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PHOTOMICROSCOPE

Operating Instructions

INDEX

The following operating instructions give a detailed description of special techniques and accessories:

G 40-160 — Phase-contrast equipment
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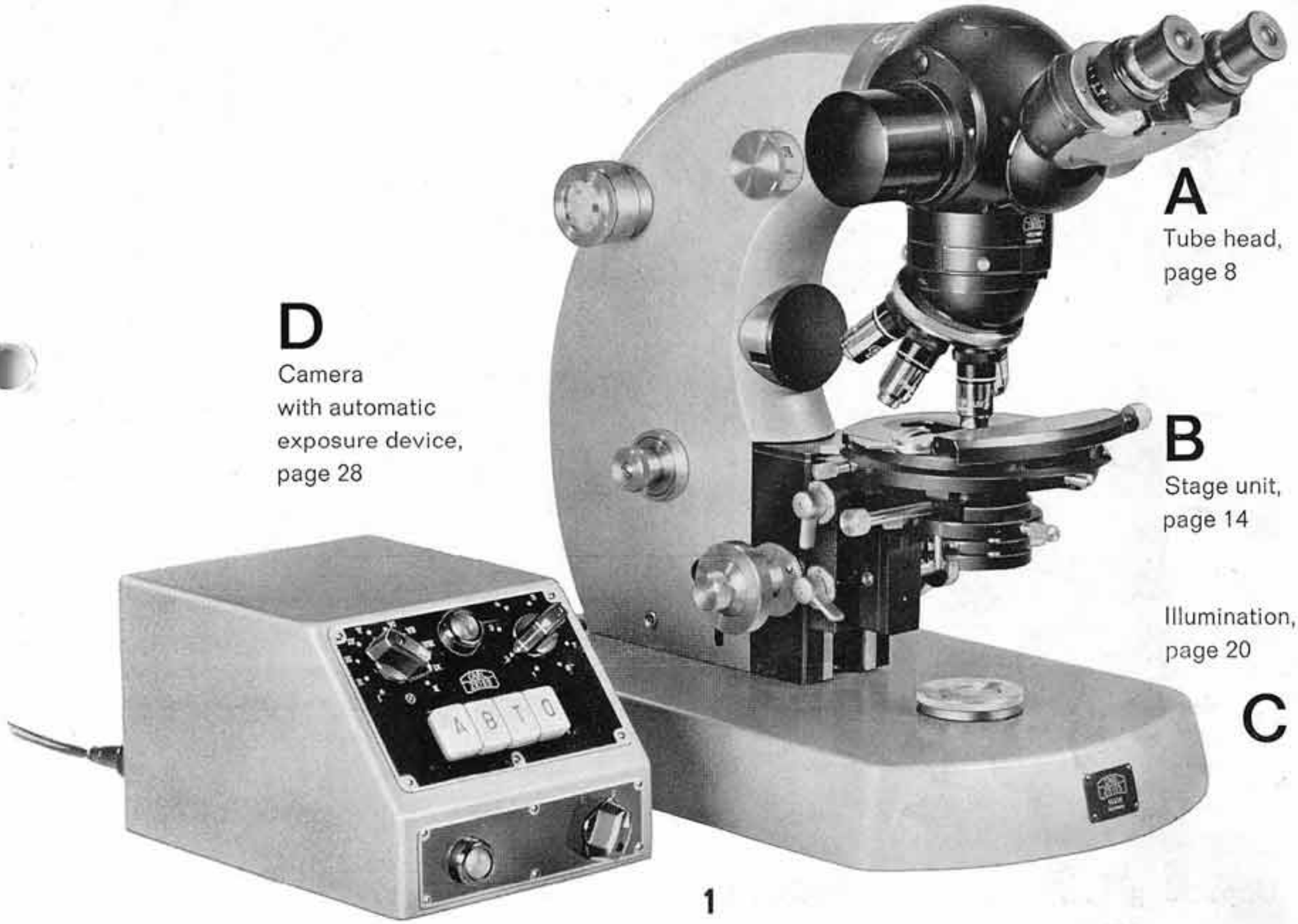
G 40-215 — Fluorescence microscopy
G 40-335 — Microflash equipment
G 40-340 — Multi-purpose microscope illuminator
G 40-540 — Equipments for Polarizing microscopy

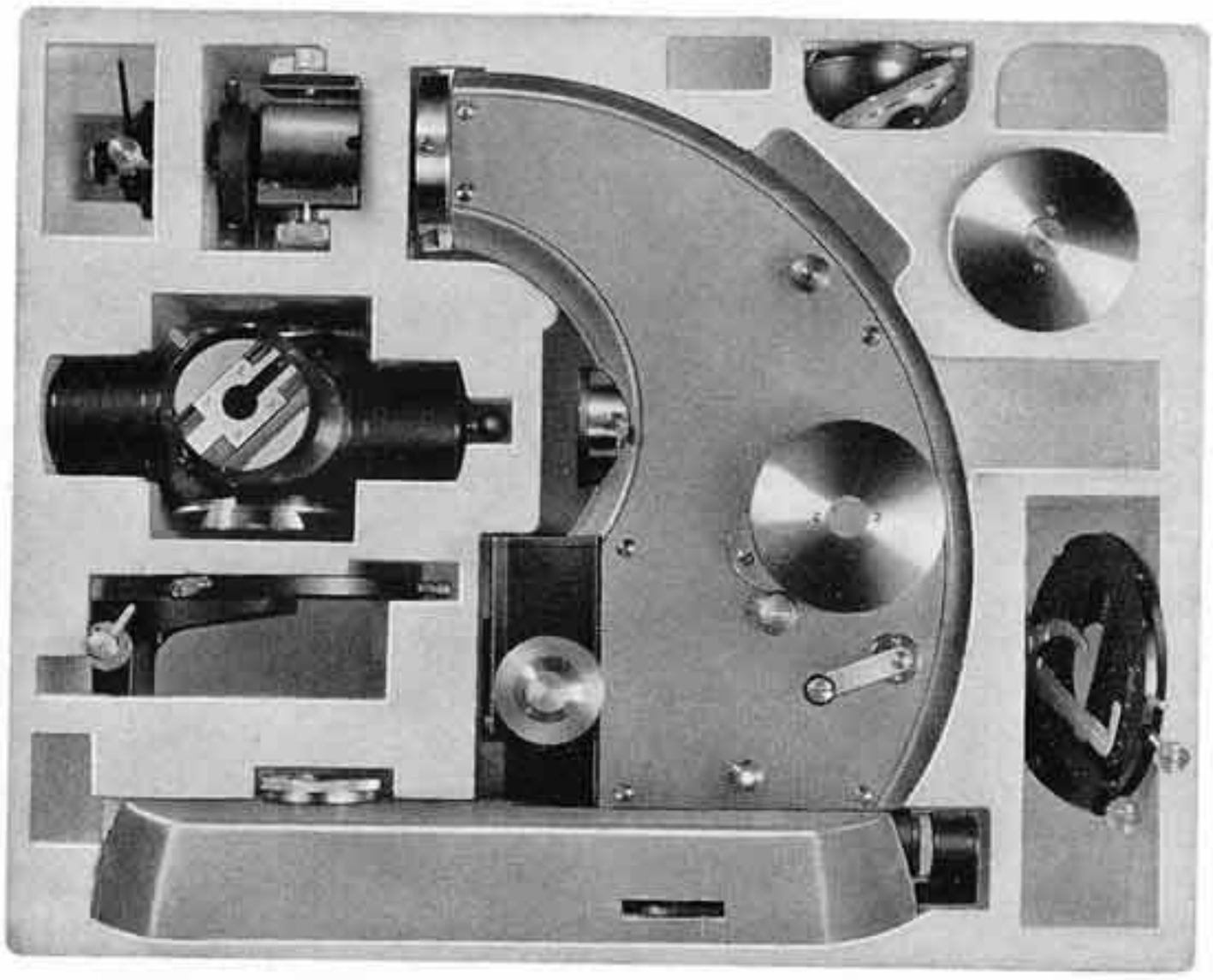
The six-digit figures shown in brackets after the instrument parts are catalog numbers.



1

The PHOTOMICROSCOPE can be modified to suit practically any microscopic technique. The tube carrier of the stand contains a 35 mm camera. The base houses the built-in illuminator. The stage and condenser units are clamped onto the rack and pinion unit with its adjusting mechanism. The tube head contains the image-forming optical system.

A knob on the reflecting system permits convenient change-over from microscopy to photography. The image portion recorded on the film will then automatically become visible in the binocular tube. The self-setting shutter of the camera is designed for automatic exposure control from approx. ½ second upwards and for instantaneous exposures of 1/10, 1/25, 1/50 and 1/100 sec., as well as for operation with our highly efficient microflash unit with exposure times of 1/3000 sec. and shorter. The film is automatically advanced after every exposure.



2 Stand and components of Microscope in Styropor case. The stage (on the right) has an additional case of its own which should be in the position shown on the illustration.

Unpacking of PHOTOMICROSCOPE

The stand and the most essential parts to be attached to it are packed in a Styropor case. This case protects the instrument against damage during transportation. If it should ever become necessary to ship the Microscope to some further destination, our customers are urgently advised to pack the instrument in exactly the same manner in which it was received.

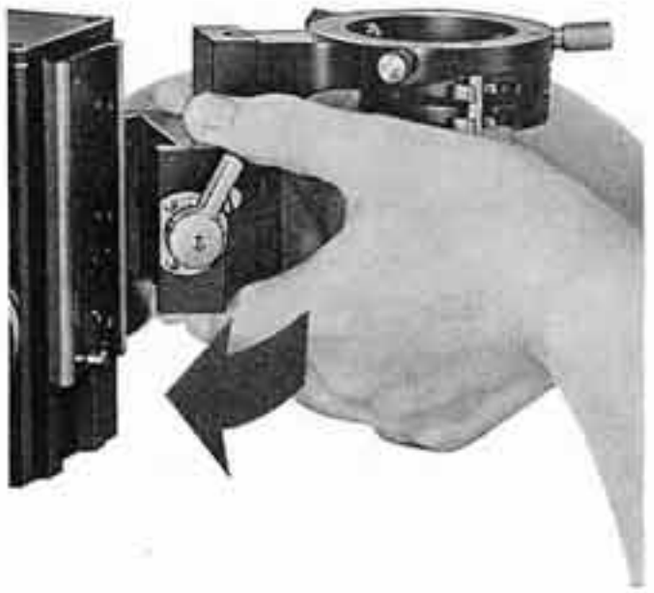
Unpack the Microscope and its components with the extreme care which is indispensable when handling such a valuable precision instrument. On no account should the various setting knobs and other control elements be used as handles. Only start assembly after all components have been unpacked and checked for conformity with the delivery bill.

To insure optimum performance of the instrument, do not exchange any of the items supplied for others of the same kind. This applies particulary when different parts are provided with labels of identical color and number. These labels are superfluous once the instrument has been assembled and can easily be removed.

Assembly

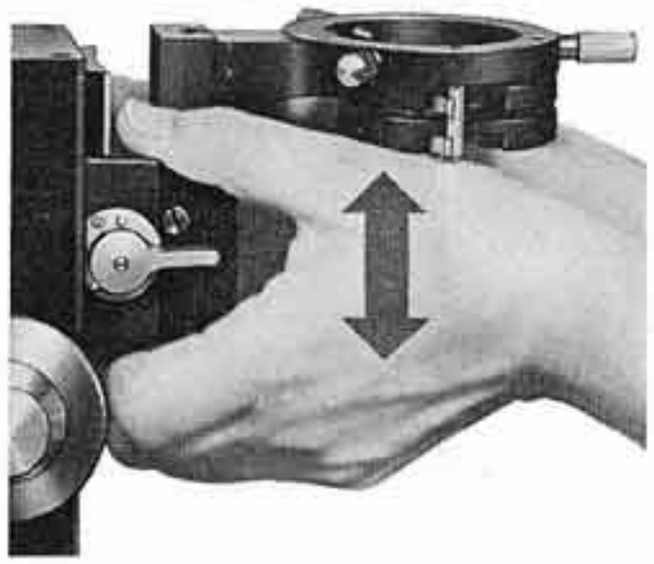
Installation of the condenser carrier

Move clamping lever right up. Hold right-hand guide rib of condenser carrier against the flank of the dovetail clamping member on the rack and pinion unit and pivot it to the left until the spring bolt engages the other side.



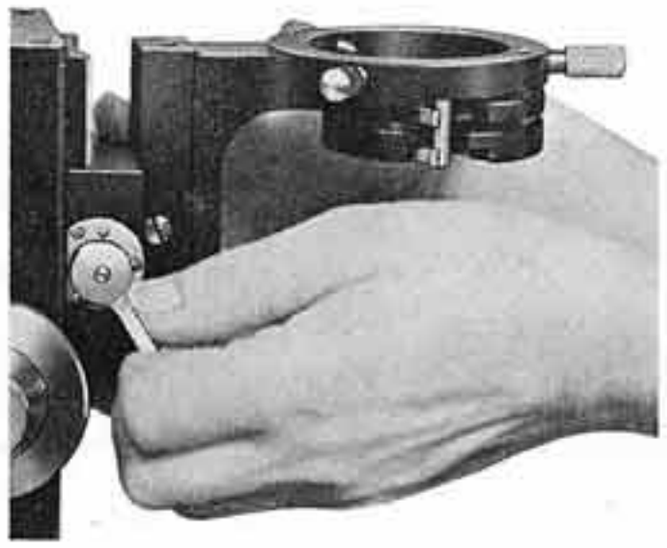
3

Turn clamping lever to horizontal position, where it lightly engages a notch and push condenser carrier down to the stop.



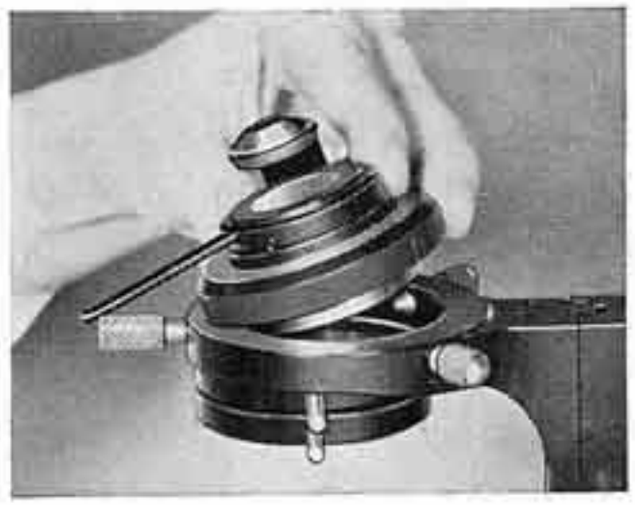
4

Push clamping lever down until the condenser carrier is firmly locked in position. Do not apply excessive pressure to the lever.



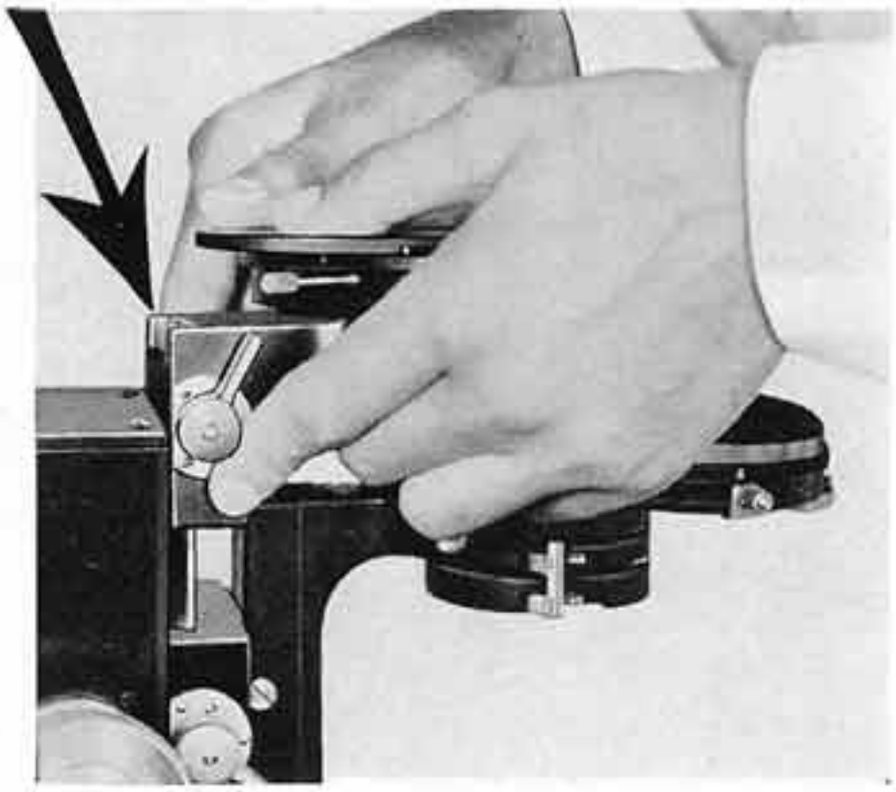
5

To insert the **transmitted-light condenser,** tilt it slightly and with its conical supporting ring press the spring bolt of the condenser carrier outwards. Then place condenser on seating face and turn until the spring bolt engages the notch in the support.
Move condenser down as far as it will go with the rack and pinion B 15.



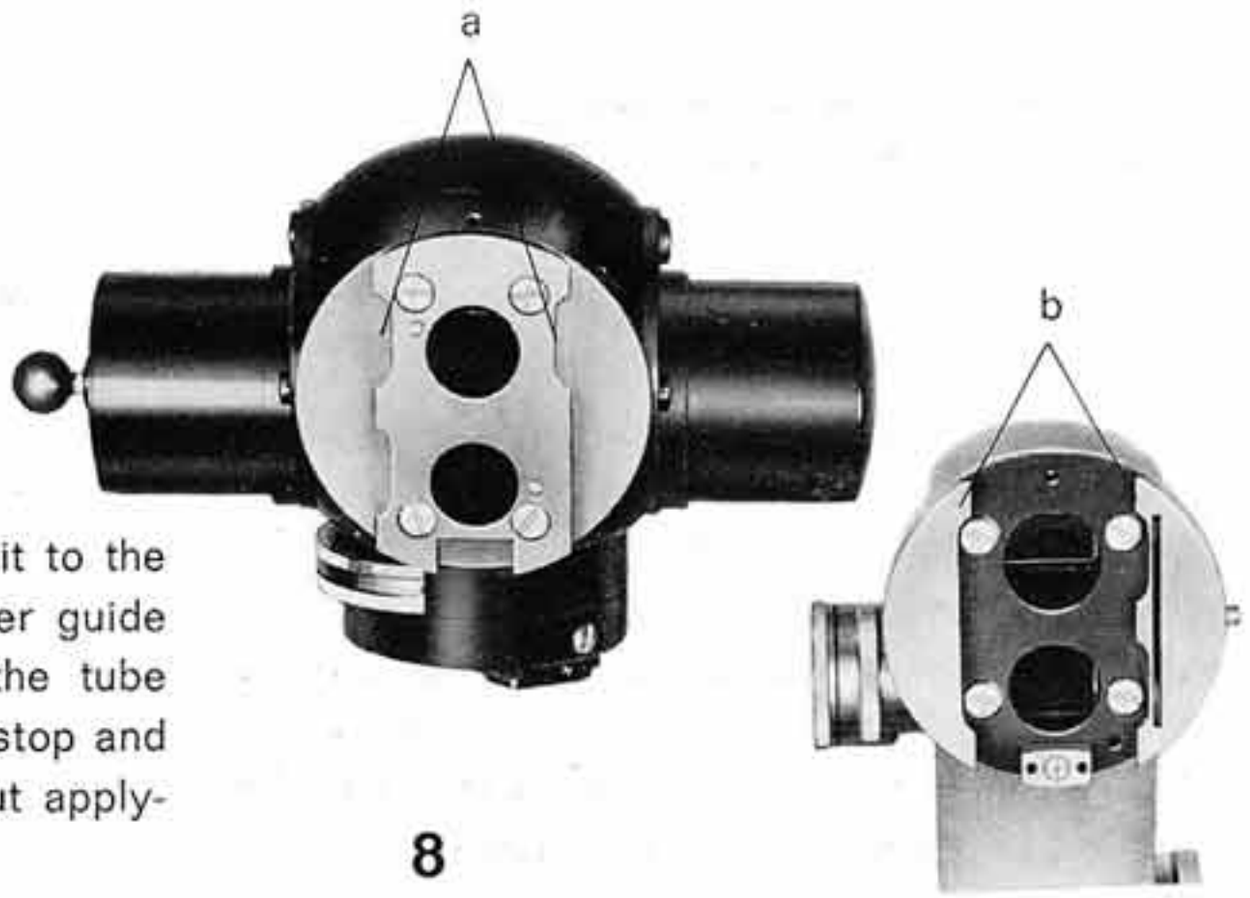
6

Attach **stage carrier** with stage from above, with the clamping lever pointing upwards. First hold the lower part of the right-hand guide rib against the right-hand flank of the dovetail clamping member. Then insert spring bolt on the left and finally slide on upper part on the right (arrow). Push stage carrier right down until it comes to rest on the condenser carrier, then move clamping lever down until it locks the stage carrier in position.
For observation with transmitted light, condenser carrier and stage carrier must always be pushed right down. Failure to do so may give rise to "inexplicable" errors of adjustment.



7

Take **tube head** with both hands and fit it to the stand at the right level so that the upper guide edges (b) engage the cutouts (a) on the tube head. Then slide tube head down to the stop and adequately tighten screw A 8, but without applying force.



8

For mounting the tube, loosen tube clamping screw A 3 sufficiently to allow the locked spring bolt to be pressed right back. Press the dovetail ring of the tube against the spring bolt until it comes to rest behind the two contact points lying opposite. Re-tighten tube clamping screw.

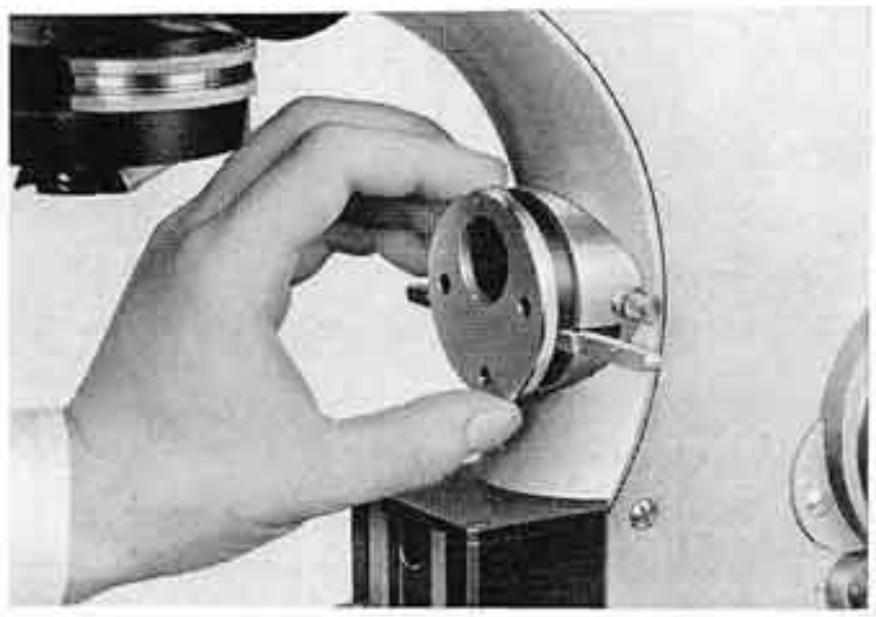
9

Attach revolving **nosepiece** from rear left, push right forward to stop and tighten with clamping screw A 13. The holder for single objectives is attached from the front, on the right, like the vertical illuminator.

