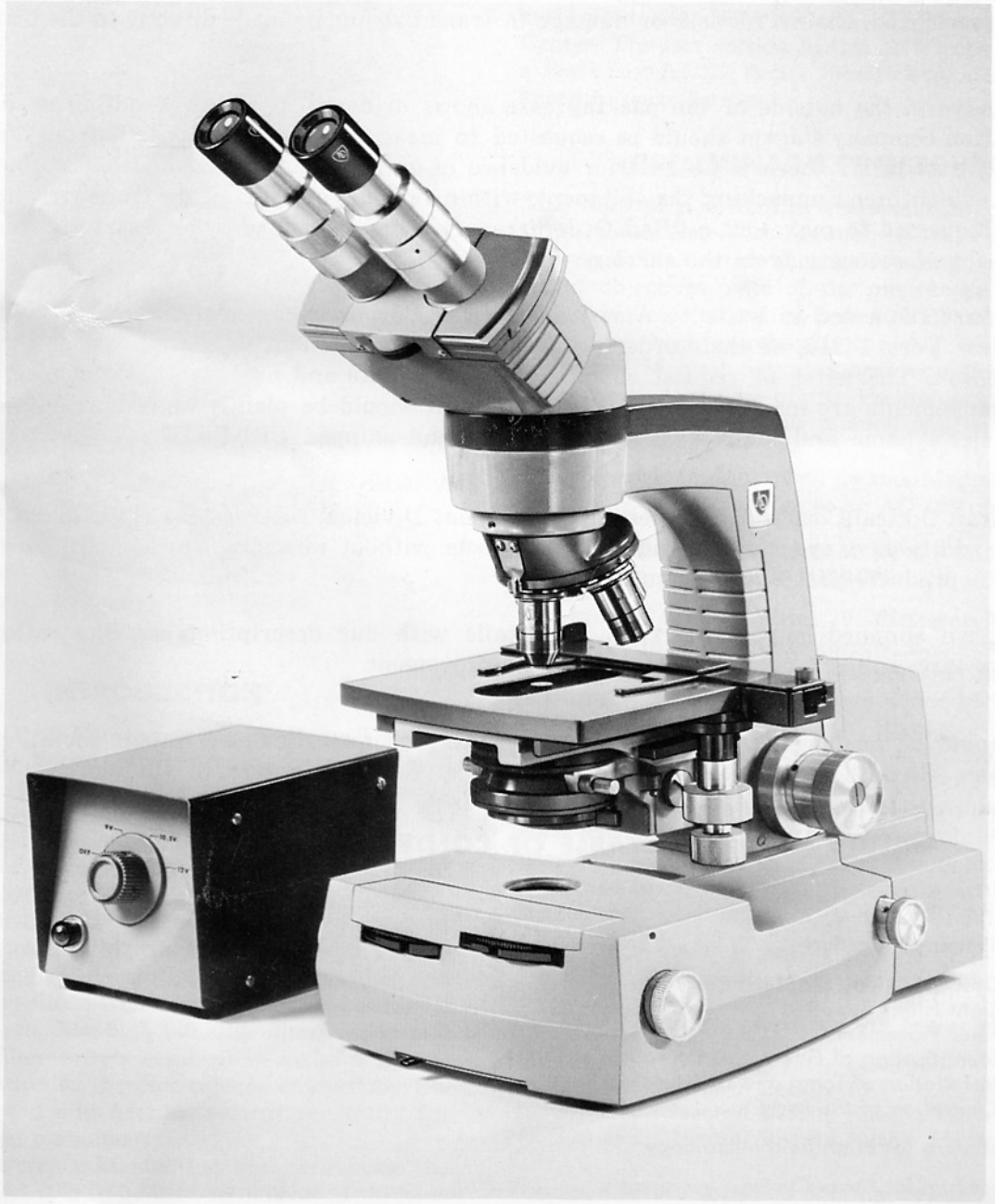
REFERENCE MANUAL

AO Series 20 Microscope

Advanced Microstar and Phasestar Models



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Advanced Microstar and Phasestar Models

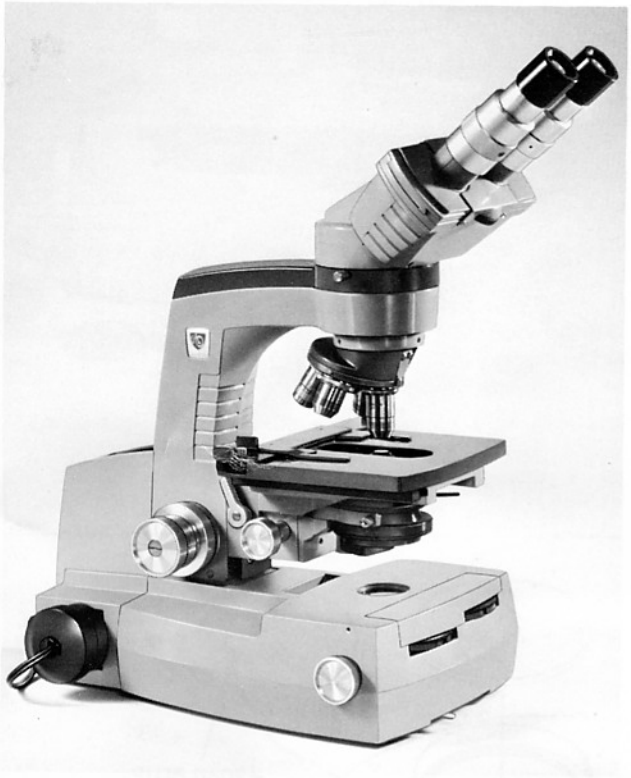


Figure A

INTRODUCTION

The AO Series 20 Microscope represents well over a century of American experience in the design and manufacture of fine microscopes. The Series 20 features a research type illuminator with a high intensity, halogen (quartz-iodine) lamp that provides uniform intensity throughout its life at a consistent desirable color temperature of 3200°K.

The two built-in filter turrets are another important Series 20 feature. The Microscope offers a wide variety of preferred neutral density, color compensating and complementary filters which can be quickly positioned in the light path. The high intensity illumination and the built-in filter turrets combine to make a significant contribution to the convenience enjoyed by the microscopist and add new instrument versatility for his professional pursuits.

While this Reference Manual has been written on the assumption that it is to be used by advanced students and experienced microscopists, procedural steps for brightfield and phase microscopy are outlined in considerable detail. These step-by-step procedures will serve as a quick review for the more advanced user and will be most helpful in the instruction and training of those less experienced.

With proper care, the AO Series 20 Microscope will provide a lifetime of satisfying, dependable service. Should an occasional need for service occur, the user can readily contact competent, trained personnel at an authorized AO dealer or an AO Technical Service Center. The last section in this Reference Manual is a Parts List for the Series 20 with exploded drawings keyed to parts listings.

PRELIMINARY PROCEDURE

This Manual is written as a supplement to the Series 10 Microstar Reference Manual, 10-101. For information on fundamentals such as focusing, infinity corrected objectives, care of the microscope, etc., read the 10-101 carefully. If a Series 20 Phasestar Microscope has been purchased, the AO 10 Phase-101 Reference Manual has also been supplied with the instrument. A review of the Preliminary Procedure and other sections of this manual will be of benefit. Additional copies of the 10-101 and 10 Phase-101 Reference Manuals, as well as this Manual 20A-101, are available at no charge as an AO customer service.

DESCRIPTION AND PLACEMENT OF FILTERS IN FILTER TURRETS

The base of the AO Series 20 Microstar Microscope contains two built-in filter turrets. Each turret is designed to accept four filters in addition to the open aperture. A hinged door permits access to the turrets for the insertion and removal of filters.

To indicate which filters are in the "in use" position, alphabetical designations are used with the upper right hand turret and numerical designations with the lower left hand turret. Turrets can be rotated in either direction. When the "O" designation on both turrets is indexed toward the user, the open apertures of the turrets are positioned in the light path of the microscope.

EIGHT FILTERS SUPPLIED

The four filters supplied for the *lower* turret are:

No. 2062	Didymium Filter, blue/pink
No. 310-601	Neutral Density Filter, 50% transmission
No. 310-602	Neutral Density Filter, 25% transmission
No. 310-603	Neutral Density Filter, 5% transmission

The four filters supplied for the *upper* turret are:

No. 619	Blue Filter for Polacolor®
No. 2060	Blue Compensated Filter, EK 80A+CC10R for color transparencies
No. 2061	Green Filter for phase microscopy and black & white photography
No. 406	Blue Filter, daylight

Polacolor® by Polaroid Corporation

FILTER PLACEMENT

The suggested sequence for placement of the filters into the turrets is the most convenient arrangement for anticipated general usage. The individual can, if desired, interchange filter positions or use additional special filters to best accomplish his own particular efforts.

