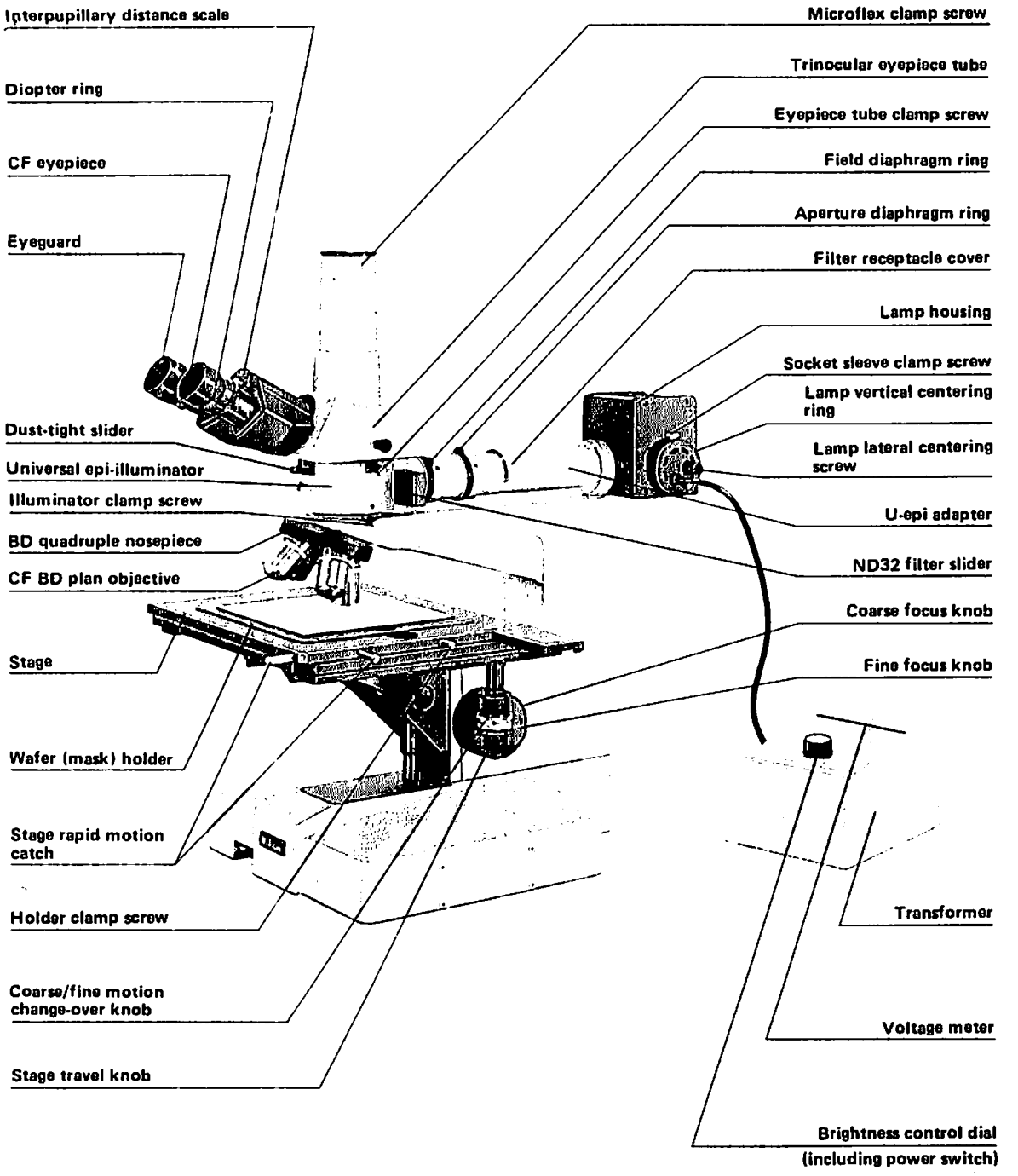
Nikon

Microscope
OPTIPHOT 66

INSTRUCTIONS

NIKON CORPORATION

(1)



