# M17 biological microscope instructions

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# BASIC INSTRUCTIONS for M17 BIOLOGICAL MICROSCOPE (type A, B, and C)


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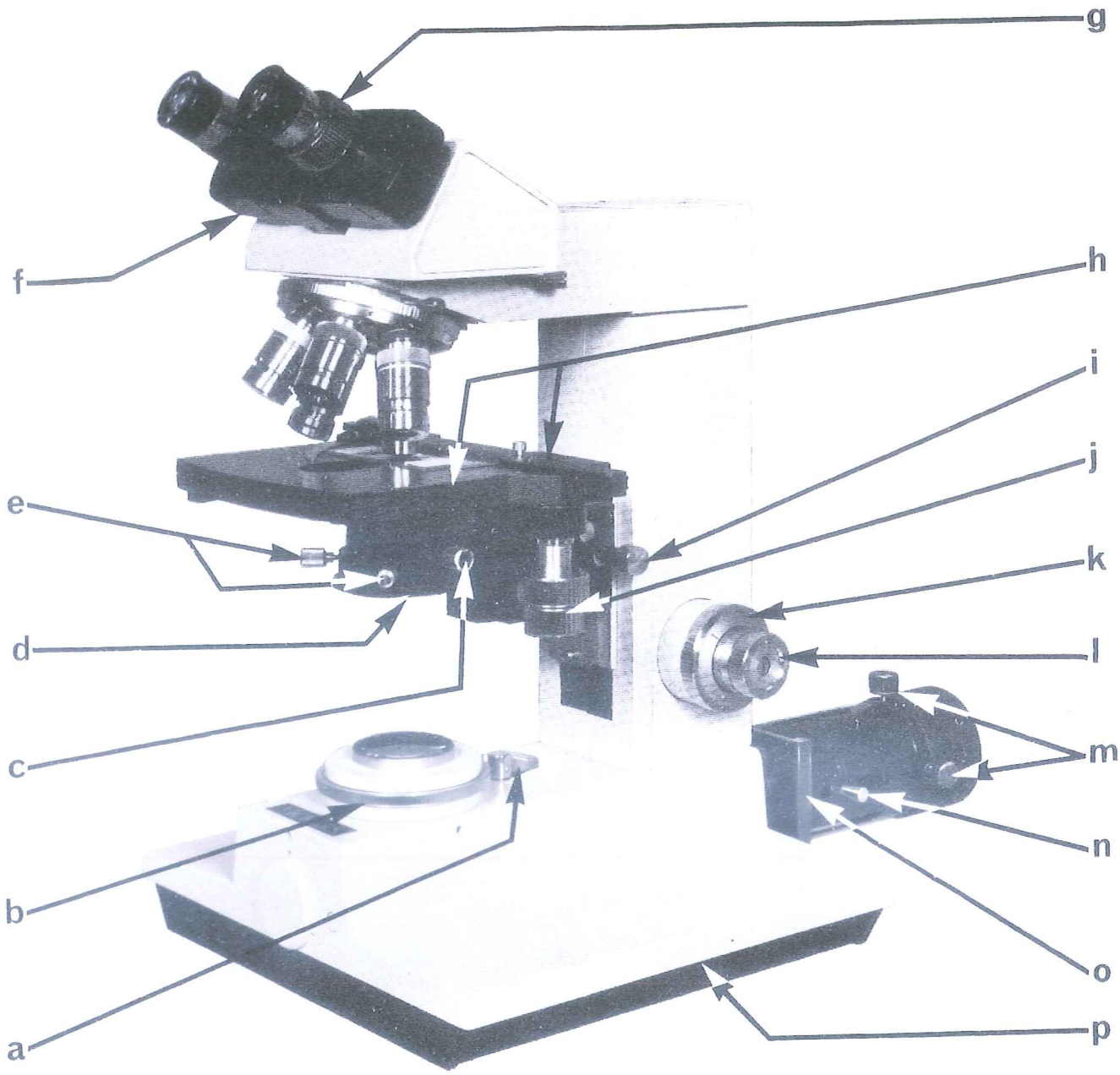
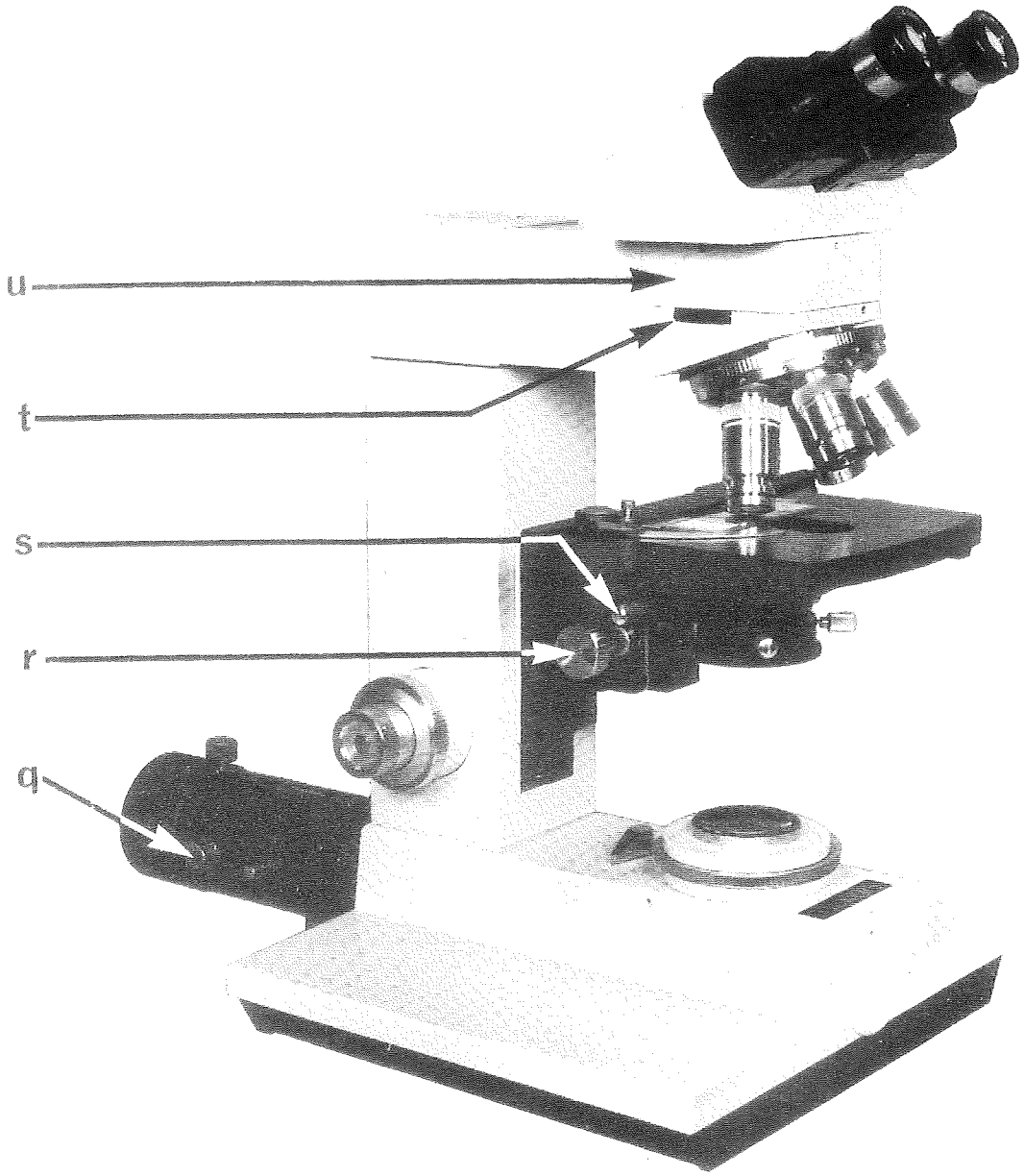



# VICKERS M17 MICROSCOPE (Type B)

## Layout of Controls

a Change lever — base optics
b Field iris
c Trip-out control for condenser top lens
d Aperture iris
e Condenser centring screws
f Interocular distance adjustment
g Dioptric correction collar
h Stage vernier scales
i Auxiliary slide clamp screw
j X-Y stage controls
k Coarse focus knob
l Fine focus knob
m Filament centring controls
n Lamp diffuser slide
o Lamp filter tray
p Recessed hand grips (beneath edge of casting)




# VICKERS M17 MICROSCOPE (Type A)

q Clamp screw — lamp focusing movement
r Substage (condenser) focus
s Clamp screw — condenser bracket
t* Filter slot with dust-excluding slide
u* 25mm field corrector lens module

**25mm microscope (Type A) only — NOT interchangeable with components of 20mm field microscopes (B or C)*

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# M17 BIOLOGICAL MICROSCOPE

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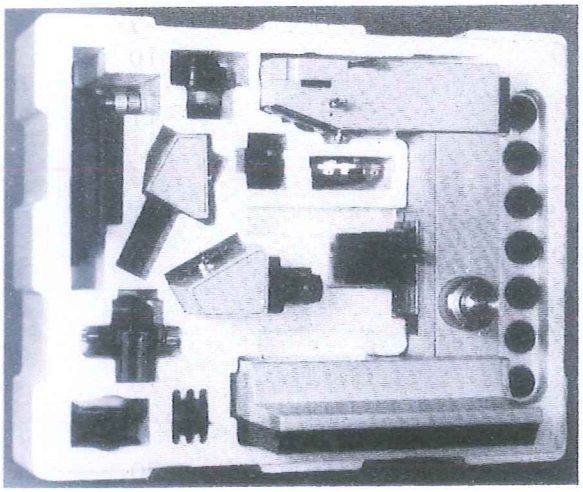


## UNPACKING

The main microscope components will normally be delivered in a two-part expanded polystyrene pack, which may be used for future transport/stowage if required.

Other items such as lamps, power units, photographic attachments etc. will be packed in separate cartons.

Remove all components carefully from their packing and check that they conform to the packing note. Examine the packing materials to ensure that no small items are accidentally discarded.

Dust-excluding rubber plugs and any further protective wrappings should be removed prior to assembly.

See Section 1b for details of electrical connection.