Using *Figure B* as a reference, place the filters in their respective turret apertures. Begin with the *lower* turret set at "O". Rotate this turret clockwise until the aperture between "O" and "1" is most accessible (as shown in *Figure C*) and insert the blue/pink Didymium Filter. When inserting, hold the filter by the edge to keep surfaces clean. (If dust, dirt or a grease smear is noted on any of the filters, use a soft brush, lint-free cloth, or cotton and, if required, a mild detergent solution to clean. Since the No. 2060 filter (positioned later in the upper turret) is a multi-layered filter, only slightly moisten surfaces, if necessary, to clean. Keep water or solution away from filter edges. Should a filter inadvertently be placed in the wrong aperture, use a toothpick or similar slender

Figure C

RECOMMENDED POSITIONS OF FILTERS INTO ILLUMINATOR TURRETS OF SERIES H20 MICROSTAR

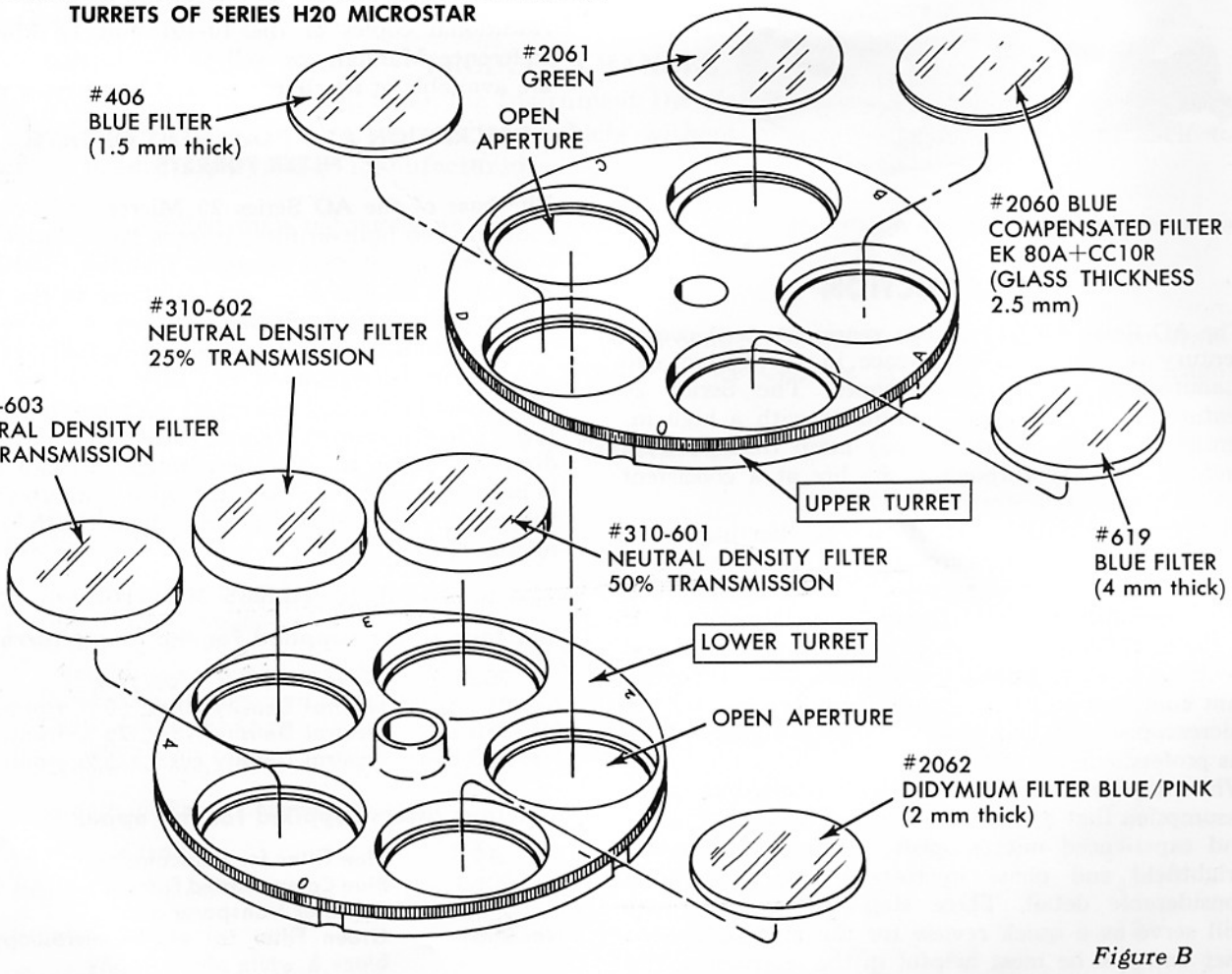


Figure B

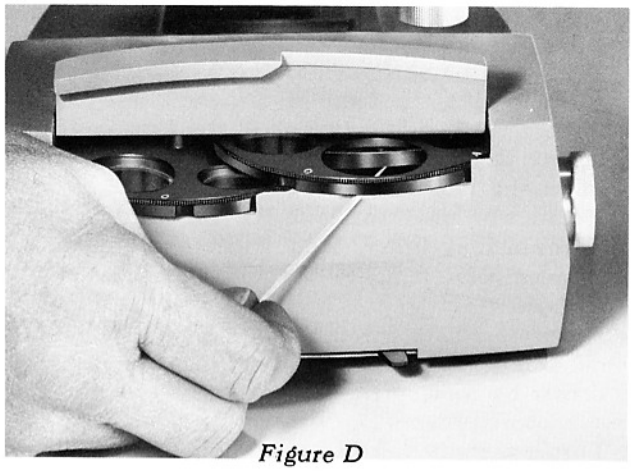


Figure D

object to push the filter up sufficiently to grasp with the fingers as shown in *Figure D*.

Continue rotating the lower turret clockwise going past the next aperture (used for open aperture) until the filter position between "2" and "3" is most accessible. Insert the 50% Transmission Neutral Density Filter. To aid in differentiating between neutral density filters, remember that the thicker the filter and the darker the color, the less light the filter transmits. Thus, the 50% filter is the thinnest and lightest in color of the three. Continue clockwise positioning the 25% Neutral Density Filter between "3" and "4" and the 5% between "4" and "0".

Place the filters in the *upper* turret in the same manner, starting at "O" and rotating the turret clockwise. This will place the No. 619 Blue Filter (4mm thick) between "O" and "A"; the EK 80A+CC10R Filter (a multi-layered blue filter with a glass thickness of 2.5 mm) between "A" and "B"; and the Green Filter between "B" and "C". The open aperture is next followed by the No. 406 Blue Filter (1.5mm thick) positioned between "D" and "O".

NOTE: Be sure the filters are properly inserted and fully seated in the turret wells. Remove the filters, whenever the microscope is transhipped or excessively tilted. Keep the filter turret access door closed to exclude dust.

IDENTIFICATION OF FILTERS IN LIGHT PATH

When using the suggested sequence for filter placement, the numbers and letters on the turrets, when indexed toward the user, indicate which filters (or open apertures) are in the light path as follows:

Lower Turret	Upper Turret
"O" — Open Aperture	**"O"** — Open Aperture
"1" — 50% Neutral Density Filter	**"A"** — Blue Filter, daylight
"2" — 25% Neutral Density Filter	**"B"** — Blue Filter for Polacolor
"3" — 5% Neutral Density Filter	**"C"** — Blue Compensated Filter, EK 80A+CC10R
"4" — Didymium Filter	**"D"** — Green Filter

INSTALLATION OF LAMP AND LAMP HOLDER

1. Use the paper wrapper to keep fingers from directly contacting glass. (Fingerprints and stains will etch into the quartz lamp and should be removed with cleaning tissue and alcohol or acetone before using the lamp.) Insert the No. 2052 lamp into the socket of the lamp holder. Take care not to force lamp excessively. *Important:* The lamp is properly inserted when approximately 1/8" of the contact pins remain exposed above the lamp holder socket plate as illustrated in *Figure E*.
2. Check to see that the lamp holder locking screw is turned out sufficiently and insert lamp holder into microscope base as shown in *Figure E*. Note that the holder is positioned so that the diffusing glass is toward the front of the instrument.
3. Temporarily tighten lamp holder locking screw.
4. Check to see that the No. 2051 Variable Transformer is turned off and insert the 3-prong plug of the lamp holder cord into the receptacle on the back of the transformer.
5. Plug the transformer cord into a 115V, 60 cycle outlet. Pilot light indicates when the transformer is turned on.

