



JENAPHOT 2000

Reflected-light Photomicroscope

Operating instructions

55550

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D. Cautionary instructions

Caution! Before using the instrument, read the following instructions!

1. This instrument has been designed and tested acc. to IEC Publication 348 - Safety requirements for electronic measuring instruments -, and has been delivered in a safe condition. The Operating Instructions in hand contain information and warnings to be followed by the operator.
2. The JENAPHOT-2000 Reflected-Light Photomicroscope is a state-of-the-art light microscope for visual, photographic and video investigation of mainly metallo-graphic objects. The instrument should be used only for the operations and applications described in this manual. Any other application (also that of individual subassemblies not provided for by the manufacturer) represent a misuse of the instrument which we are not liable for.
3. When changing the location of the microscope, take care that in transport or setting up the bottom cover plate is not damaged and thus the electrical components in the microscope base remain covered.
4. The microscope is not specially protected against specimens of caustic, toxic radioactive or any other effects detrimental to health.
5. Before switching the instrument on, make sure that the instrument is set to the local mains voltage. The factory-set voltage is marked by a square sticker.
6. The microscope is an instrument of Safety Class 1. Connect the mains cable to a socket with protective wire only. The protective effect should not be neutralized by the use of extension cords without protective

wire. Any interruption of the protective wire inside or outside the instrument, or any disconnection of the protective earth connection may cause dangers to the operator. Deliberate disconnection is not allowed.

7. When the instrument is connected to mains, connecting terminals may carry dangerous voltages. Thus, opening of covers or removal of components (unless functionally necessary) might make such live elements accessible. Disconnect the instrument from all voltage supplies before opening it for adjustment, parts exchange, maintenance or repair. If adjustment, maintenance or repair operations on the powered instrument are unavoidable, they should be carried out by a specialist who knows about any involved dangers.

Exception: In operating condition, the cover of the 12V 100W lamp unit may be removed for lamp centring. When doing so, take care to avoid dazzling of the eyes.

8. Do not neutralize the effect of ventilation slots of lamps, power supplies and control consoles by covering them. Take care that tools, objects and liquids do not enter the instrument through ventilation slots and other openings of the instrument.
9. Make sure that spare fuses comply with the prescribed rating and design. The use of makeshift fuses as well as shorting of fuse holders are not allowed.
10. If the protection of the instrument should be reduced, take it out of operation and secure it against unintentional operation. Return the microscope to the manufacturer.
11. To avoid dazzling of eyes when using the JENAPHOT-2000 keep an attenuation filter (included in the outfit) in the light path, or when changing the illumination

method (e.g. dark field/bright field) bring it into the light path. It should be removed from the light path only if the light intensity is too low.

12. When working with the large format camera, take the spring tension of the diffusion screen holders into account. Do not put your hand between screen and instrument!
13. When actuating the free lift mechanism of the revolving nosepiece the distance between nosepiece and solid support becomes less than 1 cm.
14. The instrument is not designed for continuous operation without supervision.

1. Description

The JENAPHOT-2000 is an inverted-type reflected-light photomicroscope of high performance and universal applications. Its compact construction as a bench-top instrument with integral electrical system (Fig. 1) permits space-saving and efficient use. Modern ergonomic requirements are met to a high extent by the use of optionally adjustable arm rests (Fig. 2/3 and 17) containing clear control panels for the electronics (Figs. 5 and 6), a tilting binocular head (2/6) for viewing height adjustment, and controls arranged within reach. The motorized objective change provides the microscopist with an operational comfort which has never been available before for a microscope of this class. This facility permits a riskless change of objectives independent of the objective's working distance.

The modular construction of the JENAPHOT-2000 allows for a quick method change and facilitates the attachment of accessories to the basic unit.

The photomicrographic system is designed for the use of all customary photo formats and materials of traditional and instant-print photography. The integrated auto-exposure system is effective for both the large format camera with international camera back and the 35 mm camera. Besides, it can be employed for the MF-AKS AUTOMATIC-2 photomicrographic accessory at the universal port of the microscope. Commercial 35 mm cameras can be connected via I2 mount.

Frequently used accessories are clearly and handily arranged in accessory boxes.

1.1. Optics

Scheme 1 shows the optical diagram of the JENAPHOT-2000. The connectable lamp units (12V 100W halogen lamp, XBO-150 xenon high-pressure lamp) are provided with reflectors for an efficient utilization of lamp radiation.

The light path through the illuminator is shown for bright field illumination after the Koehler principle. In dark field,

a deflector/annular mirror assembly serves for illumination of object fields. The used wide-field B/D planachromatic and planapochromatic objectives provide an effective intermediate image plane diameter of 32 mm.

Additionally, Scheme 1 shows the deflectors for the 4 microscope ports (viewing, large-format and 35 mm camera, universal port) which have parfocal image planes. Thus, image focussing for photomicrographs can be done while looking through the binocular head. Magnification change (tube lens systems of 0.8X, 1.0X, 1.25X, 1.5X, 2.0X) and projection eyepiece change (2:1, 3.2:1) are indicated on the diagram, also the light path to the photo sensor of the auto-exposure system.

The JENAPHOT-2000 has a common intermediate image for visual observation and both camera ports. Thus, reticles located in the counting and comparing module can both be viewed through the eyepieces and recorded photographically.

Microscopic objects can also be viewed on a Fresnel lens screen which can be connected to the large-format camera port.

1.2. Electrical/electronic system

Scheme 2 shows design and arrangement of the electrical/electronic system of the JENAPHOT-2000 in a simplified way. The power supply for 12V 100W lamp (2/11), motorized objective change and automatic exposure system are accommodated in the power supply module (7/102) at the rear side of the instrument, while logic and control circuits as well as control panels (Figs. 5 and 6) are combined with the arm rests.

Drive, control and sensor elements for motorized objective change and automatic exposure are arranged at the revolving nosepiece and its guide, as well as in the light path to the camera ports of the microscope.

Mains cable (7/98) with safety plug, mains key (7/101) as well as connectors (7/97, 7/100, 7/109) for 12V 100W lamp and electronics in the arm rests are located at the rear side of the JENAPHOT-2000. There, also fuses F1/F2 (7/99) and 5 green LED indicators are mounted which signalize the availability of the

necessary operating voltages.

A sixth LED (red) indicates the status of a logically activated electronic fuse for the motorized objective change. When this LED is off, it is sufficient to switch the unit off and then on again immediately to activate the respective operating voltage.

When mounting accessories of the MF-AKS 24x36 AUTOMATIC-2 photomicrographic system (35 mm format), they can also be controlled via the JENAPHOT-2000 automatic exposure system. The required connectors (5/65, 5/67) are arranged at the rear side of the control panel of the auto-exposure device (Fig. 5).

1.3. Specification

Instrument size	width x depth x height 200mm x 552mm x 354mm
Weight	42 kg
Power requirements	100V, 110V, 127V, 220V, 240V (factory-set)
Permissible line voltage fluctuations	-15%...+10% at 100V: $\pm 10V$
Line frequency	50 Hz, 60 Hz
Power consumption	180 VA
Environmental data	+10/+35/30/75 001.0 after TGL 9200/03 (GDR standard)
Electric safety	The JENAPHOT-2000 and its accessories comply with the electric precautions acc. to TGL 14283/07 and IEC Publication 348. They meet the safety standards acc. to ASVO 3 (1), (2) and belong to Safety Class 1 (m.p.e.) acc. to TGL 21366. Continuous operation of the instrument without supervision is not permissible.
12V 100W lamp unit	
Light source	Halogen lamp HLW 12V 100W S5A

Continuous lamp voltage adjustment with display

- | | |
|--------------------|---------------------|
| 1. LED \geq 6.0V | 4. LED \geq 8.5V |
| 2. LED \geq 6.5V | 5. LED \geq 9.5V |
| 3. LED \geq 7.5V | 6. LED \geq 10.5V |
| | 7. LED \geq 11.5V |

Power supply of HLW 12V 100W lamp limited to 12V by stop at lamp voltage control (6/86).

Specimen focussing range

Coarse focus control
Fine focus control

4 mm
4 mm (i.e. throughout range of coarse focus) with scale reading to 1 μ m

Stage load capacity

50mm x 30mm mechanical stage

\leq 5 kg sample weight

50mm x 30mm X/Y motion range with position-reading vernier scale and 90° rotation facility

Stage inserts

Outside diameter 56 mm:
10, 20, 27mm inside dia.
Outside diameter 132mm:
40, 50, 70mm inside dia.

Magnification change

0.8X, 1.0X, 1.25X, 1.5X, 2.0X
tube lenses

Objectives and eyepieces

Type of objective		free working distance (mm) minimum value
GF-PA-HD	3.2X/0.06 ∞ /-A	3.1
GF-PA-HD	6.3X/0.12 ∞ /-A DIK	3.1
GF-PA-HD	12.5X/0.25 ∞ /-A DIK	2.5
GF-PApo-HD	25X/0.60 ∞ /0-A DIK	1.0
GF-PApo-HD	50X/0.90 ∞ /0-A DIK	0.3
GF-PApo-HD	100X/0.90 ∞ /0-A DIK	0.8
Additional objectives		
GF-PApo-HD-HI	100X/1.30 ∞ /0-A	0.1
GF-PA	7.5X/0.15 ∞ /-A	16.0
Eyepieces		
GF-Pw	10X (25) ∞	
Designations		
GF	wide field	
PA	planachromat	
PApo	planapochromat	
HD	bright/dark field (B/D)	
HI	homogeneous immersion	
A	systems with corrected chromatic magnification difference	
Pw	eyepiece with 30 mm plug-in diameter	
DIK	suitable for differential interference contrast (DIC)	

Projection eyepieces 3.2:1, 2:1
Magnification range through binocular head 25X...2000X

Objectives	Magnification changer set to				
	0.8X	1.0X	1.25X	1.5X	2.0X
3.2X	25	32	40	48	63
6.3X	50	63	80	94.5	125
7.5X	60	75	94	112.5	150
12.5X	100	125	160	187.5	250
25X	200	250	320	375	500
50X	400	500	630	750	1000
100X	800	1000	1250	1500	2000

Photographic 16:1...2000:1 (large format camera)
Image scales 5:1... 630:1 (35 mm camera)

Image scales at TV adapter JP 1.6:1...125:1

Image scales of large format camera

Objectives	Projection eyepieces	Magnification changer set to				
		0.8X	1.0X	1.25X	1.5X	2.0X
3.2X	2:1	16:1	20:1	25:1	30:1	40:1
	3.2:1	25:1	32:1	40:1	48:1	63:1
6.3X	2:1	32:1	40:1	50:1	60:1	80:1
	3.2:1	50:1	63:1	80:1	94.5:1	125:1
7.5X	2:1	37.5:1	47:1	60:1	71:1	94:1
	3.2:1	60:1	75:1	94:1	112.5:1	150:1
12.5X	2:1	63:1	80:1	100:1	120:1	160:1
	3.2:1	100:1	125:1	160:1	187.5:1	250:1
25X	2:1	125:1	160:1	200:1	240:1	320:1
	3.2:1	200:1	250:1	320:1	375:1	500:1
50X	2:1	250:1	320:1	400:1	480:1	630:1
	3.2:1	400:1	500:1	630:1	750:1	1000:1
100X	2:1	500:1	630:1	800:1	945:1	1250:1
	3.2:1	800:1	1000:1	1250:1	1500:1	2000:1

Photo formats

9cm x 12cm
Formats of cassettes and film holders attachable to the international camera back
24mm x 36mm (35)
6cm x 6cm

2. Setting up and starting the instrument

2.1. Unpacking

After removing the instrument from the transport container loosen the red-marked transportation locks. The following units are locked in position:

- Revolving nosepiece (2 transportation locks)
- Fine- and coarse-focus controls
- Controls of the stand.

Note! Do not operate fine and coarse focus controls before having removed the transportation locks.

2.2. Setting up and connecting the instrument

- Fix the 12V 100W lamp (2/11) to quick-lock mount (3/21) at the rear of the stand and connect it to connector (7/97) of the power supply.
- After loosening the clamp screw (3/28) by means of special wrench B-2 (9/152) remove the filter turret (3/22). Take the circlip rings out of the filter turret apertures. Provide the turret with light filters of 32 mm dia.. Secure filters by means of circlip rings.
- Loosen centring screws (4/46) of stage carrier (4/43). Introduce mechanical stage (2/10) into stage carrier so that the cone of the counterpressure spring (centring motion) in the stage carrier fits into the notch of the specimen stage. Tighten centring screws (4/46) until they engage. Screw handles (4/45) in.
- Arrange arm rest with control panel for auto-exposure device (2/3) at the left side of the stand. Establish plug-and socket connection (7/109).
- Arrange arm rest with control panel for motorized objective change (2/17) and 12V 100W lamp at the right side of the stand. Make plug-and-socket connection (7/100).

Note: Connect or disconnect the cables between arm rests and stand only with the mains switch being in OFF-position.

- Lower revolving nosepiece (3/25) by actuating coarse focus control (2/15).
- Screw objectives (8/144) into the apertures of the revolving nosepiece.

Aperture 1 : GF-PA-HD 3.2X/0.06 ∞/-A or
GF-PApo-HD 100X/0.90 ∞/0-A DIK

Aperture 2 : GF-PA-HD 6.3X/0.12 ∞/-A DIK

Aperture 3 : GF-PA-HD 12.5X/0.25 ∞/-A DIK

Aperture 4 : GF-PApo-HD 25X/0.60 ∞/0-A DIK

Aperture 5 : GF-PApo-HD 50X/0.90 ∞/0-A DIK

- Insert binocular head (2/6) into quick-lock mount of stand, and clamp it in position by means of special wrench B-2 (9/152).

Insert eyepieces GF Pw 10X(25) 60° (2/7) into eyepiece sockets.

- Remove dust-protective slide plug (9/165) from dovetail guideway (4/47) on top of the illuminator (4/48) (loosen clamp before!). Push dark field module (8/124) in up to stop. Push framing graticule module (8/130) in up to stop.

- Connect mains cable (7/98) to safety socket.

Note! Check, if the mains voltage corresponds to the value marked on the rating plate of the rear panel!

2.3. Starting the instrument

- Switch the instrument on by pressing mains key (7/101).
- Set selector wheel (4/41) to position "HF" (bright field).

2.3.1. Motorized revolving nosepiece

After switching on the instrument the objective in aperture 2 is brought into working position, LED indicator 2 (6/87) is lighting. Actuate coarse and fine focus controls to focus the object.

