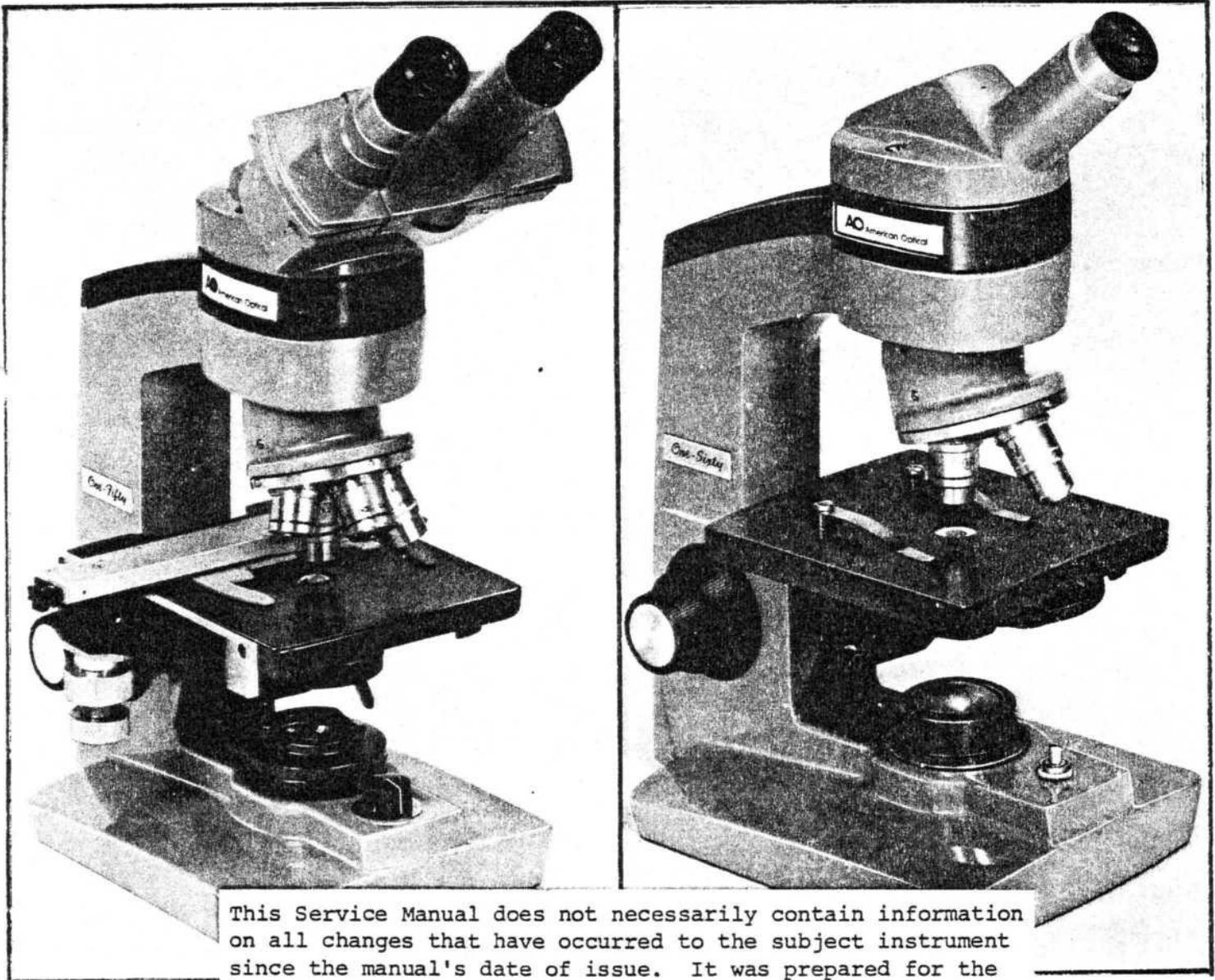


**AO® SERIES
ONE-SIXTY STUDENT
ONE-FIFTY LABORATORY
MICROSCOPES
DEALER
SERVICE MANUAL**



This Service Manual does not necessarily contain information on all changes that have occurred to the subject instrument since the manual's date of issue. It was prepared for the use of AO Scientific Instrument factory-trained service personnel who are kept up to date through a program of Service Bulletins and Training Seminars.

AO® Scientific Instruments
DIVISION OF WARNER-LAMBERT TECHNOLOGIES, INC.
TECHNICAL SERVICES
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SERVICE

Repairs should be performed by qualified service personnel. Complete repair facilities are available at many AO Scientific Instruments authorized dealers, and AO Scientific Instruments, Technical Service Centers.

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INTRODUCTION

This service manual has been prepared as an instruction guide for performing troubleshooting, field repair and routine maintenance of the Model 150-160 Student Microscope.

It is intended to assist both operating and service personnel.

Instructions for setup and use, in addition to directions for performing routine maintenance, are given in the Reference Manuals 150-101 and 160-101 that are packaged with the instrument or are available from the factory in Buffalo, New York.

I. BASIC MAINTENANCE MATERIALS

The tools, accessories and lubrication material listed will assist the operator in the basic maintenance of this Microscope.

1. Small camel-hair brush - $\frac{1}{2}$ inch
2. Infant ear syringe
3. Screwdrivers - assorted, Jeweler's type and off-set type
4. Lens paper
5. Cotton Tip applicators
6. Allen wrenches - assorted sizes
7. Alcohol - Methyl - technical grade
8. Lubricant grease - Mobil #3 or Shell Plastilube
9. Tube of graphite powder to mix with grease

NOTE: Sporting Goods stores supply a graphite/grease mixture used to lubricate fishing reels and firearms.

10. Volt-ohm multi-test meter

Method for Inserting and Calibrating

AO[®] Eyepiece Reticles in

AO Eyepieces Nos.133,134,142,145,146,146B, 147,147B,157,157B,176,180,184

To Insert Reticles: Reticle insertion procedure varies with eyepiece type and construction. Therefore, first identify eyepiece by catalog number engraved on it. Then follow applicable directions below.

1. Wide Field Eyepiece:

Catalog No. 180 — 10X

Accepts reticles of AO 475-481 Series, 21.9mm in diameter. Place reticle, with ruled side up, into bottom of eyepiece. Seat reticle against field diaphragm (Figure 1). Push retaining ring against reticle to hold in place.

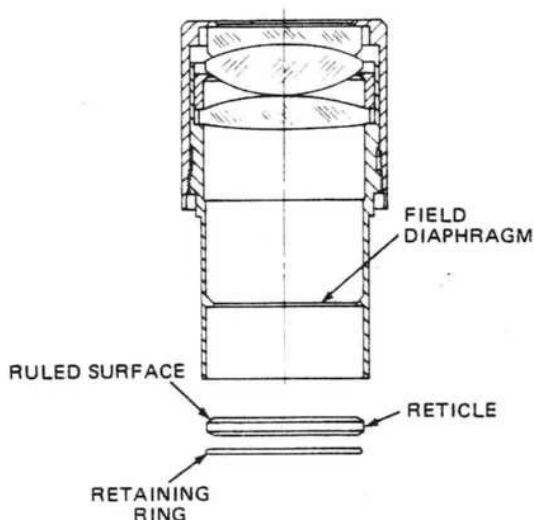


Figure 1. Catalog No. 180 10X Wide Field Eyepiece

2. Wide Field Eyepieces:

Catalog Nos. 134, 145, 176 — 10X
147, 147B, 184 — 15X
157, 157B — 20X

These eyepieces accept reticles of AO 1400 Series, 20mm in diameter.

To insert a reticle into the eyepiece, place the reticle into the No. 148 reticle mount with the ruled side facing up. Slide the mounted reticle into the eyepiece tube until it seats against the field diaphragm.

NOTE: Reticles provided for STEREOSTAR[®] /Zoom Microscopes are factory-installed in reticle mount.

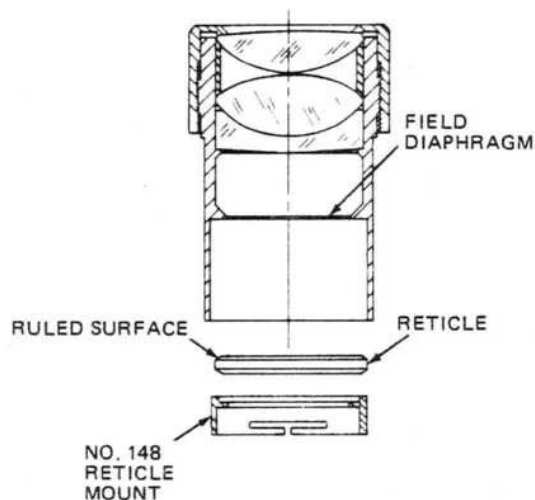


Figure 2. Catalog No. 176 Wide Field Eyepiece

3. Wide Field Eyepieces:

Catalog Nos. 146, 146B — 10X

The 146 and 146B eyepieces accept reticles of the 1400 series, 20mm in diameter. To install reticle, remove field lens assembly using wrench as indicated in Figure 3. Do not completely disassemble eyepiece. Insert reticle, with ruled side up, into retaining cell of the field lens assembly. Use care to keep lenses clean.

4. Huygenian Eyepieces:

Catalog No. 133 — 5X
Catalog No. 142 — 10X

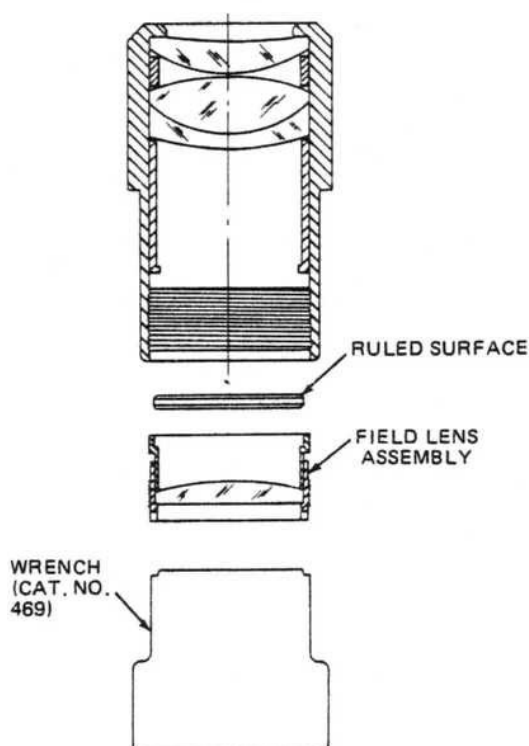


Figure 3. Catalog No. 146 Wide Field Eyepiece

Both Cat. No. 133 and Cat. No. 142 accept reticles of AO 405-427 series, 21mm in diameter. To install a reticle in the Huygenian eyepiece, the reticle must be inserted in the eyepiece from the top with the ruled side facing down, and secured with circular spring retainer.

Calibration of Micrometer Disc

The projected values of reticle graduations vary with the optical combination used and, consequently, should be pre-calibrated before accurate measurements can be made.

To calibrate, focus on a stage micrometer and move it until the zero graduations on it and on the reticle line up exactly. Choose a graduation as far (numerically) up the reticle scale as possible that corresponds exactly with a line on the micrometer scale. The calibration factor is this distance on the micrometer scale divided by the distance on the reticle scale. The calibration factor is actually the true distance subtended by one unit on the reticle scale.

Example: We have chosen Cat. No. 400 Stage Micrometer (2mm scale/200 divisions) and Cat. No. 475 Reticle (10mm scale/100 divisions), corresponding to X and Y respectively. Note that the zero graduations line up exactly. We can see that the highest reticle graduation that lines up

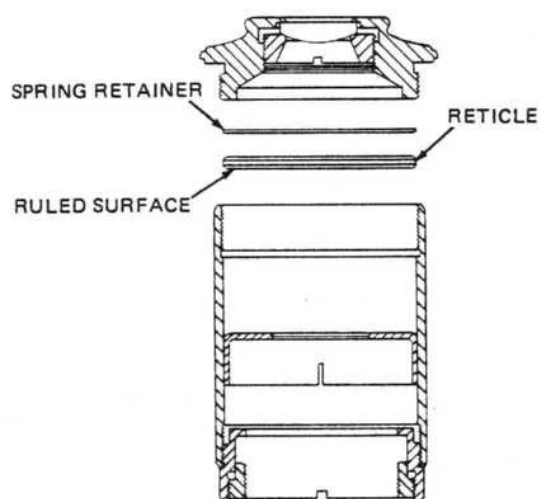
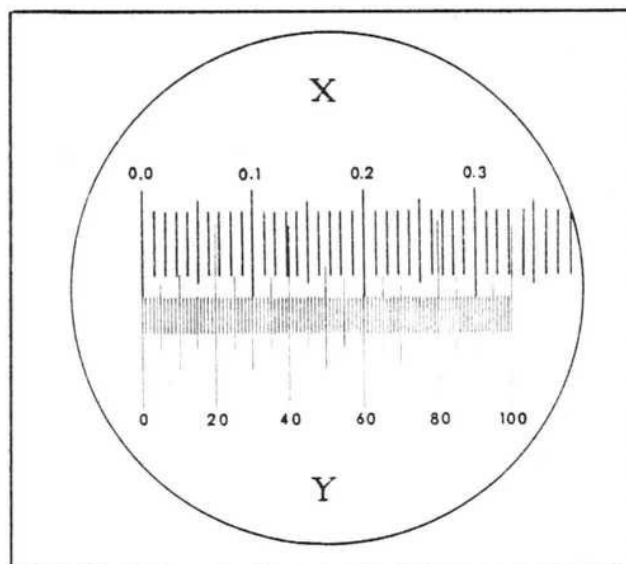


Figure 4. Catalog No. 177 10X Huygenian Eyepiece

exactly with a micrometer graduation is at 90 divisions. This corresponds with 0.3 on the micrometer scale.



