Large, transmitted - light research microscope Universal

Operating instructions

G 41 - 140 / I - e

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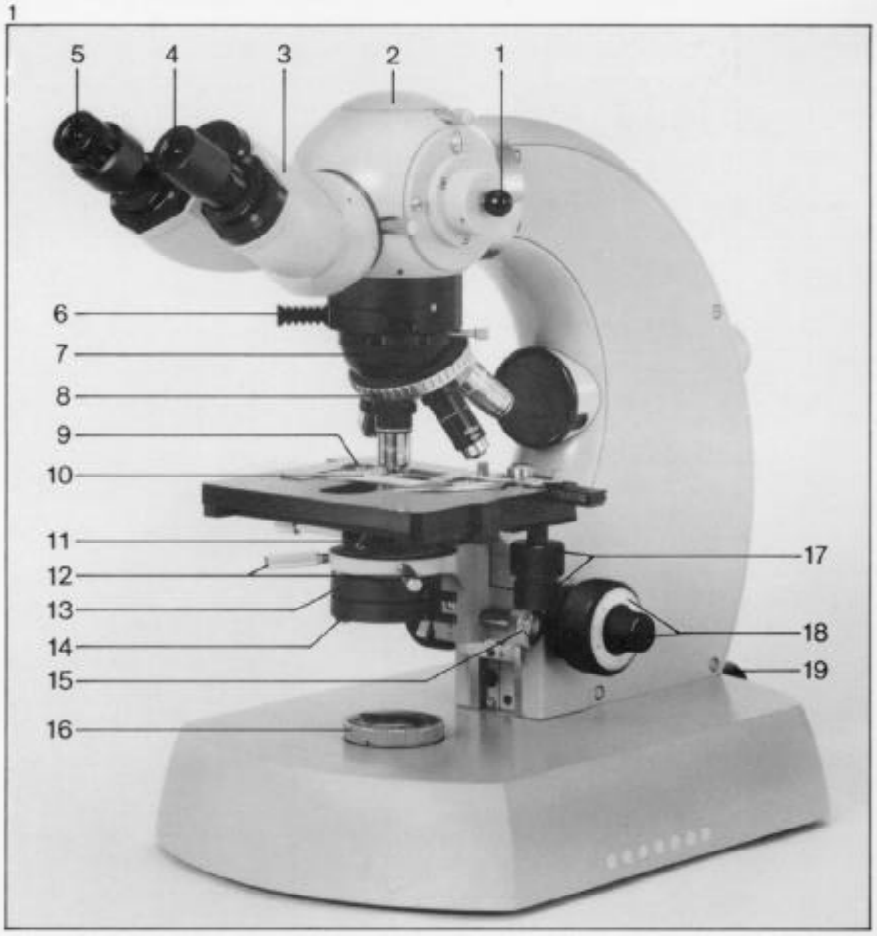

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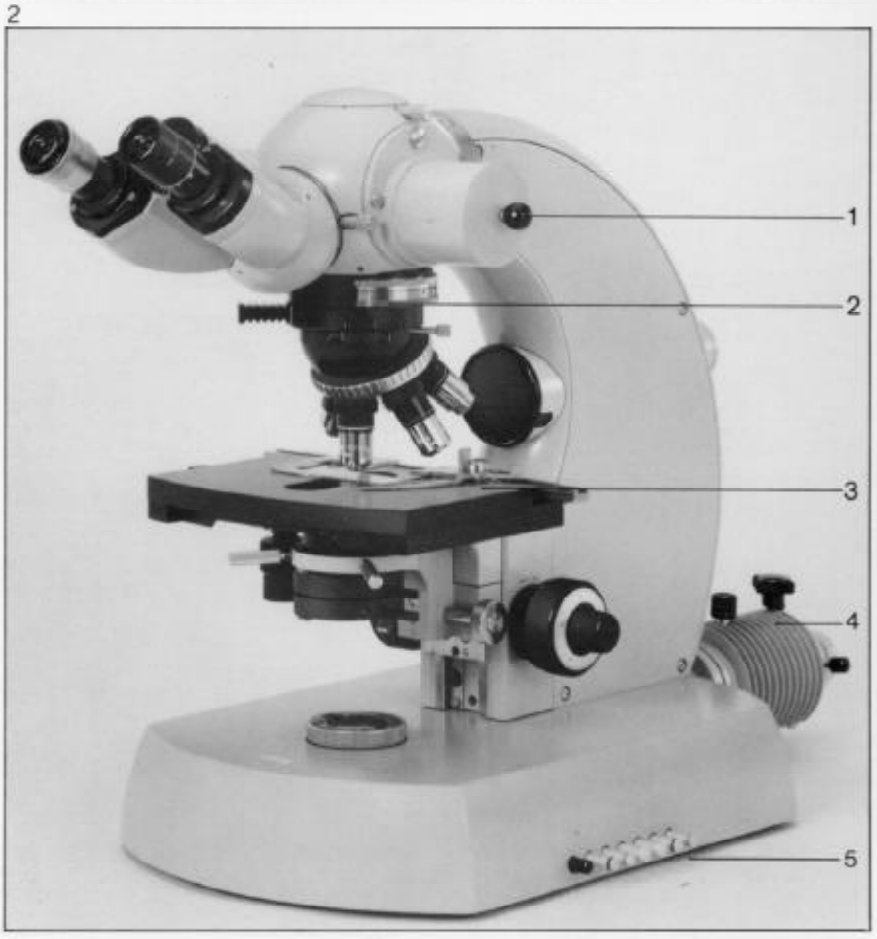


Fig. 1: Transmitted-light microscope Universal R

1 Pushrod pushed in: all light relayed to the binocular tube
Pushrod pulled out: all light relayed upwards, e.g. to a photomicrographic camera

2 Receptacle for image receivers, e.g. camera or photometer head.
When not in use close it dust and moisture-proof with a lid.

3 Binocular tube *(47 30 12)**

4 Wide-angle eyepiece

5 Focusing wide-angle eyepiece

6 Fill plug to close receptacle for analyzer slide

7 Slot accepting compensators or auxiliary objects

8 Exchangeable objective turret

9 Mechanical stage with specimen holder and deep-lying controls

10 Specimen

11 Condenser

12 Condenser centering screws

13 Swing-in holder for 32 mm dia. filters

14 Swung-in auxiliary lens produces an image of the lamp field stop at infinity.

15 Knob for condenser adjustment.
In case of accidental lowering of the condenser carrier, tighten the screw of this knob.

16 Ring for lamp field stop adjustment.
Within the ring: dust cover and filter support.

17 Coaxial controls for specimen movement

18 Coarse and fine focusing controls**

19 In-base 6 V, 15 W illuminator

Fig. 2: Transmitted-light microscope Universal

1 Pushrod in click-stop position:
white ring: all light relayed to the binocular tube
red ring: 1/3 of the light to the binocular tube and 2/3 upwards, e.g. to a camera
colorless ring: all light relayed upwards, e.g. to a camera
black ring: without function

2 **Optovar** magnification changer with Bertrand lens
The upper knurled ring is for focusing of the objective exit pupil, where, for instance, an image of the aperture diaphragm is formed.