CENTRATION OF THE LAMP TO THE OPTICAL PATH OF THE MICROSCOPE

1. Turn on transformer to the 9 volt setting.
2. Position both filter turrets at "O" (open apertures).
3. Place a piece of white paper or a ground glass over the light well in the microscope base as shown in *Figure F*. Make certain that the paper is flat on the well.
4. Partially close the field diaphragm by moving the field diaphragm lever to the left until the lever is approximately 1/2" from the end of its excursion.
5. Loosen the lamp holder locking screw with one hand and simultaneously hold lamp holder with the

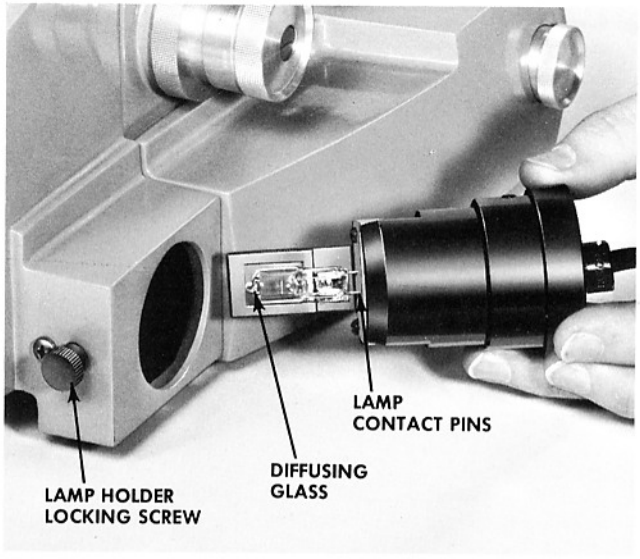


Figure E

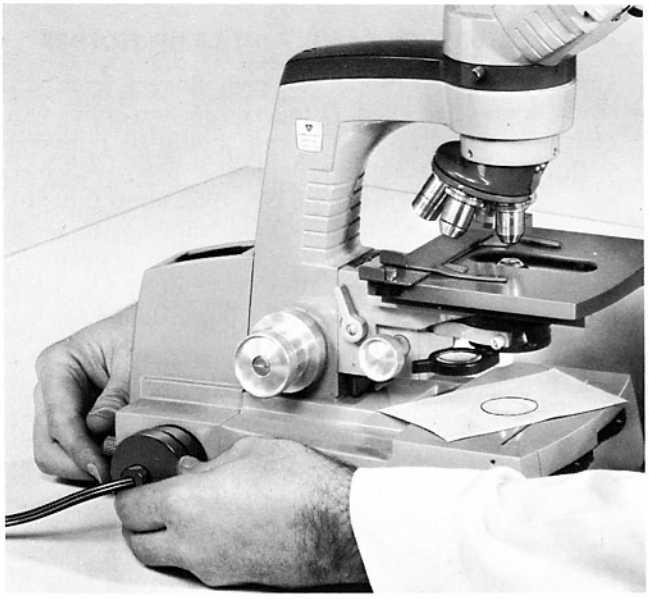


Figure F

other hand as shown in *Figure F*. Move lamp holder in or out of microscope base and rotate holder until the light directed to the paper is centered in the light well opening. While carefully keeping the lamp holder in the correct position for light centration, tighten the locking screw. Remove paper or ground glass from top of light well.

PROCEDURE FOR BRIGHTFIELD MICROSCOPY

1. Turn on the transformer to the 9 volt setting.
2. Make certain the lamp is centered following the method entitled "Centration of the Lamp, etc."
3. Rotate the upper turret to the "A" setting to position the No. 406 Blue Filter in the light path. Rotate the lower turret to "3" for use of the 5% Transmission Filter. Add Filter #310-602, 25% Transmission, if light level is too intense for your purpose.
4. Fully open both the field diaphragm of the illuminator and the aperture diaphragm of the condenser by moving the levers to the extreme right as shown in *Figure G*.
5. Turn the condenser focusing knob, on the side of the microscope base as seen in *Figure G*, counterclockwise to the end of its excursion.
6. Place a specimen slide on the stage.
7. Rotate the microscope objective nosepiece to move the 10X objective into working position.
8. Check to see that the auxiliary swing-in condenser, *Figure G*, (used only with 4X scanning objective) is out of the light path.
9. Raise the microscope condenser by means of the condenser rack and pinion knob, *Figure H*. Raise until the top of the condenser is approximately the thickness of a piece of paper beneath the slide. In the event that the top lens of the condenser is

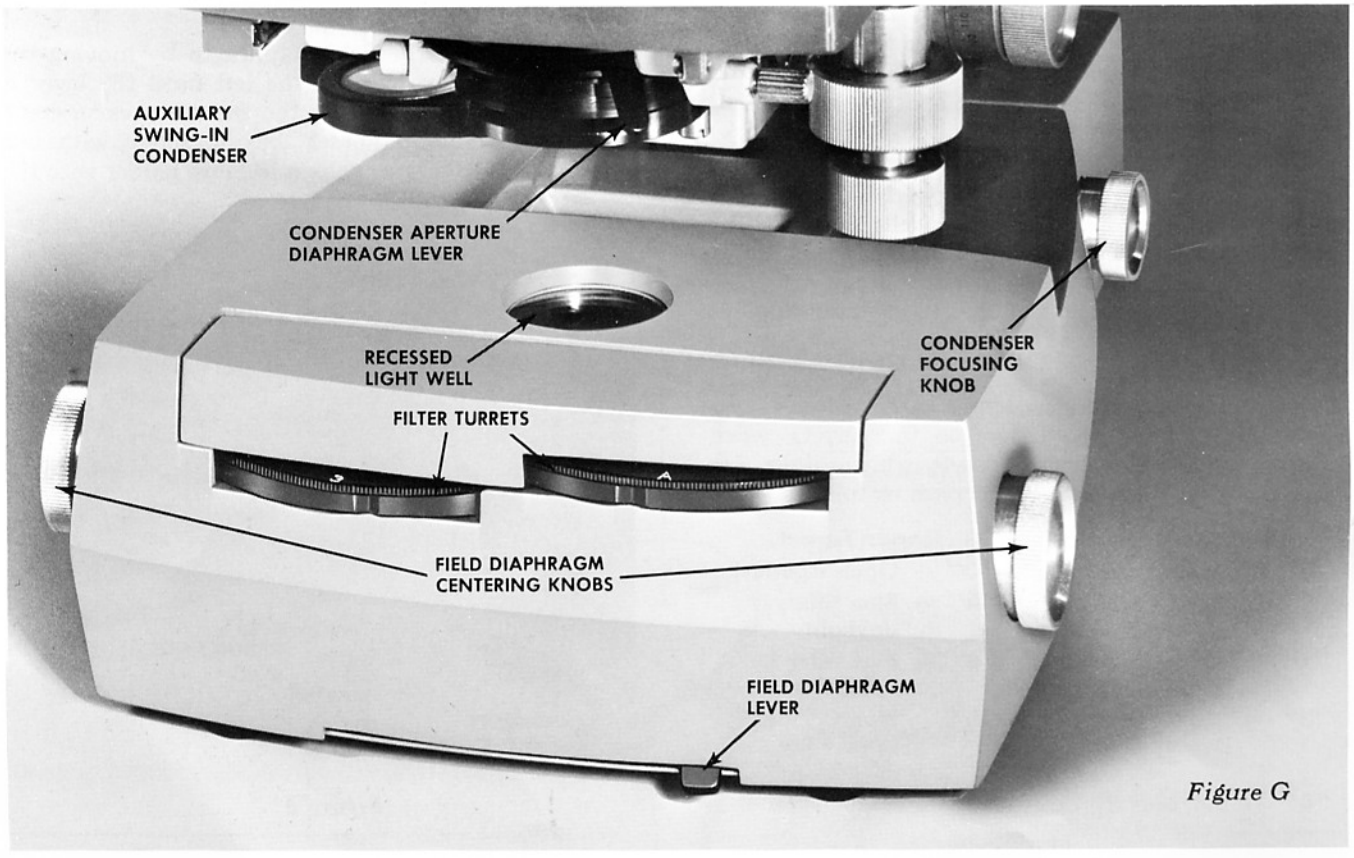


Figure G

too far from, or too close to, the underneath side of the specimen slide, adjust the height of the stop screw in the substage condenser assembly in accordance with the section entitled "Substage Equipment" in Reference Manual 10-101.

10. Lower the 10X objective by rotating a coarse adjustment focusing knob to its positive stop. Use a fine adjustment focusing knob to bring the specimen into sharp focus. If necessary, adjust lamp centration by very slightly re-positioning the lamp holder, as shown in *Figure F*, for full, even illumination of the field of view.
11. Adjust the microscope body for interpupillary setting and eye difference. See section entitled "Bodies" in Reference Manual 10-101.
12. While viewing thru the microscope, partially close the field diaphragm (move lever approximately 1" to the left as shown in *Figure I*) so that the iris diaphragm leaves are imaged within the field of view. Bring the leaves into sharp focus by raising or lowering the condenser by means of the condenser rack and pinion knob without disturbing the fine adjustment knob setting.
13. Using the centering knobs on the microscope base, as shown in *Figure I*, center the image of the field diaphragm to the periphery of the field of view. This is best accomplished by rotating the two knobs simultaneously. After centering, open the field diaphragm until the iris leaves "just" disappear beyond the field of view.
14. Remove an eyepiece and view the back aperture of the objective as shown in *Figure J*. Close the condenser aperture diaphragm . . . then re-open until the iris diaphragm leaves "just" disappear from view to obtain the full resolving power of the microscope.
    If desired, the condenser aperture diaphragm may be closed as required, depending upon the specimen, to enhance contrast and depth of focus. It also may be desirable to rotate the condenser focusing knob, *Figure G*, very slightly clockwise to obtain optimum illumination.
15. When changing to higher power objectives, the positions of the aperture and field diaphragms must be reset. As magnification increases, the aperture diaphragm must be opened and the field diaphragm closed as required. Also recenter field diaphragm and refocus the condenser if necessary. For bright, evenly uniform illumination, readjust the position of the condenser focusing lens in the microscope base with a slight turn of the condenser focusing knob.
    As specimens and instrument applications vary, the other turret-mounted filters and transformer settings are used appropriately. Additional neutral density, compensating or complementary filters may be inserted into the recessed light well *(Figure G)* in the microscope base if desired. The aperture and field diaphragms should never be used to control light intensity.