Our calibration factor is:

$$\begin{aligned}
 C &= \frac{x}{y} \\
 &= \frac{0.3\text{mm}}{90} \\
 &= .0033\text{mm per reticle division}
 \end{aligned}$$

The number of divisions covered by the specimen multiplied by the calibration factor C gives the length of the specimen. For example, if a particular specimen covered 67 reticle units, its true length would be $67 \times .0033\text{mm} = 0.22\text{mm}$.

III. EYEPiece CLEANING

Remove the eyepiece and hold it under a bright light. Tilt the eyepiece so the light reflects off the lens surface. Examine the lens for dirt and clean as required.

Loosen dirt with a camel-hair brush and blow off loose particles with an infant ear syringe.

If the lens has oil or grease on the surface, clean sparingly with a clean cotton tip applicator dampened with alcohol. Use a gentle circular motion to clean.

DO NOT --

1. Breathe on the lens surface as this will deposit moisture/oil particles.
2. Soak the lens surface with alcohol as it will not clean properly.
3. Scrub the lens excessively as the anti-reflective coating can be scratched and the lens will have to be replaced.
4. Use paper towels or tissues as they are coarse enough to scratch the coated lens surfaces.
5. Touch the lens or cotton applicator with the fingers as body oil will be deposited on the cleaning material and the lens.
6. Use acetone or xylene to clean lenses.

Place the eyepiece in the Microscope Body and observe a plain bright field of view. Rotate the eyepiece and if any spots in the field of view rotate, the inner lens surfaces may require cleaning.

Refer to the eyepiece diagrams, Figure 6. There are two methods used to assemble eyepieces. In both cases, they should be disassembled by placing them upside-down on a table covered with a soft cloth.

When disassembling the eyepiece, it is very important that the lens surface be identified so that it is not reversed at assembly. Some of the curvatures will look identical but optimum performance can only be achieved if it is replaced so the curve of the lens faces the proper direction.

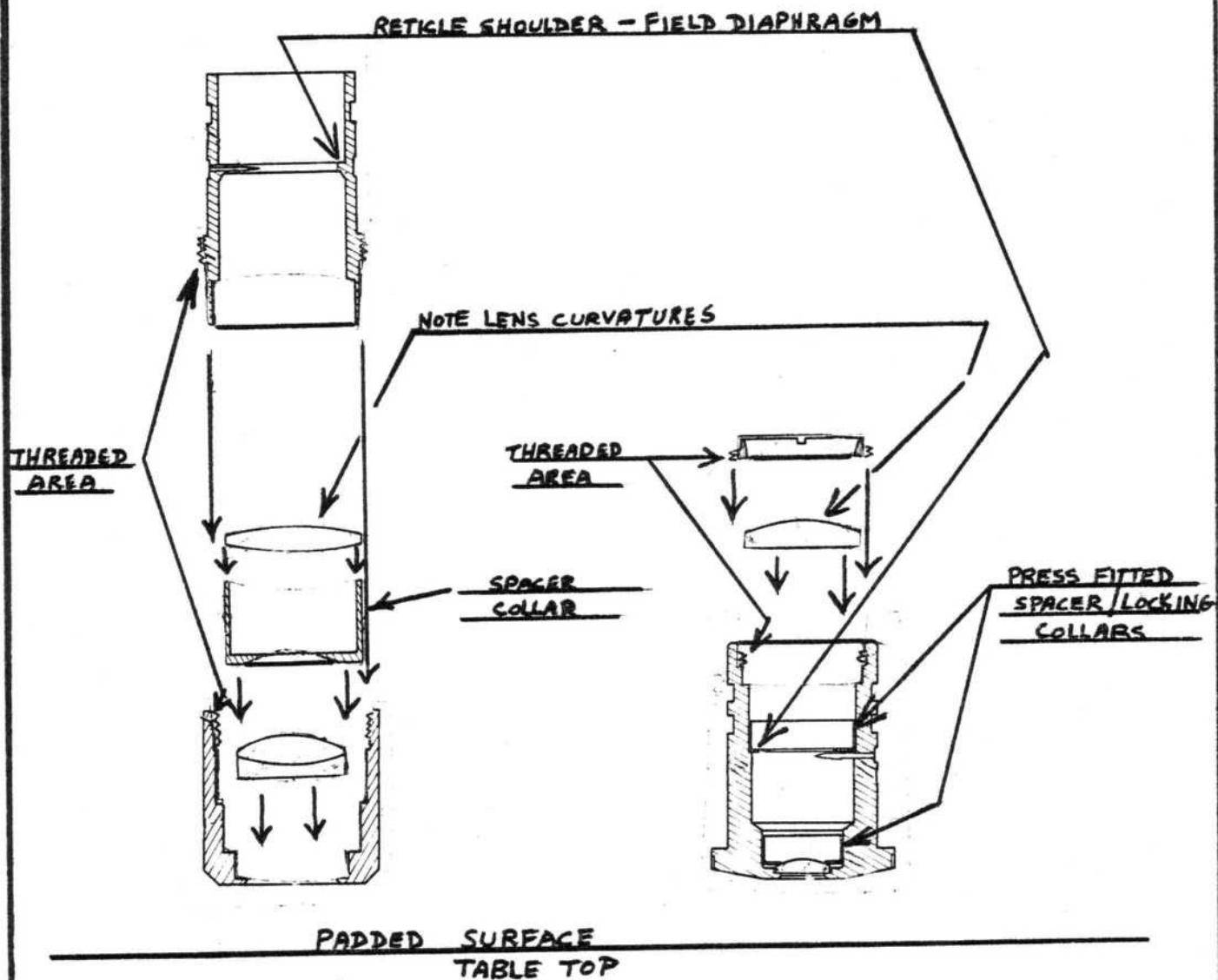
The No. 138 10x Wide Field Eyepiece can be disassembled by unscrewing the top and bottom sections. Separate the eyepiece halves carefully, as the lenses are held in place with spacer collars and can fall out when the housing is removed. Refer to Figure 5.

Hold lenses by the edges and clean using the same procedure described for exterior lens surfaces.

Reassemble the eyepieces using Figure 5 as a guide for lens elements, spacers and lock rings.

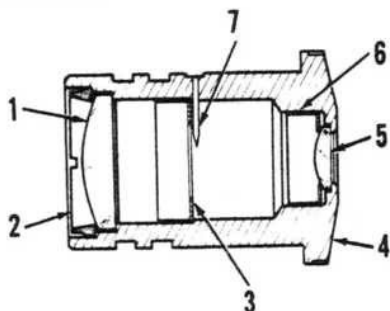
Cat. No. 138 10X Wide Field Eyepiece
with Pointer

Cat. No. 139 10X Huygenian Eyepiece
with Pointer

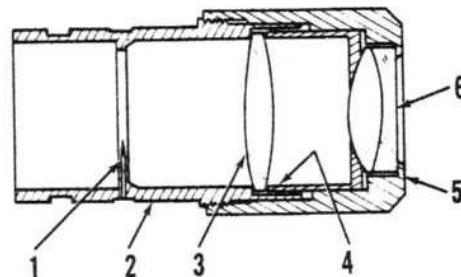


EYEPiece VIEWS

FIGURE 5



Cat. No. 139 10X Huygenian Eyepiece
with Pointer



Cat. No. 138 10X Wide Field Eyepiece
with Pointer

Figure 2 Eyepieces

Index No.	Part No.	Description	Qty
	Cat. No. 139	10X Huygenian Eyepiece with Pointer	
1	163-601	Field Lens	1
2	163-3	Retainer	1
3	139-12	Diaphragm	1
4	139-11	Body	1
5	139-605	Front Lens	1
6	139-13	Retainer	1
7	160-50	Pointer	1
	Cat. No. 138	10X Wide Field Eyepiece with Pointer	
1	164-4	Pointer	1
2	138-8	Tube	1
3	63-613	Eyepiece Crown	1
4	138-10	Separator	1
5	138-9	Cap	1
6	63-705	Eyepiece Doublet	1

FIGURE 6

I V OBJECTIVES

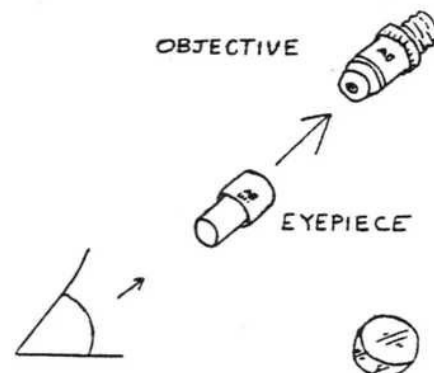
Microscope objectives must not be disassembled. Special fixtures, tool and techniques are required to service this critical part of the instrument.

Reconditioned exchange objectives are available from all Technical Service Centers that are conveniently located throughout the Country.

Exterior objective lens surfaces can be inspected and cleaned,

Remove the objective from the nosepiece using care that the front lens element does not hit the stage when detaching from the threaded nosepiece opening. The nosepiece should be raised to the uppermost position and a cloth placed across the stage surface.

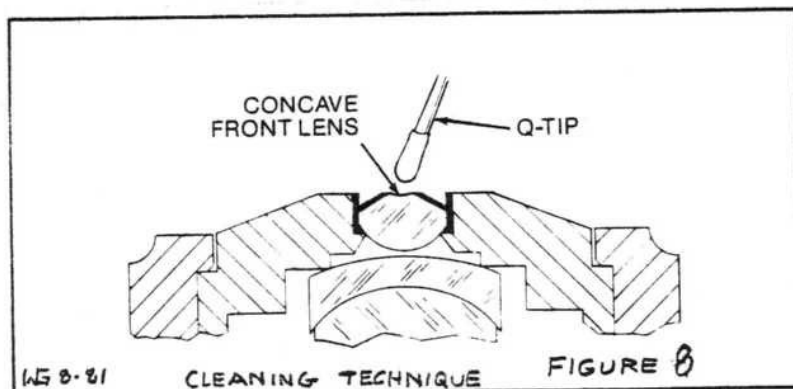
Examine the front lens of the objective using a magnifying glass. An eyepiece, held backwards, can be used as a magnifier. Refer to Figure 7. A crescent shadow on one side of the lens can indicate oil leakage inside the lens, and the objective should be returned immediately for exchange.



OBJECTIVE
EXAMINATION

WG 8-81

FIGURE 7



The objective front lens can be cleaned using the same material and techniques as when cleaning the eyepiece lenses. Refer to Figure 8.

V. STAGE

The 1534 Mechanical Attachment can be removed from the 1579-2 Stage Plate by removing the two screws 1580-2. See Figure 9.

Reconditioned Exchange 1534 Mechanical Stage Attachments are available from all Technical Service Centers.

The 1579-2 Stage Plate must not be removed from the Microscope Stand. It is adjusted to proper height and leveled using factory fixtures.

Exposed gear surfaces may be cleaned with alcohol and a cotton tip applicator. A small amount of lubricant can be applied to the gears with a plain applicator stick.

Recommended lubricant - Plastilube #1, Warren Refining Chemical Company, Cleveland, Ohio.

A. Control Unit - Disassembly Sequence

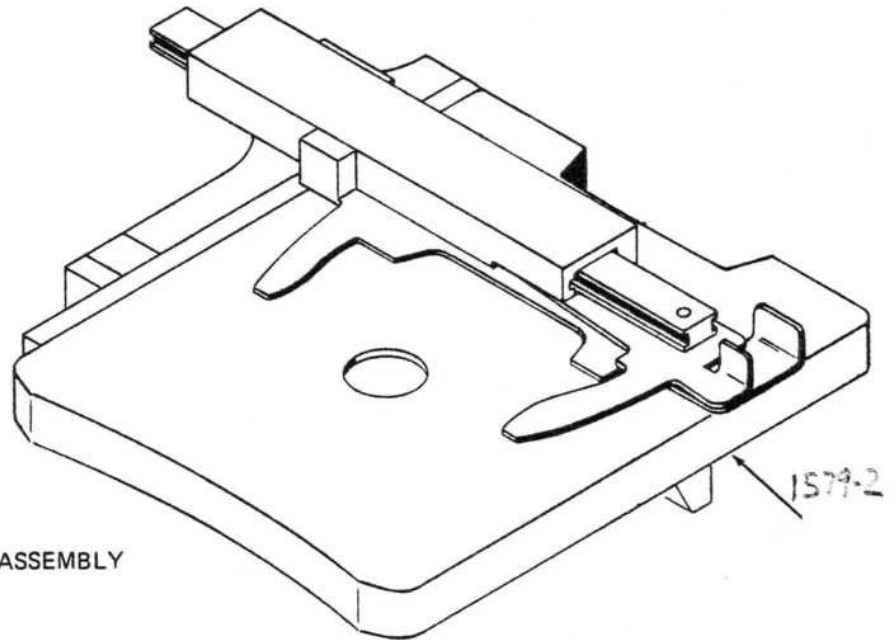
Reference: Figure 10

Remove parts in the following order:

