SECTION IV

THEORY OF OPERATION

4-1. GENERAL. The airborne night observation system is a battery-operated, electro-optical device which uses ambient night illumination (starlight, moonlight, or nightglow) to produce a visible image of the scene being viewed. The night sight is equipped with controls that allow the individual operator to adjust for focusing distance and viewing clarity.

4-2. POWER SUPPLY. The battery supplies 6.75 volts dc to the image intensifier tube assembly which internally converts this dc voltage to the several thousand ac volts necessary to operate the intensifier tube.

4-3. IMAGE INTENSIFIER TUBE ASSEMBLY. The image intensifier tube assembly consists of three cascaded photoelectric amplifier stages. The image from the objective lens assembly is focused on the cathode of the first stage. The cathode is a light-sensitive phosphor layer which emits electrons in proportion to the amount of light received on the cathode surface. The emitted electrons also contain the image information of the illuminated scene. The electrons are accelerated by successively higher potentials (provided by a high-voltage oscillator) through the three stages to produce the final image on a fluorescent screen located at the eyepiece end of the device.

4-4. EYEPIECE ASSEMBLY. The eyepiece assembly magnifies the small visual image on the screen of the image intensifier tube assembly by a factor of 12. A focusing ring located on the eyepiece lens cell housing (which contains three lens elements) provides for ocular focusing of the screen image. The individual operator should adjust the eyepiece focusing to satisfy his viewing comfort.

SECTION V

ORGANIZATIONAL MAINTENANCE

5-1. SCOPE

5-2. This section contains troubleshooting and maintenance information that may be performed at the organizational maintenance level. Troubleshooting and maintenance level is necessarily limited in scope by the tools, test equipment, and replaceable parts issued, and by the existing tactical situation.

5-3. TEST EQUIPMENT REQUIRED. (See Table 5-1)

TABLE 5-1

MAINTENANCE TEST EQUIPMENT

Name	AN Type	Alternate	Use

(to be supplied)

5-4. OPERATOR'S PREVENTIVE MAINTENANCE SERVICES. (See Table 5-2.)

5-5. PURPOSE. To insure efficient operation and to discover and correct defects before they result in serious damage or failure, it is necessary that the airborne night observation device be systematically inspected at designated intervals. Certain scheduled maintenance services will be performed at these designated intervals. Any defect or unsatisfactory operating characteristics beyond the scope of the operator to correct must be reported immediately to higher echelon maintenance for correction.

5-6. SERVICES. The preventive maintenance that must be performed by the operator is listed in Table XVI.

NOTE

Defects discovered during operation of the unit shall be noted for future correction when possible corrections will be made as soon as operation has ceased. Operational discrepancies and the corrective action taken are to be recorded on DA form 2404 at the earliest possible opportunity.

CAUTION

Stop operation immediately if a malfunction is noticed during operation which would damage the equipment if operation were continued.

1. The night observation system consists of three major components, what are they? NIGHT SIGHT, DAY SIGHT, YOKE ASSEMBLY

2. What are the three types of ambient lights?
   SKY GLOW, STAR LIGHT, MOONLITE.
3. What is the magnification factor of the day sight?
   3 POWER.
4. What are the names of the three yoke switches?
   THUMB SW, TRIGGER, 4 POSITION.
5. What are the ranges in degrees of the yoke assy, in azimuth, in elevation? 180° AZIMUTH
   30° UP 70° DOWN ELEVATION
6. What are angle of view of the day sight, night sight?
   12° DAY
   13° NITE

1. What precaution must be taken before installing a new battery?
   INSURE PWR. SW. OFF
2. Describe the position of the OFF position of the power switch.
   AGAINST FACE OFF.
3. When installing a new battery, which end is installed first?
   POSITIVE END
4. When is the elapsed time meter in operation?
   WHEN PWR. SW. IS ON.

What is the power requirement of the Night Sight? 6.75 V DC

What are the three basic parts of the night observation systeM?

What is the maximum amount of the NOD travel in the azimuth plane, in degrees?

What is the rnage of the NOD, in degrees, in the elevation plane?

What is the amplication of the Day Sight?

PWR SUPPLY 6.75

F.87 — F8.0 (LENS OPENING)

4° AFT 15° DOWN BORESIGHT

NIGHT OBSERVATION SYSTEM

INTRODUCTION

This handout is intended for use with the airborne night observation system, manufactured by Electro-Optical Systems, Inc., Pasadena, California. The handout provides information on the operation, preventive maintenance, location and use of the equipment, accessories, components, and attachments. Also included are descriptions of the various subassemblies and their functions in relation to other components in the device.

PURPOSE AND USE

The airborne night observation system is a precision electro-optical instrument used for covert observation of distant objects at night from standard operational aircraft. The system consists of a night viewing device, a day sight and a yoke assembly.

The night viewing device amplifies reflected ambient night illumination (moonlight or starlight) to produce a visible image of the object when viewed through the eyepiece.

CAUTION

> When not in use, the night observation device should be stored. Do not observe bright lights, flares, searchlights, or vehicle headlights, directly, as this will cause the device to turn off. Though small bright sources may not cause the device to fail, they may cause a hole to be burned in the phosphor of the tube and should therefore be avoided.

The night observation device is capable of operation under temperature conditions varying from -20° to +125°F at humidities to 90%.

The day sight assembly is a standard 3X power sight which is mounted on the housing of the night sight. A FOCUS CONTROL adjustment ring is provided for optimum operator viewing and boresighting adjustment with the night sight.

The yoke assembly is secured to a mounting shaft in the aircraft. The yoke assembly consists of a yoke housing, azimuth and elevation resolvers, azimuth and elevation potentiometers, and two gun-grip operating controls. Provided in each grip are switches for functional control of the night sight. Also provided are position locking knobs and mechanical stops to limit travel of yoke. The azimuth and elevation resolvers transmit information to the aircraft control computer, indicating position of night sight. Respectively, the azimuth and elevation potentiometers provide signals to the aft control panel of the airlight. The assembly allows the night sight to travel 180 degrees maximum in the azimuth plane, and 70 degrees down, maximum, and 30 degrees up, maximum, in the elevation plane.

