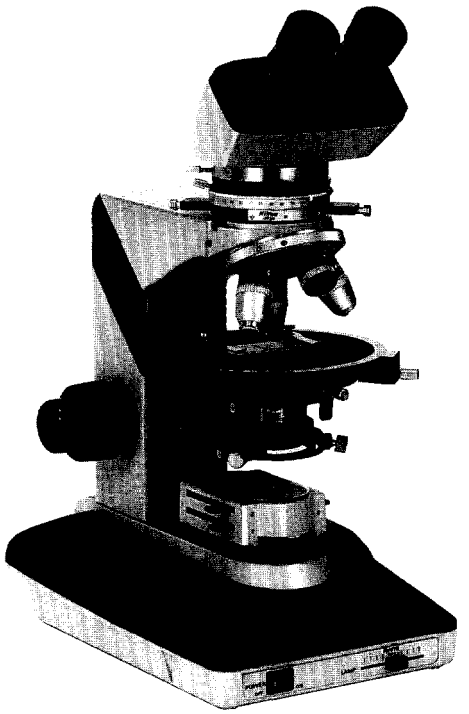
Nikon

Polarizing Microscope

LABOPHOT2-POL

INSTRUCTIONS

NIPPON KOGAKU K.K.



Thank you very much for purchasing a Nikon Microscope. This microscope is a high precision instrument with a very delicate structure and varied functions. Please thoroughly read this manual first to use the microscope correctly.

CAUTIONS

1 Avoid Strong Shocks!

Handle the microscope gently, taking care to avoid strong shocks.

2 When Carrying the Microscope

When carrying the microscope, support the bottom of the microscope base. The instrument weighs about 7.9kg. Do not hold the overhanging portion of the base.

3 Purpose

Use the microscope only for microscopic observations. Do not use it for any other applications.

4 Place of Use

Avoid exposing the microscope to place where it may be subject to dust, vibrations, high temperatures, moisture or direct sunlight.

5 Installation

Install the microscope apart from wall in such a way that the lamp unit warning label is visible.

6 Input Voltage

Confirm that the input voltage to the microscope corresponds to your line voltage.

7 Light Source

Use a 6V-30W halogen lamp. Do not use lamps other than the one specified on p.41 (Electrical Specifications). If a lamp of more than the suggested wattage is used, the light adjusting circuit may be damaged.

8 When the Lamp Is On

Take care not to touch the lamp housing or bring inflammable substances such as gasoline, thinner and alcohol near it, as some parts of the lamp housing become very hot.

9 Changing the Lamp-bulb

Before replacing the Lamp-bulb, turn off the main switch and disconnect the power source plug. Before replacing the halogen lamp (6V-30W), be sure that it is cool enough. Do not touch the glass part with your bare hands.

10 Dirt on the Lens

Do not leave dust, dirt or finger marks on the lens or bulb surfaces. They will prevent you from observing the specimen clearly.

11 Focus Knobs

Never attempt to adjust the tightness of the right- and left-hand focus knobs by turning one while holding the other. It may cause problems. Avoid forcing the coarse focus knobs to turn past their limits since that may cause problems.

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CARE AND MAINTENANCE

1 Cleaning the Lenses

To clean the lens surfaces, remove dust using a soft brush or gauze. Only when removing finger marks or grease, use a soft cotton cloth, lens tissue, or gauze lightly moistened with pure alcohol (methyl alcohol or ethyl alcohol). For cleaning the objectives of immersion oil use only xylene. Do not use xylene for cleaning the surface of the entrance lens of the eyepiece tube or the prism surface of the Ultra-Wide Eyepiece Tube "UW". Observe sufficient caution in handling alcohol and xylene (they are inflammable), and the ON-OFF of the power source switch.

2 Cleaning the Painted Surfaces

Avoid the use of any organic solvent (for example, thinner, ether, alcohol) for cleaning the painted surfaces and plastic parts of the instrument. We recommend you use the silicon cloth.

3 Never Attempt to Dismantle!

Never attempt to dismantle the instrument because you may impair the functions.

4 When Not in Use

When not in use, cover the instrument with the accessory vinyl cover, and store it in a place free from moisture and fungus. It is especially recommended that the objectives and eyepieces be kept in an airtight container containing desiccant.

5 Periodic Checking

To maintain the best performance of the instrument, we recommend that the instrument be periodically checked. (For details of this check, contact your authorized Nikon distributor.)

★Please note as per your Nikon warranty, **"Any defects or damage directly or indirectly caused by the use of unauthorized replacement parts and/or performed by unauthorized personnel"** will void the warranty.

I . NOMENCLATURE

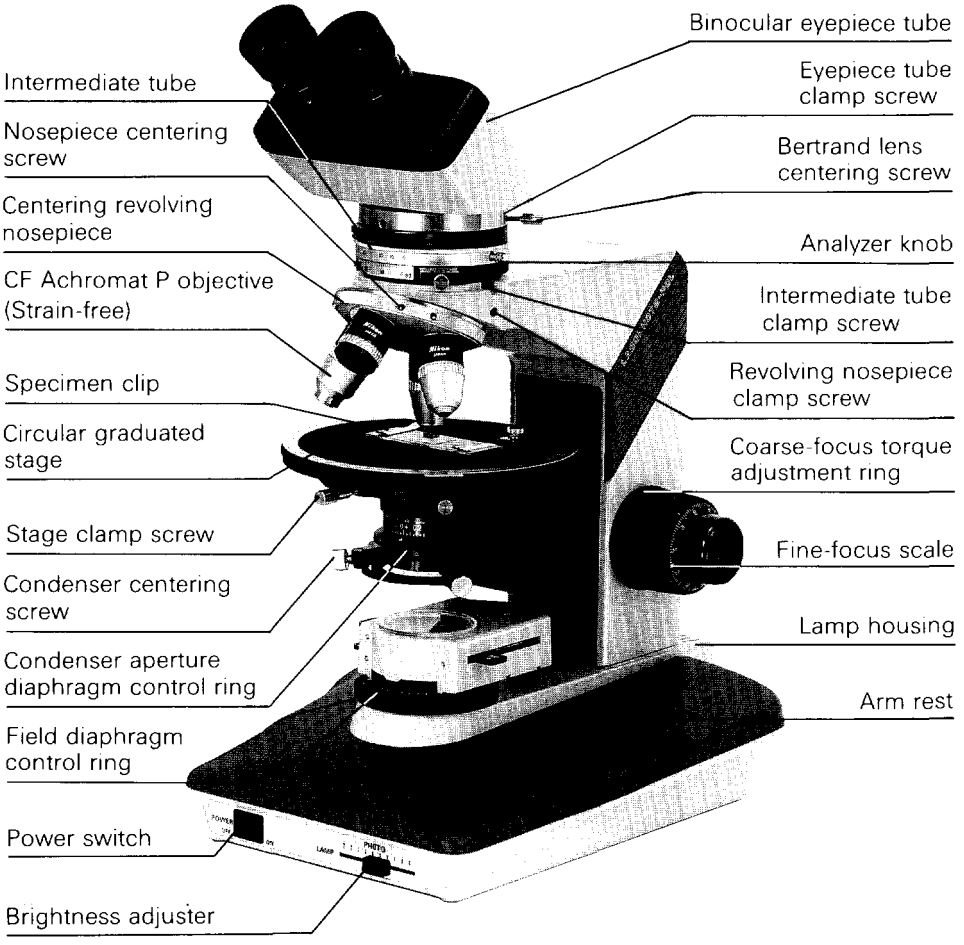


Fig. 1-1

II. ASSEMBLY

To assemble the microscope, follow the procedures given from ① to ⑮. For details, read p.5 to p.10.

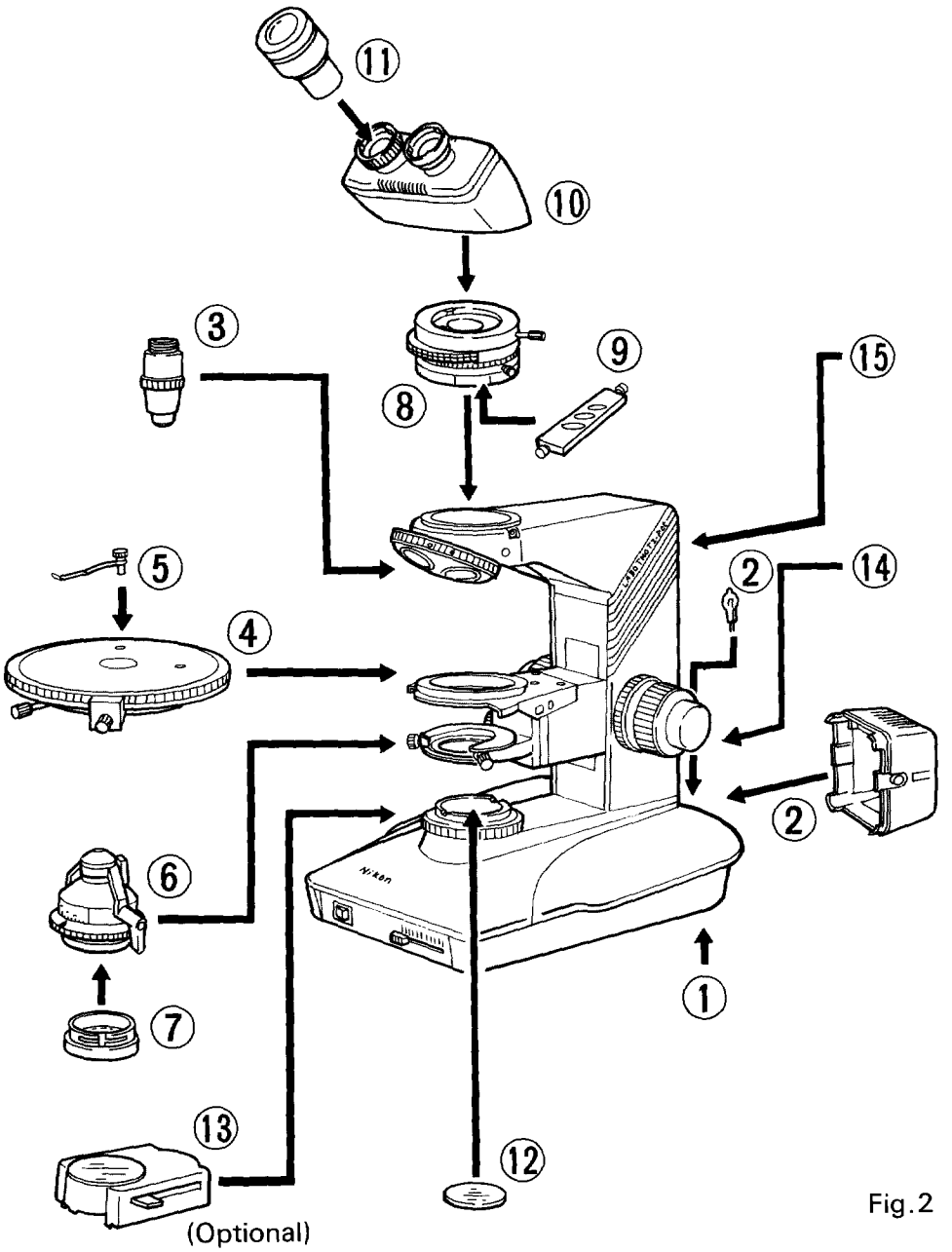


Fig.2

Tools: hexagon wrench (accessory), plus screwdriver, minus screwdriver, coin, etc.

