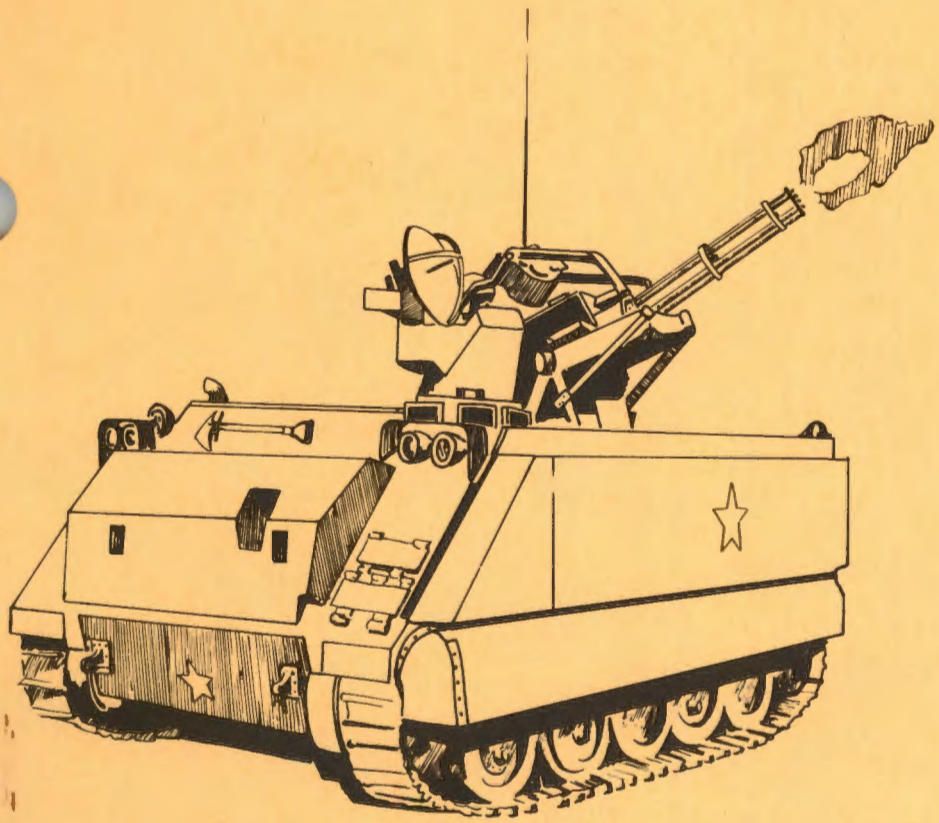
FM 44-5

FIELD MANUAL

PROCEDURES AND DRILLS FOR VULCAN SELF-PROPELLED WEAPON SYSTEM



HEADQUARTERS, DEPARTMENT OF THE ARMY

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FIELD MANUAL
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DEPARTMENT OF THE ARMY
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*This manual supersedes FM 44-5, 9 August 1968.

CHAPTER 1

INTRODUCTION

1-1. Purpose and Scope

a. This manual provides guidance for platoon and squad personnel in the techniques and procedures for tactical employment of the Vulcan self-propelled weapon system and associated equipment. A general description of the weapon to include the mount, radar, sights, communication equipment, firing techniques, target identification, target selection, and crew drill and responsibilities also are presented.

b. The material contained herein is applicable to both nuclear and nonnuclear warfare.

1-2. Recommended Changes and Comments

Users are encouraged to submit recommended changes and comments to improve this manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons will be provided for each comment to insure understanding and complete evaluation. Comments should be prepared, using DA Form 2028 (Recommended Changes to Publications) and forwarded direct to Commandant, US Army Air Defense School, ATTN: ATSAD-DL, Fort Bliss, Texas 79916.

1-3. References and Abbreviations

References listed in the appendix should be consulted for details beyond the scope of this manual. Abbreviations used in the manual that are not listed in AR 310-50 are explained in the text where they first appear.

1-4. Safety

Operation of Vulcan equipment presents hazards to both personnel and equipment. Personnel operating the equipment and personnel in the immediate area must be constantly alert and exercise caution to preclude injury to personnel or damage to equipment. Specific hazards and required precautions are described in this manual where the appropriate item of equipment or procedure is discussed.

CHAPTER 2

MISSION AND MANNING

2-1. Missions

The missions of the self-propelled Vulcan units are—

a. To provide air defense for forward combat elements, areas, vital areas, or installations against low-altitude hostile aircraft.

b. To attack and destroy hostile targets on land and water.

2-2. Manning

The Vulcan self-propelled weapon system is manned by a squad of four men consisting of a squad leader, senior gunner, driver, and gunner. The squad's duties include operation, emplacement, displacement, and operator maintenance of the system and associated equipment and delivery of effective fire on hostile aerial and surface targets.

CHAPTER 3

SYSTEM DESCRIPTION

3-1. General

The Vulcan self-propelled weapon system is a surface-to-air gun system with a surface-to-surface (ground) capability. It is deployed in forward areas of the field army to protect against hostile aircraft operating at low altitudes. Since visual target detection, tracking, and identification are required to engage hostile aircraft, the system is capable of air defense operation only during periods of good visibility. The Vulcan system can be used in the ground role for perimeter or area defense during daylight or darkness. It can be used to deliver a high rate of fire during assault.

3-2. Major Components

The Vulcan self-propelled weapon system XM163 consists of a six-barrel, 20-mm, automatic cannon with a fire control system mounted on a full-tracked armored chassis (fig. 3-1). It is capable of high-speed travel on improved roads, extended travel over rough terrain, and amphibious operation on streams and small lakes. The system is equipped for on-vehicle intercommunications between crew members, and voice radio communications. The system can be transported by cargo aircraft. Major components of the system are a 20-mm automatic cannon XM168; a sighting system (fig. 3-2) consisting of lead-computing sight XM61, telescope XM134, and night vision sight AN/TVS-2; and range-only radar AN/VPS-2; all on mount XM157; and a full tracked armored chassis XM741.

a. Vulcan Cannon XM168.

(1) The Vulcan cannon XM168 is an electrically powered, 6-barrel, air-cooled, rotary weapon. It fires electric primer 20-mm ammunition at a selected rate of 1,000 or 3,000 rounds per minute. The length of a burst is operator-controlled at the low rate of fire and is selectable at 10-, 30-, 60-, or 100-round bursts at the high rate of fire. The six barrels are mounted in a circular cluster that is rotated in a counterclockwise direction by a gun drive assembly. Each barrel has its own bolt mechanism that chambers, fires, and extracts one round each time the barrel cluster makes a complete revolution.