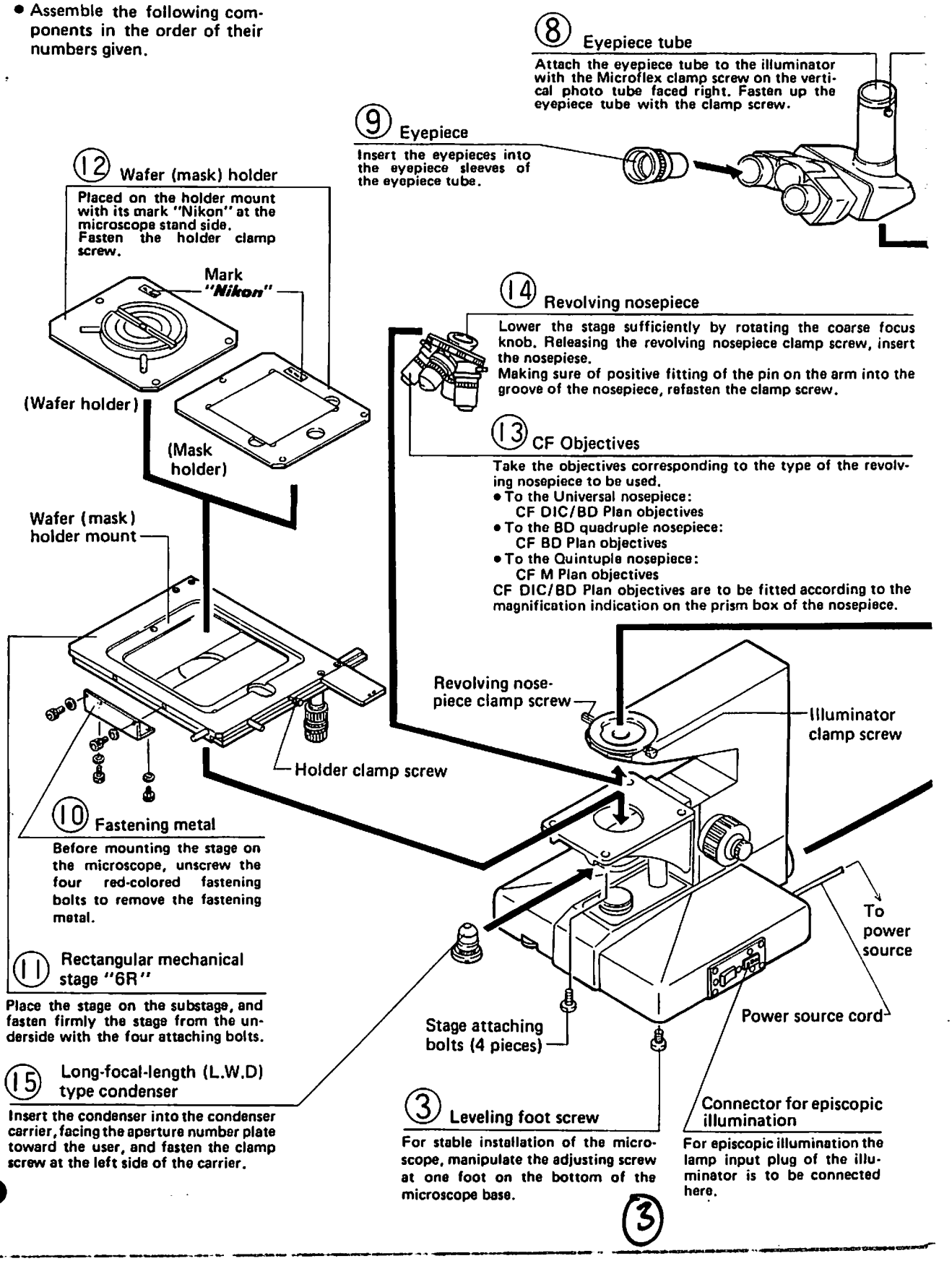
For Episcopic Bright Field Microscopy

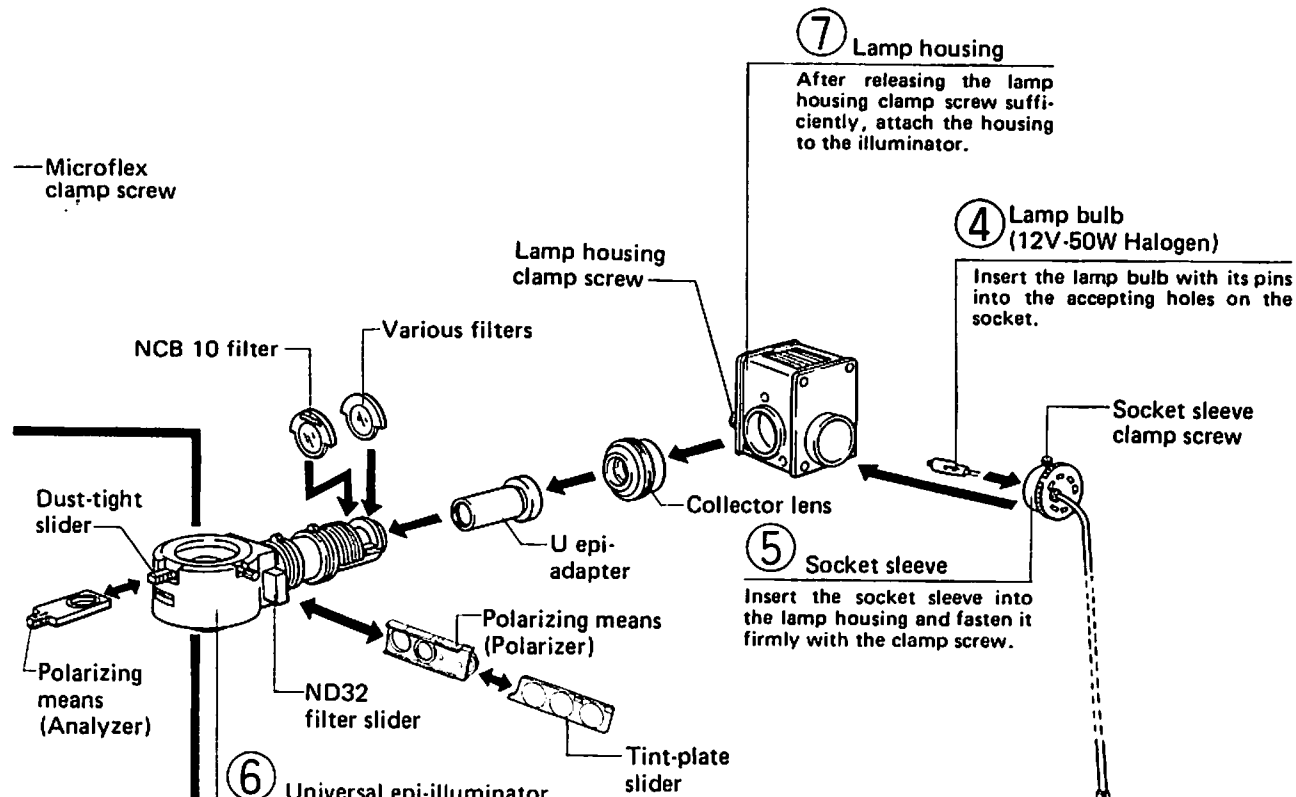
Fig. 2

(2)

II. ASSEMBLY

- Assemble the following components in the order of their numbers given.





(7) Lamp housing

After releasing the lamp housing clamp screw sufficiently, attach the housing to the illuminator.

(4) Lamp bulb (12V-50W Halogen)

Insert the lamp bulb with its pins into the accepting holes on the socket.

(5) Socket sleeve

Insert the socket sleeve into the lamp housing and fasten it firmly with the clamp screw.

(6) Universal epi-illuminator

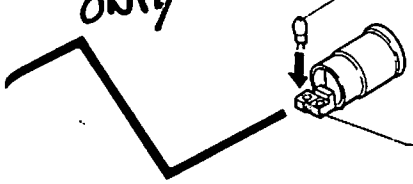
Remove once the collector lens from the illuminator, attach the U-epi adapter to the illuminator then reattach the collector lens to the U-epi adapter.
Attach the Illuminator onto the arm with the optical-path change-over knob faced left, and fasten it up with the clamp screw.

(18) Lamp input plug

Connect the plug to the connector for episcopic illumination on the microscope base.
For simultaneous epi- and dia-illumination connect the plug with the transformer available on order.
Note: For disconnecting the plug, pull out the plug itself, not the cord.

TRANSMITTED ONLY

Light → **(16) Lamp bulb (6V–20W Halogen)**



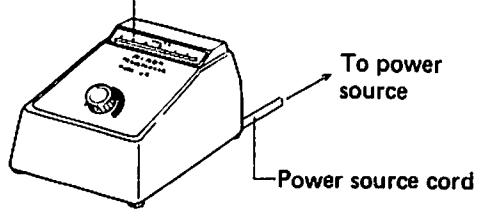
Insert the lamp bulb with its pins into the accepting holes on the socket.

(17) Socket

Insert the socket into the microscope base with the white index dot on the socket coinciding with that on the base.

Transformer (available on order)

Use the transformer for the power source of the Epi-illuminator when the simultaneous epi- and dia-illumination is used.
Make sure of the indication of the power source voltage.

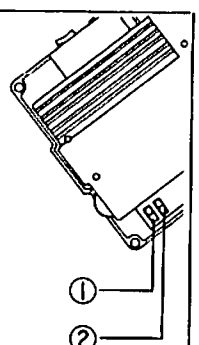


(1) Setting the lamp voltage change-over switch

Set the lamp voltage change-over switch on the bottom of the microscope base to 12V–50W.
(When the Epi-Bright/Dark Field Illuminator "BD" is used, this switch is to be set to 6V–20W.)

(2) Setting the power source voltage change-over switch

Set the power source voltage change-over switch on the bottom of the microscope base to the line voltage to be used.



III. PREPARATIONS

1. Preparations for Episcopic Illumination Microscopy — Centering the lamp —

① Push in the optical-path change-over knob for brightfield illumination.

② Change over the dia/epi illumination change-over switch on the microscope base to EPI.

③ Connect the power source cord to the AC power source, turn the brightness control dial (including power switch) to ON to light the lamp of the illuminator, and set the scale on the dial to 8. (The middle of the white figure 4 and engraved figure 8 is faced to the index on the microscope base.)

④ If the Nomarski prism, polarizer, analyzer and tint-plate sliders are in the optical path, pull them all out. (Refer to p.21~24-2.)

⑤ Fully open the aperture diaphragm.

⑥ Place a high reflection wafer on the stage, and swing in the objective 10×. (ND 16 filter may be used in place of the wafer.)

⑦ Focus on the wafer. For facilitating the focusing, close the field diaphragm and obtain the clear image of the diaphragm.

⑧ Draw out an eyepiece from either of the observation tubes on the trinocular eyepiece tube. Look into the tube, and the image of the exit pupil of the objective will be visible as a bright circle, together with the surface of the diffuser built in the illuminator.
Releasing the lamp housing clamp screw, move the lamp housing back and forth, until the filament image is focused on the diffuser and the exit pupil. Lock the lamp housing in this position. Thereafter, releasing the socket sleeve clamp screw, rotate the lamp lateral centering screw and vertical centering ring, so that the filament image is centered to the exit pupil. (Fig. 4)

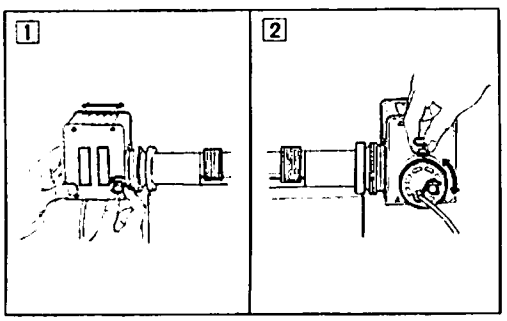


Fig. 4

[Note] When the high pressure mercury lamp housing is used, push in the polarizer and analyzer to the optical path and rotate the polarizer to obtain an adequate brightness, thereafter make centering the lamp.

2. Preparations for Diascopic Illumination Microscopy — Centering the condenser lens —

① Change over the dia/epi illumination change-over switch to DIA.

② Connect the power source cord to the AC power source, turn the brightness control dial (including power switch) to ON to light the lamp of the illuminator, and set the scale on the dial to white figure 4.
The middle of the white figure 4 and engraved figure 8 is faced to the index on the microscope base.
(Note that the centering of the diascopic illumination lamp is not necessary because of being precentered type.)

③ Close the field diaphragm in the microscope base to its smallest size by means of 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 wafer (mask) surface.

④ Bring the field diaphragm image to the center of the field of view by means of the condenser centering screws. (Fig. 5- 1)

⑤ Change over to the 40× objective, and adjust the field diaphragm so that the image of the diaphragm is about the same as that of the field of view, as shown in Fig. 5- 2 .
If not centered, use the condenser centering screws again.
If the condenser should not be correctly centered, insufficient brightness of illumination would result.

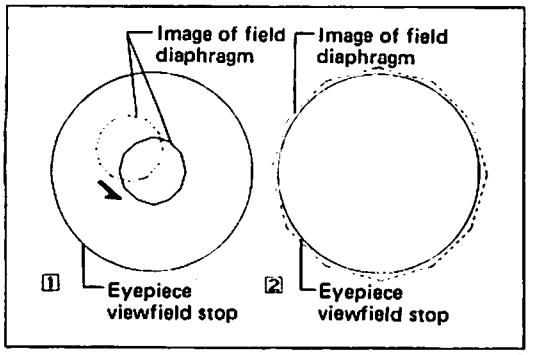


Fig. 5

3. Preparations for Simultaneous Epi- and Dia-Illumination Microscopy

Proceed the preparations for episcopic illumination microscopy and diascopic illumination microscopy.
In this case, the optional transformer is used for the power source of the episcopic illuminator, therefore, take notice of the followings, when the centering of the episcopic illumination lamp is made.

① Change over the dia/epi illumination change-over switch to DIA.

② Connect the power source cord of the microscope base and that of the transformer to the AC power source, respectively.

③ Set the scale on the brightness control dial on the microscope base to white figure 4, and voltage meter on the transformer to 6V or so.

1. Episcopic brightfield microscopy

① Push in the optical-path change-over knob to the limit and make sure of the brightfield illumination, indication "B. F.".

② Change over the dia/epi illumination change-over switch on the microscope base to EPI.

③ If the polarizer, analyzer and tint-plate are in the optical path, pull them all out.
When the universal revolving nosepiece is used, pull out the built-in Nomarski prism slider. (Refer to p.25-3.)

④ Turn ON the brightness control dial on the microscope base to light the lamp.
Set the scale on the dial to 8 ~ 10.

⑤ Remove the ND32 filter out of the optical path.
Place the NCB10 and ND16 filters in the optical path.

⑥ Place the wafer on the stage and focus on the wafer using 10× objective.

⑦ Adjust the interpupillary distance and diopter.
(Refer to p.25-5. & 6.)

