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Metallurgy and Ceramics

A REMOTELY CONTROLLED METALLOGRAPH

by

J. D. Ross

Instrument Development Division

January 1955

E. I. du Pont de Nemours & Co.
Explosives Department — Atomic Energy Division
Technical Division — Savannah River Laboratory

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ABSTRACT

Seven controls of a Bausch and Lomb Metallograph were modified for remote operation to permit the use of the instrument in examining highly radioactive materials behind shielding.

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A REMOTELY CONTROLLED METALLOGRAPH

INTRODUCTION

A suitable metallograph was required for the examination of highly radioactive material. Because of the radiation hazard, it was necessary to locate the metallograph in a high level cave and to operate it from a point outside the cave. No commercially available instrument had an adequate remote control system. This report covers the modification of a Bausch and Lomb Metallograph for remote operation.

SUMMARY

A metallograph, equipped with a remote viewing periscope, was purchased from the Bausch and Lomb Company. Seven of the controls were adapted for remote operation. These controls are driven at their optimum speed by small electric motors mounted on the metallograph. The speed and direction of rotation of each motor is controlled from a panel located near the eyepiece of the periscope. Satisfactory performance of the modified metallograph was demonstrated.

DISCUSSION

Seven controls of the metallograph were motorized: coarse focus of the microscope, fine focus of the microscope, lens turret, field selector, rotation of the mechanical stage, and the two adjustments for translation of the mechanical stage. The remaining controls were unaltered because they could either be satisfactorily preset or could be operated by a master-slave manipulator in the cave.

COARSE FOCUS OF THE MICROSCOPE

The metallograph, as received, had a provision for a mechanical remote control of the coarse focus. The opening for this control was used to accommodate a drive shaft. A 4.1-rpm "Bodine" induction motor of the KCI type is used to drive the shaft. The motor is coupled to the drive shaft by a multijaw coupler. The drive shaft is connected to the feed screw of the coarse focus control through a pair of internally mounted, right-hand helical gears. Thrust is taken up by both a bracket inside the metallograph housing and by an oil-impregnated bushing mounted in the base plate. The motor can be stalled indefinitely at the mechanical stops of the feed screw since the motor's torque is not sufficient to cause damage.

FINE FOCUS OF THE MICROSCOPE

A "Bodine" motor is mounted with a bracket on the unused camera-bed rack; the shaft of the motor is aligned with the fine focusing button. The focusing button acts as one disk of a friction clutch. The drive disk on the motor has a keyway along its bore so that it slides over a pin in the motor shaft. The disk is faced with cork and is held against the focusing button by a coil spring on the motor shaft. The motor and the friction clutch are shown in the center of Figure 1. The friction clutch prevents the fine focus screw from being damaged when the mechanical stops are reached. Since the required torque is very small, two speeds are obtained by switching a resistor in or out of a power lead of the motor. The motor is a "Bodine" type KCI with a nominal speed of 1.4 rpm.

THE LENS TURRET

The lens turret is driven by a "Bodine" motor, type KCI, that rotates at 4.1 rpm. The motor is mounted with a bracket on the support of the turret. A simple miter and spur gear couple the motor to a 24-tooth spur gear which meshes with the rim of the lens turret. This arrangement is shown in Figure 2. The turret can rotate continuously in one direction, so no limit stops are required.

THE FIELD SELECTOR

A 32-pitch ring gear is fitted over the outside of the field disk and is attached to it by small screws (Figure 2). Power is supplied through a right-angle drive by a small, Hansen "Magnatorc", 24V DC, 10-rpm, motor (Figures 1 and 3). The motor bracket is hard-soldered to one arm of an "L" shaped plate. The motor shaft extends along this same arm. Miter gears, at the intersection of the two arms of the "L", drive a shaft that extends along the second arm. This shaft has a small spur gear pressed on the free end which engages the ring gear. The shafts are supported on the plate by three bearing blocks containing inserts of oil-impregnated bronze. The "L" plate is fastened to the back of the optical housing. As continuous rotation is possible, no limit stops are required.

ROTATION OF THE MECHANICAL STAGE

A large spur gear, with the center cut out, is secured to the underside of the stage as shown in Figure 4. A 10-rpm "Magnatorc" motor, which is mounted on the support of the stage in a vertical position, supplies the driving power. A small spur gear pressed on the shaft of the motor engages the large spur gear. Two speeds are obtained by switching a resistor in or out of a power lead of the motor. Two microswitches, which serve as limit stops, are mounted directly above the motor on the outside of the frame. Cams on the rotating stage actuate these switches.

