INSTRUCTIONS

JSM-T220A/T330A

SCANNING MICROSCOPE
(MAINTENANCE)

JEOL

No. ISMT220A/T330A-1B
(MP169101/MP168101)

(2)

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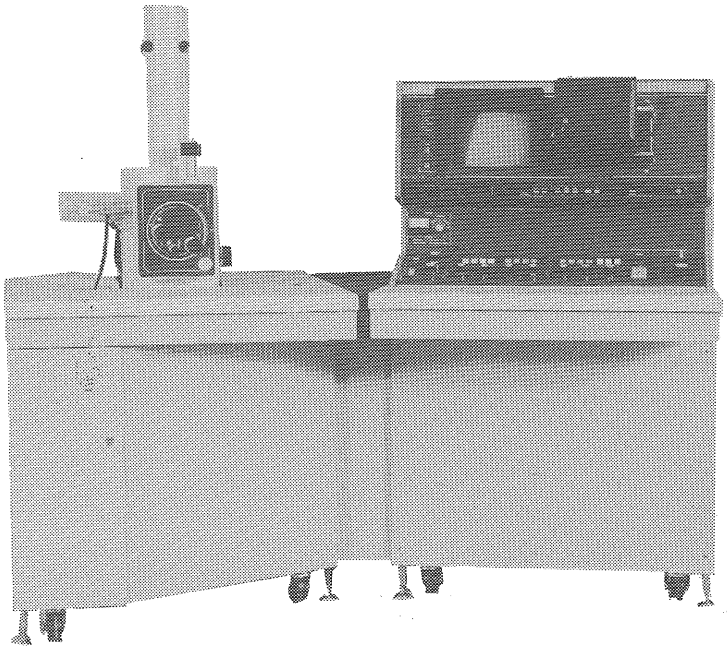
PREFACE

Although JSM-T220/T330 is easy to operate, you are requested carefully to read this Instructions before starting its operation for better understanding of keypoints on operation and for full comprehension of operational techniques.
This Instructions (2nd Volume) cover the MAINTENANCE section.

Please refer to OPERATION section in Instructions (1st Volume) for further details of specifications, panels and operation of the microscope.



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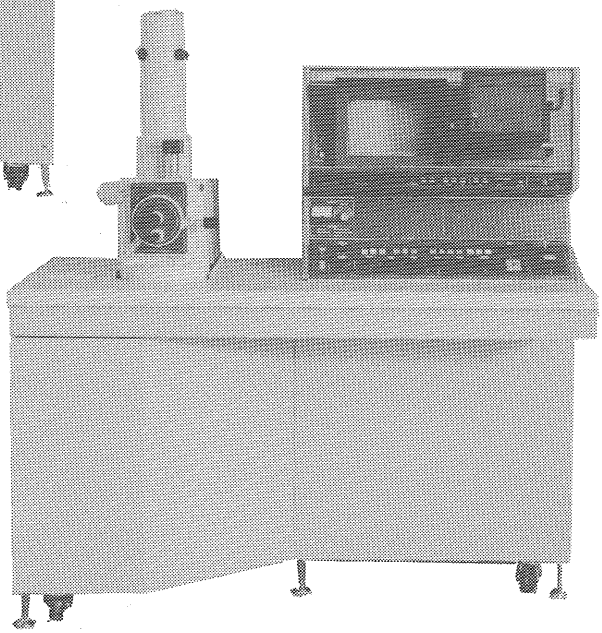


JSM-T220

Description of this Instructions may be slightly different from the factual microscope due to its subsequent modification.

CONTENTS

CHAPTER 5 MAINTENANCE I
(Basics: General Cautions And Cleaning)

CONTENTS

REQUIREMENTS FOR MAINTENANCE

In the course of using the microscope for long period of time, the following phenomena may be recognized and they make difficult to obtain the fine image as a result of contamination:

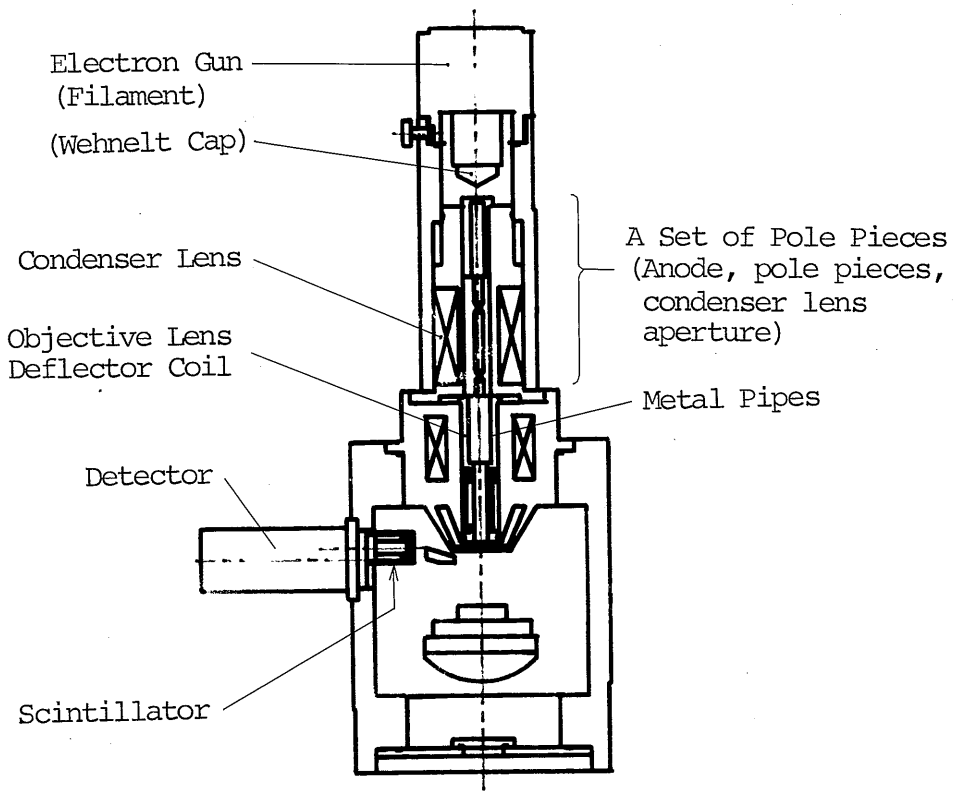
- o Burnout of gun filament
- o Increase of astigmatism/degradation of resolution
- o Unstability of probe current/image disturbance due to jump of probe

The above contamination is caused by irradiation of electron beam. Besides, the component parts inside the column is also contaminated gradually by sticking of evaporated and/or fine dust.

For solution to ensure the fine image at all times, so-called "Maintenance" is required to maintain the parts clean by periodically cleaning up some parts of microscope or by replacing the parts with new ones.

5.1 Points Requiring for Maintenance

5.1.1 Maintenance Points for Electron Optical System



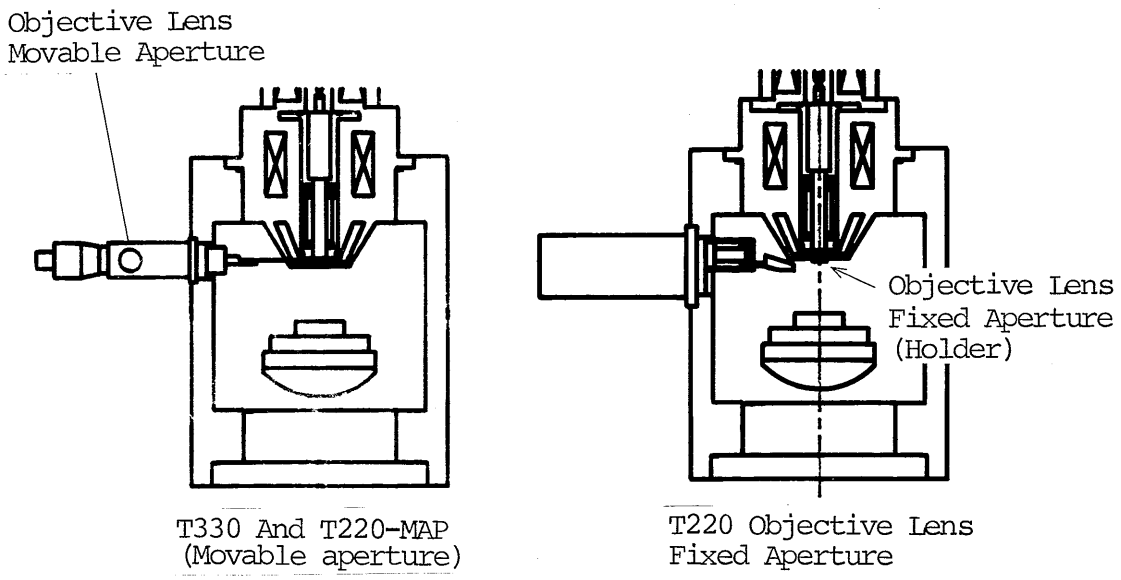


Fig. 5.1-1

Maintenance Parts	General Maintenance Cycle	Maintenance Method	Reference Page
Filament	Burnout, fluctuation or deterioration	Replacement	6-11, 7-5
Wehnelt Cap	Together with filament replacement	Cleaning B	6-14, 7-5
Anode	1 to 2 years	Cleaning B	6-25
Condenser Lens Aperture	1 to 2 years	Replacement	6-25
Pole Pieces	1 to 2 years	Cleaning B	6-25
Objective Lens Aperture	1 to 2 years	Replacement	6-29, 6-32
Objective Lens Aperture Holder	Together with objective lens aperture replacement	Cleaning B	6-29, 6-32
Metal Pipe (In Deflector coil)	2 years	Cleaning A or B	6-34
Scintillator Chip	2 years	Replacement	6-37

- o Cleaning A: The method of cleaning the parts with a little dirts 5-12
- o Cleaning B: The method of cleaning the parts with much dirts 5-14

1. Perform the cleaning operation periodically so as to observe the image always under the best condition.
2. Cleaning cycle depends on the using frequency of microscope, but, if the contamination is recognized at the time earlier than the specified cleaning cycle time, shorten the cleaning cycle time.
3. Generally, if you turn [SPOT SIZE] control clockwise more, probe current increases more. This makes it contaminate more and the cleaning operation is required much more frequently. Besides, image observation at high resolution stimulates more the degradation of resolution and this also requires to clean up more frequently.
4. Cleaning frequency also depends on the kinds of specimen to observe.

5.1.2 Other Maintenance Points

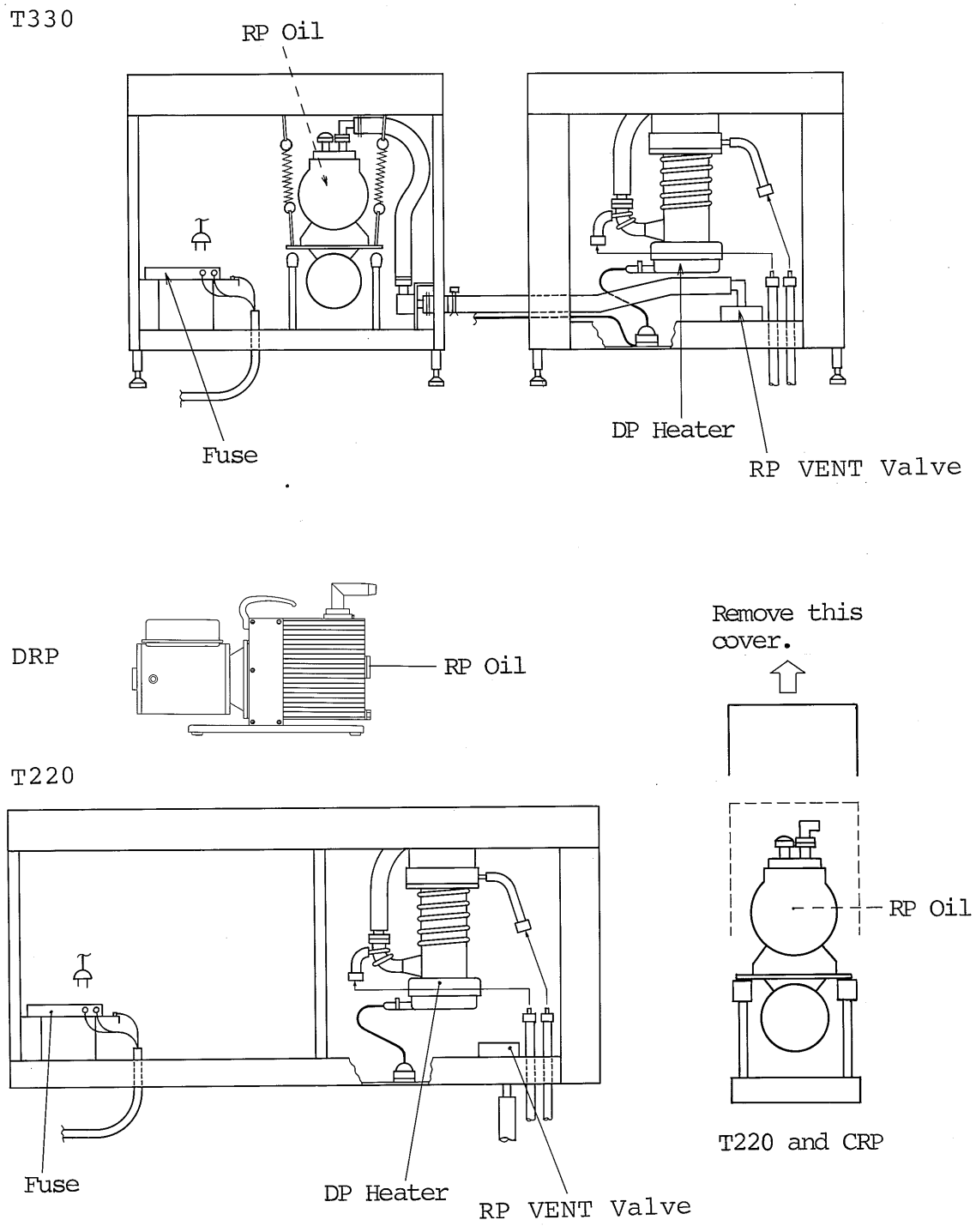


Fig. 5.1-2

Maintenance Parts	General Maintenance Cycle	Maintenance Method	Reference Page
RP VENT valve	1 year	Apply grease	6-40
DP Heater	At time of disconnection	Replacement	6-43
RP Oil	Insufficient	Add oil	6-44
Fuse	At time of blownout	Replacement	6-46

1. RP VENT Valve
   The vent valve which leaks automatically for RP at the time of microscope stoppage may not properly operate if the grease is insufficient for the piston to function as valve. Apply grease once in a year.
2. DP Heater
   If column is not evacuated and DP heater is not heated even after 15 minutes of power application, fuse may be blown out and/or DP heater or lead wire is disconnected. Replace DP heater or lead wire if it is disconnected.
3. RP Oil
   Add oil if oil level goes down below ◎ mark by consumption.
4. Fuse
   If it cannot start normally after the power supply, it may be caused by blowout of fuse. Here, replace the fuse.

Note: To add or change DP oil with the reason that fair vacuum condition cannot be ensured, please call our service engineer.

5.2 General Cautions for Disassembly And Reassembly Procedures

Here, the description covers general cautions in relation to cleaning and 6. MAINTENANCE II (disassembly/reassembly of each component).

Perform the operation in correct procedure with these cautions in mind.

1. Take special care for handling the component parts inside the column, since they are made in high precision.

   Example: Mount, dismount and disassemble parts by wearing clean gloves (made of cotton or nylon), but do not do the job with bare hands. If you forget it, dirt such as finger fat is stuck to the parts and may oxidize the parts. (Especially, care must be taken at the time of reassembly.)

2. Prepare in advance the table and the cover to place the disassembled parts. The table should be robust work table and spread clean cloth or else as mentioned below on it to prevent dust from sticking to the removed parts.

   Example: Gauze or rayon paper* is suitable for the parts from which yarn waste can be easily removed if once stuck. But, plastics sheet or Saran film is suitable for the parts with complicated shape. Here, select plastics sheet that is unsoluble to organic solvent if you use the plastics sheet.

   As for the cover, use the plastics sheet, Saran film or aluminium foil.

   For the weighed parts, place something for cushion (such as synthetic foam resin used for packing material) under the spreading and, then, place the parts after ensuring that any small

piece such as screw is not left on the table.

*Rayon paper: The paper without fluff and paper powder

3. Be sure not to damage the parts with the tool used for disassembly and reassembly as in the following examples.

   Examples: (1) Scratches or flaws to the parts by screwdriver, special tool or tweezers
   (2) Dent to the parts by dropping the parts
   (3) Eccentricity or scuffing to be made by forcible mounting/dismounting of the parts
   (4) Disconnection of wired parts. (This must be avoided with special attention.)

   Note: The damage of parts if caused may result in failure of reassembly, poor operability and degradation of microscope performance.

4. Use the screwdriver, wrench and other tool correctly and following points must be observed especially for loosening or tightening the screw:

   Examples: (1) Select the screwdriver and the other tool exactly to meet with the screw or the parts to be loosened.
   Then, loosen them by fully pushing them.
   (2) Tighten the screw and other parts, but not forcibly.
   First of all, make sure of them to be same as the ones removed. Then, tighten all the screws to be secured on the same face very lightly to the end.
   Finally, tighten each screw evenly and alternately a little by little to the same proper torque.

Note: If you neglect these cautions, screw head may be damaged, microscope is affected by vibration and/or screw thread is damaged. Moreover, if you slip off the parts, the parts may be damaged. Even tightening is inevitable for reassembly of the high precision parts.

5. At the time of disassembly, sort and keep all the parts for easy reassembly.
   For example, keep small parts and screws in specially selected box or Sheare.
6. Those parts to be reassembled soon may be placed on the table. But, if the parts are left for long time, they should be stored in desiccator to protect them from oxidization. If proper desiccator is not available, wrap the parts with the paper containing antioxidant, wrap them with Saran film together with desiccating agent, further wrap them with aluminum foil and keep them at the place in low humidity. This arrangement can expect the same effect as desiccator.

5.3 Cleaning

Clean up chiefly the electron optical system. Also, apply the grease to leak valve.

5.3.1 Preparation for Cleaning Requisites And Tools

Prepare the following requisites and tools required for cleaning operation.

Requisites And Tools	Purpose	Caution	Recommendations
Thin Gloves for Work	Use to handle the component parts inside the column that must be especially free from dirts. The gloves can protect the parts from dirts by finger fat and oxidization by salt.	The gloves should be free from fluffs nor be dirty.	The gloves are made of cotton or nylon for clean room use and plastics gloves without powder are also applicable.
Ultrasonic Wave Cleaner	Finish clean the parts polished by fine grain metal polish and clean the dust off.	Wipe fine grain metal polish off well and dip them in cleaning liquid in the beaker and apply them to this ultrasonic wave cleaner by placing in the cleaner with beaker with them.	Small type will do.
Handblower	Blow off the dust cleanly after cleaning operation.		(Accessories)
Beaker	Use to contain the cleaning liquid.	Be careful of breakage if the beaker is made of glass.	The beaker made of stainless steel, aluminum and enamelled.
Standard Tool	Use to loosen/tighten the screws.		(Accessories)
Tweezers	Used to mount/dismount very small parts as difficult to handle with hands.	Take special care for handling these small parts.	(Accessories) For dentist and precision job

Requisites And Tools	Purpose	Caution	Recommendations
Brush	Use to remove fine grain metal polish with cleaning liquid from screws, etc.	Brush should not be spoilled by organic solvent.	Such as Saran filaments embedded into bamboo
Mini Drill	Shorten the cleaning time by attaching cotton applicator to it.	Clean up the parts by attaching cotton applicator with absorbent cotton wound around it and applying the fine grain metal polish. However, be caresul not to polish excessively, as it has a strong polishing force.	
Gauze or Rayon Paper	Use to polish and wipe the polish off and to clean up the parts in details.	Use the ones not to produce impurities and is not fluffy.	Rayon paper should be crepe paper or gauze.
Cleaning Liquid (Organic solvent)	Use to clean, degrease and remove the fine grain metal polish. Cleaning A.	The solvent that has excellent cleaning ability with least impurities and high allowable density to human bocy, and is not inflammable (unflammable if possible). For application, be sure of following points. ①Ventilate well inside the room. ②Do not dip fingers in liquid for long time.	Trichloroethane, aceton, alcohol or other volatile solvents
Absorbent Cotton	Use to polish, wipe off and clean up parts in details.	Select clean cotton and do not leave it onto the parts after polishing with it.	
Fine Grain Metal Polish	Cleaning B	This is paste form and easily removable by organic solvent.	(Accessories)
Cotton Applicator, Toothpick, Stick or Chopstick	Use to polish, wipe off and clean up parts in details.	Use it by winding absorbent cotton or gauze around it. Approx. 5mm dia.	

