DP -450

Instruments

AEC Research and Development Report

A REMOTELY CONTROLLED METALLOGRAPH - II

by

W. H. Leith

Laboratory Services Division

December 1959

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ABSTRACT

A Bausch and Lomb metallograph that had been adapted so that it could be operated remotely was modified further to facilitate its operation. The instrument has performed satisfactorily in the examination of highly radioactive materials behind the heavy shielding of a high level cell.

CONTENTS

LIST OF FIGURES

A REMOTELY CONTROLLED METALLOGRAPH - II

INTRODUCTION

A Bausch and Lomb metallograph that was modified so that it could be controlled remotely for the examination of highly radioactive material in a high level cell was described in report DP-99, "A Remotely Controlled Metallograph", by J. D. Ross, January 1955. Use of this metallograph demonstrated the necessity for further modifications to permit satisfactory operation. This report describes these additional modifications and thus is supplemental to DP-99.

SUMMARY

After operation of a remotely controlled metallograph for a period of time, additional modifications were made to facilitate operation with the master-slave manipulators, to improve dependability, and to adapt the metallograph for use in a particular shielded cell. The control knobs were replaced with ones that could be gripped with a manipulator; the optical system was modified so that the metallograph could be moved farther from the front wall of the cell to provide additional room for manipulation of the controls; the remote mechanical drives were modified to give more dependable service; and the arc illuminator was replaced with one of greater intensity to make it possible to take photographs with polarized light. The modified metallograph was installed in a shielded cell, strip coated, recollimated, adjusted, and put into service. Performance has been satisfactory since September 1958.

DISCUSSION

A number of additional modifications were made to a Bausch and Lomb metallograph that had been modified previously so that it could be controlled remotely for the examination of highly radioactive material in a high level cell. The modifications were made to permit better operation and lower maintenance.

Coarse Focus of the Microscope

The coupling that connects the motor to the drive shaft was keyed to the shafts to prevent slippage. It was previously held with setscrews.

Limit switches ("Microswitch" No. BZ-2RD-A2) were added to restrict the vertical motion of the stage (Figure 1). The stage is thus prevented from being stalled against a mechanical stop, which would strain the housing and ruin the collimation of the light beam. The stage is also prevented from hitting and damaging the objective lenses.

Lens Turret

An additional support point was added to the right angle drive connected to the lens turret (Figure 2). With one support point the gears did not always mesh.

Field Selector

The gears and couplings in the field selector drive mechanism were keyed to the shaft to prevent slippage. They were previously held with setscrews.

Rotation of the Mechanical Stage

To eliminate interference with the full translation of the mechanical stage a new mount was made for the motor that rotates the mechanical stage. The new mount is smaller in diameter and is oriented at a different angle to the stage.

Translation of the Mechanical Stage

The O-ring belts in the mechanical stage drive were replaced with small Pick friction clutches, No. R3-6 (Figure 3). The original O-rings deteriorated within six weeks and could not be replaced remotely.

Aperture Diaphragm

A slotted knob (Figure 4) was attached to the aperture diaphragm decentering control (Figure 5) to facilitate operation with a master-slave manipulator. The knob replaced a knurled shaft that was difficult to grip with the manipulator.

Field Diaphragm

A swivel lever (Figure 4) was attached to the field diaphragm (Figure 5) for operation with a master-slave manipulator. Control of the field diaphragm was difficult without the lever.

Water Cell

The water cell that absorbs heat in the light path was replaced by an infrared-absorbing glass filter, No. 42-3122-022, purchased from the Bausch and Lomb Company (Figure 1). The water evaporated rapidly from the cell that was previously used; if the arc were operated when the water cell was empty, the optics of the metallograph would be permanently damaged.

Illuminator

The original zirconium-arc illuminator did not work satisfactorily and its power supply was inadequate. The light from this arc was not of sufficient intensity for photography with polarized light. The zirconium-arc illuminator was replaced with a carbon-arc illuminator, Bausch and Lomb No. 42-44-86-12, which has a light intensity that is ten times greater. The carbon rods are automatically adjusted and the unit is remotely operable. A safety switch (Figure 1) was added to the illuminator to de-energize the electrodes when the illuminator is not in its operating position or when it is opened for changing the electrodes. Slotted control knobs (Figure 5) were added to the illuminator to facilitate manipulation with a master-slave manipulator. A 10-amp, 115-volt DC selenium rectifier, No. YF-1800-BQ, was purchased from the Northern Electric Company for the illuminator.

