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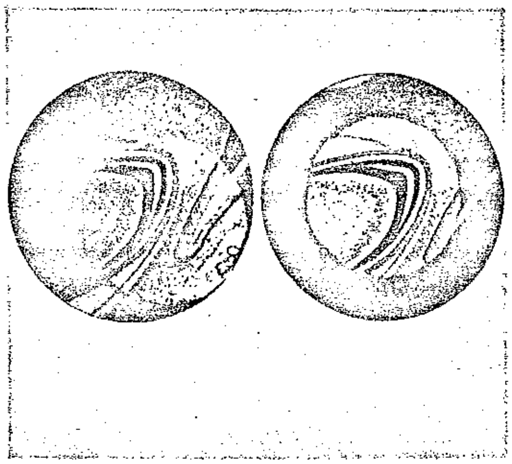
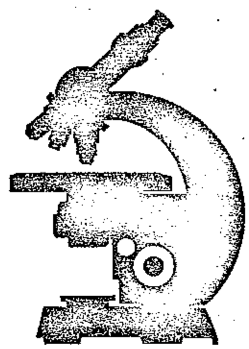
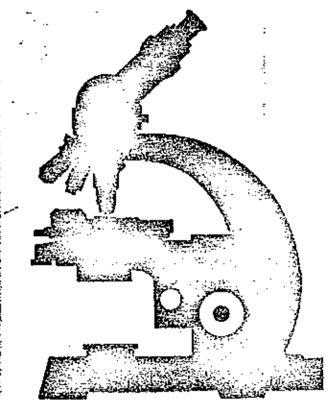
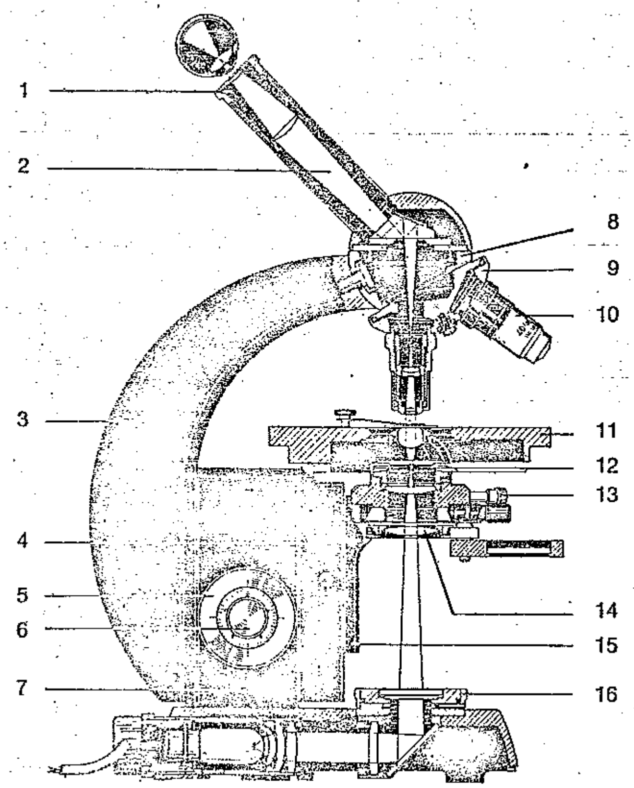
STANDARD GFL and WL Microscopes

Operating Instructions



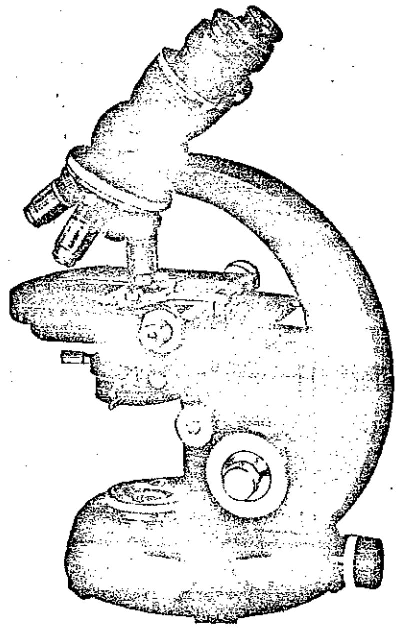




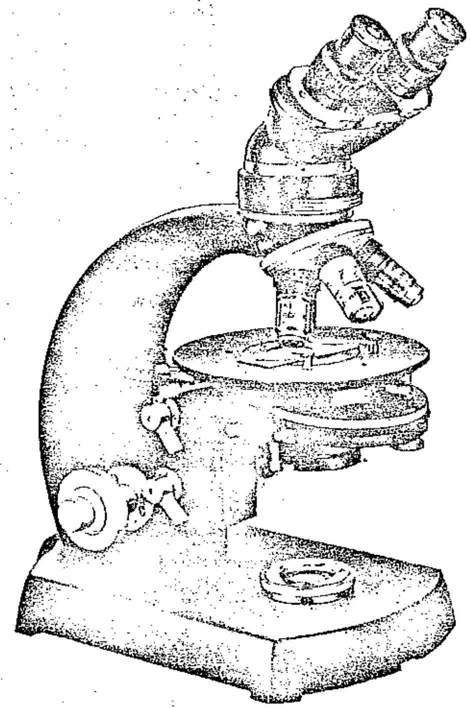


1

1 = Eyepiece
2 = Inclined tube
3 = Tube support
4 = Stage support
5 = Coarse adjustment knob
6 = Fine adjustment knob
7 = Illuminating tube with collector
8 = Stand head
9 = Revolving nosepiece
10 = Objective
11 = Stage
12 = Condenser (aperture) diaphragm
13 = Knob for swinging condenser front lens in and out
14 = Auxiliary condenser lens
15 = Condenser carrier
16 = Diaphragm insert with field stop