⑧ Make sure of correct illumination. (Refer to p.8-1.)

⑨ Insert the filters to be used. (Refer to p.21-1.)

⑩ Swing in the objective to be used and refocus on the wafer.
Though the BD 60× and higher magnification objectives are provided with a safety device, their top end lens surface being somewhat projected from the circumferential metal, be careful not to strike it against the wafer or others.
Put the optionally available L900C filter into the optical path when the M/BD 150× or 200× objective is used.

⑪ Adjust the brightness by ND filter or by changing the lamp voltage.
(Refer to p.21-1.)
Lamp voltage is to be adjusted within the range of 6V ~ 12V.

⑫ Adjust the aperture and field diaphragms (episcopic).
(Refer to p.26-7. & 8.)

2. Episcopic darkfield microscopy

① Pull out the optical-path change-over knob to the limit and make sure of the darkfield illumination, indication "D.F.".

② Change over the dia/epi illumination change-over switch on the microscope base to EPI.

③ If the polarizer, analyzer and tint-plate are in the optical path, pull them all out.
When the universal revolving nosepiece is used, pull out the built-in Nomarski prism slider.

④ Turn ON the brightness control dial on the microscope base to light the lamp.
Set the scale on the dial to 12.

⑤ Place the NCB10 and ND32 filters in the optical path.

⑥ Open the field and aperture diaphragms (episcopic).

⑦ Place the wafer on the stage and focus on the wafer using 10 × objective.

⑧ Adjust the interpupillary distance and diopter.
(Refer to p.25-5. & 6.)

⑨ Make sure of correct illumination. (Refer to p.8-1.)

⑩ Insert the filters to be used. (Refer to p.21-1.)

⑪ Swing in the objective to be used and refocus on the wafer.
Though the BD 60 × and higher magnification objectives are provided with a safety device, their top end lens surface being somewhat projected from the circumferential metal, be careful not to strike it against the wafer or others.
Furthermore, the characteristics (directionality, etc.) of the image produced by such objectives may be affected by the degree of centering of the lamp (light source). It is necessary to perform recentering of the lamp, watching the image.

⑫ Adjust the brightness by ND filter or by changing the lamp voltage.
(Refer to p.21-1.)
Lamp voltage is to be adjusted within the range of 6V ~ 12V.

★ Changing-over the episcopic brightfield microscopy to the episcopic darkfield or vice versa

(1) Insert the ND32 filter for dazzle-prevention into the optical path. (Refer to p.21-2. -(1)).

(2) Changing-over the brightfield microscopy to the darkfield

① Pull out the optical-path change-over knob to the limit.
② Open the field and aperture diaphragms (episcopic).
③ Adjust the brightness by ND filter or by changing the lamp voltage.

(3) Changing-over the darkfield microscopy to the brightfield

① Push in the optical-path change-over knob to the limit.
② Adjust the aperture and field diaphragms (episcopic).
(Refer to p.26-7. & 8.)
③ Adjust the brightness by ND filter and by changing the lamp voltage.

Lamp voltage is to be adjusted within the range of 6V ~ 12V.

3. Universal revolving nosepiece

Different Nomarski prisms being to be used depending upon the microscope magnification, it is important to bring the magnification indication into coincidence with the magnifying power of the CF BD Plan DIC objective to be used.
In differential interference observation, push in the Nomarski prism slider, until it comes to the limit, but in other types of microscopy, pull it out to the limit.
(Fig. 13)

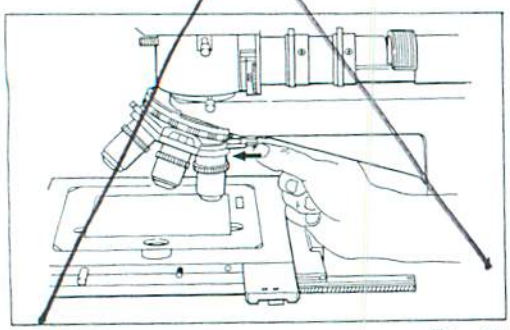


Fig. 13

4. Changing over of illuminating light

Pushing in or pulling out of the optical-path change-over knob to the limit permits bright-or darkfield observation, respectively. (Fig. 14)

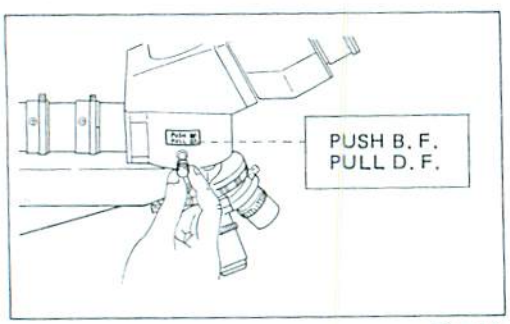


Fig. 14

To diascopic microscopy using the microscope stand with the built-in diascopic illuminator, pull out the knob.
For simultaneous dia-and-epi illumination microscopy, push in the knob.

5. Interpupillary distance adjustment

① Insert the NCB 10 filter into the filter receptacle.
② As shown in Fig. 15, adjust the interpupillary distance, so that both the right and left viewfields become one.

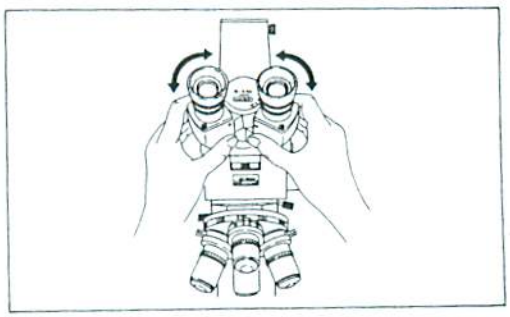


Fig. 15

6. Diopter adjustment

Make diopter adjustment for both the right and lefthand eyepieces.
① Turn the diopter ring on each eyepiece, until the end surface of the milled ring coincides with the engraved line, as shown in Fig. 16.

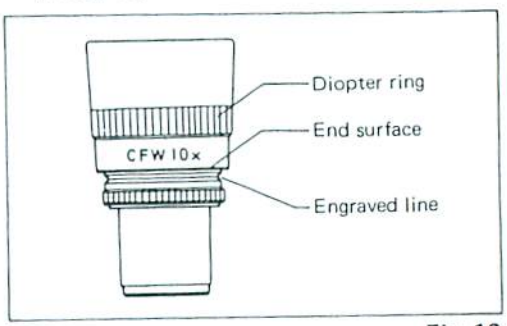


Fig. 16

② Place the wafer on the stage. Swing the objective 40× into position, and bring the wafer image into focus. For facilitating the focusing, first use the 10× and then 40× objective.
③ Thereupon, swing the objective 5× into position.
Without manipulating the coarse-and-fine focus knob, turn the diopter rings on the eyepieces, so that the wafer images in the right and lefthand eyepieces are focused individually.

- Repeat the above procedure two times, and a perfect diopter adjustment will be achieved.
- The above adjustment, compensating the diopter difference between the user's right and left eyes, will keep the tube length of microscope correct, thus enabling him to realize the full advantages of the high-class objectives, including their parfocality.

④ Since the CF eyepieces are of high eyepoint type, it is not necessary for the user putting on his spectacles to remove them. Only fold down the eyeguard rubber. (Fig. 17)

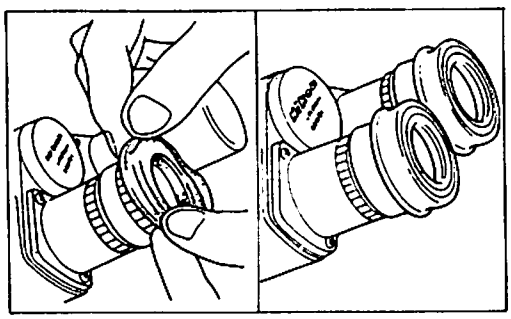


Fig. 17

7. Use of aperture diaphragm(episcopic)

The aperture diaphragm is provided for adjusting the numerical aperture (N.A.) of the illuminating system of microscope. It is important because it determines the resolution, 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. (Figs. 18 & 19)

After removing the eyepiece from the eyepiece tube, adjust the size of the diaphragm, observing the image of the diaphragm which is visible on the bright circle of exit pupil of objective inside the eyepiece tube.

Stopping down the aperture diaphragm too far will lower the resolving power.

Therefore, it is not recommended to stop down the aperture to a size smaller than 60% of the N.A. of the objective in use except when observing special wafers.