The motorized objective change is effected as follows:

- Press key (6/88) of the objective to be switched in.
- The revolving nosepiece is lowering by about 3 mm, LED indicator ▲ (6/82) is lighting.
- The objective selected moves into detent position on the shortest way possible.
- The revolving nosepiece is raising, the LED indicator ▲ (6/82) being extinguished. The LED indicator of the objective in use is lighting.
- Refocus by actuating fine-focus control (2/14) of the stand.

Exchanging the objectives is possible

- by taking the stage inserts out and screwing, from top, the objective just in working position in or out
- by lowering the revolving nosepiece via key ▼ (6/81) and screwing the objectives in or out from the side.

The manual change of the objectives is feasible at any operational state:

- Lower revolving nosepiece (3/25) by means of coarse-focus control (2/15).
- Turn the revolving nosepiece by hand up to the detent position of the respective objective.
- Focus the object.

2.3.2. Centring the 12V 100W light source

The light source is factory-centred. Fine centring is done by means of the adjustment insert (9/160) which is used for imaging both the light source and the aperture diaphragm onto the viewing screen (2/4) of the large-format camera (2/5):

- Set magnification changer to 0.8X and projection eyepiece selector to 2:1.
- Open field diaphragm (3/24).
- Remove stage inserts from mechanical stage.
- Exchange one of the objectives for the adjustment insert (9/160), which must be screwed in from top through the stage.

- Switch the light path to the large-format camera.
 - Open the shutter by pressing key **U** (5/70) of auto-exposure device (LED indicator **Q** is lighting).
 - Remove any filters from the light path.
 - The filament image and its mirror image as well as the aperture diaphragm image appear on the screen of the large-format camera.
 - Centre the aperture diaphragm (3/23) and open it.
 - Actuate adjusting screws (7/104) until the filament image is concentric to the diaphragm aperture.
 - Critically focus onto filament image by means of the lamp focussing control (7/106).
 - Actuate adjusting screws (7/107) at mirror (7/105) of 12V 100W lamp to adjust the mirror image of the filament until the real filament image and its mirror image lie in each other and represent a homogeneous luminous area.
 - In the event of the mirror image of the lamp filament being not sharply depicted readjust mirror (7/103) by displacing the mirror system accordingly after loosening screw (7/105).
- Note: Do not switch the instrument on or off with the adjustment insert being screwed into the nosepiece!

The lamp voltage is controlled via the control panel of the arm rest (6/85). Voltages from 6V to 12V are infinitely variable. The lamp voltage can be read on the LED display (6/83).

2.3.3. Centring the mechanical stage

The 50mm x 30mm stage should be centred only if required by the microscopic examination method applied.

- Put the microscope into operation.
- Push framing graticule module (8/130) to use position. Put cross-hair slide (8/147) or an object onto the stage.

- Move mechanical stage to zero position (marked by **V** or **A** at vernier 3/26).
- Focus objective GF-PA-HD 6.3X/0.12 oo/-A DIK onto cross-hair slide (8/147) or the object, and make centre of this slide or a striking object spot (setting point) coincide with centre of framing graticule (=image centre).
- Loosen rotation lock (4/44) of mechanical stage and turn the stage by means of the handles (4/45) until the maximum distance of the setting point from the framing graticule centre has been reached.
- Then move setting point by half the distance towards the framing graticule centre by actuating X-Y stage controls (2/12), and make it coincide with framing graticule centre by actuating centring screws (4/46) of stage carrier with the aid of the square socket wrenches 3/65 (9/151).
- Repeat this centring procedure until the setting point remains in coincidence with the image centre when rotating the mechanical stage.

3. Illumination and contrasting methods of the JENAPHOT-2000

- Put instrument into operation.
- Set light path selector (4/40) to position **Q**.
- Set rod (4/39) to position **E**.

3.1. Bright field

- Set knurled wheel (4/41) to position "HF" (bright field).
- Place light or attenuation filter into light path by turning the filter turret (3/22) accordingly.
- Focus onto object at a low magnification (e.g. 6.3X/0.12 objective).
- Centre field diaphragm (3/24) and open it until it just falls out of the visual field.

- Remove an eyepiece (2/7), centre aperture diaphragm (3/23) now visible in the eyepiece socket.
- Adjust aperture diaphragm to about 2/3 of the diameter of the objective pupil.
- Adapt magnification to requirements by objective change and/or magnification changer (4/49).

Note: For the adjustment of field and aperture diaphragm it is recommended to use a highly reflective object (surface mirror, non-etched section).

3.2. Dark field

- Set knurled wheel (4/41) to position "DF" (dark field).
- Check, if dark field module (8/124) is attached to the illuminator (4/48).
- Remove filter from light path.
- Open aperture diaphragm (3/23) completely.

3.3. Oblique illumination

- Set bright field illumination.
- Close aperture diaphragm (3/23) to 1/3...1/2 of the pupil diameter, and decentre it until the desired image impression is obtained.

3.4. Qualitative polarization

The equipment for qualitative polarization includes

- polarizer (4/42) (mounted to HD-illuminator (4/48))
- analyzer module (8/128)
- λ -a compensator sub (8/126) for colour contrast

Operation:

- Prepare microscope for bright field illumination.
- Switch in GF-PA-HD 12.5X/0.25 oo/-A DIK objective. Set magnification changer (4/49) to position 1.0X.
- Focus isotropic object (metal mirror).

- Close aperture diaphragm (3/23) to half the diameter of the objective pupil.
- Remove filter from light path.
- Use control (4/42) to push polarizer to use position. Replace filter module (9/164) by analyzer module (8/128).
- Actuate knurled ring (8/129) of analyzer module (8/128) until the visual field is dark (max. extinction).
- Place object to be examined onto mechanical stage, and clamp it in position by means of the stage clip.
- Set the desired magnification and focus onto the object.
- Set the aperture diaphragm in relation to the size of the objective pupil acc. to the following table:

Objective	aperture diaphragm : objective pupil	
3.2X/0.06	1	: 1
6.3X/0.12	1	: 1
7.5X/0.15	1	: 1
12.5X/0.25	3	: 5
25X/0.60	1	: 4
50X/0.90	1	: 5
100X/0.90	1	: 5
100X/1.30	1	: 10

- Turn knurled wheel (8/129) to optimize the polarization (If required, use compensator λ -a sub (8/126).

3.5. Differential interference contrast equipment (NOMARSKI)

The equipment for differential interference contrast (DIK) operates on the basis of optical polarization. Two images of the object are formed which are laterally displaced by a small amount and interfere with each other.

Differential interference contrast is feasible with all JENA-PHOT-2000 objectives of a power of $\geq 6.3X$.

The differential interference contrast outfit comprises

- DIK module (8/135)
- compensator λ -a (8/125) for extending the range of colour contrast nuances.

Operation:

- Prepare microscope for bright field illumination. Bring analyzer (8/128) and polarizer (4/42) into light path with the polars being crossed (extinction). Put object onto stage and swing desired objective to use position.
- Push DIK module (8/135) up to stop into dovetail slideway (4/47). Before doing this and before pulling it out, make sure that the red dot on set-screw (8/134) is on top.
- Focus onto object plane.
- Actuate set-screw (8/133) until the visual field is dark ("quasi" dark field without relief effect).
- Actuate set-screw (8/134) to optimize the homogeneity of the illumination of the visual field.
- Actuate set-screw (8/133) to optimize the contrast.
- For obtaining further colour contrast nuances introduce compensator λ -a (8/125) into slot of analyzer module and actuate its set-screw (8/133) to vary the colour contrast.

It is recommended to carry out examinations in differential interference contrast with the magnification changer set to $\geq 1.0X$ (or $\geq 1.25X$ when using the GF-PA-HD 6.3X/0.12 oo/-A DIK objective).


Open field diaphragm only so far that it is just outside the field. This will result in an increase in contrast with increasing tube factor.

- Differential interference contrast has an azimuthal, privileged direction. Therefore, by turning the mechanical stage find that stage position where the contrast is optimal.

4. Photomicrography

The auto-exposure device of the JENAPHOT-2000, the integral large-format camera (2/5) and the T2 mount (11/185) for commercial 35 mm cameras enable photomicrographs to be taken in the sizes of 4" x 5", 9cm x 12cm, and 24mm x 36mm (35 mm). The universal port additionally provides the possibility of taking 24mm x 36mm, 6cm x 6cm, and 8" x 10" photomicrographs.

4.1. Setting the microscope

- Set selector (4/40) to position (instrument-internal light path).
- Set rod (4/39) to position  (binocular head).
- Put object onto stage. Select magnification and illumination method. Focus onto object plane..
- Push framing graticule into light path.
- Focus eyepieces of binocular head (2/6) onto double cross-hairs of framing graticule by turning setting rings (2/8) of the eyepiece sockets.
- Refocus the image by actuating the fine focus control. Since the image planes of binocular head and camera ports are parfocal, focussing of the photomicrograph has thus been accomplished.

- Select projection eyepiece (2:1 or 3.2:1) by means of push/pull rod (4/37).
- Actuate push/pull rod (2/1) to select either 35 mm or large format photographs.
- Select the image section to be recorded photographically by means of the frame patterns of the framing graticule (Fig. 13).
- Actuate push/pull rod (4/39) to switch the light from binocular head to camera ports.
- If graticule patterns shall be recorded together with the microscopic image, insert them along with the counting and comparing module (8/131).

4.2. JENAPHOT-2000 auto-exposure device

The control panel (5/68) of the auto-exposure device is combined with arm rest (2/3). On switching on the microscope the auto-exposure device is ready for operation.

If the red indicator (5/63) is lighting, automatic exposures are not possible for the following reasons:

- The light is not directed to the instrument-integrated camera ports.
- The required exposure time falls below or exceeds the working range of the auto-exposure device.

The film speed indicator band (5/64, yellow LED's) is graded in steps of one exposure value each. Increments/decrements by one step correspond to halving/doubling the exposure time. Intermediate values are displayed in steps of ISO x 1.26/+1° and ISO x 1.6/+2° by two green LED's.

Basic setting after switch-on: ISO 50/18°.

Key ◀ (5/62) - decrementing the ISO value

Key ▶ (5/61) - incrementing the ISO value

Examples: - Film ISO 400/27° (= 400 ASA/27 DIN);
LED "ISO 400/27°" (yellow) lighting

- Film ISO 80/20° (=80 ASA/20 DIN);
LED "ISO 50/18°" (yellow) and
LED "x1.6/+2°" (green) are lighting

Setting range: ISO 6/9° - ISO 5000/38°
(ASA 6-5000)
(DIN 9° - 38°)

LED's "35" (35 mm format) and "4x5" (large format) (5/63) - when being on - indicate the standby state of the auto-exposure device for the respective camera.

If these LED's are flashing, the auto-exposure device setting must be changed by means of key "35/4x5" (5/72).

- Key ① (5/70) manual opening/closing of the instrument-internal camera shutter
- LED ☐ (5/63) lighting - shutter is open
- LED ● (5/63) lighting - shutter is closed
- Key E3▶ (5/71) initiates film advance by one frame; the key is effective only if the MF-AKS AUTOMATIC-2 equipment is used on the external port and its shutter unit connected to connector (5/65) of the auto-exposure device control panel.

- Key Ⓞ (5/73) initiates automatic exposures.
- LED ☐ lighting - shutter is open
- LED's "1", "2", "3" - indicates progress of exposure time t: 1/4t, 1/2t, 3/4t)
- LED ● lighting - exposure is finished, shutter is closed.

The interval between 2 successive exposures should be ≥ 2 sec. If the exposure time is beyond the working range of the auto-exposure device, the shutter of the JENAPHOT-2000 can be operated manually by actuating key ① (5/70). The respective exposure time must be determined empirically. If the exposure time is below the shortest shutter speed of 1/100 sec, insert attenuation filters in the light path for reducing the light intensity.

4.3. Large-format camera port

The large-format camera port is designed for all cassette types attachable to the International back (POLAROID film

and film pack holder 405, 545, 550, 9x12 Linhof double cassette, GRAPHMATIC interchangeable cassette). In addition, it can be converted to accommodate also CB-33 Polaroid cassettes.

The interchangeable frame (9/154) which is mounted by two screws permits 9cm x 12cm metal cassettes (9/161) to be used.

The image section to be photographed and its definition can be checked on the screen with clear-glass portion.

4.4. 35mm camera port

Via quick-lock mount (11/184) of this port and the T2-JP adapter (9/155) a commercial 35mm camera (with respective T2 mount) can be connected.

If the exposure time is within the working range of the camera's TTL and automatic exposure system, proceed as follows:

- Open instrument-internal shutter of the JENAPHOT-2000 by actuating key (5/70), LED will light up.
- Operation acc. to the Operating Instructions of the respective camera.
- After finishing the work close the shutter of the microscope by actuating key (5/70), LED will light up.

If the required exposure time is beyond the working range of the attached camera, the auto-exposure device of the JENAPHOT-2000 must be employed:

- Open camera shutter manually, select setting "B" or "T" of the camera. In conjunction with the "B" setting use a lockable release.
- Take into account that the film advance of the camera is effected only after closing the camera shutter, i.e. after each exposure process and closing of the JENAPHOT shutter the camera shutter must be closed, too.
- If the camera used has no motorized film winder, wind the film manually after lighting of LED (shutter closed).

4.5. Hints for photomicrography with the JENAPHOT-2000

Compensation of the Schwarzschild effect (reciprocity failure):

- All films show the reciprocity failure, i.e. with long exposure times at constant exposure (exposure = exposure time x illuminance) the obtained density is not the same as with short exposure times. Therefore, underexposures may occur with longer exposure times.
- Since the various film materials (particularly colour films) show differently high reciprocity failures, follow the instructions given by the manufacturer.

Regarding colour fidelity colour films are optimized for defined exposure times. Daylight films are mainly optimized to 1/50 sec, indoor films to 1/5 sec. For longer exposure times special L films (L=long) are available which enable exposure times of up to 60 sec without any variations in colour.

Occurring colour displacements should also be compensated by the use of colour filters (correction filters). The filters should be selected by the desired reproduction of object colours and by image contrast.

Black/white (B/W) photography:

In B/W photography colour filters are used to improve the contrast. The filters are chosen by taking the following facts into account:

- The contrast of object features relative to the background will be increased, if the colour of the filter is complementary to that of the object feature.
- If the colour of the object feature matches that of the filter, the feature/background contrast will be reduced.