(2) A muzzle clamp, mounted near the forward end of the barrel cluster, controls the dispersion pattern by pointing the barrels in slightly different directions. Two muzzle clamps, one for antiaircraft fire and one for ground fire, are furnished. When the antiaircraft clamp is used, the dispersion pattern has a vertical spread of approximately 6 mils and a horizontal spread of approximately 18 mils. When the ground fire clamp is used, the dispersion pattern is circular and approximately 5 mils in diameter.

b. Vulcan Mount XM157. The Vulcan mount XM157 supports the Vulcan cannon and provides the means for mounting it on the chassis. The mount components are divided into the following functional groups: structure group, cannon control group, ammunition feed and storage group, mount positioning group, power and signal distribution group, and fire control group.

(1) The structure group consists of a plate and bearing, drum mount, gunner's shield assembly, and saddle assembly. The plate and bearing group supports the weight of the entire armament system and permits the mount to rotate continuously in azimuth. The saddle assembly provides mounting points for the cannon recoil adapters and rear plate.

(2) The cannon control group contains the arming connector, gun drive assembly, portions of the control assembly, and portions of the distribution box. The gun drive assembly drives the

Figure 3-1. Vulcan self-propelled weapon system, 20-mm, XM163.

cannon rotor. Circuits in the control assembly control the length of bursts and the electrical trigger circuits for firing the cannon. The cannon drive and trigger circuits are disabled when the arming connector is disconnected from the distribution box.

(3) The ammunition feed and storage group consists of a storage drum assembly, conveyor system, and case chute. The drum assembly stores 1,080 to 1,090 rounds of ammunition and feeds it into the ammunition conveyor system which carries the ammunition to the cannon. The case chute guides empty cartridge cases or unfired rounds to an area clear of the cannon and mount. It also contains the universal joint, transfer drive assembly, and flexible shaft assembly, which transmit drive power from the declutching feeder assembly to the drum assembly.

(4) The mount positioning group contains the components necessary to drive and control the mount in azimuth and elevation. The group consists of portions of the control assembly, three servoamplifier assemblies, azimuth drive assembly, elevation drive assembly, azimuth switch assembly, and elevation limit switch assembly.

(5) The power and signal distribution group consists of three nickel-cadmium mount batteries, cables, portions of the gun distribution box, inverter, and slipring assembly.

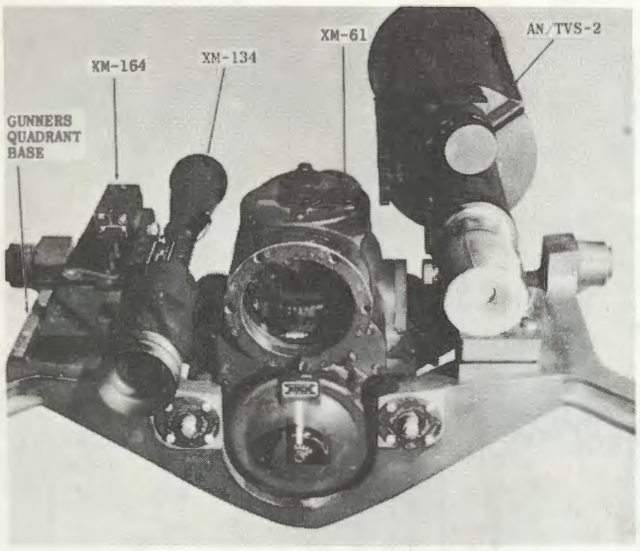


Figure 3-2. Vulcan sights.

(*a*) The mount batteries supply power to operate the XM163 system (less the XM741 chassis). Two batteries supply power for the gun drive and loading motors. The third battery supplies power for all other circuits.

(*b*) The gun distribution box (fig. 3-13) functions as a junction box for electrical interconnection of gun mount assembly components. It contains a power supply for converting 24 vdc battery power to 330 vdc firing power, circuits to route the ac and dc voltage outputs of the inverter, time delay circuits, and connections to route signals to various mount assemblies. The gun distribution box has externally mounted meters for monitoring battery charging current and voltage, a NORM/STATIC/TEST switch, and an elapsed time indicator for recording total system power-on time. An arming connector on the gun distribution box enables the weapon trigger circuit.

(*c*) The inverter converts battery power to ac and dc power suitable for use by the sight gyro motor and sight current generator.

(*d*) The slipring assembly provides sliding electrical connections between the mount and vehicle to allow unlimited traverse in azimuth.

(6) The fire control group contains the elevation potentiometer assembly, sight current generator, portions of the control assembly, external range unit, and the foot switch assembly. These components, with the exception of the foot switch assembly, operate in conjunction with the sight XM61 to automatically generate a lead angle when the system is operated.

(*a*) The elevation potentiometer assembly provides cannon elevation data to the sight current generator.

(*b*) The sight current generator receives data from the elevation potentiometer assembly, sight XM61, and the range-only radar (ROR), external range unit, or control assembly. It provides magnet current and torque motor current to the sight. Two rotary switches on the sight current generator are used to set in air density and muzzle velocity factors.

1. In the manual mode, estimated target speed and range are set with the control panel knobs, and that information is transmitted to the sight current generator from the control assembly.

2. In the radar mode, the ROR provides range and range rate data to the sight current generator. The radar is caused to radiate by operating the foot switch.

(*c*) The external range unit is connected to a receptacle on the right rear of the chassis. In the external mode, it is used to insert range information into the sight current generator and to light the ready-to-fire lamp from a point up to 60 feet from the weapon.

c. Range-Only Radar AN/VPS-2.

(1) The range-only radar is mounted on the gun mount assembly. The radar searches automatically in range from 250 to 5,000 meters and will lock on the target being tracked by the senior gunner. It measures target motion along the line of sight as target range and range rate and supplies this information to the sight current generator.

(2) The radar can operate on any one of six frequencies. This feature permits simultaneous operation of up to six Vulcan systems in clustered deployment without mutual interference between radars. Frequency selection is controlled by plug-in crystal oscillator subassemblies and retuning of the klystron power amplifier.

