SFS-2000 Series

Optical Fiber Fusion Splicer

Maintenance Manual

Saluki Technology Inc.

Preface

Thanks for choosing Saluki Technology Inc instrument. We devote ourselves to meeting your demands, providing you high-quality measuring instrument and the best after-sales service. We persist with “superior quality and considerate service”, and are committed to offering satisfactory products and service for our clients.

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Saluki Technology

Authorization

The information contained in this manual is subject to change without notice. The power to interpret the contents of and terms used in this document rests with Saluki.

Product Quality Assurance

The warranty period of the product is 24 months from the date of delivery. The instrument manufacturer will repair or replace damaged parts according to the actual situation within the warranty period. The user should return the product to the manufacturer and prepay mailing costs. The manufacturer will return the product and such costs to the user after maintenance.

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1 Product Introduction

This manual applies to the repair of SFS-2000 series fiber fusion splicer. The fiber fusion splicer is mainly used for the permanent connection of fiber and is widely used in the production test of fiber communication engineering and optical passive devices. This product is applicable for connecting the single-mode, multi-mode, non-zero dispersion, dispersion displacement and bending insensitivity and other quartz fibers with a cladding diameter of 80μm - 150μm. The fusion splicer realizes the integration of optics, mechanics and electronics, and it shall be kept clean and from strong vibration or shock during use. The appearance of SFS-2000 series fiber fusion splicer is as shown in Fig.1.

Fig.1 Appearance of SFS-2000 series fiber fusion splicer

2 Functional Block Diagram

Basic working principle of the whole machine is as shown in Fig.2. The high-brightness light source is used to illuminate the fiber, and the fiber is imaged on the CMOS sensor via a special microscope. The image characterizes the physical and geometrical positions of the fiber in two directions which are perpendicular to each other. The two-way fiber images are processed and spliced by FPGA and then sent to LCD through the ARM system.

CPU system analyzes and processes the image signals to generate various prompting and control signals. The prompting information is displayed simultaneously with the real-time fiber image. Control signals drive two propel motors to get two fibers to approach to each other, and then drive two displace motors to align the fiber core or cladding face in a two-dimensional plane. The discharge signal is given to the high-voltage board to generate a certain high voltage, and an arc is generated across the electrodes. The fiber is permanently connected through the high temperature of arc. Finally, the current fusion loss is calculated according to the physical properties of spliced fiber image, and is displayed on the screen. In the actual construction process, the heat-shrink protection is conducted for the bare fiber which is connected successfully through the heater.

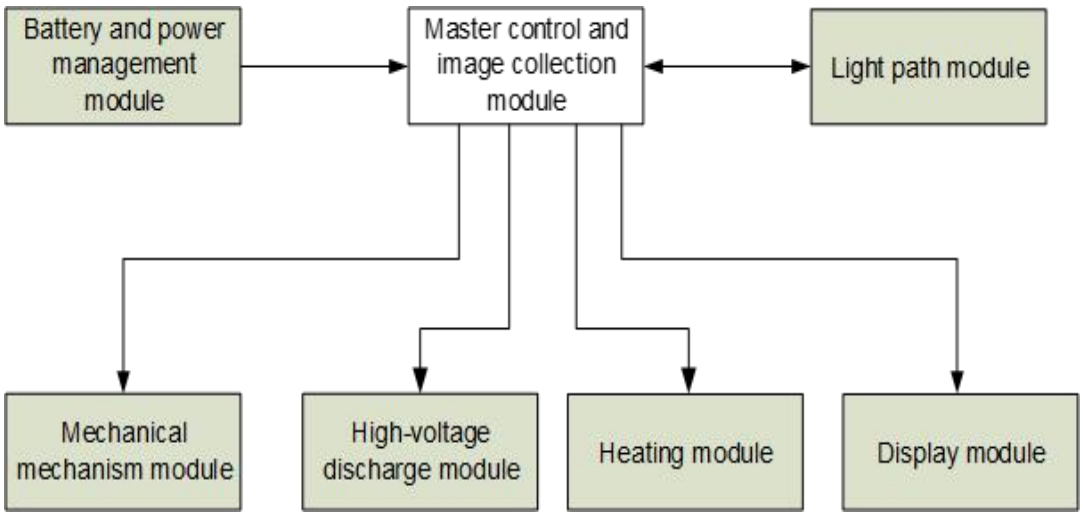


Fig.2 Block diagram of whole machine

3 Common Fault

3.1 Common Faults of Instrument

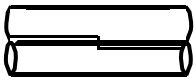
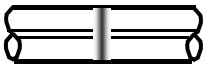
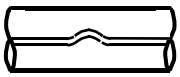
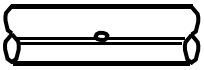
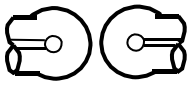
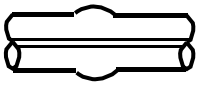
Table 1 Common faults of Instrument

Phenomenon	Cause	Repair method
Failure to start	1. Damage of battery or adapter 2. Power board cable not plugged 3. Power board damage 4. Control board damage	1. Replace the battery or adapter 2. Plug in the power board cable 3. Replace the power board 4. Replace the control board
Flower or white screen at start	1. Display cable not plugged 2. Damage of display cable or cable socket	1. Plug in the display cable 2. Replace the display cable or cable socket
No respond from button	1. Button cable not plugged 2. Damage of button board	1. Plug in the button cable 2. Replace the button board
Abnormality of touch screen	1. Turnoff of touch screen function in the menu 2. Touch screen not calibrated 3. Touch screen cable not plugged 4. Damage of touch screen cable or touch screen	1. Open the touch screen function in the menu 2. Calibrate the touch screen 3. Plug in the touch screen cable 4. Replace touch screen cable or touch screen
Black screen of X/Y camera	1. Imaging lamp cable not plugged 2. Damage of imaging lamp component 3. Hall switch cable not plugged 4. Damage of Hall switch	1. Plug in the imaging lamp cable 2. Replace the imaging lamp component 3. Plug in the Hall switch cable 4. Replace the Hall switch
Charging failure	1. Damage of battery 2. Damage of power board	1. Replace the battery 2. Replace the power board
Flashing of charge indicator	Damage of power board	Replace the power board
White screen, discharging at start, and restart of instrument when the windshield is opening or closing	Damage of imaging lamp component	Replace the imaging lamp component

X/Y camera too bright or too dark	Incorrect setting of CMOS gain	Reset the gain value
Abnormal display of X/Y camera	1. Camera plate cable not plugged 2. Damage of camera plate or control board	1. Plug in the camera plate cable 2. Replace the camera plate or control board
Left/right motor error at start	1. Propel motor cable not plugged 2. Foreign material between propel motor gears 3. Jam of propel motor	1. Plug in the propel motor cable 2. Clean up the foreign objects 3. Replace the propel motor
Abruption or abnormal noise of propel motor	1. Foreign objects between the propel motor gears 2. Propel motor fault	1. Clean up the foreign objects 2. Replace the propel motor
"Displace motor error X/Y" at aligning	1. Align (displace) motor cable not plugged 2. Jam of align (displace) motor	1. Plug in the align (displace) motor cable 2. Replace the align (displace) motor
No discharge	1. High-voltage discharge plate cable not plugged 2. Damage of high-voltage discharge plate	1. Plug in the high-voltage discharge plate cable 2. Replace the high-voltage discharge plate
Discharge to V-groove	Offset of electrode position	Adjust the electrode position
Weak or unstable discharge	1. Improper setting of discharge parameters 2. Dirty electrode	1. Adjust the discharge parameters or perform the discharge correction 2. Clean or replace the electrode
Heater failure	1. Heater cable not plugged 2. Heater damage	1. Plug in the heater cable 2. Replace the heater
Auto heating failure if the heater cover is closed	1. Manual operation of heater 2. Damage of heater optical switch	1. Set it to auto 2. Replace the heater
Fiber not held by heater cover	Magnetic steel shedding	1. Re-bind the magnetic steel 2. Replace the heater
Fiber not held by fixture pressure plate	1. Fixture magnetic steel shedding 2. Upper and lower sliders not came out	1. Re-bind the magnetic steel 2. Replace the fixture
Obvious tilt of X/Y fiber image	Minor changes in camera plate position	Re-adjust the camera plate
Dark spots or shadows on X/Y video background	Dirt on the X/Y microscope lens or CMOS surface	Clean the lens or CMOS

3.2 Causes of Fusion Loss Increase and Solutions

Table 2 Causes of Fusion Loss Increase and Solutions

Phenomenon	Cause	Solution
Axial misalignment of fiber core 	Dirty V-groove or fiber presser	Clean V-groove and fiber presser
Too fine 	Improper discharge current intensity	Discharge Correction
	Too short propelling distance	Correct the propelling distance or increase the size of overlap
Black line pattern 	Incorrect fusion parameter	Check whether the fusion mode is correct Adjust the current intensity and discharge time
Fiber core bending 	Poor quality of fiber cross-section	Check the cutting quality of fiber cutter
	Small discharge current intensity or longer propelling distance	Correct the discharge or propelling distance Adjust the propelling distance
Bubble 	Dirty fiber cross-section	Check the cutting quality of fiber cutter
	Small discharge current or decreasing discharge time	Discharge Correction or increase the fusion time
Fiber separation 	Too short propelling distance of fiber	Correct the propelling distance or increase the size of overlap
	Too large discharge current or too long discharge time	Discharge Correction or reduce the discharge time
Too rough 	Too long propelling distance of fiber	Correct the propelling distance or reduce the size of overlap
	Too small discharge current	Discharge Correction or increase the fusion current

4 Repair of Parts

4.1 Disassembly

First power off, and remove the protective soft rubber and the screws on the front and rear covers with an Allen screwdriver to disassemble the entire instrument, and do not drop the screw into the inside of instrument. As shown in Fig.3, three specifications of the screws on the protective soft rubber shall be distinguished for installation (especially four screws on the bottom are M3X6).

