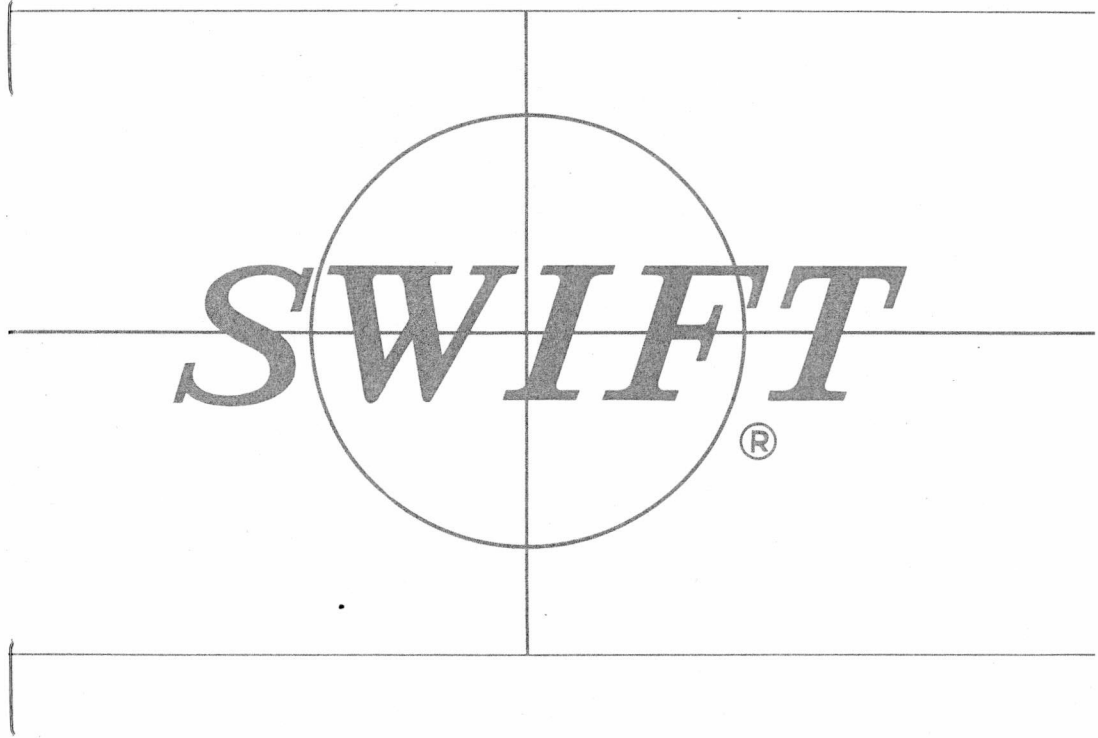


USE AND CARE OF SWIFT SERIES M970  
MICROSCOPE



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## USE AND CARE OF SWIFT SERIES M970

### MICROSCOPE

Your Swift microscope, Series M970 (with inclinable frame) is an instrument of precision, both optically and mechanically, and will last a lifetime with a minimum of maintenance. It is built to the highest and most rigid optical and mechanical standards, and has many built-in features to insure durability and high performance. It is designed to withstand the rigors of daily classroom and laboratory use with only normal care.

### UNPACKING

If your M970 was ordered without case, it will be in a molded styrofoam container. Lay the container on its side, remove the tape from its perimeter and carefully lift the top half of the container. The objectives will be found within individual plastic vials.

Install the objectives into the microscope's revolving nosepiece from the lowest magnification to the highest, in a clockwise direction from the rear.

Familiarize yourself with the components and terminology of the microscope.

- Base — This is the rectangular shaped part that rests on the table and supports the instrument.
- Stage — The table of the microscope where the slide or specimen is placed.
- Condenser — The optical lens built on or below the center of the stage.
- Body — The part between the upper optical element and the lower.
- Arm — The frame that supports all components above the base.
- Objective — The optical system which does the initial magnifying to form the primary image.
- Nosepiece — The revolver which carries the objectives.
- Eyepiece — The upper optical component that further magnifies the primary image and brings the light rays to a focus at the eyepoint and forms the final image.

## THE COMPONENTS

**EYEPICE**—Most models in the M970 series are equipped with the 10x widefield eyepiece. Because of the extremely wide field of view and a much higher eyepoint than the 10x Huygenian eyepiece, this ocular enables even those with thick eyeglasses to view the specimen with ease. The widefield eyepiece has a built-in pointer, and is designed to accept a variety of measuring and counting accessories. The lenses are highly corrected and coated to reduce glare and reflection.