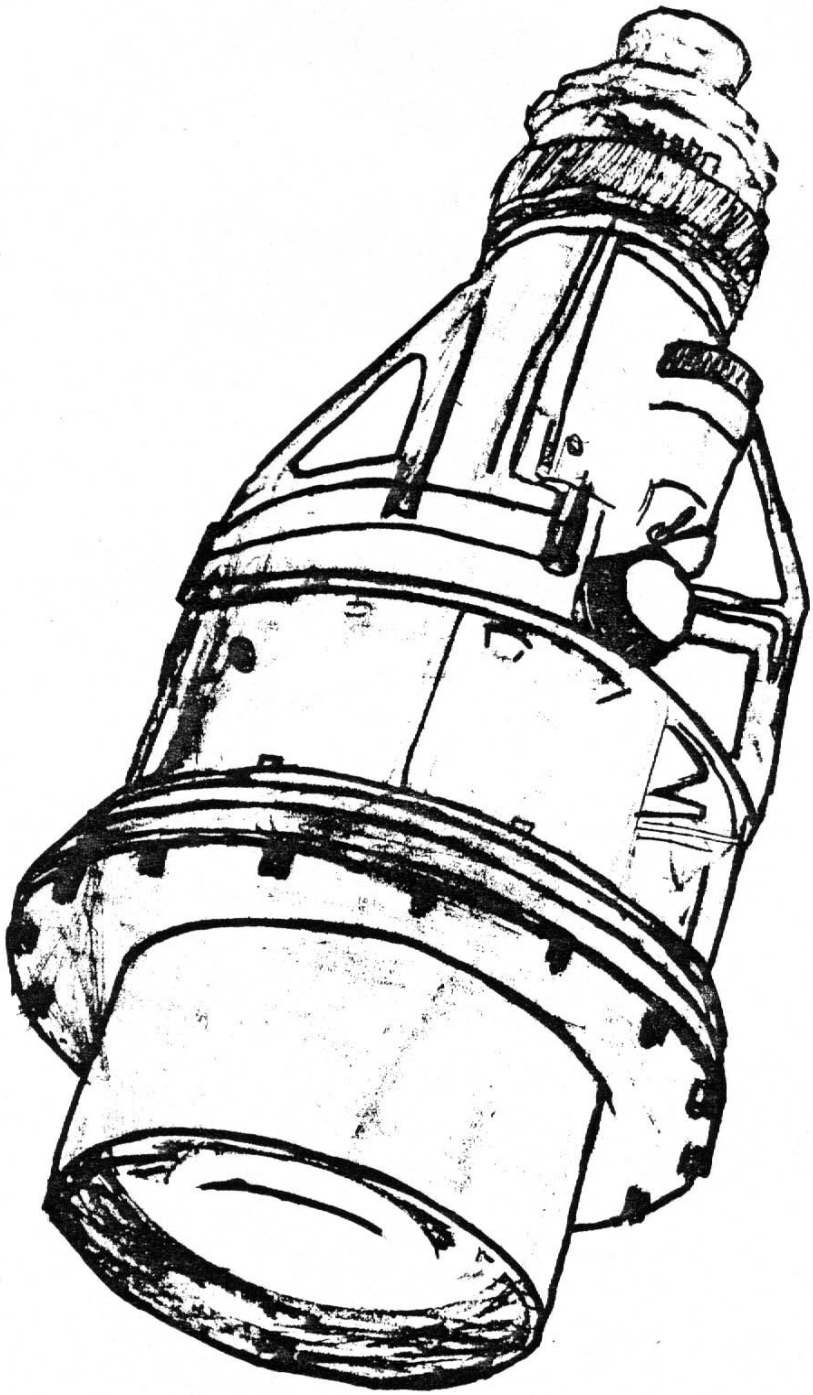


FIGURE 1-1

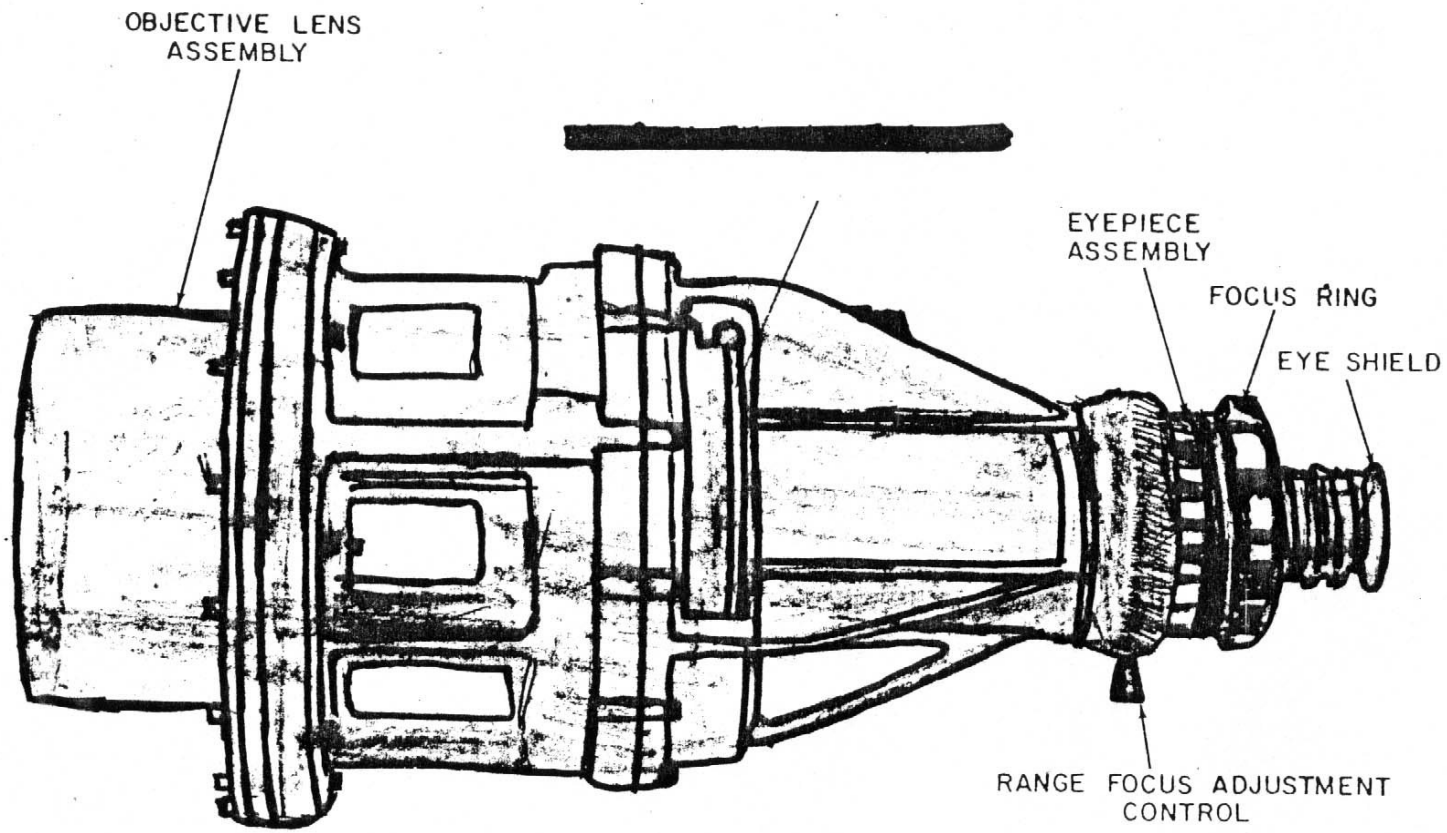


Figure 1-2. Airborne Night Observation System, Left Side View