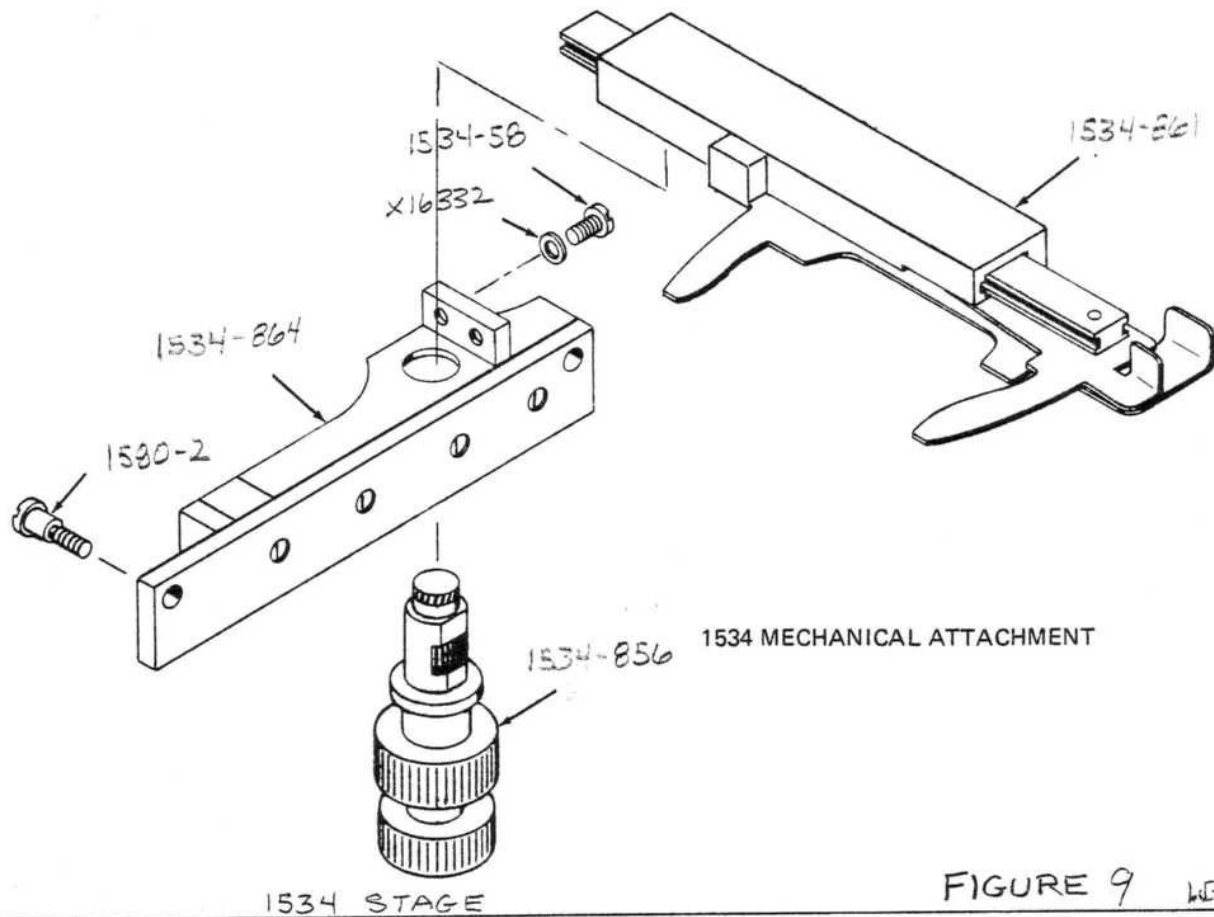
1. X-53538 Set Screw 1534-38 Plug in 1534-48 Nut.
2. 1534-48 Nut1 each
3. Cross Motion Knob group consisting of:
 - a. 1534-48 Nut.....1 each
 - b. 1534-37 Spring Washer.....1 each
 - c. 1534-36 Fiber Washer.....2 each
 - d. 1534-49 Cross Motion Knob.....1 each
 - e. X-53447 Spring Retainer.....1 each

SERVICE NOTE: Further disassembly of this group is not recommended.

4. 1062-76 Spring Washer.....1 each
5. 1534-30 Brass Plate Washer.....1 each
6. 1534-34 Nylon Washer.....1 each
7. 1534-55 Steel Washer.....1 each
8. 1534-31 Slotted Lock Washer.....1 each
9. 1534-22 Inner Pinion.....1 each



1581A MECHANICAL STAGE ASSEMBLY



1534 MECHANICAL ATTACHMENT

1534 STAGE

FIGURE 9 WGB-81

10. X-53538 Set Screw and 1534-39 Plug in 1534-26 Adjusting Nut.
11. 1534-26 Adjusting Nut.....1 each
12. X-50584 Spring Washer.....1 each
13. 1534-29 Brass Plate.....1 each
14. 1534-33 Nylon Washer.....1 each
15. N-S Control Knob group consisting of:
 - a. 1534-50 Control Knob.....1 each
 - b. 1534-36 Fiber Washer.....1 each
 - c. 1534-60 Outer Pinion.....1 each
 - d. 1534-37 Spring Washer.....1 each
 - e. X-53447 Spring Retainer.....1 each

SERVICE NOTE: Further disassembly of this group is not recommended.

16. 1534-24 Sleeve Press fitted to 1534-6 Support.1 each

SERVICE NOTE: Some parts are lap-fitted using factory fixtures and may require re-work to assure proper fit.

B. Control Unit - Assembly Sequence

Reference: Figure 10

Replace parts in the following order:

1. 1534-24 Sleeve with 1534-6 Support.....1 each pressed unit
2. Lube Control Knob group as indicated in Figure 10 with Mobil #3 grease and graphite powder.
3. N-S Control Knob group consisting of:
 - a. 1534-50 Control Knob.....1 each
 - b. 1534-36 Fiber Washer.....1 each
 - c. 1534-60 Outer Pinion.....1 each
 - d. 1534-37 Spring Washer.....1 each
 - e. X-53447 Spring Retainer.....1 each
4. 1534-33 Nylon Washer.....1 each
5. 1534-29 Brass Plate.....1 each
6. X-50584 Spring Washer.....1 each

7. 1534-26 Adjusting Nut with X-53538 Set Screw and 1534-39 Plug.....1 each
8. Lube Pinion Shaft with Mobil #3 and graphite powder.
9. 1534-22 Inner Pinion.....1 each
10. 1534-31 Slotted Lock Washer.....1 each
11. 1534-55 Steel Washer.....1 each
12. 1534-34 Nylon Washer.....1 each
13. 1534-30 Brass Plate Washer.....1 each
14. 1062-76 Spring Washer.....1 each

SERVICE NOTE: Convex surface of washer faces upwards.

15. Cross Motion Knob group consisting of:
 - a. 1534-48 Nut with X53538 Set Screw.
 - b. 1534-37 Spring Washer.....1 each
 - c. 1534-36 Fiber Washer.....1 each
 - d. 1534-49 Cross Motion Knob.....1 each
 - e. X-53447 Spring Retainer.....1 each

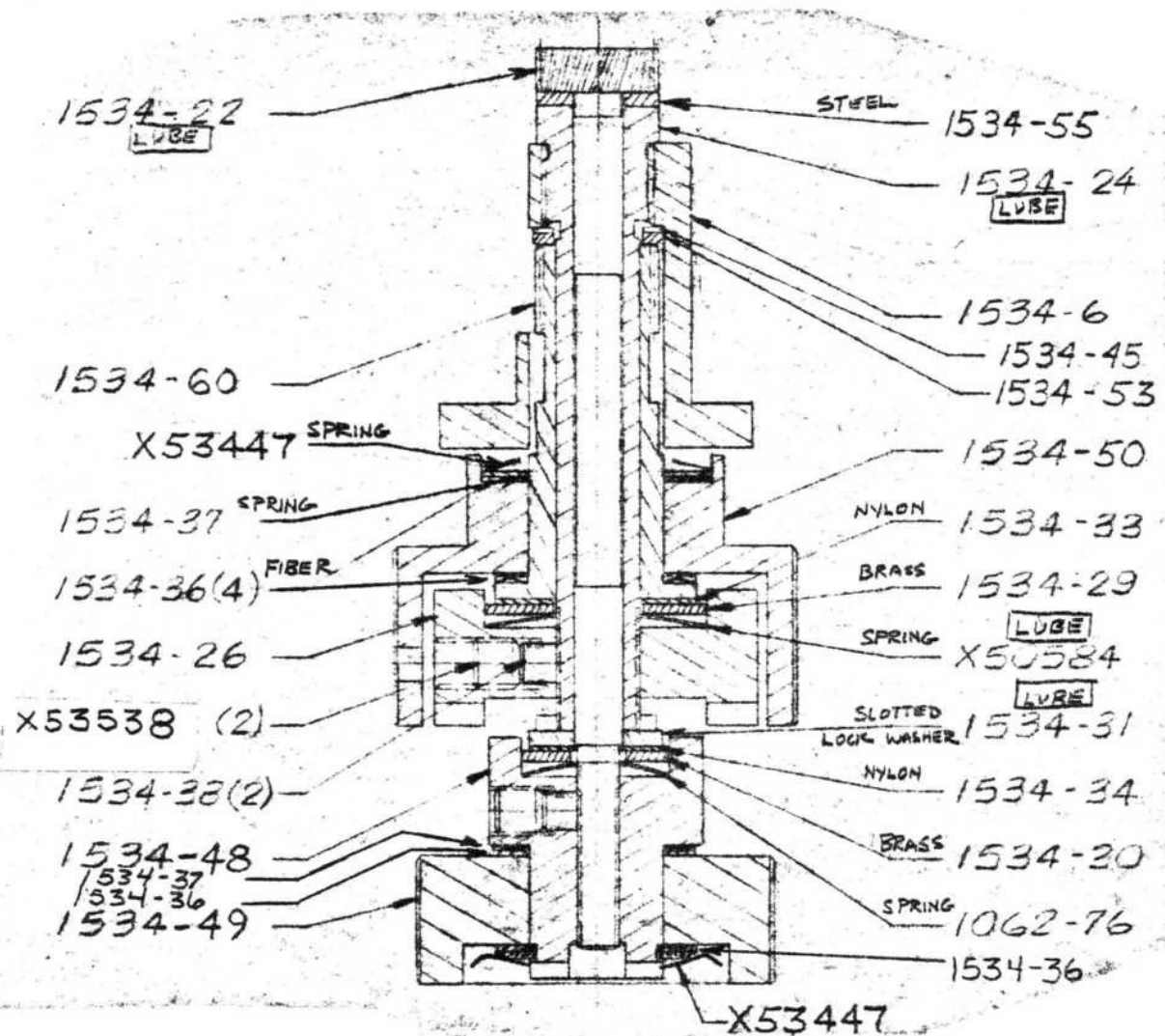
16. Refer to Section V ,C for adjustment instructions.

SERVICE NOTE: Do not tighten the two X53538 Set Screws excessively.

C. Control Knob Tension Adjustment

Reference: Figure 10

1. Loosen the X-53538 Set Screw in the 2534-26 Lock Nut by inserting a 1/16 allen wrench through the hole in the 1534-50 Knob.
2. Tighten or loosen the 1534-26 Lock Nut to increase or decrease the tension of the forward and backward control. The K1569 wrench can be modified and used for this adjustment.
 - a. Tightening the 1534-26 Lock Nut pushes the 1534-60 Pinion Shaft upwards against the 1534-53 Nylon Washers and 1534-24 pressed in shaft bushing. Continued tightening of the 1534-26 Lock Nut compresses the X50584 Spring Washer causing a stiff movement.



1534-856 CONTROL KNOB ASSEMBLY

FIGURE 10

W5B-91

- b. Tighten the X53538 set screw after adjusting the control tension. This forces a soft 1534-38 plug against the threads of the 1534-60 pinion shaft. Do not tighten the set screw excessively.
 - c. The 1534-50 knob is held to the 1534-60 pinion shaft by a friction fit using washers 1534-37, 1534-36 and X53447.
3. Loosen the X53538 1/16 allen head set screw in the 1534-48 lock nut.
 4. Tighten or loosen the 1534-48 lock nut to increase or decrease the tension of the right to left control. The K1569 wrench can be modified and used to adjust the nut from the bottom of the control assembly.
 - a. Tightening the 1534-48 nut pushes the 1534-30 square brass plate against the 1534-31 slotted washer which is indexed onto the 1534-24 shaft bushing. This pulls the 1534-22 pinion shaft downwards and, at the same time, compresses the 1062-76 spring washer creating more tension on the cross motion control assembly.
 - b. Tighten the X53538 set screw after adjusting the control tension. This forces a soft 1534-38 plug against the threads of the 1534-22 cross motion pinion shaft. Do not overtighten the set screw.
 - c. The 1534-49 cross motion knob is held in place on the 1534-48 tension nut by a friction fit of washers 1534-36, 1534-37 and X53447.
 5. Lube note: Mobil #3 with graphite powder.