2 Routine and Research Microscope STANDARD GFL



3 Large Research Microscope STANDARD WL with gliding stage and phase-contrast condenser

These operating instructions assume a knowledge of basic principles for the manipulation of a Microscope and refer only to special points concerning the use of our STANDARD Microscopes.

The stands of the Microscopes **STANDARD GFL and WL** closely resemble each other in their design. On the Research Microscope STANDARD WL, however, the stages are interchangeable. Also the condenser carrier can be removed from this stand, thus extending the vertical range of motion for the stage by 45 mm for examinations with vertical illumination.

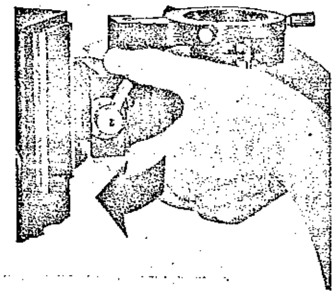
Unpacking the microscope

The STANDARD microscope is supplied in a styropor case. On the STANDARD GFL, the fine adjustment drive is protected by a thin plate between the circular base and stage carrier. This plate should be removed in the following manner before the microscope is used:

First turn the coarse adjustment knob so that the tube carrier is lowered and turn the fine adjustment (6 in Fig. 1) in the same direction until it stops. Then lift the knob for condenser adjustment against the force of the spring and withdraw the plate to one side.

Attaching the condenser carrier and the stage support **to the changing slide** of the STANDARD WL:

Set the clamping lever into its upper position. Place the r i g h t guide rib of the carrier against the changing slide, then swing the l e f t rib against it until the spring bolt snaps into place.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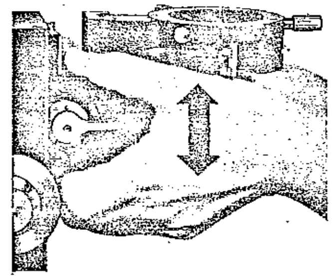
With the clamping lever in center position, where it lightly engages, the carrier can be vertically shifted. Before mounting the stage support, lower the condenser carrier **into its lowest possible position . . .**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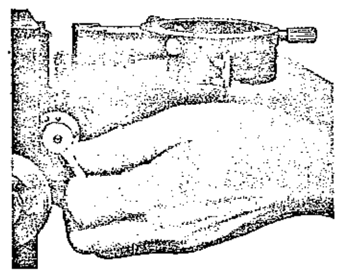
. . . and clamp by operating the clamping lever.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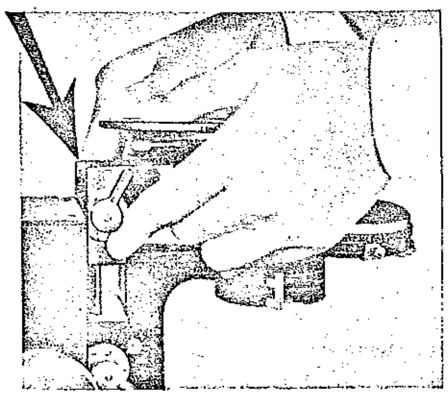
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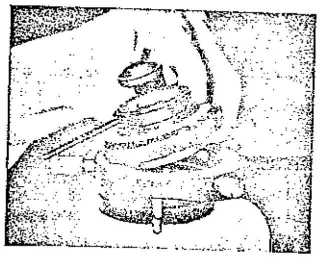
After mounting the condenser carrier, insert the stage support from above in such a manner that first the lower part of its right guide rib, then the spring bolt on the left side, and finally the upper part of the guide rib (arrow) engage at the rear of the changing rail.



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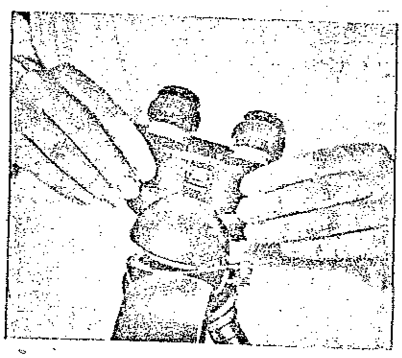
To insert the condenser, tilt it slightly and press the spring bolt on the condenser carrier outward with the tapered condenser retaining ring. Place the condenser on the bearing surface and rotate it until the spring bolt engages in the retaining ring notch. Finally move the condenser by the pinion to its extreme upper position.

9

The revolving nosepiece on slide is attached to the stand head (8 in fig. 1) in such a way that first only the rail, on which the clamping screw is seated, rests about ²/₃ parallel in the guide. Then the other guide rail is swung to the stand, the revolving nosepiece on slide is drawn in both guides in the direction of the tube support (3) up to its stop, and then tightened firmly with the clamping screw.