Optical Path

An offset (Figure 6) was originally included in the optical path from the metallograph to the camera so that shielding could be placed behind the hole in the cell wall. Because of the location and size of the hole, shielding was found not to be necessary. The offset was removed and the optical tube was extended to make it possible to move the metallograph to provide space for manipulation between the front wall of the cell and the metallograph and to provide more working space in the center of the cell. Corrections were made in the distances between the lenses to compensate for the removal of the two prisms.

Camera Stage

The camera stage was turned around so that an operator can view a specimen while he adjusts the metallograph (Figure 7). As originally built, the camera focusing screen faced in the reverse direction from the area in which the metallograph was operated.

Specimen Holder

Two specimen holders were designed to position specimens over the lens (Figure 8). Type A (Figure 9) is used with 1-1/4-inch-diameter mounted specimens; Type B is for unmounted specimens.

Installation

The metallograph was installed in a cell (Figures 5 and 10). A Bausch and Lomb representative recollimated the light beam and made other necessary adjustments. As far as possible, the exposed parts were strip coated with Better Finishes Liquid Envelope, aluminum 67N-5291A, to prevent excessive contamination of the instrument.

Operation

The metallograph has operated satisfactorily since September 1958. Figure 11 shows a photograph of an etched uranium specimen taken at 2000X.

W. H. Leith

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Laboratory Services Division