**OBJECTIVES**—The objectives are of the research type, with large numerical aperture (N.A.) to permit maximum resolution. All objectives are achromatic, color coded and parfocalized to each other. The 40x (high dry) objective is in a retractable mount to eliminate the possibility of accidental breakage of either the slide or the front lens of the objective. All lenses are hard coated for maximum resolution and produce an excellent flat field.

**DISC DIAPHRAGM**—The round disc beneath the stage. It has circular openings positioned at various points, and may be rotated to align any one of the apertures with the optical path.

**COARSE FOCUS**—The body is moved by a diagonally cut rack and pinion. The rack is plated brass and the pinion is of steel and they do not require lubrication.

**FINE FOCUS**—The fine focus is of the taper-roller type with a micrometer screw. It is operated from either side of the arm. This fine adjustment has an long range of travel for ease of operation.

**CONDENSER**—The built in condenser has a numerical aperture of 0.65 which is matched to the high dry objective. To insure maximum resolution, the condenser must always have a numerical aperture equal to or greater than the objective in use.

**NOTE:** Should the user wish to use part MA305-100x oil immersion objective with N.A. 1.25-the stage plate with built in condenser, part MA2206\* should be replaced by part MA2207 with condenser, N.A. 1.25 with iris diaphragm. The part MA889 graduated mechanical stage is highly recommended.

**RESOLUTION, OR RESOLVING POWER**—This is the ability of an objective to separate two lines without the two lines merging or blurring. Resolving power is computed at 1000 times the numerical aperture (N.A.) of the objective, thus the 40x objective with N.A. 0.65 has a maximum resolving power of 650 times the size of the specimen. If the resolving power of an objective is exceeded, the resulting magnification is termed "empty magnification", which is enlargement without revealing additional features or characteristics of the specimen. A "high dry" objective of less than an N.A. of 0.65 cannot produce an image equal in clarity (definition) and brightness to one of 0.65 N.A.

## USING YOUR SWIFT SERIES M970 MICROSCOPE

After securing the slide into position with the stage clips, turn to the lowest power objective. The disc diaphragm should be turned to align the largest opening with the condenser, and the mirror adjusted to direct the light into the optical path.

(NOTE: The use of a mirror to provide illumination is not efficient. Daylight, especially in the classroom, is not easily controlled, therefore the light obtained may vary considerably. On the Series M970, the SWIFT MA25 substage illuminator is recommended to provide a constant, even dispersion of light to the optical system.)

While looking in the eyepiece, focus down on the specimen until the image is sharp and clear. The 4x objective has a long working depth, so focus is done with ease at this power. The specimen may be centered to the field at this point, and the nosepiece rotated to the higher magnifying objectives. The objectives are parfocalized so that once the 4x objective is focused, only a slight turn of the fine focus knob is required in changing to the 10x and 40x objective.

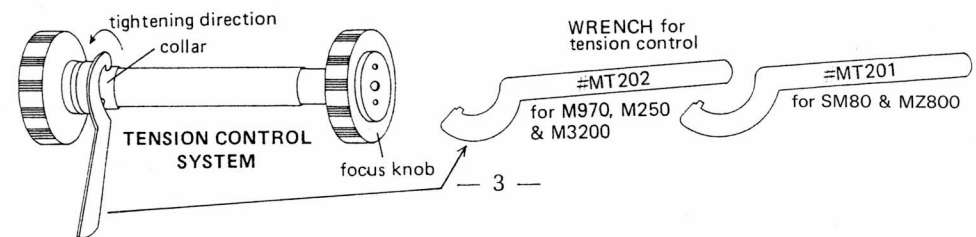
Note that should the objective be brought into contact with the slide, no damage will result, since the 40x objective is in a retractable mount. It is impossible for the 4x or 10x objectives to contact the slide.

**USE OF THE DIAPHRAGM**—The disc diaphragm is not intended to control the brightness of the illumination. The SWIFT MA25 is designed for the M970 series, and the intensity of the illumination is computed to be adequate for general use. The purpose of the disc diaphragm is to control the angle of the light rays. Smaller apertures increase contrast and larger ones will decrease contrast. A good procedure in selecting the proper aperture is to start with the largest, and reduce until the fine details of the specimen are imaged sharply.