5.3.2 Cleaning Procedures A And B

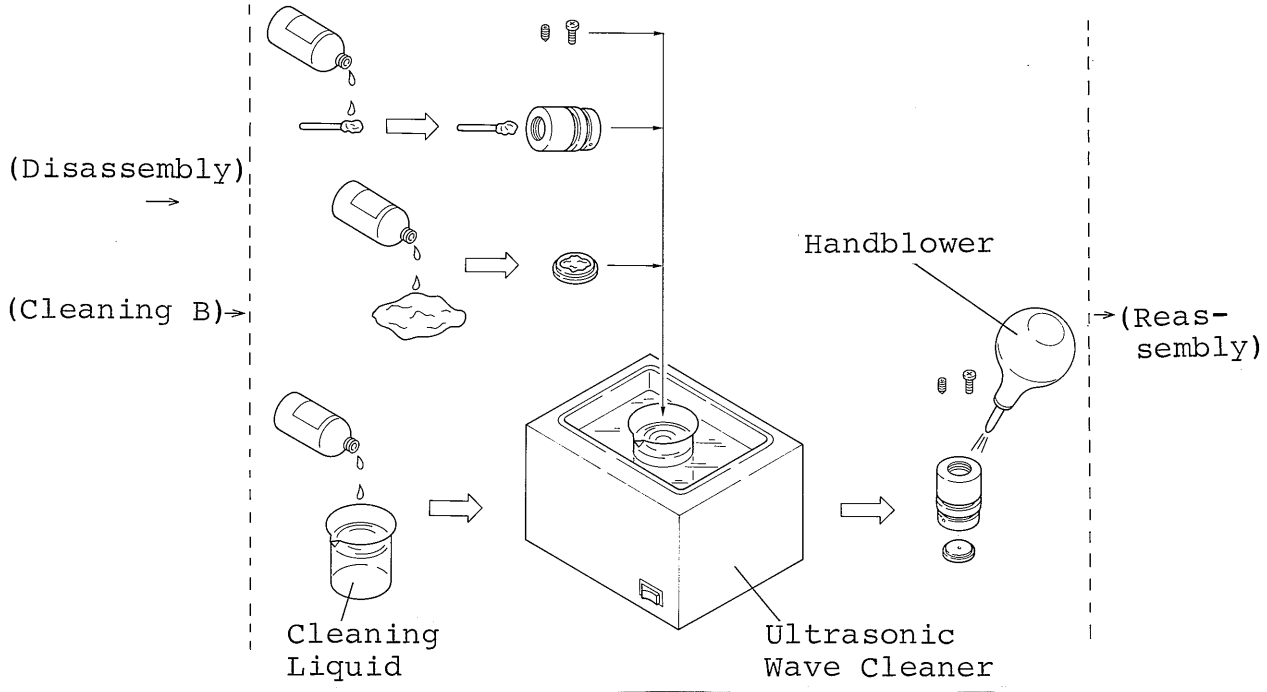


Fig. 5.3-1 Cleaning Procedure A

1. Cleaning Procedure A

(Object) The method of cleaning the parts with a little dirts

(Procedure) Wipe off the surface with gauze, rayon paper or absorbent cotton by dipping cleaning liquid (organic solvent). (But, use absorbent cotton to wipe off those sections that must be absolutely free from fine scratches.) For cleaning hole and bore of cylinder, use cotton applicator, toothpick with absorbent cotton wound, stick or chopstick also with absorbent cotton wound dependently on the size of hole or bore. To remove oil and fat from the complicated shape or screw portion, apply the ultrasonic wave cleaner by placing them in the beaker or use the brush.

(Cautions) ① Do not use the brush to clean the parts which must be quite free from fine scratches.

② Use the handblower and blow off quickly the liquid deposited to the parts taken out of liquid so as to prevent residue from condensing.

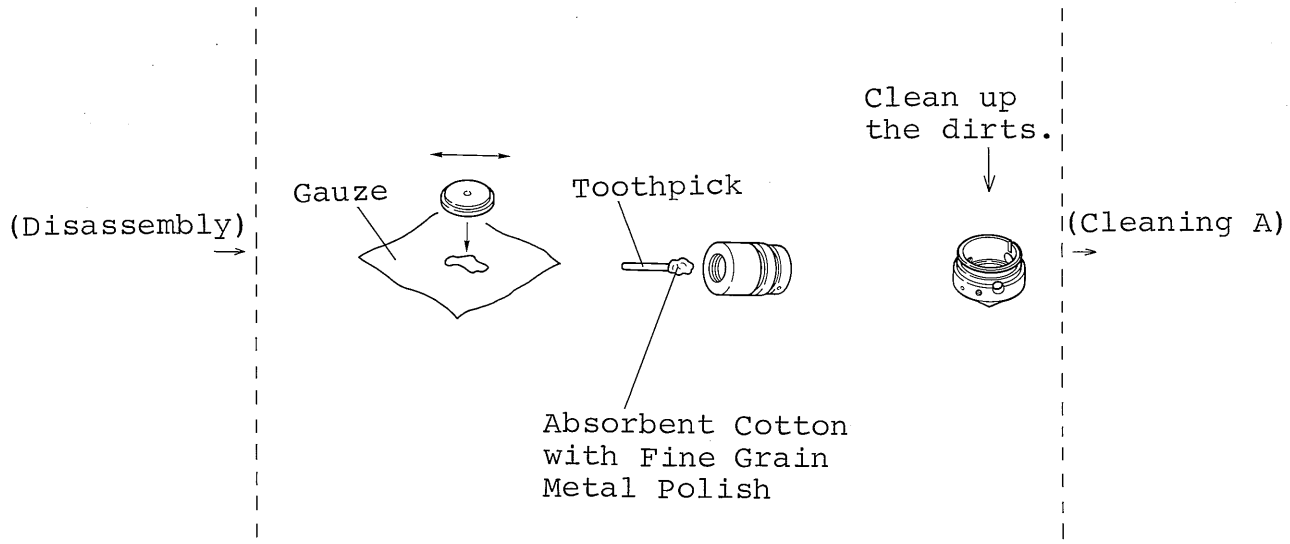


Fig. 5.3-2 Cleaning Procedure B

2. Cleaning Procedure B

(Object) The method of cleaning the parts with much dirts

Example: Such as anode, Wehnelt cap, inside the pole pieces

(Procedure) ① Polish the plane face with gauze, nayon paper or absorbent cotton by applying a small amount of fine grain metal polish to remove contamination and other dirts and oxide. (Use absorbent cotton for polishing the sections that should be free from fine scratches.)

② For cleaning dirts on hole and bore of cylinder, use cotton applicator, tooth-pick with absorbent cotton wound, stick or chopstick also with absorbent cotton wound dependently on the size of hole or bore.

Note 1: However, do not use the metal polish for cleaning the parts with complicated shape, screw or synthetic resin.

Note 2: To polish the parts, do not apply much force, but polish them smoothly with patience.

③ Visual check is enough to ensure that the dirts and oxide are removed.

④ In the end, remove the metal polish with cleaning liquid by repeating "Cleaning Procedure A" several times.

Note 3: If the metal polish is left on the parts, the polish residue itself is dirt and this means that cleaning operation is meaningless if it is not removed perfectly.

Note 4: Additionally, to protect the cleaned parts from dirts sticking again, special attention should be paid to their storage until the time or reassembly by covering aluminum foil over them.

CHAPTER 6 MAINTENANCE II

(DISASSEMBLY AND REASSEMBLY OF COMPONENT PARTS)

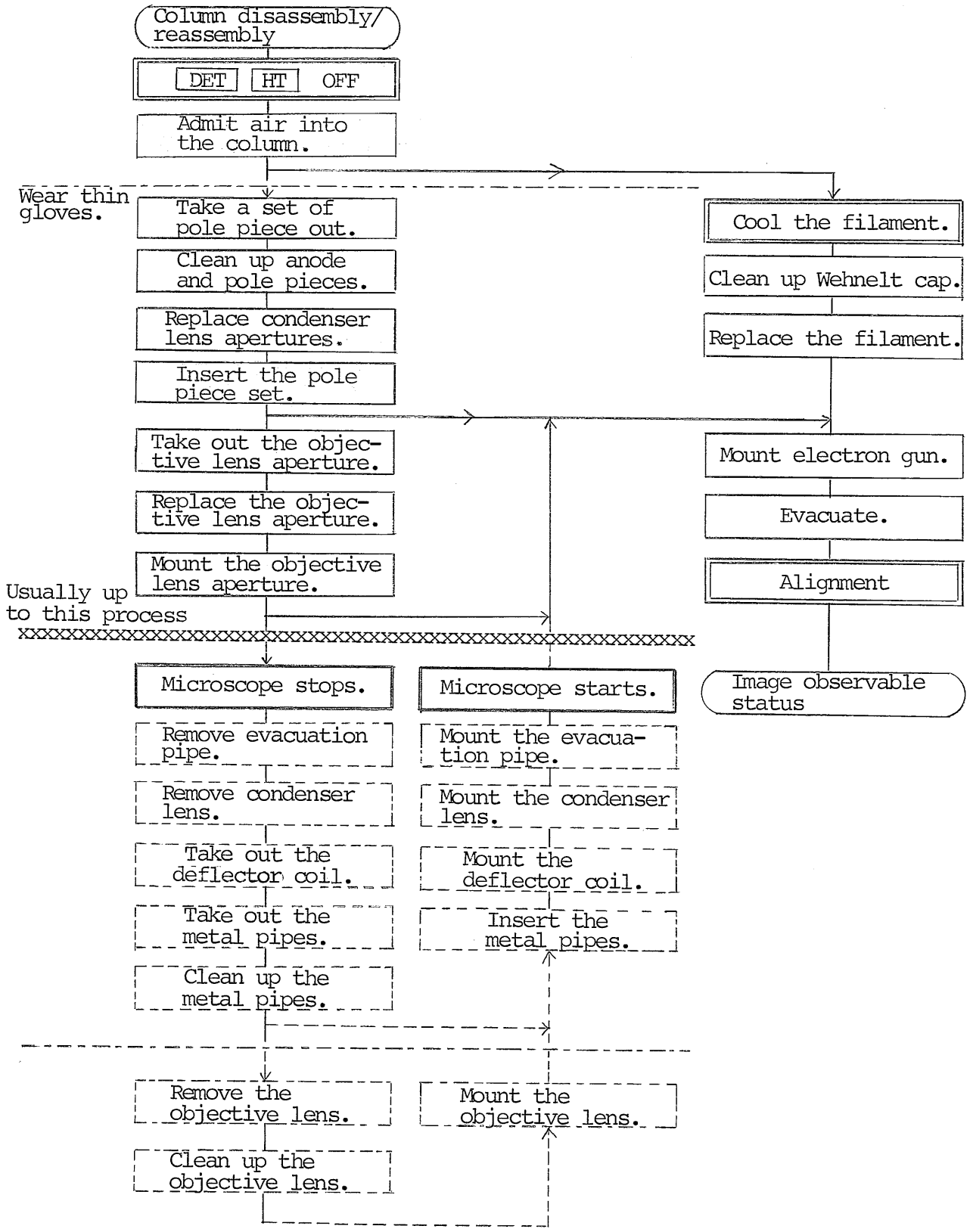
CONTENTS

6.1 Precautions for Disassembly

Perform disassembly/reassembly operations in correct sequence after reading again Chapter 5. MAINTENANCE I.
Refer also to Chapter 5. MAINTENANCE I for details of cleaning procedure of the disassembled parts.
To clean up as a result of any abnormality in observing the image, following operations are enough to correct it.

(1) Clean up Wehnelt cap and replace filament.
(2) Clean up anode and pole pieces and replace condenser lens aperture.
(3) Replace objective lens aperture.

It takes too much time for reassembly operation and may cause the risk to damage the parts if you disassemble the section not required to be disassembled and the parts not required to be cleaned up. Additionally, cover the aluminum foil over the exposed section that is not disassembled.
Besides, if you touch the parts inside column, wear the thin gloves. But, be sure not to leave yarn waste of gloves inside the column.
(Otherwise, yarn waste may be charged and affect the image adversely.)


Column disassembly/ reassembly
DET
HT
OFF
Admit air into the column.
Wear thin gloves.
Take a set of pole piece out.
Clean up anode and pole pieces.
Replace condenser lens apertures.
Insert the pole piece set.
Take out the objective lens aperture.
Replace the objective lens aperture.
Mount the objective lens aperture.
Usually up to this process
Cool the filament.
Clean up Wehnelt cap.
Replace the filament.
Mount electron gun.
Evacuate.
Alignment
Image observable status
Microscope stops.
Microscope starts.
Remove evacuation pipe.
Mount the evacuation pipe.
Remove condenser lens.
Mount the condenser lens.
Take out the deflector coil.
Mount the deflector coil.
Take out the metal pipes.
Insert the metal pipes.
Clean up the metal pipes.
Remove the objective lens.
Mount the objective lens.
Clean up the objective lens.

1. Turn OFF [DET] [HT].
2. Press [VENT] and admit air into the column.
3. Remove alignment screws and take off electron gun from condenser lens by pulling it up vertically.
4. If the filament is burnout, replace the filament after it is cooled down.
   After replacing the filament, proceed to step 18 in this section.

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5. Wear thin gloves, but do not leave yarn waste of gloves inside the column (yarn waste may be charged and affect image adversely).
6. Take out a set of pole pieces (refer to item 6.4 Clean Up A Set of Pole Pieces).
7. At this step, clean up anode and pole pieces and replace the condenser lens apertures.
   Proceed to step 18 in this section after cleaning and replacing as above.
8. Replace the objective lens aperture (refer to item 6.5 Objective Lens Aperture Replacement).
   Note: Usually, cleaning and replacement up to this step are enough for the purpose.

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If any abnormality in image observation is still recognized after the above operation, refer the CHAPTER 7 TROUBLE-SHOOTING PROCEDURE or please call our service engineer.
If you proceed further the maintenance operation,

① Ensure again that the parts have been cleaned up or replaced properly.
② If cleaning and replacement have been not enough, repeat the operation.
③ If the operation have been done properly, perform the following steps for cleaning the metal pipe (inside the deflector coil).

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9. Stop the microscope and turn OFF the switch on distribution panel and wait for longer than 30 min to cool down the microscope.
10. Remove evacuation pipe.
11. Remove 4 pieces of Allen screws and remove the condenser lens by pulling it upward (be careful for removing it, since it is weighed).
12. Ensure the mounting direction of deflector coil and take out the deflector coil (refer to item 6.6 Deflector Coil Disassembly).
13. Take out 3 pieces of metal pipes located inside the deflector coil by turning it upside down after covering the deflector coil with gauze so as not to damage them and not to drop them. (Refer to item 6.6 Deflector Coil Disassembly.)
14. Now, clean up the metal pipes.
15. After cleaning the deflector coil, reassemble the deflector coil with following points in mind.
    (1) Reassemble it to the original configuration.
    (2) After starting the microscope, perform alignment of astigmatism correction coil at the image observable condition.

    Proceed to step 18 (reassemble condenser lens, evacuation pipe and electron gun in reversal order of disassembly procedure and start the microscope).
    "Objective Lens Removal" is not almost required.

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16. Remove upper section of objective lens and clean up if required.
17. Ensure that the objective lens movable aperture is taken out and, then, remove the lower section of objective lens and clean up if required.

18. After completing the cleanup operation and replacement as required, reassemble component parts in reversal order of procedure with following points well in mind. If the care is forgotten, cleaning effect becomes meaningless and it may cause vacuum failure. So, be sure to check up at each step of reassembly. The negligence of stepwise checkup may cause vacuum failure and this requires again to disassemble the parts, resulting in increase of job load.

① Perform dust prevention and dust collection.
Reassemble parts each time by ensuring that dust and yarn waste are not stuck onto the parts. If they stick onto the parts, remove the dust and yarn waste from the parts with handblower during reassembly process. If it takes a certain time until proceeding next step of reassembly halfway on the reassembly operation, protect the reassembled parts and the parts to be reassembled from the dust by covering Saran film or aluminum foil over them.
Negligence of covering comes to no purpose of cleaning and cause high tension discharge and the image disturbance.

② Check up to ensure that the surface and contact face of O-ring have not scratches and yarn waste is not stuck on them.
Surplus vacuum grease causes the contamination of parts inside the column and of specimen and, accordingly, apply the grease in minimum for requirement.
If any scratch is recognized on the metal of contact face, such parts may be usable when the depth of scratch is negligibly shallow. Or, the scratch can be corrected by polishing it in direction that the O-ring contacts with super-fine grain sandpaper.

However, if the scratch is deep, call our service engineer for solution.

19. After mounting the electron gun, start the microscope if it has stopped.
20. Evacuate the column again and perform alignment for filament and objective lens aperture.
21. When the deflector coil is taken out, perform the alignment of astigmatism correction coil with the following procedure.

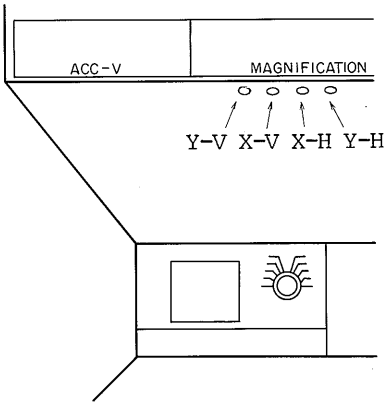


Fig. 6.2-1

1) Mount standard specimen (ZnO) and evacuate the column.
2) Adjust the focus and correct astigmatism with accelerating voltage at 30kV, working distance at 10mm, magnification at 50,000×.
3) Perform alignment for objective lens aperture so that the image does not move even by turning FOCUS FINE knob.
4) Turn VR under the display panel with the supplied screwdriver as below:
   a) Adjust X-H and X-V alternately so that the image does not move even by turning X-control of STIGMATOR.
   b) Similarly, adjust Y-H and Y-V alternately so that the image does not move even by turning Y-control of STIGMATOR.