10

For vertical illumination only:

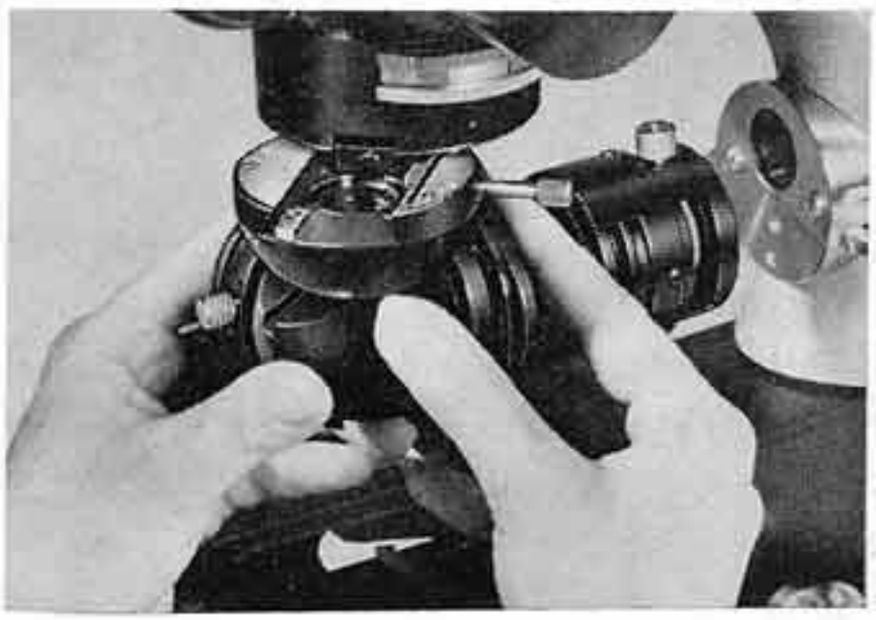
Introduce **mirror insert** with incident-light aperture diaphragm into the housing in place of the cover secured with a knurled screw, with the slide in the recesses provided. The mirror insert must also be firmly pressed down on its seat.



11

The **vertical illuminator** is mounted in the same way as the revolving nosepiece, except that it is introduced from the right front to the left rear. Both during assembly and disassembly of this illuminator, the filter holder must be **swung in.**

Connection to the automatic exposure device, which at the same time serves as a power supply unit for the built-in illuminator incorporated in the microscope, is shown in figure 24, page 20.



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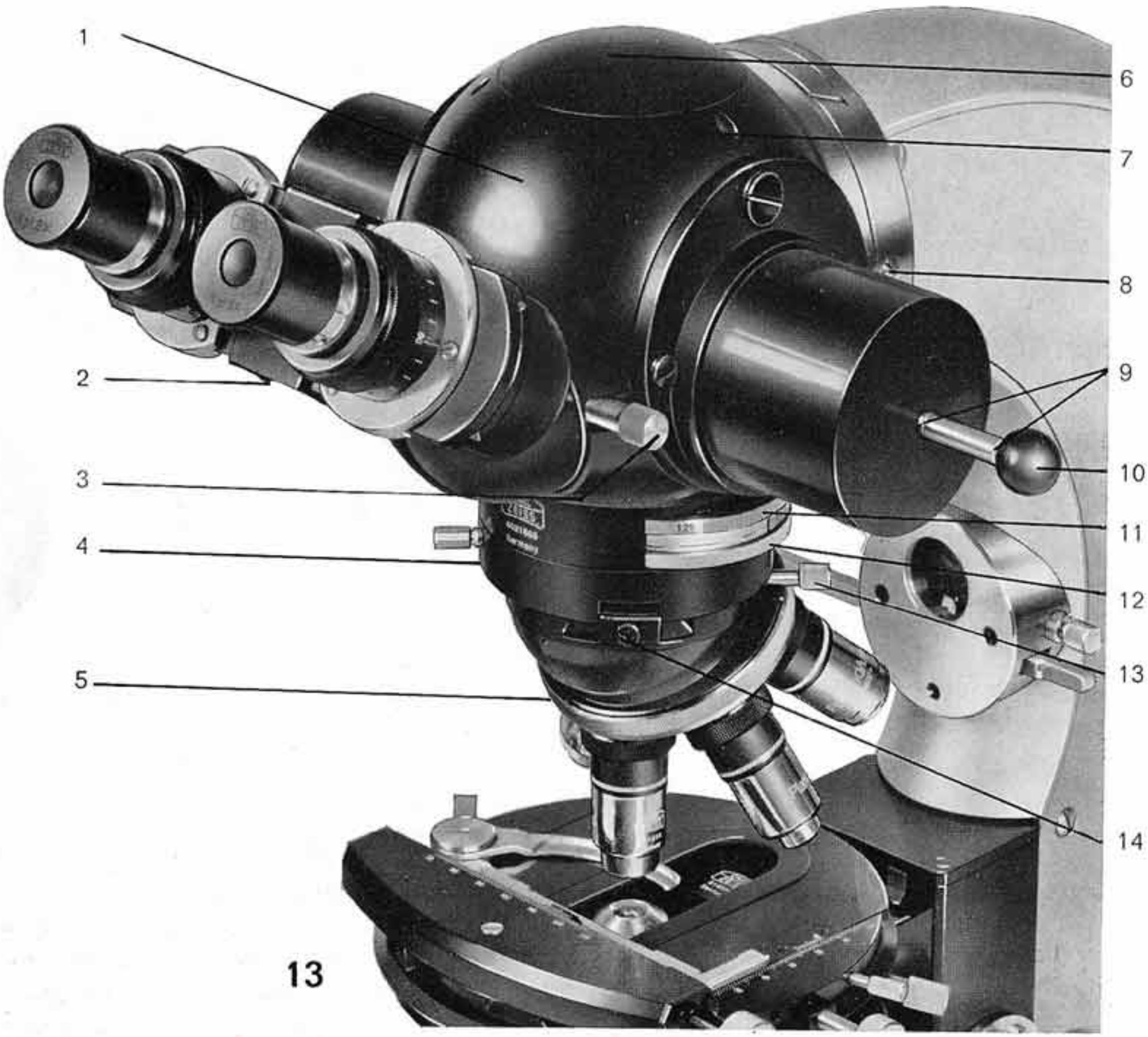

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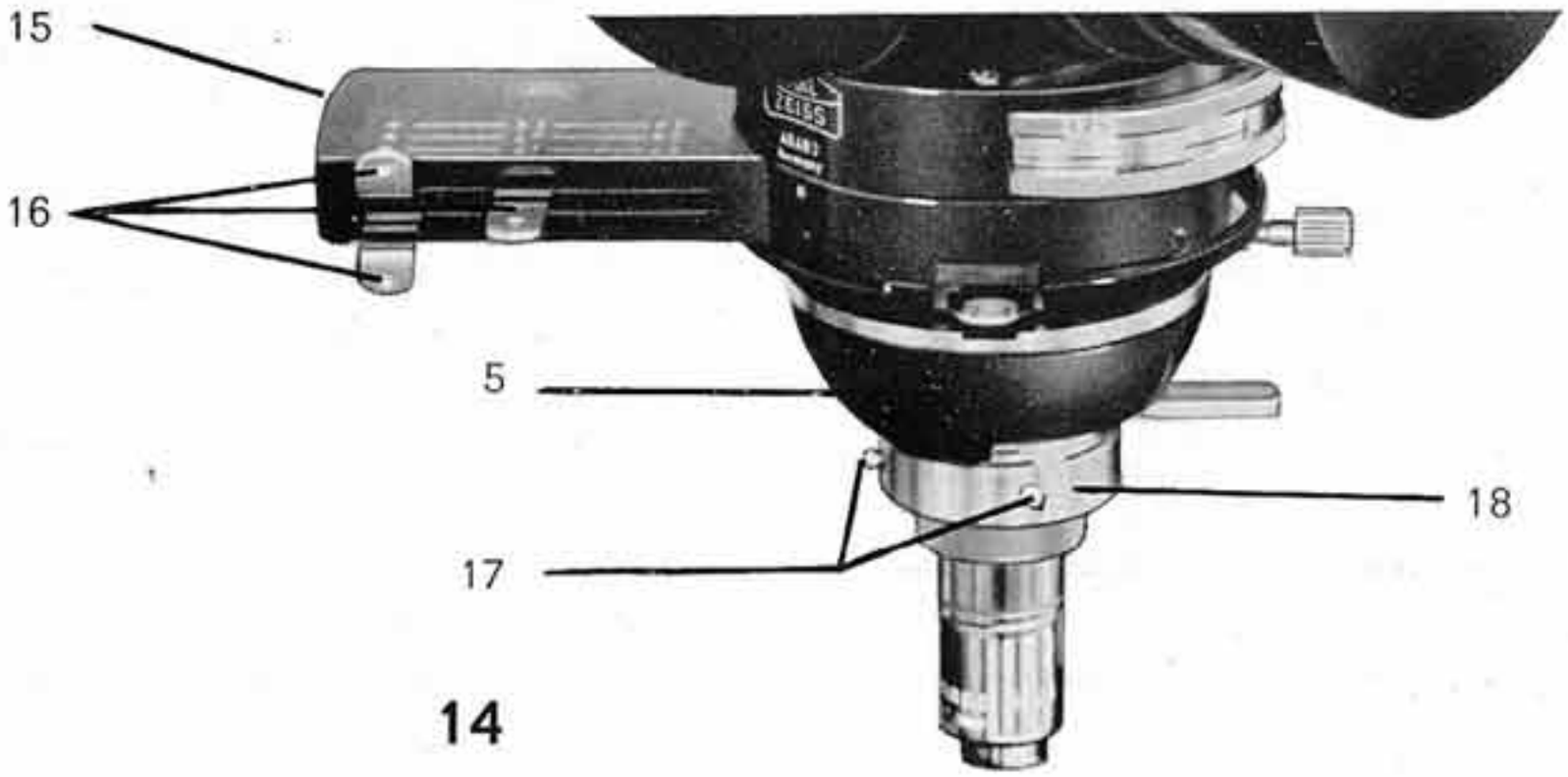


14

1 = Spherical housing
2 = Binocular tube for visual observation. The eyepiece tubes can be adjusted to suit the interpupillary distance of the observer.
3 = Tube clamping screw
4 = Insert covering the opening for analyzer slide and barrier filter insert
5 = Objective changers
above: quintuple revolving nosepiece
below: holder for single objectives with centerable changer ring
6 = Cover, which may be exchanged, for instance, for a vertical tube for projection purposes.
7 = Cover screw
8 = Clamping screw for tube head
9 = Colored rings indicating position of reflecting system (Table 1, page 12)
10 = Setting knob for reflecting system
11 = Knurled ring for operation of OPTOVAR magnification changer (Table 2, page 13)
12 = Knurled ring for focusing objective pupil by means of auxiliary microscope, with Optovar set to "Ph" (required for phase contrast and microscopy with polarized light).
13 = Clamping screw of objective changer
14 = Opening for introduction of quartz plates, compensators and barrier filter slides (shown closed).
15 = Barrier filter insert for fluorescence microscopy (page 54) in opening A 4. Three slides contain two barrier filters and one free opening each.
16 = Grips for introduction of barrier filters
17 = Centering screws, to be operated by means of the two socket wrenches supplied with the instrument
18 = Changer ring for single objectives, with provision for centering.

Tube head

Since the entire image-forming system is incorporated in the tube head, the latter actually constitutes the basic microscope.
The housing A 1 of this tube head is spherical and is connected to the stand by means of a quick-change device. This provides for easy attachment of the tube head to the carrier on the stand, where it is locked in place by means of screw A 8 (page 6).

OPTOVAR

The spherical housing has a cylindrical extension at the bottom which contains the OPTOVAR magnification changer A 11. This magnification changer incorporates the optical systems giving magnifications of 1.25×, 1.6× and 2×, as well as a "Ph" system for observing the exit pupil of the objective (phase annuli in the case of phase contrast — conoscopic images in connection with polarized light microscopy).
In polarized light microscopy, this system is called a Bertrand lens. It can be used for monocular **and** binocular observation of conoscopic images and for photographing them.
The different systems are successively brought into the light path by turning the upper knurled ring A 11. When using the auxiliary microscope "Ph", the lower knurled ring A 12 has to be turned against the upper one in order to focus the phase annulus in the objective (or the conoscopic image).

Tube head inserts

An analyzer for microscopy with polarized light can be inserted in the opening A 4 of the tube head, which is normally closed by an insert (page 52). The same opening will accommodate the filter insert 47 25 47, by means of which different barrier filters can be conveniently interchanged and combined for purposes of fluorescence microscopy. The barrier filter insert can be used with PHOTOMICROSCOPES of serial number 52 292 and higher (with the exception of 6-digit numbers).
Below and at right angles to opening A 4 is a slot A 14 for inserting a quartz plate or other compensators (page 52).If the barrier filter insert A 15 cannot be used, two slides carrying the barrier filters should be inserted here for fluorescence microscopy. The opening should always be kept closed. With instruments up to serial number 52 291, this is done by means of a ring, in instruments of higher serial number by means of two stoppers.

Objective changers for transmitted light

The lower end of the cylindrical extension of the tube head is designed as a changing device for the objective carriers A 5. In instruments up to serial number 52 291, this is a dovetail ring with three-point contact; in instruments of higher serial number, it is a dovetail slide. The objective carrier is usually a quintuple revolving nosepiece running on ball bearings. If a larger number of objectives is in frequent use, or if the objectives

are to be individually centered (such as, for instance, special objectives for the universal rotary stage for polarized light), a special holder for single objectives is preferable. This holder will accommodate single objectives in a centerable changer ring A 18.
Objectives for vertical illumination are mounted in the vertical illuminator with the aid of a fixed changer ring or one which can be centered (page 44).

Objectives

The scale factors of our objectives correspond to a standardized series with intervals of 1.6. Every objective has its scale factor engraved on it. In addition, every objective is provided with a clearly visible colored ring which corresponds to its scale factor; objective 10 has a yellow ring, 16 a light green one, 40 a light blue one, etc.
The figure behind the scale factor (e.g. 40/0.65) indicates the numerical aperture of the objective and is thus a measure of its resolving power. If the total magnification lies between 500 and 1000 times this value, all the details resolved by the objective can be recognized in the microscopic image. If this range is exceeded by the use of too powerful eyepieces, the result will be excessive magnification which does not supply any additional information on the specimen.

Our objectives have been corrected for a mechanical tube length of 160 mm. Insofar as they have been computed for the examination of specimens with a specified cover glass thickness of 0.17 mm, this value is engraved in the mount.

The objectives are parfocalized, so that the image will remain visible after another objective has been moved into position with the revolving nosepiece. For maximum sharpness, a slight readjustment of B 4 will be quite sufficient. All objectives for use with transmitted light are so designed that damage to the specimen is practically impossible. For this purpose, the high-power systems, which allow only a minimum working distance, have been provided with resilient mounts.

In order to obtain a particularly flat field, Planachromats or, for very exacting demands, Planapochromats should be used on the PHOTOMICROSCOPE. For color photography, NEOFLUAR objectives or the aforementioned Planapochromats will be found particularly advantageous.

Special objectives (strain-free and in centering mount) are available for quantitative microscopy with polarized light, as well as for the universal rotary stage and for observation under vertical illumination (see objectives for vertical illumination, Table 12, page 45).

Reflecting system

In the horizontal guide tube of the tube head a slide can be adjusted by means of the rod A 10 protruding on the right. This slide can be arrested in four different positions marked by click stops. The position of the reflecting systems thus selected is indicated by the colored rings A 9.

Depending on its position, the reflecting system will direct the beam either through the tube to the eye, or to the eye and the camera, or simply straight up through the tube head, as may be required for special purposes. Table 1 gives a survey of the different functions.

Table 1

Positions of reflecting system

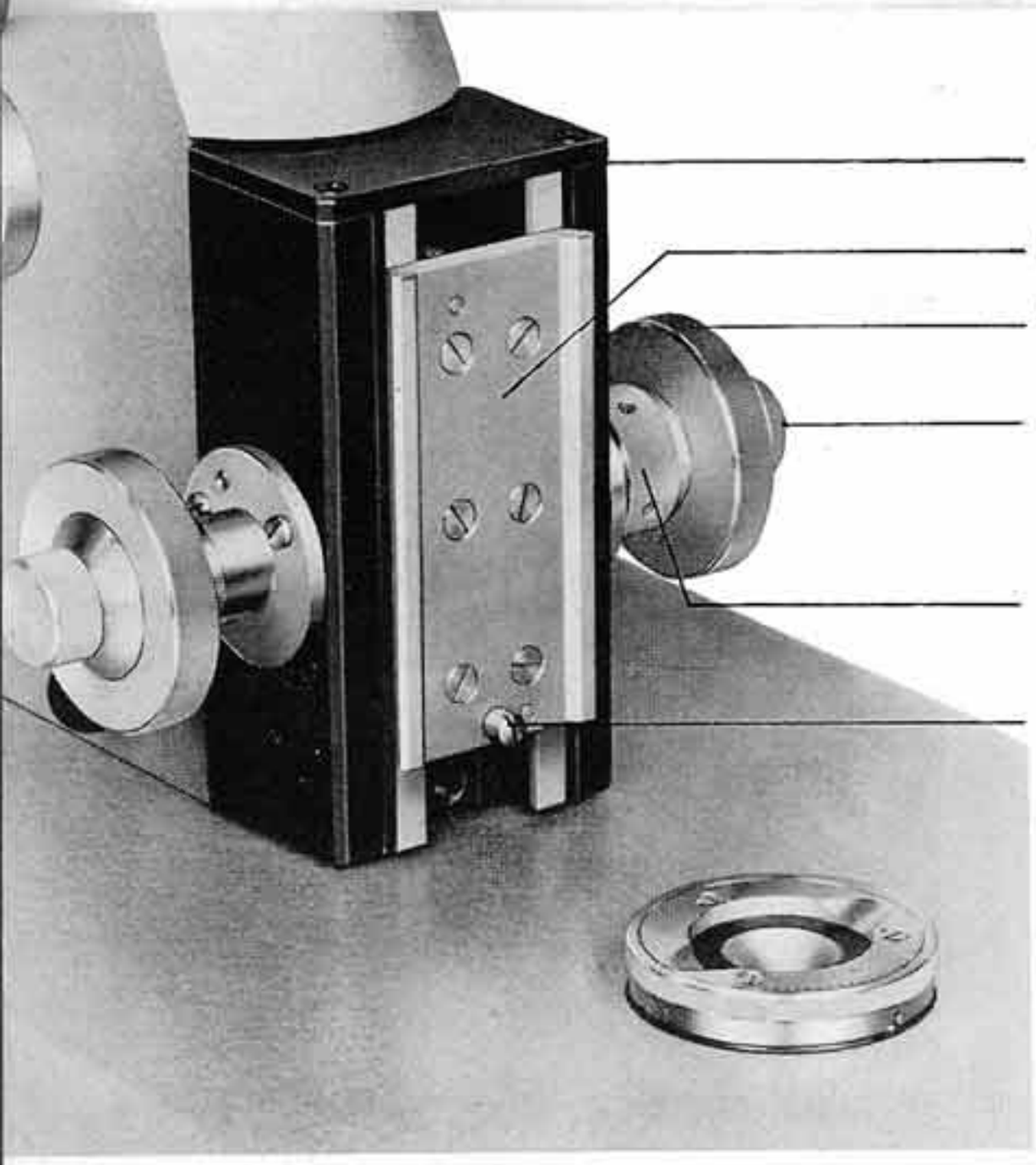
Position	I	II	III	IV
Ring color	white	red	black	colorless
	Observation images of low brightness: all the light used for observation	**Observation** if image in position I too bright: uses only part of light in tube	**Photography** ⅓ of light conveyed to tube, photocell and film, respectively: Image section covered by photograph is visible	**For special tasks** all light leaves top of tube head vertically

For observation, the following eyepieces are supplied with the instrument:
8× Kpl eyepiece (46 39 20) and
8× Kpl eyepiece for spectacle wearers (46 39 22).
The field-of-view number of both types is 18.

Table 2

Magnification with 8× eyepieces

Objective	OPTOVAR **1.25** Total factor 10×	OPTOVAR **1.6** Total factor 12.5×	OPTOVAR **2** Total factor 16×
1	10×	12.5×	16×
2.5	25×	32 ×	40×
4	40×	50 ×	63×
6.3	63×	80 ×	100×
10	100×	125 ×	160×
16	160×	200 ×	250×
25	250×	320 ×	400×
40	400×	500 ×	630×
63	630×	800 ×	1000×
100	1000×	1250 ×	1600×



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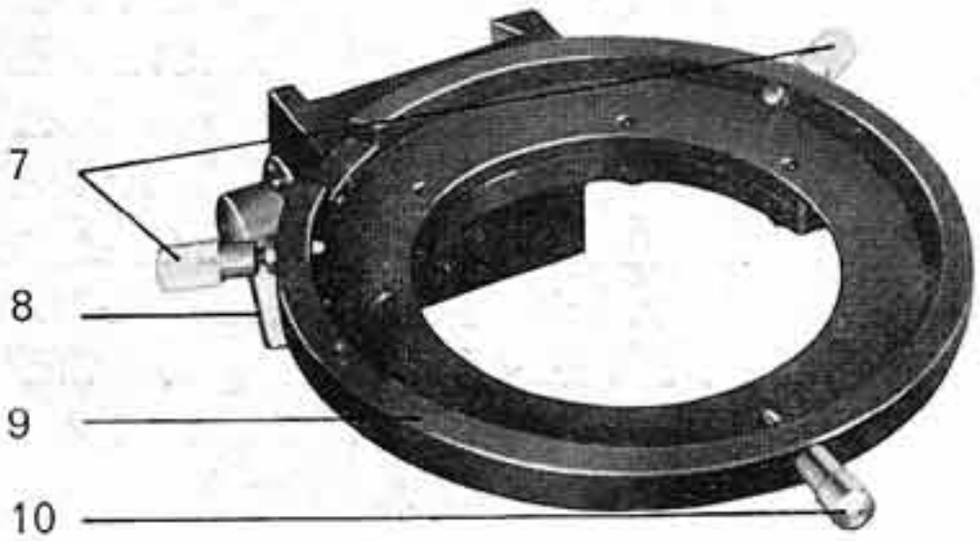

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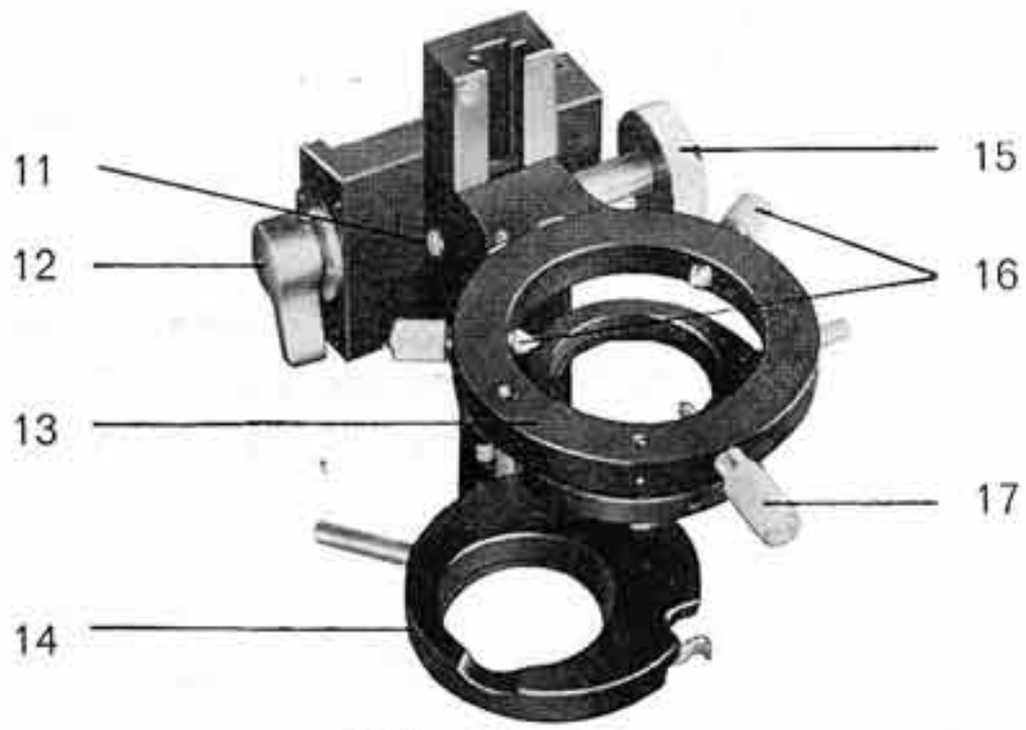