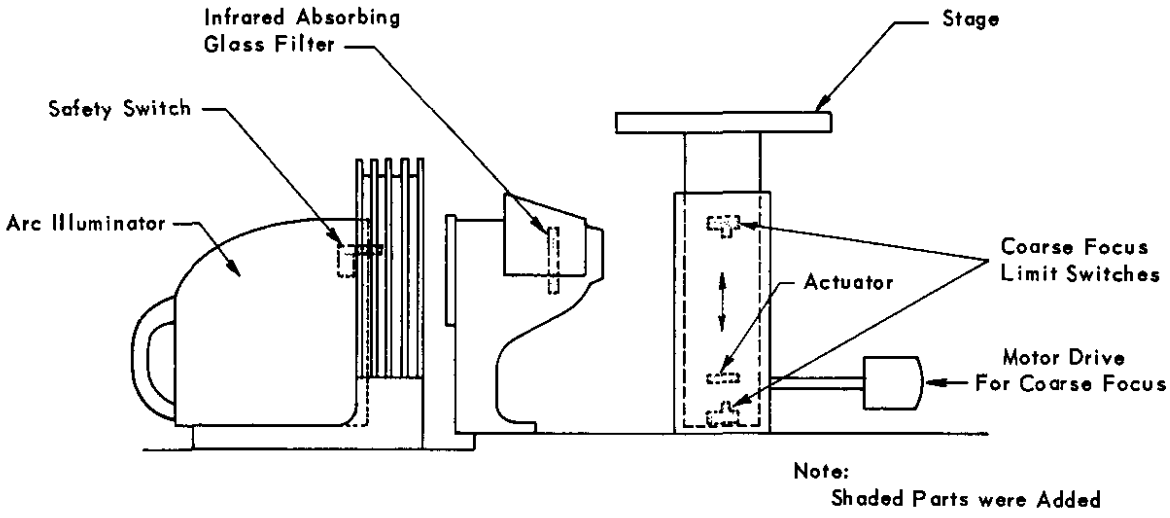


FIGURE 1 – COARSE FOCUS LIMIT SWITCHES, ILLUMINATOR, INFRARED FILTER, AND SAFETY SWITCH

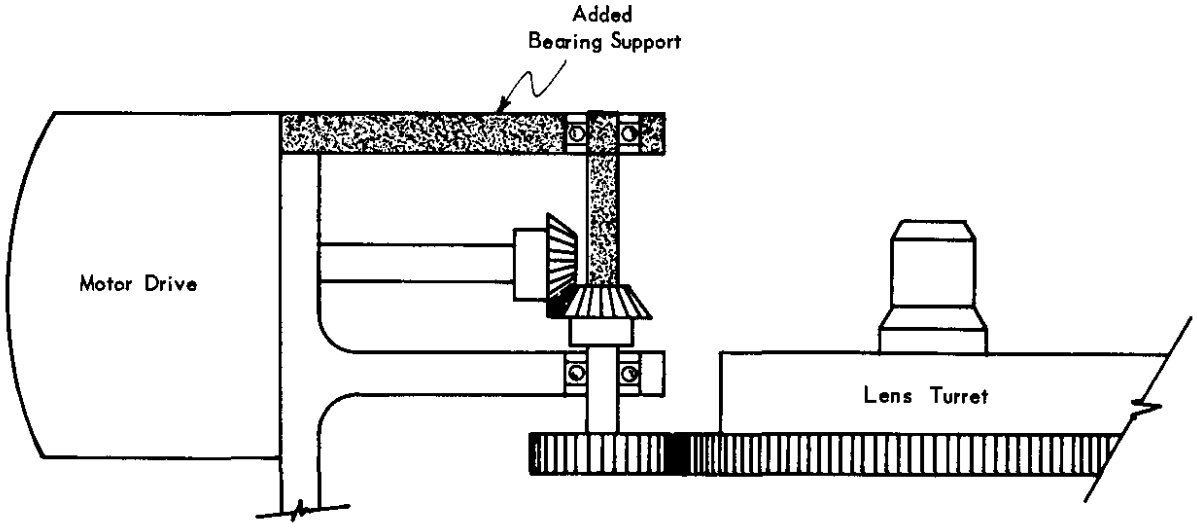