When panchromatic films are used, all colours of the object are reproduced in correct tone values. Orthochromatic films, however, are insensitive to red. Therefore, it is recommended to use them along with a V-233 green filter. Data exposure

via the MF-AKS DATEX unit is not possible with this film material.

Adaptation of light source to colour films

Colour films are highly sensitive to the light sources (colour temperatures) used. Depending on the sensitization they are available as indoor or daylight films.

The 12V 100W lamp has the spectral characteristic of an artificial (indoor) light source of a colour temperature of 3200 K (increased red portion), whereas the accessory Xe lamp has that of a daylight source of a colour temperature of 5500 K (increased blue portion). In general, films should be used according to the employed light source.

Of course, daylight film can also be used in connection with the 12V 100W lamp.

For matching the colour temperature of the light source to the film conversion filters are employed:

C-311/32)	filters for diminishing the
C-312/32)	red/yellow colour content
C-313/32)	
C-314/32)	filters for diminishing the
C-315/32)	blue/violet colour content.
C-316/32)	

Example: When using daylight film (colour temperature of 5500 K) and the 12V 100W lamp (colour temperature of 3200 K), it is recommended to use the C-311 conversion filter.

It should be taken into account that the colour temperature of the lamp depends on the operating voltage, which should, thus, not be varied in photographic series, if possible. In case of colour photographs it is of advantage to work with maximum voltage.

4.6. Universal instrument port

On the standard JENAPHOT-2000 the universal port is covered by a plate (10/174) which can be removed by means of special

wrench B-2 (9/152).

The universal port can accommodate the following accessories:

Units of the MF-AKS AUTOMATIC-MOT 2 photomicrographic system

These units are attached to the universal port via the MF adapter JP which is fixed to the port by three slotted screws, using special wrench B-2 (9/152) or a suitable screwdriver after having removed the cover plate. Take care that the adapter is attached in the marked position, i.e. the hole of the adapter should face the dot applied on its mating part of the stand.

The MF-AKS AUTOMATIC-MOT-2 system comprises the MF-AKS shutter unit AUTOMATIC-2 (10/176), MF-AKS winder MOT-2 (10/178), MF-AKS 35 mm camera body (10/177). The auto-exposure device is controlled via the control panel (5/68) of the left arm rest of the JENAPHOT, connecting, to this end, the cable of the MF-AKS shutter unit AUTOMATIC-2 at the rear of arm rest (2/3) to instrument socket (5/65).

The DATEX data exposure unit designed for the exposure of data onto the photomicrograph consists of the DATEX control unit and the DATEX data strip attachment. The DATEX control unit is connected via the screened cable to the "CO" jack (5/67) at the rear of the arm rest (2/3) and to the mains.

Further details on the connection and the use of the units of the MF-AKS AUTOMATIC-MOT-2 system are contained in brochure No. 30-G0603 (e.g. on the PENTACONSIX-M camera body with special adapter for 6cm x 6cm photographs).

TV camera

With the aid of the components included in the TV adapter JP outfit it is possible to connect TV cameras with C-thread or bayonet mount to the reflected-light photomicroscope. The TV adapter JP (magnification factor 0.63X) (10/171) is connected to the universal port (2/13) by means of three screws (10/179) after removing the cover plate. Take care that the adapter is mounted in the marked position (hole in TV adapter JP - dot on its mating part of the stand). The TV camera adapter ring with

C-thread (10/172) or bayonet mount (10/173) (acc. to the type of camera used) is mounted to the camera, and this unit then attached to the quick-lock mount (10/170) of the microscope. Further details on the connection of the TV equipment with the microscope are contained in brochure No. 30-G0841.

Equipment for Polaroid 8"x10"

The 8"x10" equipment (triple tube) permits simultaneous connection of

- TV camera via TV camera adapter ring
- MF-AKS 35 mm camera body with MF-AKS MOT-2 winder and MF-AKS MATIC-MOT-2 control unit
- 8"x10" camera attachment

The triple tube is attached via the triple tube adapter JP, which is fixed to the JENAPHOT-2000 universal port by means of three screws. Prior to attaching the triple tube to the adapter JP the supporting element has to be screwed on.

5. Measuring-counting-comparing

5.1. Graticules

For solving measuring, counting, and comparing tasks the JENAPHOT-2000 standard outfit includes 3 graticules:

- Horizontal micrometer 20:200 JP
20 mm divided into 200 graduations, graduation interval = 0.10 mm.
- Grid graticule 1 x 1 JP.
Grid squares of 1 mm side length over the entire visual field.
- Stage micrometer 1/0.01 A
1 mm divided into 100 graduations, graduation interval = 0.01 mm.

The data on the graticules refer to the eyepiece intermediate image.

The accessory set JP of measuring, counting and comparing

graticules comprises:

- | | |
|--|-------------------|
| - Crossed micrometer graticule | 2x20:200 JP |
| - Grid graticule | 25/2x2 JP |
| - Grid graticule | 225/0.5x0.5 JP |
| - Indexed square graticule | 400/0.5x0.5 JP |
| - Circle graticule | 0.2...2.2 dia. JP |
| - Concentric circle graticule | U3-54 JP |
| - Graticule with logarithmic division, module 1.4 JP | |
| - Grain size graticule A JP acc. to ASTM E 112/P1. I | |
| - Grain size graticule 8 JP acc. to ASTM E 112/P1. I | |

The above graticules can be inserted into the counting and comparing module where they are rotatably arranged. Insert them as follows:

- Place counting and comparing module (8/131) onto the table top so that the knurled ring (8/132) is on the right, unscrew the retaining ring.
- Insert cleaned graticules into apertures so as to lie within the recess and with the line patterns being on the underside. Reinsert retaining ring.
- When the graticule is in the light path its inscription must appear unreversed in the microscopic image.

Operation:

- Push counting and comparing module (8/131) into the slot (4/38) of the microscope up to the stop.
- Turn setting rings (2/8) at the two sockets of the binocular head (2/6) to focus the line pattern of the graticule.
- Refocus by actuating the fine-focus control (2/14) so that the line pattern is sharply depicted together with the object.

If the relationship between the size of graduations or lengths on graticules and the dimensions of the object features is to be determined (e.g. scale constants, lengths of grid squares on grid graticules), a standard scale with known graduation interval is used in place of the object (stage micrometer 1/0.01 A (8/145) or another suitable scale) and, with given optics combination, its graduation is compared with that or

with the respective length on the graticule.

For simple measurements the scale value is determined in the microscopic image by dividing the graduation interval of the graticule (e.g. 0.10 mm of graticule 20:200) by the product of "objective magnification x tube factor".

Example: - GF-PApO-HD 25X/0.60 ∞/0-A DIK

graticule 20:200 JP

tube factor 0.8X

- The size of the object to be measured comprises 5 graduations on the graticule in the microscopic intermediate image.

- The approximate object size results as follows:

$$\frac{5 \times 0.10 \text{ mm}}{25 \times 0.8} = 0.025 \text{ mm}$$

Detailed information on graticules for measuring, counting, and comparing is contained in brochure No. 30-G0510.

5.2. P 16X monocular micrometer tube

When using the accessory P 16X monocular micrometer tube on the JENAPHOT-2000 the measuring accuracy is higher than that obtained by the graticules.

For details on the use of the P 16X monocular micrometer tube see brochure No. 30-G0525.

5.3. Structure comparison eyepiece

The structure comparison eyepiece is an accessory for comparative microscopic examinations with the aid of grain size and standard structure reticles and for simple-type counting and comparing work. The following reticles are inserted in the structure comparison eyepiece:

- Grain size hexagon patterns after ASTM E 19.
- Grain structures after TGL 39118/patterns A and B or ASTM E112/P1. I

- Grain structures with twin formation after TGL 39118/Pattern C or ASTM E 112/P1. II

Furthermore, for simple counting tasks the revolving disk is provided with a squared grid, a line pattern comprising three reference lines, and a free aperture for finding object features.

For details on the use of the structure comparison eyepiece see brochure No. 30-G0660.

5.4. Binocular measuring equipment and RETARMET-2 system

The binocular measuring equipment delivered as a supplementary unit represents a combination of the P 10X micrometer eyepiece and the binocular head.

See brochure 30-G0525 for instructions on the use and the connection of the binocular measuring equipment.

Applications of the RETARMET-2 system when used in conjunction with the binocular measuring equipment:

- Length measurement: series of measurements for obtaining statistical information on linear quantities of an object feature. Calculation and display of the actual mean value and its mean square error.
- Information on a population of homogeneous structures: One single measuring value of each structure is determined. The RETARMET-2 determines the current mean value and the standard deviation as parameters of the population.

The RETARMET-2 system comprises the

- pulse processing system for the signals of the IGR-M sensor (11/191)
- central processing and control unit (11/188)
- control panel (11/187)
- display panel for digital, point, and status indicators (11/189).

Peripheral units are

- foot switch for remote control

- hard-copy printer

See brochure 30-G0066 for hints and operating instructions on the use of the RETARMET-2 system.

6. Accessories

6.1. Polarizing interferometer (NOMARSKI)

The polarizing interferometer (Pol-I) is a shearing interferometer operating on the basis of optical polarization. It permits step heights of sharply contoured object structures (steps, reliefs, thin layers) to be measured by means of interference fringes.

With the light of the JENAPHOT-2000 lamp being unfiltered orientation measurements can be carried out only. For higher demands on measurement accuracy monochromatic light (e.g. with SIF-586 interference filter) should be employed.

The step height d is determined according to the following formula:

$$d = \frac{\Delta}{2}$$

$$\Delta = \frac{b}{a} \cdot \lambda$$

- d - step height
- Δ - path difference
- a - interference fringe spacing
- b - displacement of interference fringes at the step
- λ - wavelength of the light employed

Operation:

- Set bright field conditions, move polarizer (4/42) and analyzer (8/128) into light path and rotate them to crossed (extinction) position. Put object onto stage and set desired objective to use position.
- Push Pol-I module (8/138) up to stop into slideway (4/47). When doing this and when pulling it out again, take care that the red dot on set-screw (8/136) is on top. Focus onto object plane.
- Actuate set-screw (8/137) to shift the interference fringe

system so that the dark (middle) interference fringe is approximately in the middle of the field.

- Select fringe spacing "a" by varying the magnification changer setting (4/49) (coarse adjustment) or that of set-screw (8/136) (fine adjustment).

For judging the object surface use the middle section of the dark interference fringe.

- Insert micrometer graticule 20:200 JP (8/146), focus both graticule pattern and object.
- Actuate knurled wheel (8/132) to set the scale lines parallel to the interference fringes. Read fringe spacing "a" and fringe displacement "b" (in scale units).

When using white light (without filter), insert $\lambda = 550$ nm in the formula, when using an interference filter insert its centroid wavelength (filter designation SIF-586 means $\lambda = 586$ nm). It is recommended to select a fringe spacing of $a = 1000 \cdot \lambda$.

In this case, the formulas are simplified to

$$d = \frac{b}{2000} \quad \text{and} \quad \Delta = \frac{b}{1000}$$

Example: Determination of the step height on homogeneous material

Interference filter SIF-586 in the light path

Micrometer graticule 20:200 JP

Fringe spacing set to $a = 1000 \cdot \lambda = 0.586$ mm

Fringe displacement "b" measured: 3.5 scale units = 0.35 mm

The resultant path difference Δ and step height d are:

$$\Delta = \frac{b}{a} = \frac{3.5}{1000} = 0.35 \mu\text{m} \quad \text{and} \quad d = \frac{\Delta}{2} = 0.175 \mu\text{m}$$

With surface steps between different materials or with a thin, transparent layer on a reflecting substrate, phase jumps in reflection and interferences in the layer must be taken into account. In this case, the step height d is not proportional to path difference Δ . Thus, reference measurements are required on suitable test or calibration specimens of known surface step heights to determine the step height d .

6.2. Microhardness tester

The MHP-100/45 Microhardness Tester (available as accessory) permits the VICKERS microhardness of materials to be determined with test loads of 0.049N...0.981N (5...100 gf).

The outfit comprises

- microhardness tester
- monocular micrometer tube for manual data acquisition or
- monocular micrometer tube and RETARMET-2-T central processing unit for automatic data acquisition and processing.

See brochure 30-G0677 for instructions on the set-up and operation of the MHP-100/45 Microhardness Tester.

6.3. Xe light source

The high-intensity daylight-quality Xe lamp is available as accessory.

It comprises

- lamp housing and
- SX-150 power supply.

Specification:

Light source	150 W Xenon high-pressure lamp
Lamp current	7.5 A
Output voltage of constant-current source before starting the gas discharge	75V \pm 2V

Permissible variation of lamp operating voltage	15V...22V
Permissible lamp current variation at permissible line voltage and lamp operating voltage variations	< 5 %
Short-time operation of starting key	\leq 4 s
Forced interval between starting operations	about 4 s
Hour counter operating with gas discharge being started	resettable 6-digit counter reading to 0.1 h

The Xe lamphouse can be exchanged for the 12V 100W lamp unit connected to quick-lock mount (3/21). For the adjustment of the Xe lamp electrodes use adjustment device (9/160) which projects light source and pupil image onto the screen of the large format camera.

The state of adjustment is easily checked by removing an eyepiece from its socket of the binocular head thus making the pupil image visible in the socket.

See brochure No. 30-G0360a for further details on the adjustment of the Xe lamp, the operation of its SX-150 power supply and necessary cautionary instructions.

6.4. 20mm x 20mm mechanical

The 20mm x 20mm mechanical stage (12/209) - available as accessory - has the advantage of being rotatable through 360°. This stage is attached and centred same as the 50mm x 30mm mechanical stage.

- 20mm x 20mm X-Y motion with position indication, scale reading to 0.1 mm
- Rotatable through 360°, centrable
- Vernier reading (12/210)
- Adjustable 45° detents

The detent is made effective by tightening knurled screw

(12/211). It should be loosened by means of knurled screw (12/211) in one of the detent positions only!

6.5. Transmitted-light equipment

This accessory provides transmitted light and combined transmitted/reflected light illumination on the JENAPHOT-2000. The equipment includes:

- transmitted-light attachment with 6V 25W halogen lamp
- series transformer for 6V 25W lamp
- set of filters.