D. Slide And Finger Unit - Disassembly Sequence

Reference: Figures 11 and 12

Remove parts in the following order:

1. X-16332 screws.....2 each
2. Separate 1534-861 slide and finger unit from 1534-864 frame unit.
3. X-32150 screws.....2 each
4. 1434-79 fixed finger.....1 each
5. 0278 through 02786 clearance washer - as required

6. 1534-39 spring.....1 each
7. 1534-65 moveable finger.....1 each
8. 1534-19 spacers.....2 each
9. 1534-41 screws.....3 each
10. 01008 washers.....3 each
11. 1534-74 rail.....1 each
12. 1534-75 cross slide.....1 each
13. 1534-77 top.....1 each
14. 1534-43 balls.....18 each
15. 1534-16 separators.....2 each
16. 1534-80 wires.....8 each
17. 0861-1 screws.....2 each
18. 1534-46 long rack gear.....1 each

E. Slide And Finger Unit - Assembly Sequence

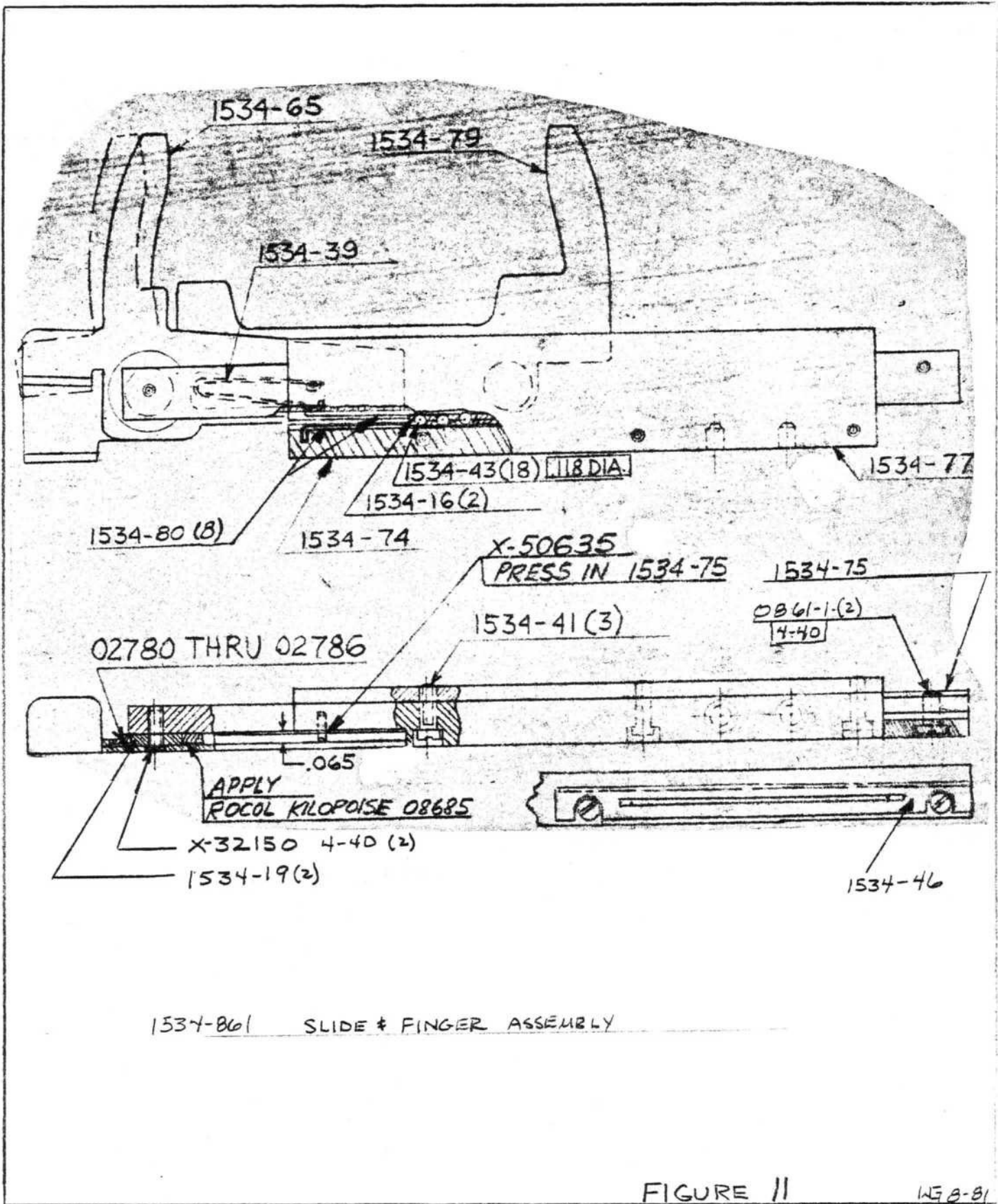
Reference: Figures 11 and 12

Replace parts in the following order:

1. 1534-46 long rack gear.....1 each
2. 0861-1 screws.....2 each

NOTE: Do not tighten.

3. 1534-80 wires.....8 each
4. Lube - separators and wires with Plastilube #1.
5. 1534-16 separators.....2 each
6. 1534-43 balls.....18 each
7. 1534-77 top.....1 each
8. 1534-75 cross slide.....1 each



9. 1534-74 rail.....1 each
10. 01008 washer.....3 each (Do Not Tighten)
11. 1534-41 screws.....3 each (Do Not Tighten)
12. Align and center separators.
13. Apply 6 lb. force - top - cross slide - rail.
14. Check rail movement.
15. Tighten 1534-41 screws.
16. 1534-65 moveable finger.....1 each
17. Lube - bearing surface with Rocol Kilopoise.
18. 1534-19 spacers.....2 each
19. 1534-39 spring.....1 each
20. 0278 through 0286 clearance washer - as required
21. 1534-79 fixed finger.....1 each
22. X-32150 screw.....2 each
23. Mount the 1534-861 slide and finger unit onto the 1534-864
frame unit with X16332 screws.....2 each
Do not tighten screws.
24. See Section V , H for adjustment instructions.

F. Frame Unit - Disassembly Sequence

Reference: Figure 12

Remove parts in the following order:

1. 1534-41 screw.....4 each
2. 1534-73 frame.....1 each
3. 1534-43 balls.....18 each
4. 1534-16 separators.....2 each
5. 1534-76 gib.....1 each

6. 1534-81 wires.....6 each
7. 1534-73 wires.....2 each
8. 0194-5 screws.....2 each
9. 1534-21 short rack gear.....1 each
10. 01202-1 washers.....2 each

G. Frame Unit - Assembly Sequence

Reference: Figure 12

Replace parts in the following order:

1. 01202-1 washer.....2 each
2. 1534-21 short rack gear.....1 each
3. 0194-5 screws.....2 each
4. 1534-73 wires.....2 each
5. 1534-81 wires.....6 each
6. 1534-76 gib.....1 each
7. Mount 1534-76 gib onto 1534-78 mount with 1534-41 screws.....4 each

SERVICE NOTE: Bevel on gib faces bevel on mount. Do not tighten 1534-41 screws.

8. Lube: separators, rack, wires - Plastilube #2.
9. 1534-16 separator.....1 each
10. 1534-43 balls.....9 each
11. Place separator and balls on wires in bottom area of frame casting 1534-73.
12. 1534-78 mount with 1534-76 gib - numbers facing upwards - slide into the 1534-73 frame.
13. 1534-16 separator.....1 each
14. 1534-43 balls.....9 each

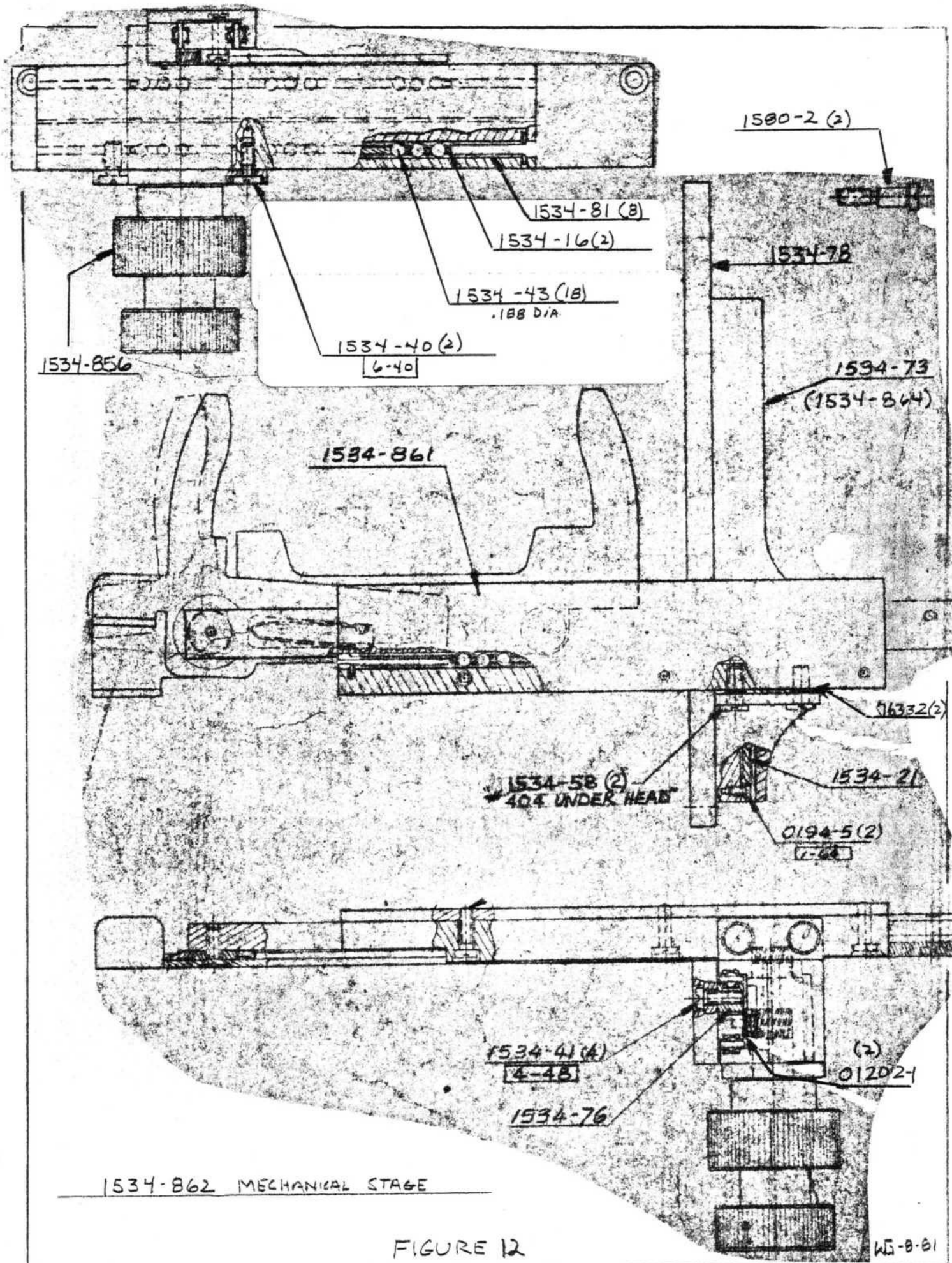


FIGURE 12

SERVICE NOTE: Slide separator and balls (one at a time) into place on gib wires.

SERVICE NOTE: Separate 1534-76 gib from 1534-78 mount to ensure proper sliding motion - then tighten 1534-41 screws.....4 each

H. Stage Adjustments

To achieve optimum performance from the mechanical stage, there are specific sections of the stage that must be properly adjusted. The cross motion assembly, 1534-861 (Figure 9), can be adjusted up and down by loosening the two mounting screws 1534-58. The height of the stage fingers above the stage surface, 1579-2, should be about the thickness of ordinary paper. The cross motion assembly should also be parallel to the stage surface before tightening the screws.

Bearing guides are flattened slightly by applying pressure to the housings, 1534-861 or 1534-864, and rolling back and forth. See Figure 13.

Rack and pinion gear mesh is important and is adjusted by bending the rack gear. In actual practice, the rack should have a slight crown in the middle. This will provide the same knob tension when the pinion is in the middle of the suspended rack as it does at the end of the rack where the flex action is minimal. See Figure 14.

The pinion teeth must engage the teeth in the rack gear with no lateral play. Wear (Figure 15) will cause spaces between the teeth and there will be a loss of motion during the first moment of moving a specimen slide.