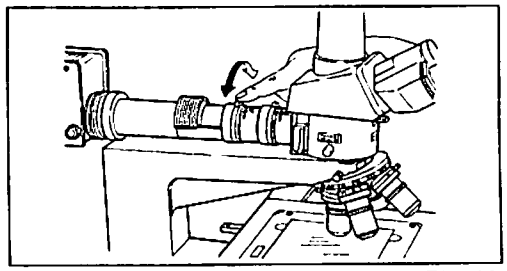


Fig. 18

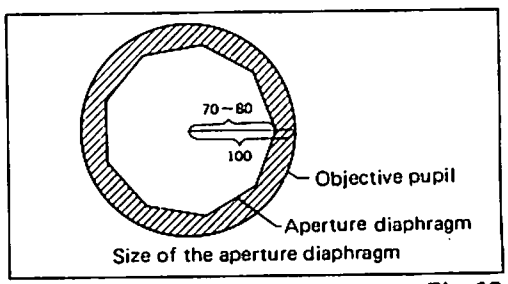


Fig..19

8. Use of field diaphragm (episcopic)

The field diaphragm is used for determining the illuminated area on the wafer surface in relation to the field of view of the microscope. (Fig. 20)

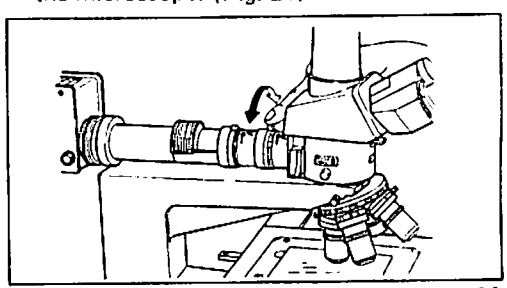


Fig. 20

Generally, it is stopped down to such an extent that the circumference of the illuminated area circumscribes or inscribes that of the eyepiece field of view. If the former be larger than the latter, 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

11. Use of stage

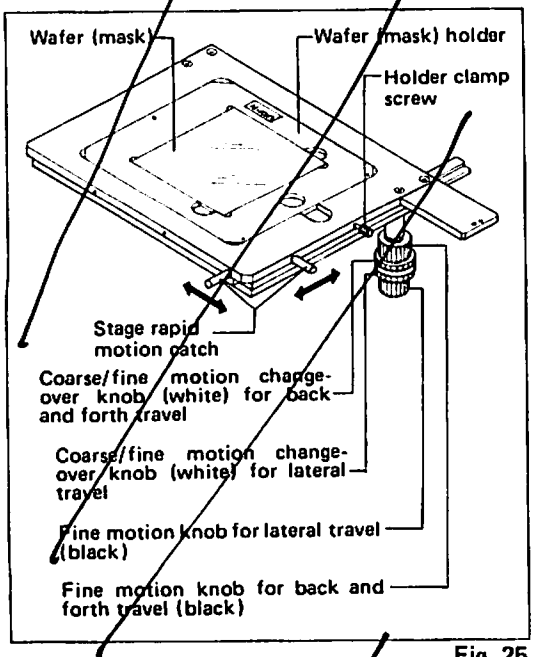


Fig. 25

Attachable wafer (mask) holders are four kinds of mask holder (6" × 6", 5" × 5", 4" × 4" and 3" × 3") and two kinds of wafer holder (5"/4" and 4"/3").

Stage can be moved with coarse or fine motion.

To change over the coarse/fine motion, manipulate the coarse/fine motion change-over knob for back and forth travel and lateral travel, respectively. For coarse motion, turn the change-over knob and settle it into the groove. Holding the stage rapid motion catch, move the stage.

Use the coarse motion for lower magnification inspection. In the position where the change-over knob rides on from the groove, the fine motion knob for each travel can be operated for higher magnification inspection.

One rotation of the fine motion knob for back and forth travel moves the stage 32mm, and that for lateral travel moves the stage 18.7mm. The stage rapid motion catch can be attached to either right or left side of the stage.

Note: For replacing the wafer (mask), lower the stage 5 ~ 10mm from the focused position.

12.Use of aperture diaphragm(diascopic)

The aperture diaphragm is provided for adjusting the numerical aperture (N.A.) of the illuminating system of microscope. It is important because it determines the resolution, 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. 26)

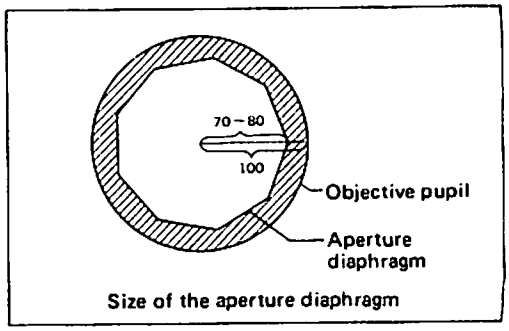


Fig. 26

After removing the eyepiece from the eyepiece tube, adjust the size of the diaphragm, observing the image of the diaphragm which is visible on the bright circle of exit pupil of objective inside the eyepiece tube.

Or the aperture diaphragm may be adjusted referring to the N.A. scale on the condenser according to the N.A. of the objective being used. It will be convenient for the future use to remember the scale reading and the magnification of objective, where the best image is obtained by this method.

Stopping down the aperture diaphragm too far will lower the resolving power.

Therefore, it is not recommended to stop down the aperture to a size smaller than 60% of the N.A. of the objective in use except when observing special wafer (mask).

IV. MICROSCOPY

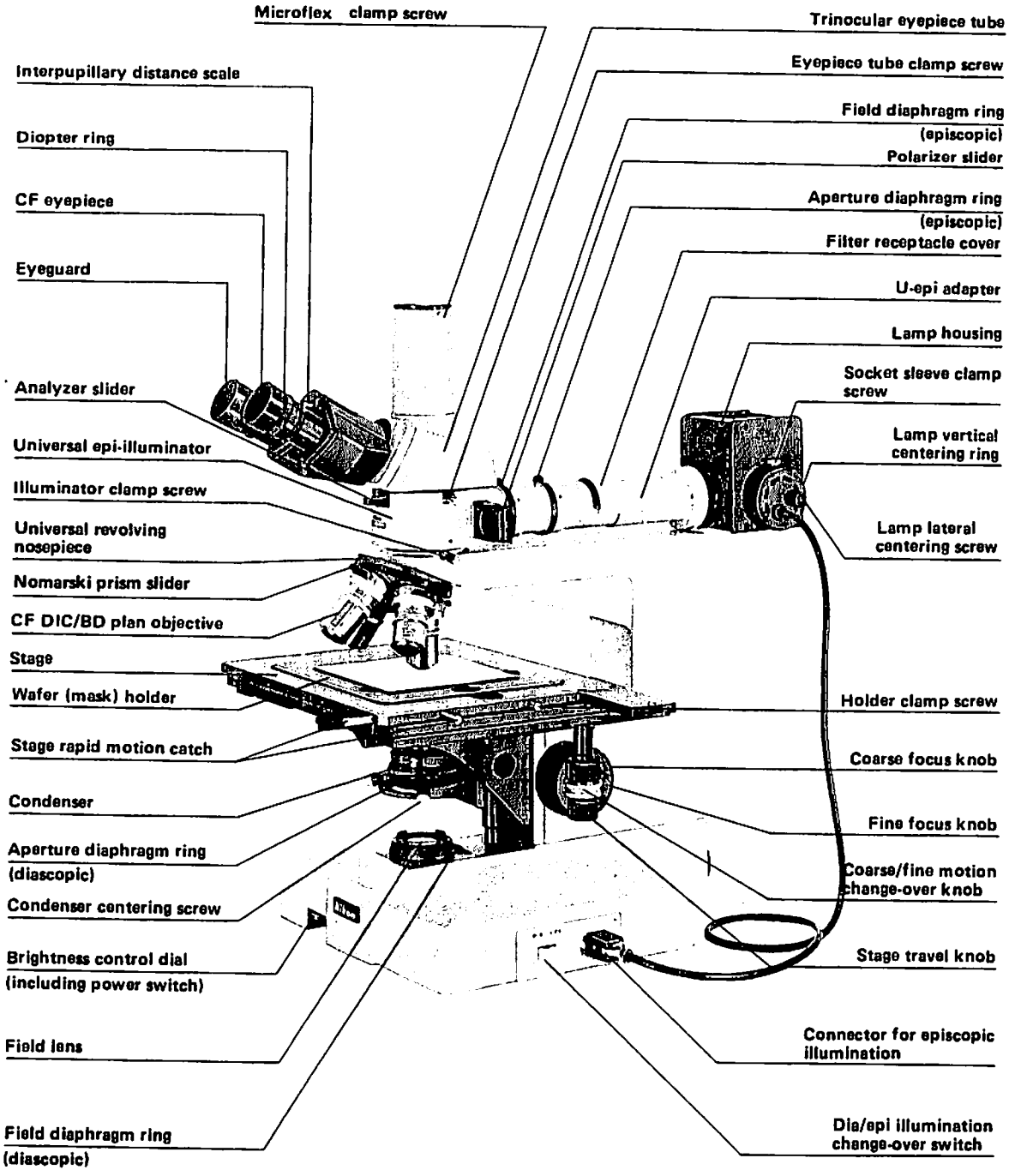
Available sets of microscope and Possible types of microscopy

Table 1

Microscopy / Microscope set	Episcopic							Diascopic brightfield
	Brightfield	Darkfield	Brightfield simplified polarizing	Darkfield simplified polarizing	Brightfield sensitive polarizing	Darkfield sensitive polarizing	Differential interference contrast	
X6B-M	○		○		●			○
X6B-BD	○	○	○	○	●	●		○
X6B-NR/BD	○	○	○	○	○	○	○	○
XP6B-M	○		○		●			
XP6B-BD	○	○	○	○	●	●		
XP6B-NR/BD	○	○	○	○	○	○	○	

○ : Microscopy as standard
○ : Necessitating additional use of polarizer and analyzer
● : Necessitating additional use of polarizer, analyzer and tint-plate

I. NOMENCLATURE



For Episcopic Differential Interference Contrast, Bright/Dark Field and Diascopic Bright Field Microscopies

Fig. 1

13. Use of field diaphragm (diascopic)

The field diaphragm is used for determining the illuminated area on the wafer (mask) surface in relation to the field of view of the microscope.
Generally, it is stopped down to such an extent that the circumference of the illuminated area circumscribes or inscribes that of the eyepiece field of view. If the former be larger than the latter, 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 illuminated area is slightly larger than the diagonal of film format.