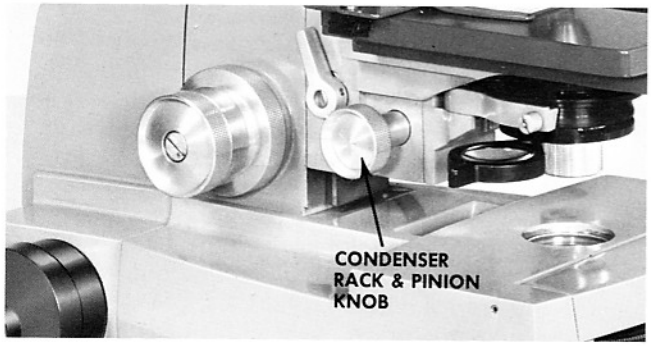


Figure H

Figure I

Figure J

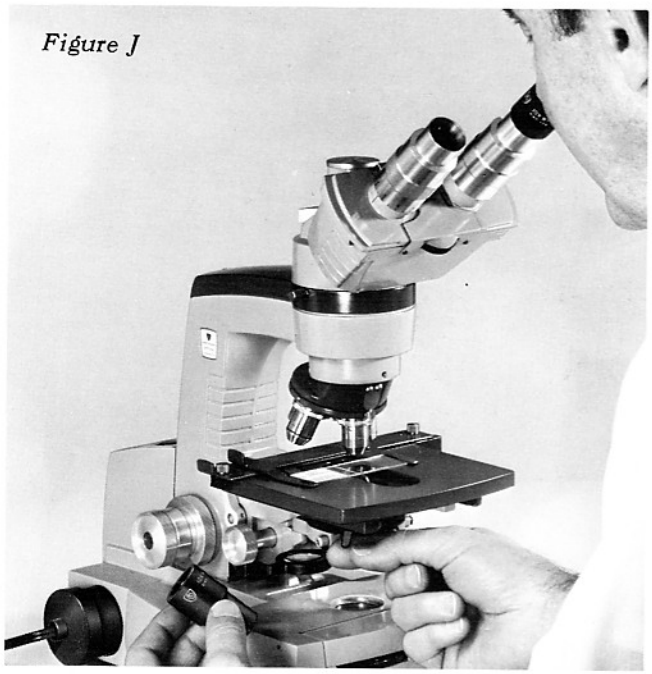
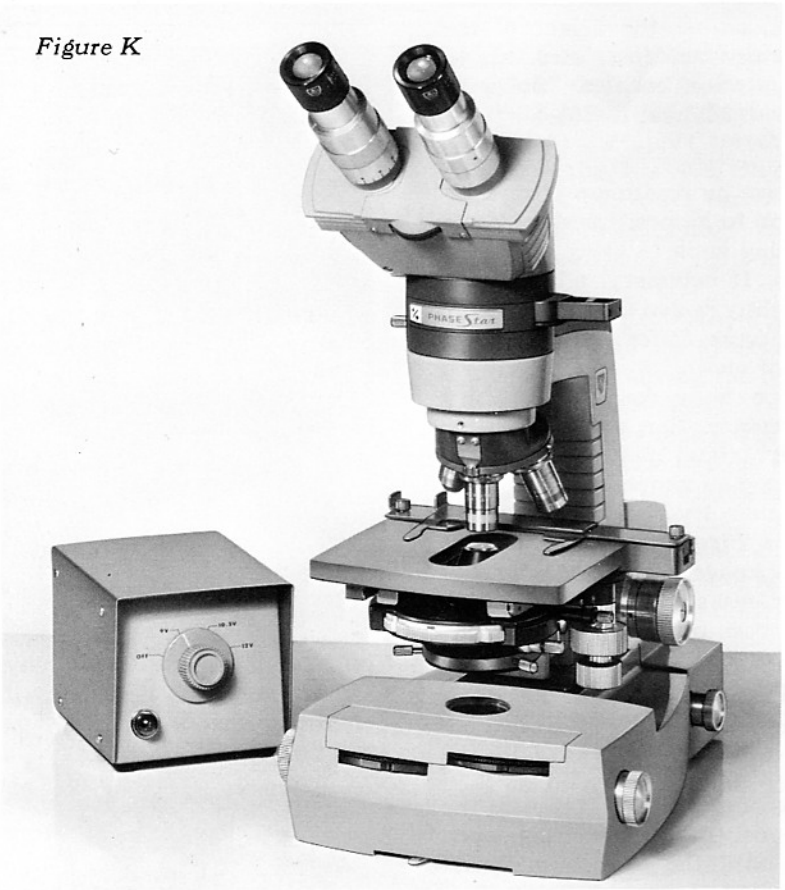


Figure K

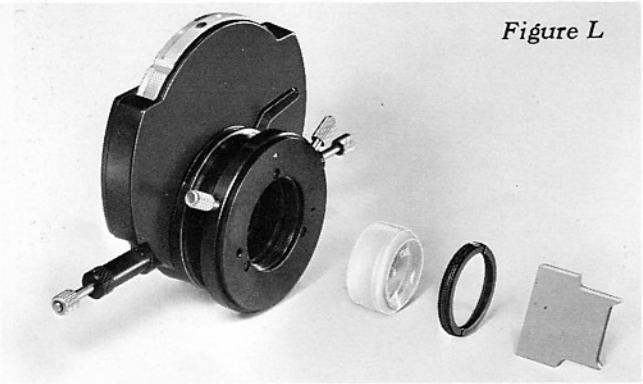


PROCEDURE FOR PHASE CONTRAST MICROSCOPY

The No. 1240 Phase Turret Condenser and the No. 1246 Single Annulus Phase Condenser are designed for universal use on both AO Series 20 and Series 10 Microscopes. When using either type phase condenser on a Series 20, the bottom (doublet) lens of the condenser must be removed regardless of whether the condenser was supplied with a Series 20 or a Series 10 Microscope.

After removing the phase condenser from the fork mount of the microscope, unscrew the retaining ring with the spanner wrench supplied to free and remove the doublet lens as pictured in *Figure L*. Save the ring and lens as they are returned to position when using the condenser with an AO Series 10 Microscope. When mounting the phase condenser in the fork, be certain that the slot in the back of the condenser assembly fully "seats" around the pin in the fork mount and that the retaining screw is firmly hand tightened.

Figure L



If using Series 10 phase accessories to convert a Series 20 Microscope from brightfield to phase microscopy, a condenser stop extension cap must be attached to the stop screw in the fork mount. Mounting the condenser and attaching the extension cap are both illustrated in Reference Manual 10 Phase-101 under "Operation of Turret Condenser".

1. If necessary, withdraw the two annular diaphragm centering wrenches, *Figure M*, and rotate the phase turret condenser to the open aperture. (All annular diaphragm settings are color-coded to the phase objectives by colored rectangles on the face of the knurled ring of the turret condenser. The 10X annulus setting is designated by a green rectangle; 20X by a blue rectangle; yellow, 45X; and red, 100X.) The open aperture setting has no designation; therefore, rotate the knurled ring to a point midway between the red and green rectangles.

2. Follow steps 1 thru 7 under **PROCEDURE FOR BRIGHTFIELD MICROSCOPY** keeping in mind that a stained specimen slide is used to accomplish initial steps in the phase operating procedure because an unstained specimen generally lacks sufficient contrast.

3. Raise the condenser to its stop by means of the rack and pinion knob, *Figure H*. The top lens of the condenser should be approximately the thickness of a piece of paper beneath the slide. In the event that the top lens of the condenser is too far from, or too close to, the underside of the specimen slide, adjust the height of the stop screw (with extension cap attached) in the substage condenser assembly as shown under "Operation of Turret Condenser" in 10 Phase-101.

4. Using the 10X phase objective, bring the specimen into sharp focus. Adjust the microscope body for interpupillary setting and eye difference. If necessary, adjust lamp centration by very slightly repositioning the lamp holder, as shown in *Figure F*, for full, even illumination of the field of view.

5. While viewing thru the microscope, partially close the field diaphragm of the illuminator (move lever approximately 1″ to the left as shown in *Figure M*) so that the iris leaves are imaged within the field of view. Approximately center the diaphragm to the field using the two centering knobs on the sides of the microscope base, *Figures I and M*. Open field diaphragm until the leaves disappear from view.

