AS03-9B002

Applicable lots:
9708 lot -

Prepared in May 1998

No. 1

Service Manual

for

TERUMO Tube Sealer

Model: AC-155

Development Section	Engineering Section	Quality Assurance Section	ME Service Section	Responsible Engineer

TERUMO Corporation.

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1. General

This Service Manual has been prepared for the field maintenance and services for the Tube Sealer AC-155.
When informed of a tube sealer malfunction from a user, please troubleshoot according to the following procedures.

① Before visiting the user for servicing, read the Operating Instructions and the Service Manual carefully.

② Make sure that the user handles the equipment properly as specified in the Operating Instructions.

③ If any fault is found to be caused by improper operation by the user, correct the cause of the problem and instruct the user how to operate the equipment properly so that recurrence of the fault can be prevented.

④ Before starting the actual repair of the equipment, be sure to confirm the fault that the user has brought to your attention. After assessing the actual state of the fault, only then should you start any repair work.

⑤ If the equipment is found to malfunction even when it is operated properly, use the troubleshooting procedure in this manual to diagnose the faulty equipment.

⑥ If you are unable to correct the fault by using this manual, return the faulty equipment to your local TERUMO service organisation or TERUMO and attach a memorandum indicating the details of the fault and the actions taken before return of the equipment.

⑦ Disinfect the items contaminated by patient's body fluids before returning to TERUMO service organisation or TERUMO as described in section 10. If it is necessary to send back those items that have not been disinfected, seal them completely and attach a memorandum indicating that the contents are unsanitary and to be handled with care.

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(General precaution)

① Don't detach connectors or printed-circuit boards while the equipment is supplied with power.

② First visually check the malfunction equipment for open circuits, short circuits, loose
connectors and damaged parts. Also, check for abnormal sounds or foul smells (caused
by burned resistor, etc.).

③ After completion of repair work, check that all parts are set in the respective original
settings. Clean the equipment and its periphery and, then, report the result of repair work to the use person in charge.

④ When handling semiconductors, especially MOS-IC, take special care not to cause electrostatic breakage, etc.
- Keep your body and your soldering iron in constant connection with a ground point through a 1M Ω resistor. (A statically insulated type of soldering iron does not require grounding, but it must be used only after being checked for completeness of insulation.)
- When carrying ICs and printed-circuit boards, be sure to keep them in electrically conductive containers or wrap them in metal sheets (such as aluminum foil).
(Never use plastic containers or sheets for this purpose.)
- Don't apply any strong impacts and pressures.

⑤ If you find that an abnormality disappears when a printed-circuit board is replaced, try to remount the original board to ascertain that the previous abnormality still occurs.
If there is no recurrence, poor contact or another fault could be suspected; continue troubleshooting.

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2.Specification

Name of product	: TERUMO Tube sealer	
Model	: AC-155	
Tube material	: Polyviny chioride(PCV)-(O.D.:less than 6mm)	
Oscillation Frequency	: 40.68MHz	
Sealing Time	: Less than 2seconds (When the Terumo tubing is sealed)	
Power Requirements	: AC230V±10%、50 / 60Hz	
Power consumption	: When sealing;250W,Stand by;8W	
Classification	: Class Ⅰ	
Operating Conditions	: +10 to 40℃(+50 to +104° F)	
	30 TO 85%RH (No condensation)	
Storage Conditions	: -20 to 45℃(-40 to +113° F)	
	10 to 95%RH (No condensation)	
Dimensions	: W171×H158×D319(mm)	
	(W:Including Carrying Grip)	
Weight	: Approx.7.0kg	
Accessories	: Shielded AC Power code	1 pcs.
	Outer Fuses(T3.15A/250V)	2 pcs.
	Plate	1 pcs.
	Screw for Attaching Plate	2 pcs.
	Nylon washer	2 pcs.
	Carrying Grip	1 pcs.
	Screw for attaching Carrying Grip	2 pcs.
	Instruction Manual	1 pcs.

3. Required Tools and Measuring Instruments

- Constant voltage supply: 12V DC (0.1A), 24V DC (0.5A)
- Thickness gauge: 0.06, 0.07, 0.18, 0.20, and 1.90mm or equivalent combinations
- Stop watch
- (+) screwdriver
- (−) screwdriver
- Nipper
- Spanner: 5.5 mm width across corners
- Allen wrench: 1.5 mm
- Heat gun (Heater)
- Digital multi meter
- Alcohol
- Gauze
- Rubber gloves
- Cotton swab
- TERUMO single blood bag (BB＊SC506E:500ml)
- Adjusting harness 1 and 2
- Jig 1 for attaching spacing detection plate(6.40 and 6.60mm spacer)
- Jig 2 for attaching spacing detection plate

4. Operation principle

Tube Sealer AC-155 consists of a power circuit, RF circuit, power/control circuit, detection circuit, and sealing electrodes.

4.1 Sealing Process

① With the tube sealer supplied with power, insert a tube between the sealing electrodes and push the tube detection lever downward. The photo sensors (PS1 and PS2) on the detection circuit detect the tube, activating the solenoid (SO) to push the tube.

② The photo sensor (PS3) on the detection board detects the electrode spacing. After making sure that the solenoid (SO) has moved, the equipment starts oscillation. The oscillation output is used for the dielectric heating and sealing of the tube.
If the electrode spacing becomes 1.9 mm within 0.1 second after the detection by the photo sensors (PS1 and PS2), the equipment starts oscillation. If not, the equipment does not start oscillation, and the solenoid turns off, opening the electrodes.

③ The tube is sealed and the electrode spacing becomes smaller. When the photo sensor (PS3) detects that the electrode spacing reaches 0.18 mm, the equipment stops oscillation.

④ For about 0.4 seconds after that, the tube is cooled and stuck. The tube cooling period is determined by IC3 (R8, 9, and C13) on the power/control circuit. After the cooling period, the power to the solenoid (SO) turns off, opening the electrodes.

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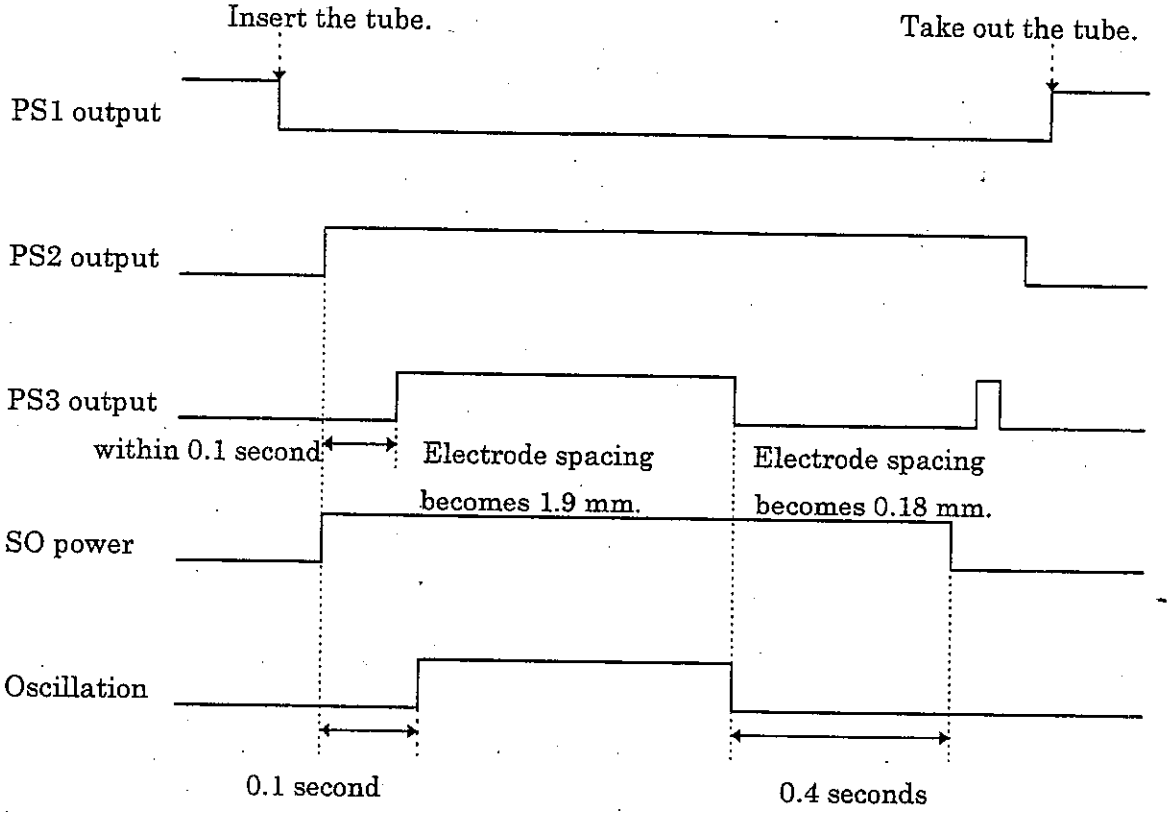

- Two sensors (PS1 and PS2) are used to avoid that the sensor is chattering.
- The equipment does not start oscillation unless PS3 reaches the level "H" within 0.1 second after PS2 changes from level "L" to "H". This is the protection function of the overload,in this case that the thing over the matching tube diameter was inserted wrong.

4.2 Protective Circuit

(1) Prevention against extended-time oscillation

If a tube cannot be sealed due to wetting or for any other reasons and extends the oscillation, it will give damage to the equipment. To prevent this, the equipment is designed to stop oscillation in a certain time and return the solenoid.
Time to activate the prevention is specified by IC2 (R6, 7, C9) on the power/control circuit to about 4 seconds.

(2) Overheat prevention

Sealing a wet tube will cause abnormal heat in the electrodes and oscillating circuit, which gives damages to the equipment. To prevent this, a thermostat is in the equipment.
When the thermostat works, the power lamp will go off, disabling sealing. After that, when the circuit is cooled down, the thermostat will reset automatically, making the equipment operational.

Note: The thermostat works according to the temperature rise in the equipment which depends on the room temperature, the number of times of sealing, and others.
The following are the rough standard at the time of a normal temperature.
- Thermostat operating condition: After sealing has been performed about 10 times with the electrodes short-circuited.
- Thermostat reset condition: Time during overheat and cool down is about 30 seconds.

Temperature of thermostat operation

Over 80°C → Stop (overheat)
Below 60°C → Restart (cool down)

4.3 Electric System

4.3.1 Structure of Electric System (See the connection diagram on page 4-5.)

Description	Main functions
① RF circuit	Outputs the high-frequency power.
② Power/control circuit	- 12V DC power circuit to stabilize the control circuit - 45V DC power circuit to drive the solenoid - Seal timing circuit Start timing Stop timing Time-up
③ Detection circuit	- Sealing-start signal detection by photo sensor - Sealing-stop signal detection by photo sensor
④ Display circuit	- Indicates that sealing is in progress by an orange lamp - Indicates that the equipment is powered by a green lamp
⑤ Matching circuit	- Matches the oscillating circuit and the electrode unit
⑥ Electrode cover detection switch	Safety circuit Disconnects the power when the electrode cover is out of position

4.3.2 Connection Diagram

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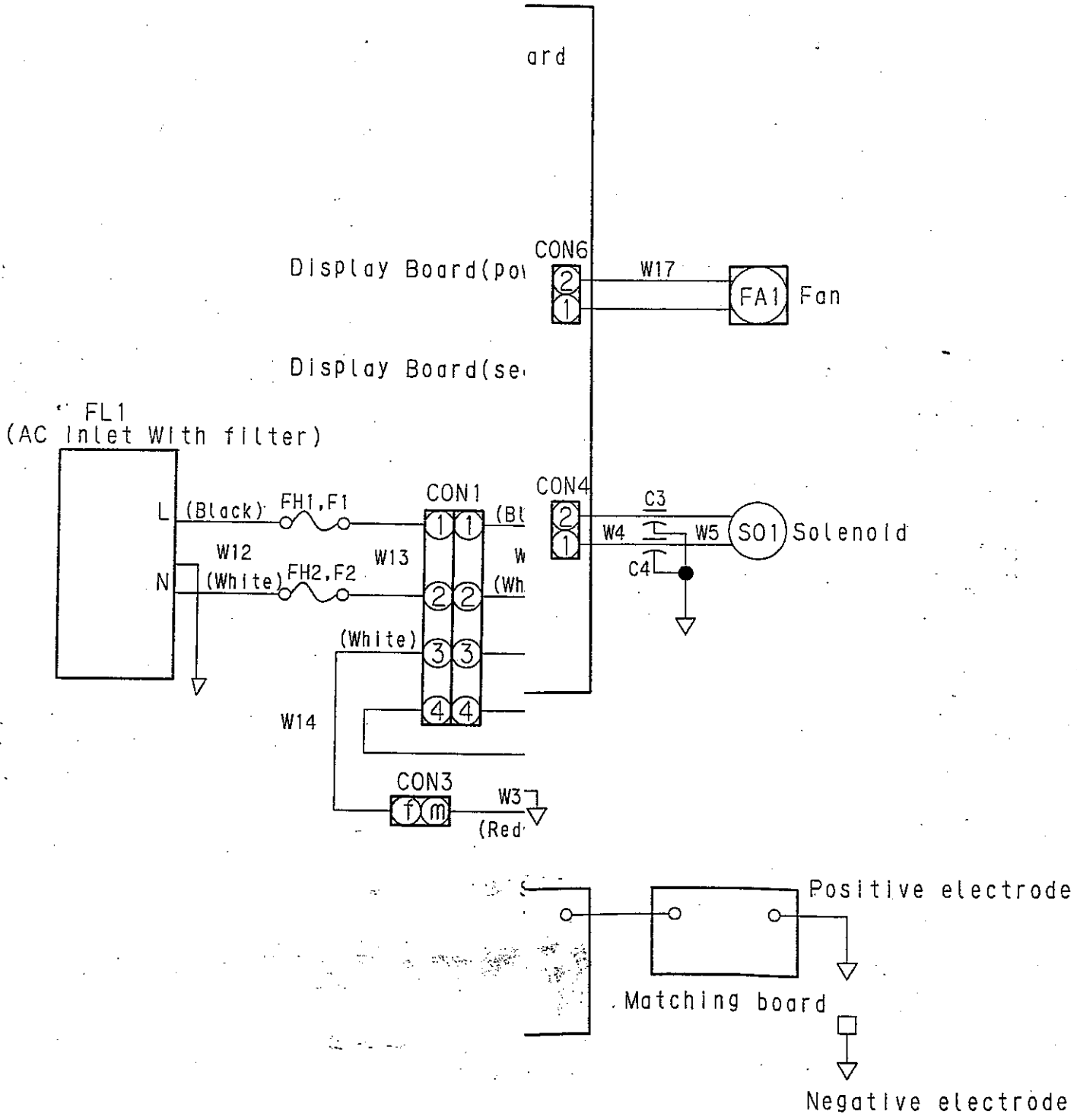

4.4 Mechanical System

4.4.1 Structure of Mechanical System (See the structural drawing on page 4-7.)

Description	Main functions
① Positive electrode	Outputs the high-frequency power.
② Negative electrode	Outputs the high-frequency power.
③ Block A	Holds and slides the negative electrode shaft.
④ Block B	Holds the positive electrode shaft.
⑤ Detection board	Detects the existence of a tube (to startautomatic sealing). Detects the electrode spacing (to stop sealing).
⑥ Spacing detection plate	A shading plate for the electrode spacing detection (to stop sealing)
⑦ Detection lever	A shading plate for the tube detection (to start automatic sealing)
⑧ Stopper	Adjusts the position of the electrode spacing detection (to stop sealing).
⑨ Compression spring 1	A buffer spring between the solenoid and the negative electrode shaft.
⑩ Compression spring 2	A spring to return the negative electrode shaft.
⑪ Solenoid	
⑫ Washer	Transmits the force of the solenoid to the compression spring 1.
⑬ Collar	Maximum pushing point.
⑭ Ring	To prevent metal to metal contact
⑮ Guide	To prevent the turning of the solenoide on the shaft.

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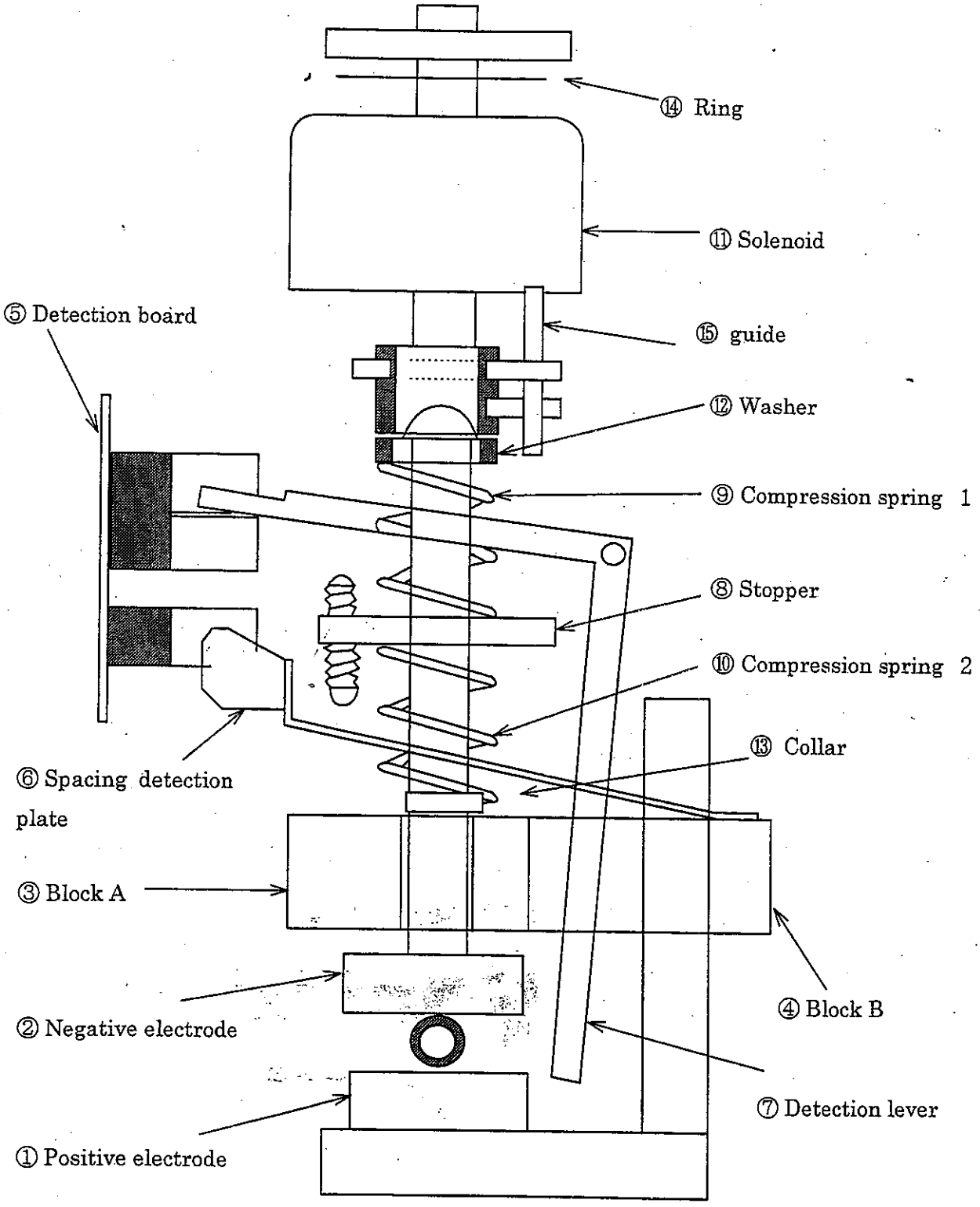
4.4.2 Structural Drawing for Sealing Electrodes



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5. Spare Parts List

No.	Description	Q'ty	Parts included	Remarks
05BT01	Plate	1		
05BT03	Carrying Grip	1		
05BT08	Fuse holder (L),(N)	1		L:White N:Black
05BT11	Positioning spring set	2		
05BT12	Detection board	1		
05BT13	Detection lever spring	1		
05BT14	Heat radiation grease	1		
05BT15	Rubber feed	4		
06BT502	Power/Control board	1		
06BT504	Electrode cover	1		
06BT505	Electrode set	1	Positive & Negative electrode	
06BT506	RF unit	1	RF board Detection board Electrode unit Solenoid unit Detection lever Detection lever spring Electrode cover detection microswitch Electrode set Finger set Cover guide Thermostat	
06BT507	AC inlet	1		
06BT516	Inner fuse holder	1		
06BT517	Outer fuse	2		250V 3.15A
06BT518	Inner fuse	1		15A
06BT519	Electrode unit	1	Electrode set	
06BT520	Front panel unit	1	Display board unit	
06BT521	Upper pannel	1		
06BT522	Display board unit	1	Display board(power) Display board(seal)	
06BT523	RF board	1		
06BT524	Matching board	1		
06BT525	Detection lever	1		
06BT526	Electrode cover detection microswitch	1		
06BT527	Cover guide	1		
06BT528	Solenoid unit	1		
06BT529	Finger set	1		
06BT530	Thermostat	1		
06BT531	Fan	1		
06BT532	Spacing detection plate	1		
06BT533	Shielded AC Power Cord	1		

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No.	Description	Q'ty	Parts included	Remarks
06BT534	Adjusting harness (1,2)	1		
06BT535	Jig 1 (6.4 and 6.6mm spacer)	1		
06BT536	Jig 2 (Attaching spaceing detection plate)	1		
—	TERUMO single blood bag (500ml)	10		BB* SC506E

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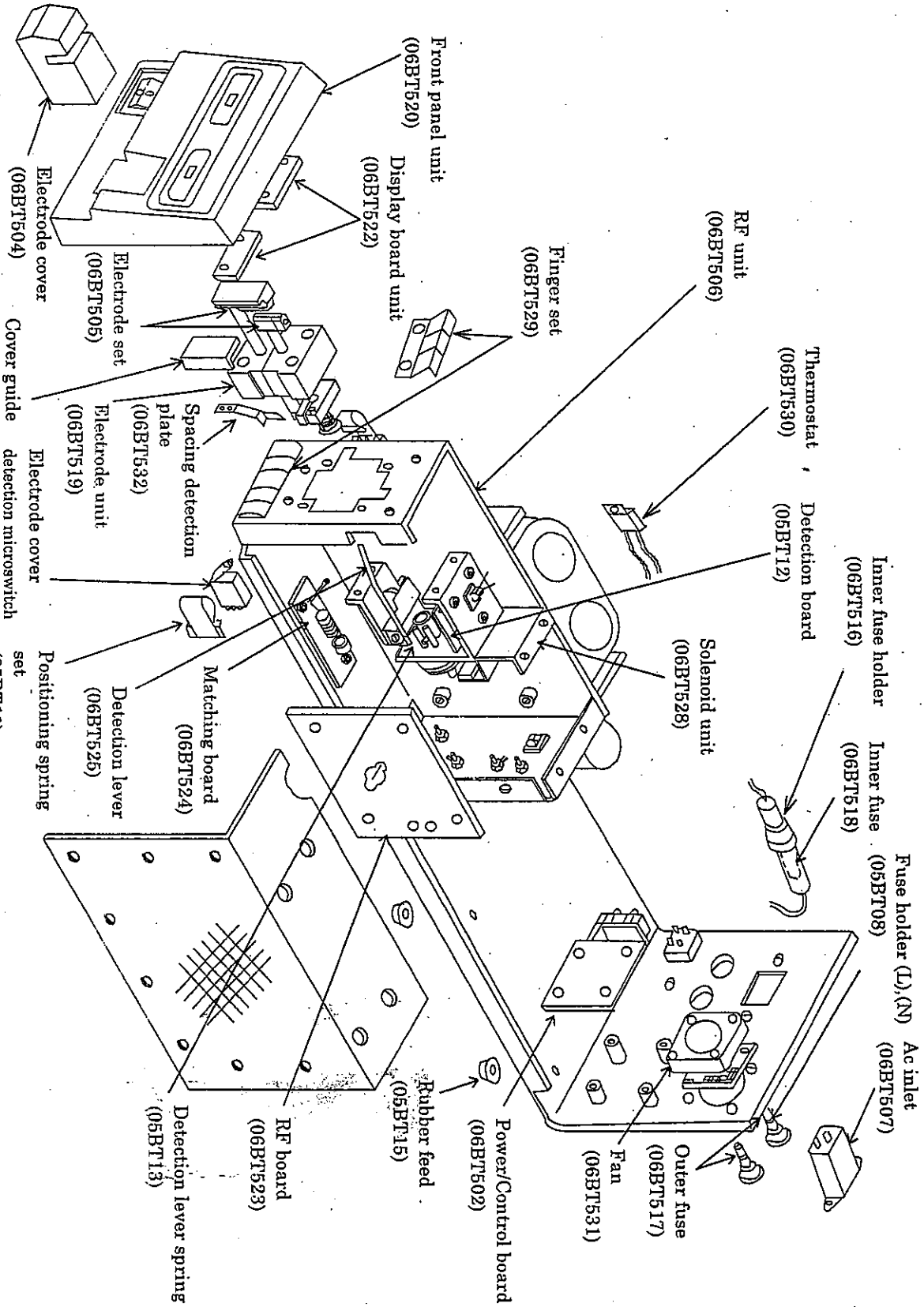
5.1 Accembly of parts



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6. Disassembly Procedure

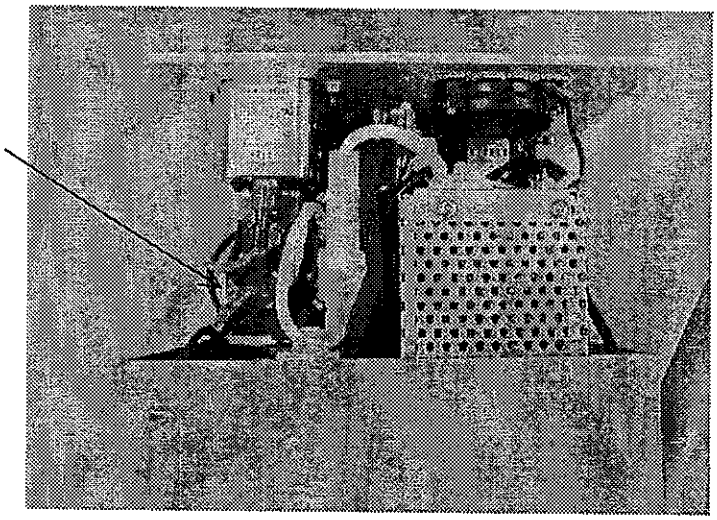
This chapter describes the disassembly procedure for the AC-155 device.