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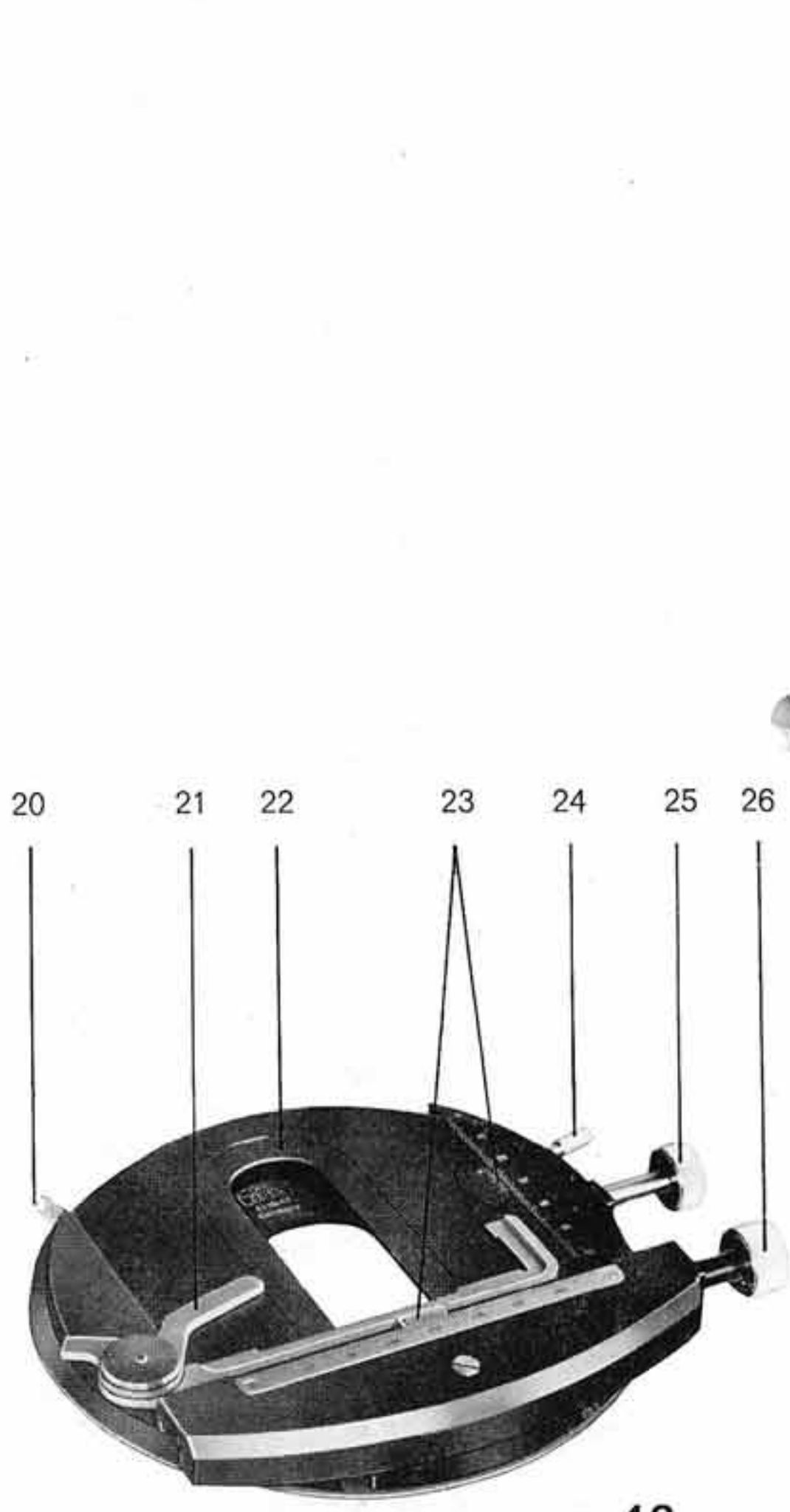


18

Rack and pinion unit

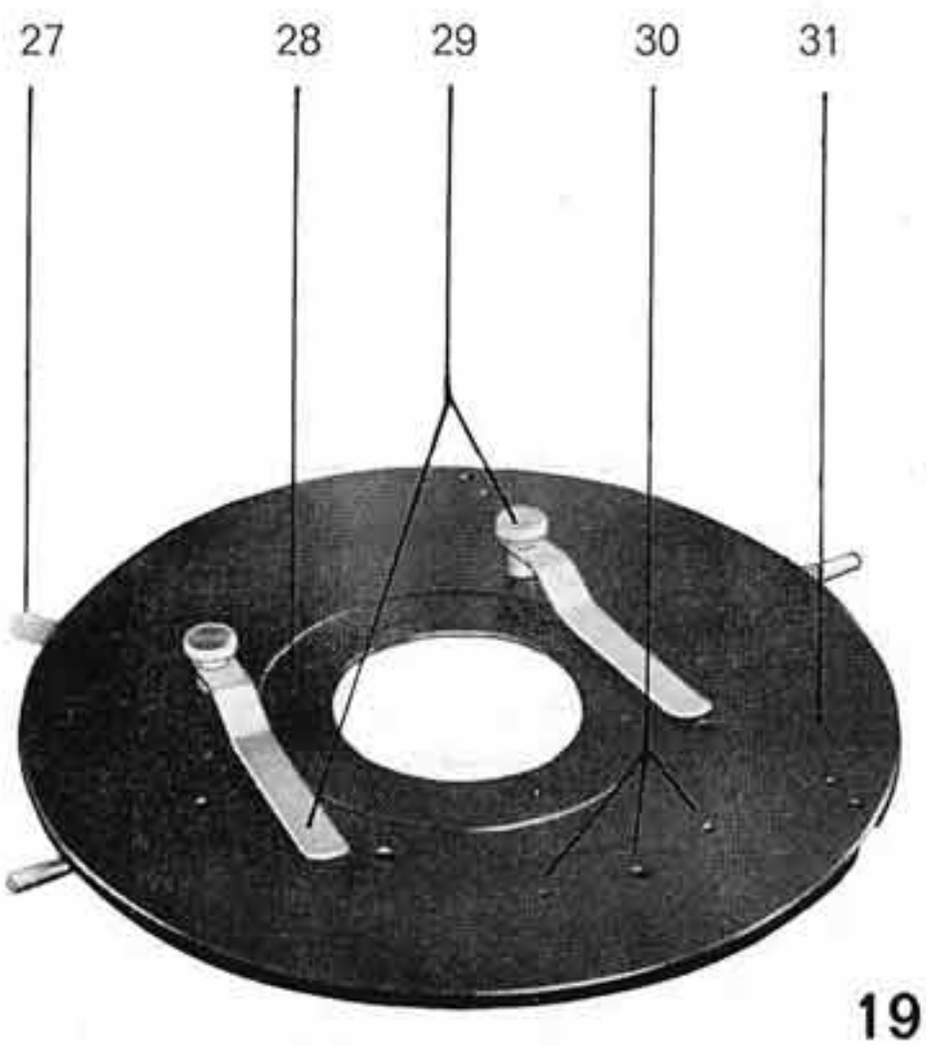
1 = Housing
2 = Clamping plate for stage carrier and condenser carrier
3 = Coarse adjustment
4 = Fine adjustment
5 = Coarse adjustment brake
6 = Stop for condenser carrier

Stage carrier with centering piece

7 = Stage centering screws
8 = Clamping lever for locking stage carrier on clamping plate B 2
9 = Centering piece
10 = Spring bolt

Condenser carrier with rack and pinion

11 = Screw for controlling smoothness of pinion adjustment
12 = Clamping lever for locking condenser carrier to clamping plate B 2
13 = Condenser carrier
14 = Filter holder, swung out
15 = Knob for adjusting height of condenser
16 = Condenser centering screws
17 = Spring bolt



19

Circular, rotary mechanical stage with provision for centering

20 = Locking screw for rotary motion of stage
21 = Slide holder
22 = Interchangeable diaphragm
23 = Vernier scales
24 = Set screw for adjusting smoothness of motion of B 25
25 = Knob for forward or backward displacement of slide
26 = Knob for lateral displacement of slide

Rotary gliding stage with provision for centering

27 = Set screw for locking rotary stage in position
28 = Interchangeable diaphragm
29 = Stage clips
30 = Holes for attaching a mechanical stage
31 = Stage top, horizontally adjustable by hand

20

Stage for polished specimens

32 = Stage top, horizontally adjustable by hand
33 = Interchangeable, circular diaphragm, adheres magnetically to the bridge
34 = Plate with plastic pad, presses the polished specimen against the bridge
35 = Bridge

Stage unit

The stage unit consists of a rack and pinion unit firmly attached to the lower part of the stand, to which are attached the stages, mounted on stage carriers, as well as the condenser carrier for incident-light work.

Rack and pinion unit

The adjusting elements combined in the rack and pinion unit B 1 act only on the stage unit. There are two elements providing for coarse adjustment and fine adjustment, respectively. The two pinion shafts are coaxial and are operated by separate knobs B 3 and B 4. The coarse adjustment can be controlled by a brake B 5 on the shaft of the right-hand knob.

Rotation of the knurled ring B 5 in the direction of the arrow will gradually slow down the adjustment. Excessive application of the brake should be avoided. Complete immobilization of the shaft is impossible.

The coarse adjustment acts on a dovetail member which is fitted to the front of the rack and pinion housing and rigidly joined to the clamping plate B 2 for the attachment of the stage carrier and the condenser carrier.

The fine adjustment runs on roller guides, which have many advantages over ball guides. It moves the whole rack and pinion unit up and down by about 2 mm. The range of movement is indicated by two white lines on the right side of the pinion housing. The index line on the stand should always lie approximately midway between these two lines. An interval of one graduation on the fine adjustment scale corresponds to a height adjustment of the specimen by about 2 microns (= 0.002 mm).

On instruments with serial numbers higher than 52 303 the motion of the fine adjustment can also be regulated. When the stage is lowered, so that the specimen leaves the zone of sharp focus, the fine adjustment knobs need only be turned very slightly in opposite directions. It is sufficient to hold the left-hand knob in its position and turn the right-hand knob clockwise.

Stages

Any of our stages for large microscope models can be mounted on the stage carrier. For the PHOTOMICROSCOPE, we supply above all the circular, rotary mechanical stage with provision for centering, or the rotary gliding stage. A rotary stage is always advisable because of the possibility of conveniently orienting the specimen within the recorded image section.

The large rotary polarizing stage is employed if the PHOTOMICROSCOPE is to be used as polarizing microscope (page 52). It is screwed firmly to the stage carrier and adjusted at the factory so that its axis of rotation coincides exactly with the optical axis of the microscope.

A special stage is available for the examination of polished specimens. This is a rotary gliding stage with provision for centering, which permits the specimens to be positioned and oriented without difficulty.

All our rotary stages run on ball bearings. The circular mechanical stage, the gliding stage and the stage for polished specimens are mounted in a centering piece screwed to the stage carrier.

With the aid of the two centering screws B 7, the stage can be displaced from its central position in the centering piece by 2.5 mm in all directions, against the pressure of spring bolt B 10. The image center can thus easily be made to coincide with the axis of rotation of the stage.

For centering of stages, see page 19.

The circular, rotary mechanical stage, with provision for centering, rotates on two ball bearing races in a centering ring. This centering ring fits into the centering piece B 9. The rotation of the stage can be arrested by means of screw B 20. The slide carrying the specimen is fastened in the holder B 21 which can be displaced from right to left by means of knob B 26 and forward or backward by means of knob B 25. To prevent unintentional forward or backword displacement of the specimen during right to left motion, the stiffness of the former can be adjusted by tightening screw B 24. This adjustment is approximately correct if, when the stage is in a vertical position, the stage top no longer falls by its own weight.

The brake screw B 24 is n o t a clamping screw. Excessive tightening of this screw should be avoided, since this will only destroy the mechanism without ever completely locking the stage.

The stage is provided with two scales, B 23, the position of which can be read to within 1/10 mm with the aid of a vernier. They serve for the rapid relocation of a specific point on the specimen. For this purpose, the stage must, however, be centered, i. e. its axis of rotation must coincide with the optical axis of the microscope. If a point of particular interest has been found in a specimen, so that it will be desirable to relocate it later, this can be done by recording the coordinates of this position on the two scales (e. g. 15.7/113.4). When the specimen is later placed in the same position on the same centered stage and the two coordinates set on the scales, the desired point will again appear in the microscope's field of view.

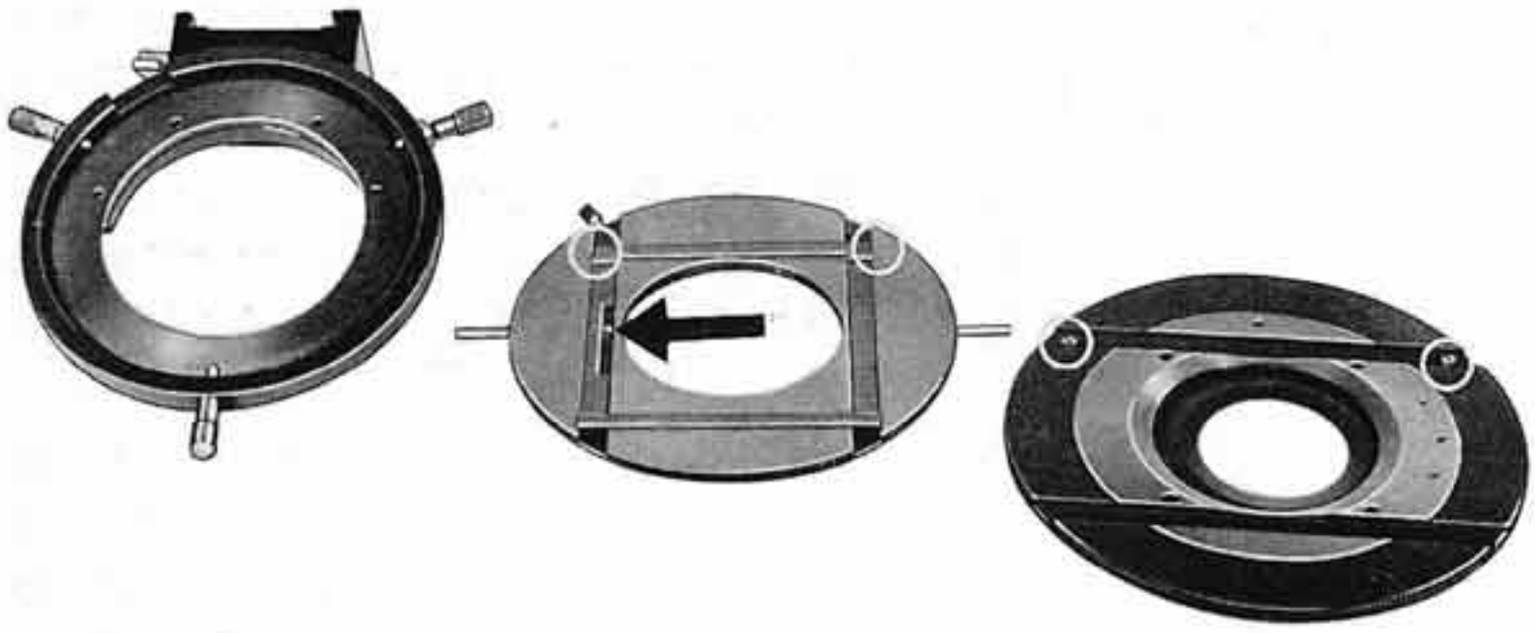
As is customary in searching a slide, it is an advantage here, too, to employ a low-power objective, since the precision of scale readings is, of course, limited. The object finder (46 29 65) can be used for the same purpose. This contains three fields, one beside the other, marked A, B and C. Each of these large fields is subdivided into 30 × 30 squares. These squares are numbered 1—900 and are again subdivided into 3 × 3 squares.

The gliding stage consists of a base plate which is mounted in the centering ring so that it can be rotated. The rotary motion can be arrested by means of clamp screw B 27. A thin film of oil is between the stage top and the base plate B 31. The top is guided on the base plate in two coordinate directions with the aid of a guide frame. Stop screws limit the range of displacement which is 14.5 mm from the central position in each direction.

The stage should be lubricated at appropriate intervals (about every six months) in order to maintain its smoothness of operation. Suitable oil (47 33 91) is supplied with every stage.

Like the gliding stage, the **stage for polished specimens** consists of a base plate mounted in a centering ring so that it can be rotated. A stage top can be displaced on an oil film on the base plate. The stage top carries a bridge. Three circular diaphragms with openings of 20 mm, 10 mm and 5 mm Ø, respectively, serve to hold and orient the specimen with respect to the axis of the microscope. They adhere magnetically to the underside of the bridge and can be interchanged.

A spring-loaded plate B 34 with a foam-rubber pad is pressed from below against the bridge. This plate can be pushed down by slight pressure on its edge, so that the polished specimen can be positioned in the opening of the bridge from below. When the plate is released, it presses the specimen against the bridge, which is thus oriented as simply and accurately as if it had been placed on the stage of an inverted metallurgical microscope. Like the other stages, the stage for polished specimens is inserted in the centering piece B 9 mounted on the stage carrier. It is lubricated in the same manner as the gliding stage.



Centering piece | Base plate | Stage top (underside)

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Lubrication of gliding stage

Screw centering screws B 7 of the centering piece right back. Press base plate with stage top against the relieved spring B 10 and lift them out of centering piece. Slide stage top and base plate against each other up to the stop and separate them by pushing them apart.

Clean gliding surfaces of base plate and stage top carefully, if necessary with xylene. When they are dry, with your finger apply a very thin film of oil to the gliding surface of the stage top. The less oil is used, the better. Likewise, apply a thin film of oil to the grooves for the guide frame.

Insert guide frame in base plate in such a manner that the stop screw in the guide groove of the base plate lies in the cutout of the guide frame, thus limiting its movement.

Place stage top B 31 on base plate and guide frame in such a manner that the guide groove with the two limiting screws is above the projecting part of the guide frame which has small notches on either side (circles in Fig. 21).

Move the two plates back and forth against each other a few times under moderate pressure, in order to distribute the oil uniformly. The stage top must not move too easily on the base plate. Should this be the case, there is still too much oil between the gliding surfaces.

It is advisable to center the stage at least approximately, so that the object will remain in the field of view as the stage is rotated.

Centering of stages

1. To locate the optical axis of the microscope, insert a cross-hair eyepiece in the tube. If such an eyepiece is not available, the image of the centered, closed luminous field stop may also be used to mark the center of the field of view (Fig. 39 C, page 39).

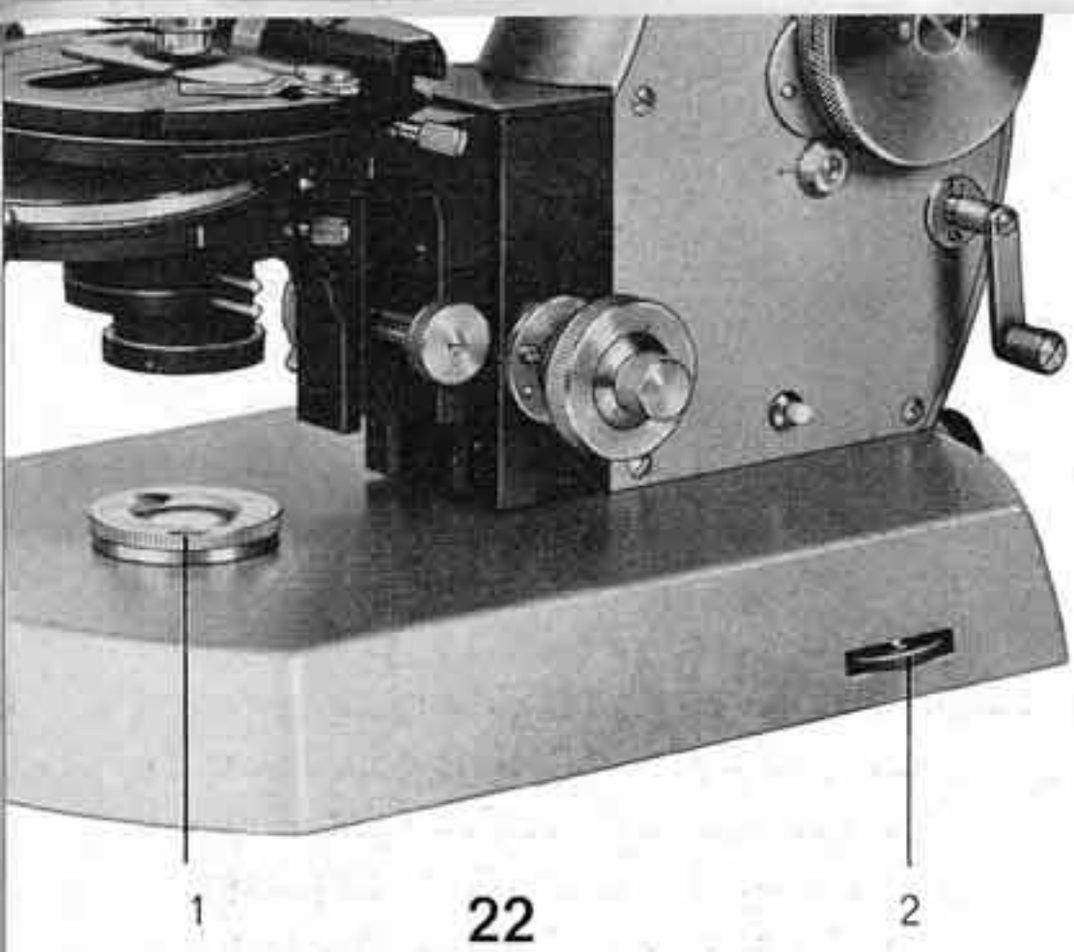
2. Mount a slide on the stage on which numerous small particles are distributed irregularly — such as dust particles — and focus with a objectiv 10 or 16.

3. When the stage is rotated, the approximate center of rotation is easily recognized, even if it is located outside the field of view. Bring this center of rotation approximately into the center of the field of view indicated by the cross-hair eyepiece, operating the two centering screws B 7. Such approximate centering will generally be sufficient, if a specimen is just to be brought into a certain position within the field of view.

4. More precise centering can easily be achieved by repeating the procedure. It must also be taken into account that precise centering will not be maintained under all circumstances. Small deviations of about 1/100 mm are just as inevitable in centering the objectives as in attaching the stages. However, in the microscopic field of view distances of only 1/1000 mm can still be recognized without difficulty. Centering of the stage must therefore, as a rule, be repeated after every exchange of objectives and, naturally, after removing and replacing the stage.

Condenser carrier

This part is so designed that the condenser holder is at the same time a centering device provided with two centering screws B 16 and one counterspring B 17. The height of the condensers can be accurately adjusted with the aid of a rack and pinion operated by knob B 15. Here again the smoothness of the rack and pinion motion can be varied. For this purpose, slightly thighten or loosen screw B 11 until the desired degree of stiffness has been attained. Turning the screw clockwise causes stiffer motion, counterclockwise rotation eases the motion.
There are two swing-out filter holders below the condenser carrier.