14. Use of optical lenses

- In every case use the CF objectives in combination with the CF eyepieces.
- CF BD60× and BD100× objectives are with safety device, however, take care not to hit the top lens part of the objective which is slightly projected from the circumferential metal part against the wafer (mask) etc.
- CF PL Projection lenses are exclusively designed for photomicrography.
  Do not use them for observation.
- Every eyepiece is liable to gather dirt and dust, which not only appear as shadows but also impair image quality and contrast. Keep the eyepieces clean at all times.

CAUTIONS

❶ Avoid sharp knocks!
Handle the microscope gently, taking care to avoid sharp knocks.

❷ When carrying the microscope
When carrying the microscope, hold its arm with one hand, supporting the bottom of the microscope base with the other.

❸ Locations of microscope
Avoid the following conditions: dust, vibration and exposure to high temperature, moisture or direct sunlight.

❹ Power source voltage
In every case, make sure of the power source voltage referring to the specification indication plate on the rear of the microscope base and on the transformer. (Refer to the ELECTRIC SPECIFICATIONS on p. 43.)

❺ Lighting the lamp
Take care not to touch the lamp housing, and do not bring inflammable substances such as gasoline, thinner or alcohol near to the lamp housing.

❻ Replacing the lamp bulb and fuse
Before replacing the lamp bulb or fuse, turn OFF the power switch and disconnect the plug of the power source cord.
In such cases as of replacement, do not touch the lamp bulb with bare hands. If touched, clean with alcohol immediately.

❼ Dirt on the lens
Do not leave dust, dirt of finger marks on the lens surfaces.
They will prevent you from clear observation of the specimen image.

❽ Focus knobs
Never attempt to adjust the tension by turning the one focus knob, while holding the other. Adjustment is internal and can only be done by authorized Nikon Repair Personnel.

CARE AND MAINTENANCE

❶ Cleaning the lenses

To clean the lens surfaces, remove dust using a soft brush or gauze. Only for removing finger marks or grease, should soft cotton cloth, lens tissue or gauze lightly moistened with **absolute alcohol** (ethanol or methanol) be used.

For cleaning the objectives and immersion oil use only xylene. For cleaning the surface of the entrance lens of the eyepiece tube and the prism surface of the Trinocular Eyepiece Tube "T" or the Ultra Wide Eyepiece Tube "UW", use absolute alcohol.

Observe sufficient caution in handling alcohol and xylene.

❷ Cleaning the painted surfaces

Avoid the use of any organic solvent (for example, thinner, ether, alcohol, xylene etc.,) for cleaning the painted surfaces and plastic parts of the instrument.

❸ Never attempt to dismantle

Never attempt to dismantle the instrument so as to avoid the possibility of impairing the operational efficiency and accuracy.

❹ 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 air-tight container containing desiccant.

❺ Periodical checking

To maintain the performance of the instrument, we recommend the customers to check the instrument periodically by our qualified service personnel. (For details, contact your dealer.)

CONTENTS

3. Episcopic differential interference contrast microscopy

① Push in the optical-path change-over knob to the limit.

② Change over the dia/epi illumination change-over switch on the microscope base to EPI.

③ Insert the polarizer, analyzer and tint-plate into the optical path.
(Refer to p.21-2.)

④ Make certain that the CF BD Plan DIC objectives are attached to the universal revolving nosepiece according to the indication on the nosepiece. Then, push in the Nomarski prism slider to the limit.
(Refer to p.25-3.)

⑤ Turn ON the brightness control dial on the microscope base to light the lamp.
Set the scale on the dial to 8 ~ 10.

⑥ Remove the ND32 filter out of the optical path.
Place the NCB10 filter in the optical path.

⑦ Place the wafer on the stage and focus on the wafer using 10× objective.

⑧ Adjust the interpupillary distance and diopter.
(Refer to p.25-5. & 6.)

⑨ Make sure of correct illumination. (Refer to p.8-1.)

⑩ Insert the filters to be used. (Refer to p.21-1.)

⑪ Swing in the objective to be used and refocus on the wafer.
Though the BD 100 × DIC objective is provided with a safety device, their top end lens surface being somewhat projected from the circumferential metal, be careful not to strike it against the wafer or others.

⑫ Adjust the brightness by ND filter or by changing the lamp voltage.
(Refer to p.21-1.)
Lamp voltage is to be adjusted within the range of 6V ~ 12V.

⑬ Adjust the aperture and field diaphragms (episcopic).
(Refer to p.26-7. & 8.)

⑭ **To change the image contrast, rotate the polarizer and put in or out the tint-plate, as follows:**

In the state of the tint-plate pulled out of the optical path, when the index dot [●] on the polarizer rotation ring is brought to the triangle [▶] (refer to Fig. 6), the background will be dark, offering an interference image similar to the brightfield phase-contrast image.

When the background is changed from black to grey by a slight roration of the polarizer, a so-called sensitive color of grey will be obtained, offering the best image contrast, so that the image appears in relief like the shadowing in electron microscope to afford a bird's eye view of the phase-contrast distribution over the entire wafer.

In the state of black background, when the tint-plate is put in the optical path, the background will show a sensitive color of red-violet, offering the best color contrast.

Furthermore, in the state of the tint-plate put in the optical path, to make the background sky-blue, and interference image similar to the dark-contrast in the phase-contrast will appear. In the case of a wafer with large phase-contrast difference, in other words, with a surface uneven or in relief, it will be possible to change the background to another color, whereby the desired contrast will be obtained.

4. Episcopic brightfield simplified polarizing and sensitive polarizing microscopy

① Push in the optical-path change-over knob to the limit and make sure of the brightfield illumination, indication "B.F.".

② Change over the dia/epi illumination change-over switch on the microscope base to EPI.

③ If the polarizer, analyzer and tint-plate are in the optical path, pull them all out.
When the universal revolving nosepiece is used, pull out the built-in Nomarski prism slider. (Refer to p.25-3.)

④ Turn ON the brightness control dial on the microscope base to light the lamp.
Set the scale on the dial to 8 ~ 10.

⑤ Remove the ND32 filter out of the optical path.
Place the NCB10 and ND16 filters in the optical path.

⑥ Place the wafer on the stage and focus on the wafer using 10× objective.

⑦ Adjust the interpupillary distance and diopter.
(Refer to p.25-5. & 6.)

⑧ Make sure of correct illumination. (Refer to p.8-1.)

⑨ Insert the filters to be used. (Refer to p.21-1.)

⑩ Swing in the objective to be used and refocus on the wafer.
Though the BD 60 × and higher magnification objectives are provided with a safety device, their top end lens surface being somewhat projected from the circumferential metal, be careful not to strike it against the wafer or others.
Put the optionally available L900C filter into the optical path when the M/BD 150× or 200× objective is used.

⑪ Adjust the aperture and field diaphragms (episcopic).
(Refer to p.26-7. & 8.)

⑫ Insert the polarizer and analyzer into the optical path.
(Refer to p.21-2.)

⑬ Rotating the polarizer rotation ring, bring the index dot [●] into coincidence with the triangle mark [▶] to obtain the position of Crossed Nicols. (Refer to Fig. 6.)

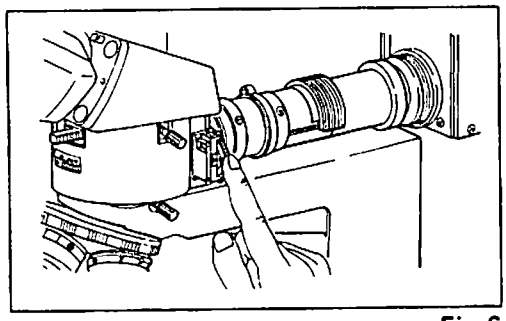


Fig. 6

⑭ Adjust the brightness by ND filter or by changing the lamp voltage.
(Refer to p.21-1.)

Lamp voltage is to be adjusted within the range of 6V ~12V.

⑮ Adjust the aperture and field diaphragms (episcopic).
(Refer to p.26-7. & 8.)

⑯ In this position, push in the tint-plate into the optical path in place of the ND32 filter supplied for the polarizer slider as an accessory (refer to p.23-2. (4)), and the microscopy by a sensitive color of red-violet will be effective.

5. Episcopic darkfield simplified polarizing and sensitive polarizing microscopy

① Pull out the optical-path change-over knob to the limit and make sure of the darkfield illumination, indication "D.F.".

② Change over the dia/epi illumination change-over switch on the microscope base to EPI.

③ If the polarizer, analyzer and tint-plate are in the optical path, pull them all out.
When the universal revolving nosepiece is used, pull out the built-in Nomarski prism slider.

④ Turn ON the brightness control dial on the microscope base to light the lamp.
Set the scale on the dial to 12.

⑤ Place the NCB10 and ND32 filters in the optical path.

⑥ Open the field and aperture diaphragms (episcopic).

⑦ Place the wafer on the stage and focus on the wafer using 10 × objective.

⑧ Adjust the interpupillary distance and diopter.
(Refer to p.25-5. & 6.)

⑨ Make sure of correct illumination. (Refer to p.8-1.)

⑩ Insert the filters to be used. (Refer to p.21-1.)

⑪ Swing in the objective to be used and refocus on the wafer.
Though the BD 60 × and higher magnification objectives are provided with a safety device, their top end lens surface being somewhat projected from the circumferential metal, be careful not to strike it against the wafer or others.
Furthermore, the characteristics (directionality, etc.) of the image produced by such objectives may be affected by the degree of centering of the lamp (light source).
It is necessary to perform recentering of the lamp, watching the image.

⑫ Insert the polarizer and analyzer into the optical path.
(Refer to p.21-2.)