Caution

Even if the power is turned off, the aluminum electrolytic capacitor (C5) is charged with electricity. Turn the power off and wait for about five minutes before starting disassembly.

Pushing the seal lever will not discharge the capacitor.

Electrolytic capacitor



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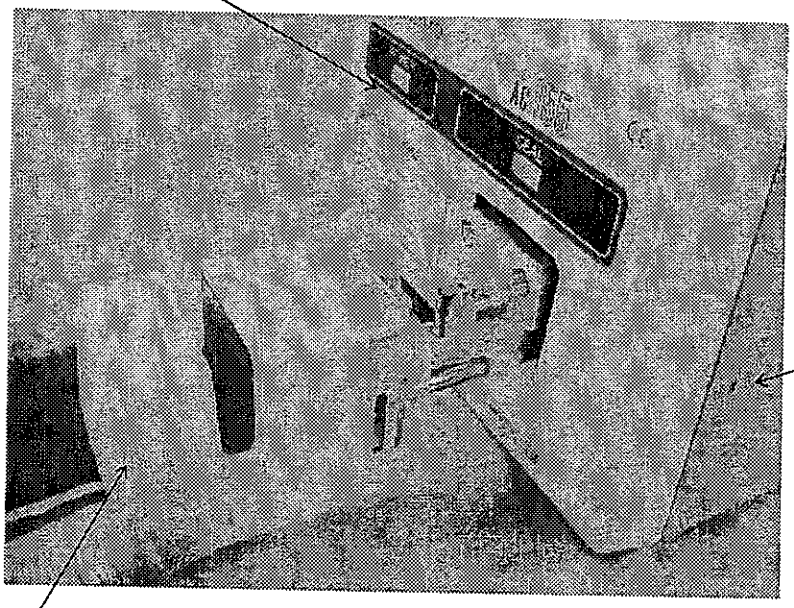
6.1 Removing the Electrode Cover

① Pull out the electrode cover straight.

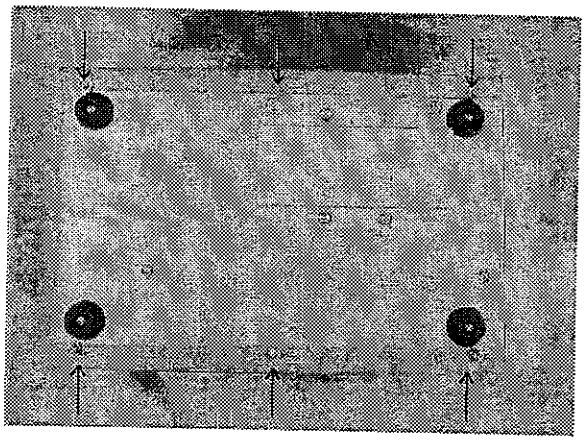


6.2 Removing the Upper Panel

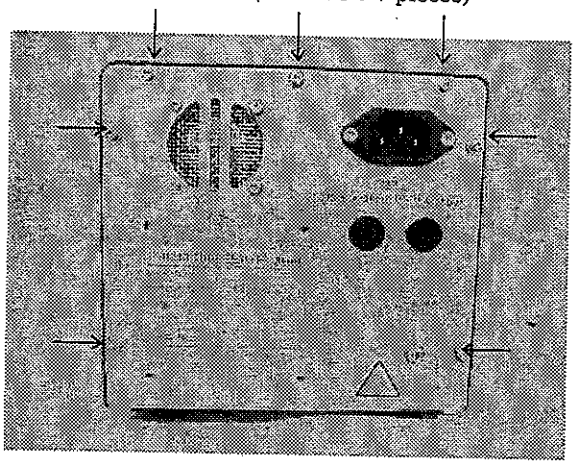
① Remove the screws on the bottom. (M3×L8, Clip washer: 6 pieces each)

② Remove the screws on the rear side. (M3×L8, Clip washer: 7 pieces each)

【Bottom】 Screws (M3×L8 : 6 pieces)



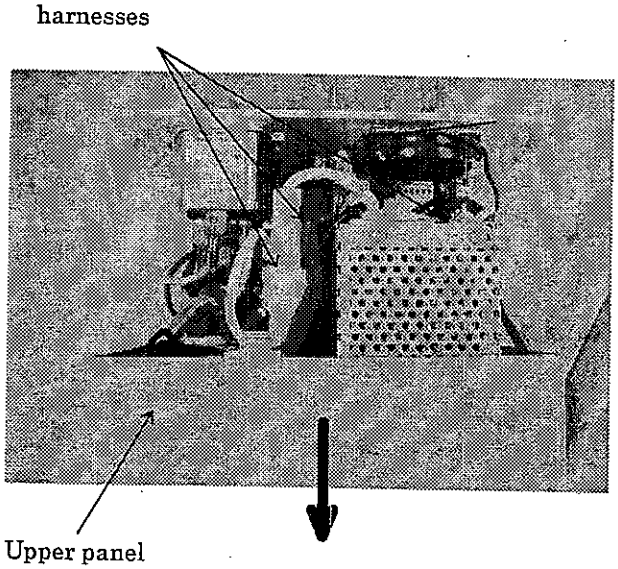
【Rear side】 Screws (M3×L8 : 7 pieces)

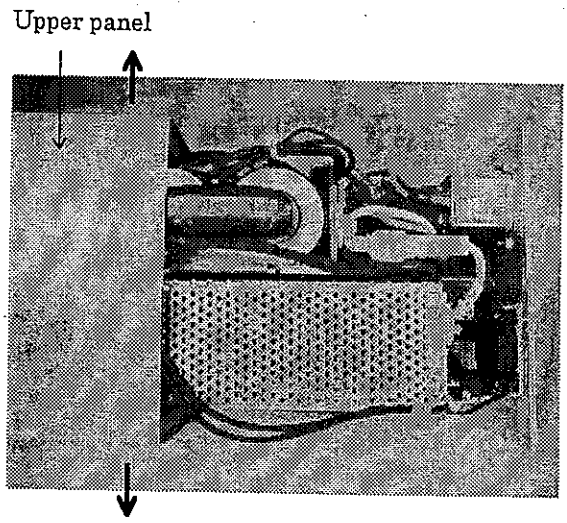


③ Pull out the upper panel toward you.

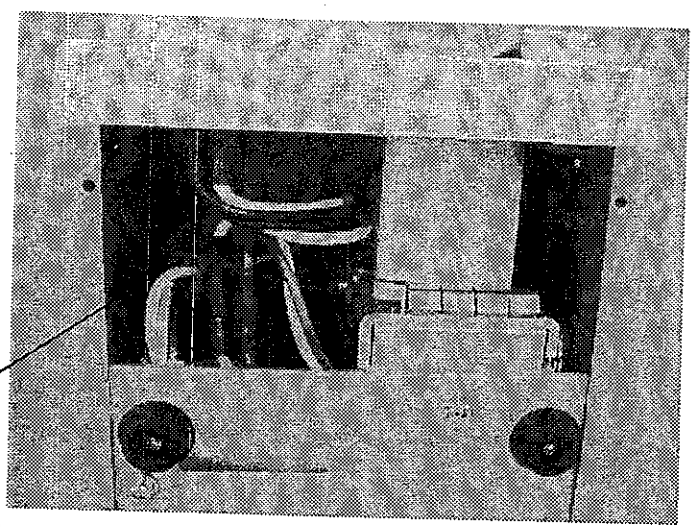
Cautions

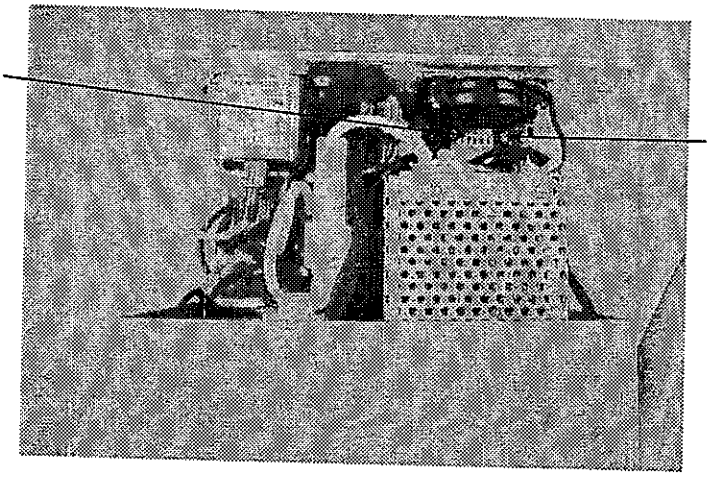
- When pulling out the upper panel, pay close attention to the harnesses which may catch the panel.
- After pulling out the upper panel three fourths , spread it and remove from the base.





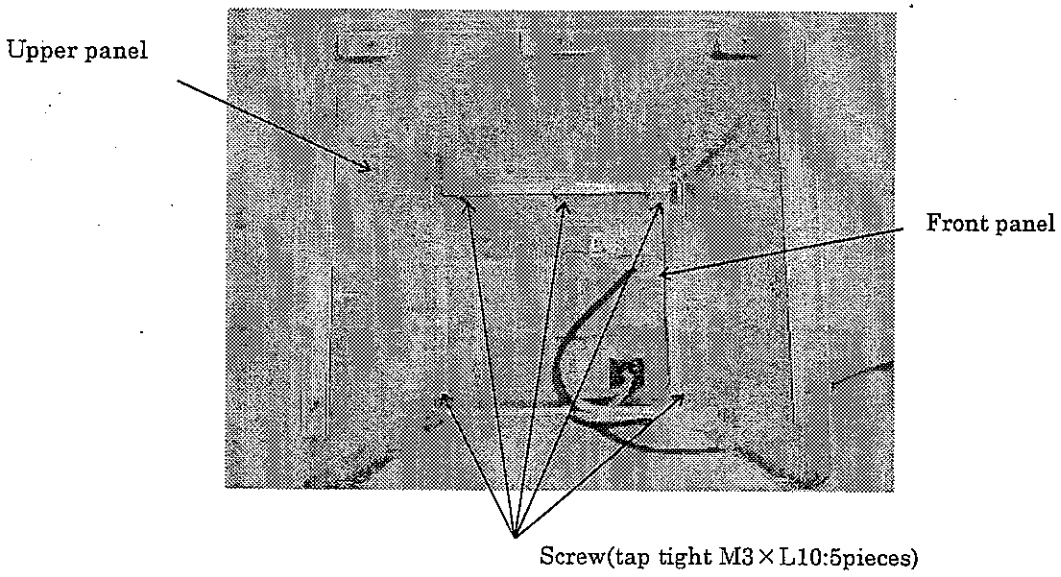
④ Disconnect the power switch connector (CON1) and remove the wire of the display board unit (CON2) on the power/control board with a screwdriver.





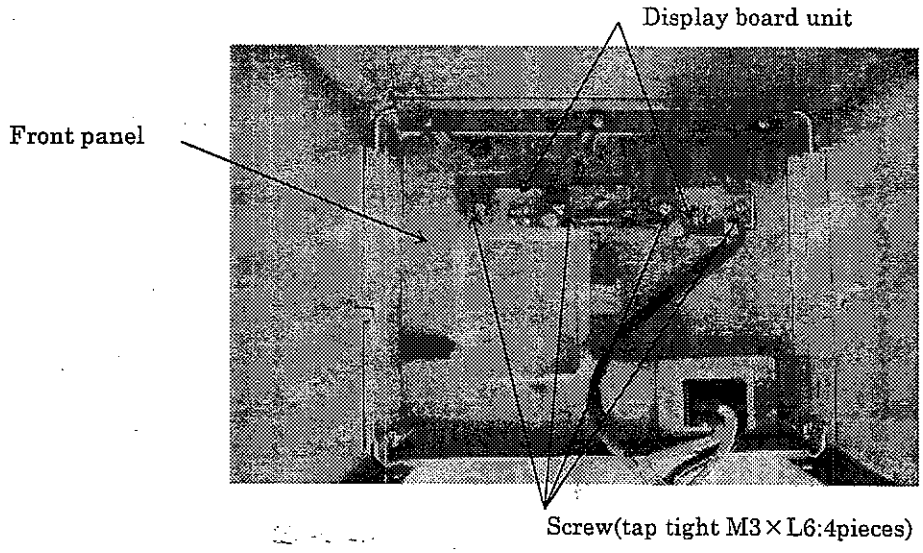
6.2.1 Removing the Front Panel Unit

① Remove the front panel unit. (Tap tight M3×L10: 5 pieces)



6.2.1-A Removing the Display Board Unit

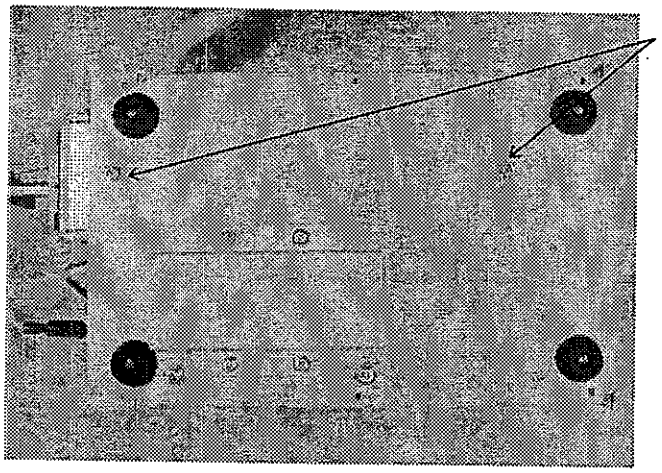
① Remove the display board unit. (Tap tight M3×L6: 4 pieces)



6.3. Base

6.3.1. Removing the RF Unit

① Remove the screws on the bottom. (M4×L10, Clip washer: 2 pieces each)



② Disconnect the wires as follows:

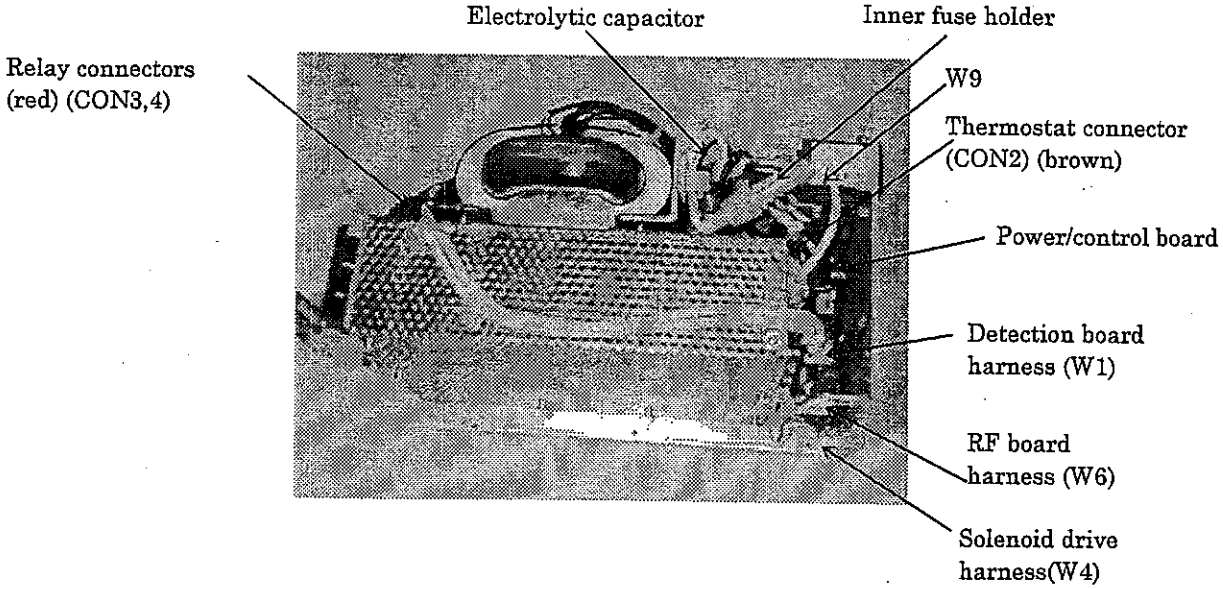
(1) Disconnect the connectors for the detection board harness (W1), RF control signal harness (W6), and solenoid drive harness (W4) from the power/control board.

(2) Disconnect the thermostat relay connector (CON2).

(3)Disconnect the power supply (W9).

- Rotate the inner fuse holder to remove.
- Remove the wire coming from the aluminum electrolyte capacitor. (Dedicated screw)

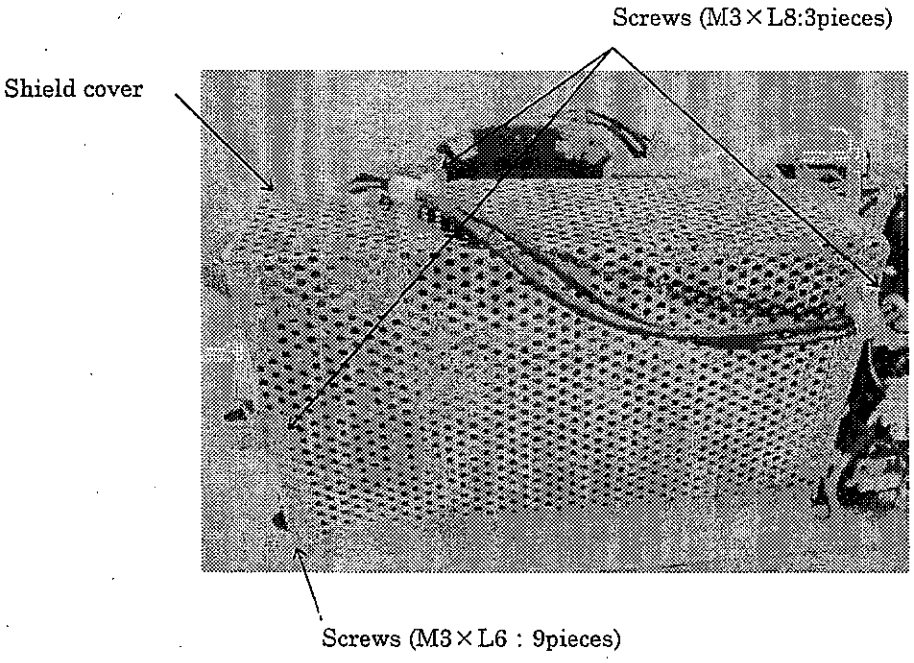
(4) Disconnect the relay connectors (CON3 and CON4) for the electrode cover detection microswitch.



6.3.1-A Removing the Shield Cover

You don't have to remove the RF unit.

① Remove the shield cover. (M3×L6: 9 pieces, M3×L8: 3 pieces)
The positioning spring in the right-hand side will come off at the same time.



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6.3.1-B Removing the RF board

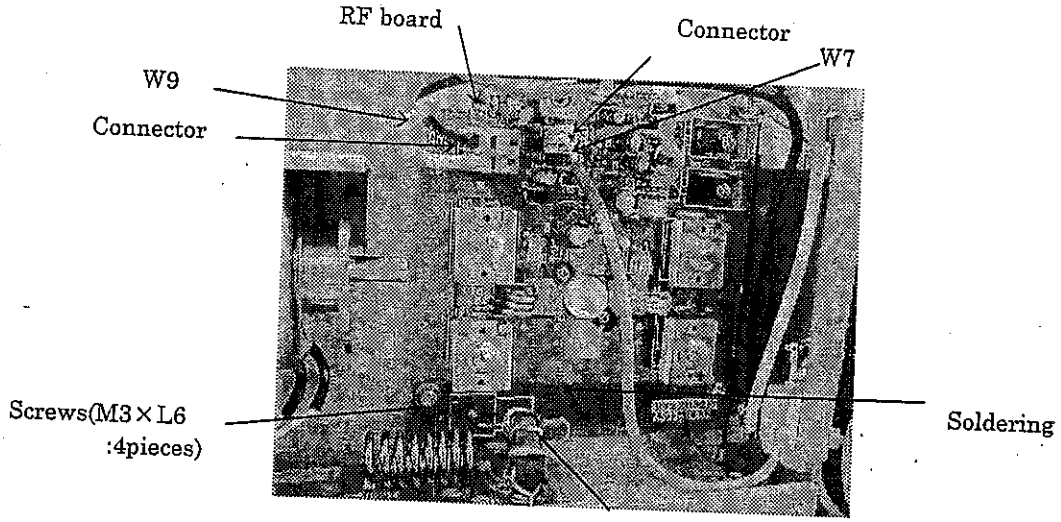
① Remove the shield cover.

Refer to 6.3.1-A Removing the Shield Cover on page 6-8.

② Remove the solder on the toroid transformer at one point.

③ Disconnect the wires as follows:

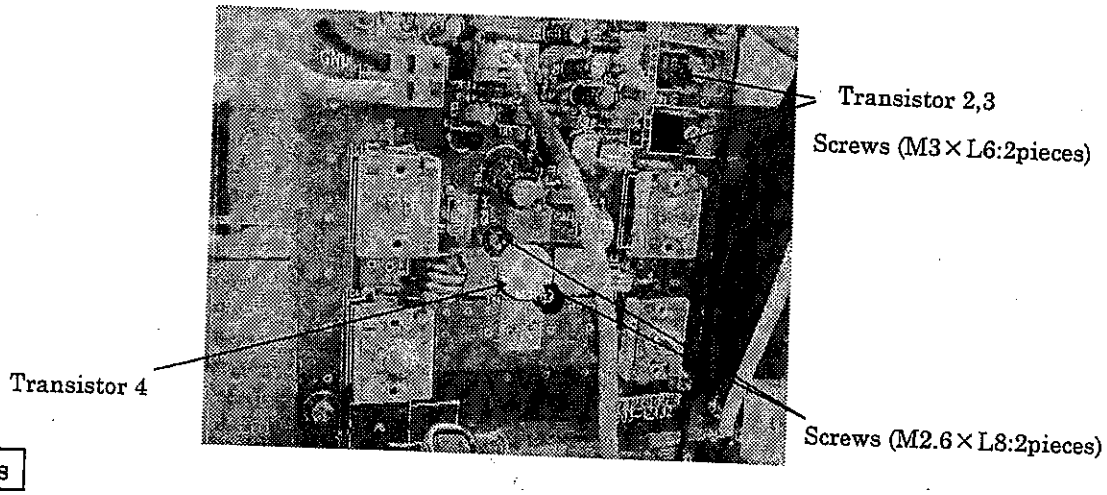
Disconnect the connectors for RF control signal harness (W7), and the power supply (W9) from the RF board.



④ Remove the transistor2,3,4.

(Tr4: M2.6×L8 with the small washer: 2 pieces, Tr2, 3: M3×L6: 2 pieces)

⑤ Remove the board fixing screws. (M3×L6: 4 pieces)



Cautions

- Do not melt the core wire of toroid transformer during soldering.
- Do not deform the coil on the Matching board.

6.3.1-C Removing the Electrode Unit

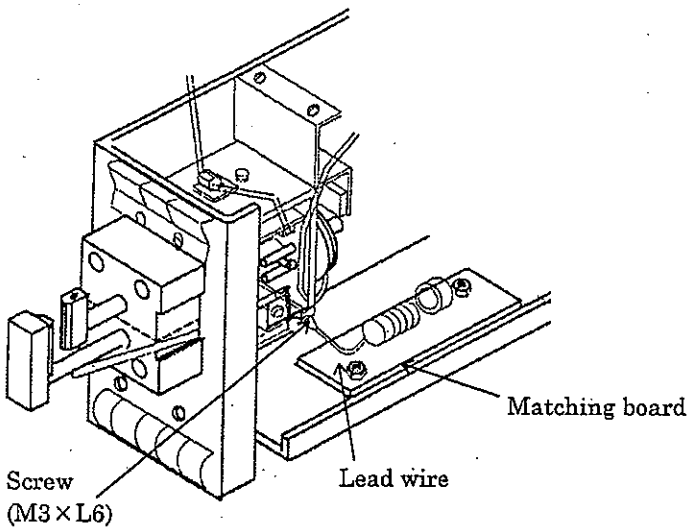
You don't have to remove the RF unit.

① Remove the shield cover.