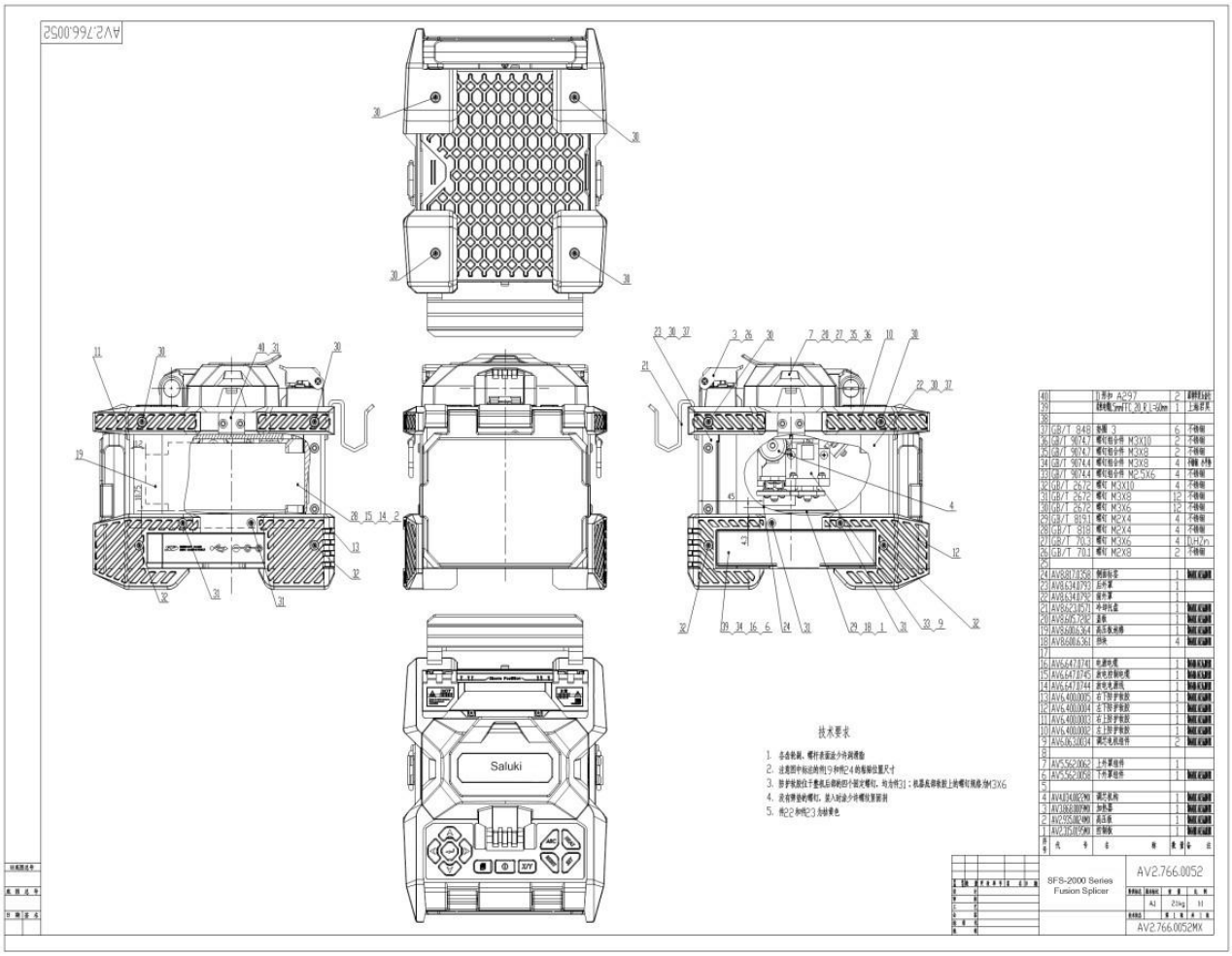


Fig.3 Overall appearance of instrument

4.2 Propel Motor

If “Left/right motor error” is displayed at the lower left corner of screen during the startup (as shown in Fig.4), the propel motor may be stuck. In most cases, the jam of motor is caused by the foreign objects between two gears of propel motor which may lead to the starting or propulsion failure. Repair steps are as follows:

① Open the windshield and remove the fixture and pressure plate.

② As shown in Fig.5, there are foreign objects between the gears of propel motor. Clean the foreign objects.

③ Start the instrument, and when the propel motor is stuck, manually assist the motor to smoothly pass the jam and enable the instrument to normally start.

④ Press the "Menu" button to enter the menu page, select "maintenance" ---> "motor" ---> "motor adjustment", and select the left or right motor to be cleaned via the "Enter" button.

⑤ Operate the "Left" and "Right" buttons to locate the different parts of micrometer head of propel motor for the convenient cleaning.

⑥ Gradually clean the foreign objects in various parts of micrometer head with the cotton stained with alcohol held by tweezer.

Clean the foreign objects according to the above six steps, so as to solve the jam of propel motor, reinstall the pressure plate and fixture, and complete the repair.

If the jam still exists, you can remove the screws of propel motor (see Fig.6) and replace the propel motor.

