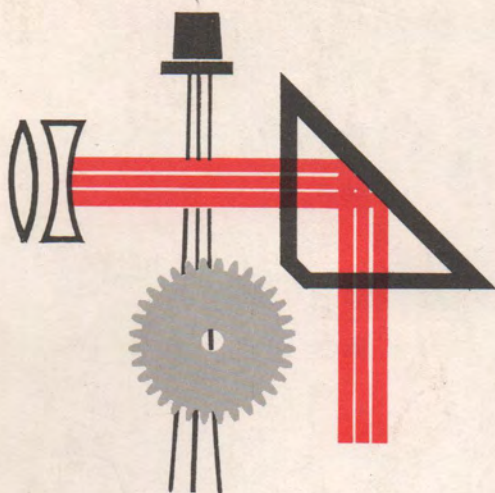


THIRD EDITION
FIRST PRINTING



INSTRUCTIONS

DYNAZOOM[®] **BENCH METALLOGRAPH**

BAUSCH & LOMB 

PRICE \$2.00

You have become the owner of a fine quality instrument. There is no similar instrument made anywhere in the world that will give you greater satisfaction or more dependable service. From the raw materials used in making optical glass to the final inspection of finished instruments, Bausch & Lomb products are made under the rigid control of optical, electronic, and mechanical experts. The formulae for the glass, and the design and manufacture of all parts contribute to one purpose—a product which will afford the highest satisfaction.

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DYNAZOOM®

BENCH METALLOGRAPH

INSTRUCTIONS

**Third Edition
First Printing**

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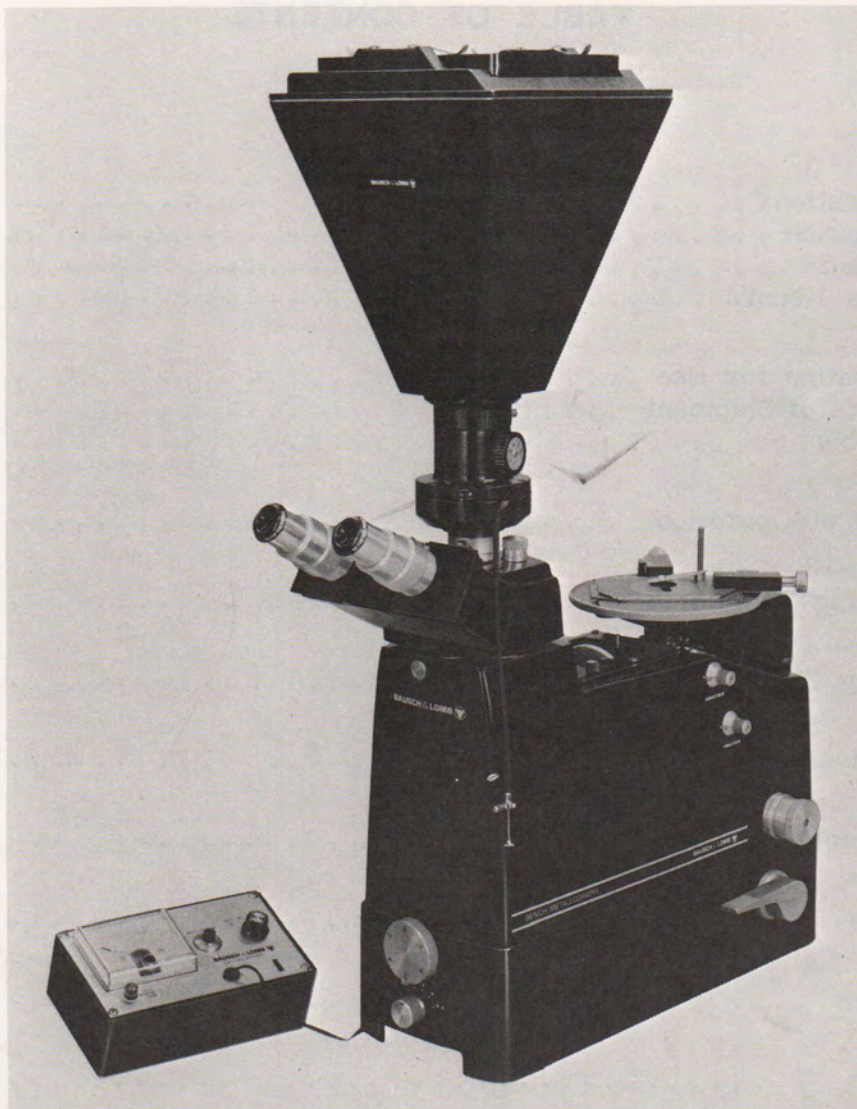


FIG. 0 - THE BAUSCH & LOMB DYNAZOOM BENCH METALLOGRAPH

SPECIFICATIONS

- | | | |
|-------------------|---|--|
| Optical | <ul style="list-style-type: none"> . All optics are anti-reflection coated . Magnification range: 25X to 2000X; to 3750X with special accessories | |
| Electrical | <ul style="list-style-type: none"> . G. E. Lamp #1630, pre-focused, 2.75 amps, 6.5 volts, A.C. . Primary voltage 120 volts, 50/60 cycles, 30 watts . Secondary voltage (control positions), 3.5, 4.5, 6.5 and over volt 8.0 volts . UL approved . Standard, 3-wire, grounded electric cord | |
| Dimensions | <ul style="list-style-type: none"> . Height 15-1/2 inches . Length 17 inches | <ul style="list-style-type: none"> . Width 7-1/2 inches . Weight 24 lbs. |

INTRODUCTION

A metallograph is a specially designed microscope used to study the surface features of metallic specimens and other materials. The Bausch & Lomb DynaZoom Bench Metallograph is constructed to the inverted microscope principle, incorporating features of convenience, ease of operation, durability, compactness, and an incomparable system of continuously variable magnification.

Three Metallograph models, provided with either bright field, dark field, or polarized light - or a combination of illumination types - are available for your particular needs. A choice of four interchangeable and parfocalized viewing bodies lend versatility to any of the three instrument models.

A Transmitted Light Accessory is available for use with transparent and translucent specimens.

Several camera formats are also available

that may be easily attached to the photomicrographic viewing bodies.

The DynaZoom Metallograph is a bench unit designed for all general metallurgical work, whether in industrial laboratories, production line operations, or metallography classes in high schools and colleges.

The Balphot and Research Metallographs are advanced instruments used for more complex analyses and research work.

The Bausch & Lomb technical staff will be glad to advise you in your selection and application of our metallographic instruments and accessories. Please address your inquiries to:

Bausch & Lomb Incorporated
Scientific Instrument Division
Industrial Products Sales
635 St. Paul Street
Rochester, New York 14602

SERVICE

All optical and mechanical equipment requires periodic servicing to keep it performing properly and compensate for normal wear.

Anticipating this need by establishing a schedule of regular preventive maintenance will help to assure long life and sustained optimum performance for your instrument. It will also help to avoid unexpected trouble and the necessity of having the instrument serviced at inconvenient times.

Such a program of planned preventive maintenance, involving a thorough cleaning, checking and adjustment of mechanisms is recommended for all instruments.

This work should only be performed by qualified personnel with the proper training and equipment. Your dealer, or Bausch & Lomb, can arrange this service.

The chart on the following page provides a handy means of recording the service history of your instrument.

IF - unexpected trouble is experienced with your instrument, FIRST - contact your Bausch & Lomb dealer. He may be able to suggest simple remedies to correct

the apparent difficulty without having to send the instrument out for servicing.

SHOULD - it become necessary to send your instrument out for service:

PLEASE - pack the instrument carefully in a crush resistant carton with at least three inches of shock absorbing material surrounding it to prevent transit damage. Saving the original carton in which your instrument is received will prove helpful for this purpose. If a suitable carton is not available, one may be ordered from the factory.

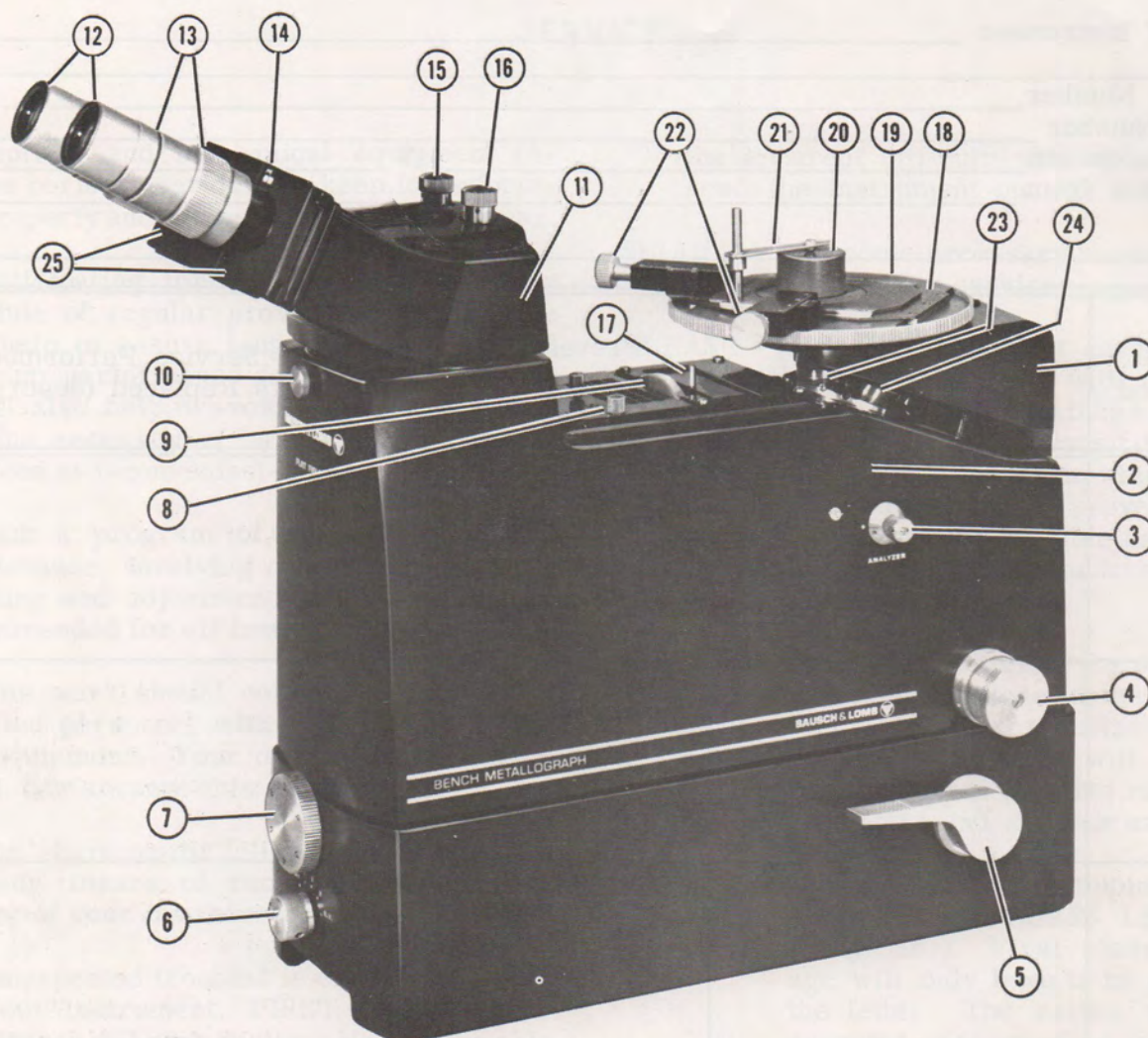
INCLUDE - A detailed letter in the shipping carton, preferably fastened to the instrument, describing the trouble experienced. This information will enable the service technician to effect required repairs promptly and at least expense.

NOTE: Please mark on shipping container FIRST CLASS LETTER ENCLOSED. First class postage will only have to be paid on the letter. The carton will be accepted at standard package rates.

SERVICE RECORD

Type of Instrument _____
 Model _____
 Catalog Number _____
 Serial Number _____
 Date Purchased _____ 19 _____
 Purchased from _____
 _____ Phone _____

Date Served	Service Center or Technician Servicing Instrument	Preventive Maintenance Check Up (Check)	Other Service Performed or Parts Replaced (describe)



1. Stage Support
2. Dark Field Knob (on "Regular" Model only)
3. Analyzer Knob
4. Fine Focus Knob
5. Stage Elevation Lever
6. Light Switch
7. Reticle Turret Knob
8. Cover Plate
9. Iris Diaphragm Wheel
10. Clamp Screw
11. Viewing Body
12. Eyepieces

13. Eyepiece Focus Rings
14. Interpupillary Scale
15. Zoom Knob
16. Visual-Camera Knob
17. Filter Rack Cover
18. Mechanical Stage
19. Stage Plate
20. Specimen
21. Specimen Holder
22. Direction Knob
23. Objective
24. Nosepiece
25. Eyepiece Sliders

FIG. 1-1 - DYNAZOOM II FLAT FIELD BENCH METALLOGRAPH

SECTION - 1

PREPARATION FOR USE

CONTENTS OF SHIPMENT

The DynaZoom Bench Metallograph is shipped in one Carton which contains the following basic components:

- 1 Bench Metallograph (with mounted Stage and Objectives)
- 2 Stage Plates
- 1 Viewing Body
- 2 Eyepieces
- 1 Green Filter
- 1 Plastic Dust Cover

If you ordered any additional small accessories, such as Filters, or Reticles, the Carton will also contain these.

NOTE: Be sure to remove the small piece of sponge rubber packing material from under the bottom of the Metallograph's Stage Support, 1 Fig. 1-1.

CAUTION

PLEASE CHECK ALL ITEMS AGAINST YOUR ORDER BEFORE DISCARDING THE SHIPPING CARTON.

Larger accessories, such as cameras, are shipped in separate Cartons.

ASSEMBLY

1. Seat the Viewing Body, 11 Fig. 1-1, in the large hole provided in the Metallograph Casting. The Viewing Body may be oriented in any position through 360°.
2. Tighten the Clamp Screw, 10 Fig. 1-1.
3. Insert the Eyepiece(s), 12 Fig. 1-1, into the Eyepiece Tube(s) of the Viewing Body.

Plug the Line Cord into a grounded 120 Volt, 60 Cycle AC electrical outlet, and your Metallograph is now ready to operate.

SECTION - 2

THEORY OF OPERATION

Your choice of a particular Metallograph model was based upon your particular illumination needs. The illumination you select for viewing will be determined by the specific properties of the specimen under study.

Bright Field

Most metallography is carried out under the conventional bright field illumination with a Green Filter. The Green Filter improves contrast for both visual and photographic work.

The primary control of bright field illumination is the Iris Diaphragm. The setting of the Iris Diaphragm Control, 9 Fig. 1-1, affects the contrast, resolving power, depth of focus, and brightness of the specimen which you see. Closing down the Iris Diaphragm aperture will increase contrast and depth of field, but it decreases brightness and resolution.

Brightness should generally be controlled by the Light Switch, 6 Fig. 1-1, or by the addition of suitable Filters. It should never be controlled by exclusive use of the Iris Diaphragm.