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1 = Front diaphragm
2 = Rear diaphragm
For adjustment and operation of diaphragms, see Tables 4, 5 and 6, pages 26—27

Built-in illuminator

3 = Low-voltage incandescent bulb, 6 V, 2.5 A (38 01 77)
4 = Screen to be slipped onto bulb of illuminator
5 = Lamp holder

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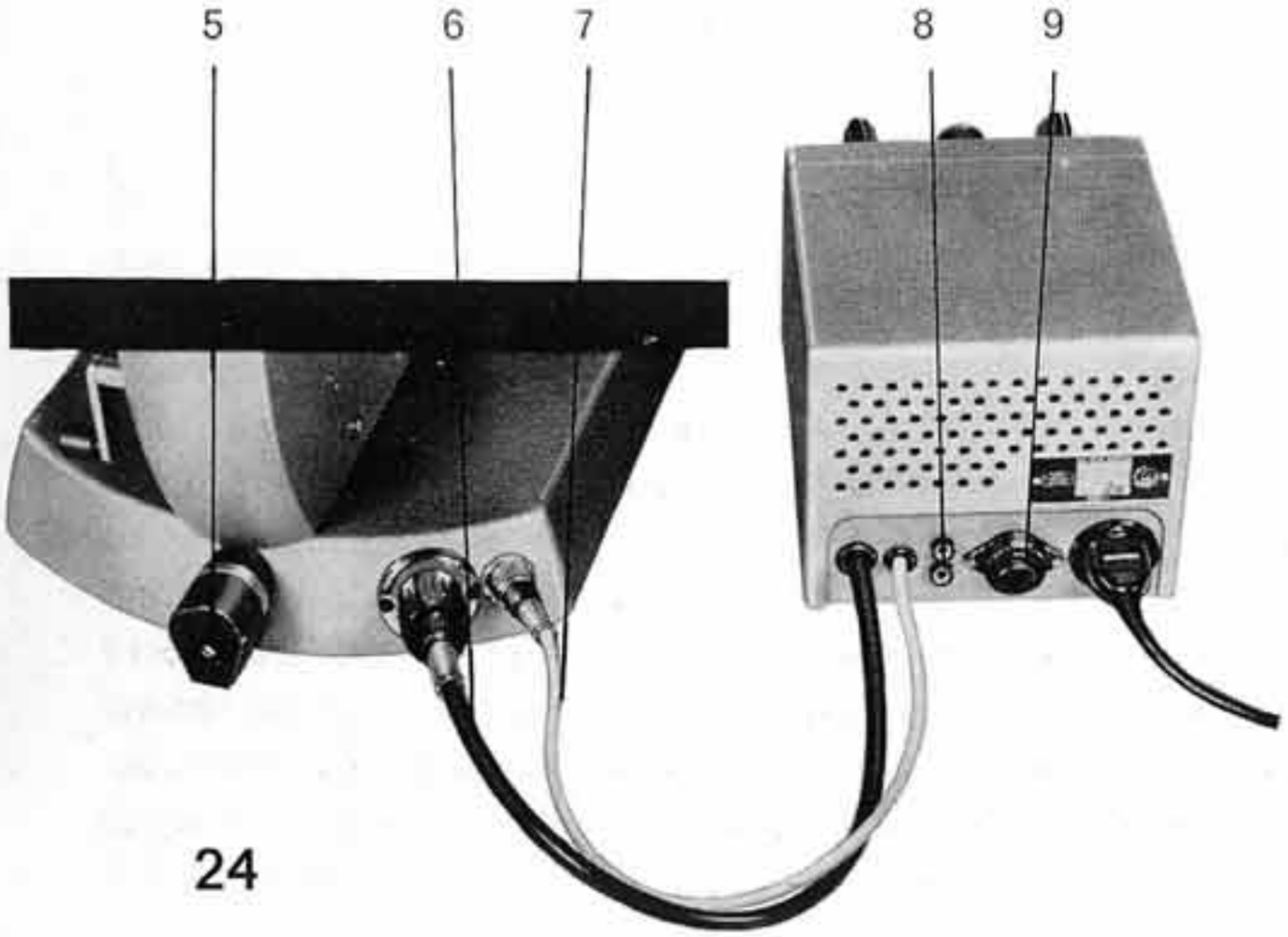
6 = Black cable feeding built-in illuminator and camera shutter
7 = White connection cable for photocell
8 = Socket carrying the same voltage as built-in illuminator
9 = Voltage selector with fuse (page 32). The rated voltage must be clearly legible.

10 = Multi-purpose microscope illuminator (Operating Instructions G 40-340), mounted above special illuminating device
11 = 60 W illuminator attached to special illuminating device. In this case, the connecting tube C 15 is not required.
12 = Special illuminating device (see also Fig. 49, page 50)



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13 = Selector knob, placed in lower position when multi-purpose microscope illuminator is used, in upper position for use of 60 W illuminator.

14 = Selector knob, upper position for transmitted light, lower position for vertical illumination.

60 W illuminator

15 = Connecting tube for mounting the illuminator directly on the PHOTOMICROSCOPE. It is exchanged for the illuminating tube of the built-in illuminator and is not required with the special illuminating device.

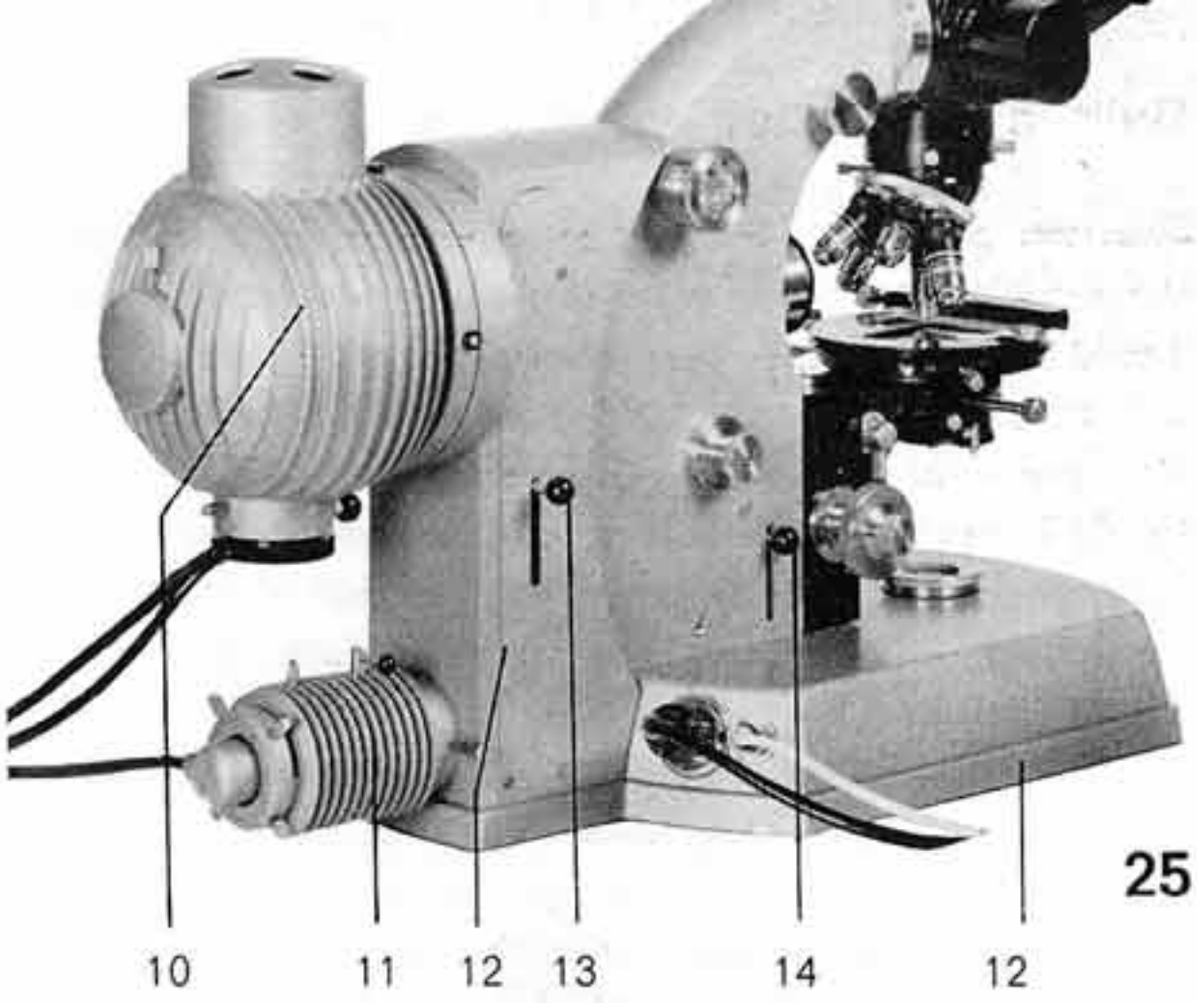
16 = Clamping screw for attaching illuminator. To fit on illuminator, loosen screw and press its spring bolt back with dovetail ring of illuminator, so that dovetail ring can be fully introduced.

17 = Diffusion disk

18 = Clamping screw. When it is loosened, the lamp holder can be displaced in relation to the collector. With screw 18 removed, the lamp holder can be withdrawn from the lamp housing.

19 = Lamp holder centering screws

20 = Spring bolt clamping screws (counterparts for C 19)



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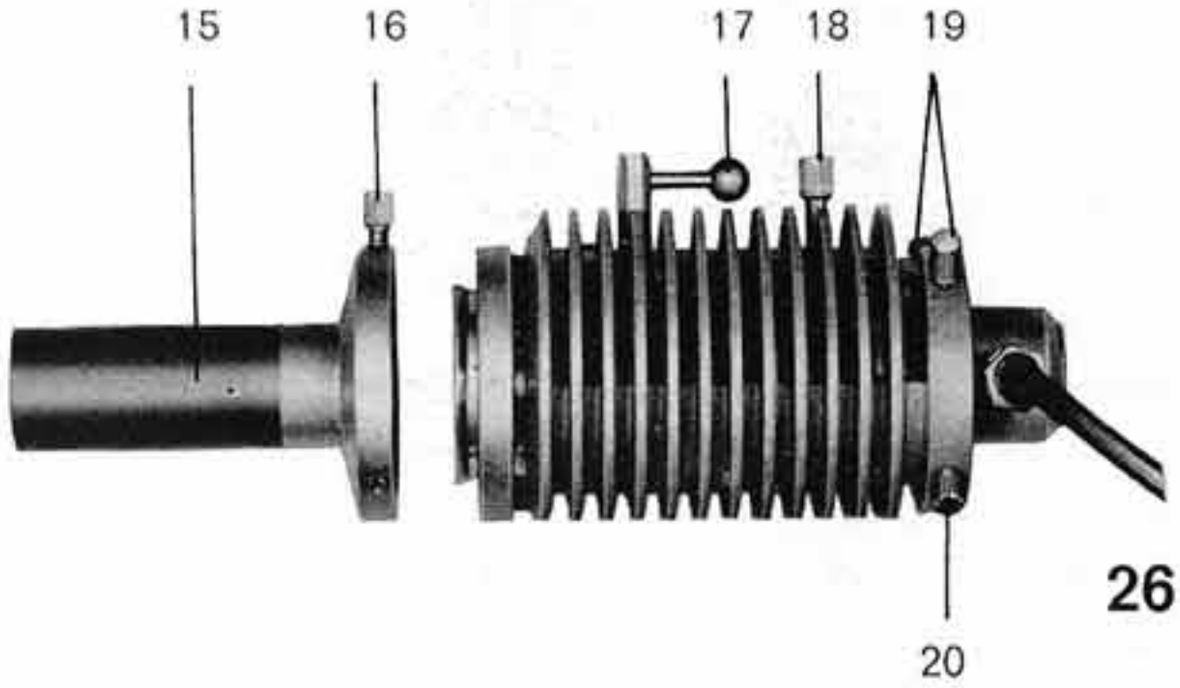

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Illumination system

The illuminating beam is aligned in the base of the instrument by means of lenses and diaphragms. During observation with transmitted light, two diaphragms (front diaphragm C 1 in the diaphragm insert, rear diaphragm C 2) act as luminous field stop or as aperture diaphragm, depending on the size of the field that is reproduced. The different working positions of these diaphragms are indicated in Tables 4, 5 and 6. In order to allow certain diaphragm positions to be accurately reproduced, both diaphragms are provided with a scale indicating stop diameters in millimeters.

For vertical illumination, the selecter knob C 14 is used to interpose a mirror in the light path, which deflects the light rays vertically upward towards the aperture stop insert. The rear diaphragm C 2 must be completely open when vertical light is used.

Built-in illuminator

The rear portion of the microscope base houses the illuminating tube with three-lens collector. The tube is secured by a screw (Fig. 27) and serves to accommodate the built-in illuminator. For inserting the 6 V 2.5 A low-voltage bulb (38 01 77) in the lamp holder, the red dot on the lamp socket must be opposite the red pin of the lamp holder. Then push the bulb down into the holder and secure it by clockwise rotation. The lamp holder is introduced into the base of the instrument with the two pins engaging the corresponding bushings. Fingerprints or similar marks should be removed from the bulb with the aid of a moist cloth (alcohol, ether), before they are baked in and impair the illumination. The bulb should be protected against all shocks, especially during operation, because its filament is extremely sensitive.
The 6 V 2.5 A low-voltage lamp should only be run at overload for short periods. In most cases, it will be entirely sufficient to operate the lamp at undervoltage.

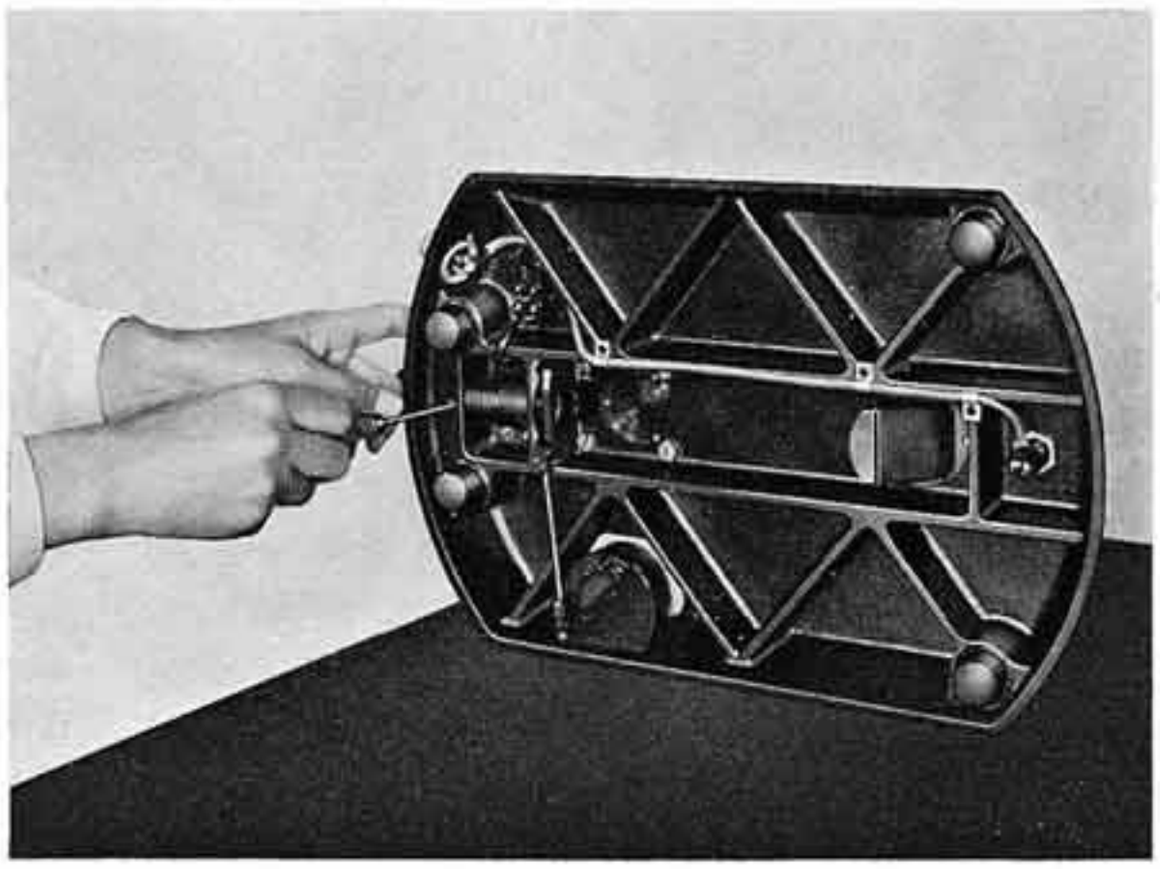
For color photography, see page 34.

A second lamp or an AC meter can be connected for short periods to the bushings C 8 at the rear of the automatic exposure device, which carry the same voltage as the built-in illuminator.

Table 3

Voltage and amperage with automatic exposure device connected to rated input voltage

Step	I	II	III	IV	V	VI	VII	VIII	IX	X
Volts	2.5	2.75	3.0	3.3	3.75	4.2	4.8	5.4	**6.1**	6.9
Amperes	1.65	1.73	1.8	1.9	2.0	2.12	2.25	2.38	**2.52**	2.7



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Exchanging illuminating tube of built-in illuminator prior to use of 60 W illuminator or special illuminating device.

60 W illuminator

If the built-in illuminator should be insufficient in special cases, a 12 V 60 W (5 A) illuminator may be used instead. This illuminator is particularly suited for incident light. The lamp is fed from a transformer (39 25 27). The illuminator is attached by its dovetail ring to the connecting tube C 15 which must first be exchanged for the illuminating tube of the standard illuminator incorporated in the base of the PHOTOMICROSCOPE. In order to effect this exchange, loosen the screw (Fig. 27), insert the connecting tube in place of the illuminating tube and secure it with the same screw.

Centering the lamp

1. Swing out diffusion disk C 17 and loosen both clamping screws C 20 for the spring bolts as well as the slotted screw C 18.

2. Switch on lamp and point it at a vertical surface 2—3 meters away. Project lamp filament onto this surface by axial displacement of lamp holder. Then secure screw C 18 and mount illuminator on instrument.

3. The light beam must emerge centrically from the base. In order to check this, place a sheet of paper on the diaphragm insert C 1, close rear diaphragm C 2 and operate the two centering screws C 19 on the lamp holder until the image of the filament is in the center of the exit opening.

4. Tighten the two screws C 20 for the spring bolts. Swing in diffusion disk C 17.

Special illuminating device

The special illuminating device (47 20 19) makes it possible to use the gas discharge lamps of the multi-purpose microscope illuminator (Operating Instructions G 40-340) on the PHOTOMICROSCOPE. In addition, the 60 W illuminator may be attached as incandescent lamp.
With this device, the light is left unchanged, so that the standard auxiliary condenser lenses I or IV are used.
With the special illuminating device mounted on the instrument, the eyepiece will be in a slightly higher position.

Assembly

The special illuminating device is supplied with an orienting tube which is inserted in the microscope base in place of the illuminating tube of the standard built-in illuminator. In order to exchange the two, loosen the screw (Fig. 27), replace the illuminating tube by the orienting tube and secure with the same screw. Then unscrew the four rubber feet of the microscope and place the instrument on the supplementary base of the special illuminating device, so that the orienting tube projects into the light exit opening of the special illuminating device. Finally, insert four clamping bolts into the threaded holes from below in order to secure the microscope firmly on the supplementary base of the special illuminating device.

Centering of light source

The light source must be imaged centrically in the light exit opening C 1 of the microscope. For this purpose, close the rear diaphragm C 2 and swing out the diffusion disk on the lamp housing of the multi-purpose microscope illuminator. As a check, place a sheet of paper on the front diaphragm C 1 in the case of transmitted light, and in front of the reflector insert in the case of vertical illumination (before attaching the vertical illuminator). In the latter case, the slide E 1 of

the reflector insert must be in the central position at right angles to its axis.

The position of the source image can be corrected
in the multi-purpose microscope illuminator:

by adjusting the height of the lamp holder and by lateral adjustment of the holder with the aid of the setscrew on the lower side of the lamp housing;

in the 60 W illuminator:
by turning the two centering screws C 19 on the lamp holder. When this adjustment has been completed, open the rear diaphragm C 2 again and, if necessary, interpose the diffusion disk.

Transmitted-light condensers

The condenser illuminates the specimen with the correct aperture. In order to image the luminous field stop on the specimen according to the Köhler method, the condenser can be adjusted in height, together with the condenser carrier, and centered in the latter.
Owing to the wide range of different field sizes and the correspondingly wide range of illuminating apertures, one single method of illumination is not sufficient. Certain modifications are required in order to attain perfect illumination of the field of view with the different objectives and condensers. Thus, for instance, the auxiliary condenser lens may be introduced into the light path, the condenser front lens swung out, or the entire condenser removed if very large fields of view have to be illuminated while using low-power objectives. Tables 4, 5 and 6 illustrate the different positions and effects of the auxiliary lens and the condenser front lens, as well as the condenser diaphragm and the diaphragms C 1 and C 2 in the instrument base, in conjunction with the different condensers and objectives (pages 26—27).

Bright-field condensers

Condensers for bright-field illumination have an iris diaphragm (aperture diaphragm) for varying the illuminating aperture. With the condensers 0.9 Z and 1.3 Z (for bright-field illumination only) and with the II Z phase-contrast condenser (bright field and phase contrast), the front lens can be swung out. This is necessary for illuminating larger fields when using low-power objectives.

Phase-contrast condensers

These phase-contrast condensers have a complete bright-field condenser with aperture dia-

phragm in the J-position of their revolving disk. In positions 1, 2 and 3, the respective annular phase-contrast diaphragms are interposed. The achromatic-aplanatic V Z phase-contrast condenser has a central diaphragm for dark-field illumination in its D position.

Achromatic-aplanatic condensers have a spherically and chromatically corrected optical system of high aperture. In order to make full use of this excellent correction and to attain an aperture of 0.95 to 1.40, it is necessary to join the condenser front lens optically to the lower side of the microscope slide with the aid of immersion oil. These condensers are not suitable for illuminating large fields.

The high correction of achromatic-aplanatic condensers guarantees an image of the luminous field stop which is largely free from aberrations — and thus strict adherence to the Köhler method — even in the case of maximum apertures. Achromatic-aplanatic condensers are particularly suited for very exacting work, especially in connection with high-aperture objectives.

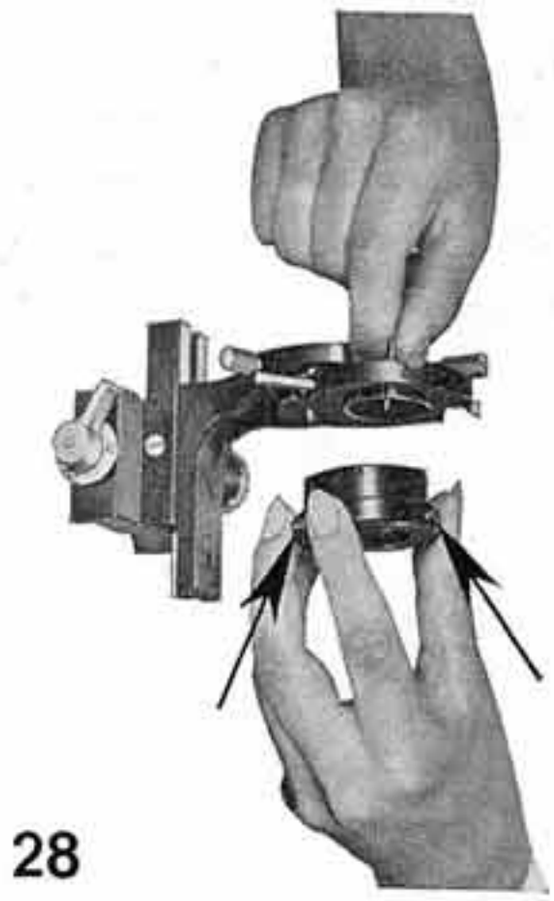
The achromatic-aplanatic V Z phase-contrast condenser (46 52 77) is designed for critical bright-field, phase-contrast and dark-field observation and permits rapid change-over from one type of illumination to another.