Column Disassembly I

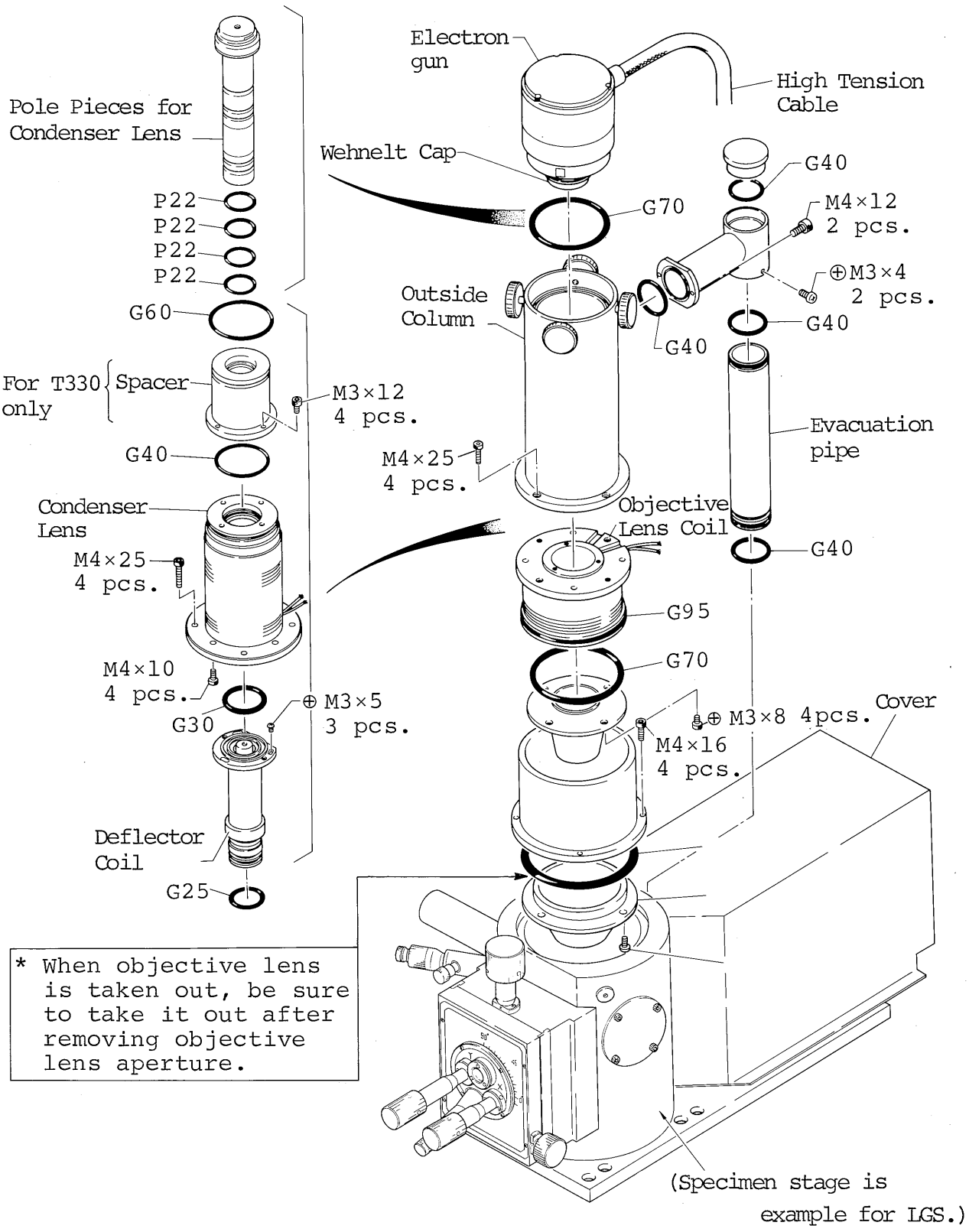


Fig. 6.2-2

Column Disassembly II

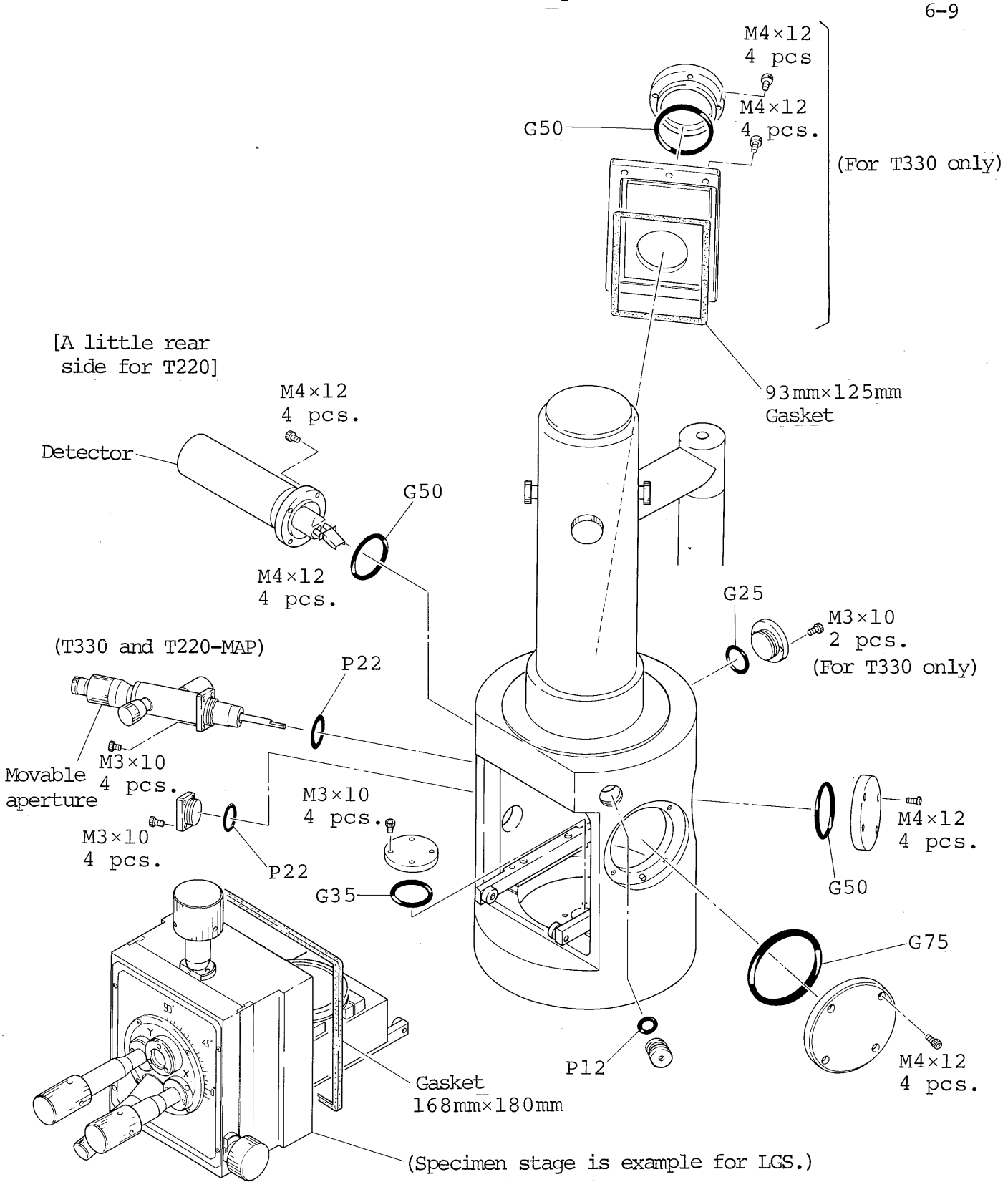
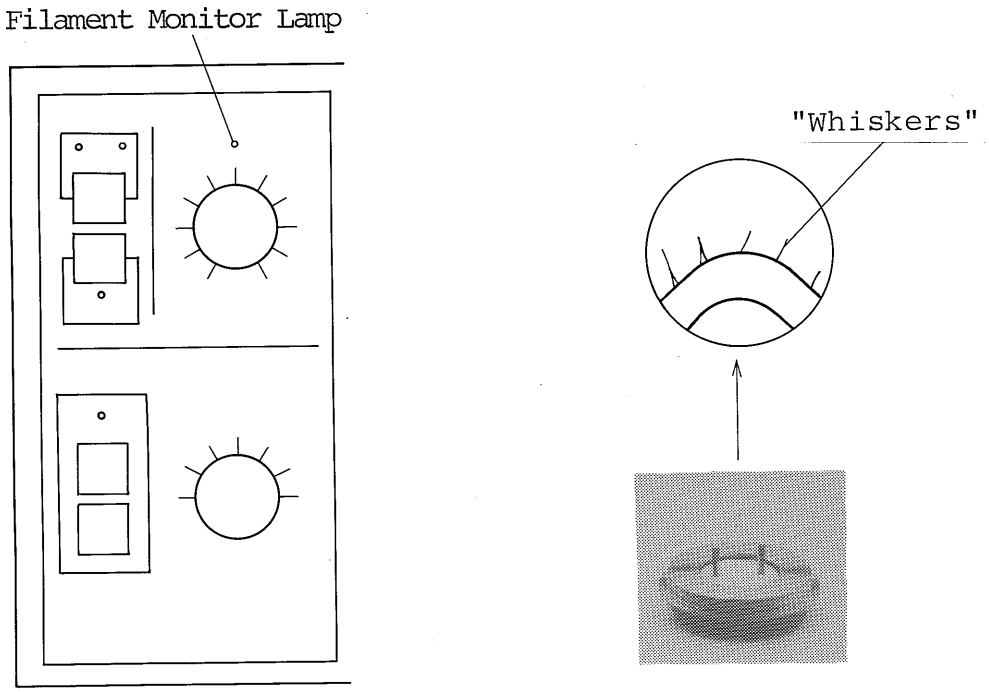


Fig. 6.2-3

6.3 Replacing Filament



a Filament Lamp　　b Filament Checkup

Fig. 6.3-1 Filament Replacement

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* Filament replacement is required in the following cases. *
* ① The image does not appear and filament monitor lamp *
* does not light even by turning [FILAMENT] knob clock- *
* wise beyond 11 o'clock with [HT] on (gun filament is *
* burnt out in this case). *
* ② [LD CUR.] meter indication of checker fluctuated. *
* So, filament was checked and whiskers were recognized *
* (whisker-like substance can be seen with 15× loupe). *
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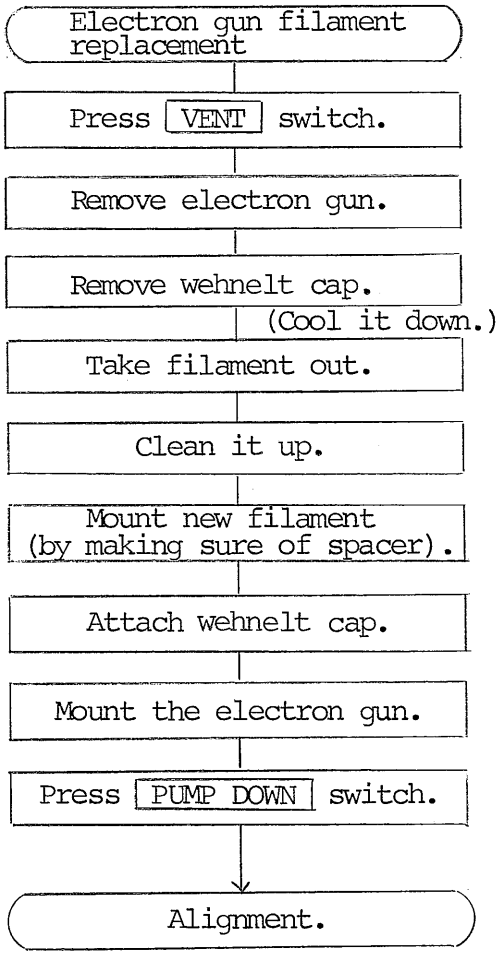
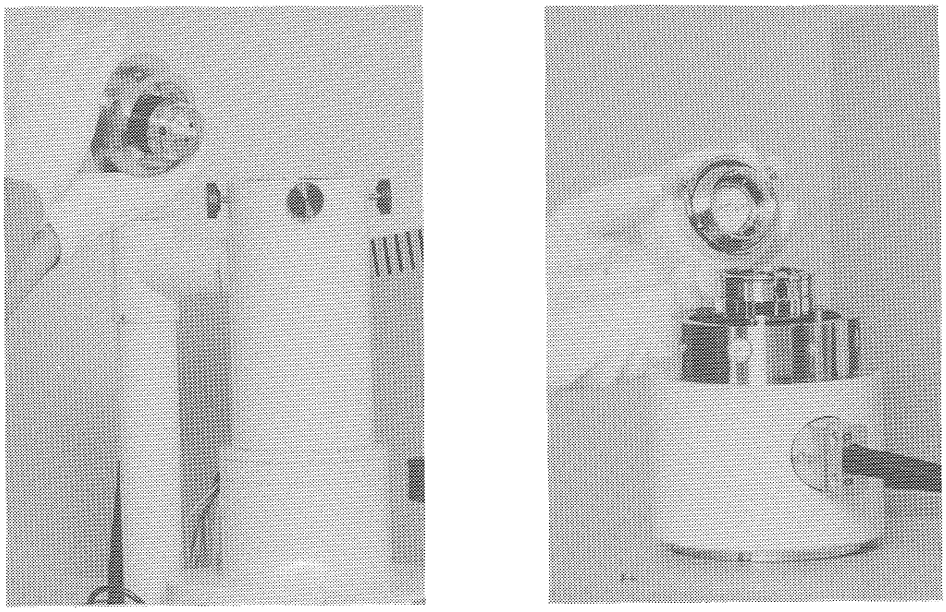
6.3.1 Gun Filament Replacement





a Electron Gun Removal b Wehnelt Cap Removal

Fig. 6.3-2 Electron Gun Removal

The column and specimen chamber are exposed to the air at the time of filament replacement and this requires to complete the operation in shortest time by observing the operation procedure.

1. Admit column air to atmospheric pressure (press SEQUENCE VENT).
2. Loosen alignment screws (4 pieces), wipe off the dust from the top of electron gun, pull it up vertically and turn it around in the way that Wehnelt cap faces upward. Then, place it on the vent cover. (See Fig. 6.3-2.)
3. Cover Wehnelt cap removing tool over Wehnelt cap and tighten it with fixing screw.

   Note: Be careful of handling it, as Wehnelt cap just after used is at high temperature.

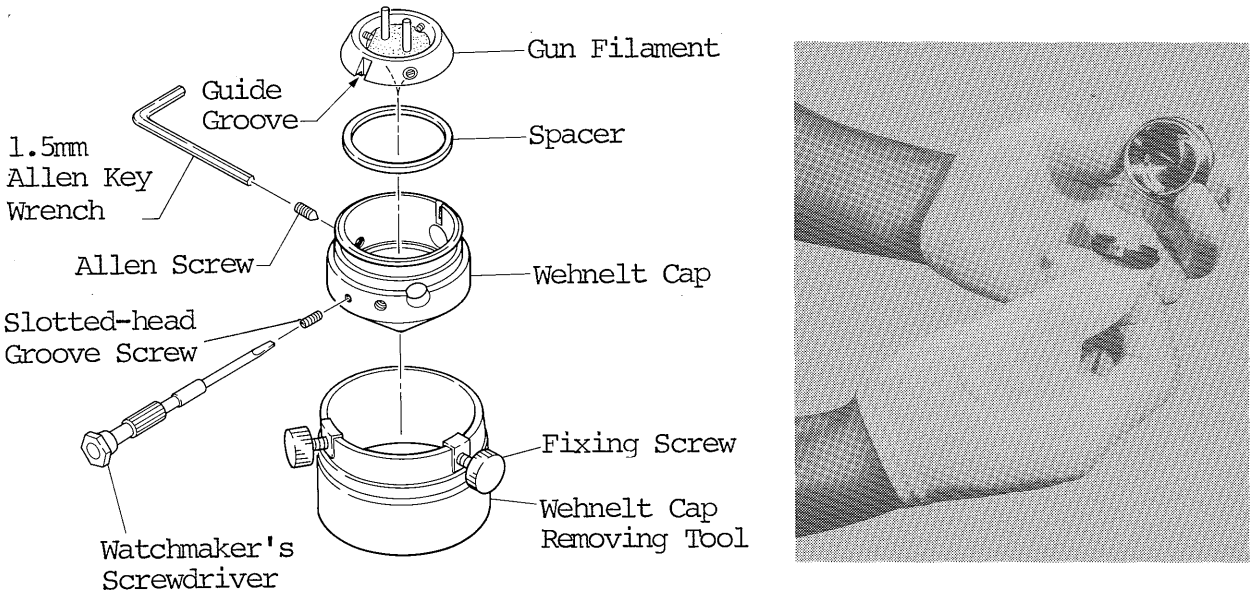
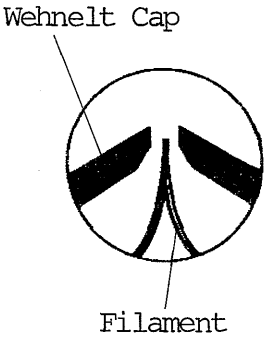


Fig. 6.3-3

4. Pull Wehnelt cap removing tool upward and remove the Wehnelt cap from the main body and cool it down enough.
5. Return the electron gun to original position. (Evacuate it if it takes a time for cleaning.)
6. Loosen 2 pieces of fixing screws and remove the Wehnelt cap removing tool from Wehnelt cap.
7. Loosen Allen screws (3 pieces) of Wehnelt cap with Allen key wrench. Slotted-head groove screw is used as a pin to set the filament in the same direction and Allen screws are used to fix the filament.
8. Loosen the slotted-head groove screw with watchmaker's screwdriver and take out the gun filament.

9. Clean up the wehnelt cap.

Caution for Cleaning Wehnelt Cap



Eliminate contamination especially at the inside near the lead end of filament with the fine grain metal polish. It is recommended to polish it with toothpick by winding the gauze around it. Be careful no to polish it excessively, otherwise, hole diameter may grow larger. Additionally, finish (clean) it carefully and sufficiently.

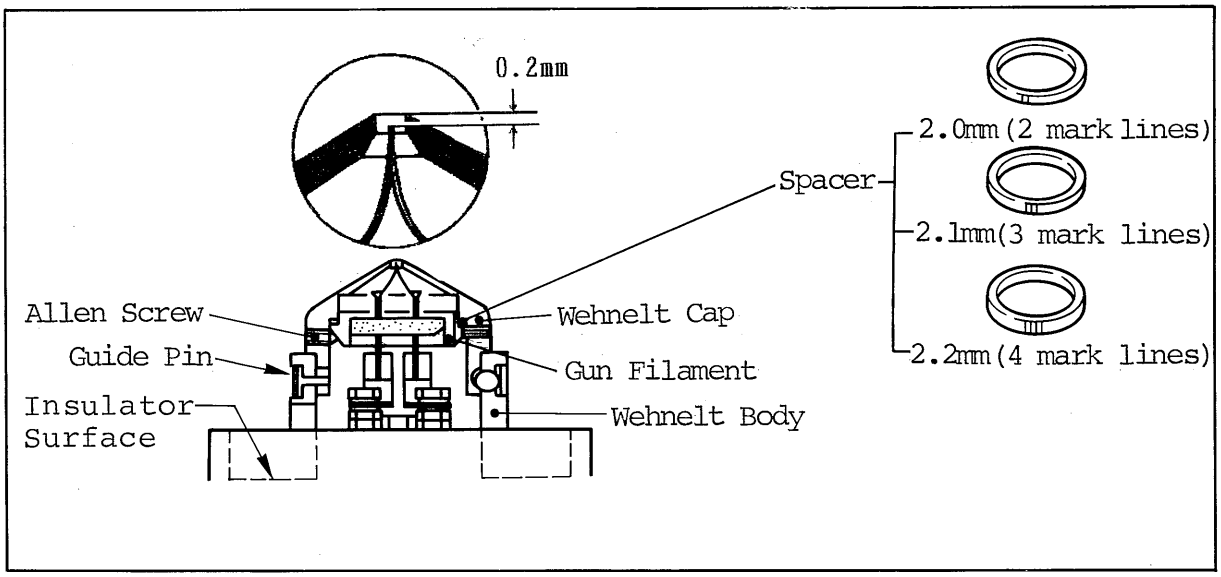


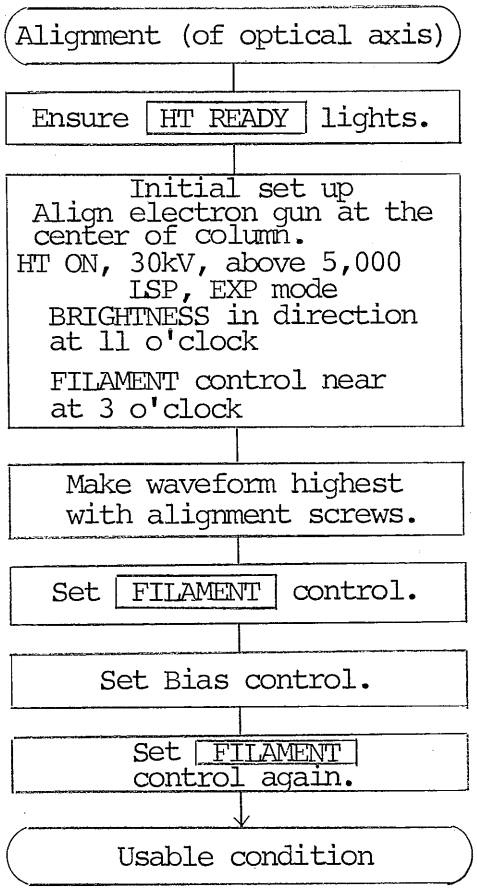
Fig. 6.3-4

10. Screw in slotted-head groove screw halfway to the wehnelt cap.
11. Meet the guide groove of new gun filament with the slotted-head groove screw, mount it to wehnelt cap and tighten them Allen screws (3 pieces) and slotted-head groove screw.