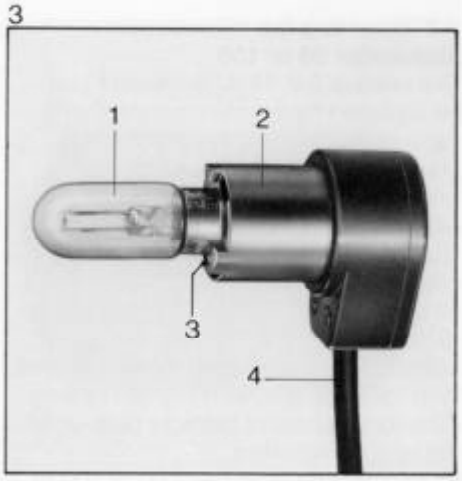
3 Large mechanical stage with specimen holder, range of motion 50x75 mm

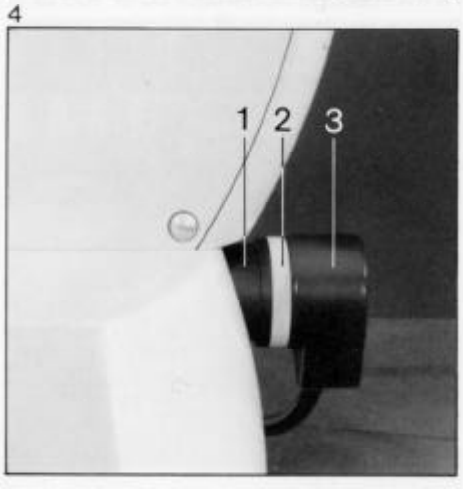
4 Microscope illuminator 60

5 Filter selectors
Pushbutton-operated filters in the holder are brought into the light path.
Pushing the black key removes the filter from the light path.

* The 6 or 10-digit numbers in brackets are catalog numbers which are also imprinted on the individual modules.

** Before operating the coarse and fine focusing controls (**1**.18 = Fig. **1**, item 18) remove the transport lock (plastic plate under the rack-and-pinion box) by lifting the box with the coarse focusing control.





1.1 In-base 6 V, 15 W illuminator
Press 6 V, 15 W filament lamp *(38 00 18–1740)* (**3**.1) into socket *(46 80 10–9903)* (**3**.2); the red dot must be opposite the red pin (**3**.3). Turn the lamp clockwise as far as it will go and let it engage. Wipe off fingerprints on the bulb.
Insert lamp with socket (**4**.3) in the collector tube with lamp condenser *(46 70 50)* (**4**.1); adjust red dot on clamping ring (**4**.2) to red dot on collector tube. Secure the inserted lamp socket with the clamping ring. Via transformer, e.g. *(39 25 24)*, connect lamp cable (**3**.4) to the mains.

Adjust brightness with the voltage selector of the transformer. It is generally sufficient to run the lamp at undervoltage, which increases its life. The lamp should be run at overvoltage only for short periods.

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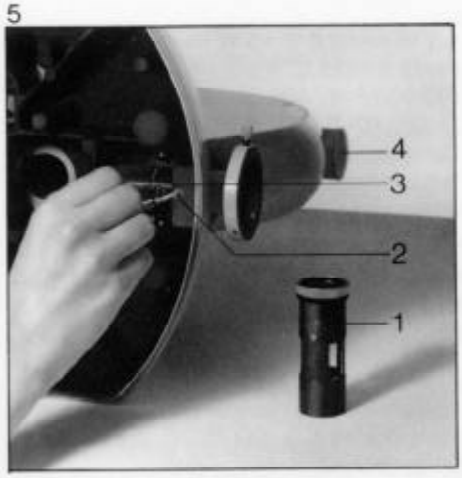

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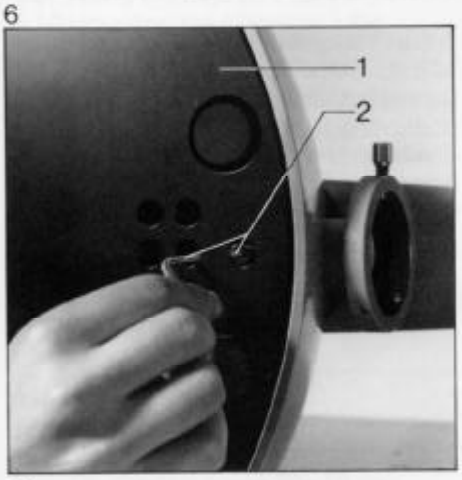

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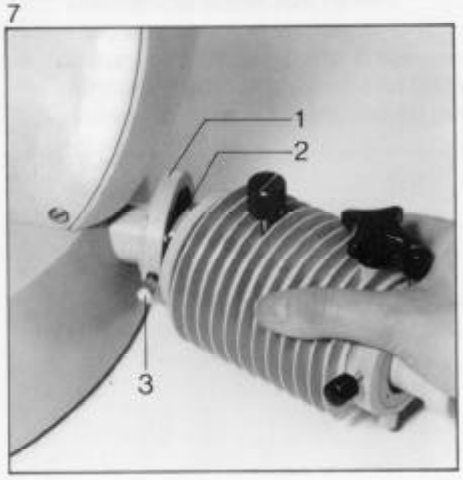

1.2 Mounting the microscope illuminator 60 or 100

The in-base 6 V, 15 W illuminator can be replaced by the microscope illuminator 60 or 100. Lay the microscope stand on the left side (see Fig. 8), unscrew the 4 screws and take off the plate (**6**.1).

Unscrew screw (**5**.2) and remove collector tube *(46 70 50)* (**5**.1).

Fit connection tube *(46 70 40–9903)* (**5**.3) and secure with screw (**5**.2). Refit bottom plate and secure it with 4 screws.

With the supplied Allen key (**6**.2) swing diffusion disk out of the light path while the lamp is adjusted.

Fit microscope illuminator 60 or 100 to the connection tube (**7**.1): loosen clamping screw (**7**.3), push back its spring bolt with the dovetails (**7**.2) and let the dovetails engage.

Tighten clamping screw (**7**.3).

Microscope illuminators 60 and 100 see also operating instructions G 41-305 and G 41-310.

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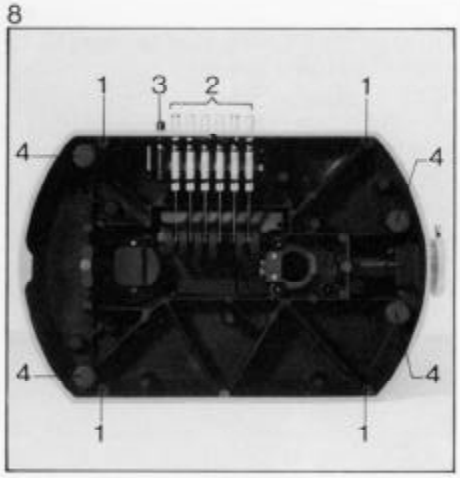

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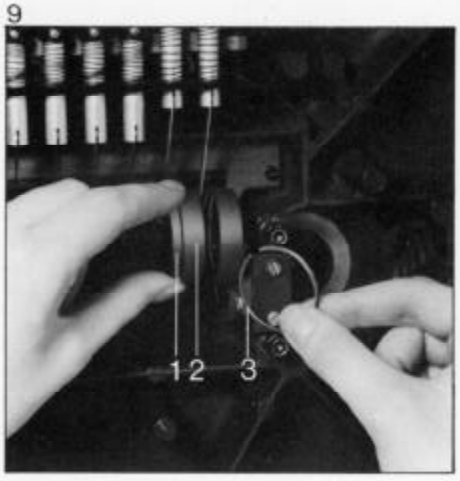

1.3 Fitting 32 mm dia. filters in filter holder

Lay Universal (not Universal R) stand on the left side (see Fig. 8).
Remove 4 screws (**8**.1) and take off plate (**6**.1).
Push key (**8**.2) of selected filter holder.
Place filter (**9**.1) in holder (**9**.2) and secure with snap ring (**9**.3).
The filter selectors are color-coded. It is recommended to write down filter positions once fixed.
Example of a filter setup from front to rear:

Neutral density filter 0.03	*(467842)*
Neutral density filter 0.12	*(467841)*
Neutral density filter 0.5	*(467840)*
Neutral density filter 0.5	
Green filter VG 9	*(467805)*
Blue conversion filter for daylight film	*(467850)*

After filter insertion refit the bottom plate and secure it with 4 screws.
Filter combinations are brought into the light path by pushing several filter selectors at a time.
With the neutral density filters the transmittance can be graded at a ratio of 2:1. The transmittance of a filter set is determined by multiplying the individual filter values, e.g. 0.5 x 0.5 = 0.25.
To swing the filters out of the light path push the black key (**8**.3).

