings

For example, change the parameter [Monitor Shut Down] when using the battery pack. At present, assume that the ADC-07 is installed.

(1) The [Power Source Type] is set to "Auto Detect" on the screen below.
   - The splicer is aware that the ADC-07 is installed (section ①).
   - The currently displayed settings of the parameters [Monitor Shut Down] and [Splicer Shut Down] (sections ②) are for the AC adapter, not for the battery pack.
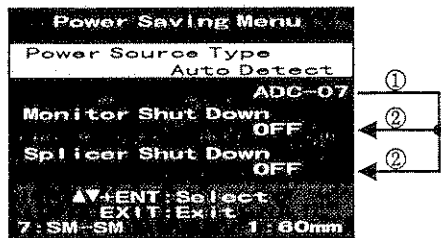
Fig. 6-45. Change of Power Saving Settings (1)

Turn off the power and change the ADC-07 currently in use to the BTR-05. By confirming the change to "BTR-05 (NiMH) / DCA-01" in display section ① and changing the settings in display sections ②. Finally, change the settings for the battery pack. To make this change with the ADC-07 installed, refer to the next step.

(2) To display the settings for the battery pack, change the [Power Source Type] to "BTR-05 (NiMH) / DCA-01." In this state, change the power saving settings for the battery pack.
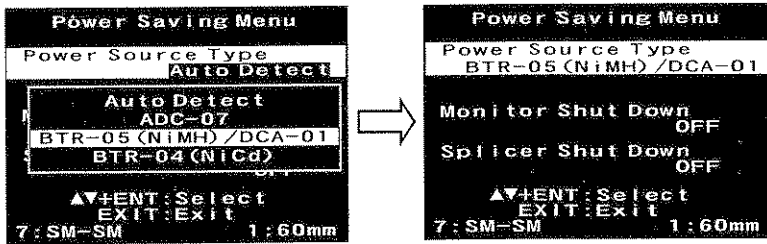
Fig. 6-46. Change of Power Saving Settings (2)

(3) <u>After changing the settings, always return the [Power Source Type] to "Auto Detect."</u>

Initial Settings at Factory

Parameter	Initial Settings		
Power Source Type	ADC-07	BTR-05(NiMH) DCA-01	BTR-04(NiCd)
Monitor Shut Down	OFF	20 seconds BTR-05/BTR-04 common parameter	
Splicer Shut Down	OFF	6 minutes BTR-05/BTR-04 common parameter	

Battery Indicator

Battery indicator on [READY]	None	Displayed	Displayed
Battery indication	None	for NiMH	for NiCd

Fig. 6-47. Initial Settings & Battery Indicator

Parameter	Description
Power Source Type	• Selects the type of power supply unit before setting the power saving parameters. Usually set it to "Auto Detect." • It is necessary for the "Auto Detect" function to have a power supply unit with "ID" mark on label. If an old type of power supply unit without "ID" mark such as those attached to different products (FSM-30R, FSM-16R and FSM-16S) is installed, the "Auto Detect" function does not detect it correctly. Set this [Power Source Type] manually, instead of using the "Auto Detect" function.
Monitor Shut Down	• Setting this function turns off the power supply to the LCD monitor and two cameras if the splicer performs no operation for a certain period of time. As the effect of power saving is great, always set this function when using the battery pack. • Setting Range : 0 (OFF) - 600 sec • When the power supply to the LCD monitor and two cameras turns off, the LED lamp at the upper right of the ⟨SET⟩ key blinks. Pressing ⟨SET⟩ turns on the LCD monitor and cameras again.
Splicer Shut Down	• Automatically turns off the power supply to the splicer if it performs no operation for a certain period of time. The function serves to prevent the battery capacity running low due to failure in turning off the splicer power. Enter a longer time than the mean splicing cycle time. • Setting Range : 0 (OFF) - 120 min

Fig. 6-48. Power Saving Parameters

↪ *Note : The battery mode "BTR-04(NiCd)" described in this section, however, the BTR-04 is for a different product.   The standard battery pack of FSM-40S is BTR-05(NiMH).   Do not use the BTR-04 except in case of emergency.*

§ 6.6.3. Configurations

This function is used to precisely set various operations of the splicer and when the supervisor restricts its functions.

(1) Move the cursor to [Configurations] on the [Utility Menu] screen and press ⟨ENT⟩. The [Password] screen is displayed.

Fig. 6-49. Password Screen

(2) Move the cursor onto each character to be entered, and press ⟨ENT⟩ to enter them.

(3) After inputting the password, move the cursor to [FINISH] and press ⟨ENT⟩. When the input agrees with the preset password, the [Configurations] screen is displayed. If not, the [Utility Menu] screen opens again.

⇨ *Note : At the time of shipment from factory, the password is set at "0".*

⇨ *Note : To change the password, use the [Password] field of the [Configurations] screen. The maximum number of characters of the password is 8 (eight).*

⇨ *Note : In the event you have forgotten your password, contact your nearest sales agency.*

