SECTION I

GENERAL DESCRIPTION

1.1 INTRODUCTION

This manual provides information required for installation, operation and maintenance of the Tamarack Model 165R.

The manual is divided into five sections. This section contains general information. Section II contains installation information and procedures. Section III contains operating information and procedures. Section IV contains set-up and adjustment information and procedures. Section V contains maintenance information and procedures.

1.2 OVERALL EQUIPMENT DESCRIPTION

Major components of the 165R as are follows:

a) Alignment/Exposure Station
b) Collimated Illuminator
c) TV System
d) Pnuematic Regulators and Valves

The alignment/exposure station holds the mask and substrate. It provides the precise substrate positioning control required to align the substrate to the mask. It provides the planarization and gap control required to establish uniform gaps between the mask and the substrate for alignment and for the proximity mode of exposure.

The illuminator provides a collimated beam of ultra-violet light of uniform intensity for use in exposing the substrate. A shutter within the illuminator opens for a preset interval to accomplish each exposure.

The split screen TV system provides the means of simultaneously viewing two mask fiducials and the associated substrate fiducials at a magnification factor of 60X during the substrate alignment. It is slide mounted so that is is easily moved clear of the alignment/exposure station after each sub-

strate alignment has been completed.

An adjustable pneumatic regulator controls the exposure gap dimensions by controlling the air pressure to the gappers. Pneumatic toggle valves control vacuum to vacuum chucks and air pressure to the gappers.

The major components of the 165R are described in more detail in the paragraphs which follow.

1.3 ALIGNMENT/EXPOSURE STATION (Figure 1-1)

The alignment/exposure station provides the facilities for aligning the substrate with respect to the mask and for providing the required proximity gap between the mask and the substrate during exposure. Functions performed by alignment/exposure station components include the following:

a) holding of the mask and substrate by vacuum chucks;
b) planarization of the mask to the substrate and establishment of a uniform gap between the mask and substrate to allow the substrate motion required during alignment;
c) precise, operator controlled linear and/or rotational motion of the substrate so as to align it with respect to the mask;
d) for proximity mode exposure, establishment of the required exposure gap between the mask and the substrate.

The major components of the alignment/exposure station are:

a) the mask frame which holds the mask;
b) the frame raise arms used to support and raise the mask frame;
c) four proximity gappers which provide the means of lifting the mask off the substrate while at the same time maintaining parallelism between the mask and substrate;
d) the substrate vacuum chuck which holds the substrate;
e) the alignment stage which holds the substrate chuck and is moved to align the substrate with respect to the mask.