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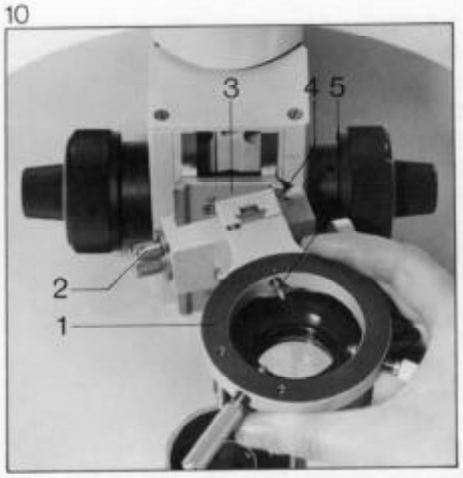

1.4 Clamping condenser carrier (10.1) on change slide (10.3)

Flick up lever (**10**.2), and place the right-hand guide rail (**10**.4) against the change slide. Then swing in the left side until the spring bolt engages.
Flick the lever in horizontal position.
Lower condenser carrier as far as it will go. Flick down lever and tighten slightly.

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1.5 Mounting the condenser

Rack down condenser carrier with control (**1**.15).
Press dovetails (**11**.1) of the condenser against the spring bolt (**10**.5) of the condenser carrier until the condenser snaps into position. If the condenser is provided with an orientation notch, this must engage the spring bolt.

With control (**1**.15) rack up the condenser as far as it will go.

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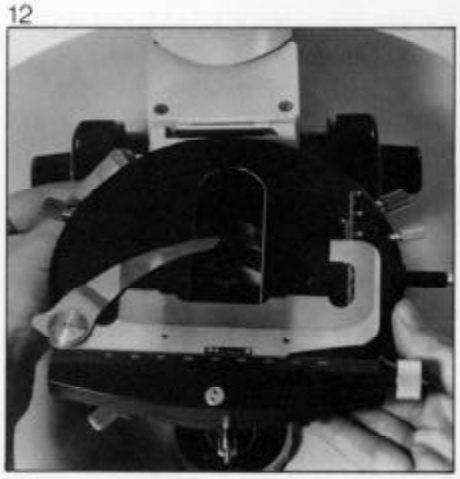

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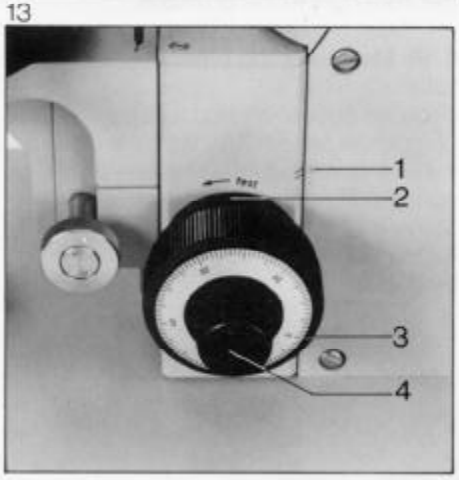

1.6 Clamping specimen stage on stage carrier on change slide

With coarse focusing control (**1**.18) rack down change slide. Flick up lever of stage carrier. Place stage carrier on change slide from above; insert at first the lower right projection, then the left spring bolt and finally the upper right projection, thereby pressing the stage carrier against the change slide. Mount the stage carrier on the condenser carrier, and flick down the lewer.

1.7 Coarse and fine focusing controls act on the specimen stage.

The coarse motion can be adjusted as follows: with the supplied Allen key turn the hex socket-head screw (**13**.2), not visible in the picture, in the direction of the arrow to stiffen the coarse focusing motion.

Adjusting the fine focusing control to a medium working range: turn the fine focusing control unit dot (**13**.1) is bracketed by the two lines. Then focus the specimen with the coarse focusing control; this leaves sufficient space above and below for fine focusing.

One interval of the graduation (**13**.3) corresponds to a vertical movement of the stage of 2 µm = 0.002 mm.

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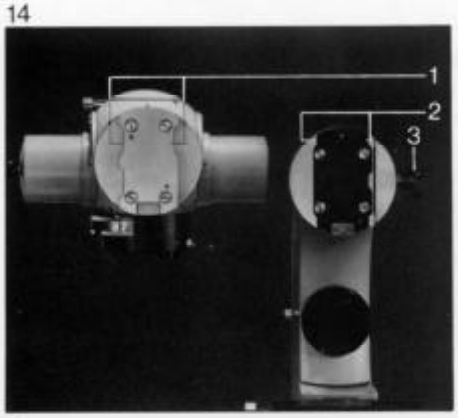

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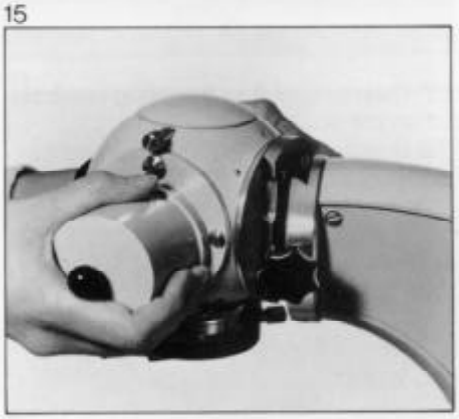

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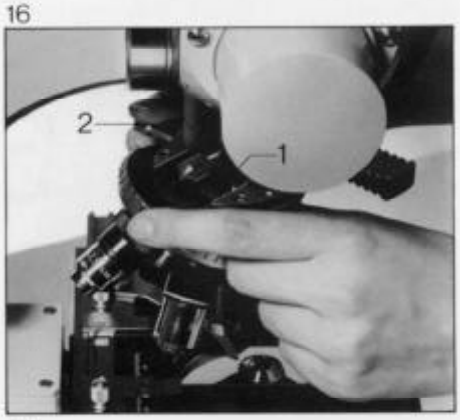

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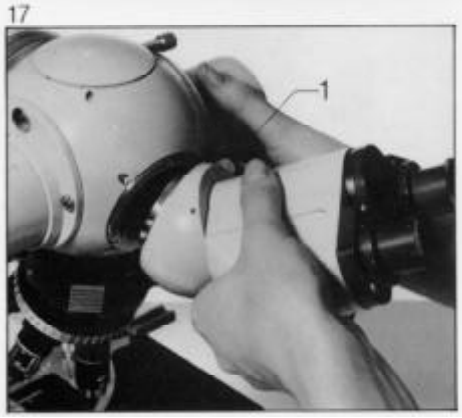

1.8 Mounting the tube head on the Universal stand
(the Universal R is supplied with rigidly mounted tube head).
Hold the tube head (**14**.1) against the dovetails of the stand (**14**.2), let it snap into position and secure with clamping screw (**14**.3).

1.9 Mounting the objective turret
with objectives fitted in rising sequence: insert the turret from behind left in the dovetails (**16**.1), let it snap into position and secure it with clamping screw (**16**.2).
Insert holder for single objectives from the front right in the dovetails.

1.10 Mounting the binocular inclined tube
Remove dust cover and loosen clamping screw (**17**.1). With the sloped surface down (dovetails) press down the spring bolt underneath the clamping screw and fit the dovetails completely. Tighten clamping screw before letting go the tube.