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To mount the tube tilt it slightly and push the spring bolt back with the dovetail ring until the tube can be properly inserted. Then lock the spring bolt with the aid of the clamp screw on the tube.

Stages

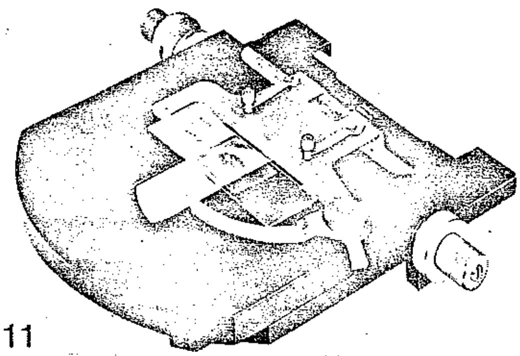
Several stages are available for the STANDARD microscope. While in the STANDARD GFL the stage is permanently mounted, in the STANDARD WL the stage can be exchanged.

STANDARD GFL:

Large rectangular mechanical stage
Circular rotating and centering gliding stage
Fixed rectangular stage

STANDARD WL:

Circular rotating and centering mechanical stage
Circular rotating and centering gliding stage
Fixed rectangular stage



11

Large Rectangular Mechanical Stage (fig. 11)

When used on the STANDARD GFL it has a range of motion of 50×75 mm. On the STANDARD WL the range of motion is limited to 27×75 mm.

Auxiliary scales make it possible to relocate any desired point on the specimen. The two verniers guarantee an accuracy of $^{1}/_{10}$ mm.

On the graduated drum the black numbers (0–35) are valid for the first complete turn (longitudinal displacement). For the next turn, a red mark appears at the opening in the metal cover near the graduated drum and the red marks (35–55) are then valid.

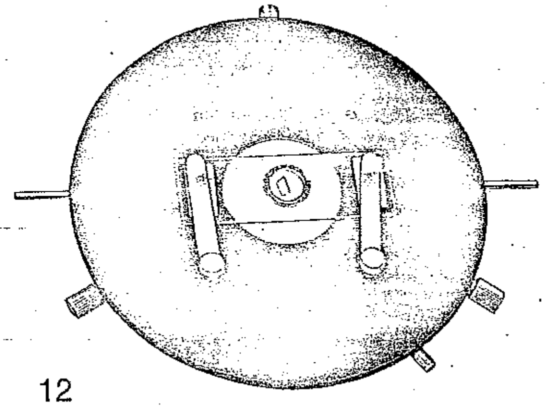
The transverse displacement can be read off from a vernier at the window in the specimen holder. These values are always greater than those on the drum, so that errors are eliminated. A typical pair of readings for a specimen's position might be 40.3/104.2. Such notations are best made on the label of the specimen.

The longitudinal movement of the stage can be either loosened or tightened with the screw beneath the control knobs on the right in fig. 11.

To clean the stage the specimen holder can be removed after moving two toggles. A dish holder (Cat. No. 47 33 85) can also be put in place of the specimen holder, and its adjustable jaws will hold dishes with a diameter of up to 105 mm.

In addition, a staining slide (Cat. No. 47 33 86) can be attached instead of the specimen holder. This glass plate can be displaced over the mechanical stage like the specimen holder. It is recommended for a microscopic control of staining procedures as well as for all examinations where there is danger of liquids dropping down.

For the use of slides of unusual dimensions, the specimen holder can be removed after loosening two screws, and replaced by an adjustable specimen holder (47 33 87). This adjustable holder is designed for specimens up to a width of 110 mm.

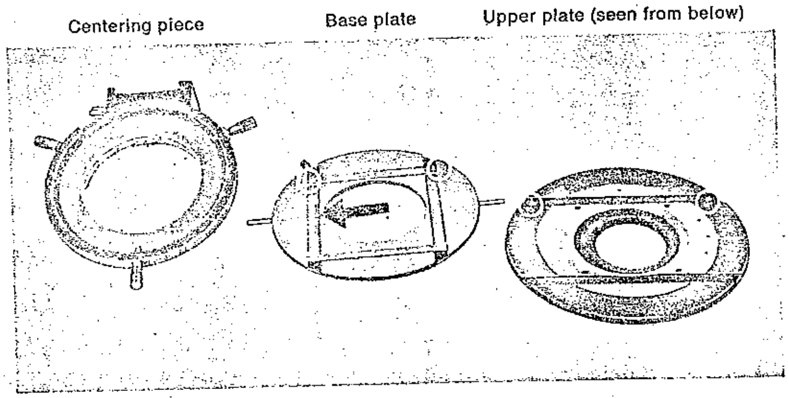


12

Circular Rotating and Centering Gliding Stage (fig. 12)

With the upper plate of this stage the specimen can be reliably adjusted at all magnifications. For this purpose the upper plate has to be brought into contact with the base plate and the guide frame (fig. 13) by a film of oil. Suitable oil (10 cm³, Cat. No. 47 33 91) is supplied with the stage.

The upper part of the base plate has two handles which permit rotating it on a ball bearing. The entire base plate can be shifted around the axis of rotation in a centering piece by means of two screws. The rotary motion can be arrested by a set screw.