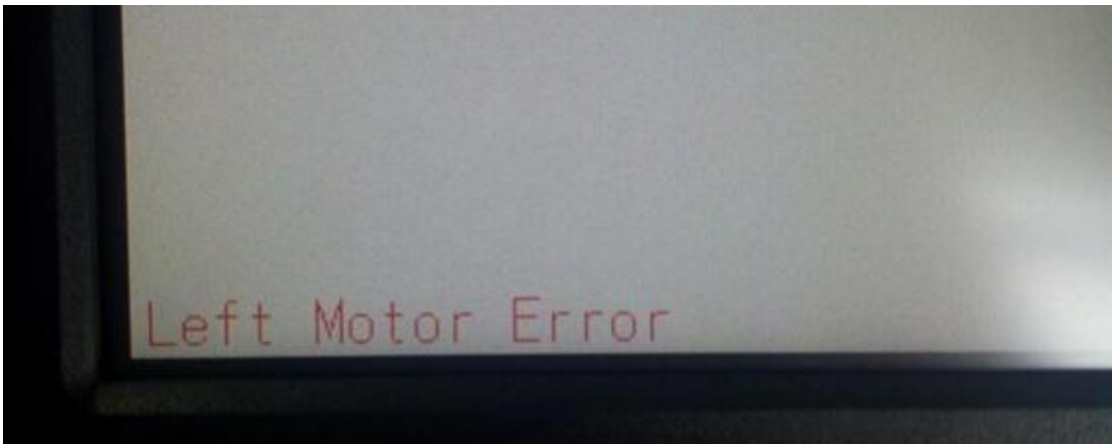


Fig. 4 Jam of propel motor

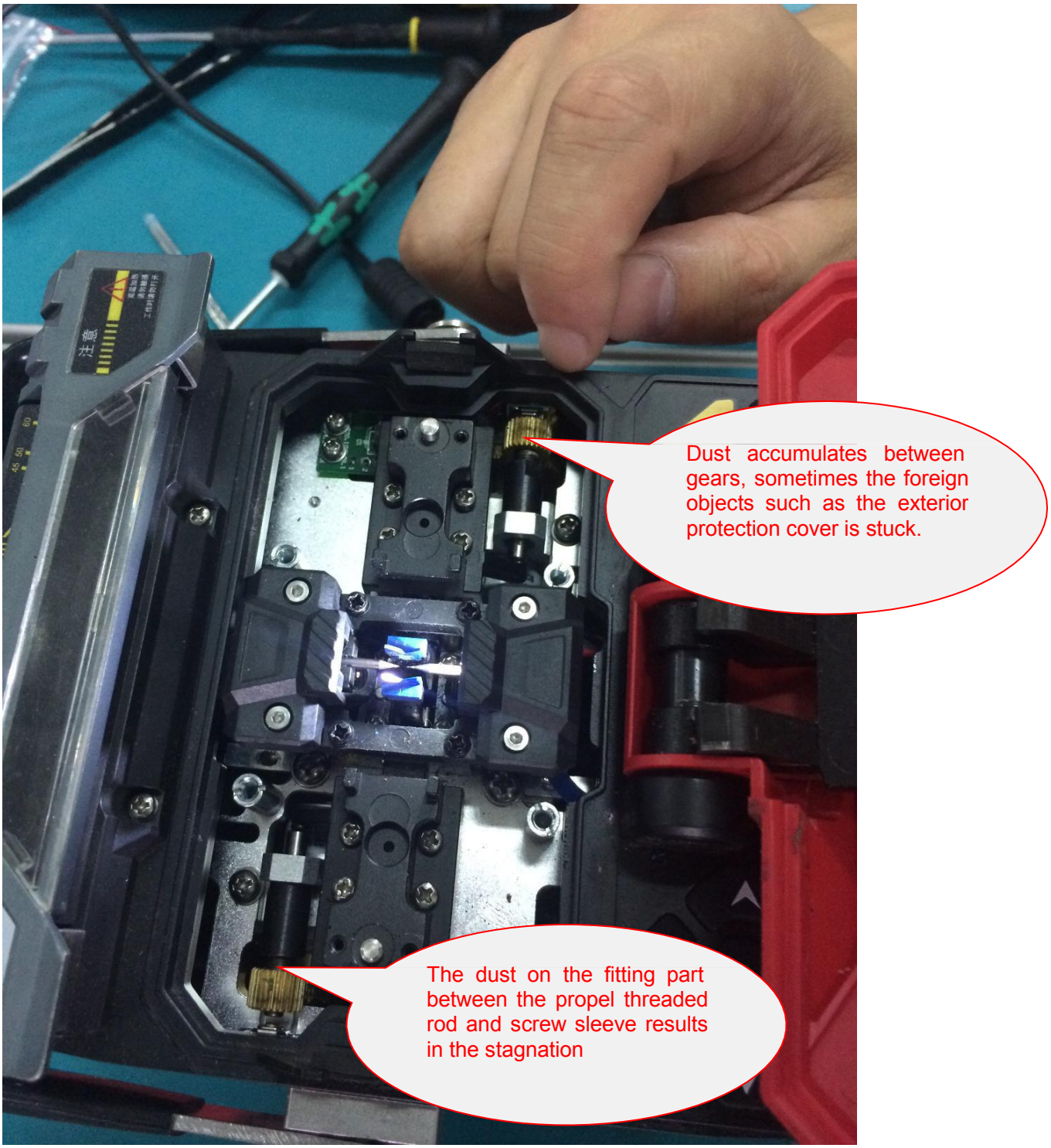


Fig.5 Cleaning of foreign objects between motor gears

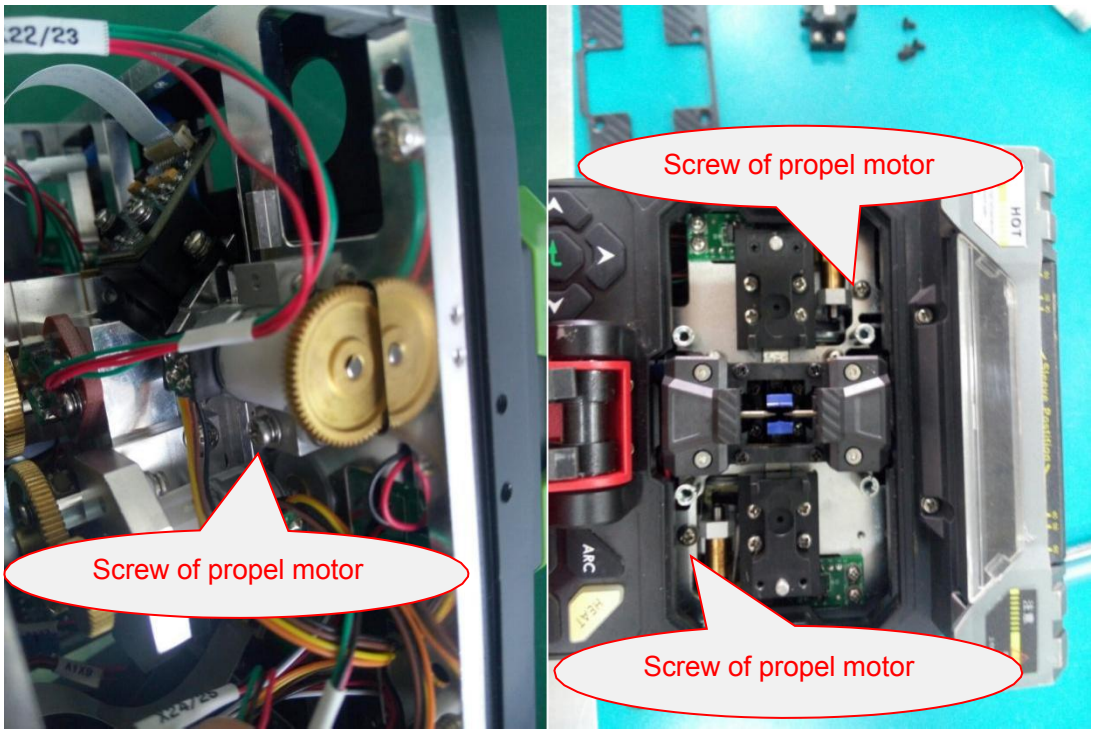


Fig. 6 Positions of propel motor screws

4.3 Align Motor

In case of the displace motor error during the normal use or the align motor error during the self-test (as shown in Fig.7), the align motor has failed. Check the meshing between the align motor gear and the align micrometer head gear, and if it is too tight or shafts are not parallel, adjust the relative positions by loosening the screws of align motor (see Fig.8); or if the micrometer head does not rotate smoothly, remove the align motor, and then manually toggle the micrometer head of align motor (see Fig.9) until the rotation is smooth; if the problem still exists, replace the align motor.

Fig.7 Jam of align motor

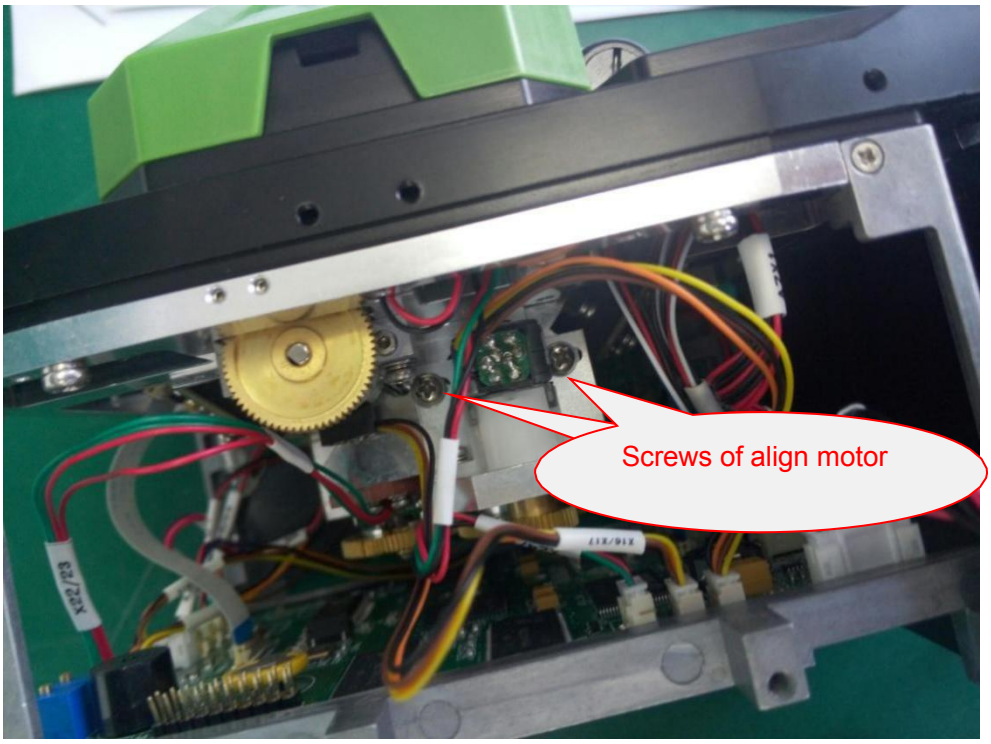


Fig.8 Align motor

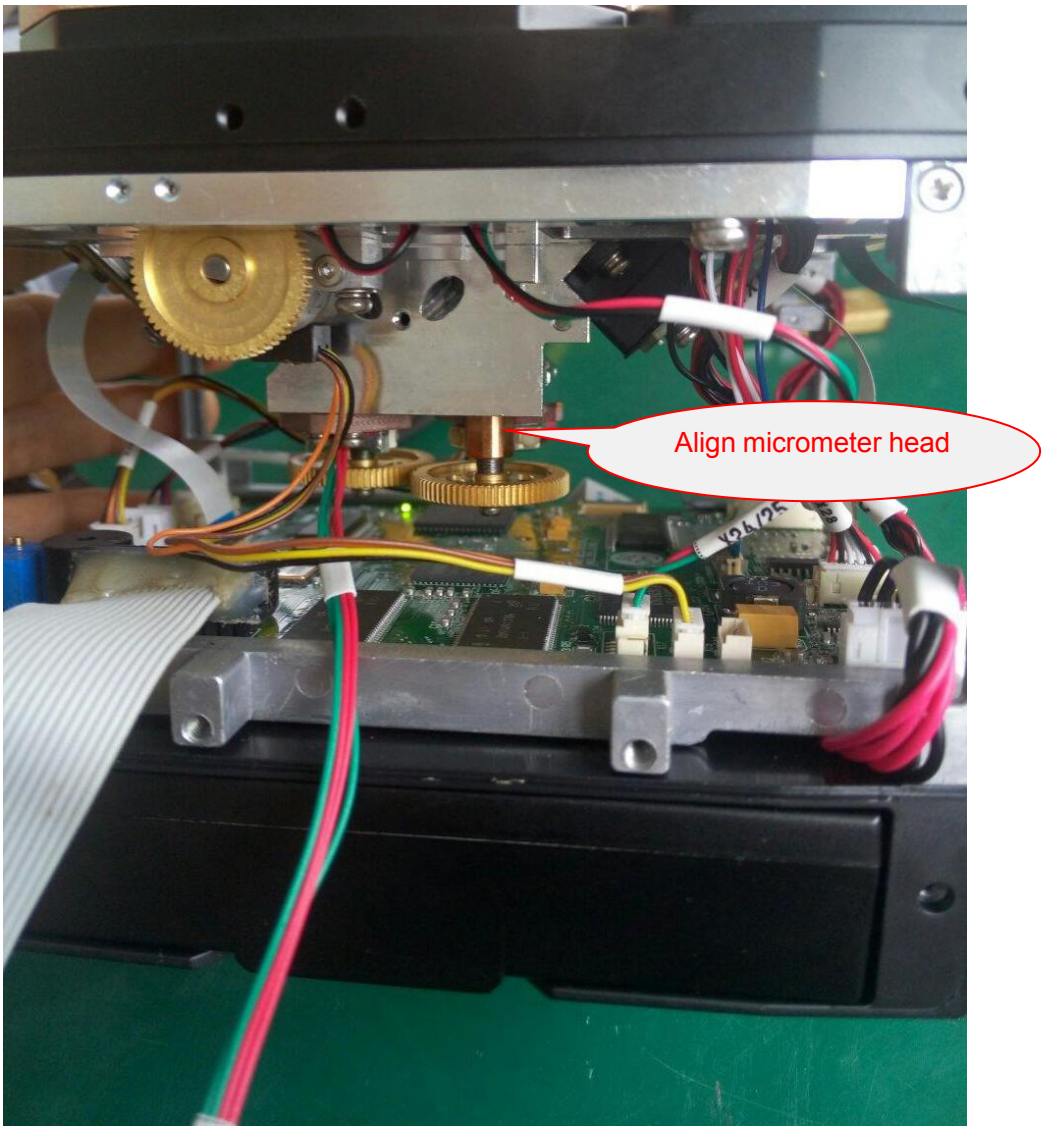


Fig.9 Align micrometer head

4.4 Imaging Lamp

White screen, sometimes with the discharge, occurs at the startup, or the instrument restarts when the windshield is opened or closed, or X/Y camera looks like black screen after the windshield is closed, it may be that the imaging lamp cable is damaged at the spindle or the imaging lamp cable is broken at the weld point of printed board, the imaging lamp and spindle shall be replaced.

① As shown in Fig.10, remove the limiting plate of sketch mounting plate to present the imaging lamp, and remove 4 screws fixing the imaging lamp (Fig.11).

② As shown in Fig.12, pull out X26 plug and jet out X26 pin from plug with tweezer and do not discard the plug.

③ Pull out the X26 cable from the spindle, and cut it directly if it is not easy to pull out.