Depth of focus can be increased by using lower powered Objectives. Consequently, the Iris Diaphragm is used to achieve a suitable balance between contrast and resolution.

The optimum Iris Diaphragm Control Setting will be determined by the properties of the specimen and the operator's own requirements.

Polarized Light

Polarized light is used extensively in the microscopic study of crystals, fibers and minerals because of its ability to effectively discern anisotropic specimens. Light from the Lamp, when passed through a polarizing Filter (the Polarizer) is filtered in such a manner that only light vibrating in one direction is transmitted. The presence of a second polarizing Filter (the Analyzer) with its vibrational axis aligned perpendicular to the axis of the Polarizer, can almost completely prevent the passage of light through the system. This minimum brightness condition is called "extinction". When an anisotropic specimen is interposed between the two filters in this extinct position, the light from the Polarizer is rotated toward the Analyzer axis and thus is transmitted through the Analyzer to the observer.

Dark Field

Dark field illumination is useful for examining pits and deep depressions in a specimen. It is particularly useful to examine bright grain boundaries against a black background.

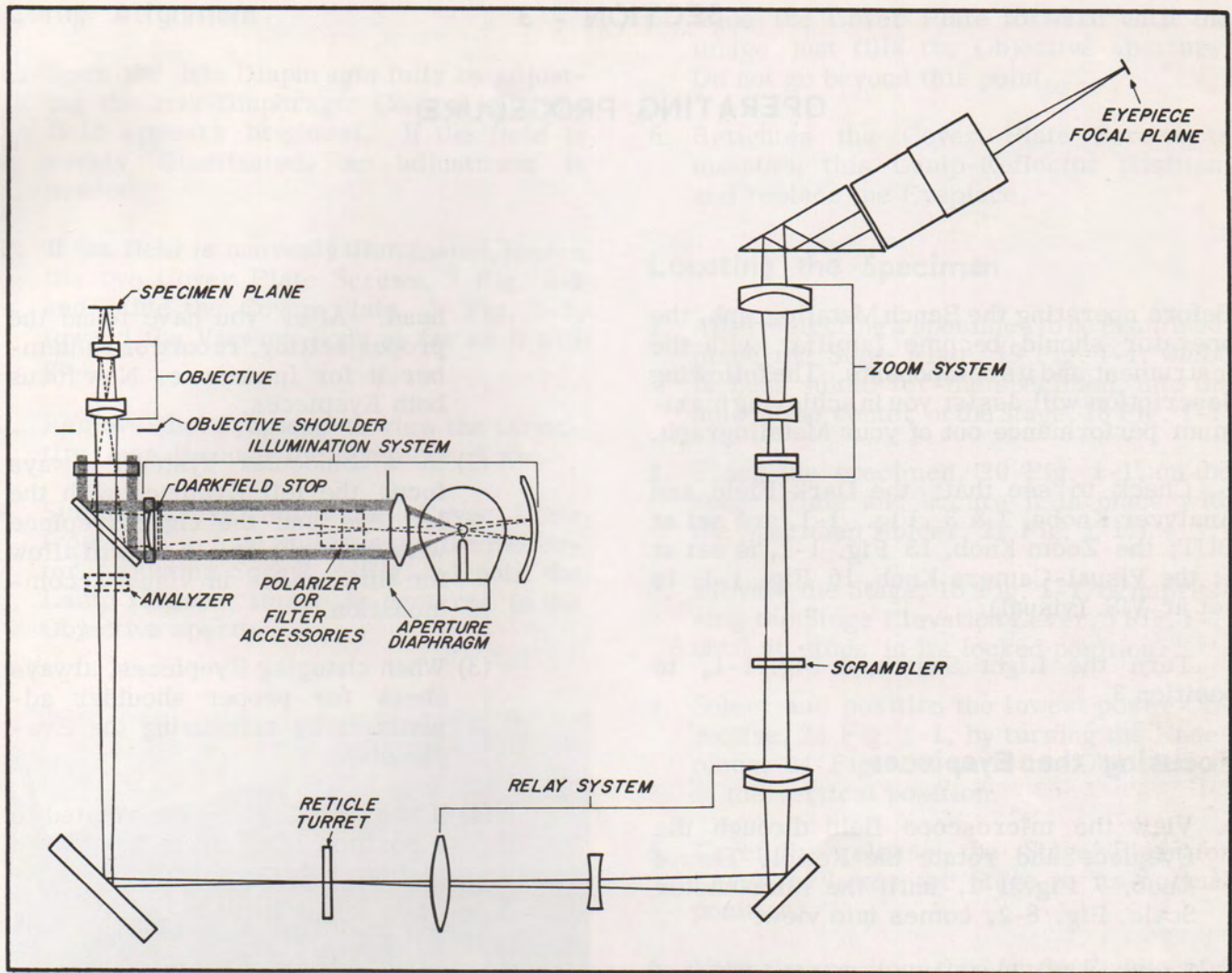


FIG. 2-1 - OPTICAL PATH, DARK FIELD METALLOGRAPH

SECTION - 3

OPERATING PROCEDURE

Before operating the Bench Metallograph, the operator should become familiar with the instrument and its components. The following description will assist you in achieving maximum performance out of your Metallograph.

Check to see that: the Dark Field and Analyzer Knobs, 2 & 3 Fig. 1-1, are set at OUT; the Zoom Knob, 15 Fig. 1-1, is set at 1; the Visual-Camera Knob, 16 Fig. 1-1, is set at VIS. (visual).

Turn the Light Switch, 6 Fig. 1-1, to position 3.

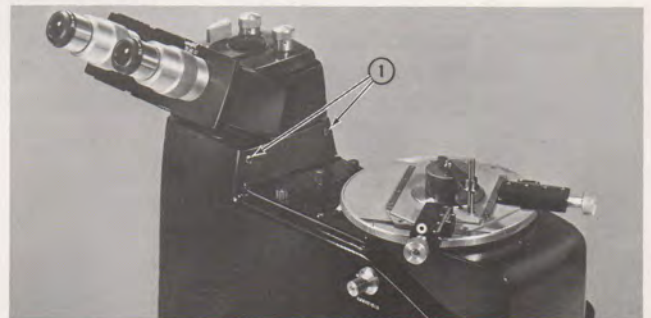
Focusing the Eyepieces

1. View the microscope field through the Eyepiece and rotate the Reticle Turret Knob, 7 Fig. 1-1, until the Micrometer Scale, Fig. 8-2, comes into view.
2. Focus on the scale by turning the knurled Eyepiece Focus Ring, 13 Fig. 1-1, until the scale image is sharp and clearly defined.

NOTE: (1) If your Metallograph is equipped with one of the Binocular Viewing Body types, it is necessary to set the Eyepieces to your interpupillary distance. Grasp the straight knurled ridges on the Eyepiece Sliders, 25 Fig. 1-1, and slide the Eyepieces together or apart to the desired distance as indicated on the Interpupillary Scale, 14 Fig. 1-1. In the event that you do not know your own interpupillary distance, move the Eyepieces together or apart until you are seeing the full field with both eyes. Check this by closing one eye and then the other without moving your

head. After you have found the proper setting, record or remember it for future use. Now focus both Eyepieces.

- (2) In a binocular system, always focus the left Eyepiece with the left eye and the right Eyepiece with the right eye. This will allow for differences in visual accommodation.
- (3) When changing Eyepieces, always check for proper shoulder adjustment by refocusing the Eyepiece(s).
- (4) If the Viewing Body is rotated to a position other than that shown in Fig. 1-1, the centration alignment may be slightly altered. If you wish to adjust the alignment, simply adjust the two Centering Screws, 1 Fig. 3-1, with a hex. head Wrench, until the Reticle Turret aperture is centered to the field aperture. Instructions on how to reorient the Micrometer Scale for this case are found under RETICLE TURRET, Section 7.

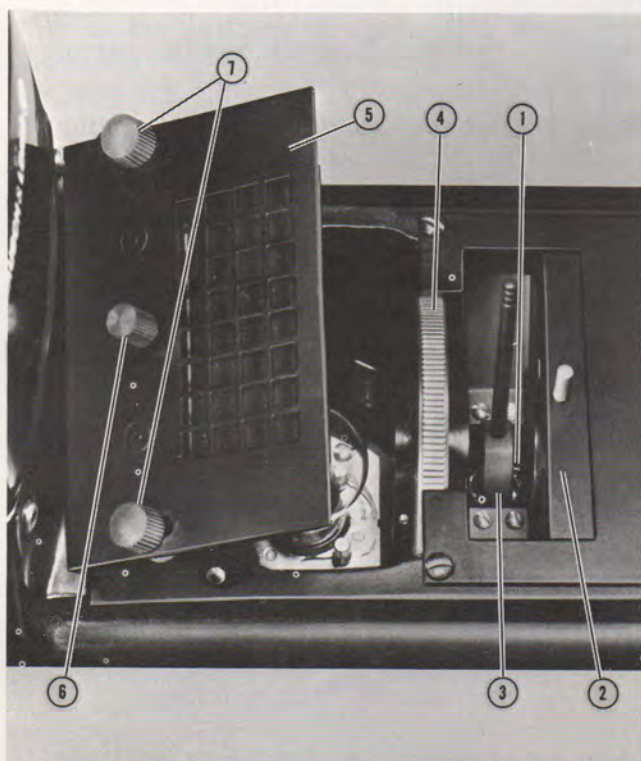


1. Centering Screws

FIG. 3-1 - CENTERING SCREWS

Lamp Alignment

1. Open the Iris Diaphragm fully by adjusting the Iris Diaphragm Control until the field appears brightest. If the field is evenly illuminated, no adjustment is needed.
2. If the field is unevenly illuminated, loosen the two Cover Plate Screws, 7 Fig. 3-2 and slide the Cover Plate, 5 Fig. 3-2, toward the Viewing Body as far as it will go.
3. Remove the Eyepiece to view the Objective lens through the Eyepiece Tube.
4. Simultaneously move the Cover Plate from side to side while turning the Reflector Adjusting Screw, 6 Fig. 3-2 until the Lamp filament image is centered in the Objective aperture.



- | | |
|---------------------------|------------------------------|
| 1. Filter Rack | 5. Cover Plate |
| 2. Filter Rack Cover | 6. Reflector Adjusting Screw |
| 3. Filter | 7. Cover Plate Screws |
| 4. Iris Diaphragm Control | |

FIG. 3-2 - COVER PLATE, IRIS DIAPHRAGM CONTROL AND FILTER RACK

5. Slide the Cover Plate forward until the image just fills the Objective aperture. Do not go beyond this point.
6. Retighten the Cover Plate Screws to maintain this Lamp-Reflector position, and replace the Eyepiece.

Locating the Specimen

1. After selecting a specimen to be examined, place the Stage Plate, 19 Fig. 1-1, which is best suited for the specimen, into the hole in the center of the Stage, 18 Fig. 1-1.
2. Place the specimen, 20 Fig. 1-1, on the Stage Plate and secure it in place with the Specimen Holder, 21 Fig. 1-1.
3. Elevate the Stage, 18 Fig. 1-1, by depressing the Stage Elevation Lever, 5 Fig. 1-1, until it stops in its locked position.
4. Select and position the lowest power Objective, 23 Fig. 1-1, by turning the Nosepiece, 24 Fig. 1-1 until this Objective is in the vertical position.
5. Carefully release the Stage Elevation Lever to lower the Stage to its normal position.
6. View the specimen through the Eyepiece(s) and bring the image into focus by turning the Fine Focus Knob, 4 Fig. 1-1.
7. After locating an area of interest you may elevate the Stage, select a higher power Objective, and then lower the Stage. It may be necessary to touch up the specimen image slightly by turning the Fine Focus Knob a small amount. The continuously variable magnification (zoom) system may be utilized with any Objective, as desired.

ENERGIZING A TYPE OF ILLUMINATION

Bright Field

1. Check to see that the Dark Field and Analyzer Knobs are set at OUT.

2. Slide the Filter Rack Cover, 2 Fig. 3-2, towards the Objectives and place the Green Filter, Cat. No. 42-34-56, in the Filter Rack, 1 Fig. 3-2.
3. Remove the Eyepiece and view the Objective Lens through the Eyepiece Tube.
4. Rotate the Iris Diaphragm Control until the Objective Lens is about 2/3 filled with light.
5. Replace the Eyepiece and view the specimen field.
6. From the above Diaphragm setting, slightly rotate the Iris Diaphragm Control until an optimum balance between contrast and resolution is achieved.

Polarized Light

1. Check to see that the Dark Field Knob is set at OUT.
2. Set the Analyzer Knob at IN, to place the Analyzer in the optical path.
3. Place the Polarizer, Cat. No. 42-34-57, in the Filter Rack.
4. While viewing the field through the Eyepiece(s) rotate the Polarizer until minimum brightness is achieved. The magnetic property of the Polarizer Mount will

prevent the Polarizer from shifting from this position.

5. Adjust the Iris Diaphragm as in Bright Field.

Dark Field ("Regular" Model, only)

1. Check to see that the Analyzer Knob is set at OUT.
2. Set the Dark Field Knob at IN.
3. Check to see that no Filters are in the Filter Rack.
4. Select and position a Dark Field Objective.
5. Open the Iris Diaphragm fully to provide maximum illumination.

CONTROLLING THE LIGHT INTENSITY

Light intensity is controlled by a multi-position Light Switch which has five settings.

OFF

1	(3.5 volts)
2	(4.5 volts)
3	(6.5 volts)
O.V.	(Over Volt: 8.0 volts)

The normal setting is at position 3, which gives the Lamp a color temperature of 3200°K.

SECTION - 4

VIEWING BODIES

Zoom System

All DynaZoom Bench Metallograph Viewing Bodies are equipped with a continuously variable (zoom) magnification system which allows the operator to continuously vary the magnification from 1X to 2X while maintaining constant focus, and without changing Eyepieces or Objectives. This is done by turning the Zoom Knob, 15 Fig. 1-1, which is engraved in 0.1X intervals from 1.0X to 2.0X magnification.

The total magnification of the optical system is the product of Objective, Eyepiece, and zoom magnification factors. If, for example, you are using a 10X Objective and a 10X Eyepiece, the zoom system enables you to go continuously from 100X to 200X. If the Zoom Knob reads 1.5, the total magnification of this setup is 150X.

This zoom feature is particularly desirable where exact ASTM magnifications are required.

Body Types

There are four DynaZoom Bench Metallograph Viewing Body types (Figs. 4-1 through 4-4):

- Monocular Zoom
- Binocular Zoom
- Photobinocular Zoom
- Photobinocular StereoZoom

All four types are interchangeable with one or another by simply loosening the Clamp

Screw, 10 Fig. 1-1, changing Bodies, and re-tightening the Clamp Screw.

The three Binocular Body types are all equipped with a fixed tube length, interpupillary adjustment. As you adjust the interpupillary distance, the Eyepieces automatically move in and out to maintain the fixed tube length. This feature assures constant magnification and strict parfocality among the Objectives.