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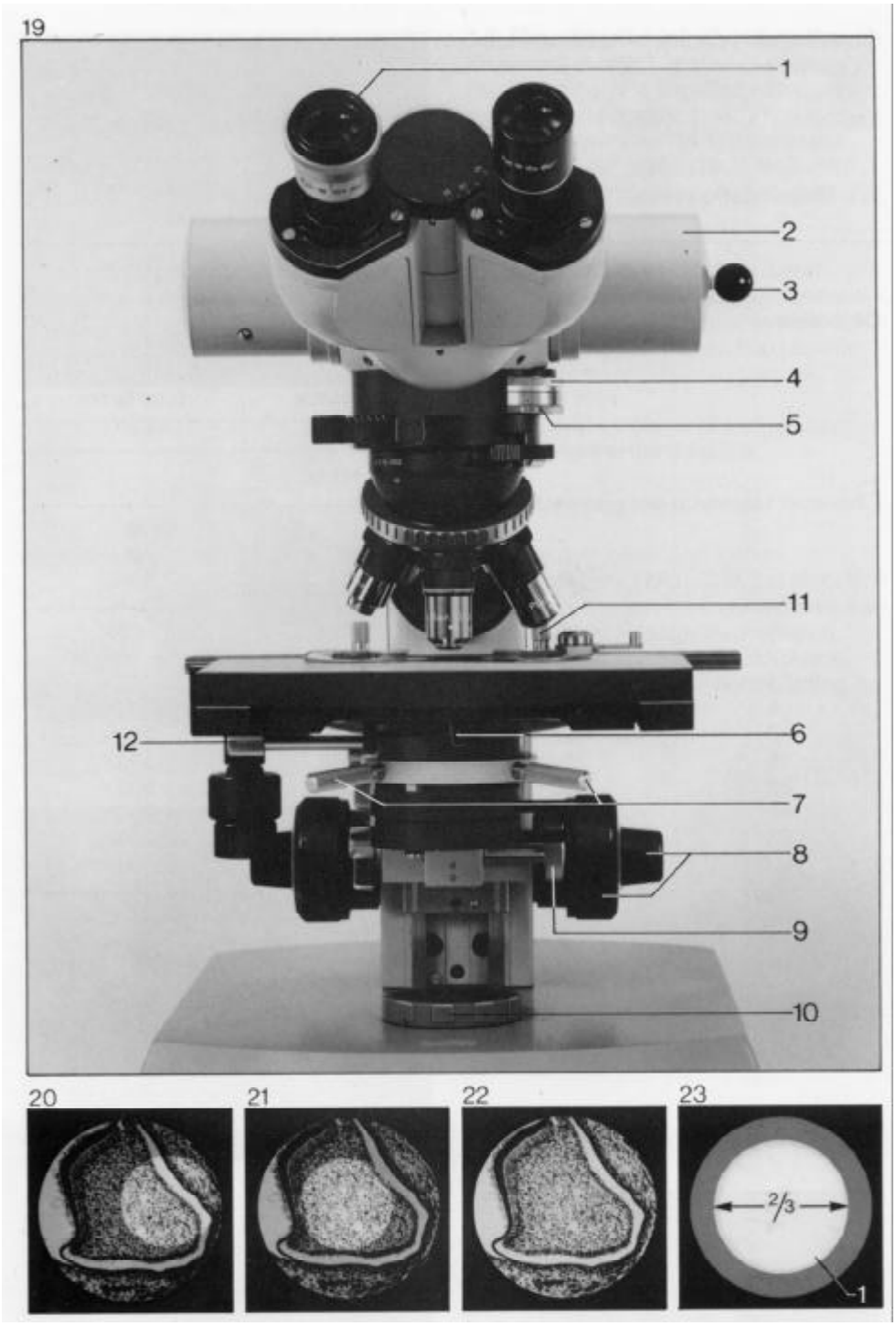
Objective magnification × factor of wide-field system (0.63) (in wide-field turret) × Optovar factor (e.g. 1.25) × eyepiece magnification

Example: 200 = 16 × 0.63 × 1.25 × 16

2.1 Magnification table

	Eyepiece 10× or 16× and wide-field system 0.63×		
Objective	**Optovar** (**2**.2)		
	1.25×	1.6×	2×
	Total factor 12.5×	Total factor 16×	Total factor 20×
	Red dots		
	●	● ●	● ● ●
1	12.5×	16×	20×
2.5	32×	40×	50×
4	50×	63×	80×
6.3	80×	100×	125×
10	125×	160×	200×
16	200×	250×	320×
25	320×	400×	500×
40	500×	630×	800×
63	800×	1000×	1250×
100	1250×	1600×	2000×



3.1 Brightfield (H)

1. Connect microscope illuminator with transformer and the latter with the mains, and switch on. The voltage selector setting should not be higher than the rated power of the lamp.
2. Mount the specimen in the specimen holder: loosen clamping screw (**19**.11), move the specimen holder towards the specimen slide, and re-tighten the clamping screw.
3. Turn in 10× or 16× objective.
4. Push in pushrod (**19**.3). On the Universal with tube head (**19**.2) it can be adjusted to red ring.

5. Insert eyepieces of the same magnification in the binocular tube, e.g. a focusing eyepiece (**19**.1) in the left-hand tube and a fixed eyepiece in the right one.
   Adjust the distance between the two tubes until a circular, sharply defined field of view is visible.
6. Adjust uniform illumination of the objective exit pupil (Fig. 23): set the **Optovar** magnification changer (**19**.5) to position (PH), observe the image, and focus with the upper knurled ring (**19**.4) of the **Optovar.** If the instrument is not equipped with an **Optovar,** mount centering telescope *(464822)* in one tube of the binocular body instead of the eyepiece; the objective pupil will be enlarged (or of normal size in the empty tube). Focus the pupil image in the centering telescope (**25**.1) by shifting the eyelens (**25**.2).
   Centering the lamp coil in the pupil center: loosen lamp socket (**4**.3) with clamping ring (**4**.2), and shift the lamp socket in longitudinal direction until the pupil image is uniformly illuminated by the lamp. Clamp the lamp socket.
   Replace the centering telescope again by an eyepiece, or set **Optovar** to magnification system, e.g. (1.25).
7. Focusing the specimen: look through the right eyepiece and focus the specimen with the focusing control (**19**.8). Then adjust the focus of the left eye by turning the eyelens of the eyepiece (**19**.1).
8. Close the lamp field stop (**19**.10) while observing it through the tube. With control (**19**.9) lower the condenser until the stop is in focus in the specimen image (Fig. 20).
9. Center the lamp field stop with the screws (**19**.7) (Fig. 21).
   Open the lamp field stop almost to the edge of the field of view, make precision centering, and open it further until it just disappears behind the edge of the field of view (Fig. 22).
10. Adjust the image contrast with the condenser aperture. To check this stop without eyepiece or in (PH) position of the **Optovar,** observe the objective exit pupil; the stop diameter should cover about 2/3 of the objective aperture (**23**.1); see para. 6. above.
11. **The use of oil immersions**
    With condenser apertures higher than 0.9 and for high illuminating apertures immersion of the condenser is recommended. With the oiler that comes with every immersion objective apply one drop of immersion oil each to the bottom surface of the specimen slide and the condenser front lens. There must always be immersion oil between an oil immersion objective and the coverglass. Turn the objective out of the light path and apply oil to the coverglass.
    Push the resilient mount of the objective front lens in and lock it by turning it clockwise. Turn in an immersion objective and immerse its front lens in the oil. Focus with the fine focusing control.
12. Low-power objectives (6.3× and less) image large fields. To completely illuminate such a large field swing out or unscrew the condenser front lens (**19**.12). Better illumination can be achieved by slightly lowering the condenser. Open the lamp field stop (**19**.10) which acts here as aperture contrast diaphragm.
    The Planachromat 1.0/0.04 *(462010)* produces images of large object fields; due to its built-in field lens it is used without condenser. The auxiliary lens (**1**.14) remains fitted. This objective is not parfocalized with other objectives.