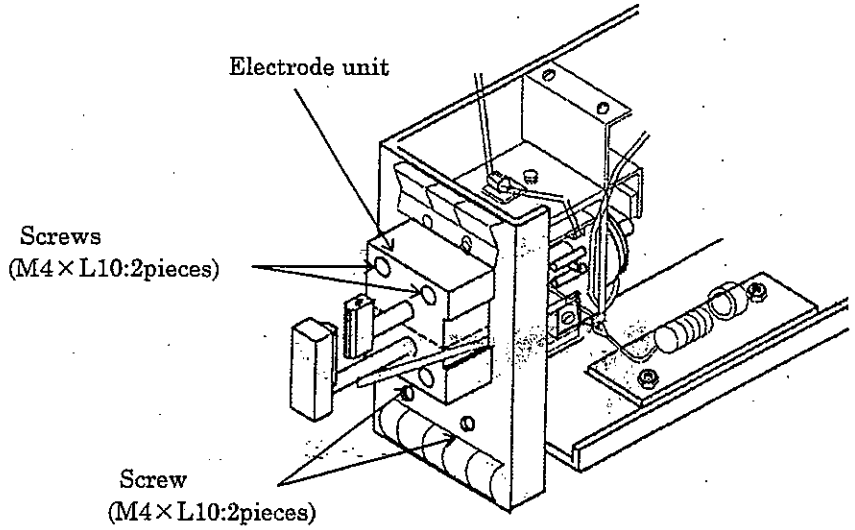
Refer to 6.3.1-A Removing the Shield Cover on page 6-8.

② Disconnect the lead wire from the matching board. (M3×L6: 1 piece)

Caution **Do not deform the coil on the Matching board.**



③ Remove the screws that fix the electrode unit. (M4×L10: 4 pieces)



Cautions **- Be careful of two shafts.**

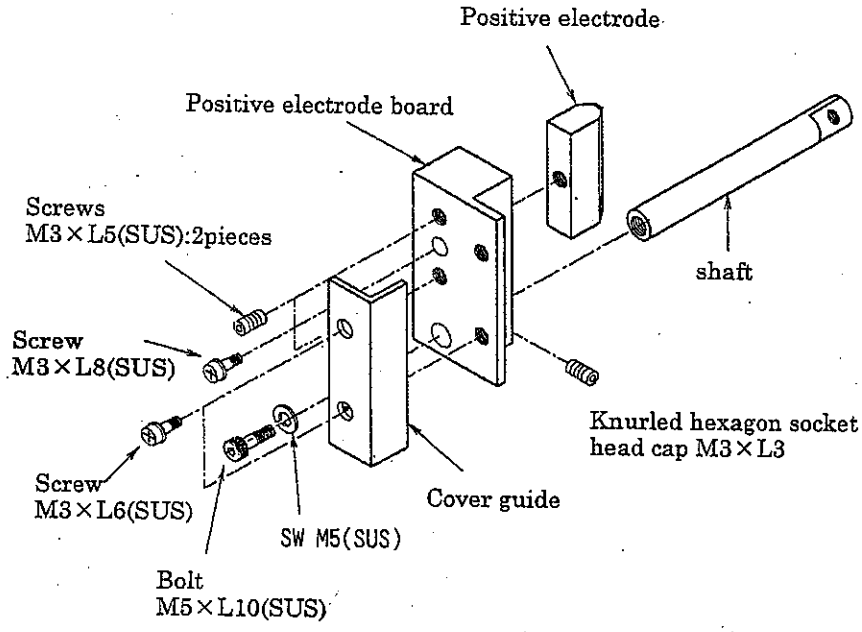
- Be careful so as not to bend the lead wire of the Matching board.

6.3.1-C1 Remove the Electrode Set

You don't have to remove the RF unit and the electrode unit.

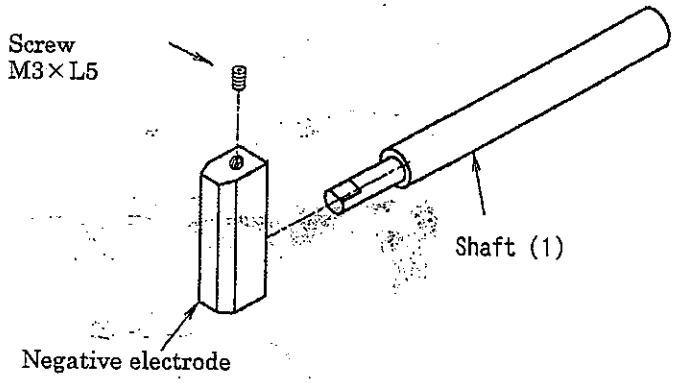
① Removing the positive electrode:

Remove the screw on the front side of the positive electrode bracket.
(M3×L8: 1 piece)



② Removing the negative electrode:

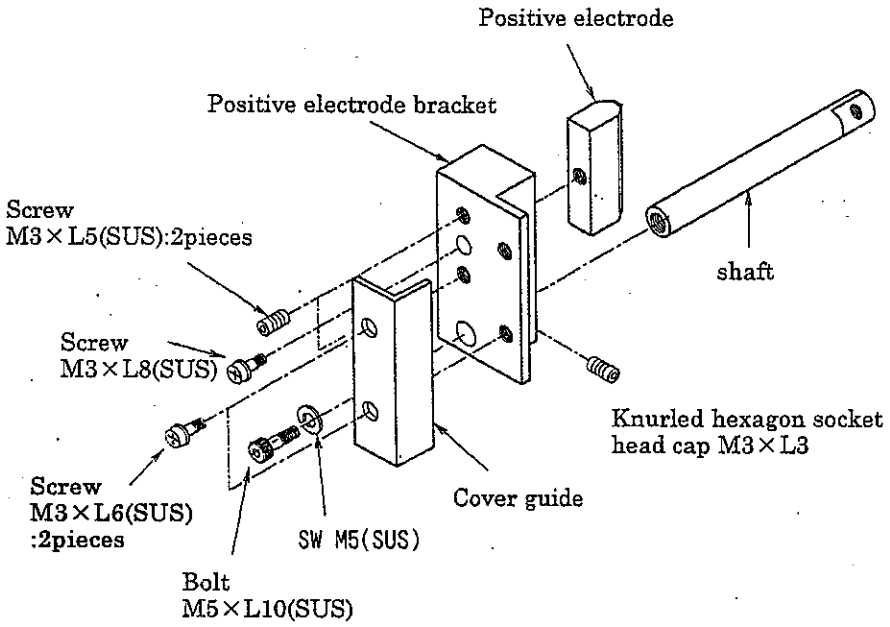
Remove the screw on the upper side of the negative electrode.
(Knurled hexagon socket head cap screw M3×L5: 1 piece)



Note:Replace the electrode when the silber is gone.

6.3.1-C2 Removing the Cover Guide

① Remove the screws on the front side of the positive electrode bracket.
(M3×L6: 2 pieces)



6.3.1-D Removing the Solenoid Unit

① Remove the shield cover.

Refer to 6.3.1-A Removing the Shield Cover on page 6-8.

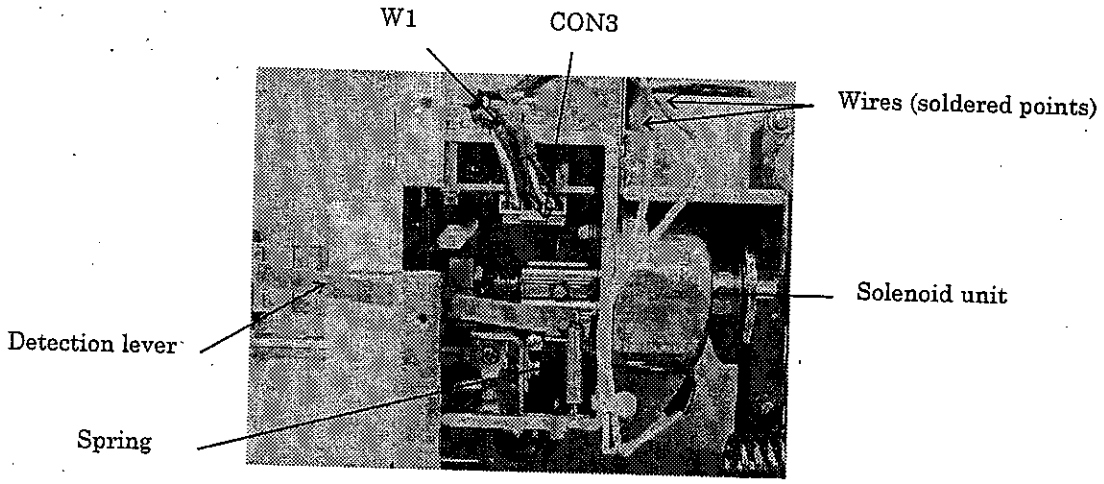
② Remove the electrode unit.

Refer to 6.3.1-C Removing the Electrode Unit on page 6-10.

③ Disconnect the solenoid wires.

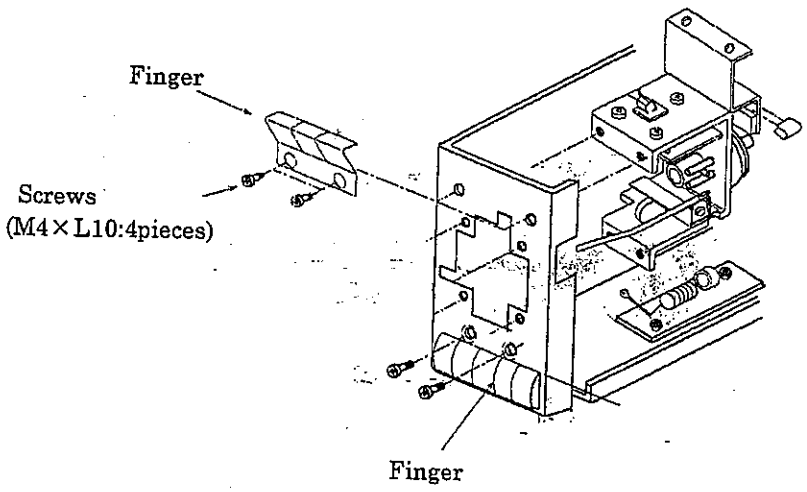
Cut two wires at the soldered points.

④ Remove the detection circuit harness (W1) from CON3 on the detection board.



⑤ Remove the solenoid unit. (M4×L10: 4 pieces)

It is screwed together with the upper finger.



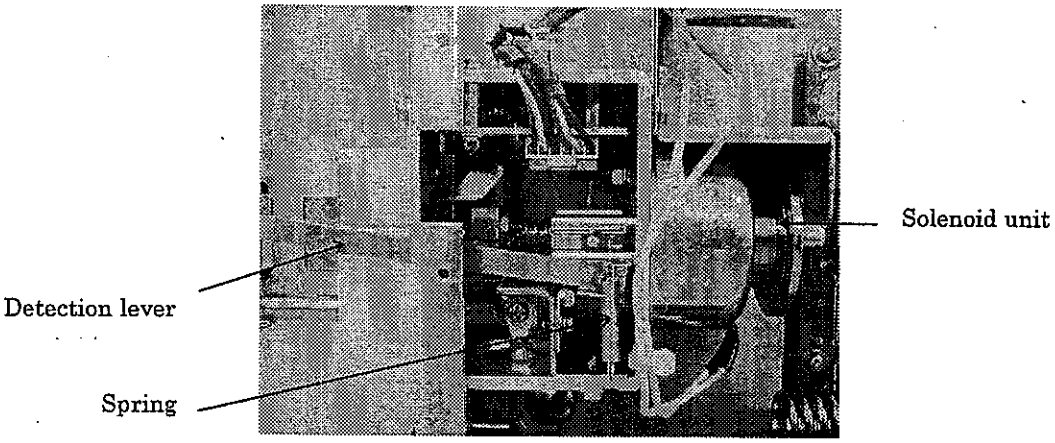
6.3.1-D1 Removing the Detection Lever Spring

You don't have to remove the RF unit and the solenoid unit.

① Remove the shield cover.

Refer to 6.3.1-A Removing the Shield Cover on page 6-8.

② Remove the detection lever spring.



6.3.1-D2 Removing the Detection Lever

You don't have to remove the RF unit.

① Remove the shield cover.

Refer to 6.3.1-A Removing the Shield Cover on page 6-8.

② Remove the electrode unit.

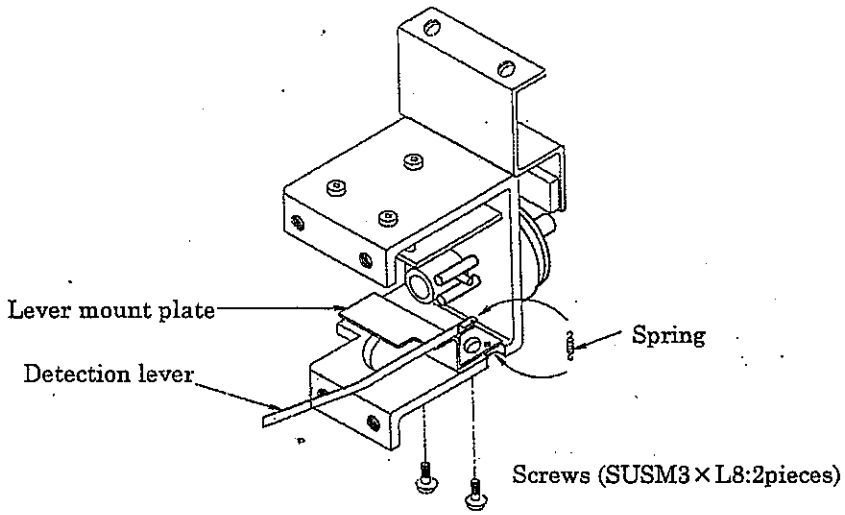
Refer to 6.3.1-C Removing the Electrode Unit on page 6-10.

③ Remove the solenoid unit.

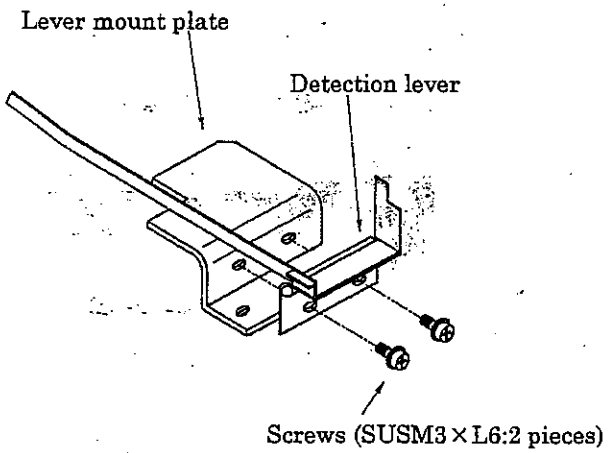
Refer to 6.3.1-D Removing the Solenoid Unit on page 6-13.

Do not disconnect the wires.

④ Remove the lever mount plate. (M3×L8: 2 pieces)



⑤ Remove the detection lever. (M3×L6: 2 pieces)



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6.3.1-D3 Removing the Detection Board

① Remove the shield cover.

Refer to 6.3.1-A Removing the Shield Cover on page 6-8.

② Remove the electrode unit.

Refer to 6.3.1-C Removing the Electrode Unit on page 6-10.

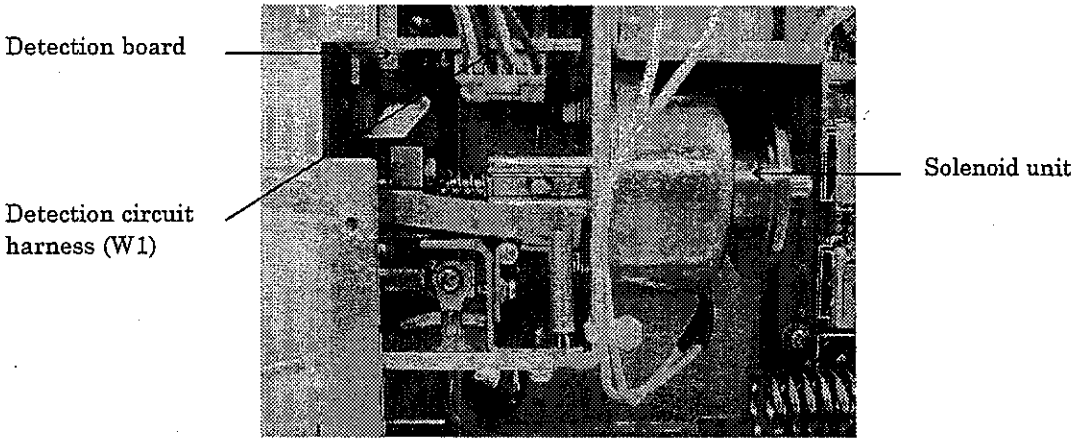
③ Remove the solenoid unit.

Refer to 6.3.1-D Removing the Solenoid Unit on page 6-13.

Do not disconnect the wires.

④ Remove the detection circuit harness (W1) from CON3 on the detection board.

⑤ Remove the detection board. (M3 × L8: 3 pieces)



Caution

-Take care not to deform the spacing detection plate and start lever shading section.

6.3.1-E Removing the Electrode Cover Detection Microswitch

① Remove the shield cover.

Refer to 6.3.1-A Removing the Shield Cover on page 6-8.

② Remove the electrode unit.

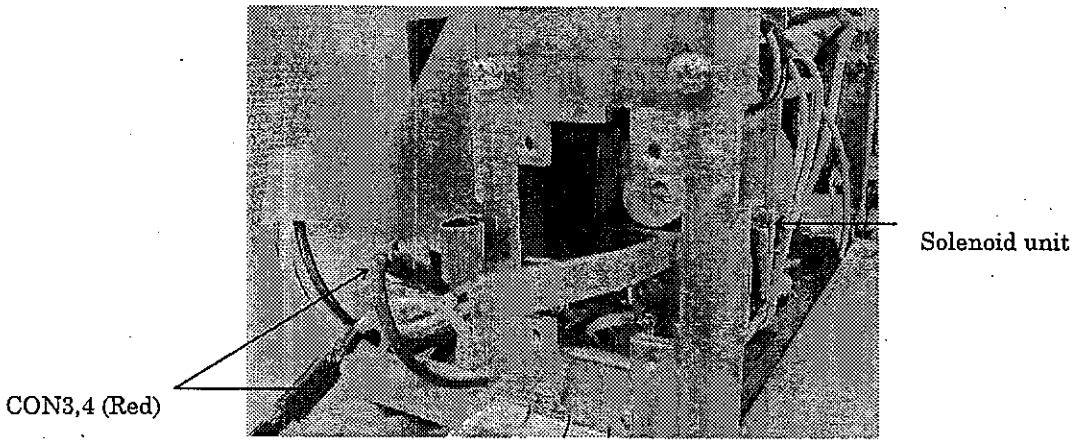
Refer to 6.3.1-C Removing the Electrode Unit on page 6-10.

③ Remove the solenoid unit.

Refer to 6.3.1-D Removing the Solenoid Unit on page 6-13.

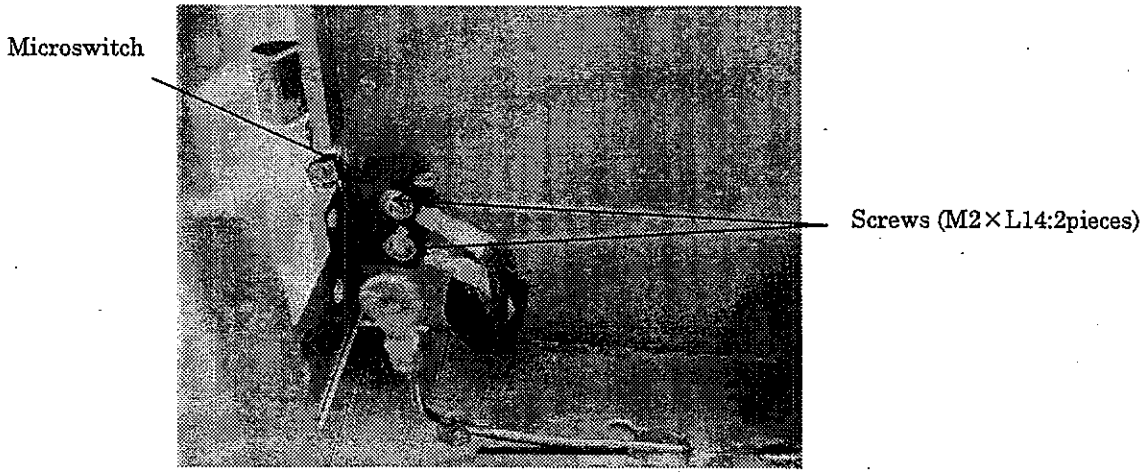
Do not disconnect the wires.

④ Disconnect the wires(W3). (CON3, 4)



⑤ Remove the electrode cover detection microswitch.

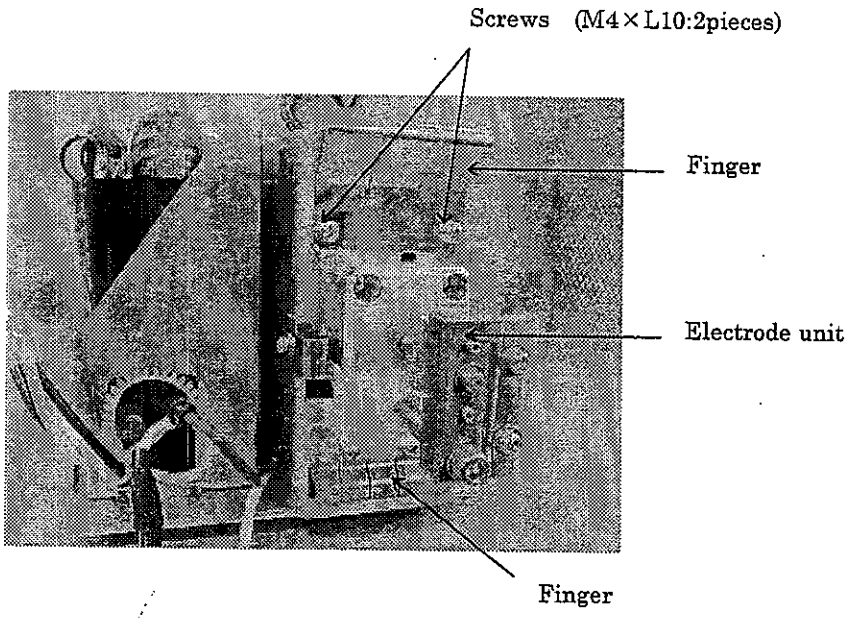
(M2 washer, Spring washer, Round-head screw M2×L14, Collar L3: 2 pieces each)



6.3.1-F Removing the Finger Set

You don't have to remove the RF unit, shield cover, electrode unit, and solenoid unit.

① Remove the upper finger.(M4×L10: 2pieces)
It is screwed together with the sorenoid unit.
② Remove the lower finger. Tear it off as it is adhered with adhesive.



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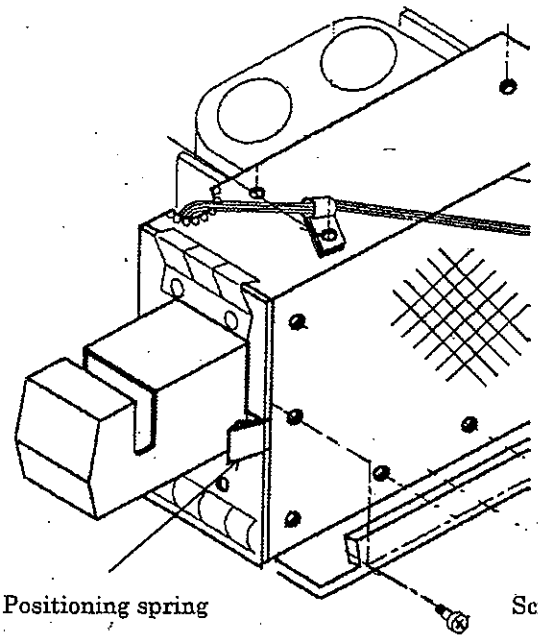
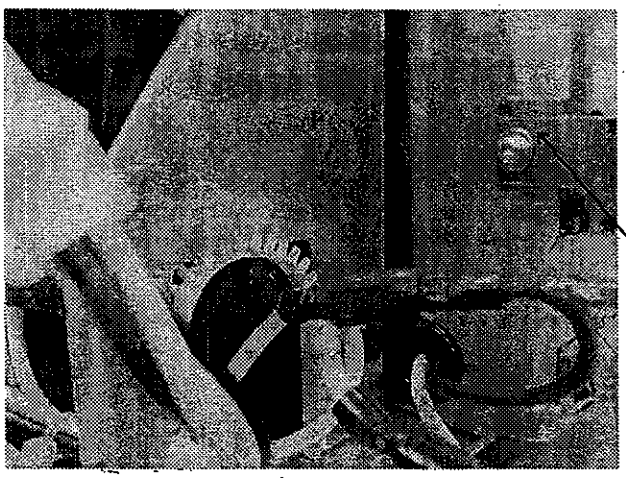
6.3.1-G Removing the Positioning Spring

You don't have to remove the RF unit, shield cover, electrode unit, and solenoid unit.