The two Photobinocular Body types have a moveable Prism which directs all of the illumination to either the inclined Eyepieces for visual observation, or to the Vertical Tube for photomicrography. To switch from visual to Camera use, give the Visual-Camera Knob, 16 Fig. 1-1, a partial turn until it comes to a positive stop at the CAM. (camera) position. These Bodies may be used with externally mounted or attachable Cameras, as described under PHOTOMICROGRAPHY, Section 12.

The Photobinocular StereoZoom Body has, in addition to the aforementioned features, a stereo viewing facility which presents a three-dimensional perspective of the specimen. This feature shows various surface levels caused by polishing and etching, and enables the operator to differentiate between inclusions and hole, and to quickly scan a surface for fractures. Stereo viewing is particularly good in polarized light and Dark Field illumination. To actuate the stereo viewing system, set the lever on top of the Body at IN; if non-stereo viewing is desired, set the lever at OUT.



FIG. 4-1 - MONOCULAR ZOOM,
CAT. NO. 42-34-60



FIG. 4-2 - BINOCULAR ZOOM,
CAT. NO. 42-34-61



FIG. 4-3 - PHOTOBINOCULAR ZOOM,
CAT. NO. 42-34-62



FIG. 4-4 - PHOTOBINOCULAR STEREOZOOM,
CAT. NO. 42-31-80

SECTION - 5

OBJECTIVES AND EYEPIECES

Objectives

There are five types of Objectives available for use with the DynaZoom Bench Metallograph:

1. Standard Achromats
2. Fluorite (Semi-apochromats)
3. Apochromats
4. Flat Field Achromats
5. Bright Field - Dark Field Achromats

The first three types reflect a progressive improvement in their degree of color correction and the ratio of their numerical aperture to magnification. The fourth type, the flat field achromats are similar to the standard achromats in color correction and numerical aperture characteristics, but differ in their improved correction for curvature of field, which makes it possible for the entire field of view to be in sharp focus at the same time. The fifth type, the bright field - dark field achromats, can be used for normal bright field work and, when used in conjunction with the Dark Field Stop of the Metallograph, for dark field studies.

The achromats, bright field, flat field and dark field types, are recommended for use in all polarized light studies.

Eyepieces

There are four types of Eyepieces available:

- | | |
|--------------|-----------------|
| 1. Huygenian | 3. Wide Field |
| 2. Hi-point | 4. Compensating |

The first three types are all for general use, with the hi-points best suited for eye-glass wearers and the wide fields giving a larger field of view. The compensating Eyepieces eliminate the lateral color present in many Objectives and are used only when using apochromatic or fluorite Objectives.

OBJECTIVE-EYEPIECE COMBINATIONS

Your DynaZoom Bench Metallograph will achieve its maximum performance level only when equipped with the proper combination of Objectives and Eyepieces. Certain types of Objectives are designed for use only with certain types of Eyepieces and Nosepieces.

Metallographs that are marked FLAT FIELD are equipped with a special flat field Nosepiece and should be equipped only with flat field Objectives (also marked FLAT FIELD) and with 31-05-22 Eyepieces (marked WF-22). The only flat field Objective which should NOT be used on Flat Field Metallographs is the 42-35-01, 5X Achromatic Flat Field Objective. This Objective is designed for use with conventional non-flat field systems, and is the only flat field Objective that will perform satisfactorily on a non-flat field Metallograph.

SECTION - 6

NOSEPIECES

Every DynaZoom Bench Metallograph is equipped with one of the three types of quadruple, revolving Nosepieces available:

1. Centerable
2. Non-centerable
3. Centerable Flat Field

A centerable, or a centerable flat field Nosepiece, is fitted to each polarized light model Metallograph. Each Objective on this Nosepiece has been factory centered and oriented for the highest quality of polarized light. Hence, it is important to keep each Objective in its proper mounting hole.

IMPORTANT

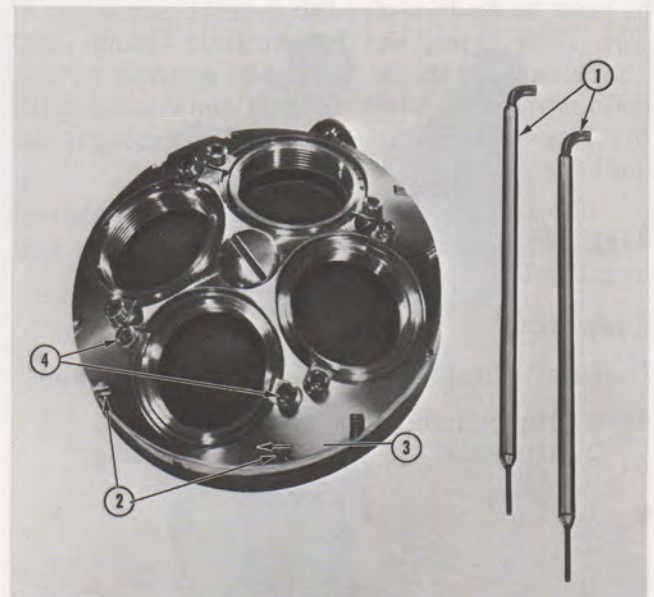
Do not place flat field Objectives on a non-flat field Nosepiece (except Cat. No. 42-35-01), or non-flat field Objectives on a flat field Nosepiece, as this will result in a deterioration of performance and may possibly damage the Objective and/or the Nosepiece.

Centration

If you add new Objectives, or an Objective becomes decentered:

1. Bring the highest power CENTERED Objective into position.
2. Manipulate the specimen until an easily identifiable point is located in the exact center of the field (an Eyepiece Cross Line Reticle Disc, Cat. No. 31-16-30, is available for converting a standard Eyepiece into a Cross Line Eyepiece, which may be used for this alignment).
3. Bring the decentered Objective into position.
4. Using one of the Adjusting Wrenches, 1 Fig. 6-1, provided, slightly loosen the two Clamp Screws, 4 Fig. 6-1, at the base of the Objective, with the curved end of the Wrench.
5. Center the predetermined point in the field by adjusting the two Centering Screws, 2 Fig. 6-1, as required using the straight ends of the two Wrenches.
6. Retighten the Clamp Screws.

NOTE: Retightening the Clamp Screws may slightly alter the centration, requiring



1. Adjusting Wrench
2. Centering Screws
3. 40X Identification Dot
4. Clamp Screws

FIG. 6-1 - CENTERABLE NOSEPIECE, WITH WRENCH

repetition of steps 4, 5 and 6 for precise requirements.

If the Objectives are removed for any reason, a black identification dot, 3 Fig. 6-1, on the Nosepiece locates the 40X Objective, followed by the 20X, 10X, and 5X Objectives in a clockwise direction.

Orientation

To orient an Objective for maximum extinction in polarized light:

1. Loosen the two Clamp Screws at the base of the Objective, using the curved end of an Adjusting Wrench, until the Objective can be rotated.
2. Position the Objective and focus on a highly reflective specimen (a first-surface mirror is excellent).
3. Set the Analyzer Knob at IN, place the Polarizer in the Filter Rack, and adjust the Polarizer until minimum illumination is achieved.
4. Remove an Eyepiece and view the Objective lens through the Eyepiece Tube.
5. Rotate the Objective until the most distinct crossed pattern (+) is produced in the Objective Lens.
6. Retighten the Clamp Screws.

SECTION - 7

RETICLE TURRET

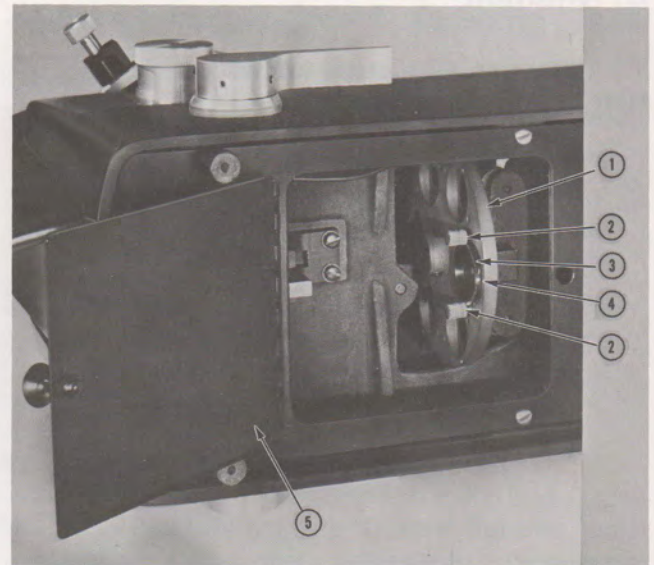
The Reticle Turret, 1 Fig. 7-1, has six apertures which accept any of a variety of standard measuring Reticles. The Reticles are moved in and out of the optical system by rotating the Reticle Turret Knob, 7 Fig. 1-1. Access to the Turret is obtained by carefully laying the Metallograph on its side and opening the Access Door, 5 Fig. 7-1, located on the underside of the instrument.

To orient a Reticle in the Turret, line up the white alignment dot, 4 Fig. 7-1, on the Reticle Cell, 3 Fig. 7-1, with the dot on the Turret, and secure the Cell in place with the two Clamp Screws, 2 Fig. 7-1, supplied with each Reticle.

NOTE: (1) If the Viewing Body is oriented in one of the alternate viewing positions, Fig. 3-1, the Reticle must be rotated in the Cell, before lining up the dots.

(2) If the Reticles get dirty from handling, refer to MAINTENANCE, Section 13.

The Metallograph is designed to place the image of the Reticle plane in the focal plane



- 1. Reticle Turret
- 2. Clamp Screws
- 3. Reticle Cell

- 4. Alignment Dots
- 5. Access Door

FIG. 7-1 - RETICLE TURRET, VIEWED FROM UNDERSIDE

of the Eyepiece(s). If the Reticle pattern does not appear sharp, adjust the Eyepiece focus.

SECTION - 8

RETICLES



FIG. 8-1 - RETICLE CELL

All of the Reticles for the DynaZoom Bench Metallograph are calibrated for use with 10X Objectives, with the exception of the Intercept Count Reticle which can be used with any Objective magnification and the Graphite Flake Reticles. The use of these Reticles with other Objective magnifications will invalidate the calibrations. Eyepiece or zoom system magnification, however, will not effect calibration.

MICROMETER DISCS

CAT. NO. 42-34-82
42-36-02

One of these Reticles is supplied with each Metallograph. Number 42-34-82 is for non-flat field models, and 42-36-02 is for flat field models and is marked "F.F.". Both Micrometer Discs measure .0005 inch per scale division in the specimen plane. In addition to their use for measuring, these Discs can also be used to check the focus setting of the camera accessories. When the

camera is properly focused, the Reticle image will appear sharp. This image can be viewed through the Eyepiece or on a ground glass placed at the camera's film plane.

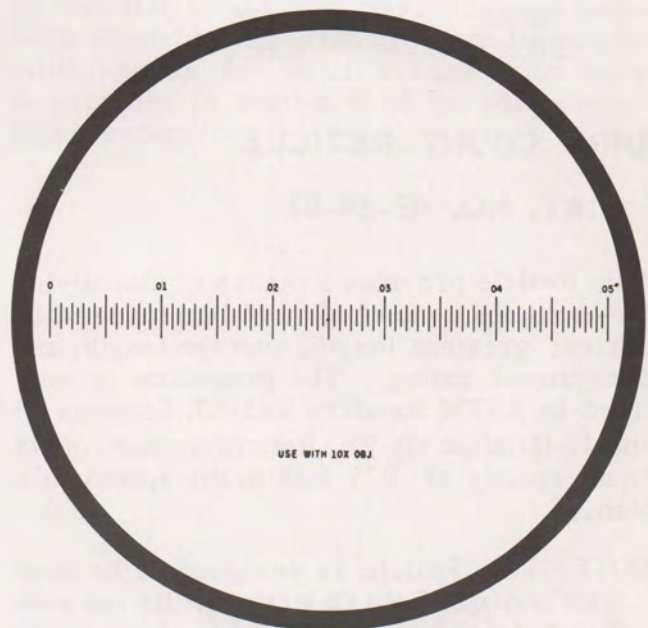


FIG. 8-2 - MICROMETER DISC RETICLE

INTERCEPT COUNT RETICLE

CAT. NO. 42-34-84

This Reticle provides a convenient and accurate method for measuring unequiaxed grains, the procedure for which is described in ASTM Standard E112-63, Section 7. Measurement is made by determining the average number of grains/millimeter, $\frac{nM}{6}$, where n = the number of grains in the intercept length and M = the Objective magnifi-

cation being used. The intercept length in the specimen plane is $\frac{6}{M}$ millimeters and is tabulated below for the various Objective magnifications M:

<u>M</u>	<u>Intercept Length</u>
5X	1.20 mm
8X	0.75
10X	0.60
20X	0.30
25X	0.24
40X	0.15
50X	0.12
75X	0.08
80X	0.075
100X	0.06

DIRT COUNT RETICLE

CAT. NO. 42-34-83

This Reticle provides a means of classifying the inclusion content of steel into three categories: greatest length, average length, and background rating. The procedure is outlined in ASTM Standard E45-63, Sections 15 and 16 (Method B). The Reticle consists of six equal spaces of .005 inch in the specimen's plane.

NOTE: This Reticle is designed to be used with non-flat field Objectives. Its use with flat field Objectives will introduce slight inaccuracies.

TWINNED GRAIN SIZE RETICLE

CAT. NO. 42-34-85

The Twinned Grain Size Reticle is a replica on film of Plate III, Section 6, ASTM Standard E112-63. It is used as a basis for comparison between twinned grains in copper and copper base alloys. The Reticle is composed of 12 charts, calibrated from .01 to .20mm grain diameters, with a central clear portion through which the specimen image is compared.

NOTE: This Reticle is designed to be used with non-flat field Objectives. Its use with

flat field Objectives will introduce slight inaccuracies.