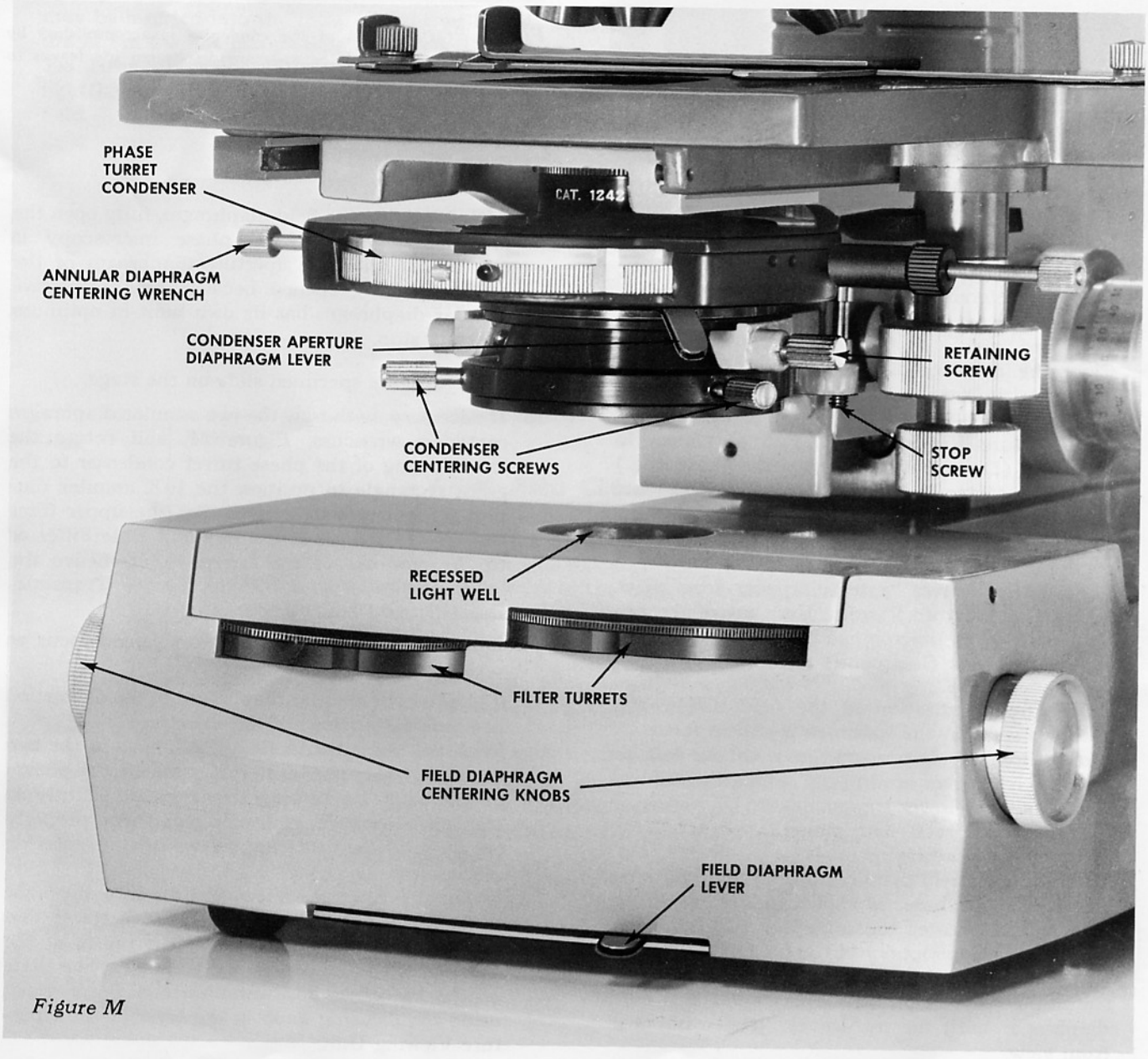


Figure M

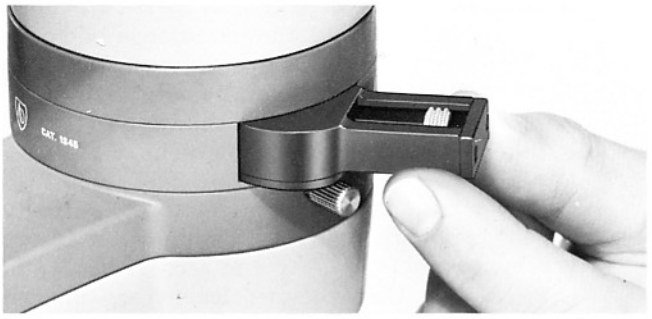


Figure N

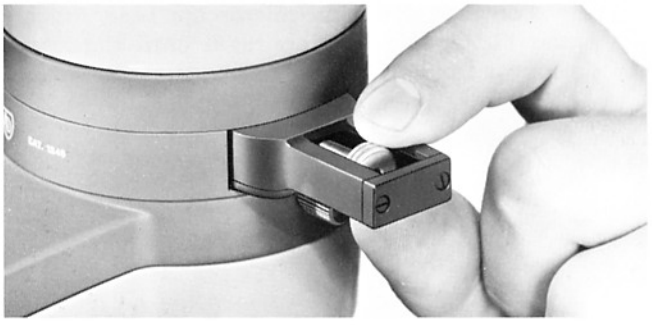


Figure O

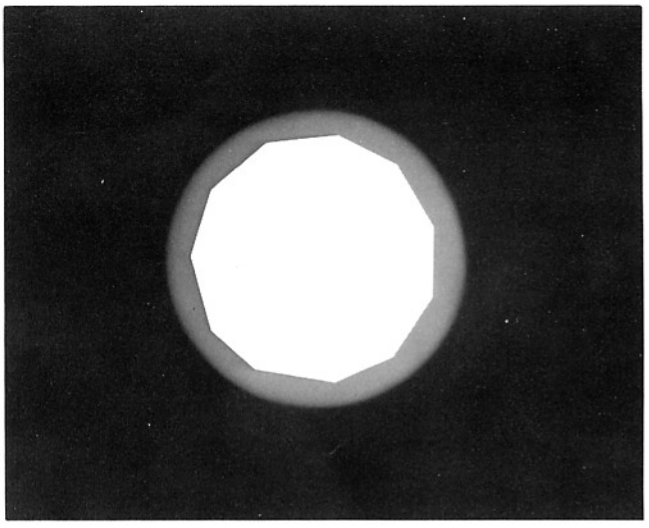


Figure P: Centration of the condenser is accomplished by centering the image of the aperture diaphragm iris leaves to the periphery of the back aperture of the objective.

6. To center the condenser, swing the Aperture Viewing Unit, *Figure N,* into the optical path of the microscope (see "Use of the Aperture Viewing Unit" in Reference Manual 10 Phase-101) or remove eyepiece and insert the No. 1265 Phase Telescope.
   Close the aperture diaphragm of the condenser until the iris leaves are brought into view. Bring the leaves into focus by moving the knob inside the Aperture Viewing Unit lever as shown in *Figure O.* (Disregard the focus of the phase ring.) Carefully center the iris leaves of the aperture diaphragm, as shown in *Figure P,* to the periphery of the back aperture of the objective using the condenser centering screws, *Figure M,* then open until the iris leaves "just" disappear from view. Swing the Aperture Viewing Unit out of the optical path of the microscope by moving the lever toward the back (lamp end) of the instrument.

7. Before final centration of the field diaphragm, check to see that the specimen is still in focus.
   Move the field diaphragm lever to the left so that the iris leaves are imaged within the field of view. Raise or lower the condenser by means of the condenser rack and pinion knob until the leaves are in sharp focus.
   Using the two field diaphragm centering knobs on the microscope base, as shown in *Figures I and M,* carefully center the image of the field diaphragm to the periphery of the field of view. This is best accomplished by rotating the two knobs simultaneously. After centering, open the field diaphragm until the iris leaves "just" disappear from view.

8. After centering the field diaphragm, fully open the aperture diaphragm. All phase microscopy is carried out with the aperture diaphragm of the condenser fully opened because each respective annular diaphragm has its own built-in optimum aperture stop.

9. Place a phase specimen slide on the stage.

10. If necessary, withdraw the two annular diaphragm centering wrenches, *Figure M,* and rotate the knurled ring of the phase turret condenser to the green rectangle to position the 10X annular diaphragm into the light path. Set the upper filter dial to "A" for use of the daylight Blue Filter or to "D" for use of the Green Filter. Leave the lower filter dial set at "3" for the 5% Transmission Neutral Density Filter.

11. Bring the phase specimen into as good focus as possible.

12. To center the annular diaphragm to the diffraction or phase plate (ring) of the objective:
    With the phase turret set at "A", push in the two annular diaphragm centering wrenches as shown in *Figure Q.* By turning the wrenches slightly as they are inserted, you will feel them properly engage into the centering screws of the centering mechanism.
    Swing the Aperture Viewing Unit into the light path of the microscope (or remove eyepiece and insert Phase Telescope). Bring the image of the annulus of the condenser and the diffraction plate of the objective into simultaneous sharp focus using the focusing knob in the lever of the Aperture Viewing Unit.