Care must be exercised not to reduce the aperture too much to gain high contrast, as then the fine structure of the image will be destroyed. Reducing the aperture does increase contrast and depth of focus, but it also reduces resolution and introduces diffraction. The aperture must be selected for each objective, i.e., the aperture for the 10x (N.A. 0.25) will not be the same for the 40x (N.A. 0.65), since the angle of the light required is determined by the numerical aperture of the objective. Proper selection of the diaphragm aperture is easily determined after a little experience with the microscope.

### TENSION CONTROL OF FOCUSING MOVEMENT

Illustrated below is the way to adjust the tension of the focusing movement, using C Wrench (MT 202) enclosed with the microscope.



## SWIFT QUODLIBET SYSTEM OF PHASE CONTRAST MICROSCOPY

The Quodlibet system of phase contrast offers techniques in a form simple enough for even the newest science student, yet with phase contrasted results comparable to instruments costing many times more.

The Swift Quodlibet Phase set, part MA318, may be ordered as a complete microscope or added to your M970 series microscope that is presently equipped with a disc diaphragm.

### HOW TO USE YOUR SWIFT QUODLIBET MICROSCOPE

You will note the 10x and 40x objectives are designated "Phase". This means phase contrast may be achieved with these two objectives, while the 4x objective remains brightfield only.

Look at the disc diaphragm, found attached to the underside of the stage plate. Note the openings (called apertures) in the disc, and the green phase annulus mounted in a green cylindrical mount. Phase contrast is achieved by rotating the disc to position the green annulus under the condensing lens in the stage plate.

With the annulus positioned thus, the 10x and 40x will produce a fine, phase contrast image of the specimen.

Your Swift Quodlibet will also function as a normal, brightfield microscope. Simply rotate the disc diaphragm to any other position, which removes the phase annulus from the path of light, and your 10x and 40x phase objectives will perform as normal brightfield objectives.

Another feature of your Swift Quodlibet is evident when the disc diaphragm is rotated to position the phase annulus under the condensing lens in the stage, and the low power 4x objective is positioned for viewing. In this manner, the specimen is viewed brightly illuminated against a dark background. This is actually low powered darkfield microscopy.

### WHAT IS PHASE CONTRAST ?

Phase contrast is literally "optical" staining of the specimen, rather than physical. Phase contrast is achieved by passing light from the illuminator through a phase annulus which is attached to the disc diaphragm of your SWIFT QUODLIBET microscope, which separates the central and outer beams. These light rays consist of undeviated

central rays and deviated diffracted rays. The diffracted rays are a quarter wave ( $1/4\lambda$ ) behind the central rays. After passing through the phase ring at the back focal plane of the objective the central rays are retarded ( $1/4\lambda$ ) and are reduced in intensity. The central rays are now in phase with the diffracted rays. These rays when brought to a focus at the eyepiece produce a well contrasted image of the specimen.

### THE SWIFT MA25 ILLUMINATOR FOR SERIES M970 MICROSCOPES

If your microscope is fitted with a mirror in fork mount, the illuminator may be installed to replace this mirror from the mounting stud in which the mirror-fork is inserted. This will expose the hole in the microscope stage support, and the illuminator may now be installed.

**NOTE:** To order Illuminator MA25 specify the serial number of the microscope on which the illuminator will be used.

### CARE OF THE SWIFT SERIES M970 MICROSCOPE

The Series M970 is designed to require only a minimum of maintenance and has many features to prevent accidents common to the "student" microscope. Loss of stage clips is eliminated since these are secured to the stage by allen socket capscrews. Mirrors and forks are also secured in a similar manner. Gear damage is eliminated by internal devices which prevent the rack and pinion from being disengaged. Overfocusing is prevented by a unique clutch system activated at upper and lower limits of travel. This is a special feature of SWIFT teaching microscopes and is covered under U.S.A patent #3451739.

Tension of the focusing movement is controlled by a tension system found on the pinion metal of the rapid focus control. This is adjusted only by a special tool, Swift Cat. No. MT202. Unauthorized persons are cautioned against tampering with this device.

**Cleaning:** The front lens of the objectives, particularly the 40x, should be cleaned after using by first brushing with a soft camel-hair brush to remove particles of dust, then wiping gently with soft lens tissue moistened (not soaked) with Xylol, and dried with clean lens paper immediately. The objectives should never be taken apart except by a qualified Swift serviceman. Should dust be observed on the back lens of the objective, an all-rubber ear syringe may be utilized to blow the dust out.