① Remove the positioning spring of the 2pieces of right and left.(M3×L8: 2pieces)



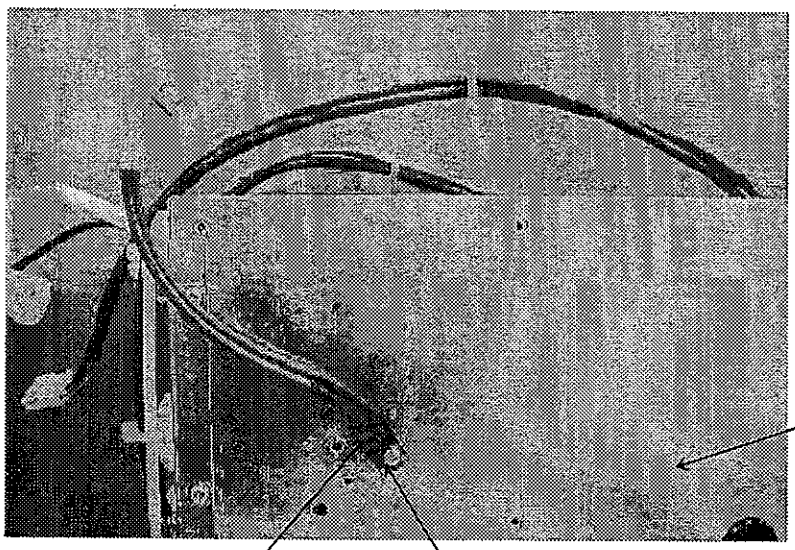


6.3.1-H Removing the Thermostat

① Remove the RF unit.

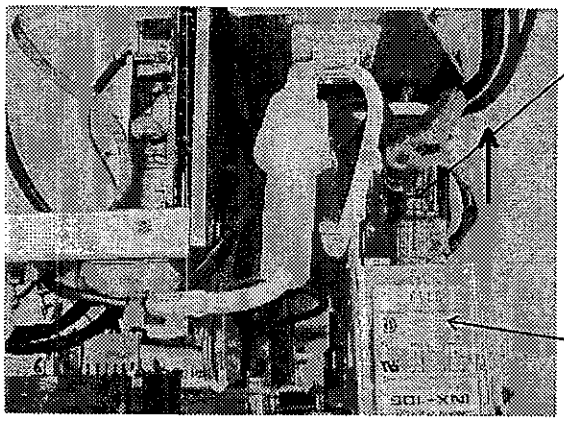
Refer to 6.3.1.Removing the RF unit on page 6-7.

② Remove the Thermostat fixing screw.(M3×L6: 1piece)

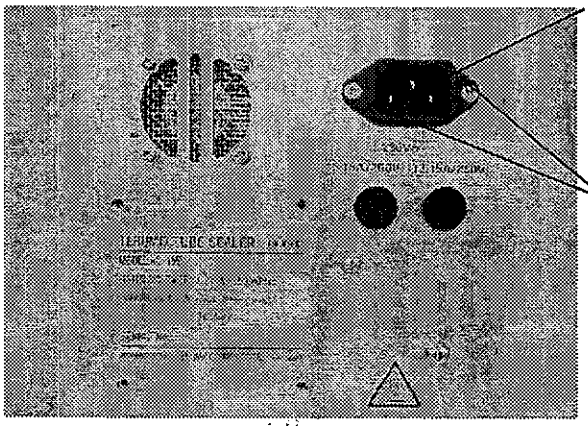


6.3.2 Removing the AC Inlet

① Disconnect the fasten terminal from the AC inlet.

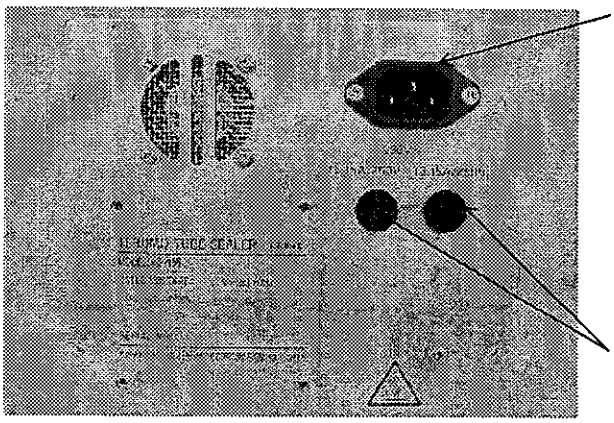


② Remove the AC inlet.(M3 nut,Clip Washer,Flat countersunk head screw M3×L12: 2 pieces each)



6.3.3 Removing the Outer Fuse

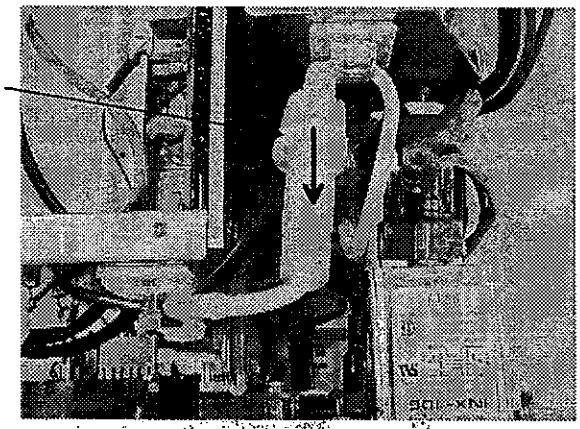
① Take out the fuse by rotating the fuse holder to the left and pressing the fuse holder cover.



6.3.4 Removing the Inner Fuse

① Take out the fuse by pressing and rotating the fuse holder.

Inner fuse holder



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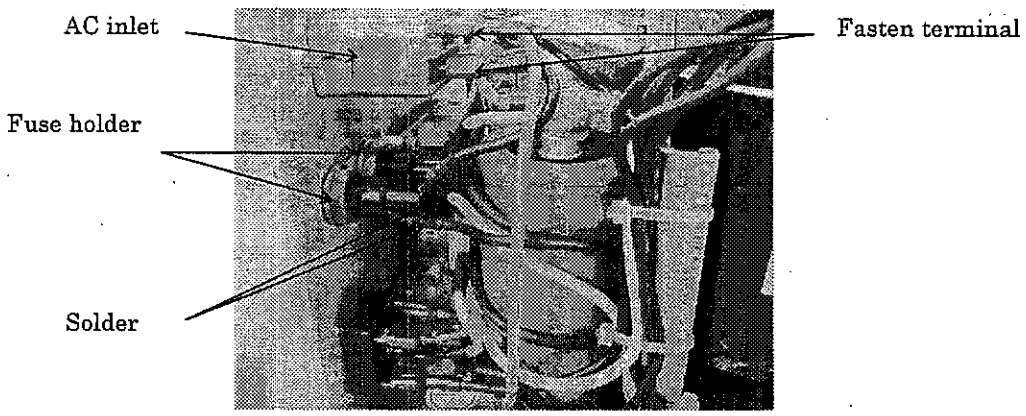
6.3.5 Removing the Fuse Holder (L) and (N)

① Disconnect the wires as follows:

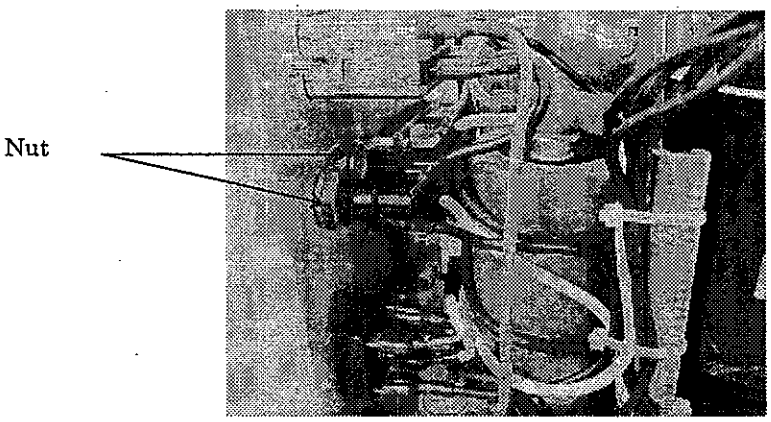
(1) Disconnect the wire (fasten terminal) from the AC inlet.

(2) Cut the heat shrink tube below the fuse holder and remove the solder.

(Wire to the ON/OFF switch)

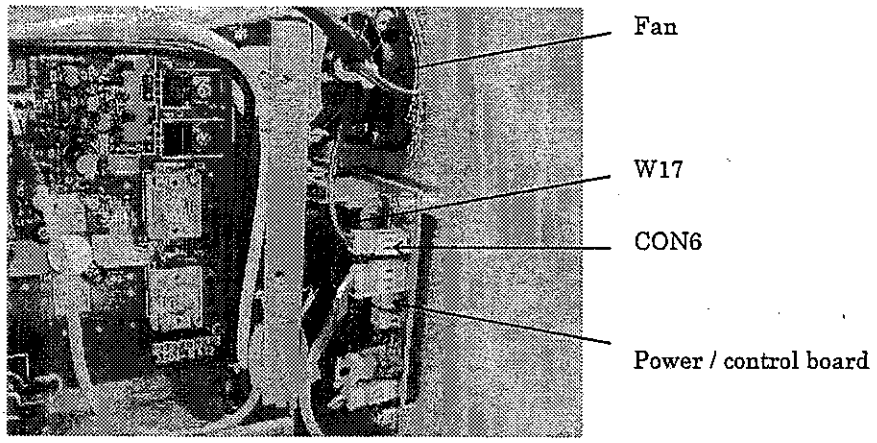


② Loosen the nut and remove the fuse holder.

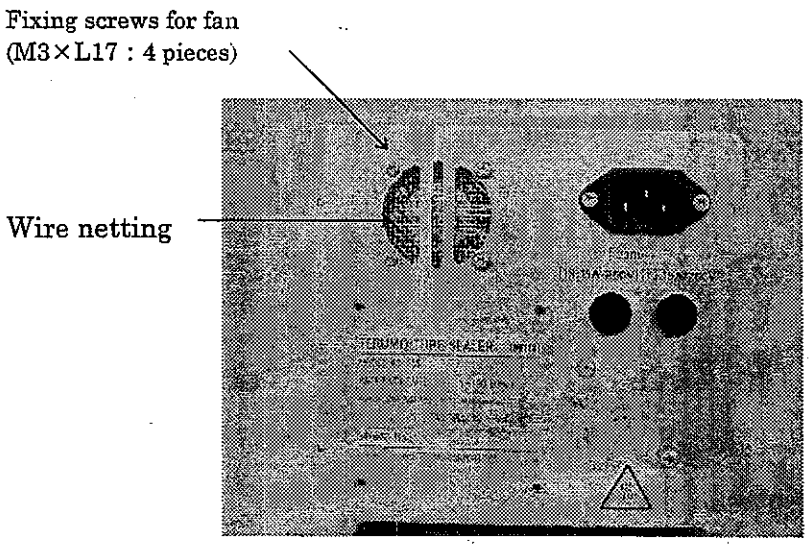


6.3.6 Removing the Fan

① Disconnect the harness (W17) from CON6 on the power / control board.
(Remove tie rap)



② Remove the Fan.(M3×L17, M3nut, 4 pieces each)
It is screwed together with the wire netting.



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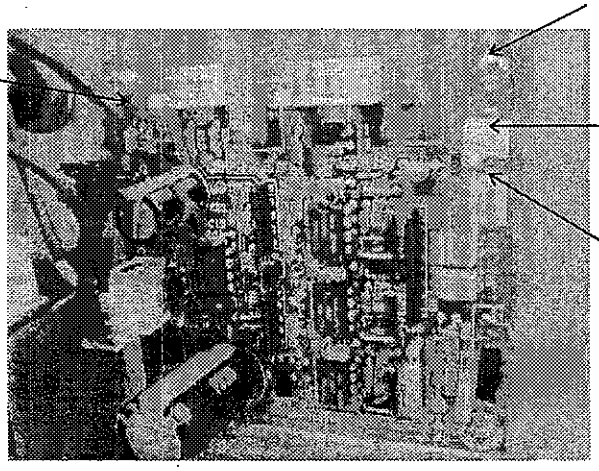
6.3.7 Removing the Power / control Board

① Remove the RF unit.

Refer to 6.3.1.Removing the RF Unit on page 6-7.

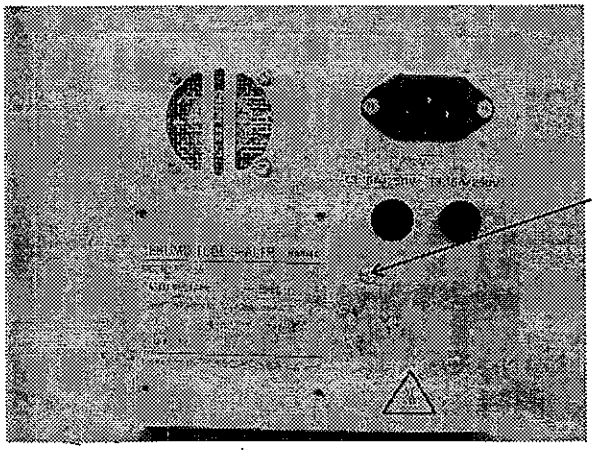
② Disconnect the wire from CON3 (W16 for power)and CON6 (W17 for fan) on the Power/control board.



③ Remove the transistor fixing screw.(M3×L12, Flat washer, nut:1 piece each)

Heat radiation grease is used for the transistor.

④ Remove the board fixing screws.(M3×L6: 4 pieces)



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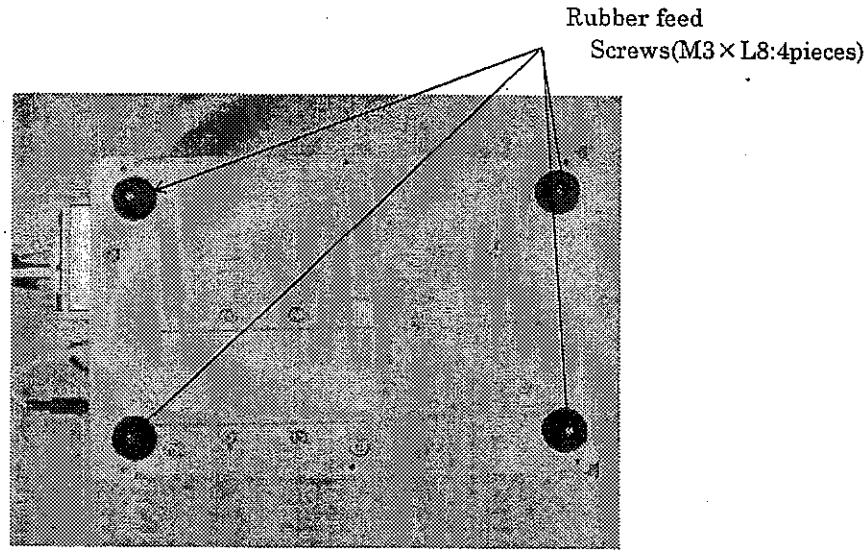
6.3.8 Removing the Rubber feed

① Removing the rubber feed.(M3×L8: 4pieces)



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7. Assembly Procedure

This chapter describes the assembly procedure for the AC-155 components.

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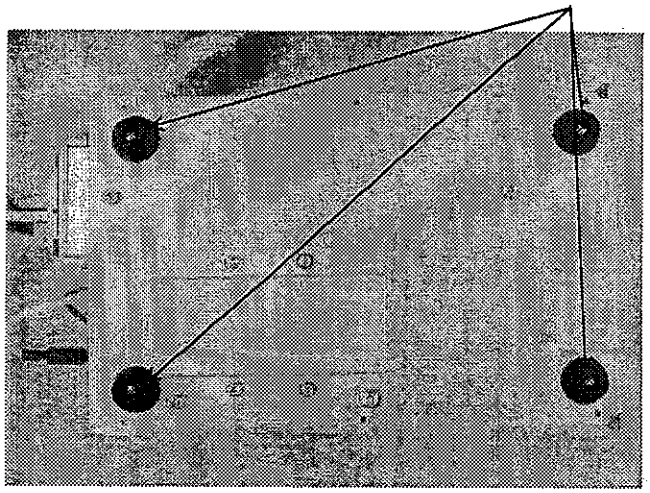
7.1.1 Mounting the Rubber feed

① Mount the rubber feed. (M3×L8: 4 pieces)

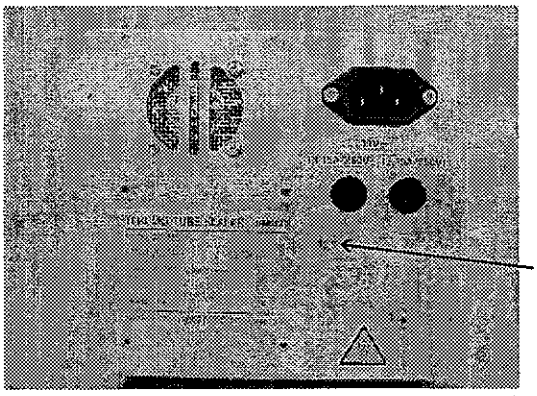
Rubber feed
Screws (M3×L8:4pieces)



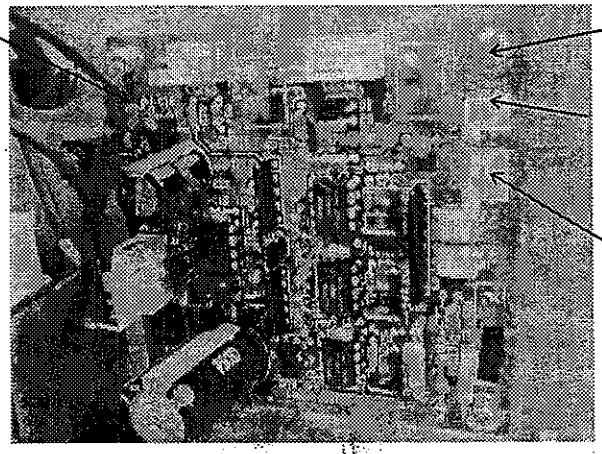
7.1.2 Mounting the Power/control Board

① After applied the radiation grease to the transistor,Mount the transistor temporarily. (M3×L12, Flat washer, Nut: 1 piece each)

② Secure the board (M3×L6: 4 pieces) and tighten the transistor fixing screw.



③ Connect the power (W16) to CON3 and the fan (W17) to CON6 on the power/control board.

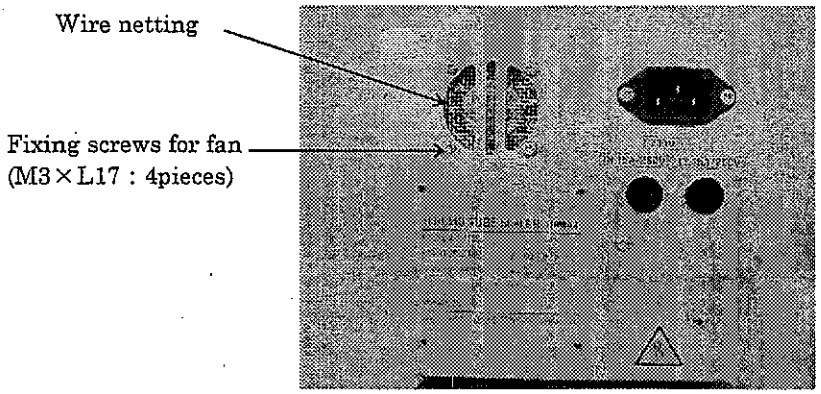


④ Mount the RF unit.

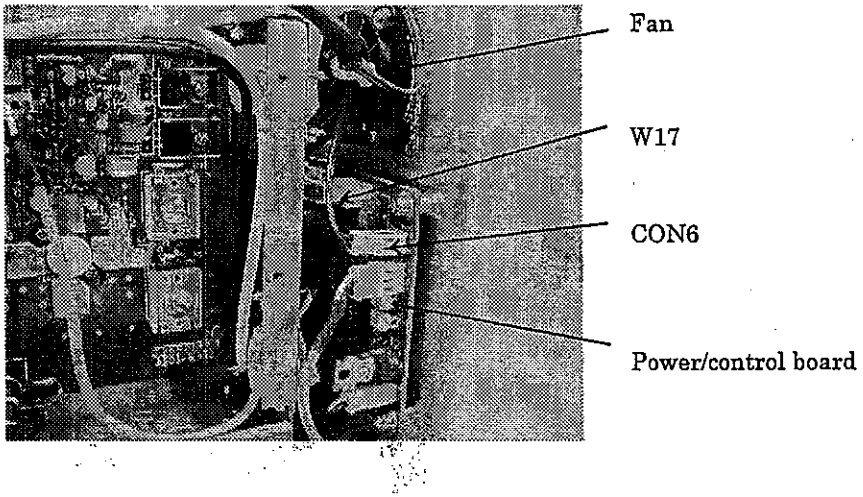
Refer to 7.1.8 Mounting the RF Unit on page 7-9.

7.1.3 Mounting the Fan

① Mount the fan. (M3×L17, M3 nut: 4 pieces each)
At this time, secure the wire netting together.

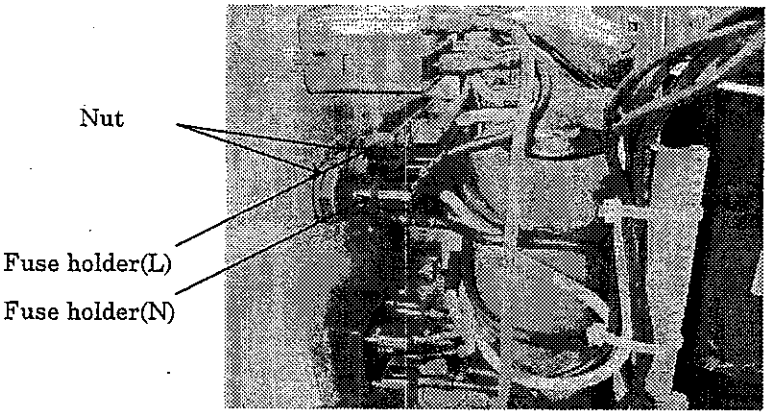


② Connect the harness (W17) to CON6 on the power/control board.



7.1.4 Mounting the Fuse Holders (L) and (N)

① Mount the fuse holders with the accessory nuts.

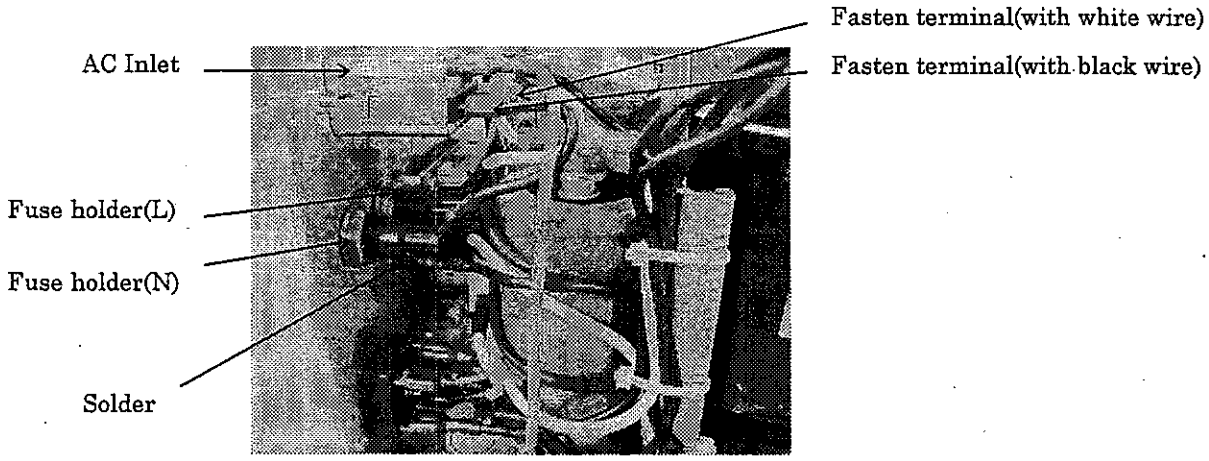


Cautions

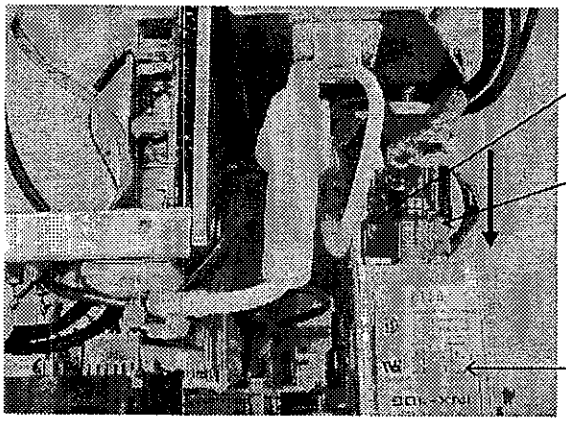
- The transformer(T1) side from,the fuse holder of inside with the white wire is named "L", the fuse holder of outside with the black wire is "N".
- Be careful in the position of terminal bill the solder of the fuse holders and Mount. (The above figure reference)

② Pass the heat shrink tube through the harness before soldering.

③ Contract the heat contraction tube with heat gun.

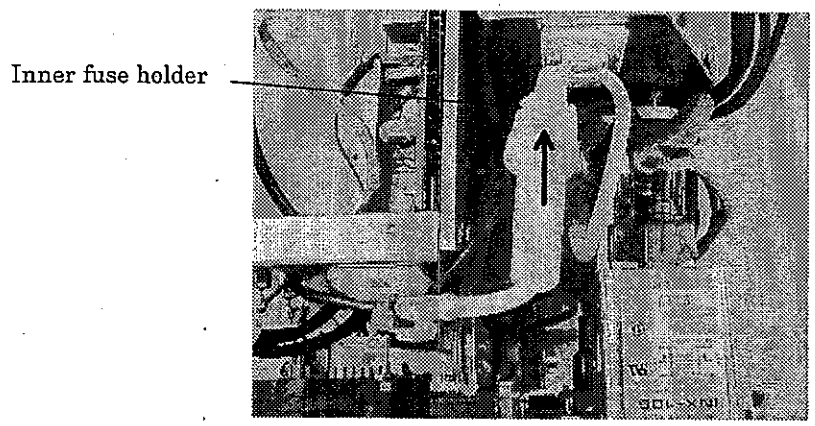


④ Connect the fasten terminal to the AC inlet.