TRANSLATION OF THE MECHANICAL STAGE

Two 10-rpm "Magnatorc" motors are used for the stage translation motors (Figure 5). One motor bracket is fastened directly to the stage and the other to the sliding rack by arms that extend through the openings on each side of the stage buttons. A small, grooved pulley is attached to each stage button and each motor shaft. Power is transmitted by O-rings used as belts. When the mechanical stops are reached, the belts slip and prevent the feed screws from being damaged. Two speeds are provided by the use of resistors in the power line.

THE CONTROL PANEL

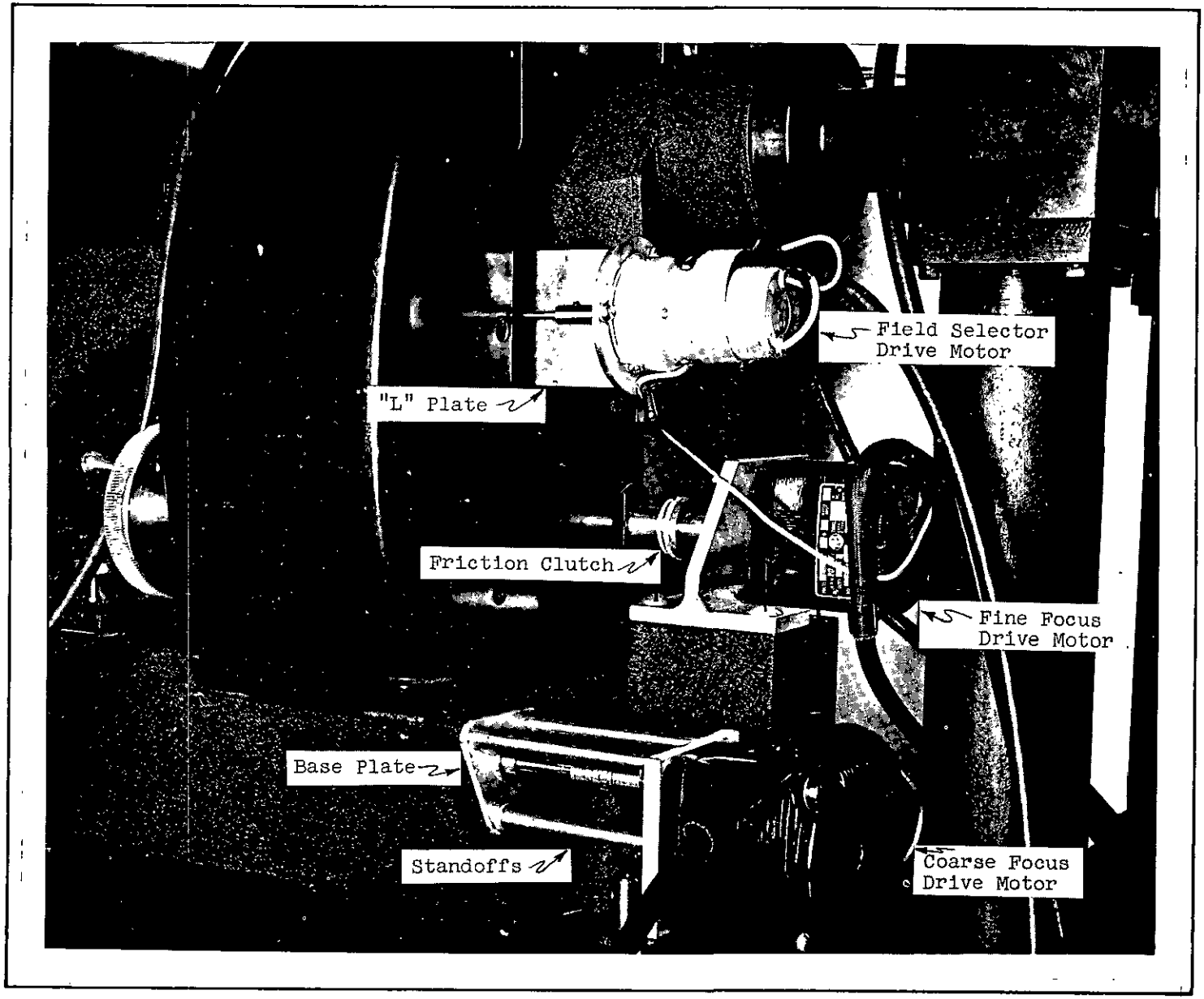
The leads from all of the motors are terminated in a junction box mounted on the metallograph stand (Figure 6). A cable connects this box to a feed-through junction on the cave wall. Another cable leads from the external junction to a control panel that is bolted to the periscope viewing table (Figure 7).