Initial Settings

```
Configurations  1/16       Configurations   5/16

System Settings            Power On Settings

 Password     ????????      Opening Title1
 RS-232C      19200 bps
 Buzzer Vol.      6         Opening Title2
                                   Fujikura Ltd.

 ▲▼+ENT:Select             ▲▼+ENT:Select
     ◄►:Change Page             ◄►:Change Page
    EXIT:Exit                  EXIT:Exit
```

```
Configurations  2/16       Configurations   6/16

Ignore Splice Error        Power On Settings

 Cleave       Enable        Power ON Menu
 Loss         Enable                   ON
 Core Angle   Enable
 Bubble       Enable        Dust Check
 Fat          Enable                  OFF
 Thin         Enable

 ▲▼+ENT:Select             ▲▼+ENT:Select
     ◄►:Change Page             ◄►:Change Page
    EXIT:Exit                  EXIT:Exit
```

```
Configurations  3/16       Configurations   7/16

Arc Calibration            Fiber Image on Screen
                            Gapset          X
 Cleave Limit    3.0°       Pause1          X/Y
                            Align           Y
                            Pause2          X/Y
 Max. Num. of Tests         Arc             Y
                   ∞         Estimate        Y

 ▲▼+ENT:Select             ▲▼+ENT:Select
     ◄►:Change Page             ◄►:Change Page
    EXIT:Exit                  EXIT:Exit
```

```
Configurations  4/16       Configurations   8/16

Arc Compensation           Splice Mode
                            Edit         Enable
 Pressure        ON         Select       Enable

 Temperature     ON         Heater Mode
                            Edit         Enable
 Humidity        ON         Select       Enable

 ▲▼+ENT:Select             ▲▼+ENT:Select
     ◄►:Change Page             ◄►:Change Page
    EXIT:Exit                  EXIT:Exit
```

Fig. 6-50. Configurations (1)

```
Configurations  9/16

Memory Operation

Clear
                 Enable
Cancel Data Storage
                 Enable


▲▼+ENT:Select
   ◄►:Change Page
   EXIT:Exit
```

```
Configurations  13/16

Maintenance

Discharge Battery
                 Enable
Calendar Set
                 Enable


▲▼+ENT:Select
   ◄►:Change Page
   EXIT:Exit
```

```
Configurations  10/16

Power Saving Edit

Monitor
                 Enable
Splicer
                 Enable


▲▼+ENT:Select
   ◄►:Change Page
   EXIT:Exit
```

```
Configurations  14/16

Other Settings

Re-align after Pause2
                 ON
Max.Number of Rearcs
                 ∞


▲▼+ENT:Select
   ◄►:Change Page
   EXIT:Exit
```

```
Configurations  11/16

Maintenance

Arc Calibration
                 Enable
Dust Check
                 Enable
Diagnostic Test
                 Enable
▲▼+ENT:Select
   ◄►:Change Page
   EXIT:Exit
```

```
Configurations  15/16

Other Settings

Electrode Caution
                 1000
Electrode Warning
                 2000


▲▼+ENT:Select
   ◄►:Change Page
   EXIT:Exit
```

```
Configurations  12/16

Maintenance

Replace Electrodes
                 Enable
Clear Arc Count
                 Enable
Motor Drive
                 Enable
▲▼+ENT:Select
   ◄►:Change Page
   EXIT:Exit
```

```
Configurations  16/16

Other Settings

Last Maintenance
                 2000.01.01
Last Maintenance
                 2001.01.01


▲▼+ENT:Select
   ◄►:Change Page
   EXIT:Exit
```

Fig. 6-51. Configurations (2)

Parameter	Description
System Settings	
Password	Changes the password to access the [Configurations]. Maximum Characters : 8
RS-232C	Sets the speed of communication with the PC. Setting Range : 2400, 9600, 19200 bps
Buzzer Vol.	Sets the sound volume of the buzzer. Setting Range : 0 (OFF) - 10、 Step : 1
Ignore Splice Error	
Cleave	Setting to "Disable" prevents the splicer to continue a splice in disregard of the message "Cleave Angle Error."
Core Angle	
Loss	Setting to "Disable" prevents the splicer to normally finish its operation in disregard of the message "Loss Error," "Core Angle Error," "Bubble Error," "Fat Error" or "Thin Error."
Bubble	
Fat	
Thin	
Arc Calibration	
Cleave Limit	Sets the threshold of cleave angle error in the [Arc Calibration]. Setting Range : 0.0 (OFF) - 10.0 °, Step : 0.1 °
Max. Num. of Tests	Sets the number of tests to finish the [Arc Calibration] with "Test Finished" message. Setting Range : ∞ - 1 - 20, Step : 1

Fig. 6-52. Configurations (3)

Parameter	Description
Arc Compensation	
Pressure	Setting to "OFF" turns off the function of arc power compensation by pressure, temperature and humidity.
Temperature	
Humidity	
Power On Settings	
Opening Title1	Sets the message to be displayed when the power is turned on.
Opening Title2	Max. number of characters : 15 (Opening Title1) 15 (Opening Title2)
Power ON Menu	Setting to "ON" displays the [Power ON Menu] when the power is turned on.
Dust Check	Setting to "ON" executes the [Dust Check] function when the power is turned on.
Fiber Image on Screen	
Gapset	Sets the method of displaying the fiber image on the screen during splicing operation. X : Enlarged display of X-axis image
Pause1	
Align	Y : Enlarged display of Y-axis image X/Y : Composite display of X-axis and Y-axis image
Pause2	X→Y : Change from X-axis enlarged image to Y-axis enlarged image during operation
Arc	Y→X : Change from Y-axis enlarged image to X-axis
Estimate	enlarged image during operation
Splice Mode	
Edit	Setting to "Disable" prevents the function of editing and selecting the splice mode.
Select	
Heater Mode	
Edit	Setting to "Disable" prevents the function of editing and selecting the heater mode.
Select	

Fig. 6-53. Configurations (4)

Parameter	Description
Memory Operation	
Clear	Setting to "Disable" prevents the function of erasing splice result data on the memory.
Cancel Data Storage	Setting to "Disable" prevents the function of canceling storage of splicing data on the [FINISH] screen.
Power Saving Edit	
Monitor	Setting to "Disable" prevents the action of changing the power saving function.
Splicer	
Maintenance	
Arc Calibration	Setting to "Disable" prevents various functions related to maintenance. For details of the maintenance function, refer to § 6.7 (Page 112).
Dust Check	
Diagnostic Test	
Replace Electrodes	
Clear Arc Count	
Motor Drive	
Discharge Battery	
Calendar Set	