⑬ Rotating the polarizer rotation ring, bring the index dot [●] into coincidence with the triangle mark [▶] to obtain the position of Crossed Nicols. (Refer to Fig. 6.)

⑭ Adjust the brightness by ND filter or by changing the lamp voltage.
(Refer to p.21-1.)

Lamp voltage is to be adjusted within the range of 6V ~ 12V.

⑮ Adjust the aperture and field diaphragms (episcopic).
(Refer to p.26-7. & 8.)

⑯ In this position, push in the tint-plate into the optical path in place of the ND32 filter supplied for the polarizer slider as an accessory (refer to p.21-2. (4)), and the microscopy by a sensitive color of red-violet will be effective.

6. Diascopic brightfield microscopy

① Change over the dia/epi illumination change-over switch to DIA.
② Turn ON the brightness control dial on the microscope base to light the lamp of the Dia-Illuminator built in the base, and set the scale on the dial to white figure 4.
③ Remove the dust cap and place the daylight filter onto the field lens.
④ Pull out the optical-path change-over knob to the limit and make sure of the darkfield illumination, indication "D.F.".
⑤ Place the wafer on the stage.
Focus on the wafer using 10 × objective.
⑥ Adjust the interpupillary distance and diopter. (Refer to p. 25-5. & 6.)
⑦ Carry out the centering procedure for the condenser. (Refer to p. 9)
⑧ Swing in the objective to be used and re-focus on the wafer.
⑨ Adjust the condenser. (Refer to Table 2)

Table 2

Type of condenser / Object distance / Objective		L.W.D. type condenser N.A. = 0.65
		About 10 mm
M and BD	5 ×※	Usable
	10 ×	
	20 ×	
	40 ×	
	50 ×	
	60 ×	
	100 ×	

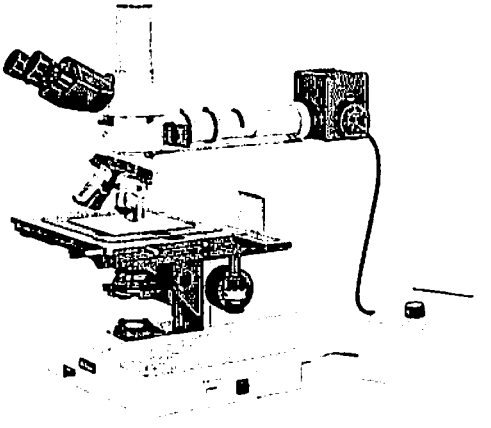
※ 5 × objective is usable if removing the condenser.

⑩ Adjust the brightness by brightness control dial.
⑪ Adjust the aperture and the field diaphragms (diascopic). (Refer to p. 28, p.29)

7. Simultaneous episcopic and diascopic brightfield microscopy

Simultaneous microscopy can be done by combining the previously mentioned episcopic brightfield microscopy with the diascopic brightfield microscopy. In this case, special attention should be paid to the following operations.

- Connect the lamp cord of the universal epi-illuminator to the transformer available on order, not to the connector for episcopic illumination on the microscope base.
- Set the dia/epi illumination change-over switch on the microscope base to DIA.
- For adjusting the brightness of episcopic illumination, use the transformer, and for diascopic illumination, turn the brightness control dial on the microscope base.



V. MANIPULATION OF EACH PART

1. Use of filters

Use of the filters is as shown in Table 3:
Cover the filter receptacle with its hood while the illumination lamp is being lighted.

Table 3

Indication	Type of filter	Use
NCB10	Color balancing filter	For general microscopy and color photomicrography
ND2	ND 2 filter (T=50%)	Brightness adjustment for general microscopy and photomicrography
ND16	ND 16 filter (T=6.25%)	
GIF	Green interference filter	For contrast adjustment

2. Manipulation of each slider

(1) ND 32 filter slider

The ND 32 filter slider is used for protecting the eye from the glare likely caused by much difference of brightness at the time of changing over to bright-or darkfield illumination.

In the position of the slider as shown in Fig. 7-1, the ND 32 filter is put in the optical path. When the filter slider is pushed leftward in, until it stops once with a click, the transparent glass will be put into the optical path. (Fig. 7-2)

The filter is effective as an ND 32 under the brightfield illumination, but as a transparent glass under the darkfield illumination.

When the use of the ND 32 filter is not necessary, interpose the transparent glass. The slider should be inserted always to prevent dust from entering the inside of the illuminator.

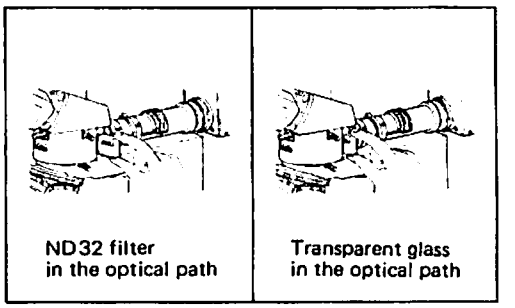


Fig. 7-1 Fig. 7-2

(2) Polarizer slider

The polarizer is to be used in conjunction with the analyzer for simplified polarizing observation.

The polarizer slider in the illuminator, accompanying an ND32 filter slider, permits preventing glare at the time of changing over to bright-or darkfield observation. (Fig. 8)

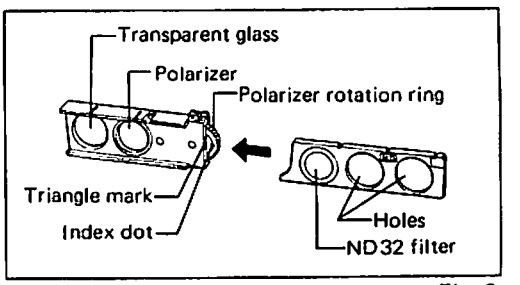


Fig. 8

① In the case of simplified polarizing observation, push the polarizer slider leftward in together with the accompanied ND slider, so that the position of polarizer coincides with the empty hole in the ND filter slider. (Fig. 9-1)

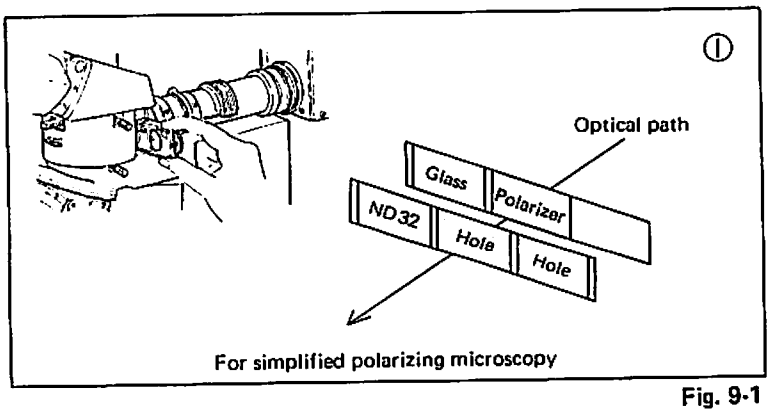


Fig. 9-1

② When changing over to bright-or darkfield observation, pull the polarizer slider rightward out together with the ND filter slider, until the slider stops once with a click. (Fig. 9-2)

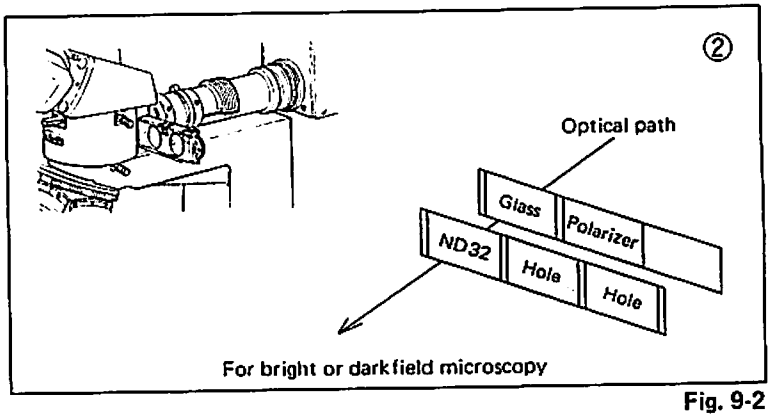


Fig. 9-2

③ If no use of the ND 32 filter is necessary under bright-or darkfield illumination, push only the ND filter slider leftward in, until it stops with a click. (Fig. 9-3)

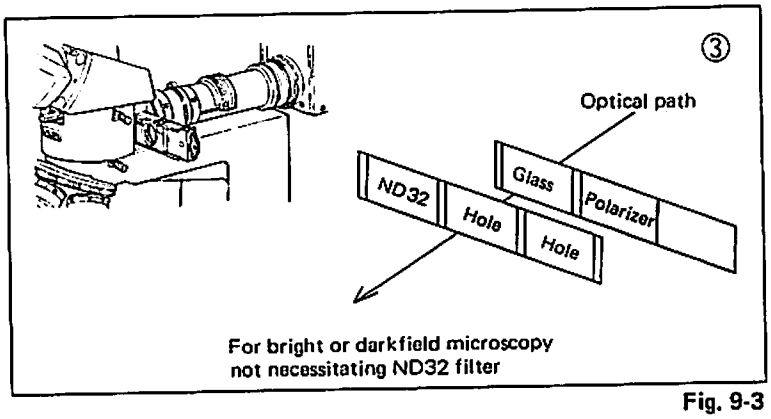


Fig. 9-3

Failures	Causes →	Actions
Image moves while being focused	• Revolving nosepiece not in click-stop position	Revolve it to click-stop position
	• Revolving nosepiece not correctly attached, and not clamped	Insert it to the limit and clamp tightly
	• Objectives not attached securely	Screw in securely
	• Lamp bulb not correctly centered	Correct centering (Refer to p. 8)
	• Optical path in trinocular tube not fully changed-over	Changing-over to the limit (Refer to p. 27)
Image tinged yellow	• NCB 10 filter not used	Use NCB 10 filter
	• Too low power source voltage	Raise the voltage on the transformer
Too bright image	• ND filter not used	Use ND filter