    Note: Use the spacer in 2.1mm as usual and position the gun filament so that its lead end is a little lower (by about 0.2mm) than wehnelt cap. If the lead end of gun filament protrudes or recesses from the lead face of wehnelt cap by using 2.1mm spacer, adjust the height by using other spacers.
12. Pull up the electron gun. (Admit air if evacuated.)
13. Clean up the glass surface of electron gun, if it is dirty.
14. Attach wehnelt cap onto wehnelt body by meeting the guide pin with pin groove.

15. Blow off the dust stuck around Wehnelt with handblower and mount the electron gun to the column.
    Note: To return the electron gun to original position, turn it reversely to the direction for placing it to protect the cable from twisting.
    Tighten the alignment screw by meeting the mark at the front.
16. Evacuate the column again. (Press SEQUENCE PUMP DOWN switches.)
17. Perform alignment if SEQUENCE HT READY light.
    (Refer to item 6.3.2 Alignment (of Optical Axis))

6.3.2 Alignment (of Optical Axis)



Perform alignment adjustment to face the electron gun upon the optical axis, after replacing gun filament, replacing and cleaning objective lens aperture or disassembling the column.

- Set bias control (to clock direction to about 3 o'clock so that [LD CUR.] meter reading on checker does not exceed 0.7 (140μA) after performing alignment with accelerating voltage at 30kV. Meter reading is at approx. 0.5 if accelerating voltage is at 30kV, bias control at approx. 3 o'clock by using 2.1mm spacer.
- Adjust [FILAMENT] control at every several hours on the day of replacement. Expecially, adjust at every hour for 3 hours just after replacement.

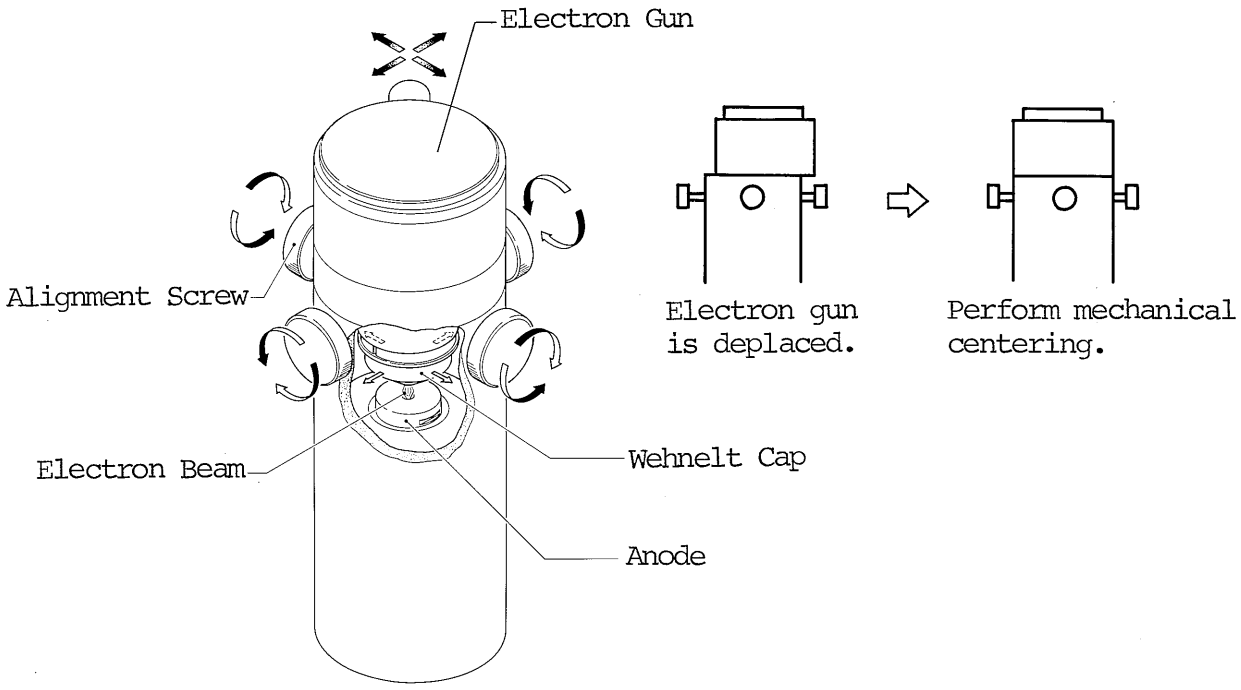


Fig. 6.3-5 Movement of Alignment Screw And Electron Gun

1. Evacuate and ensure that [SEQUENCE] [HT READY] light.
2. Fix the electron gun temporarily by positioning it to the center of column with alignment screws (4pcs.).

(Caution for Turning Alignment Screw)
Be sure to turn the screws at left side counter-clockwise when the screws at right side are turned clockwise so as to always secure the electron gun.

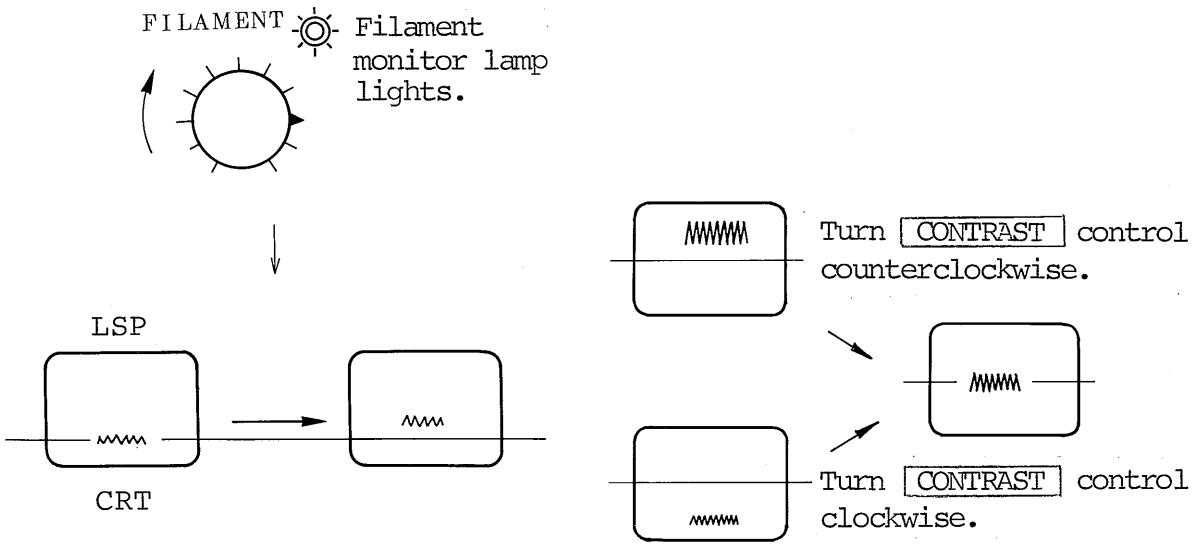


Fig. 6.3-6

3. Set up as follows:

DET HT switch:	ON (LED ON)
ACCELERATING VOLTAGE control:	30
MODE LSP switch:	Pressed
SPEED EXP switch:	Pressed
BRIGHTNESS control:	11 o'clock position
MAGNIFICATION control:	Above 5,000×
FILAMENT control:	Near 3 o'clock

4. Ensure that the filament monitor lamp lights.

   Note 1. Replace gun filament with new one, since the filament is burnt out if the filament monitor lamp does not light.

   2. If FILAMENT control is set beyond 3 o'clock position, filament may be overheated and be burnt out.

5. Adjust the position of electron gun with alignment screws (4pcs.) so that the waveform on CRT screen moves to highest position.

   Note: Move the waveform to the center of CRT screen with [CONTRAST] control if the waveform moves only a little or too largely up to the upper limit of screen.

6. Return [FILAMENT] control to 9 o'clock.

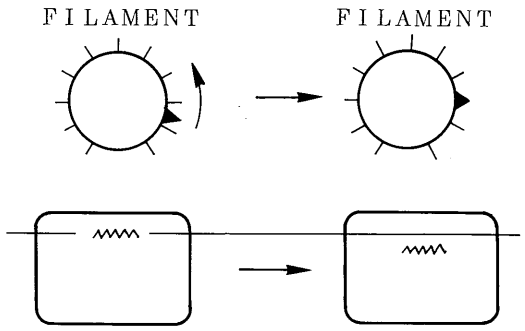


Fig. 6.3-7

7. Set the applicable position of [FILAMENT] control.
   ① Ensure that it is near to the ideal curve in Fig. 6.3-8.
   ② While monitoring the waveform on CRT screen, return [FILAMENT] control slightly counterclockwise and set it to the position just before the waveform starts a drastic drop (position just lower than saturation point: Position A in Fig. 6.3-8).

   Note 1. The height of 1st peak and saturation position is different depending on condition of filament. And, there may be the case that 1st peak is higher than saturation position if the filament is new one.
   2. If alignment is insufficient, waveform goes down by turning the control further clockwise from saturation position. Here, perform alignment again.

8. Adjust bias control so as to keep checker's [LD CUR.] meter reading within the following range. However, turn the bias control fully to the clockwise direction at the time of changing to high accelerating voltage from low accelerating voltage.

Accelerating Voltage	0.5 - 3kV	5 - 30kV
Meter Reading	0.3 - 0.5	0.5 - 0.6

Note: If total time of filament use increases, its applicable position approaches to 10 o'clock position.

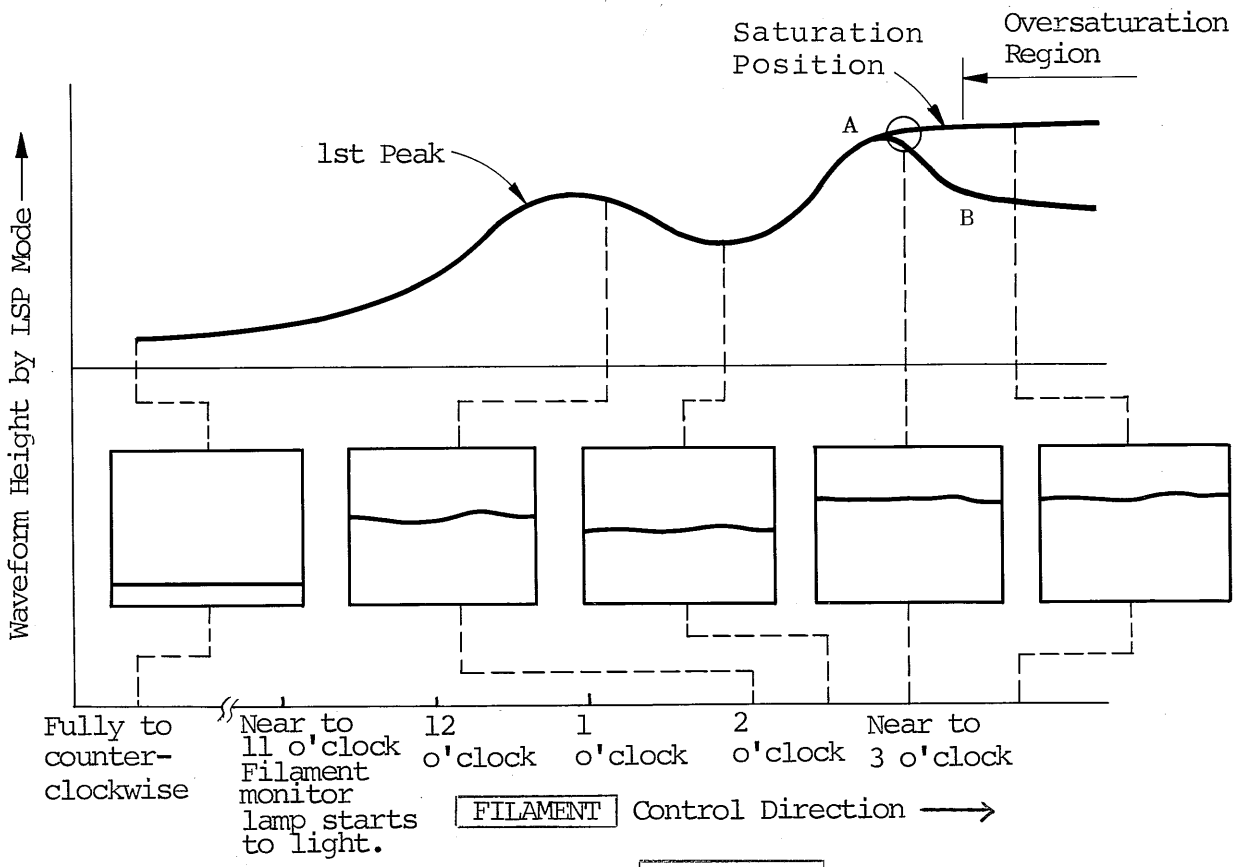


Fig. 6.3-8 Setting [FILAMENT] Control

9. Set [FILAMENT] control again to its final position.

Note 1. If the gun filament is used at the oversaturation condition, it may cause to shorten service life of gun filament and to bend the filament.

2. Observe the following points for adjusting [FILAMENT] control with by monitoring the [LD CUR.] meter reading of checker.

   ① Set the control so as not exceed 0.7 (140μA).

   ② Clean up Wehnelt cap if fluctuation is recognized. Here, if the filament has whiskers, replace it with new one (the whiskers can be seen with loupe 15X).

3. As in B of Fig. 6.3-8, if waveform lowers by turning around 3 o'clock, it shows insufficient alignment. For solution, turn [FILAMENT] control a little past 3 o'clock and perform realignment.

6.4 Clean Up A Set of Pole Pieces

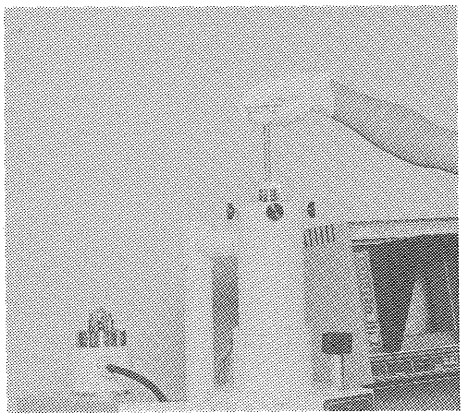


Fig. 6.4-1 Taking Pole Pieces Out

Remove the electron gun. Then, pole pieces can be taken out by the supplied tool without disassembling the column. Just by taking out a set of pole pieces, you can clean up the anode and pole pieces, and replace condenser lens apertures.

1. Perform the following checkpoints.
   a) Press the vacuum control switch [VENT] and admit air into the column.
   b) The electron gun is removed (cover it with aluminum foil).
2. Enter the pole piece removing tool in the groove of anode and loosen the anode counterclockwise. Then, take it upward very carefully to take out pole pieces (refer to Fig. 6.4-1).

   Note 1. Be careful not to drop pole pieces nor to damage the nearby parts when you take out the pole pieces.

   2. Do not touch pole pieces with bare hand, but wear the gloves to handle them.

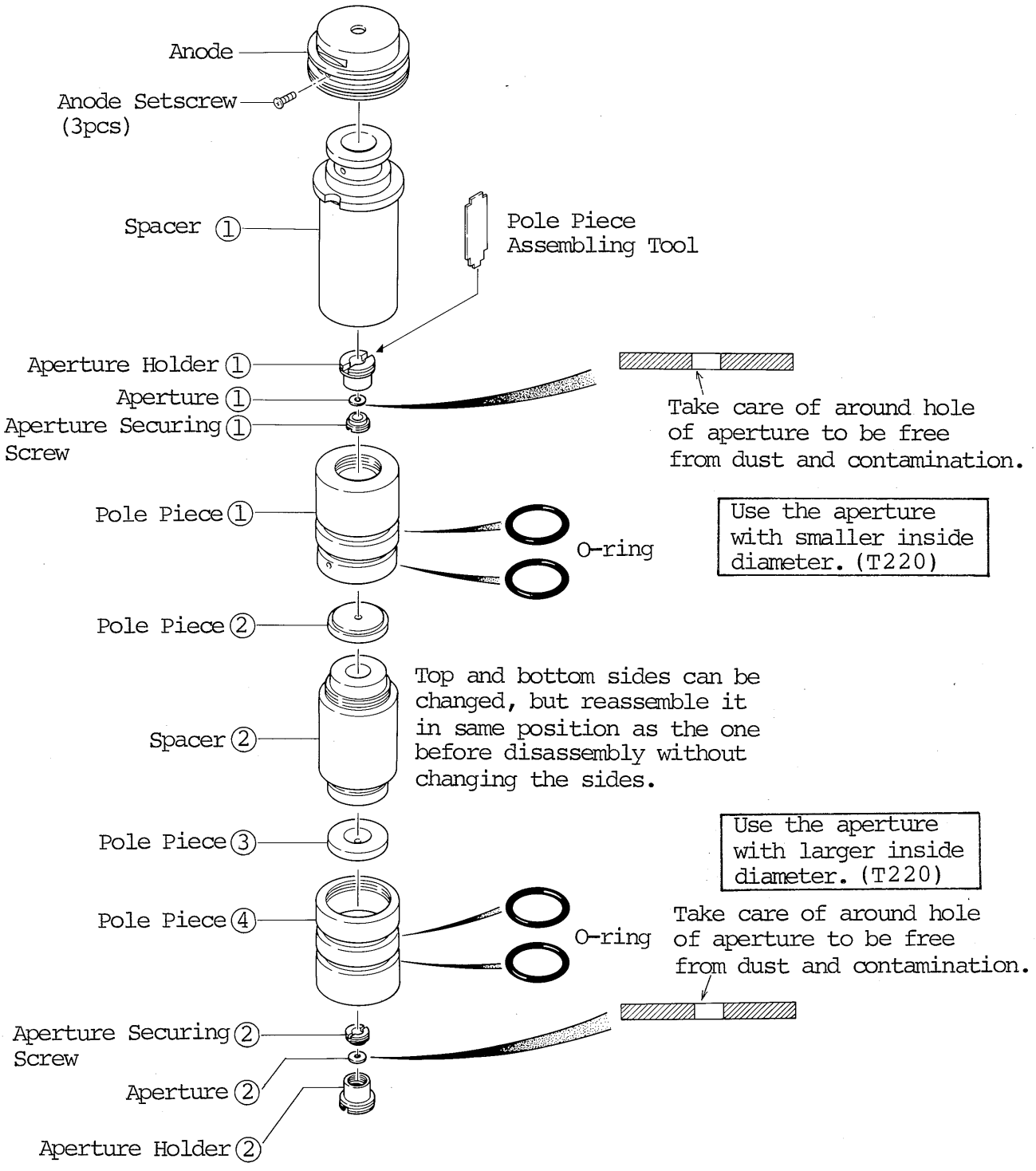


Fig. 6.4-2 Disassembling Pole Piece of Condenser Lens

3. Proceed to next operation after pole pieces are cooled down enough.
   Aperture holders (① and ②) may be scuffed if turning them before cooling them down.
   (Refer to Fig. 6.4-2.)