The eyepieces may be cleaned in the same manner as the objectives, except in most cases Xylol will not be required. In most instances breathing on the lens to moisten it, then wiping dry with clean lens tissue will be sufficient to clean the surface.

The finish of the microscope is hard epoxy and is resistant to

acids and reagents. Clean this surface with a damp cloth and mild detergent.

**Mechanical Parts:** Mechanical parts are mostly concealed from the outside. Microscopes should be serviced by a qualified serviceman periodically to remove contaminants from the moving surfaces. These surfaces should then be relubricated using only those lubricants recommended by Swift.

Swift microscopes are covered by the most liberal warranty available and your authorized Swift dealer has all the necessary data to insure fast, efficient service. Swift Instruments, Inc. stands ready to assist you at any time and your inquiries are invited. Your Swift Series M970 microscope is a highly versatile instrument and many accessories are available to further enhance its use.

You will note the exploded view of M970 Series in this manual. Each part is numbered and named on the reverse side. If the occasion should arise where it becomes necessary to order a part, specify the model of your microscope, its serial number, the number of the part and its name. Complete parts are available through authorized Swift dealers or direct from the factory.

Cover instrument with dust cover when not in use.

### IMPORTANT MICROSCOPICAL TERMS

**COMPOUND MICROSCOPE**—A microscope having a primary magnifier (the objective) and a secondary (the eyepiece) to further magnify the image, and bring the light rays to a focal point (the eyes).

**ACHROMATIC OBJECTIVE**—An optical system corrected for two colors chromatically and one color (yellow-green) spherically.

**APERTURE, ANGULAR**—The angle (or cone) of light rays capable of entering the front lens of the objective from a point in the object. By increasing the angular aperture of an objective more light rays from the specimen can be taken in by the lens, hence the resolving power is increased.

**APERTURE, NUMERICAL (N. A.)**—A mathematical formula devised by Ernst Abbe for the direct comparison of dry and all types of immersion objectives for resolving power. Numerical aperture (N. A.) is the sine of half the angular aperture of the objective multiplied by the refractive index of the medium between the front lens and the cover glass. N. A. ranges of the Series M970 objectives are 0.10 (4x), 0.25 (10x) and 0.65 (40x). These are research type objectives and have a larger N. A. than most competitive objectives in the Teaching microscope field, finally, N. A. 1.25 must be used for 100x oil objective.

**CONDENSER** — A lens or system of lenses to collect light rays and converge them to a focus. The series M970 has a condenser built into the stage. The N. A. of the condenser is 0.65, matched to the highest power objective. N. A. 1.25 for use with up to 100x objective, (oil immersion).

**COVER GLASS**—Thin glass cut in circles, rectangles or squares, for covering the specimen, usually a thickness of 0.17 to 0.18mm. The majority of specimens should be covered by a cover glass, and a necessity for the 40x lens, not to exceed 0.20 mm.

**DEPTH OF FOCUS**—The ability of a lens to furnish a distinct image above and below the focal plane. Depth of focus decreases with the increase of numerical aperture or with the increase of magnification.

**EYEPIECE**—The lens system near the eye which magnifies the primary image of the objective so as to form a virtual image 10" away from the eyepoint.

**FIELD**—The area of the object that is seen when the image is observed. It may range in diameter from several millimeters to less than 0.1mm. Also the size of the diaphragm opening in the eyepiece governs the diameter of the field of view.

**FOCAL LENGTH**—Parallel rays of light after refraction through a lens will be brought to a focus at the focal point. The distance from the optical center of the lens to the focal point is the focal length or focus.

**OBJECTIVE**—The lens system near the object which forms the primary image.

**PARFOCAL**—A term applied to objectives and eyepieces when practically no change in focus has to be made when one power is substituted for another. The objectives on your SWIFT Series M970 are parfocalized at the factory so that only a slight turn of the fine adjustment is required when a change is made from a lower to a higher power.