### Lifting and carrying the microscope

Carrying the assembled microscope by means of the horizontal cross-arm is NOT recommended

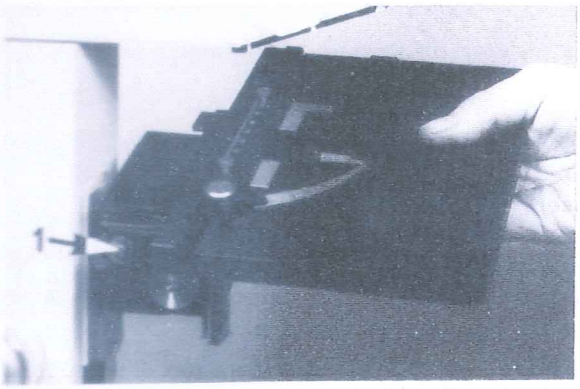
Moulded recesses beneath the edges of the base casting are provided as hand-grips for lifting.

The microscope stand is robust yet light enough to be carried with ease but to minimise risk of accidental damage, major components such as lamphousing and camera should be removed prior to lifting.

### Note: illustrations

The M17 is available in several basic forms. Each text figure illustrates a particular operation or a group of controls; detail differences should be ignored unless specifically mentioned in the text.

# 1. INSTALLATION




## 1a. ASSEMBLY OF BASIC COMPONENTS

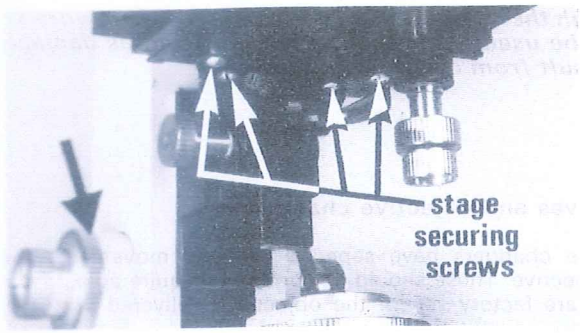
See Section 4 of this manual for details on fitting of common accessory systems.

### Stage — dovetail fitting

Each stage is mounted on a bracket provided with a broad dovetail fitting.

Engage the left-hand edge of the dovetail in the recessed stage-support block and slacken clamp screw (1) until the stage may be lowered into a horizontal position.

Tighten the clamp screw (1) firmly, ensuring that the rear edge of the bracket remains in contact with the vertical face of the support block recess.




### Stage — 4 screw fitting

Attach the stage to the forked support bracket using the four screws provided (entering from below). A short screwdriver is supplied, but additional clearance may be gained by raising the stage with the coarse focus control (arrowed).

Do not tighten the screws fully until the stage has been set to run truly "North-South" and "East-West". Check this, and finally tighten the stage screws during initial adjustment (Section 2b).

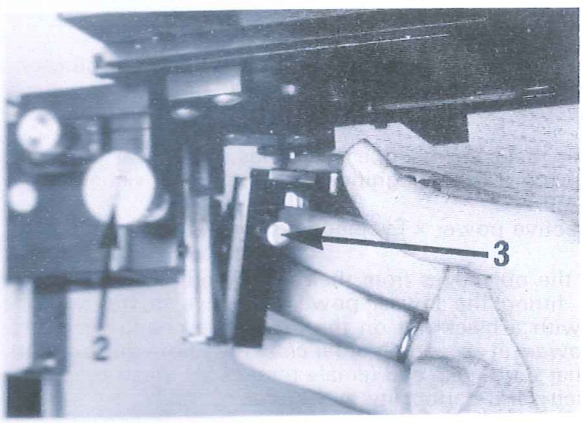
### Condenser bracket — dovetail fitting

A condenser carrier bracket must be attached to the substage dovetail; any standard Vickers condenser may then be used provided that it is mounted in an Akehurst slide.

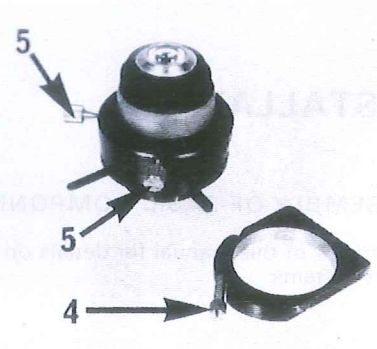
The trip-out achromatic condenser (illustrated) has an integral support bracket and is attached direct to the dovetail.

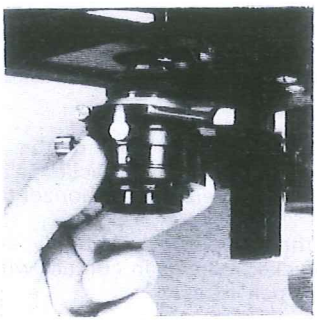
Turn the substage focus (2) to lower the dovetail slightly and engage the right-hand edge of the dovetail in the carrier bracket slot, allowing the weight of the bracket to rest on the retaining plate below the dovetail.

Slacken the clamp screw (3) and swing the bracket into position. Tighten the clamp screw firmly.




***If the dovetail is fully lowered it will be difficult to fit the bracket; also the rack and pinion may disengage. If this occurs, restore mesh by applying gentle upward pressure to the dovetail while turning the substage focus (2) and raise the dovetail until the bracket may be fitted.***



### Condenser

Slip the Akehurst slide over the condenser mount so that the bevelled edges are uppermost and tighten the clamp screw (4) ensuring that the condenser centring screws (5) will face the operator.

Slide the mounted condenser fully into the fork of the support bracket and tighten the clamp screw.

***Although these clamp screws are slotted, a screwdriver should be used only with extreme caution as damage may result from overtightening.***

### Objectives and objective changer

Objective changers have separate centring movements for each objective. These should *not* normally require adjustment as they are factory-set for the objectives delivered with the microscope.

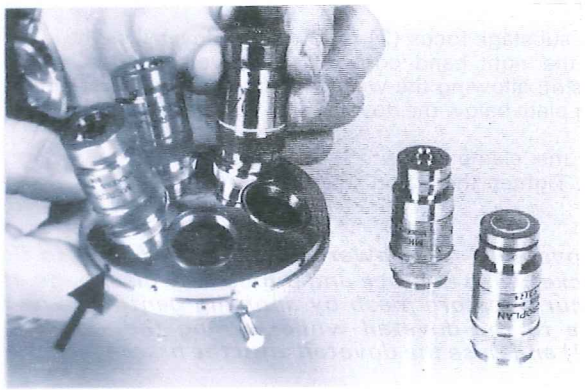
Bright field/dark ground objectives for incident light are factory-centred and mounted on their changer; their settings must not be disturbed.

Objective powers are indicated by engraved numbers and by a coloured band nearer the threaded end of the body:-

| | | | |
|---|---|---|---|
| 2·5X | BROWN | 25X* | DARK GREEN |
| 4X | RED | 40X* & 50X* | LIGHT BLUE |
| 10X | YELLOW | 63X* | DARK BLUE |
| 20X* | LIGHT GREEN | 100X* | WHITE |

**Spring-loaded to avoid damage due to focusing errors*

Objectives for oil immersion carry in addition a black band nearer the front lens; for water immersion this band is white and for glycerol, orange.



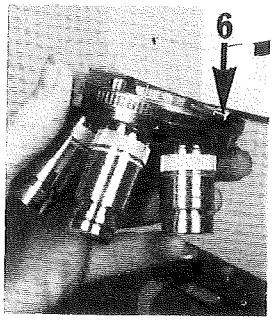
N.B. The 20mm field microscope stand has a unit magnification factor. The visual magnification is simply:

Objective power x Eyepiece power

The 25mm field microscope stand has an optical correction system giving a 0.8x magnification factor. The visual magnification is:

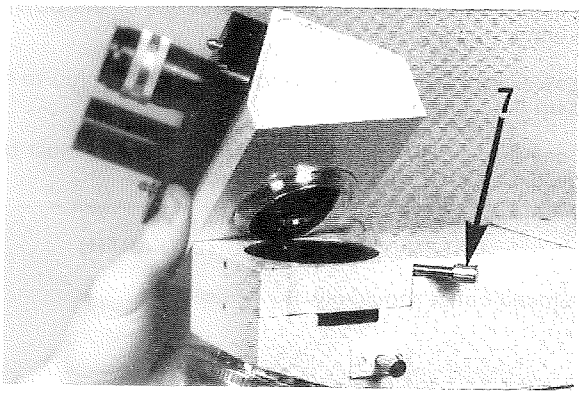
Objective power x Eyepiece power x 0.8

Remove the objectives from their cases and assemble to the changer, fitting the lowest power objective in the aperture marked with a black dot on the rim of the changer and the higher powers in ascending order *clockwise* from this position. Ensure that both male and female threads are clean otherwise parcentricity and parfocality may suffer.




Ensure that the stage is not fully raised and thus in danger of fouling the objectives, and slide the loaded changer onto the inclined dovetail fitting. Tighten the clamp screw (6).

Objective changers should only be rotated by gripping the fluted rim, never by applying pressure to the objectives.

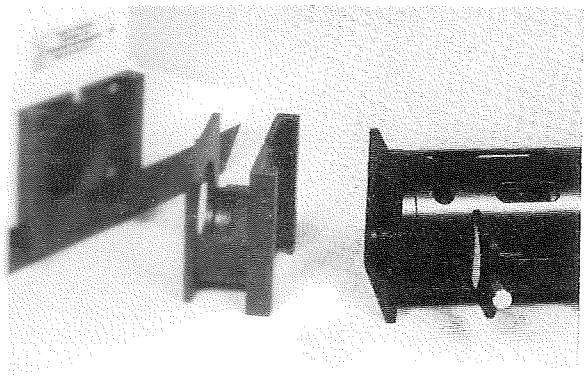



### Viewing head

Slacken clamp screw (7), insert the viewing head cone fitting into the recess in the microscope cross-arm and tighten the clamp screw until the head is firmly gripped. The clamp screw is nylon-tipped and should not be over-tightened.

Insert the eyepiece(s) in the eyetube(s) of the viewing head.

If a focusing eyepiece is supplied with a binocular head, it should be used in the LEFT tube after initial adjustment (Section 2b).



### Lamphousing and lamp filter tray

Lamphousings are attached to the microscope stand by a simple slot-in fixture; to fit a lamp simply lower the lamphouse flange into the slotted shoe at the back of the microscope limb.

The lamp filter tray has male and female fittings identical to those on lamp and microscope respectively and should be simply slotted into position prior to fitting the lamp.

## 1b. ELECTRICAL CONNECTIONS

See Section 5a for details of bulb and fuse replacement.

Two illuminants are normally available:

(a) 6V 30W tungsten filament; standard (6 mm) jack plug connects to variable 6V control unit.

(b) 12V 100W tungsten halogen; 6-pin plug connects to variable 12V control unit.

For all control units, power input connections must be made as follows:-

### 220V and 240V units, 50/60 Hz A.C. ONLY (U.K./ Europe)

Before making any connection, ensure that the operating voltage of the power unit is correct for your local mains supply. The operating voltage is marked on a plate mounted on the casing adjacent to the mains input lead.