2. Manipulation

Failures	Causes →	Actions
High power objective touches the wafer (mask), when changed-over from low power	• Eyepiece diopter not adjusted	Diopter adjustment (Refer to p. 25)
Insufficient parfocality of objective (when changed-over)	• Eyepiece diopter not adjusted	Diopter adjustment (Refer to p. 25)
Movement of image not smooth by moving the wafer (mask)	• Wafer (mask) holder not tightly fixed	Fix it tightly
No fusion of binocular images	• Interpupillary distance not adjusted	Adjustment (Refer to p. 25)
Fatigue of observing eyes	• Incorrect diopter adjustment	Correct adjustment (Refer to p. 25)
	• Inadequate brightness of illumination	Use ND filter or change power voltage

3. Electrical

Failures	Causes →	Actions
Lamp does not light even though switched ON	• No electricity obtained →	Connect the cord to socket
	• No lamp bulb attached →	Attaching
	• Lamp bulb blown →	Replacement
	• Fuse blown →	Replacement
Unstable brightness of illumination	• House current voltage fluctuates too much →	Use transformer or the like (for adequate voltage)
Lamp bulb promptly blown	• Not specified lamp bulb used →	Use specified bulb (Refer to p. 43)
	• Too high voltage of house current →	Use transformer for adjustment
Insufficient brightness of illumination	• Lamp bulb not centered →	Centering (Refer to p.8)
	• Aperture too much closed →	Open it properly (Refer to p. 26 & 28)
	• Not specified lamp bulb used →	Use specified bulb (Refer to p. 43)
	• Dirt on lens (Objective, eyepiece, filter) →	Cleaning
Fuse blown	• Not specified fuse used →	Use 1A (250V) or 0.5A (250V)
Flickering or unstable brightness of lamp bulb	• Lamp bulb going to be blown →	Replacement
	• Connector not connected securely →	Secure connection
	• Fuse holder not firmly fastened →	Firm fastening
	• Irregular change of house current voltage →	Use stabilizer
	• Lamp bulb insufficiently inserted into the socket →	Positive connection

4. Photomicrography

Failures	Causes ——→	Actions
No sharp picture obtained	● Improper focusing ——→	● Viewing into the finder and turning diopter ring, bring double crosshair into focus. Moving the eye laterally, rotate fine focus knob, until no parallax separation appears between the image and double crosshair. ● At lower magnifications use focusing magnifier in addition.
	● Out of focus ——→ (Especially with high power objective and long-exposure)	● For preventing external vibration, use vibration-proof table or rigid desk. ● Select a place free from vibration, such as caused by traffic, passers-by or motors etc.
	● Momentary vibration ——→	● Using ND filters or others, elongate exposure time (for color film, to 1/4 ~ 1/15 sec.). ● Lower the voltage, and elongate exposure time (for black-and-white film). Note, however, for color film, that lowering of color temperature and change of spectral characteristics will be unavoidable.
	● Wafer (mask) with coverglass observed ——→	● Remove converglass.
Fogging of image	● Grease, dust or dirt on optical surfaces ——→	● Clean the front of objective thoroughly, top surface of eyepiece, wafer (mask), projection lens, etc. Usually take care to avoid dirt. Cover the instrument, when not in use.
Illuminated image not uniformly	● Inadequate adjustment of illumination (This shows up more conspicuously in photography than in observation) ——→	● Adjust illumination properly. (Refer to p. 8) ● If lamp bulb is cause, replace it immediately.
Insufficient image contrast	● Aperture diaphragm opened too large ——→	● Generally, good results will be achieved with aperture stopped down to 70 ~ 80% of N.A. of the objective being used. (Refer to p. 34-5.)
	● Incorrect use of filter ——→	● Use of a GIF filter will increase contrast.
	● Inadequate use of field diaphragm ——→	● Stop down field diaphragm to a diameter slightly larger than the diagonal of picture frame. (Refer to p. 34-5.)
	● Low contrast in wafer (mask) ——→	● To increase contrast optically, select darkfield or differential interference methods. ● In black-and-white photography, for low contrast wafer (mask) a film of finer grain and higher contrast is more suited (such as minicopy film). ● For general wafer (mask) a film of wider latitude and finer grain is preferable.

Failures	Causes ——→	Actions
Deficient resolving power of microscope	• Insufficient N.A. of objective	• Use a large N.A. objective. • For the same magnification, increase power of objective rather than that of eyepiece to attain higher resolution and sharpness.
	• Excessive magnification	• 500 ~ 1000 times N.A. are magnification limits for resolving power.
Ghosts or flare appears	• Extraneous light entering the ocular finder	• Darken the surroundings or place the cap on the ocular finder.
	• Stray light entering	• Take care not to expose microscope and wafer (mask) to direct sunlight and other intense lights.
Poor photograph obtained	• Inadequate use of filter	• Use NCB 10 filter.
	• Film of another make or emulsion NO.	• Note that, when using a daylight film, remarkably different spectral sensitivities will result depending upon the types, make, etc. • Even though of same make, according to emulsion number, different color rendition will be obtained.
	• Wrong power source voltage used	• Take picture in every case at the specified voltage. (Refer to p. 34-3.)
	• Incorrect exposure time	• By inadequate exposure time, color rendition will not be true on account of "reciprocity law failure". • Then, with the help of exposure time indicator, adjust exposure time according to characteristics of film by means of ND filters, or compensate for such failure by means of CC filters. (Refer to Kodak Data)
	• Influenced by film development	• Especially, for making color prints, it is recommended to contact the development laboratory.

★ Microscope Stand with Epi-Bright/ Dark Field Illuminator "BD"

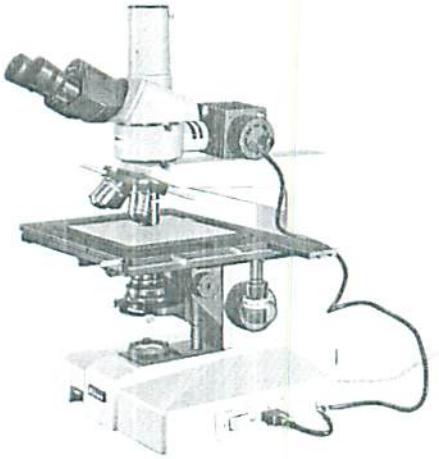


Fig. 37

Caution:

For using the Epi-Bright/Dark Field Illuminator "BD", set the lamp voltage change-over switch on the bottom of the microscope base to 6V–20W.

Read also the Instructions for Epi-Bright/Dark Field Illuminator "BD".

★ Microscope Stand with Motorized Revolving Nosepiece

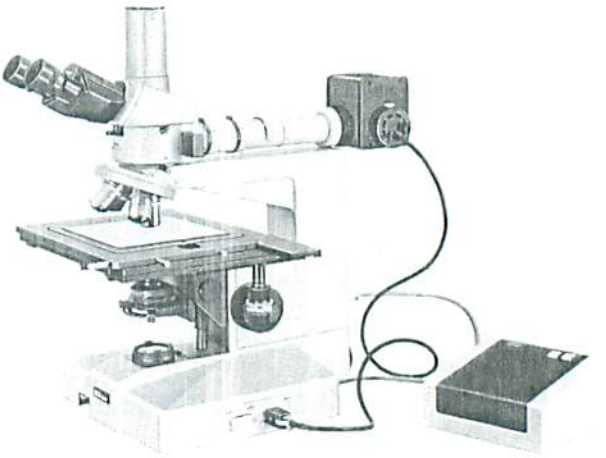


Fig. 38

Use of the Motorized Revolving Nosepiece

① Connect the lamp input plug to the transformer.
(Connect both power source cords of the stand and the transformer to the power sources.)

② Turn ON the power switch for revolving nosepiece, and make sure of the switch lighting.

③ The relation between the turning direction of the revolving nosepiece rotation switch and the rotating direction of the motorized revolving nosepiece is shown by the arrows in the Fig. 38.

④ Keeping the rotation switch depressed rotates the nosepiece continuously.

ELECTRIC SPECIFICATIONS

	Episcopic illumination		Diascopic illumination
	Universal Epi-Illuminator	Epi-Bright/Dark Field Illuminator	
Power source	100/120V 220/240V 50/60 Hz		100/120V 220/240V 50/60 Hz
Secondary voltage	OFF ~ 12V (Engraved figures on the brightness control dial)		OFF ~ 6V (White figures on the brightness control dial)
Halogen lamp	12V–50W (OSRAM 64610 or PHILIPS 7027)	6V–20W (PHILIPS 7388)	6V–20W (PHILIPS 7388)
Fuse	2A/250V for 100/120V 1.5A/250V for 220/240V		

★ In case of simultaneous illumination microscopy, use the U-epi transformer for the episcopic illumination.

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 illustrations in this handbook may not conform in every detail to models in current production.

VII. PHOTOMICROGRAPHY

The Microscope OPTIPHOT 66 is designed with particular care to assure the finest photomicrographs. Although various types of Nikon photomicrographic attachments (Microflex) are mountable, it is especially recommended that the Microflex FX-series be used.