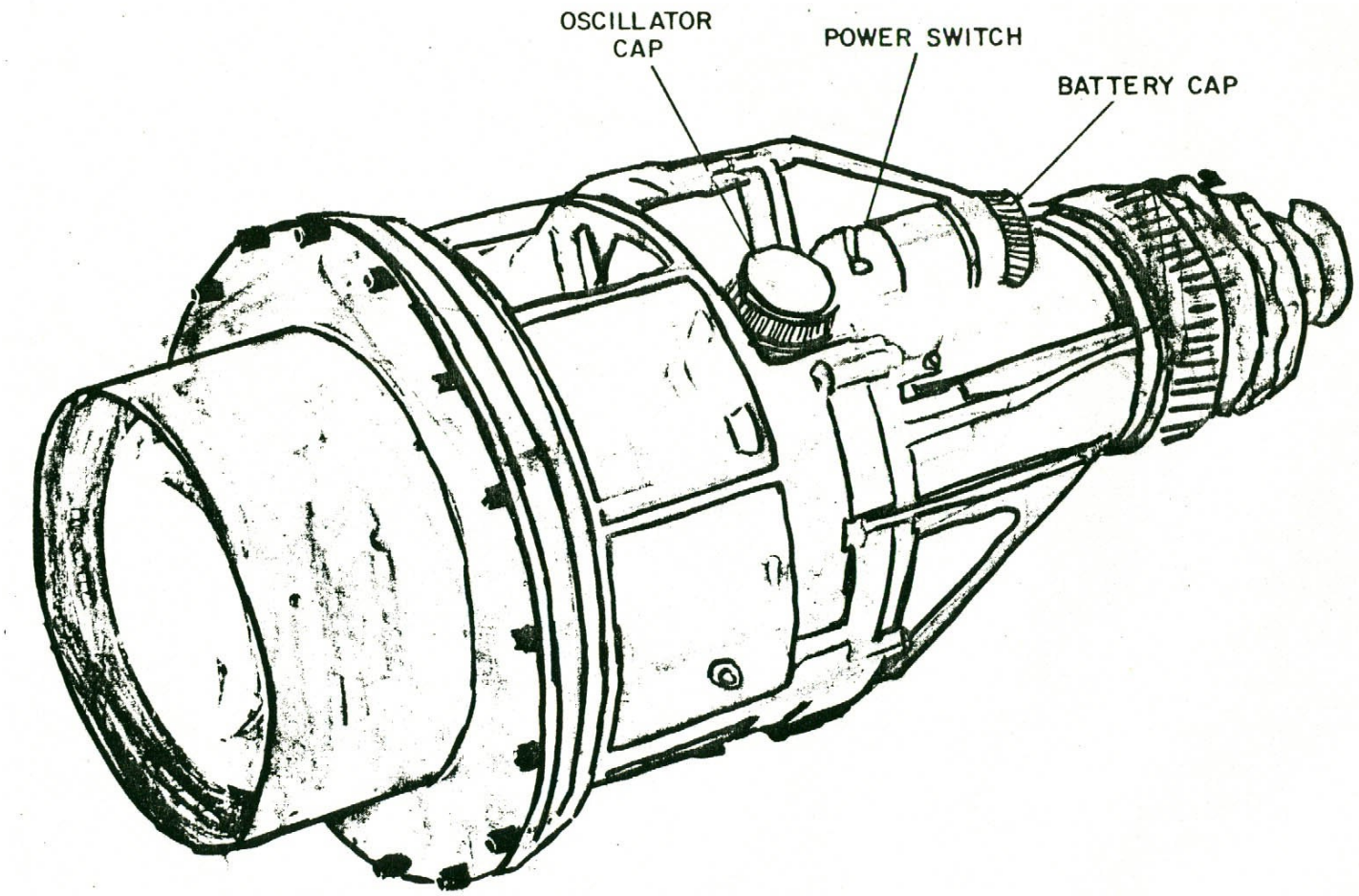


Figure 1-3. Airborne Night Observation System, Right Side View

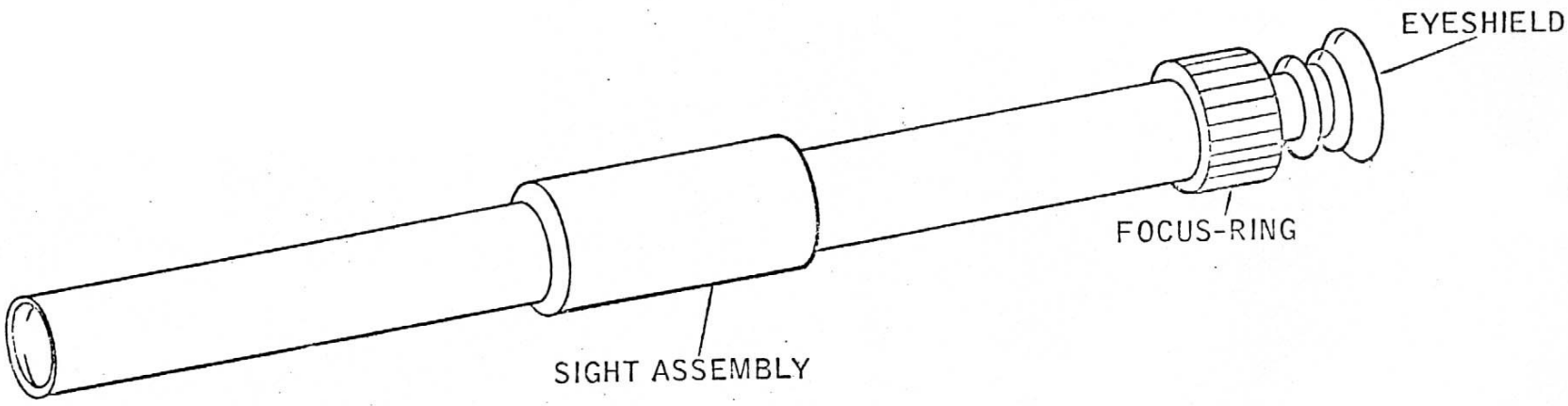