Adjust the annular diaphragm centering wrenches, *Figure Q*, until the annulus image is positioned concentric with, and is superimposed on, the diffraction plate as shown in *Figure R*. After centering, swing out the Aperture Viewing Unit.

13. Bring the phase specimen into sharp focus. The microscope is now ready for use with the 10X objective.

14. To center other annuli to their respective phase objectives and for technique with higher magnification objectives, refer to the last two steps under "Optical Alignment Procedure" and "General Comments on Technique" in 10 Phase-101. As specimens and instrument applications vary, the other turret-mounted filters and transformer settings are used appropriately. Additional neutral density, compensating or complementary filters may be inserted into the recessed light well *(Figure M)* in the microscope base if desired. The No. 308 Heat Absorbing Filter is recommended for light/heat sensitive specimens. The aperture and field diaphragms should never be used to control light intensity.

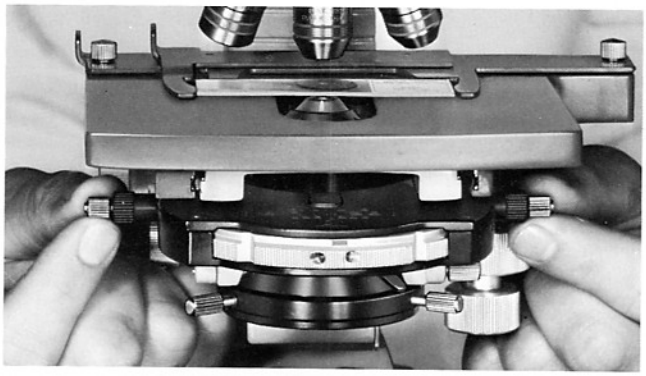


Figure Q

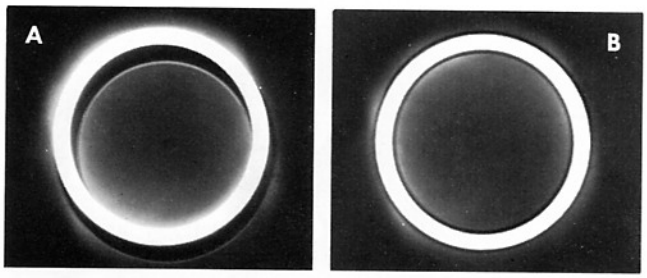


Figure R — Appearance of the image of the annulus and the diffraction plate of the objective when annulus is: (A) out of center; and (B) concentric with, and properly superimposed on, the diffraction or phase plate.

CARE AND CLEANING

Refer to the section entitled "Care of the Microscope" in Reference Manual 10-101 for a comprehensive description of cleaning procedures. Also refer to the copy on cleaning in section entitled "Filter Placement" under PRELIMINARY PROCEDURE in this Manual.

LAMP REPLACEMENT

When replacing the lamp, *make certain* that the lamp previously in use has cooled sufficiently to handle. Insert the new lamp in the manner described in "Installation of Lamp etc." under PRELIMINARY PROCEDURE. To order replacement lamps, see Parts List, page 20.

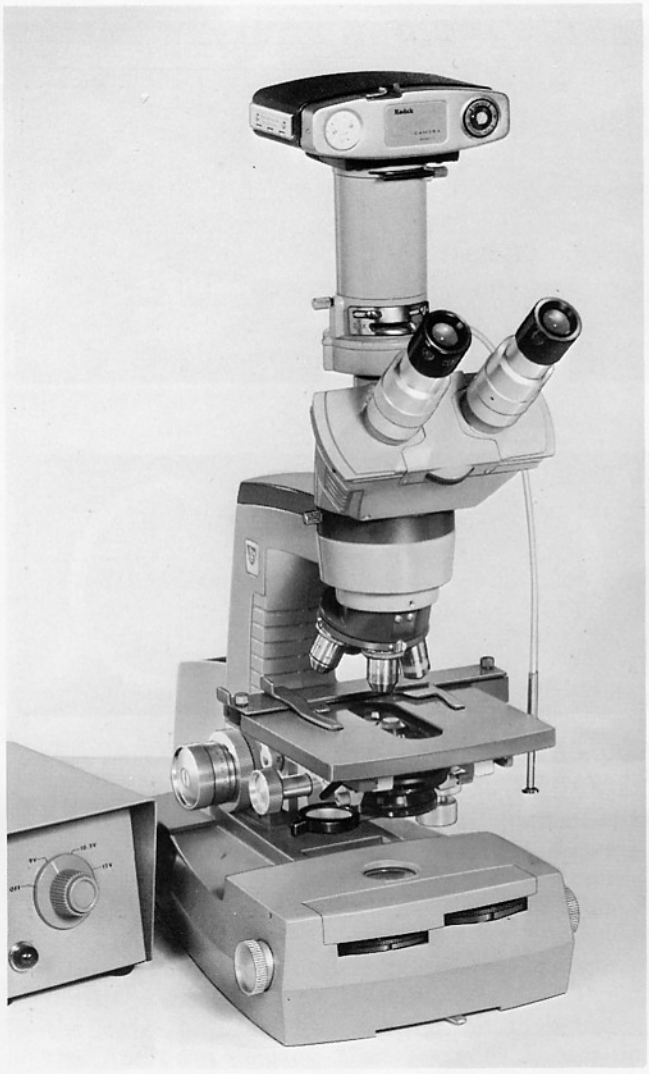


Figure S: Pictured on the above left, the No. 1053A 35mm Camera shown with the 5X Adapter. The No. 1057 Shutter, Cable and Lens Assembly has a 2.8X and 5X position lever. Pictured on the above right, the No. 1052A Polaroid Land Camera which utilizes the 3-1/4″ x 4-1/4″ Polaroid Land film pack. The No. 1055A Camera Back Adapter (not illustrated) accepts 4″ x 5″ Polaroid Land film.

EXPOSURE TABLES FOR SERIES H20 Microstar
Models with AO Catalog No. 1052A, 1053A, and 1055A Cameras

General photomicrographic technique with a Series H20 Microscope is the same as with a Series L10 except that selected filters in the built-in, filter turrets are utilized. Also with a Series H20 Microscope, faster exposure times are used because of the high intensity, halogen lamp. The exposure tables in this manual are predicated on the use of stained specimens of average density. (As a guide, phase specimens require approximately 10 times more exposure.) The variable transformer is set at 12 volts for photomicrography; however, use the 9 volt setting while making preparations to take photomicrographs to assure longer lamp bulb life.

With Kodachrome II Film and black and white Polaroid Type 107 Land Film, note that three filters are required. If extra, loose filters are not available, remove the 25% Transmission Neutral Density Filter from the lower filter turret and insert into the recessed light well in the microscope base. For removal of this filter, refer to "Filter Placement" under PRELIMINARY PROCEDURE in this manual. If your Series 20 Microscope is used extensively for photomicrography, an extra set of Neutral Density Filters, AO Catalog No. 310, can be purchased.

Review the sections entitled, "Description" and "Set Up and Use" in Photomicrographic Equipment Reference Manual 1052-101. A complimentary copy of this manual is available upon request.

EXPOSURE TABLES FOR SERIES H20 MICROSTAR

I. 35mm. Films

A. EK Kodachrome II

ASA - 25

Filters - #2060, EK 80A/CC10R
#2062, Didymium
#310-602, Neutral Density, 25% Transmission

Transformer - 12 volt setting

Objective	Shutter Speed	
	2.8X Position	5X Position
4X	1/125	1/50
10X	1/50	1/25
20X	1/50	1/25
40X, 45X	1/25	1/10
100X	1/10	1/5

B. EK Panatomic X

ASA - 40

Filters - #2061, Green
#310-601, Neutral Density, 50% Transmission

Transformer - 12 volt setting

Objective	Shutter Speed	
	2.8X Position	5X Position
4X	1/50	1/25
10X	1/50	1/25
20X	1/50	1/25
40X, 45X	1/25-1/10	1/10
100X	1/10-1/5	1/5

II. Polaroid Land Film

A. Polacolor Types #108, 58

ASA - 75

Filters - #619, Blue
#2062, Didymium

Transformer - 12 volt setting

Lens and Shutter Assembly Lever - set at 5X position

Objective	Shutter Speeds	
	3¼" x 4¼"	4" x 5"
4X	1/50-1/125	1/50
10X	1/50-1/125	1/50
20X	1/50-1/125	1/50
45X	1/25	1/10
100X	1/10	1/5

B. Black & White Type #107

ASA - 3000

Filters - #2061, Green
#310-602, Neutral Density, 25% Transmission
#310-603, Neutral Density, 5% Transmission

Transformer - 12 volt setting

Lens and Shutter Assembly Lever - set at 5X position

Objective	Shutter Speeds	
	3¼" x 4¼"	4" x 5"
4X	1/125	1/125
10X	1/125	1/125
20X	1/125	1/125
40X, 45X	1/25-1/50	1/25
100X	1/10-1/25	1/10