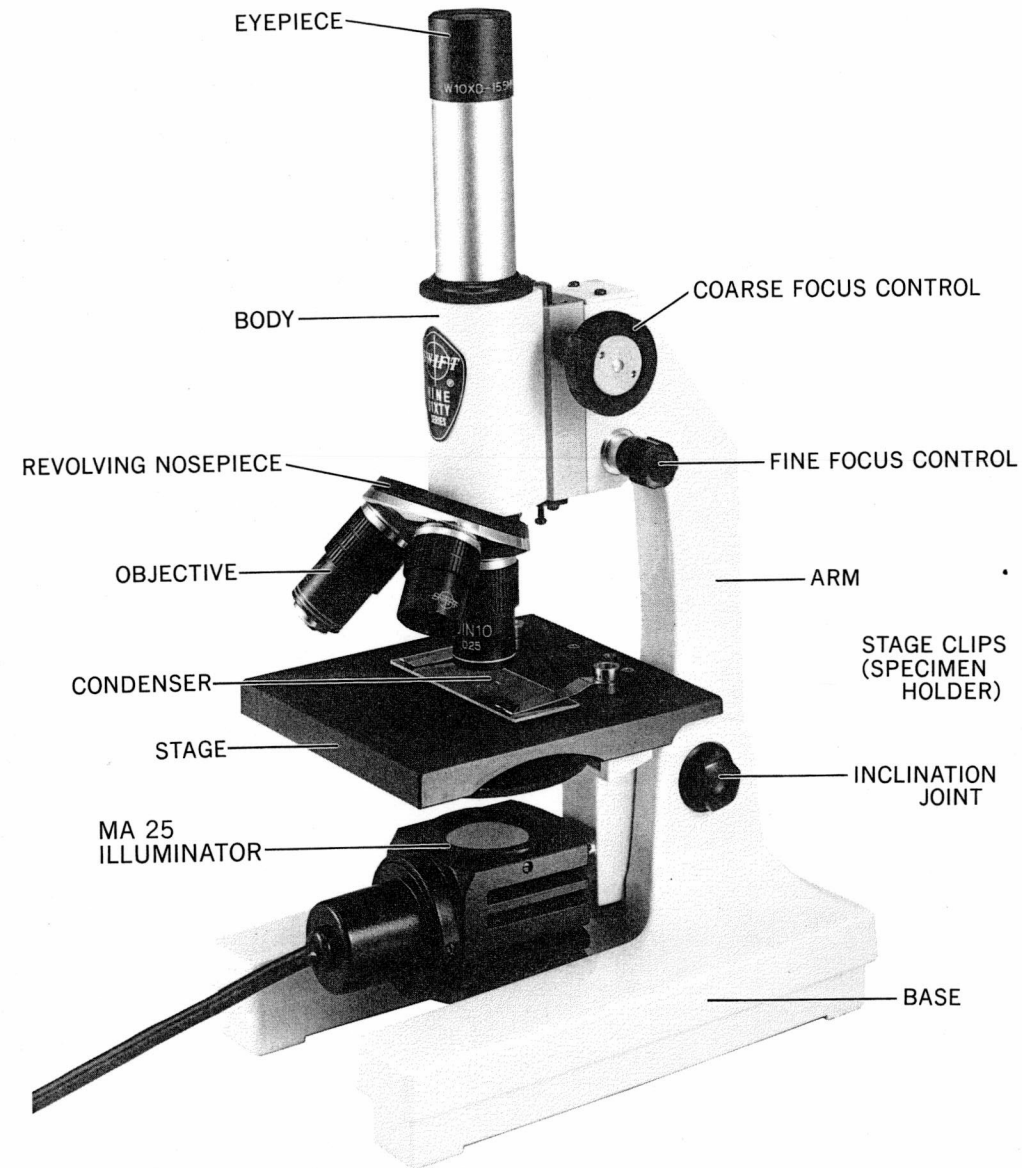
**RESOLVING POWER**—The ability of a lens to clearly separate fine detail. Resolving power is directly proportional to the numerical aperture of the objective. Also the shorter the wavelength of the light used, the greater the resolving power of the optical system.

**WIDEFIELD EYEPIECE**—An ocular with an achromatic doublet for the eye lens and with the plane side of the lower lens nearest the objective. Such a corrected system does not have to be stopped down with a diaphragm, hence a large flat field is insured,

**WORKING DISTANCE**—The distance between the front lens of the objective and the cover glass when the lens is focused on the specimen.

Inquiries regarding the M970 Series or other Swift products should be directed to your authorized Swift dealer or: Swift Instruments, Inc. 1190 North Fourth Street, San Jose, CA 95112.