Figure 1-4. Day Sight Assembly

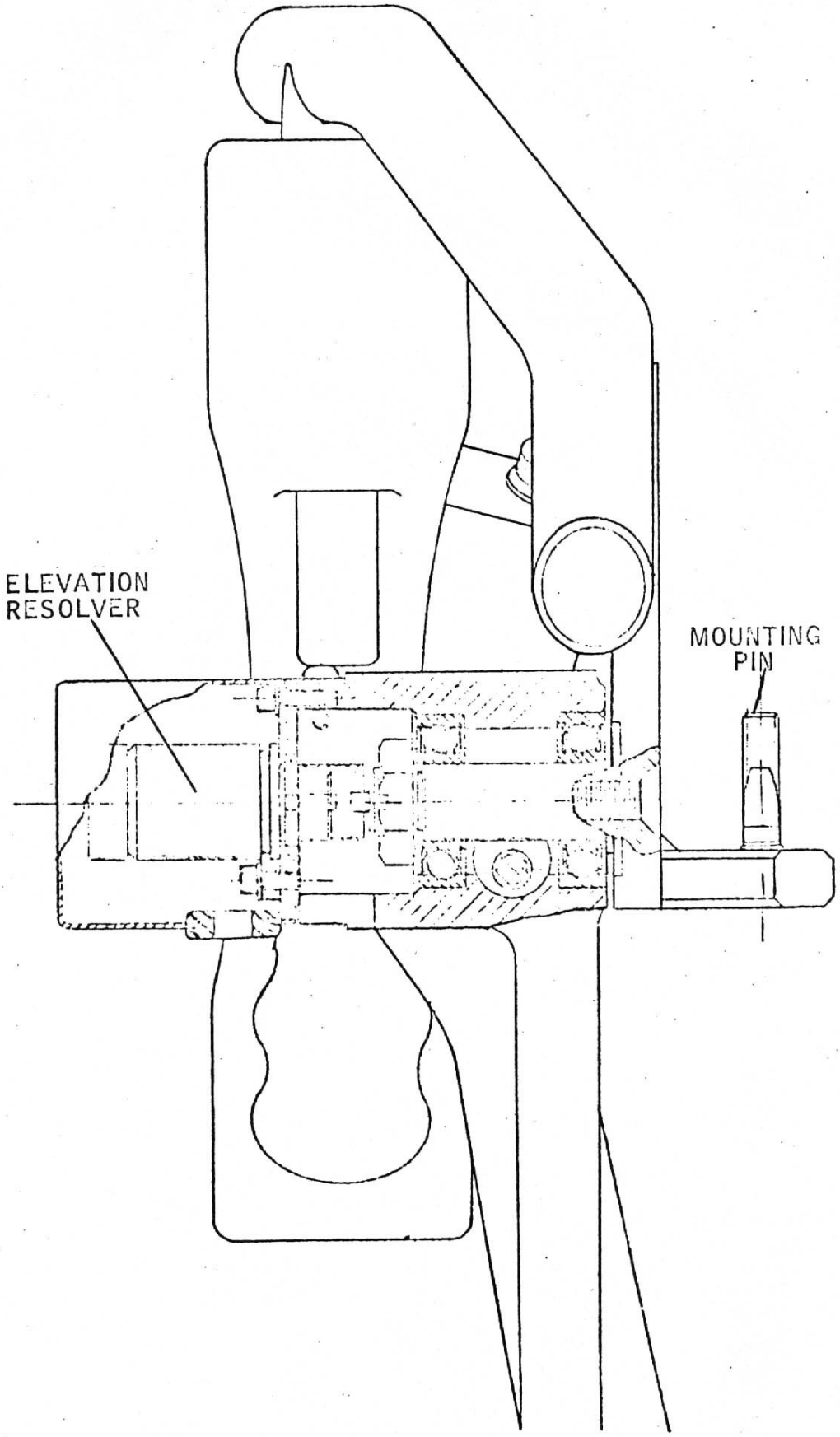
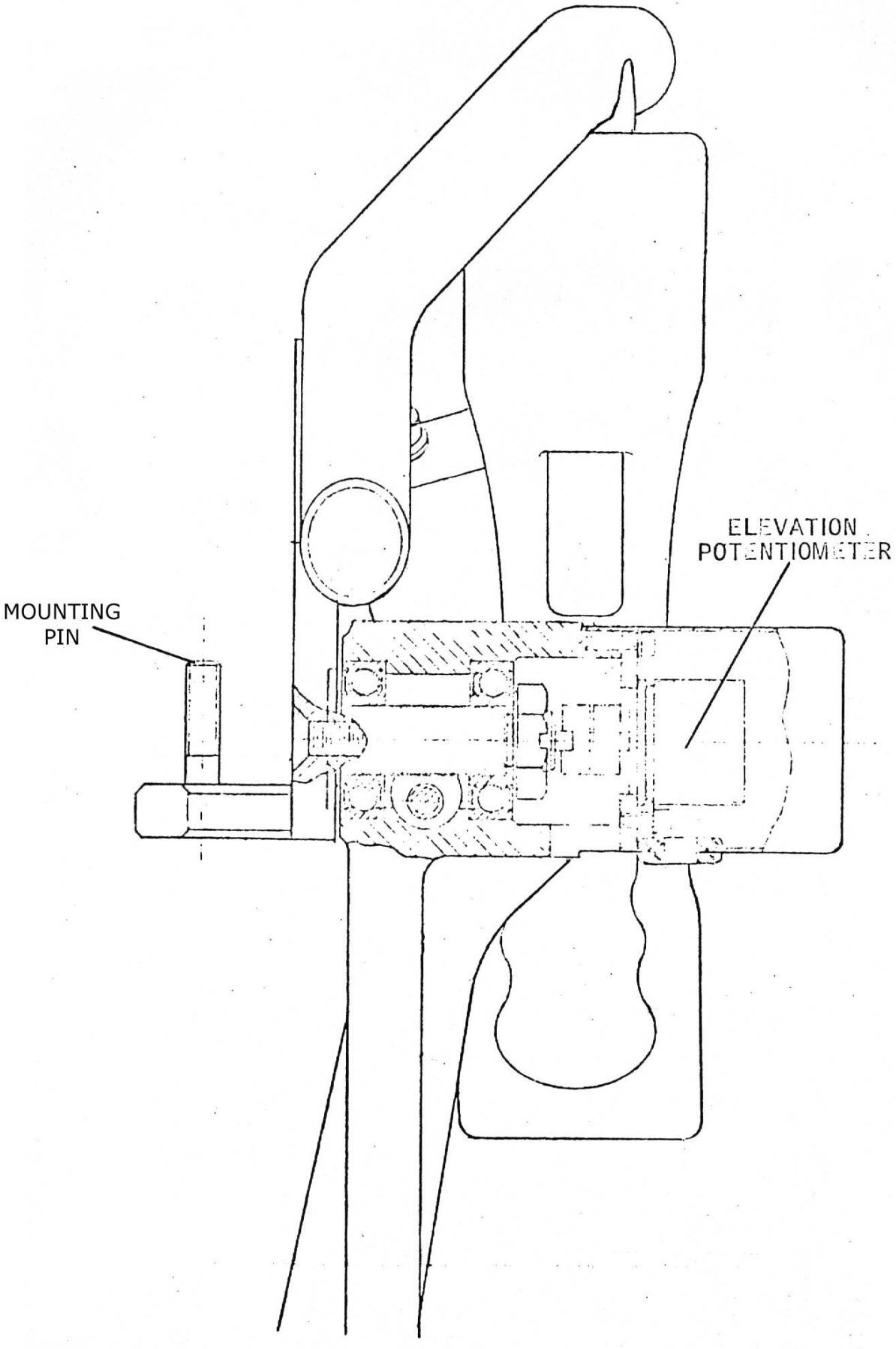
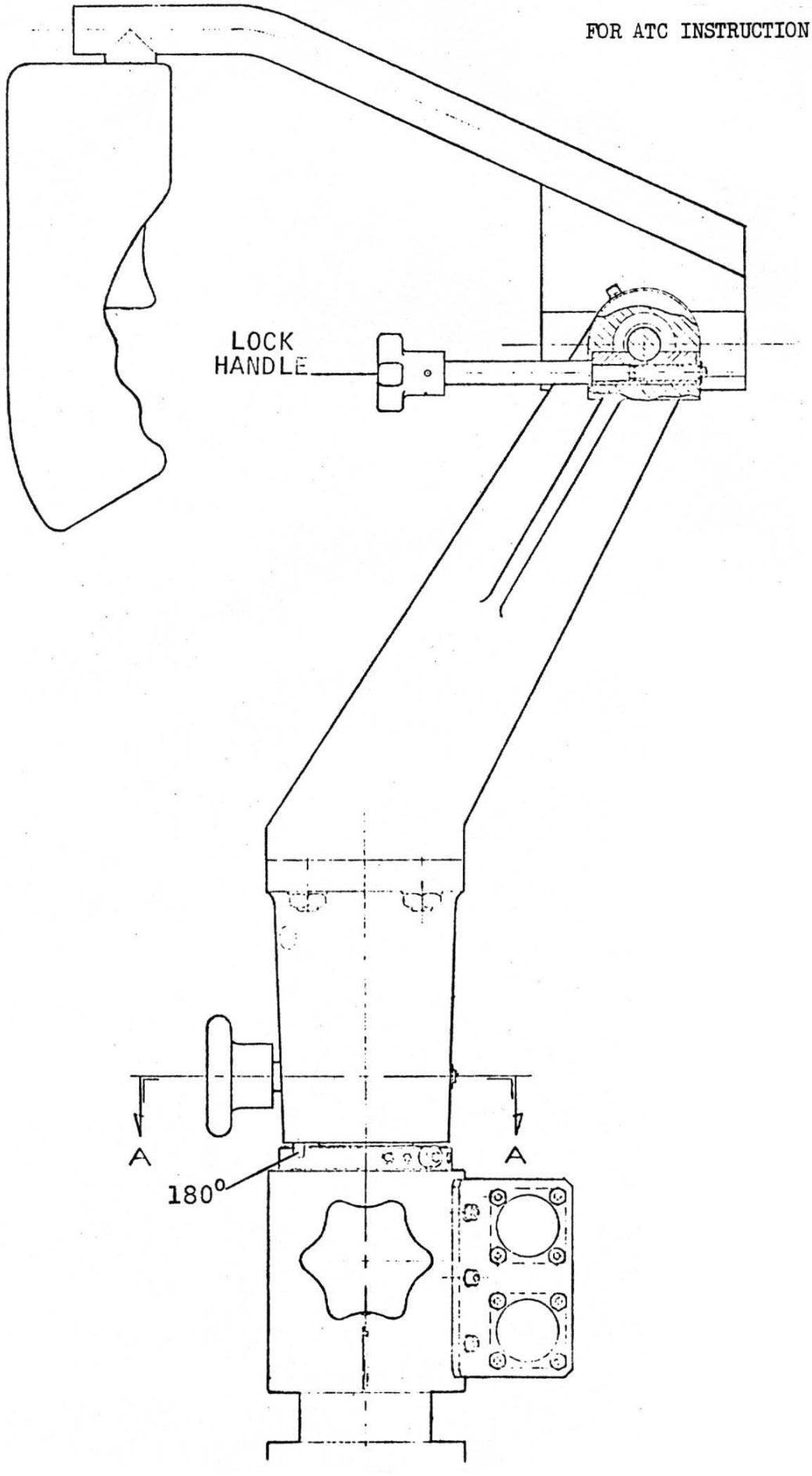