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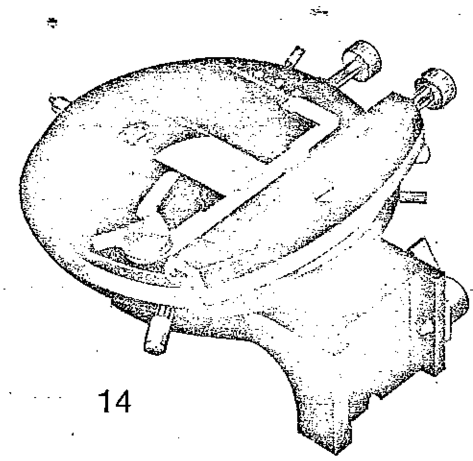
In order to preserve the gliding properties of the stage, and to ensure proper functioning at all magnifications, it should be regreased about twice a year.

For greasing, the stage is lifted out of its centering piece. For this, loosen the centering screws and press the stage by the two handles of its base plate against the spring thus released and then lift up. Both, upper plate and base plate are now hold in the hand. The upper plate is now pushed in one direction to the stop, again perpendicularly to the line connecting the two handles, and released from the base plate. At this point note the position of the guide frame, to avoid mistakes in reassembling.

The gliding surfaces of both plates should be well cleaned with xylol. When they are completely dry, the gliding surface of the upper plate is covered with a very thin film of lubricant, applied with the finger. Too little of it is better than too much. After also rubbing the grooves of the guide frame with lubricant, best done with a small bristle brush, the two plates can be reassembled. In lubricating, special attention should be given to the spots marked in fig. 13. After assembly, the two plates should be rubbed against each other for a while so that the lubricant is well distributed.

The stiffer the movement of the stage, the better the gliding action, especially at high magnifications. However, this stiffness of movement should not exceed a certain extent. Finally the stage is remounted on its centering piece. It is advisable to center the stage approximately, so that the specimen will not disappear from the field of view when the stage is turned.



14

Circular Rotating and Centering Mechanical Stage (fig. 14)

Like the gliding stage, this stage (range of traverse motion 50×75 mm) can be centered relative to the optical axis in a centering piece by means of two screws. As an aid for this purpose we supply a centering cross.

To center the axis of rotation, place the centering cross on the stage true to side, and set the coordinates of the stage to the values indicated on the centering cross. The microscope is then focused on the centering cross with a low-power objective, and it is moved to the center of the field of view with the required accuracy by means of the centering screws of the stage.

Since usually no eyepiece crosshairs is furnished, the center of the field of view can be marked by the centered, closed luminous field stop (fig. 18 C). The same procedure is then repeated with high-power objectives. For good visibility of the centering cross, we recommend closing the aperture diaphragm as far as possible.

As in the case of the rectangular mechanical stage, auxiliary scales permit any desired point on the specimen to be easily relocated.

Focusing Adjustment

The coarse adjustment (5 in fig. 1) of the STANDARD WL acts upon the stage (11), that of the STANDARD GFL on the tube support (3).

A knurled ring is secured to one end of the coarse adjustment shaft. It is used to control this adjustment motion. If the knurled ring is turned in the direction of the arrow on the flange to „Fest", the coarse adjustment is tightened, if the ring is turned in the opposite direction the movement is eased.

Usually this knurled ring can be held together with the coarse adjustment knob (5 in fig. 1) and be turned to the correct setting. Should it be tightened too firmly, apply the pin in one of its holes as a lever. The knurled ring should neither be tightened too firmly nor adjusted too loosely.

The fine adjustment (6 in fig. 1) acts upon the stage (11). Its total range of motion is 2 mm. The fine adjustment should be kept in the center between the two limiting stops. This range is marked by white lines on the side of the rack and pinion box where the coarse adjustment brake is located. A graduation interval for fine adjustment corresponds to a lift of approx. 2 μ (= 0.002 mm).

The friction of the fine adjustment can be varied. If the stage slides down under its own weight, so that the image is thrown out of focus, it is only necessary to turn the fine adjustment knobs slightly against each other.

Objectives

(10 in fig. 1)

The scale numbers on our objectives are terms of a series and differ from each other by the factor 1.6. Each objective bears a scale number. In addition, the objective is fitted with a colored ring different for each scale number. This ring is clearly visible from all sides. Objective 10 has a yellow ring, 16 a light green one, 40 a light blue one, etc.

The figure behind the scale number (e. g. 40/0.65) indicates the appropriate numerical aperture of the objective and is thus a measure for its resolving power. If the total magnification is between 500 to 1000 times of this value, all details of the specimen resolved by the objective can be observed in the microscope. Exceeding these limits by use of too strongly magnifying eyepieces will result in empty magnifications and not reveal additional information on the specimen.

Our objectives are corrected for a mechanical tube length of 160 mm. Objectives marked 0.17 guarantee optimum image quality when the cover glass thickness is 0.17 mm.

The objectives are parfocalized in such a manner that the image remains visible after changing the objective (9 in fig. 1). To obtain optimal focus, the slow motion requires only minor readjusting. All objectives are adequately protected. For this purpose, the high-power systems with shorter working distances are installed in spring-loaded mounts. Oil immersion objectives can be locked in the upper position by turning their mounts clockwise. After applying the immersion liquid and lowering the objective mount into the observing position, the image appears in the microscope.