The mains lead carries a label with the following wording:

WARNING

THIS APPARATUS MUST BE EARTHED

IMPORTANT

The wires in this mains lead are coloured in accordance with the following code:

| | | |
|---|---|---|
| GREEN AND YELLOW | — | EARTH |
| BROWN | — | LIVE |
| BLUE | — | NEUTRAL |

As the colours of the wires in the mains lead of this apparatus may not correspond with the coloured markings identifying the terminals in your plug proceed as follows:

The wire which is coloured GREEN AND YELLOW must be connected to the terminal which is marked 'E' or ⏚ or coloured GREEN or GREEN AND YELLOW.

The wire which is coloured BROWN must be connected to the terminal which is marked 'L' or coloured RED.

The wire which is coloured BLUE must be connected to the terminal which is marked 'N' or coloured BLACK.

If a 13A plug is used, fit a 3A fuse. If any other plug is used, protect with a 5A fuse in the plug, adaptor, or at the distribution board.

These instructions must be obeyed *in full* to ensure safe operation.

### 100V and 120V units: 50/60 Hz A.C. ONLY (U.S.A. and Japan)

Before use ensure that the power unit supplied is correct for your A.C. line voltage. The operating voltage is marked on a plate mounted on the casing adjacent to the power cord entry.

The power cord terminates in a moulded 3-blade plug to fit standard A.C. line outlets.

If for any reason the cord is cut, the colour coding must be observed carefully when reconnecting:-

| | | |
|---|---|---|
| BLACK | — | LIVE |
| WHITE | — | NEUTRAL |
| GREEN | — | GROUND (EARTH) |

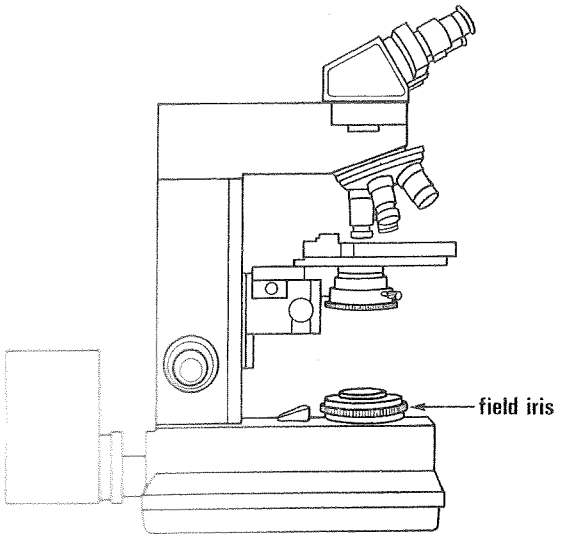
A grounded outlet should always be used.

# 2. INITIAL ADJUSTMENT

## 2a. KÖHLER ILLUMINATOR — PRINCIPAL CONTROLS

Both transmitted and incident lighting systems are designed to provide Köhler illumination when correctly set. The benefits of this method of illumination, which gives optimum contrast and uniformity of illumination in the final image, cannot be achieved unless care is taken in alignment, nor will the full performance of highly corrected objectives be attained. Adjustment is particularly critical when the instrument is to be used for photomicrography.

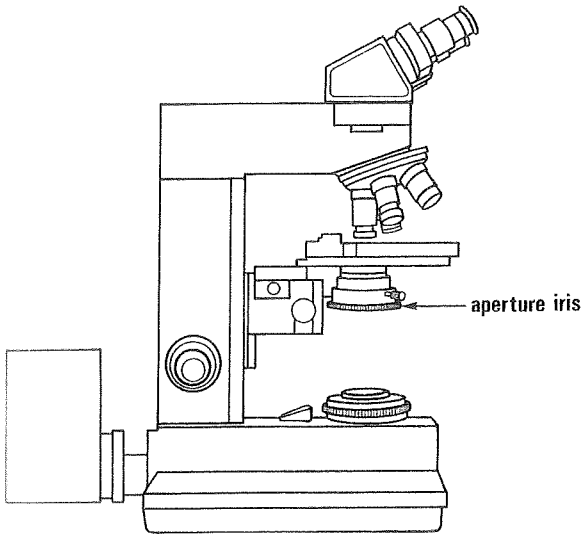
The Köhler illuminator is provided with two variable iris diaphragms which perform quite separate functions.




### The "FIELD" Iris

This iris is positioned so that its image is projected into the specimen plane when the condensing system is correctly focused: it is commonly used as a guide to centration and focus of the illuminator and as its image when closed down appears in the field of view, it is conventionally described as the FIELD iris.

The reduced image of the FIELD iris limits the illuminated area of the specimen, which is normally adjusted to be equal to the real field of view. In this adjustment, specimen features outside the field of view are not illuminated and therefore cannot cause glare or reduce contrast by scattering or refracting light into the viewing optics. For consistent results, the FIELD iris setting should be checked at each change of objective power.




## The "APERTURE" iris

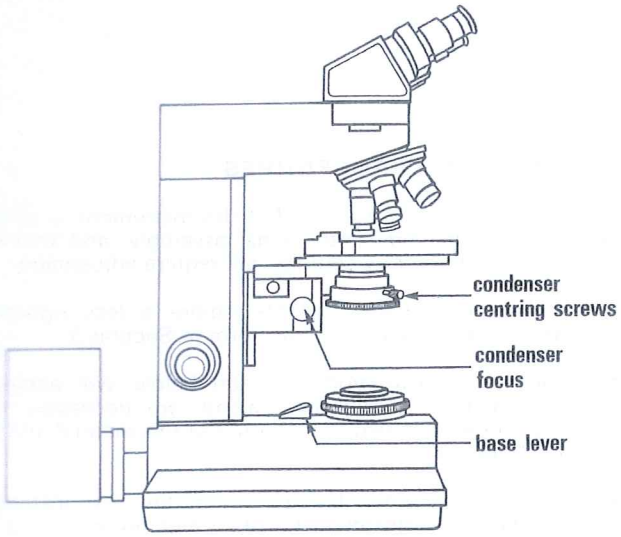
This iris is positioned so that its image is projected into the back focal plane of the objective, which may be observed by removing an eyepiece and inserting an auxiliary (phase) microscope. This projected image effectively controls the numerical aperture of the objective, and thus the iris is conventionally described as the APERTURE iris.

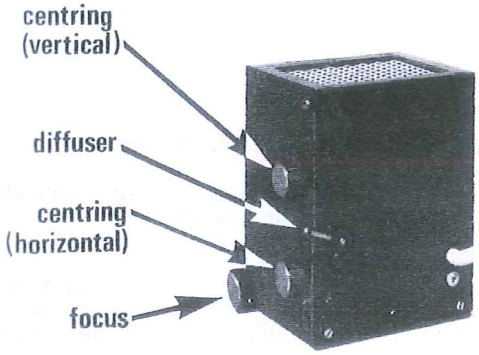
When the objective is working at full aperture, resolution is at its theoretical maximum but image contrast may be relatively poor due to scatter of wide-angle rays.

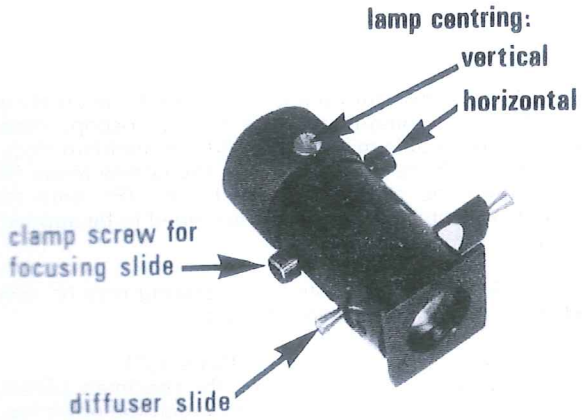
Partial closing of the APERTURE iris eliminates this scattered light and enhances image contrast at the expense of some loss of resolution due to the effective reduction in numerical aperture.

For most purposes the APERTURE iris is adjusted so that its image exposes approximately seven tenths (0.7) of the objective aperture, giving a useful contrast improvement with minimal loss of resolution. Resolution suffers dramatically if the iris is further closed, but this may be tolerable on occasion in view of the "relief" introduced to an otherwise featureless image.

***Careful attention must always be given to APERTURE iris adjustment in view of its powerful control over image quality.***




### The Köhler illuminator—additional controls

For transmitted light, centring and focus controls are mounted in the substage and act on the condenser. A two-position lever on the microscope base operates a lens system which alters the filament magnification as required for high or low power objectives. The transition from 'high' to 'low' depends on the condenser fitted. (See table in Section 2b).

All lamphousings are fitted with bulb centring controls and a focusing movement. The 100 W tungsten halogen source is focused by an insulated knob which operates a rack and pinion movement; the 30 W lamp is focused by releasing a clamp screw and sliding the bulbholder.

To remove the last traces of filament image a diffuser is sometimes required; a trip-lever on the 100 W lamp and a slider on the 30 W lamp permit the diffuser to be inserted or removed at will.

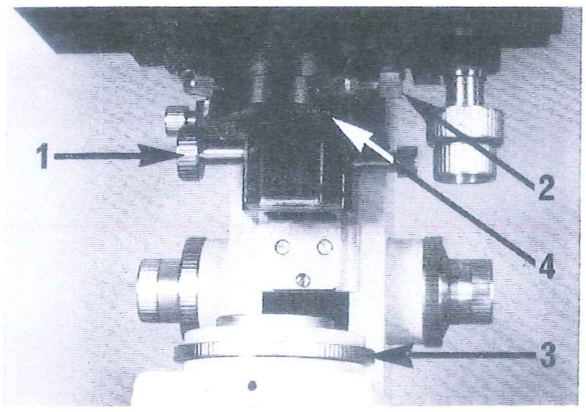
## 2b. SETTING-UP PROCEDURES

In the following, it is assumed that the instrument is to be aligned for the first time after initial assembly, and that all controls other than factory settings will require adjustment.

Routine alignment checks, which require a less rigorous procedure, are summarised in short form in Section 3.

The sequence of instructions detailed below will achieve Köhler illumination; further adjustments are necessary for special techniques, detailed in Section 4 of this manual and in accessory booklets.