BEARING GUIDES

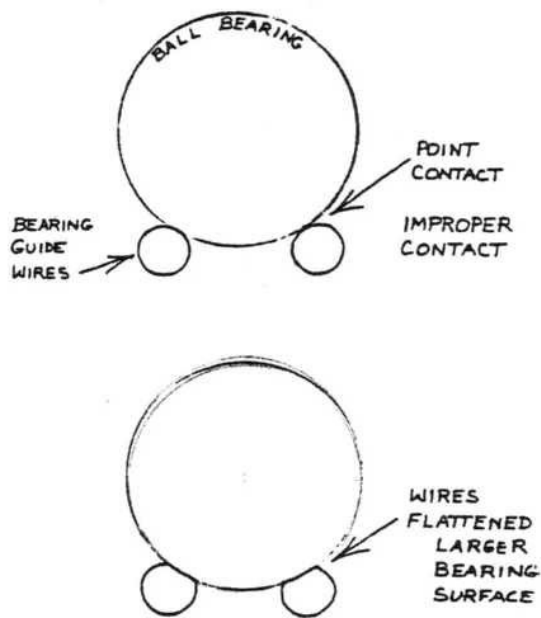
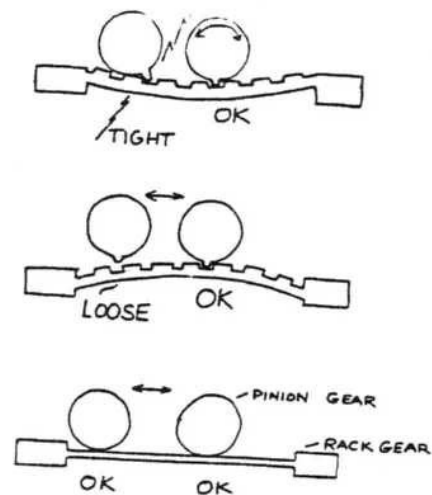


FIG. 13

WG 10-81



RACK & PINION GEAR ADJUSTMENT WG 10-81

FIG. 14

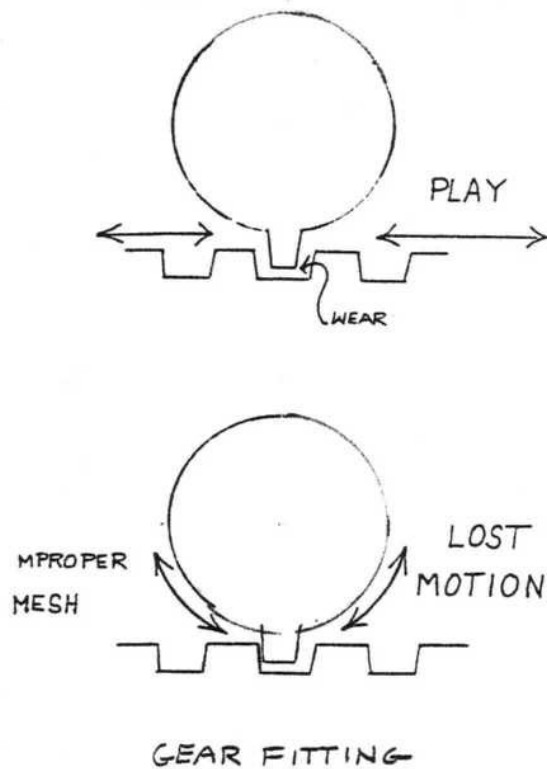


FIG. 15

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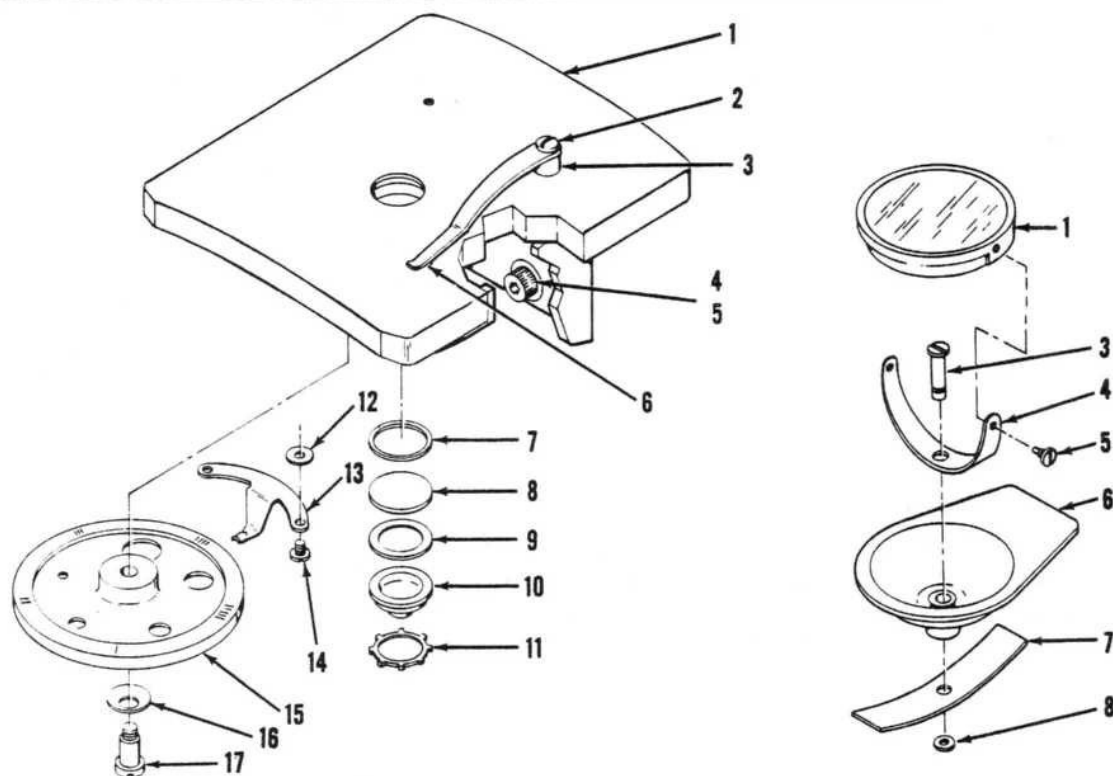
VI. SUBSTAGE CONDENSER

Adjustment of the condenser in stages using a fixed element, such as the 1570A stage, is not recommended. Realignment would require moving the stage and special fixtures to set the stage at the proper height and square the surface to the optical axis.

Parts can be replaced using the parts list and diagram, Figure 16.

Centration of the condenser assembly on the 1571A, 1579, 1587A and 1586A stages can be examined using the 4X objective and 10X eyepiece, or the #1245 aperture viewing eyepiece. Lower the condenser until the iris diaphragm outline is visible in the field of view. A perfectly centered diaphragm will be concentric with the field of view. Condensers with movable mounts, such as the 225 and 223, can be centered by loosening the bolts and recentering the mount while viewing the iris diaphragm through the body.

SERVICE NOTE: Centering adjustments on the condenser mount can only be performed on instruments that have a factory set nosepiece detent index spring and a properly aligned body.



Stage and Mirror Assemblies

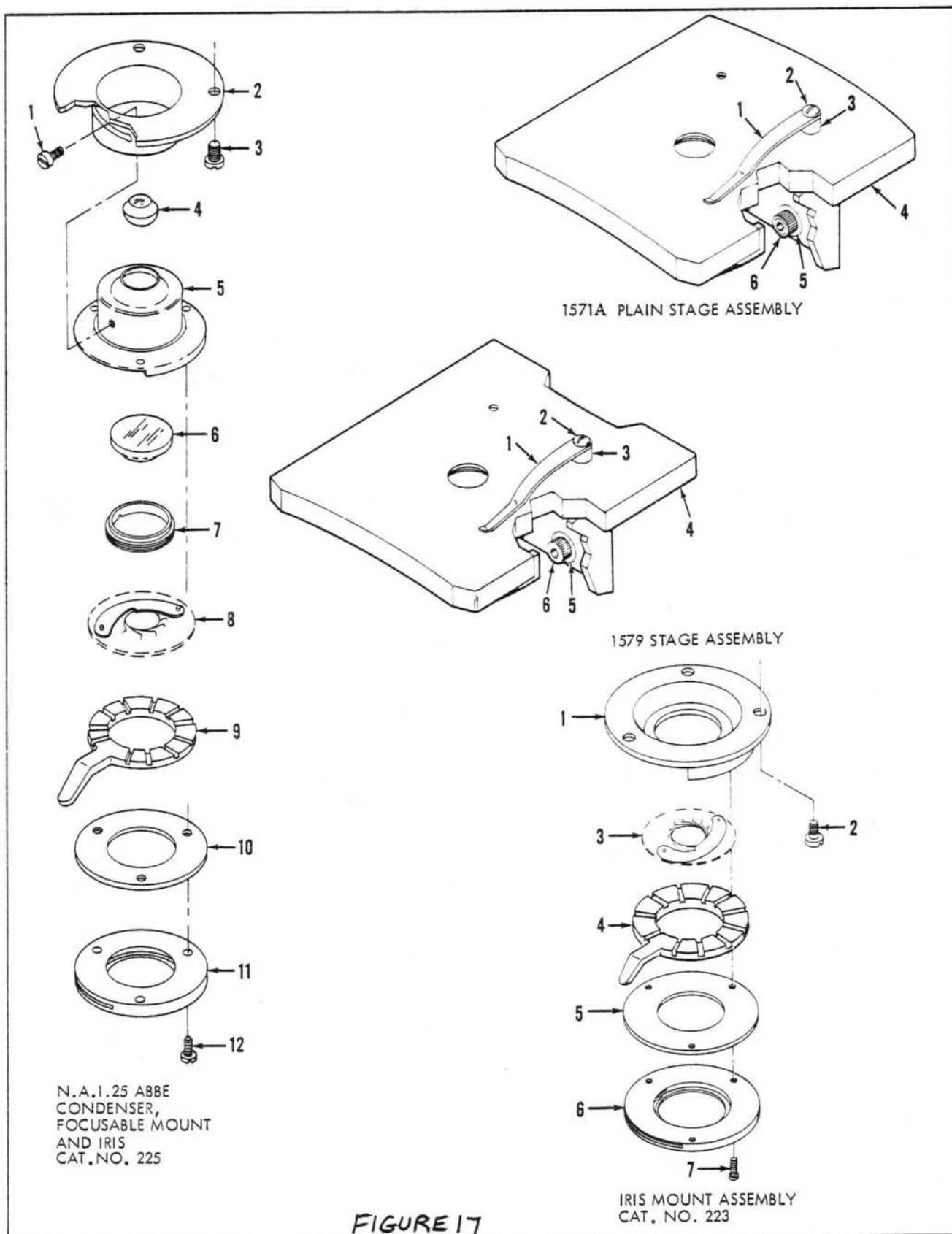
Index No.	Part No.	Description	Qty
	Cat. No. 1570A	Stage Assembly with Condenser	1
1	1570-2	Stage	1
2	X-30750-2	Screw	2
3	60-24	Bushing, stage clip	2
4	X-16090	Washer	2
5	X-36090	Screw	2
6	60-25	Clip, stage	2
7	227-4	Gasket	1
8	227-602	Window	1
9	227-2	Diaphragm	1
10	227-601	Condenser	1
11	X-50878	Ring, retaining	1
12	220-5	Washer	2
13	220-3	Spring, index	1
14	X-38827-2	Screw	2
15	220-1	Disc, diaphragm	1
16	X-50695	Washer, spring	1
17	220-4	Screw	1
	Cat No. 217A	Plano-Concave Mirror Assembly, complete	1
1	217-851	Mirror, Plano-concave, mounted in frame	1
2	205-5	Pin	1
3	205-3	Fork	1
4	205-4	Screw, pivot	2
5	205-2	Mount	1
6	205-6	Spring	1
7	B-3801-59	Ring, retaining	1