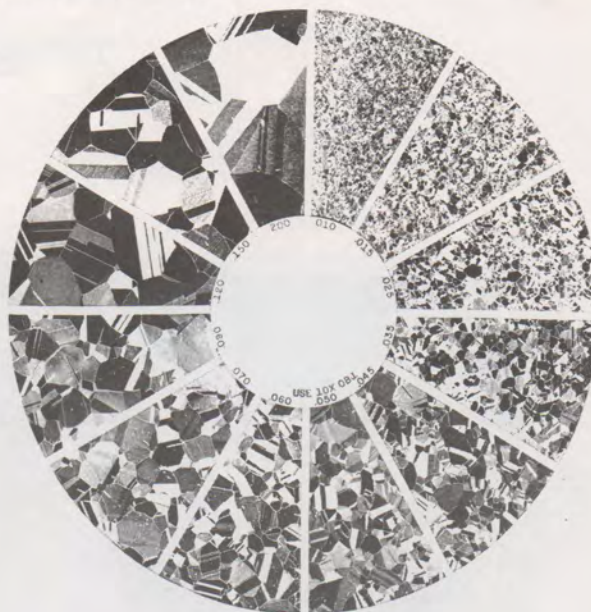


FIG. 8-3 - TWINNED GRAIN SIZE RETICLE

UNTWINNED GRAIN SIZE RETICLE

CAT. NO. 42-34-86

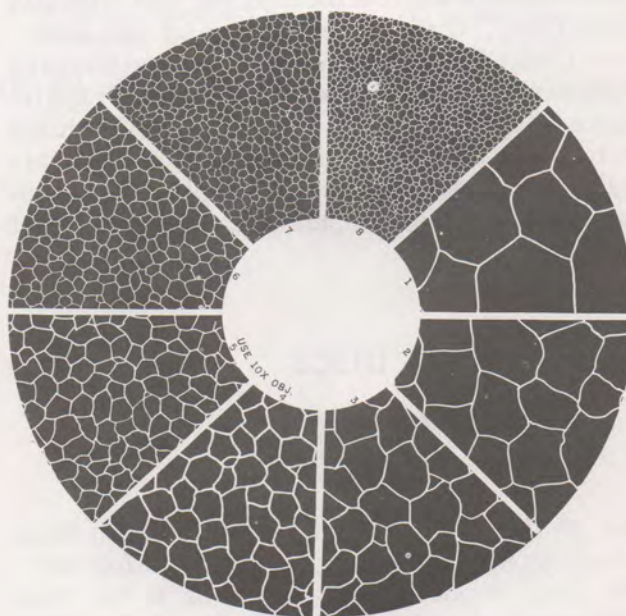


FIG. 8-4 - UNTWINNED GRAIN SIZE RETICLE

This Reticle is a film replica of Plate I, Section 6, ASTM Standard E112-63. It is

used as a basis for comparison between un-twinned equiaxed grains in metallic materials such as aluminum, steel, magnesium (and its alloys), nickel (and its alloys), zinc (and its alloys). Comparisons of grain, crystal or cell size may also be made of nonmetallic materials having structures similar to those on the Reticle. This Reticle is divided into 8 comparison charts, each with the appropriate ASTM micro grain size number, with a clear central portion for the specimen image comparison. Grain sizes can be found in Table II of ASTM E112, opposite the corresponding micro grain numbers.

NOTE: This Reticle is designed to be used with non-flat field Objectives. Its use with flat field Objectives will introduce slight inaccuracies.

25X AND 100X GRAPHITE FLAKE RETICLES

CAT. NO. 42-34-80, 25X
42-34-81, 100X

These Reticles are used for measuring graphite flakes according to the technique described in ASTM Standard A247-47 (1965), Section 8. The 25X Reticle, with sizes 1 through 6, is calibrated for use with 5X non-flat field Objectives. Its use with flat field Objectives will introduce slight inaccuracies. The 100X Reticle, with sizes 3 through 8, is calibrated for use with either 20X flat field or non-flat field Objectives. The size numbers must be converted to length (inches or millimeters), for which a conversion table is provided in Section 8 of the above mentioned reference.

SECTION - 9

FILTERS

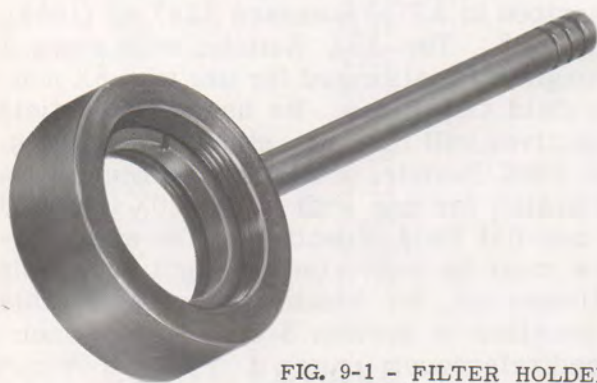


FIG. 9-1 - FILTER HOLDER

GREEN FILTER (GREEN HANDLE)

CAT. NO. 42-34-56

A Green Filter is supplied with every Dyna-Zoom Bench Metallograph. It is an absorption-type filter, with a peak wavelength of 550nm, which produces a monochromatic image for both visual observation and photomicrography.

DAYLIGHT FILTER (BLUE HANDLE)

CAT. NO. 42-36-10

This Filter converts the normal tungsten quality of the illumination to approximate daylight quality for visual viewing or for use with Polacolor* film in photomicrography.

NEUTRAL DENSITY FILTERS (BLACK HANDLES)

CAT. NO. 42-34-51, 0.3 N.D.

42-34-59, 0.5 N.D.

42-34-64, 1.0 N.D.

These Filters are completely neutral between wavelengths of 400 and 700nm, and effectively

lower the light level while maintaining the color quality. The values of 0.3, 0.5, and 1.0 which are engraved on the Filter Mounts represent a reduction in illumination of 1/2, 1/3, and 1/10 respectively.

POLARIZER (SILVER HANDLE)

CAT. NO. 42-34-57

The Polarizer is used to achieve a polarized light effect for both visual observation and photomicrography when used in conjunction with Polarized Light Models of the DynaZoom Bench Metallograph, and is supplied with all Models 32 and 42.

SENSITIVE TINT PLATE (RED HANDLE)

CAT. NO. 42-34-07

The Sensitive Tint Plate is a quartz retardation plate which allows an observer to detect weak birefringence in a specimen. When used in polarized light studies, the Polarizer should always be placed between the Iris Diaphragm Control and the Sensitive Tint Plate. When the handles of both the Sensitive Tint Plate and the Polarizer are in the vertical position they are in their standard orientation. They may be rotated together or separately to obtain various desired effects.

YELLOW FILTER (YELLOW HANDLE)

CAT. NO. 42-34-47

This is an absorption type filter which absorbs wavelengths below 490nm.

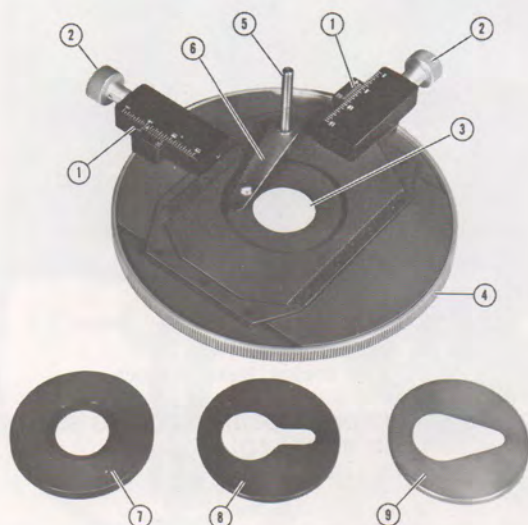
* Reg. Polaroid Corp.

SECTION - 10

STAGES

MECHANICAL STAGE

CAT. NO. 42-36-52



- | | |
|------------------------|--------------------------|
| 1. Vernier Scale | 7. 1-1/4" Stage Plate, |
| 2. Direction Knob | Cat. No. 42-36-80 |
| 3. Stage Plate Opening | 8. Keyhole Stage Plate, |
| 4. Rotation Ring | Cat. No. 42-36-81 |
| 5. Post | 9. Teardrop Stage Plate, |
| 6. Specimen Holder | Cat. No. 42-36-82 |

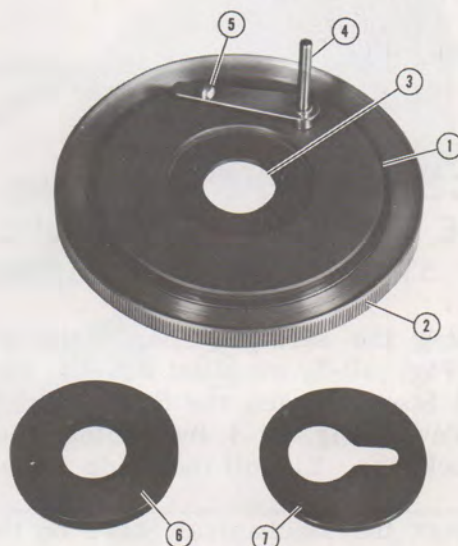
FIG. 10-1 - MECHANICAL STAGE AND STAGE PLATES

All DynaZoom Bench Metallographs come equipped with mechanical Stage and two Stage Plates as standard equipment. Flat field models comes with the 1-1/4 inch and Teardrop Stage Plates, 7 and 9 Fig. 10-1, while non-flat field models come with 1-1/4 inch and Keyhole Stage Plates, 7 and 8 Fig. 10-1. These Plates are placed in the Stage Plate Opening, 3 Fig. 10-1, of the Stage. The Mechanical Stage permits 1 inch east-west and north-south motions by means of the two knurled Direction Knobs, 2 Fig. 10-1, and full 360° rotation of the specimen about the Objective axis through use of the knurled Rotation Ring, 4 Fig. 10-1. The graduations on the Vernier Scales, 1 Fig. 10-1, are in inches and permit readings to .005 inch. A

spring-type Specimen Holder, 6 Fig. 10-1 is provided for firmly clamping specimens against the Stage Plates.

GLIDE STAGE

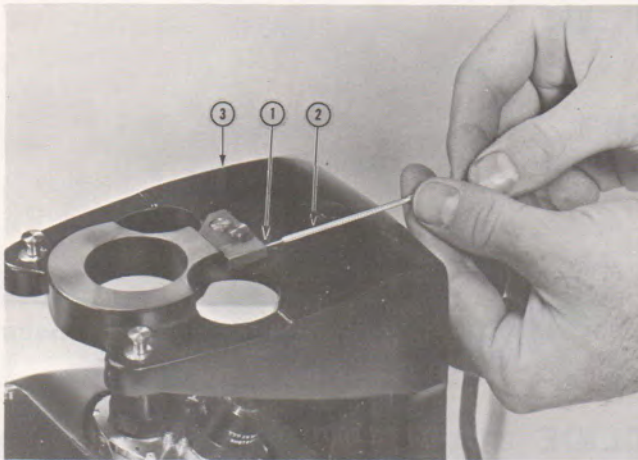
CAT. NO. 42-36-50



- | | |
|------------------------|-------------------------|
| 1. Glide Plate | 5. Specimen Holder |
| 2. Rotation Ring | 6. 1" Stage Plate, |
| 3. Stage Plate Opening | Cat. No. 42-34-76 |
| 4. Post | 7. Keyhole Stage Plate, |
| | Cat. No. 42-34-79 |

FIG. 10-2 - GLIDE STAGE AND STAGE PLATES

The Glide Stage is similar to the Mechanical Stage except that it does not have the east-west and north-south motion control. This stage is moved by sliding the Glide Plate, 1 Fig. 10-2, in any direction. A flat bearing surface plus the gliding properties of the special Glide Stage Grease (Cat. No. 42-36-31) provide an excellent "controlled drag" for the sliding motion.



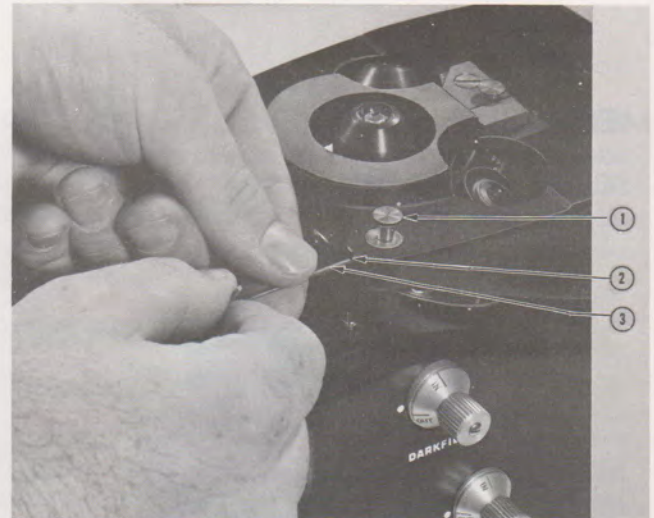
1. Spring Plunger Set Screw
2. Wrench
3. Support

FIG. 10-3 - LOOSENING THE SPRING PLUNGER SET SCREW (STAGE REMOVED)

PROCEDURE FOR REPLACING THE GLIDE STAGE WITH THE MECHANICAL STAGE (OR VICE-VERSA)

1. Using the straight end of the Wrench, 2 Fig. 10-3, supplied with the Mechanical Stage, loosen the Spring Plunger Set Screw, 1 Fig. 10-3, by turning it counter-clockwise. Lift off the Glide Stage.
2. Mount the Mechanical Stage on the Support, 3 Fig. 10-3, and retighten the Spring Plunger Set Screw by turning it clockwise until the Mechanical Stage rotates freely and smoothly.
3. Place a specimen on a Stage Plate and clamp it in place with the Specimen Holder.

4. Focus the Metallograph on the specimen and rotate the Mechanical Stage using the Rotation Ring to check for centration of the stage to the optical axis.



1. Stage Centering Guide
2. Set Screw
3. 3/64 Socket Head Wrench

FIG. 10-4 - LOOSENING A GUIDE-LOCKING SET SCREW (STAGE REMOVED)

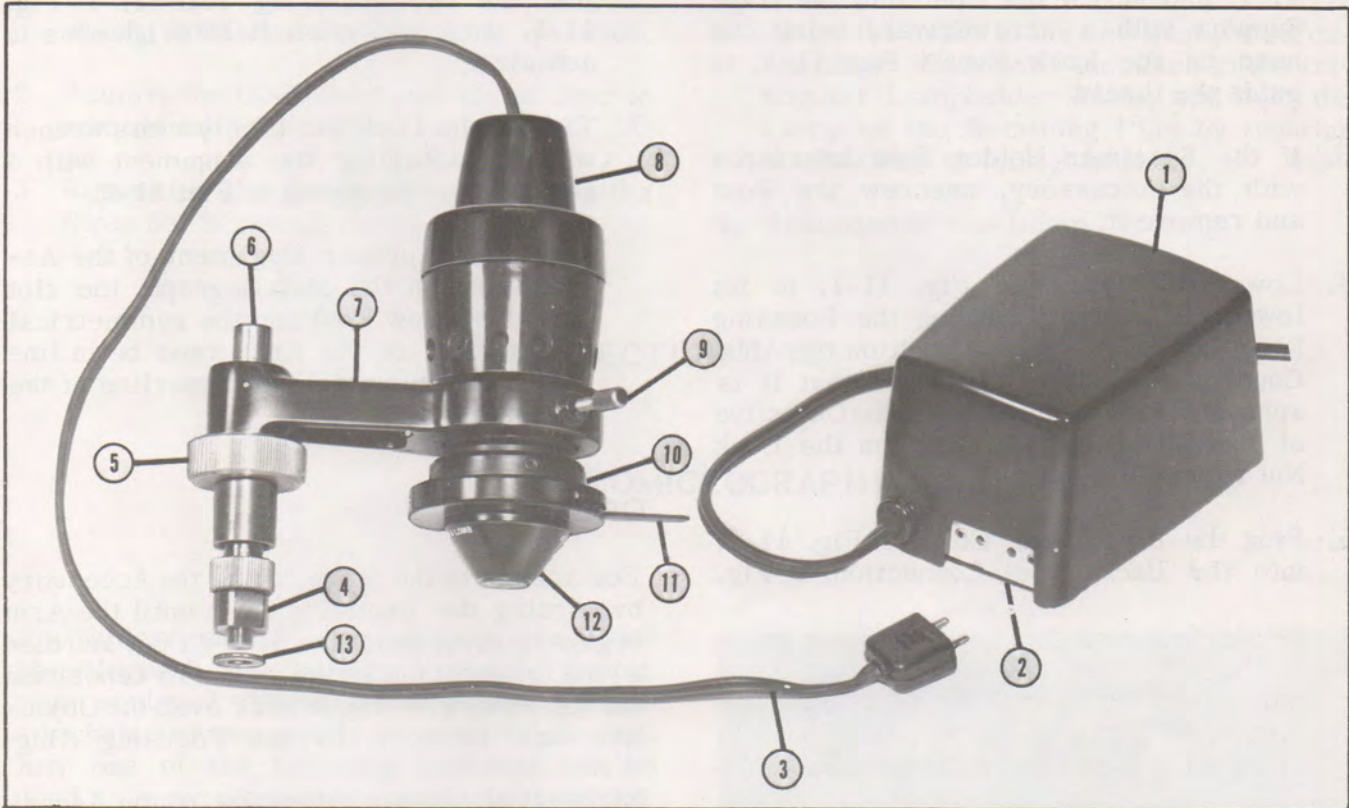
If the Stage is not centered satisfactorily:

1. Loosen the two Guide-Locking Set Screws, 2 Fig. 10-4, with a 3/64 socket head wrench.
2. Rotate one or both eccentric Stage Centering Guides, 1 Fig. 10-4, as required to improve centration (a slight adjustment should be sufficient).
3. Retighten the two Guide-Locking Set Screws. If tightening these screws de-centers the Stage, repeat steps 1 and 2.