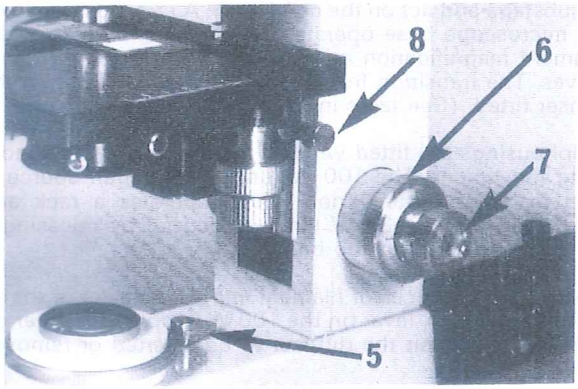
Correct setting of Köhler illumination in the first instance greatly simplifies re-adjustment for other techniques, *and it is strongly recommended that the user becomes thoroughly familiar with basic procedures.*




### Köhler illumination — transmitted light

Rack the condenser to the top of its run using the substage focus control (1). If the trip-out condenser is fitted, trip the top lens IN (2)

Switch on the lamp and verify (by observing the light emitted obliquely by the condenser) that both field (3) and aperture (4) irises are fully open, and that the lamp diffuser is in place




Select the 10x objective, turn the lever (5) on the microscope base to 'LOW' (i.e. pointing towards the microscope limb) and place a recognisable microscope slide of standard thickness on the stage. Raise the stage using the coarse focus (6) and where fitted the auxiliary dovetail slide (8) until the clearance between objective and slide is judged to be approximately 5–6mm ($\frac{1}{4}$")

If a 10x objective is not available, the following may be used as a guide to approximate working distance:

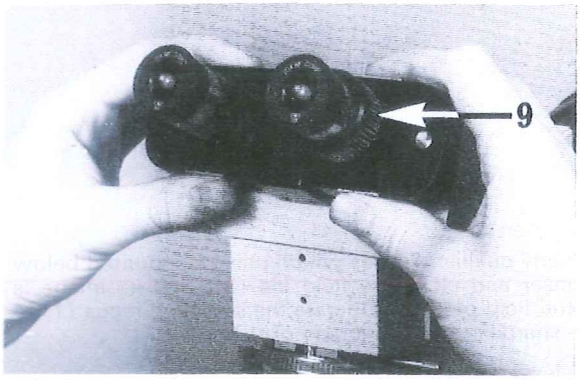
| | | |
|---|---|---|
| 2.5x, and 4x | : | 12 — 13mm ($\frac{1}{2}$") |
| 20x and above | : | < 1mm; the specimen appears *almost* to touch the objective. |

### Adjustment of the binocular head

Adjust the interocular distance of the binocular head to suit your eyes and focus the microscope (6) and (7) to obtain a well-defined image of the specimen in the LEFT eyepiece. This adjustment must be made using the LEFT eye.

Turn the dioptric correction collar (9) on the RIGHT eyetube to establish focus for the RIGHT eye.

*NOTE:* A slightly different procedure is needed where a focusing eyepiece is in use. The focusing eyepiece of a pair is to be used in the LEFT eyetube.




#### (a) Focusing eyepiece with graticule

Before focusing the specimen, rotate the eyelens collar (10) relative to the eyepiece body to achieve a sharply focused graticule image for the LEFT eye. With the focusing eyepiece in the LEFT tube, focus the specimen image onto the graticule and then adjust the dioptric correction collar (9) to suit the RIGHT eye.


#### (b) Focusing eyepiece used without graticule (not recommended)

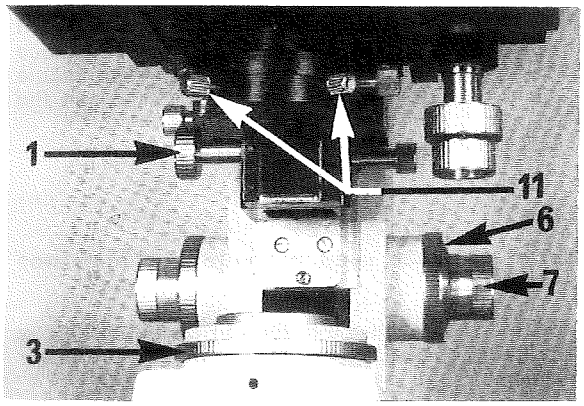
Place the non-focusing eyepiece in the LEFT tube and focus the specimen image for the LEFT eye using the lowest power objective available.

Substitute the focusing eyepiece and adjust the eyelens focus (10) *only* to achieve sharp focus for the LEFT eye without altering the main microscope focus controls.

Return the non-focusing eyepiece to the RIGHT tube and adjust the dioptric correction collar (9) for simultaneous focus in the RIGHT eye.

The binocular head and eyepieces are now adjusted to suit your own eyes; other persons using the microscope may find this unsatisfactory and should repeat the setting procedure to avoid long-term fatigue.

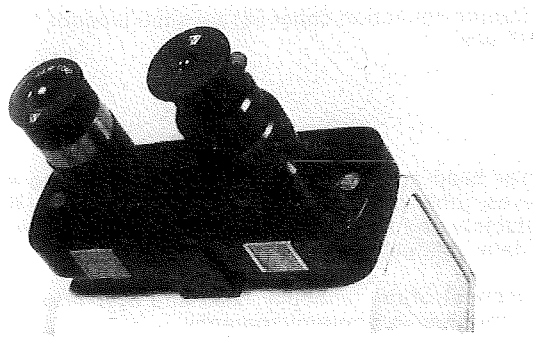
Precise adjustment of the binocular head and eyepieces is of particular importance in photomicrography.



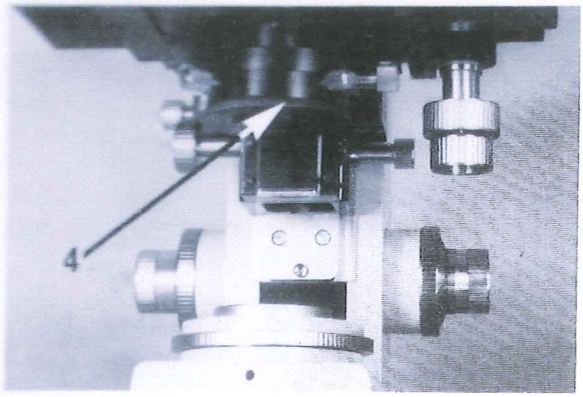

Swing out any auxiliary lenses which may be mounted below the condenser and close the field iris (3) until its image is visible in the field of view. Operate the substage focus (1) to obtain the sharpest possible image of this iris.

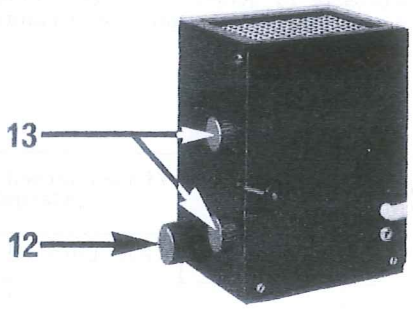
Operate the condenser centring screws (11) to move the reduced image of the field iris into the centre of the field and open the field iris (3) until the full field is visible.

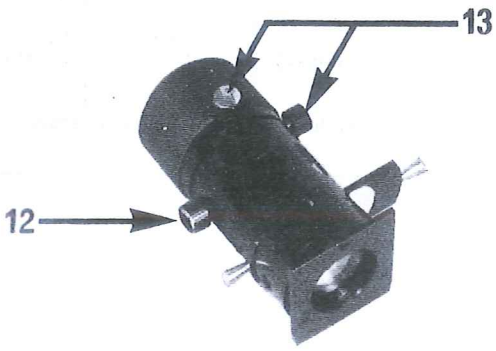
(If an objective below 10x is in use, it may not be possible to achieve full field illumination at this stage with certain types of condenser — see table on p.18)



Remove an eyepiece and inspect the illuminated area at the back of the objective (an auxiliary microscope focused on the back focal plane may be used if available).




Remove the lamp diffuser from the optical path and adjust the lamphouse focus (12) and centring (13) controls to obtain a well-centred and focused image of the lamp filament which fills the objective aperture. A relatively clear area of the slide is advisable for this step, which will be found easier if the lamp intensity is reduced.

Close the APERTURE iris (4) so that approximately seven tenths of the objective aperture is exposed and check the lamp focusing (12). When this is correctly set, slight movements of the eye should cause no motion of the filament image relative to the aperture iris.

Replace eyepiece and commence normal viewing.

If appreciable filament image is visible in the field of view, it is permissible to refocus the lamp slightly (12). The diffuser is normally necessary only to achieve full field illumination at the lowest powers with particular condenser types. See table overleaf.

### Change of objective power

*To change to a higher power objective,* grip the objective turret by its fluted rim and click into its new position, adjusting the fine focus as necessary. For 20x objectives and above, the base lever should normally be set to 'HIGH', i.e. pointing to the left.

Close the FIELD iris to suit the smaller field of view. Remove an eyepiece and open the APERTURE iris to expose seven tenths of the new objective aperture. Replace the eyepiece. No further adjustment should be necessary, but the last two steps should be repeated at each change to a higher power objective.

*To change to a lower power objective,* grip the objective turret by its fluted rim and click into its new position, adjusting the fine focus as necessary. For objectives below 20x the base lever should normally be set to 'LOW', i.e. pointing toward the microscope limb.

Open the FIELD iris to suit the larger field of view. Remove an eyepiece and close the APERTURE iris so that only seven tenths of the new objective aperture is exposed. Replace the eyepiece.

The following table summarises additional operations which may be necessary to achieve full-field illumination at the lowest powers, dependent on the type of condenser fitted.

### Type A microscope – 25mm field of view

| Objective power | Trip-out condenser (M174900) | | Achromatic condenser (M152970) | | Phase contrast condenser (M410975) | |
|---|---|---|---|---|---|---|
| | Base Lever | Top Lens | Base Lever | Aux. Lens | Base Lever | Aux. Lens |
| ⩾20x | HIGH | IN | HIGH | OUT | HIGH | OUT |
| 10x | LOW | IN | LOW | OUT | LOW | IN |
| 4x | LOW | OUT* | LOW | IN (+ Diffuser) | LOW | IN (+ Diffuser) |
| 2.5x† | LOW | OUT* | Not recommended – use M174900 condenser | | | |

* Köhler illumination if condenser refocused with top lens OUT.

† Trip-out condenser M174900 **must** be used for full-field illumination.