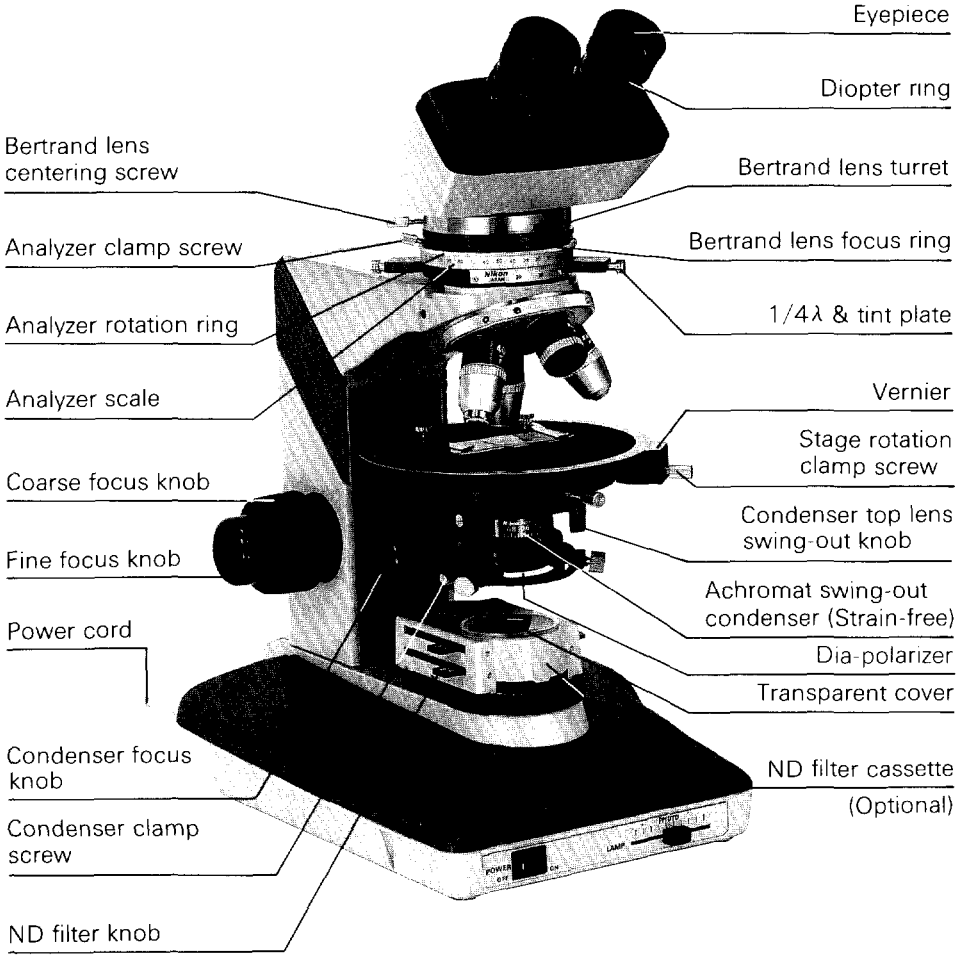

Eyepiece
Diopter ring
Bertrand lens centering screw
Bertrand lens turret
Analyzer clamp screw
Bertrand lens focus ring
Analyzer rotation ring
1/4λ & tint plate
Analyzer scale
Vernier
Stage rotation clamp screw
Coarse focus knob
Condenser top lens swing-out knob
Fine focus knob
Achromat swing-out condenser (Strain-free)
Power cord
Dia-polarizer
Transparent cover
Condenser focus knob
ND filter cassette (Optional)
Condenser clamp screw
ND filter knob

Fig. 1-2

① Leveling Foot Screw

- For stable installation of the microscope, manipulate the adjustment screw at the rear-right of the base (Fig.2-1).

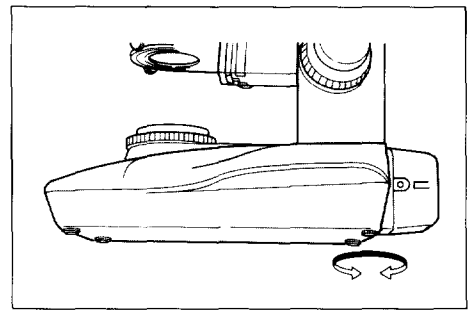


Fig.2-1

② Lamp and Lamp Housing

CAUTIONS

- Use the specified lamp "Nikon Halogen 6V 30W".
- Use the specified Halogen Lamp. See Electrical Specifications on p.41 for details.
- Keep the lamp cover on or use gloves when mounting the lamp bulb, so as not to touch the surface directly with your fingers. If the bulb surface is contaminated with finger marks or dirt, wipe them off with lens tissue. Be sure to remove the lamp cover after mounting the lamp.

- Remove the lamp housing cover pressing the cover detaching buttons (Fig.2-2).
- Insert the lamp into the socket pin holes until it reaches the limit (Fig.2-3).
- Reattach the cover.

Cautions when dismounting

- Turn off the power switch. (Assure that it is off.) Do not touch the lamp-bulb immediately after turning it off because it is very hot. Wait until it cools enough for replacing.
- Power supply cord should be kept away from lamp housing while the lamp housing is hot.

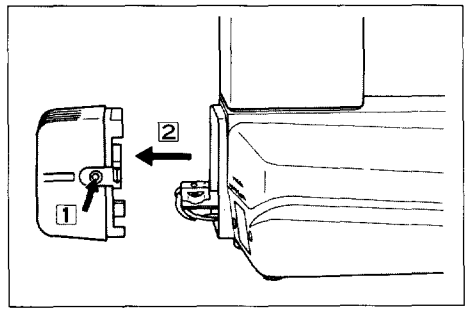


Fig.2-2

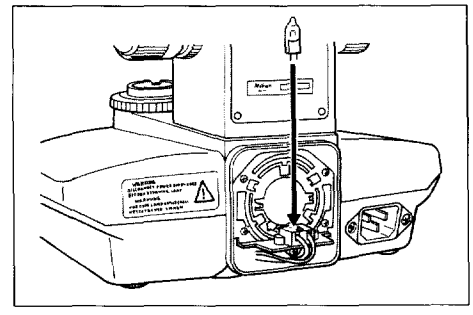


Fig.2-3

③ Objectives

- Screw in the objectives to the holes of the revolving nosepiece in such positions that, when viewed from above, their magnifying power increases as the nosepiece is revolved clockwise (Fig.2-4).

Cautions when dismounting

- Remove the ND filter cassette if attached and lower the stage by turning the coarse focus knob.
- Remove any specimen from the stage.
- Hold the objective so as not to drop it when unscrewing.

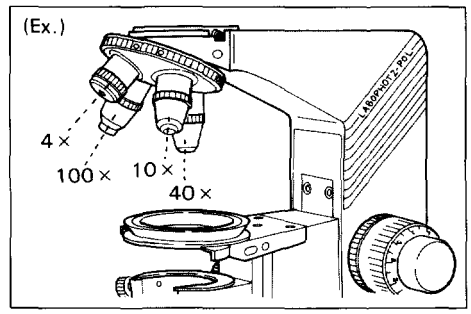


Fig.2-4

④ Stage

- Lower the substage by turning the coarse focus knob.
- Loosen the stage clamp screw sufficiently.
- Fit the stage to the circular dovetail of the substage [1]. Fasten the stage with the stage clamp screw [2] (Fig.2-5).

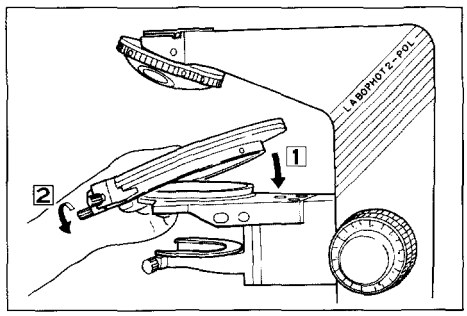


Fig.2-5

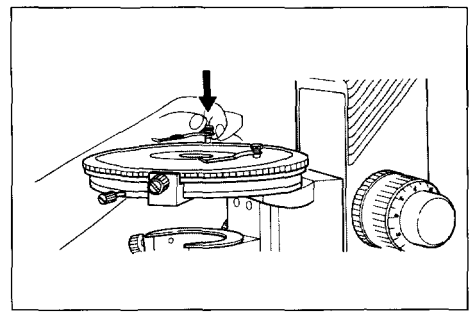


Fig.2-6

⑤ Specimen Clip

- Insert the two speciment clips into the holes on the stage surface (Fig.2-6).

⑥ Condenser

- Raise the substage by turning the coarse focus knob.
- Lower the condenser carrier to its limit by turning the condenser focus knob.
- Insert the condenser into the condenser carrier [1] with the numerical aperture plate facing toward the user. Fasten it with the condenser clamp screw [2] (Fig.2-7).
- Raise the condenser carrier to its limit by turning the condenser focus knob.

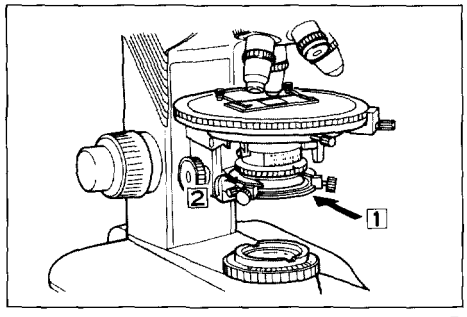


Fig.2-7

Cautions when dismounting

- Remove the ND filter cassette if attached.
- Lower the condenser carrier to its limit by turning the condenser focus knob. Remove the condenser by releasing the condenser clamp screw.

⑦ Dia-polarizer

- Fit the dia-polarizer into the bottom of the condensor (Fig.2-8).

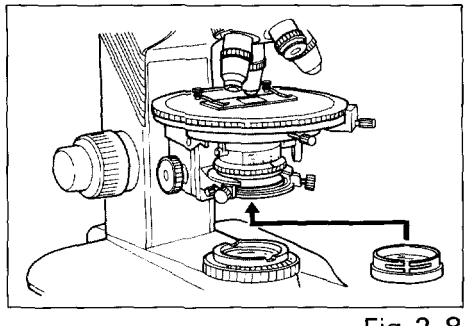


Fig.2-8

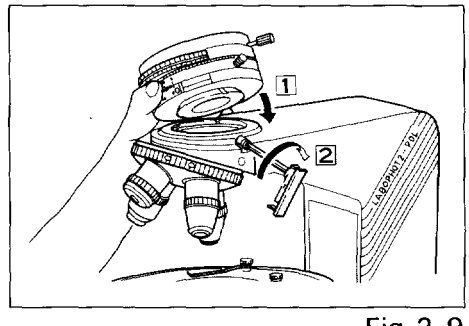


Fig.2-9

⑧ Intermediate Tube

- Mount the intermediate tube onto the microscope arm fitting the notch of the circular devetail of the intermediate tube with the end of the clamp screw. Tighten the clamp screw holding the mid-stem of the hexgon wrench. Do not over tighten the screw holding the L-shaped holder of the wrench. (Fig.2-9)

⑨ 1/4λ & Tint Plate

- Remove the screw from the side of the 1/4λ plate. Insert the plate into the compensator slot of the intermediate tube facing the positioning notches toward the user.
  Screw in the screw once removed (Fig.2-10).