FIGURE 2 – LENS TURRET DRIVE MECHANISM

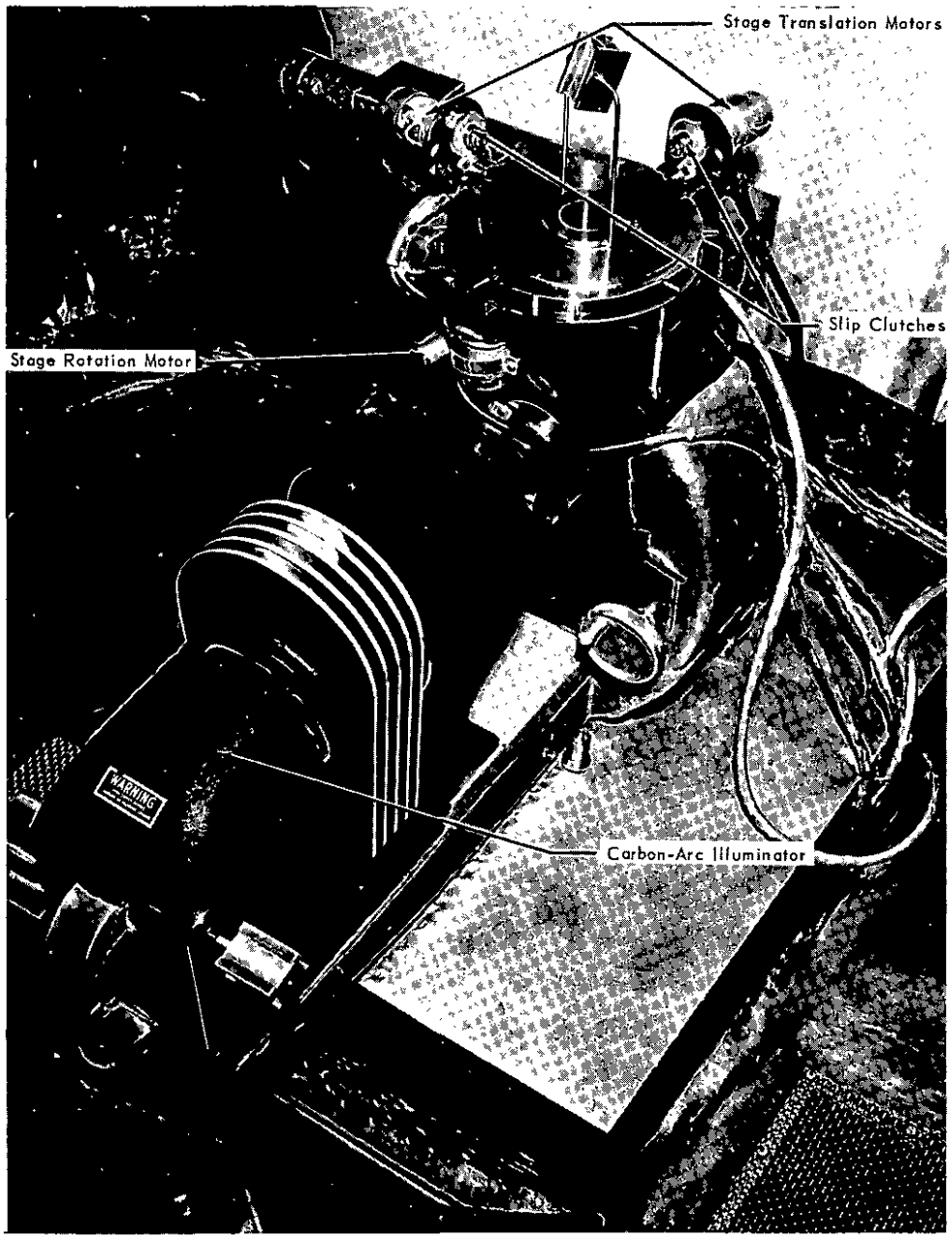


FIGURE 3 – TRANSLATION OF MECHANICAL STAGE, ROTATION OF