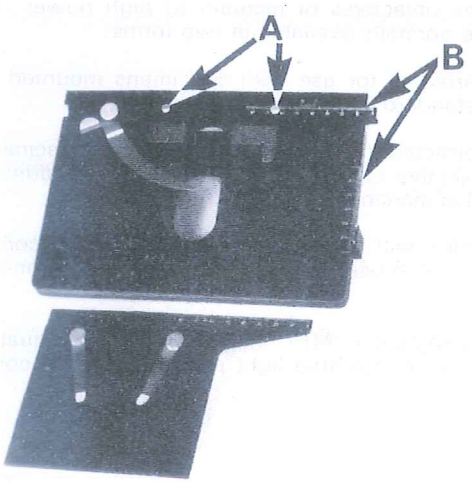
### Type B or C microscope – 20mm field of view

| Objective power | Trip-out condenser (M174900)* | | Achromatic condenser (M152970) | | Phase contrast condenser (M410975) | |
|---|---|---|---|---|---|---|
| | Base Lever | Top Lens | Base Lever | Aux. Lens | Base Lever | Aux. Lens |
| ⩾20x | HIGH | IN | HIGH | OUT | HIGH | OUT |
| 10x | LOW | IN | LOW | OUT | LOW | OUT |
| 4x | LOW | OUT† | LOW | IN | LOW | IN (+ Diffuser) |
| 2.5x | LOW | OUT† | LOW | IN + Diffuser) | Not recommended ‡ | |

* Type B microscope only.

† Köhler illumination if condenser refocused with top lens OUT.

‡ Condenser M410975 is designed for use with phase contrast objectives 10x and above; illumination will be unsatisfactory if used with the 2.5x objective.




NOTES:

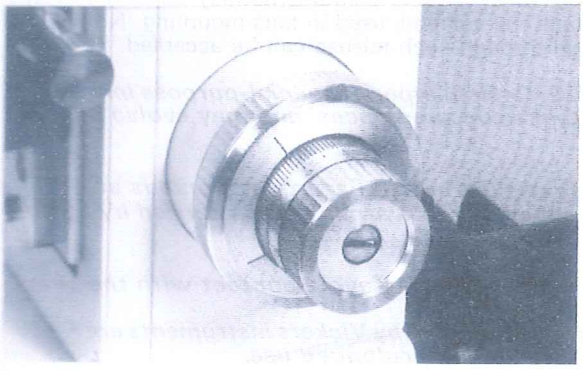
**(i) Stage and focusing movement**

The spring-loaded slide carrier and the incident light adaptor plate for the large mechanical stage are interchangeable by releasing the two screws (A).

Any thin spacer washers below the slide carrier should be refitted.

The travel of the X-Y stage movement is 50mm x 75mm and both movements may be read to 0.1mm by means of the vernier scales (B). This facility is usable with both slide carrier and adaptor plate.

See Section 5 for adjustment of the stage controls.



The 2mm fine focus movement is available at any point in the 38mm coarse focus travel; the right hand fine focus control is graduated for simple depth measurement, each division representing 1 micron stage movement ($10^{-3}$mm).

The focusing mechanism is protected by a spring clutch which will disengage if the end of the focusing travel is reached.

If this occurs, continue turning the coarse focus until the clutch engages with an audible click and raise or lower the stage on the auxiliary slide to gain the required height.

The auxiliary slide (where fitted) offers up to 27mm additional clearance, permitting opaque specimens up to 65mm (approximately $2\frac{1}{2}$") deep to be examined by reflected light using the standard stage.

### (ii) Specimen slides and cover slips

Standard microscope condensers are designed for use with slides of thickness 1.0 – 1.2mm. Glass substrates used in some industrial processes may be considerably thicker than this, rendering precise condenser focusing impossible. Condensers with removable (or trip-out) top lenses are preferred for these applications.

Microscope objectives of medium to high power (20x and above) are normally available in two forms:

(a) Corrected for use with specimens mounted beneath a standard 0.17mm glass coverslip.

(b) Corrected for use with uncovered specimens. The objective body is engraved "MET" in addition to its other markings.

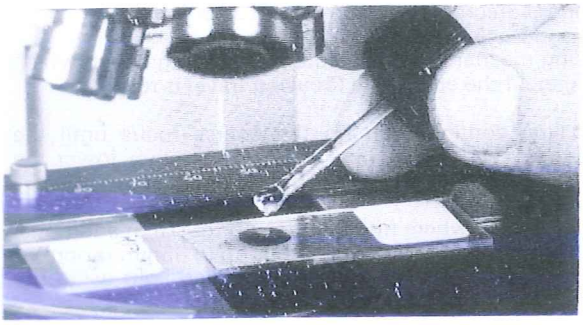
Image quality will deteriorate markedly if the incorrect type of objective is in use, or if the coverglass is of non-standard thickness.

Objectives engraved "MET" may be used with equal success in incident or transmitted light provided that no coverslip is present.

### (iii) Oil immersion

For optimum resolution at high power, oil immersion objectives are used since numerical apertures exceeding 1.0 are then available. Such objectives are engraved "OIL" and should not be used dry. Conversely, dry objectives must *never* be oiled.

As the M17 is designed to DIN standards, only the special DIN immersion oils ($n_D$ = 1.515) supplied by Vickers Instruments must be used. Other oils may have incorrect properties and impair optical performance. Oils other than those supplied by Vickers Instruments may contain solvents which attack the cements used in lens mounting. No liability for damage through such misuse can be accepted.



***WARNING: Certain types of special-purpose immersion oils contain toxic substances, and may evolve harmful vapours.***

***To avoid possible health hazard, scrupulous attention must be given to the warning labels carried by bottles of such oils.***

***Do not ingest or inhale; avoid contact with the skin.***

***Oils currently supplied by Vickers Instruments are P.C.B. free and are safe in prolonged use.***

## Application

The space between specimen and objective lens must be filled with a film of immersion oil containing no bubbles. Extremely small quantities of oil are required; excess should be avoided.

Many microscope users apply a droplet of oil to the slide and raise the stage until the oil wets the front lens of the objective. This method is generally unsatisfactory as air bubbles are likely to be trapped.

The ideal method is to remove the objective from the changer, clean the front lens, apply a small droplet of oil and inspect for air bubbles; apply a drop of oil to the slide, replace the objective and rack the stage up to contact the oiled objective.

The above procedure is tedious; a compromise is achieved by applying a droplet of oil to the specimen and turning the objective changer gently into position so that the wiping action of the objective sweeps air bubbles aside. This operation must be performed without raising or lowering the stage from its normal position.

If the image is poor, check for the presence of bubbles by inspecting the back aperture of the objective with an eyepiece removed. If bubbles are detected, clean both objective and specimen and start afresh; *do not simply apply more oil in an attempt to eliminate bubbles.*

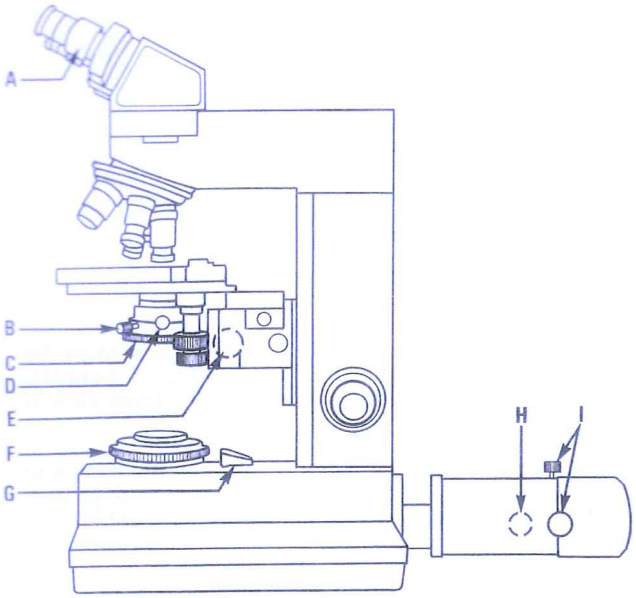
In transmitted light at high power it may be advisable to use also a condenser designed for oil immersion. Unless this is done, the full numerical aperature of the objective cannot be utilised.

In this case a higher viscosity oil is normally used and is applied to the top lens of the condenser prior to racking the condenser into contact with the slide.

Both condenser and objective should be cleaned immediately after use with lens tissues moistened with industrial alcohol. Other organic solvents should not be used.

Only objectives and condensers designed for immersion must be allowed to contact an oiled slide. High power "dry" objectives have short working distances and may be contaminated with oil if insufficient care is taken. Their performance will be severely impaired and they should be cleaned immediately. (See Section 5.)

***The trip-out achromatic condenser should not be oiled unless the high power top lens assembly is fitted (1·3 N.A.).***



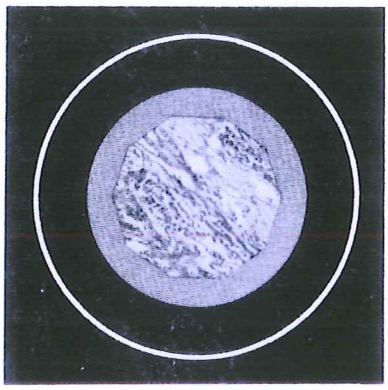



**Fig. 3.1 Image before re-opening field iris. Condenser correctly focused and centred.**

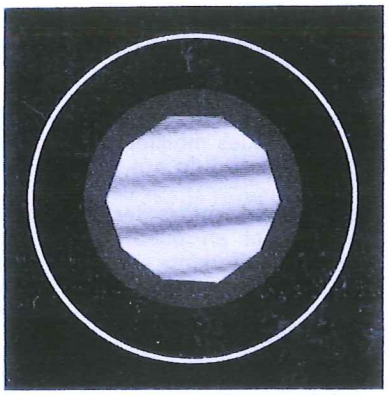


**Fig. 3.2 View with eyepiece removed. Aperture iris set correctly, filament centred and focused.**

# 3. SHORT-FORM OPERATING INSTRUCTIONS FOR ROUTINE USE

The following short-form instructions assume that the instrument has been in use and is therefore not grossly out of alignment. Reference to the detailed instructions in Section 2 should be made if a fault is suspected or if the user is not familiar with basic procedures.

### Transmitted light observation (bright field)

Follow this procedure in full if the trip-out condenser is fitted; other condensers require different settings for low power objectives—consult table in Section 2b.

(i) Switch on the lamp, place the specimen slide on the stage and rack the condenser to the top of its travel.

(ii) Select a medium to low power objective (10x); set the base lever (G) to LOW, and trip the condenser top lens firmly IN (D).

(iii) Adjust the interocular distance of the binocular head, set the focusing movement (where fitted) of the LEFT eyepiece, and focus the specimen image for the LEFT eye. Adjust the dioptic correction collar (A) for the RIGHT eye.

(iv) Partly close the FIELD iris (F) and focus the condenser (E). Centre the field iris image using the condenser centring screws (B). Reset the FIELD iris to expose the full field of view.

(v) Remove an eyepiece and check the "seven tenths" APERTURE iris setting; remove the diffuser and check bulb alignment. Adjust if necessary (C) (H) and (I).