FIGURE 16

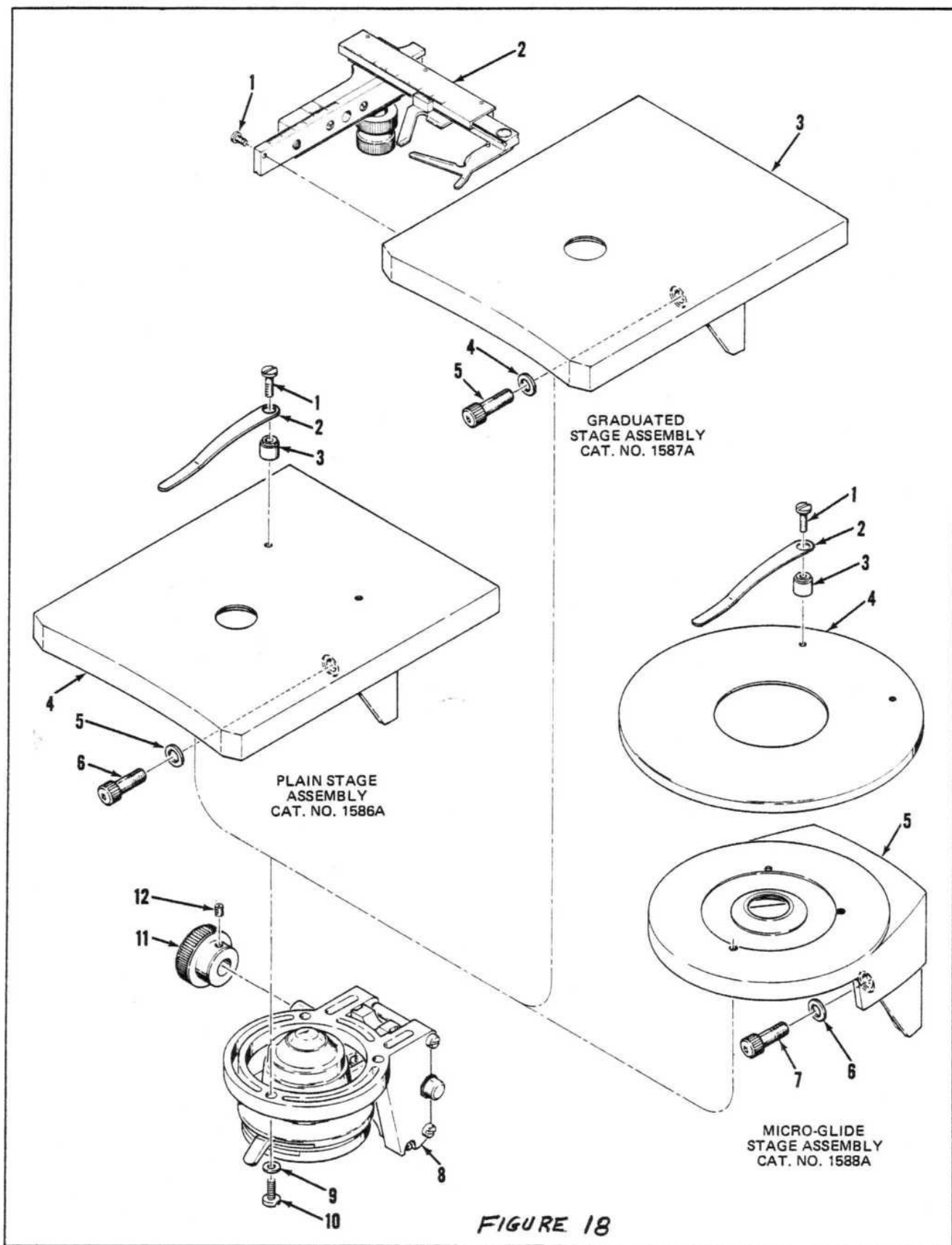
WS 1081

Plain Stage, Condensers, and Iris Mount Assembly

Index No.	Part No.	Description	Qty
	Cat. No. 223	Iris Mount Assembly	
1	223-2	Mount, iris	1
2	X-30388-2	Screw	3
3	1093-851	Iris Leaf Assembly	11
4	225-5	Ring, shifting	1
5	223-4	Retainer	1
6	223-3	Holder, blue glass	1
7	0138-4	Screw	3
	Cat. No. 225	N. A. 1. 25 Abbe Condenser, Focusable Mount and Iris	
1	228-5	Screw	1
2	225-4	Bearing, sleeve	1
3	X-30388-2	Screw	3
	225-851	Iris Mount Assembly (includes items 4, 5, 6, 7)	1
4	233-602	Lens, front	1
5	225-2	Mount, iris	1
6	233-601	Lens, back	1
7	225-7	Ring, retaining	1
8	1093-851	Iris Leaf Assembly	11
9	225-5	Ring, iris shifting	1
10	223-4	Retainer	1
11	223-3	Holder, blue glass	1
12	0138-4	Screw	1
	Cat. No. 1571A	Stage, simple, complete	
1	60-25	Clip, stage	2
2	X-30750-2	Screw	2
3	60-24	Bushing, stage clip	2
4	1570-2	Stage	1
5	X-16090	Washer	2
6	X-36090	Screw	2
	Cat. No. 1579	Stage, simple, complete	
1	60-25	Clip, stage	2
2	X-30750-2	Screw	2
3	60-24	Bushing, stage clip	2
4	1579-2	Stage	1
5	X-16090	Washer	2
6	X-36090	Screw	2



Plain Stage, Condensers, and Iris Mount Assembly



Stage Assemblies

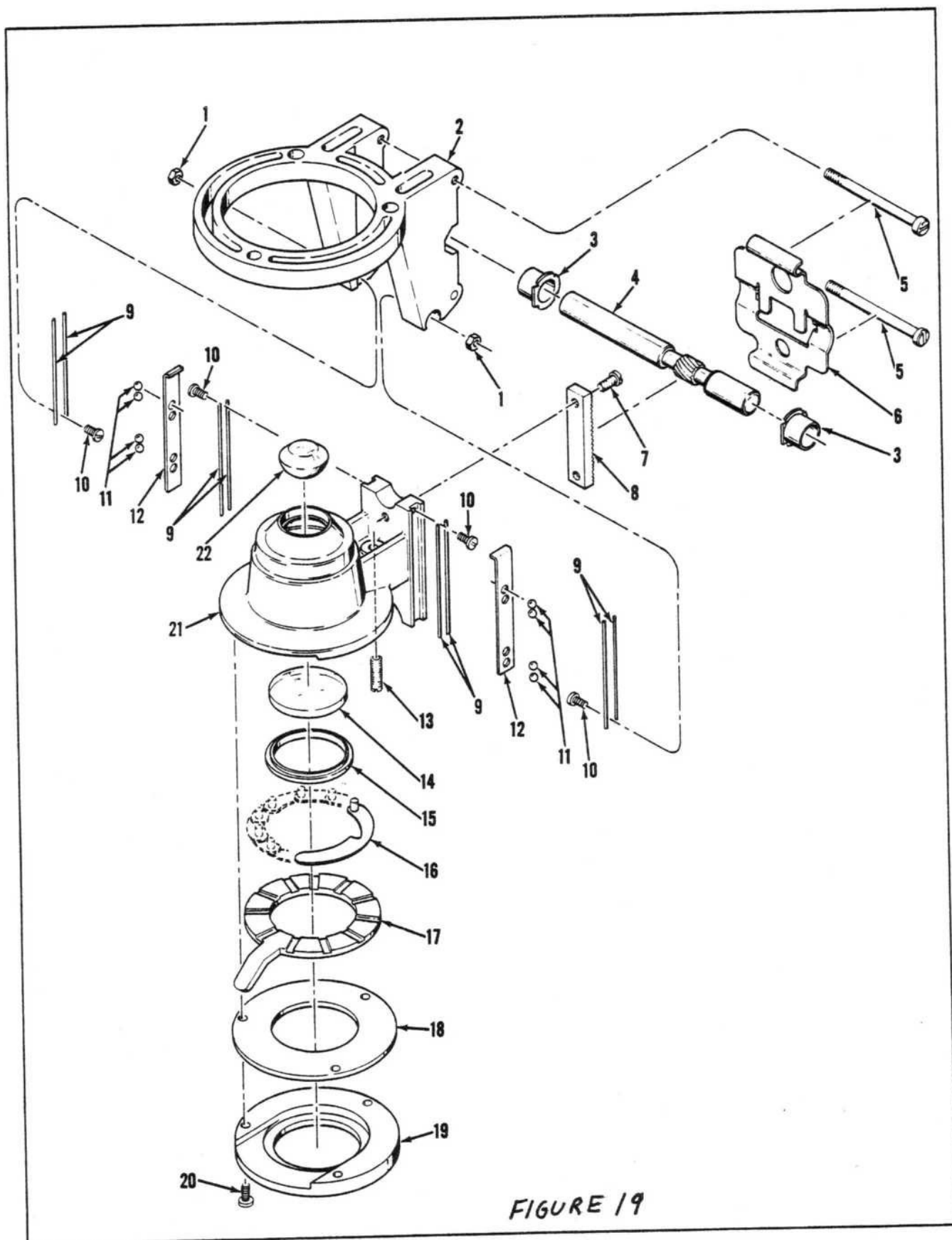


FIGURE 19

Rack and Pinion Assembly

Stage Assemblies

Index No.	Part Number	Description	Quantity
	Cat. No. 1586A	Plain Stage Assembly	
1	X-30750	Screw	2
2	60-25	Clip, stage	2
3	60-24	Bushing, stage clip	2
*	1586-853	Stage Assembly (includes items 4 thru 12)	1
4	60-311	Stage	1
5	X-16090	Washer	2
6	X-36090	Screw	2
8	1586-852	Rack & Pinion Assembly (see Figure 8 for breakdown)	1
9	220-5	Washer	3
10	X-30750	Screw	3
11	60-310	Knob	1
12	X-51772	Screw	1
	Cat. No. 1587A	Graduated Stage Assembly	
1	1580-2	Screw	2
2	Cat. No. 1580	Mechanical Attachment (see Figure 9 for breakdown)	1
*	1586-853	Stage Assembly (includes items 3 thru 12)	1
3	60-311	Stage	1
4	X-16090	Washer	2
5	X-36090	Screw	2
8	1586-852	Rack & Pinion Assembly (see Figure 8 for breakdown)	1
9	220-5	Washer	3
10	X-30750	Screw	3
11	60-310	Knob	1
12	X-51772	Screw	1
	Cat. No. 1588A	Micro Glide Stage Assembly	
1	X-38093	Screw	2
2	60-25	Clip, stage	2
3	60-24	Bushing, stage clip	2
*	1588-851	Stage Top Assembly (includes items 4 and 5, which are a matched set)	1
4		Slide Top	1
5		Stage	1
6	X-16090	Washer	2
7	X-36090	Screw	2
8	1586-852	Rack and Pinion Assembly (see Figure 8 for breakdown)	1
9	220-5	Washer	3
10	X-30750	Screw	3
11	60-310	Knob	1
12	X-51772	Screw	1

Rack and Pinion Assembly

Index No.	Part Number	Description	Quantity
	1586-852	Rack and Pinion Assembly - includes Condenser	
1	X-8074	Hex Nut	2
2	60-303	Arm, stage	1
3	60-314	Bearing	2
4	60-305	Pinion, adjusting	1
5	60-313	Screw, tension	2
6	60-307	Spring, tension	1
7	0863-1	Screw	2
8	60-306	Rack, substage	1
9	60-309	Track	8
10	60-312	Screw	4
11	10-6	Ball	8
12	60-308	Separator	2
13	X-51868	Stopscrew	1
14	233-601	Lens, back	1
15	225-7	Retaining Ring	1
16	324-853	Iris Leaf Assembly	11
17	225-5	Ring, shifting	1
18	223-4	Retainer	1
19	223-3	Holder, blue glass	1
20	0138-4	Screw	3
21	60-304	Slide, iris mount	1
22	233-602	Lens, front	1
	1586-851	Condenser Assembly (Includes items 14, 15, 21, 22)	

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VII. AUTOFOCUS STOP SETTING

1. When adjusting the auto focus stop, raise the nosepiece carefully. If the stop has not been set properly, the nosepiece may drop suddenly. The objective will hit the slide which will probably result in damage to both.
2. Place a slide on the Microscope Stage. Rotate the LH fine adjustment control CW to its lowest stop. Lower the nosepiece with the LA/CA knob to a point where the 45X objective is almost touching the slide.
3. Raise the nosepiece by rotating the LH FA knob $3\frac{1}{4}$ turn CCW.
4. Loosen the set screw on the LH/CA knob.
5. Focus onto the slide by rotating the RH CA knob in either direction while holding the LA CA knob stationary with the other hand.

When the slide is in focus, tighten the LA/CA knob set screw in place which should position the auto focus adjustment where the slide will automatically come into focus when the CA is turned all the way down and the FA is rotated upwards $3\frac{1}{4}$ turns. The tolerance is $\pm 3/8$ of a turn on the FA knob.

VIII. COARSE AND FINE ADJUSTMENT

Reference: Figure 20

Remove parts in the following order:

1. X-30765-2 base cover screws.....2 each
2. 60-390 or 623-14 base cover plate.....1 each
3. X-30764 screws.....2 each
4. 623-40 transformer.....1 each
5. (#31) 60-403 cover.....1 each
6. (#27) 32-41 FA cover discs.....2 each
7. (#24) X-50972 retaining rings.....2 each
8. (#26) 32-40 FA knob.....2 each
9. (#25) X-50584 spring washers.....2 each
10. (#34A) Loosen 60-357 set screws.....2 each
11. (#18) X-50370 retaining rings.....2 each
12. (#16) 32-39 RH/CA knob.....1 each
13. (#15) X-51623 spring washer.....1 each
14. (#14) 60-228 fiber washer.....1 each
15. (#13) 32-56 flat steel washer.....1 each
16. (#16) 32-39 LH/CA knob.....1 each
17. (#34) 32-55 flat steel washer.....1 each
18. (#10) 32-72 half moon C washer.....1 each
19. (#30) X-25190 loosen set screw.....1 each
20. (#17 & 20) 32-1 CA tube and 32-2 FA shaft
assembly.....1 each
21. (#28) 32-15 gear box.....1 each

- 22. (#9) 32-83 washer.....1 each
- 23. (#8) 32-19 spacer.....1 each
- 24. (#36) 32-13 cam.....1 each

Replace parts in the following order:

1. Place the Microscope Stand face down on a flat table and view the inside of the stand through the base. The open stage surface faces the table surface and the (#7) 60-876 lifting lever will be horizontal. The open base faces the technician. Designations for right and left will be given with the instrument in this position.
2. Begin to insert the (#17) 32-1 CA tube/(#20) 32-2 FA shaft assembly through the bearing opening on the left side of the stand.

ASSEMBLY NOTE: The fine adjustment pinion opening in the coarse adjustment barrel will be at the extreme right end of the shaft assembly.

3. (#9) 32-83 flat steel washer - place on shaft assembly inside the instrument stand.
4. (#8) 32-19 plastic spacer bearing - place on shaft assembly next to steel washer.

ASSEMBLY NOTE: The smaller diameter section of the plastic spacer bearing faces right and will move in the elongated slot of the (#7) 60-876 lifting lever.

5. Continue inserting the adjustment shaft assembly through the stand from the left side and through the elongated slot in the (#7) 60-876 lifting lever.
6. (#36) 32-13 cam - place the cam onto the adjustment shaft assembly on the right side of the (#7) 60-876 lifting lever.

ASSEMBLY NOTE: The long hub section of the (#36) 32-13 cam extends through the (#7) 60-876 lifting lever and fits inside the (#8) 32-19 plastic bearing. The roller bearing, mounted on the bottom of the (#7) 60-876 lifting lever, will ride on the outside of the cam (#36) 32-13.

7. The gear teeth section of the (#36) 32-13 cam should be towards the bottom of the stand (facing the open base). The nosepiece is at its lowest position.

8. (#28) 32-15 gear box - continue to insert the shaft assembly through the steel washer, plastic bearing, lifting lever, cam and through the (#28) 32-15 gear box.

ASSEMBLY NOTE: The gear box is inserted to the right of the cam and with the locking screw pointing upwards. The small gears on the gear box face left towards the (#7) 60-876 lifting arm. The small upper gear will engage the teeth in the cam. Do not engage at this time.

9. Position the (#28) 32-15 gear box so that the large lower gear engages the fine adjustment shaft pinion gear through the slot in the coarse adjustment tube but does not contact the ends of the slotted opening in the tube.