Auxiliary lenses

Auxiliary lens I is supplied for use with condensers with a swing-out front lens as well as with dark-field condensers. It is placed directly below the condenser, in the swing-out holder B 14.

Auxiliary lens IV belongs to the achromatic-aplanatic condensers.

If an achromatic-aplanatic condenser is used alternately with another one, the auxiliary lens IV will also serve for the second condenser. It is then advisable to remove auxiliary lens I from its holder, so as to prevent both auxiliary lenses from being left in the light path at the same time, by mistake.



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Mounting and centering the auxiliary lens IV

1. With the wrench supplied unscrew retaining ring and remove it from the mount of auxiliary lens IV.
2. Swing out lower filter holder of condenser carrier, insert retaining ring from above and screw auxiliary lens in from below (Fig. 28). Secure auxiliary lens in position so that the two centering screws marked in Fig. 28 are facing outwards when the filter holder is in.
3. Swing out auxiliary lens IV with filter holder.
4. Focus specimen with low-power objective (10 or 16) and image front diaphragm C 1 as luminous field stop by suitably adjusting height of condenser. For this purpose, open diaphragm C 2 completely. Center condenser in the usual manner until the image of the luminous field stop is as close to the center of the field of view as is possible.
5. Swing in auxiliary lens IV in filter holder.
6. Adjust position of condenser until luminous field stop is again sharply defined.
7. Re-position image of luminous field stops in center of field of view by means of the two centering screws of the auxiliary lens.

Illumination for PHOTOMICROSCOPE

The following tables indicate the conditions for optimum illumination of the specimen when using our objectives with different condensers. They show operation and effect of the substage diaphragms, the condenser front lens and the auxiliary lens.

The data refer to observation with eyepieces of field-of-view number 18 (e.g. 8× Kpl eyepiece) with the OPTOVAR set to 1.25. Under these conditions, the object field covered is of the size indicated in column 2.

The smallest scale on the film can be achieved with the aid of the Planachromat 1/0.04. In this case, do not use any condenser, swing auxiliary condenser lens into position and open rear diaphragm C 2. The front diaphragm C 1 will then act as aperture diaphragm.

Table 4

Condenser with swing-out front lens **0.9 Z** (46 52 52); **1.3 Z** (46 52 53);
Phase-contrast condenser II Z (46 52 70) also POL **with auxiliary condenser lens I**

<table>
<tr><th>Objective</th><th>Object field diameter mm</th><th>Front lens</th><th>Auxiliary lens</th><th>Condenser diaphragm</th><th>Front diaphragm C 1</th><th>Rear diaphragm C 2</th></tr>
<tr><td>1</td><td>2</td><td colspan="2">3 4</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td>2.5
4
6.3[1])</td><td>5.5
3.6
2.25</td><td colspan="2">out of light path</td><td>open</td><td>aperture diaphragm</td><td rowspan="2">open</td></tr>
<tr><td>10
16</td><td>1.45
0.9</td><td rowspan="3">in
light path</td><td>in</td><td rowspan="2">aperture diaphragm</td><td>luminous field stop</td></tr>
<tr><td>25
40
63[2])
100[2])</td><td>0.56
0.36
0.23
0.15</td><td>out of
light path</td><td>open</td><td>luminous field stop</td></tr>
</table>

[1]) Illuminates only aperture 0.14. Use this setting only with condenser 1.3. For other condensers and objective apertures larger than 0.16 (e.g. NEOFLUAR 6.3/0.20) use the same setting as for objective 10.

[2]) Apertures beyond 0.9 to be obtained only with 1.3 condenser and condenser immersion. Perfect image of luminous field stop cannot be obtained due to aberrations inherent in condenser.

Table 5 **Achr. apl. condenser 1.4 Z** (46 52 57); **Achr. apl. phase-contrast condenser V Z** (46 52 77) **with auxiliary condenser lens IV**

Objective	Object field diameter mm	Front lens	Auxiliary lens	Condenser diaphragm	Front diaphragm C 1	Rear diaphragm C 2
1	2	3	4	5	6	7
2.5	5.5	without condenser[4])	**in** light path	none	aperture diaphragm	**open**
4	3.6					
6.3	2.25[3])				luminous field stop	
10	1.45	fixed		aperture diaphragm		luminous field stop
16	0.9					
25	0.56		**out of** light path		**open**	
40	0.36					
63[5])	0.23					
100[5])	0.15					

[3]) Object field not quite fully illuminated. Remove condenser to illuminate entire field of view. Then, however, aperture is not fully illuminated.

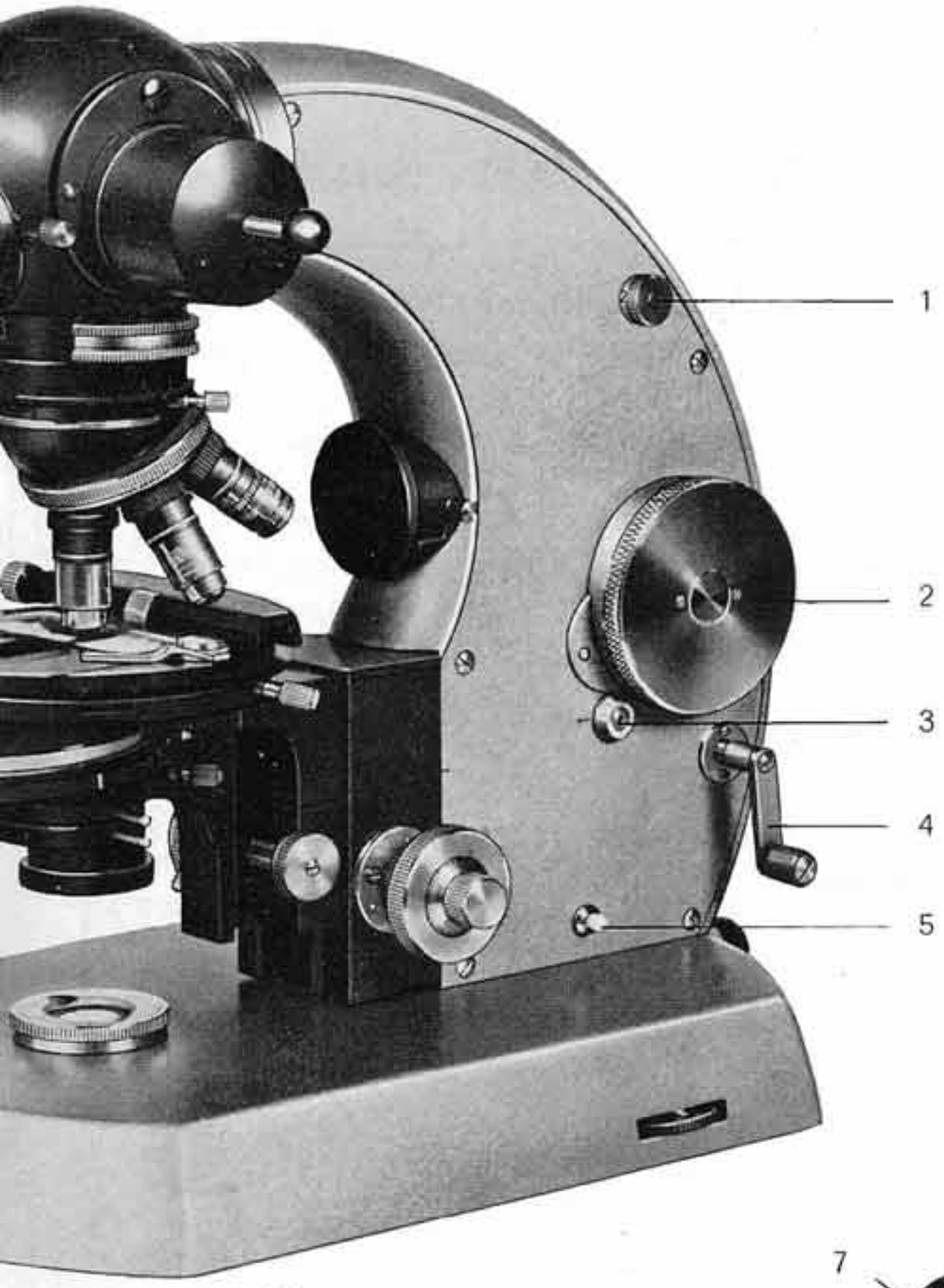
[4]) For a scanning of the specimen the field of view will be sufficiently illuminated if the **condenser** with its auxiliary lens is merely lowered, without paying any attention to aperture and luminous field stops.

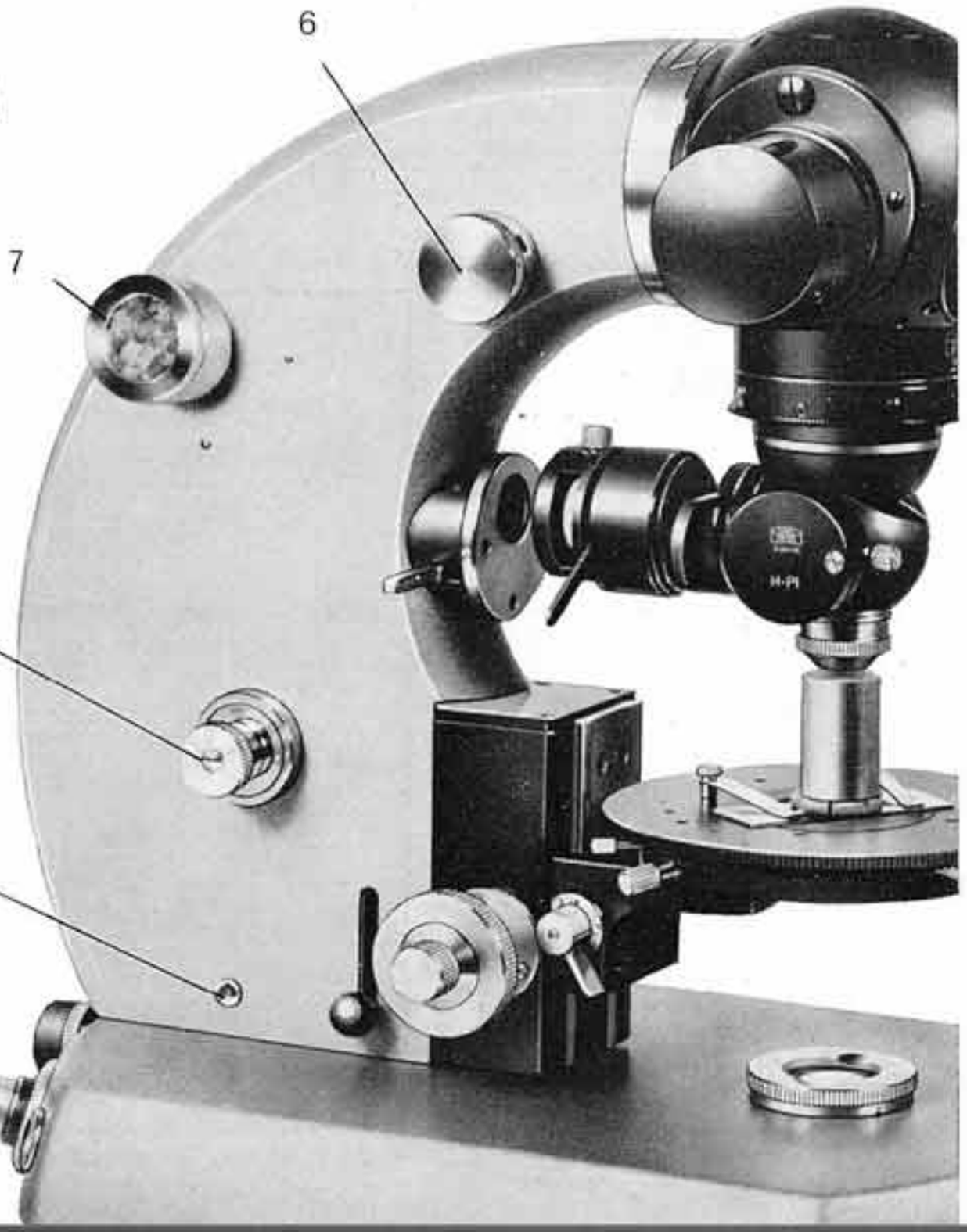
[5]) Aperture fully illuminated only with immersed condenser.

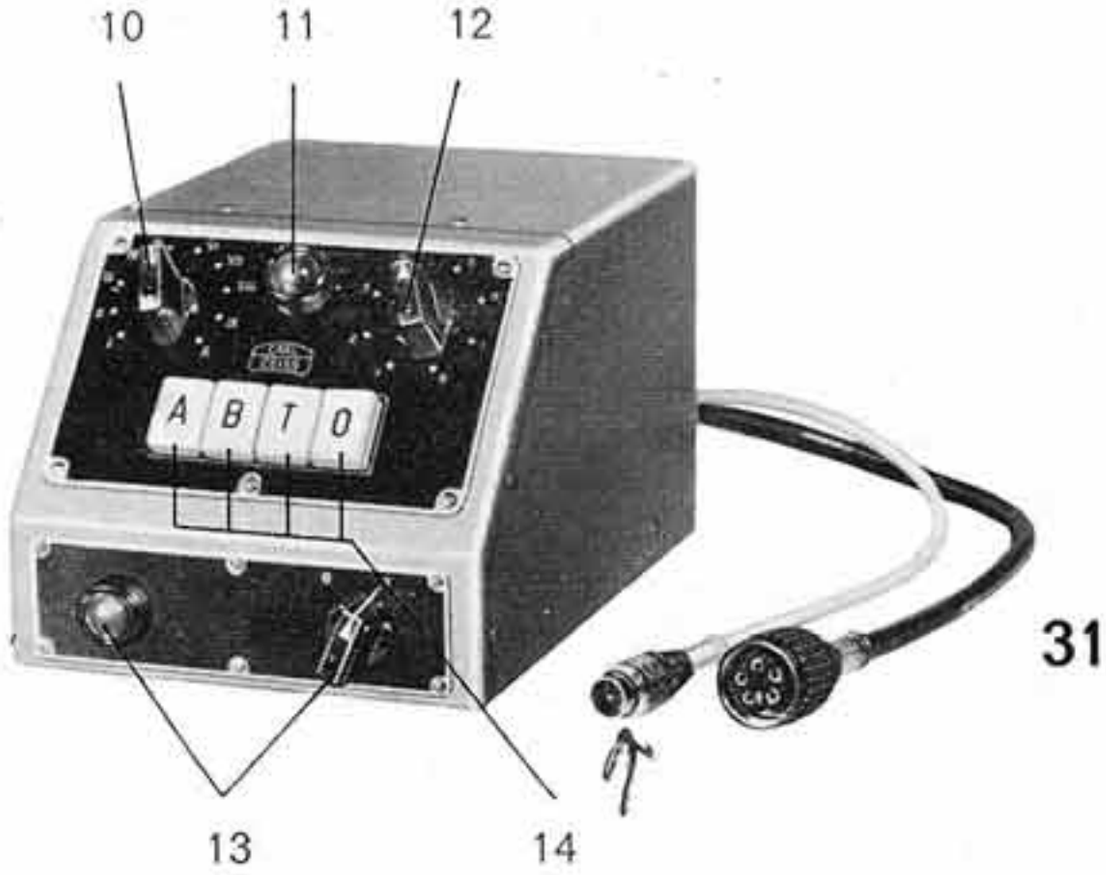
Table 6 **Phase-contrast condenser IV Z 6** with extra-long focal intercept (465271), **with auxiliary condenser lens IV**

Objective	Object field diameter mm	Front lens	Auxiliary lens	Condenser diaphragm	Front diaphragm C 1	Rear diaphragm C 2
1	2	3	4	5	6	7
2.5	5.5	fixed	**in** light path	**open**	luminous field stop	aperture diaphragm
4	3.6					
6.3	2.25					
10	1.45		**out of** light path	aperture diaphragm	**open**	luminous field stop
16	0.9					
25	0.56					
40	0.36					
63[6])	0.23					
100[5])	0.15					

[6]) Clear image of luminous field stop cannot be obtained due to condenser aberrations with high illumination apertures.


1
2
3
4
5


6
7
8
9



1 = Photocell stop,normally in position "2". For position "1", see page 33.

2 = Film magazine. Red mark serves as guide for insertion. Clockwise rotation couples magazine with stand and opens film gate.

3 = Exposure counter, counts every shutter release; to be turned back if shutter was released with disconnected magazine for determination of exposure time.

4 = Clockwork mechanism, cocks shutter and operates film advance. To be wound after loading the film.

5 = Mechanical shutter release, locks in midway position for time exposures. Full depression overrides midway lock. Shutter remains open as long as button is pressed.

6 = Projective 3.2× and 6.3× for varying magnification on the film.

7 = Mount for photocell of automatic exposure device with silica gel cartridge. If silica gel is no longer blue, remove cartridge and dry it on moderately warm heating plate until silica gel has regained its deep blue color.

8 = Exposure time setting knob. Pull knob right out and turn until desired shutter speed is opposite the index. The knob must engage a stop in this position. For operation of shutter see page 35.

9 = Flash contact. For flash photography set knob D 8 to the yellow "10".

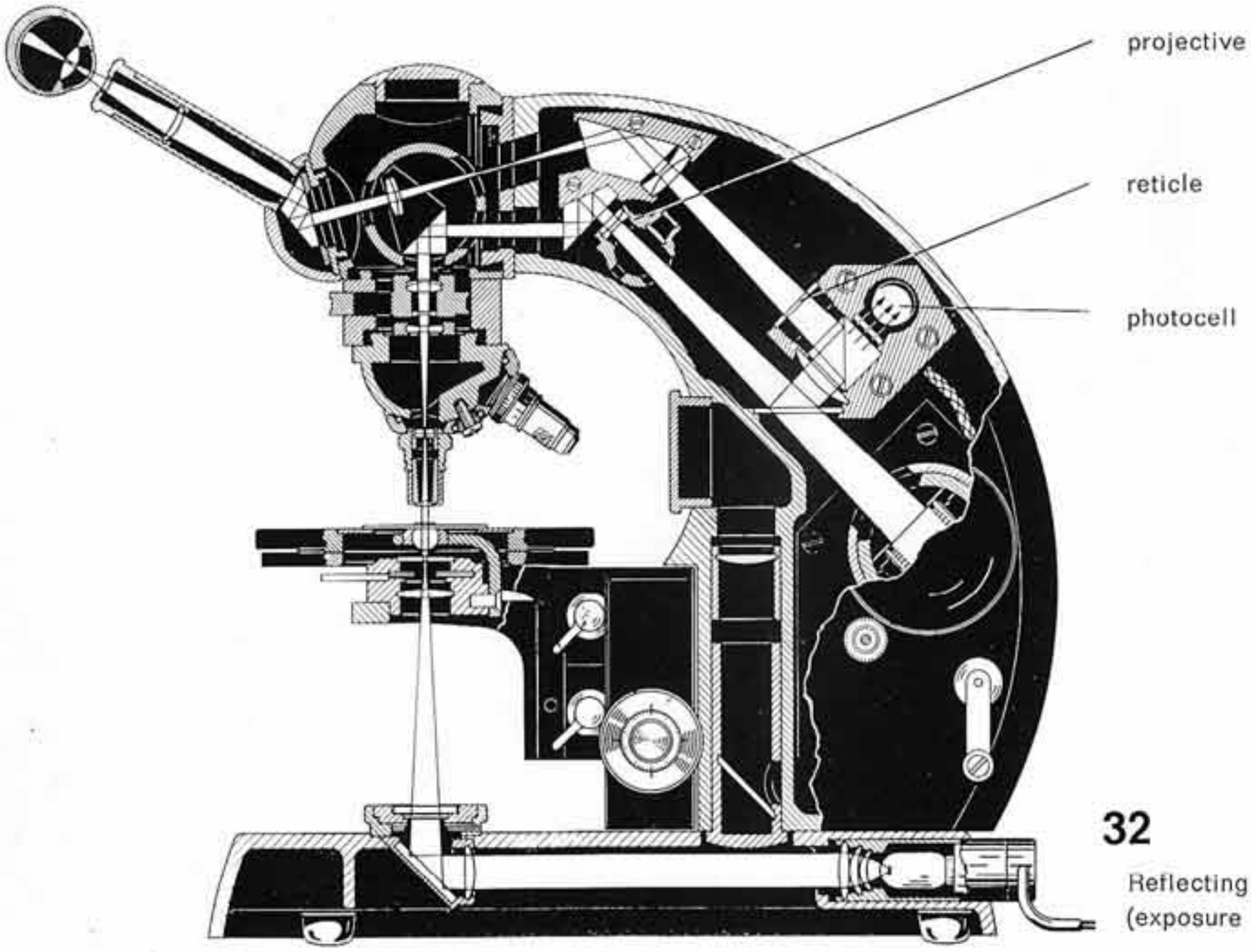
10 = Transformer for built-in illuminator (Table 3). Controlled by master switch D 13.

11 = Signal lamp for electrically or automatically opened shutter D 14.

12 = Knob for selecting sensitivity of automatic exposure device. One step changes the exposure time by a factor of about 2× (Table 10).

13 = Master switch for automatic exposure device and transformer for built-in illuminator, with pilot lamp. Should be switched on at least five minutes before first photograph is taken with automatic exposure device.

14 = Shutter release, see page 35.



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Reflecting system set to III
(exposure position)

Light path in exposure position

When the reflecting system is in the exposure position (Table 1), the object is imaged in the film plane and on the focusing reticle (Fig. 32) by one of the two projectives D 6. At the same time, a portion of the light falls on the photocell of the automatic exposure device.

The image will be sharply focused on the film if it is seen sharply defined on the focusing reticle. It should therefore become a habit to start work on the PHOTOMICROSCOPE by setting the interpupillary distance and afterwards focusing the cross of the reticle in both eyepieces. The double lines of this cross must be seen in perfect focus by each eye. For this purpose, rotate each eyepiece tube inwards until this position has been reached. Turning the eyepiece in this direction will prevent accommodation of the eye. The eyepiece tubes should also be left in this position when the reflecting system is switched over for observation. This position is absolutely necessary for taking photographs, and it should therefore be frequently checked.

In the exposure position of the reflecting system, the image section on the focusing reticle is presented to the eye magnified about 3.5×, if 8× eyepieces are used. Hence the relatively small image of 24×36 mm is seen magnified to 9×12 cm.

The special arrangement of the light path in the PHOTOMICROSCOPE makes it necessary to place the film negative in the enlarger with the emulsion side facing the lamp, in order to obtain non-reversed enlargements.

Image scale on the film

The image scale on the film depends on the position of the projective. It is computed as the product of

$$\text{image scale on the film} = \text{scale factor of objective} \times \text{OPTOVAR factor} \times \text{projective}$$

The table below gives the image scales which can be obtained with the instrument. For visual magnifications at eyepiece see Table 2, page 13.

Table 7

Image scales to be obtained with PHOTOMICROSCOPE

	OPTOVAR 1.25		OPTOVAR 1.6		OPTOVAR 2	
Objective	proj. 3.2	proj. 6.3	proj. 3.2	proj. 6.3	proj. 3.2	proj. 6.3
1	4	8	5	10	6.3	12.5
2.5	10	20	12,5	25	16	32
4	16	32	20	40	25	50
6.3	25	50	32	63	40	80
10	40	80	50	100	63	125
16	63	125	80	160	100	200
25	100	200	125	250	160	320
40	160	320	200	400	250	500
63	250	500	320	630	400	800
100	400	800	500	1000	630	1250

Automatic exposure device

All parts which contribute to the automatic exposure of the film are combined in the automatic exposure device.