Fig. 6-54. Configurations (5)

Parameter	Description
Other Settings	
Realign after Pause2	After a long time in the [PAUSE2] state, alignment may be sometimes lost. Therefore, the splicer performs the realigning function after the end of the [PAUSE2] state. Setting this function to "OFF" prevents this function. When splicing fibers and making axial offset in the [PAUSE2], it is recommendable to use the manual splice mode, instead of setting this function to "OFF."
Max. Number of Rearcs	Re-arc discharge sometimes improves the splice loss, but sometimes worsens it. Splicing with resort to re-arc discharge degrades the total splice quality. With this function, it is possible to limit the number of re-arcs or to disable re-arc discharge. Setting Range : ∞ - 0 - 10, Step : 1
Electrode Caution	When the number of splices made exceeds 1,000, the caution message prompting for electrode replacement is displayed when the power is turned on. When the number of splices exceeds 2,000, the caution message changes to the warning message. The number of arc discharges at which to start these messages is set in this field.
Electrode Warning	
Last Maintenance	The date of last maintenance and the scheduled date for next maintenance are entered in the respective fields. This information is displayed on the [Maintenance Info.] screen. Refer to the next section.
Next Maintenance	

Fig. 6-55. Configurations (6)

§ 6.7. Maintenance Menu

The splicer has the function of performing routine maintenance. This section describes how to use the maintenance menu.

(1) Move the cursor to [Maintenance Menu] on the [Main Menu] screen and press ⟨ENT⟩. The [Maintenance Menu] screen shown below opens.
(2) Move the cursor to the function you want to perform, and press ⟨ENT⟩.
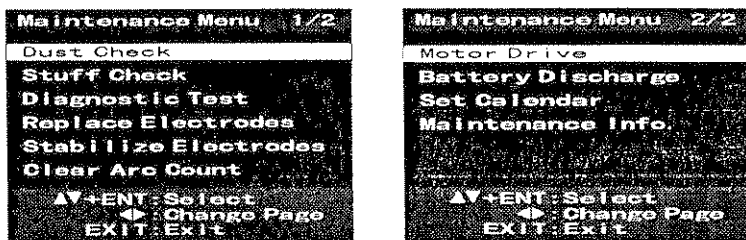
Fig. 6-56. Maintenance Menu Screen

§ 6.7.1. Dust Check

The splicer observes fibers through image processing. Dust or contaminants on the cameras, lenses and wind protector mirrors disturbs normal observation of fibers and may result in improper splicing. This function checks the optical path for the presence or absence of contaminants and judges whether they cause trouble for fiber splicing.

Operation Procedure
(1) Move the cursor to [Dust Check] and press ⟨ENT⟩.
(2) If fibers are set in the splicer, remove them and press ⟨ENT⟩ again. The splicer starts checking.
(3) The message "Now Checking" is displayed in the middle of the screen. After observation, the location of contamination judged as a potential problem blinks. If contamination is discovered, clean the wind protector mirrors and objective lenses and redo [Dust Check]. For the cleaning method, refer to § 5.1.3 (Page 45) and § 5.2.4 (Page 54).
(4) Press ⟨EXIT⟩ to finish dust check.

⤷ *Note : In case you have cleaned the wind protector mirrors and objective lenses, but dust still remains, contact your nearest sales agency.*

§ 6.7.2. Stuff Check

When splicing fibers, the splicer overlaps them by stuffing the left fiber
into the right fiber.   If the overlap (amount of stuffing) is too small or too
large, the splice loss will increase.   This function checks the overlap and
automatically corrects it by adjusting the stuffing speed.

Operational Procedure
(1) Load prepared fibers into the splicer.
(2) Move the cursor to [Stuff Check] and press <ENT>.
3) The splicer checks the overlap. If it is too small or too large, the
   splicer automatically adjusts the stuffing speed.   After the overlap
   has been corrected, the messages "Test Finish" and "OK" are displayed
   on the screen as below.
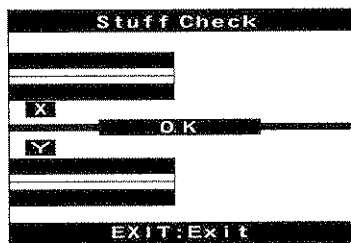
Fig. 6-57. Finish Screen of Stuff Check

*⇨ Note : Overlap changes infrequently, usually the splicer checks it only
once and the stuff check is complete.   However, when the
overlap has changed, the splicer checks it as many times as
necessary to adjust the motor speed.*

§ 6.7.3. Diagnostic Test

Refer to the description given in § 5.2.3 (Page 53).

§ 6.7.4. Replacing Electrodes

Refer to the description given in § 5.2.1 (Page 50).

§ 6.7.5. Stabilizing Electrodes

In the event of sudden change in environmental conditions, etc., the arc power sometimes becomes unstable, resulting in higher splice loss. Especially when the splicer is moved from lowland to highland, it takes time for the arc power to stabilize. In such a case, stabilizing electrodes will expedite the process of making the arc power stable. If many tests are needed until the "Test OK" message appears in [Arc Calibration], use this function as well.

<u>Operational Procedure</u>
(1) Move the cursor to [Stabilize Electrodes] and press ⟨ENT⟩.
(2) Set stripped fibers on both sides of the splicer as in the case of splicing.
(3) Press ⟨ENT⟩ and the splicer begins to stabilize the electrodes in the following ways:
   · Repeat short arc discharge four times to measure the arc position.
   · Performs [Arc calibration] to calibrate the arc power.
   · Perform 30-cycle continuous discharge to stabilize the electrodes.