Mounting the transmitted-light equipment:


- After removing the cover plate between lamp housing and mechanical stage, fix the transmitted-light equipment loosely by means of 4 cheese-head screws.
- Use GF-PApo HD 50X/0.90 objective. Set lamp voltage control (6/86) of 12V 100W lamp to lower stop. Rotate filter turret (3/22) to bring attenuation filter into light path. Connect 6V 25W lamp to its series transformer and switch it on.
- Shift the transmitted-light attachment to centre the light spot relative to the front lens of the objective in use.
- Retighten the fixing screws.

Note: When using the GF-PA HD 3.2X/0.06 objective, remove N.A. 0.4 condenser from the light path.

6.6. Viewing screen

For viewing, demonstrating and discussing microscopic images the viewing screen attachment with Fresnel lens can be mounted to the large format camera. For this purpose, depress the two springs (11/190) at the frame of the camera screen simultaneously and withdraw the frame from the large format camera to the right side. Attach the viewing screen analogously. The viewing screen is mainly applicable with bright-field illumination

of objects, if the object surface reflectivity is $> 10...20\%$. Filters should always be removed from the light path. Set push/pull rod (4/39) to position  (photo path). Set push/pull rod (2/1) to position "4x5/3.2X" (large format camera).

Open camera shutter by actuating key  (5/70).

Further applications are possible by using measuring, counting and grain size gratitudes in the counting and comparing module.

6.7. Slit diaphragm stage inserts

Slit diaphragm stage inserts (12/105) are available as accessories to the JENAPHOT-2000 for microscopic investigations on non-embedded samples having a small locating surface and for the observation of peripheral specimen areas.

The slit diaphragm stage inserts are inserted into the JENAPHOT specimen stages (2/10) and (12/109). The specimen locating area of the slit diaphragm stage insert is 25 mm in diameter. For observation and photomicrography all objectives (i.e. also immersion objectives) can be used. Three types of slit diaphragm stage inserts with rectangular slits of 2 mm, 5 mm, and 10 mm width are delivered.

Note: Avoid any damage to the 0.1 mm thick sheet-metal plates serving as specimen support in order to ensure the vertical position of the locating surface of the section to the optical axis of the objectives. When working with slit diaphragm stage inserts do not use the stage clip (3/27) of the specimen stages.

6.8. Fluorescence filters

The set of fluorescence filters for blue excitation includes:

Excitation filters	2x KP-490	32 mm dia.
	B-228G	32 mm dia.
Barrier filter	G-247	32 mm dia.

By treating the specimens with fluorochromes (e.g. fluorescein) cavities and defects such as cracks, pores, shrink holes in

metal, ceramic, plastic and concrete samples can be made visible.

If the light intensity of the 12V 100W lamp is not sufficient, use the Xenon lamp accessory.





Inserting the filters:

- Remove circlip ring from the mount of the filter turret (3/22), insert the exciter filter and secure it in position by means of circlip ring.
- Arrange B-228-G filter between the short-wave transmitting filters. The sides bearing the filter type engraving of the short-wave filters must face each other.
- Insert G-247 barrier filter in filter module (9/164) and slide it into the light path on illuminator (4/48).
- Open aperture diaphragm fully (3/23) and set lamp voltage to maximum.
- Avoid touching the filter surfaces and remove any dust particles with a clean, soft brush. Clean smeared filters with distilled water and a cotton swab.

7. Operator prompts

Prompt	Cause	Correction
LED ▲▼ (6/82) is lighting	Revolving nosepiece at its lower stop position or just moving.	
LED "2" (6/87) is blinking	Revolving nosepiece has been turned by hand out of its detent position	Press key "2" (6/88), to actuate automatic objective change to detent position 2
LED "2" (6/87) and LED (6/82) are blinking simultaneously	Revolving nosepiece is not in one of its detent positions. Lift mechanism not in one of its end positions	Switch microscope off and on.

Note: Before any manual objective change move the revolving nosepiece to its lower end position by actuating the coarse-focus control.

Prompt	Cause	Correction
Indicator "35" (5/63) is blinking	Light path has been switched to 35mm camera without setting auto-exposure device to "35"	Switch auto-exposure device to 35 mm camera by means of key "35/4x5" (5/72)
Indicator "4x5" (5/63) is blinking	Light path has been switched to large-format camera without setting auto-exposure device to "4x5"	Switch auto-exposure device to large-format camera by means of key 35/4x5 (5/72)
Indicator > (5/63) is red-lighting	Automatic exposure is blocked for at least one of the following reasons: <ul style="list-style-type: none"> • Rotary handle (4/40) set to universal port • Light path has not been changed over to instrument-internal photomicrographic equipment by means of handle (4/39). • Exposure time determined by auto-exposure device is < 0.01 s (shortest shutter speed) • Time range of auto-exposure device has been exceeded 	Set rotary handle (4/40) to  . Set handle (4/39) to  . Insert attenuation filters into light path. Reduce lamp voltage by means of control (6/86). (Caution in case of colour photomicrography: Variation of colour temperature of halogen lamp!) • Remove filters from light path. • Check aperture diaphragm setting and correct it, if necessary. • Use Xe lamp. Operate shutter by hand via key  (5/70)
LED > (5/63) is blinking	End of film (only applicable, if MF-AKS units are connected to universal port)	Insert a new film. Actuate film advance key  (5/71).

If, after switching the instrument on, the basic states

- motorized revolving nosepiece position 2
- film speed ISO 50/18°

are not set, repeat the switch-on operation by actuating mains key (7/101).

8. Maintenance

8.1. Operation of the instrument in countries with temperate climate

The JENAPHOT-2000 is an optical precision instrument and should be protected against

- vibrations,
- dust,
- humidity,
- corrosive vapours and
- room temperatures above 35 °C.

Any uncovered optical components are to be carefully cleaned with the aid of the optics cleaning kit (9/163). Unprotected sliding and guiding surfaces (dovetail mount of illuminator, stage support) should be cleaned periodically and provided with a thin film of acid-free vaseline.

Remove immersion oil from HI objectives with the aid of an anti-dust cloth and pure benzine (do not use alcohol!).

X/Y drift of the mechanical stage (i.e. slight object displacements without actuation of stage controls) is eliminated by readjusting the torque of the controls in the following way (see Fig. 14):

- In the case of X drifts (i.e. parallel to the front edge

of the stage) loosen slotted nut (14/220). For loosening the slotted nut use a screwdriver fitting into the slot (14/221). Then secure the stage plate of the mechanical stage against displacement by holding it tight, and slightly turn control (14/222) clockwise by hand. Lock this position by tightening nut (14/220).

- Y drifts (control (14/223) are eliminated by loosening lock screw (14/224) and tightening screw (14/225) slightly. Finally, the latter is fixed in position by screwing in lock screw (14/224).

The binocular head contains a tensioning system which - if adjusted properly - prevents the interpupillary distance of the eyepiece tubes from being changed by itself. The tensioning system is readjusted as follows:

- Set eyepiece tubes to minimum distance to make two groups of 3 screws visible.
- Small screw
Tighten the screws uniformly for tensioning.
Loosen them for relieving the tension.
- Do not actuate large screws!

The tension of the variable-angle tube (ergonomy tube) can be readjusted, if necessary, as follows:

- Remove cap (2/9)
- Loosen grub screw (slotted screw) in hexagon nut.
- Use wrench D 17 and tommy pin A 10 to change the position of the hexagon nut for varying the tension within the motion range of the ergonomy tube.
- Tighten the grub screw.

Any interventions into the optical system and moving mechanisms inside the instrument as well as repairs of the JENAPHOT electrical system should be done by service specialists only.

8.2. Operation of the instrument in countries with damp and warm climate

On principle, regular use of the instruments is the best way of maintaining its performance in tropical rain climate.

All precision mechanical-optical instruments are exposed to become covered with mould fungus under the following conditions:

- relative air humidity above 75 % for more than 3 days on end at temperatures between +15 and +35 °C
- setting up of the instruments in dark rooms without air ventilation
- dust and finger prints on optical surfaces
- longer storage times of the components in closed wooden or leather containers.

The setting-up of the microscope in bright, dry (air humidity < 65%) and ventilated rooms is an essential prerequisite for maintaining its performance. Components and accessories, e.g. objectives and eyepieces, especially susceptible to mould fungus should be stored in drying cabinets.

The attack by moulds on instruments in storage containers can largely be avoided by impregnating absorbent materials with fungicide and putting them into the storage container.

As a rule, surfaces of optical components are especially coated and thus subject to careful treatment and maintenance. Dust should be removed only with a soft and clean (grease-free) brush.





Stronger contaminations (e.g. finger prints) are best removed from optical surfaces by using clean, commercial optics cleaning cloths which may be moistened slightly with benzene.

9. Symbols used








9.1. Power supply unit (7/102)




0I	ON/OFF switch (7/101)
12V 100W	Connector XH4 for 12V 100W lamp (7/97)
1/.../T	Primary fuse (7/99)
2/.../T	Primary fuse (7/99)

9.2. Stand (2/9)



	Light path selector (4/40), position "internal"
	position "external"
	Handle/change-over from visual observation to photography (4/39)
	Handle pulled out - photographic path
$\frac{2:1}{3.2:1}$	Projection eyepiece selector (4/37)
	Handle pulled out - projection eyepiece 2:1 in light path
$\frac{35}{4 \times 5 / 3.2 \times}$	Large format/35mm camera selector (2/1)
	Handle pulled out - 35mm camera

9.3. Control panel of auto-exposure device (5/68)

	Key for increasing film speed
	Key for reducing film speed
	Manual shutter release key
	Film advance key
35/4x5	35mm camera/large format camera selector key
	Automatic exposure release key
	Shutter open indicator
	Shutter closed indicator
1	LED indicator: 25% of exposure time passed
2	LED indicator: 50% of exposure time passed

3	LED indicator: 75% of exposure time passed
	LED indicator: exposure not possible
	LED indicator: shutter opened by hand
35	LED indicator: auto-exposure device set to 35mm camera
4 x 5	LED indicator: auto-exposure device set to large-format camera
EXT	LED indicator: universal (external) port in use
	Socket for connecting external MF attachment camera system
CO	Socket for connecting MF-AKS DATEX data exposure attachment

9.4. Control panel of motorized revolving nosepiece (6/85)

	Key for raising lowering the revolving nosepiece
1	Selector key for objective in aperture 1
2	Selector key for objective in aperture 2
3	Selector key for objective in aperture 3
4	Selector key for objective in aperture 4
5	Selector key for objective in aperture 5
	Lamp voltage control

10. Legende to illustrations

Fig. 1	JENAPHOT-2000 - general view, left
Fig. 2	JENAPHOT-2000 - general view, right
1	Large format/35mm camera light path selector
2	35mm camera
3	Arm rest and control panel of auto-exposure device
4	Viewing screen
5	Large-format camera (9cm x 12cm, 4"x5")
6	Binocular head WF, tiltable
7	GF-Pw 10X (25) 60° eyepiece
8	Setting rings of (6)
9	Cap
10	50mm x 30mm mechanical stage
11	12V 100W lamp unit
12	Coaxial X-Y stage controls
13	Universal instrument port
14	Fine-focus control
15	Coarse-focus control
16	Control panel of motorized revolving nosepiece
17	Arm rest, right-hand
Fig. 3	Detail view, right side
21	Quick-lock mount for lamp unit
22	5x filter turret
23	Aperture diaphragm with centring screws
24	Field diaphragm with centring screws
25	Revolving nosepiece
26	Vernier of stage motion
27	Stage clips
28	Filter turret clamping screw
Fig. 4	Detail view, left side
37	Projection eyepiece selector
38	Slot for framing graticule module

39	Viewing path/photographic path selector
40	Internal/external path selector
41	Bright field (HF)/dark field (DF) selector wheel
42	Handle of polarizer module
43	Stage carrier
44	Stage rotation clamp
45	Handle for rotating the stage
46	Centring screw
47	Dovetailed guideway on top of illuminator
48	Illuminator
49	Magnification changer
Fig. 5	Control panel of auto-exposure device
61	Key for reducing film speed
62	Key for increasing film speed
63	LED indicators
64	LED band of film speed entered
65	Connector for MF-AKS AUTOMATIC-MOT-2 system fixed to universal port
66	Auto-exposure device connecting cable
67	Socket for connecting the MF-AKS DATEX unit
68	Control panel of auto-exposure device
69	LED indicator/universal port in use
70	Shutter open/close key
71	Manual film advance key
72	Key for switching the auto-exposure device from 35mm format to large format (35/4x5)
73	Automatic exposure release key
Fig. 6	Control panel of motorized revolving nosepiece
81	Lift/lower key of revolving nosepiece
82	Status indicator/revolving nosepiece lift
83	LED band/lamp voltage
84	Connecting cable f. motorized objective change - lamp voltage control
85	Control panel of motorized revolving nosepiece - voltage control of 12V 100W lamp
86	Lamp voltage control

87	LED indicators for objectives selected
88	Objective selector keys
Fig. 7	Rear side of the JENAPHOT-2000 with 12V 100W lamp
97	12V 100W lamp connector
98	Mains connecting cable of JENAPHOT-2000
99	Primary fuses
100	Connector for control panel "motorized revolving nosepiece"
101	Mains key
102	Power supply unit
103	Clamp screws for 12V 100W lamp
104	Adjusting screws for 12V 100W lamp
105	Mirror for 12V 100W lamp
106	12V 100W lamp focussing screw
107	Mirror adjusting screw
108	Connecting cable of 12V 100W lamp
109	Connector for control panel "auto-exposure device"
Fig. 8	JENAPHOT accessories
118	Micrometer eyepiece
119	Measuring drum
120	Screw for fixing (118)
121	Concave mirror
122	Monocular micrometer tube
123	Screw for fixing (121)
124	Dark-field module
125	λ -a compensator
126	λ -a compensator, subparallel
127	Knurled wheel for (126)
128	Analyzer module
129	Knurled wheel for (128)
130	Framing graticule module
131	Counting and comparing module
132	Knurled wheel for (131)
133	Horizontal prism control of (135)

134	Vertical prism control of (135)
135	DIK-JP module
136	Horizontal prism control of (138)
137	Vertical prism control of (138)
138	Pol-I-JP module
139	Wollaston prism of (135)
140	Holder of (121)
141	Monocular tube of (143)
142	Revolving disk of (143)
143	Structure comparison eyepiece
144	GF-HD objectives of JENAPHOT-2000
145	Stage micrometer 1/0.01, in case
146	Micrometer graticule 20:200 JP and grid graticule 1x1 JP, in case
147	Centring cross-line plate, in case
Fig. 9	Accessories of JENAPHOT-2000
151	2x socket wrench 3/65
152	Special wrench B-2
153	Fuse links
154	Intermediate frame for 9cm x 12cm metal cassettes
155	T2 adapter ring "JP"
156	Glass stage inserts of 56mm o.d.: 10, 20, 27mm i.d.
157	Glass stage inserts of 132mm o.d.: 40, 50, 70mm i.d.
158	Stage insert holder
159	6X focussing magnifier
160	Lamp adjusting device
161	9cm x 12cm metal cassette for (5)
162	Set of 32mm dia. filters
163	Cleaning kit
164	Filter module
165	Slide plug for dark-field module slot