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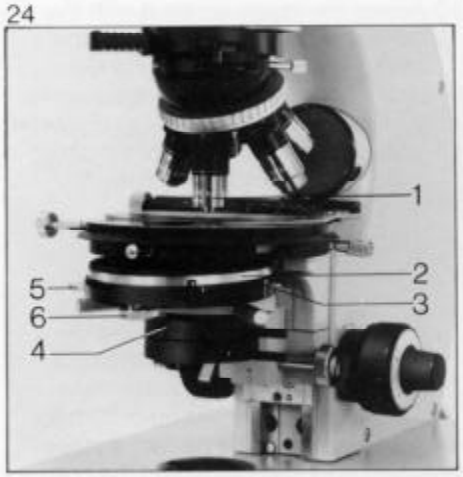

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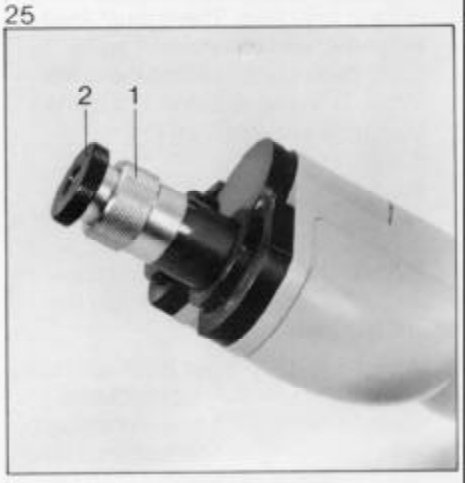

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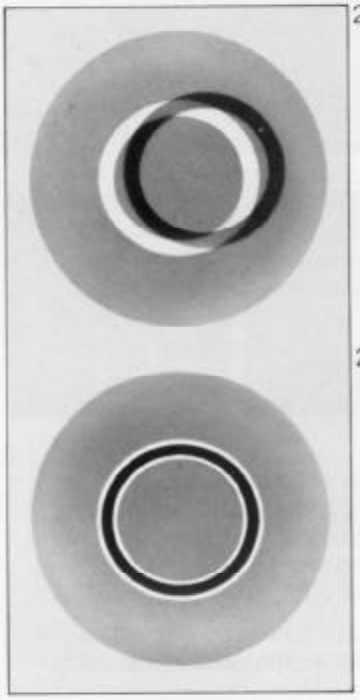

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3.2.1 Mounting the Ph equipment:

1. Screw Ph objectives (**24**.1) in objective turret, and turn 10× or 16× objective in the light path.
   Insert Ph condenser (**24**.2) in the condenser carrier so that the spring bolt engages the notch of the condenser adapter. Set knurled ring (**24**.3) to (J).

2. Adjust the specimen in brightfield (see 3.1 above).

3. Swing green filter in filter holder (**24**.4), in filter selector (**2**.5) or on filter support (**1**.16) into light path.

4. Turn knurled ring (**24**.3) of Ph condenser to a position which corresponds to the Ph objective, e.g. to (2) for a **Neofluar** 16/0.40 Ph.

5. Replace one eyepiece by the centering telescope *(46 48 22)* (**25**.1) and shift the latter's eyelens, or set the **Optovar** magnification changer to (PH) and turn the upper knurled ring; focus phase ring and annular diaphragm (Fig. 26).

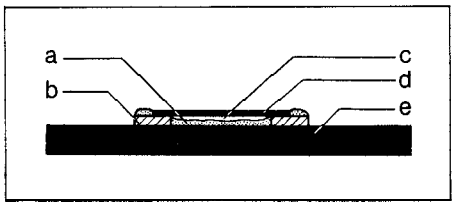
6. With lockable lever (**24**.5) and knob (**24**.6) of the Ph condenser move the bright ring to lie within the black one (Fig. 27).

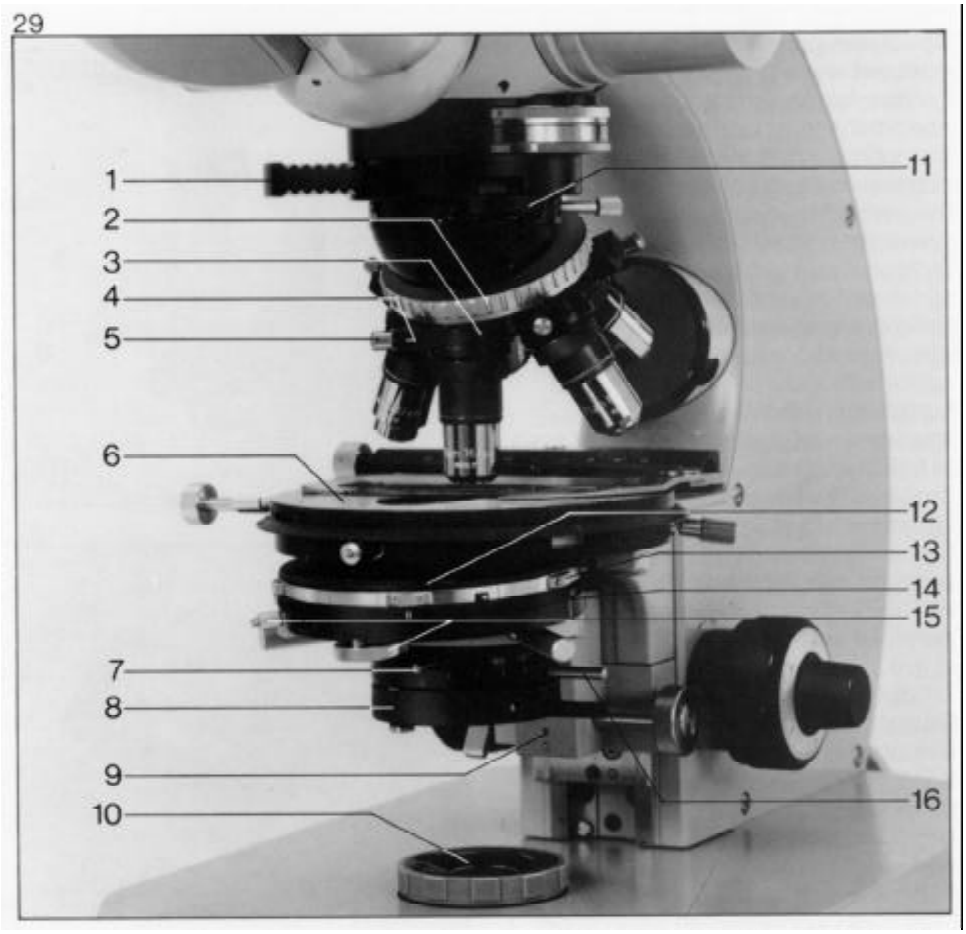
7. Replace the centering telescope (**25**.1) by an eyepiece or set the **Optovar** to a magnification system (1.25).
   Through the binocular tube you will see the Ph image.
   After objective exchange always adjust the lamp field stop (**1**.16) to the size of the field of view (see 3.1.9 above), and with the knurled ring of the condenser turn in a Ph annular diaphragm which corresponds to the Ph objective (see 3.2.4 above). Check the centering of the annular diaphragm after specimen exchange.

Specimen preparation for phase-contrast work

For satisfactory results the microscopic specimens must be optimally adapted to the optical conditions of the phase-contrast method. The high sensitivity of the method requires particularly careful preparation. Use only optically perfect (schlieren and bubble-free) specimen slides and coverglasses, and always remove all residues of detergents on specimen slides and coverglasses. The specimens must be limited by plane surfaces, and the examination of specimens in suspended drops or even in hollow-edged specimen slides is not possible. For this kind of work we recommend an oil chamber.
Some necessary plastic rings are supplied with the mounting media *(46 29 29)*. This chamber has proved particularly valuable for the observation of live specimens.

Oil chamber
a = paraffin oil
b = 0.5 – 1 mm thick plastic ring
c = culture medium
d = coverglass
e = specimen slide





This technique produces a visible relief of differences in the optical path length of unstained specimens (product of mechanical height and refractive index). The contrast also depends on the orientation of a structure in the field of view (azimuth effect), and the specimen should therefore be rotated around the optical axis, preferably on a rotary microscope stage.