SECTION - 11

TRANSMITTED LIGHT ACCESSORY

CAT. NO. 42-36-54



- | | |
|--------------------------|--------------------|
| 1. Transformer | 8. Lamp Housing |
| 2. Back Panel Connection | 9. Centering Screw |
| 3. Illuminator Cord | 10. Set Screw |
| 4. Lock Nut | 11. Iris Diaphragm |
| 5. Focusing Ring | 12. Abbe Condenser |
| 6. Screw Post | 13. Washer |
| 7. Arm | |

FIG. 11-1 - TRANSMITTED LIGHT ACCESSORY

The Transmitted Light Accessory provides an overhead light source for all models of the DynaZoom Bench Metallograph, and enables their use for the microscopic examination of transparent and translucent specimens.

The Accessory consists of two separate units: an Illuminator and a Transformer. The Illuminator is a modified Nicholas Illuminator, fitted with an Iris Diaphragm and a

1.30 NA Abbe Condenser. A Blue Filter, used to provide a whiter light, is included and may be removed if desired.

The transformer unit has a 115 volt, 50/60 cycle primary with a standard two-prong plug and an on-off switch. The secondary provides 6.4 volts at 2.75 amps to operate the Lamp.

INSTALLATION AND ALIGNMENT

1. Remove the Plug from the threaded hole on the top of the Metallograph Stage Support.
2. Put the washer, 13 Fig. 11-1, on the threaded end of the Screw Post, 6 Fig. 11-1, and screw the Post into the Stage Support with a screwdriver, using one hand on the Lock Nut, 4 Fig. 11-1, to guide the thread.
3. If the Specimen Holder Post interferes with the Accessory, unscrew the Post and remove it.
4. Lower the Arm, 7 Fig. 11-1, to its lowest position by turning the Focusing Ring, 5 Fig. 11-1, and position the Abbe Condenser, 12 Fig. 11-1, is that it is approximately centered over the Objective of the Metallograph. Tighten the Lock Nut with your fingers.
5. Plug the Illuminator Cord, 3 Fig. 11-1, into the Back Panel Connection, 2 Fig.



FIG. 11-2 - INSTALLING THE TRANSMITTED LIGHT ACCESSORY

11-1, of the Transformer, 1 Fig. 11-1, and plug the Transformer Line Cord into a 115 volt, 50/60 cycle, A.C. outlet. Turn the Transformer Switch on (to the right).

6. While viewing through the Eyepiece, adjust the two centering Screws, 9 Fig. 11-1, until maximum field brightness is achieved.
7. Tighten the Lock Nut firmly with a wrench while maintaining the alignment with a screwdriver as shown in Fig. 11-2.

NOTE: For proper alignment of the Accessory on the Metallograph, the slot in the Screw Post and the symmetrical centerline of the Arm must be in line with the symmetrical centerline of the Metallograph.

OPERATION

For access to the Stage, raise the Accessory by turning the Focusing Ring until the Arm begins to pivot about the Screw Post and then swing the Arm out of the way. To reposition the Accessory, swing it back over the Objective and lower it by the Focusing Ring.

NOTE: For proper alignment of the Accessory on the Screw Post, the slot in the top of the Post must be in line with the symmetrical centerline of the Arm.

CAUTION

TAKE CARE WHEN LOWERING THE ACCESSORY TOWARD THE SPECIMEN. AVOID TOUCHING THE SPECIMEN WITH THE LEADING CONDENSER LENS.

The Iris Diaphragm is opened and closed by the Iris Diaphragm Handle, 11 Fig. 11-1.

DIAPHRAGM ADJUSTMENT

The Iris Diaphragm Handle may be oriented in any convenient position by loosening the

three slotted Set Screws, 10 Fig. 11-1, rotating the Abbe Condenser to the desired position, and retightening the Screws.

FILTER REMOVAL

1. Loosen the three slotted Set Screws, which hold the Condenser in position.
2. Remove the Condenser and tip it over to remove the Blue Filter.
3. Reposition the Condenser and tighten the three Set Screws.

LAMP REPLACEMENT

1. Back off the two captured Screws in the top of the Lamp Housing, 8 Fig. 11-1, and remove the Housing.
2. Twist the old Lamp counterclockwise and remove it.
3. Align the notch in the new Lamp's circular Base Plate with the notch in the triangular Lampholder Plate, and seat the Lamp on the Retaining Pins by twisting it clockwise to lock it in place.
4. Reassemble the Lamp Housing.

SECTION - 12

PHOTOMICROGRAPHY

Photomicrography with a DynaZoom Bench Metallograph is a relatively simple matter when equipped with one of the Bausch & Lomb attachable or separately supported Cameras. Any one of the following Cameras can be used to make photomicrographs in black and white or color. They are classified by size and by the types of film they use. There is no "best" Camera. There is, however, one Camera which should be best suited to your needs. The Cameras have their own reference manual No. 42-12-10-100ND, and will be described only briefly here.

3-1/4 x 4-1/4 CAMERA KIT

CAT. NO. 42-12-27-10

This Camera incorporates a Polaroid* CB-100 Land pack type back. It provides finished prints, complete and ready for viewing in approximately ten seconds for black and white and one minute for color. Total magnification at the film plane is the product of objective and zoom magnification multiplied by the 7.5X camera factor.

*Reg. Polaroid Corp.



FIG. 12-1

4 x 5 CAMERA KIT

CAT. NO. 42-12-28-10

This Camera is equipped with a ground glass focusing screen and will accept 4 x 5 sheet film and plate holders, the Polaroid Land Film Holder, standard 4 x 5 film pack adapters, and roll film holders to fit a 4 x 5 back. Total magnification at the film plane is the product of objective and zoom magnification multiplied by the 10X camera factor.

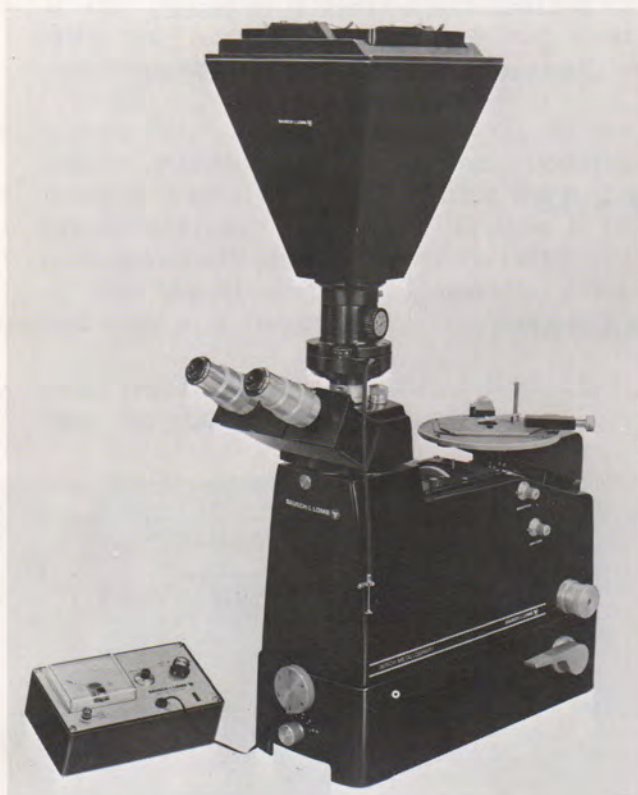


FIG. 12-2

EXPOSURE METER

CAT. NO. 42-12-40-01

The Exposure Meter consists of a Light Sensor permanently connected to a Metering Unit by means of a flexible cord. The Metering Unit has been factory-calibrated to provide readings within the range of .02 to 100 foot-candles. A circular Exposure Computer is supplied to convert from meter

reading to exposure setting relative to Film Speed and Camera Magnification being used.

The unit is designed principally to be used in conjunction with the Bausch & Lomb Integrated Camera System II which has an accessory slot for insertion of the Sensor. However, an auxiliary Sensor Holder is available permitting usage of the Sensor either at the Microscope Eyepiece position or at a Film Plane location.

35MM CAMERA KIT

CAT. NO. 42-12-29-10

This Camera is equipped with a 35mm film back which will accept the standard 35mm film cartridge. Total magnification at the film plane is the product of objective and zoom magnification multiplied by the camera factor which may be 3.0X or 5X.

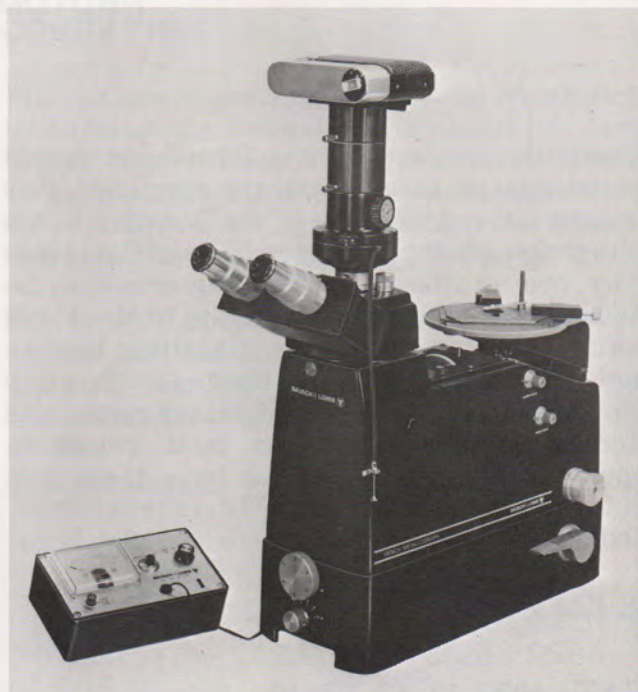


FIG. 12-3

VIEWING SCREEN & OPTICS TUBE

CAT. NO. 42-12-20-01

The Viewing Screen is designed for use on the DynaZoom and Dynoptic Microscopes,



FIG. 12-4

Bench Metallograph and the StereoZoom 7 Microscope with Camera Adapter. It may be purchased as a complete unit consisting of a Viewing Screen (42-12-20), Optics Tube (42-12-21) and Screw Adapter (42-12-23) or the Viewing Screen may be purchased separately for use with the Focusing Tube of the New Integrated Camera Series.

The unit has a magnification factor of 7.5X so Total Magnification at the Screen = Objective Mag. x Zoom Setting (if applicable) x 7.5.

The lens system is focusable thus allowing the image on the Screen to be parfocaled to the image in the right Eyepiece of the instrument on which it is being used.

10X WIDE FIELD VIEWFINDER EYEPIECE

CAT. NO. 42-12-02

This Eyepiece offers great convenience in framing the image area to be photographed through a Microscope or Metallograph. In the center of its field is a crossline to aid in centering the image area. Three rectangular

frames are visible in the Eyepiece. One frame represents the areas covered by the 3-1/4 x 4-1/4 and the 4 x 5 Cameras. The other two frames represent the areas covered by the 35mm - 3X and the 35mm - 5X Cameras. Each frame is identified as such.

LCC FOCUSING TUBE

CAT. NO. 42-12-13

Cat. No. 42-12-13 (identified by white stripe)

For optimum sharpness, with DynaZoom (not Dynoptic), this should be used with any of the following Objective Lenses. It will sharpen both black & white and color photographs, and will improve color rendition. It does not affect the focal setting, nor will it appreciably increase exposure time.

It should be used with:

All Bausch & Lomb Apochromats (bronze finish mounts)

All Bausch & Lomb Flat Field Objective (bright chrome finish mounts)

MIRROR VIEWING ATTACHMENT

CAT. NO. 42-12-31

The 4 x 5 Mirror Viewing Attachment is an adjustable Mirror that can be mounted on the top of the 4 x 5 Camera Body. The Mirror can be positioned such that the operator is able to focus and frame the image, on the ground glass, from a normal viewing position.

OPTIONAL GROUND GLASS VIEWING SCREEN

CAT. NO. 42-12-33

This Focusing Screen is a fine-ground Glass Screen with a clear center and clear rectangular area along each diagonal. The clear areas allow the operator to observe the image directly with a magnifier in a more critical focus.

Section 13

Bench Metallograph

for use on the Quantitative Metallurgical System



A modified version of the Flat Field Bench Metallograph is used on the Quantitative Metallurgical System (Q.M.S.). It is essentially the same as the standard flat field model but has a beam dividing prism in the viewing body to permit simultaneous viewing of the image on the monitor and through the eyepieces.

A second difference is the substitution of an image rotator in the camera tube which directs the microscope image into the television camera. When the calibrated knurled ring is rotated, a $\pm 180^\circ$ rotation of the image is produced. The calibrated scale is divided into 5° increments and there is a detent at each 45° position. The rotation of the image takes place on the monitor only, not through the eyepieces.

When used on the Q.M.S., the illumination system of the Bench Metallograph must be aligned to insure even field illumination. The adjusting is done by moving the mirror

back and forth and adjusting the mirror centering screws until the field is evenly illuminated. In most cases best results will be had when the light is set on tap 3 or on O.V. Instructions for adjusting the mirror and for replacing the lamp will be found in Section 14.

On the cover of the metallograph under the stage, is attached a microswitch which electronically signals the computer which objective is being used. When the objective magnification knob on the size measurement module corresponds to the objective in use, the uncalibrated light will be off and the measurements will be calibrated.

Special Parts

Viewing Body	42-31-81
Rotator	42-31-82
Microswitch Assy.	37-19-96

SECTION - 14

MAINTENANCE

GENERAL

A plastic dust cover is supplied with each Metallograph and should be used to cover the instrument when not in use.