## PARTS LIST

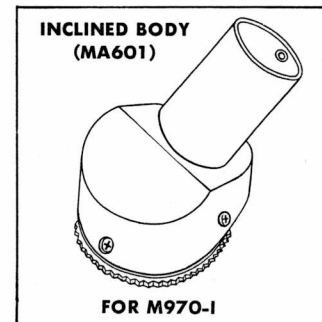
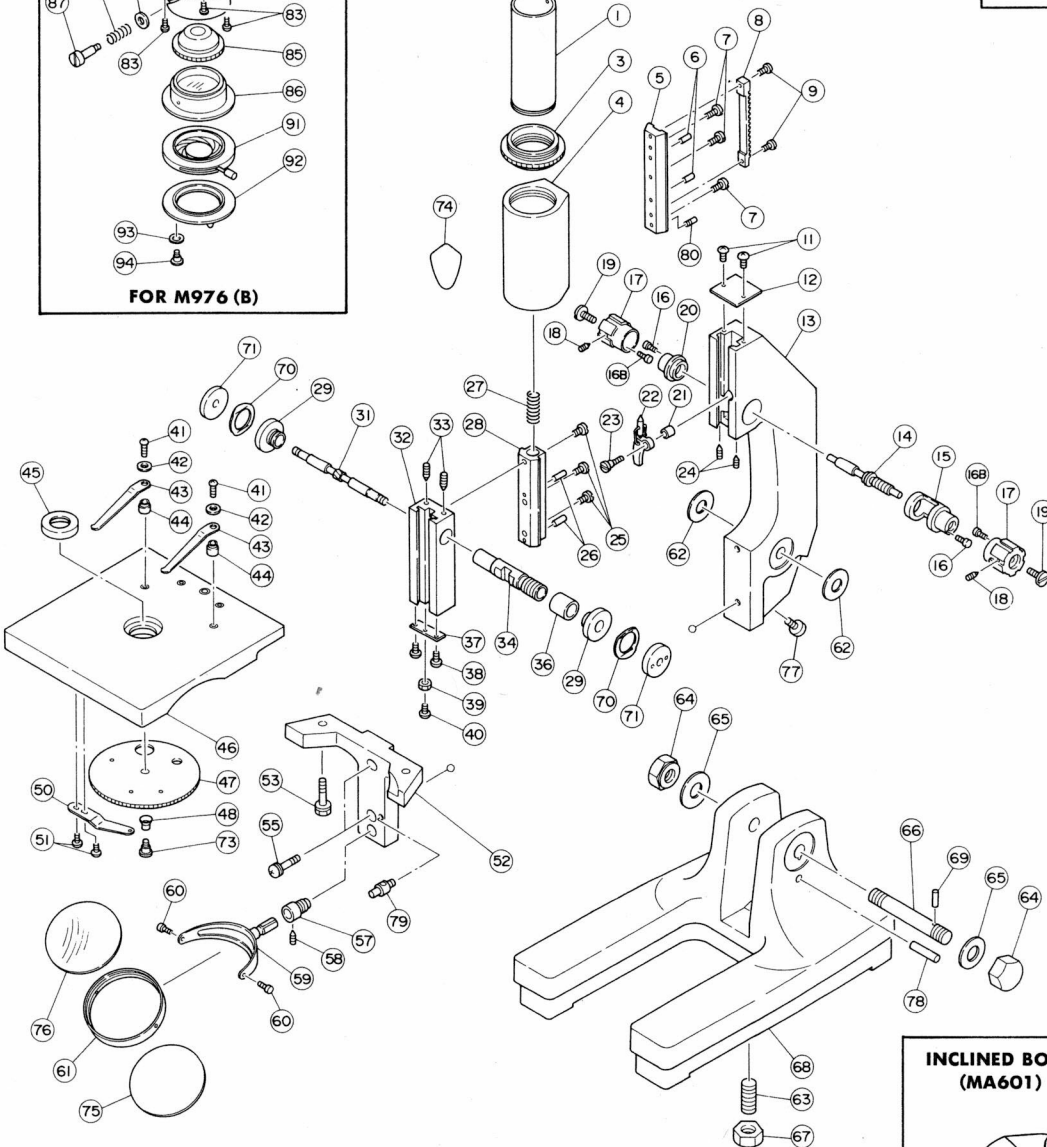
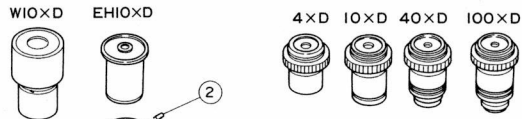
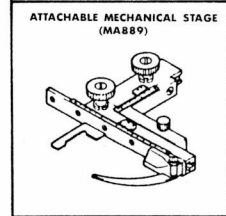
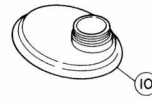
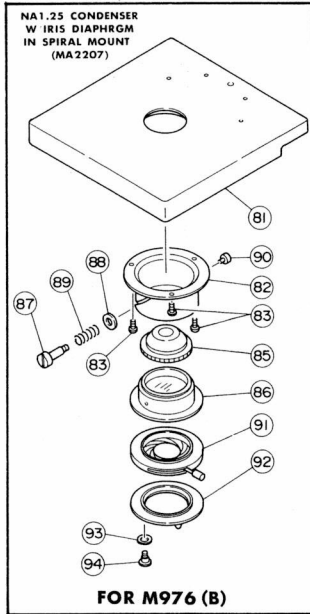