MECHANICAL STAGE, CARBON-ARC ILLUMINATOR

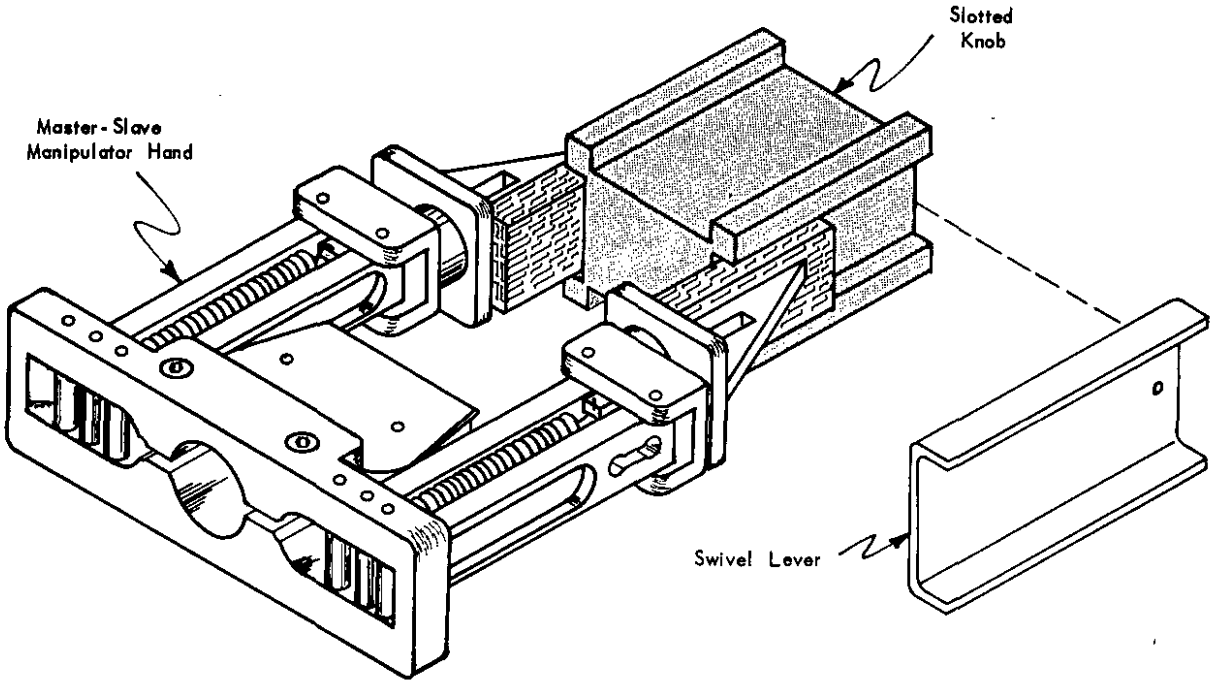


FIGURE 4 – SLOTTED KNOB AND SWIVEL LEVER FOR MANIPULATOR CONTROL