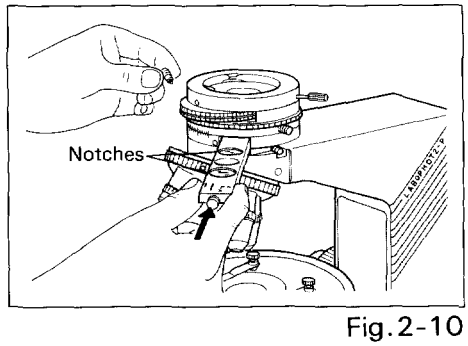


Fig.2-10

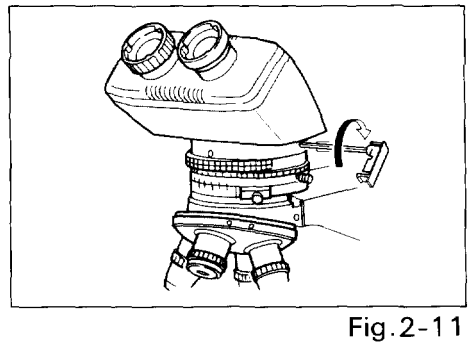


Fig.2-11

⑩ Binocular Eyepiece Tube

- Mount the eyepiece tube onto the intermediate tube fitting the notch of the circular dovetail of the eyepiece tube with the end of the clamp screw. Tighten the clamp screw using the hexagon wrench. (See ⑮ and Fig.2-11.)

Cautions when clamping

- Tighten the eyepiece tube clamp screw holding the stem of the hexagonal wrench. If overtightened holding the plastic part, optical-path change-over of the eyepiece tube may be malfunctioned.

⑪ Eyepiece

- Use the same magnification eyepieces for both the right and left eyes.
- Insert the eyepieces into the sleeves of the binocular eyepiece tube by engaging the three grooves of the eyepiece with the three protrusions of the sleeve (Fig.2-12).
- When using eyeguard rubbers, put them onto the eyepieces (Fig.2-13).

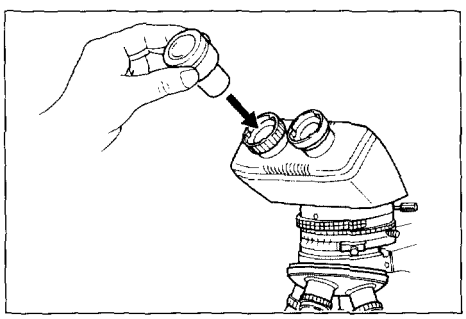


Fig.2-12

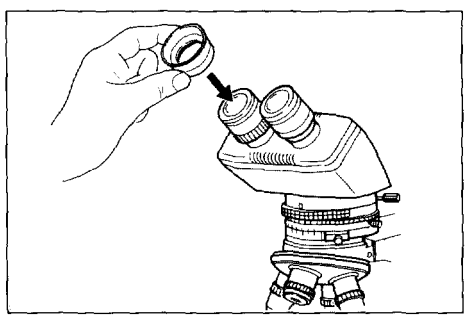


Fig.2-13

★Rotation clamp ring for the eyepiece

The rotation clamp ring is mounted on the eyepiece sleeve to prevent the rotation of the eyepiece.
When removing the eyepiece, take care not to accidentally hold this ring and pull it out together with the eyepiece.

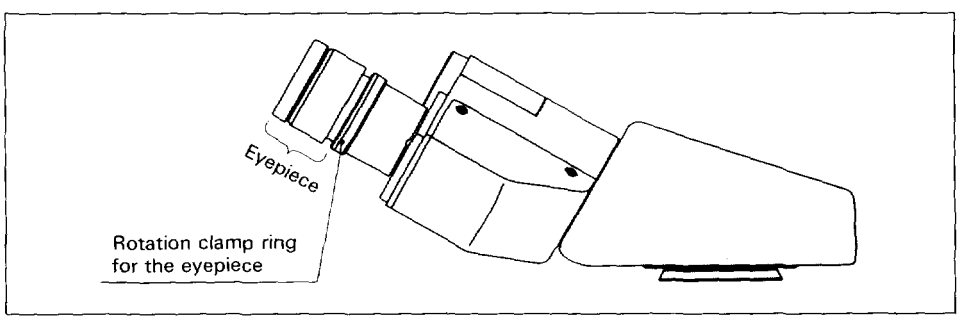


Fig.2-14

The rotation clamp ring must be removed when mounting the old type of eyepiece. When attaching the ring again, note on the following points.

☆Caution when attaching rotation clamp ring
Hold the ring so that the ϕ0.8 protrusion on the brim faces up. There are two pawls on the ring and two grooves on the sleeve to prevent the ring from falling off. Attach the ring so that these pawls and grooves fits together.

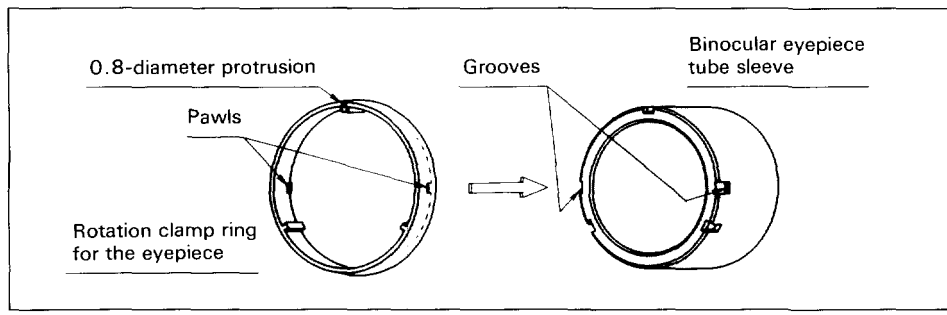


Fig.2-15

⑫ Filter on the Filter Receptacle

Place the ϕ45mm filter on the filter receptacle of the field lens part (Fig.2-16).

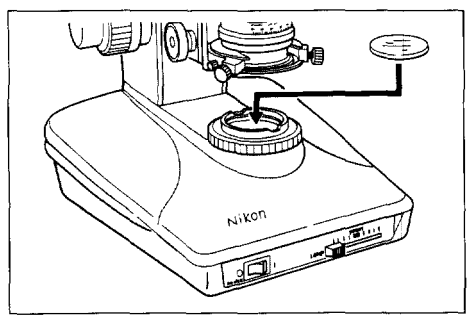


Fig.2-16

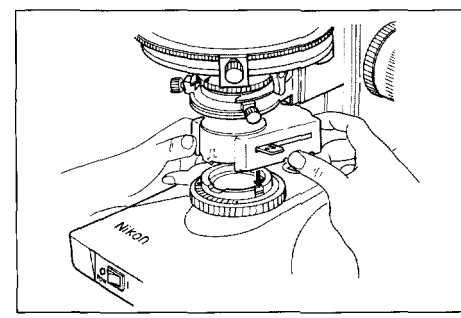


Fig.2-17

⑬ ND Filter Cassette (optional)

- Push down the ND filter cassette so the two protrusions of the cassette bottom fit with the two mounting grooves on the rim of te field lens part (Fig.2-17).
- When frequently lowering the stage, mount the ND filter cassette in the direction as shown in Fig.2-18.
- When dismounting, push the cassette either to the left or right and raise the opposite side.

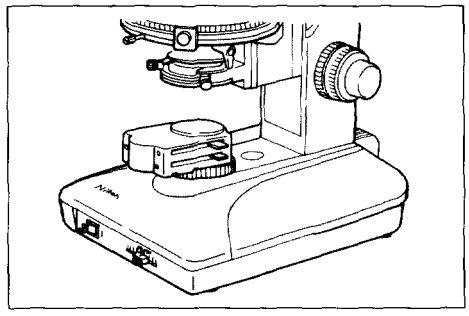


Fig.2-18

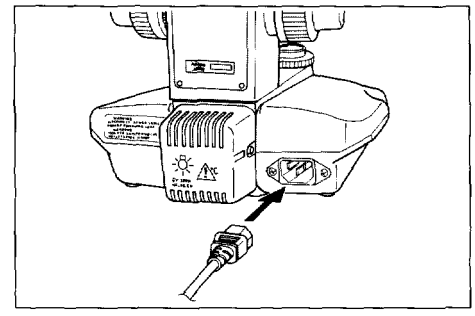


Fig.2-19

⑭ Power Cord

- Connect the socket of the power cord to the AC inlet on the rear of the base (Fig.2-19). Plug in the other end of the cord to an AC line receptacle with the ground conductor (earth conductor).

For 100-120V area

- Use only the following power supply cord set.
  UL listed, detachable cord set. 3-conductor grounding type SVT, No.18 AWG rated a minimum 125V, 7A.
- In case of using the extension cord, use only the power supply cord including PE wire.

For 220-240V area

- Use only the 3-pole power supply cord type H05VV-F or H05VVH2-F, which must be approved according to DIN VDE 0625. The plug and the outlet are to be approved according to DIN VDE 0620 and DIN VDE 0625, respectively.
- Class I equipment should be connected to PE (protective earth) terminal.
- In case of using the extension cord, use only the power supply cord including PE wire.

⑮ Hexagon Wrench

- The hexagon wrench is stored in the back of the microscope stand.
  Take it out as shown in Fig.2-20.

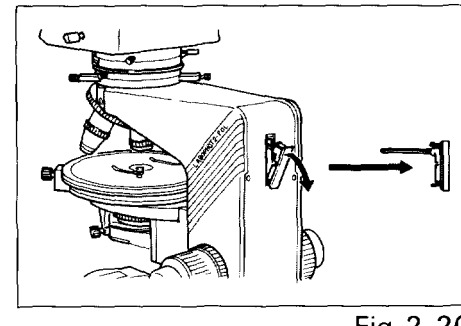


Fig.2-20

III. MICROSCOPY

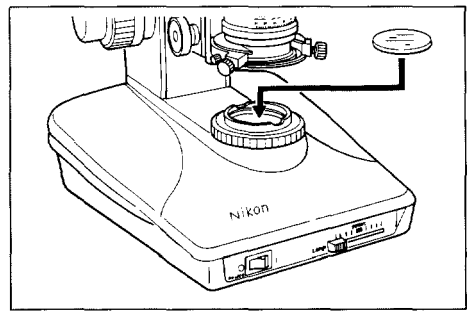


Fig.3-1

1) Put the NCB 11 filter (or necessary filter) on the filter receptacle of the field lens part (Fig.3-1).

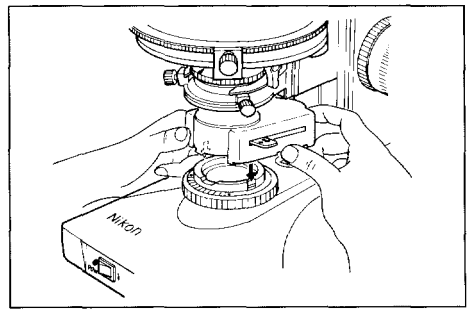


Fig.3-2

2) Mount the optional ND filter cassette, if used (Fig.3-2). (Refer to II. ASSEMBLY- ⑬ p.9.)