Fig. 10	JENAPHOT-2000 with MF-AKS photomicrographic equipment
170	Quick-lock mount for (172) and (173)
171	TV adapter JP
172	Camera adapter with C-thread
173	Camera adapter with bayonet mount
174	Cover plate for (13)
175	MF adapter JP
176	MF-AKS AUTOMATIC-2 shutter unit
177	MF-AKS 35mm camera body
178	MF-AKS MOT-2 winder
179	Fixing screws

Fig. 11	JENAPHOT with binocular measuring equipment and RETARMET-2
184	Quick-lock mount for (155)
185	35mm camera port
186	Diffusion screen
187	Control panel of RETARMET-2 system
188	Control unit of RETARMET-2 system
189	Display of RETARMET-2 system
190	Leaf springs for holding diffusion screen
191	RETARMET-2 sensor head
192	Reaining nut of (191)
193	Micrometer eyepiece for (197)
194	Fixing screw for (193)
195	Eyepiece tubes for (197)
196	Setting ring
197	Binocular measuring equipment
198	POLAROID Land sheet film holder 545

Fig. 12	20mm x 20mm mechanical stage and stage accessories
205	2 mm, 5 mm, 10 mm slit diaphragm stage inserts
206	Recessed stage insert
207	Intermediate ring for (205) and (206)
208	X-Y-stage controls
209	20mm x 20mm mechanical stage

- 210 Vernier scale for (209)
 211 Knurled screw for 45° detent of (209)
- Fig. 13 Framing graticule pattern
- Fig. 14 Coaxial stage controls of 50mm x 30mm stage
- 220 Slotted nut
 221 Slot of (220)
 222 X-motion control
 223 Y-motion control
 224 Lock screw for (223)
 225 Screw for (224)

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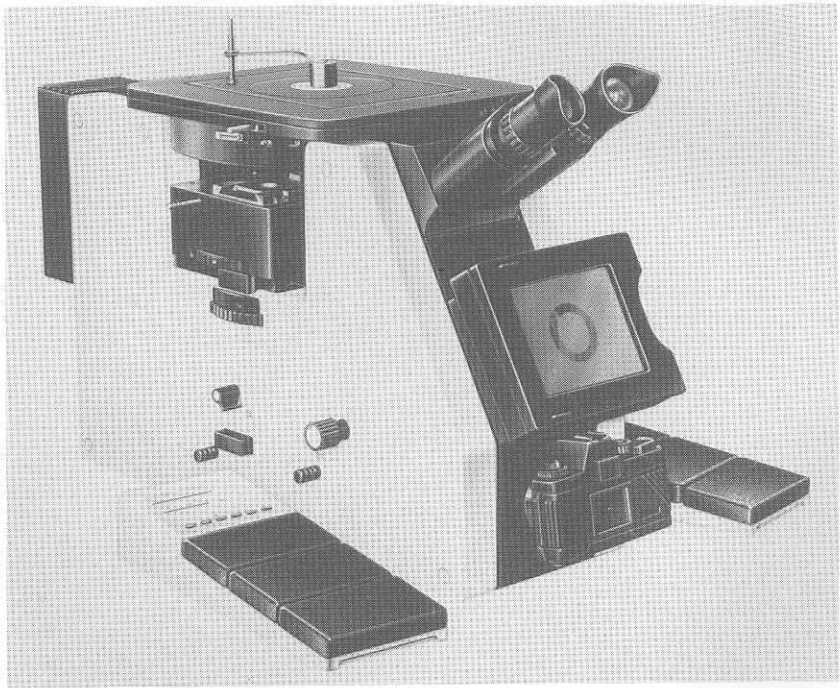