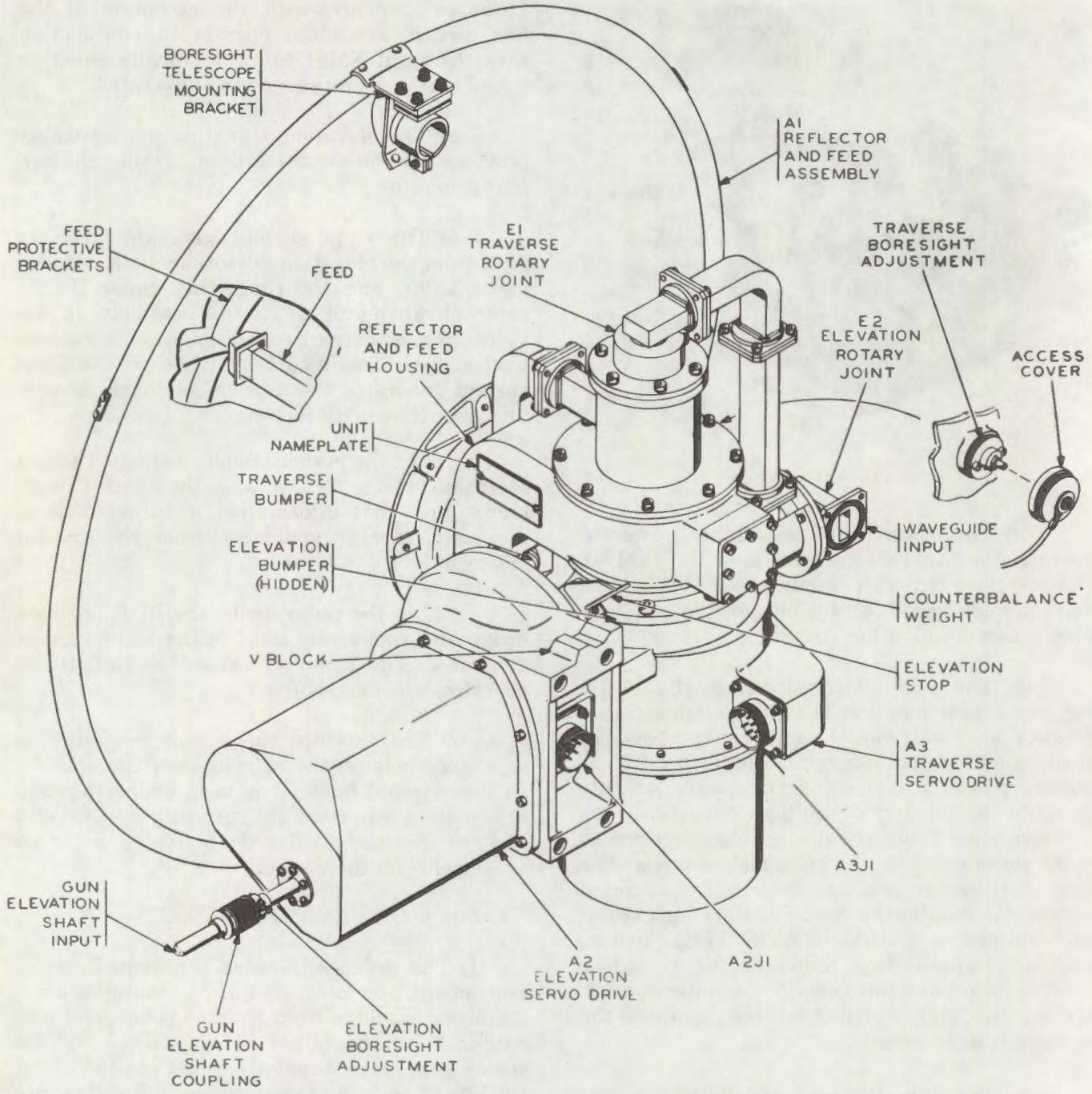


Figure 3-3. Radar antenna.

(3) The range-only radar consists of six major components; antenna, receiver-transmitter, receiver, range computer, power supply, and distribution box.

(*a*) The antenna (fig. 3-3) radiates RF energy and receives target echoes. It is composed of elevation and azimuth servodrive assemblies, reflector and feed assembly, and elevation and azimuth rotary joints. The servodrive assemblies receive position data from the sight XM61 and keep the radar antenna alined with the line of sight to the target. A boresight telescope mounting bracket is mounted on the antenna reflector.