Figure 1-6, Part 1. Yoke Assembly Details


ELEVATION
POTENTIOMETER
MOUNTING
PIN


LOCK
HANDLE
A
A
180°

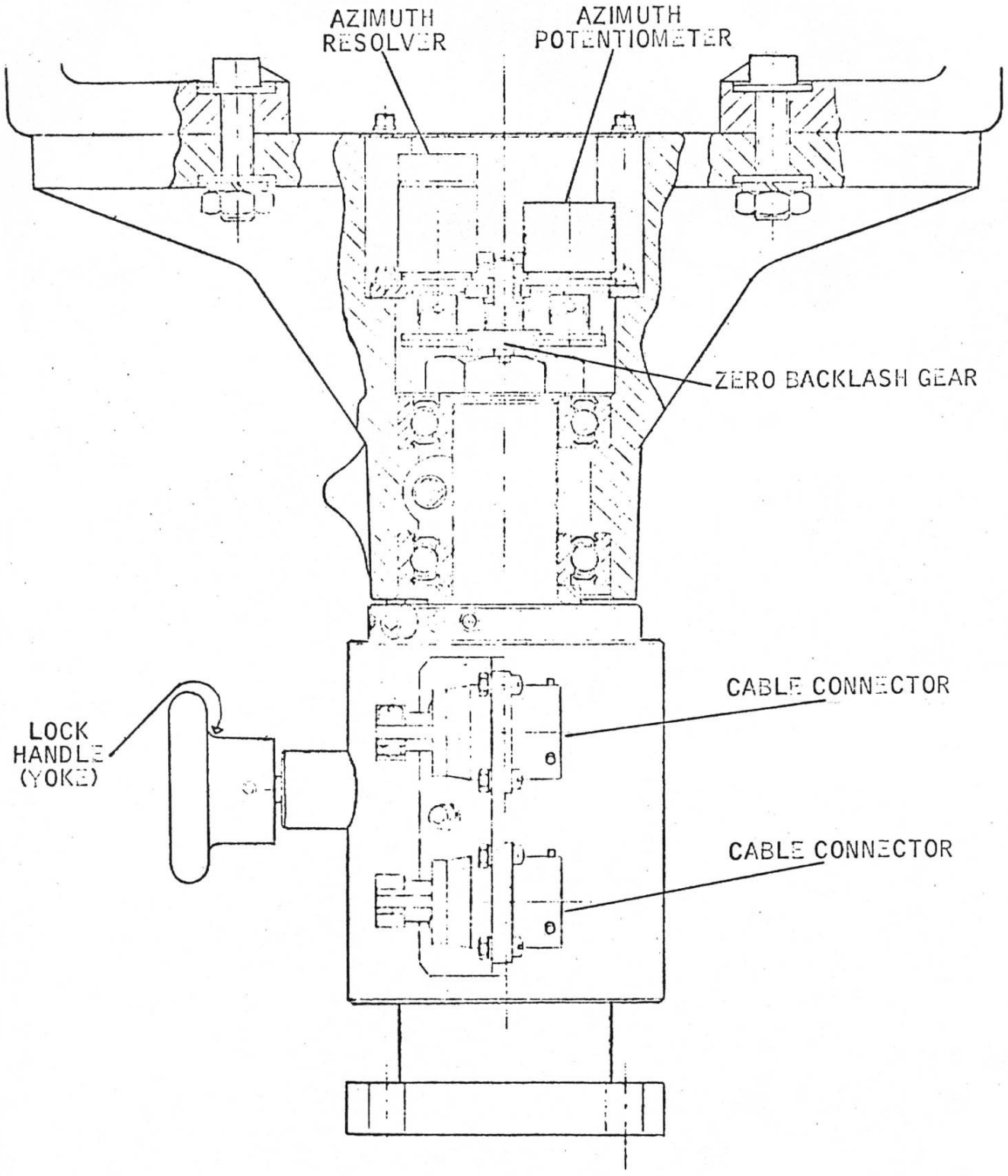


Figure 1-6, Part 4. Yoke Assembly Details

Right Hand 4 Position Switch	Spring Loaded Switch	Switch-up, drives lamp head down Switch-down, drives lamp head up Switch left, drives lamp head aft Switch-right, drives lamp head fore.
Right hand Thumb Switch	Spring loaded, Press type, Switch (Button)	Depressed by operator, to connect him to the A/C intercomm system.
Right Hand Trigger Switch	Spring Loaded, Press type, Lever, Switch	Depressed to indicate that a targer has been acquired.
Elevation Resolver	Rotary type transformer	Sends to the computer a signal that represents the position of the NOD, in the vertical plane.
Elevation potentiometer	Rotary resistor	Sends signal to and it positions elevation bar to indicate view of NOD vs that of the A/C.
Azimuth resolver	Rotary type transformer	Same as elevation resolver, but represents the horizonal plane.
Azimuth potentiometer	Rotary resistor	Same as elevation potentiometer, but indicates in the horizontal plane.

Day Sight Assy

Focus-ring	Knurling focusing ring	Adjusts the viewed images to the operator's desire

Location of controls (Yoke assy)

Figure	Controls	Descriptions	Function
	Elevation Knob lock (2)	Star knob and spring plunger	Locks NOD into stow position. Also releases brake so that NOD can obtain 30° up and 70° down motions.

Figure	Controls	Descriptions	Functions
	Azimuth lock knob	Star knob and spring plunger	Locks NOD in azimuth and release brake, so that NOD can obtain 90° left and 90° right motions.
	Yoke lock knob	Star knob and spring plunger	Connect yoke assy to the mount. This knob should never be adjusted.

Rack assy-hold the NOD assembly and seat. The rack is swung and locked to the ceiling of the aircraft for storage. The rack is has two pinned slots, a safety bolt is inserted into slots and held by two carter pins, to prevent the bolts from working loose during non-NOD operational periods.

Armor plate shield - This shield is used to protect the NOD operator. It is stored by folding it down so that it will lay level with the aircraft flooring. The shield must be raised into its operational position before lowering NOD rack assy into place. Insure that when install the shield into its operational position, that the armor plating is flush against the frame of starboard door (front). With the shield in the up position the operator must be able to install the two safety pins. The pins are installed to insure the NOD is aligned with the guns. The above step allows the NOD and the guns to be in proper boresight at all ranges.

TPI = Threads per inch

1. Turn switch off.
2. Remove oscillator.
3. Remove eyepiece assembly.
4. Tap battery compartment gently to loosen tube.
5. Pull image tube from image focusing tube.
6. Carefully touch high voltage pin on image tube (see figure 6-3) to image focusing tube until charge is removed. Do not damage the end of image tube.