(vi) Replace eyepiece and observe specimen, inserting diffuser if required.

(vii) For higher magnification, swing the new objective into position, (oiling if necessary), turn the base lever (G) to HIGH, refocus and repeat steps (iv) (v) and (vi).

(viii) For objective powers below 10x, swing in the new objective, trip the condenser top lens (D) OUT, and set the base lever (G) to "LOW", Refocus the image as necessary and open both irises (F) and (C) to suit.

(ix) For true Köhler illumination at low powers the condenser must be racked down to a new focus; Repeat (iv), (v) and (vi) with the condenser top lens tripped OUT, and the base lever set to "LOW".

N.B. The 20mm field microscope stand has a unit magnification factor. The visual magnification is simply:

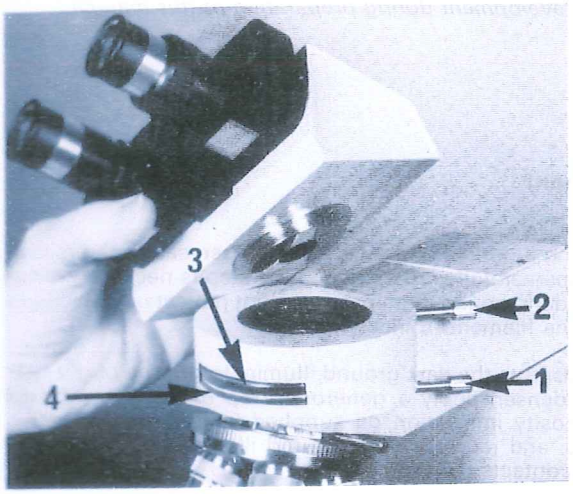
Objective power x Eyepiece power

The 25mm field microscope stand has an optical correction system giving a 0.8x magnification factor. The visual magnification is:

Objective power x Eyepiece power x 0.8

Photographic magnifications are tabulated in Section 6e.

# 4. ADDITIONAL INSTRUCTIONS for BASIC ACCESSORY SYSTEMS




### 4a MAGNIFICATION CHANGER (cannot be used on Type A wide field microscope)

Remove the viewing head by releasing clamp screw (1) while supporting the head to ensure that it does not fall when unclamped.

Insert the male cone of the magnification changer in the microscope arm and clamp with screw (1).

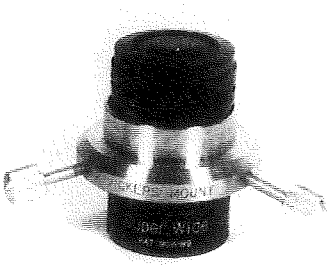
Refit the viewing head and lock in position with clamp screw (2) on the magnification changer.

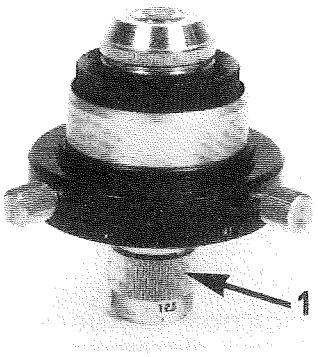
Magnification factors of 1.0x, 1.25x and 1.6x are selected by rotating the upper ring (3). The possibility of empty magnification should be borne in mind, particularly in photomicrography (See Section 6.)

The fourth position 'B' on the upper ring inserts a Bertrand lens which is focusable by rotation of the lower ring (4).

The Bertrand lens is used to observe the objective aperture without removal of an eyepiece, for purposes of basic alignment, adjustment of special accessory systems and for conoscopic observations in polarized light.

## 4b DARK GROUND ILLUMINATION






### High power

Two dark ground illuminators are available:

The Tiyoda condenser is designed for high intensity wide-field illumination with objectives 20x and above.

The Vickers high power dark ground illuminator is fitted with a graduated focusing collar (1) which should be pre-set to suit the thickness of the microscope slide (0·75—1·5mm). Highly corrected dark ground illumination is achieved with objectives 40x and above; below 40x the field of view is not uniformly illuminated.

Both condensers are designed for oil immersion; they cannot be used dry.

| | Working Distance | Numerical Apertures |
|---|---|---|
| Tiyoda (M150970) | 0.9mm | 1.2 – 1.4 |
| Vickers (M151970) | 0.4mm | 1.15 – 1.4 |

The Numerical Aperture of the objective must not exceed the lower N.A. of the dark ground illuminator, or direct light will be transmitted to the eye, destroying the dark ground image. The standard 100x objective (N.A.1·25) cannot be used thus; only the 100x objective with built-in iris diaphragm* should be used with its aperture stopped down to about 1·0.

**Under development during preparation of this manual*

### Adjustment

(i) Using a normal bright field condenser, set up the microscope carefully. This preliminary step is necessary since the dark ground illuminators do not project useful images of the filament or irises.

(ii) Substitute the dark ground illuminator for the bright field condenser, apply a generous drop of the special high viscosity immersion oil supplied for use with condensers, and rack the dark ground illuminator up until the oil contacts the slide.

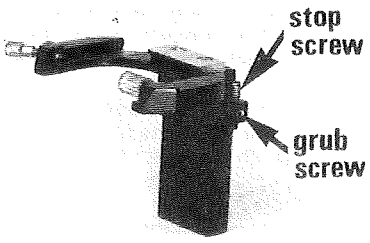
(iii) Select the 10x objective, turn the lamp intensity up and open the field iris. An illuminated spot or halo will now be observed in the field of view.

(iv) Adjust the substage focus to achieve a uniform, high intensity spot of light and centre this spot in the field of view using the condenser centring screws.

(v) Change to the higher power viewing objective.

The lever on the microscope base should normally be set to LOW. If illumination is not completely uniform, the lamp focusing *(not centring)* may be slightly adjusted; the diffuser should not be used as it reduces light intensity dramatically.

The iris built into the 100x objective should be simply closed until the maximum image contrast is achieved.



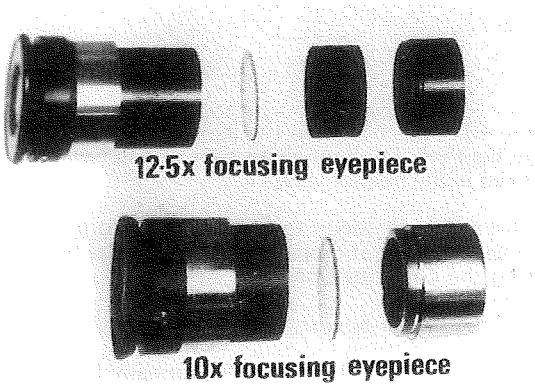

*NOTE:* The substage condenser bracket carries a pre-set stop screw which prevents the condenser being racked into contact with the slide; this screw may need adjustment to permit focusing with the dark ground illuminator. The screw is mounted vertically on the LEFT of the bracket on the Type C microscope and on the RIGHT on all others; it is locked in position by a small horizontal grub screw. If adjustment is necessary, release the grub screw and adjust the vertical stop screw until the condenser may just be racked into contact with the slide; do not attempt to over-tighten the grub screw after adjustment.

### Low power

Dark ground illumination at moderate to low power is rarely required, and no special condenser is manufactured. Acceptable dark ground illumination may be achieved by means of the phase contrast condenser if *low* power objectives are used with the phase annuli (Nos. 2 or 3) intended for *high power* phase objectives.

The main requirement is simply that the annulus is large enough to lie *completely outside* the objective aperture (viewed with Bertrand lens or auxiliary microscope). The phase annulus then functions as a dark ground patch stop and prevents direct light entering the objective.

Field and aperture irises should be adjusted by experiment to give optimum image contrast; see table in Section 2b for further information. The phase condenser will not fully illuminate the field of the 2.5x objective.



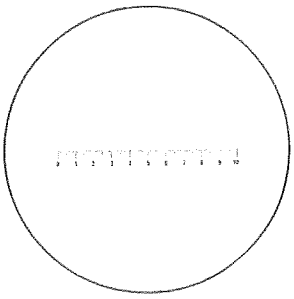



**Fig. 4.1 Standard measuring graticule. 1 cm ÷ 100 (M047312).**

## 4c SIMPLE MEASUREMENT USING EYEPIECE GRATICULE

Both 10x and 12.5x focusing eyepieces are designed to accept graticules 21mm (0.825") diameter. The focal planes of these eyepieces are internal, and it is necessary to unscrew the lower portion of the eyepiece body to fit a graticule.

*Do not attempt to remove the framing graticule from the focusing eyepiece supplied with camera equipment.* The graticule is cemented in a predetermined position relative to the external scale for rotational alignment of the camera and must *not* be disturbed.

A machined recess in the upper section of the 10x eyepiece body locates the graticule, which is held in position by screwing home the lower portion of the eyepiece.

The 12.5x eyepiece has an internal sleeve which incorporates a machined recess at its upper end to locate the graticule. Gently remove the sleeve from the upper portion of the eyepiece body, place the graticule in the recess, and refit the sleeve. Secure by screwing home the lower portion of the eyepiece body.

Great care must be taken to ensure that the graticule is scrupulously clean and that no dust is allowed to enter the dismantled eyepiece. Any foreign matter on the graticule will be immediately noticeable, since it lies in the eyepiece focal plane and will appear superimposed on the specimen image.

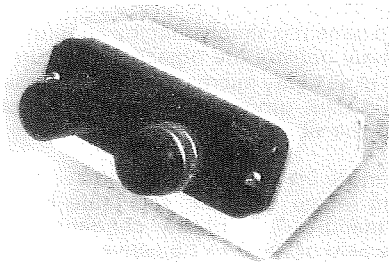
Measuring graticules should be fitted so that numerals and other markings appear correct in the final image. If numerals are reversed, the graticule should be removed, turned over and refitted.

For general use, the most suitable graticule is a 1cm scale divided into 100 equal parts.

### Calibration

The optical system must be calibrated for each objective used in measurement.

This calibration will be valid for all users of the microscope provided that the instructions on adjustment of the eyepiece and binocular head are followed carefully by each individual prior to making a measurement.



### IMPORTANT

***This does NOT apply to the simpler binocular head M171800, which has no tube-length compensating mechanism. Changes in interocular setting alter the tube length and hence the magnification; each user MUST determine his own calibration factor for each objective when using this viewing head.***

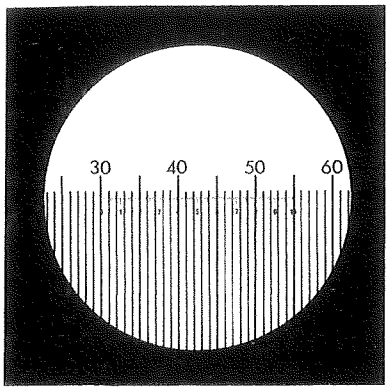



Fig. 4.2 **Eyepiece graticule superimposed on magnified image of stage micrometer.**

Insert the measuring eyepiece in the LEFT tube and adjust the microscope and illuminating system as detailed in Section 2b, taking particular care over binocular head and aperture iris settings.