Cautions for Cleaning

o Pole Pieces

Apply Cleaning Procedure B.
Remove contamination from inside wall of hole very carefully by polishing it so as not to damage it.
Especially, take care of not damaging edge of hole.
Do not use the brush for this cleaning.
Finish cleaning carefully by Cleaning Procedure A.

o Condenser Lens Aperture

Replace the lens aperture with the cleaned lens aperture purchased from JEOL Ltd.

Condenser Lens	Gap ID	Aperture ID		
		T220		T330
Upper	Large	Aperture ①	Small	Same
Lower	Small	Aperture ②	Large	

Disassemble pole pieces by refering to Fig. 6.4-2.

3. Remove spacer ① from pole piece ① (Fig. 6.4-2) and loosen the aperture holder ① with assembly tool. Then, remove the pole pieces (Fig. 6.4-2).
4. Loosen the aperture ① with the assembly tool and remove it from the aperture holder ① .
5. Remove the aperture ② similarly as described in above item 4 and 5.

   Note: The aperture ① is secured inside the aperture holder ① by the aperture securing screw ① .

The aperture ② is also secured inside the aperture holder ② by the aperture securing screw ②.

6. Clean up those parts other than condenser lens aperture by Cleaning Procedure B.
7. Replace the condenser lens aperture ① and the aperture ② with the cleaned ones.

   Note: Take it in mind that hole diameter of aperture ① and aperture ② is different in case of T220. The cleaned condenser lens aperture can be purchased from JEOL Ltd.
8. After cleaning operation, reassemble them in reversal order of procedure with following points in mind.
   a) Although the aperture holders ① and ②, and the aperture securing screws ① and ② are same, their mounting positions are different and, accordingly, reassemble them each original positions carefully.
   b) Although the spacer ② can be placed upside down, place it in the same side as before disassembly.
   c) Each pole piece ①, ②, ③ and ④ cannot be placed in different side, and each of them should be placed in same side as before disassembly.
9. Now, clean up the other parts.
   If the other parts are not cleaned (or finish to clean), insert the pole pieces inside the column with the pole piece removing tool.
10. Return the electron gun to the original position with care not to fly the dust away (such as by blowing with handblower and evacuate it again.

6.5 Replacing Objective Lens Aperture

Please refer to item 6.5.3 "Objective Lens Fixed Aperture Replacement" for replacement of T220 objective lens fixed aperture.

6.5.1 Mount/Dismount Objective Lens Aperture (T330/T220-MAP)

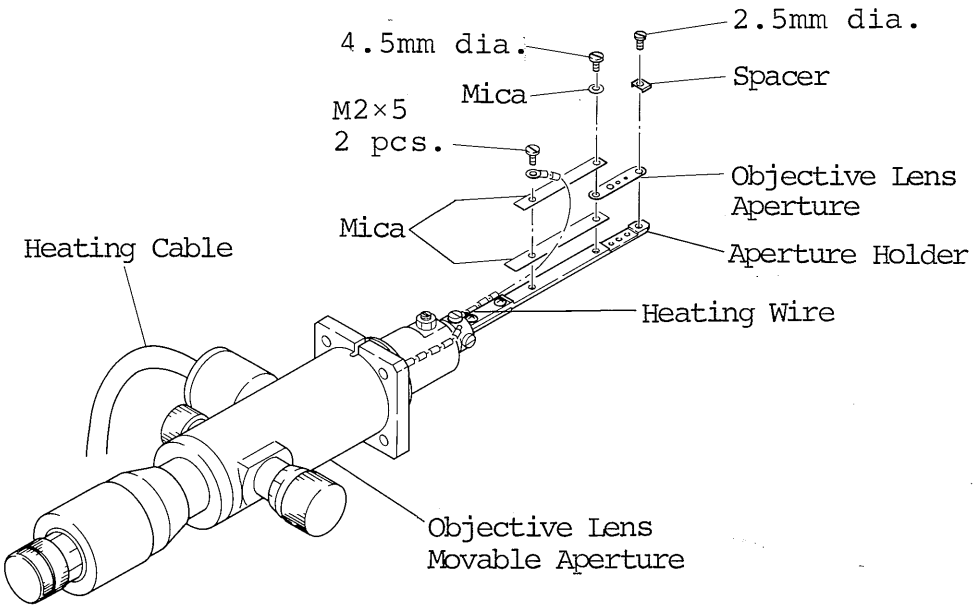
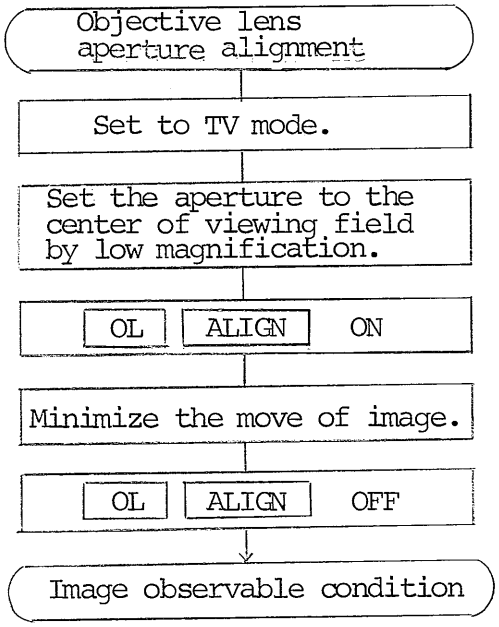


Fig. 6.5-1 Objective Lens Movable Aperture (MAP)

1. Admit air into the column (press VENT).
2. Remove 4 pieces of screws that secure the objective lens movable aperture.
3. Pull out the objective lens movable aperture with care not to hit it to nearby parts.
4. Remove 4.5mm dia. screw and 2.5mm dia. screw.
5. Remove the objective lens aperture with care not to lose mica and spacer.
6. Remove the objective holder by disconnecting the heating wire from the objective holder.
7. Clean up the aperture holder with Cleaning B Procedure.
8. Reassemble the aperture holder in reversal order and attach new objective lens aperture to it.
   Note: The cleaned objective lens aperture can be purchased from JEOL Ltd.
   We recommend to use the coated aperture for X-ray analysis.
9. Mount the objective lens movable aperture to the speciment chamber.
10. Evacuate the column (press PUMP DOWN).
11. When the image is observable, adjust alignment of objective lens movable aperture (refer to 6.5.2).



1. Confirm the following condition.
   ACCELERATING VOLTAGE at 30kV
   [FILAMENT] control and
   bias control ..... As used.
2. Set to TV mode from PIC.
3. Select the movable aperture.
   No. 2 (200μm dia.) for standard and No. 3 (600μm dia.) for X-ray analysis with T330-FCS.
4. Set magnification to 35X and adjust the movable aperture so that the viewing field comes to the center.
5. Increase magnification to 10,000X and adjust the focus and correct the astigmatism.
6. Press [OL] [ALIGN] switch to turn ON (LED ON).
7. Minimize the image move by fine adjustment (for both X and Y directions) of movable aperture.
   Note 1. Repeat this adjustment until it is successful.
   2. If it is not correctly aligned, astigmatism may grow larger.
8. After completing the alignment, press [OL] [ALIGN] switch to turn OFF (LED OFF).

6.5.3 Replacing Objective Lens Fixed Aperture (T220)

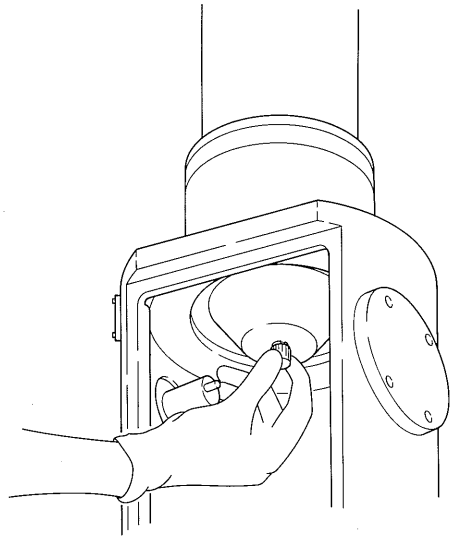


Fig. 6.5-2 Taking out Objective Lens Aperture Holder

Clean up the tweezers and the fixed aperture removing tool in advance by Cleaning Procedure A.

1. Admit air into the column (press [VENT]).
2. Take out the specimen stage from specimen chamber and cool aperture holder for about 10 min.
3. Place the supplied fixed aperture removing tool to the objective lens aperture holder, turn it to counterclockwise as seen from the bottom and take out the objective lens aperture holder (refer to Fig. 6.5-2)
4. Turn the cap counterclockwise and take out both the spacer and aperture carefully (Fig. 6.5-3).

   Note 1. Be careful of the spacer and aperture not to damage nor bend them with tweezers. Also, be sure not to lose them, since they are small pieces.

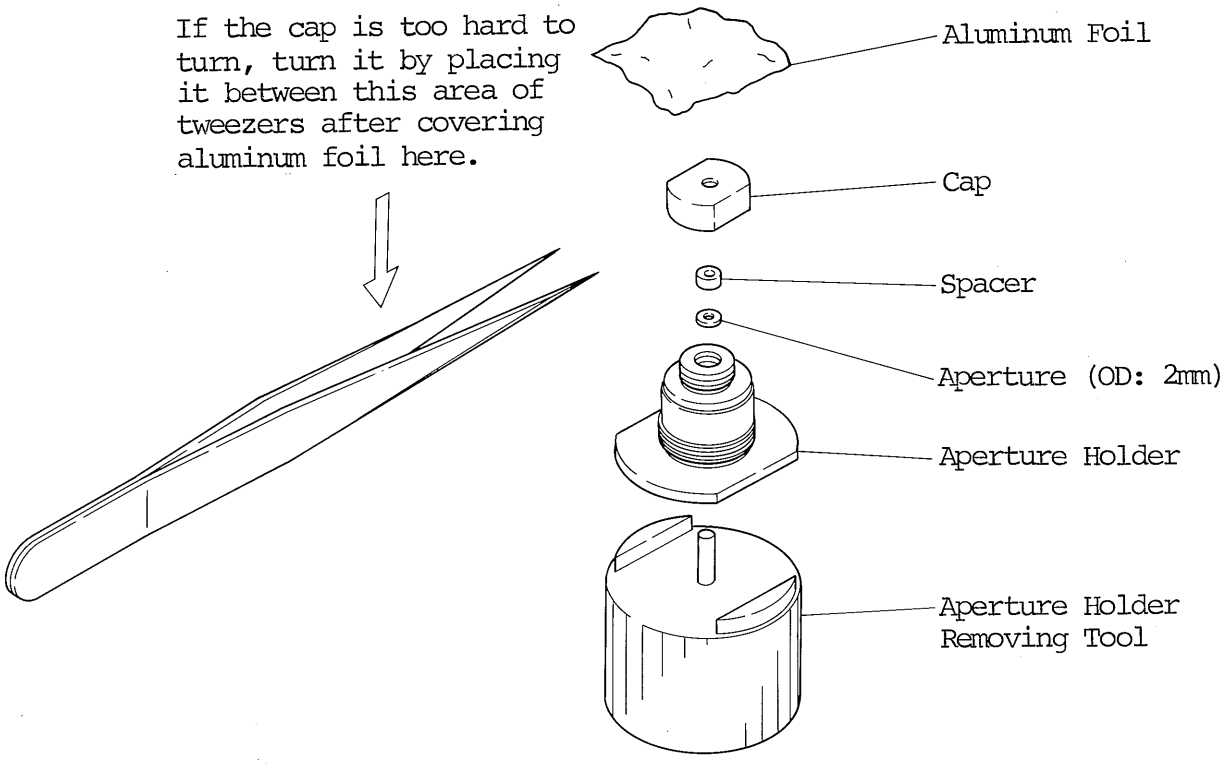


Fig. 6.5-3 Disassembling Objective Lens Fixed Aperture

2. If the aperture is not removed from the holder, then, push it lightly from the rear side with such tool as toothpick that does not damage it.

5. Clean up the cap, spacer and aperture holder by Cleaning B Procedure. Here, clean them up very carefully without any contamination left.
6. Replace the fixed aperture with the cleaned one.
   Note: The cleaned aperture can be purchased from JEOL Ltd.
7. After cleaning, place the fixed aperture and spacer into the aperture holder with tweezers very carefully and screw in the cap.
   At this time, do not touch the cleaned holder, cap, spacer and aperture with bare hand.
8. Attach the aperture holder to the objective lens.
9. Return the specimen stage to specimen chamber and press PUMP DOWN to evacuate the column.

6.6 Disassembling Deflector Coil

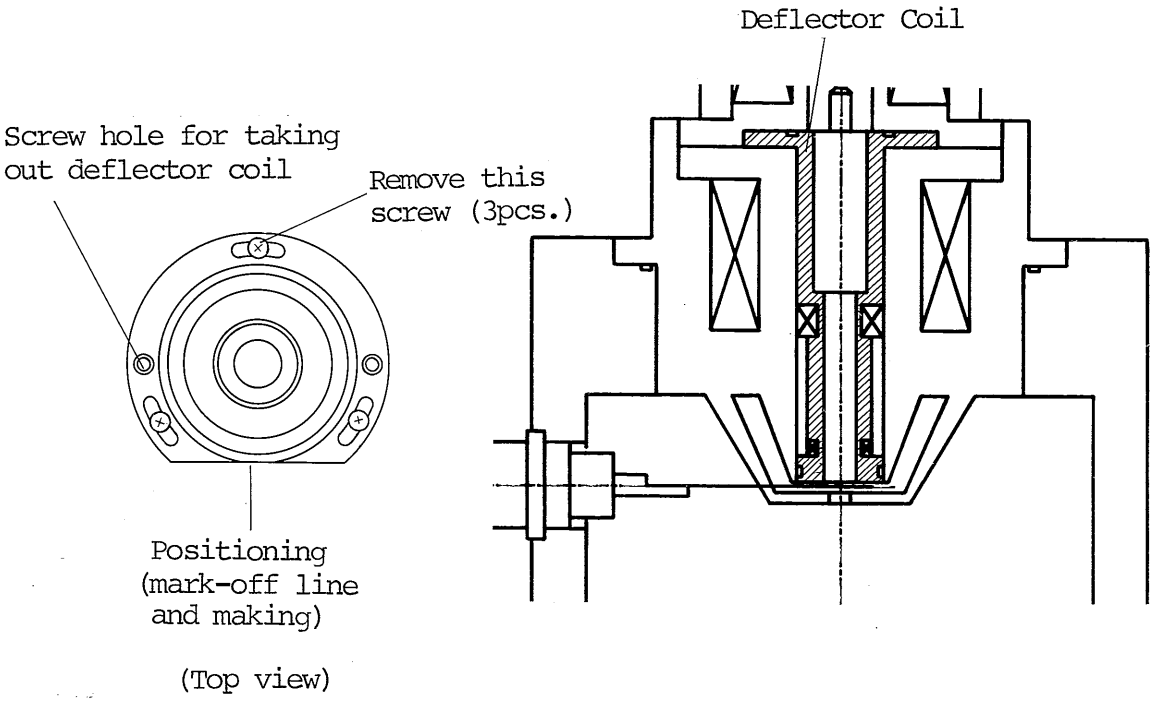


Fig. 6.6-1 Taking Out Deflector Coil

Take out the deflector coil only when it is necessary with reference to item 6.2 Column Disassembly/Reassembly Procedures. Take out the deflector coil vertically by referring to the figures Column Disassembly I and II in Fig. 6.2-2 and Fig. 6.2-3, most carefully not to contact with the other parts.

1. Ensure the following checkpoints before starting the disassembly of deflector coil.
   (1) Power supply to the microscope is cut OFF.
   (2) Condenser lens is removed.
2. Check up the secured position before taking out the deflector coil.

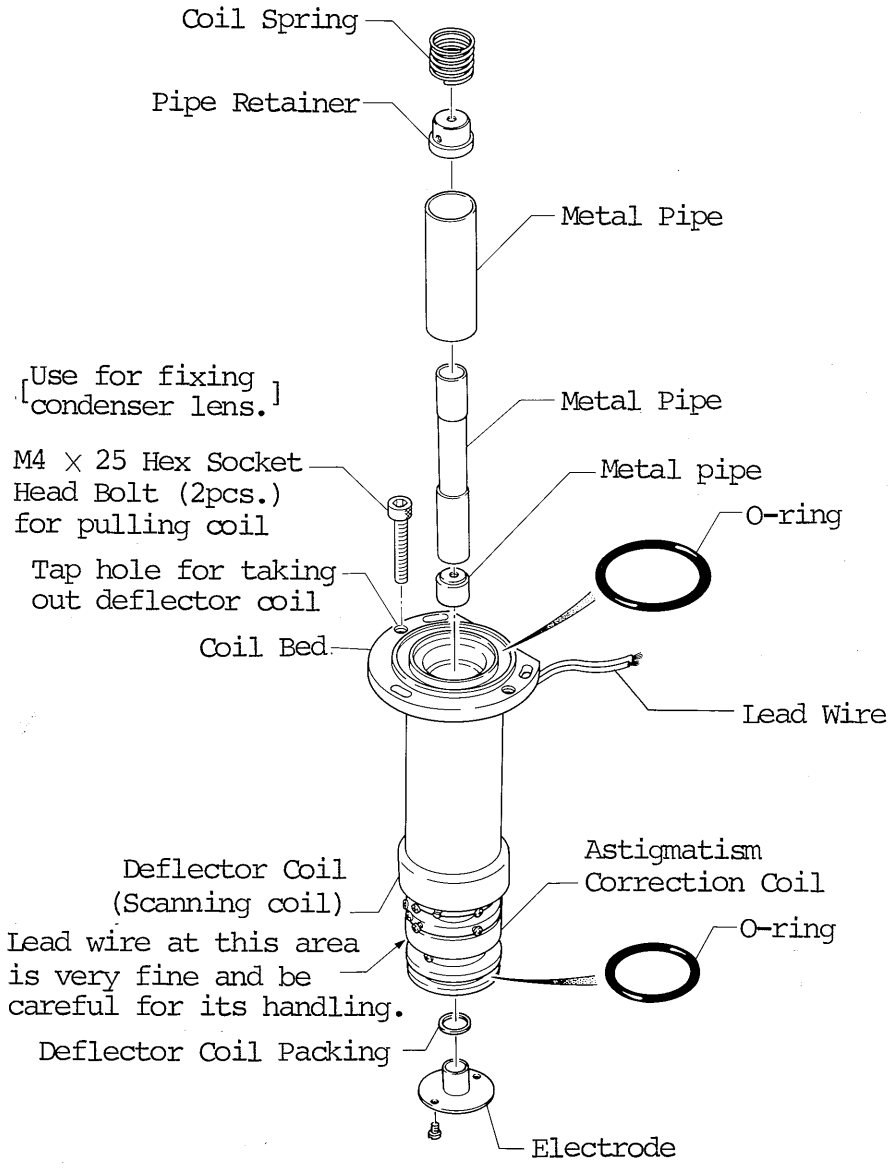

Coil Spring
Pipe Retainer
Metal Pipe
[Use for fixing condenser lens.]
Metal Pipe
M4 × 25 Hex Socket Head Bolt (2pcs.) for pulling coil
Metal pipe
O-ring
Tap hole for taking out deflector coil
Coil Bed
Lead Wire
Deflector Coil (Scanning coil)
Astigmatism Correction Coil
O-ring
Lead wire at this area is very fine and be careful for its handling.
Deflector Coil Packing
Electrode

Fig. 6.6-2

3. Remove 3 pieces of screws that secure the deflector coil.
   Screw in 2 pieces of M4 × 25 bolts to the deflector coil pulling holes and pull it up slowly.
4. When the deflector coil is taken up about 5 to 10mm, pull it out vertically by holding the screws.
5. Pull out the metal pipe by removing coil spring and pipe retainer.
6. Clean up the metal pipe by Cleaning B Procedure.
7. If the electrode is dirty, clean it up also by Cleaning B Procedure.
8. After completing the cleaning operation, reassemble them in reversal order of disassembly procedure by positioning.
   Note: Be sure not to place lead wire between them.
   (If it is placed between, it may be disconnected.)
9. Reassemble the condenser lens and electron gun, perform evacuation and alignment for electron gun, objective lens aperture (T330 and T220-MAP).
10. Align the astigmatism correction coil (refer to item 6.2 Column Disassembly/Reassembly Procedures).