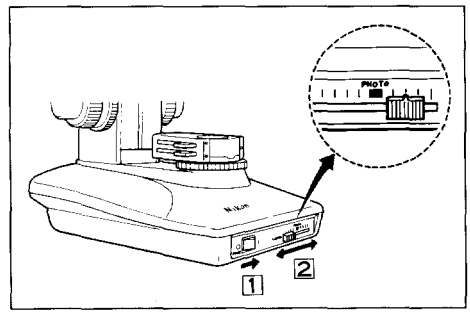


Fig.3-3

3) Turn on the power switch [1] to light the lamp.
Move the brightness adjuster and align it with the 3rd scale line from the right [2] (Fig.3-3).

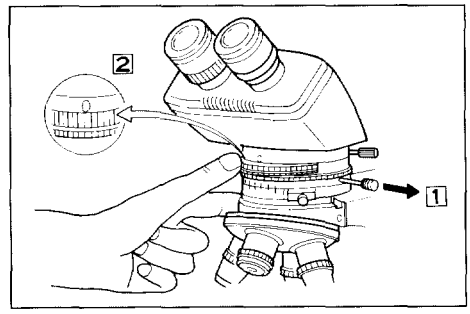


Fig.3-4

4) Pull the analyzer knob of the intermediate tube [1] to remove the analyzer from the optical path. Turn the Bertrand lens turret to the position "0" [2] to remove the Bertrand lens from the optical path (Fig.3-4).

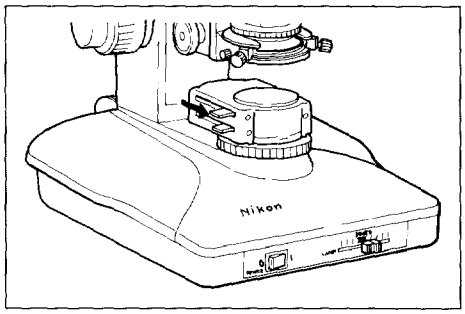


Fig.3-5

5) Move the filter knobs of the ND filter cassette to the limit to bring all ND filters into the optical path (Fig.3-5).

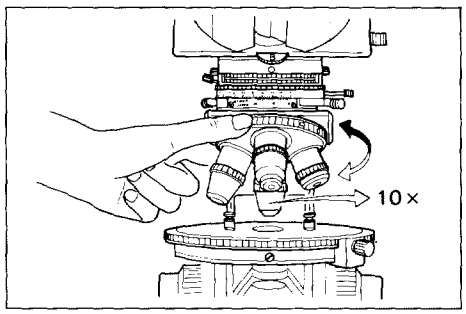


Fig.3-6

6) Revolve the revolving nosepiece to swing in the 10× objective to the optical path. Assure that the nosepiece properly settles in position (Fig.3-6).

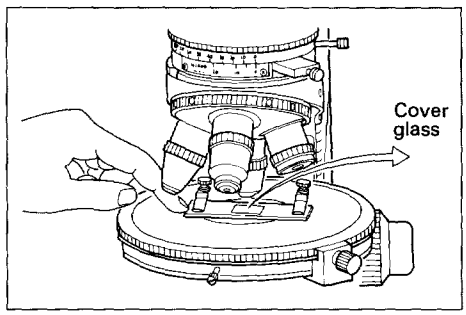


Fig.3-7

7) Place the specimen (glass slide) on the stage with its cover glass facing up and fasten it with the two specimen clips (Fig.3-7).

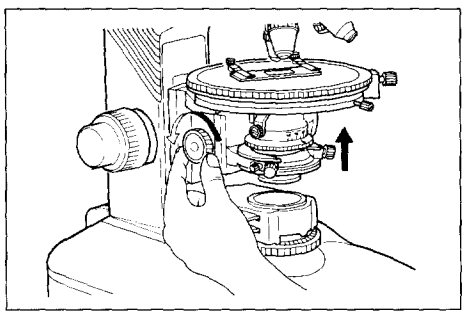


Fig.3-8

8) Raise the condenser uppermost using the condenser focus knob (Fig.3-8).

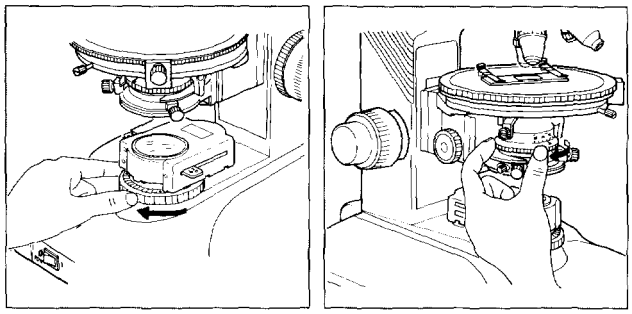


Fig.3-9

9) Fully open the field and aperture diaphragms (Fig.3-9).

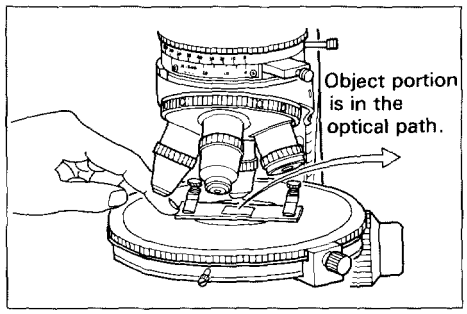


Fig.3-10

10) Bring the object portion of specimen into the optical path (Fig.3-10). (Object portion is just above the condenser lens.)

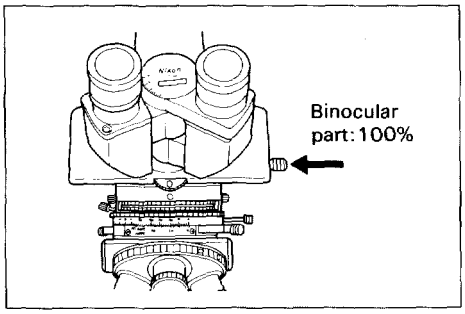


Fig.3-11

11) When the trinocular eyepiece tube is used, change the optical path of the eyepiece tube to enter 100% of the light into the binocular part (Fig.3-11).
(See p.24, Operations in Detail-11.)

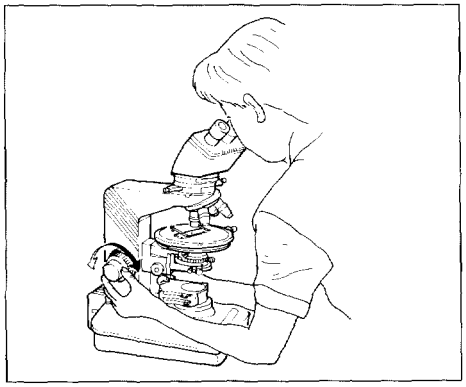


Fig.3-12

12) Focus on the specimen looking in the eyepiece by manipulating the coarse/fine focus knob (Fig.3-12).

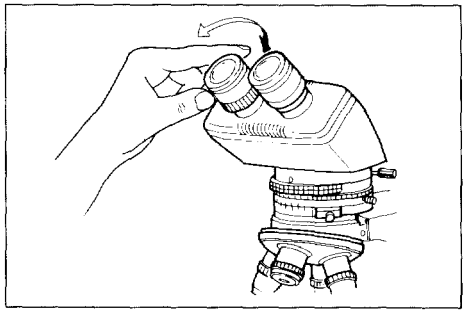


Fig.3-13

13) Adjust the diopter (Fig.3-13).
(See p.25, Operations in Detail-13.)

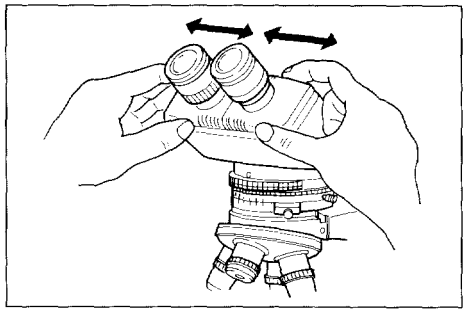


Fig.3-14

14) Adjust the interpupillary distance (Fig.3-14).
(See p.25, Operations in Detail-12.)

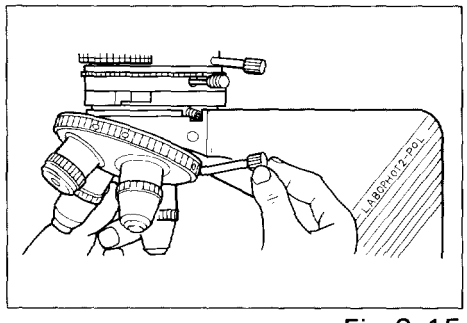


Fig.3-15

15) Center the objective (Fig.3-15).
(See p.20, Operations in Detail-5.)

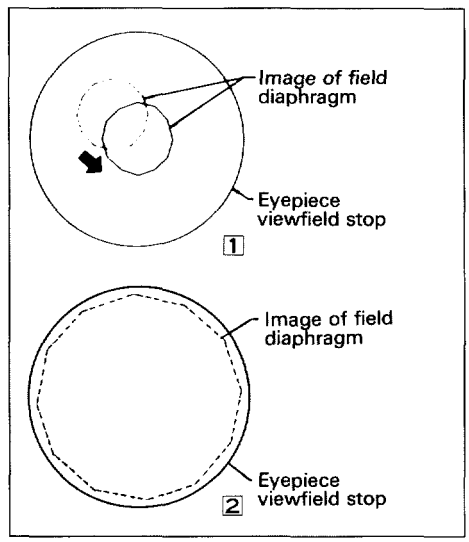


Fig.3-16

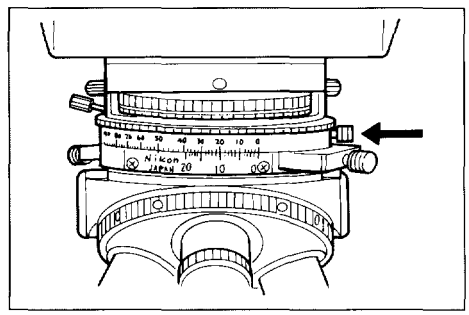


Fig.3-17

16) Focus and center the condenser (Fig.3-16). (See p.22, Operations in Detail-8.)

17) Push in the analyzer knob to put the analyzer into the optical path (Fig.3-17).

18) Revolve the revolving nosepiece to the objective to be used and focus on the specimen by manipulating the fine or coarse focus knob. (See Note: 2.)
When using an oil immersion objective, apply oil to the space between the top of the objective and the specimen. Take care not to produce bubbles in the oil. (See p.26, Operations in Detail-14.)

19) When the ND filter cassette is used, Adjust the brightness by sliding the filter knob. (See p.27, Operations in Detail-15.)
When the ND filter cassette is not used, adjust the brightness of the lamp by manipulating the brightness adjuster.

20) Adjust the viewfield and the aperture diaphragms by manipulating their respective control rings. (See p.23 and 24, Operations in Detail-9 and -10.)