Place a stage micrometer on the stage and position it so that its image is superimposed on, and aligned with, the eyepiece graticule.

By comparing the two superimposed scales, determine the number of microns at the specimen surface spanned by one eyepiece graticule division. The stage micrometer scale is 1 mm divided into 100 parts, thus each division equals 10 microns ($\mu$).

*Example:* With a particular objective, the image might appear as illustrated, 40 graticule divisions spanning 10 divisions of the stage micrometer (100 $\mu$).

*Thus:*

40 divisions of eyepiece graticule } represents { 100 microns at specimen surface

$\therefore$ 1 graticule division } represents { $\frac{100}{40}$ or 2·5 microns at the specimen

A "micrometer value" of 2·5 microns per division should be recorded for this objective.

If in subsequent measurement with this objective it is found that a feature of the specimen is spanned by, say, 28 divisions of the eyepiece graticule,

*Then:*

| Dimension of feature | = | Number of divisions | x | Micrometer value |
|---|---|---|---|---|
| | = | 28 | x | 2.5 |

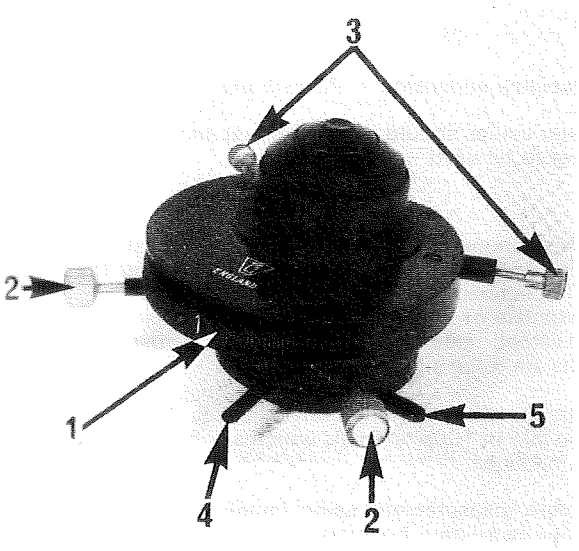
*Specimen dimension = 70 microns*

Similar micrometer values should be determined and recorded for each objective to be used.

In any micro-measurement careful setting-up is most important. Incorrect aperture iris adjustment may change the apparent size of specimen features (dark features tending to expand at the expense of bright areas if the iris is closed excessively). Consistent, careful adjustment by all users is *essential* if results are to be significant.

At lower powers it will be more convenient to base the calibration on the 50$\mu$ or 100$\mu$ intervals which are indicated by the longer scale markings.

For precision micro-measurement using image-splitting devices, see separate instruction booklets.




## 4d. PHASE CONTRAST

The semi-achromatic research phase contrast condenser has a Numerical Aperture of 0.95; it must not be oiled to the slide even when using objectives of high Numerical Aperture.

The condenser is primarily designed for use with the 10x, 25x, 40x, 50x and 100x phase objectives but may be used for bright field observations at all but the lowest powers. The very wide field of the 2.5x objective will *not* be satisfactorily illuminated, particularly on the Type A (25mm field of view) microscope stand.

The annular phase apertures are mounted in disc (1) which has five positions; each position is positively located by a sprung "click-stop" mechanism.

0 — clear; for bright field observation

1 — Ph 1; for 10x objective

2 — Ph 2; for 25x, 40x objectives

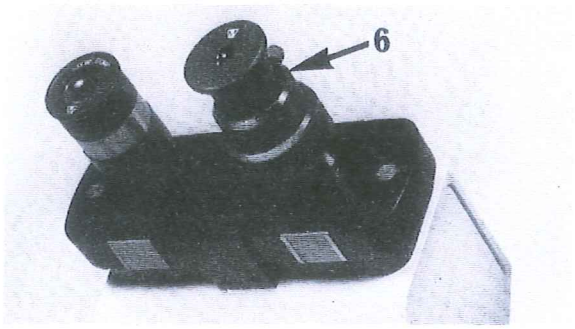
3 — Ph 3; for 50x, 100x objectives

4 — clear; spare aperture with centring facility.

In addition to the normal condenser centring screws (2) which face the operator, two annulus centring pins (3) are fitted. These pins are spring-loaded and must be depressed to centre each annulus individually.

The aperture iris (4) for bright field observations is mounted below the disc carrying the phase annuli; its image will *not* be be sharply focused behind the objective when the condenser is correctly adjusted. This is of little importance since the iris plays no part in phase microscopy.

Auxiliary lens (5) should be swung IN only for bright-field with the 4x objective; it must be swung OUT for higher objective powers.



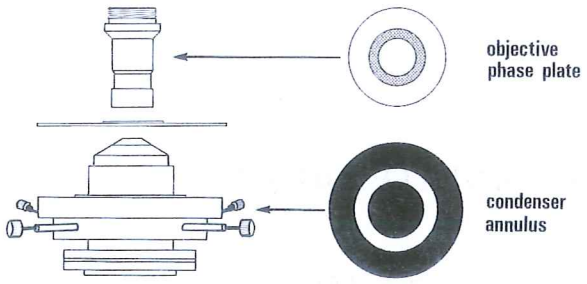




**Fig. 4.3 (a) Location of phase plate and annulus.**

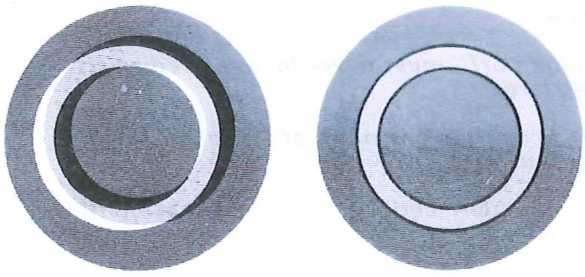



**Fig. 4.3 (b) As seen with eyepiece removed.**

(i) Turn the annulus disc to position 0, and carefully set up the microscope for bright field with the 10x objective. Use a recognisable stained slide and consult Section 2b or 3 if in doubt (pp 14 – 17 and 22).

(ii) Select a reasonably clear area of the specimen slide, open the aperture iris (4) and turn the annulus disc to position 1.

(iii) Insert the auxiliary microscope (6) in place of one eyepiece and focus on the phase ring and annulus now visible. If the magnification changer is available, the focusing Bertrand lens (position B) may be used *without* removing the eyepiece.

(iv) Press in the annulus centring pins (3) and turn them until annulus and phase ring are exactly superimposed.

Release the centring pins, which will disengage from the centring screws under spring pressure.

(v) Replace the eyepiece (or swing the Bertrand lens out) to view the correctly adjusted phase image, substituting an unstained preparation for the slide used in setting-up.

Each annulus must be individually centred to the appropriate objective by repeating this procedure. With careful handling, continual readjustment should not be necessary; coincidence of phase ring and annulus should simply be checked before use.

### Filters

The phase contrast microscope employs an optical interference effect to convert invisible phase changes to visible amplitude variations. Contrast is enhanced by using a coloured filter to limit the range of wavelengths which contribute to the final image.

The green filter is particularly suited to the optical corrections of Microplan objectives, and should be regarded as an essential part of the phase system.

As preparations for phase microscopy are normally unstained the inclusion of a colour filter causes no problem in interpreting the image.

# 5. BASIC MAINTENANCE

## 5a. BULB AND FUSE REPLACEMENT

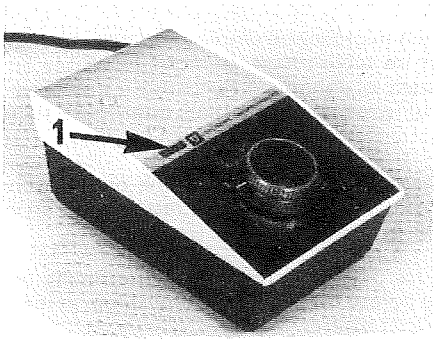
IMPORTANT

***Electrical equipment must be completely isolated by removing the plug from the mains socket (line outlet) before servicing.***

***Simply "switching off" must never be regarded as an adequate safeguard.***

***Never attempt to operate any piece of equipment with safety covers removed.***

***Allow time for complete cooling before attempting to handle a failed bulb.***

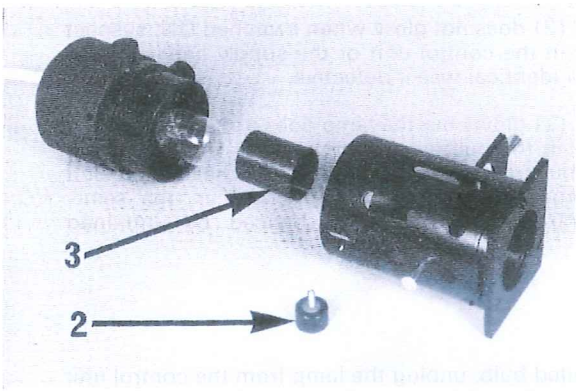



### (i) 6V 30 watt lamp and control unit

The control unit is *not* fitted with an internal fuse; it must be protected by a 3 Amp fuse either in the plug, socket or distribution board.

If the indicator (1) does not glow when switched ON, suspect the fuse; test and replace with an identical fuse if defective.

If the indicator (1) glows but the lamp does not illuminate, the fault lies either in the bulb or the low voltage winding of the transformer. If bulb replacement does not cure the fault consult a Vickers Instruments trained Service Engineer; the semiconductor control unit *cannot* be serviced by untrained personnel.




To replace a failed bulb, unplug the lamp from the control unit as a safety precaution and completely remove the screw (2) which clamps the bulb focusing movement.

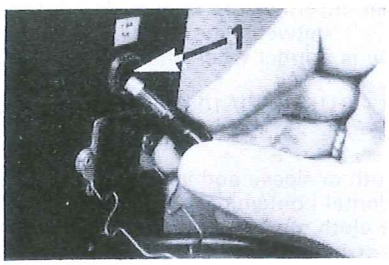
Slide the bulbholder out of its housing, remove the blackened metal sleeve (3) from the bulb and release the bulb from its bayonet fitting by depressing and turning 45° anti-clockwise. Check that the sprung contacts in the bulbholder are clean and move freely; insert the replacement bulb, turn it 45° clockwise to secure, and refit the metal sleeve. (3).