Microswitches on the control panel are used for control of the motors. The row of switches on the left

controls rotation in one direction, and the row on the right controls the counterrotation. The direction of rotation of the "Magnatorc" motors is changed by reversing the polarity of the current. The induction motors are reversed by changing a capacitor from one field coil of the motor to the other. Toggle switches, marked "S" and "F", are used to short out the resistors in the leads of those controls that have two speeds. The power supply for the DC motors and the phase-shifting capacitors for the induction motors are mounted beneath the control panel. Figure 8 is a wiring diagram of the control panel and the limit switch arrangement on the mechanical stage.

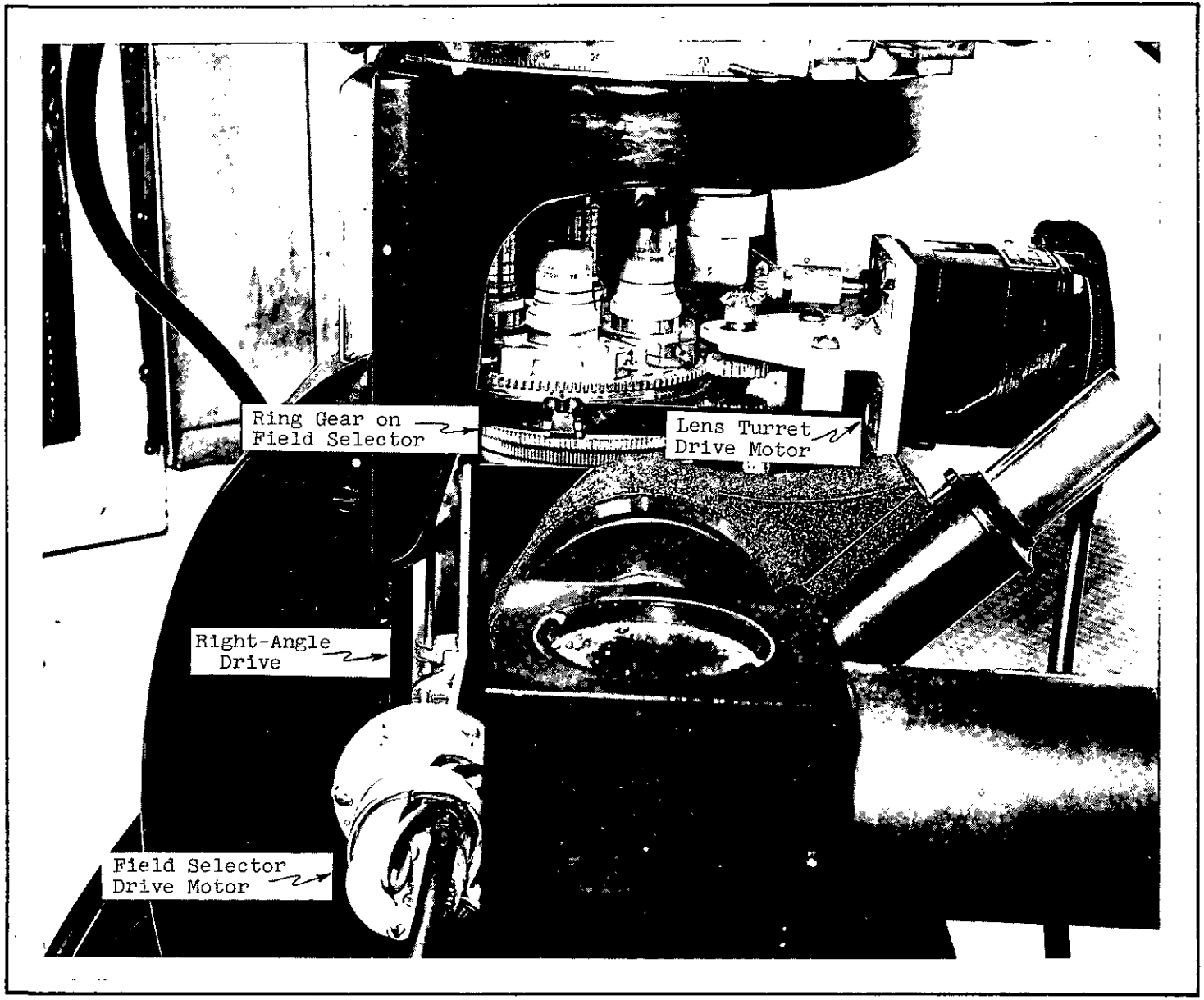
J. D. Ross

J. D. Ross
Instrument Development Division



COARSE FOCUS, FINE FOCUS AND FIELD SELECTOR

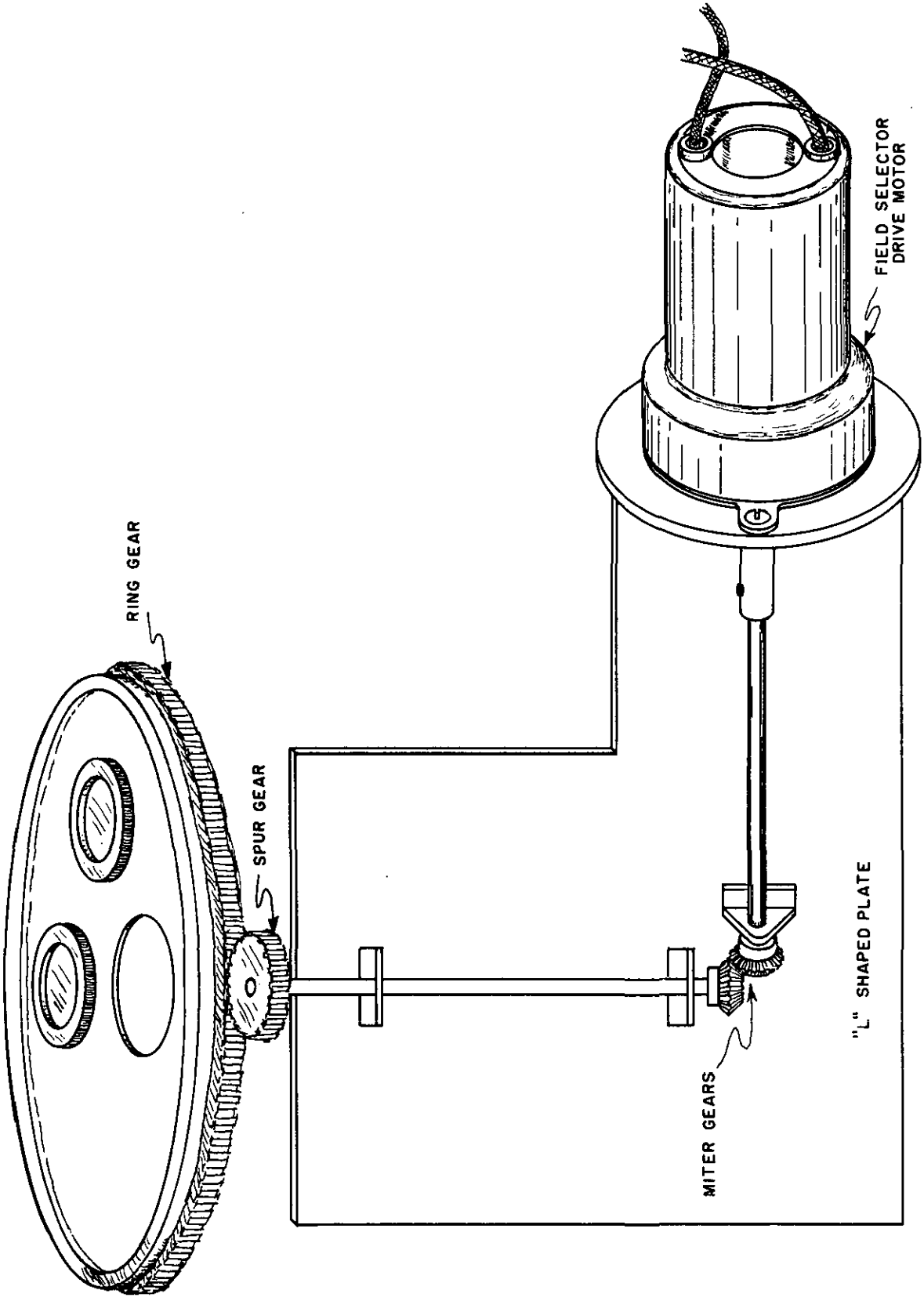