1.4 EQUIPMENT CHARACTERISTICS. (See Table 1-1)

TABLE 1-1

PHYSICAL CHARACTERISTICS

Characteristics	Requirements
Physical	
Night Observation Device	Diameter: 11 1/2 inches
Electro-Optical Systems, Inc.	Length: 25 5/8 inches
	Weight: 45 pounds
Assembly	**Characteristics**
Day Sight	Length: 23.07 inches
Electro-Optical Systems, Inc.	Diameter: 2 1/4 in. large O.D.
	1 3/4 in. small O.D.
	Weight: Approx. 15 pounds
	Magnifying Power: 3X
	Field of View: 12^{o}
	Eyepiece Focus
	Range: ±4 diopters
	Reticle Pattern: Crosshair
Yoke Assembly	NOT AVAILABLE AT THIS TIME
Electro-Optical Systems, Inc.	

1-5. ADDITIONAL EQUIPMENT REQUIRED. (See Table 1-2)

TABLE 1-2

ADDITIONAL EQUIPMENT LIST

Item	Quantity Each	Description
1	1	Battery
2	1	Cover, objective lens

2-3. INSPECTION

2-4. Visually inspect the night observation device after the final wrapping is removed to determine if defects or damages have occurred during shipment. Inspect the equipment as follows:

1. Check the contents of the shipping container against the packing slip and against the list in Table 1-2. In the event of discrepancies or missing items, notify the cognizant organizational maintenance representative immediately.
2. Examine all external parts for excess dust and dirt, chipped or bent surfaces, etc.
3. Check all nameplates, range venier, and controls for general legibility.
4. Remove the eyepiece and objective lens covers and examine lenses for cracks, chips, or evidence of moisture.

2-5. INSTALLATION OF BATTERY (See figure 2-2)

The following steps describe the procedure for installing the battery:

1. Verify that viewing device power switch (see figure 2-2) is down (off position).

CAUTION

Installation of battery with power switch on could result in damage to the system.

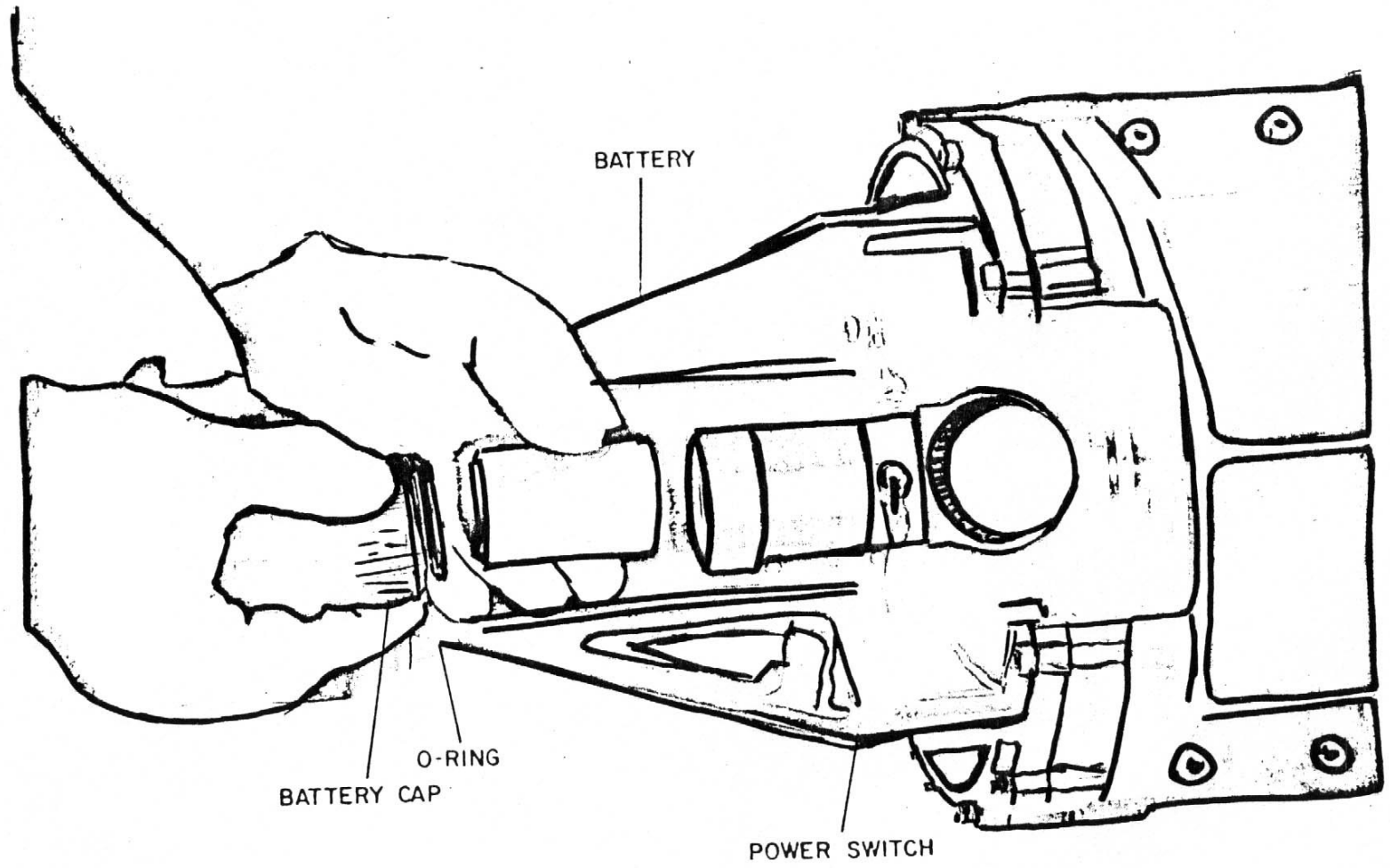


Figure 2-2. Installation of Battery

2. Unscrew and remove battery cap.
3. Remove battery from shipping container.
4. Install battery with plus (+) end into power supply housing.
5. Replace battery cap.

2-6. REPACKING

The system is to be repacked in the original shipping container before shipment aboard vehicles or when the system is not to be used for extended periods. Repack the system as follows:

1. Verify that power switch is off.
2. Turn battery cap counterclockwise until the cap is free of the night observation device.
3. Remove battery from housing.
4. Replace battery cap on night observation device.
5. Install lens covers over objective and eyepiece.
6. Repack battery and assemblies in original shipping container.
7. Check for all items listed in Table 1-2.

2-7. TRANSPORTING UNDER ADVERSE CONDITIONS

If tactical conditions prohibit repacking in the original shipping container for transport, the dismantling procedure should be used. Lens covers should be used to protect the device.