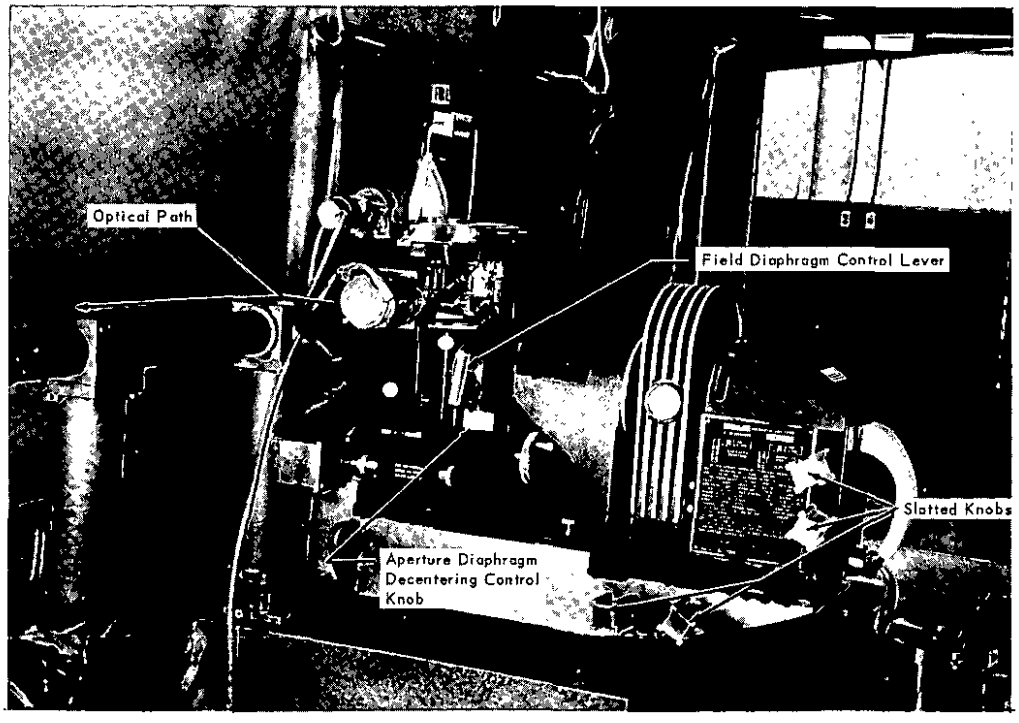


FIGURE 5 – FIELD DIAPHRAGM, APERTURE DIAPHRAGM, SLOTTED KNOBS, OPTICAL PATH

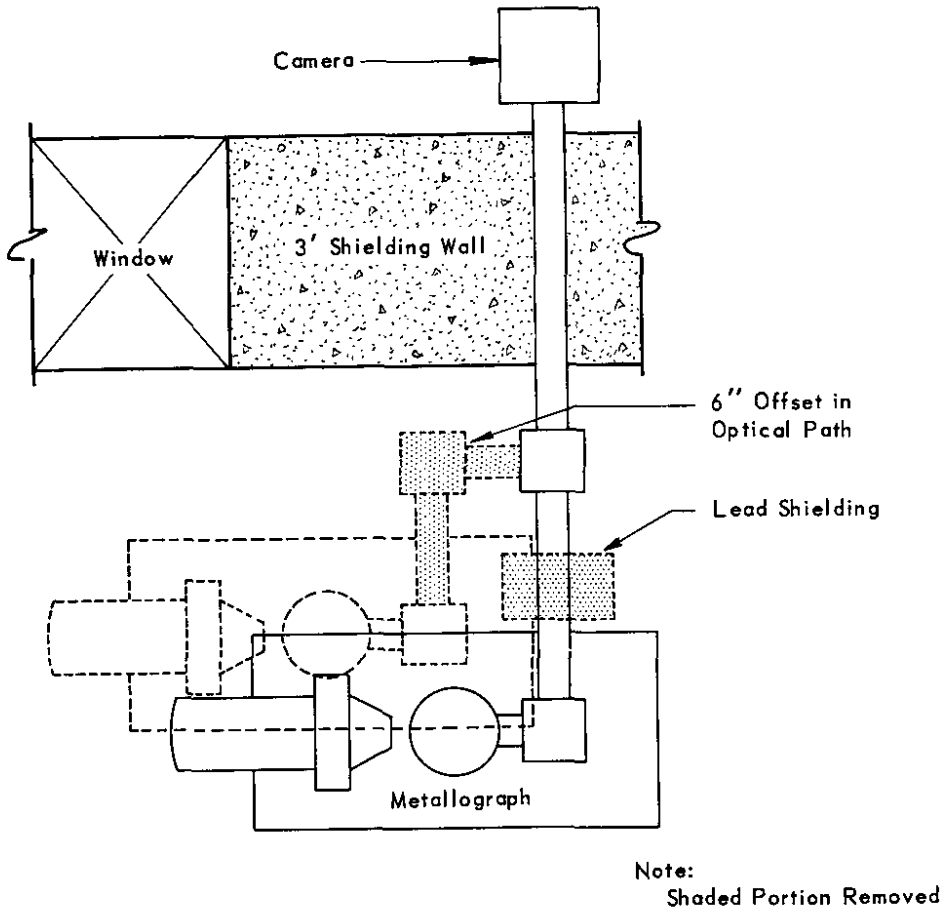