FIGURE 1



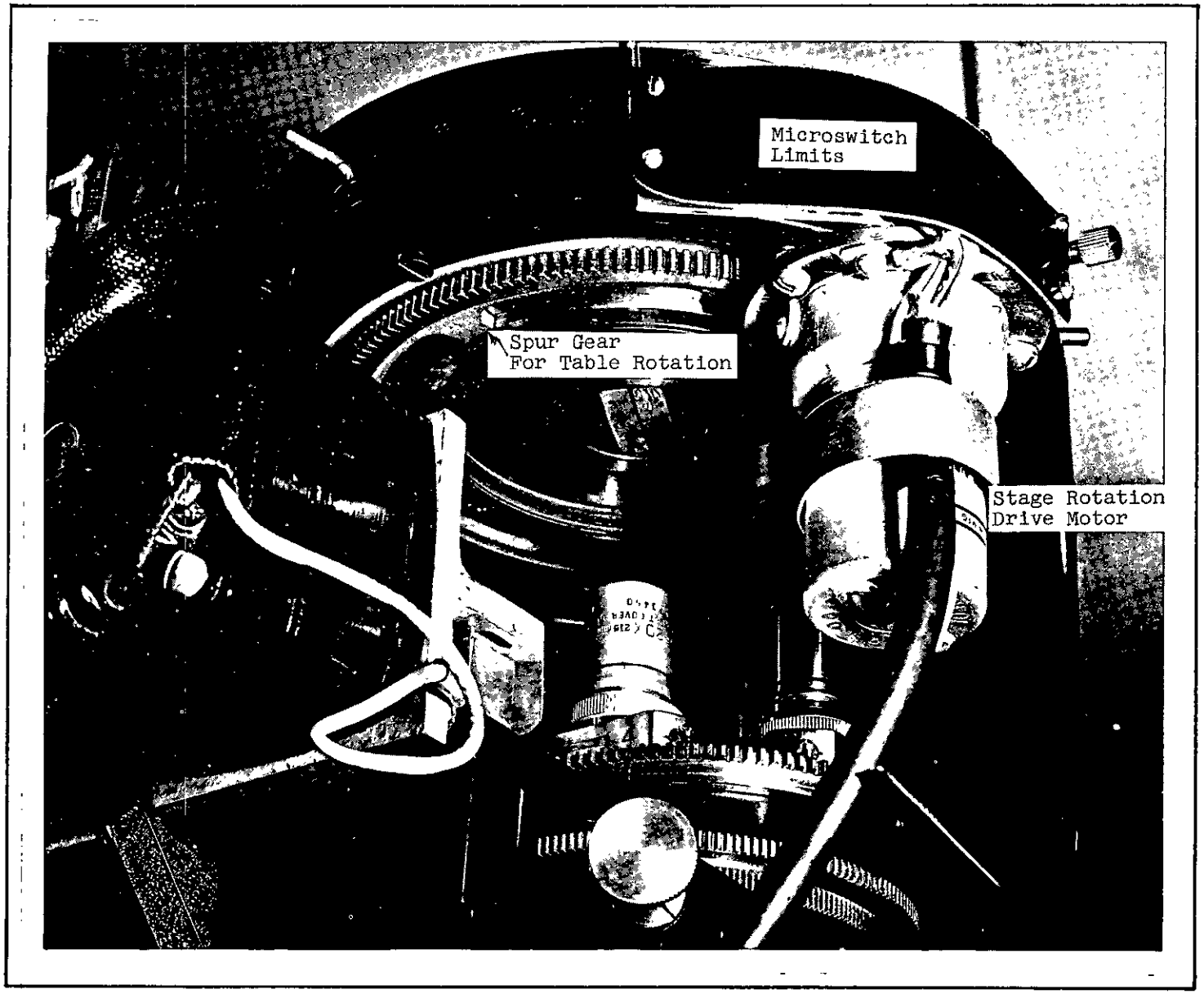
FIELD SELECTOR AND LENS TURRET

FIGURE 2

FIGURE 3

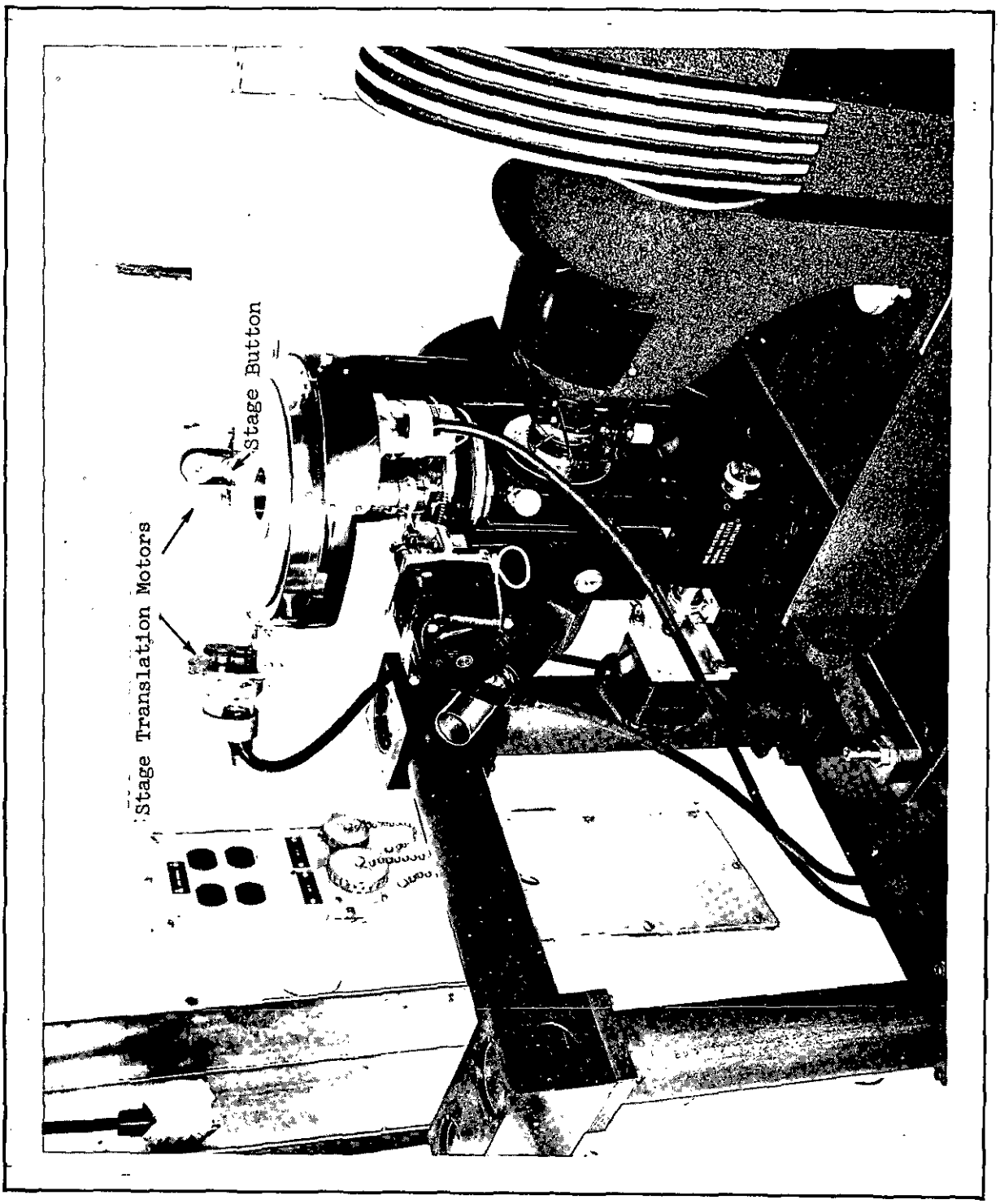


RIGHT-ANGLE DRIVE OF FIELD SELECTOR



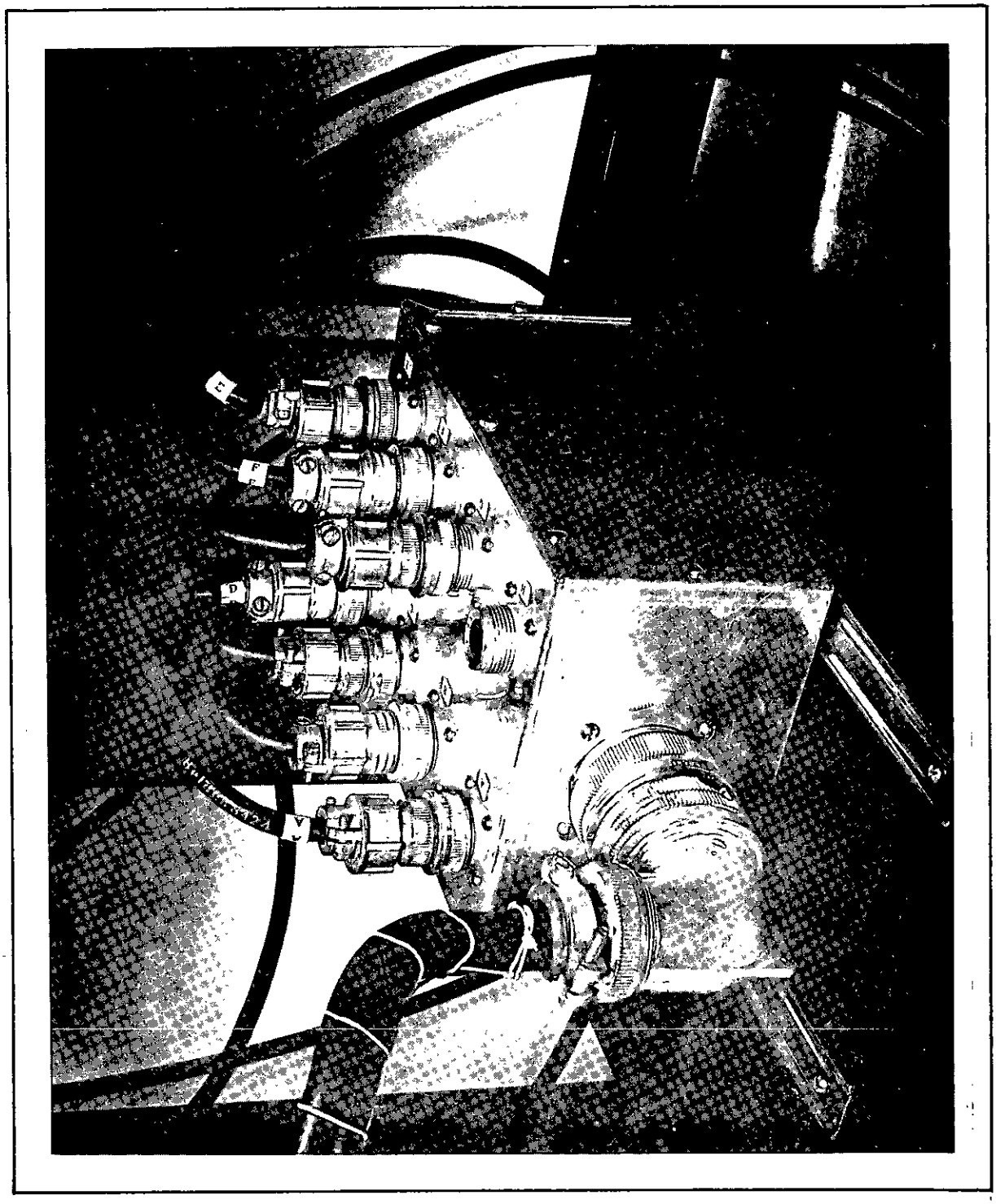