10. Lock the (#28) 32-15 gear box to the (#17) 32-1 CA tube with the (#30) 25-190 set screw.

ASSEMBLY NOTE: Push the gear box and cam $\frac{1}{4}$ revolution to access the gear box set screw.

11. The smaller upper gear on the (#28) 32-15 gear box assembly must now be properly positioned under the gear teeth of the (#36) 32-13 cam. The cam can be pushed far enough to one side of the stand to permit alignment with the small gear on the gear box. This can only be done while the coarse adjustment knobs and (#10) 32-72 "C" washer are removed.
12. Rotate the LH/FA control CW to its stop position. The fine adjustment stop pin on the (#28) 32-15 gear box will be facing the top of the instrument.
13. Push the gear box to the right side of the instrument stand and move the cam/lifting lever to the left side of the stand. There should now be about a one-quarter-inch separation between the gear box and cam.
14. Rotate the LH CA barrel about $\frac{1}{4}$ revolution CCW to raise the gear box gears slightly above the gear teeth on the cam. The CA should contact a stop at this time.
15. Slide the cam, lifting lever, plastic bushing and steel washer to the right side so the teeth in the cam engage the small gear on the gear box.
16. Replace the (#10) 32-72 "C" retaining washer onto the CA barrel.
17. (#16) 32-39 LH CA knob.....1 each

NOTE: Do not tighten the knob set screw 60-358.

18. (#13) 32-56 flat steel washer.....1 each

19. (#14) 60-228 fiber washer.....1 each
20. (#15) X-51623 spring washer.....1 each
21. (#16) 32-39 RH CA knob.....1 each

NOTE: Tighten the set screw 60-358.

22. (#18) X-50370 retaining rings.....2 each
23. Rotate the FA control to its lower stop position.
24. Rotate the RH/CA knob CW to raise the nosepiece upwards until the lifting lever roller is about in the middle area of the cam. It may be necessary to push the nosepiece upwards by hand so the roller moves on the cam.
25. Hold the cam assembly in place by hand so that the weight of the nosepiece does not cause it to move.
26. Rotate the LH CA knob CCW to its stop and lightly tighten the set screw (#19) 60-358.

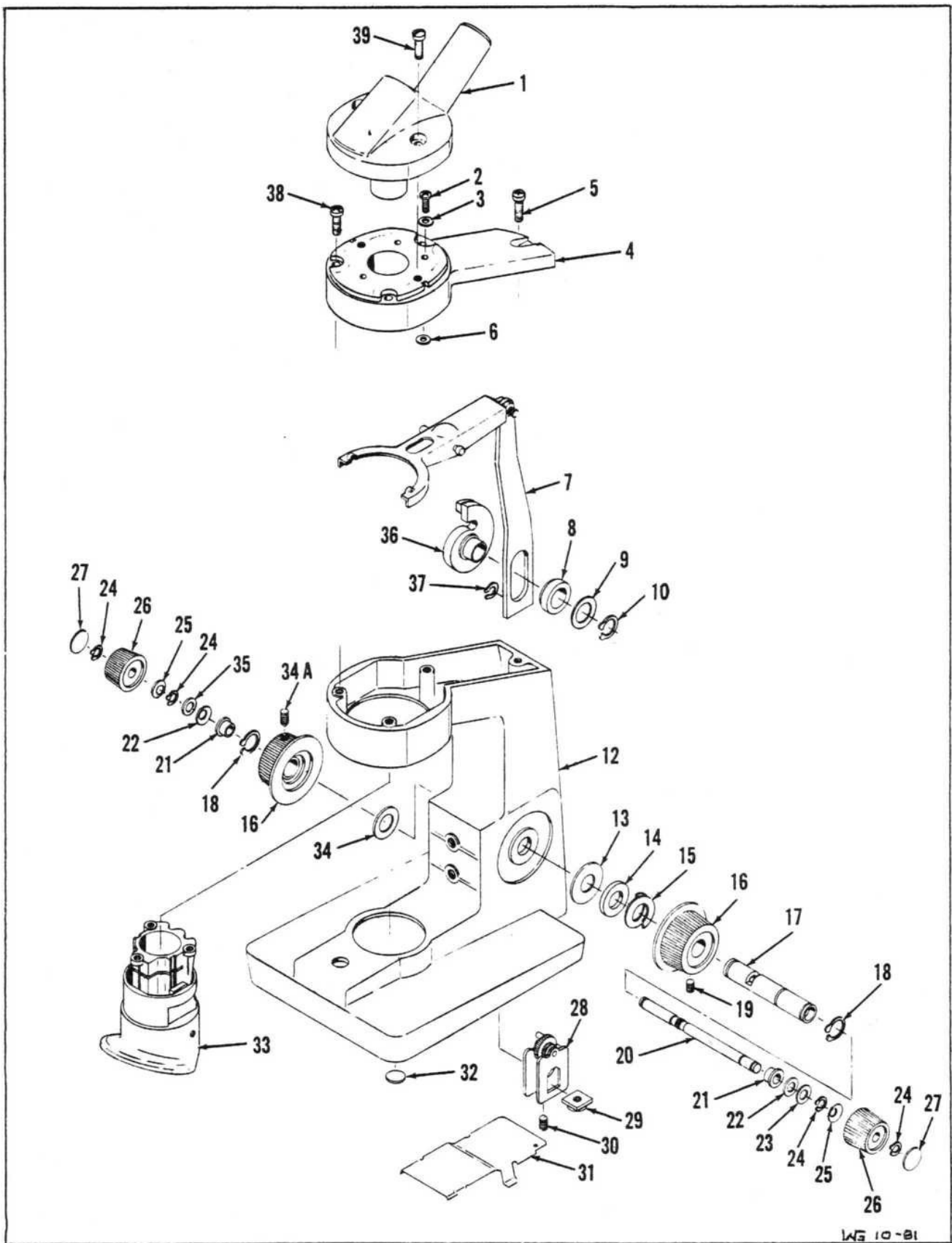
SERVICE NOTE: This stop position of the left hand knob should be with the nosepiece in the up position. Rotating the coarse adjustment knob CW should rotate the cam without allowing the roller to drop off the edge of the cam.

27. Rotate the LH fine adjustment shaft CCW to its upper stop position. The lifting lever roller should not extend past the edge of the cam.

NOTE: Steps 26 and 27 would be the maximum upward limit of both the fine and coarse adjustment controls.

28. Replace the following parts:

- a. (#25) X-50584 spring washers.....2 each
- b. (#26) 32-40 FA knobs.....2 each
- c. (#24) X-50972 retaining rings.....2 each
- d. (#27) 32-41 FA cover discs.....2 each
- e. (#31) 60-403 cover.....1 each
- f. 623-40 transformer.....1 each
- g. X-30764 screws.....2 each
- h. 60-390 or 623-14 base cover plate.....1 each
- i. X-30765-2 base cover screws.....2 each



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Stand
FIGURE 20

Stand

Index No.	Part No.	Description	Qty
1	Cat. No. 76	Monocular Body Assembly	1
2	X-29469	Screw	3
3	60-53	Washer	3
4	60-373	Cover, machined	1
5	X-27453-11	Screw	1
6	01030-1	Washer	3
7	60-876	Lever Assembly	1
8	32-19	Spacer	1
9	32-83	Washer	1
10	32-72	Retaining Ring	1
11	60-409	Spring	1
12	60-381	Arm	1
13	32-56	Washer	1
14	60-228	Washer	1
15	X-51623	Washer, lock	2
16	32-39	Knob, coarse adj.	2
17	32-1	Tube, coarse adj. (PART OF 32-852)	1
18	X-50370	Retaining Ring	2
19	60-358	Setscrew	1
20	32-2	Shaft, fine adj.	1
21	60-58	Bearing	2
22	60-22	Washer <i>plastic</i>	2
23	X-50875	Washer, spring	1
24	X 50972 B12400-120	Retaining Ring	4
25	X-50584	Washer, spring	2
26	32-40	Knob, fine adj.	2
27	32-41	Disc	2
28	32-15	Gear Box	1
29	32-12	Insert	1
30	X-25190	Setscrew	1
31	60-403	Cover	1
32	2-52	Base Foot	4
33	60-873	Nosepiece & Sleeve Bearing	1
34	32-55	Washer	1
34A	60-357	Setscrew	1
35	32-87	Washer	1
36	32-13	Cam	1
37	X-51404	Retaining Ring	1
38	X-27863	Screw	3
39	X-32570-22	Screw	2
40	32-952	COARSE AND FINE ADJUSTMENT ASSEMBLY	

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IX. NOSEPIECE AND OBJECTIVE DETENT

Reference: Figure 21

The nosepiece unit, including items 3 through 13, should not be disassembled from the stand. Assembly of this unit requires special fixtures, tools and techniques in order to assure optical centration of the objectives. Service on this assembly is available from authorized service facilities such as AO Technical Service Centers that are conveniently located throughout the country.

A. Servicing The Nosepiece Bottom

1. (#22) 60-20 - Remove two slotted screws using an offset screwdriver inserted through one of the objective mounting holes in the nosepiece bottom.

SERVICE NOTE: Use caution when removing the nosepiece bottom as the balls will drop out when the nosepiece bottom is removed.

2. Remove the following parts:

- a. (#14) 60-36 inner ball race.....2 each
- b. (#15) 60-45 outer ball race.....2 each
- c. (#17) B35-14 ball bearing.....10 each
- d. (#16) 60-40 bearing spacer.....1 each

3. (#18) B-3801-59 truarc ring.....1 each
4. (#19) 60-53 retaining washer.....2 each
5. (#20) 60-54 nylon spacer.....1 each
6. (#21) 60-44 retainer.....1 each
7. (#24) 60-142 nosepiece axle pin.....1 each

SERVICE NOTE: The axle pin has a serrated shaft and is pressed (swayed) into the nosepiece bottom.

8. (#23) 32-46 nosepiece bottom.....1 each

SERVICE NOTE: Do not remove the (#25) X-10014 pins from the nosepiece bottom.

9. Examine the following parts for wear and replace as required:

- a. (#14) 60-36 inner ball race - dents, flat spots, out-of-round
- b. (#15) 60-45 outer ball race - dents, flat spots, out-of-round
- c. (#17) B35-14 ball bearing - dents, flat spots, out-of-round
- d. All washers and spacers - cracks, burrs, etc.
- e. (#24) 60-142 nosepiece axle pin - wear in the recessed truarc groove.

10. Reassemble in reverse order by placing the spacers and retainer (#18, 19 & 21) onto the axle pin (#24).

SERVICE NOTE: If the axle pin has been removed from the nosepiece bottom it may be necessary to replace both parts as the hole in the nosepiece bottom may become enlarged.

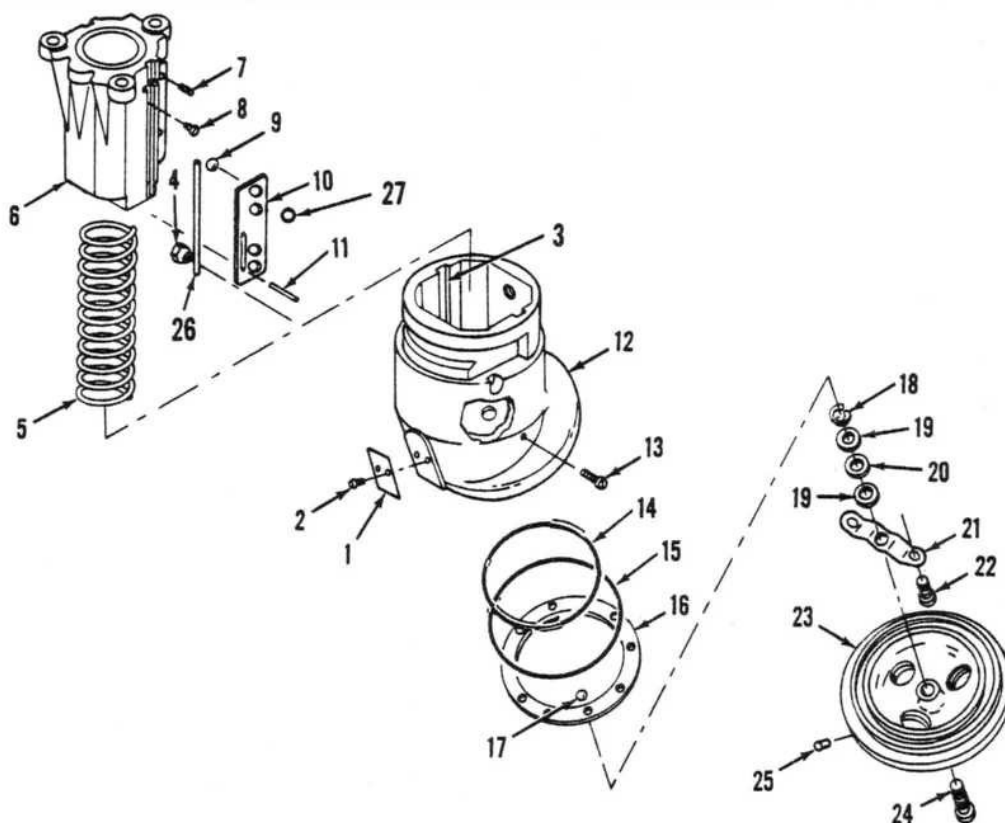
11. Replace the balls, races and spacer (#14, 15, 16 & 17). Lubricate with Shell Plastilube.