FIGURE 6 - MODIFICATION OF OPTICAL PATH

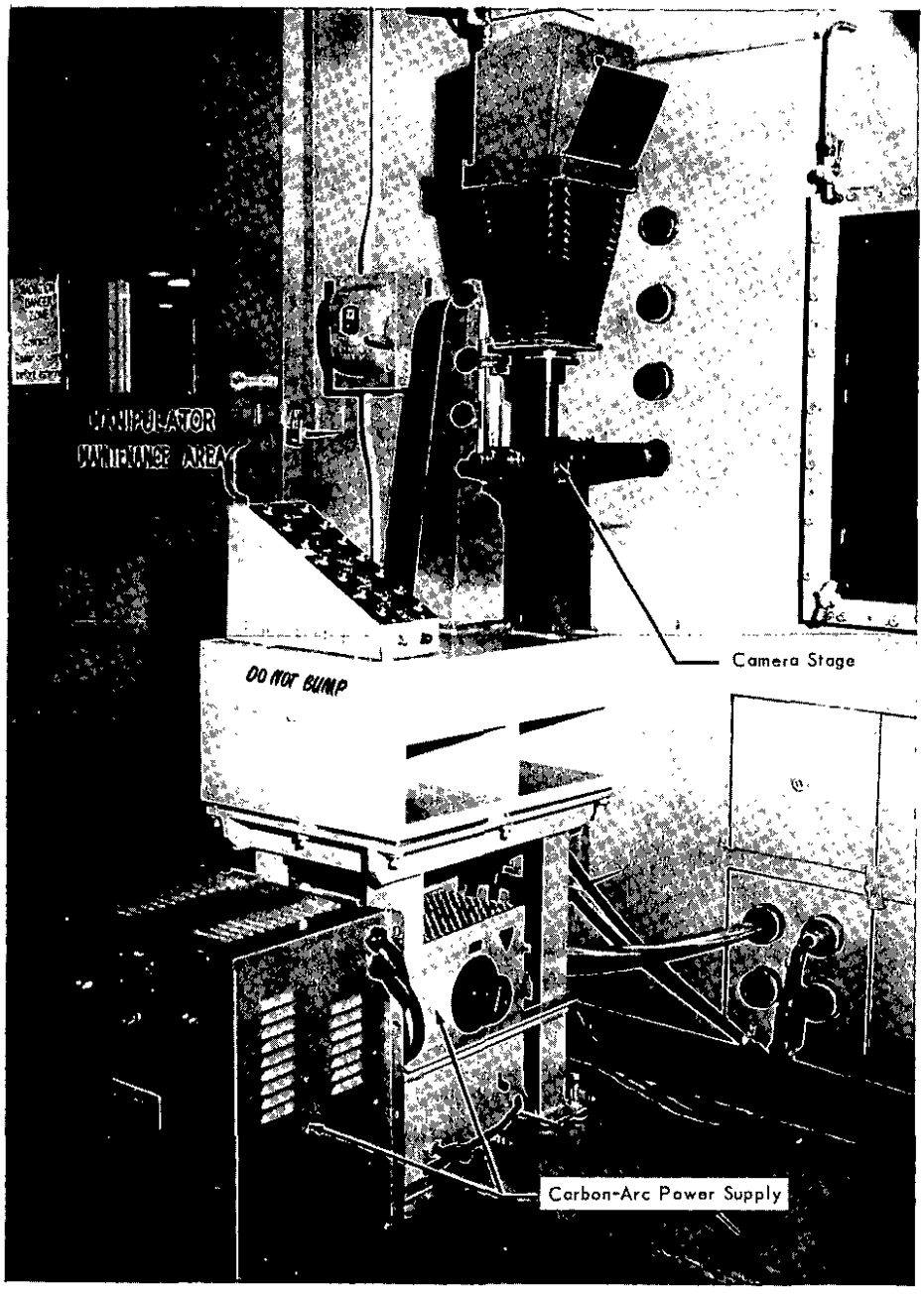
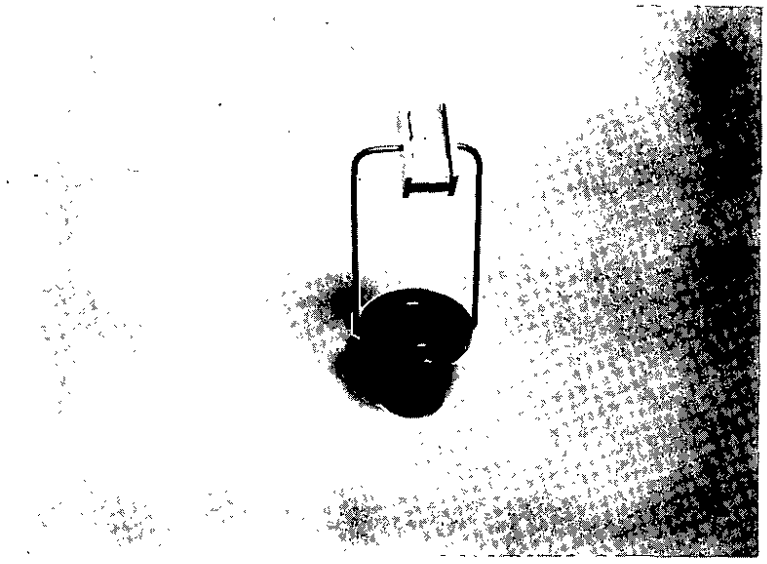
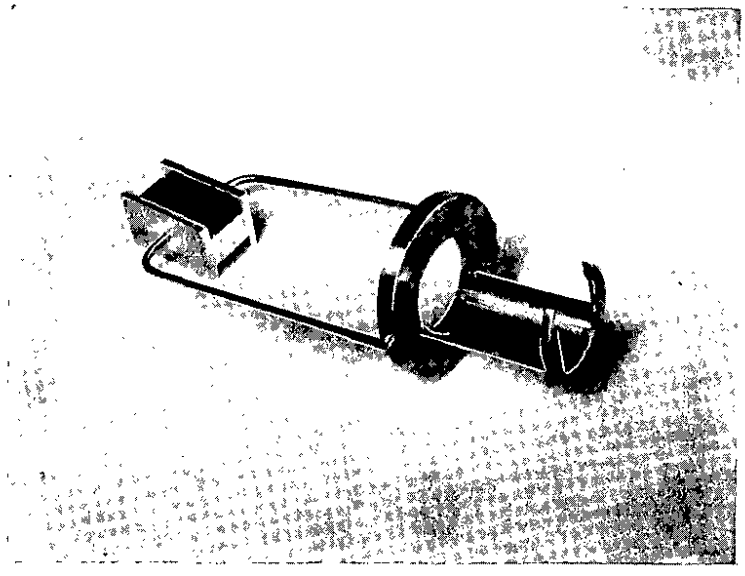