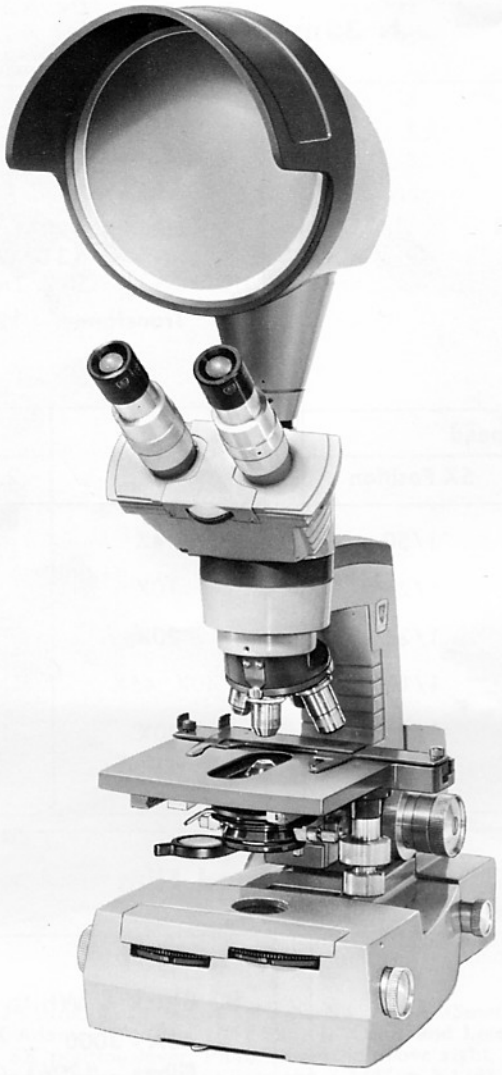


Figure T

Figure T: When using the No. 1050 Viewing Screen on a Series 20 Microscope, the No. 2051 Variable Transformer is generally set at 12 volts and the use of a Neutral Density Filter is not required. Resultant magnification at the screen plane is 7.5 times the initial magnification of the objective and the field of view is the same as through 10X wide field eyepieces.

PARTS LIST

The Series 20 Parts List in this Reference Manual is a supplement to the Parts List in Manual 10-101. When a part is desired for a unit common to both Series 10 and 20 Microscopes, such as a body or stage, use the 10-101 Parts List.

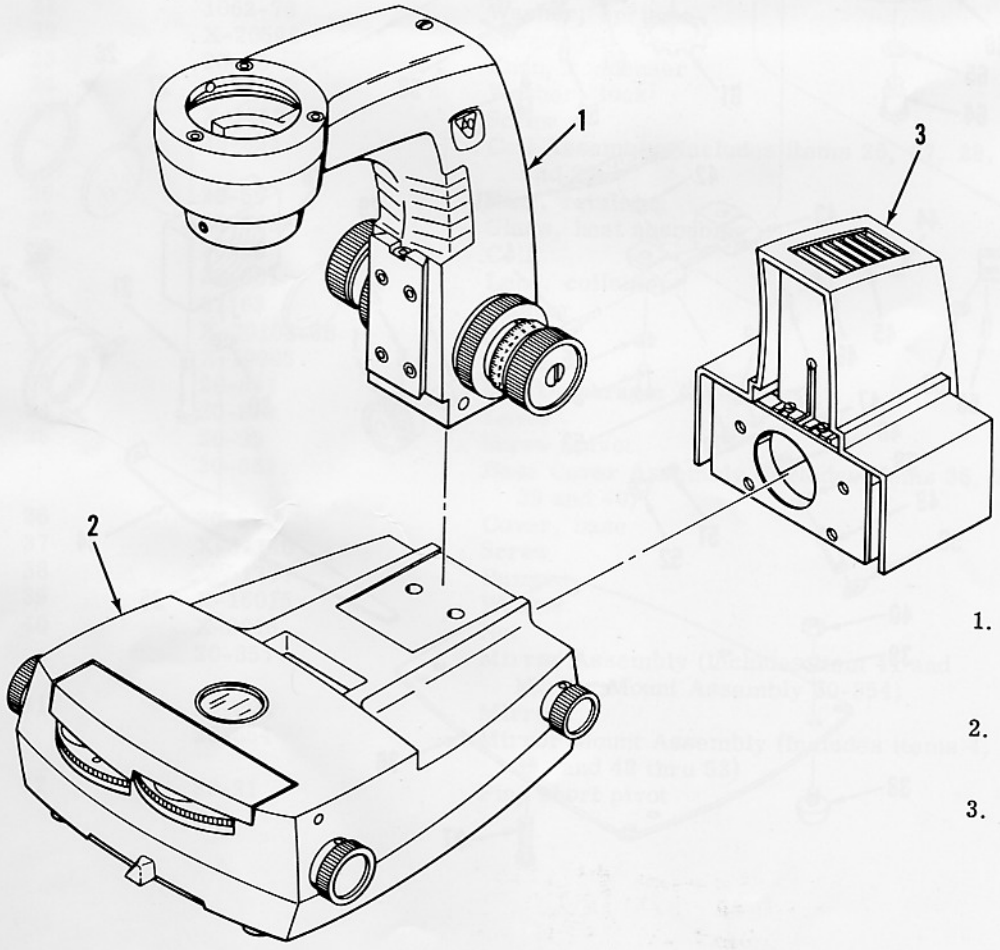
The illustrations are used to identify and locate parts of the microscope, and are keyed to the parts lists by the use of index numbers. To order a part, identify and locate the part by using the illustrations. Note the index number for the part and cross-reference it to the parts list. The part number, description, and quantity required will be found opposite the index number.

In certain cases, it may be desirable to replace a complete assembly instead of overhauling or rebuilding with detail parts. Where complete assemblies are available, they are indicated by a note in the description column to show which parts they include. Detail parts of these assemblies are also available separately.

Parts or assemblies should be ordered directly from AO's Instrument Division plant at Buffalo, N.Y., or from any of AO's authorized dealers. When ordering parts, be sure to include a complete description, part number, and correct quantity.

SERVICE

Complete repair facilities are available at many of AO's authorized dealers, the American Optical Corporation, Scientific Instrument Division plant, Buffalo, N.Y., and AO Technical Service Centers in Chicago, Ill., Glendale, Calif., Springfield, N.J., and Dallas, Texas.