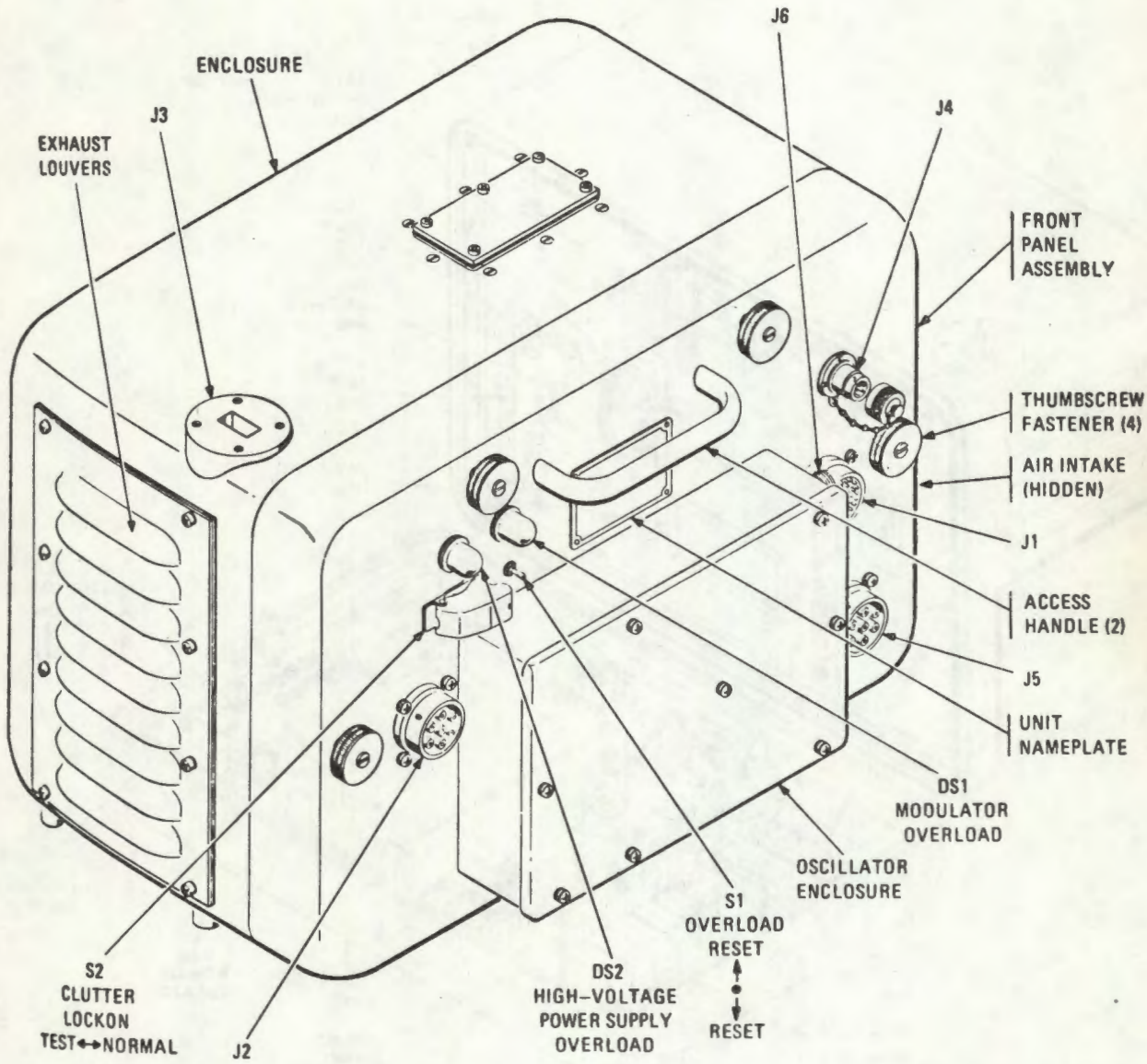


Figure 3-4. Radar receiver-transmitter.

(*b*) Receiver-transmitter RT-860/VPS-2 (fig. 3-4 and 3-5) generates the high-power transmit pulses that are radiated by the antenna and receives target pulses from the antenna. The received pulses are converted to an intermediate frequency (IF) and applied to the receiver R-1475/VPS-2.

(*c*) Receiver R-1475/VPS-2 (fig. 3-6) extracts information from the received IF. This information goes to the range computer CP-888/VPS-2.

(*d*) Range computer CP-888/VPS-2 (fig. 3-7) generates range and range rate information from the signals it receives from the receiver and transmits this data to the sight current generator as analog voltages. The range computer also establishes the pulse repetition frequency of the radar and coordinates timing functions of other radar circuits.

(*e*) Power supply PP-4812/VPS-2 (fig. 3-8) develops and regulates all primary power required by the radar. It also develops and con-

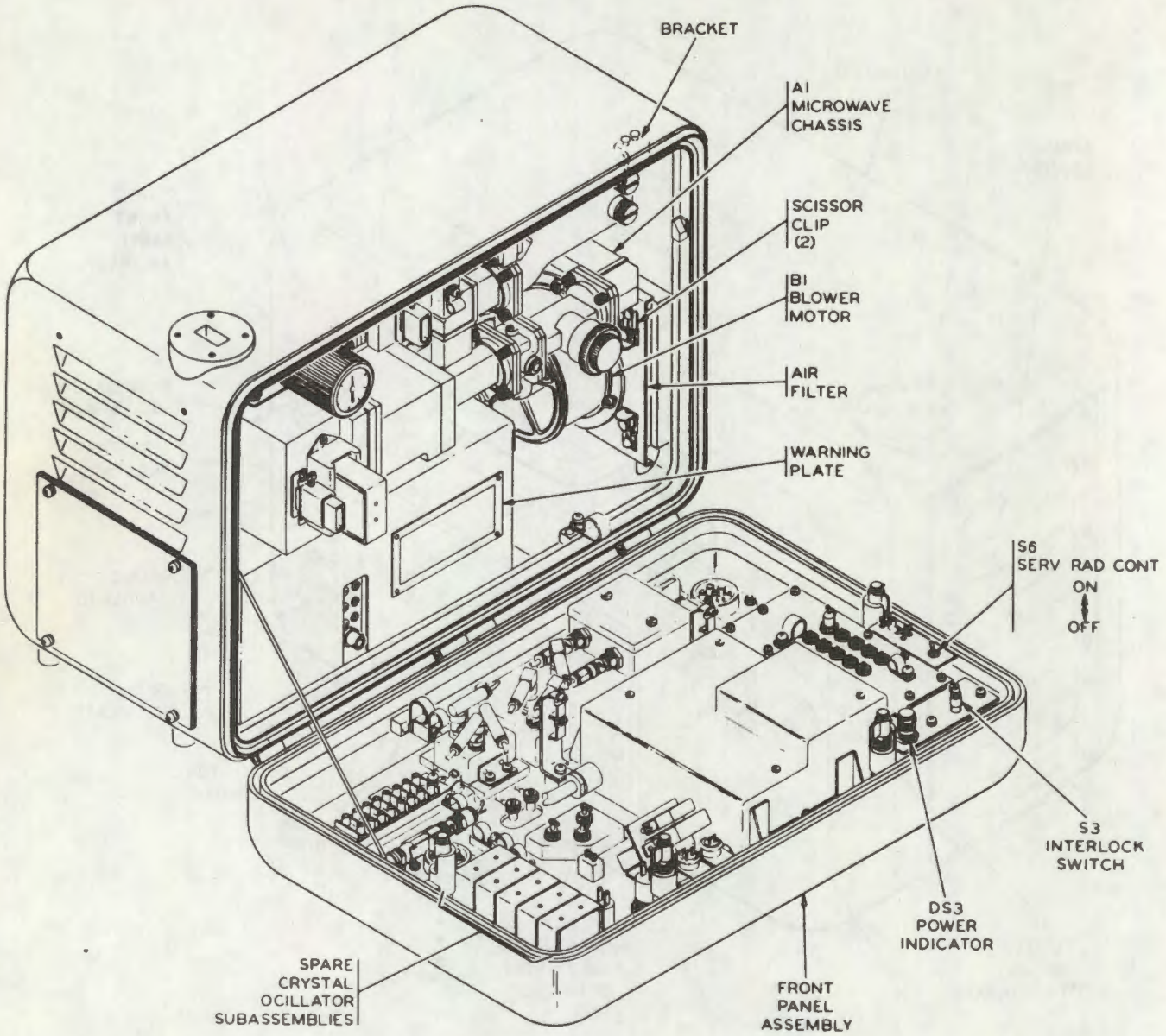


Figure 3-5. Radar receiver-transmitter (interior).

trols the elevation and azimuth dc drive voltages. The power supply operates on 24 volts dc obtained from the mount batteries.

(*f*) The radar set distribution box (fig. 3-9) (stow control) provides switches for selecting the stow or normal mode of positioning the radar antenna reflector, and for traversing and elevating the reflector when operating in the stow mode. Five connectors (jacks) on the sides of the box provide for interconnection of radar components.

d. Vulcan Chassis XM741. The self-propelled Vulcan carriage is a modified armored personnel carrier M113A1, redesignated chassis XM741 (fig. 3-1). The XM741 has a diesel engine, an automatic transmission, and full tracks. The tracks are used to propel and steer the chassis on land and in water. A flotation kit, consisting of seven metal-covered foam pods, has been attached to maintain proper chassis position when operated in water. The watertight, welded aluminum armor plate hull is thick enough to protect the crew from small arms fire.