6.7 Replacing Scintillator

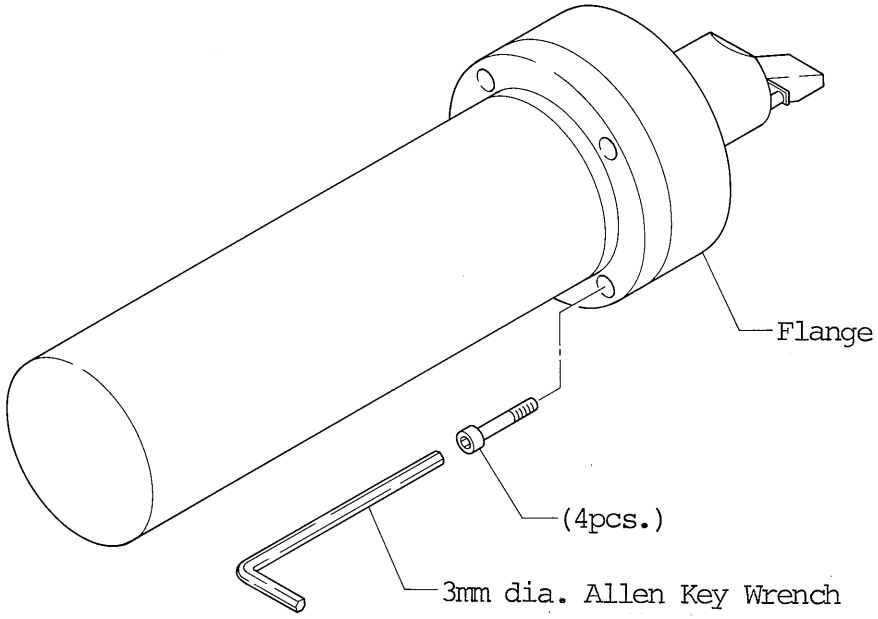


Fig. 6.7-1 Taking Out Deflector

Scintillator should be replaced in any one of following cases:

When aluminum-coated film of scintillator is stripped off or Phosphor is degraded due to a long time use (image is much noisy and checker's PMT reading exceeds 0.32 at the time of normal exposure with standard specimen; ZnO), scintillator must be replaced.

1. Ensure that the air in column is at atmospheric pressure and the microscope stops.
2. Loosen 4 pieces of Allen screws that tighten the detector and remove the detector from specimen chamber (refer to Fig. 6.7-1).

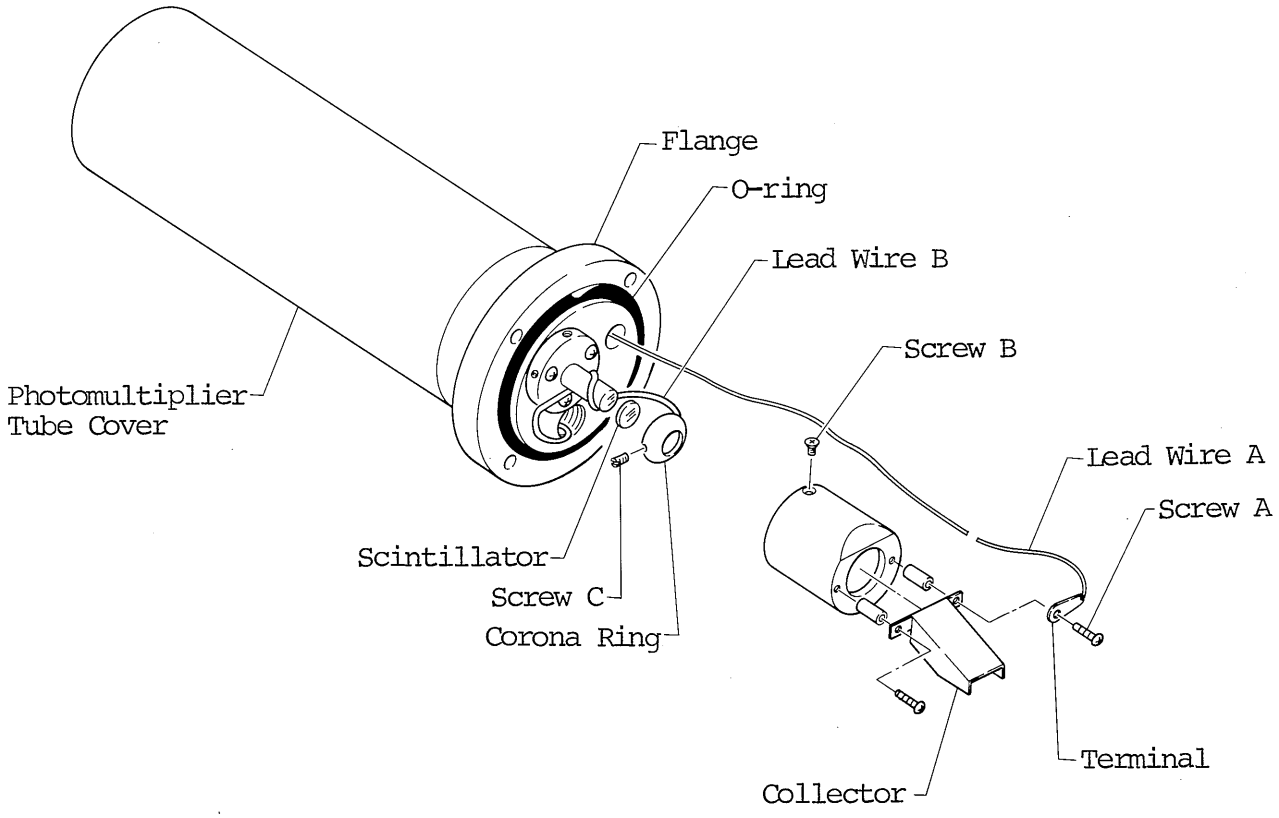
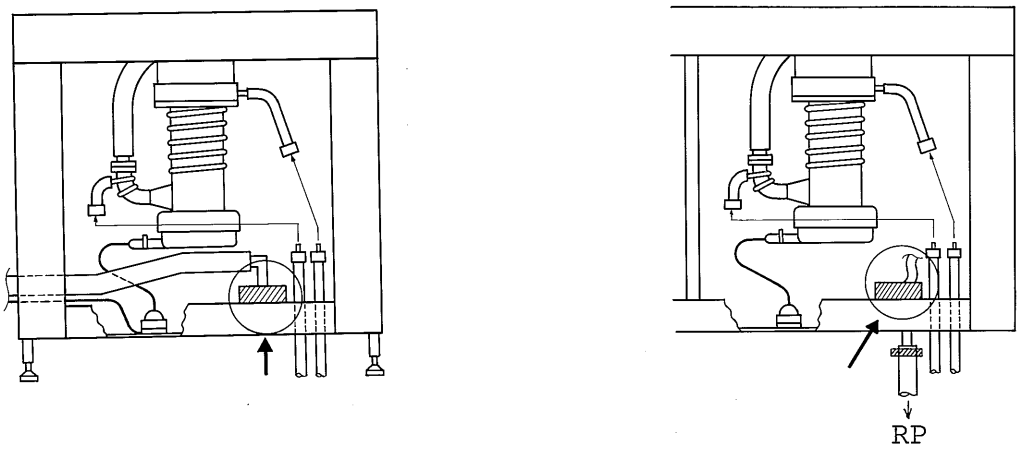


Fig. 6.7-2 Taking Out Scintillator

3. Loosen screw A and remove lead wire A. Then, remove collector by pulling it after loosening screw B (refer to Fig. 6.7-2 also for the following steps).
4. Loosen screws C (2pcs.) securing corona ring with watchmaker's screwdriver and remove the corona ring and scintillator from light pipe.
5. If the lead face of light pipe is dirty, clean it.
   Note: Light pipe is quite vulnerable to the solvent. So, to remove the dirts, wipe them off lightly with quaze by slightly dipping alcohol, but do not use any other type of solvents.

6. Attach new scintillator to the lead end of light pipe with its treated surface outside, with full care not to damage the surface of the scintillator.
   Note: Be careful not to damage the scintillator nor light pipe and not to stick the dust onto them. Especially, do not absolutely touch to the surface of scintillator.
7. Cover the corona ring upon them and secure them with screw C (2pcs.).
8. Insert the collector to the original position.
9. Mount the detector unit to its original position at the specimen chamber and secure them with Allen screws (4pcs.).
10. Start the microscope.

6.8 Lubrication for RP VENT Valve



T330 T220

Fig. 6.8-1

Apply the grease to vent valve with the following procedures dependently on the frequency to use the microscope. (Once in a year if it is used everyday.)

1. Turn [POWER] key switch to [OFF] to stop the microscope and turn OFF the switch on distribution board. Then, ensure that the oil diffusion pump(DP) is cooled down.
2. Disconnect the vacuum rubber hose and solenoid valve wire from the vent valve.
3. Remove the vent valve from the frame.

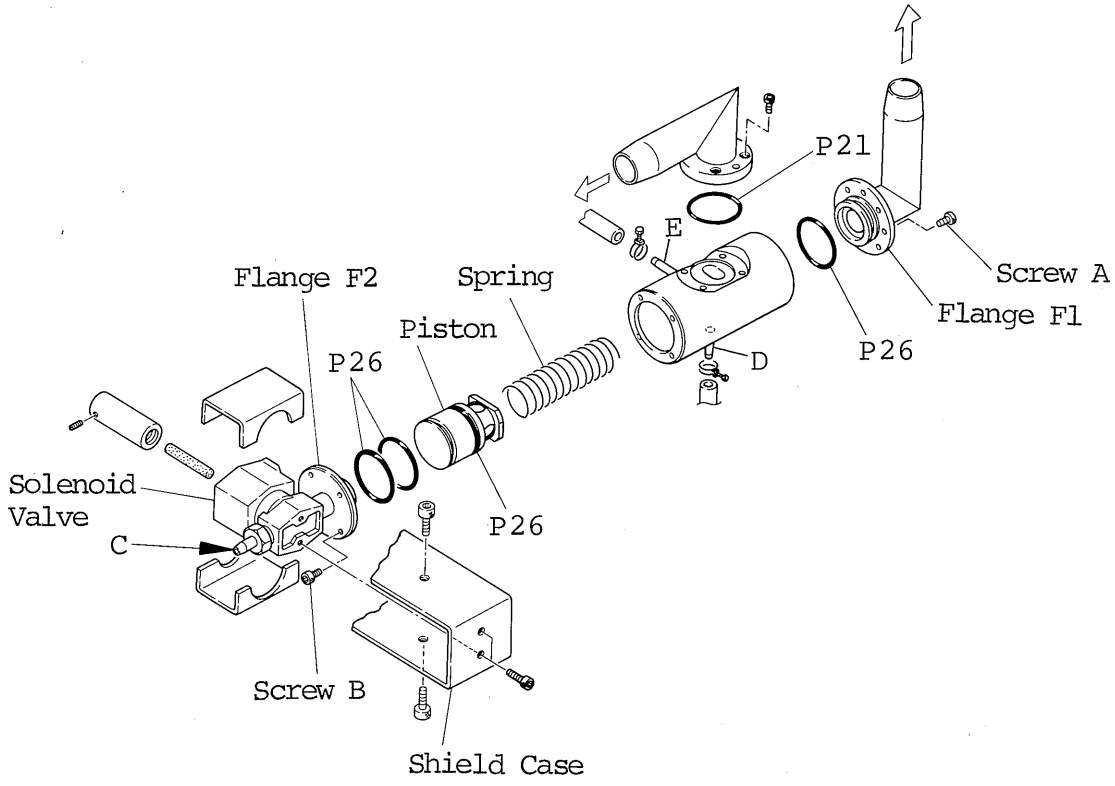


Fig. 6.8-2

4. Ensure with wire (below 0.3mm dia.) that nozzle holes (0.3mm dia.) at C, D and E are not blocked.
5. Remove screw A and then flange Fl. Take out the inside spring too.
6. Remove the shield case for solenoid valve.
7. Remove screw B and then flange F2.
8. Take out the piston positioned inside the vent valve and clean up the vent valve and piston.
9. Apply the vacuum grease (Apiezone L or its equivalent) to the inner wall of vent valve and O-ring of piston.
10. Secure the flange F2 with screw B and mount the shield case (refer to Fig. 6.8-2).

11. Build in the piston in the same direction as before disassembly and reapply the vacuum grease (Apiezone L or its equivalent) to the inner wall of vent valve.
12. Build in the spring and secure the flange Fl with screw A (refer to Fig. 6.8-2).
13. Mount the vent valve onto the frame and reconnect the vacuum rubber hose and solenoid valve wire.
14. Start the microscope.
    Startup: Flow the water and turn [POWER] switch key to [START] ⟶ [ON].

6.9 Replacing Oil Diffusion Pump (DP) Heater

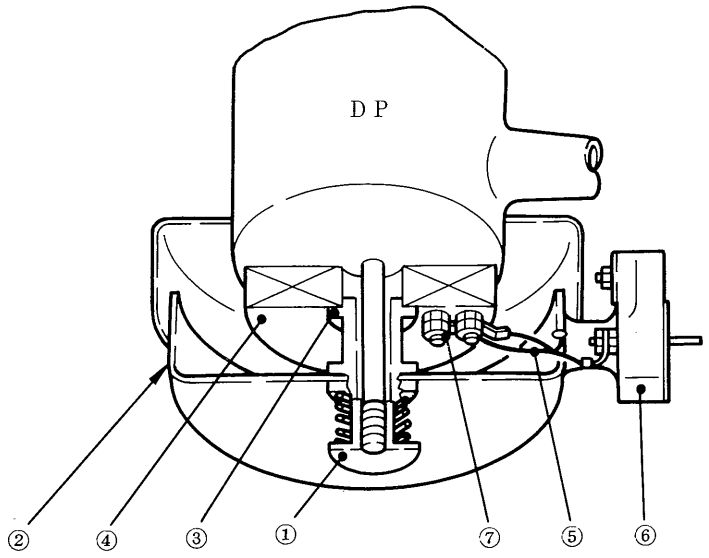


Fig. 6.9-1 DP Heater

1. Stop the microscope by turning [POWER] key switch to [OFF] and turn OFF the switch on the distribution board.
2. Loosen the screws (4pcs.) at the rear to the frame of column and remove the rear panel.
3. Remove the oil diffusion pump (DP) heater by loosening the nut ①, after the heater is cooled down sufficiently.
4. Remove the heater assembly with metal ③, heater ④, lead wire ⑤ and plug socket ⑥ mounted to the lower cover 2 from the oil diffusion pump (DP).
5. Remove the heater ④ from lower cover ②.
6. Loosen nut ⑦, disconnect lead wire ⑤ and take out the heater ④.
7. Mount the new heater.
8. Then, reassemble the oil diffusion pump (DP) in the reversal order of disassembly procedure.
9. Start the microscope.
   Startup: Flow the water and turn [POWER] switch key to [START] → [ON].

6.10 Refilling Oil in Oil Rotary Pump (RP)

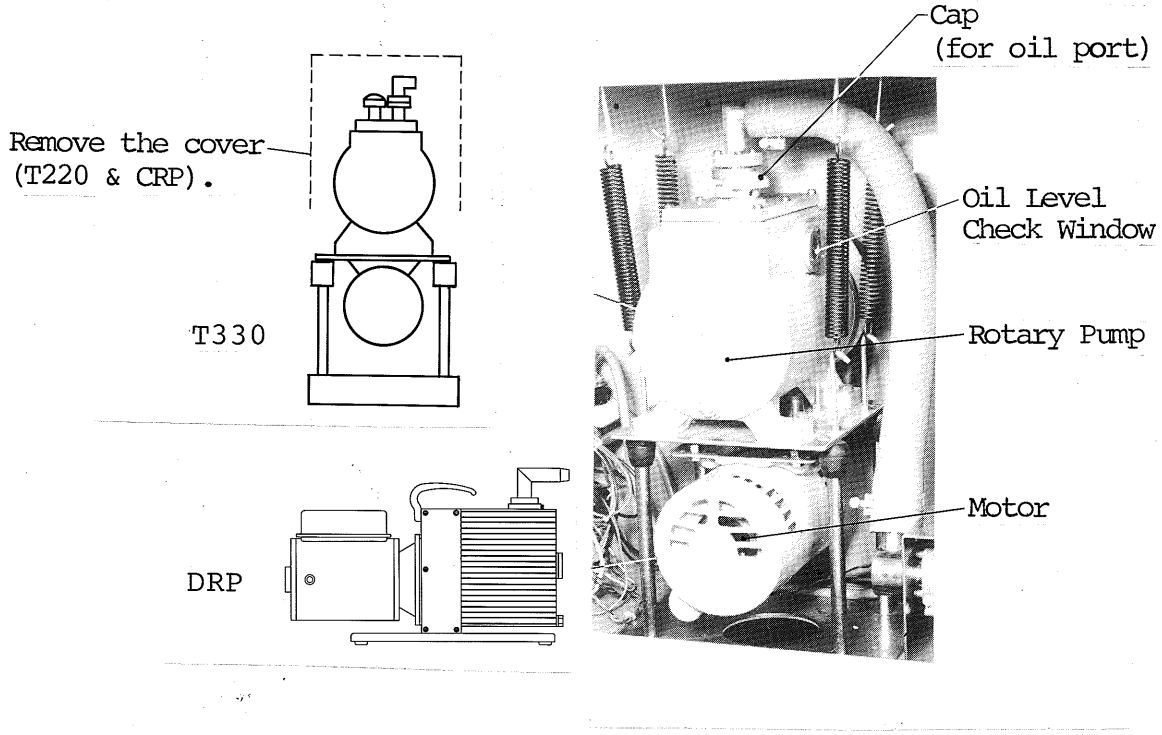


Fig. 6.10-1 Oil Rotary Pump (RP)

Oil is consumed by the use for long period of time. Check up the oil level from oil level check window and add oil if the oil level goes down below ● mark by the following procedure.