④ As shown in Fig.13, remove the spindle with a flat-blade screwdriver and replace it with a new one.

⑤ Replace it with new imaging lamp, screw down 4 screws fixing the imaging lamp, insert the imaging lamp cable into two heat-shrink tube, and fit the imaging lamp cable into the spindle.

⑥ The heat-shrink tube on the heat-shrink imaging lamp cable is as shown in Fig.14.

⑦ Insert the pin of imaging lamp cable into the plug that has just been removed (the cable is black, white and blue in sequence from the inside to the outside), and then insert the plug into X26 base.

⑧ Install the sketch mounting plate.

Fig.10 Sketch mounting plate

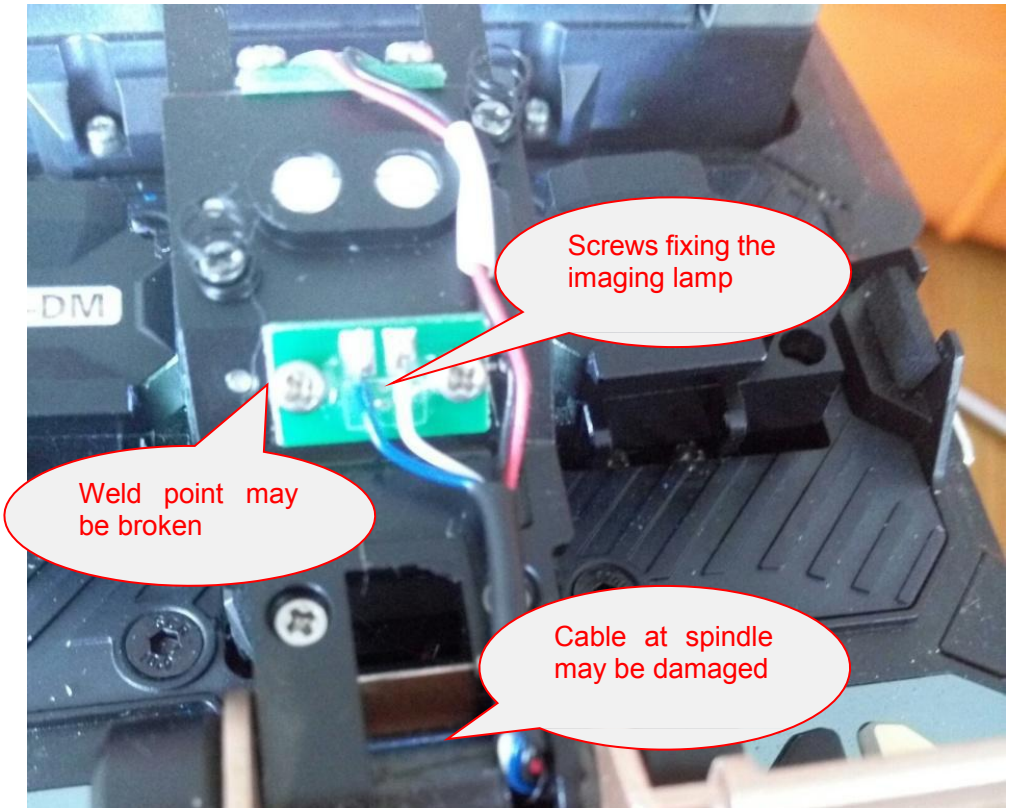


Fig.11 Imaging lamp

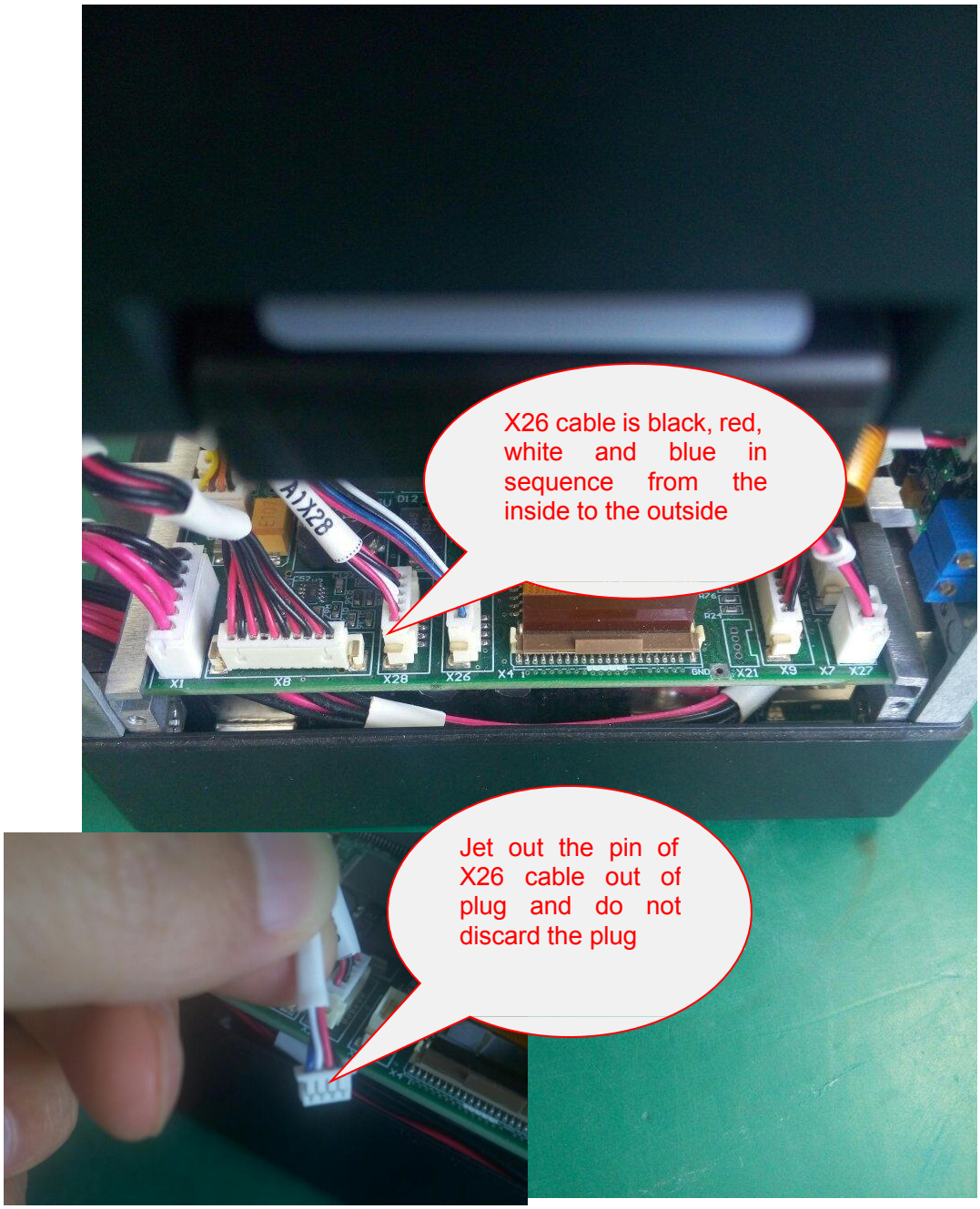


Fig.12 X26 cable

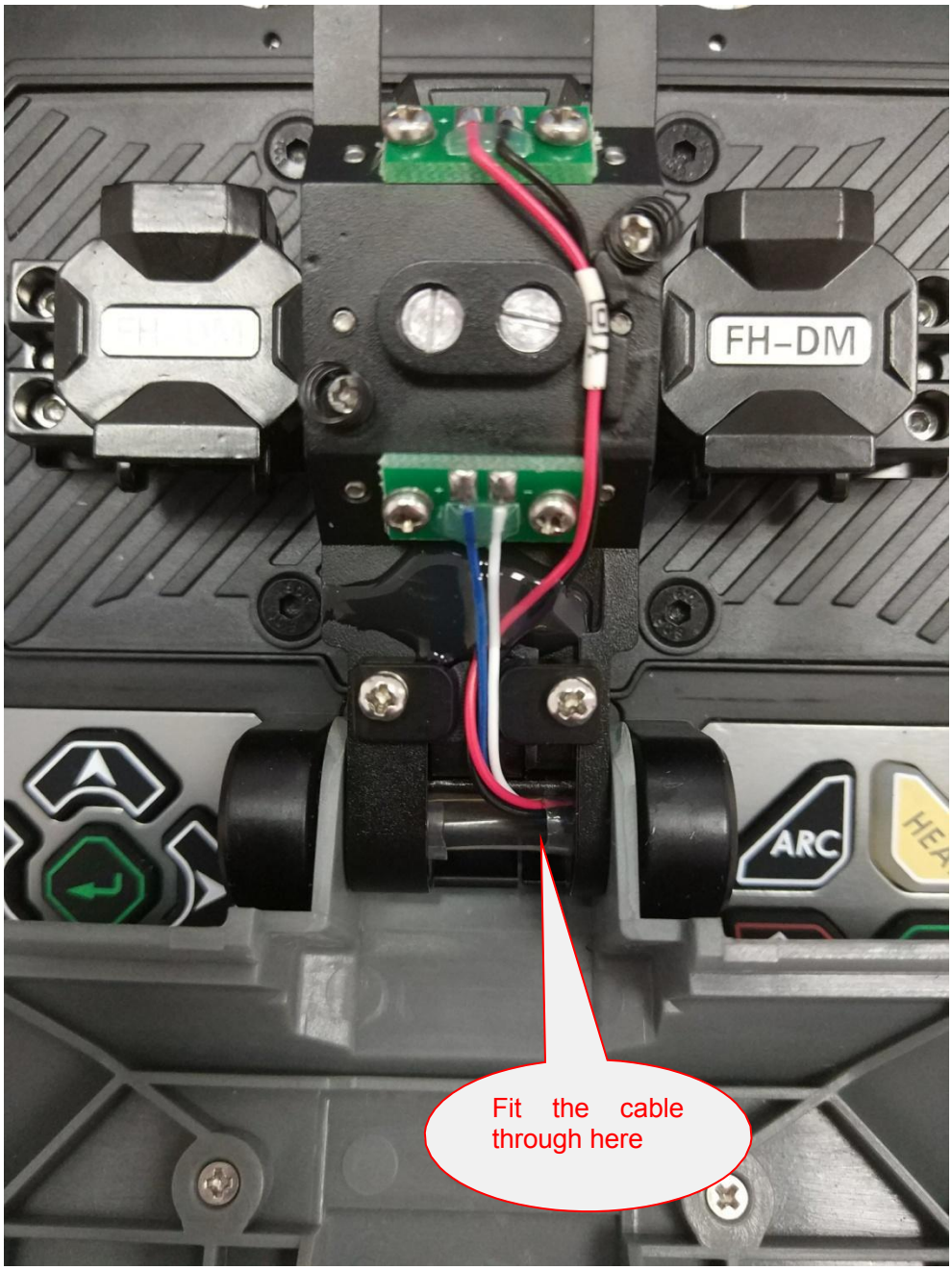


Fig.14 Installation of imaging lamp

4.5 Heater

If the heater does not work or can not automatically heat (automatic heating function is on in the menu), first check whether cables X11 and X12 of control board are plugged in. If they are plugged in, it means that the heater is damaged and shall be replaced. Unplug cables X11 and X12, and remove the fixing screws of heater (Fig. 15) to replace the heater.