3.3.1 Orientation of polarizer and analyzer

1. Remove condenser, auxiliary lens, objective, DIC slide and eyepiece from the light path.

2. Swing in the polarizer and adjust its oscillation direction East-West: with lever (**29**.16) swing polarizer *(47 08 65)* into light path, and set the corresponding scale to 0° with lever (**29**.7) or put 32 mm dia. polarizing filter *(47 36 00)* in filter holder (**1**.13) or on filter support (**29**.10) so that both white lines on the filter mount are in East-West (right-left) direction.

3. With the lamp switched on and the lamp field stop open, look through the empty tube.
   Slide in analyzer (**29**.1) as far as it will go.
   Set scale of rotating analyzer *(47 36 62)* to 0°. Maximum extinction must be achieved in this position. Recorrect in case of slight deviations. Retain the position of maximum extinction for DIC examinations. Swing in auxiliary lens (**29**.8) and insert eyepiece in tube.

3.3.2 Fitting the DIC equipment

1. Insert DIC-Ph-H-D condenser (**29**.12) (see table on p. 19) in condenser carrier (**10**.1) (see section 1.5 on p. 8).

2. Screw objectives (see table on p. 19) into quintuple DIC objective turret (**29**.2) *(47 31 56)* which features five oriented, fixed DIC adapter rings (**29**.3) *(47 44 65)*. Replace the standard objective turret by the DIC objective turret. From the front left to the rear right slide the DIC slider (**29**.4) (see table on p. 19) into the slot of the DIC adapter ring, corresponding to each objective and with the engraving pointing upwards.
   Other objectives on the DIC turret, e.g. for phase-contrast work, are screwed into the empty DIC adapter rings or mounted via spacer ring *(47 44 66)*.
   Only then are all objectives par-focalized.
   Subsequent fitting of DIC adapter rings *(47 44 65)* and alignment of the slots for DIC sliders see operating instructions G 41-215.

3.3.3 Object focusing in DIC

1. Focus object, preferably with Plan-achromat 16/0.35 and corresponding DIC prism in position Ⓘ of the DIC condenser (**29**.14).
   Check microscope adjustment according to section 3.1 above.
   Center condenser aperture with lever and knob (**29**.15) and open it with knurled ring (**29**.13) until 2/3 of the objective exit pupil are covered (see para. 3.1.10 above).

2. By turning screw (**29**.5) of DIC slider select black-and-white contrast and adjust it to the image structures to be examined.

3. λ-plate *(47 37 04)* (**29**.11) in the light path produces color contrast.

4. The DIC equipment can also be used to observe weakly stained specimens in **amplitude contrast.** To achieve maximum contrast polarizer or analyzer must perhaps be slightly turned out of the cross position.

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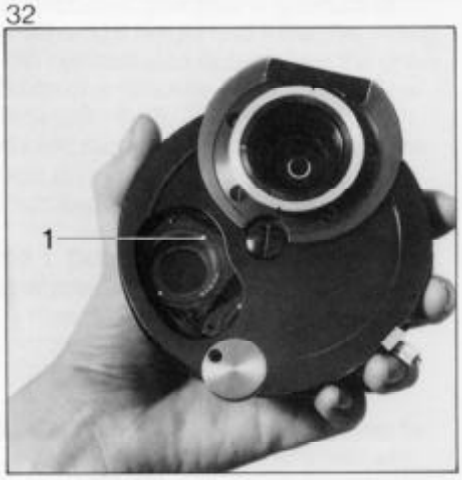

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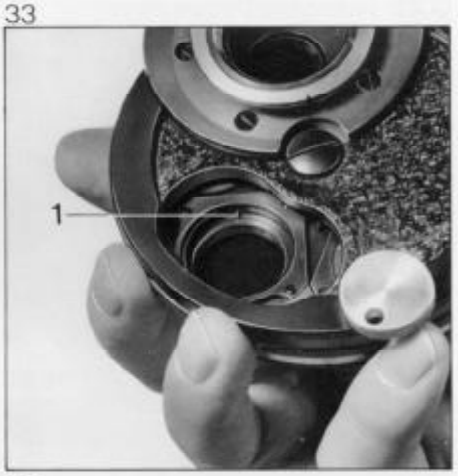

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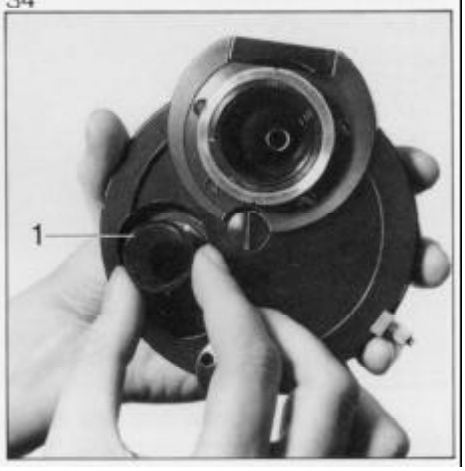

3.3.4 Checking the orientation of the DIC prisms in the DIC condenser
if the condenser was not supplied with the microscope.
Checking the prism position: take DIC condenser out of the condenser carrier. Remove dust cover (Fig. 31) at condenser bottom, and turn the condenser ring until the DIC prisms are visible. **The notch marked with a line (32.1) must be assigned to the pin (33.1) of the turret.** If the line is in opposite direction, the DIC prism must be changed: screw the supplied threaded tube (**34**.1) into the DIC prism mount, pull out the prism and insert it again in correct orientation. The symbols (**30**.1) and (**30**.2) indicate the DIC prism notch positions relative to the pin of the condenser ring. T means that on the **Universal microscope** the notch marked by a line must engage the pin. S means that on the **Standard microscope** the notch marked by a dot must engage the pin.

Table

Objective	DIC slider Cat. No.	DIC condenser aperture 0.63 *(465273)* position (**29**.14)	DIC condenser aperture 1.4 *(465285)* position (**29**.14)
Plan 6.3/0.16	*474531*	I	I*
Plan 16/0.35	*474551*	I	I
LD-Plan 40/0.60 corr.	*474564*	II	II
Plan 40/0.65	*474571*	II	II
Achromat 40/0.75 W	*434501*	II	II
Planapo 63/1.40 oil	*474581*	II	II
Plan 100/1.25 oil	*474591*	II	II
Plan-**Neofluar** 16/0.5 W oil	*474555*	II	II
Plan-**Neofluar** 25/0.8 W oil glyc.	*474560*	II	II
Neofluar 63/1.25 oil	*434500*	II	II
Plan 63/0.9 without coverglass	*434500*	II	II

*The field of view is inadequately illuminated.

Condenser position Ⓙ (iris) for bright-field only.
Condenser setting ② or ③ for Ph 2 or Ph 3 objectives.
Condenser setting Ⓘ is intended for special prisms.

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3.4.1 The microscope equipment for darkfield corresponds to that for brightfield (Fig. 19, p. 12).
A darkfield condenser replaces the brightfield condenser. The darkfield condenser illuminates the object with a hollow cone of rays whose internal aperture must be higher than the objective aperture. Only the light refracted by the object reaches the objective while the background of the image remains dark.

3.4.2 Object adjustment with immersion condenser

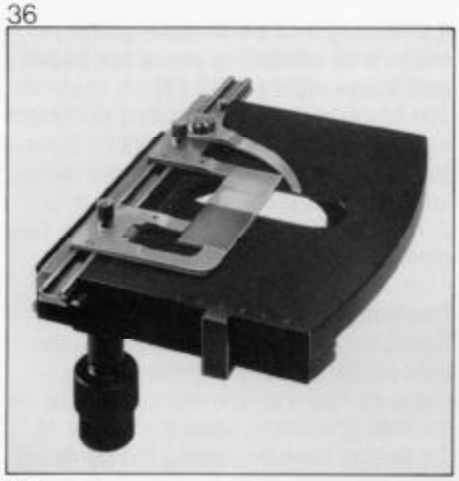
1. Insert H-Ph-D condenser V/Z *(46 52 77)* or ultra condenser *(46 55 00)* (**35**.2) on condenser holder Z *(46 55 42)* (**35**.3) in the condenser carrier. Apply a drop of immersion oil bubble-free on the condenser front lens. Provide a specimen and rack up the condenser until the immersion oil has reached the specimen slide.