> ➪ *Note : When the fibers melt back as a result of repeated arc discharges, the splicer will pauses. Set new cleaved fibers into the splicer to complete the electrode stabilization process. Press ⟨ENT⟩ to restart continuous arc discharges.*

(4) After completing stabilization, always perform [Arc Calibration].

> ➪ *Note : This function is included in the [Replace Electrodes] function.*

§ 6.7.6. Clearing Arc Count

This function enables the stored number of arc discharges to be reset.

(1) Move the cursor to [Arc Count Clear] and press ⟨ENT⟩.
(2) As the confirmation screen "Is it OK to clear?" appears, press ⟨ENT⟩ to clear.

> ➪ *Note : This function is included in the [Replace Electrodes] function.*

> ➪ *Note : The number of arc discharges in the "Total Arc Count" field displayed on the [Maintenance Info.] screen cannot be reset.*

§ 6.7.7. Motor Drive

The six motors incorporated in the splicer can be manually operated individually. In the course of splicing, the motors can also be operated by calling this menu on the [PAUSE1], [PAUSE2], [FINISH] state.

⇨ *Note : With the display of the X-axis or Y-axis enlarged fiber image on the [PAUSE1], [PAUSE2], [FINISH] state, the focus motors can be operated by pressing ⟨▲⟩ or ⟨▼⟩.*

Operational Procedure
(1) Move the cursor to [Motor Drive] and press ⟨ENT⟩.
(2) Pressing ⟨MENU⟩ changes motor selection. The name of the selected motor is displayed in the upper section of the screen.
(3) Press ⟨▲⟩ or ⟨▼⟩ to drive the motor in the desired direction.
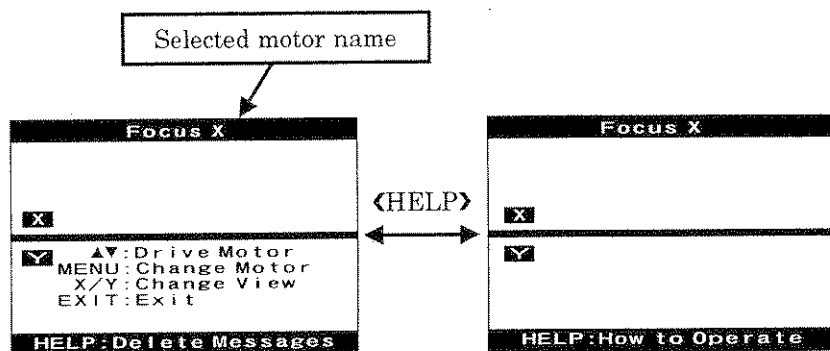
Selected motor name

⟨HELP⟩

Focus X

▲▼:Drive Motor
MENU:Change Motor
X/Y:Change View
EXIT:Exit
HELP:Delete Messages

Focus X

HELP:How to Operate

Motor	Z motors:▶. Others:▲	Z motors:◀. Others:▼
ZL	Moves left fiber forward.	Moves left fiber backward.
ZR	Moves right fiber backward.	Moves right fiber forward.
X	Moves X-fiber upward.	Moves X-fiber downward.
Y	Moves Y-fiber upward.	Moves Y-fiber downward.
Focus X	X-lens moves nearer fiber.	X-lens moves away from fiber.
Focus Y	Y-lens moves nearer fiber.	Y-lens moves away from fiber.

Fig. 6-58. Motor Drive

⇨ Note : When the motor reaches the limit of the operating range, the buzzer sounds and the motor stops.   As the motor cannot move further, press the opposite arrow key to reverse.
⇨ Note : If you finish this operation by pressing ⟨RESET⟩, the motor will return to the reset position.   To finish the operation with the motor held in the adjusted position, press ⟨EXIT⟩.
⇨ Note : If the motor is moved too much with respect to the spliced fiber, the fiber may break.

§ 6.7.8. Battery Discharge

Refer to the description given in § 5.2.5 (Page 55).

§ 6.7.9. Calendar Setting

This function sets the date and time in the calendar incorporated in the splicer.

Operation Procedure

(1) Move the cursor to [Calendar Set] and press ⟨ENT⟩.
(2) As the year, month, day and time are displayed, press ⟨◄⟩ or ⟨►⟩ to move the cursor to the parameters, and press ⟨▲⟩ or ⟨▼⟩ to adjust numerical values.
(3) After completion of calendar setting, press ⟨ENT⟩.   The date and time are stored.

Fig. 6-59. Calendar Set Screen

§ 6.7.10. Maintenance Information

Move the cursor to [Maintenance Info.] and press ⟨ENT⟩. The following information is displayed.

Parameter	Description
Serial Num.	Displays the serial number of the splicer.
ROM Version	Displays the version number of the software.
Arc Count	Displays the number of arc discharges after electrode replacement. Performing the function [Replace Electrodes] or [Arc Count Clear] resets this parameter to zero.
Total Count	Displays the total number of arc discharges.
Last Maintenance	Displays the date of last maintenance. To enter the date, refer to § 6.6.3 (Page 105).
Next Maintenance	Displays the scheduled date of next maintenance. To enter the date, refer to § 6.6.3 (Page 105).

Fig. 6-60. Maintenance Information

§ 7. Personal Computer Communication Function

The splicer has the function of communicating with a personal computer via the RS232C port.