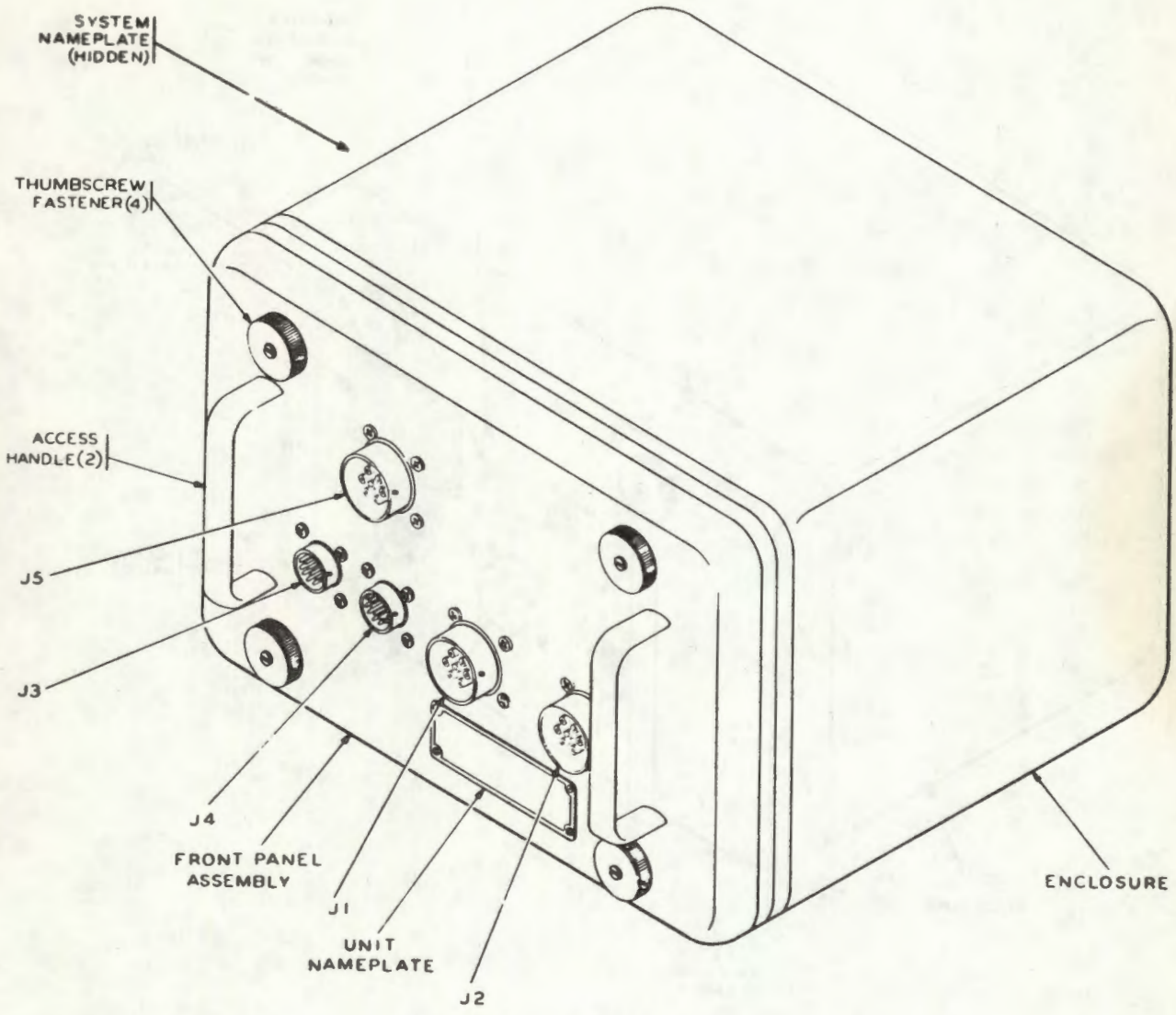


Figure 3-6. Radar receiver.

3-3. Sighting and Fire Control Equipment

a. Sight XM61. The Vulcan sight XM61 (fig. 3-2) is a gyro-stabilized, lead-computing sight designed primarily for use against aerial targets, which can also be used against moving or stationary surface targets. It is mounted in the center of the sight support assembly. The sight and sight current generator (para 3-2*b*(6)(*b*)) compute lead angle and superelevation, and the optical line of sight is automatically offset from the axis of the cannon accordingly. Electrical outputs from the sight provide position reference data to the radar antenna servos. A detailed listing of the controls and instruments is contained in TM 9-2350-300-10.

b. Telescope XM134. Telescope XM134 (fig. 3-2) is a fixed-focus, six-power sight with a 5° (89m) field of view. It is mounted on the left side of the sight support assembly by means of mount XM164. This sight is used during daylight hours for direct fire at ground targets. Detailed descriptions of the telescope and mount are contained in TM 9-1240-318-35 and TM 9-1240-319-35, respectively.

c. Night Vision Sight AN/TVS-2. The night vision sight AN/TVS-2 (fig. 3-2) is a battery-powered, electro-optical, seven-power sighting device. It is used for observation and aimed fire under minimum light conditions such as star-