2. Focus the object with 10× to 25× objective. Close lamp field stop (**19**.10).
   Adjust the height of the condenser until the light spot in the field of view is small, bright and in focus. With the centering screws (**19**.7) center this image of the lamp field stop in the field of view. Open the lamp field stop until its image just disappears behind the edge of the field of view.

3. The use of oil immersion objectives with numerical apertures higher than 1.0 requires a built-in objective iris diaphragm. Push in the resilient mount of the objective front lens and lock it by turning it clockwise.
   Apply immersion oil to the coverglass without bubbles.
   Immerse the objective front lens.
   Close the objective iris diaphragm (**35**.1).
   Focus the object.
   Re-adjust the lamp field stop. Open the objective iris diaphragm only so far that the dark background is not brightened.

3.4.3 Adjustment with dry darkfield condenser
Insert dry darkfield condenser in the condenser carrier. Swing a dry objective into the light path with an aperture that is smaller than that of the condenser. Do not use immersion oil. All other adjustments see para. 3.4.2 above.

36



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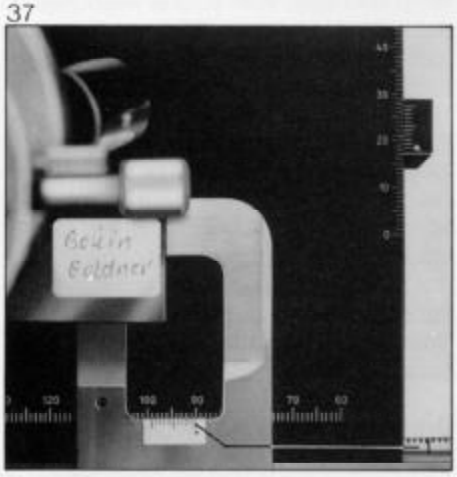

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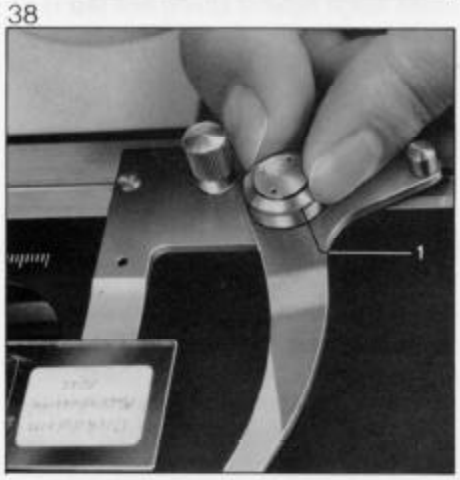


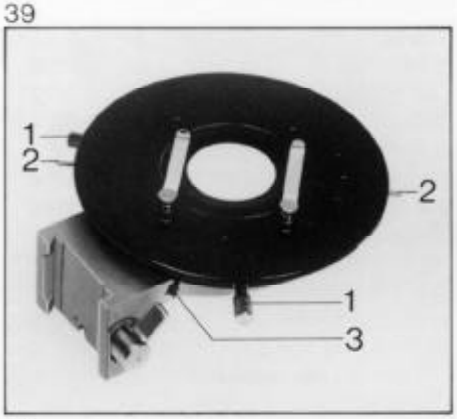
The specimen stage is fixed with 4 screws on the attachable stage carrier *(47 15 40)*, and clamped to the change slide of the microscope (see section 1.6 p. 9). From the ample selection of specimen stages the user can choose the one which best suits his purposes. Some stages are described below.

4.1 Mechanical stage 30×75 mm with graduation and deep-lying controls right *(47 34 15)* (Fig. **1**.9) or left *(47 34 16)*. The range of motion can be extended to 50×75 mm by fixing the stage with its 4 screws on the stage carrier turned through 180° so that the controls are in front (nearer to the user). The outer stop screw at the bottom of the stage must then be unscrewed.

4.2 Large mechanical stage with a range of motion of 50×75 mm, and controls either left *(47 34 25)* or right *(47 34 26)*. One of the specimen holders of the mechanical stage with graduation is provided with index and vernier (**37**.1). A specimen area can only be relocated according to its coordinates if the specimen holder with index and vernier has not been moved. To hold it use only the other specimen holder, shift it towards the specimen slide and tighten the clamping screw. With the graduation a specimen area can be determined most accurately to within 1/10 mm, and it can always be relocated with its coordinates. The values of the x (left-right) and y (forward-backward) directions are noninterchangeable (Fig. 37).
Fig. 37 shows the readout 90/18.5.

The spring pressure the clamp exerts on the specimen slide can be adjusted by pressing down knob (**38**.1) turning it and letting it engage again.

39



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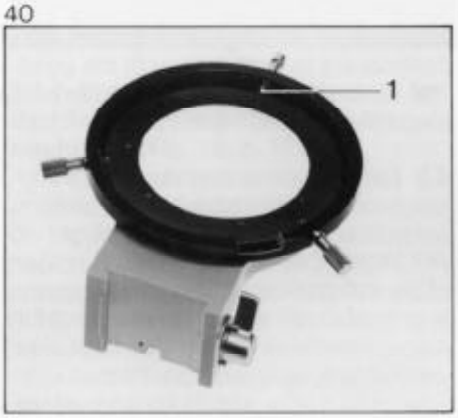

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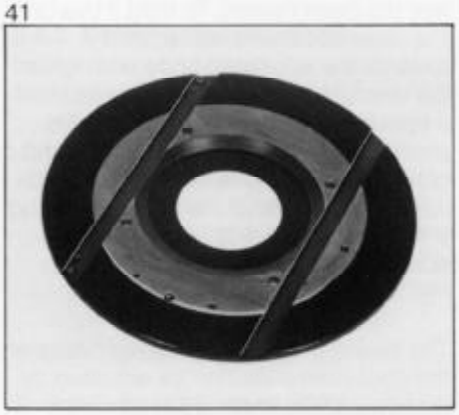

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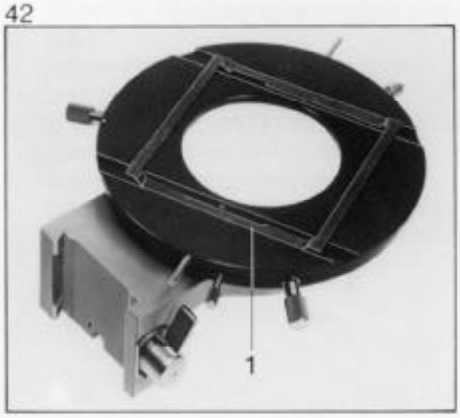


4.3 Rotary and centerable gliding stage with centering piece (47 34 54) and stage clips (47 33 73)

The stage plate can be shifted by hand and turned using two pins (**39**.2). During stage rotation the object remains in the field of view if the axis of rotation is centered relative to the center of the field of view.

Centering the gliding stage

Swing a 10× or 16× objective into the light path. Turn and shift the gliding stage so that a prominent feature lies on the axis of rotation. Mark the center of the field of view by closing the centered lamp field stop. With socket wrenches on the centering screws (**39**.1) center the axis of rotation in the field of view. The stage rotation can be locked with clamping screw (**39**.3).

If the gliding stage was not in use for a longer period, shift it several times in all directions to smoothen the motion.

To maintain the gliding properties of the stage and for correct microscopy at all magnifications, grease the gliding surface of the stage every six months. Suitable oil (10 ccm) *(47 33 91)* is supplied with the equipment.

Greasing the gliding stage

Unscrew centering screws (**39**.1).