To prevent dust from settling in the Eyepiece Tubes, always keep the Eyepiece in the Tubes.

Your Metallograph should be cleaned at a service center every few years to maintain its performance. Complete service and repair facilities are generally provided by Bausch & Lomb dealers, while the plant in Rochester, New York maintains a fully staffed repair department. Refer to Section - 0, Service, for further instructions.

OPTICS

1. If dust collects on external optical surfaces, blow it off with clean air from a syringe or brush it off with a clean camel's hair brush.

IMPORTANT

Avoid hard wiping. Dust can be hard and abrasive, and thereby scratch a lens surface.

2. Avoid touching or handling the surfaces of any of the Lenses in the Metallograph, as unclean Lenses will effect performance. To remove fingerprint smudges, wipe the Len with a clean, soft, lint-free cloth, or use a cotton swab moistened with soap and water, alcohol, or xylol.

NOTE: When cleaning optics, always sweep across the surface in smooth, one stroke motions - in the same direc-

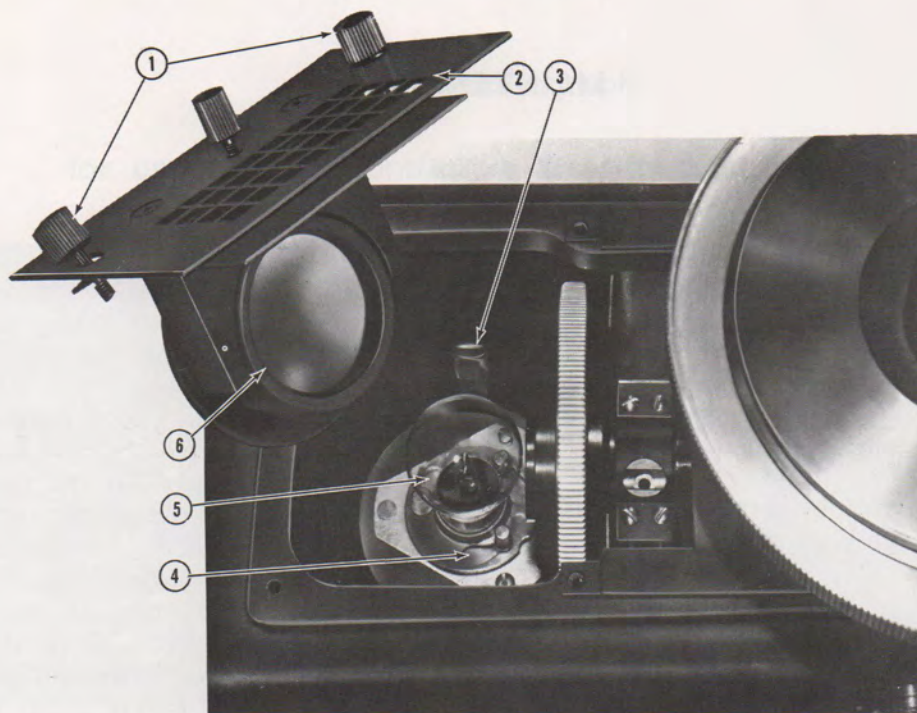
tion - and avoid using an excess of cleaning solvent.

3. The Reticles may be removed for cleaning by removing them, in their Cell Mounts, from the Reticle Turret (see Fig. 7-1). All of the Reticles, with the exception of the Twinned and Untwinned Grain Size Reticles, Figs. 8-3 and 8-4, may be cleaned as in steps 1 and 2. Fingerprints smudges can be removed from the Twinned and Untwinned Grain Size Reticles with Kodak Film Cleaner, and dust and lint should be removed by blowing it off with a syringe.
4. The Reflector, 6 Fig. 14-1, may be removed for cleaning by loosening the two Cover Plate Screws, 1 Fig. 14-1, and removing the Cover Plate Assembly, 2 Fig. 14-1. After cleaning the Reflector, replace the Cover Plate Assembly and then check for Lamp alignment (see Section 3, Lamp Alignment).

MECHANICAL

A minimum of maintenance is required for the DynaZoom Bench Metallograph since it is factory lubricated for the life of the instrument.

1. The Mechanical Stage is factory lubricated and should not require any maintenance. If the slides should become sticky, apply a few drops of light machine oil to the bearing surfaces.
2. The Glide Stage depends on "controlled drag" for its gliding motion. The underlying friction surfaces should be periodically cleaned and relubricated using the special Glide Stage Grease (Cat. No.



- | | |
|-------------------------|-------------------|
| 1. Cover Plate Screws | 4. Locking Eyelet |
| 2. Cover Plate Assembly | 5. Lamp |
| 3. Lamp Change Lever | 6. Reflector |

FIG. 14-1 - LAMP HOUSING WITH COVER PLATE
ASSEMBLY REMOVED

42-36-31). This is necessary to remove any foreign particles which may have contaminated the lubricating film and which could damage the gliding surfaces.

LAMP REPLACEMENT

1. Loosen the two Cover Plate Screws, 1 Fig. 14-1, and remove the Cover Plate Assembly, 2 Fig. 14-1.
2. Move the Lamp Change Lever, 3 Fig. 14-1, counterclockwise to relieve the spring pressure of the Lamp Socket on the Lamp.
3. Rotate the Lamp counterclockwise and remove it.
4. Insert a new Lamp by reversing the directions in steps 2 and 3.
5. Replace the Cover Plate Assembly and then check for Lamp alignment (see Section 3, Lamp Alignment).

NOTE: To achieve proper orientation and centration of the Lamp Filament to the optical axis, the Lamp Base's Locking Eyelets, 4 Fig. 14-1, permit Lamp installation in only one position.

PARTS LIST AND EXPLODED VIEWS

SECTION - 15

PARTS LIST AND EXPLODED VIEWS

MODEL 32 : CAT. NO. 42-31-32

MODEL 42 : CAT. NO. 42-31-42

MODEL 52 : CAT. NO. 42-31-52

Legend	Description	Drawing No.	Legend	Description	Drawing No.
1	4-40T x 1.000 Screw	423152-310ND	54	Valve Disc	423152-223
2	Lamp, G.E. No. 1631X	313185-107	55	Tru-Arc Retainer	423152-139ND
3	LY-49A Lampholder	313353-136ND	56	Washer	423152-272
4	Lamp Support	423152-107	57	Stud	423152-130
5	Plate Assembly	423152-248	58	Cam Pin	423152-321
6	Lever Assembly	423152-246	59	8-32 x .625 lg. Socket Cap Screw	423152-292ND
7	F-130 Washer	90008-135	60	Tube	423152-138
8	4-40T Nut	423152-294ND	61	Lever Right	423152-151
9	1/4 - 20 x 1/2 lg. Cap Screw	338315-201ND	62	6-40 x .437 Socket Set Screw	312118-186ND
10	4-48 x .125 lg. Socket Set Screw	334556-205ND	63	SE-91 Screw	90048-129
11	Retardation Plate	423152-028	64	6-40F15S Screw	96206-1617
12	Mount	423152-253	65	Lockwasher	423152-295ND
13	Cell	423152-252	66	Bearing Blank	423152-134
14	Lens AB Assembly	423152-032	67	Washer	423152-220
15	Spring	423152-170	68	6-32 x 1/4 lg. Socket Set Screw	423152-260ND
16	Mirror Mount Assembly	423152-211	69	Lens C	423152-034
17	Housing	423152-165	70	Spacer	423152-174
18	Lockwasher	423152-297ND	71	I-322 Pin	90011-338
19	10-24F12S Screw	96206-1001	72	Lens D	423152-033
20	Support	423152-164	73	Retainer	423152-162
21	6-32 x .875 lg. Cap Screw	423152-298ND	74	Turret	423152-166
22	Bushing	423152-212	75	Micrometer Disc	42-34-82
23	4-48 x .125 Socket Set Screw	423152-225ND	76	SD-88 Screw	90047-150
24	Bracket	423152-241	77	Lever Left	423152-137
25	Lockwasher	423152-296ND	78	Groove-Pin	423152-293ND
26	Screw	423152-313	79	Bushing	423152-240
27	Index Spring	311923-110	81	Clamp (LX-74-5)	412340-237ND
28	.125 ϕ Ball	531271-316ND	82	10-32B12S Screw	96200-2004
29	Retaining Spring	311923-108	83	SD-62 Screw	90047-120
30	2-56F10S Screw	96206-0201	84	Knob Screw	310105-169
31	Knob	423152-169	85	F.A. Drum B	310105-167
32	Shaft	423152-168	86	F-39A Washer	90008-95
33	4-40 x 1/2 lg. Socket Cap Screw	423152-262ND	87	No. R-3 Ball Bearing	310102-129ND
34	Knob	423152-232	88	Ring-Left	423152-219
35	LX-53 Nut	714862-188ND	89	4-48S10T Screw	97222-1414
36	6-32 x 1/4 lg. Socket Set Screw	423152-260ND	90	Shaft	423152-368
37	Lockwasher	423152-234ND	91	SB-20 Screw	90045-25
38	Base	423152-355	92	6-40F16S Screw	96206-1624
39	1/4-20 x 3/4 lg. Socket Cap Screw	211043-204ND	93	8-32 x .750 lg. Socket Cap Screw	338640-186ND
40	Base Cover Assembly	423152-379	94	Support	423152-356
41	Switch	423152-345	95	.0937 ϕ Steel Ball	512108-122ND
42	8-32 x 1/4 lg. Screw	214315-378ND	96	8-32 x .250 lg. Socket Set Screw	714801-215ND
43	Transformer	423152-377	97	F.A. Nut Spring	310102-136
44	8-32 x .250 lg. Screw	211005-184ND	98	Nut	310102-177
45	Roll Pin	423152-206ND	99	Power Cord Assy.	423152-333
46	Cam Arm	423152-320	100	Nut Housing	423152-122
47	Cam Link	423152-318	101	Ring-Right	423152-120
48	SF-44 Screw	90049-122	102	F-21 Washer	90008-269
49	Roller	423152-131	103	F.A. Drum A	310105-113
50	Shaft	423152-316	104	F.A. Roller	310102-113
51	4-48 x 1/4 lg. Nylok Screw	423152-287ND	105	Piston	423152-132
52	Washer	423152-307	106	Spirol Pin	423152-300ND
53	Cap	423152-222	107	I-254 Pin	90011-265

Legend	Description	Drawing No.	Legend	Description	Drawing No.
108	- F.A. Lever	310102-114	179	- Condenser Lens B Assembly	423132-118
109	- Stop	423152-116	180	- Stop	423132-125
110	- SF-44 Screw	90049-122	181	- Spring	423132-123
111	- Push Rod	423152-127	182	- 4-40B8S Screw	96200-0401
112	- Rod	423152-128	183	- Light Stop Assembly	423132-111
113	- Slide	423152-358	184	- Collar	423132-112
114	- I-258 Pin	90011-269	185	- Guide	423132-114
115	- 187 ϕ Steel Ball	310102-165ND	186	- 2-56B6T	97200-0200
116	- 8-32 x 3/8 Ig. Screw	310105-220ND	187	- Guide	423132-115
117	- Spacer	423152-273	188	- Gib	313464-206
118	- I-331 Pin	90011-347	189	- 2-64F5S Screw	96206-1218
119	- 8-32C21S Screw	96202-0810	190	- Reflector	313464-023
120	- Support	423152-375	191	- Mirror Mount	423132-101
121	- Spring Plunger and Set Screw	423152-284ND	192	- 4-48 x .437 Ig. Socket set Screw	423132-121ND
122	- 2-64U4T	97226-1209	193	- SC-67 Screw	90046-118
123	- Link	423152-283	194	- 6-32 x .375 Ig. Socket Cap Screw	423152-332ND
124	- Roller	423152-146	195	- O-80C5B	91202-0006
125	- SE-28 Screw	90048-63	196	- Housing	423132-102
133	- 4-48 x .187 Socket Screw Set	716140-333ND	197	- Magnet	332804-397
134	- Guide	423152-150	198	- Case	313464-117
135	- 8-32F16S Screw	96206-0801	199	- Knob	423132-104
136	- Screw	423152-155	200	- 2-64T3T Screw	97224-1205
137	- Lock Screw	310105-186	201	- Screw	423132-107
138	- Mount	423152-278	202	- Ring	423132-105
139	- Reflector	423152-029	203	- Retainer	423132-106
140	- Tru-Arc Retaining Ring	423152-282ND	204	- Condenser Lens A	423132-021
141	- Spring	423152-269	205	- Retainer A & B	313464-103 & -109
142	- 4-48W8S Screw	96230-1402	211	- Condenser Lens B	423152-021
143	- Thumbscrew	423152-266	212	- Housing	423142-112
144	- Thumbscrew	423152-351	213	- Guide	423142-110
145	- Tru-Arc Retaining Ring	423152-326ND	214	- Beam Divider	423142-024
146	- Cover Assembly	423152-364	215	- Reflector Pad B	312908-103
147	- Centering Screw	423152-344	216	- Reflector Pad A	312908-102
148	- 4-40 x 1/4 Ig. Screw	423152-203ND	217	- Reflector Mount	423152-268
149	- Cover	423152-363	218	- 4-48 x .500 Ig. Socket Set Screw	423152-230ND
150	- Guide & Slide Assembly	423152-362	219	- 2-64T6N Screw	95224-1201
152	- Camera Mount Cap (Plug)	311959-350	220	- 2-64UT3 Screw	97226-1208
153	- Eyepieces		221	- Slotted Ring	423152-101 & -331
154	- Binocular Zoom	42-34-62	222	- Knob	423152-102
155	- Key	423142-122	223	- Screw	423152-104
156	- I-305 Pin	90011-321	224	- Collar	423152-105
157	- Shaft	423142-121	225	- 2-64T5T Screw	97224-1202
158	- Tru-Arc Retainer	423142-123ND	226	- Cover	423152-261
159	- Bushing	423142-120	227	- 4-40B8S Screw	96200-0401
160	- Knob	423142-118	228	- Gib	423152-357
161	- 2-56 x .094 Ig. Socket Set Screw	332804-461ND	229	- Housing	423152-106
162	- Cover	423152-354	231	- Roll Pin	423152-206ND
163	- Upright	423152-109	232	- Cam Mount	423152-319
164	- Mount	423142-102	233	- 8-32G16S Screw	96208-0806
165	- 4-40F20S Screw	96206-0401	234	- Foot Screw	423152-348
166	- Bearing	423142-101	235	- Bumper	423152-323ND
167	- Spring	423142-116	236	- Foot Screw Adapter	423152-347
168	- Analyze Assembly	423142-021	237	- Bearing	423152-327
169	- Shaft	423142-119	238	- Roller	423152-317
170	- Stop	423152-103	239	- Cover	423142-136
171	- 4-40G20S Screw	96208-0407	240	- Cover	423132-132
172	- Clamp Pad Assembly	423152-113	241	- Washer	423152-285
173	- Mirror A	423152-023	242	- 2-64D7T Screw	97204-1206
174	- Objective				
175	- Focusing Tube	423467-107			
176	- Nosepiece, Quad				