1. Combination of CF objectives and CF PL Projection lenses

The combined use of the CF objectives and CF PL Projection lenses is essential.
For the same total magnification, select a combination of the highest possible objective power and lowest possible projection lens power to achieve the utmost image definition and contrast.

2. Checking the illumination

Unevenness in the illumination will show up more conspicuously in photomicrography than in observation. Consequently, before taking a photograph, recheck the centering of the lamp.

3. Selection of voltage and filter

The color temperature of the light source varies with the voltage being used. Therefore, in color photomicrography, the selection of voltage and filter is essential (for the result to be obtained).

1) When using a daylight type color film
Set the mark ▼ on the brightness control dial to the index on the microscope base and use the NCB 10 filter※
Adjustment of the image brightness should be made by means of the ND filter.

2) When using a monochrome film
Remove the NCB 10 filter. Contrast filters such as X-1 green are usable.

※ ●The NCB 10 filter is most suitable for a standard film. Depending upon the make of the film different color renditions may result. It is recommended that in addition to the NCB 10 filter a color compensation filter (CC filter), available from the film manufacturer, be used.
●For monochrome photomicrography, use such filters as GIF for contrast adjustment.

4. Shutter speed

Favorable shutter speeds will be 1/4 ~ 1/15 sec.
For color photography, adjust the brightness not by changing the transformer voltage, but by selecting the ND filters (available as accessory).

5. Manipulation of field and aperture diaphragms

In photomicrography, the adjustment of the field diaphragm is important for the purpose of limiting extraneous light which causes flare in the microscope image. Stop down the diaphragm so as to get an illuminated area slightly larger than that of the picture field.
By adjusting the aperture diaphragm, a change of depth of focus, contrast and resolution of image is attainable. Select a size suited to the purpose.
Generally speaking, the aperture diaphragm, is properly stopped down to 70 ~ 80% of the aperture of the objective being used.

6. Focusing

The binocular observation tube with mask eyepiece on the trinocular eyepiece tube or the ocular finder is used for focusing.
Note that there are some kinds of eyepiece tube the binocular observation tube of which can not be used for focusing. (Refer to Table 4)

Table 4

	Focusing with 10× or higher objective	Focusing with 5× or lower objective
"F" tube	Use Microflex finder	Use Microflex finder + Focusing telescope
"T" or "UW" tube	Use observation tube	Use observation tube or + Focusing telescope Microflex finder

① Adjust diopter.

- **Binocular of eyepiece tube :**
  Use 5× or 10× objective.
  Insert the mask eyepiece into either of right or left eyepiece sleeve that is accustomed to usual use. Adjust the diopter ring to bring the double cross line in the view field center into focus. (Fig. 33)
  Then focus the wafer (mask) image also on the central area of the mask by means of the focus knob of the microscope.
  The diopter of another eyepiece is to be adjusted by focusing wafer (mask) rotating the diopter ring without using the microscope focus knob.
  Rotate the mask eyepiece so as the mask positions as shown in Fig. 37.

- **Ocular finder :**
  Adjust the diopter ring so as the double cross line in the view field center can be seen clear and each line separated. (Fig. 34)

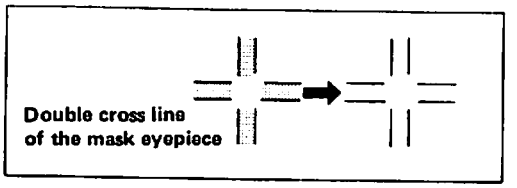


Fig. 33

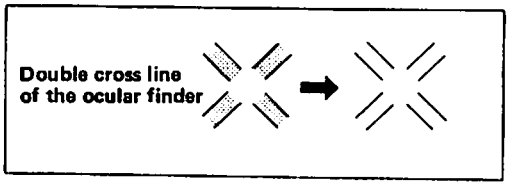


Fig. 34

② Make focusing according to the magnification of objective to be used.

- **Using 40× or higher objective :**
  With diopter adjusted eyepiece make the wafer (mask) image sharp by rotating the microscope fine focus knob and make sure that both of the double cross line and the wafer (mask) image are seen crisply at the same time.

- **Using medium magnification objective 10×, 20×, etc. :**
  After focusing the same way as above, bring the wafer (mask) image to coincide with the double cross line so as their relative position is fixed and unchanged under observation by swinging your eye laterally. (Focusing by parallax method.)

- **Using 5× or lower objective :**
  Attach the focusing magnifier to the ocular finder. (Fig. 35)

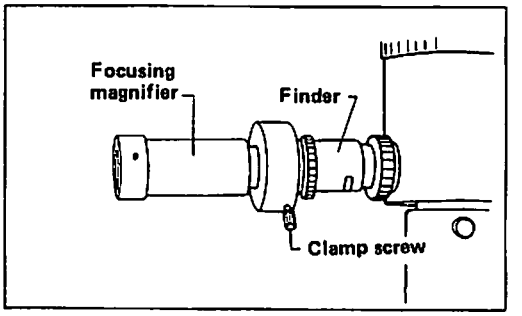


Fig. 35

Viewing through the attached focusing magnifier, move it back and forth until the double cross line is seen clear. Then, focus the double cross line and the wafer (mask) image by rotating the fine focus knob as sharp as possible.

7. Picture composing

Compose the picture within the mask in the ocular finder corresponding to the film size in use by driving the microscope stage by lateral and longitudinal movement and rotation. (Fig. 36)

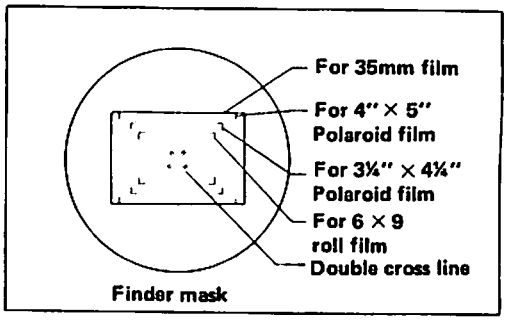
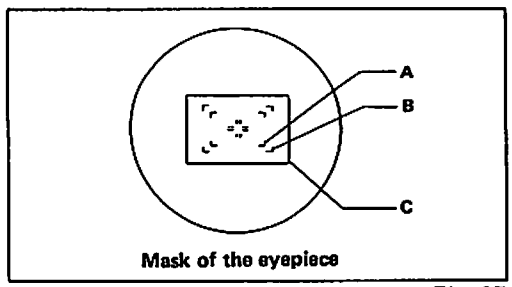


Fig. 36

When the mask eyepiece is used, select one out of masks in the view field suitable to the film size relative to CF PL Projection lens in use, in reference with Fig. 37 and Table 5.



Mask of the eyepiece

Fig. 37

Table 5

Mask	CF PL Projection lens	Film size			
		35 mm	6×9 cm	3¼"×4¼"	4"×5"
A (Inner frame)	2 ×	×	—	—	—
	2.5×	—	—	—	—
	4 ×	—	—	◎	—
	5 ×	◎	—	—	△
B (Intermediate frame)	2 ×	×	—	—	—
	2.5×	—	◎	△	—
	4 ×	◎	—	—	△
	5 ×	—	—	—	—
C (Outer frame)	2 ×	×	—	◎	—
	2.5×	◎	—	—	◎
	4 ×	—	—	—	—
	5 ×	—	—	—	—

Note : Framing for picture composing will be more accurate by the ocular finder than the mask eyepiece.

8. Vibration-free operation

Set the microscope on a vibration-resistant, rigid desk or a bench with a vibration-proof device.

9. Others

- For photomicrography, when focusing with the binocular observation tube, use the CF eyepiece, CF PL Projection lens and CF Photo Mask eyepiece, with the magnification and other indications engraved in yellow, or in white with a white dot in addition.
- For the use of other photomicrographic attachments refer to the pertinent instruction manuals.

VIII. TROUBLE SHOOTING TABLE

Although nowhere the user can find any disorder or derangement in the instrument, if he encountes some difficulty or dissatisfaction, recheck the use, referring to the table below:

1. Optical

Failures	Causes → Actions
Darkness at the periphery *or uneven* brightness of viewfield (No appearance of viewfield)	● Optical path in trinocular tube not fully changed-over → Changing-over to the limit (Refer to p. 27) ● Optical path in the illuminator not fully changed-over → Changing-over to the limit ● Revolving nosepiece not in click-stop position (Objective not centered in optical path) → Revolve it to click-stop position ● Lamp bulb not centered → Centering (Refer to p. 8) ● Field diaphragm too much closed → Open it properly ● Dirt or dust on the lens (Objective, eyepiece, wafer or mask) → Cleaning ● Revolving nosepiece not correctly attached → Correct attaching (Refer to p. 6)
Dirt or dust in the viewfield	● Dirt or dust on the lens (Objective, eyepiece) → Cleaning ● Dirt or dust on the wafer (mask) → Cleaning
No good image obtained (low resolution or contrast)	● Wafer (mask) with coverglass observed → Remove coverglass ● Dirt or dust on the lens (Objective, eyepiece, wafer or mask) → Cleaning ● Incorrect illumination → Correct the illumination (Refer to p. 8) ● Dirt or dust on the entrance lens → Cleaning
Image quality deteriorated	● Aperture diaphragm too much closed → Open properly (Refer to p. 26 & 28)
One side dimness of image	● Wafer (mask) placed on the stage tilted → Make it parallel to the stage ● Revolving nosepiece not in click-stop position → Revolve it to click-stop position ● Revolving nosepiece not correctly attached, and not clamped → Insert it to the limit and clamp it firmly ● Objectives not attached securely → Screw in securely