Table 1

	Orthoscopic microscopy		Conoscopic microscopy
Top lens of condenser	10× or higher	IN	IN
	4× or lower	OUT	
Bertrand lens	OUT		IN
Aperture diaphragm	10× or higher	70%~80% of the numerical aperture of the objective	Circumscribed the circumference of the conoscopic field of view (or fully opened)
	4× or lower	Fully opened	
Field diaphragm	10× or higher	Circumscribed the circumference of the eyepiece field of view	Circumscribed the circumference of the orthoscopic field of view
	4× or lower	Fully opened	

Note 1 Manipulate the condenser centering screws if part of the viewfield is dark. If this doesn't help, check the following items:

- Insertion/removal of the ND filter — III. MICROSCOPY-5)
- Turning the revolving nosepiece (click-stop position) — III. MICROSCOPY-6)
- Position of the condenser — III. MICROSCOPY-8)
- Viewfield and aperture diaphragms fully open — III. MICROSCOPY-9)
- Change-over of the optical path of the eyepiece tube — III. MICROSCOPY-11)
- Mounting the lamp — II. ASSEMBLY-② Lamp and Lamp Housing
- Mounting the condenser — II. ASSEMBLY-⑥ Condenser
- Placing the filter on the filter receptacle — II. ASSEMBLY-⑫ Filter on the Filter Receptacle

Note 2 Check the following items when the specimen cannot be focused.

- Placing the specimen — III. MICROSCOPY-7)
- Thickness of the cover glass (standard = 0.17mm)

1. Orientation of the Dia-polarizer

(Dia-polarizer and analyzer)

① Place the specimen on the stage, focus on the specimen using the objective 40×.
② Set the analyzer scale on the intermediate tube to 0.
③ Insert the dia-polarizer into the bottom of the condenser as shown in Fig.4.

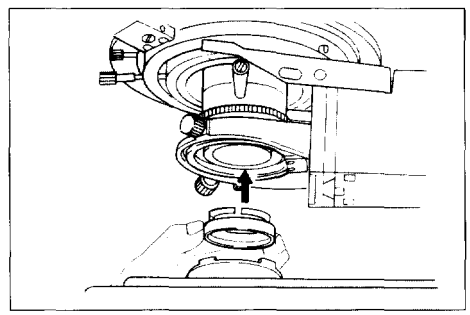


Fig.4

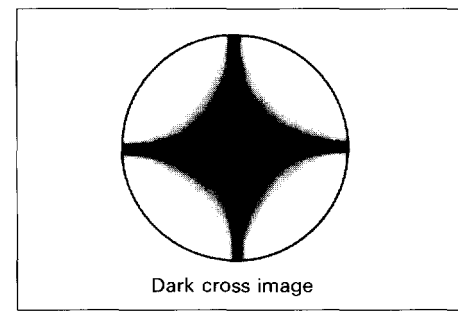


Fig.5

④ Remove the eyepiece from the sleeve or put the Bertrand lens into the optical path. Observing the exit pupil of objective inside, rotate the dia-polarizer so as to form a dark cross image on the exit pupil as shown in Fig.5.

- The analyzer can be rotated by loosening the analyzer clamp screw [1] and rotating the rotation ring [2].
  The rotation angle can be read in the range between 0° to 180° with the unit of 0.1° by the vernier.
  The analyzer can be removed from the optical path by pulling the analyzer knob [3]. (Fig.6)

Note As the depolarizer is built in the intermediate tube, you don't need to be concerned about the relation between the orientation of the polarizing plate and photomicrographic device.

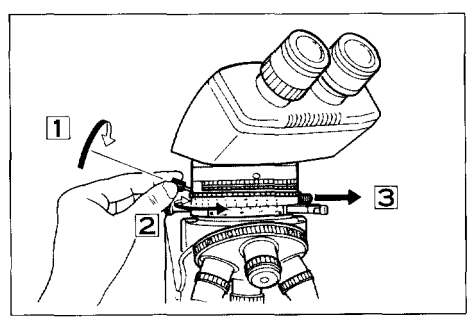


Fig.6

2. Focusing and Centering the Bertrand Lens

(Bertrand lens of the intermediate tube)

- When objectives are replaced, turn the Bertrand lens focus ring under the Bertrand lens turret and focus the Bertrand lens.
  Centering is carried out using the condenser aperture diaphragm image and the two centering screws. (Fig. 7)
  Centering procedure for the Bertrand lens is the same as that for the condenser except that the condenser aperture diaphragm image is used in place of the field diaphragm image in condenser contering. (Refer to Item 8.)

Note Another Bertrand lens is built in the optional trinocular eyepiece tube.
Turn the Bertrand lens ring to the position "B", and the Bertrand lens will be brought into the optical path and a conoscope image may be observed. (Fig. 8)

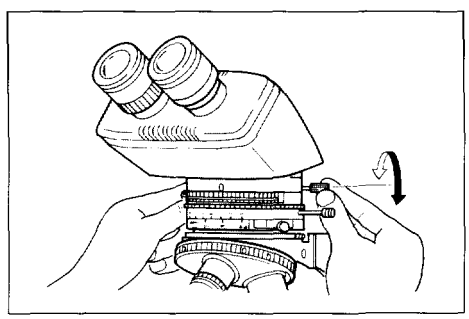


Fig. 7

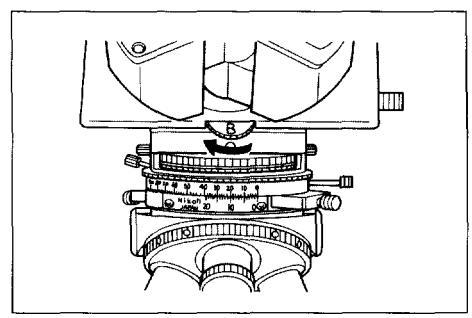


Fig. 8

3. Swing Out the Top Lens of the Condenser

(Swing-out condenser)

- The top lens of the condenser can be removed from the optical path by the swing-out knob. (Fig.9)
  Bring the top lens into the optical path during normal orthoscopic microscopy or conoscopic microscopy. Swing it out for orthoscopic microscopy with 4× or lower magnification objective.
- When measuring the retardation or observing the interference color, swing out the top lens (or stop down the condenser aperture diaphragm) so as to make the illumination light flux as parallel as possible to the optical axis.

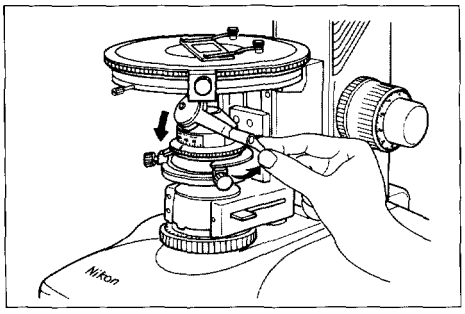


Fig.9

4. 1/4λ & Tint Plate

- The 1/4λ & tint plate has an empty hole at the center. By pushing it into the compensator slot, the sensitive tint plate (530nm) is brought into the optical path and by pulling it out the 1/4λ plate is brought into the optical path.
  It is used for recognition of very weak birefringence and the determination of X' and Z' of the specimen.

5. Centering the Objectives

(Centering revolving nosepiece, Circular graduated stage)

(Before centering the objectives, implement the microscopy procedures from 1) to 14) so that a specimen is focused using the 10× objective.)
Make coincidence with the rotation center of the stage and the cross lines center of the eyepiece by the following procedure.

① Bring an appropriate target on the specimen to the center of the cross lines in the eyepiece.
② Insert the centering tools in the centering screws on the nosepiece. (Fig.10)
③ Rotate the stage about 180°, and the target is displaced from the center of the cross lines. Move the objective using the centering tools so that the center of the cross lines moves one half the displacement of the target. (Fig.11)

- Repeat the above procedure two or three times.
- Carry out centering for each objective.

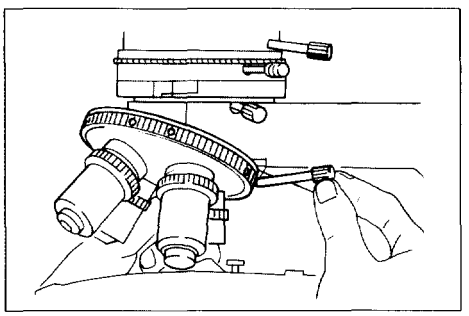


Fig.10

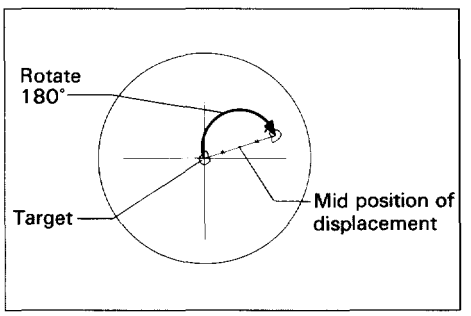


Fig.11

6. Stage Rotation

(Circular graduated stage)

- The stage can be rotated by loosening the stage rotation clamp screw.
  The rotation angle of the stage is readable with the accuracy of 0.1° via a vernier scale. (Fig.12)

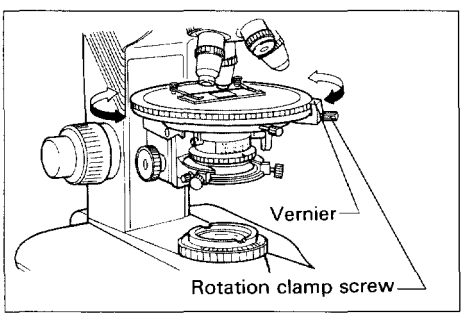


Fig.12

7. Focusing

(Coarse, Fine focus knobs and Coarse-focus torque adjustment ring)

- Focusing is carried out by the coarse and fine focus knobs at the left and right of the microscope stand.
- The direction of vertical movement of the stage corresponding to the turning direction of the focus knob is shown in Fig.13.
- One rotation of the fine focus knob moves the stage 0.1mm and the graduation on the fine focus knob is 1 micron. One rotation of the coarse focus knob moves the stage 12mm.
  The range of coarse and fine motion is 2mm up and 28mm down from the standard position.
  Never turn the right or left knob while holding the other. It may cause problems.
  Do not turn the coarse and fine focus knobs further than the limit.
- The rotation of the coarse-focus knob can be tightened when the torque adjustment ring is turned counter-clockwise.

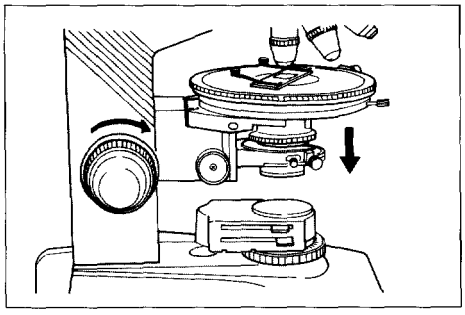


Fig.13

8. Centering the Condenser

(Condenser focus knob, condenser centering screw, Field diaphragm control ring)

(Before focusing and centering the condenser, implement Microscopy procedure from 1) to 15) and focus on the specimen with 10× objective.)

① Close the field diaphragm to its smallest size by manipulating the field diaphragm control ring. Rotate the condenser focus knob to move the condenser vertically so that a sharp image of the field diaphragm is formed on the specimen surface (Fig. 14-1).