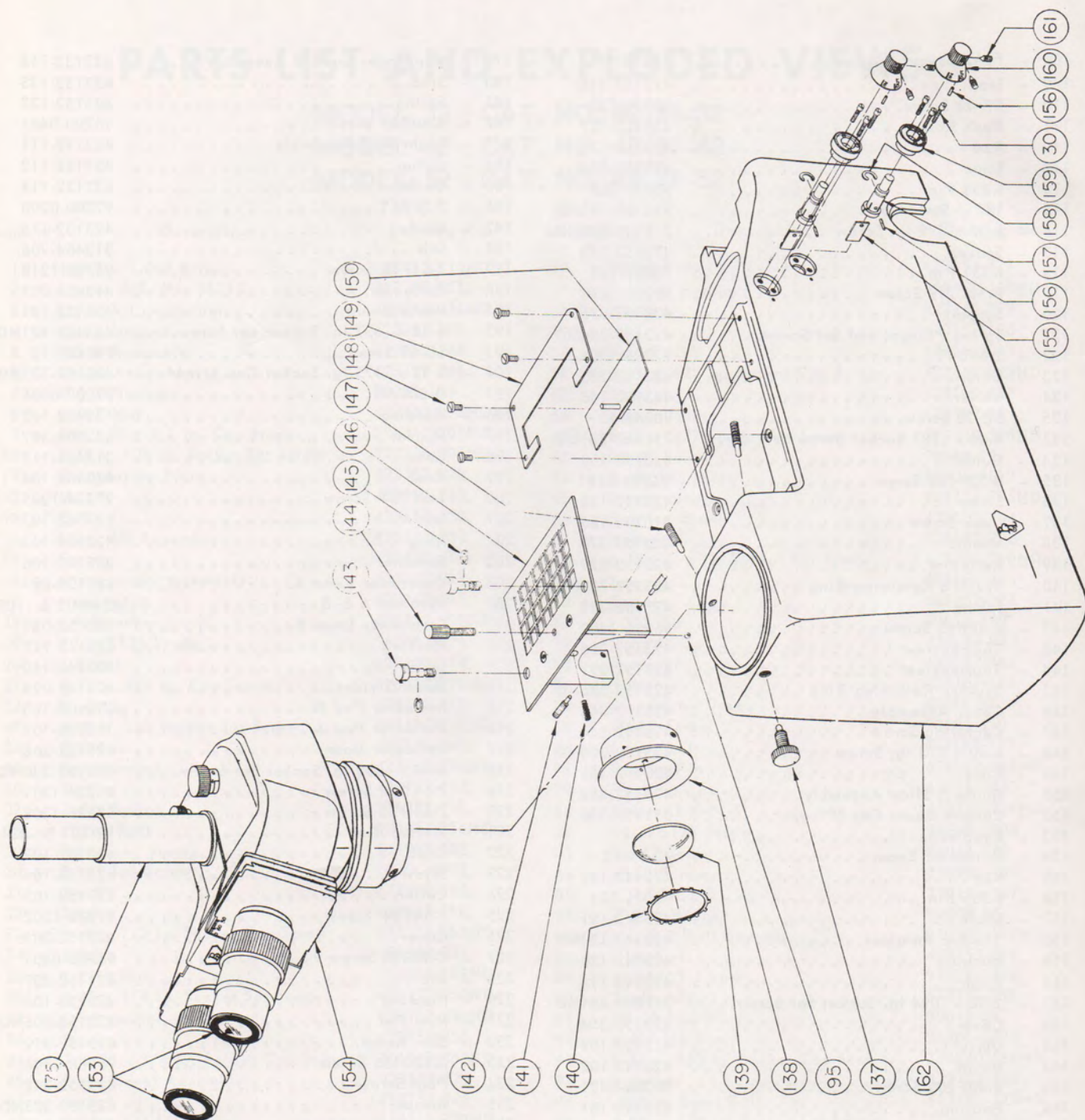
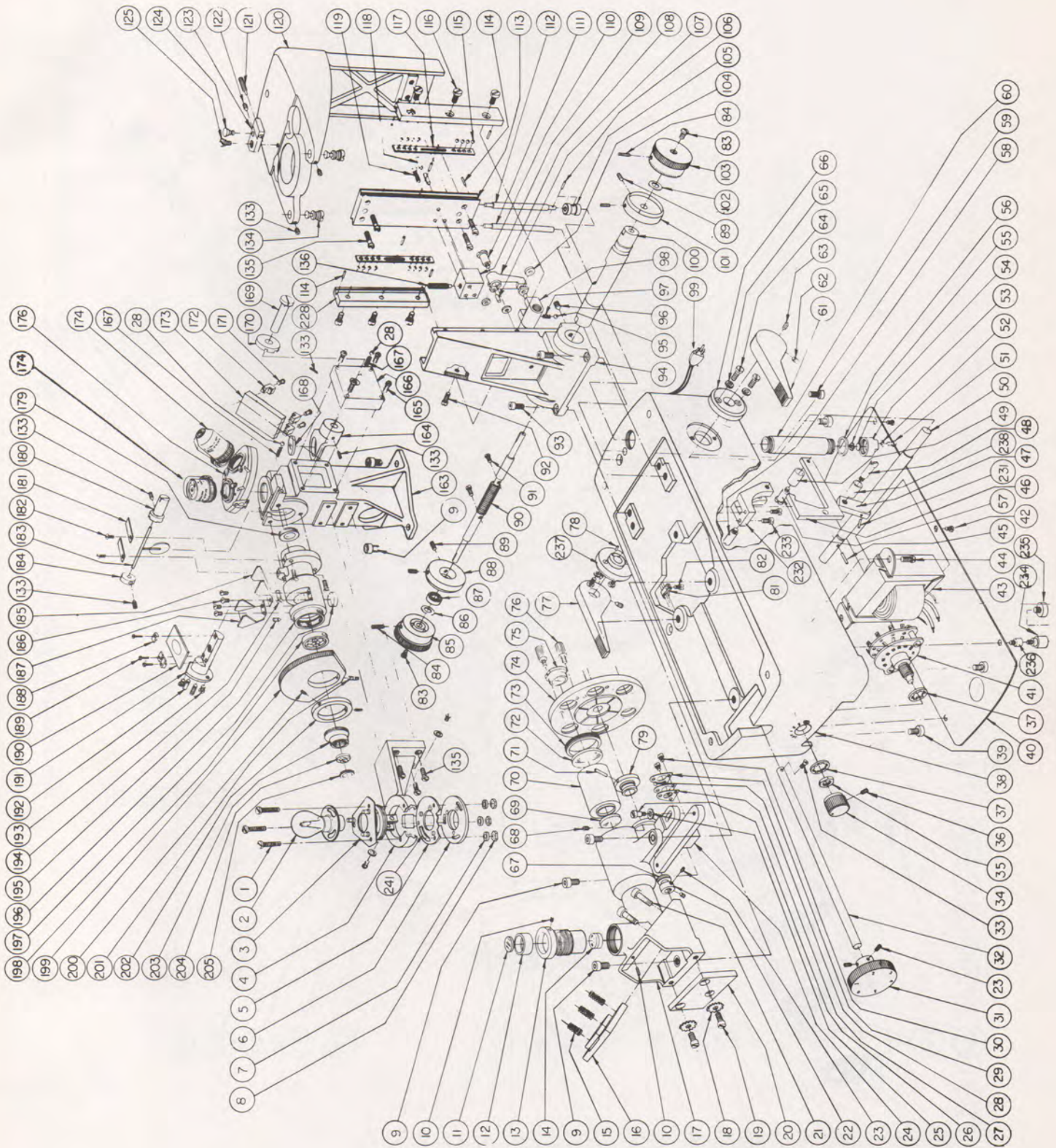


FIG. 15-1 EXPLODED VIEW
42-31-32 DYNAZOOM BENCH METALLOGRAPH
(Dark Field, Bright Field, and Polarized Light)



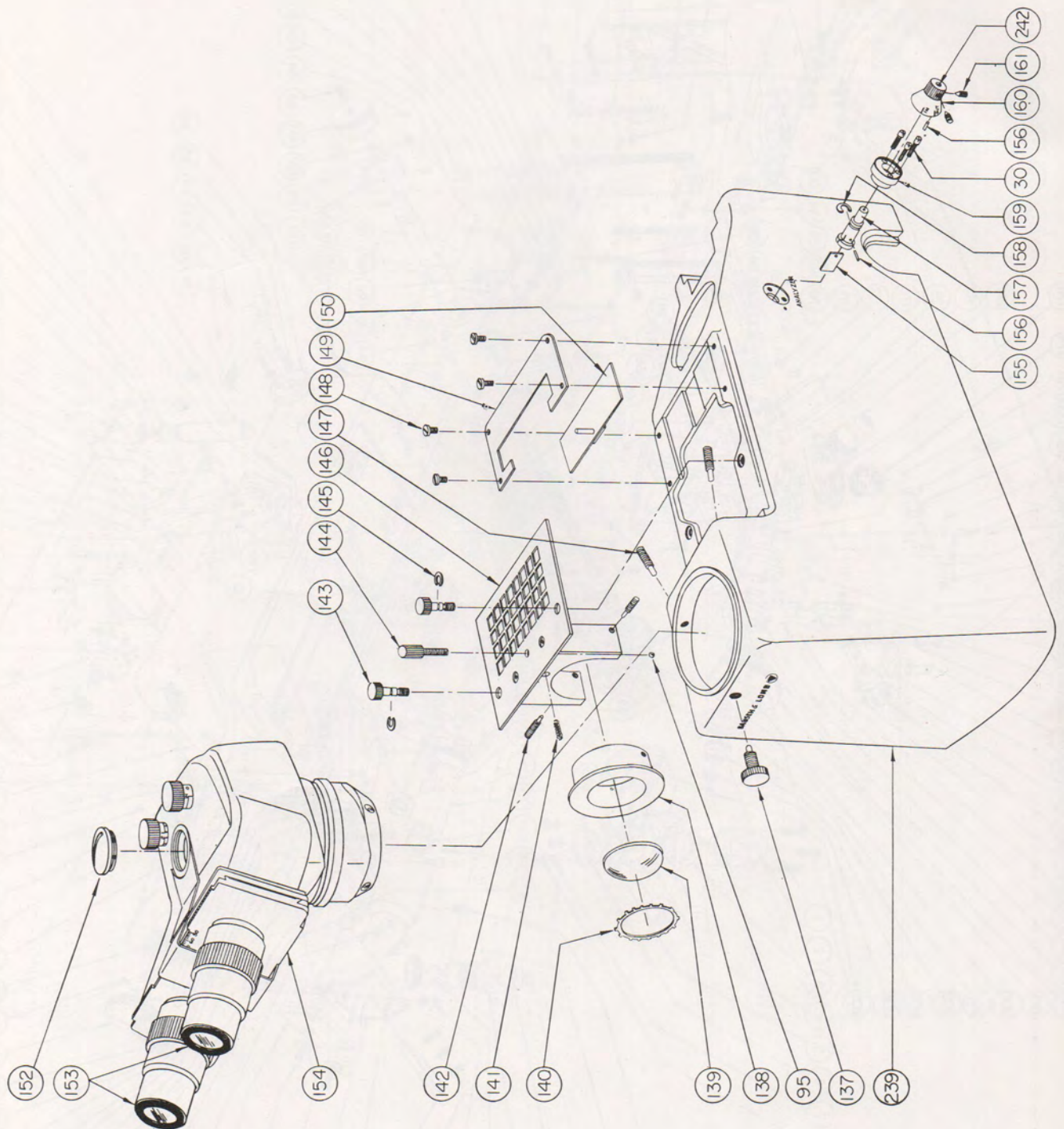
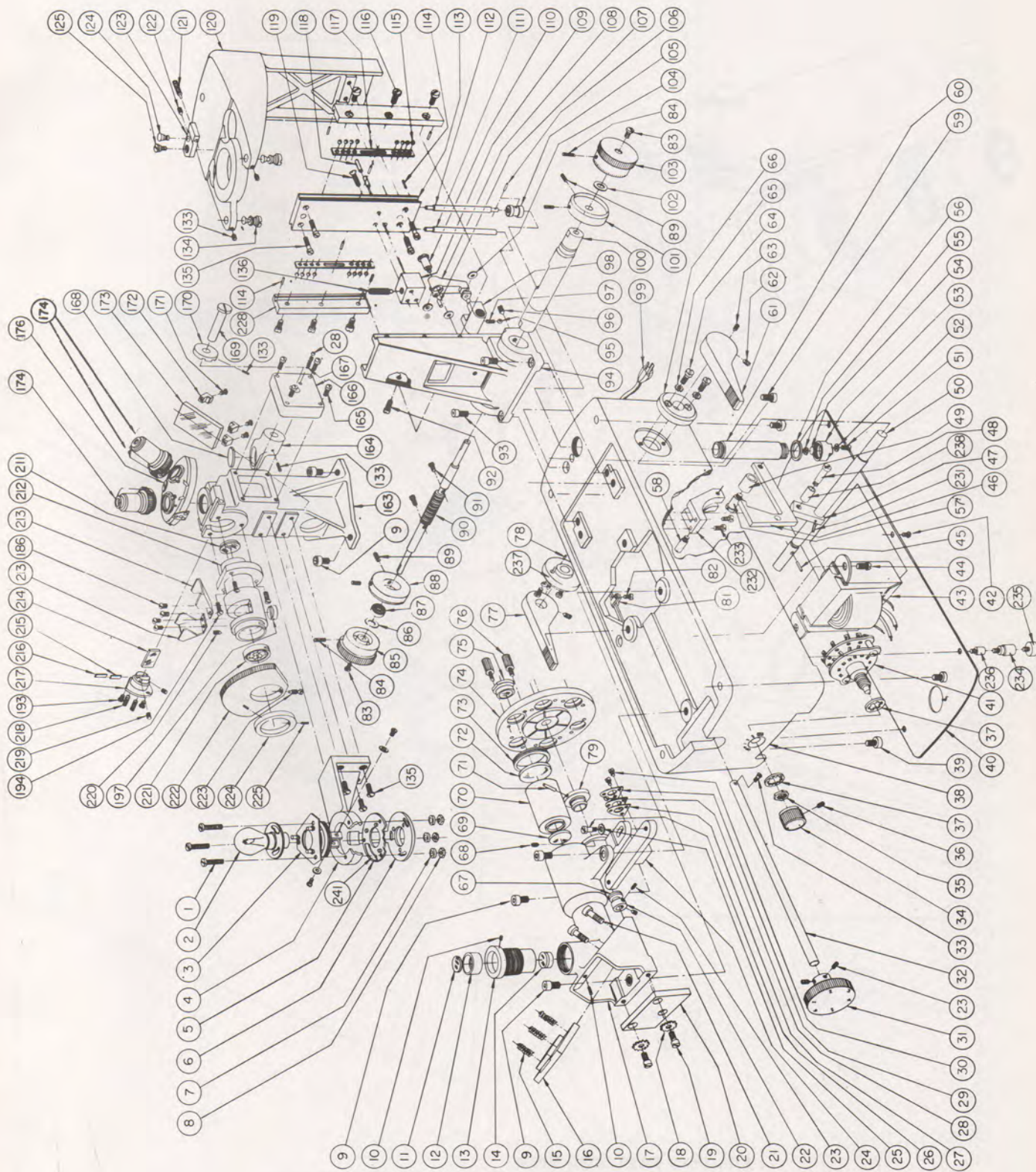