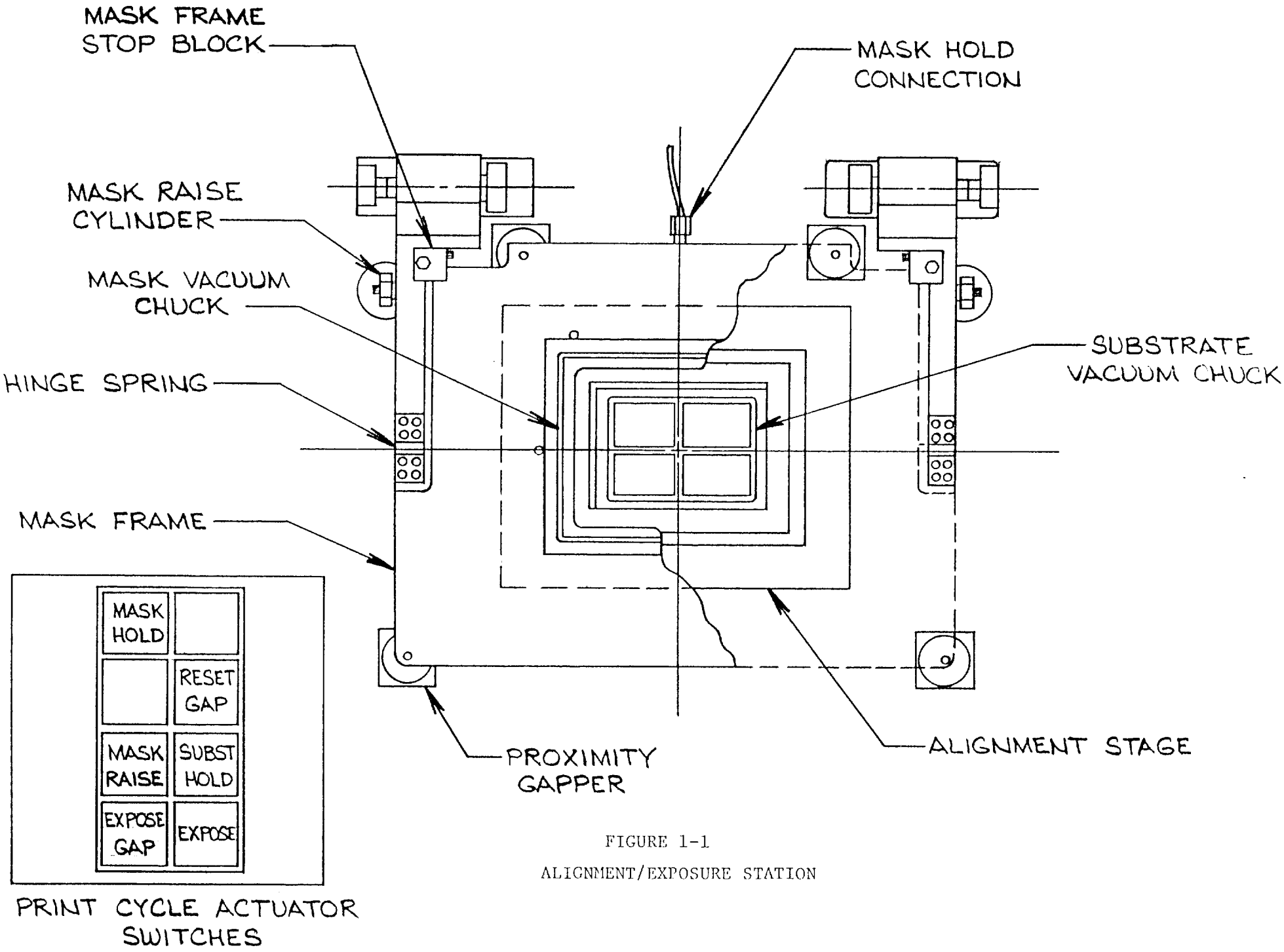

FIGURE 1-1

ALIGNMENT/EXPOSURE STATION

The mask is secured to the mask frame by a vacuum chuck which grasps the periphery of the mask. Three locating pins provide reference for correct positioning of the mask on the frame.

The mask frame is attached to beryllium-copper leaf springs on the frame arms. The spring flexibility and the independent motion of the frame arms with respect to each other create the two degrees of freedom required to allow planarization of the mask to the substrate. The frame arms are raised under pneumatic control to separate the mask frame and substrate chuck during installation of the mask and substrate. Mask frames are available in different sizes which can be quickly interchanged on the frame arms.

Planarization of the mask to the substrate establishes parallelism between the bottom face of the mask and the top face of the substrate. This is accomplished under conditions of actual contact between these two faces. The mask frame is lowered until the mask rests on the substrate. As this occurs, pins move in the four gapper pistons so as to maintain contact with the mask frame. Thus, with the mask resting on the substrate, the pins are positioned as required to support the frame in the planarization orientation. When the expose gap toggle valve is turned on, air pressure locks the pins to the gapper pistons establishing a condition under which the four pins move up or down together so as to maintain the require orientation. Additional air pressure is then used to extend the gapper pistons so as to raise the mask off the frame. Within the operating range, the gap created between the mask and the substrate is a function of the air pressure applied to the gapper pistons. An adjustable regulator provides the means for presetting the required exposure gap.

Individual substrate vacuum chucks are designed to hold substrates of particular sizes and shapes. The substrate vacuum chuck is, itself, held in place on the alignment stage by vacuum. Thus, substrate vacuum chucks are easily interchanged. Alignment pins provide the reference for positioning a substrate vacuum chuck on the alignment stage.