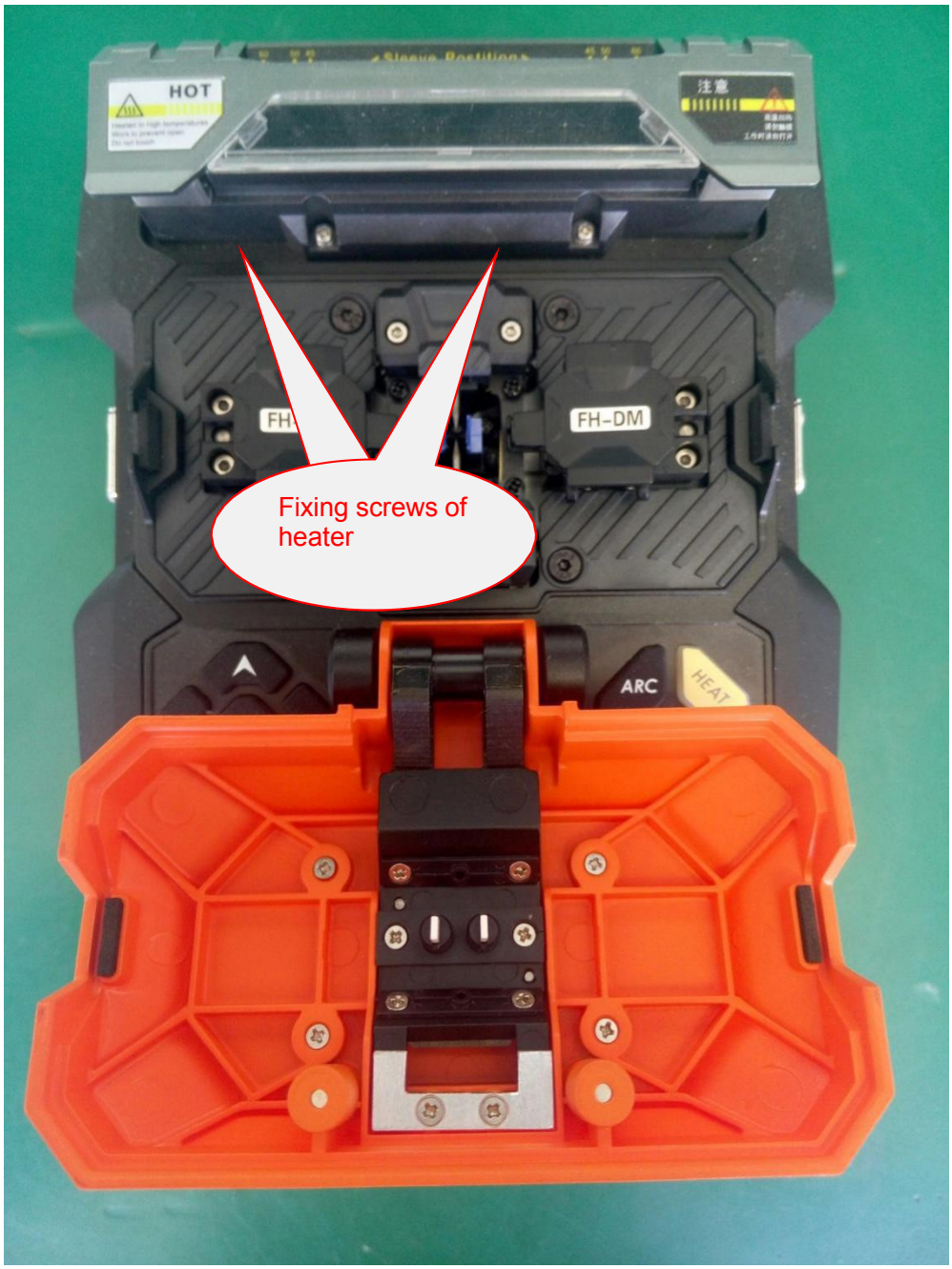


Fig.15 Heater

4.6 Power Board

In case of the failure to start, charge or the flashing of charge indicator, the power board may be damaged. If the instrument fails to start, first check whether the cables of control board X1 and power board X3 are plugged in. If they are plugged in, remove 4 screws on the bottom of instrument (as shown in Fig.16) and gently pull out the base of instrument with care not to damage the cable X2, pull out cables X2 and X3, measure whether there is 12.6V output at pins 1 and 4 of cable X3 (as shown in Fig.17); if so, the power module is not damaged; if not, the power module is damaged, and proceed to the determination whether the power board or battery is damaged. If the power board is damaged, remove the screws on the power board to replace the power board.

The charge failure may be caused by the damage of battery or power board. To find out the cause, insert the good-working battery which is fully charged into the instrument, start the system and observe the battery icon at the upper right corner of screen, and if no lightning symbol is shown on the icon, it means

that the power board is damaged; or measure the voltage on both sides of R9 on the back of power board, and if there is no charge voltage (less than 0.1V), the power board is damaged.

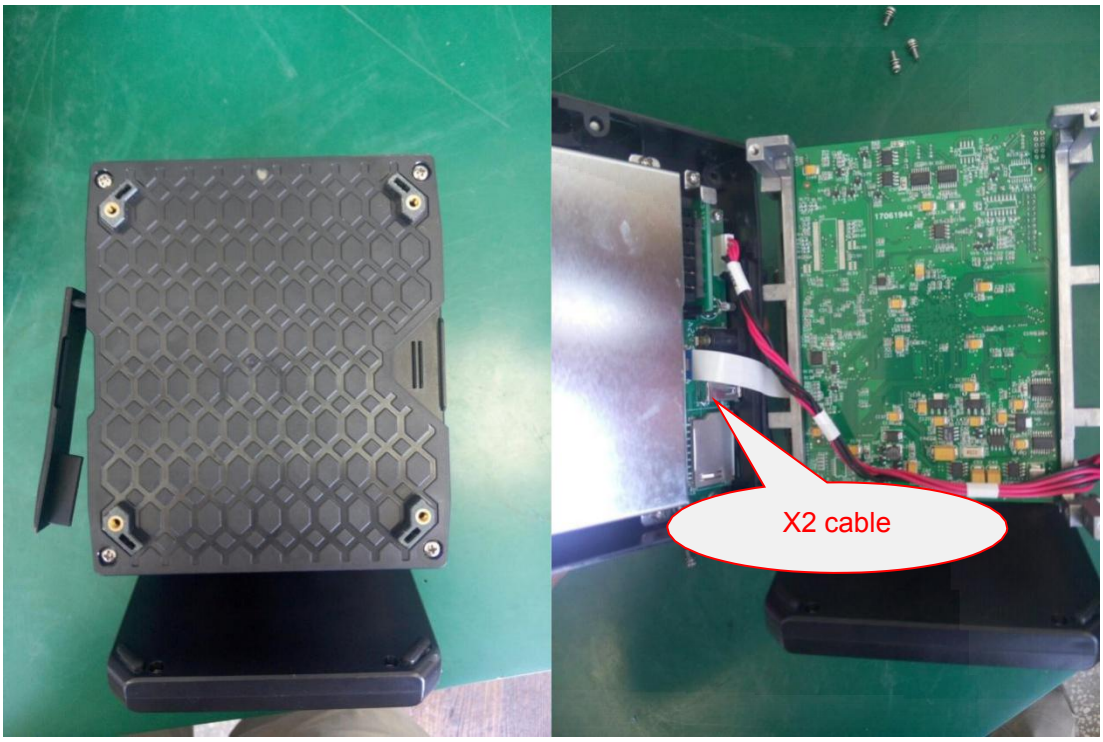


Fig.16 Removal of base

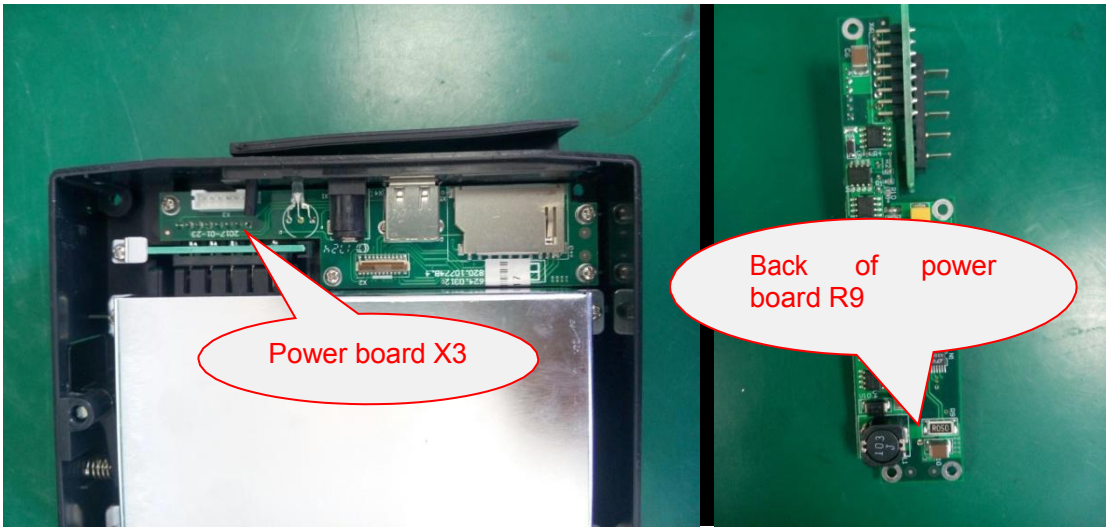


Fig.17 Power board

4.7 High-voltage Board

In case of no discharge, check whether the connecting cables between the high-voltage board X1 and the control board X7 and between the high-voltage board X2 and the control board X6 is off or loose. Make sure that the connection is normal. If the discharge failure still exists, the high-voltage board is damaged. Replace the high-voltage board by pulling out the cables X1 and X2 of high-voltage board, removing two high-voltage wires (on the front and back) and fixing four screws on the high-voltage board (as shown in Fig.17). Because there are many cables passing between the high-voltage board and align motor, be careful not to hold down the other cables when installing the high-voltage board.