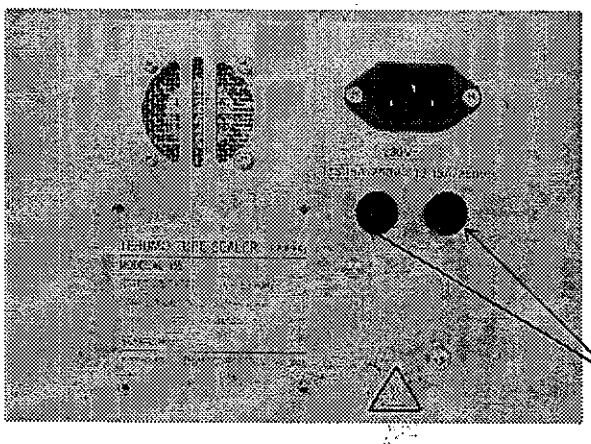
7.1.5 Mounting the Inner Fuse

① Put the fuse in the fuse holder and rotate the holder.



7.1.6 Mounting the Outer Fuse

① Put the fuse in the fuse holder and rotate the fuse holder to the right while pressing the cover.



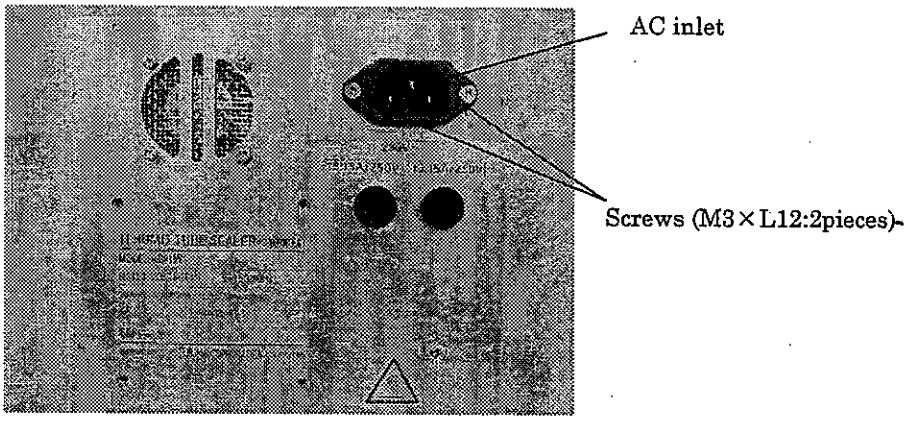
7.1.7 Mounting the AC Inlet

① Mount the AC inlet with screws and nuts,after inserted the clip washer in the screw.

(M3 nuts, Clip washer, and Flat countersunk head screw: 2 pieces each)

② Connect the fuse holder wire (fasten terminal) to the AC inlet.

Refer to 7.1.4 Mounting the Fuse Holder(L)and (N) on page 7-6.



7.1.8 Mounting the RF Unit

① Connect the wires as follows:

(1) Connect the detection board harness (W1) to CON1, the solenoid drive harness (W4) to CON4, and the RF control signal harness (W6) to CON5 on the power/control board.

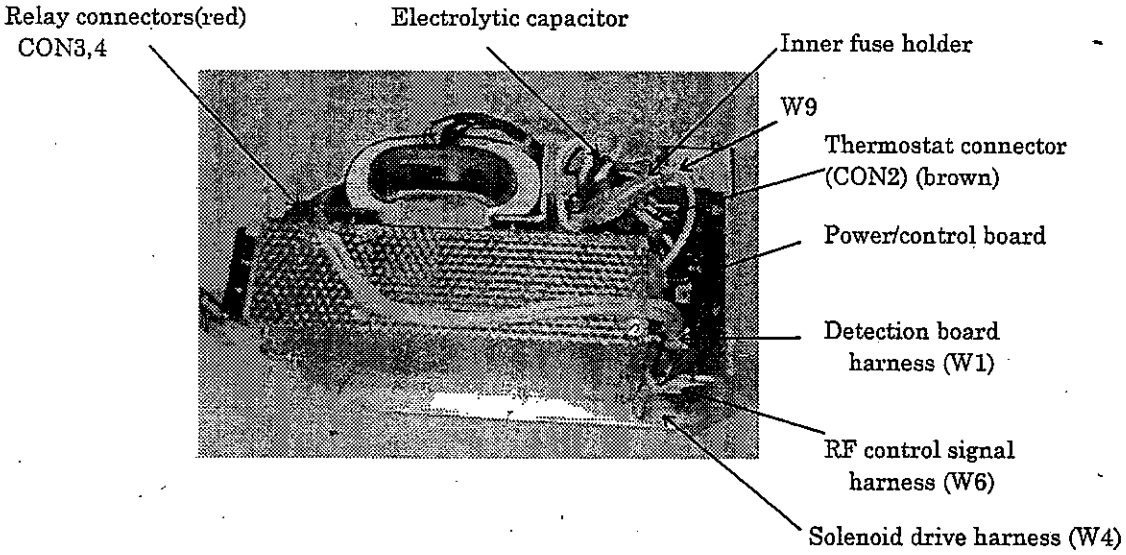
(2) Connect the relay connector (CON2) to the thermostat.

(3) Connect the power supply(W9)to RF board.

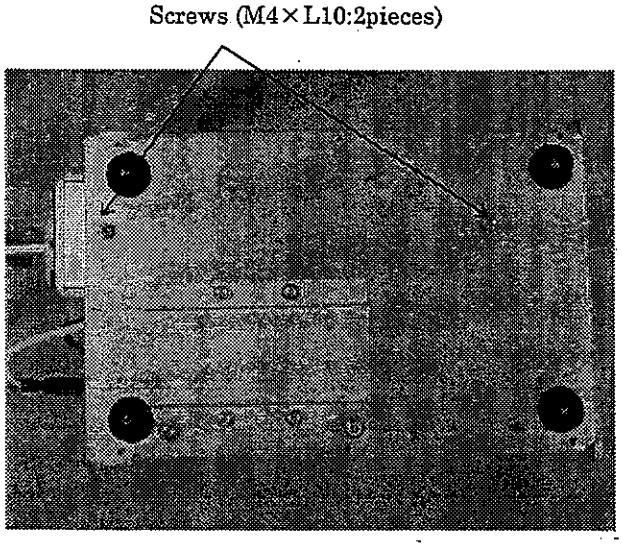
- Connect the inner fuse holder by rotating it.
- Connect the wire to the aluminum electrolyte capacitor with the dedicated screw.

(4)Connect the relay connectors(CON3,4)for the electrode cover detection microswitch.

For wiring, refer to 4.3.2. Block Diagram on page 4-5.



② Secure the RF unit. (M4×L10, Clip washer: 2 pieces each)



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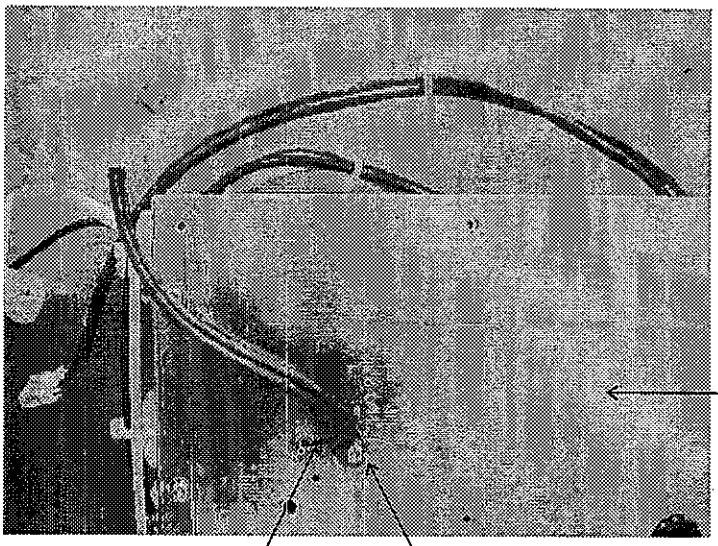
7.1.8-A Mounting the Thermostat

① Mount the thermostat. (M3×L6: 1 piece)

Attach it with the angle that shows it in the figure.



② Mount the RF unit.

Refer to 7.1.8 Mounting the RF Unit on page 7-9.

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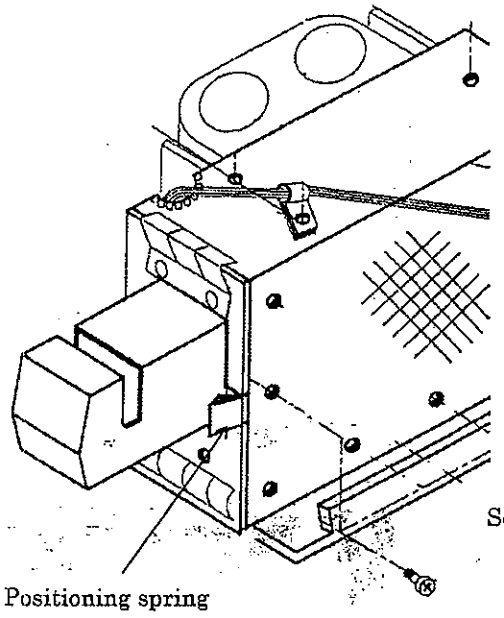
7.1.8-B Mounting the Positioning Spring

① Mount the positioning spring. (M3×L8: 2 pieces)

Place the right-hand side of the spring into the shield cover, and tighten the spring and the cover together.



7.1.8 Mounting the RF Unit

① Connect the wires as follows:

(1) Connect the detection board harness (W1) to CON1, the solenoid drive harness (W4) to CON4, and the RF control signal harness (W6) to CON5 on the power/control board.

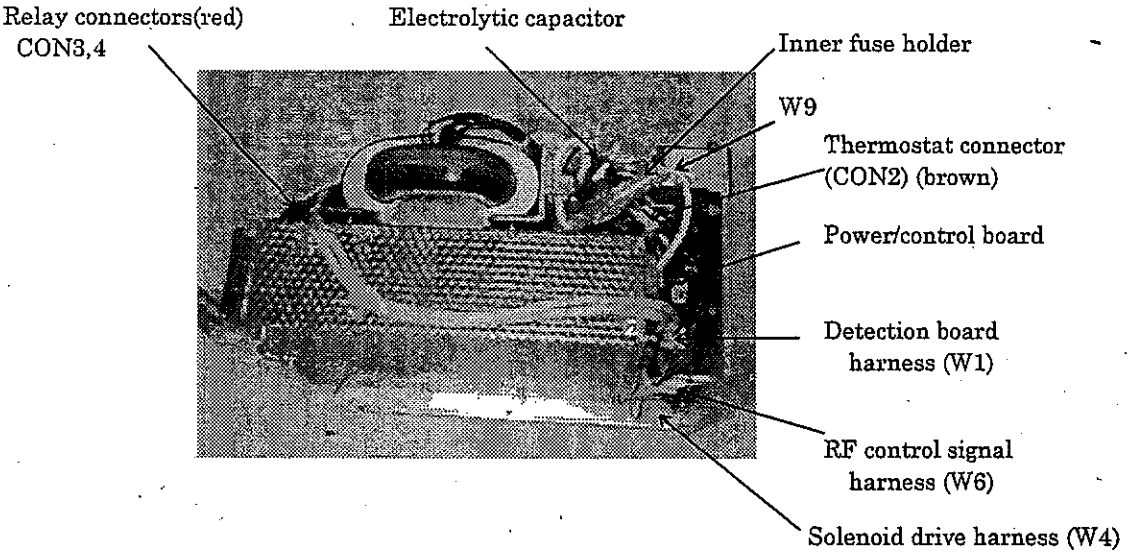
(2) Connect the relay connector (CON2) to the thermostat.

(3) Connect the power supply(W9)to RF board.

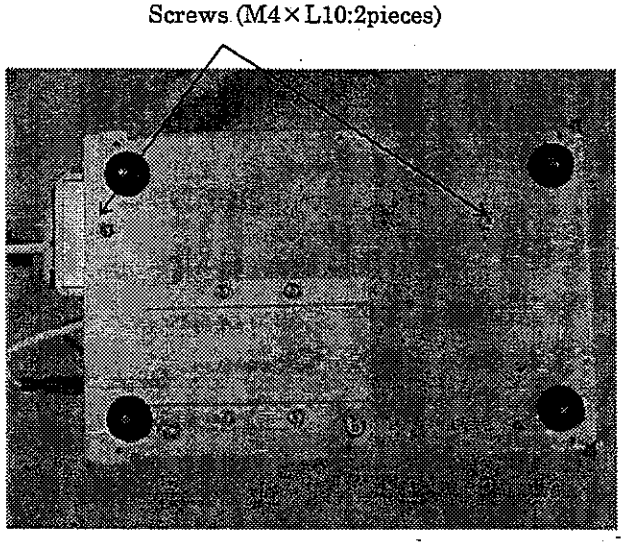
- Connect the inner fuse holder by rotating it.
- Connect the wire to the aluminum electrolyte capacitor with the dedicated screw.

(4)Connect the relay connectors(CON3,4)for the electrode cover detection microswitch.

For wiring, refer to 4.3.2. Block Diagram on page 4-5.



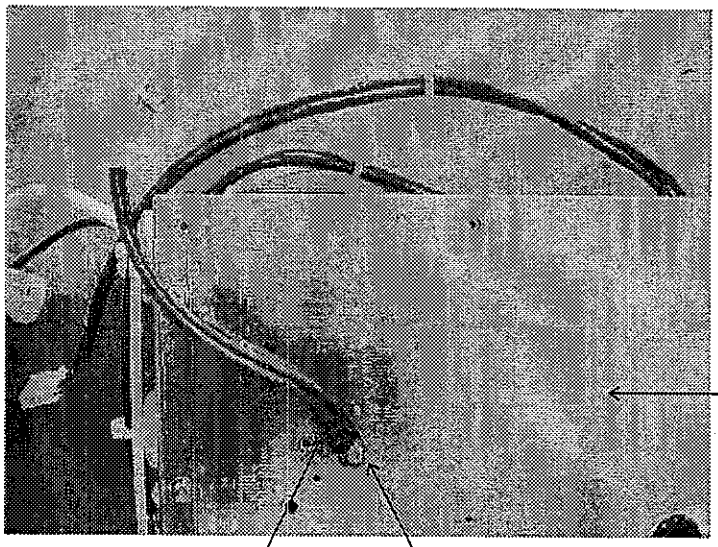
② Secure the RF unit. (M4×L10, Clip washer: 2 pieces each)



7.1.8-A Mounting the Thermostat

① Mount the thermostat. (M3 × L6: 1 piece)

Attach it with the angle that shows it in the figure.



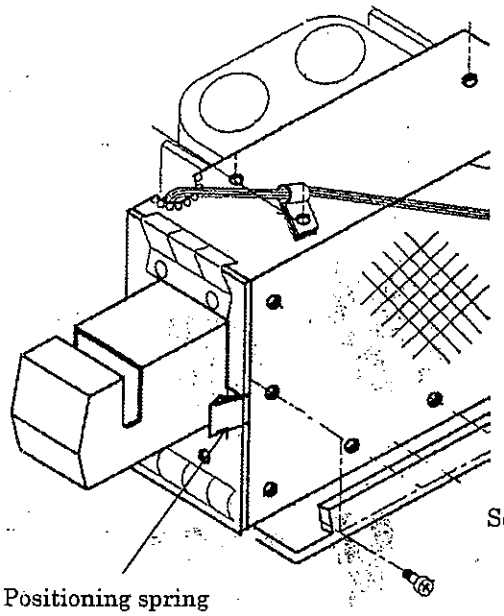
② Mount the RF unit.

Refer to 7.1.8 Mounting the RF Unit on page 7-9.

7.1.8-B Mounting the Positioning Spring

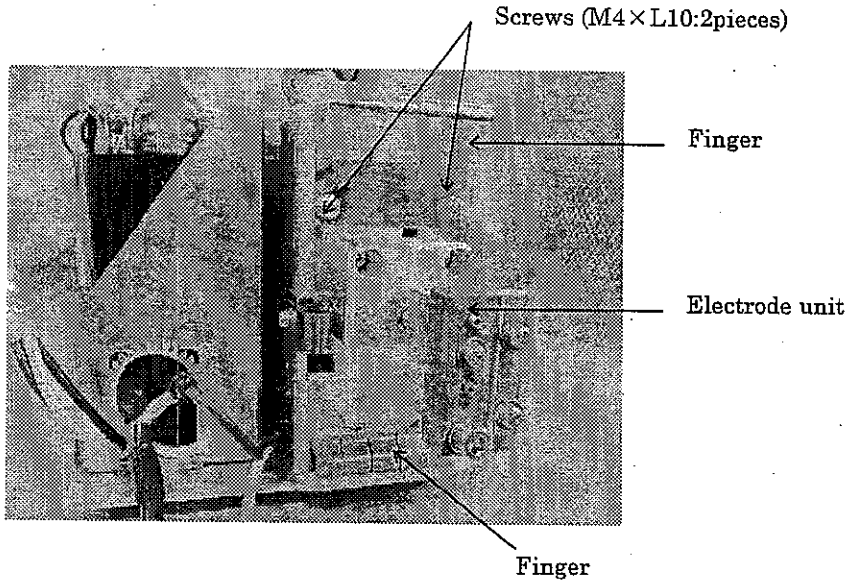
① Mount the positioning spring. (M3×L8: 2 pieces)

Place the right-hand side of the spring into the shield cover, and tighten the spring and the cover together.



7.1.8-C Mounting the Finger Set

① Mount the upper finger. (M4×L10: 2 pieces)
It is screwed together with the solenoid unit.
② The lower finger has adhesive. Remove the separate paper and mount the lower finger.

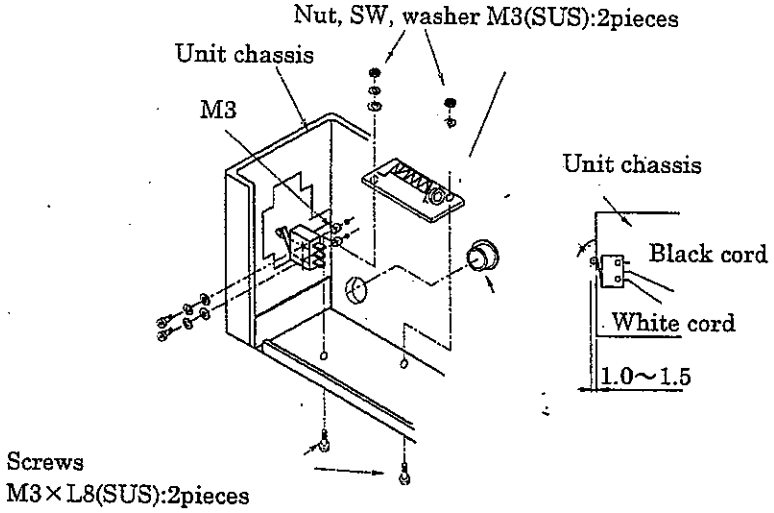


Caution

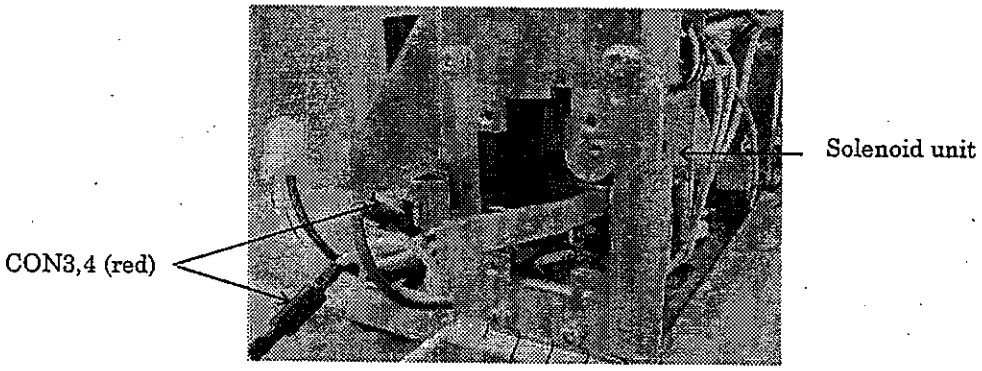
Degrease the adhering side with alcohol or something similar.

7.1.8-D Mounting the Electrode Cover Detection Microswitch

① Mount the collar and the electrode cover detection microswitch.
(M2 washer, Spring washer, Round-head screw M2×L14: 2 pieces each)
Secure the microswitch so that its operating position is 1.0 to 1.5 mm away from the front side of the unit chassis.



② Connect CON3 and CON4.



③ Mount the solenoid unit.
Refer to 7.1.8-E Mounting the Solenoid Unit on page 7-14.

④ Mount the electrode unit.
Refer to 7.1.8-F Mounting the Electrode Unit on page 7-18.

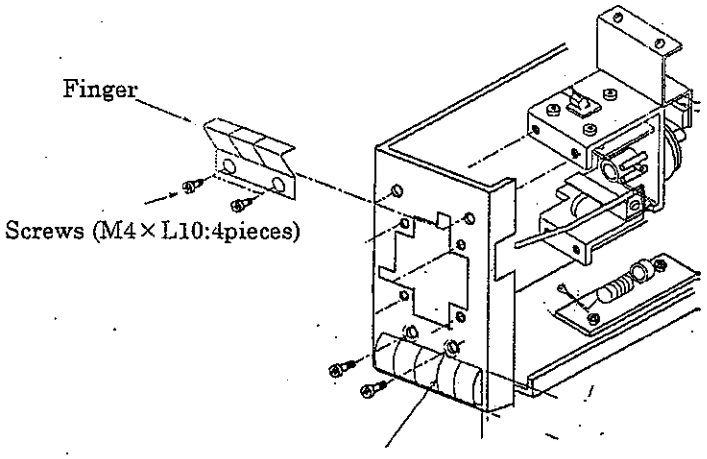
⑤ Adjust the electrode spacing 8.1 page 8.1

⑥ Adjust the spacing detection position.
Refer to 8.2 Adjusting the Spacing Detection Position on page 8-3.

⑦ Secure the shield cover.
Refer to 7.1.8-H Mounting the Shield Cover on page 7-22.

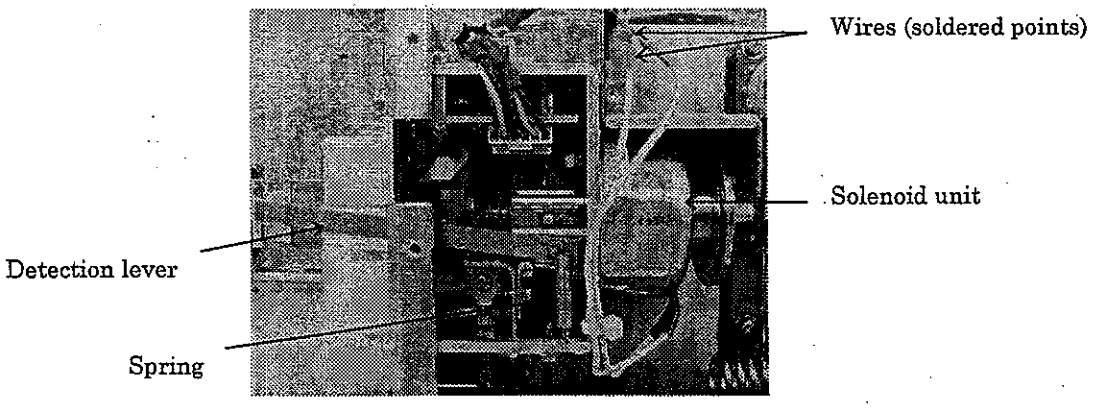
7.1.8-E Mounting the Solenoid Unit

① Mount the solenoid unit. (M4×L10: 4 pieces)
Screw the solenoid unit together with the upper finger.



Caution Be careful so as not to bend the lead wire of the Matching Board.

② Insert the heat contraction tube (ϕ 2, L20) into W5 and solder it to lead wires of solenoid.
③ Contract the heat contraction tube with heat-gun.



④ Mount the electrode unit.
Refer to 7.1.8-F Mounting the Electrode Unit on page 7-18.
⑤ Adjust the electrode spacing 8.1 page 8.1.
⑥ Adjust the spacing detection position.
Refer to 8.2 Adjusting the Spacing Detection Position on page 8-3.
⑦ Secure the shield cover.
Refer to 7.1.8-H Mounting the Shield Cover on page 7-22.

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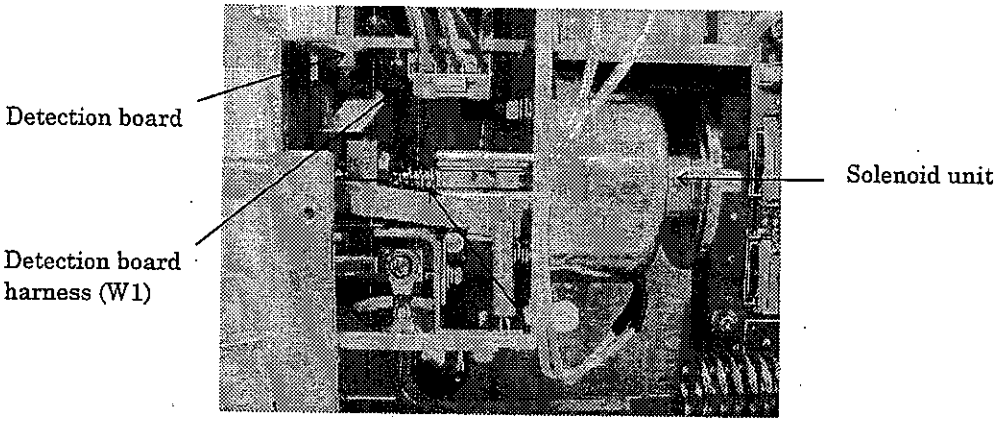
7.1.8-E1 Mounting the Detection Board

① Mount the detection board. (M3×L8: 3 pieces)

② Connect the detection board harness (W1) to CON3 on the detection board.