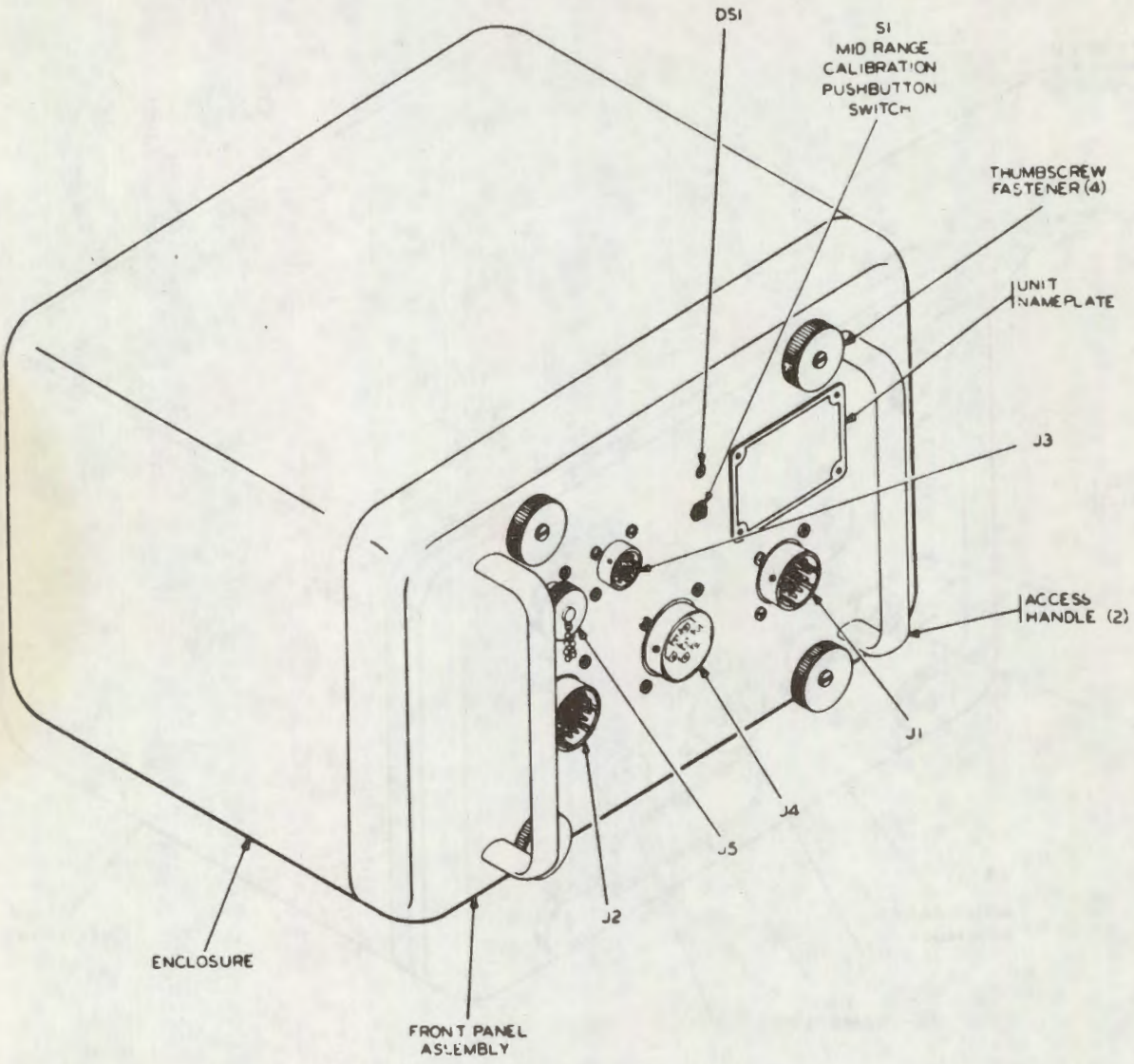


Figure 3-7. Range computer.

light, moonlight, or artificial illumination. It is mounted on the right side of the sight support assembly. A more detailed description of the night vision sight is contained in TM 11-5855-202-13.

d. Gunner's Quadrant M1A1. The gunner's quadrant is stowed in a carrying case, carried in the oddment bin of the Vulcan. It is used for leveling the cannon XM168, for laying the cannon in elevation, or for measuring its angle of elevation. The gunner's quadrant consists of a level holder with an index plate, elevation scale, micrometer, and level vial. The elevation angle is read as the sum of the elevation scale and micrometer readings when the level bubble on the level holder is centered. A plunger in the level holder, when pressed into the holder, permits rapid setting of coarse steps, and the micrometer permits fine adjustments. Two elevation scales, one on each side of the quadrant, are graduated in 10-mil increments and numbered every 50 mils. One scale reads from 0 to 800 mils, and the other from 800 to 1,600 mils. The micrometer has two scales graduated in 0.2-mil increments from 0 to 10 and numbered every mil. Red or black figures on the scales are read according to the engraved instructions below the micrometer. Arrows marked "LINE OF FIRE" indicate the correct reference surface for the scale in use as well as the direction for positioning the quadrant on the gun. Additional in-