REPLACEMENT BULB: 6V 30W Vickers Code M006033 Pack of three (lifetime = 1500 hours at 6 volts).

Re-assemble the lamp and secure with clamp screw (2).

Ensure that the control unit is switched OFF before plugging in the lamp. It will be necessary to repeat the focusing and centring adjustments described in Section 2b before use.

Uncontrollable lamp intensity or the need for regular fuse replacement indicates an internal fault demanding attention by a Service Engineer.




### (ii) 12V 100W lamp and control unit

A fuseholder (1) is mounted on the back panel of the control unit, adjacent to the mains lead (power cord) entry.

For absolute safety, the plug should be removed from the mains socket (line outlet) before replacing the fuse.

REPLACEMENT FUSE: 1.6A A/S (Anti-surge) Cartridge type, 20mm x 5mm.


If the indicator (2) does not glow when switched ON, suspect the fuse either in the control unit or the supply line; test and replace with an identical fuse if defective.

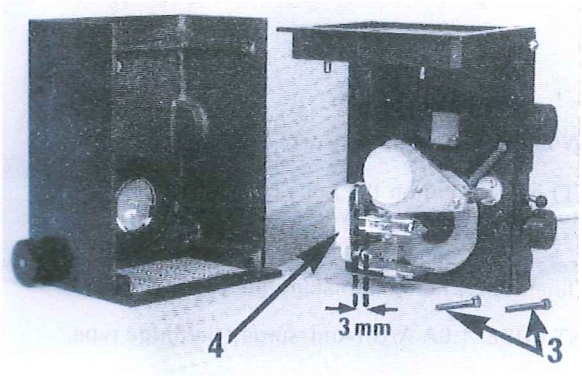
If the indicator (2) glows but the lamp does not illuminate, the fault lies either in the bulb or the low voltage winding of the transformer. If bulb replacement does not cure the fault consult a Vickers Instruments trained Service Engineer: the semi-conductor control unit *cannot* be serviced by untrained personnel.

To replace a failed bulb, unplug the lamp from the control unit as a safety precaution and remove the two red-painted screws (3) at the back of the lamphousing; lift the backplate assembly clear of the lamphousing.

***Do not attempt to handle the bulb with the fingers until it has cooled completely – the operating temperature is extremely high.***

When cooled, remove the failed bulb by easing it from its two-pin holder, and discard.

The replacement bulb must *not* be handled with bare fingers as its envelope is made of quartz and will be permanently marked by grease smears. A clean cloth or the sleeve in which the bulb is supplied should be used to protect the envelope during fitting.




To avoid straining the centring mechanism, support the bulb-holder (4) while inserting the new bulb. (A gap of approximately 3mm ($\frac{1}{8}$") between the holder and the base of the quartz envelope is normal when the bulb is fully inserted).

REPLACEMENT BULB: 12V 100W tungsten halogen; Vickers code M006017.

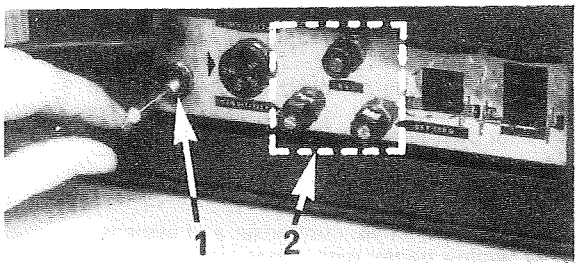
Remove the cloth or sleeve and inspect the lamp envelope for traces of accidental contamination. Grease must be removed with a lint-free cloth moistened in alcohol, and the bulb must be allowed to dry thoroughly before switching on.

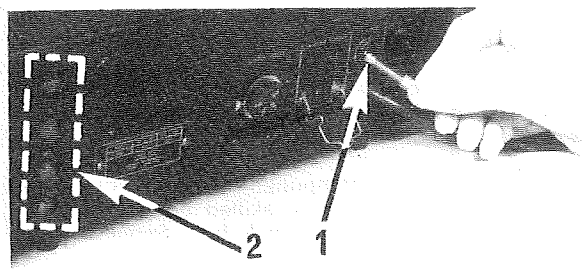
Reassemble the lamphousing, ensuring that the control unit is switched OFF and reconnect. It will be necessary to repeat the focusing and centring adjustments described in Section 2b before use.

Uncontrollable lamp intensity or the need for regular fuse replacement indicates an internal fault demanding attention by a Service Engineer.

NOTE: The bulb has a mean lifetime of about 200 hours at 10 volts, dropping to about 50 hours at 12 volts. Prolonged operation at very low voltage leads to blackening and shortened life as the tungsten-iodine cycle breaks down and the filament gradually evaporates.

Performance is optimised at about 9V; filters or the lamp diffuser should be inserted as required to limit the intensity for viewing comfort.




### (iii) J35 and J37 exposure units

A fuseholder (1) is mounted on the back panel of the unit.

For complete safety, the plug must be removed from the mains socket (line outlet) before servicing.

Unscrew the fuseholder, fit a new fuse of the correct type, and replace.

REPLACEMENT FUSE: 2A Cartridge type $1\frac{1}{4}$" x $\frac{1}{4}$" (32mm x 6·5mm).

If regular fuse replacement is necessary, consult a Vickers Instruments trained Service Engineer.

*NOTE: The pre-set controls (2) adjust the sensitivity and timing of these exposure units and must not be disturbed.*

## 5b. CLEANING — PAINT SURFACES AND OPTICS

### Painted surfaces

The main microscope components are finished in epoxy based paint which is extremely durable, but any injurious chemicals which may accidentally come into contact with it should be removed as quickly as possible.

Paint surfaces should be cleaned with a lint-free cloth lightly moistened with industrial alcohol and afterwards polished with a dry cloth.

### Optics

All optical surfaces, including filters, graticules, etc., must be kept scrupulously clean for optimum performance.

Remove loose dust carefully with a clean camel-hair brush.

A combined brush/air blower as supplied by photographic dealers will be found extremely useful, while dry aerosol sprays designed *specifically* for dust removal are also available.

These items are *not* supplied by Vickers Instruments.

Oiled or smeared surfaces (objective, condenser and eyelens) should be cleaned by wiping *gently* with a lens cloth or tissue lightly moistened with industrial alcohol.

A spiral motion starting from the lens centre should be adopted; *never re-use a lens tissue — discard it immediately.*

Oil immersion objectives and condensers should always be cleaned after use; dry objectives require only periodic inspection and dust removal unless contaminated with grease or oil.

High power objectives are precision components and *must* be handled carefully; thorough cleaning is a skilled operation which should be performed at regular intervals by a Service Engineer.

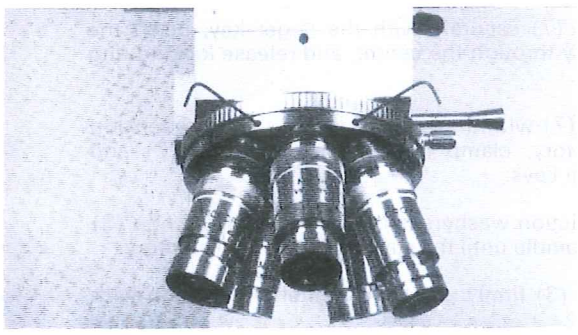
## 5c. OBJECTIVE CENTRING

This adjustment should *not* normally be required unless an objective is removed from its mount and another substituted; if one objective consistently fails to centre with sufficient accuracy, the following procedure should be employed.

***It is not recommended that the user attempt to disturb the centring of more than one objective. If other settings are disturbed it may be impossible to re-align the microscope correctly without access to service tools.***

Place a scale or slide with distinctly recognisable point features on the microscope stage, and move this to a position so that a prominent feature is well centred for all objectives but the one to be adjusted. An eyepiece fitted with a cross-line (or similar) graticule should be used if available; a guide may be obtained by observing the closed image of the FIELD iris.

DO NOT ALLOW THE STAGE TO MOVE AFTER THIS STEP.

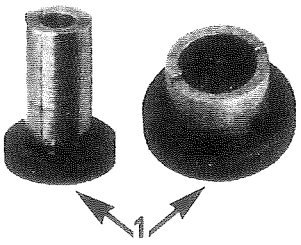


Insert the two miniature hexagon keys provided into the sockets of the objective centring grub screws and swing the objective into position.

Centre the objective onto the chosen specimen feature using the hexagon keys.

Gently remove the keys, turn the objective changer away, then back to its click-stop position and re-check the centring of the image against the other objectives. Make further small adjustments as necessary.

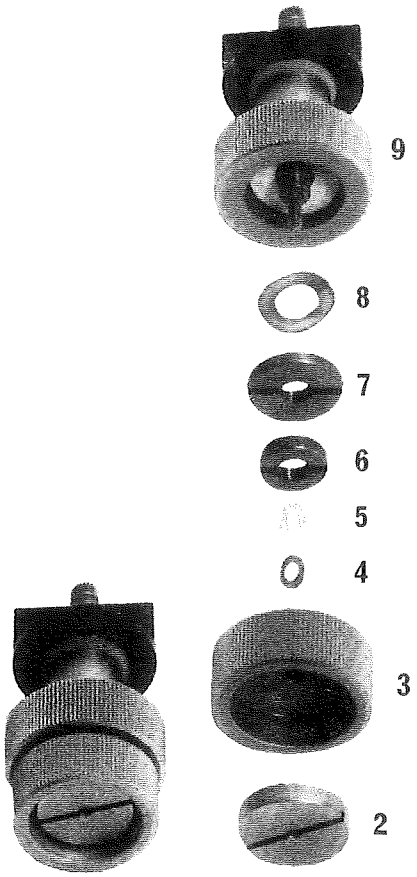
No attempt should ever be made to adjust any other stop-screw or centring device unless it is intended as a user adjustment and is mentioned in this booklet.




## 5d. MECHANICAL STAGE TENSION ADJUSTER

The stiffness of the stage X-Y movements is adjustable to suit the operator by means of the keys (1) supplied.

The diagram shows the components of the pendant concentric control assembly.




(i) Grip lower knob (3) and unscrew locking ring (2).

(ii) Unscrew knob (3) from its spindle, ensuring that friction washers (4) and (5) are not mislaid.

(iii) Hold ring (7) securely with the larger key, insert the smaller key through the centre, and release locking ring (6).

(iv) Turn ring (7) with the larger key until the stage tension is satisfactory, clamp ring (6) against ring (7) and remove the keys.

(v) Replace friction washers (4) and (5) and spin knob (3) onto the spindle until the stage tension is satisfactory.

(vi) Grip knob (3) firmly and lock securely in position with ring (2).