SECTION III

OPERATING INSTRUCTIONS

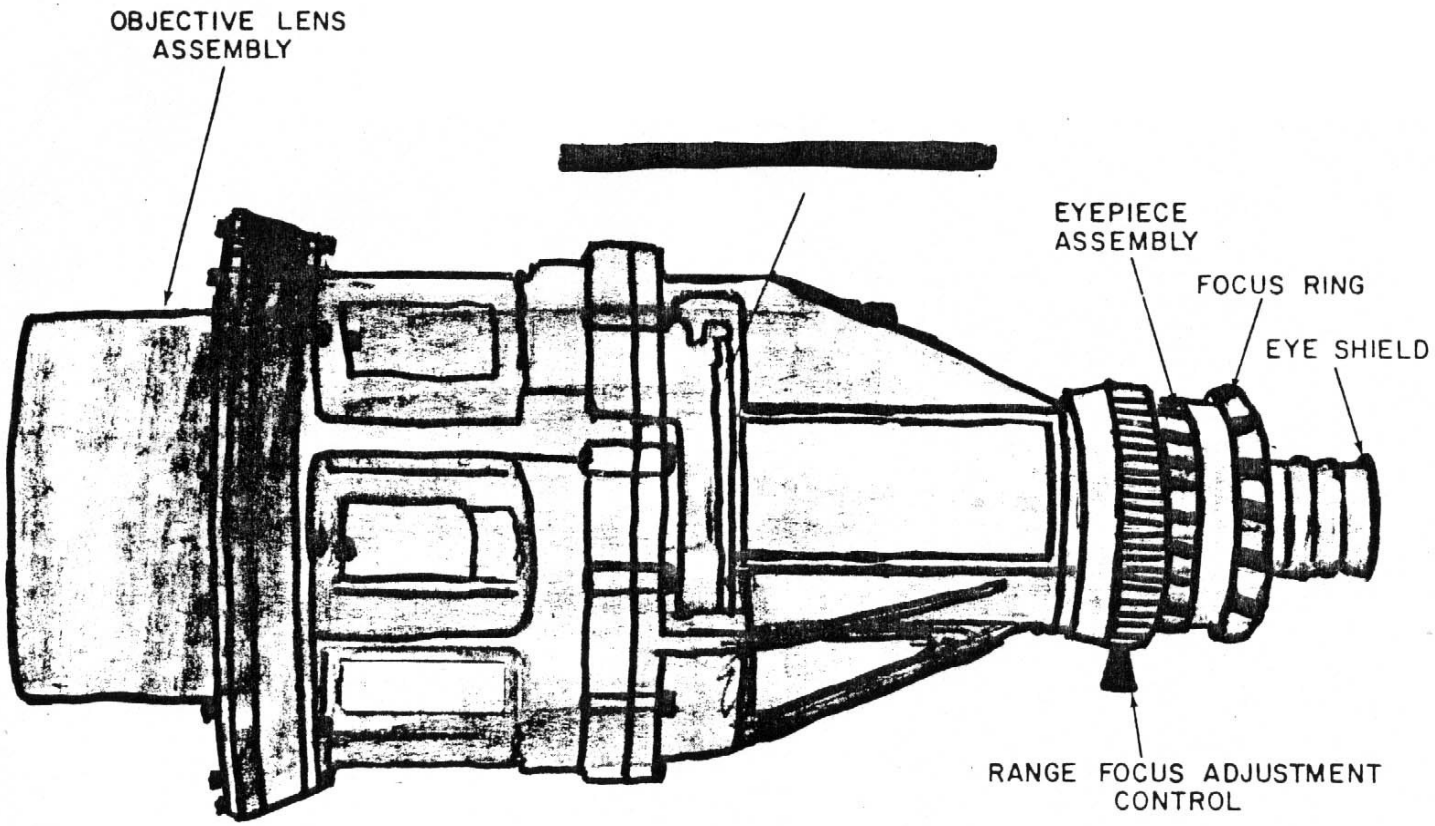
3-1. CONTROLS AND INDICATORS

This section describes, locates, illustrates, and furnishes the operator and organizational maintenance personnel sufficient information to operate the airborne night observation system. Table 3-1 lists all controls and indicators and describes their functions. Figures 3-1 and 3-2 show their locations.

TABLE 3-1

LOCATION OF CONTROLS AND INDICATORS

Figure	Control/Indicator	Description	Function
3-4	IRIS ADJUSTMENT CONTROL	Star knob and spring plunger	Adjusts amount of light admitted by objective lens. Opening should be reduced for high ambient light level. Should be focused with fully open iris, then reset to existing light conditions.
3-2	RANGE FOCUS CONTROL	Knurled focusing collar with handle	Rotates to adjust image clarity.
3-1	POWER (viewing device)	Toggle switch	Provides power to night observation device.
3-2	EYEPIECE FOCUS CONTROL	Knurled focusing ring	Rotates for adjusting sharpness of reticle image.
	ELAPSED TIME METER	Running time meter	Automatically turns on when system is activated. Permanently records elapsed running time of system.


OBJECTIVE LENS ASSEMBLY
EYEPIECE ASSEMBLY
FOCUS RING
EYE SHIELD
RANGE FOCUS ADJUSTMENT CONTROL

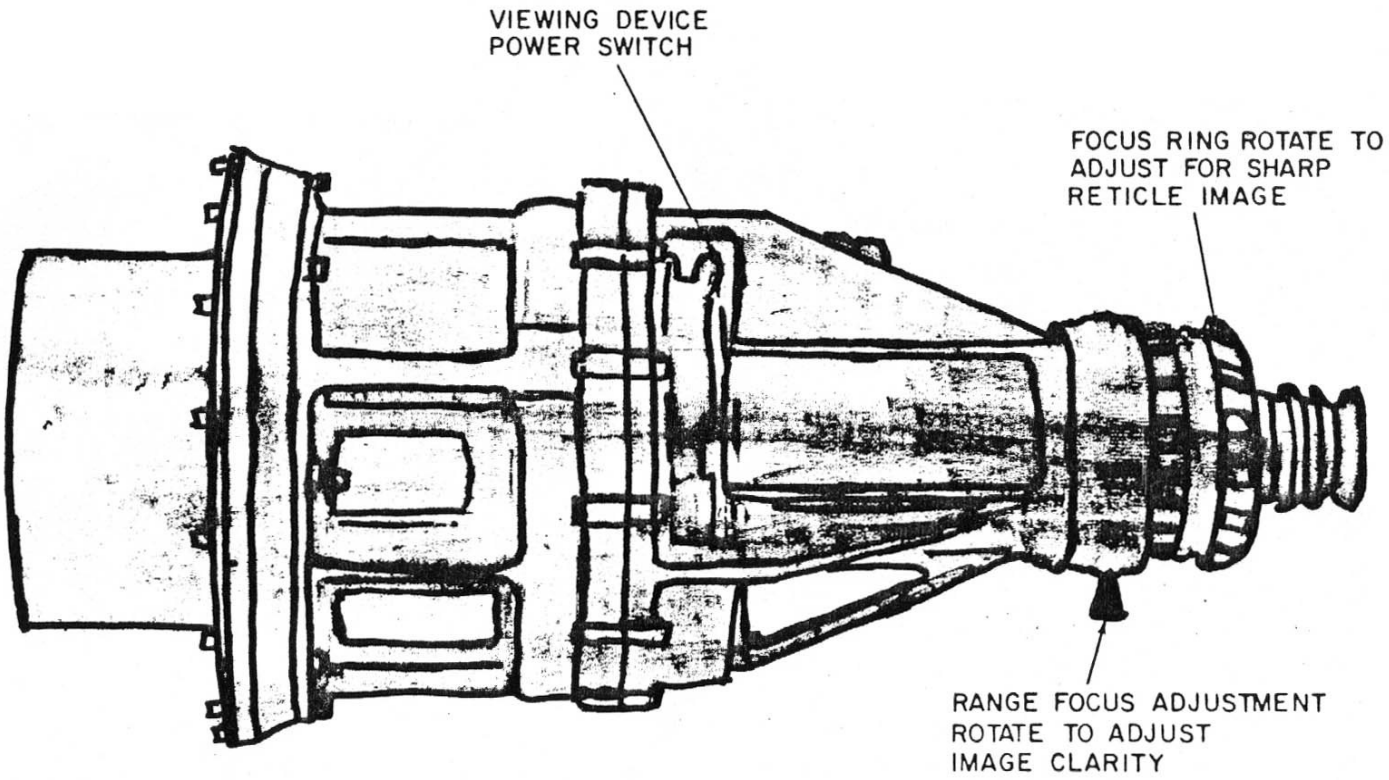


Figure 3-1. Airborne Night Observation System, Left Side View

3-2. OPERATING PROCEDURE

Before operating the airborne night observation system, the operator should read all instructions to become familiarized with the overall device operation.

3-3. VIEWING DEVICE TURN-ON

Perform the following procedure for viewing device turn-on:

CAUTION

Do not turn on the viewing device in high ambient lighting conditions. This will cause the image tube to fail to function. Perform this procedure only at night or in a darkened room.