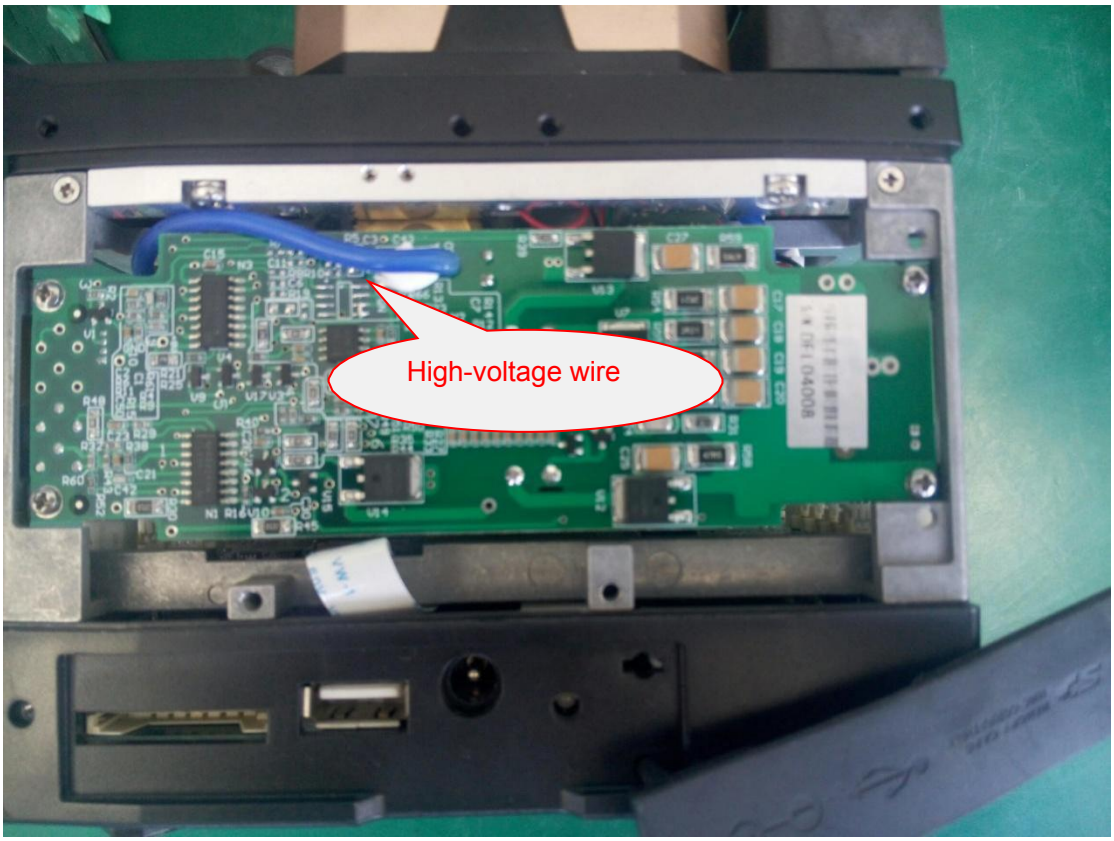


Fig.17 High-voltage board

4.8 Control Board

In case of starting failure, check whether the control board FPGA load indicator V17 (as shown in Fig.18) is on. If not, the control board is damaged. Pull out all the cables on the control board, and remove the stopper fixing the control board (as shown in Fig.19) by extracting the control board if necessary.

In case the white screen at start, pull up the plug of X26 cable (imaging lamp) on the control board, and then restart the instrument. If the white screen disappears, it means that the control board is normal, and check whether X26 cable is damaged. If so, replace the imaging lamp.

In case of flower screen, check whether the LCD cable and socket X4 are loose. Try to re-insert LCD cable to correct the flower screen, and if not, replace the LCD cable.

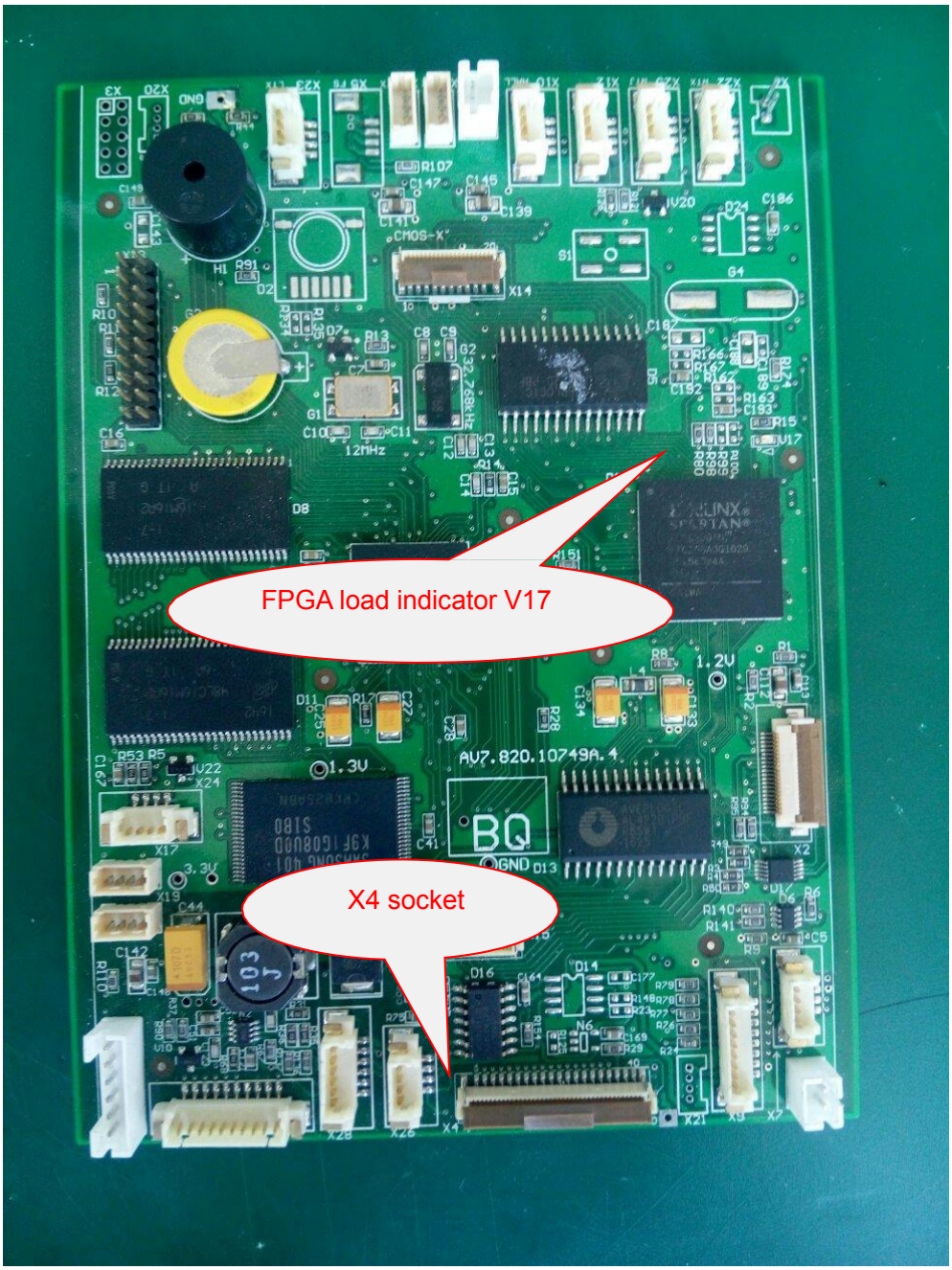


Fig.18 Main control panel

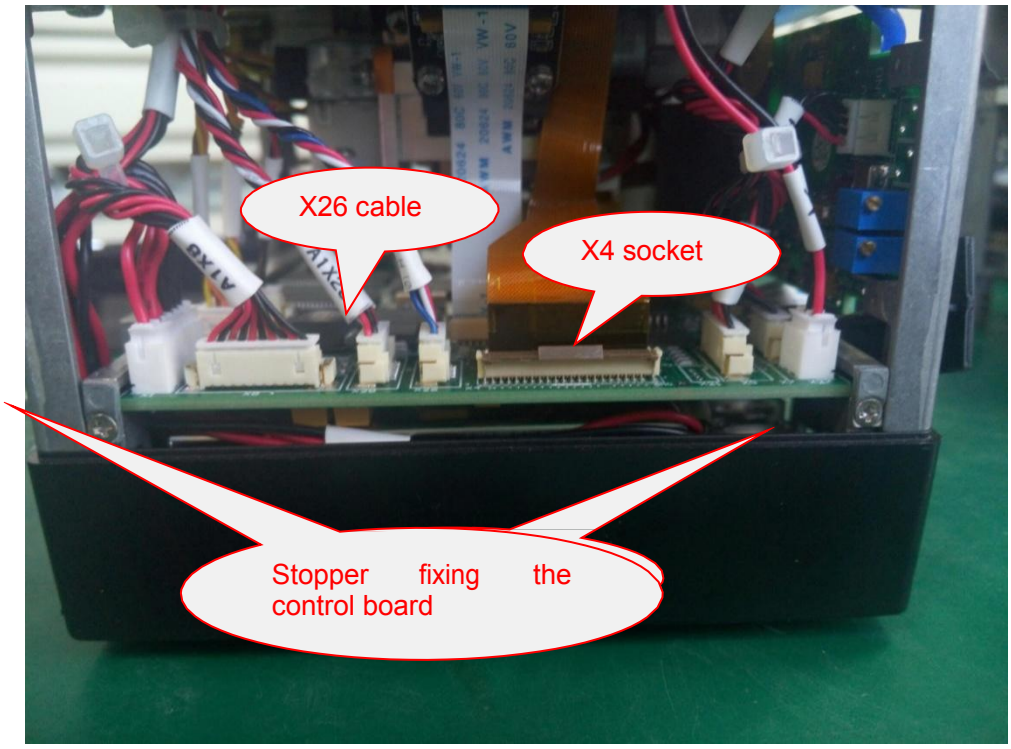


Fig.19 Stopper of main control panel

4.9 Light Path

In case of the significant inclination of fiber image in X/Y camera, the position of CMOS camera plate of X/Y camera may be slightly changed due to the long-term vibration or self-stress. To rectify the fault, unscrew the screws on the camera plate of X/Y camera (as shown in Fig.20), manually adjust the position of camera plate of this image and observe the fiber imaging condition in the horizontal double-vision video of X/Y camera, and fix the screws when the image is centered and flush with another image.