With regard to image quality, our immersion objectives should be used with non-resinifying and non-fluorescing oil ($n_D = 1.515$) supplied in a 15 cm^3 burette (Cat. No. 46 29 58). In addition, there are burettes available containing 50 cm^3 of immersion oil (Cat. No. 46 29 51), 100 cm^3 (Cat. No. 46 29 52), 250 cm^3 (Cat. No. 46 29 53) and 500 cm^3 (Cat. No. 46 29 54).

The single nosepiece (47 31 10) features a centering device which is operated by means of two socket wrenches. This nosepiece is used for special-purpose work, such as work with the heating stage, with UD objectives, etc. In addition, it is very useful if a larger number of objectives is frequently needed or if the objectives have to be centered individually.

OPTOVAR

The OPTOVAR permits rapid change of magnification without exchange of objectives. It is installed between the tube support and the tube in such a way that the two milled disks are turned toward you. A magnification changer, with magnification factors 1×, 1.25×, 1.6× and 2×, is placed between two lenses, the latter compensating for the increased tube length. The magnification is changed by the upper milled disk. In the position "Ph" of this disk an Amici-Bertrand lens is installed. This lens, together with the eyepiece, forms an auxiliary microscope which can be focused (with the lower milled ring) on the exit pupil of the objective L" (fig. 21), where the aperture diaphragm of the condenser is also imaged. This serves to control the illumination and, in the case of phase-contrast work, the centering of the phase-contrast condenser.

Tube

(2 in fig. 1)

The screw for clamping the tube is furnished with a supplementary spring bolt. This has the advantage of preventing heavier tubes from falling down, in case the screw has not been securely tightened.

If the clamping screw is eased by only about 1/4 to 1/2 turn, the tube still cannot be removed, but it can be turned easily. This enables you to allow a second observer sitting beside you to look into the eyepiece of the microscope.

Binocular Tube

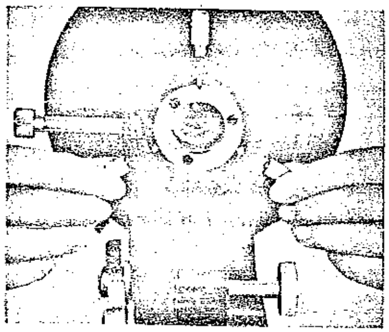
Your interpupillary distance is set on the inclined binocular tube by shifting the eyepiece sleeves with the aid of the chromium-plated knurled rings.

The distance set can be read on the scale between the two eyepiece tubes. Since the tube length is changed slightly by this method of interpupillary distance adjustment, both eyepiece tubes should be set to the value indicated on the scale. Accurate parfocalizing of all objectives with scale numbers above 2.5 is only ensured if the afore-mentioned adjustment is made.

Should the conditions of refraction differ on either the left or right side, the image is focused with the emmetropic eye. Focus is then corrected for the other eye until a distinct image is obtained for both eyes. Observing with the ametropic eye may have an adverse effect on parfocalizing, especially in the case of less powerful objectives.

Condenser

The condenser serves to illuminate the specimen with the required illuminating aperture. With higher power objectives it ensures that full use is made of their resolving power. Special condensers are available for dark-field and phase-contrast work.



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Each condenser can be centered in its carrier (fig. 15) and adjusted vertically to form the luminous field stop image by the Köhler method.

To regulate the illuminating aperture, the condenser contains an iris diaphragm (12 in fig. 1). To obtain the necessary contrast in the specimen, this **aperture diaphragm** is closed far enough so that its image in the objective aperture is never larger than the complete objective aperture in order to avoid scattered light. On the other side, the image of the diaphragm should only in exceptional cases be smaller than ²/₃ of the diameter of the objective aperture. This objective aperture can be observed either by removing the eyepiece (1) from the tube (2 in fig. 1), or with eyepiece and OPTOVAR in "Ph" position.

The condenser front lens opening of low-power objectives is not wide enough to allow full illumination of the field of view. In such cases, the front lens of some bright-field condensers is swung out.

With swung-out front lens, the condenser (aperture) diaphragm is no longer required and should, therefore, be fully opened. If also the auxiliary lens is swung out of the path of rays, the diaphragm (16 in fig. 1) will function as the aperture diaphragm.

Achromatic-aplanatic condensers incorporate a spherically and chromatically well corrected high aperture optical system. To ensure that their good **correction** is effective or to reach the high aperture of 0.95 to 1.40, the front lens of the condenser has to be connected optically with the lower side of the specimen slide by means of **immersion oil.** These condensers are not suitable for illuminating large object fields.

The correction quality of these condensers ensures that formation of the luminous field stop image is free from aberration. It is therefore possible to adhere strictly to the Köhler principle of illumination even at the largest apertures. Achromatic-aplanatic condensers can be used to advantage in exacting bright-field and phase-contrast observations, particularly with high aperture objectives. **For color photographs** only an achromatic-aplanatic condenser should be used. Non-corrected condensers can lead to color hues.

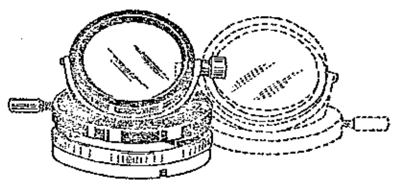
Auxiliary lenses

An auxiliary lens is contained in the light path in order to ensure that the illuminating aperture of the condenser is fully exploited.