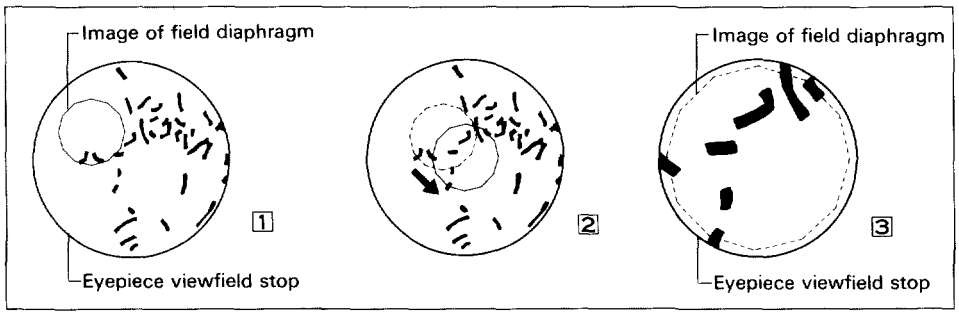


Fig. 14

② If the image decenters from the viewfield of the eyepiece, bring it roughly to the center of the viewfield by means of the condenser centering screws (Figs. 14-2 and 15).

③ Change to the 40× objective. Focus on the specimen by turning the fine focus knob and form an image of the field diaphragm on the specimen surface by manipulating the condenser focus knob.

④ When the image decenters from the viewfield of the eyepiece, bring it to the center of the viewfield by means of the condenser centering screws. At this time, adjusting the field diaphragm image to be slightly smaller than the viewfield of the eyepiece may be convenient for centering (Fig. 14-3).

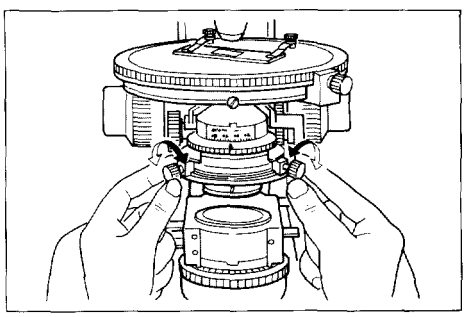


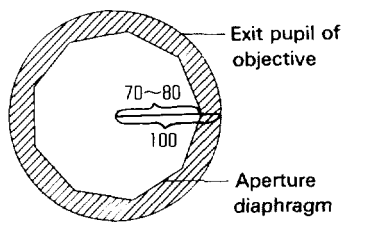
Fig. 15

9. Use of Condenser Aperture Diaphragm

(Condenser aperture diaphragm control ring)

1) For orthoscopic microscopy

The condenser aperture diaphragm is provided for adjusting the numerical aperture (N.A.) of the illuminating system of the microscope. It is important because it determines the resolution of the image, contrast, depth of focus, and brightness.
Stopping down the aperture diaphragm will lower the resolution and brightness but increase the contrast and depth of focus. In general, when **it is stopped down to 70%~80% of the numerical aperture of the objective,** a good image of appropriate contrast will be obtained (Fig.16).



Size of the condenser aperture diaphragm

Fig.16

To adjust the size of the condenser aperture diaphragm, manipulate the diaphragm control ring referring to the condenser's N.A. scale, or observing the diaphragm image visible on the exit pupil inside the objective. The exit pupil can be seen by removing the eyepiece from the eyepiece tube or putting the Bertrand lens into the optical path.
Stopping down the aperture diaphragm too far will lower the resolving power. Therefore, it is recommended not to stop down the aperture to a size smaller than 60% of the N.A. of the objective in use, except when observing almost transparent specimens.

Note When swinging out the top lens of the condenser (for microscopy using 4× or lower objective), fully open the condenser aperture diaphragm.

2) For conoscopic microscopy

In conoscopic microscopy, the condenser aperture diaphragm works as a field diaphragm on the conoscopic image surface. Stop down the diaphragm to such an extent that it circumscribes the circumference of the field of view of the conoscopic image (exit pupil of objective) to shut out the stray light.

10. Use of Field Diaphragm

(Field diaphragm control ring)

The field diaphragm is used for determining the illuminated area on the specimen. The size of the diaphragm is adjusted by manipulating the field diaphragm control ring. In general stop down the diaphragm to such an extent that the circumference of the illuminated area circumscribes or inscribes that of the eyepiece field of view. If a wider area than required is illuminated, extraneous light will enter the field of view, causing flare in the image and lowering the contrast. Therefore, especially in photomicrography, the proper adjustment of the field diaphragm is very important. Generally, good results will be achieved when the diaphragm is stopped down to such an extent that the diameter of the illuminated area is slightly larger than the diagonal of the film format.

Note

- Thickness of the glass slide must be 1.7mm or less, otherwise, the field diaphragm image may not be focused on the specimen surface.
- This diaphragm does not work as the field diaphragm when the condenser top lens is swung out of the optical path. In this case, fully open the diaphragm as the numerical aperture of the illuminator will be cut off when this diaphragm is excessively stopped down.

11. Optical Path Change-Over

(Optical path change-over knob of the trinocular eyepiece tube)

As shown in Fig.17, when the change-over knob is pushed until it reaches the limit [1], 100% of the light enters the observation tube. When the change-over knob reaches the intermediate click [2], the proportion of light entering the observation tube and photo tube will be 14:86. When the change-over knob is pulled to the limit [3], 100% of the light enters the photo tube.

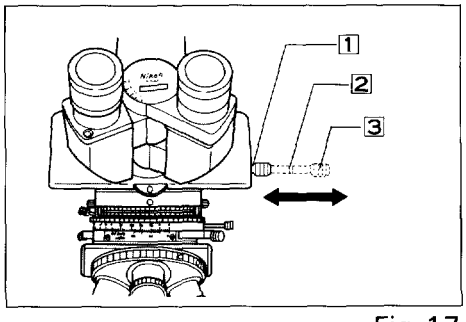


Fig.17

12. Interpupillary Distance Adjustment

(Observation tubes)

(Before adjusting the interpupillary distance, implement Microscopy procedure 1) to 13) and focus on the specimen with the 10× objective.)
Adjust the interpupillary distance, so that both the right and left viewfields become one (Fig.18).
This adjustment will enable the user to observe the specimen with both eyes.

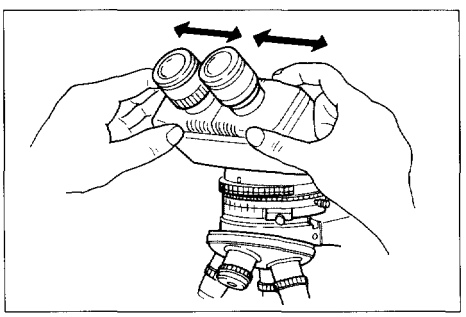


Fig.18

13. Diopter Adjustment

(Eyepiece)

(Before adjusting the diopter, implement MICROSCOPY procedures 1) to 12) and focus on the specimen with the 10× objective.)
Make diopter adjustments for both the right and left eyepieces.

① Turn the diopter compensation rings on each eyepiece until the end surface of the ring coincides with the engraved line.
(This is the position of 0 dioptic compensation.) (Fig.19-1)

② Swing in the 40× objective by turning the revolving nosepiece and bring the specimen image into focus by turning the fine focus knob (or the coarse focus knob).

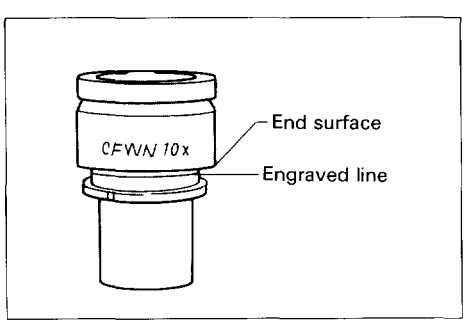


Fig.19-1

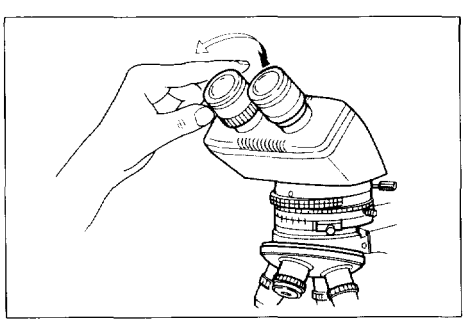


Fig.19-2

③ Swing the 4× or 10× objective into position. Without **manipulating the fine and coarse focus knobs,** turn the diopter rings on the eyepieces so that the specimen images in the right and left eyepieces are focused individually (Fig. 19-2).

- Repeat the above procedure two times, to adjust the diopter perfectly.
- The above adjustment, compensating diopter difference between the user's right and left eyes, will keep the tube length of the microscope correct. This enables the user to take full advantage of the high-quality objectives, including their parfocality.

14. Oil Immersion Manipulation

(Oil immersion objective)

The CF achromat P objective 100× is an oil immersion type, and is to be immersed in oil between the specimen and the front lens of the objective. Use only the **included oil.**

Apply the minimum amount necessary (the quantity that fills the gap between the front of the objective and the specimen) to avoid a flow of excessive oil that will adhere to the stage.

To see if air bubbles are present in the immersion oil, which deteriorate the image quality, pull out the eyepiece from the eyepiece tube. Fully open the viewfield diaphragm and the aperture diaphragm to examine the objective exit pupil (bright circle) inside the tube.

To remove air bubbles, slightly rotate the nosepiece several times, or apply additional oil, or replace the oil.

Any remnant of oil left on the oil immersion objective or adhesion of oil to the front of the dry system objective will deteriorate the image quality. Clean off the oil after using it and make sure that the oil did not adhere to the front of other objectives.

To clean off the oil, wipe with lens tissue or a soft cloth, moistened with xylene, lightly two or three times over the lens. It is essential at this time to avoid touching the lens with a part of tissue or cloth already used.

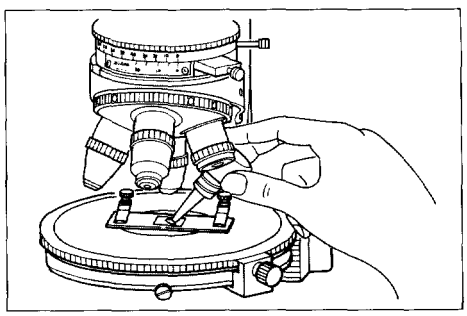


Fig.20

15. Brightness and Contrast Adjustment

(Filters on the filter receptacle of field lens part, optional ND filter cassette)

- Filters of 45mm in outer diameter can be placed on the filter receptacle of field diaphragm ring part. If the thickness of the filter is 4.5mm or less, the ND filter cassette (optional) can be mounted with the filter placed on the filter receptacle. Therefore, less frequently changed filters such as shown in Table 2 are conveniently used placed on the filter receptacle.
- Optional ND filter cassette, holding such ND filters as shown in Table 3, is conveniently used for brightness adjustment in general microscopy and photomicrography.
  Illumination brightness can be reduced to 1/2～1/128 by the combined use of these filters. Securely change the filter knob when inserting or removing the filters.
  Any filters of 45mm in outer diameter and 3mm or less in thickness can be mounted to the ND filter cassette.

Filters on Filter Receptacle — Table 2

Name	Purpose	Use
NCB11	Color balancing	For general microscopy and color photomicrography
GIF (Green interference)	Retardation measurement, Contrast adjustment	For phase-contrast microscopy and monochrome photomicrography

Filters in ND Filter Cassette — Table 3

Name	Transmission Rate	Light Reduction by Filter Combination		
		1pc.	2pcs.	3pcs.
ND2	About 50%	•→1/2	•→1/8 •→1/64 →1/32	•→1/128
ND4	About 25%	•→1/4		
ND16	About 6%	•→1/16		

● Removing and mounting the ND filters

Use gloves or gauze so as not to touch the filters with your bare hands.