In case of dark spots or shadows on the video background of X/Y camera, there may be the dirt on the X/Y camera microscope lens or X/Y camera CMOS surface To rectify the fault, wipe the surface of front lens of microscope with a cotton swab soaked in alcohol, and quickly blow it dry with ear washing bulb. At this time, close the windshield and observe the screen imaging. If the dark spot still exists on the X/Y camera, loosen the screws of camera plate, take off the camera plate, gently wipe the CMOS surface with a cotton swab soaked in alcohol, blow it dry with the side of ear washing bulb, re-adjust the camera plate to make X/Y fiber imaging at center and vertically aligned.

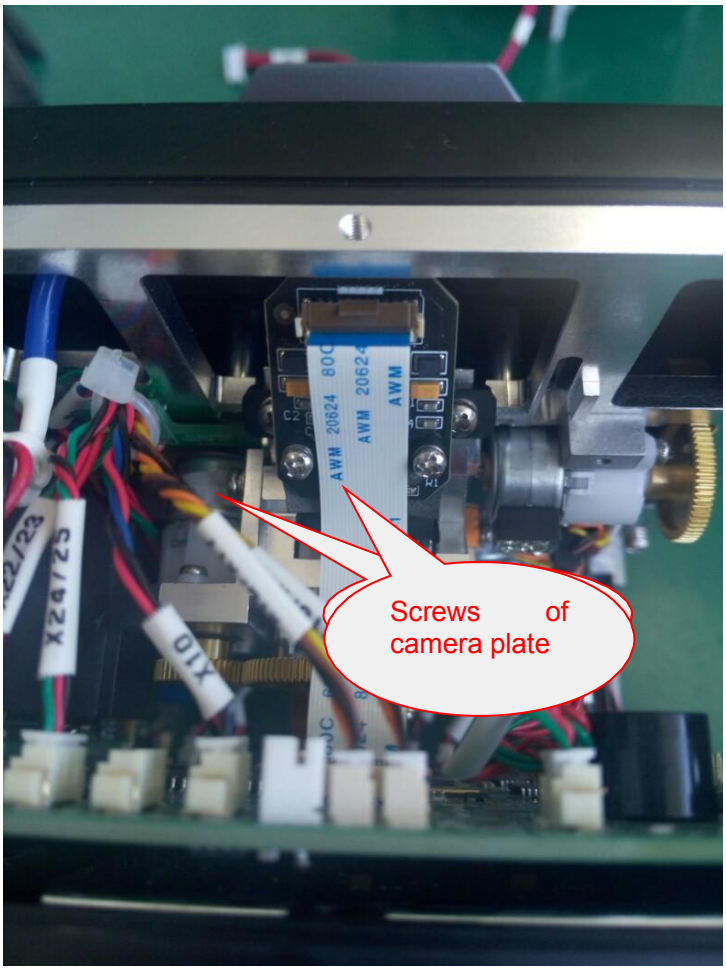


Fig.20 Camera plate

5 Repair and calibration of Instrument

5.1 Software Upgrade

Fusion splicer comes with the system upgrade function, and the operating steps are as follows:

In the power-off state, first hold on SET, and then click ⏻, the instrument will enter the upgrade state in about 2s (as shown in Fig.21).

Insert the USB flash drive with upgrade information into the USB port and the system will automatically upgrade. After the upgrade is complete, the system prompts "Upgrade is complete. Please unplug the USB flash drive and then reboot."

If the USB flash drive is not in the format of FAT16/FAT32 , the system prompts "Please insert an upgrade USB flash drive."

If the FAT16/FAT32 USB flash drive has no upgrade information, the system prompts “Please check the USB flash drive and upgrade file”.

After the upgrade is complete, restart the fusion splicer to work properly.

Note:

1) **The upgrade USB flash drive shall be FAT16 or FAT32 formatted, and other formats may not be recognized by the system.**
2) **Do not unplug the USB flash drive during the software upgrade process of fusion splicer. Otherwise the system will be out of service.**
3) **Restart the fusion splicer regardless of whether the fusion splicer is upgraded successfully. Otherwise the system will be out of service.**

4) If the upgrade is abnormal, upgrade it again.

Fig.21 Software upgrade interface

5.2 Cleaning of V-groove

In case of the contaminant in V-groove, the fiber may not be properly clamped, which will cause the larger fusion losses. Therefore, V-groove shall be checked and cleaned regularly during the normal work process. Follow these steps to clean V-groove:

a） As shown in Fig.22, open the dust cover;

b） Clean the contaminants in V-groove by pushing it with the end of a well-cut fiber along the one direction;

c） Clean the bottom of V-groove with a fine cotton swab moistened with alcohol, and remove the excess alcohol left in the V-groove with a dry cotton swab.

d） As shown in Fig.23, clean the fiber presser with a fine cotton swab moistened with alcohol.

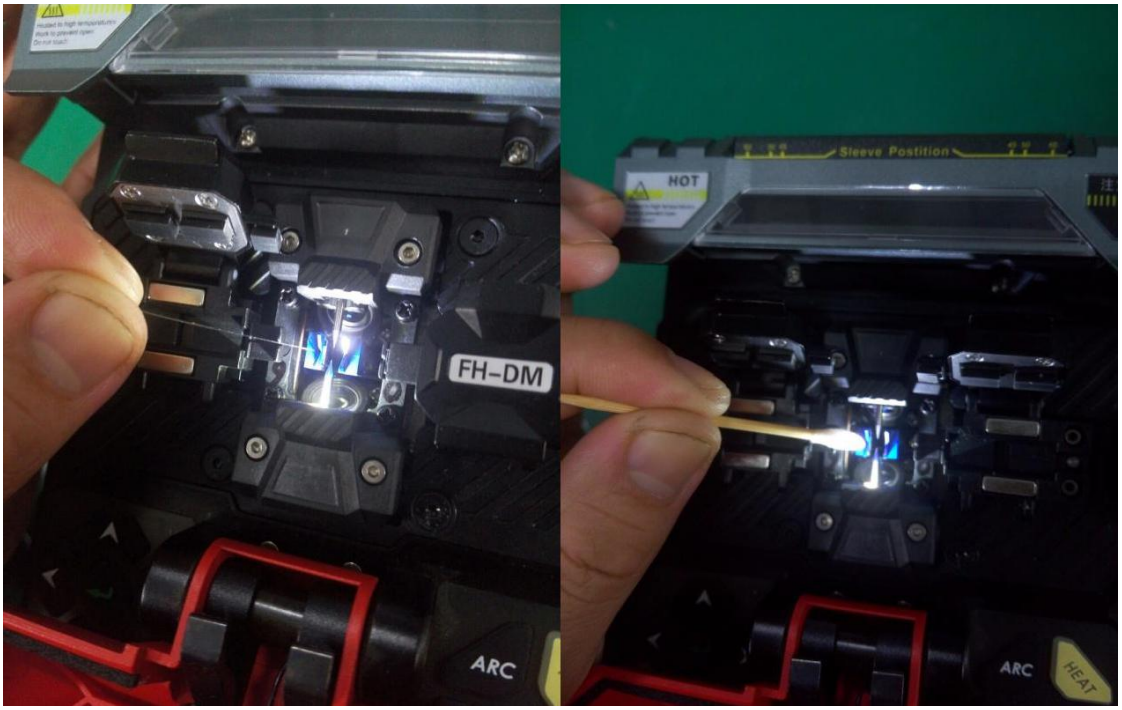


Fig.22 Cleaning of V-groove

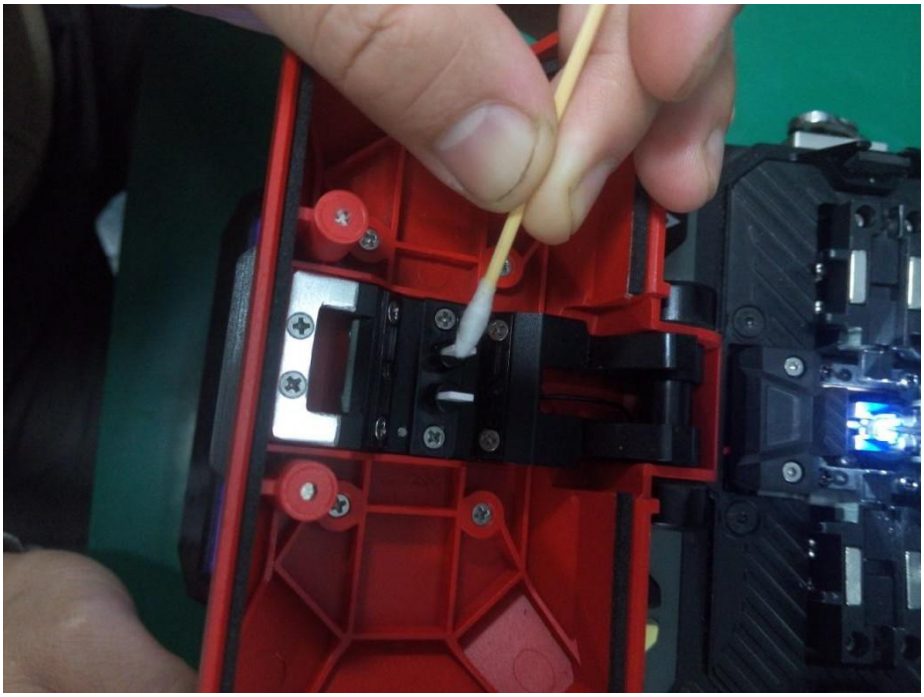


Fig.23 Cleaning of presser

5.3 Cleaning and Replacement of Electrode

If the electrode is dirty, clean the electrode with the Electrode Cleaning function of instrument maintenance in the main menu, and then wipe the tip of electrode gently with a cotton swab moistened with alcohol, or gently rub the tip of electrode with a 3mm wide and 50mm long metallographic sandpaper strip. Take care to protect the tip of electrode from damage. Regular original electrode is generally able to complete more than 3000 fusions. When the number of applications for electrode is greater than this value, the electrode shall be replaced timely. Otherwise it may affect the connecting quality. Electrode shall be replaced according to the following steps:

a) Electrode shall be replaced when the instrument is shutdown. In case of the discharge, the high voltage up to thousands of volts on the electrodes will cause great harm to the human body.