Auxiliary lens I is used in conjunction with the built-in illuminator, while auxiliary lens II is required if a separate illuminator is employed. Lens II is identified by two white lines on its mount.

For the polarizing microscope- strain-free auxiliary lenses are supplied. These are marked by red lines.

The auxiliary lenses are accommodated in the upper filter holder of the condenser carrier (14 in Fig. 1).

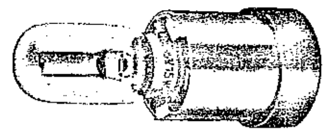


16

The swing-out **microscope mirror** (Cat. No. 46 51 07) is placed on the diaphragm insert (16 in fig. 1). With each mirror a screw is supplied which has to be inserted in the diaphragm insert instead of the screw located next to the rack and pinion box of the microscope. A slot in the mirror support serves for locking the mirror in place on the diaphragm insert.

The position of the mirror with one reflecting surface in its support can be fixed by means of two clamping screws. Thus the mirror requires no adjustment to the separate illuminator if the built-in illuminator has been used and the mirror is now to be swung into the beam path of the separate illuminator.

17



Built-in Illuminator

The low-voltage lamp 6 V 15 W (fig. 18) of high luminous density installed in the base of the microscope is connected to A. C. via a transformer. For connection to D. C. an appropriate resistor is required. The bulb centering ring serves to align the illuminator to the optical axis. The filament bulb is inserted in the lamp socket under slight pressure — red dot opposite red pin — and turned.

Finger prints should be removed from the bulb before they burn into the glass and disturb illumination. The lamp can be inserted in the microscope base, if the dot on the knurled ring is set opposite the dot on the illuminating tube (7 in fig. 1). The lamp socket can be clamped in place by turning the knurled ring.

The bulb should be protected against shock at all times, especially while in operation, since its filament is extremely sensitive.

It should illuminate as soon as the transformer is switched on. In most cases operation of the lamp at an undervoltage of 5 V will suffice. That prolongs its life. At overvoltage it should be operated for short periods only.

After removal of the housing bottom plate, the transformer can be set alternatively for 110 — 127 — 220 — 240 V. Apart from the plug-in transformer 2.5 — 3.5 — 4.5 — 5.5 — 8 V there is a regulating transformer 100 — 110 — 127 — 220 — 240 / 0 . . . 8 V, 50 . . . 60 c/s, 30 VA with voltmeter available.

Adjustment of illumination

with built-in illuminator

The Köhler method described in the following makes it possible to illuminate only the portion of the specimen to be studied – and to illuminate it perfectly evenly. Troublesome reflections and contrast-reducing flare are largely eliminated. The Köhler method thus offers optimum conditions of illumination, particularly for photomicrography.

Any light filters inserted in the diaphragm unit should be meticulously clean, since impurities are imaged together with the specimen.

1. Switch on lamp and insert neutral filter into light path. Stop down field diaphragm (16 in Fig. 1).

2. Move condenser with rack and pinion to uppermost position after having swung in condenser front lens and inserted auxiliary lens. Focus specimen with 10× or 16× objective (Fig. 18 A).

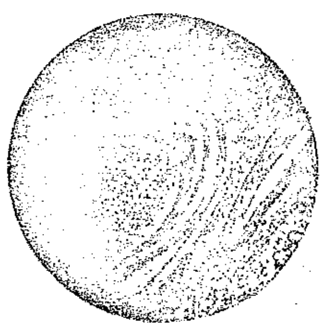
3. Lower condenser slowly, thus focusing the field diaphragm within specimen area (Fig. 18 B).

4. Operate the two centering screws of the condenser (Fig. 15) until the image of the field diaphragm is centered in relation to the field of view (Fig. 18 C). The condenser is now centered.

5. Open field diaphragm until its shadow disappears from the field of view (Fig. 18 D). If the field of view is then still illuminated unevenly, displace lamp socket slightly in axial direction and clamp it again.

6. Swing in viewing objective (9 in Fig. 1). The field diaphragm should always be adjusted so that its image just disappears behind the edge of the eyepiece stop. At the same time, check the adjustment of the condenser and, if necessary, correct it.

A Field stop, blurred



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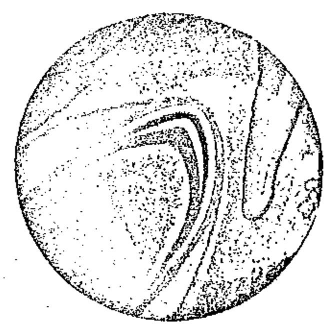
B Field stop, sharp



For work with low-power objectives, see page 12, right-hand column.

When immersion objectives are used for observation, open the field diaphragm further than would normally be necessary by the rules of the Köhler method, in order to allow for condenser aberration. This is, however, unnecessary when the well-corrected achromatic-aplanatic condensers are employed.

7. **Adjust image contrast** and, if necessary, sharpness – but not image brightness – with the condenser (aperture) stop. For this purpose, open up this stop entirely and then close it down just far enough to remove glare from the important portions of the specimen.