1.4 COLLIMATED ILLUMINATOR (Figure 1-2)

The light source for the collimated illuminator is a high pressure mercury arc lamp mounted in a forced air cooled housing. Because of the explosion hazard associated with this type of light source, even if properly maintained, the housing is designed to contain and withstand lamp explosion.

The lamp is positioned at or above the first focus of an ellipsoidal reflector. Three thumbscrews provide the means of moving the lamp along the X, Y and Z axes in order to obtain tbe proper lamp position.

The ellipsoidal reflector directs the reflected light toward a distant second focus thus avoiding the possibility of lamp damage due to reflection of energy onto critical parts of the lamp. The ultra-violet light from the ellipsoidal reflector is turned twice to reach a second focus located at the lenticular integrator. The dichroic mirrors which turn the ultra-violet light pass most visible light and infra-red energy which are thus dissipated as heat within the lamphouse.

The lenticular integrator, located at the second focus of the ellipsoidal reflector collects the ultra-violet energy and directs it toward the collimating mirror in such a manner as to approximate a point source of light. The mirror collimates the light from the integrator so as to form a beam of light exhibiting less than $\pm$ 5% variation of intensity over its beamwidth.

Although the lenticular integrator approximates a point source, the physical aperture size does have an effect on collimation. This physical aperture size is determined by an aperture plate which is installed in a slot at the output of the integrator. Four aperture plates, associated with collimation half angles of 1°, 2°, 3° and 4° are supplied with the 165R. Of these, the 3° aperture plate has been found to provide the optimum results for most applications.