§ 7.1. Communication Software

The communication software uses a Microsoft® EXCEL spreadsheet that includes a macro program (VBA). It can receive all parameter settings and splicing results from the splicer. It can also be used to send the parameters to the splicer. To obtain the EXCEL file and the installation procedure, please contact your nearest sales agency.

§ 7.2. Necessary Items

(1) Personal Computer
- Hardware Requirement
  PC/AT compatible
- Operation System
  Microsoft® Windows® 95 / 98
  or Windows® NT
- Application Software
  Microsoft® EXCEL 97 / 2000

(2) RS232C Cable
- Connection
  Cross Wiring
- Connector Type
  Female
- Cable Length
  Not more than 3m

D-Sub 9pin	D-Sub 9pin
Pin No.	Pin No.
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
Flame	Flame
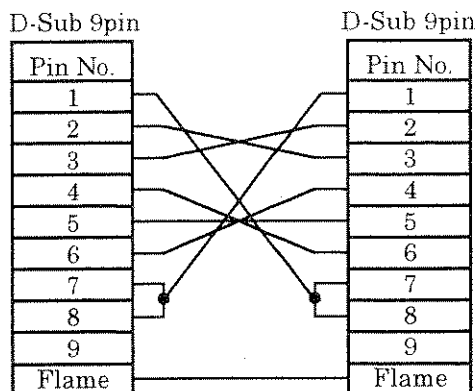
§ 7.3. RS232C Command List

To obtain the latest RS232C command list, please contact your nearest sales agency.

§ 8. Error Massage List

Press 〈HELP〉 when an error is shown on the monitor.

- The [HELP] screen shows the next key operation when an error, without a number, occurs.
- The [HELP] screen shows additional information according to the Error Code and Message.

Follow the remedy precisely as shown in the following lists. If it is not possible to eliminate the problem, there is the possibility of the splicer being faulty and the splicer may require service by a qualified service center. Consult your nearest sales agency with the following information:

- Model name of the splicer
- Serial number of the splicer
- Error message
- Error code (if shown)
- Situation when the error occurs

Error Code		Error Message	Reason	Remedy
01	01	L-Too Long Fiber	• The fiber end-face is set on electrode centerline, or over it.	• Press 〈RESET〉, and set the fiber end-face between the electrode centerline and the V-groove edge.
	02	R-Too Long Fiber	• The cleave length (bare fiber part) is too long.	• Confirm the setting position of stripped end on the fiber cleaver. Check the cleave length.
	03	LR-Too Long Fiber	• Dust or dirt on the objective lens or the wind protector mirror.	• Execute the [Dust Check]. Clean the lens or the mirror when dust or dirt exists.
02	01	X-Too Dark	Dust or dirt on the objective lens or the wind protector mirror.	Execute the [Dust Check]. Clean the lens or the mirror when dust or dirt exists.
	02	Y-Too Dark		
	11	X-Too Dark	The LED or CCD may be out of order.	Consult your nearest sales agency.
	12	Y-Too Dark		

Error Code		Error Message	Reason	Remedy
03	01	L-Fiber too Dusty	· Dust or dirt on the fiber surface.	· Just re-cleaning the fiber surface may result in dust on the end-face. Completely prepare the fiber again (strip, clean and cleave).
			· Dust or dirt on the objective lens or the wind protector mirror.	· Execute the [Dust Check]. Clean the lens or the mirror when dust or dirt exists.
			· [Cleaning Arc] time is too short or "OFF."	· Set the [Cleaning Arc] time to "30ms." When splicing carbon coated fiber, set to "100ms."
	02	R-Fiber too Dusty	· Splicing indistinct core fibers with SM or DS modes.	· Use MM mode to splice indistinct core fibers (i.e. MM fiber).
			· [Align] is set to "Core" to splice indistinct core fibers when using SPECIAL mode.	· Set [Align] to "Clad" to splice indistinct core fibers (i.e. MM fiber).
			· [Focus] is incorrectly set when using SPECIAL mode.	· Set [Focus] to "Edge" to splice indistinct core fibers (i.e. MM fiber). To splice distinct core fibers, "Auto" or correct value should be entered.

Error Code	Error Message	Reason	Remedy
04	01 — ZL Motor Overrun (Forward)	• The fiber is set too far back and does not reach the splice point. • The fiber is not set correctly at the bottom of the V-groove. The fiber misses the CCD camera's field of view. • The cleave length (bare fiber part) is too short.	• Press ‹RESET›, and set the fiber again with the end-face closer to the electrodes. • Press ‹RESET›, and set the fiber again to seat it correctly at the bottom of the V-groove. • Confirm the setting position of stripped end on the fiber cleaver. Check the cleave length.
	11 — ZR Motor Overrun (Forward)		
	02 — ZL Motor Overrun (Backward)	The taper speed or time is set too high.	Adjust the taper parameters in the splice mode.
	12 — ZR Motor Overrun (Backward)	Only occurs in manual motor operation.	
	21 — X motor Overrun (Forward)	The fiber is not set correctly at the bottom of the V-groove. The fiber offset is out of range.	Press ‹RESET›, and set the fiber again to seat it correctly at the bottom of the V-groove.
	22 — X motor Overrun (Backward)		
	31 — Y Motor Overrun (Forward)		
	32 — Y Motor Overrun (Backward)		