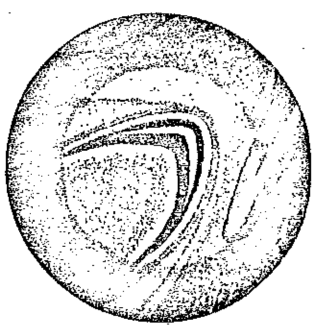
Check: Remove the eyepiece and view the image of the aperture stop in the objective opening with the naked eye or with the eyepiece and the OPTOVAR set to "Ph". Only in exceptional cases should the stop image be smaller than about $^2/_3$ of the diameter of the objective opening. On the other hand, it should never be larger than the entire objective opening, since otherwise stray light will appear. Under no circumstances should the brightness of the microscope image be controlled by means of the aperture stop. This can be done by varying the lamp voltage or inserting gray filters in the light path.

Adjustment of illumination with mirror

If the specimen is illuminated by another illuminator via the mirror, the first step consists in checking the centering of the condenser. The diaphragm in the diaphragm insert (16 in Fig. 1 / field diaphragm) lies on the optical axis of the objective. Focus the specimen with the aid of the built-in illuminator and center the condenser by adjusting the field stop image centrally in relation to the field of view. Once this has been done, the position of the centering screws on the condenser carrier must not be changed. During subsequent illumination with the separate illuminator, the field stop image must be centered within the field of view exclusively by moving the mirror.

When the mirror is used, auxiliary lens I must be replaced by auxiliary lens II. The exact adjustment of the microscope image is described in detail in the operating instructions G 40–340 for multi-purpose microscope illuminators.

C Field stop, centered



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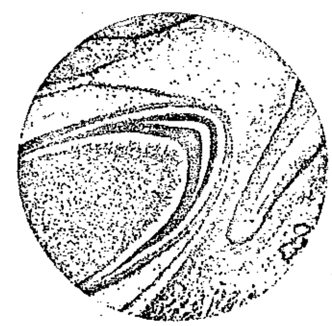
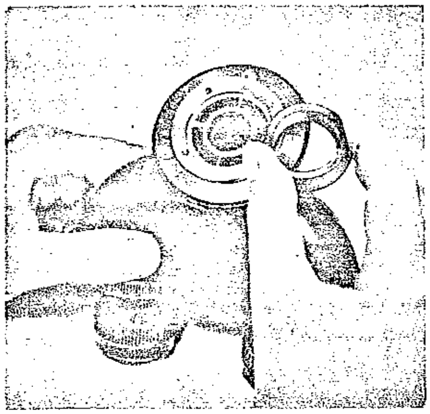
D Field stop, open





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Correct orientation of analyzer

Simple polarizing equipment

(49 36 00)

For simple observations of medium to strongly refracting specimens with polarized light and for qualitative work such as determination of birefringence, the simple polarizing equipment is entirely sufficient. It consists of a polarizer, an analyzer and a quartz plate first-order red. A rotary stage is, however, indispensable even for simple polarizing work.

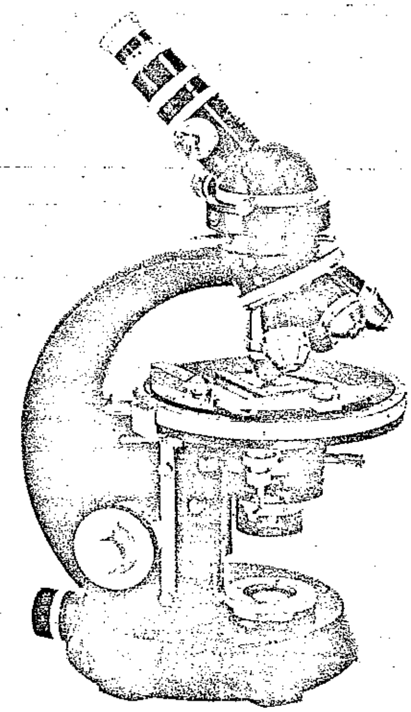
A polarizing filter (47 36 00) serving as polarizer is placed in the lower swing-out filter holder of the condenser carrier. The two white marks on the filter mount indicate the vibration direction and should be parallel to the handle on the filter holder (east-west orientation of vibration direction).

The analyzer (47 36 51) is screwed from below into the tube in front of the deviating prism with the wrench supplied for this purpose and oriented as shown in Fig. 19. With the tube in position, the vibration direction of the analyzer, which is likewise marked by white indices, should then run from north to south, i. e. perpendicular to that of the polarizer. Exact crossed position of polarizer and analyzer is checked by the darkness of the field and obtained by careful, slight rotation of the polarizer or the tube. Only birefringent elements will then light up when the stage is rotated.

The quartz plate first-order red (47 37 01) is generally used to determine the fast and slow axes of a birefringent specimen. It is placed on the polarizer in the lower filter holder so that the white line is on its mount parallel to the white marks of the polarizer. It has two mutually perpendicular vibration directions in which the light passes at different speeds. These two vibration directions make a 45° angle with the vibration directions of polarizer and analyzer. The direction marked γ on the mount indicates the plane of vibration of the light passing at a lower speed.

In "plus position", the interference color of the specimen is 550 nm higher (quartz plate first-order red), e. g. blue. The vibration plane of the slower wave train in the specimen is then parallel to the γ direction of the quartz plate. In "minus position", the interference color is thus 550 nm lower, e. g. yellow (vibration direction of the faster wave train parallel to the γ direction).