FIG. 15-2 EXPLODED VIEW
42-31-42 DYNAZOOM BENCH METALLOGRAPH
(Bright Field and Polarized Light)



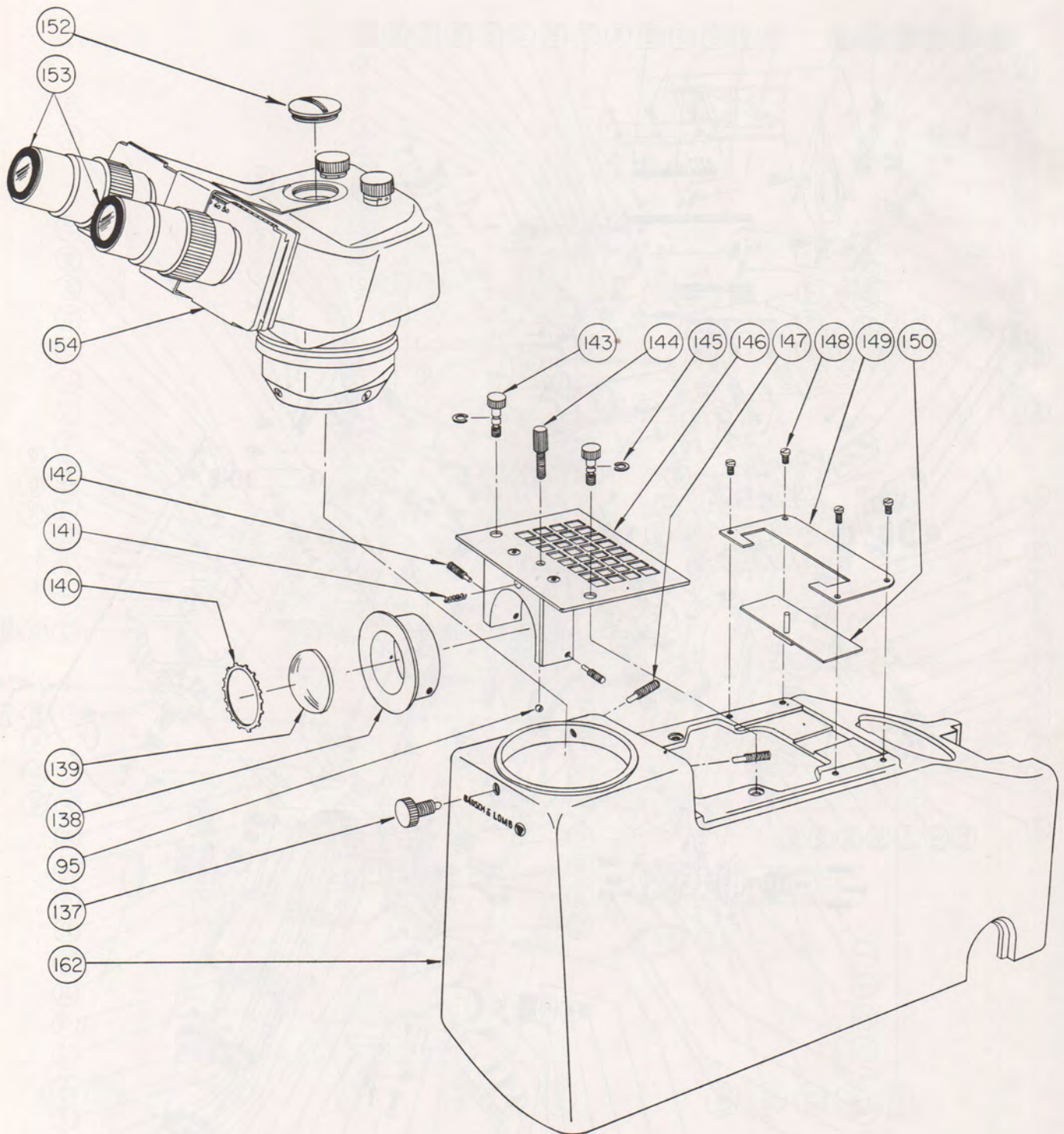
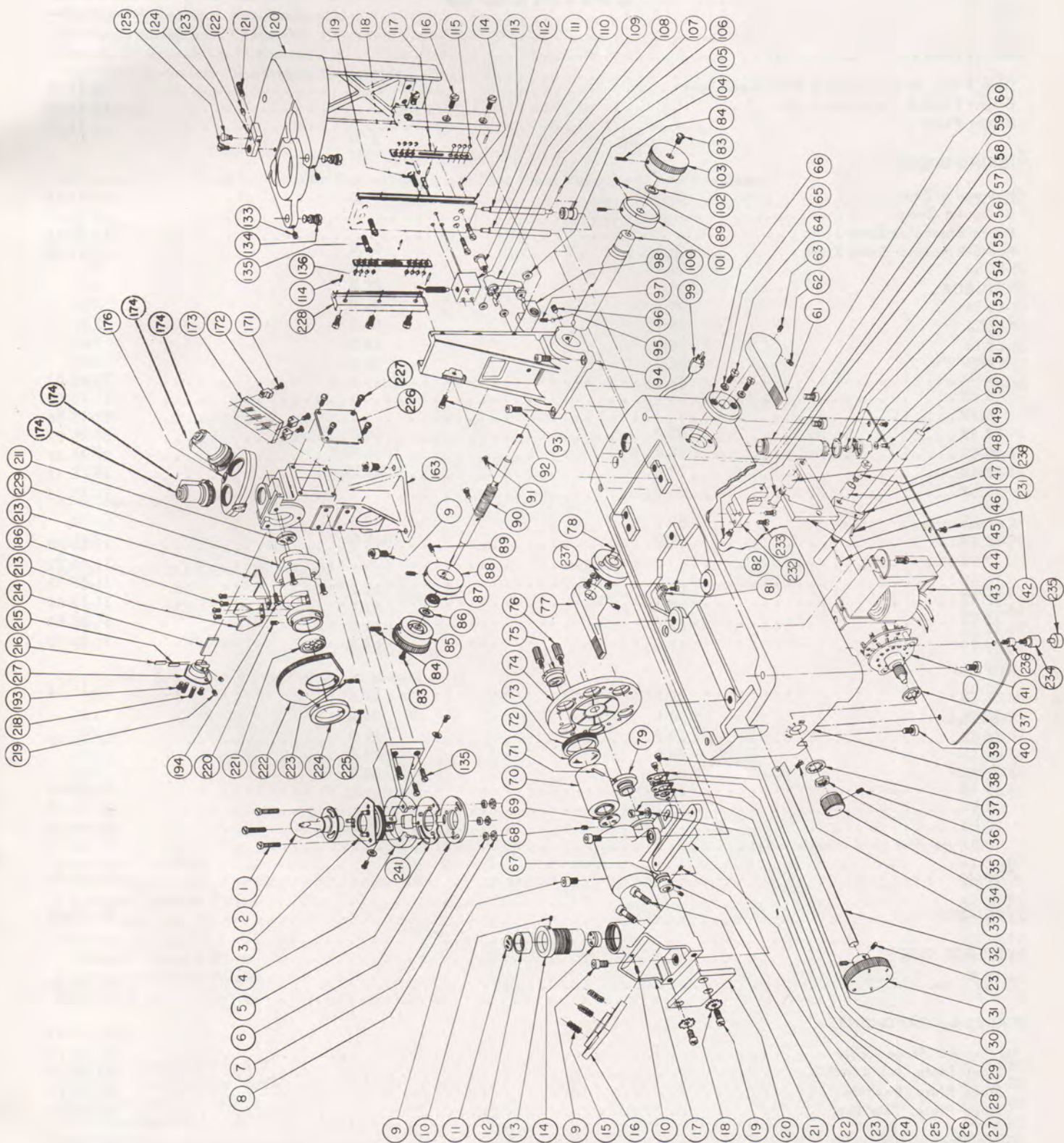


FIG. 15-3 EXPLODED VIEW
42-31-52 DYNAZOOM BENCH METALLOGRAPH
(Bright Field)



SECTION - 16

CATALOG

Item

Catalog Number

BENCH UNITS

Dark Field, Bright Field & Polarized Light	42-31-32
Bright Field & Polarized Light	42-31-42
Bright Field	42-31-52

VIEWING BODIES

Monocular Zoom	42-34-60
Binocular Zoom	42-34-61
Photo-Binocular Zoom	42-34-62
Photo-Binocular Stero-Zoom	42-31-80

EYEPIECES

Type

Huygenian	31-05-03
5.0X	31-15-08
5.0X	31-15-06
6.4X	31-15-07
7.5X	31-15-09
10.0X	31-15-12
12.5X	31-15-15
15.0X	
Compensating	31-05-70
5.0X	31-05-72
7.5X	31-05-75
10.0X	31-05-86
12.5X	31-05-88
15.0X	31-05-90
25.0X	
Hi-Point	31-15-14
10.0X	
Viewfinder	42-12-02
10.0X	
Widefield	31-05-60
10.0X	31-05-52
15.0X	31-05-53
20.0X	31-05-23
10.0X (for flat field models only)	
Pinhole	31-50-24
	31-50-68

EYEGUARD

EYEPIECE DISCS

Cross Line	31-16-30
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STAGES & COMPONENTS

Mechanical Stage - only	42-36-52
Stage Plate, 1-1/4 inch	42-36-80
Stage Plate, Keyhole	42-36-81
Stage Plate, Tear Drop	42-36-82
	42-36-50
Glide Stage - only	42-34-79
Stage Plate, Keyhole	42-34-76
Stage Plate, 1 inch	42-36-31
Glide Stage Grease	

NOSEPIECES & EQUIPMENT

Dark Field Nosepiece, Quadruple, Centerable	31-19-15
Quadruple Nosepiece, Non-Centerable	31-19-19
Quadruple Nosepiece, Centerable	31-19-20
Wrench, for Centerable Nosepieces	31-19-21
Flat Field Nosepiece, Quadruple, Centerable.	42-36-04

OBJECTIVES

Type	N.A.	Working Distance (mm)	
Achromatic (Flat Field for use with Conventional, non Flat Field Nosepieces and Eyepieces)			
5X	0.10	6.42	42-35-01
Achromatic			
5X	0.10	2.40	42-33-51
8X	0.20	14.20	42-33-52
10X	0.25	10.60	42-33-53
20X	0.40	2.80	42-33-54
25X	0.50	1.80	42-33-55
40X	0.65	0.91	42-33-56
50X	0.85	0.38	42-33-57
75X	1.25 (oil)	0.30	42-33-58
Fluorite			
50X	0.85	0.39	42-33-70
50X	1.00 (oil)	0.45	42-33-61
75X	1.25 (oil)	0.51	42-33-68
Apochromatic			
50X	0.95	0.18	42-33-71
75X	1.40 (oil)	0.29	42-33-79
Bright Field - Dark Field Achromats			
8X	0.20	14.20	42-33-63
10X	0.25	10.60	42-33-64
20X	0.40	2.80	42-33-07
40X	0.65	0.91	42-33-66
Flat Field - Bright Field (for Flat Field models only)			
5X	0.10	3.20	42-35-50
10X	0.20	3.00	42-35-51
20X	0.40	0.62	42-35-52
40X	0.65	0.60	42-35-53
80X	0.85	0.60	42-35-54
100X	1.25 (oil)	0.29	42-35-55

FILTERS

Sensitive Tint Plate	42-34-07
Yellow Filter	42-34-47
0.3 Neutral Density Filter	42-34-51
Green Filter	42-34-56
Polarizer	42-34-57
0.5 Neutral Density Filter	42-34-59
1.0 Neutral Density Filter	42-34-64
Daylight Filter	42-36-10

RETICLES

Graphite Flake Reticle, 25X	42-34-80
Graphite Flake Reticle, 100X	42-34-81
Micrometer Disc	42-34-82
Dirt Count Reticle	42-34-83
Intercept Count Reticle	42-34-84
Twinned Grain Size Reticle	42-34-85
Untwinned Grain Size Reticle	42-34-86
Micrometer Disc (for Flat Field models only)	42-36-02

Item

Catalog Number

LAMP

GE #1631X pre-focused, 2.75 amps, 6.5 volts, D.C.	333385-105
Box of 10	33-33-85

TRANSMITTED LIGHT ACCESSORY (lamp and transformer included).	42-36-54
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PHOTOMICROGRAPHIC ITEMS

Cameras

3¼ x 4¼ Polaroid Camera Equipment	42-12-27-10
4 x 5 Camera Equipment	42-12-28-10
35mm Camera Equipment	42-12-29-10
Exposure Meter	42-12-40-01
Viewing Screen, Optics, Tube & Adapter	42-12-20-01
10X Viewfinder Eyepiece	42-12-02
LCC Focusing Tube	42-12-13
Optional Ground Glass Focusing Screen	42-12-33
Viewing Screen Only	42-12-20
Film Holder, Polaroid No. 545.	42-16-20
Focusing Magnifier, for 4 x 5 back	81-34-86

IMMERSION OIL	31-50-86
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SHIPPING CARTON	42-34-99
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WARRANTY

This product is warranted to be free from defects in materials or workmanship. If within one year of its purchase it is found to have any such defects, it will be repaired without charge. . . parts not of Bausch & Lomb manufacture carry the guarantee of their manufacturers.

This warranty does not cover damage in transit; damage caused by carelessness, improper servicing, modifications made by others than Bausch & Lomb Incorporated, misuse, or neglect; or unsatisfactory performance as a result of conditions beyond our control. Expendable components (i.e. lamps, fuses, etc) carry no warranty.

Should further information on your warranty be required contact your dealer.

To validate this warranty, the attached owner's reply card must be completed and returned within 15 days after purchase.

RESPONSIBILITY FOR SAFE DELIVERY

Especially designed and tested packaging is provided for all Bausch & Lomb products to protect them from normal transportation hazards and assure their safe delivery.

After the product leaves the factory, responsibility for its safe delivery, is assumed by the transportation company handling the shipment.

If your shipment shows evidence of rough handling, request the party making the delivery to note "received in bad order" on your delivery receipt. If "concealed damage" is revealed after the shipment is unpacked, contact a representative of the transportation company and request that a "Bad Order" report be made out.

In either event, the transportation company should be notified immediately of any damage to your shipment to protect your rights to recovery.

IMPROVEMENTS

Improvements are constantly being made in all Bausch & Lomb products to provide better performance, greater convenience of use, longer life, and improved appearance.

Often, the nature of such improvements will be self evident and will not require an explanation.

If the improvements affect use or maintenance procedures, supplementary instructions will be included in your manual or with the instrument.

- Bausch & Lomb Incorporated

BAUSCH & LOMB 

ROCHESTER, NEW YORK 14602