1. Set iris for minimum aperture (8.0 on vernier).
2. Turn on viewing device power switch by placing toggle switch in up position.
3. Open iris and adjust eyepiece focus ring for sharp reticle image (see figure 3-3).
4. Adjust range focus for sharpest image.

3-4. RETICLE OPERATION

The reticle pattern, observable when viewing through the eyepiece, serves as a guide for focusing the eyepiece and centering the target. The eyepiece focus control is used to adjust the eyepiece to the requirements of an individual operator. The range focus control adjusts for variations in distance between the viewer and the object (see figure 3-4).

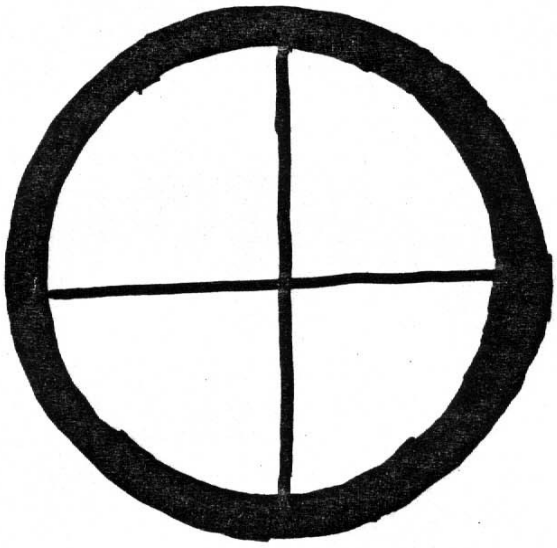


Figure 3-3. Reticle Image

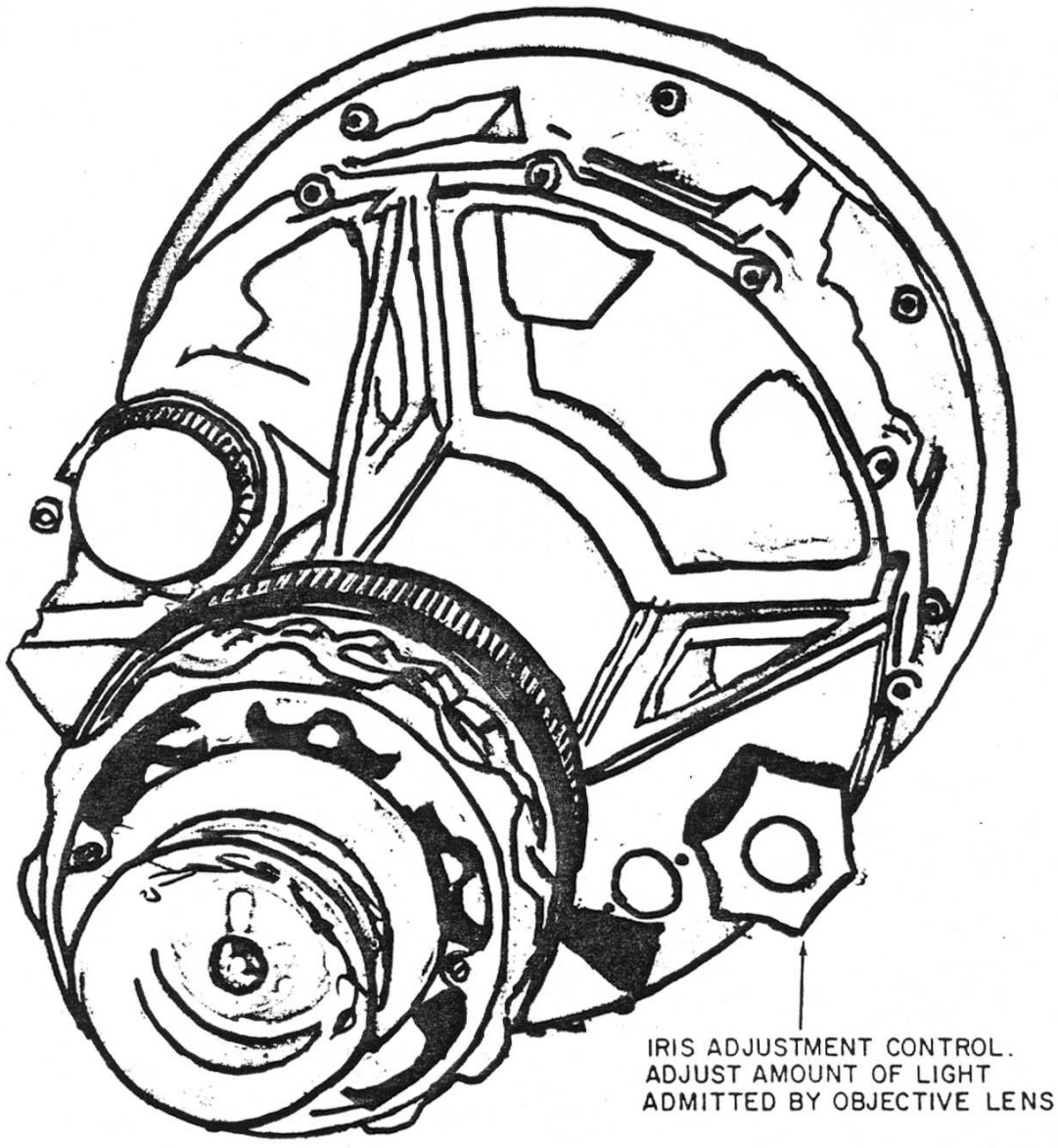


FIGURE 3-4. Range Focus Control, Eyepiece Assembly

1. When using the reticle to adjust fire, the observer must remember that the same adjustment procedure must be used for day as well as night use of reticle graduations.

2. Rotate the eyepiece focus control for sharp reticle image.

3. Open the iris fully to reduce depth of field, then rotate range focus control for sharp image of object being viewed.

NOTE

Focusing adjustments should be made on the ground before takeoff by training viewing device on stars; this assures optimum focus at infinity.

4. Rotate the iris control for sharpest image. This will be some position between 0.87 (wide open) and 8.0 (closed) on the iris adjustment vernier.

3-5. SYSTEM SHUTDOWN

Turn off viewing device power switch by placing toggle switch in down position.

3-6. OPERATION IN EXTREME COLD OR HEAT

The airborne night observation system is designed for operation at relative humidities to 90%, at temperatures between -20°F and +125°F, and to altitudes of 15,000 feet.

3-7. OPERATION IN SALT WATER AREAS

All external parts of the system should be thoroughly cleaned and dried after exposure to salt spray conditions. The system will operate satisfactorily under such conditions but care should be exercised to preserve parts from the effects of exposure.

3-8. OPERATION IN SANDY AND DUSTY AREAS

System operation in sandy or dusty areas is not recommended because the exposed oiled surfaces are susceptible to such material. When such operation cannot be avoided, the following precautionary measures should be taken.

1. Do not direct the objective lens into the wind; sand and dust particles will scratch and pit the delicate optical surface.
2. Cover the viewing device to the greatest extent practicable to prevent undue exposure of all external surfaces.
3. Keep shipping container closed except when removing or replacing equipment.
4. Clean eyepiece and objective lenses frequently with a soft lens brush and finish cleaning with lens tissue.
5. Keep lens covers on objective and eyepiece assemblies when not in use.

3-9. OPERATION UNDER RAINY CONDITIONS

The airborne night observation system is designed for satisfactory operation without damage under rainy or humid conditions.

CAUTION

To prevent corrosion or deterioration, thoroughly dry all parts of the airborne night observation system after exposure to rain or humidity. Clean the lenses with a soft lens brush and lens tissue.