FIGURE 7 - CAMERA STAGE, CARBON-ARC POWER SUPPLY



Type A – Specimen Holder for 1 ¼-Inch-Diameter Mounted Specimen



Type B – Specimen Holder for Unmounted Specimens

FIGURE 8 – SPECIMEN HOLDERS

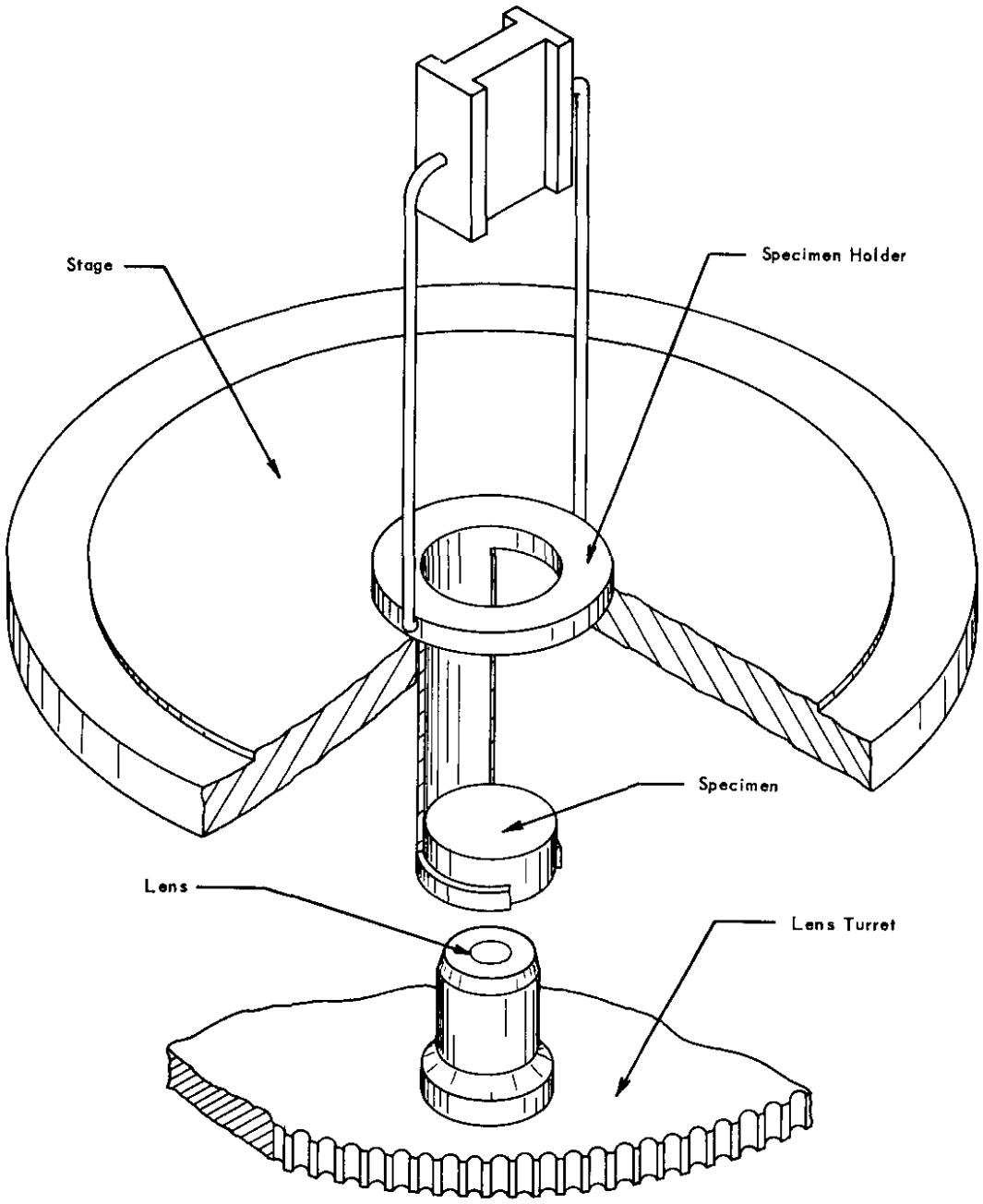


FIGURE 9 – SPECIMEN HOLDER IN METALLOGRAPH

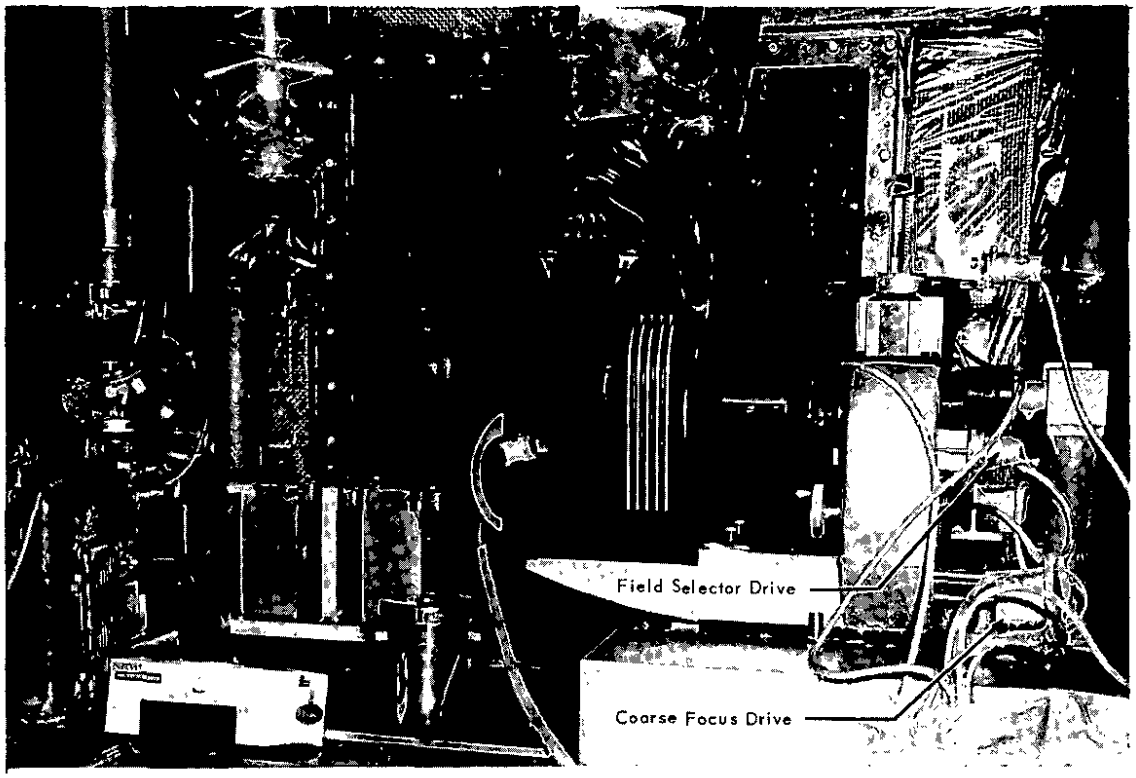


FIGURE 10 – COARSE FOCUS, FIELD SELECTOR

FIGURE 11 – PHOTOGRAPH OF ETCHED URANIUM SPECIMEN TAKEN WITH METALLOGRAPH AT 2000X