1. Arm Assembly (See Reference Manual 10-101)
2. Base Assembly (See Figure 2)
3. Lamp Housing (See Figure 3)

Figure 1. Series 20 Microscope Stand & Lamp Housing

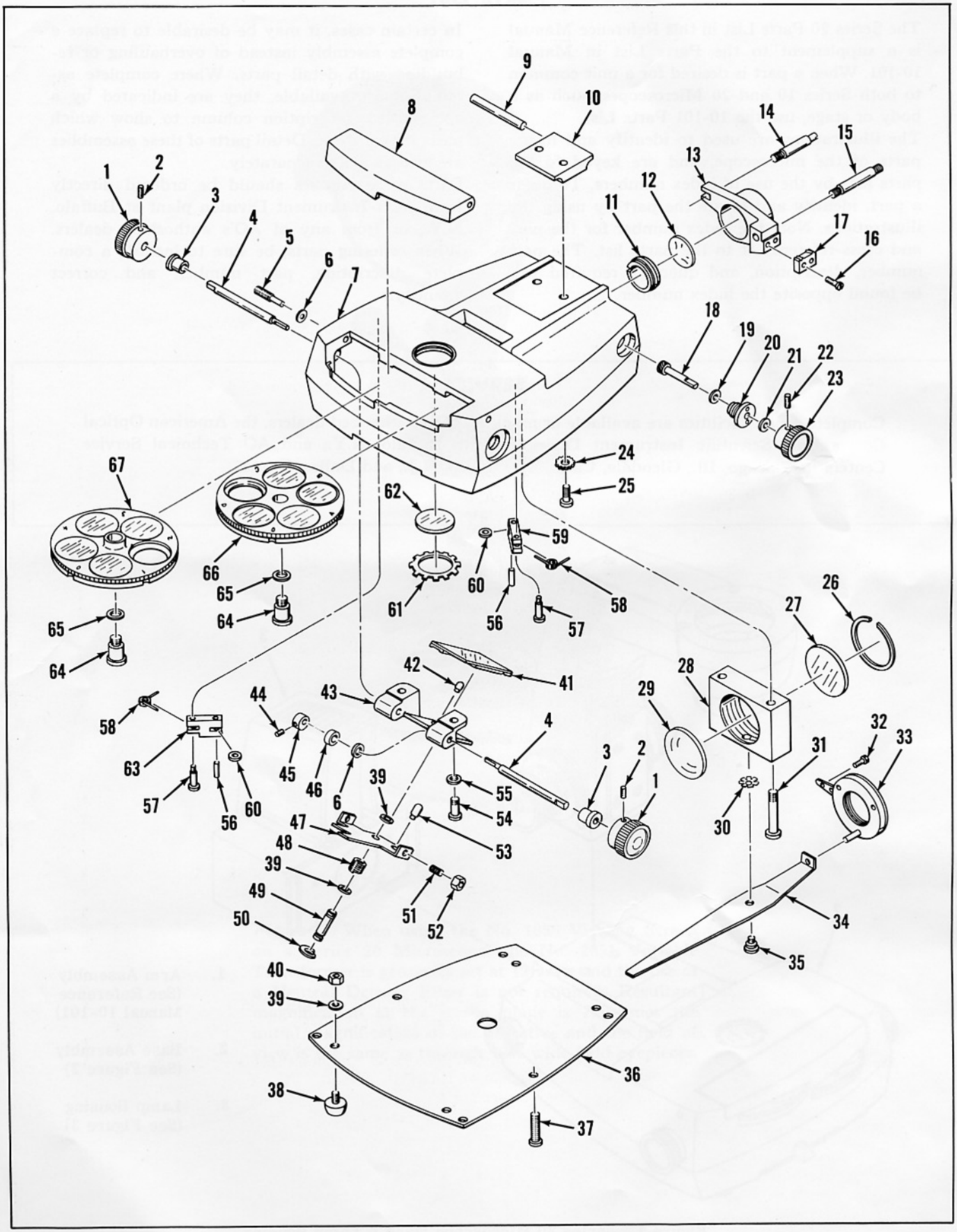


Figure 2. Base Assembly

Figure 2. Base Assembly

Index No.	Part Number	Description	Quantity
	20-859	Base Assembly	1
1	20-16	Knob	2
2	X-20599	Screw, Set	2
3	20-17	Bearing	2
4	20-14	Shaft	2
5	20-6	Screw, cover	2
6	X-51346	Washer, spring	4
7	20-501	Base Assembly (Includes item 8)	1
8	20-5	Cover	1
9	20-8	Pin, lock	2
10	20-7	Plate, lock	1
	20-864	Condenser Assembly (Includes items 11, 12, and 13)	1
11	20-44	Ring, retaining	1
12	1084-612	Lens, back (aspheric surface toward #11)	1
13	20-63	Body, condenser	1
14	20-42	Pin, guide	1
15	20-43	Pin, guide	1
16	X-38004	Screw	2
17	20-41	Rack	1
18	20-39	Shaft, pinion	1
19	X-51404	Ring, retaining	1
20	20-40	Bearing	1
21	1062-76	Washer, spring	1
22	X-20598	Screw, set	1
23	20-38	Knob, condenser	1
24	X-16336	Washer, lock	2
25	X-19526	Screw	2
	20-853	Cell Assembly (Includes items 26, 27, 28, and 29)	1
26	20-59	Ring, retaining	3
27	20-603	Glass, heat absorbing	1
28	20-23	Cell	1
29	20-601	Lens, collector	1
30	01163	Washer	1
31	X-20108-58	Screw	2
32	X-19965	Screw	2
33	20-851	Iris Diaphragm Assembly	1
34	20-863	Lever	1
35	20-35	Screw, pivot	1
	20-861	Base Cover Assembly (Includes items 36, 38, 39 and 40)	1
36	20-31	Cover, base	1
37	X-34140	Screw	6
38	X-51771	Bumper	4
39	X-16015	Washer	6
40	X-8015	Nut	4
	20-857	Mirror Assembly (Includes item 41 and Mirror Mount Assembly 20-854)	1
41	20-602	Mirror	1
	20-854	Mirror Mount Assembly (Includes items 4, 6, 39, and 42 thru 53)	1
42	20-21	Pin, short pivot	1

Figure 2. Base Assembly (Cont.)

Index No.	Part Number	Description	Quantity
43	20-25	Bracket	1
44	X-20588	Screw, set	2
45	20-15	Eccentric	2
46	20-13	Spacer	2
47	20-18	Plate, swivel	1
48	20-12	Spring	1
49	20-22	Pin, spring	1
50	X-51404	Ring, retaining	1
51	X-25361-58	Screw, set	2
52	X-8078	Nut	2
53	20-20	Pin, long pivot	1
54	X-26118	Screw	2
55	X-16010	Washer, plain	2
56	01551	Pin	2
57	20-26	Screw, shoulder	2
58	20-30	Spring, detent	2
59	20-28	Holder, right hand wheel	1
60	20-29	Wheel, detent	2
61	X-51327	Ring, retaining	1
62	1036-606	Window	1
63	20-27	Holder, left hand wheel	1
64	20-11	Bearing, disc	2
65	X-51775	Washer	2
66	20-9	Turret, right hand filter (upper)	1
67	20-10	Turret, left hand filter (lower)	1

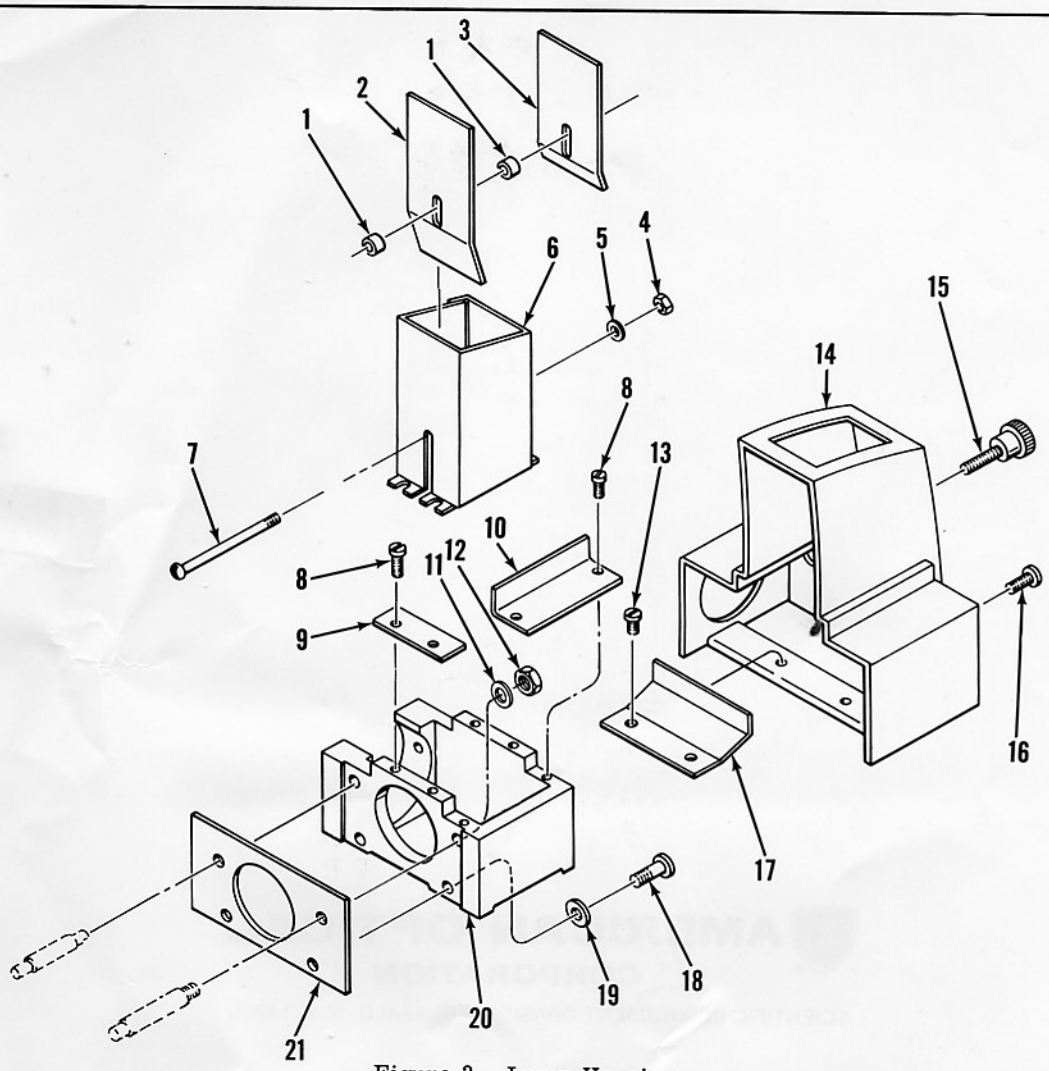


Figure 3. Lamp Housing

Index No.	Part Number	Description	Quantity
1	20-50	Spacer	8
2	20-53	Fin	6
3	20-54	Fin	1
4	X-8010	Nut	1
5	X-16010	Washer, plain	1
6	20-52	Chimney	1
7	X-285	Screw	1
8	X-38120	Screw	6
9	20-55	Deflector	1
10	20-51	Baffle	1
11	X-16020	Washer - eliminated September 1970	1
12	X-8040	Nut - eliminated September 1970	1
13	X-38001	Screw	2
14	20-48	Cover, Lamp Housing	1
15	20-852	Clamp Screw Assembly	1
16	X-38036	Screw	2
17	20-56	Baffle, bottom	1
18	X-32571-22	Screw	2
19	20-83	Fiber Spacer	2
20	20-46	Lampholder Support	1
21	20-70	Insulator Shield - modified Sept. 1970	1

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