Caution

-Take care not to deform the spacing detection plate and start lever shading section.

③ Mount the solenoid unit.

Refer to 7.1.8-E Mounting the Solenoid Unit on page 7-14.

④ Mount the electrode unit.

Refer to 7.1.8-F Mounting the Electrode Unit on page 7-18.

⑤ Adjust the electrode spacing 8.1 on page 8.1

⑥ Adjust the spacing detection position.

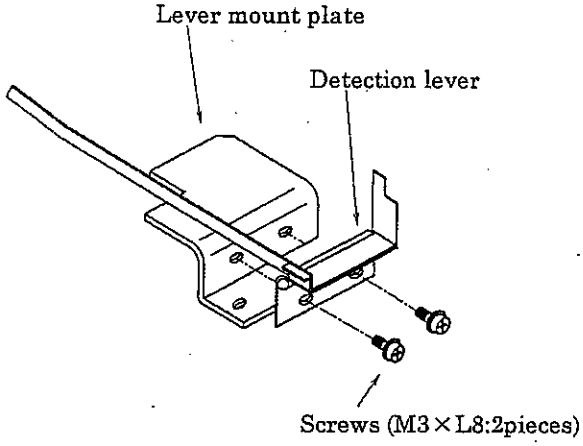
Refer to 8.2 Adjusting the Spacing Detection Position on page 8-3.

⑦ Secure the shield cover.

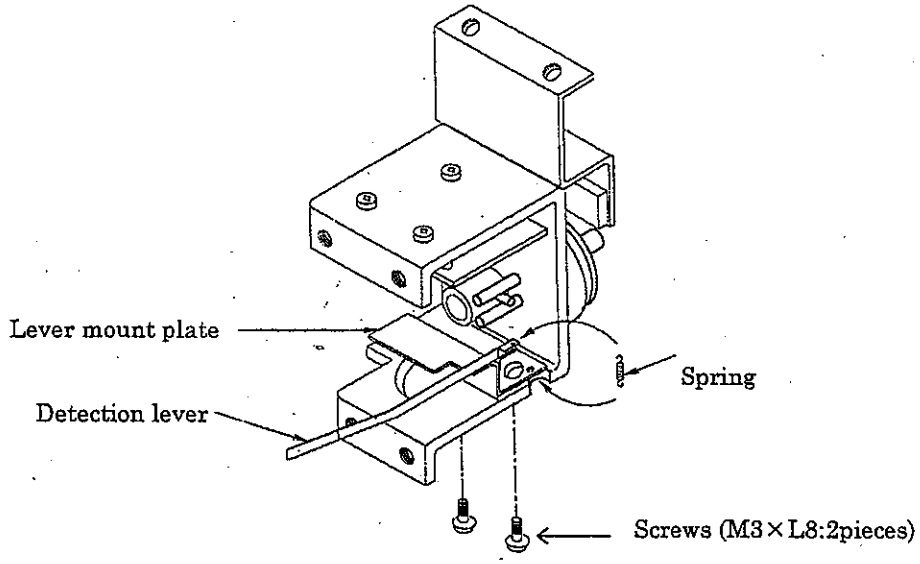
Refer to 7.1.8-H Mounting the Shield Cover on page 7-22.

7.1.8-E2 Mounting the Detection Lever

① Mount the detection lever on the lever mount plate. (M3×L6: 2 pieces)



② Mount the lever mount plate to the solenoid unit. (M3×L8: 2 pieces)



③ Mount the solenoid unit.

Refer to 7.1.8-E Mounting the Solenoid Unit on page 7-14.

④ Mount the electrode unit.

Refer to 7.1.8-F Mounting the Electrode Unit on page 7-18.

⑤ Adjust the electrode spacing 8.1 on page 8.1

⑥ Adjust the spacing detection position.

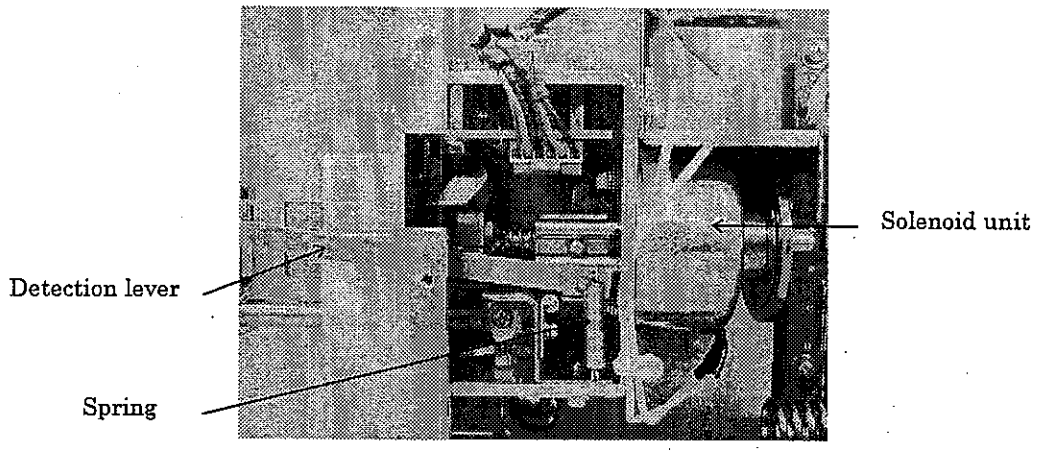
Refer to 8.2 Adjusting the Spacing Detection Position on page 8-3.

⑦ Secure the shield cover.

Refer to 7.1.8-H Mounting the Shield Cover on page 7-22.

7.1.8-E3 Mounting the Detection Lever Spring

① Mount the detection lever spring.

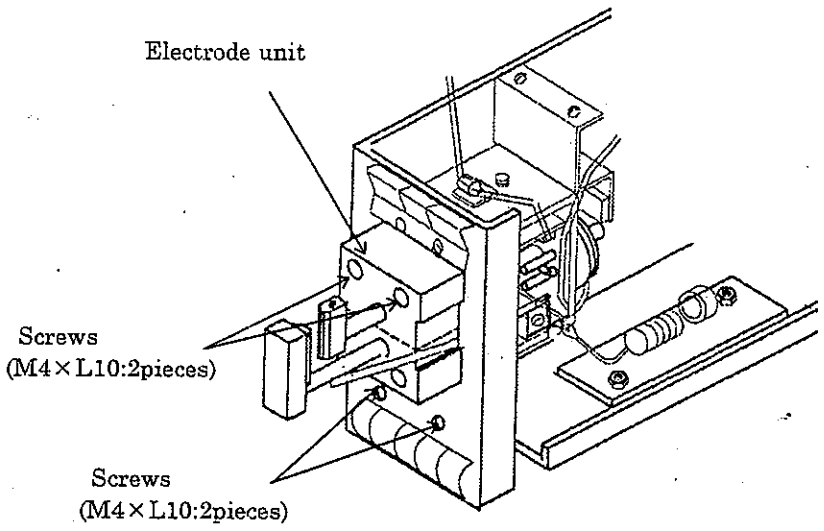


② Secure the shield cover.

Refer to 7.1.8-H Mounting the Shield Cover on page 7-22.

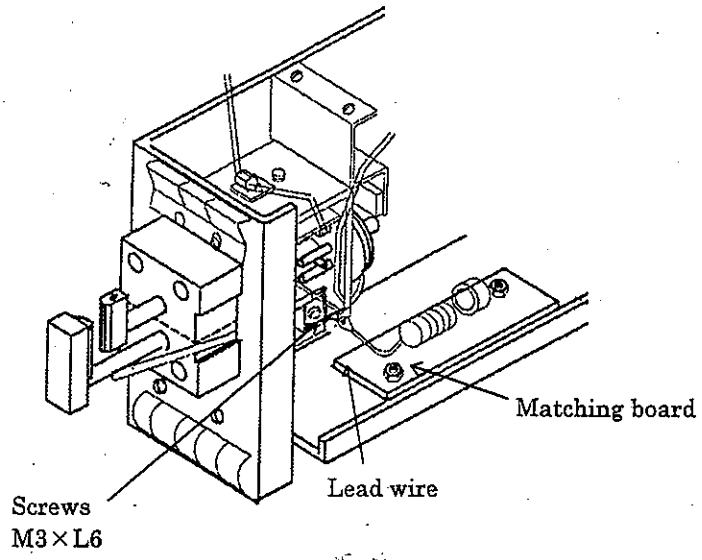
7.1.8-F Mounting the Electrode Unit

① Mount the electrode unit. (M4×L10: 4 pieces)



② Secure the lead wire from the matching board. (M3×L6: 1 piece)

Caution **Do not deform the coil on the Matching board.**



③ Adjust the electrode spacing 8.1 on page 8.1

④ Adjust the spacing detection position.

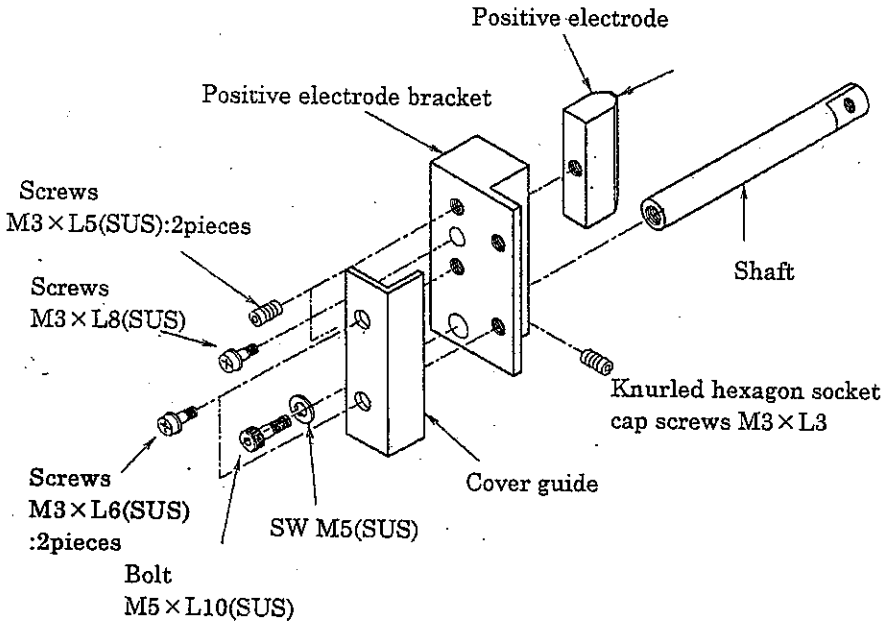
Refer to 8.2 Adjusting the Spacing Detection Position on page 8-3.

⑤ Secure the shield cover.

Refer to 7.1.8-H Mounting the Shield Cover on page 7-22.

7.1.8-F1 Mounting the cover guide.

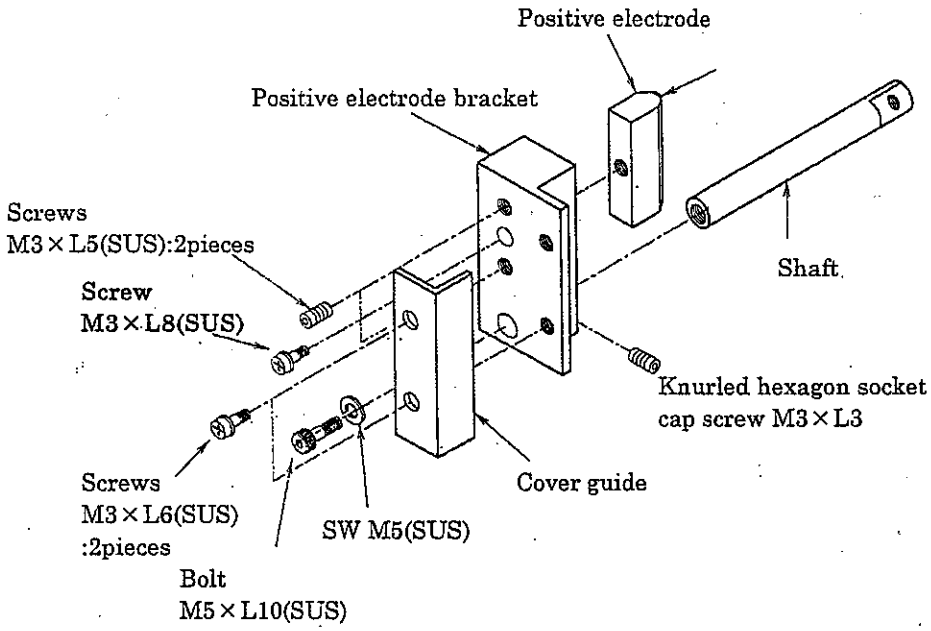
① Mounting the cover guide.(M3×L6: 2 pieces)



7.1.8-F2 Mounting the Electrode Set

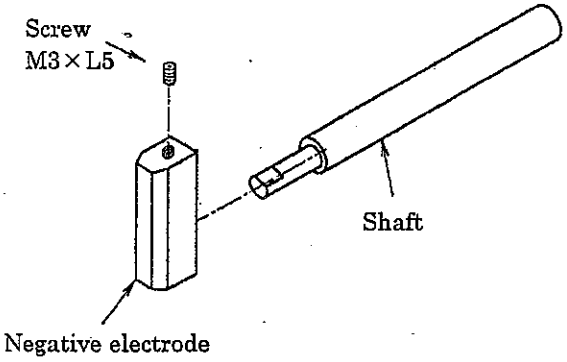
① Mounting the positive electrode:

Mount the positive electrode. (M3×L8: 1 piece)



② Mounting the negative electrode:

Mount the negative electrode. (Knurled hexagon socket head cap screw M3×L5: 1 piece)



Caution **-Secure the negative electrode pressed against the shaft.**

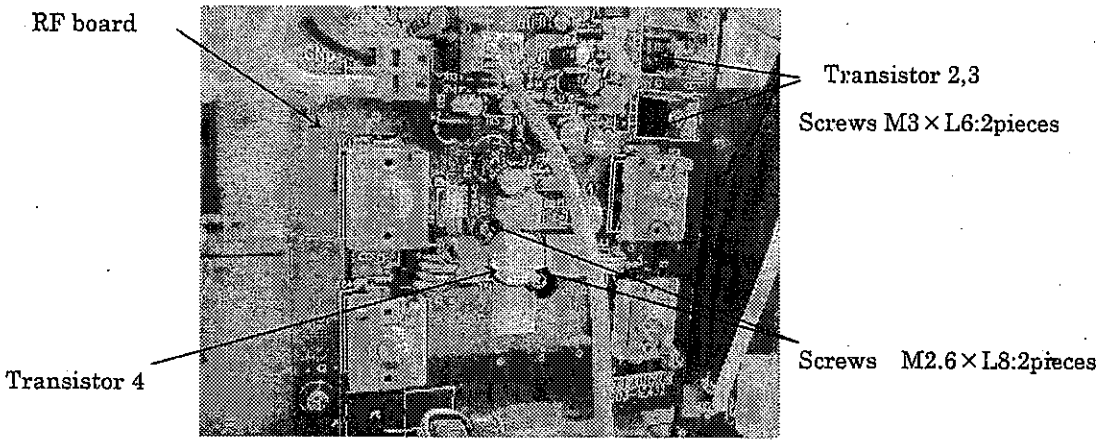
③ Adjust the electrode spacing and the spacing detection position.

Refer to 8.1 Adjusting the Electrode Spacing on page 8-1 and 8.2 Adjusting the Spacing Detection Position on page 8-3.

7.1.8-G Mounting the RF Board

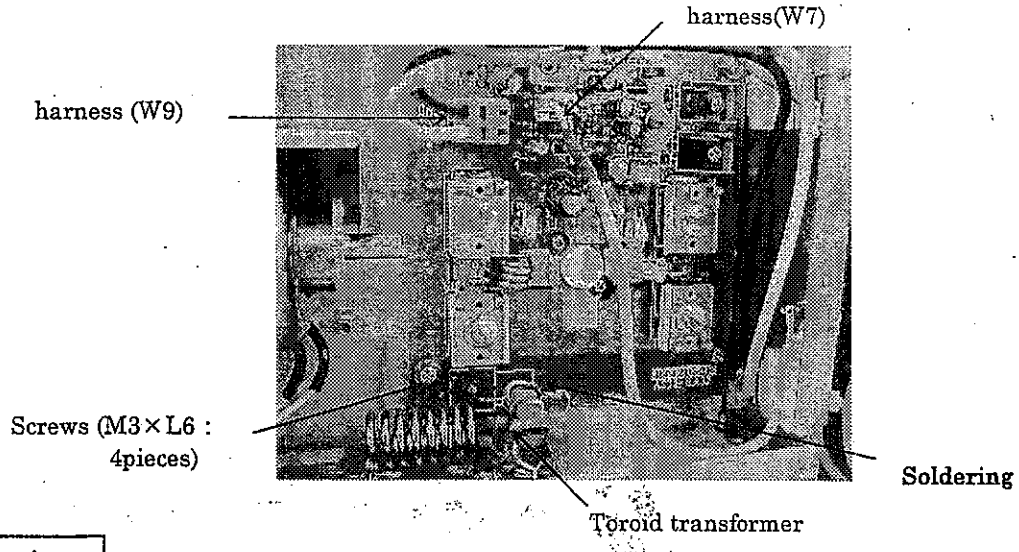
① Apply heat radiation grease on the transistor and secure it temporarily.
(Tr4: M2.6×L8 with the small washer: 2 pieces, Tr2, 3: M3×L6: 2 pieces)

② Secure the board (M3×L6: 4 pieces) and tighten the transistor fixing screws.



③ Solder the lead wire of the toroid transformer at one point.

④ Connect the harness(W7),(W9). (Refer to the figure.)



Cautions

- **Do not melt the wire of the toroid transformer core during soldering.**
- **Do not deform the coil on the matching board.**

⑤ Secure the shield cover.

Refer to 7.1.8-H Mounting the Shield Cover on page 7-22.

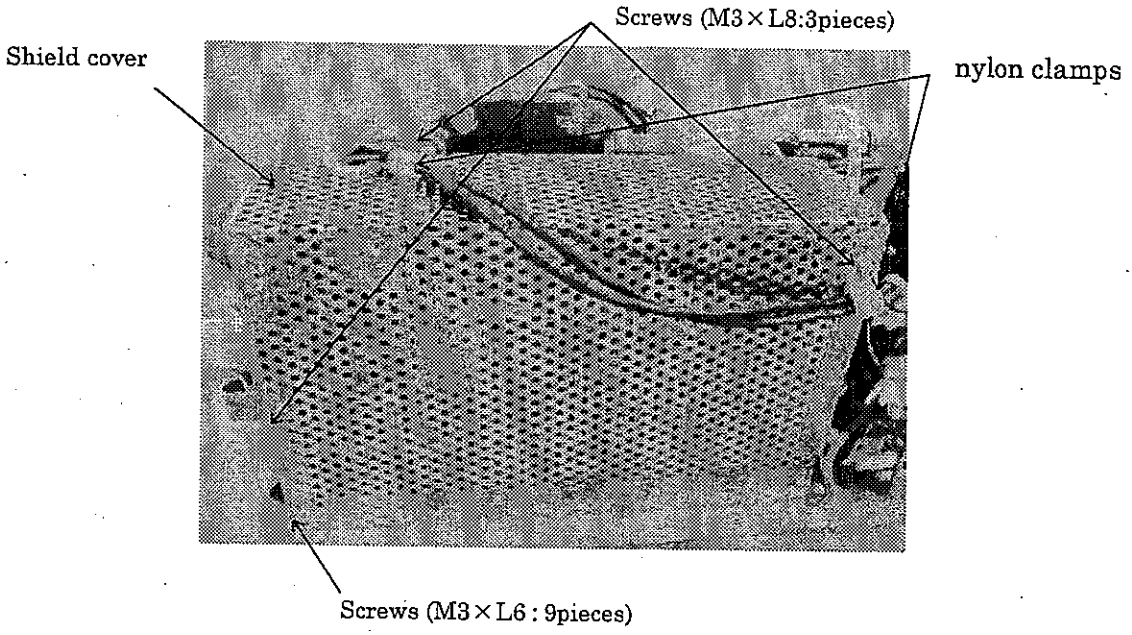
7.1.8-H Mounting the Shield Cover

① Mount the shield cover. (M3×L6: 9 pieces, M3×L8: 3 pieces)

Screw the shield cover together with the positioning spring in the right-hand side.

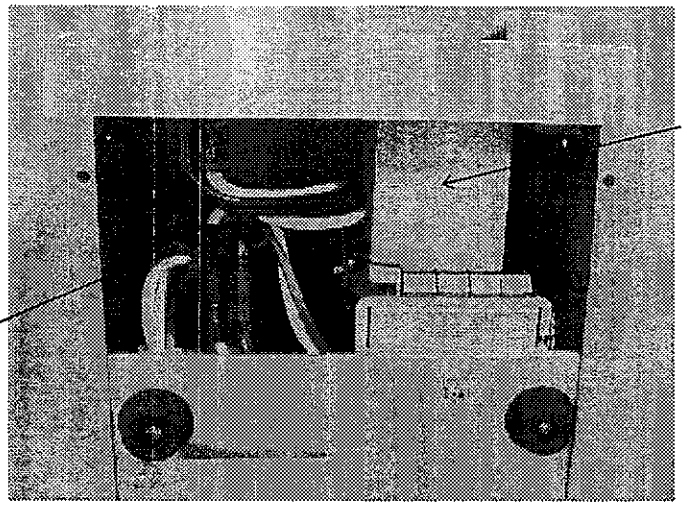
Secure the shield cover together with the detection circuit harness (W1) fixing nylon clamps at two points.

Use the M3×L8 screws for these three points.



7.2 Mounting the Upper Panel

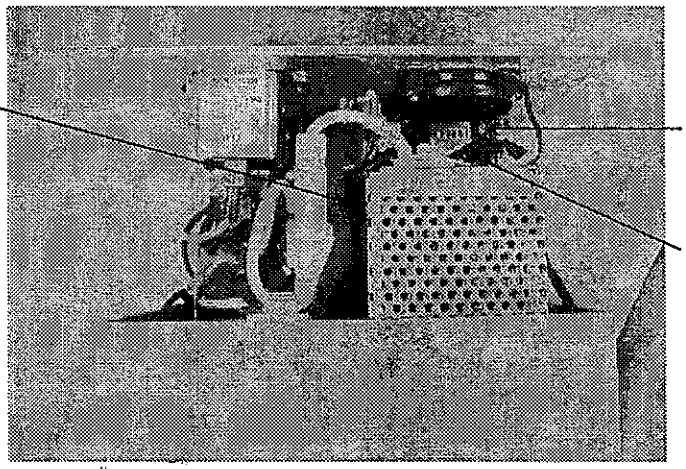
① Connect the power switch connector (CON1). Connect the display board harness (W2) to CON2 on the power/control board.



② Insert the upper panel into the base from this side.

Cautions

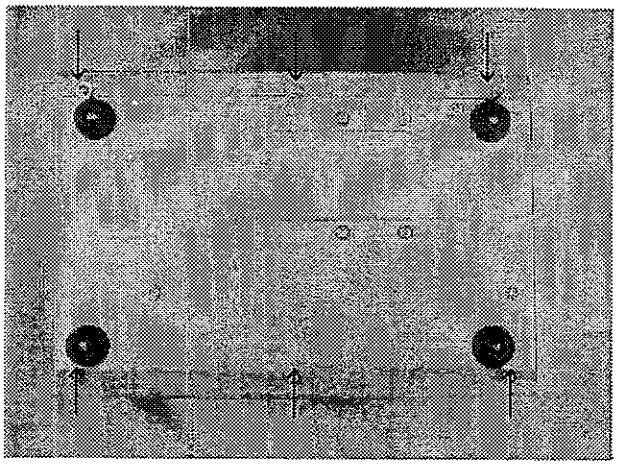
- Open the upper panel at the beginning of insertion.
- Take care not to pinch the harness.