Error Code		Error Message	Reason	Remedy
04	41	Focus X Motor Overrun (Forward)	• The fiber is not set correctly at the bottom of the V-groove. The fiber position is out of possible focus range. • Dust or dirt on the fiber surface results in failure to focus. • Dust or dirt on the objective lens or the wind protector mirror.	• Press ⟨RESET⟩, and set the fiber again to seat it correctly at the bottom of the V-groove. • Just re-cleaning the fiber surface may result in dust on the end-face. Completely prepare the fiber again (strip, clean and cleave). • Execute the [Dust Check]. Clean the lens or mirror when dust or dirt exists.
	42	Focus X Motor Overrun (Backward)		
	51	Focus Y Motor Overrun (Forward)		
	52	Focus Y Motor Overrun (Backward)		
05		Close Cover	Unable to start splicing when the wind protector opens.	The splicer automatically starts splicing after closing the wind protector.
06		Cover Opened Error	The wind protector is opened during splicing operation.	Press ⟨RESET⟩ after closing the wind protector.
07	01	ZL Motor Trouble	There may be some fault.	Consult your nearest sales agency.
	02	ZR Motor Trouble		
	03	X-Motor Trouble		
	04	Y-Motor Trouble		
	05	Focus X Motor Trouble		
	06	Focus Y Motor Trouble		

Error Code		Error Message	Reason	Remedy
08		Fiber Judge Error when using AUTO mode	Dust or dirt on the fiber surface.	Just re-cleaning the fiber surface may result in dust on the end-face. Completely prepare the fiber again (strip, clean and cleave).
			The left and right fiber types are different.	The AUTO mode can splice only the same types of fibers on the left and right sides.
			Splicing non-standard fibers.	The AUTO mode can discriminate only between standard SM, DS and MM fiber.
09	01	Calibration Error	Unable to calibrate due to strong arc.	Replace the electrodes by using the [Electrode Replace] function. When it is not possible to eliminate the problem, consult your nearest sales agency.
	02		Unable to calibrate due to weak arc.	
	03		Unable to calibrate due to bad arc position (too left).	
	04		Unable to calibrate due to bad arc position (too right).	
10		Fiber Separate	The fiber stuff amount is insufficient.	Execute the [Stuff Check] function. Check the [Overlap] setting in the splice mode when using the SPECIAL mode.
			The pre-fuse power is too strong.	Check the [Prefuse Power] and [Prefuse Time] settings in the splice mode when using the SPECIAL mode.
11	01	L-Fiber Set Error	The fiber is not set correctly at the bottom of the V-groove.	Press <RESET>, and set the fiber again to seat it correctly at the bottom of the V-groove.
	02	R-Fiber Set Error		

Error Message	Reason	Remedy
High Estimated Loss	Insufficient fiber cleaning.	Dust or dirt on the fiber surface results in bad splice loss and low tensile strength. · Clean the fiber surface sufficiently. · Do not clean the fiber after cleaving to prevent dust on the fiber end-face. · Avoid any contact with the fiber end-face.
	Bad fiber end-face.	· Check the condition of fiber cleaver. When the blade is worn, rotate the blade. · Confirm that [Cleave Limit] is not too large. 2.0° or less is recommendable.
	Dust or dirt on the V-groove or the clamp chip.	Dust or dirt on the V-groove or the clamp chip causes bad fiber motion during the fiber stuffing. Clean them periodically.
	Dust or dirt on the lens or the mirror	Execute the [Dust Check]. Clean the lens or mirrors when dust or dirt exists.
	Bad electrode condition.	Replace the electrodes when they are worn (round tip shape), dirty or bent even if the number of discharges is less than 1,000.
	Inadequate arc power.	Calibrate the arc power with the [Arc Calibration] function.
	Using unsuitable splice mode	Select a suitable splice mode for the fibers to be spliced.
	[Loss Limit] is too severe	Set the [Loss Limit] with adequate margin.
	Inadequate arc parameters in SPECIAL mode	Confirm that the arc parameters in the SPECIAL mode are adequate to splice the fibers.
	Inadequate estimating parameters in SPECIAL mode	Confirm that the estimating parameters in the SPECIAL mode are adequate to estimate the loss. The MFD mismatch function does not work for some types of special fibers. Set the [MFD Mismatch] to "OFF" in that case.

Error Message	Reason	Remedy
Large Cleave Angle	Bad fiber end-face.	Check the condition of fiber cleaver. When the blade is worn, rotate the blade.
	[Cleave Limit] is too severe.	Set the [Cleave Limit] with adequate margin.
Core Angle Error	[Core Angle Limit] is too severe	The splicer measures the core angle only when using the SPECIAL mode. Set [Core Angle Limit] with adequate margin.
	Dust or dirt on the V-groove or the clamp chip.	Clean the V-groove and clamp chip, and set the fibers again. If the error occurs again, strip, clean and cleave the fibers.
	Bad fiber end-face.	Check the condition of fiber cleaver. When the blade is worn, rotate the blade.
Too Thin Fiber	Inadequate arc power	Calibrate the arc power with the [Arc Calibration] function.
	Strong prefuse setting in SPECIAL mode	Adjust or initialize [Prefuse Power] or [Prefuse Time] settings when using the SPECIAL mode. In the normal splice mode, the prefuse is fixed.
	Insufficient [Overlap] setting	• Adjust or initialize [Overlap] setting when using the SPECIAL mode. In the normal splice mode, the overlap is fixed.
Too Fat Fiber	Too much [Overlap] setting	• Execute [Stuff Check] in the maintenance menu to calibrate the stuff amount.
Taper Thin	By taper splice.	The error message may appear when using the taper splice function.
Bubble	Bad fiber end-face.	Check the condition of fiber cleaver. When the blade is worn, rotate the blade.
	Weak prefuse setting in SPECIAL mode	Adjust or initialize [Prefuse Power] or [Prefuse Time] settings when using the SPECIAL mode. In the normal splice mode, the prefuse is fixed.