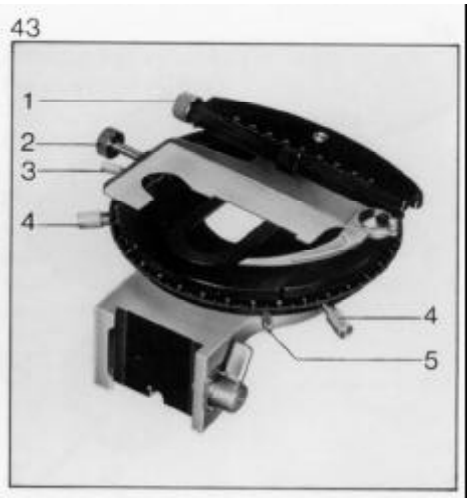
Press stage against spring bolt (**40**.1) and take it out of the centering piece (Fig. 40).

Separate bottom plate of stage (Fig. 41) and base plate (Fig. 42).

For re-assembly remember the position of the guide frame in the base plate (**42**.1) and the base plate's position with respect to the notches of the stage plate (Fig. 41).

Thoroughly clean all gliding surfaces with xylol. With a finger apply an ultra-thin film of oil to the gliding surfaces. Re-assemble the gliding stage. The spring bolt (**40**.1) must engage the notch in the base plate which is used to press it back.

After re-assembly shift the stage plate several times in all directions to distribute the oil. If the gliding motion is too smooth you have used too much oil.



4.4 Circular, rotary and centerable mechanical stage, 50 × 75 mm range of motion, with centering piece (47 34 56)

Centering the stage

With a 10× or 16× objective in the light path focus a fine-grain object by evenly turning the specimen stage.

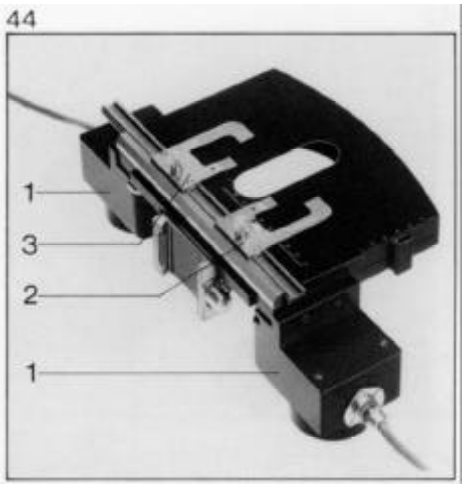
Turn the socket wrenches on the centering screws (**43**.4) so that the center of rotation of the stage moves to the center of the field of view.

The center of rotation of the stage is that point of the object which only rotates but does not move on a circle. The center of the field of view can be marked by the centered, closed lamp field stop.

The rotary motion of the stage can be locked with clamping screw (**43**.5). With control (**43**.1) the object is adjusted in X direction.

With control (**43**.2) the object is adjusted in Y direction. Its motion can be stiffened or smoothened with screw (**43**.3).

44



4.5 Scanning stage for 0.5 µm (47 34 81) and 10 µm increments (47 34 82)

The stage is similar to the large mechanical stage (see p. 21). With the stepping motors (**44**.1) on both sides object fields of max. 25 × 75 mm can be scanned. An object feature can only be relocated according to its coordinates if the specimen holder with index and vernier (**44**.2) has not been moved. Its outer edge should always lie at the inner index line of the stage. For holding press the right specimen holder (**44**.3) against the specimen slide.
Clamp the specimen in the holder. Never press the specimen against the stage plate from above (e.g. with clips), because friction would hinder the scanning motion.

The stage can be coarsely adjusted with the handwheels on the motor housings (**44**.1). They are coupled with the gear by means of a slip friction clutch. The scanning stage is operated via motor control 46 *(47 74 46)* (see operating instructions G 41-907).

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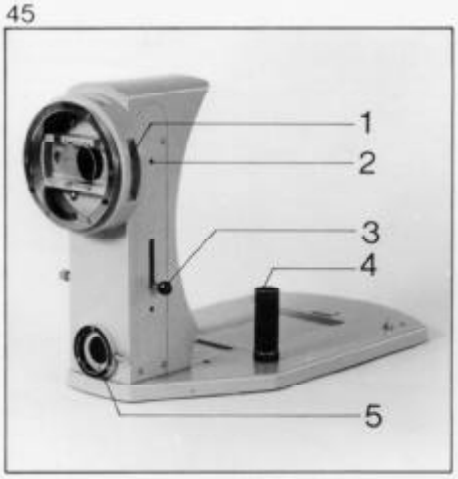

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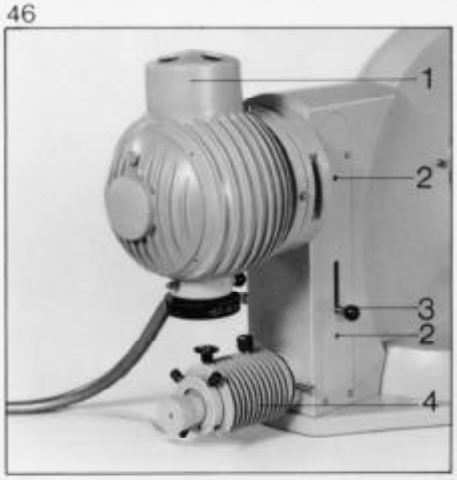
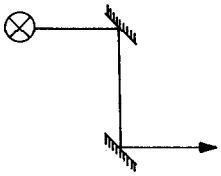


The special illuminator (Fig. 45) accepts the microscope illuminator 250 (**46**.1) via holder *46 56 44–9902)* (**45**.1) with opening for continuous interference filter b, and illuminator 60 (**46**.4) via holder (**45**.5).
The special illuminator *(47 20 15–9902)* can only be used with microscopes with 65 mm high bases, while the special illuminator *(47 20 16)* is intended for microscopes with 50 mm high bases.

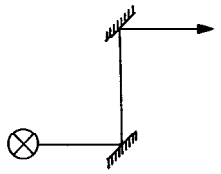
A mirror system (**46**.2) is switched with the pushrod (**46**.3).

Examples

Pushrod (46.3) down:
with Allen key mirror (**46**.2) switched according to drawing A:
illuminator 250 (**46**.1) transmitted light;
illuminator 60 (**46**.4): not operative.



Mirror (**46**.2) switched according to drawing B:
illuminator 250 (**46**.1): not operative;
illuminator 60 (**46**.4): reflected light.



Pushrod (46.3) up:
the mirror system is not in the light path, and upper and lower light sources have free passage.

Fitting the special illuminator
Lay the microscope on the left side. Instead of the collector tube with lamp condenser *(46 70 50)* (**5**.1) mount the tube (**45**.1) supplied with the special illuminator according to section 1.2 on p. 6.

Unscrew the four rubber supports (**8**.4, p. 7) of the microscope. Remove dust cover (**5**.4, p. 6) on the back of the stand.

Place microscope on blase plate.
To screw the base plate to the microscope, let the latter protrude over the table edge so that one borehole after the other becomes accessible, screw the 4 supplied screws in and tighten them.
For more details of microscope illuminator 250 see operating instructions G 42-320, of microscope illuminator 100 G 41-310/I and of microscope illuminator 60 G 41-305.

Further equipment and accessories for the **Universal microscope** see the following operating instructions:

G 41-350	Fluorescence equipment for transmitted-light excitation
G 41-351	Epi-fluorescence condenser III RS
G 41-415	MC 63 photomicrographic camera
G 41-500/I	Accessories for transmitted-light polarizing microscopy
G 41-820/I	Microscope photometer 01 K
G 41-823/I	Electronic shutter sequence control
G 41-825	Microscope photometer 03

We reserve the right to change design or extent of instrumentation in the course of advanced development.

These instruments may not be used in locations with explosion hazards.

The repair of electromedical equipment shall be the exclusive responsibility of our repair and maintenance service.