12. Replace the nosepiece bottom onto the nosepiece and fasten the retainer (#21) in place with the two screws (#22) using an offset screwdriver.

B. Objective Detent

- 1. Image the condenser aperture diaphragm as performed in Section VI.
- 2. Adjust the under spring (#1) to center the condenser diaphragm to the eyepiece field of view.

SERVICE NOTE: The detent can only be adjusted on instruments that have a factory set condenser mount and a properly aligned body.



Nosepiece and Sleeve Bearing Assembly

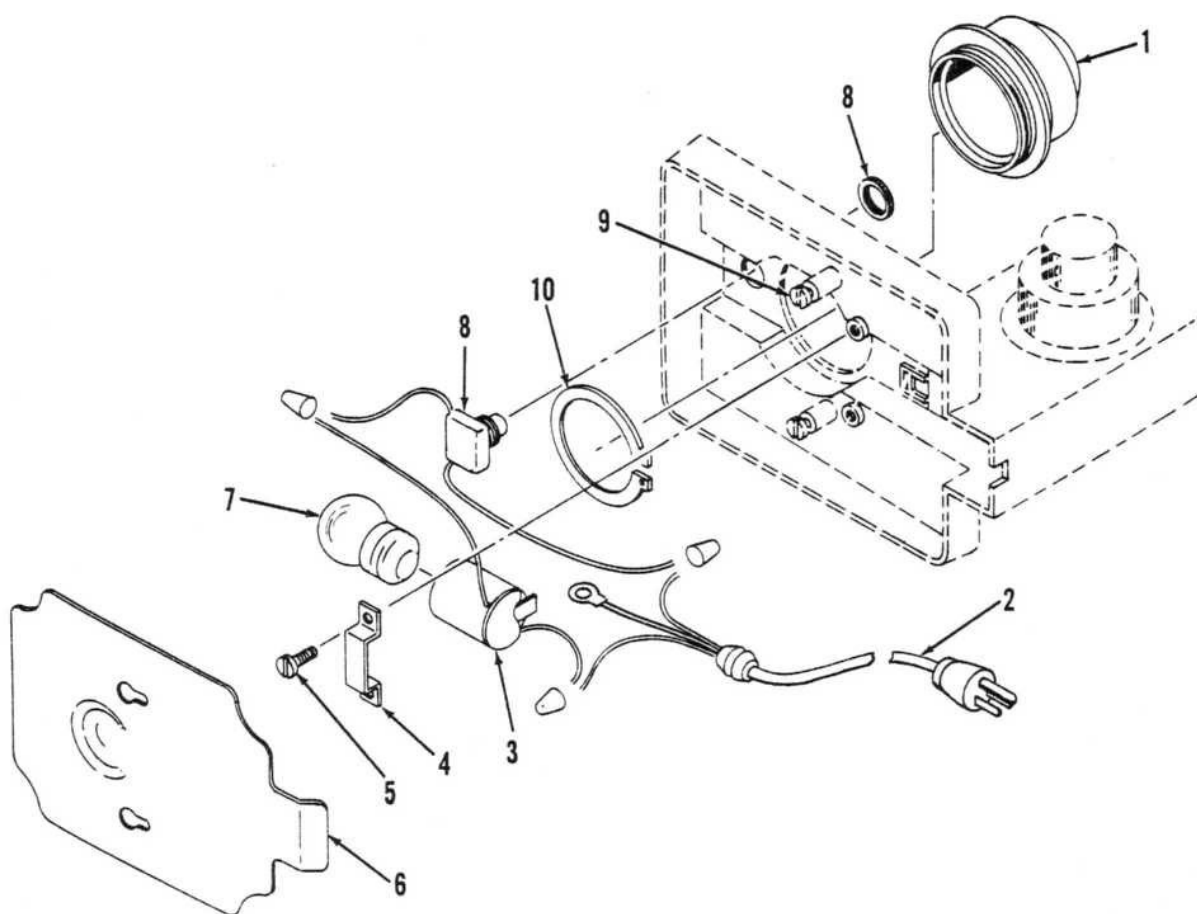
Index No.	Part No.	Description	Qty
1	253-6	Spring, index	1
2	X-34590	Screw	2
3	60-41	Rod, bearing	4
4	60-32	Nut, taper	2
5	60-410	Spring	1
6	60-42	Bearing, sleeve	1
7	X-51578	Screw	2
8	63-39	Screw, rod	2
9	B-11040-339	Bearing, ball	8
10	60-29	Retainer, bearing	2
11	32-69	Pin, roll	2
12	60-385	Nosepiece, upper	1
13	X-738-2	Screw	2
14	60-36	Race, ball, inner	2
15	60-45	Race, ball, outer	2
16	60-40	Spacer, bearing	1
17	B35-14	Bearing, ball	10
18	B-3801-59	Ring, Truarc	1
19	60-53	Washer, retaining	2
20	60-54	Spacer, nylon	1
21	60-44	Retainer	1
22	60-20	Screw	2
23	32-46	Nosepiece, bottom, triple	1
24	60-142	Pin, nosepiece axle	1
25	X-10014	Pin	2
26	63-41	Rod Bearings	4
27	60-377	Ball	8

FIGURE 21

X. ILLUMINATOR

Servicing the illuminators is simply a matter of replacing worn parts. Figures 22 and 23 provide an illustrated parts layout and a parts list. The following list indicates obvious conditions that can result in illumination problems. Adjustments and alignments on the illuminator system are not required.

1. Bulbs - contacts clean, fingerprints on bulb envelope
2. Socket contacts - clean, electrical fatigue
3. Wire leads - frayed, broken insulation, discolored
4. Switches - continuity (use ohm meter)
5. Transformer - input 115 VAC (use volt meter); output 6 VAC



Illuminator Assembly

Index No.	Part No.	Description	Qty
	Cat. No. 614A	Illuminator Assembly	
1	632-852	Condensing Lens Assembly	1
2	X-53031	Cord Set	
3	632-1	Socket, lamp	1
4	60-389	Bracket, socket	1
5	X-30764-2	Screw	2
6	60-390	Cover Plate	1
7	611	Lamp, 15W, 115V (mfrs. designation 15S11/102)	1
8	632-2	Switch, pushbutton	1
9	X-30765-2	Screw	2
10	632-6	Retaining Ring	1
	Cat. No. 613	Lamp, 15W, 230V (mfrs. designation 15S11/101 with medium screw base)	1

FIGURE 22

MODEL 623 IN-BASE ILLUMINATOR, WITH BUILT-IN TRANSFORMER

This Low-Voltage Illuminator equipped with Continuously Variable Transformer is available for use with Series One-Fifty Binocular Models only, for situations requiring greater light intensity.

Model 623 consists of: No. 623-854 Transformer, Power Cord, Variable Voltage Control and Ceramic Socket Assembly; No. 623-18 Socket Mounting Plate; No. 623-24 Intensity Indicator Plate; No. 623-25 Transformer Control Knob; No. 623-856 Condensing Lens Assembly; No. 623-14 Base Cover Plate; No. 624 Lamp (Philips 7387) and eight screws.

If you order a Series L150 Microscope the 623 Illuminator will be installed at the factory. If the illuminator is purchased separately it must be installed as follows:

1. Carefully place microscope on its side and remove cover plate. Remove existing mirror or illuminator.
2. Insert strain relief of power cord into slot at rear of microscope base.
3. Use the two shorter self-threading screws (supplied) to attach the transformer to the two lugs located on the under side of microscope base closest to the rear of base.
4. Attach ceramic socket to socket mounting plate using the two short straight screws supplied.
5. Insert condensing lens assembly into top of microscope base. **BE SURE RECESSED SHOULDERS ARE PARALLEL WITH FRONT END OF BASE.** Attach socket mounting plate to lens housing using the two long straight screws supplied. Make sure the intensity control wires run under mounting plate.

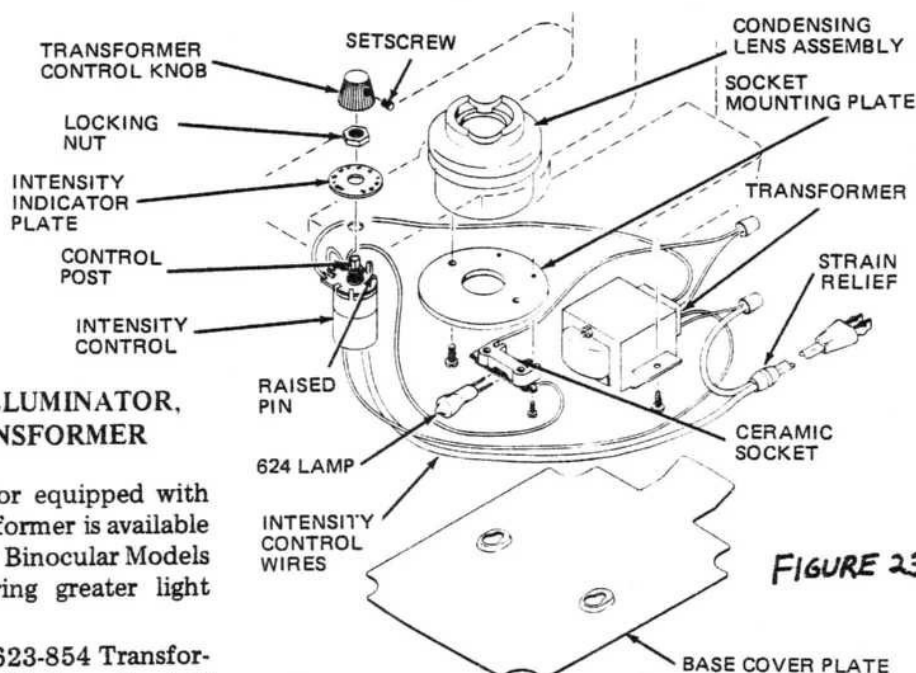


FIGURE 23

6. The combination "on-off" switch and variable intensity control is mounted in the small hole at top front of microscope base. Remove locking nut from control assembly and mount switch from under side of base making sure the raised pin on switch housing is placed into the positioning hole. The intensity indicator plate is backed with cement that is activated by adding a few drops of solvent such as acetone or xylene. Attach indicator plate with "OFF" towards front of microscope base and in line with the center of control post. Re-attach locking nut to hold switch in place.
7. Rotate switch control post clockwise so the flat side of post is facing front of microscope base.
8. Attach transformer control knob so that setscrew faces flat side of post. Tighten setscrew. Rotate control knob counter-clockwise as far as possible. This is the "OFF" position.
9. Insert No. 624 tungsten halogen lamp 6V, 10 watt (Philips No. 7387) into socket and attach base cover plate.
10. Plug directly into any standard 115 volt, 60 Hz AC outlet.

When operating illuminator the control knob should be set at the most comfortable viewing level. Settings of 1 through 10 are provided.

XI. BODY

Microscope bodies should not be disassembled. Special fixtures, tools and techniques are required to service this critical part of the instrument.

Reconditioned exchange bodies are available from all AO Technical Service Centers.

Exterior lens surfaces can be inspected and cleaned using the same material and techniques described in Section I.

Remove the eyepieces, then the body from the stand following the assembly instructions given in the reference manual that is packaged with the Microscope. Exercise care in handling the body after detaching from the stand. Sudden shocks, such as dropping the unit, can damage mirrors or prisms and disturb critical optical alignments.

A performance evaluation can be determined by substituting another Microscope body and comparing the image quality while observing a detailed specimen slide.

XII. PREVENTATIVE MAINTENANCE CHECK LIST

A. Coarse Adjustment

1. Definite stop each end _____
2. About 3/4 turn - total travel _____
3. Feel - tight, loose, gritty _____
4. Other _____

B. Fine Adjustment

1. Definite stop each end _____
2. 6 1/3 total turns _____
3. Clutch slippage _____
4. Feel - tight, loose, gritty _____
5. Lost motion _____
6. Other _____

C. Mechanical Stage

1. Feel - tight, loose, lost motion _____
2. Full travel side to side and forward to back _____
3. Ability of stage fingers to hold slide _____
4. Height of stage fingers above stage surface _____
5. Other _____

D. Stage Plate

1. Mounting - loose _____
2. Tilted - visual _____
3. Other _____

E. Autofocus Setting

Focus using stage micrometer, 1054 eyepiece and 45X objective
with CA and FA down. _____

F. Nosepiece

Index - Detent the 10X objective from left side, then from right side.

G. Parcentration Of Objectives

When checking parcentering, after reading has been taken, recenter slide to original center.

1. 10X to 45X
 2. 10X to 4X
 3. 43X to 100X
-
-
-

H. Parfocality Of Objectives

Condenser diaphragm fully open. Focus on stage micrometer scale with lowest power objective. Rotate nosepiece to next highest power objective.

Specifications: Separation of scale lines should still be apparent. Refocus and rotate to the next highest power objective.

1. 4X to 10X
 2. 10X to 45X
 3. 45X to 100X
-
-
-

I. Substage Condenser

Using a 10X eyepiece, or pinhole eyepiece, and 4X objective, close the condenser diaphragm completely. Lower the condenser until the diaphragm outline is visible in the field of view. Continue to lower the condenser until one side of the diaphragm touches the edge of the field of view. A perfectly centered diaphragm will be concentric with the field of view.

K. Binocular Body

1. Parcentration of eyetubes
 2. PD adjustment function
 3. Other
-
-
-

L. Miscellaneous

1. Optics - dirty or damaged

2. Illuminator

3. Eyepiece

4. Other