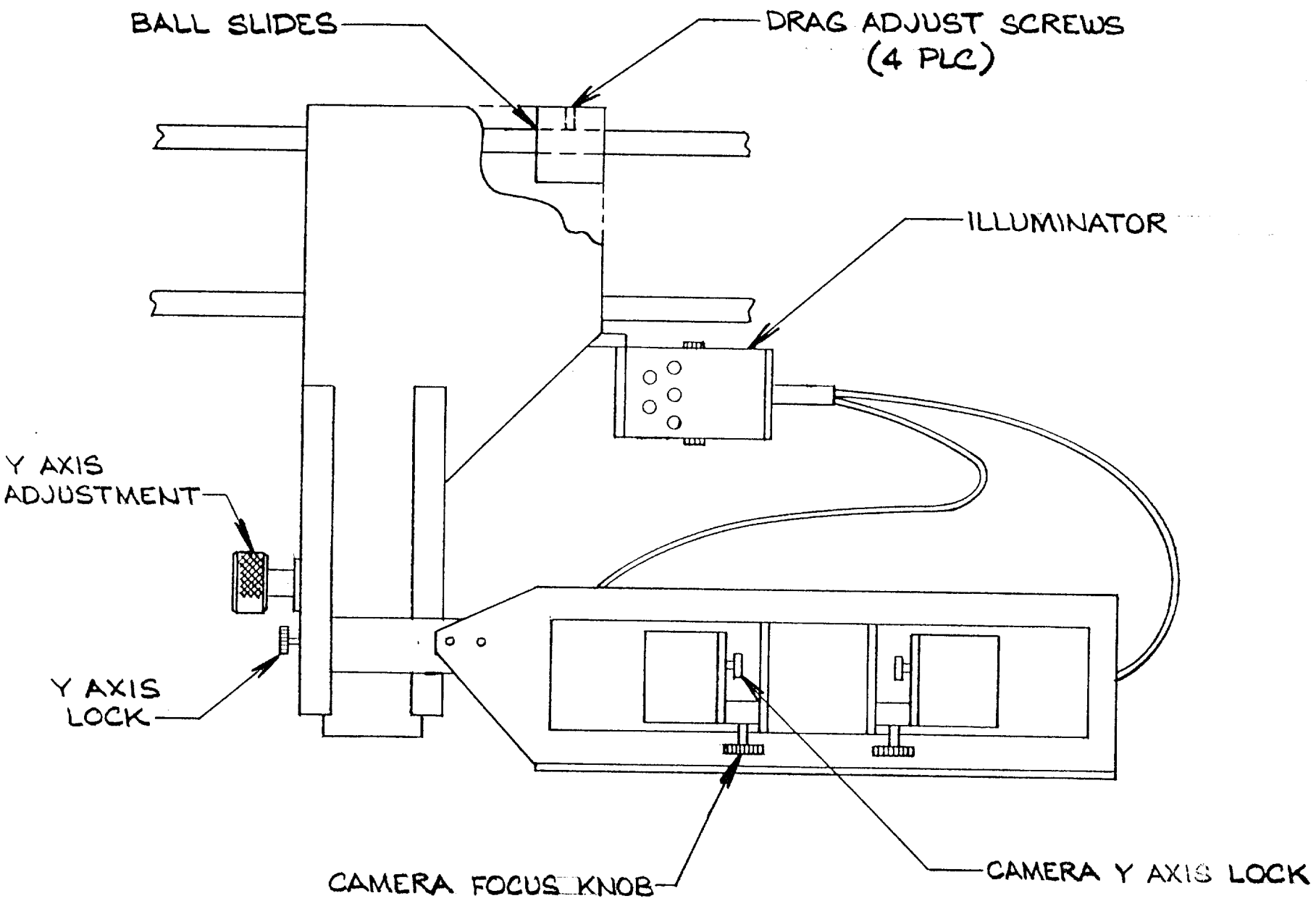

FIGURE 1-2

TV CAMERA SLIDE; TOP, PARTIAL CUTAWAY VIEW

Since the integrator and collimating mirror control the uniformity of the light beam, the intensity of illumination can be varied, without degredation of this uniformity, by adjusting the positon of the lamp with respect to the first focus of the ellipsoidal reflector. In practice, the lamp is moved upward away from the first focus of the ellipsoidal reflector. Moving the lamp downward has the effect of moving the focus of the reflected light closer to the lamp itself which could create hot spots that would degrade lamp life or cause explosive failure of the lamp.

The collimated illuminator employs either of two lamp housings depending upon the specified exposure illumination lamp wattage and any of three reflectors depending upon the specified beam sizes. The small Model 131 lamp housing is used with 200 and 350 watt lamps and the larger Model 156 lamp housing is used with 500 and 1000 watt lamps. PRX-9, PRX-12 and PRX-18 reflectors are used respectively for 8 inch, 11 inch and 17 inch beam diameters.

The shutter which controls substrate exposure is located just ahead of the lenticular integrator. An associated panel switch provides the means of holding this shutter open for the purpose of lamp intensity and focus adjustments and placing it under the control of the exposure timer during substrate processing.

1.5 SPLIT SCREEN TV SYSTEM (Figure 1-3)

The split screen TV system provides the means for viewing simultaneously two fiducials on the mask. The cameras are mounted on slides so that they can be moved clear of the alignment/exposure station after completion of each substrate alignment. In addition to the X axis motion along the slides, Y axis motion is provided under control of a rack and pinion adjustment. Theta adjustment can be implemented by Y axis motion of each camera. The spread between the objective lenses can be adjusted over the range from 30 mm to 250 mm. Focus adjustments for each camera provide the means of bringing the two fiducials into focus. Once the position, separation and focus adjustments have been set up to view simultaneously the two fiducials on the mask, operation of the TV system involves only moving it along the slides to the home position to clear the alignment/