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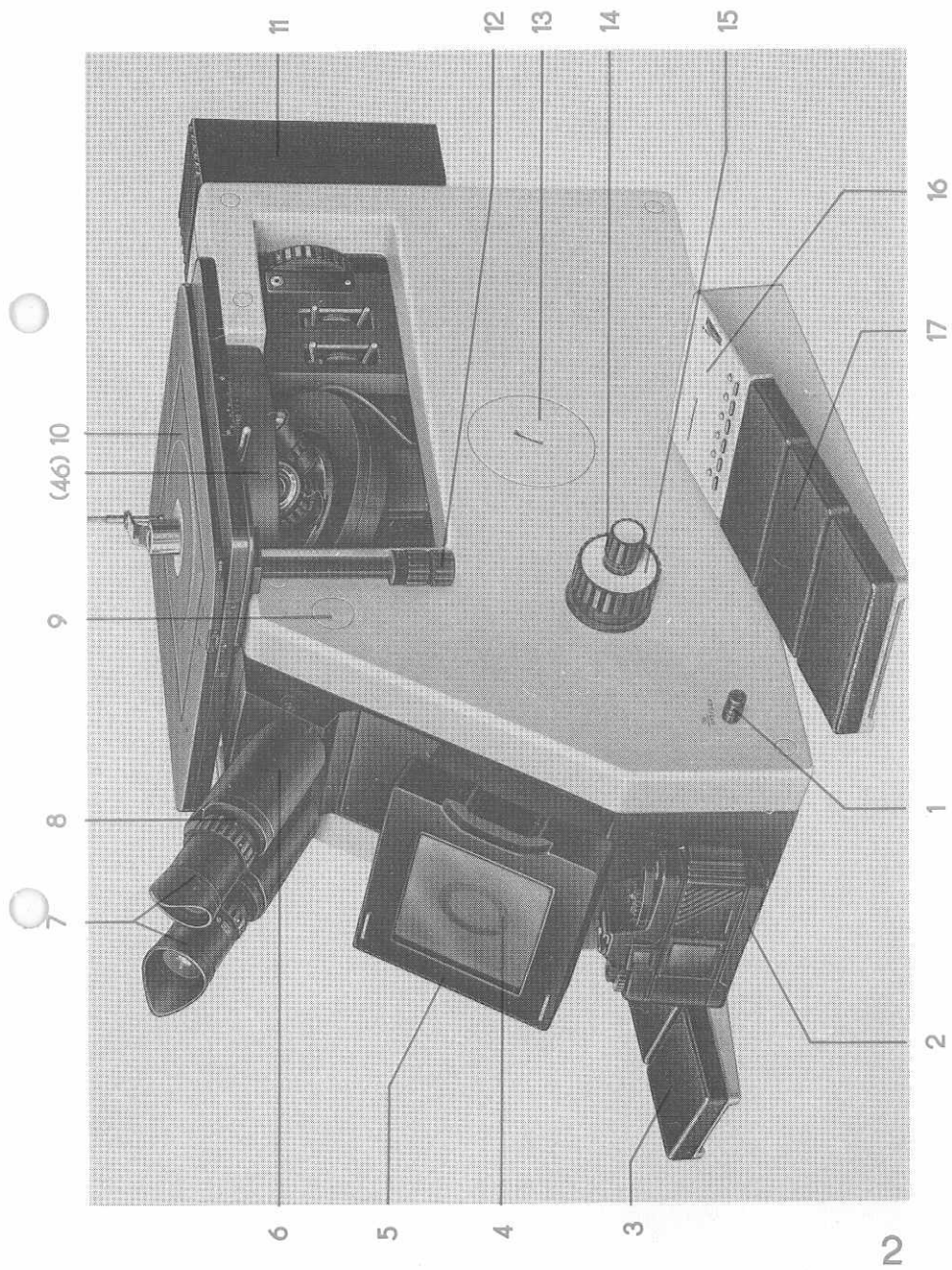
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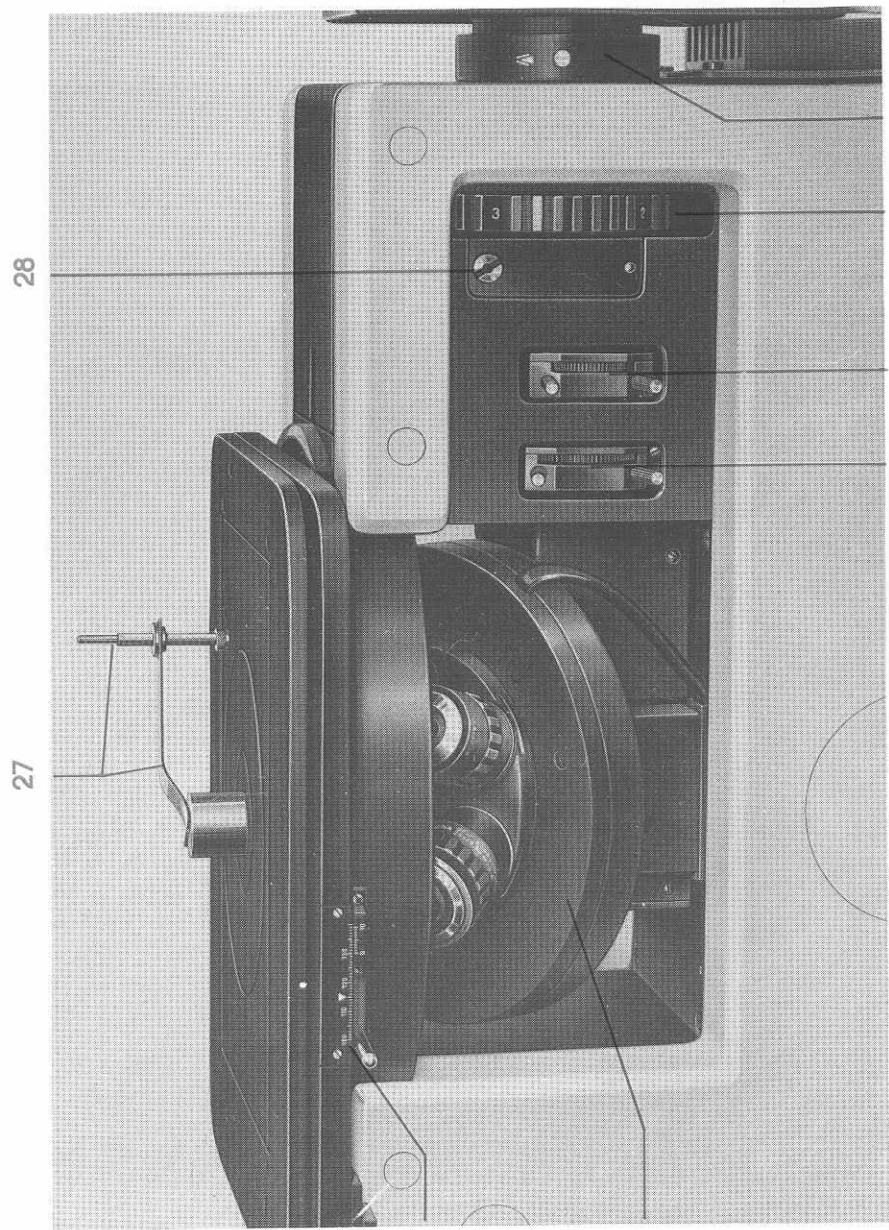
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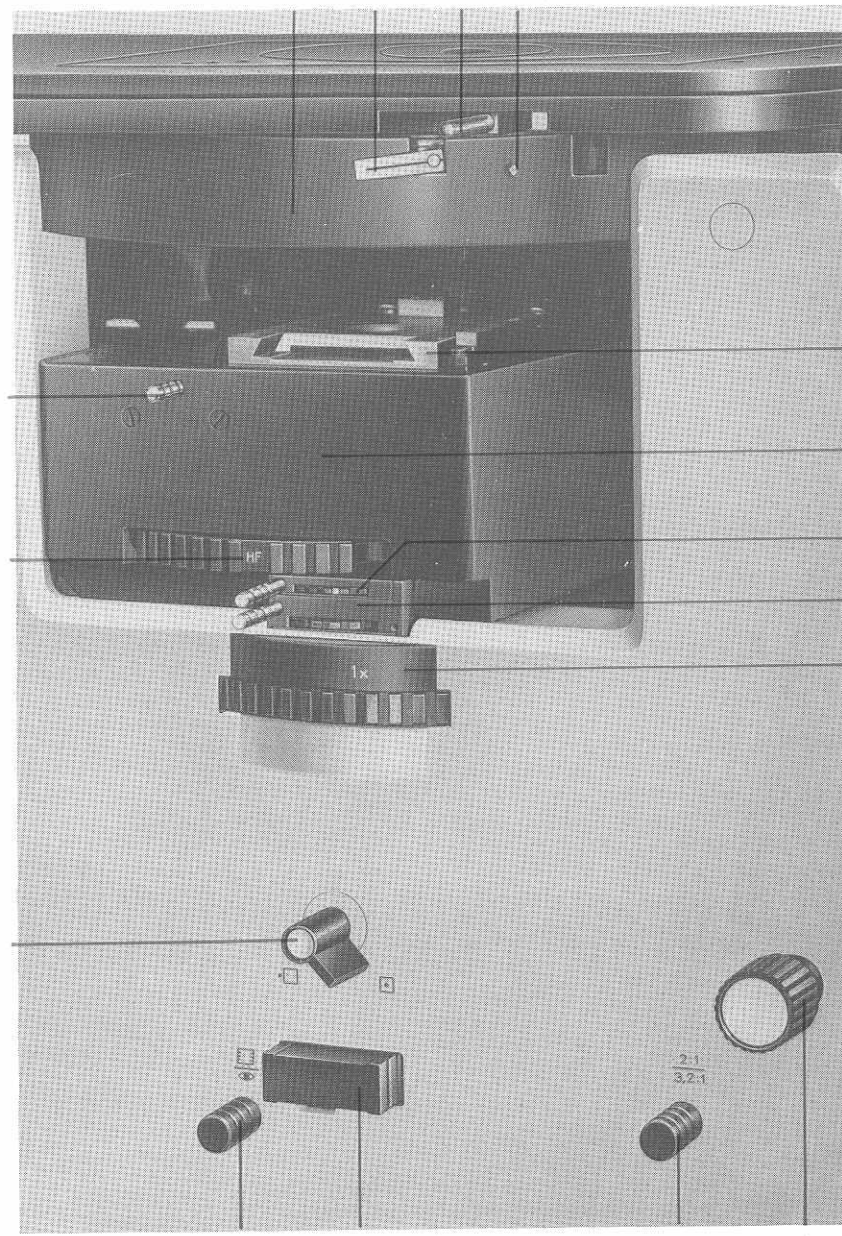
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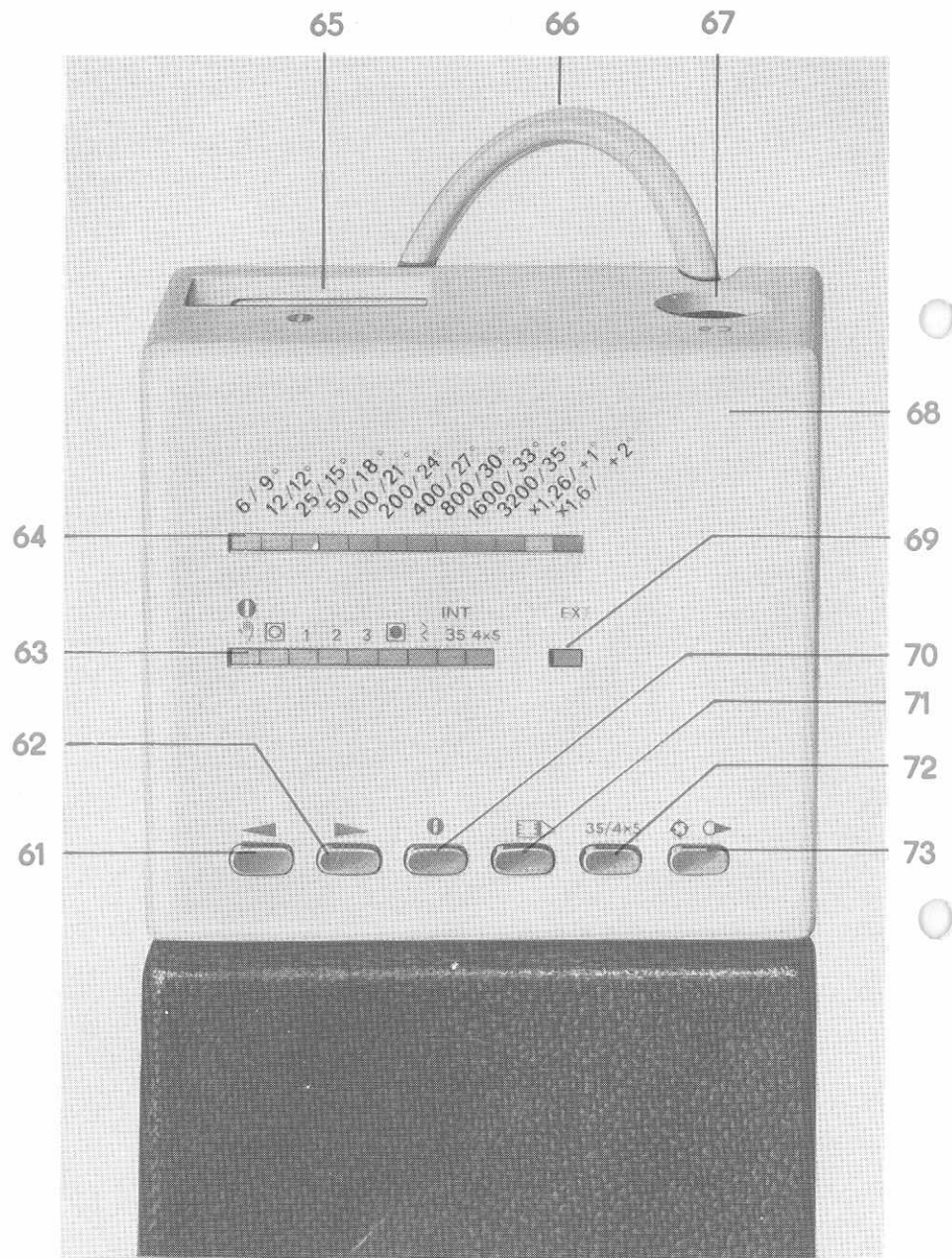
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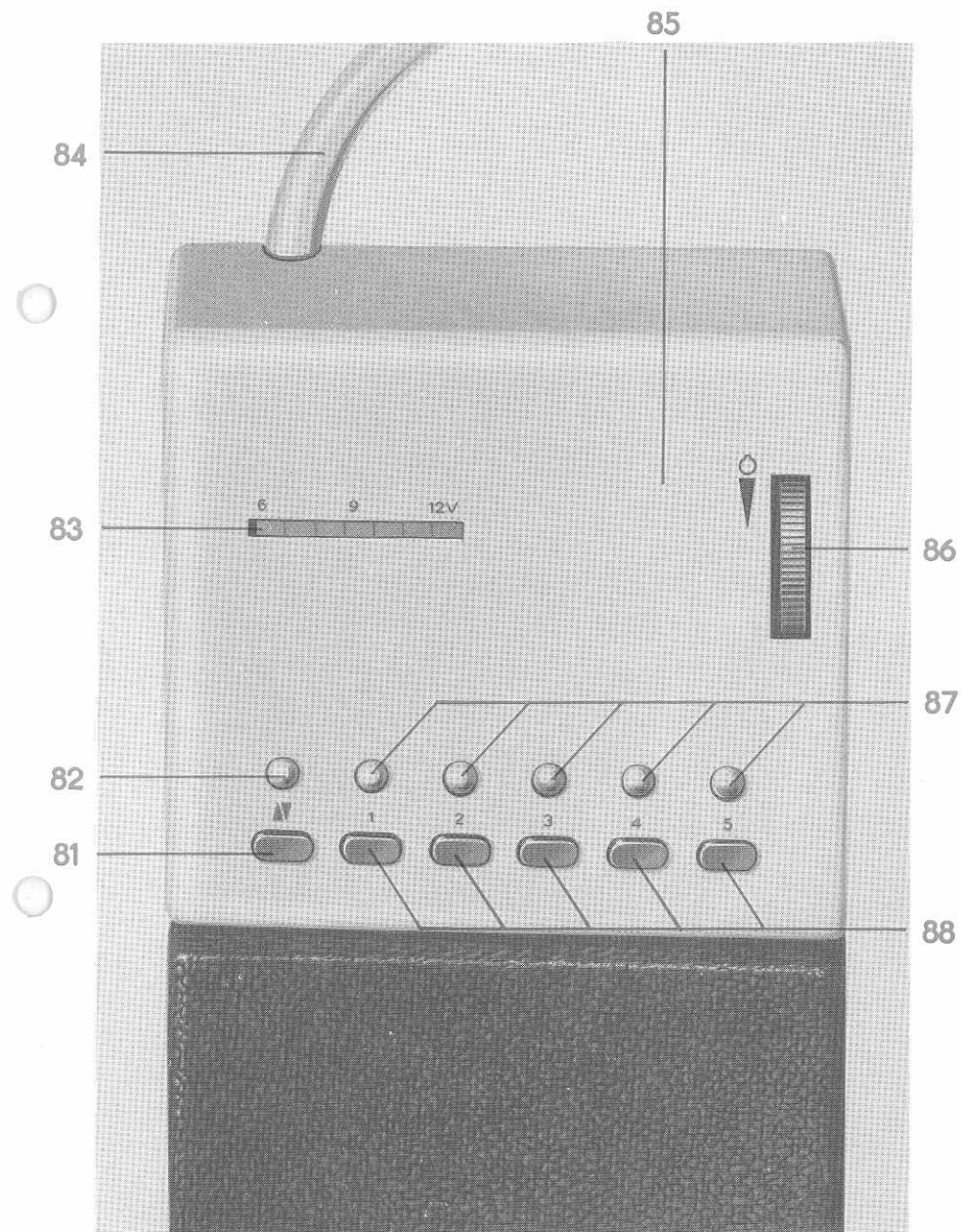
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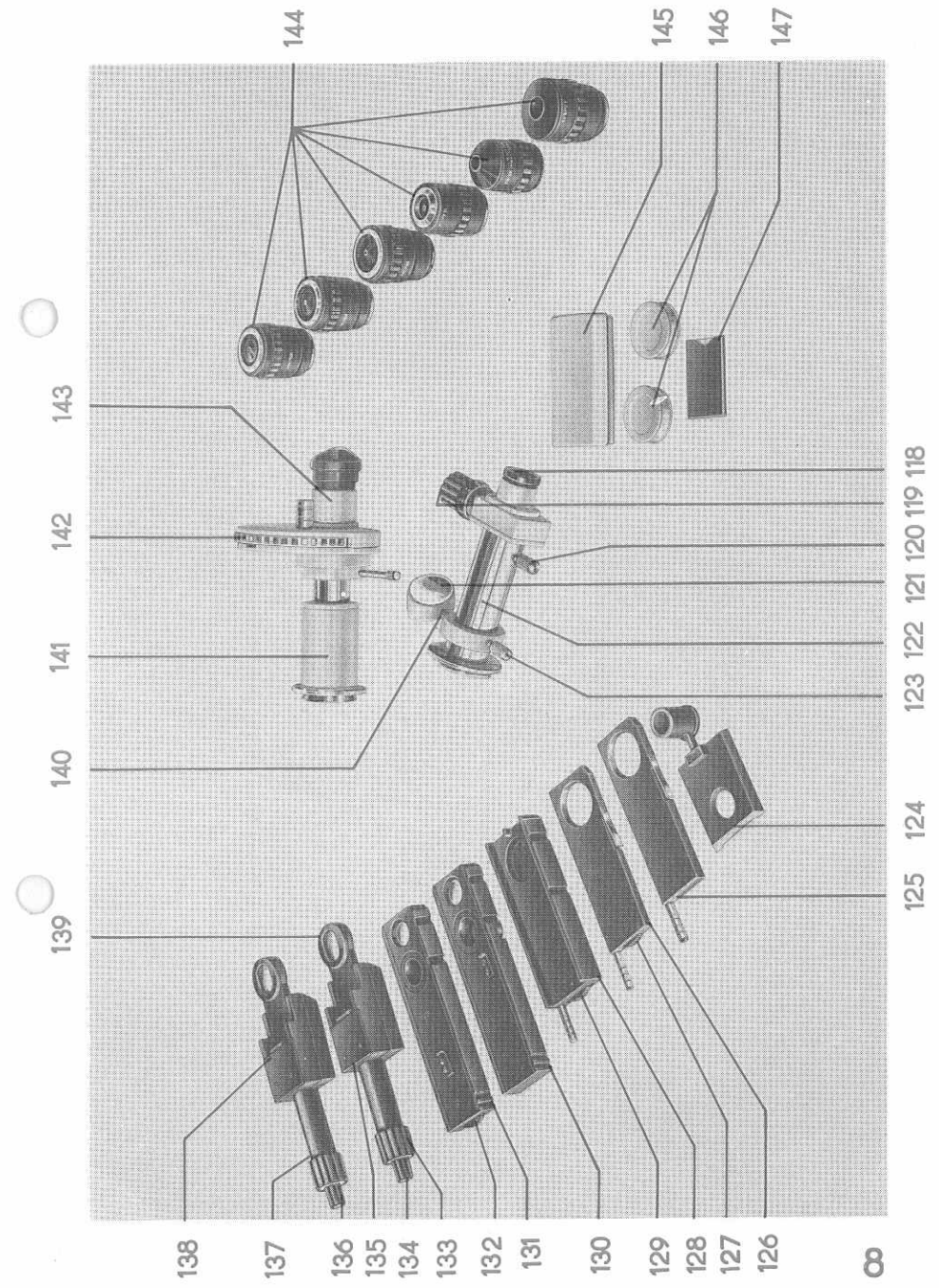
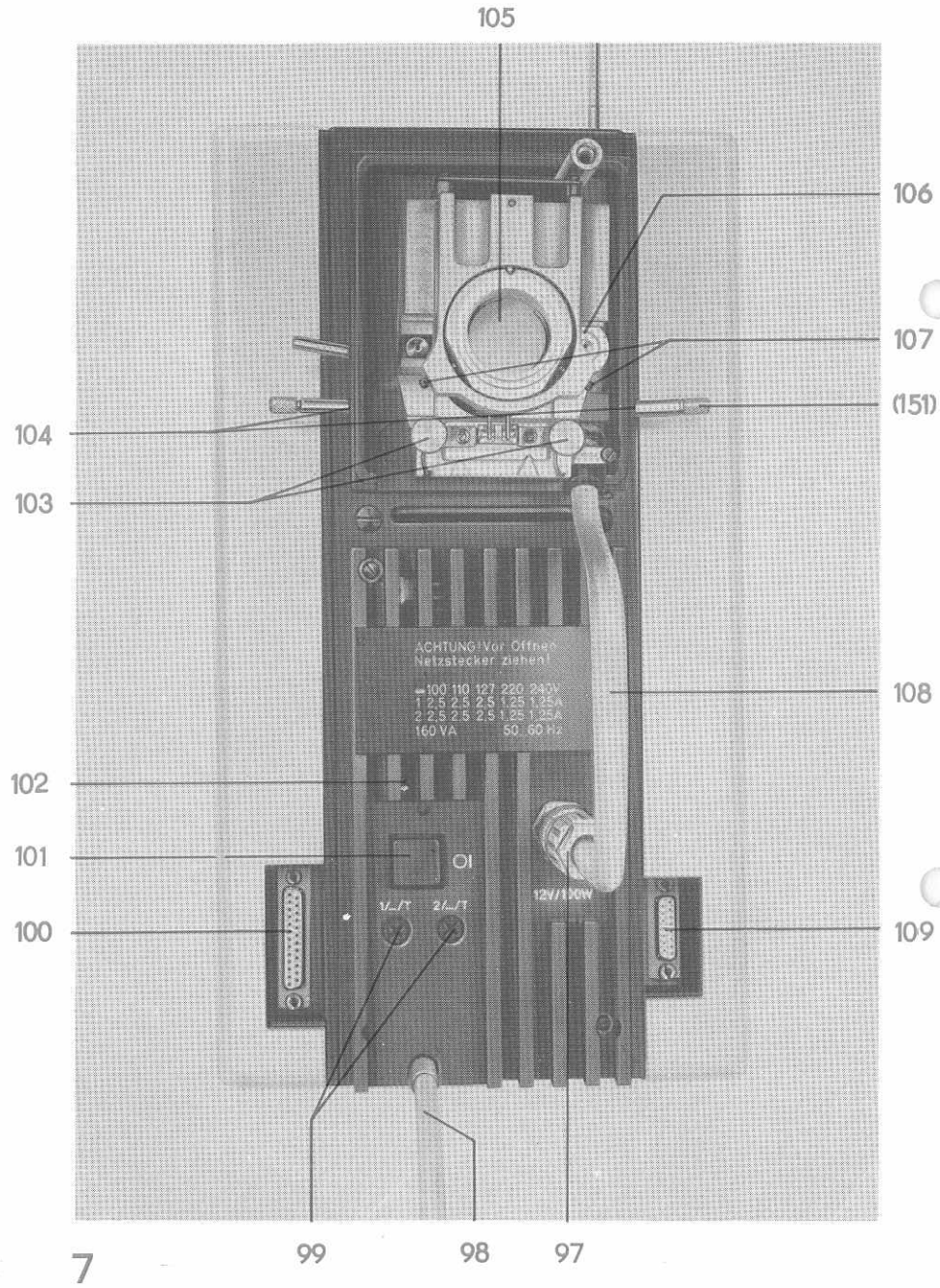
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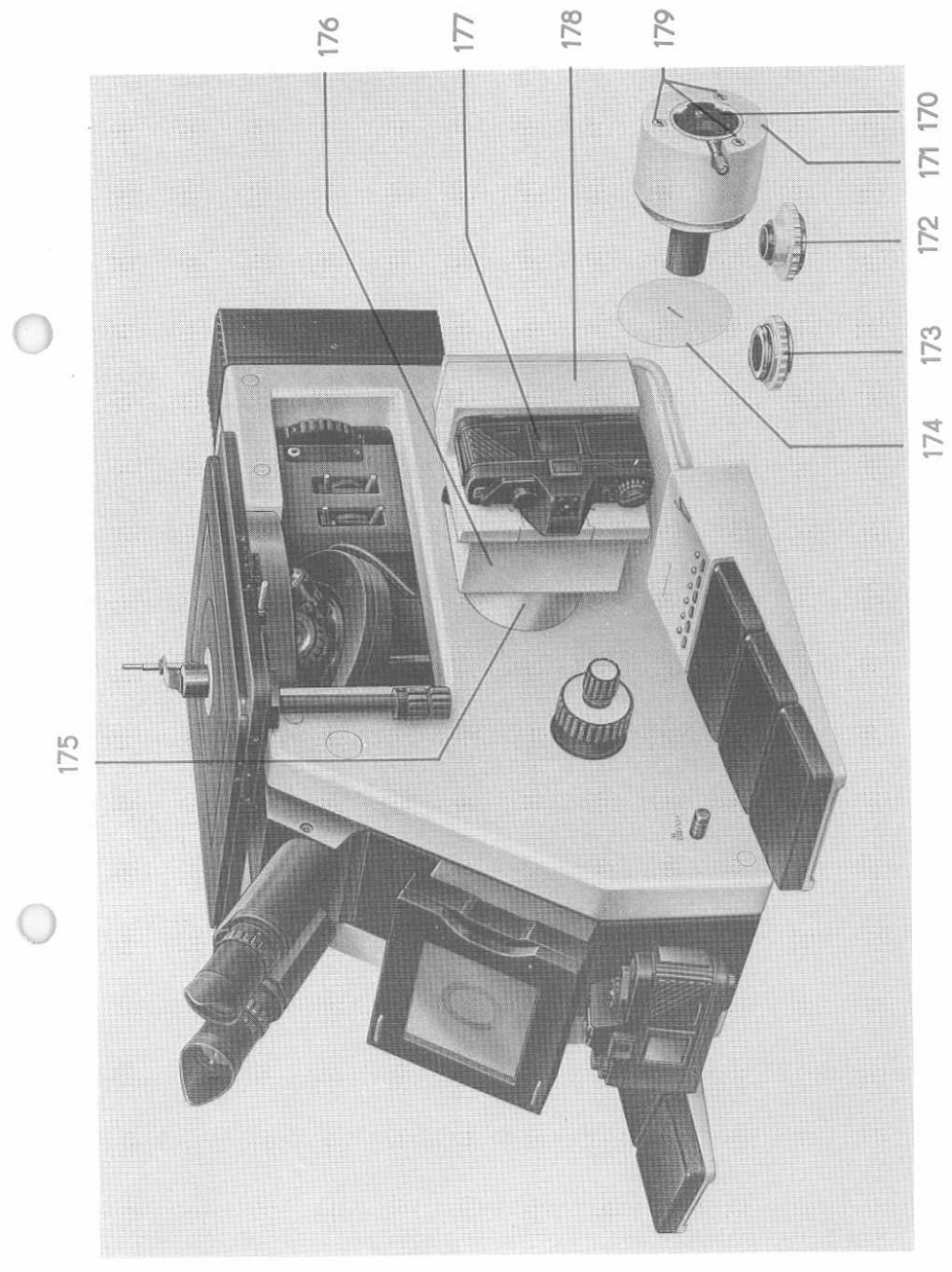
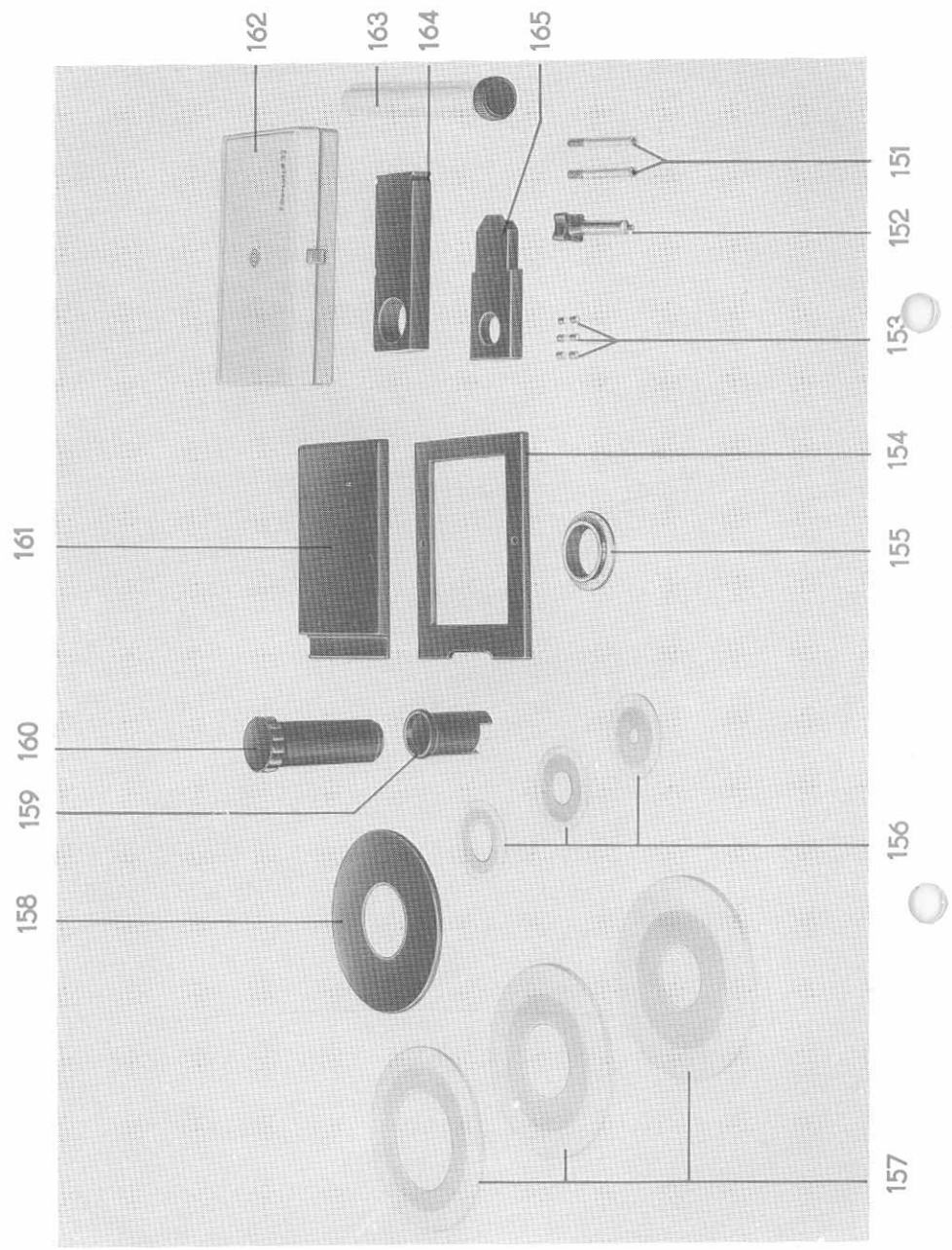