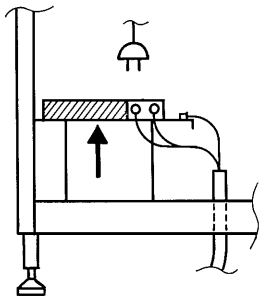
1. Turn [POWER] key switch to [OFF] to stop the microscope and turn OFF the switch on the distribution board.
2. Remove the rear panel from standard RP for T330 by loosening the screws (4pcs.) at the rear side of operation console.
   Remove RP cover for T220 and CRP*.
3. Remove the cap or oil filter at upper section of pump by turning it counterclockwise.

4. Add oil (Neovac MR-200) up to the ● mark.
   Note: The RP oil Neovac MR-200 can be purchased from JEOL Ltd.
5. Reassemble the pump in reversal order of disassembly procedure and start the microscope.
   Startup: Flow the water and turn [POWER] key switch to [START] → [ON].

CRP: Oil Rotary Pump for Clean Room

DRP: Direct-drive Oil Rotary Pump

6.11 Replacing Fuse



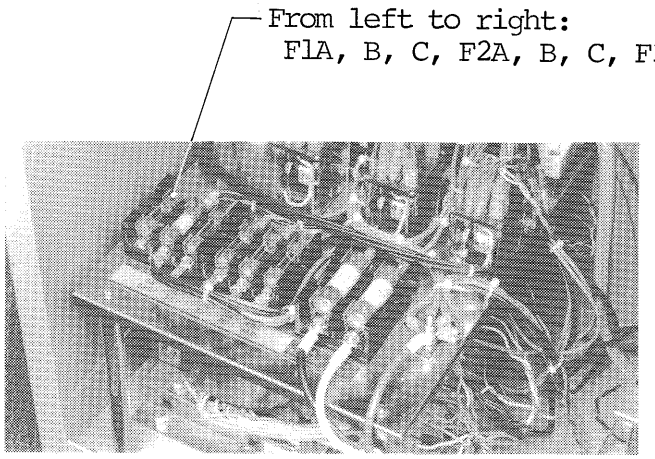


Fig. 6.11-1 Fuse Holder

Fuse No.	The Circuit To Use Fuse	Standard (JIS)
F1A	Unused	----------
F1B	Service plug socket	In 3A glass tube (MF03NM-3A)
F1C	T1 transformer	In 8A glass tube (MF03NM-8A)
F2A	T2 transformer	In 3A glass tube (MF03NM-3A)
F2B	Oil diffusion pump	In 8A glass tube (MF03NM-8A)
F2C	Vacuum system	In 20A glass tube (MF03NM-20A)
F3A	Power input	30A cylinder type (CF2-30A)
F3B	Power input	30A cylinder type (CF2-30A)

1. Turn [POWER] key switch to [OFF] to stop the microscope and turn OFF the switch on distribution board.
2. Remove the rear panel by loosening the screws (4pcs.) at the rear side of operation console.
3. Check up the fuse holder and replace the fuse of each same rated type if it is blown.
4. Start the microscope.
   Startup: Flow the water and turn [POWER] key switch to [START] → [ON].

Note: Of the supplied fuses, the fuses 2A (small) and 1A (small) are for service engineer use.

CHAPTER 7 TROUBLESHOOTING PROCEDURE

7.1 Trouble checkup

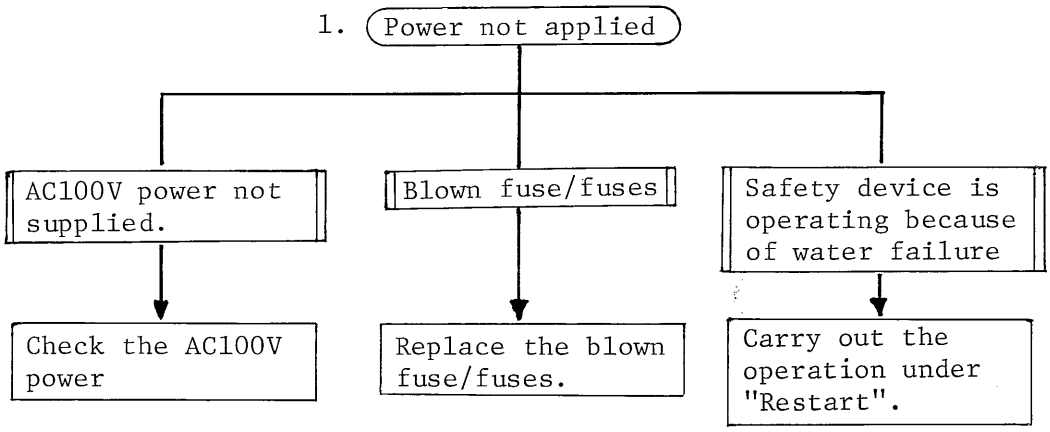
If any trouble occurs, check the microscope in accordance with the flowcharts below. If the cause of the trouble cannot be traced, contact your nearest JEOL Service Center for the assistance. In this case, give such data as CHECKER meter readings at the respective check points and installation room conditions (room temperature, water temperature, floor vibration, etc.) to the Service Center.

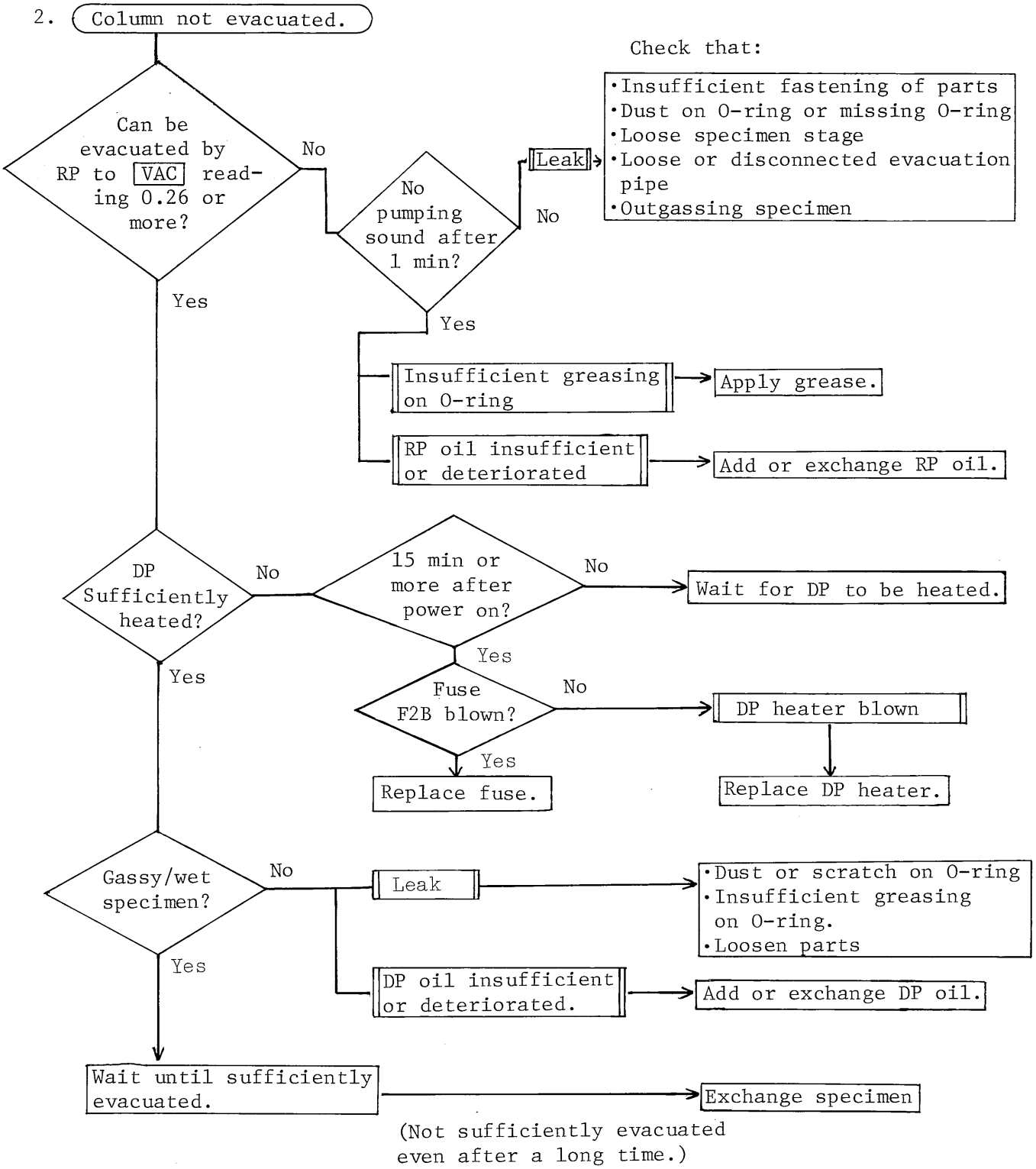
A (Startup and vacuum troubles)
1. Power not applied (p. 7-2)
2. The column not evacuated (p. 7-3)
3. Increased pumping time (p. 7-4)

B (Image troubles)
1. No image is displayed (p. 7-5)
2. Abnormal load current (p. 7-6)
   "Load current" means valve on [LD CUR.] of CHECKER.
3. Dull images (p. 7-7)
4. Poor quality images and abnormal images (p. 7-8)
   . Brightness
   . Contrast
   . Image quality (soft/grainy)
   . Noise
5. Distorted images (p. 7-9)
   . Distortion
   . Waviness

* Reference: A Guide to Scanning Microscope Observation (by JEOL).

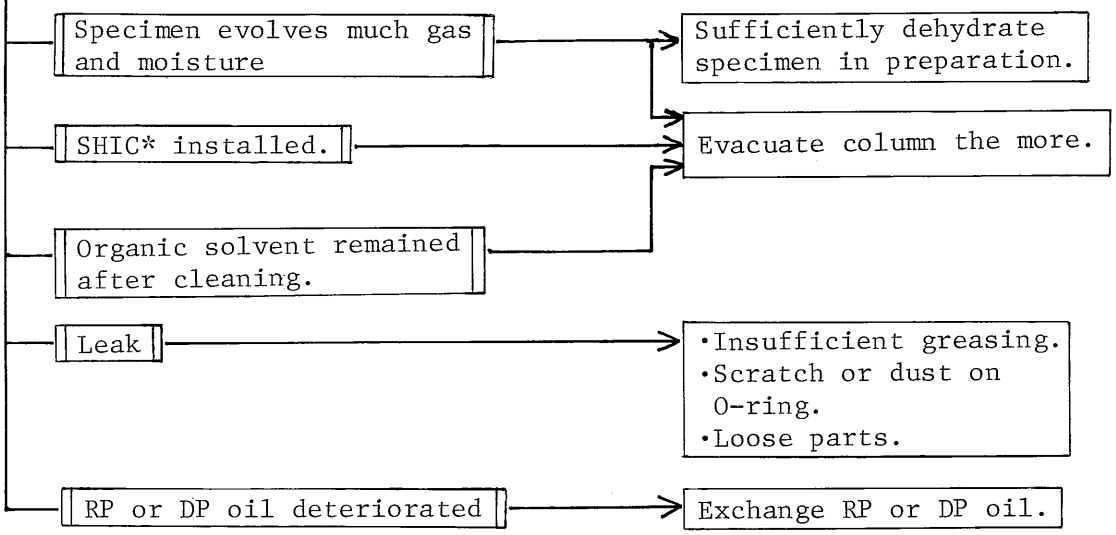
7.2 Trouble at startup And Vacuum System





RP: Oil rotary pump
DP: Oil diffusion pump

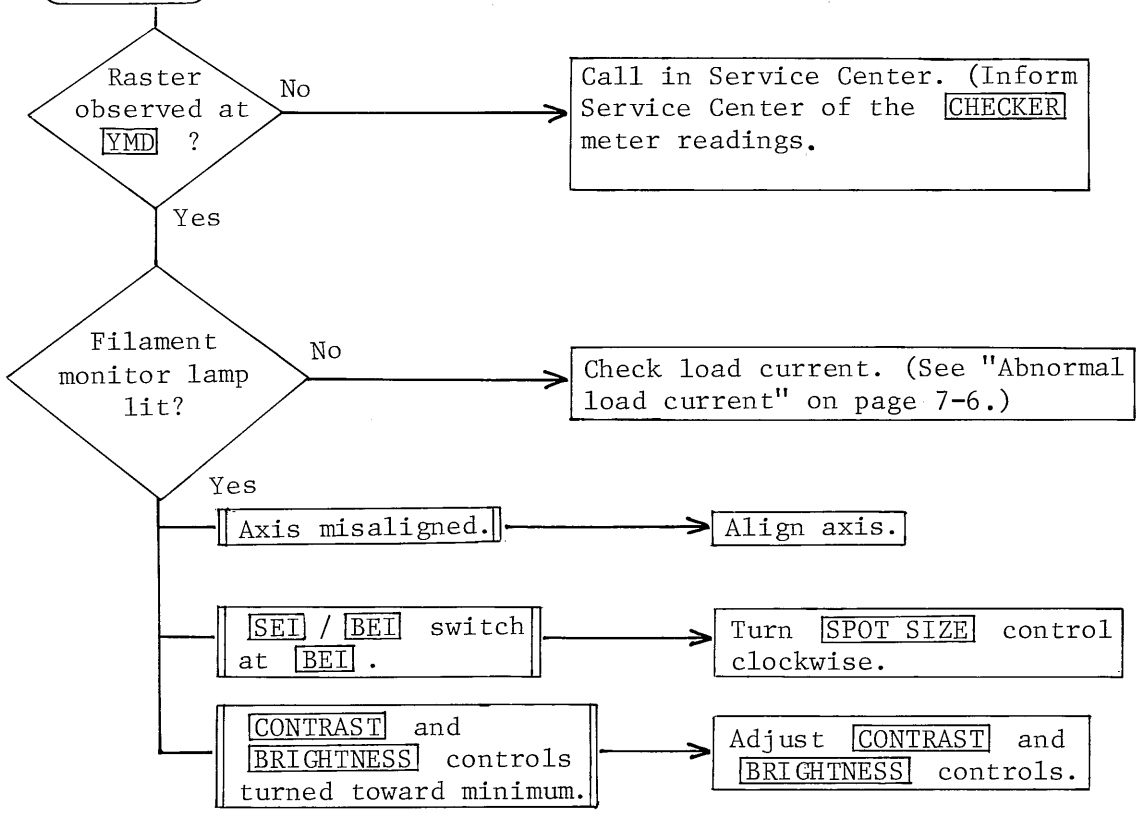
3. Increased pumping time



*SHIC: Specimen holder for IC (optional)

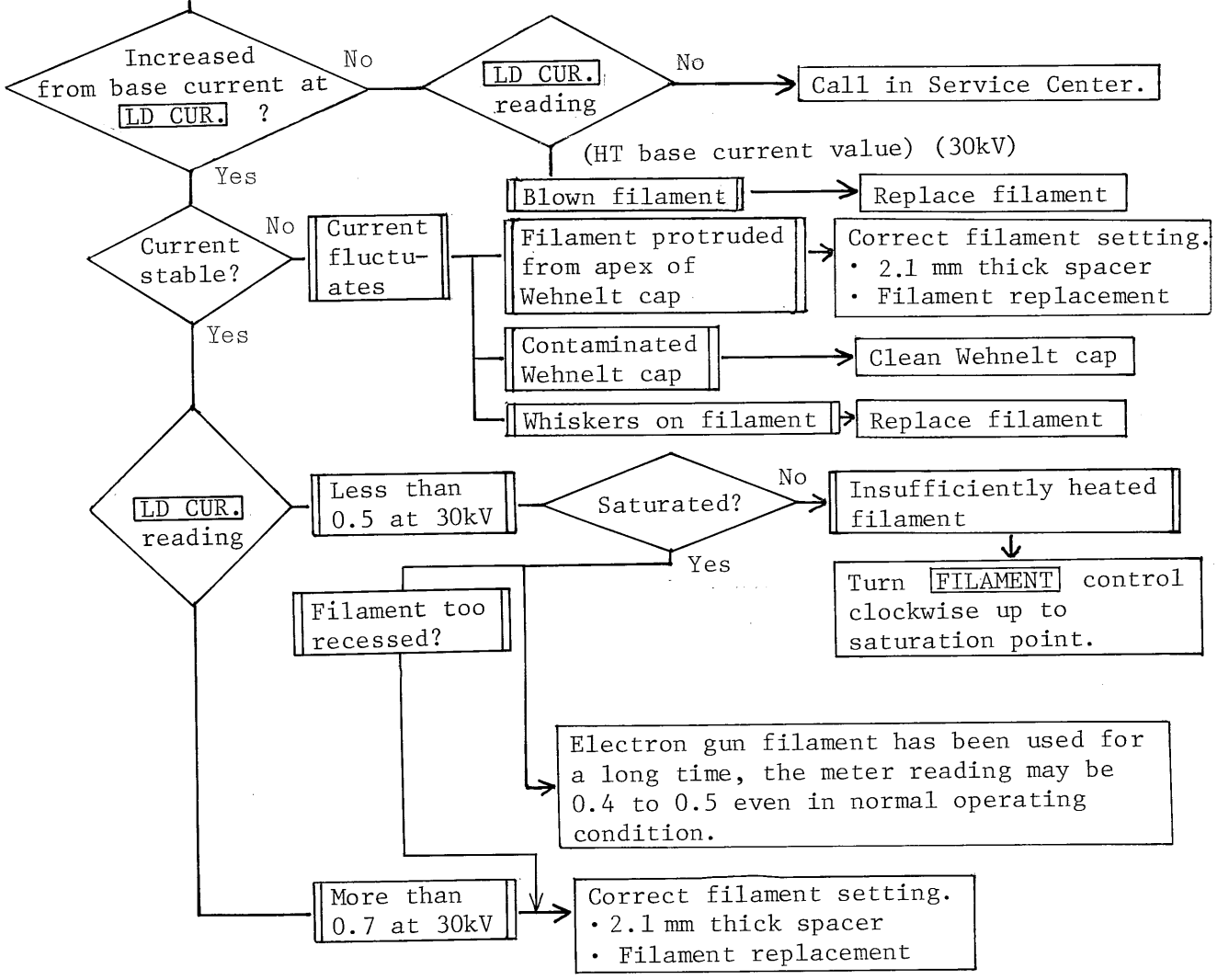
7.3 Trouble on Image Quality

1. (No image) HT is ON after completed evacuation.



2. Abnormal load current

HT is ON after completed evacuation.