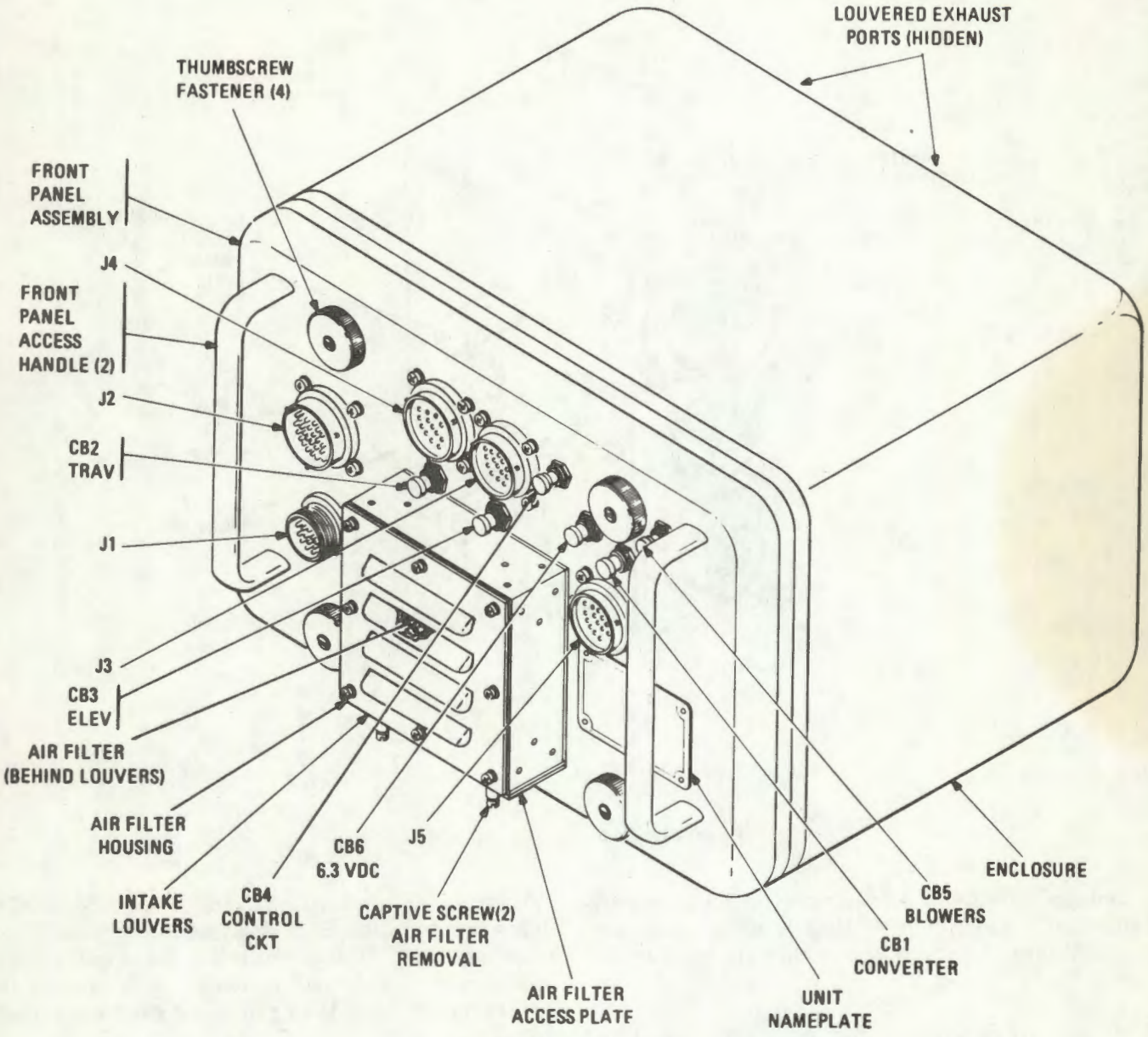


Figure 3-8. Power supply.

structions for operation of the gunner's quadrant are contained in TM 9-1290-200-15.

e. Boresight Kit Assembly. The boresight kit consists of a muzzle adapter, mandrel assembly, elbow telescope M109, keys, and case. It is used to boresight the sight XM61, telescope XM134, and AN/VPS-2 radar antenna with the cannon. The night vision sight AN/TVS-2 is alined with the telescope. Thus all sights are effectively alined with the cannon.

f. External Range Control Assembly. The external range control assembly allows an operator outside the vehicle to insert range information into the system XM163 when in the EXT mode.

3-4. Communication Equipment

a. On-vehicle intercommunications for the crew are provided by an intercommunication set AN/VIC-1(V) consisting of three intercommunication set control boxes C-2298/VRC, an audiofrequency amplifier AM-1780, and necessary cabling. A combat vehicle crewman's helmet CVC-12 is connected to each control box. The helmets contain earphones and microphones that allow the squad leader, senior gunner, and driver to listen and talk over the inter-

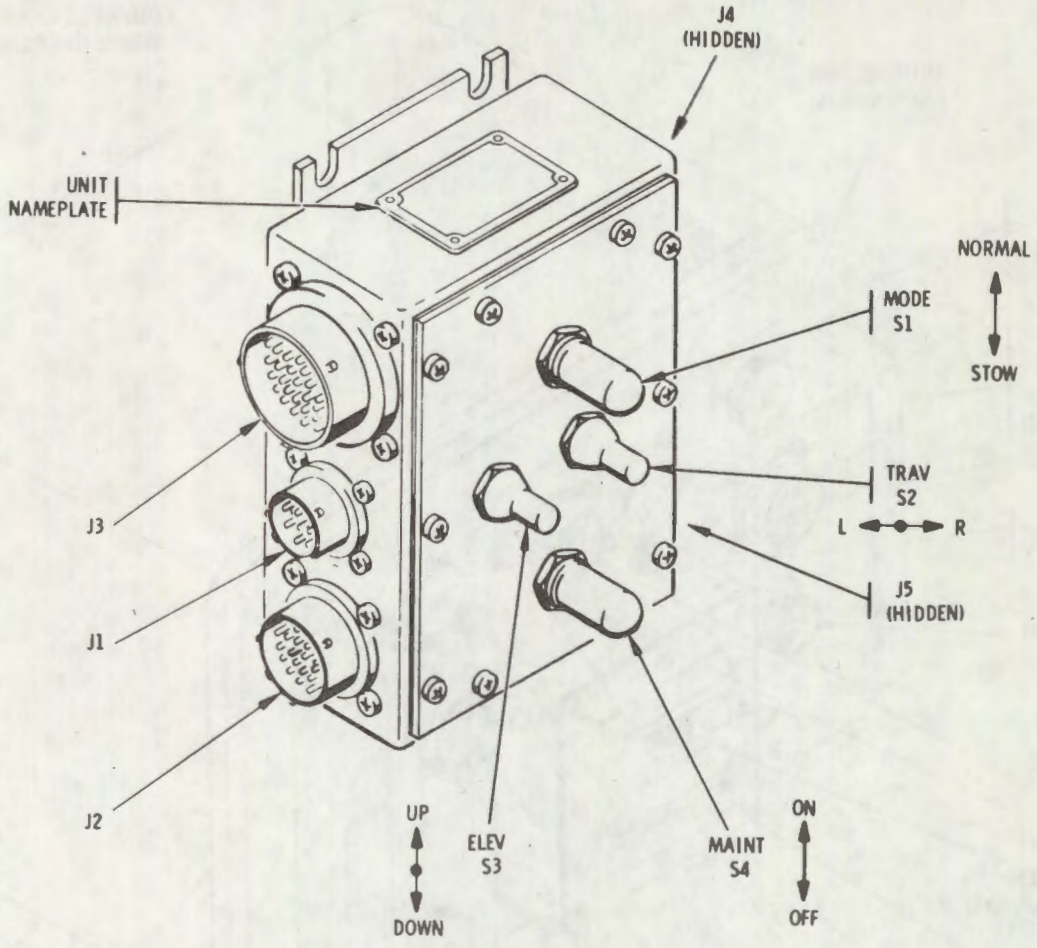


Figure 3-9. Radar set distribution box.

communication set. The gunner is not provided with a CVC-12 helmet; therefore, he must receive information and orders directly from other crewmen.

b. Two-way radio communications are provided by a frequency-modulated radio set AN/VRC-47. The AN/VRC-47 has an auxiliary receiver R-442/VRC used in monitoring the command net of an adjacent or supported unit.

c. External wire communications are provided by a TA-312/PT telephone set and 1,320 feet of field wire WD-1/TT. The field telephone can be connected into the intercommunication system if required.

3-5. Vulcan Ammunition

Ammunition used with the Vulcan cannon is described in *a* through *e* below:

a. Cartridge, High-Explosive, Incendiary, Tracer, w/Pyrotechnic SD (HEIT-SD) M246E5. This ammunition has a superquick, point-detonating fuze. If the projectile does not strike the target, a self-destruct feature will destroy it at tracer burnout. It is primarily used for aerial fire.

b. Cartridge, Ball, w/Tracer (TP-T) M220. This ammunition is used in training. It has a tracer similar to that of the M246 cartridge.

c. Cartridge, High-Explosive (HE) M56A3. This ammunition is high-explosive, point-detonating, without tracer, and is used in firing at ground targets.

d. Cartridge, MIX HEI w/TP-T 7-1 LKD. This mixture of seven M56A3 rounds to one M220 round is used in the ground role when tracer is desired with the high explosive without a self-destruct feature.

e. Cartridge, Dummy (DUM) M51A1B1. This ammunition is inert and is used for nonfiring system checkout and drill.