Lay soft cloth such as gauze on a desk beforehand. Place the ND filter cassette on it, spread the lever and remove the filter (Fig.21). When mounting, insert the filter obliquely in the opposite side of the lever and spread the lever from the lower side.

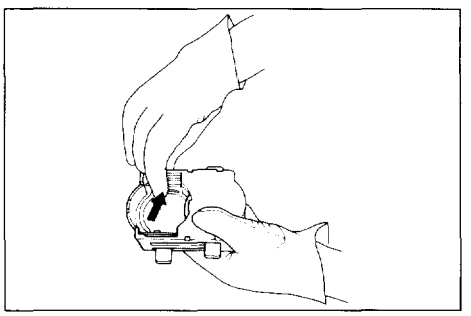


Fig.21

● Transparent Cover

Place the transparent cover on the ND filter cassette to protect the filters from dust (Fig.22-1). When the ND filter cassette is removed, place the transparent cover on the field lens (Fig.22-2). However, remove the cover during observation or photomicrographing with the viewfield diaphragm stopped down.

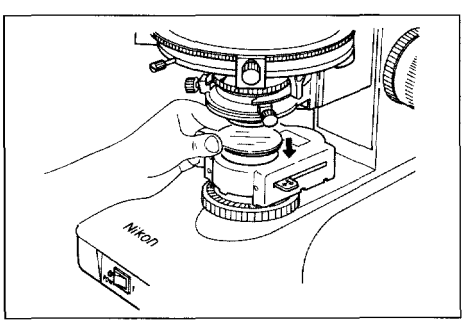


Fig.22-1

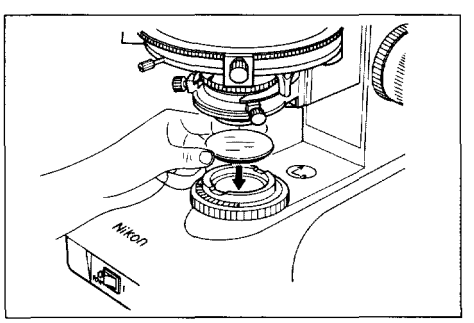


Fig.22-2

● Other filters

- ϕ33mm Lemon skin filter
  When the optional achromat condenser is used, insert the ϕ33mm lemon skin filter into the receptacle between the collector lens and the lamp bulb. (Fig.23-1)
- ϕ45mm heat absorbing filter
  When the heat absorbing filter is used, mount it into the diffuser holder and insert into the bottom of the microscope base. (Fig.23-2)

Caution when mounting

Two ϕ45 filters (each should be less than 3mm in thickness) can be set on the diffuser holder. Place the filter on the diffuser holder and insert the holder into the base as shown in Fig.23-2. (Since filters are not securely fixed on the holder, do not turn the holder upside-down while mounting.)

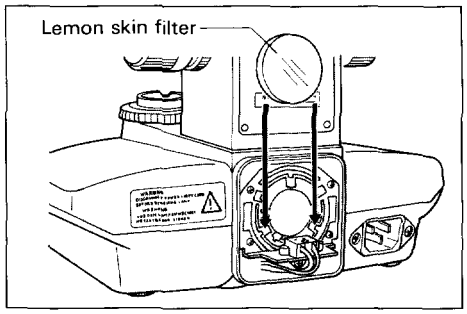


Fig.23-1

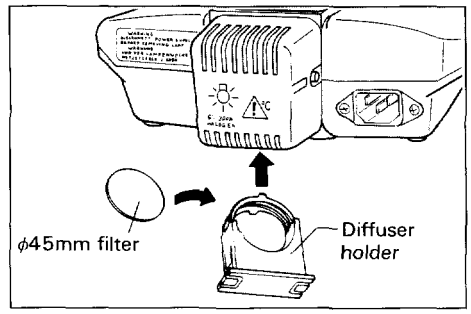


Fig.23-2

16. Objectives and Eyepieces

In the LABOPHOT2-POL, the CF P objectives (strain-free) and CF eyepieces based on the CF (Chromatic Aberration Free) system are adopted. **Always use the CF objective and the CF eyepiece in combination.**

Since the compensation of chromatic aberration is carried out respectively in the objective and the eyepiece, the direct image produced by the objective can be utilized for observation by a TV camera, etc.

- With the objectives marked "160/0.17", **use a coverglass of 0.17mm in thickness.**
- The indication "160/-" on the objective means that no matter whether a coverglass is used or not, no decrease of image definition or of contrast will result.
- When the eyepiece with cross lines and scale is inserted into the eyepiece sleeve with the orientation pin fitted to the right-hand groove of the sleeve, the 0-direction of the analyzer and dia-polarizer are aligned with the cross lines direction.
  If the orientation pin is fitted to the upper-right groove of the sleeve, the cross lines will be aligned with the diagonal position of the polarization.
- CF PL Projection lenses are exclusively designed for photomicrography. **Do not use them for observation.**
- For focusing with the binocular observation tube in photomicrography, **use the eyepiece with photo mask.**

V . OPTIONAL ACCESSORIES

1. Sénarmont Compensator

To be inserted into the compensator slot of the intermediate tube in place of the 1/4λ & tint plate to measure the retardation with the accuracy of the lambda (λ) unit. (Fig.24)

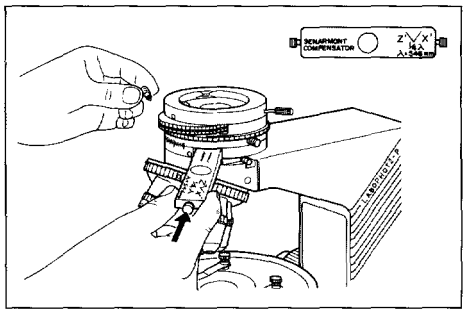


Fig.24

1) Detecting extinction position

Rotate the stage with the specimen under the crossed Nicols to find out the direction where the part of the specimen to be measured appears darkest.

2) Detecting subtraction position

Rotate the stage 45° to bring it from the extinction position to the diagonal position. Insert the 1/4λ & tint plate into the optical path, and confirm that the interference color of the part of the specimen to be measured changes toward the lower order side. If the color changes toward the higher order side, rotate the stage another 90°.

3) Measurement

Place the GIF filter on the filter receptacle, and replace the 1/4λ & tint plate with the compensator.

Rotate the analyzer so that the part of the specimen to be measured becomes darkest.

Let the angle of the above analyzer rotation be theta (θ) then the retardation R (nm) will be obtained as follows:

$$R=\frac{\theta}{180}\lambda$$

Where λ: wave length of the light used for the measurement

When the GIF filter is used: λ=546nm

2. Quartz Wedge

To be inserted into the compensator slot of the intermediate tube instead of the 1/4λ & tint plate. (Fig.25)
The quartz wedge is engraved with scale and used for the rough measurement of retardation in the range of 1λ-6λ.

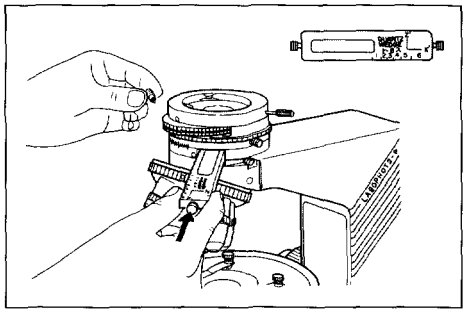


Fig.25

1) Detecting extinction position

Detect the position where the part of the specimen to be measured becomes darkest by rotating the stage under the crossed Nicols.

2) Detecting subtraction position

Rotate the stage 45° to bring it from the extinction position to the diagonal position. Insert the quartz wedge into the optical path, and confirm that the interference color of the part of the specimen to be measured changes toward the lower order side.
If the color changes toward the higher order side, rotate the stage another 90°.

3) Measurement

Slide the quartz wedge along the slot, and the interference color changes.
Stop sliding the quartz wedge where the dark stripe covers the part of the specimen to be measured. In this position, find the part with no object under the same dark stripe, and compare the interference color of that part with the Interference Color Chart to assume the amount of retardation.
If the view field around the part to be measured is entirely filled with the object, restrict the illumination to the part to be measured by means of the field diaphragm, remove the specimen from the optical path and then compare the interference color with the Chart.

3. Pin Hole Eyepiece

Replace one of the paired eyepieces with the pin hole eyepiece. Remove the Bertrand lens out of the optical path, and the conoscopic image can be observed overlapping the orthoscopic image through the binocular observation. (Fig.26)
In the above simultaneous observation of both images, the conoscopic image may be observed deviated from the orthoscopic view field center. The conoscopic image observed through the pin hole eyepiece is represented by the conoscopic light flux that covers the central part of the orthoscopic view field to the extent of about 1/20.

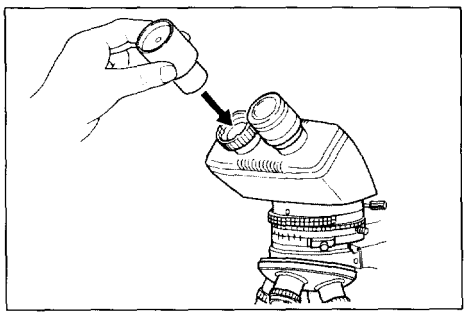


Fig.26

4. Attachable Mechanical Stage

Mount the attachable mechanical stage on the circular graduated stage, inserting the two positioning pins on the bottom of the attachable stage into the two pin holes on the graduated stage surface. Tighten the clamp screw using a screwdriver or coin. (Fig.27)
The attachable mechanical stage with point counters (whose pitch are 0.2mm or 0.3mm) is also available. The point counter can be replaced by releasing the head of the point counter using a coin and removing the milled part of the counter.
To release the click-stop of the point counter, release the click spring nut.

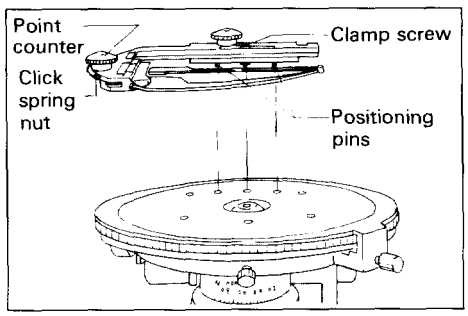


Fig.27

5. Universal Epi-illuminator

Used for episcopic polarizing microscopy, mounted between the LABOPHOT 2-POL stand and the intermediate tube.

1) Nomenclature and Assembly

Referring to Fig.28, assemble in the order given.

① Remove the eyepiece tube and the intermediate tube from the microscope stand.

② Mount the universal epi-illuminator on the microscope arm, positioning the illuminator nearly parallel to the arm. Clamp the screw.

③ Attach the lamp bulb (12-50W Halogen lamp) and socket to the lamp housing. Release sufficiently the clamp screw on the lamp housing, and mount it to the universal epi-illuminator. Retighten the clamp screw.

④ Connect the lamp cord to the transformer.

⑤ Remove the accessory ND32 filter slider from the illuminator. Insert the polarizer slider into the illuminator until the slider clicks twice.

⑥ Place the filters.

⑦ Mount the intermediate tube onto the illuminator, fitting the notch of the circular dovetail with the end of the clamp screw. Fasten the clamp screw.

⑧ Referring to p.8, mount the eyepiece tube on the intermediate tube.