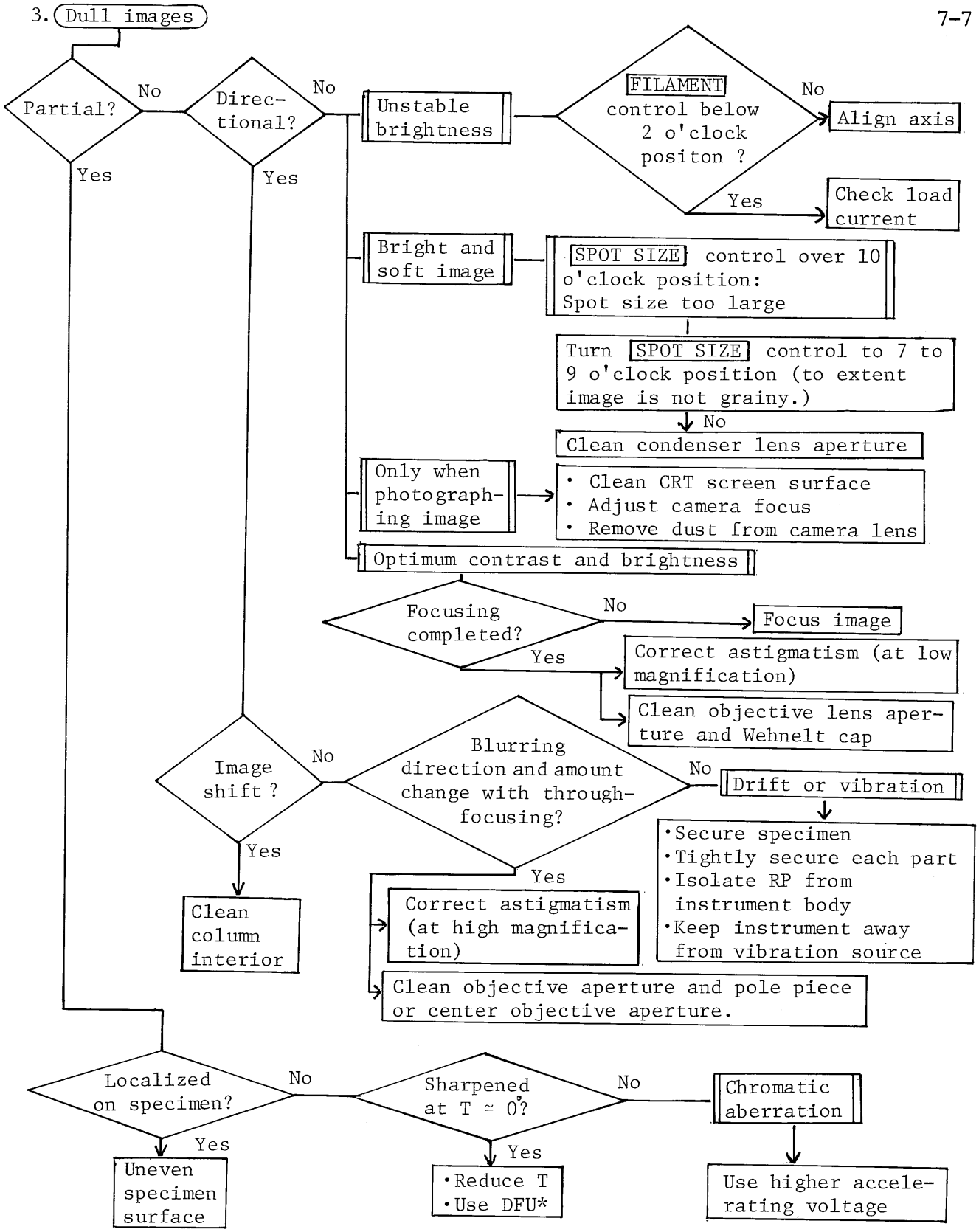


* For measuring the load current, use the CHECKER meter set at LD CUR. . The relation between the accelerating voltage and HT base current (meter reading) is as follows:

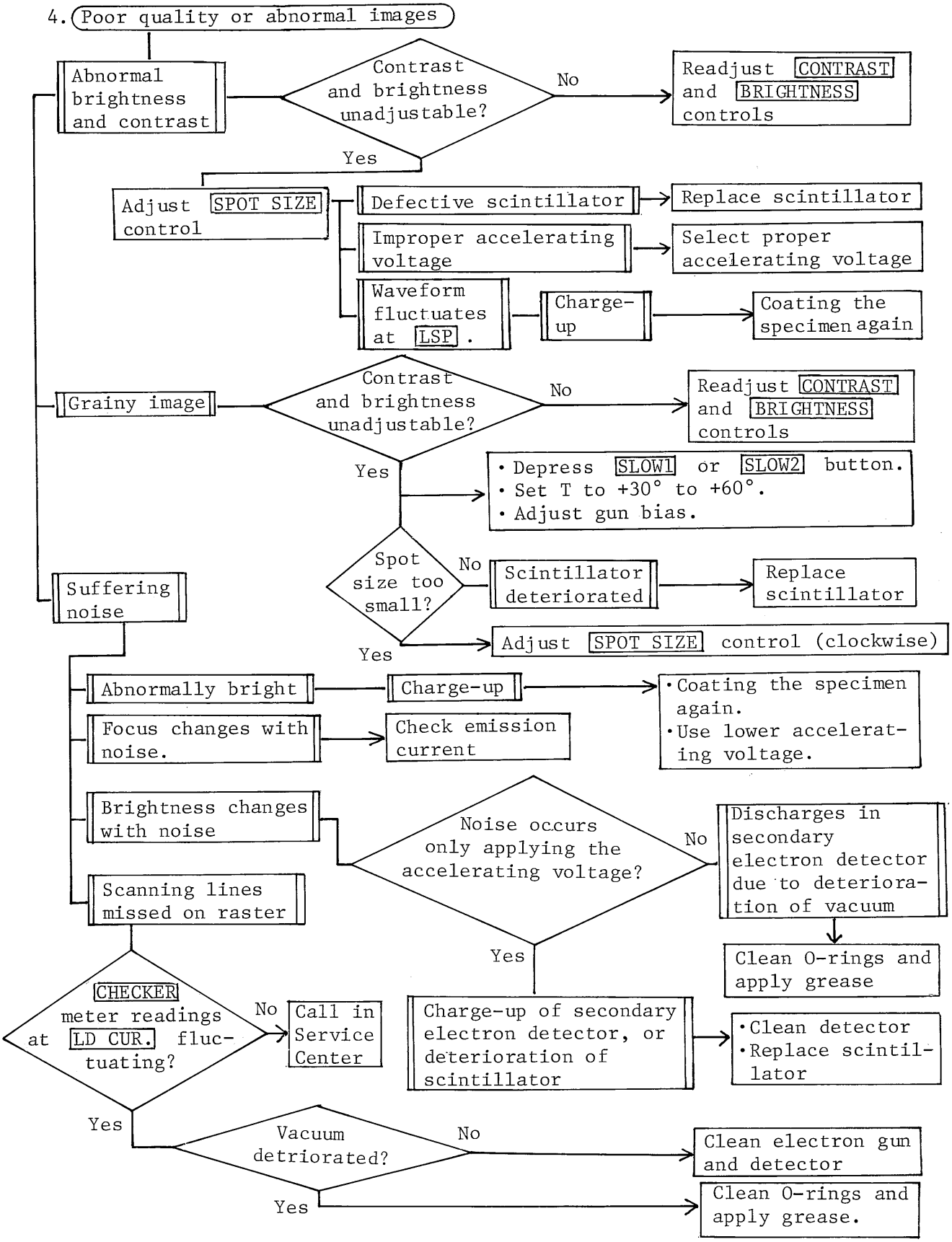
Accelerating voltage (kV).... 30

CHECKER reading 0.15

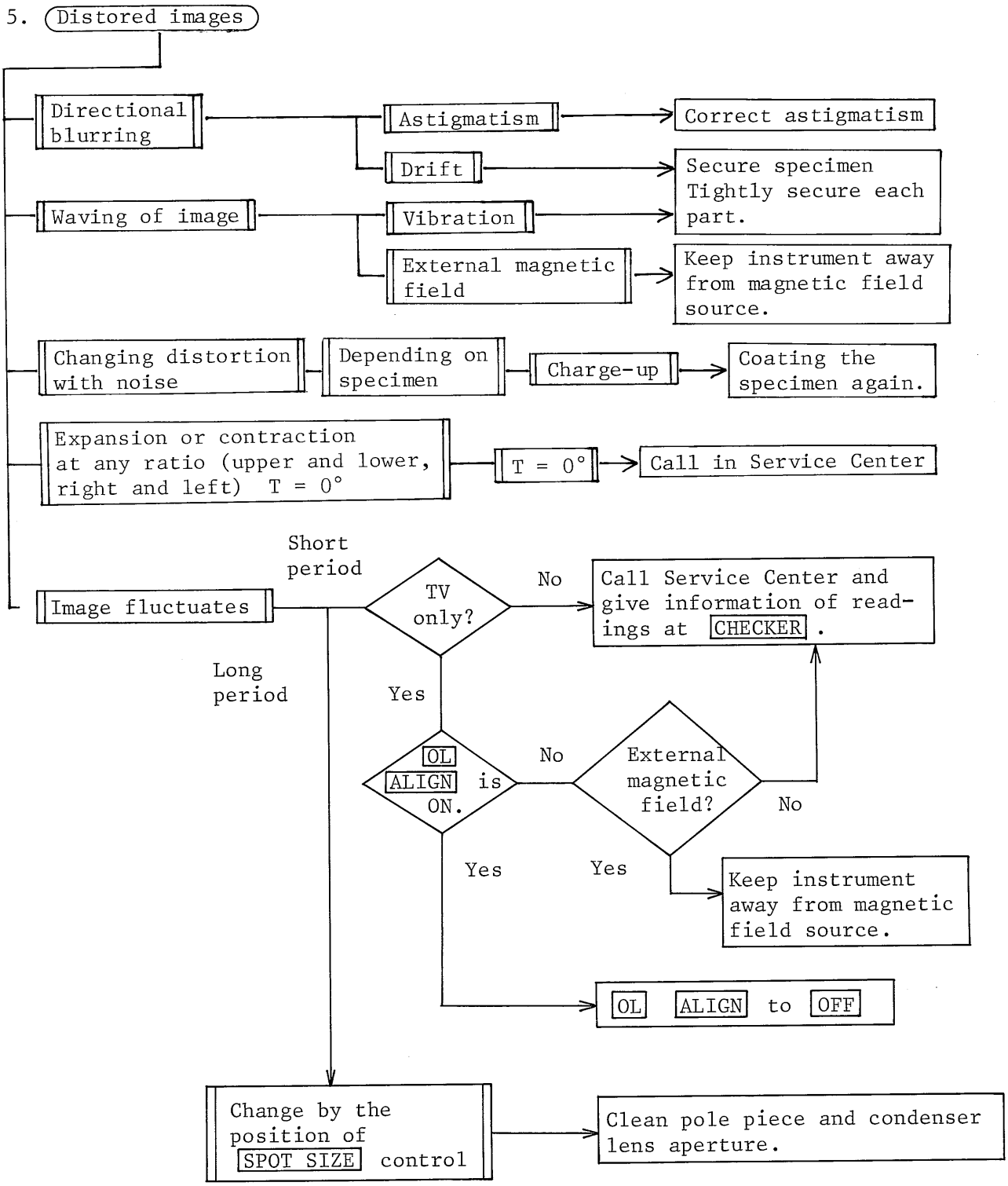
(Gun bias control: in 3 o'clock position)



* T: Specimen tilt angle
DFU: Dynamic focusing unit (focus correction for tilted specimen),
Through-focusing: To adjust focus from underfocus to overfocus through in-focus.


4. Poor quality or abnormal images
Abnormal brightness and contrast
Contrast and brightness unadjustable?
No
Readjust CONTRAST and BRIGHTNESS controls
Yes
Adjust SPOT SIZE control
Defective scintillator
Replace scintillator
Improper accelerating voltage
Select proper accelerating voltage
Waveform fluctuates at LSP.
Charge-up
Coating the specimen again
Grainy image
Contrast and brightness unadjustable?
No
Readjust CONTRAST and BRIGHTNESS controls
Yes
• Depress SLOW1 or SLOW2 button.
• Set T to +30° to +60°.
• Adjust gun bias.
Spot size too small?
No
Scintillator deteriorated
Replace scintillator
Yes
Adjust SPOT SIZE control (clockwise)
Suffering noise
Abnormally bright
Charge-up
• Coating the specimen again.
• Use lower accelerating voltage.
Focus changes with noise.
Check emission current
Brightness changes with noise
Noise occurs only applying the accelerating voltage?
No
Discharges in secondary electron detector due to deterioration of vacuum
Clean O-rings and apply grease
Scanning lines missed on raster
Yes
CHECKER meter readings at LD CUR. fluctuating?
No
Call in Service Center
Charge-up of secondary electron detector, or deterioration of scintillator
• Clean detector
• Replace scintillator
Yes
Vacuum detriorated?
No
Clean electron gun and detector
Yes
Clean O-rings and apply grease.

5. Distored images



7.4 Examples of Troubles

The following symptoms which seem to be trouble are mostly settled by maintenance operation. Refer to item 7. TROUBLESHOOTING PROCEDURE for the symptoms to be trouble other than below.

1. Image does not appear.

   Checkup item: ① [SEQUENCE] [HT READY] lights.
   ② [DET] [HT] ON
   ③ Monitor lamp does not light even by turning [FILAMENT] control toward 12 o'clock.

   Major cause : Filament burnt out.

   Solution : Replace the filament with new one.

2. Image cannot be distinct.

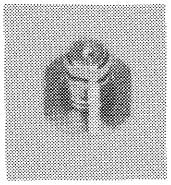
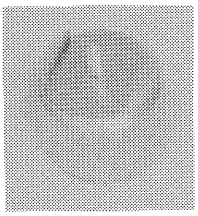
   Checkup item: Make sure at 30kV, WD 10mm by mounting standard accessory specimen (ZnO).
   ① Astigmatism is corrected and focus is properly adjusted.
   ② Electron gun is aligned.
   ③ [SEI]/[BEI] is set to [SEI].
   ④ [SPOT SIZE] control is at clockwise direction beyond 10 o'clock.
   ⑤ Alignment is performed in case of objective lens movable aperture.
   ⑥ Not related to the position of specimen.
   Note: As accelerating voltage reduces and working distance becomes longer, resolution degrades and it causes more difficult to obtain sharp image.

   Major cause : Resolution degraded by dirts inside the column.

Solution : Clean up the objective lens aperture holder, replace the objective lens aperture, clean up pole pieces and replace the condenser lens aperture.

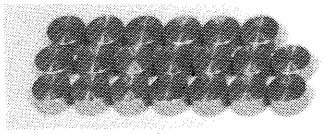
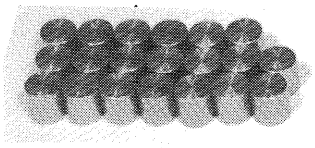
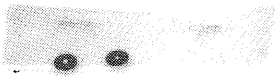
3. Astigmatism increased.
   Checkup item: ① Alignment is performed in case of objective lens movable aperture.
   Major cause : Resolution degraded by dirts inside the column.
   Solution : Clean up the objective lens aperture holder, replace the objective lens aperture, clean up pole pieces and replace the condenser lens aperture.
4. Electron probe is not stable (including jump of probe).
   Checkup item: ① Checker [LD CUR.] is not stable.
   ② Probe jumps even by changing specimen.
   Major cause : ① Underdischarge if whiskers are recognized to the lead end of filament and wehnelt cap.
   ② Change -up by dirts inside the column.
   Solution : ① Replace the filament and clean up Wehnelt cap.
   ② Clean up pole pieces and replace the condenser lens. Replace the objective lens aperture as well if necessary.

*T220 STANDARD ACCESSORIES & TOOLS

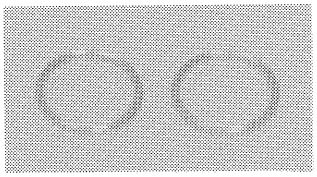
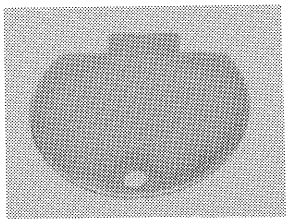
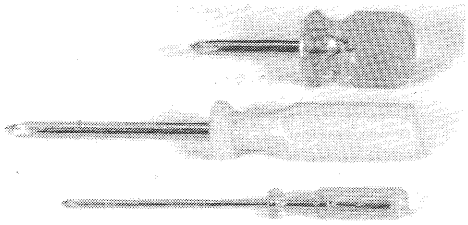
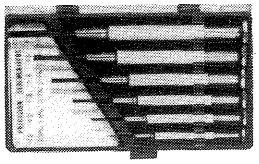
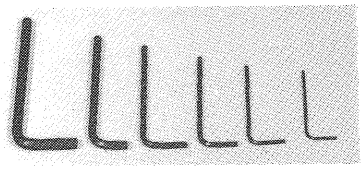
Name	Appearance	Quantity
Objective lens aperture (fixed lens aperture)*		1 set
Removing tool for objective fixed lens aperture*		1

* Those are not supplied in case that the objective lens movable aperture (MAP) is used.

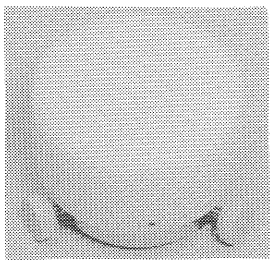
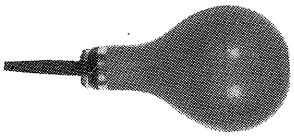
* STANDARD ACCESSORIES & TOOLS I

Name	Appearance	Quantity
Specimen stubs (10 mm dia. × 5 mmh)		20
Specimen stubs (10 mm dia. × 10 mmh)		20
Conductive paint		1
Vacuum grease		1
Fine grain metal polish		1
Condenser lens apertures (capsule)		1 set

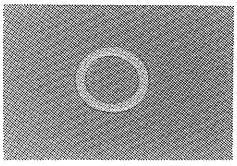
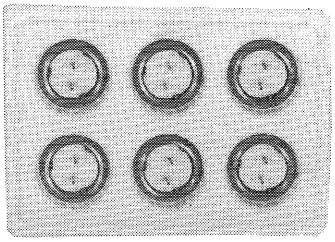
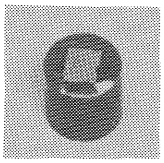
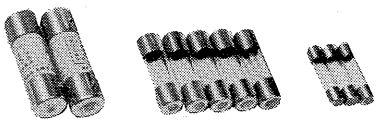
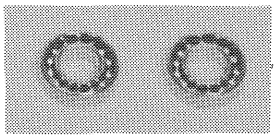
* STANDARD ACCESSORIES & TOOLS II

Name	Appearance	Quantity
Filament spacers (2 ∿ 2.2 mm)		1 set
Base plate adjusting tool		1
Screwdriver, philips-headed		1 set
Screwdriver, watchmaker's (6 sizes)		1 set
Allen key wrench (6 sizes)		1 set
Tweezers		1

* STANDARD ACCESSORIES & TOOLS Ⅲ

Name	Appearance	Quantity
Pole piece removing tool		1
Pole piece assembling tool		1
Wehnelt cap removing tool		1
Handblower		1
Pen light (with batteries) Only for T330A		1 set
Wrench, watchmaker's		1

* STANDARD ACCESSORIES & TOOLS Ⅳ

Name	Appearance	Quantity
Loupe (15×)		1
Beam deflector coil spacer		1
Electron gun filaments (6 pcs./box)		1
Standard sample		1
Fuses		30A 2 20A 1 8A 2 3A 2 2A(small) 2 1A(small) 1
Bearings		2

* PARTS LIST FOR INSTALLATION & TRANSPORTATION

Name	Quantity
Power cable	1
Water hose 10 m	1
Water tap	2
Plug	2
Water clamp	3
Exhaust port plug for RP	1
Packing (installed in the RP exhaust port)	1
Vacuum hose clamp	3
Transporting fixture	1 set
Screws 3 mm dia.	1 set
Screws 4 mm dia.	1 set

ALPHABETICAL INDEX

JEOL service office

If you need to consult with JEOL about the instrument maintenance, please contact your nearest subsidiary company.

Or presume a JEOL homepage in such cases as the information about the product, the inquiry besides that if having an order in the center of the nearby service.

http://www.jeol.co.jp/	Japan
http://www.jeol.com/	USA
http://www.jeoleuro.com/	Europe