Connection

The automatic exposure device operates on 40 to 60 cps alternating current. It must be grounded for perfect operation. It is usually supplied for connection to 220 V. Upon removal of the fuse, the voltage selector C 9 can, however, be set for 110 — 125 — 150 — 200 or 240 V. Before switching on the instrument, check whether the voltage selector C 9 indicates the rated mains voltage.

The fuse is inserted at the primary end.

for	medium-slow fuse
200 — 220 — 240 V	0.4 A
150 V	0.6 A
110 — 125 V	0.8 A

An exposure meter may be connected to the PHOTOMICROSCOPE by a cable (38 58 30) which is plugged into the bushing for the white cable. This instrument indicates the illumination intensity required for the film for flash photography, to which the illumination intensity of the microscope must be adapted. (Operating Instructions G 40-335, Microflash Equipment).

Operation

The automatic exposure device will give perfect results only if the correct **exposure time** is **not substantially shorter than one second.** If the illumination intensity is too great, it must be suitably reduced by means of gray filters or by regulating the lamp voltage. Gray filters may be introduced into the path of rays either singly or in groups. They serve to regulate image brightness in steps of 0.5.

Table 8

Transmittance of gray filters

Gray filters	Illumination intensity %
without	100
0.5	50
0.5 + 0.5	25
0.12	12
0.12 + 0.5	6
0.03	3
0.03 + 0.5	1.5
0.03 + 0.5 + 0.5	0.75
0.03 + 0.12	0.36

The automatic exposure device operates on the principle of integrating the distribution of brightness in the c e n t r a l portion of the image section to be photographed. Consequently, it can n o t produce satisfactory results if in very contrasty images only an extremely small portion of the field of view is bright, as may occasionally be the case in dark-field or fluorescence photography.

In instruments which are equipped with the photocell stop D 1, this diaphragm can be so adjusted that the automatic exposure device will produce perfect results in tho aforementioned exceptional cases as well. The photocell will then measure the brightness of only about 5% of the field of view. The limits of this area are indicated by the inner ends of the diagonal cross-hairs which do not meet in the center.

The photocell (Fig. 32) is housed in the mount D 7. This mount should not be removed without good reason. In order to keep the humidity of the air around the photocell within reasonable limits, the cover of the cell mount is designed as a silica gel cartridge in instruments with serial number 55 608 or higher. Should the silica gel have lost its blue color, the cartridge can be dried as described under D 7.

In older types of instrument (up to serial number 55 607), the cover of the photocell mount can be taken off by removing three screws and replaced by the silica gel cartridge (47 20 90).

Usually the photocell covers about half the image section to be recorded. The knob D 1 is then in its normal position "2". With this knob in position "1", the **photocell stop** is operative. In this case, only the light transmitted by about 1/3 of the central area of the image section is allowed to pass to the photocell, and the exposure time determined by the automatic exposure device is increased in each successive position of the selector knob by the factor 1.5×. Position "1" of the control knob should, however, be used only in order to obtain intermediate values between the larger intervals of selector knob D 12, for purposes of color photography (Table 9, example 2).

Sensitivity

The sensitivity of the automatic exposure device is regulated by the selector knob D 12. In position "8" of this knob, the automatic device allows the shortest, in position "1" the longest exposure time. With increasing scale value of the selector knob, the exposure time allowed by the automatic device is reduced by a factor of about 2× (i. e. by about ½). If the photocell stop is in its normal position, the exposure times indicated in Table 9, example 1, will be obtained.

The sensitivity of the automatic exposure device must be adapted by means of selector knob D 12 to the speed of the film material chosen and the development procedure employed. The correct position of the knob should be determined by a number of test exposures with each of the eight different settings of the knob. A strip of such calibration photos obtained under given conditions is supplied with the instrument as a sample. If one of these conditions is changed — for instance the type of photographic material or processing — a new test series should be made. Due to the generally unkown influence of the Schwarzschild effect (page 34), the speed ratings provided by film manufacturers for normal amateur use cannot be taken as a basis.

Table 9

Exposure timing of automatic device

Sample measurement series

Selector knob/ Photocell stop	Exposure time (sec.) example 1	Exposure time (sec.) example 2
1_1		300
1_2	183	183
2_1		142
2_2	86.5	86.5
3_1		76
3_2	46	46
4_1		38
4_2	22.5	22.5
5_1		19
5_2	11.5	11.5
6_1		9
6_2	5.5	5.5
7_1		4.5
7_2	2.9	2.9
8_1		2
8_2	1.5	1.5

Filters

For black-and-white photography on panchromatic material and with the aid of the automatic exposure device, the following filters may be used:

yellow filter GG 3 (46 78 11) and GG 14 (46 78 10)
blue filter BG 23 (46 78 00)
green filter VG 9 (46 78 05)
orange filter OG 3 (46 78 15)
interference band filter, green, 546 mμ (46 78 07)
interference wide-band filter green, 546 mμ (46 78 06)

For other filters, such as the red filter RG 2 (46 78 20), it is necessary to recalibrate the automatic exposure device. The brighter, more strongly reflecting surface of the interference filters should always face the light source. Mechanical and climatic influences reduce the life of interference filters. Therefore solid glass filters, such as the green filter VG 9, should be used in their place for reducing the image brightness.

Film

The use of high-speed film for photomicrographic purposes is not advisable. The grain of such emulsions will be found disturbing even if the negatives are enlarged only 3—4×. For this reason, panchromatic fine-grain emulsion of low to medium speed should be given preference. The automatic exposure device is adapted to such speeds.
The automatic exposure device must be calibrated for the film material normally used as well as for the development procedure employed. It is therefore immaterial which make of film is used and whether it is black-and-white or color film. For the film used in calibration, the settings of the automatic device given in the sample test series will be applicable, under corresponding processing conditions.

Color photography

For optimum color temperature, the built-in illuminator should be operated on its rated voltage (switch D 10 of transformer set at step IX, Table 3). Too intense light should be subdued with the aid of neutral, gray filters (Table 8) and not — as is recommended for black-and-white film — by a reduction of the lamp voltage. For daylight color film there must be a conversion filter in the light path.
Color photographs should be taken exclusively with an achromatic-aplanatic condenser. Condensers which are not corrected for color will lead to color distortion. Best results in natural color will be obtained with NEOFLUAR objectives or with image-flattening Planapochromats.
Daylight color film sold on the market is naturally fresher than tungsten-type emulsions. Daylight film should therefore be given preference for color photomicrography.
In color photography, allowance should be made for the Schwarzschild effect as discussed in the following paragraph.

Schwarzschild effect

The exposure times for photomicrography fluctuate within wide limits. If the exposure time differs considerably from the standard value, which may have been found by calibration, this is due to the Schwarzschild effect; the photographic material appears to be less sensitive to prolonged exposure.
Long exposure times require correction factors to increase the exposure even more. The selector knob D 12 of the automatic device must be turned back by 1 to 3 steps, for instance from 5 to 2. The safest method to determine the correct position of

the selector knob for prolonged exposure times is to make separate test series.
In practice, the Schwarzschild effect will be noticed only in the case of color photography. Under certain conditions, it may influence the different layers of a color film differently.

Table 10

Allowance for Schwarzschild effect
Approximate data for daylight reversal film

If actual exposure time is increased beyond calibrated time by factors	**Reduce** automatic exposure setting by (steps)
2.5× bis 7×	½
7 × bis 20×	1
20 × bis 50×	1½
50 × bis 100×	2

Shutter

The shutter is, in principle, a focal-plane shutter. Shutter speeds are set on the knob D 8. For microflash photos, the knob D 8 must be set at the yellow "10".

The exposure counter D 3 counts every shutter release. When the film magazine is exchanged, it is advisable to note the film data and the position of the exposure counter in pencil on the magazine cover. For this purpose, the surface of the cover is roughened.

Shutter release

The shutter is released by the keys D 14 of the automatic exposure device, or mechanically by the white knob D 5 on the right side of the instrument.

Automatic release

Knob D 8 set to "B"
Key **A:** Depress only **briefly.** Shutter is opened and closes automatically after correct exposure.

Electrical release

Knob D 8 set to "B"
Key **B:** Keeps shutter open as long as depressed.
Key **T:** Keeps shutter open until key **O** is depressed.

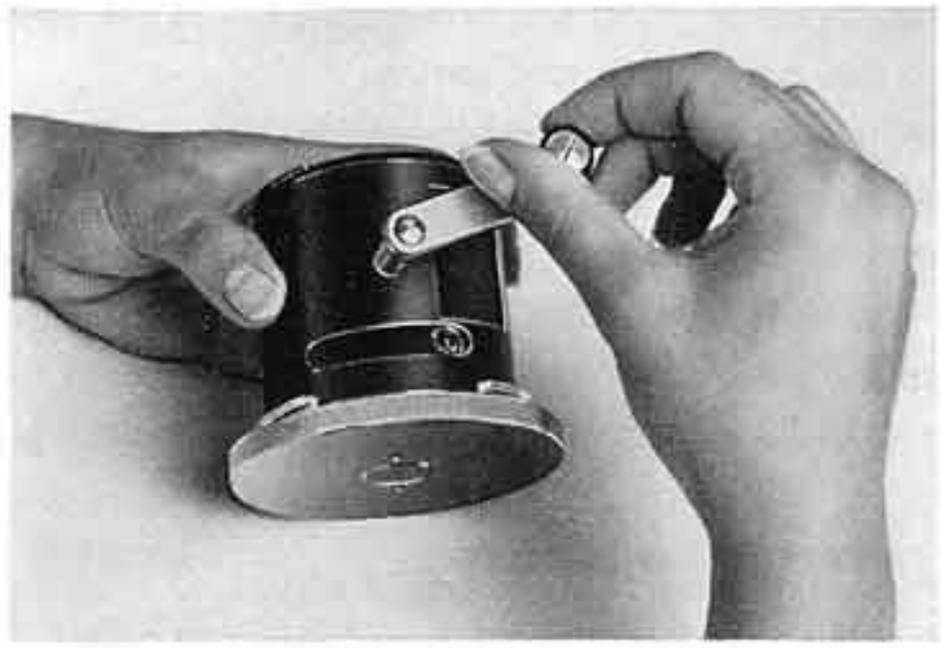
Knob D 8 set for instantaneous exposures (1/10 . . . 1/100)
Key **B:** Exposure of predetermined duration.

Mechanical release

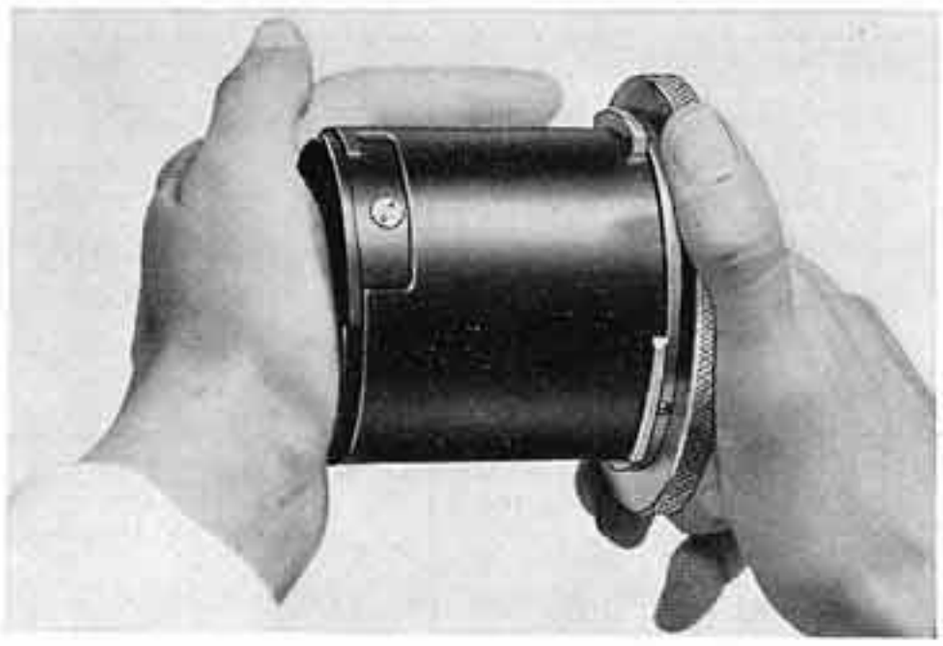
Knob D 8 set to "B"
Release button D 5: Shutter remains open as long as button is locked in midway position.

Knob D 8 set for instantaneous exposures (1/10 . . . 1/100)
Release button D 5: Exposure of predetermined duration.

Loading film magazine with cassette



33



34

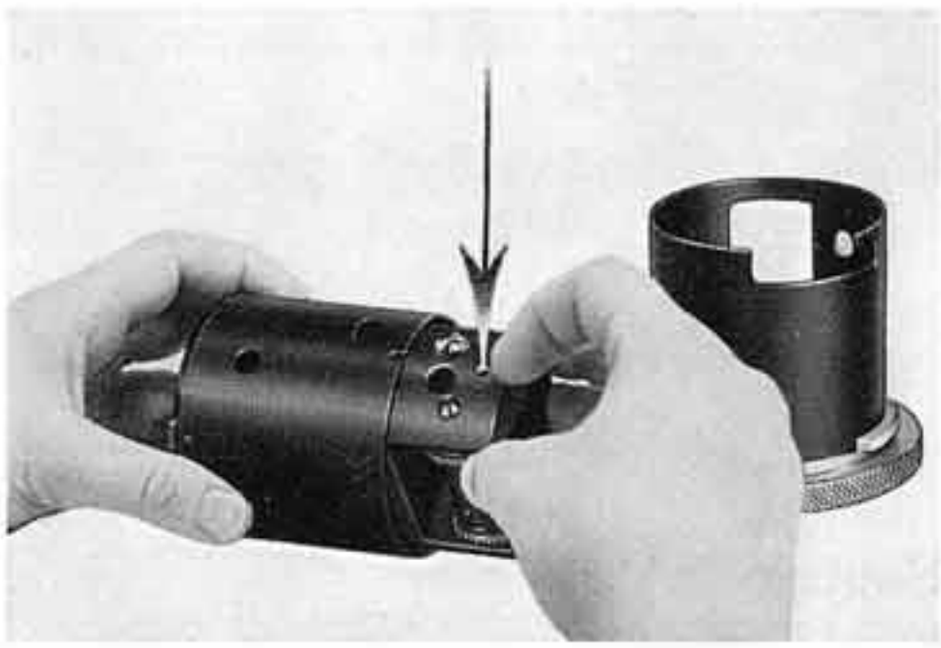
Turn magazine to the left as far as the stop, where a red line marks the position for re-insertion, and withdraw it. Rewind film in the magazine with the crank (Fig. 33).

Press on underside of magazine (Fig. 34), turn upper part and remove the inner portion thus released.

This contains the "spool holder", which is removed (Fig. 35).

Pressure on the slotted pin (arrow in Fig. 36) will cause the cover to snap back.

Insert cassette (Fig. 37), pull film over rollers with emulsion side up, so that its perforations come to rest on the sprockets of the transport roller. Close the cover, which snaps home.



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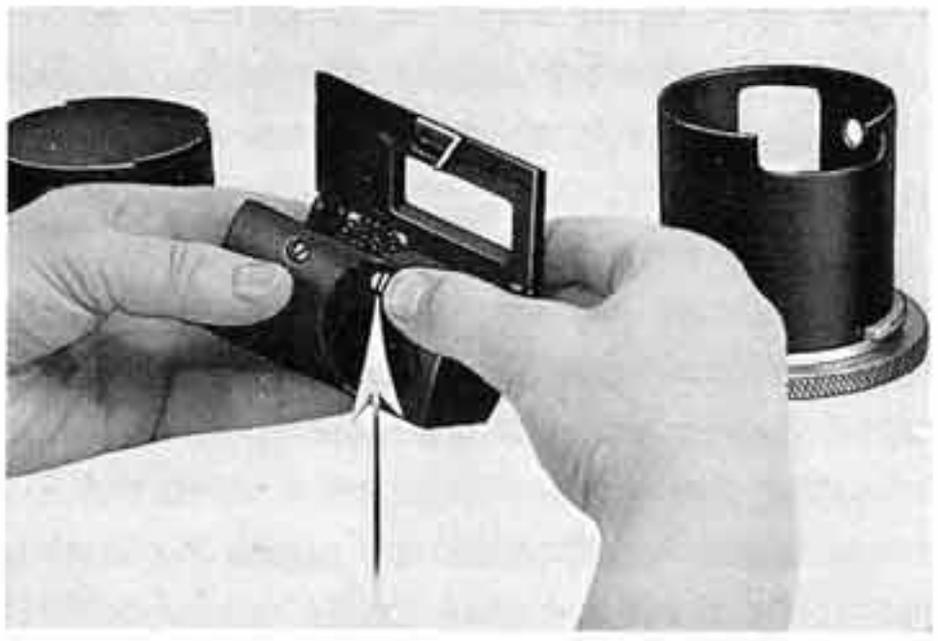
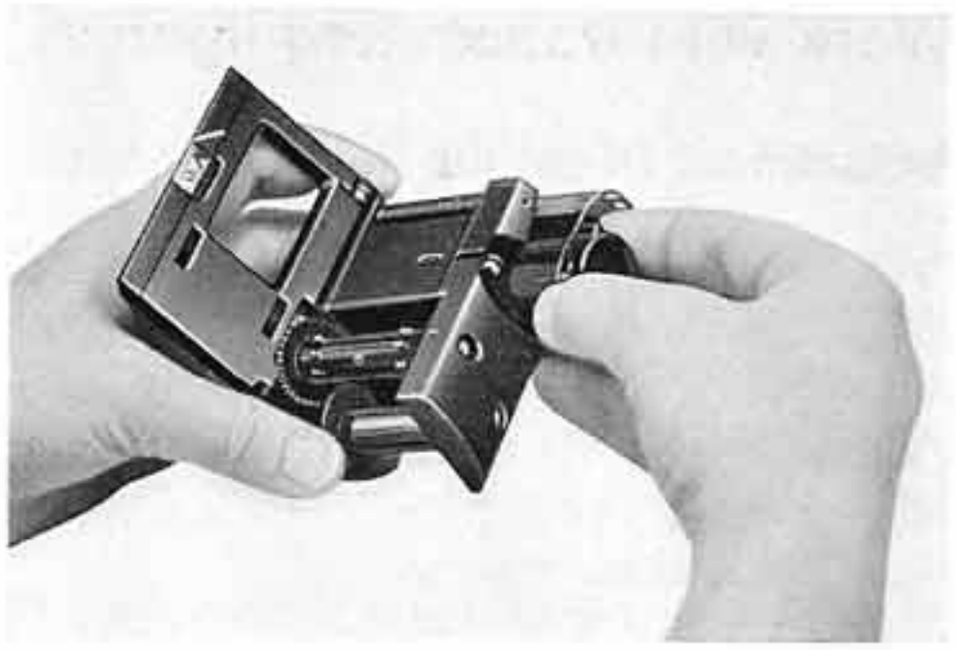


36

Insert film from below into slot of spool (Fig. 38) and tauten by turning the knurled spool flange.



37

Insert magazine unit, reassembled in reverse order, into microscope stand and lock in position by turning clockwise. (When reassembling, make sure that the small pin marked by an arrow in Fig. 35 is correctly positioned in the recess of the inner portion of the magazine).

Wind up clockwork mechanism by means of crank D 4. Set exposure counter D 3 to "33" and make the usual two blank exposures (for instance by depressing button D 5).

38

Calibration of automatic exposure device

1. Adjust illumination as described on pages 38—39. For color photography, use achromatic-aplanatic condenser. Set transformer D 10 at step IX; interpose conversion filter.
2. Set shutter D 8 to "B". Leave photocell stop D 1 in position "2".
   The automatic exposure device should not be used for exposure times below 1 second. Therefore check exposure time with table on page 51, 3a. For black-and-white photography, adjust illumination at transformer — for color photography, use gray filters.
3. With key A (D 14) make one exposure in each of the eight positions of selector knob D 12.
4. Develop film under consistently uniform conditions, select correctly exposed negative and set selector knob D 12 to the corresponding number, in order to continue work under the same conditions.

Work with transmitted light

Adjustment of bright-field illumination

First of all, move the condenser up as far as it will go, open the condenser diaphragm completely and set the OPTOVAR to 1.25. With phase-contrast condensers, set revolving disk to "J" (bright-field position). For work with transmitted light, knob C 14 is at its upper stop.

1. Switch on illuminator on switch D 13 of automatic exposure device.
2. Set reflecting system A 10 to black ring. Adjust interpupillary distance at binocular tube and focus the double line cross in the field of view of each eye by slowly turning the eyepiece tubes inwards. Failure to do so will produce unsharp photos (page 30).
3. Set reflecting system to red ring.
4. Observe specimen through the tube and focus with low-power objective (10 or 16).
5. Close luminous field stop so as to illuminate only part of the field of view (Fig. 39 A).

   The functions of the different diaphragms as well as the adjustment of auxiliary lens and condenser front lens are explained in tables 4, 5 and 6.
6. Adjust condenser by rack and pinion until the luminous field stop is projected with maximum sharpness onto the specimen (Fig. 39 B).

   If this image is too bright, its illumination intensity can be reduced to a convenient degree by decreasing the lamp voltage (D 10) or by using gray filters. Gray filters are best inserted in the filter holders below the condenser, on the condenser carrier.
7. Center the image of the luminous field stop within the field of view by adjusting the centering screws B 16 of the condenser (Fig. 39 C), and open luminous field stop until the entire eyepiece field is illuminated (Fig. 39 D).

   If illumination of the visual field is not uniform, displace lamp holder axially until uniform illumination is attained.

A Unsharp luminous field stop

39

B Sharply defined luminous field stop

Bright-field adjustment

8. Adapt aperture of illuminating rays to the requirements of the specimen by adjusting the condenser diaphragm.

   Never fail to check the relationship between the size of the aperture stop image and the entire objective aperture in the exit pupil of the objective. For this purpose, the knurled ring A 11 of the OPTOVAR can be set to "Ph" and the diaphragm image focused by turning the lower ring A 12. Otherwise, simply leave OPTOVAR unchanged, remove one eyepiece and look into the tube without it.

   The diaphragm image should never be larger than the complete objective aperture, in order to avoid scattered light. In most cases, it will have to be made smaller. Care should be taken always to keep the image as large as possible, taking into consideration depth of field and image contrast. Only in exceptional cases should it be smaller than 1/3 to 1/4 of the diameter of the objective aperture.

   As a rule, it is impossible to illuminate both field of view and aperture with one condenser for low-power and high-power objectives. For this purpose, the data listed in tables 4, 5 and 6 may be used as a guide (pages 26—27).

9. Set the desired magnification by positioning an appropriate objective and selecting the corresponding magnification factor on the OPTOVAR. Then repeat adjustments described under 6 to 8.

   The resilient mount of the immersion objective can be locked in its upper position by clockwise rotation. As soon as the mount is released again after application of the immersion liquid, the image becomes visible in the microscope. In order to obtain optimum image quality, our immersion objectives should be used exclusively with our non-resining and non-fluorescent immersion oil ($n_D = 1.515$).

Exposure see page 51.

C Centered luminous field stop

D Open luminous field stop

Other types of illumination

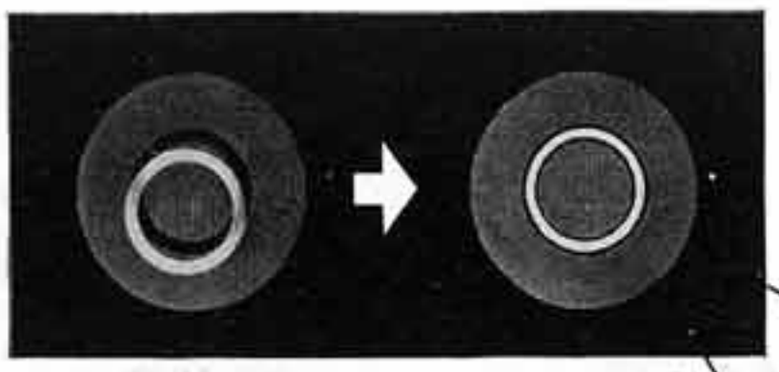
Other methods of illumination, for which any standard microscope can be equipped with the aid of suitable accessories, can also be used with the PHOTOMICROSCOPE.