§ 9. Questions and Trouble Shooting

§ 9.1. Power Supply

(1) Power does not turn off when pressing ⟨ON/OFF⟩
- Pressing ⟨ON/OFF⟩ quickly does not turn power off to avoid accidental use. Press and hold the key until the LED color changes from green to red.

(2) Not many splices can be made with a fully charged battery pack
- If the power saving functions are not enabled, power consumption is large. Refer to § 6.6.2 (Page 102), always enable feature to improve power usage.
- When degradation due to the memory effect appears, or when the battery pack has been stored for an extended period, fully discharge it. Refer to § 5.2.5 (Page 55). Then, recharge the battery pack.

(3) Method to change settings for the power saving function
- Refer to § 6.6.2 (Page 102) to change the settings.

(4) Battery indicator is not displayed / Power saving function does not work
- They do not function when using the AC adapter (ADC-07).
- Confirm [Power Source Type] is "AUTO" by referring to § 6.6.2 (Page 102).

(5) Battery indicator displayed / Power saving function works
  when using the AC adapter
- If there is no "ID" mark on an ADC-07 used from another Fujikura splicer, the FSM-40S misjudges it as a battery pack. Use only specified ADC-07.

(6) Incorrect indication of battery indicator
- Display serves as a reference only.
- If there is no "ID" mark on a BTR-05 used from another Fujikura splicer, the indication may be incorrect on the FSM-40S. Use only BTR-05 with the "ID" mark.
- When using an external battery through the DCA-01, the indication may be incorrect. Confirm the remaining capacity by input voltage in [Sensor Value] menu. Refer to § 6.6.1 (Page 100).

(7) "CHARGE" LED on ADC-07 blinks during battery recharge
- The battery pack being have a fault or have the end of its service life. If the LED blinks again having installed a new battery pack, contact your nearest sales agency.

§ 9.2. Splicing Operation

(1) Error message appears on monitor
  · Refer to § 8 (Page 119).

(2) Inconsistent splice loss / High splice loss
  · Refer to "High Estimated Error" in § 8 (Page 119).
  · If secondary coated fiber has curl or bend memory, set the fiber in such a manner that the crown of the curl is uppermost.
  · The splice loss varies according to the cleave angles, arc conditions and fiber cleanliness. When optimizing the arc parameters in SPECIAL mode, confirm at least 10 splices after changing the parameters. Optimum arc conditions cannot be determined from a small number of splices.
  · If the splice loss is still high or inconsistent after performing the above remedies, contact your nearest sales agency. Regular service once a year is recommended to maintain splicing quality high.

(3) Confirmation of splicing procedures
  · For outline, refer to § 3 (Page 18). For details, refer to § 4 (Page 22).

(4) Monitor suddenly turned off / No key response
  · The power saving function is automatically enabled when using a battery pack. The splicer turns off the monitor and cameras after extended period of splicer inactivity. Press <SET> to return to the normal state. To change the time, refer to § 6.6.2 (Page 102).

(5) Splicer power suddenly turned off without "Low Battery" message
  · The power saving function is automatically enabled when using a battery pack. The splicer turns the splicer power off after extended period of splicer inactivity. Press <ON/OFF> to turn on the splicer again. To change the time, refer to § 6.6.2 (Page 102).

(6) Method to initialize arc condition of Splice mode
  · Refer to § 6.2.9 (Page 86).

(7) Method to change error thresholds for Cleave angle, Splice loss
    and Fiber angle
  · Refer to § 6.2.2 (Page 61) when using SM, DS, MM or AUTO mode. There is no fiber angle threshold in these modes.
  · Refer to § 6.2.4 (Page 67) when using SPECIAL mode.

(8) Error message can be over-ridden
 · Refer to § 6.6.3 (Page 105) to lockout override ability.

(9) Unable to change Arc Power and Arc Time
 · It is unable to change them in SM, DS, MM or AUTO modes.
 · Performing [Arc Calibration] keeps adequate arc power in these modes.
 · Arc Power and Arc Time may be changed in SPECIAL mode, unless a
   supervisor has locked them.

(10) Method to set Pause
 · Refer to § 6.6.1 (Page 100).

(11) Method to display Cleave Angle, Fiber Angle and Core / Cladding Offsets
 · Refer to § 6.6.1 (Page 100). The fiber angle is not displayable in SM, DS,
   MM or AUTO mode.

(12) Incorrect splice mode selected and used in AUTO mode
 · The AUTO mode can detect only standard SM, DS and MM fibers. When
   splicing special fibres, the AUTO mode may misjudge them. For other
   possible troubles when using the AUTO mode, refer to § 8 (Page 119).

(13) Mismatch between Estimated splice loss and Actual splice loss
 · The estimated loss is a calculated loss, it can be used only for reference.
 · The optical parts of the splicer may need to be cleaned.
 · When splicing special fibers, adjust [MFD-L], [MFD-R], [Core Step] and
   [Core Curvature]. When splicing dissimilar fibers, adjust also [Min.
   Loss] and [MFD Mismatch]. Refer to parameter settings of other splice
   modes stored in database area to adjust them.

(14) Rearc is ON/OFF discharge when using SPECIAL mode
 · Set the [Arc2 OFF Time] to "OFF." Refer to § 6.2.4 (Page 67).

(15) Method to operate Focus motor after splicing
 · Use the [Motor Drive] function on [Maintenance Menu]. Or in [Finish]
   state, ⟨▲⟩ and ⟨▼⟩ can operate it immediately.

(16) Realignment performed after manual aligning in Pause2
 · To disable the realignment, refer to § 6.6.3 (Page 105). Alternatively use
   manual splice mode. Refer to § 6.2.7 (Page 80).