ROTATION OF THE MECHANICAL STAGE

FIGURE 5



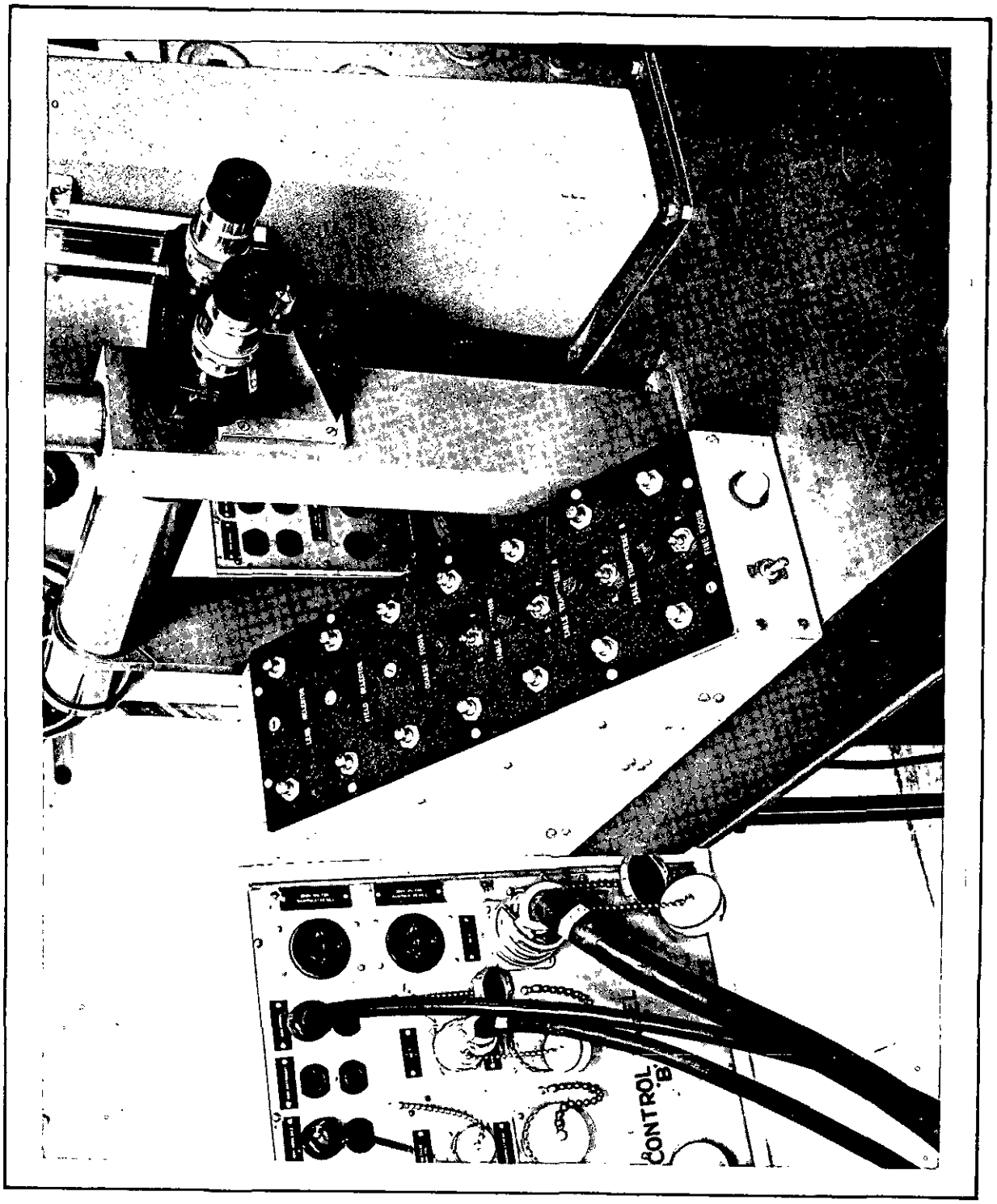
TRANSLATION OF THE MECHANICAL STAGE

FIGURE 6



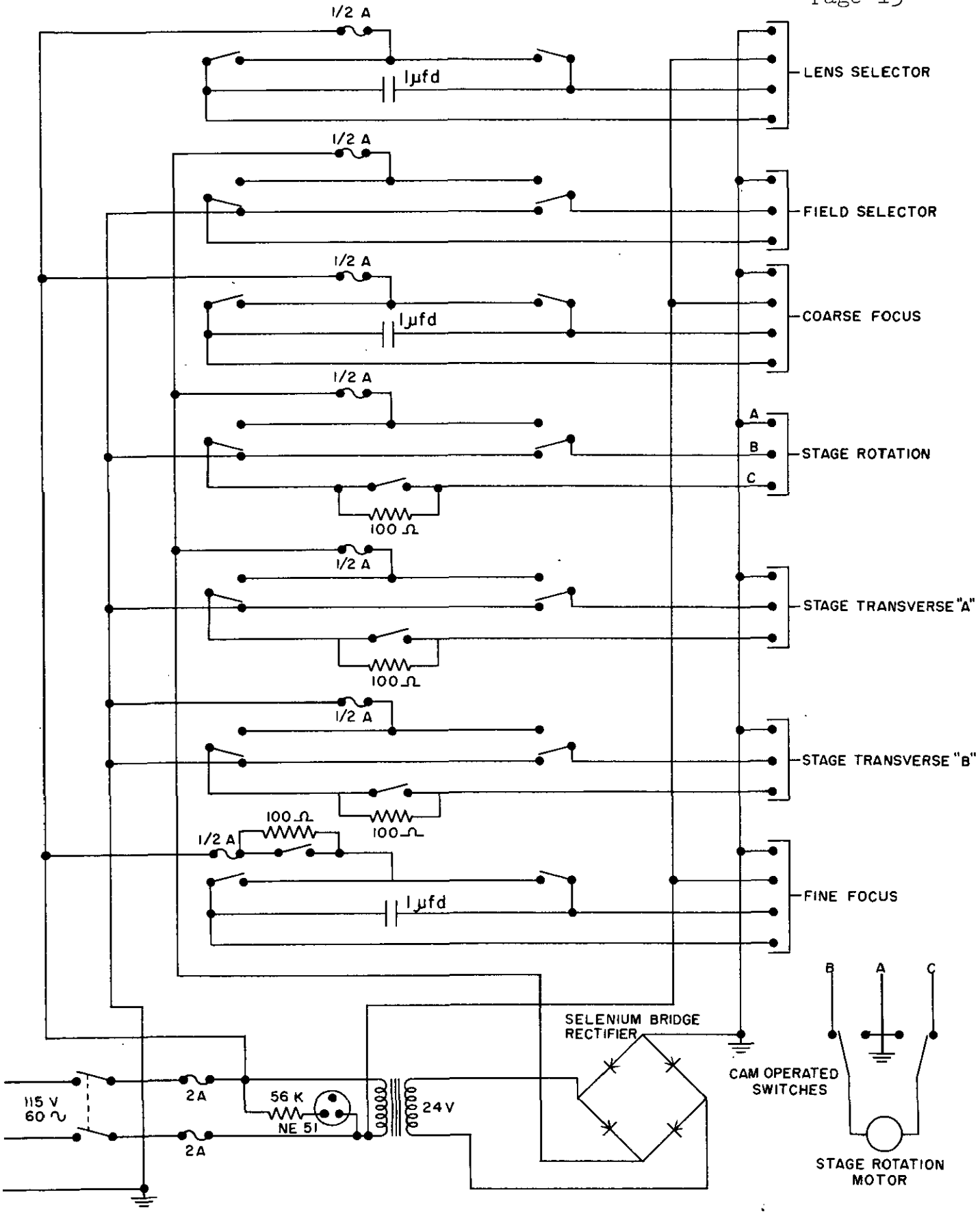
JUNCTION BOX

FIGURE 7



CONTROL PANEL

FIGURE 8



CIRCUIT DIAGRAM