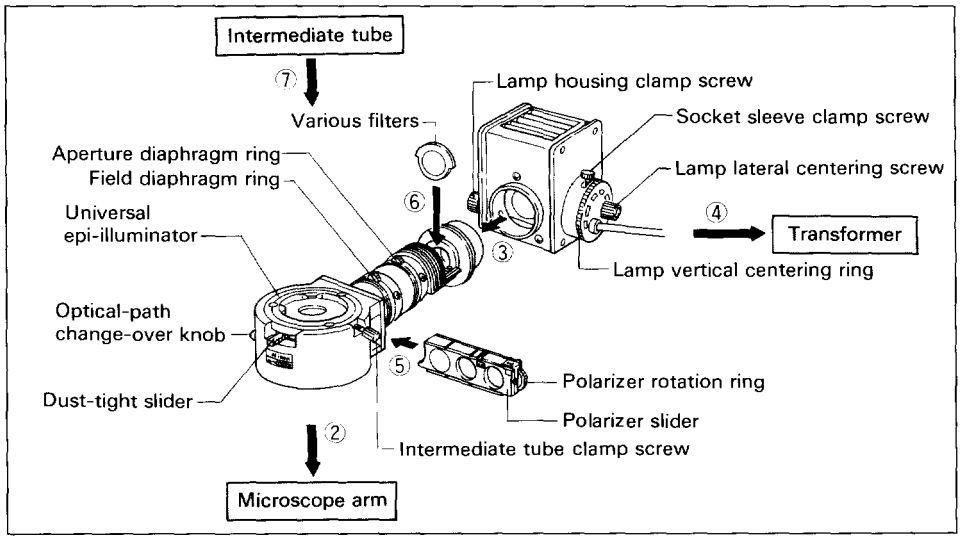


Fig.28

2) Preparation

(1) Centering the lamp

① Make certain that the optical-path change-over knob is pushed in to the limit.
② Turn ON the power switch on the transformer and set the voltage to 6V.
③ Fully open the aperture diaphragm.
④ Place the ND filter on the stage and focus on it using the 10× objective.
⑤ Remove the eyepiece from the sleeve(or put the Bertrand lens into the optical path), and looking into the exit pupil of objective, move the lamp housing back and forth to form a sharp image of the lamp filament on the diffuser of the exit pupil.
⑥ Manipulate the lamp centering screws to center the filament image on the exit pupil.

(2) Orientation of polarizer

① Roughly focus on the ND filter on the stage using the 40× objective.
② Set the analyzer scale to "0".
③ Bring the Bertrand lens into the optical path. Looking into the exit pupil of the objective, rotate the polarizer rotation ring to form the dark cross image on the exit pupil. (Fig. 29)

Note Take care not to touch the polarizer rotation ring while observing the specimen, or the orientation of the polarizer will have problems.
If it is touched by mistake, readjust the orientation.

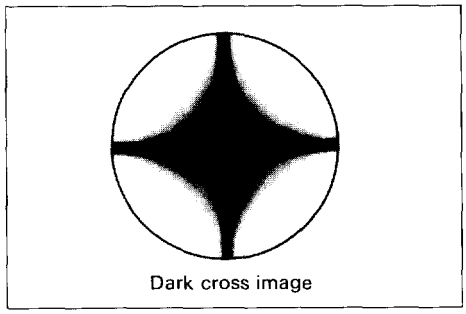


Fig.29

3) Objectives

Use the CF M Plan Achromat P series objectives (Strain-free, 210/45).

For microscopy, refer to the descriptions for diascopic polarizing microscopy.

Ⅵ. TROUBLESHOOTING

SEEING AND OPERATION

Failures	Causes	Actions
Darkness at the periphery. Uneven brightness of viewfield. No appearance of viewfield.	Optical path in trinocular tube not fully changed.	Changeover the optical path securely to binocular observation tube. (p.24)
	Optical path in trinocular tube not changed-over for binocular observation.	
	Revolving nosepiece not in click-stop position (objective not centered in optical-path).	Revolve it to click-stop position (put objective into optical path). (p.12)
	Condenser is too low.	Position correctly so the viewfield diaphragm image is formed. (p.22)
	Condenser not centered.	Centering. (p.22)
	Condenser not mounted correctly.	Mount correctly. (p.6)
	ND filter not fully changed-over.	Changeover to the limit.
	Field diaphragm closed too much.	Open properly. (p.24)
	Improper combination of objective and condenser.	Use proper combination.
	Dirt or dust on the lens (field lens, condenser, objective, eyepiece, eyepiece tube entrance lens) or specimen.	Cleaning. (p.ii)
	Lamp not mounted correctly.	Mount properly. (p.5)
	Bertrand lens in optical path.	Remove out of the optical path. (p.18)
	Top lens of the condenser not fully swung-out/in.	Swing in or out to the limit. (p.19)
	1/4λ & tint plate or compensator not in correct position.	Insert properly. (p.19)

Failures	Causes	Actions
Dirt or dust in the viewfield.	Position of condenser too low.	Position correctly so the viewfield diaphragm image is formed. (p.22)
	Aperture diaphragm too restricted.	Open properly. (p.23)
	Dirt or dust on the lens (field lens, condenser, objective, eyepiece, eyepiece tube entrance lens) or specimen.	Cleaning. (p.ii)
Poor image obtained (Contrast is too strong or too weak.) (Details are not clear.)	Aperture diaphragm too restricted.	Open properly. (p.23)
	Position of condenser too low.	Position correctly so the viewfield diaphragm image is formed. (p.22)
	Too thick or thin coverglass.	Use specified thickness (0.17mm) coverglass.
	No coverglass attached.	
	NCG objective for observing specimen without coverglass used to observe specimen with coverglass.	Use normal objective for observing specimen with coverglass.
	Normal objective for observing specimen with coverglass used to observe specimen without coverglass.	Use NCG objective.
	No immersion oil used on the front of immersion system objective.	Use Nikon immersion oil. (p.26)
	Immersion oil used not the type specified.	
	Air bubbles in immersion oil.	Remove bubbles. (p.26)
	Immersion oil soils the top of dry system objective (especially 40×).	Cleaning. (p.26)
	Compensation ring of objective not adjusted.	Adjust to match coverglass.
	Dirt or dust on the lens (field lens, condenser, objective, eyepiece, eyepiece tube entrance lens) or specimen.	Cleaning.

Failures	Causes	Actions
One side of image is dim.	Revolving nosepiece not in click-stop position.	Revolve it to click-stop position. (p.12)
	Specimen rises from stage surface.	Place it stably by specimen clips on stage. (p.12)
	Stage tilted.	Attach correctly. (p.7)
Image moves while being focused.	Revolving nosepiece not in click-stop position.	Revolve it to click-stop position. (p.12)
	Specimen rises from stage surface.	Place it stably by specimen clips on stage. (p.12)
	Condenser lens not correctly centered.	Centering. (p.22)
	Stage tilted.	Attach correctly. (p.6)
Image tinged yellow.	NCB11 filter not used.	Use NCB11 filter. (p.11)
	Lamp power source voltage too low.	Adjust the lamp voltage by manipulating the brightness adjuster. Use the optional ND filter cassette if the constant color temperature is to be desired. (p.11&27)
Image too bright.	Lamp power source voltage too high.	
Not bright enough (see also Electrical).	Lamp power source voltage too low.	
	Aperture diaphragm too restricted.	Open properly. (p.23)
	Position of condenser too low.	Position correctly so the viewfield diaphragm image is formed. (p.22)
	Optical path change-over of trinocular tube not 100% binocular.	Changeover so that 100% of light enters binocular part. (p.24)

Failures	Causes	Actions
No focused image obtained with high power-objectives.	Slide upside-down.	Attach to stage with coverglass up (when no coverglass, specimen surface should be up). (p.12)
	Coverglass too thick.	Use coverglass of specified thickness (0.17mm).
High-power objective touches the specimen, when changed-over from low power.	Slide upside-down.	Attach to stage with coverglass up (when no coverglass, specimen surface should be up). (p.12)
	Coverglass too thick.	Use coverglass of specified thickness (0.17mm).
	Eyepiece diopter not adjusted.	Diopter adjustment. (p.25)
Insufficient parfocality of objective when changed-over.	Eyepiece diopter not adjusted.	Diopter adjustment. (p.25)
Movement of image not smooth when moving the specimen. (When optional attachable mechanical stage is used)	Attachable stage not tightly fastened to stage.	Fasten it tightly. (p.32)
Travel of stage limited to one-half length of slide. (When optional attachable mechanical stage is used)	Improper attachment of attachable stage.	Shift the attachment position. (p.32)

Failures	Causes	Actions
No cohesion of binocular image.	Interpupillary distance not adjusted.	Adjust interpupillary distance. (p.25)
	Eyepiece diopter not adjusted.	Diopter adjustment. (p.25)
	Magnifications of right and left eyepieces differ.	Use same eyepieces.
Experiencing eye fatigue.	Interpupillary distance not adjusted.	Adjust interpupillary distance. (p.25)
	Eyepiece diopter not adjusted.	Diopter adjustment. (p.25)
	Inadequate illumination.	Adjust the lamp voltage by manipulating the brightness adjuster. Use the optional ND filter cassette and adjust the brightness with combination of ND filters. (p.27)

ELECTRICAL

Failures	Causes	Actions
Lamp does not light even though switched ON.	No electricity obtained.	Connect the cord to socket.
	No bulb attached.	Attach lamp. (p.5)
	Bulb blown.	Replacement. (p.5)
	Lamp not correctly mounted.	Attach securely. (p.5)
Flickering and unstable illumination.	Bulb about to blow.	Replacement. (p.5)
	Connector not secure.	Connect power source cord securely. (p.10)
	Bulb insufficiently inserted into the socket.	Positive connection. (p.5)
Bulb immediately blown.	Bulb used not the one specified.	Use 6V 30W halogen lamp.
Insufficient illumination.		

ELECTRICAL SPECIFICATIONS

For 100-120V area

(1) Power Source: 100-120V AC, 0.8A, 50/60Hz
(2) Light Source
Lamp rating: 6V DC, 30W
Lamp type: Nikon 6V 30W Halogen lamp
(3) Protection Class: Class I
(4) Coforming Standards: This product conforms to UL 1262.
(5) Operating Environmental Conditions
Room temperature: 40°C max.
Relative humidity: 85% max.

For 220-240V area

(1) Power Source: 220-240V AC, 0.4A, 50/60Hz
(2) Light Source
Lamp rating: 6V DC, 30W
Lamp type: Nikon 6V 30W Halogen lamp
(3) Protection Class: Class I
(4) Coforming Standards: This product conforms to DIN VDE0411 and IEC1010.
(5) Operating Environmental Conditions
Room temperature: 40°C max.
Relative humidity: 85% max.

REFERENCE

This manual instructs only how to manipulate the LABOPHOT2-POL microscope.

For the practical explanation on polarizing microscopy, refer to the following special works:

- "AN INTRODUCTION TO THE METHODS OF OPTICAL CRYSTALLOGRAPHY"
  — F. Donald Bloss —
  Holt, Rinehart and Winston

- "ORE MICROSCOPY"
  — Eugene n. Cameron —
  John Wiley & Sons. Inc.

- "THE POLARIZING MICROSCOPE"
  — A. F. Hallimond —
  Vickers Instruments

- Nikon reserves the right to make such alterations in design as may be considered necessary in the light of experience. For this reason, particulars and illustration in this handbook may not conform in every detail to models in current production.