On request, the interference color chart according to Michel-Lévy enclosed with the reprint S 40—554 will be supplied.



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STANDARD GFL and WL polarizing microscopes

With the exception of adapters, all aids and accessories for polarized-light microscopy are the same as for our other polarizing microscopes. Therefore the operating instructions G 40–540 on polarizing equipment for microscopes are also applicable here.

The STANDARD GFL must already be supplied as a **polarizing** microscope because its stage is permanently mounted, wheras every STANDARD WL can be used as a polarizing microscope if it is provided with the required accessories.

These accessories are: polarizer (POL condenser carrier), revolving polarizing stage, analyzer (in intermediate tube), polarizing tube with Bertrand lens or POL inclined binocular tube.

Polarizer and analyzer as well as the tube, which in this case has grooves for oriented insertion of a crosshairs eyepiece, must be oriented in relation to each other. This can only be achieved by special adjustment.

In addition, all optical elements located between polarizer and analyzer (condenser, auxiliary lens, objective) must be strain-free. Since strain-free optical elements cannot be obtained by normal mass production methods, it is indispensable to use specially made strain-free condensers and objectives. These components are engraved in red and marked with the letters "POL". For quantitative work with polarized light, the condenser type 1.3 Z POL (46 52 63) should be used.

Care and Handling of the Instrument

The STANDARD Microscope is a precision instrument. Appropriate handling will ensure safe functioning and continuous readiness for use.

Dust will reduce the performance of the instrument. The tube openings should therefore be adequately protected from dust by eyepieces or protection caps. When not in use, the instrument should be covered with a plexiglass hood or a soft plastic cover, unless it is kept in the microscope case.

The cleaning of the instrument should be restricted to the exterior surfaces. Dust is removed from all optical parts with a brush degreased in ether. More adhesive pollutions are removed with a soft linen cloth (not leather) which is free from dust. This cloth may be moistened slightly with benzine or xylol, but **in no case** with alcohol (methylated spirit).

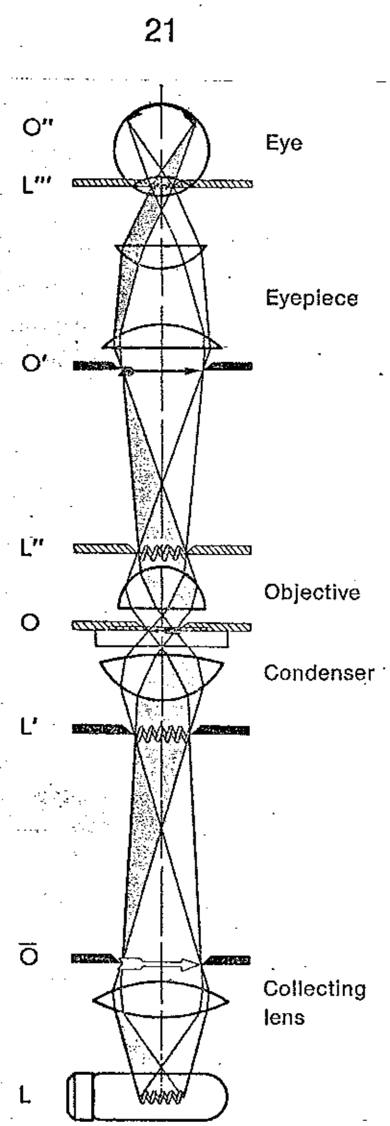
During cleaning, solvents should **never** enter guideways which obtain their gliding properties from a film of grease. Solvents would deteriorate this film and ruin the smooth working of the guideways. In order to avoid unnecessary repair costs, gliding surfaces and drive mechanisms should only be greased and oiled by expert mechanics.

If immersion oil has been used, it should be thoroughly removed from all optical and mechanical parts immediately after work has been finished. This is done with a linen cloth or with rice paper which we shall be glad to supply on request (Cat. No. 46 29 75). If our immersion oil has been used, careful wiping off will suffice. Solvents should, in that case, be used only occasionally.

In case of difficulties, which cannot be overcome by following the information given in the operating instructions, please contact the representatives in your territory who will be glad to be of assistance to you.

Path of Rays

when illuminating the specimen by Köhler's Method



Imaging the light source
(colored light path in fig. 21)

The collector images the light source L in the front focal plane L' of the condenser, the entrance pupil of the microscope. The condenser (aperture) diaphragm is in this plane. The condenser is adjusted vertically until the rays coming from its focal point are directed telecentrically to the object plane O.

The objective then collects the rays in its rear focal plane L'', the exit pupil of the objective. An additional image of the light source is formed in the plane L''', the exit pupil of the microscope.

Imaging the specimen
(grey light path in fig. 21)

The object in the plane O is imaged in the plane O' through the objective. In O' it forms an intermediate real image, reproducible on a ground-glass plate. In this plane the field diaphragm (if necessary, an eyepiece micrometer) is also brought to a focus. It appears in the eyepiece, together with the specimen, as if it were enlarged by a magnifier. Through the lens of the observer's eye the image O'' is reproduced on his retina.

Tracing the rays backwards from the object plane O, they meet again in the plane Ō. The luminous field stop, which is located in this plane, is thus conjoined with the object plane. They are sharply imaged simultaneously.

The illustrations are not binding in every deta or design of the instruments.

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