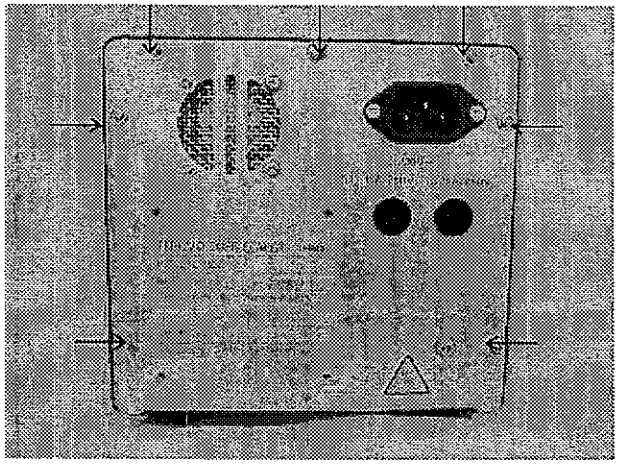
③ Tighten the screw on the rear side. (M3×L8, Clip washer: 7 pieces each)

④ Tighten the screw on the bottom. (M3×L8, Clip washer: 6 pieces each)

【Bottom】 Screws
(M3×L8 : 6 pieces)

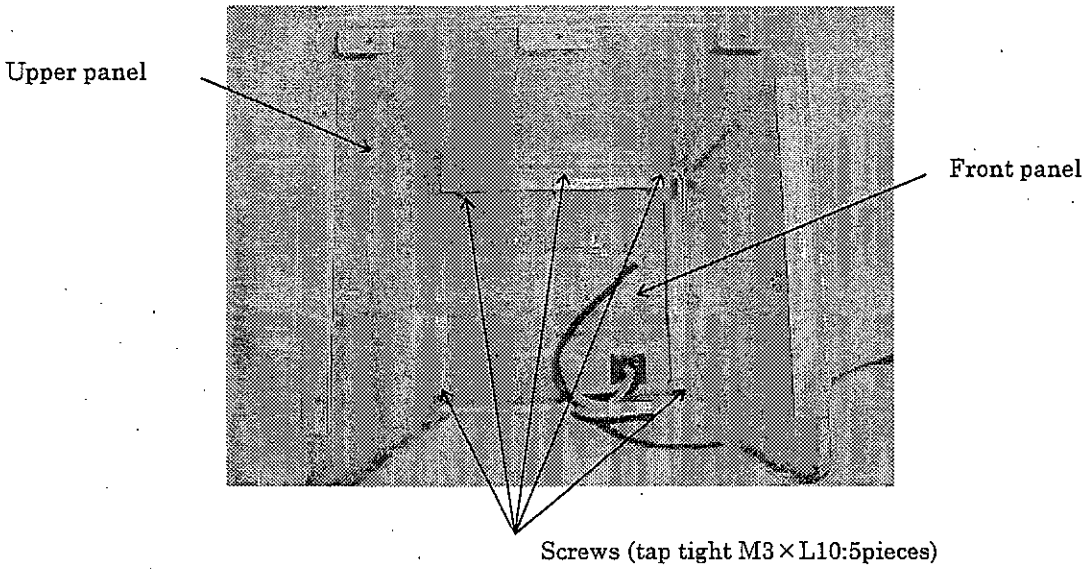


【Rear side】 Screws
(M3×L8 : 7 pieces)



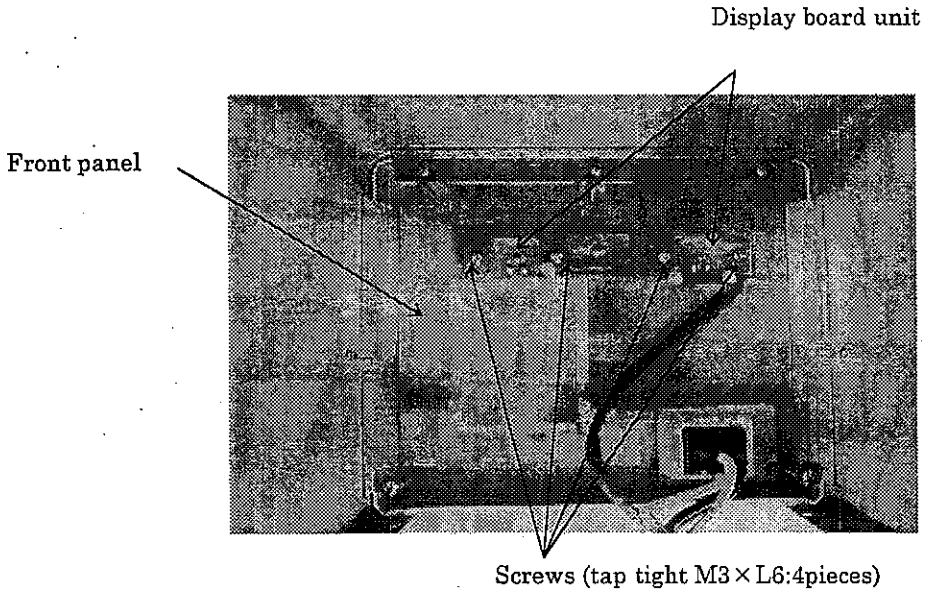
7.2.1 Mounting the Front Panel Unit

① Mount the front panel unit. (Tap tight M3×L10: 5 pieces)



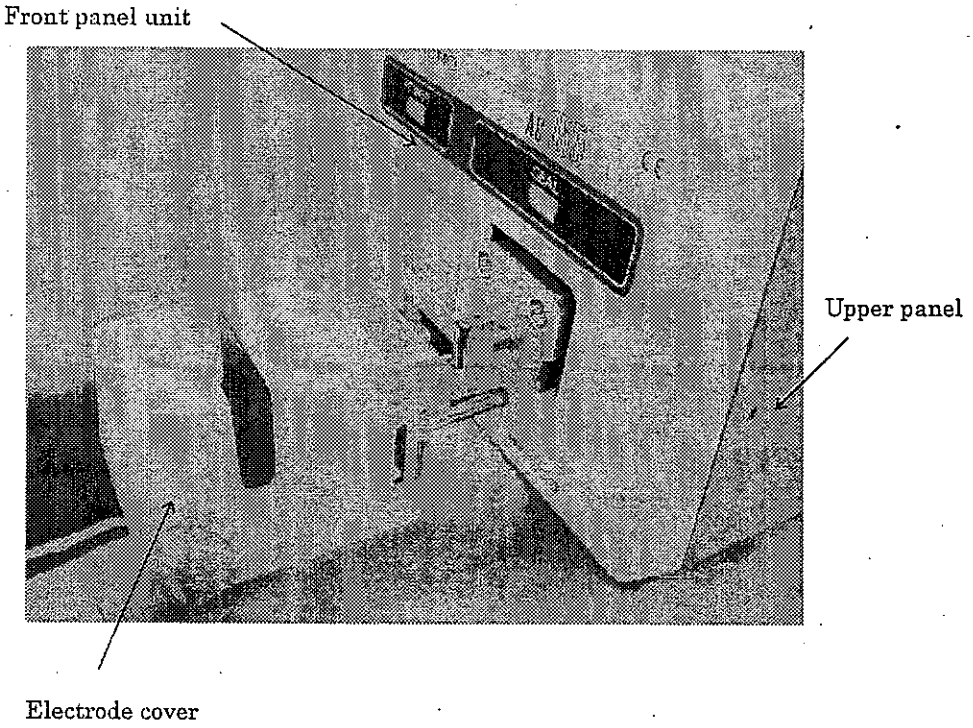
7.2.1-A Mounting the Display Board Unit

① Mount the display board unit. (Tap tight M3×L6: 4 pieces)



7.3 Mounting the Electrode Cover

① Insert the electrode cover straight.



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8. Adjustment and Check

8.1 Adjusting the Electrode Spacing

Required tools:

- Thickness gauge (0.06 mm and 0.07 mm)
- Allen wrench (1.5 mm width across corners)
-(+) screwdriver
-24V DC(0.5A) constant voltage supply(to drive solenoid)
-Adjusting harness 2 (to connect the constant voltage supply)

The purpose of this adjustment is to protect the electrodes during no-load operation by ensuring the electrode spacing when the solenoid operates to the maximum.

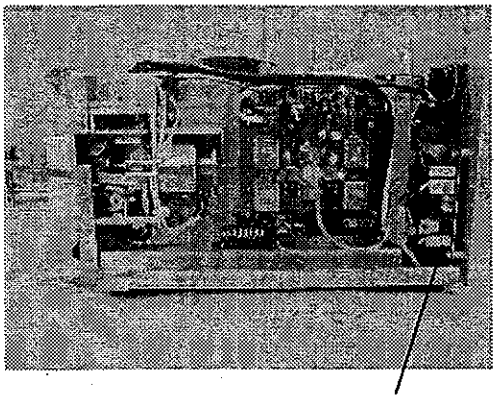
① Remove the upper case. Refer to 6.2. Removing the Upper Panel on page 6-4.

② Remove the shield cover. Refer to 6.3.1-A Removing the Shield Cover on page 6-8. Disconnect cable W4 from CON4,connect the adjusting harness 2.

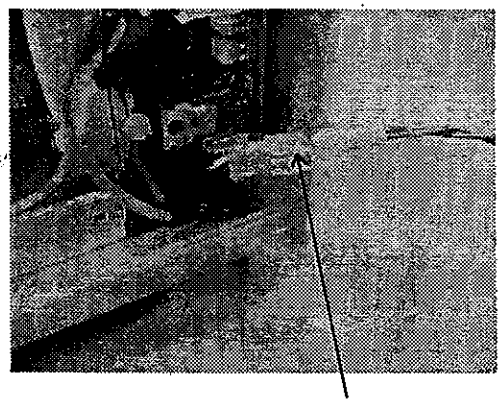
③ With the negative electrode fully turned clockwise because of play, push in the solenoid plunger with you hand and push out the negative electrode toward you.And add 24V DC to solenoid.

④ At this time, insert the thickness gauge between electrodes to check the electrode spacing.

The 0.06-mm thickness gauge must enter between the electrodes but the 0.07-mm thickness gauge must not enter on top and bottom of electrode. You can test it by playing the gauge vertical through all electrode.



Cable W4

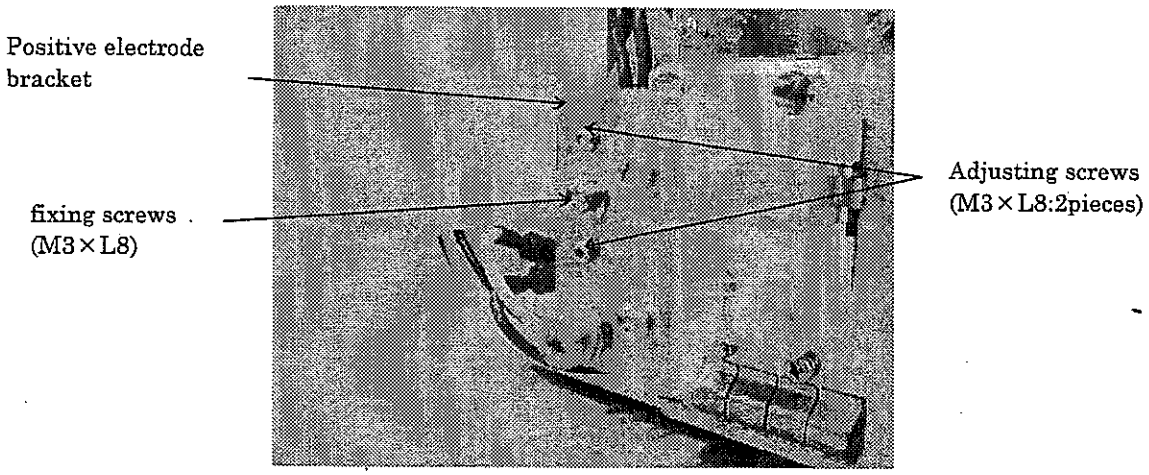


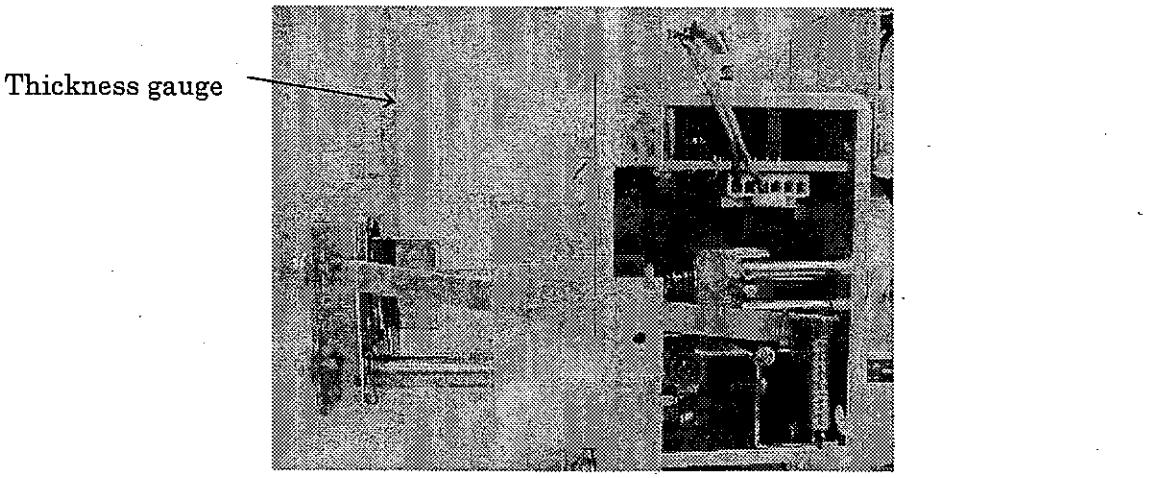
Adjusting harness 2

⑤ If the electrode spacing is too large, too small, or not parallel, loosen the electrode fixing screw (M3×L8) on the front side of the positive electrode bracket and adjust the spacing with two adjusting screws (Cup point hexagon socket head cap screw M3×L8) located above and below the fixing screw. (one turn is 0.5 mm)

⑥ Secure the electrode fixing screw tightly, and then repeat the steps ③ through ⑤.

1turn=0.5mm





Caution

Be sure to adjust the spacing detection position after every adjustment of the electrode spacing.

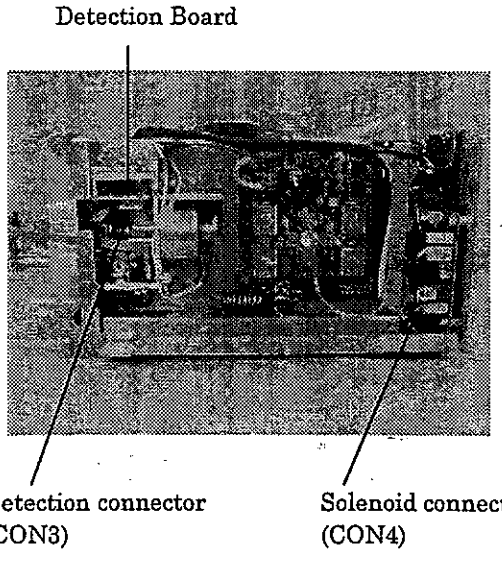
8.2 Adjusting the Spacing Detection Position

Required tools:

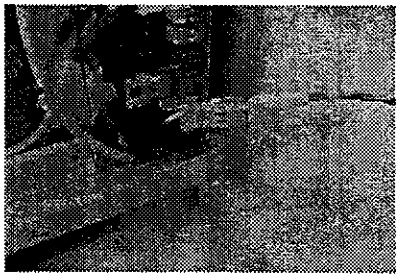
- Thickness gauge (1.9mm,0.20mm and 0.18mm or equivalent combinations)
- Spanner (5.5 mm width across corners)
- Allen wrench (1.5 mm)
- 12 V DC (0.1 A) constant voltage supply (to drive detection circuit)
- 24 V DC (0.5 A) constant voltage supply (to drive solenoid)
- Adjusting harnesses 1 and 2 (to connect the constant voltage supply)
- Jig 1 for attaching spacing detection plate (6.40 mm and 6.60mm spacer)
- Jig 2 for attaching spacing detection plate
- (−)Screwdriver
- Nipper

8.2.1 Adjusting the oscillation starting position

① Remove the upper case. Refer to 6.2 Removing the Upper Case on page 6-4.
② Remove the shield cover. Refer to 6.3.1-A Removing the Shield Cover on page 6-8.
③ Disconnect the detection circuit wire (W1) from CON3 on the detection board.
④ Connect the adjusting harness 1 to the connector CON3 on the detection board, and connect +12 V to pin 1 and 0 V to pin 3.



【Adjusting harness 2】



【Adjusting harness 1】

⑤ Disconnect Solenoid connector CON4 on the control board.
Unlock the connector with the Allen wrench or something.

⑥ Connect the adjusting harnesse 2 to the Solenoid wire removed from the Power/ control board, and connect +24 V to pin 2 and 0 V to pin 1. The solenoid will not operate by connecting +24 V only, since its rated voltage is +45 V.

⑦ Insert the thickness gauge (1.9mm) between electrodes. With the negative electrode fully turned to the right,push in the solenoid plunger with your hand,and add +24V DC to solenoid.Put the thickness gauge between the positive and negative electrode.

- The red LED4 lights **OFF** on the detection board when using the **1.9mm** thickness gauge.

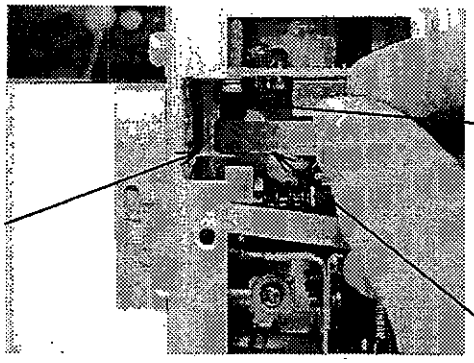
If the red LED4 lights don't turn off,ensure the spacing detection plate position as below ,and adjust again.

⑧ Ensure clearance between the photo-interrupter and spacing detection plate with the jig 1 for attaching spacing detection plate.

- 6.40mm spacer can enter without spacing detection plate's deflection.

6.60mm spacer cannot enter,or the spacing detection plate deflects.

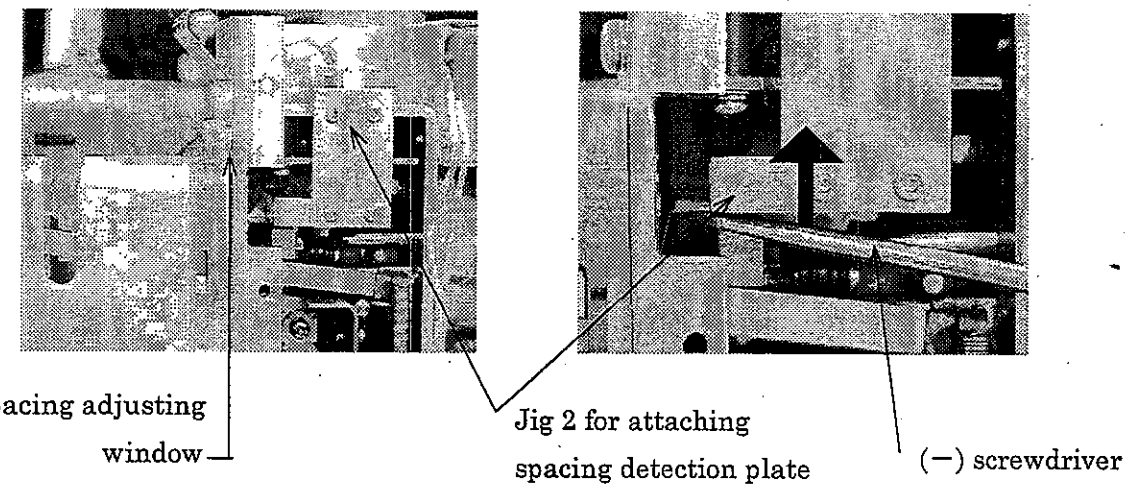
⑨ If 6.60mm spacer can enter,ensure to adjust as below with the jig 2 for attaching spacing detection plate.

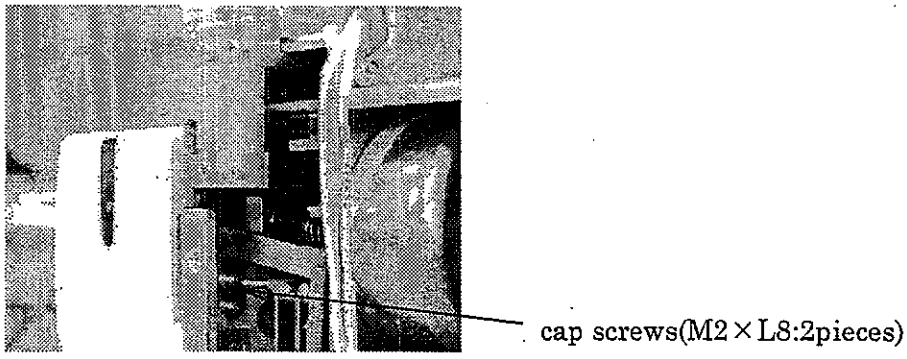


⑩ Attach the attaching jig 2 as drawing,push the spacing detection plate to the jig 2 with (−) screwdriver or nipper.

Fix one screw loosely.Adjust inclination of spacing detection plate with nipper,as ensuring that the spacing detection plate goes from spacing adjusting window through the center of the photo-interrupter,and it doesn't contact when the solenoid is pushed.

After adjusting,tighten both screws,ensure again if there is a contact or not.





⑪ Ensure ⑧ again.If it's OK,adjust the oscillation terminating position 8.2.2.And recheck the oscillation starting position 8.2.1 ⑦.

If the detection plate LED4 doesn't off,attach the spacing detection plate more upper.Be sure to not contact the spacing detection plate and photo-interrupter when the solenoid is pushed.

Caution

- If the starting position doesn't become 1.9mm after repeat adjustment,please change the spacing detection plate.

8.2.2 Adjusting the oscillation terminating position

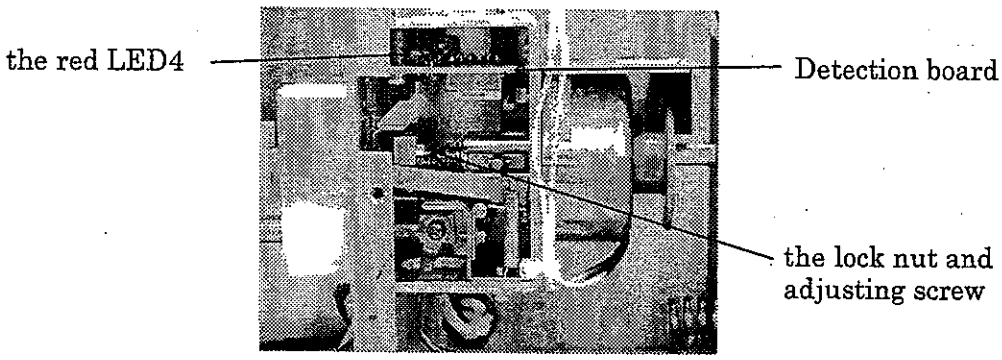
Ensure to adjust first the oscillation starting position,And then continue with the oscillation terminating position adjustment.

① Insert the thickness gauge (0.18 mm) between electrodes. With the negative electrode fully turned to the right, push in the solenoid plunger with your hand to stick it fast, and push out the negative electrode toward you.

At this time, loosen the lock nut of the detection adjusting screw, and adjust the screw so that:

The red LED4 goes ON on the detection board when using the 0.18-mm thickness gauge, and

The red LED4 lights OFF on the detection board when using the 0.20-mm thickness gauge.



② Tighten the lock nut, and then repeat the step ⑦ and check the result of adjustment.

③ Lock the nut with paint lock.

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8.3 Check for thermostat

Required tools

-(+)screwdriver

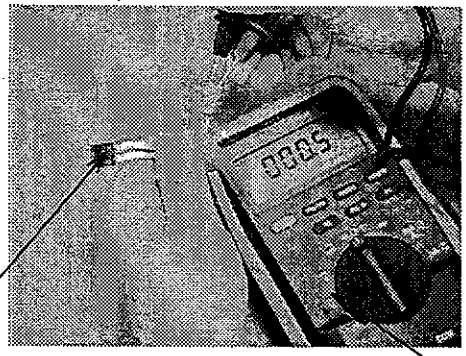
-digital multi meter

-heater(heat-gun)

① Refer to 6.3.1 -H Removing the Thermostat on page 6-20.

② Ensure the pin 1 and pin 3 of CON2 are short at room temperature.

If they are open,please change.



thermostat
(harness W15)

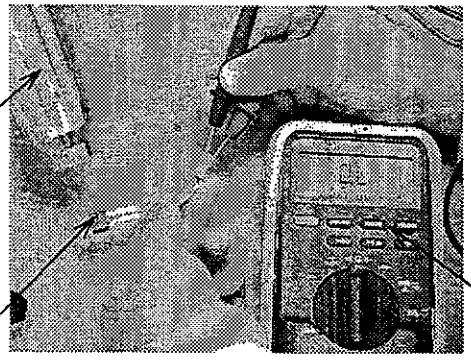
digital multi meter

③ Heat the thermostat up to 80～85°C with heater.

Ensure that the pin 1 and pin 3 of CON2 go open.

If they don't open,change is necessary become the protect function of RF plate cannot operate.

After stopping to heat,thermostat cool down up to 60°C and pins go short again.



heater

thermostat
(harness W15)

digital multi meter

④ Refer to 7.1.8-A Mounting the Thermostat on page 7-10.

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9. Inspection and Adjustment

Perform the inspection during servicing.

Prepare the following items for the regular inspection.

1. Alcohol
2. Gauze
3. Rubber gloves
4. Cotton swab
5. TERUMO blood single bag(BB＊SC506E:500ml)
6. Thickness gauge
7. Adjusting harness (1,2)

9.1 Regular Inspection

9.1.1 Appearance Inspection

(1) Damages and scratches

Contents of inspection

① Visually check the enclosure, such as the front panel, for damages and scratches which may result from falling down or other accidents.

② Visually check the rear panel fuse holder for damages.

Remedy

- If you find damages or scratches as mentioned above, visually check the internal parts for looseness or damages, and then mount or replace the parts correctly.

(2) Checking the mounting screws

Contents of inspection

① Visually check the enclosure mounting screws for spots due to leakage of blood, chemicals, and others.