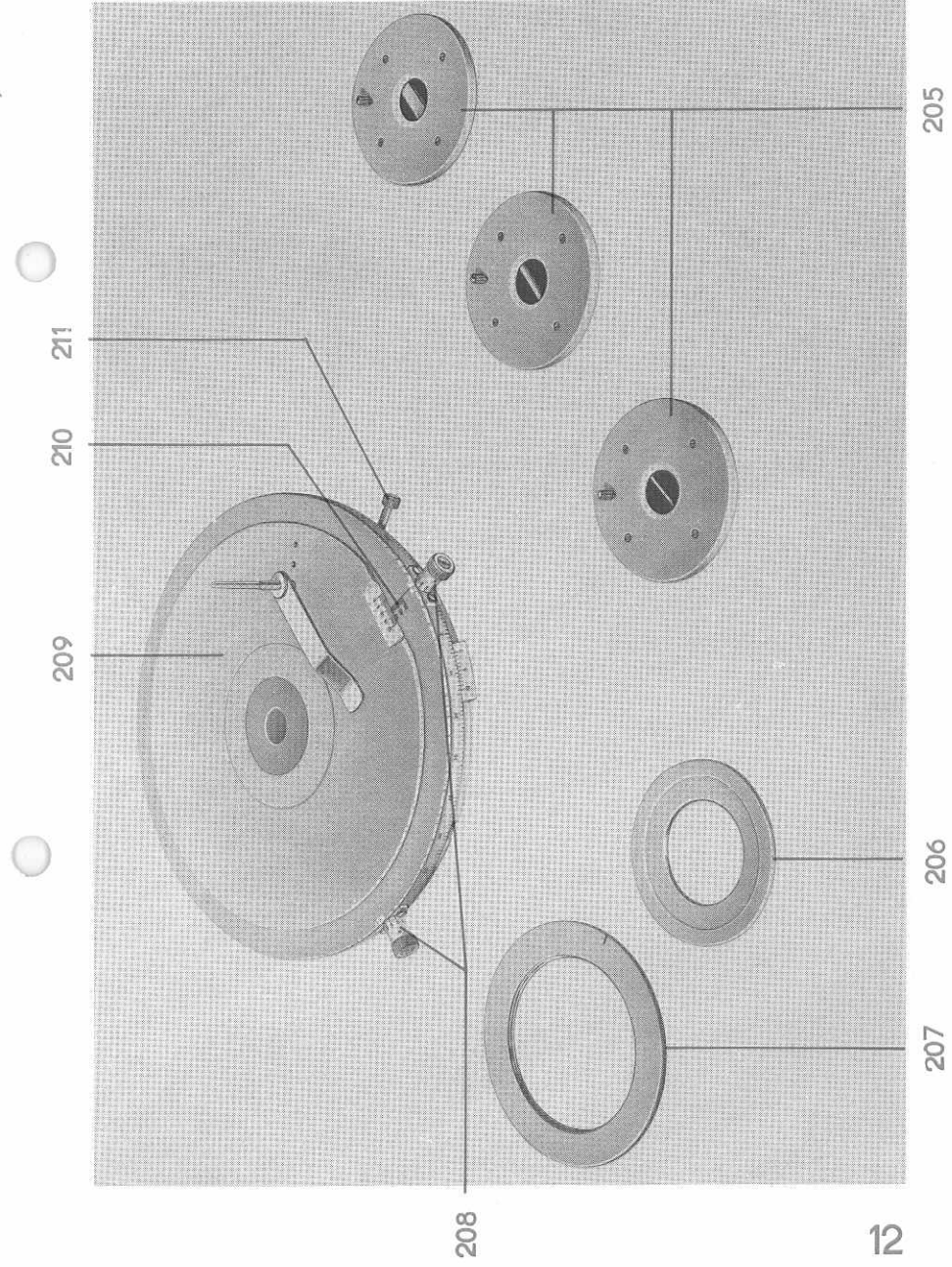
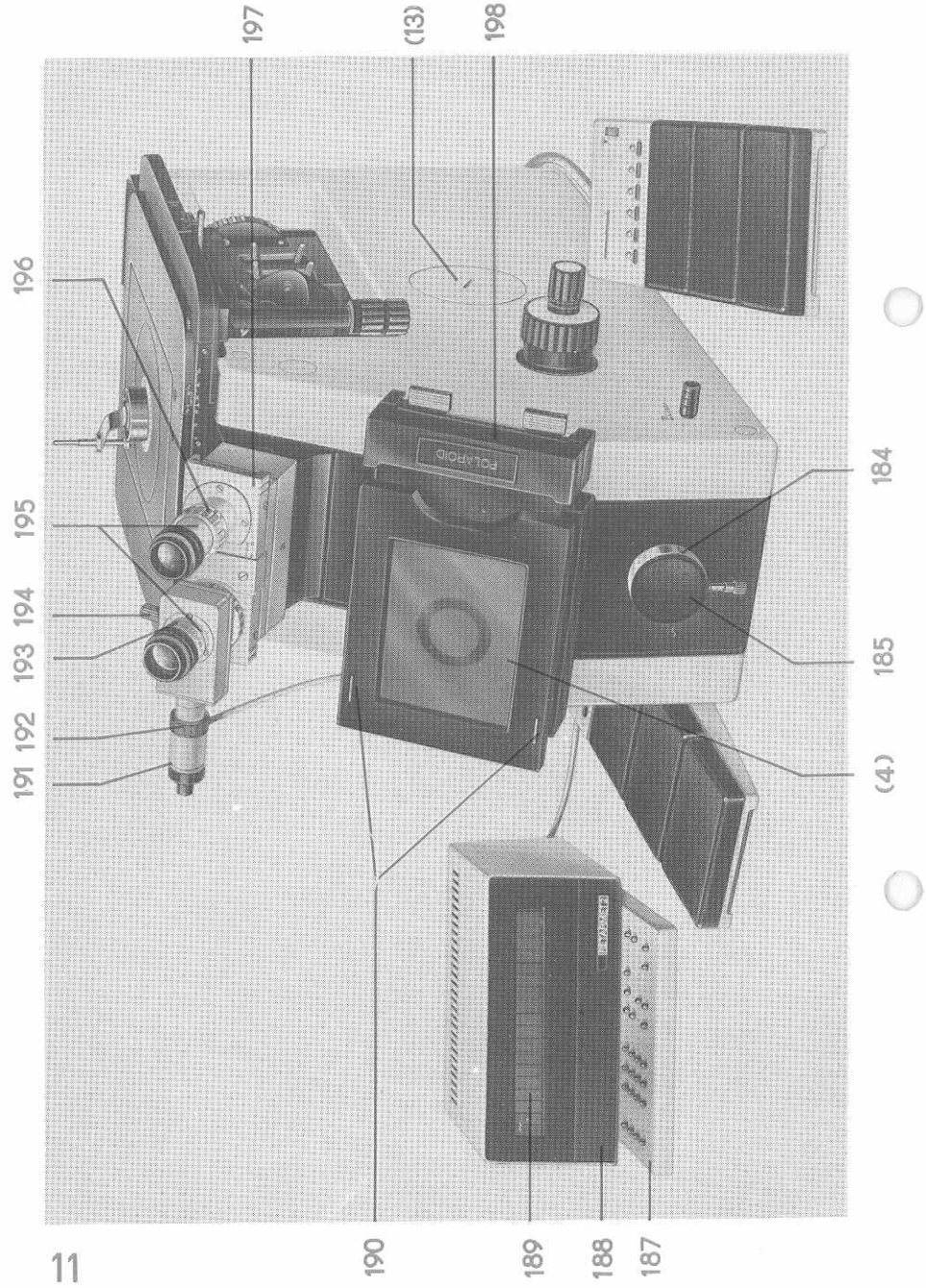
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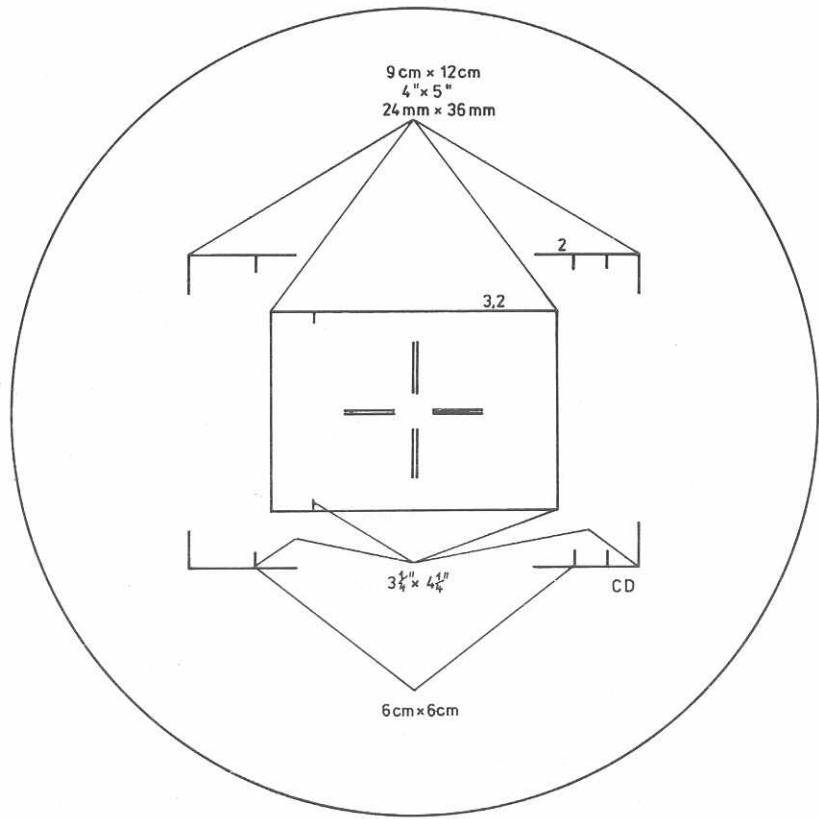