§ 9.3. Tube-heating Operation

(1) Fiber protection sleeve does not shrink completely
- Extend heating time.　Refer to § 6.3.2 (Page 90).

(2) Heater LED on panel keyboard blinks
- Pressing 〈HEAT〉 during heating causes the LED to blink.　It indicates that a cancel is acceptable by pressing 〈HEAT〉 again.　Waiting 2 seconds without pressing it, the LED indication will return to the normal state.
- If the heating temperature does not reach set temperature, the LED blinks and the alarm sounds.　Contact your nearest sales agency.

(3) Fiber protection sleeve adhered on heating plate after shrinking
- Use a cotton swab or similar soft tip object to push and remove the sleeve.

(4) Method to initialize heating condition of Heater mode
- Refer to § 6.3.3 (Page92).

(5) Method to cancel heating process
- 〈RESET〉 does not cancel the heater.　Press 〈HEAT〉 twice to cancel the heater.

§ 9.4. Supervising

(1) Confirm the function list can be prohibited
- Refer to § 6.6.3 (Page 105).

(2) Method to lock "selection" or "editing" of Splice or Heater mode
- Refer to § 6.6.3 (Page 105).

(3) Method to set parameters of Splice or Heater mode from PC
- To set the parameters, refer to § 6.2.9 (Page 86) and § 6.3.3 (Page 92). Method to connect a PC, refer to § 7 (Page 118).　To get EXCEL software on the PC, contact your nearest sales agency.

(4) Password forgotten
- Contact your nearest sales agency.

§ 9.5. Other Functions

(1) To indicate [READY] instead of [Power ON Menu] after turning power on
- Refer to § 6.6.3 (Page 105).

(2) Method to execute [Dust Check] automatically after turning power on
- Refer to § 6.6.3 (Page 105).

(3) Method to hide messages on [READY] screen
- Change the fiber image from X/Y view to X magnified view or Y magnified view by pressing ⟨X/Y⟩.

(4) Too many repetitions until "Test Finish" indicated in [Arc Calibration]
- The splicer needs to repeat the calibration after replacing the electrodes or when the environmental condition changes drastically.
- To set a maximum number of calibrations, refer to § 6.6.3 (Page 105). When the number of calibrations exceeds the setting, the splicer indicates "Test Finish" even when it is still not perfect.

(5) "Test Finish" never indicated after many repeats in [Arc Calibration]
- Execute [Stabilize Electrodes] function in [Maintenance Menu]. If the splicer still does not indicate "Test Finish," replace the electrodes by using [Replace Electrodes] function.

(6) No arc power change after [Arc Calibration]
- An internal factor is calibrated for the arc power. The displayed arc power in each splice mode does not change.
- The results of calibration affect all splice modes.

(7) Method to input different comment after each splice in splice result data
- Refer to § 6.5.1 (Page 95).

(8) Method to input same comment automatically in splice result data
- Refer to § 6.5.1 (Page 95).

(9) Method to cancel storing splice results in internal memory
- Refer to § 6.5.1 (Page 95).

(10) Method to download splice results from splicer to PC
- For the method to connect the PC, refer to § 7 (Page 118). To get EXCEL software on the PC, contact your nearest sales agency.

§ 10. Guarantee and Contact Address

§ 10.1. Guarantee

1. Guarantee period and limits
   If the splicer becomes out of order within one year from the date of delivery, we will repair it free of charge. However, note that repairs will be charged for in the following cases regardless of the guarantee period:
   (1) Trouble or damage due to natural disaster.
   (2) Trouble or damage due to abnormal voltage supply.
   (3) Trouble or damage due to mishandling.
   (4) Trouble or damage due to handling in disregard of the operating procedures or instructions described in the instruction manual.
   (5) Consumable items (discharge electrodes etc.)

2. Before sending the splicer
   Please consult nearest sales agency first.

3. Necessary information for the repair
   Attach papers to the splicer in order to inform us of details as described below.
   (1) Your full name, section, division, company, address, phone number, fax number and e-mail address.
   (2) Model name and serial number of the splicer.
   (3) Encountered Trouble
   · What state did your splicer get into and when?
   · What is its present state?
   · The state of the monitor and the contents of the relevant error message.
   etc.

4. Transportation when sending the splicer
   As the splicer is a high-precision machine, always use the attached carrying case for transportation and storage in order to protect it against humidity, vibration and shock. When you request us to repair the splicer, please send it together with its accessories.

5. Note for Repair
   Please note that the contents of the memory such as splicing results, splice mode, etc., may be lost depending on the kind of repair.

§ 10.2. Contact Address

Inquiries concerning products should be made to the nearest sales agency or one of the following:

```
Fujikura Europe Ltd.
C51 Barwell Business Park
Leatherhead Road,
Chessington,
Surrey KT9 2NY
England
Tel.   +44-20-8240-2000    (Service: +44-20-8240-2020)
Fax.   +44-20-8240-2010    (Service: +44-20-8240-2029)
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```
Alcoa Fujikura Ltd.
150 Ridgeview Circle
Duncan, SOUTH CAROLINA 29334
U.S.A.
Tel.   +1-800-AFL-FIBER       (Service: +1-800-866-3602)
Fax.   +1-864-433-5560  (Service: +1-800-433-5452)
P.O.Box 3127 Spartanburg, SC    29304-3127
```

```
Fujikura Asia Ltd.
460 Alexandra Road #22-01 PSA Building
Singapore 119963
Tel.   +65-2711312
Fax.   +65-2780965
```

```
Fujikura Ltd.
Export Department
1-5-1 Kiba, Koto-ku,
Tokyo 135-8512
Japan
Tel.   +81-3-5606-1164
Fax.   +81-3-5606-1534
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