Phase contrast

The accessories required for this type of work are special phase-contrast objectives and a condenser which permits the corresponding annular diaphragms to be interposed in the light path and adjusted. For the best photomicrographs we recommend the (phase-contrast) NEOFLUAR Ph objectives as well as the achromatic-aplanatic phase-contrast condenser V Z (46 52 77). Illumination is adjusted as in bright field. The only difference is in section 8.

Phase-contrast adjustment

8 **Ph** Insert annular diaphragm corresponding to Ph objective used into light path at condenser.
Annular diaphragm 1 corresponds to the Ph 1 objective engraved in red, annular diaphragm 2 to Ph 2 and annular diaphragm 3 to Ph 3 (see also Operating Instructions G 40-160, phase-contrast equipment).
Set knurled ring A 11 of OPTOVAR to Ph and focus phase annulus and image of annular diaphragm by turning the lower ring A 12.
Obtain maximum possible coincidence between image of annular diaphragm and phase annulus by operating the corresponding adjusting knobs on the condenser, and return OPTOVAR to object viewing position.



Adjustment of annular condenser diaphragm

Oblique illumination

This method of illumination may be used to increase image contrast in the case of low-contrast specimens, although to a lesser extent than is possible by the phase-contrast technique. Oblique illumination will also give a certain depth to flat objects, due to the asymmetrical incidence of the light. However, this often leads to a misinterpretation of the image, so that this type of illuminaton should be used only in exceptional cases. Oblique illumination can be produced with the aid of phase-contrast condensers. However, satisfactory illumination of the field of view will be obtained only with a well-corrected (achromatic-aplanatic) condenser.

Illumination is adjusted as for bright field (page 38). Oblique illumination is obtained by the following modification of the adjustment described under 8;

Adjustment of oblique illumination

8 **S** Check image of condenser (aperture) diaphragm in objective aperture — looking into the tube without the eyepiece or setting OPTOVAR to Ph position and focusing diaphragm image — and reduce its diameter to ½ to ¼ of the diameter of the objective aperture (Fig. 41). Turn revolving disk of condenser diaphragm from J position (iris in light path) to the right or left until about half of the image of the aperture diaphragm has disappeared behind the edge of the objective aperture (Fig. 42).

Then return to observation of specimen. If the object details of interest are unfavorably oriented with respect to the direction of the incident light, the object can easily be moved to a more favorable position by rotating the stage.

Dark field

One of the usual dark-field condensers is used for producing dark-field illumination. It is employed on the PHOTOMICROSCOPE in the same manner as on any other Microscope (Operating Instructions G 40-165, Dark-field Condensers).

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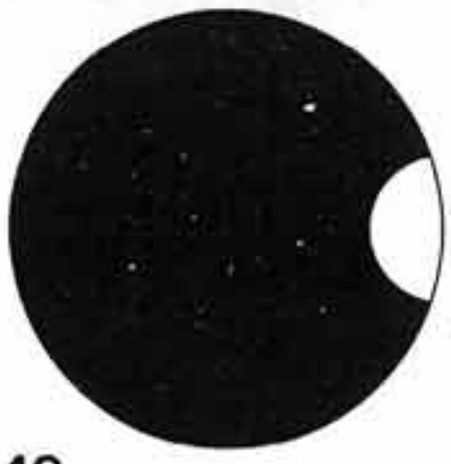

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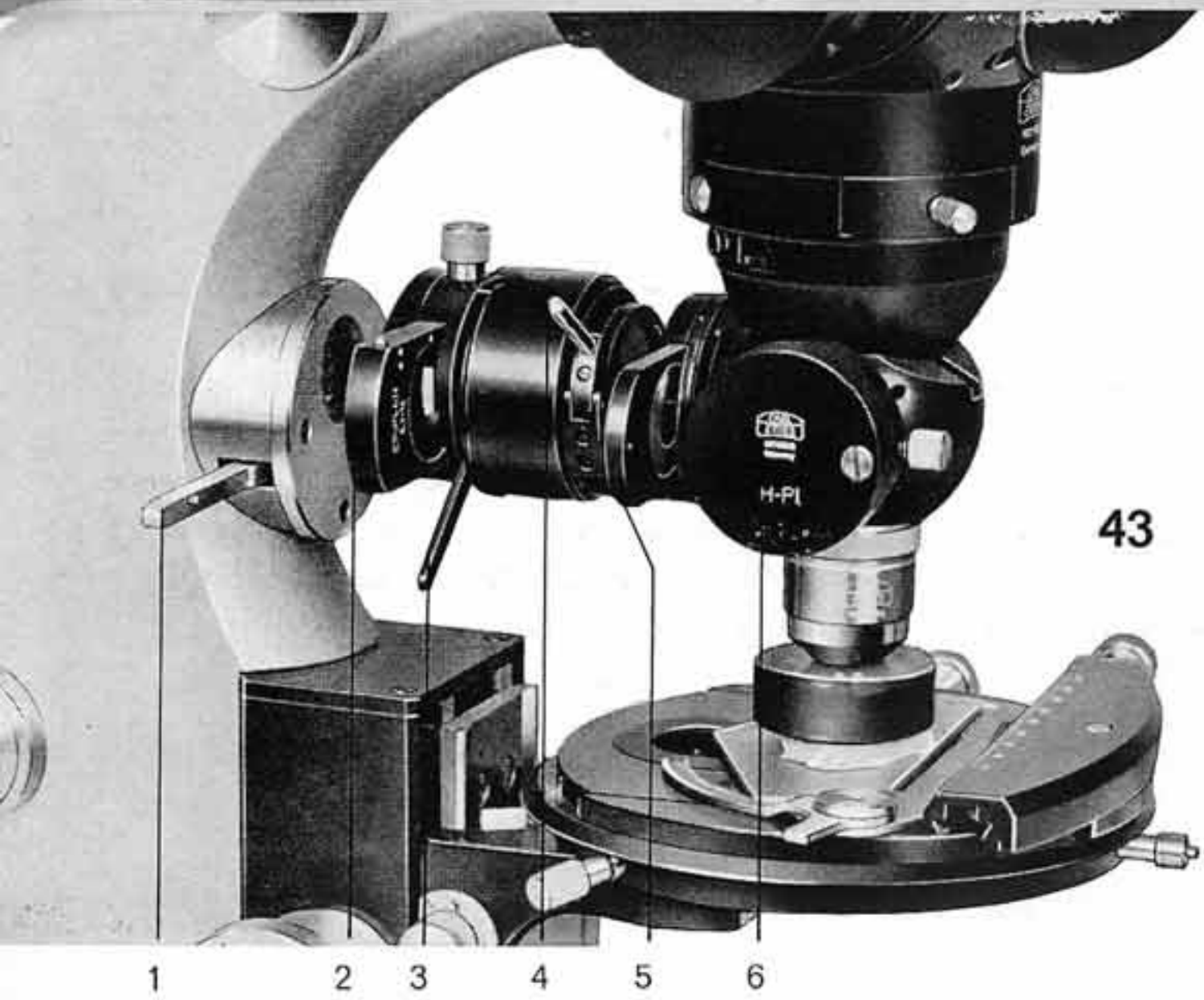

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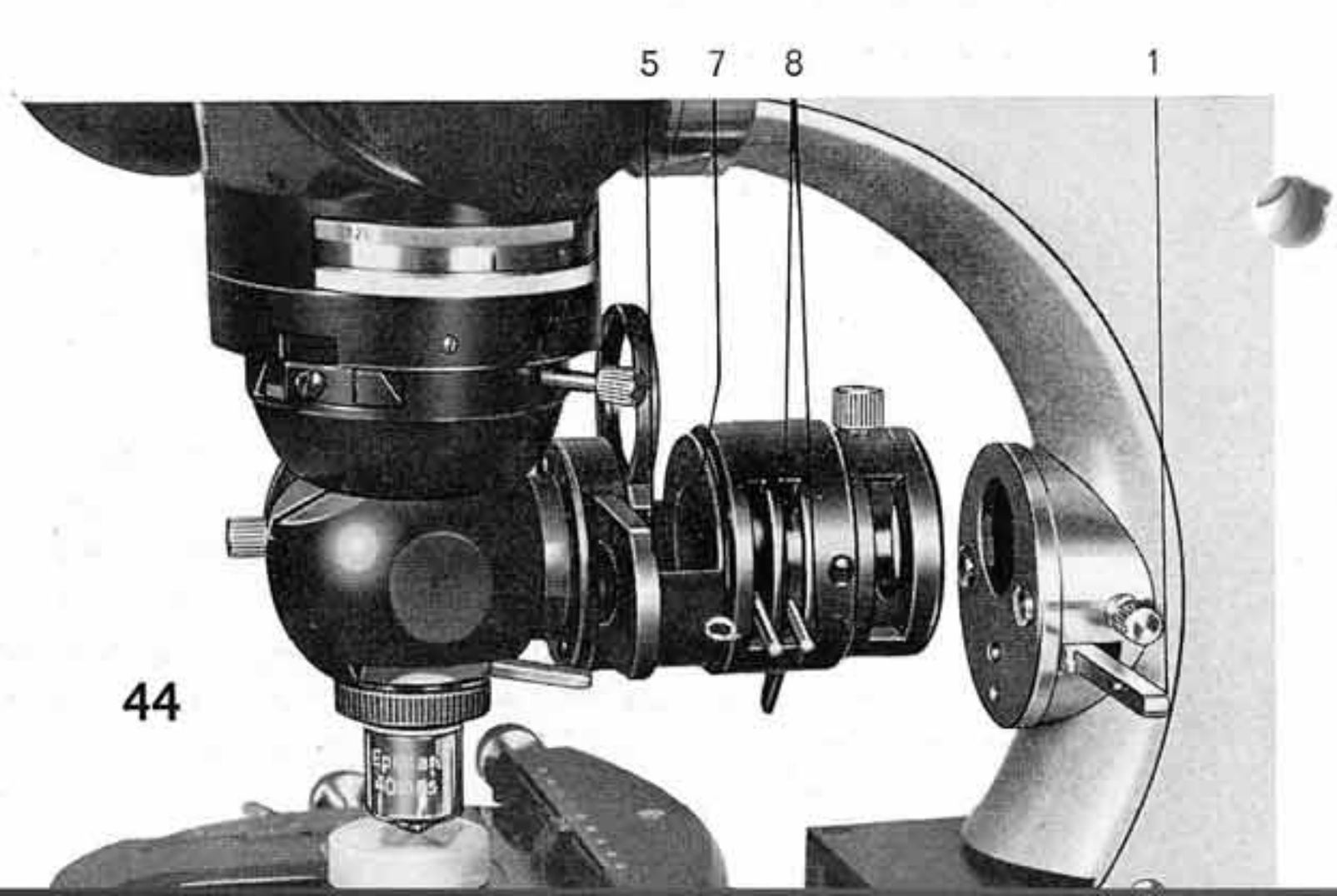
1 = Slide controlling aperture diaphragm. It is graduated to indicate the diameter of the diaphragm in millimeters. Displacement of the slide in the plane perpendicular to its axis (i.e. in the direction of the light path) will shift the image of the aperture diaphragm in a vertical direction.

2 = Auxiliary lens slide with one free opening and one centered auxiliary lens. This lens eliminates disturbing reflections in the center of the field of view with weakly reflecting objects, when EPIPLAN objectives 6.3, 10 or 16 are used for observation.

An interference gradation filter can be inserted in place of the auxiliary lens slide. The filter mount is calibrated in wavelengths. The right-hand outer edge of the vertical illuminator is taken as index.



44

3 = Lever for adjusting aperture of luminous field stop.

4 = Swing-out neutral filter NG 9 (46 78 26) for rapid reduction of light intensity.

5 = Bright-field/dark-field slide: For bright-field illumination interpose lens, for dark-field illumination central diaphragm in light path.

6 = Reflector, to be inserted in oriented position and locked in position by a screw.
Available reflectors are: for bright-field illumination, the plane-plate reflector H-Pl (46 62 60) and the prism reflector H-Pr (46 62 61), for dark-field illumination the reflector D (46 62 62).

7 = Filter receptacle taking adapter rings for light filters (32 mm Ø) or an azimuth diaphragm. The filter receptacle also accommodates the polarizer for vertical illumination.

8 = Levers for centering luminous field stop.

Work with vertical illumination

While the use of transmitted light is indicated for the observation of specimens which are thin by nature and thus transparent or translucent, or of which thin sections can be prepared by microtechnique, vertical illumination is used for studying the surface structure of opaque objects.

In this case also it may either be necessary to study unprepared surfaces or objects which have been subjected to adequate surface treatment. In the former case, the magnifying power will be kept low in view of the required depth of field, and dark-field illumination used because the object will usually be diffusely reflecting. In the second case, however, the specimen will be polished, because here the purpose of preparing the specimen is nearly always to reveal the microstructure of a more or less complex solid. The structural elements then become visible under the microscope either due to differences in their physical properties (color, reflectivity, polarizing characteristics) or due to a relief effect obtained through preparation (polishing, etching).
In all cases where polished sections have to be examined, bright-field illumination will be the method chosen. Only in special cases will dark-field illumination supply additional information. There is no limit to magnification in the observation of polished specimens.
Since it is always a plane surface which has to be imaged in this case, satisfactory results can be obtained only with objectives which provide a sufficiently flat field. For use with the PHOTOMICROSCOPE, special EPIPLAN objectives have been designed for this purpose. If examinations are to be made in a bright field only, normal EPIPLAN objectives should be used. If dark-field illumination is also to be used, the EPIPLAN HD objectives will be required, which are equipped with dark-field mirrors. A review of Zeiss objectives for work with vertical illumination and their range of application is given in Table 12.

The EPIPLAN objectives mounted on a changer ring are attached to the Microscope by inserting the changer ring sideways into its mount on the vertical illuminator and locking it in position by pushing its handle round to the back on the right. In order to adapt the PHOTOMICROSCOPE for the use of vertical light, it must be equipped with a special illuminator. This consists of an aperture diaphragm insert and the vertical illuminator. Assembly of the diaphragm insert and the vertical illuminator is described on page 7.

Up to serial number 52 291, the PHOTOMICROSCOPE is provided with a dovetail changer ring for the objective carriers A 5, and there is, of course, also a dovetail ring for the vertical illuminator.

The use of the special stage for polished specimens (page 15) will be of advantage.

Table 11

Differences and characteristics of reflectors H-Pl and H-Pr for vertical bright-field illumination

	Reflector H-Pl with plane glass plate (46 62 60)	Reflector H-Pr with prism (46 62 61)
Resolving power of objective	fully utilized	reduced by 50% in one direction (perpendicular to edge of prism), due to semi-circular exit pupil; fully utilized in other direction
Direction of illumination	normally rigorously straight; if required, oblique illumination is also possible	only oblique
Illumination	uniform distribution of light over objective aperture and surface of specimen	With identical aperture, image brightness 5× greater than with plane glass plate. Image of weakly reflecting objects sometimes darker at top or bottom.
Reflections	unavoidable on lens surfaces of objective and on glass plate. Consequently, veiling in case of weakly reflecting objects. In the case of extreme contrast, possibility of ghost images due to reflection at rear surface of glass plate.	With correctly adjusted illumination, images can be obtained practically free from reflections. Hence suited for photometric measurements of reflectivity.
With polarized light	suitable only with reservations, due to depolarization	Well-suited, since minimum effect of depolarization — absolutely indispensable for measurements with polarized light.
Photomicrography	very useful, especially with strongly reflecting specimens	

Table 12

Ojectives for reflected light

	Attached by	Bright field	Dark field	Scale factor 2.5	3.2	6.3	10	16	25	40	63	100	Characteristics and range of application
EPIPLAN objectives	fixed changer ring	×		×		×	×	×	×	×	×	×	Objectives provide optimum flattening of field. Designed for metallographic bright-field work. Objectives 2.5/6.3/10/16 with ANTIFLEX device (page 48) for use as required, permitting increased image contrast. Particularly well suited for: Coal petrography, qualitative ore microscopy, ceramic and petrographic material, very rough surfaces (e. g. paper).
EPIPLAN-HD objectives	fixed changer ring	×	×			×	×	×	×	×		×	Objectives provide optimum flattening of field. Designed for metallographic bright-field and dark-field work, and examination of rough surfaces in dark field.
"Aufl.POL" objectives	centerable changer ring	×			×	×		×		×			Strain-free Achromats for qualitative and **quantitative** work with polarized incident light: Ore microscopy, coal petrography with optically anisotropic material, metallography with optically anisotropic components in the polished surface.
Oil immersion					×	×		×		×		×	
EPIPLAN-ANTIFLEX immersion oil and methylene iodide	fixed changer ring	×		×		×							Immersion objectives for use with oil or methylene iodide, with optimum flattening of field and ANTIFLEX device. Particularly useful for increasing contrast under low magnification, since **differences** in reflectivity of different components are increased by immersion. Indicated for coal petrography, non-metallic inclusions, absorbing components in ceramic material, qualitative ore microscopy. For use with and without ANTIFLEX device.
ANTIFLEX Epi-Achromats oil and methylene iodide	fixed changer ring	×					×		×				Immersion Achromats with ANTIFLEX device for increasing contrast under medium and high magnifications. Same applications as EPIPLAN-ANTIFLEX immersions.

Adjustment of bright-field illumination

The transmitted-light condenser with the condenser carrier must be removed for incident-light work. The stage can thus be attached 46 mm lower and the working range increased accordingly. For vertical illumination, knob C 14 is in bottom position, the OPTOVAR set to 1.25, and the bright-field/dark-field slide in the bright-field position (lens in light path).

1. Switch on illuminator.
   Substage illuminator by switch D 13 of automatic exposure device.
   More appropriate for vertical illumination is the 60 W illuminator which is operated through a separate transformer.

2. Set reflecting system to black ring A 9. Adjust interpupillary distance at binocular tube and focus doubleline cross in field of view separately for each eye by slowly turning the eyepiece tubes inward. Failure to do so will cause the photos to be unsharp (page 30).

3. Set reflecting system to red ring or — if intensity of illumination is insufficient — to white ring.

4. Swing out neutral filter. Move luminous field stop lever E 3 right down and set aperture diaphragm E 1 to "2".

5. Observe specimen through tube and focus with low-power objective (scale factor about 10).

6. Close luminous field stop E 3 until its image becomes visible in the field of view. In this case it will appear sharply defined without any special adjustment. The diameter of the diaphragm image should be made somewhat smaller than that of the field of view.

7. Center image of luminous field stop with respect to edge of field of view (Fig. 45 B). This is done by means of the two levers E 8. Open diaphragm until the entire field of view of the eyepiece is illuminated (Fig. 45 C).

Image of uncentered luminous field stop

A

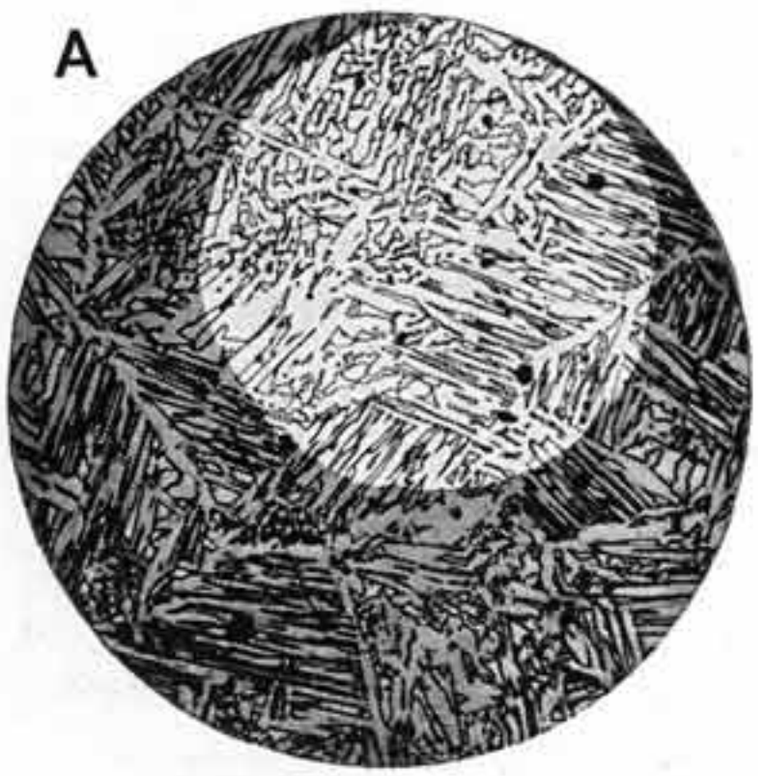
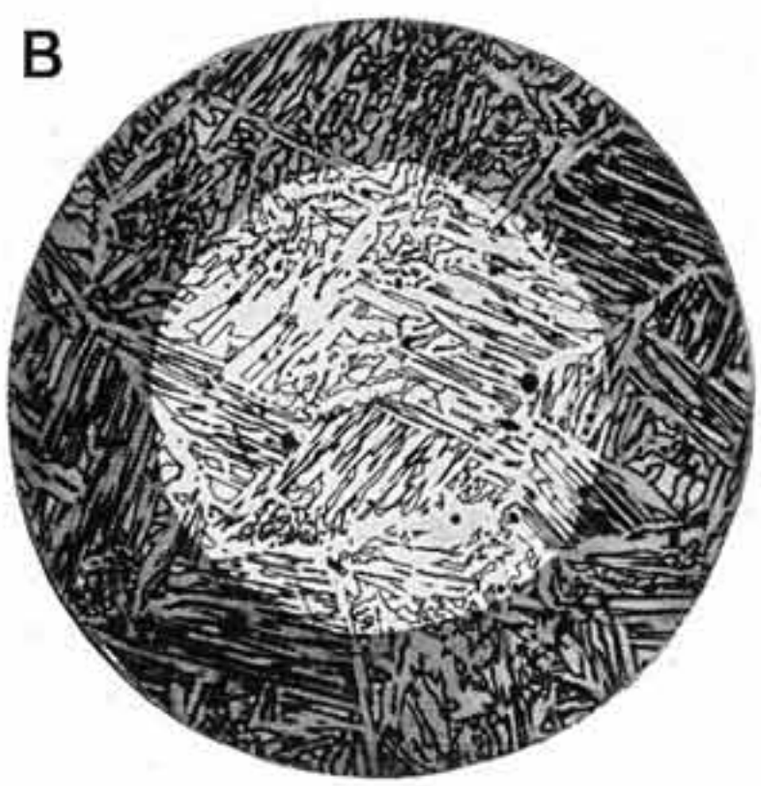


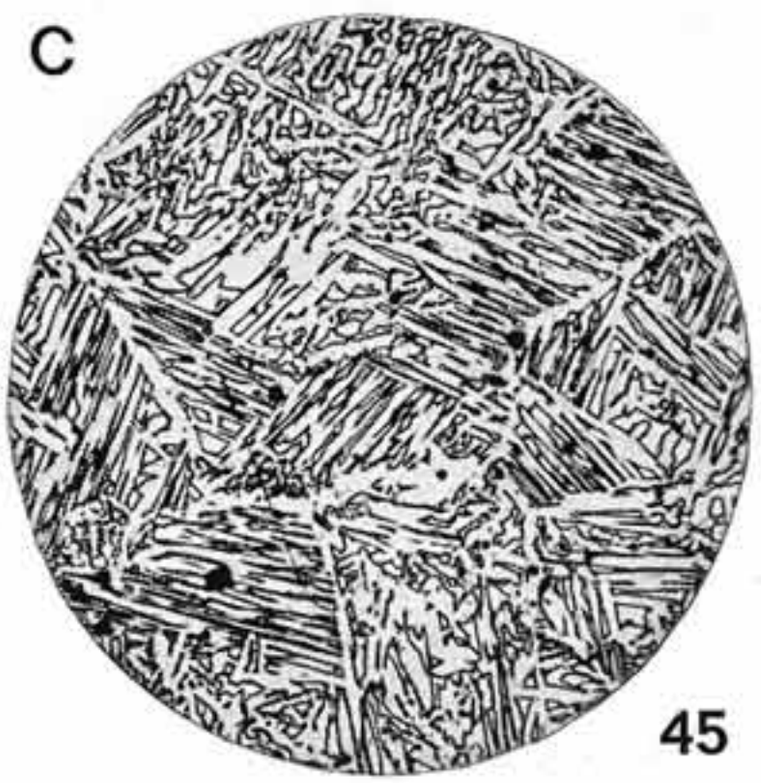
Image of centered luminous field stop

B



Luminous field stop open

C



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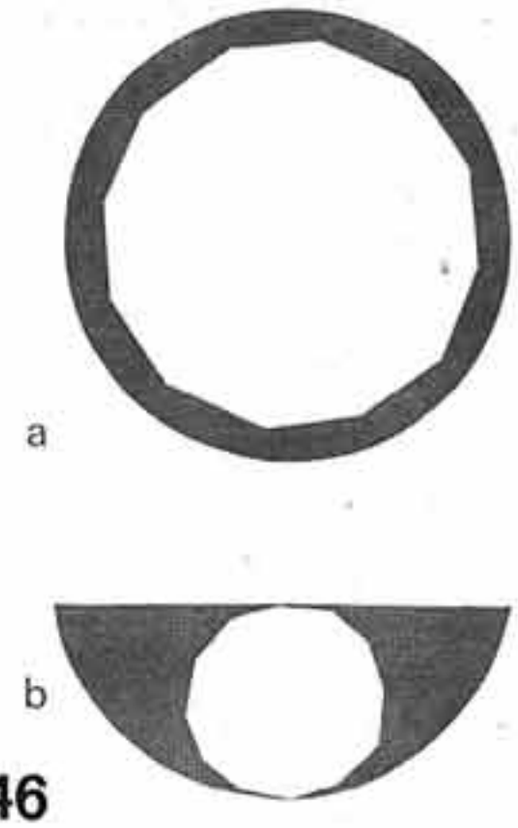
8. Set OPTOVAR to "Ph", focus image of aperture diaphragm with ring A 12 and center this image with respect to objective aperture by moving the slide in the plane perpendicular to its axis, i. e. in the direction of the light path.
If an H-Pl plane-plate reflector is used, this image should be centered in the aperture (Fig. 46 a). With the H-Pr prism reflector, it should lie in the center of the semi-circular area visible in the eyepiece (Fig. 46 b).