b) Open the windshield to present the electrode as shown in Fig.24;

c) First loosen the screws of electrode cap, take off the electrode cap and take out the electrode. Prevent the electrode from falling into the fusion splicer. Place the new electrode in the electrode holder slot, push the electrode forward to the end, and tighten the screws of electrode cap.

d) Replace the other electrode;

e) Start Discharge the battery several times or operate the electrode aging function in the menu mode to stabilize the discharge of electrode. Then perform the discharge correction.

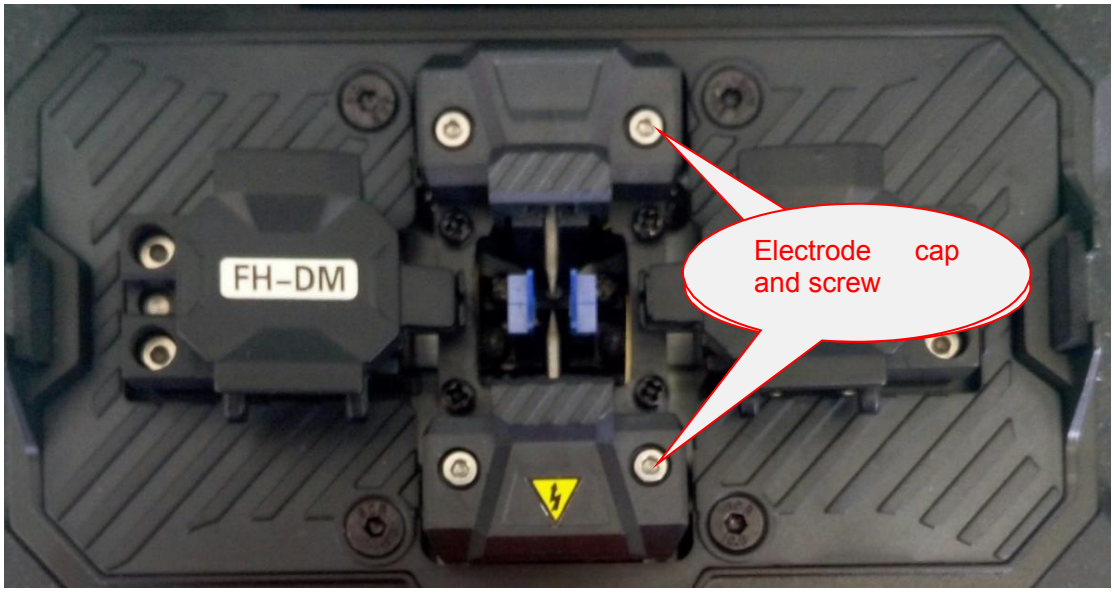


Fig.24 Electrode cap and screw

5.4 Adjustment of Electrode Holder

In case of the significant offset of discharge arc or the unstable discharge, the electrode holder shall be readjusted according to the following steps:

a） Place a well-cut bare fiber into the V-groove to make the cut cross-section between the both V-grooves if possible, and then gently press the fiber with a toothpick to make it completely drop into the groove as shown in Fig.25 . At this time, observe whether the fiber cross-section is positioned at the middle of electrode tips at both sides, and if not, loosen the screws of electrode holder, and re-adjust the position of electrode holder to make the distance from the electrode tips to fiber cross-section equal with that from the electrode tips to the V-grooves. Then press [ARC] button to observe the position of fiber end and try to ensure it at the middle of arc.

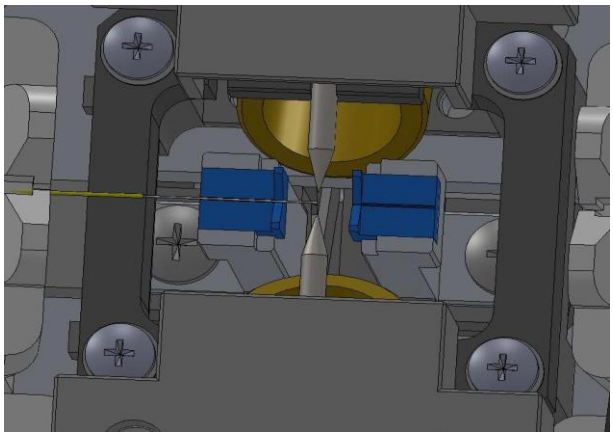


Fig.25 Schematic diagram of electrode position adjustment

b） After the above steps are completed, perform the discharge correction.

5.5 Cleaning of Objective Lens

If the microscope objective lens is dirty, the normal observation of the fiber core position may be affected, which may lead to the higher fusion loss or poor connection. Therefore, both objective lenses shall be cleaned regularly. Otherwise dust will accumulate and eventually cannot be removed. Clean the objective lens according to the following steps:

a） Before cleaning the objective lens, turn off the power.

b） As shown in Fig.26, clean the objective lens with a fine cotton swab moistened with alcohol. Wipe the lens with a cotton swab from the middle of lens and along the circular trajectory until the edge of lens is wiped. Then wipe off the remaining alcohol with a clean, dry cotton swab.

c） Turn on the power and make sure that the monitor is free of dust or streak.

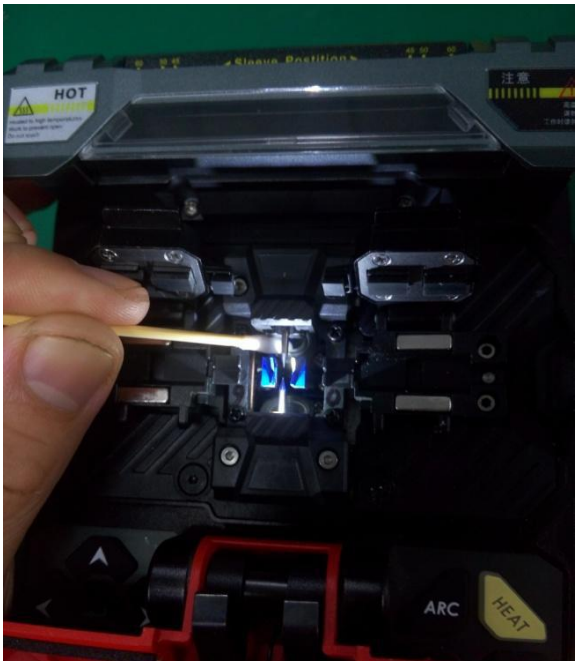


Fig. 26 Cleaning of objective lens

5.6 Propelling Distance Correction

Place the fiber with well-prepared cross-section into the fusion splicer, select the “Propelling Distance Correction” item in the motor menu and press "Enter" button. Press this button again to start the propulsion test. The process is as follows:

a） Fusion splicer automatically pushes the fiber to the center of screen and sets the gap;

b） Fusion splicer automatically withdraws the left fiber and propels the right fiber according to the "overlap + gap" value;

c） After the propulsion, fusion splicer automatically calculates and displays the propelling distance which shall be close to the set value of fusion parameter.

d） Based on the calculated propelling distance, fusion splicer automatically determines whether the propelling distance is appropriate. If not, fusion splicer automatically changes the fusion overlap parameter, and then repeat the following steps a), b) and c) until the propelling distance is successfully corrected.

Note: The propelling distance correction is used to optimize the propelling distance. Generally,multiple corrections are required to complete the process. The intermediate process does not require the re-preparation of fiber.

5.7 Propelling Distance Test

Place the fiber with well-prepared cross-section into the fusion splicer, select the “Propelling Distance Test” item in the motor menu and press "Enter" button. Press this button again to start the propulsion test. The process is as follows:

a） Fusion splicer automatically pushes the fiber to the center of screen and sets the gap;

b） Fusion splicer automatically withdraws the left fiber and propels the right fiber according to the "overlap + gap" value;

c） After the propulsion, fusion splicer automatically calculates and displays the propelling distance which shall be close to the set value of fusion parameter.

5.8 Discharge Correction

The discharge correction is used to optimize the position of discharge arc and the current. Place the fiber with well-prepared cross-section into the fusion splicer, select the “Discharge Correction” and press "Enter" button. Press this button again to confirm, and start the discharge calibration. The process is as follows:

a） Fusion splicer automatically pushes the fiber to the center of screen and sets the gap;

b） Fusion splicer automatically discharges, corrects the arc position and adjust the current;

c） If the calibration is not successful, replace the two test fibers with the well-finished cross-sections according to the instructions, and then fit the windshield and perform another discharge arc calibration.

5.9 Discharge Test

Select the "Discharge Test" in the maintenance menu. The process is as follows:

a） Fusion splicer automatically propels the fiber to the center of screen, sets the gap, and completes the alignment;

b） Electrode discharges and produces an arc, but the right fiber is no longer propelled. Therefore, the ends of two fibers are burned into the spherical shape;

c） Fusion splicer derives the arc position and current intensity from the melting deformation of both fibers at high temperature, and gives the following information:

“Left/right offset ××× Current ×××” indicates that the arc position deviates to right/left.

Left/right offset of arc is within 003. No adjustment is needed. Current shall be properly between 008 and 012. The offset of arc position is large, and the discharge correction may be performed. If the discharge correction effect is poor, the electrode holder shall be manually adjusted.

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