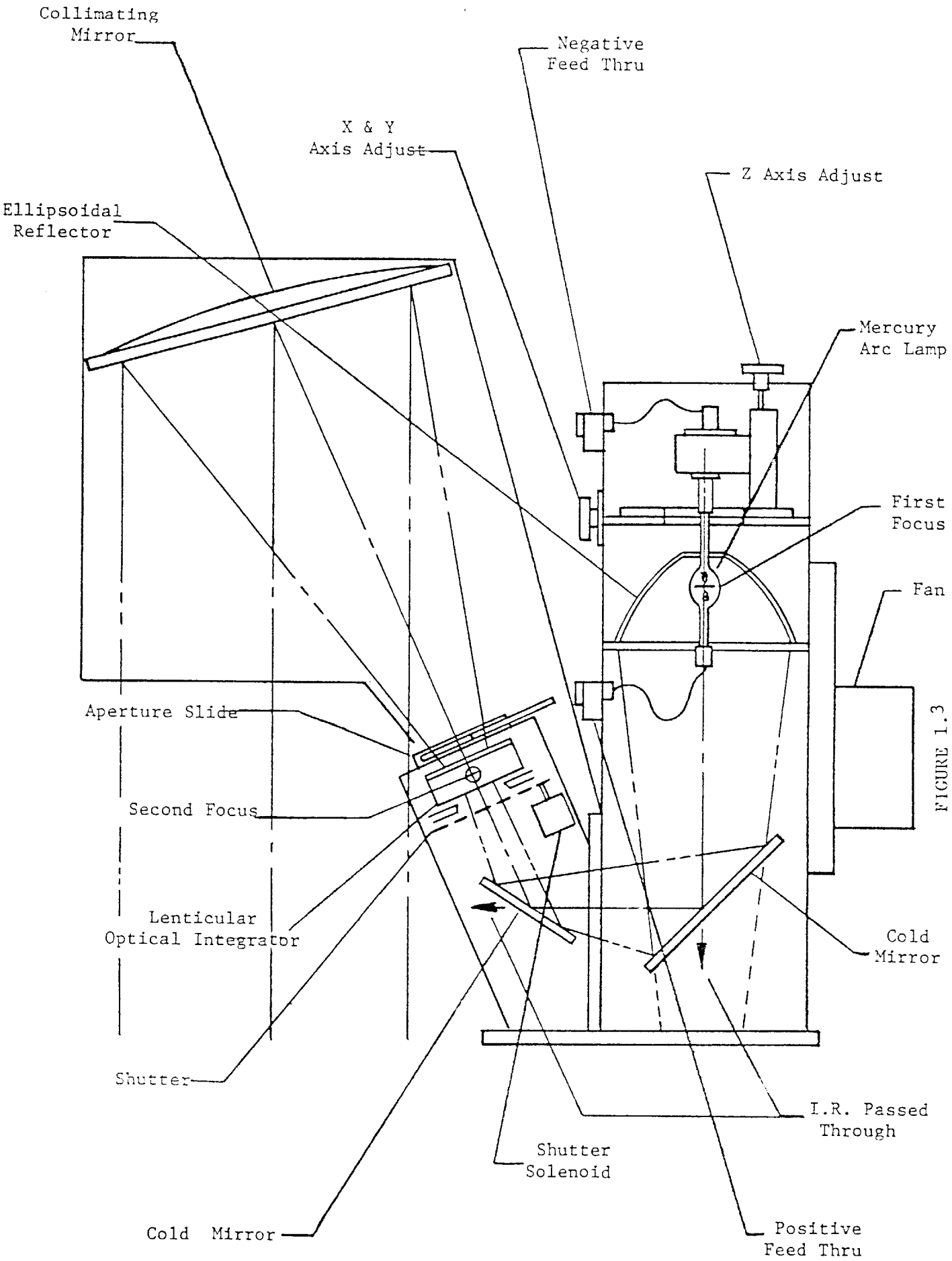

FIGURE 1-3

Collimated Illuminator: Right, Cutaway View

exposure station for each exposure and returning it to the view position for each substrate alignment.

The view illuminator source is a quartz halogen lamp housed at the back of the microscope platform together with an associated KG-3 heat absorbing filter and a green or yellow dielectric filter. Filtered light from this housing is directed through a fiber optic bundle whose output lines can be installed to provide dark field (ring light) illumination. The indirect illumination is particularly useful in connection with the alignment of ceramic substrates. A single panel control provides on-off control and intensity adjustments of the view illumination source.

1.6 PNEUMATIC REGULATORS AND VALVES

The mask hold and substrate hold toggle valves and the substrate chuck hold toggle valve vent house vacuum directly to the associated vacuum chuck channels.