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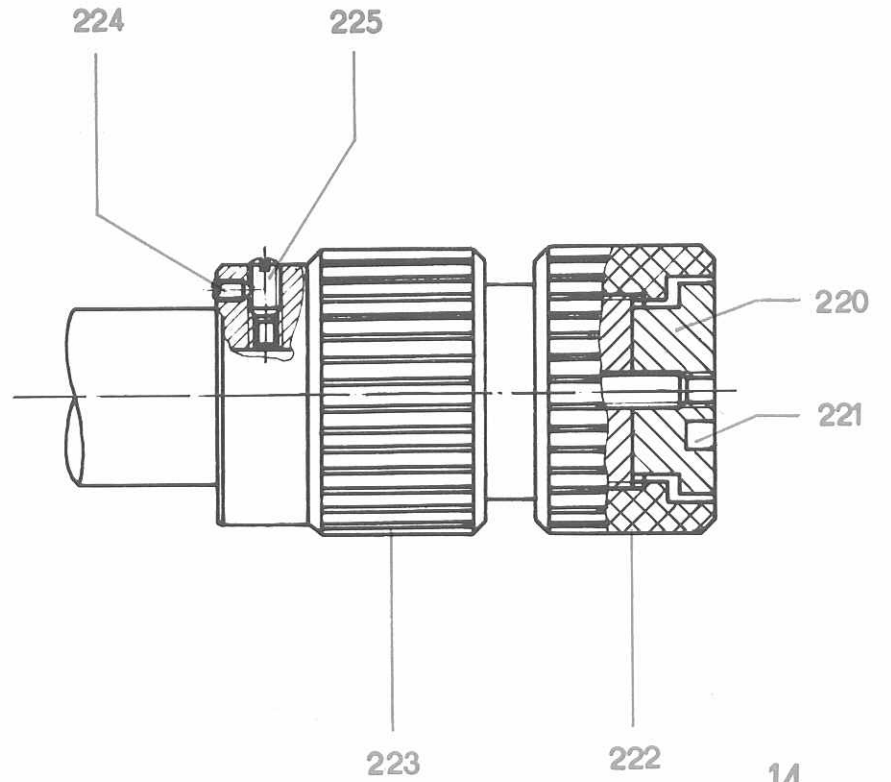




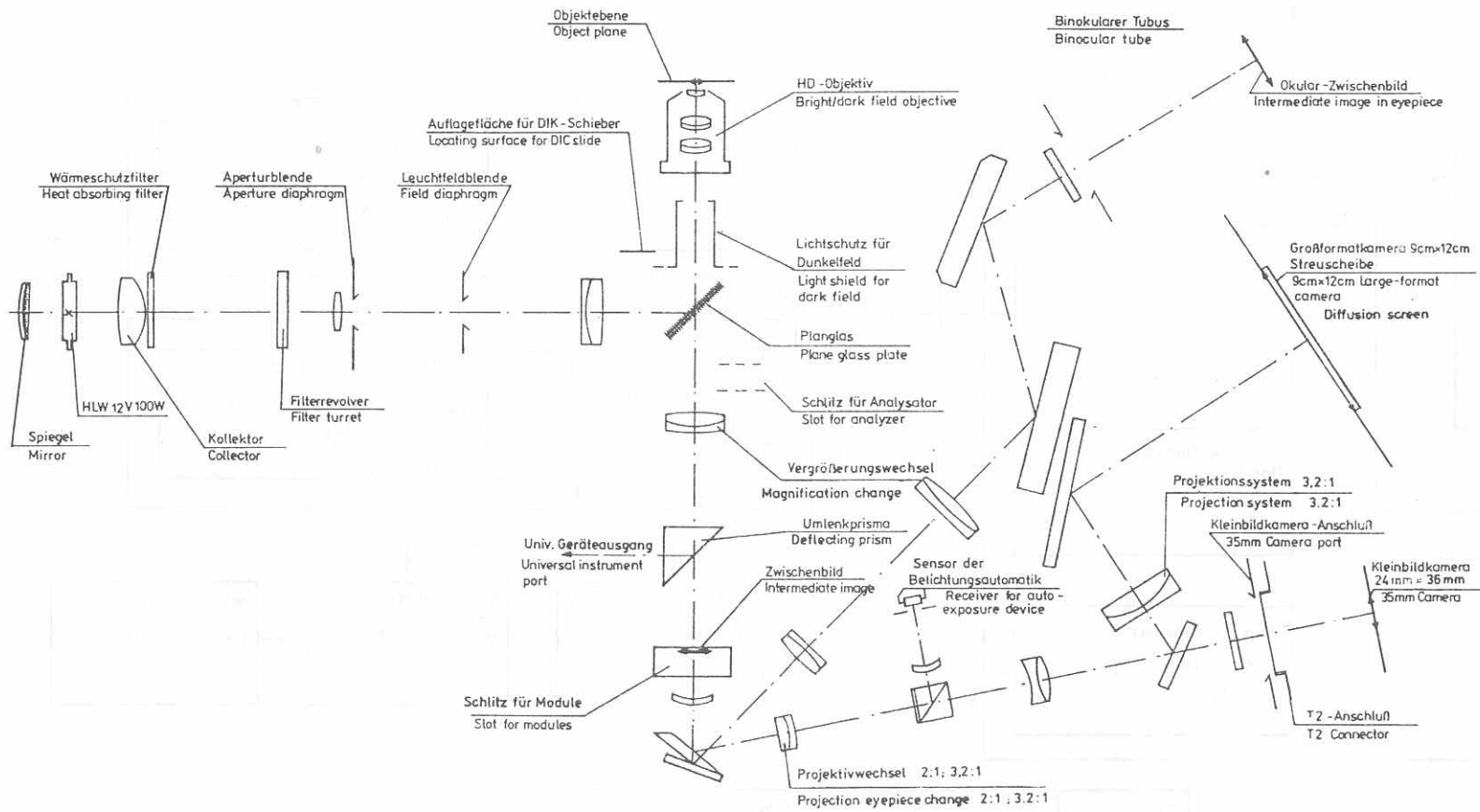




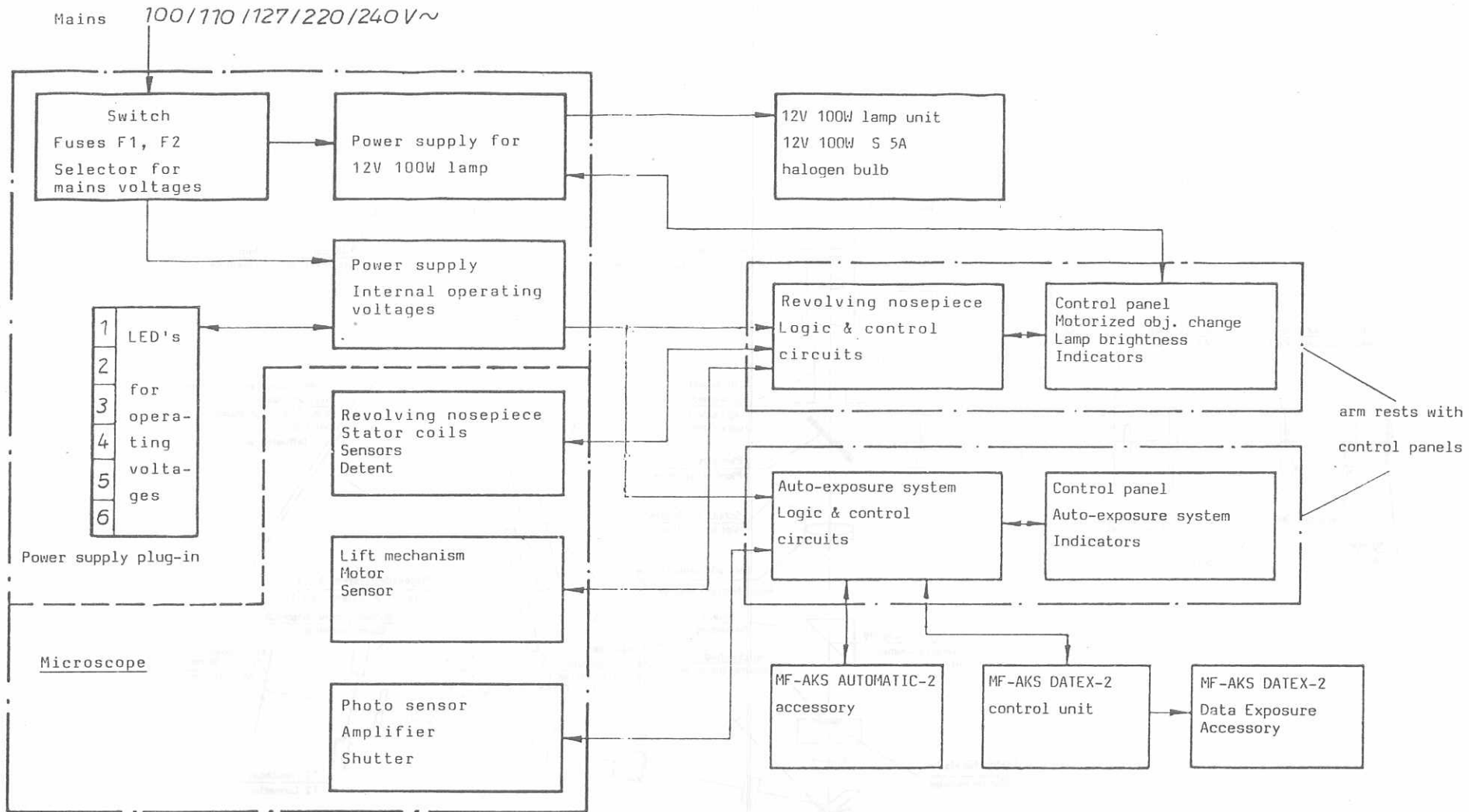
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Schema 1



Fuse	LED	Operating voltage	Fuse rating 100/110/ 127V~ 220/240V~	
F1	-	-	T 2,5 A	T 1,25 A
F2	-	-	T 2,5 A	T 1,25 A
	1 (green)	+ 15 V		
	2 (green)	- 15 V		
	3 (green)	+ 5 V		
	4 (green)	+ 14 V		
	5 (green)	+ 24 V		
-	6 (red)	+ 24 V	electronic fuse	

Scheme 2