If the image of the aperture diaphragm travels when the specimen is rotated, it is necessary to level the specimen carefully with an alignment press. — When the special stage for polished specimens is used, the specimen is always perfectly aligned, perpendicular to the optical axis.

9. Reset OPTOVAR to 1.25 and correct setting of illuminating aperture as required for specimen by adjusting slide E 1.
For the investigation of polished metal surfaces the illuminating aperture selected is frequently too small or — less frequently — too large. Too small an aperture has an unfavourable effect on the image quality, and too large an aperture may give rise to vignetting due to loss of light towards the edge of the image.
The correct aperture in this case will always be in the range from $^2/_3$ to $^4/_5$ of the objective aperture. If necessary, check as described under 8.

10. Obtain required magnification by selecting an appropriate objective and adjusting the OPTOVAR according to Table 2; then repeat adjustments as under sections 6 to 9.

Exposure see page 51.



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Correct size of image of aperture diaphragm in entrance pupil of objective
a) using H-Pl reflector
b) using H-Pr reflector

Adjustment of dark-field illumination

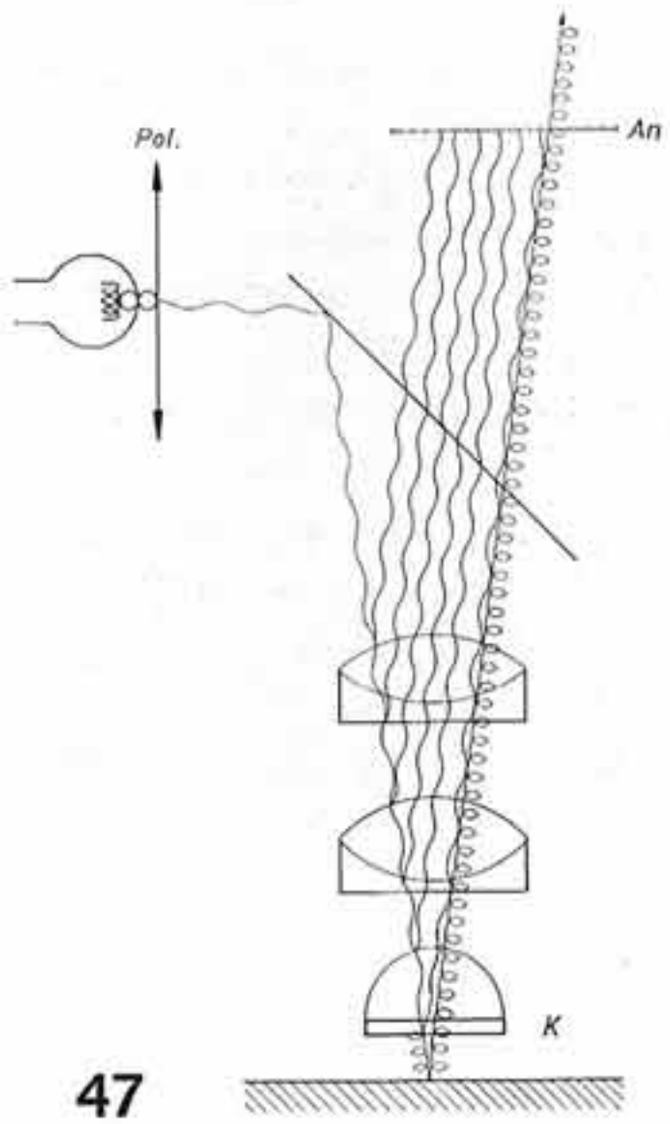
1. Insert dark-field reflector D into vertical illuminator. Use EPIPLAN HD objective.
2. Set bright-field/dark-field slide E 5 to dark-field position (annular diaphragm in light path).
3. Swing out neutral filter and open luminous field stops and aperture diaphragms completely (luminous field stop lever E 3 down to bottom stop; aperture diaphragm slide pulled out to the right).

Elimination of disturbing reflections

a) **by correct adjustment** of luminous field stop and aperture diaphragms (see pages 46—47);

b) **by displacement of image of the light source.** This is done with the aid of auxiliary lens slide E 2 and will frequently be found advantageous in the case of dark specimens such as polished ore, coal and plastic surfaces, in conjunction with the low-power EPIPLAN objectives 6.3, 10 and 16 (see also page 42).

c) **by ANTIFLEX technique**



Effect of ANTIFLEX device:
Stray light and reflected light eliminated by ANTIFLEX device.

ANTIFLEX technique

The ANTIFLEX device permits stray light and reflections to be eliminated by polarization. A contrasty image can thus be obtained, particularly in the case of weakly reflecting specimens and specimens of widely varying reflectivity (such as ceramic material, polished coal surfaces).

The objectives have a doubly refracting crystal plate in front of their front lenses. This plate rotates the vibration plane of the light linearly polarized by the polarizer by 90°, or produces circularly or elliptically polarized light. The analyzer extinguishes the light reflected from the lens surfaces of the objective before falling on the object while it is still "linearly polarized". The transformed light reflecting from the object is transmitted (Fig. 47 b). Only this portion of the light contributes to the formation of an image.

Use of ANTIFLEX device

In order to put the ANTIFLEX device into operation, the following adjustments must be made in addition to those described on pages 46—47:

a) the polarizer must be oriented parallel to the reflector plane and the analyzer accurately positioned at right angles to it.

b) the crystal plate in front of the objective front lens must be brought into correct azimuthal position by rotating the objective.

Orientation of polarizers

1. Place a strongly reflecting object, if possible without any surface structure (front surface mirror), on the stage. Insert plane-plate reflector H-Pl.
2. Insert polarizer:
   Either
   a) introduce incident-light polarizer (47 36 16)

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Correct orentation of polarizer to be screwed into tube (3 a)

— with scale and index set to zero — into filter receptacle E 7 of vertical illuminator, and lock in position.
The plane of vibration of the transmitted, linearly polarized light will then run from right to left, i. e. **parallel** (or approximately parallel) to the plane of the reflector;

or

b) insert polarizing filter with adapter ring into filter receptacle. The polarizing filter must be positioned in the vertical illuminator so that the indicated direction of vibration runs from right to left (parallel to reflector plane). Exact crossed position with respect to analyzer must be determined by trial.

3. Place analyzer in light path
either
a) Position analyzer for screwing into tube (47 36 51) so that its vibration direction, indicated by two white lines, corresponds to Fig. 48;

or

b) simple analyzer slide is automatically introduced in correct position;

or

c) set rotary analyzer slide (47 36 62) accurately to O.

4. With plane-plate reflector H-Pl in place, look through tubes at specimen, without objective and eyepiece. Check accurate crossed position of polarizer and analyzer as well as their directions, respectively parallel and perpendicular to plane of incidence (reflector plane). The field of view must either be darkened or obscured by a broad, washed-out, dark cross (extinction cross). If the visual field or the center of the cross is lightened, proceed as follows: In the case of 2 a, turn polarizer out of its zero position and clamp in position giving maximum darkness. In the case of 2 b, correspondingly rotate polarizing filter.
In addition, verify that the polarizer is **perfectly** parallel to the H-Pl reflector. For this purpose, check whether simultaneous rotation of polarizer and analyzer **without altering their crossed position** results in increased darkness or whether the symmetry of the extinction cross is improved. Fix polarizer and analyzer in position when optimum conditions have been attained.

Rotate objective cap with crystal plate into correct azimuthal position

5. Insert objective and eyepiece and replace focusing object by specimen to be examined.

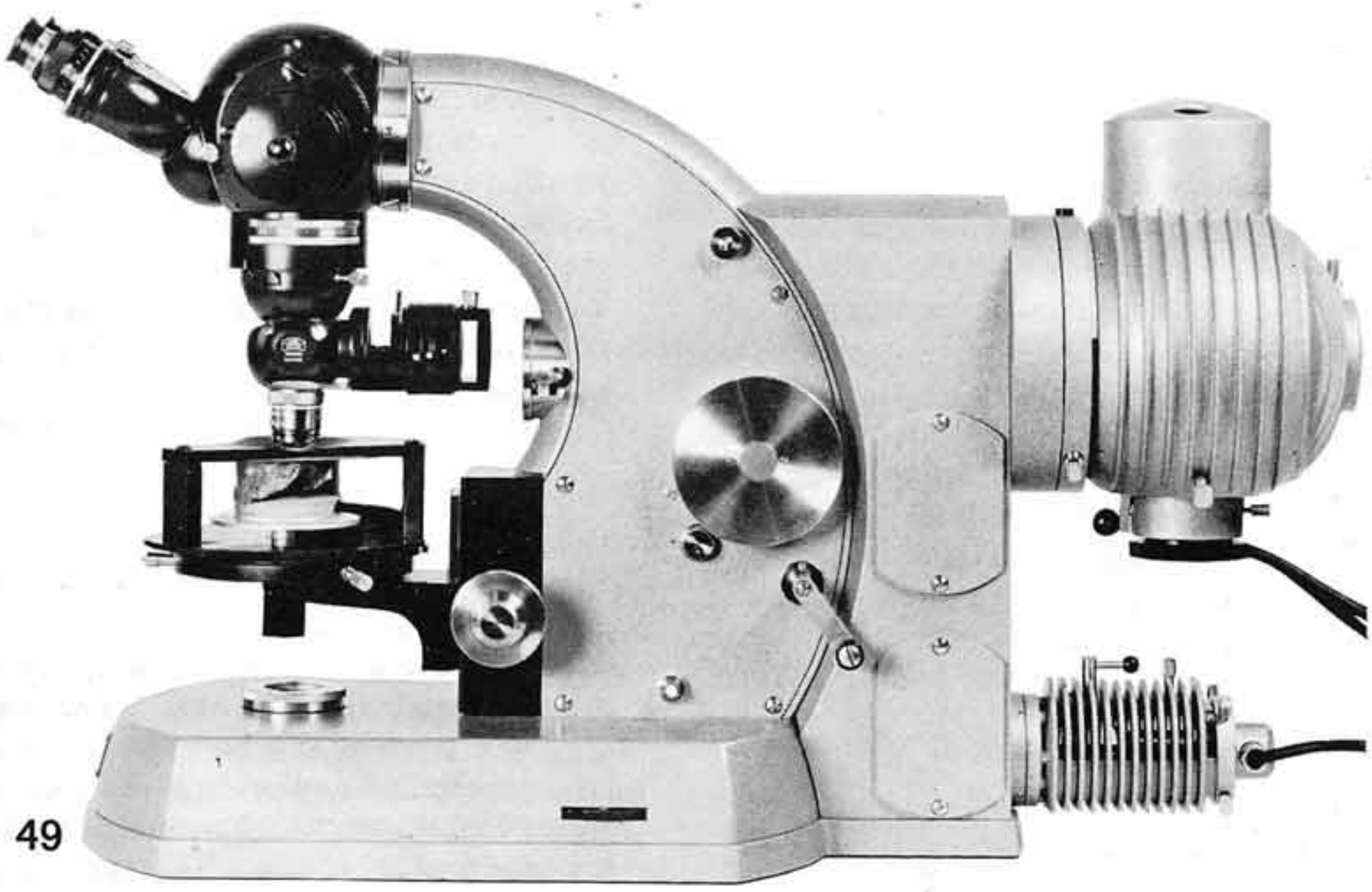
6. Focus specimen in microscope and turn objective until maximum brightness of the image has been achieved.
The principal vibration directions of the doubly refracting plate incorporated in the objec-

tive are **diagonal** to the vibration directions of the crossed polarizer and analyzer.

The crystal plate can also be turned to "parallel position". The microscopic image will then appear as such in the polarized light between the crossed polarizer and analyzer, so that — as usual — any optically anisotropic (birefringent) object can be made visible.

The direction of the "ordinary" ray of the crystal plate is given by the line connecting the axis of the objective with a dot on the outside of the objective mount.

When changing over to normal bright-field illumination, it is sufficient to swing the analyzer or the polarizer out of the light path. Only in the case of insufficient image brightness must they both be removed from the path of rays. When interposing them again, repeat adjustment as described in section 4.



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PHOTOMICROSCOPE equipped for vertical illumination with vertical illuminator and special stage for polished specimens. On the special illuminating device, the multi-purpose microscope illuminator and the 60 W illuminator.

Camera settings and exposure

Adjust illumination (transmitted light, page 38, vertical illumination, page 46). Load and insert magazine (page 36), wind clockwork mechanism, set counter to "33" and make two blank exposures. Set reflecting system A 10 to exposure position (stop at black ring) and check whether the double cross of the reticle and the microscopic image are in sharp focus (page 30). Selector knob D 12 must be in the position determined by calibration.

1. Obtain desired magnification (Table 7) by means of objective, OPTOVAR and projective. Insert light filter.

2. Correct image sharpness, reproduction of luminous field stop and illumination of objective aperture.
   As is usual with camera viewfinders, the field covered by the reticle is somewhat smaller than the one recorded on the film. In order not to vignette the corners of the negative, open the luminous field stop a little more.

3. Set knob D 8 to the desired exposure time. In general, the automatic exposure device will be used. In this case, set knob to "B". If the film is exposed only partially, this indicates that this knob had not properly engaged its notch, or was not in "B" position.
   When changing over from instantaneous or flash photographs to automatic exposure control, do not forget to set knob D 8 to "B".

   a) **For automatic exposures** the exposure time should not be shorter than about ½—1 sec. If it has to be shorter, reduce the intensity of illumination for black-and-white film by decreasing the lamp voltage at the transformer, and in the case of gas discharge lamps or color film by inserting gray filters (Table 8).

   For checking the exposure time:
   Unlock magazine by turning it to the left as far as it will go, make an automatic exposure by **briefly** depressing key **A** of automatic exposure device. Then relock magazine and turn back counter D 3.

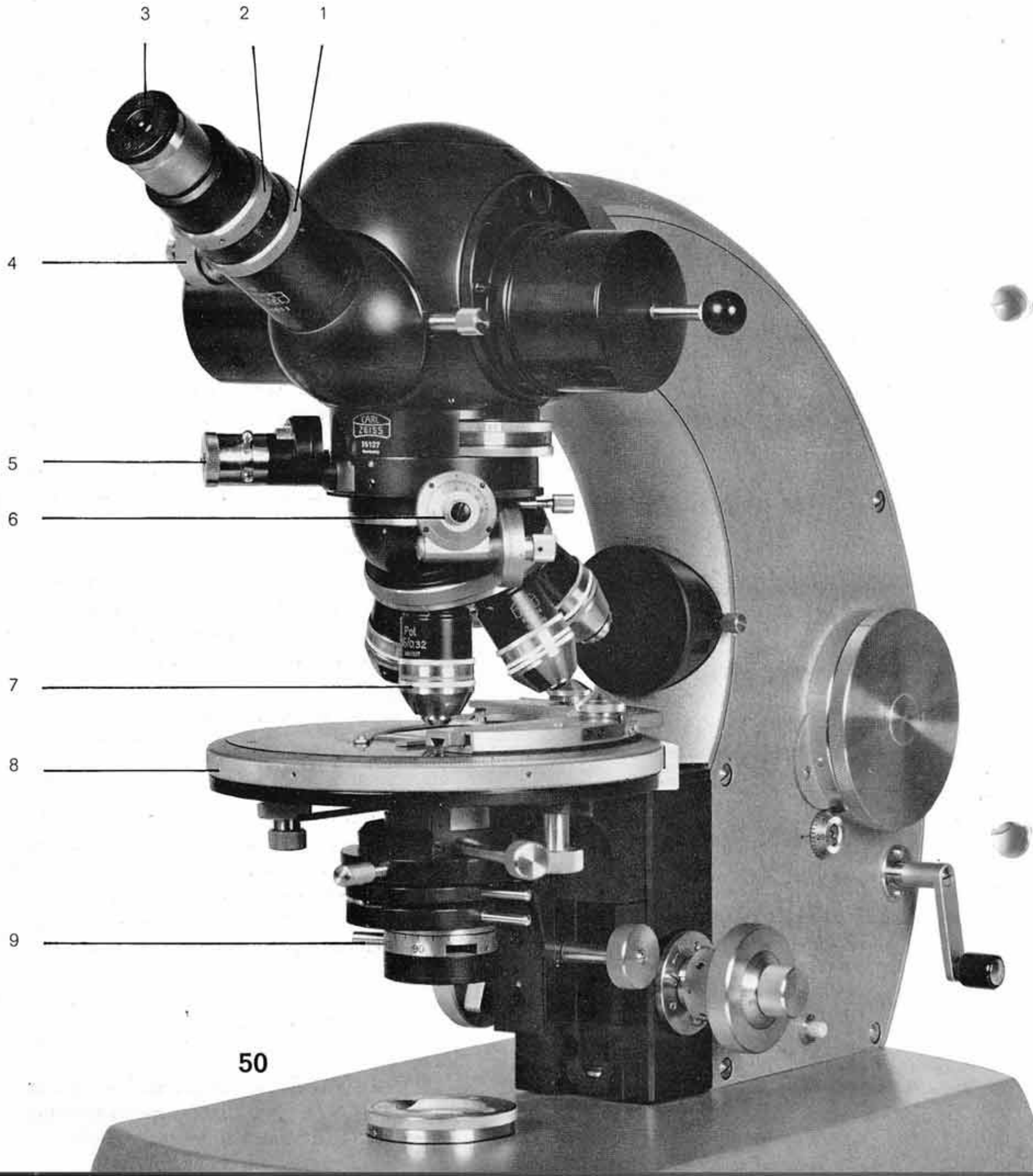
4. Make exposure

Table 13

Camera shutter

Shutter release	Knob D 8 set at	Exposure
Button D 5 Key **B** on automatic device	10≈1/10 25≈1/25 50≈1/50 100≈1/100 sec	Instantaneous exposure
released by key O Key **T** on automatic device	B	Time exposure
Depress key **A** on automatic device only very **briefly**		**With automatic device** selector knob D 12 in calibrated position

In bright rooms, the eyepieces of the tube should be protected against the light.
Before an automatic exposure is made, master switch D 13 must be ON for about 5 minutes. After an interruption of several days, it is advisable to operate the automatic device once or twice before the first exposure. Residual charges on the capacitor might otherwise lead to underexposure of the first photograph. Proceed as described under 3 a.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CARL ZEISS
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Pol
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Work with polarized light

By the addition of suitable supplementary parts, any PHOTOMICROSCOPE can be used as a simple or complete polarizing microscope. With few exceptions, the accessories and supplementary parts are the same as those used on other Zeiss polarizing microscopes.

If a PHOTOMICROSCOPE is to be employed as polarizing microscope, it must be equipped with the following accessories:

1. Polarizer
2. Rotary polarizing stage
3. Analyzer
4. Polarizing tube with Bertrand lens or inclined binocular tube POL.

Polarizer and analyzer as well as the tube, which in this case is provided with grooves for insertion of an oriented cross-hair eyepiece, must be mutually aligned. This can only be done by means of special adjustments.

In addition, all optical elements located between polarizer and analyzer (condenser, objective, auxiliary lenses), must be strain-free. For quantitative microscopy with polarized light, use the 1.3 Z POL condenser (46 52 63).

Since strain-free optical elements cannot be obtained by normal mass production methods, it is indispensable to use special strain-free condensers and objectives as well as special objective carriers (revolving nosepieces, holders for single objectives) with telan lenses. In instruments with a serial number of 52 292 and higher, all these components are engraved in red and marked with the letters "POL". If these conditions are fulfilled, no noticeable depolarization phenomena which would distort the interference patterns or colors will occur in the PHOTOMICROSCOPE POL — neither in the viewing beam nor in the photographic beam.

A detailed description of the polarizing equipment is given in the operating instructions G 40—540, equipment for polarizing microscopy.

1 = Tube iris diaphragm for eliminating and isolating certain portions of specimen.
2 = Knurled ring for focusing exit pupil of objective with the aid of auxiliary microscope for conoscopic observation, consisting of eyepiece and Amici-Bertrand lens.
3 = POL eyepiece
4 = Operating and centering knob of Amici-Bertrand lens
5 = Rotatable analyzer slide
6 = Compensator
7 = Centerable POL objective
8 = Rotary polarizing stage
9 = Rotatable swing-out polarizer

Fluorescence microscopy

The PHOTOMICROSCOPE can also be used for fluorescence microscopy with transmitted or with incident light. A suitable light source is the HBO 200 W high-pressure mercury lamp in the lamp housing of the multi-purpose microscope illuminator attached to the special illuminating device (cf. page 23). The coating of the mirrors in the illuminating path of the PHOTOMICROSCOPE is such that they possess maximum reflectivity even in the long-wave, ultraviolet region which is of importance for the excitation of fluorescence.

The exciter filters are accommodated in the exciter filter insert in the special illuminating device. If there is no such insert, the exciter filters BG 3/4, BG 12/4, UG 5/3 and UG 1/3 must be placed singly or in combination into the holder in the substage diaphragm insert. — When vertical illumination is being used, they are inserted with their mounts into the filter receptacle E 7.

The barrier filters are mounted on three slides in the barrier filter insert A 15. This insert can be used on instruments with serial number 52 292 or higher. It is introduced into the opening in the tube head which is normally closed by the insert A 4.

For more details about fluorescence microscopy, such as properties of filters and hints on their use, as well as on the preparation of specimens, see operating instructions G 40-215.

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G 40—430—e

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