Parts Number	Description	Parts Number	Description
1	Eyepiece Tube	26	P.n, Locator
2	Screw	27	Spring, Coil
3	Flange, Tube	28	Spring Case
4	Main Tube	29	Knob, Coarse Adj.
5	Rack Guide	31	Shart, Coarse Adj., Steel
6	Pin Locator	32	Coarse Adj. Block
7	Screw	33	Screw
8	Rack, Brass	34	Bushing, Coarse Adj., Steel
9	Screw	36	Ring, Tension Adj.
11	Screw	37	Plate, End
12	Cover Plate	38	Screw
13	Arm	39	Washer
14	Shaft, Fine Adj.	40	Screw
15	Bushing, Steel	41	Screw
16	Screw	42	Washer
16B	Screw	43	Stage Clip
18	Screw	44	Collar
19	Screw	45	Condenser, N.A. 0.65
20	Bushing, Fine Adj., Steel	46	Stage Plate
21	Coupling	47	Disc
22	Spring, Connector	48	Screw
23	Screw	50	Spring, Disc Stop
24	Screw	51	Screw
25	Screw		

## PARTS LIST

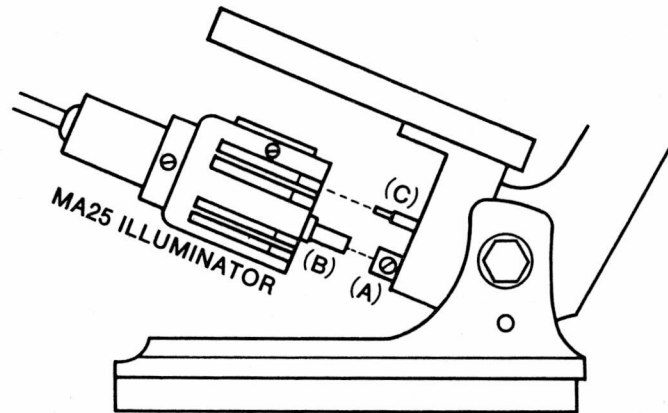
Parts Number	Description	Parts Number	Description
52	Holder, Stage Bracket	80	Pin, Locator
53	Screw	81	Stage Plate
55	Screw	82	Condenser Frame
57	Bushing, Mirror Attach	83	Screw
58	Screw	85	Condenser 1.25
59	Mirror Fork	86	Condenser Lens
60	Screw		Assem.
61	Mirror Frame	87	Screw
62	Washer	88	Washer
63	Screw	89	Spring
64	Nut	90	Screw
65	Washer	91	Iris Diaphragm
66	Shaft, Incl. Joint	92	Filter Holder
67	Nut	93	Washer
68	Base, Horseshoe	94	Screw
69	Pin		
70	Spring Washer		
71	Knob		
73	Screw		
74	Marking Plate		
75	Mirror Ret. Ring		
76	Mirror		
77	Screw		
78	Pin, Stop		
79	Screw		

# MODEL M970 SERIES





HOW TO INSTALL MA25 ILLUMINATOR TO M970 MICROSCOPE



1. Loosen screw A on the bushing slightly.
2. Carefully insert the stud B on MA25 illuminator in the opening of the bushing, aligning the guide pin C with the groove on the illuminator. When the stud goes into the bushing all the way, tighten the screw A firmly ..... Now the illuminator is secured and is ready to use.

# SWIFT INSTRUMENTS, INC.

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