Remedy

- Wipe away a slight dirt with gauze moistened with alcohol.
- To remove spots of blood, chemical, etc., visually check the internal parts, as a short circuit may have occurred in the internal circuits. If there are dirty parts, clean or replace them.
- If there is a loose screw, check the internal parts for looseness and damages. Tighten not only the loose screw but also non-loose screws securely.

(3) Checking the foreign matters

Contents of inspection

① Shake the equipment in every direction to make sure that it does not emit abnormal sounds due to entry of foreign matters.

Remedy

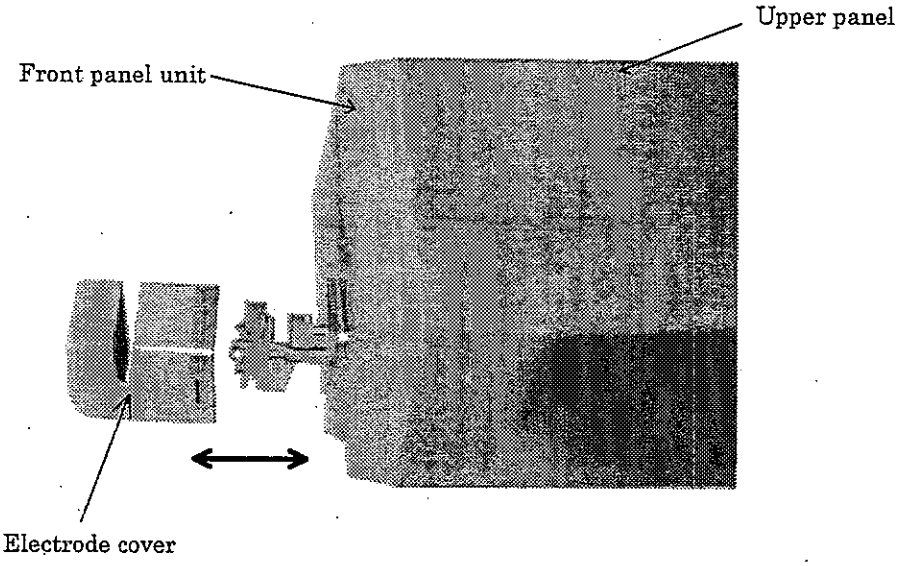
- If you hear an abnormal sound as mentioned above, check the inside of the equipment and remove the foreign matters. In addition, check the parts for looseness and damages, and mount or replace them accordingly.

9.1.2 Switch Operation

(1)Sealing start lever

Contents of inspection

① With the equipment not powered, set a tube horizontally on the sealing section. Press down the lever in the electrode cover and make sure that the lever moves smoothly without touching the cover.



Remedy

- Locate the point in contact with the cover, and correct it or replace the part(s).

(2) Power switch

Contents of inspection

① Turn on the power switch, and make sure that the green lamp lights up and the fan works probably.

② Take out electrode cover and confirm green light goes OFF. Replace the electrode cover and confirm green light remains on.

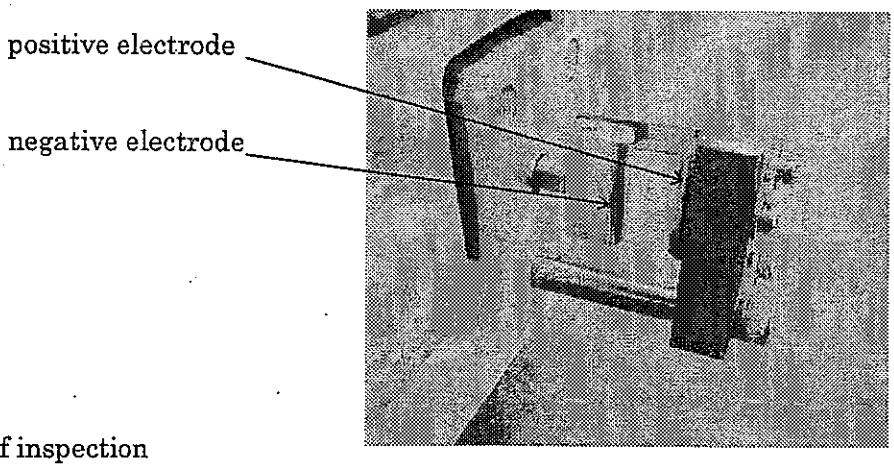
③ Turn off the power switch, and make sure that the green lamp goes off.

Remedy

- Take appropriate measures, referring to 11.2 Troubleshooting by symptom ①.

9.1.3 Sealing Operation

(1) Electrode mounting condition, cleanliness, and others



Contents of inspection

① Turn off the power switch.
② Make sure that the electrode cover is mounted properly.
③ Remove the electrode cover by pulling it toward you.
④ Check the positive electrode (fixed) and the negative electrode (movable) for looseness and dirt.
⑤ Pull out the negative electrode (movable) toward you, and make sure that it returns to the original position smoothly.
⑥ After the inspection, push the electrode cover fully into the original position.

Cautions

- Be sure to wear the rubber gloves to prevent infection.
- Take care not to bend the sealing start lever.

Remedy

Contents	Remedy
Electrode cover mounted improperly	Inspect the electrode cover and the positioning spring, and replace them, if required.
Positive/negative electrode loose	Adjust the electrode spacing and the spacing detection position as specified in 8.1 and 8.2 respectively. Tighten not only loose screws but also non-loose screws securely.
Positive/negative electrode dirty	Wipe away dirt with a cotton swab moistened with alcohol. Replace the electrode, if the dirt still sticks to it.
Malfunction of negative electrode	Replace the electrode unit, solenoid unit, or RF unit.

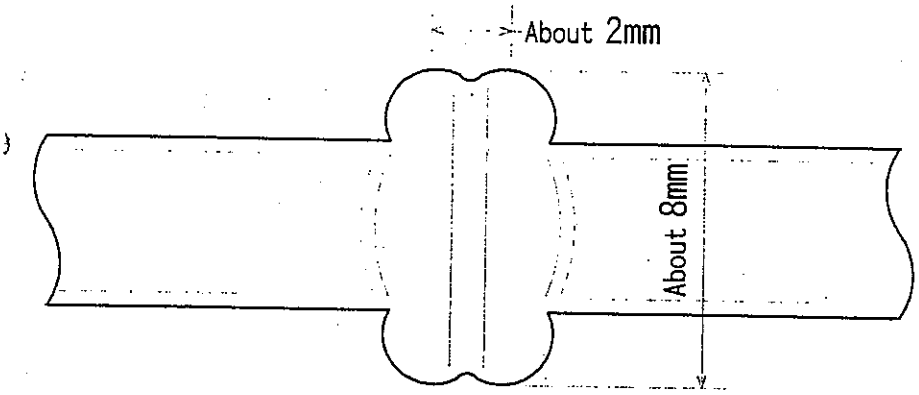
(2) Sealing condition

Contents of inspection

① Turn on the power switch.

② Set a tube horizontally on the sealing section. Push down the lever in the electrode cover and seal the tube, and make sure that it takes two seconds or less to seal the tube (until the electrodes return to their original positions).

③ The tube must be completely sealed, free from leakage, and the sealed area must have a shape as shown below.



④ The sealed area must be tearable with hands. The cut edges must be straight and symmetrical, free from leakage.

Cautions

- **Fill the tubes with anti-coagulant.**
- **Seal point must be 4 cm or more away from the end of the tube.**

Remedy

- Adjust the electrode spacing and the spacing detection position as specified in 8.1 and 8.2 respectively, and then check them again.
- If the sealing condition is still abnormal after re-adjustment:

① If the electrode unit has rattles, replace it.

② In other cases, replace the RF unit.

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9.1.6 Check List for AC-155

Check list for AC-155

Serial No.:

Date: / /

Checked by:

Check items	Result	
1. Appearance		
(1) There are no damages and flaws on the exterior.	OK	N.G.
(2) There are no looseness and dirt on screws.	OK	N.G.
(3) There are no abnormal sounds when the equipment is shaken in every direction.	OK	N.G.
2. Switch operation		
(1) The sealing start lever moves smoothly.	OK	N.G.
(2) The power switch operates properly.	OK	N.G.
(3) Power light off when electrode cover is not fixed.	OK	N.G.
3. Sealing operation		
(1) There are no looseness and dirt on the electrodes.	OK	N.G.
The electrodes move smoothly.	OK	N.G.
(2) Sealing is completed in the proper time (two seconds or less).	OK	N.G.
Sealed area has the proper shape.	OK	N. G.
Sealed area is tearable by hands. (between 2 and 4 Kgf)	OK	N. G.

10. Cleaning

- Before cleaning the equipment, be sure to turn off the power switch and disconnect the AC power cable. (Wait 5 minutes)
- To clean the electrodes or blood stained areas, be sure to wear rubber gloves to prevent infection.
- To remove stains of blood and chemicals, wipe them away with a soft cloth slightly moistened with neutral detergent, alcohol-based disinfectant, or chlorhexidine gluconate.
- Do not use any other organic solvents than alcohol-based disinfectant, such as thinner, for cleaning purpose.

The followings are disinfectant solutions available for cleaning.
After using a disinfectant solution, wipe it away with gauze moistened with cold or warm water.

Example of disinfectant solutions
Chlorhexidine gluconate
Benzalkonium chloride

- Do not use an autoclave for sterilization.

- Do not use a dryer or other heaters for drying.

Note:
After finishing the above inspection (Section 9.1.6.), clean the electrodes and internal parts. Remove dust from the inside of the equipment, since the air cooling fan is used.

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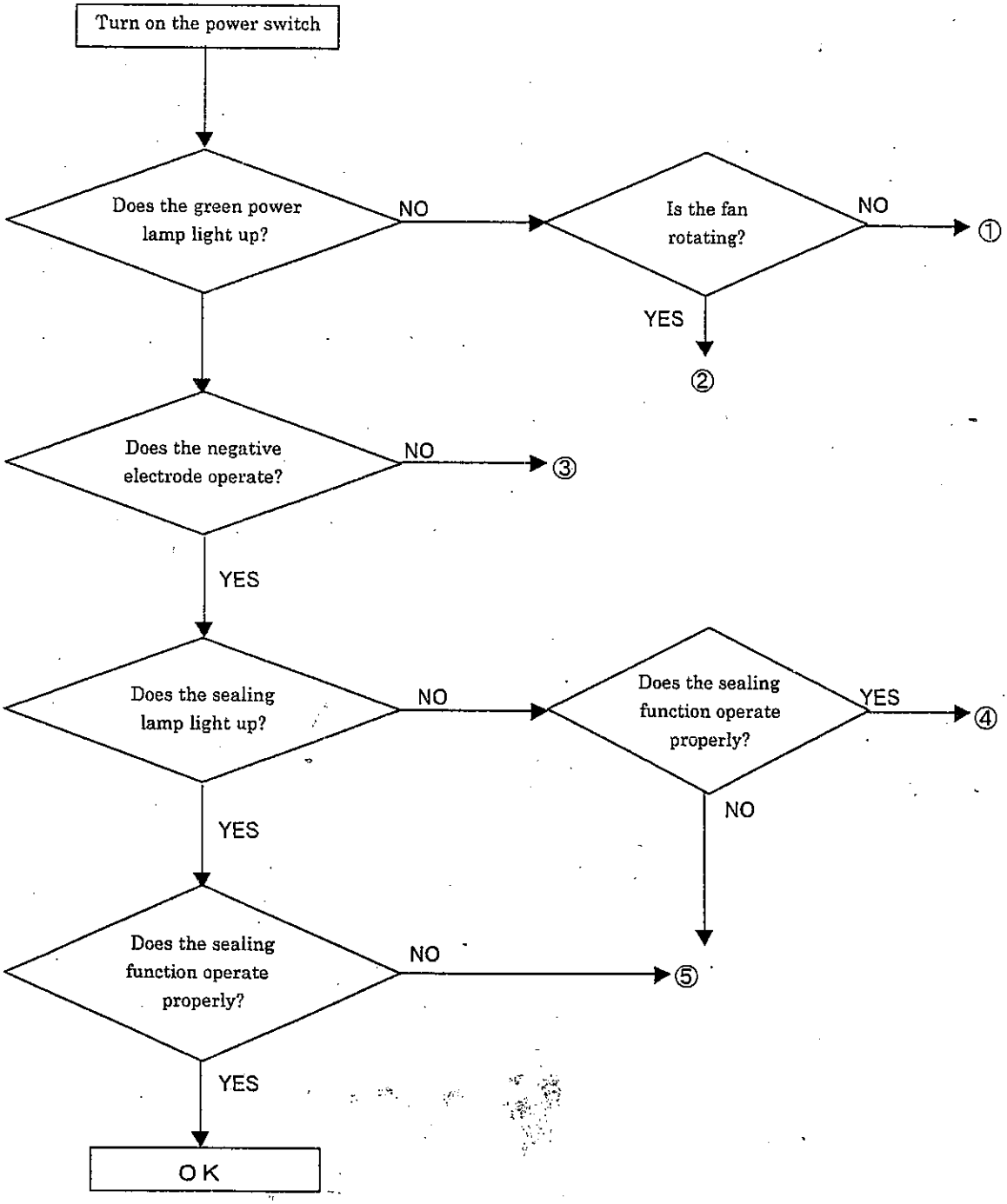
11. Troubleshooting

11.1 Flowchart



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11.2 Troubleshooting by Symptom

① The power lamp does not light. (The fan does not operate.)

Cause	Check item	Remedy
The electrode cover is out of position. The electrode cover detection is defective.	Check the operation of the electrode cover detection microswitch. Check the continuity.	- Attach the cover properly. - Replace the electrode cover detection microswitch.
The power cord is disconnected.	Check the continuity.	Replace the cord with a new one.
The fuse is disconnected. Outer fuse Inner fuse	- Visually check the fuse. - Visually check the circuits and wires for scorches.	- Replace the fuse. - Replace defective part(s).
Power supply is defective.	Check the voltage. 12VDC (TP1)	Replace the power/control board.
Overheat		Wait about 30 seconds.
Thermostat broken	Check the thermostat, referring to Chapter 8.3.	Replace thermostat

② The power lamp does not light. (The fan rotates.)

Cause	Check item	Remedy
The display LED is defective.	Visually check the LED.	Replace the display board unit.

③ The negative electrode does not operate.

Cause	Check item	Remedy
The tube detection photo sensor does not work.	- Make sure that the tube detection lever shading section does shade the photo sensors (PS1, 2) on the detection board. - Make sure that the yellow LED3 lights up on the detection board.	- Modify the position of the tube detection lever or replace the lever. - Replace the detection board.
The power/control board is defective.	Check the voltage. 45VDC (Solenoid output from pins 1 and 2 at CON4)	Replace the power/control board.

Cause	Check item	Remedy
Dirt of the shaft of electrode department.	- Visually check the electrode department. - Make sure that returns smoothly when it draws, separated a negative electrode (moved electrode) in the front is confirmed.	Replace the electrode department.

④ The sealing lamp does not light.

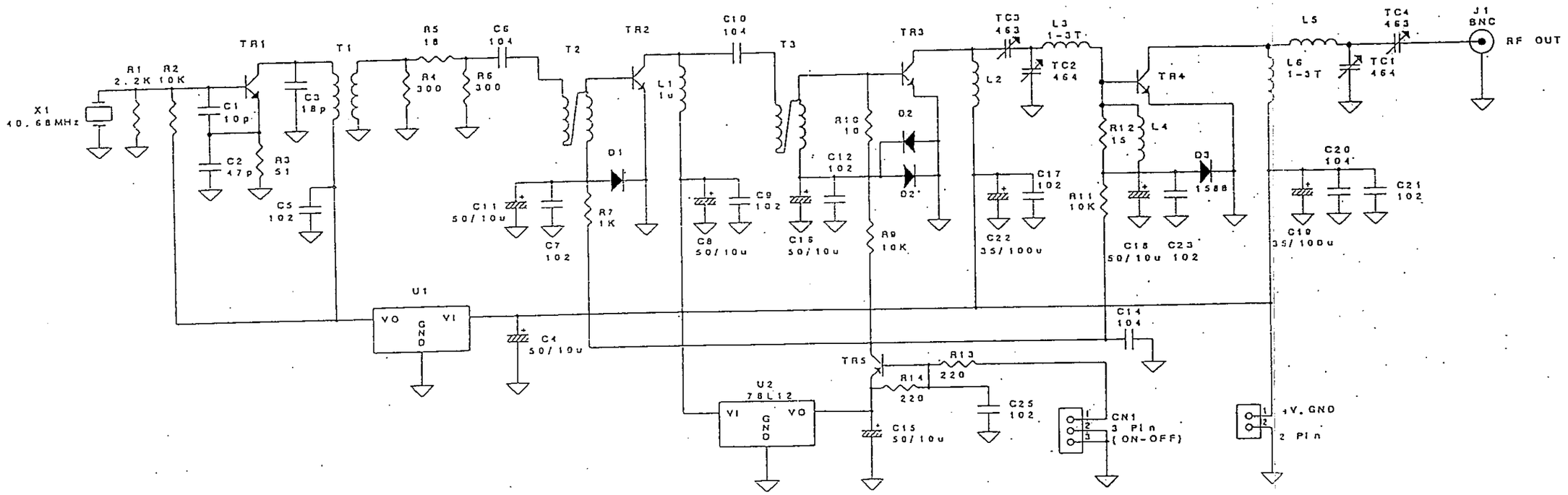
Cause	Check item	Remedy
The sealing lamp LED is disconnected.	Visually check the LED.	Replace the display board unit.

⑤ Sealing operation cannot be done at all or cannot be done properly.

Cause	Check item	Remedy
The electrode spacing is not adequate.	Check the electrode spacing, referring to Chapter 8.1.	Adjust the electrode spacing.
The detection spacing is not correct.	Check the detection spacing, reference to chapter 8.2.	Adjust detection spacing.
The power/control board is defective.	Disconnect CON5 on the power/control board. In this status, set the electrode cover. Push down the tube detection lever and make sure that the pin 1 and 3 of CON5 are under 1k Ω. (usual state is open)	Replace the power/control circuit board.
The RF board is defective.		Replace the RF board.

12. Circuit Diagrams

12. 1 Circuit Diagram of RF board



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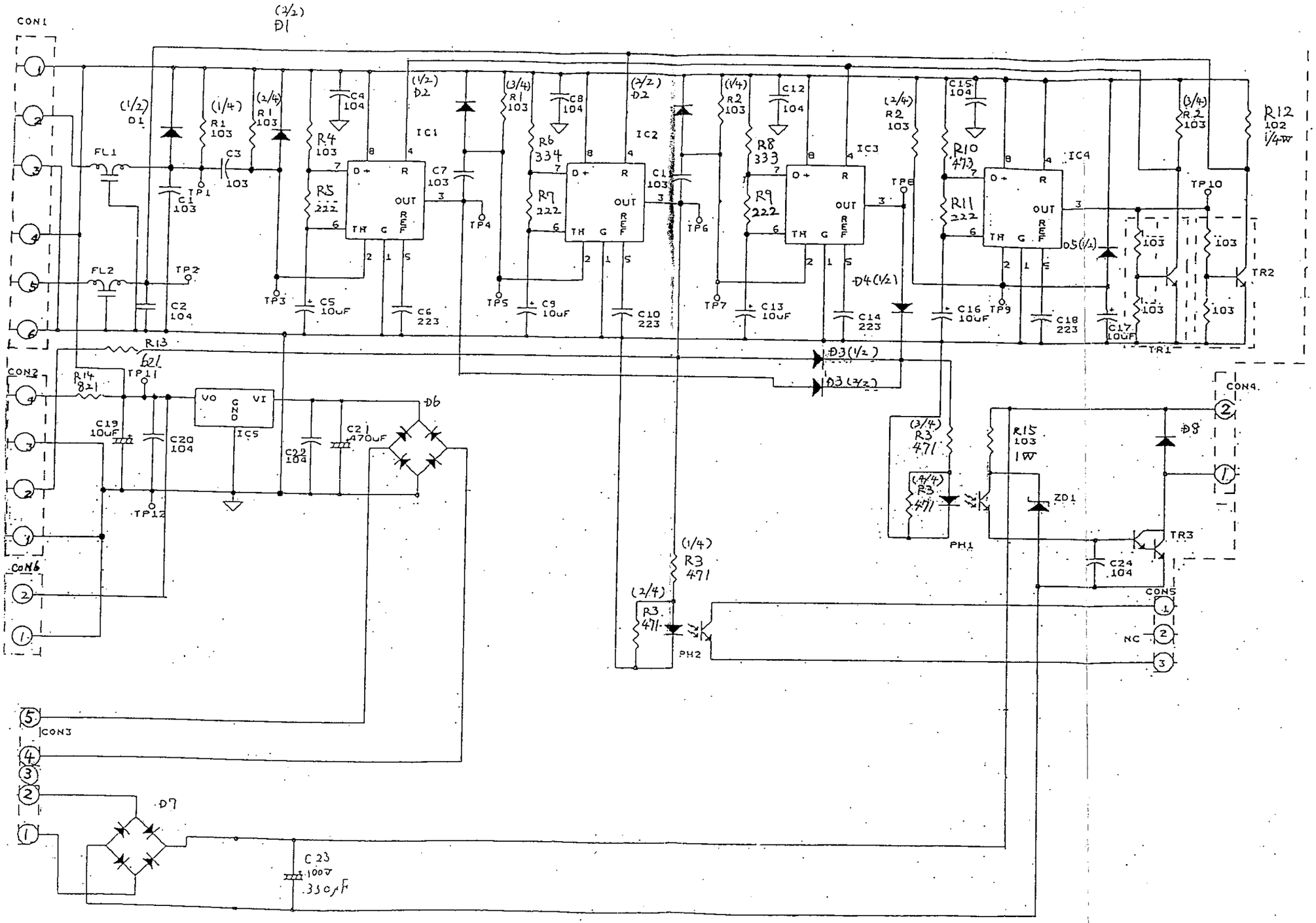
12. 2 Circuit Diagram of Power/Control board



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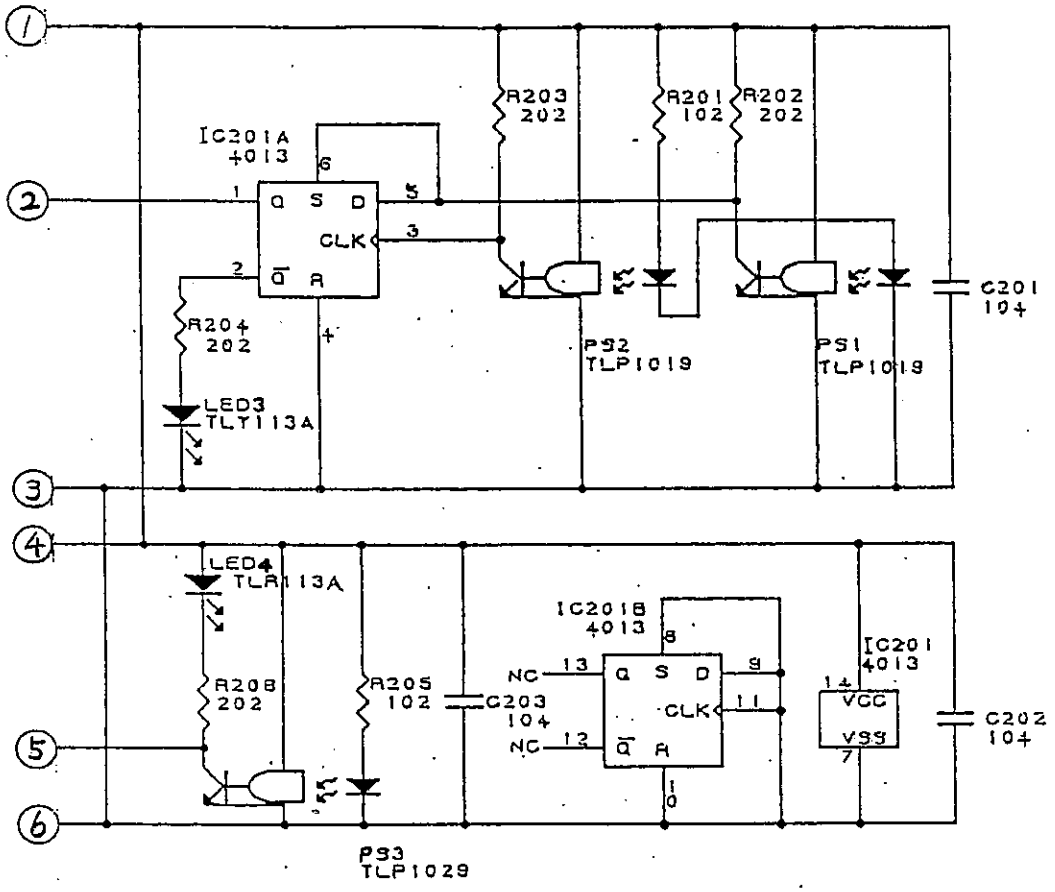
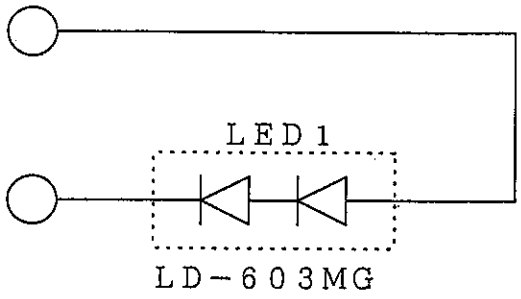
12. 3 Circuit Diagram of Detection board



12.4 Circuit Diagram of Display board

Power



Seal