3-6. Tabulated Data

a. Physical Characteristics.

(1) *Dimensions.*

(*a*) Length:

1. Maximum, overall .... 15 ft, 11.5 in.
2. Minimum, less towing eyes ..... 15 ft, 10 in.

(*b*) Width:

1. Maximum, overall .... 9 ft, 4.4 in.

2. Minimum, less track shrouds ..... 8 ft, 4 in.

(*c*) Height:

1. Maximum ..... 8 ft, 10 in.

2. Minimum ..... 8 ft, 3 in.

(*d*) Ramp opening:

1. Height ..... 4 ft, 1.5 in.

2. Width ..... 4 ft, 6 in.

(*e*) Ground clearance ..... 16 in.

(2) *Weight (approx).*

(*a*) Combat-loaded weight* ..... 24,700 lb

(*b*) Shipping weight ..... 19,200 lb

(*c*) Center of gravity: From centerline of drive sprocket ..... 70 in.

(3) *Bridge classification numbers.*

(*a*) Unloaded 11

(*b*) Combat-loaded 12

(4) *Carriage.* Full-tracked XM741

*Vehicle fully equipped and serviced for operation.

(*a*) *Performance.*

1. On land.

Range	Miles per hour
(a) Maximum speed forward:	1 10
	1-2 21
	1-3 40
	2-3 40
(b) Maximum speed reverse	9 mph
(c) Cruising range (approx)	300 miles
(d) Fuel consumption (approx)	3.4 mpg
(e) Minimum turning radius (with steering levers) ..	22.7 ft
(f) Minimum turning radius (with pivot steering levers)	12.8 ft
(g) Maximum grade ...	60 %
(h) Maximum side slope	30 %
(i) Maximum vertical wall	2 ft
(j) Maximum trench .	5 ft, 6 in.
(k) Maximum towed load	14,500 lb

2. On water.

(a) Speed forward (approx) .....3.6 mph

(b) Fording depth .... Unlimited

(c) Freeboard, combat-loaded ..... 11 in.

(b) *Engine.*

1. Type	Six-cylinder, two-cycle, diesel-compression ignition.
2. Idle speed	550-600 rpm
3. No-load governor speed	2,925-2,975 rpm
4. Fuel types:	
(a) Grade DF-2 (VV-F-800)	Do not use below +32° F.
(b) Grade DF-2 VV-800)	Use for all temperatures.
(b) Grade DF-2 (VV-800)	Use for all temperatures.
(c) Grade DF-A (VV-F-800)	Use for all temperatures.
(d) CITE (MIL-F-46005)	Use for all temperatures.
(e) JP-5 (aircraft turbine engine)	Can be used for emergency conditions above -40° F.

(c) *Transmission.*

1. Speeds	3 fwd., 1 rev.
2. Ranges	4 fwd., 1 rev.

(d) *Bilge pumps.*

1. Type	Submersible
2. Bilge pump output (each) (approx)	44 gpm

(e) *Periscope M17.* *Driver's hatch (4); stowed spare (1).*

1. Power	Unity power (no magnification).
2. Horizontal field of view	150°
3. Vertical field of view	50°

(f) *Periscope M19.* Stowed (1); stowed spare head (1).

1. Optical characteristics:	
(a) Power (approx)	Unity power (no magnification).
(b) Field of view	26.8°
(c) Effective focal length of objective	2.012 in.
(d) Effective focal length of eyepiece	1.452 in.
2. Operating voltage	16,000 volts

(g) *Suspension lockout system.*

1. Type	Hydraulic actuated
2. Control	Manually operated
3. Pressure	1,000 to 1,500 psi

(h) *Component capacities (approx).*

	Refill	*Dry*
1. Engine cooling system	40 qt	40 qt

2. Engine oil system	18 qt	22 qt
3. Transmission oil system	16 qt	20 qt
4. Differential oil system	20 qt	24 qt
5. Transfer gearcase	5 pt	5 pt
6. Final drive (each)	3 pt	3 pt
7. Ramp and suspension hydraulic system ..	7 qt	8 qt
8. Fan gear box	1/2 pt	1/2 pt
9. Fuel compartment	95 gal	95 gal
10. Pivot steer master cylinders (each)	1/2 pt	1/2 pt

(*i*) *Maximum safe fuel acceptance rate* ..... 50 gpm

(5) *Cannon XM168.*

(*a*) Caliber ..... 20 mm

(*b*) Overall length ..... 72 in. (approx)

(*c*) Number of barrels 6

1. Length ..... 60 in.

2. Lands 9

3. Twist ..... Gain twist rh

(*d*) Rotation of barrels ..... Counterclockwise viewed from breech end.

(*e*) Firing rate (round/minute):

1. High 3,000

2. Low 1,000

(*f*) Burst limits ..... High rate: 10, 30, 60 or 100 rounds selected burst; low rate: no preselection of burst.

(*g*) Weight:

1. Less barrels, recoil adapters, mid-barrel, and muzzle clamps . 134 lb (approx)

2. Barrel (each) ..... 18 lb (approx)

(6) *Mount XM157.*

(*a*) Ammunition feed ..... Linkless

(*b*) Type of ammunition storage ..... Drum

(*c*) Rounds stored in drum ..... 1,100 (approx)

(*d*) Drum loading speed ..... 100 rounds per min

(*e*) Elevation limits ..... -89 to +1,423 mils

(*f*) Traverse ..... 6,400 mils

(7) *Sights.*

(*a*) Lead-computing sight XM61:

1. Reticle ..... Concentric circles, 15 and 60 m in diameter.

2. Maximum lead angle ..... 445 m

3. Power 1X

(*b*) Telescope XM134:

1. Reticle ..... See figure 3-10

2. Power 6X

3. Field of view ..... 89 mr

(c) Night sight AN/TVS-2:

1. Type ..... Image intensifier

2. Power 7X

3. Field of view ..... 108 mr

b. Electrical Characteristics (System XM163 Less Chassis).

(1) *Power requirements.*

(a) Standby ..... 20 amperes

(b) Cannon elevating and slewing ..... 113 amperes

(c) Firing ..... 663 amperes

(2) *Power source.*

(a) Mount drive battery ..... 24 volts, 34 ampere-hours.

(b) Gun drive batteries (2) .... 24 volts, 68 ampere-hours.

c. Radar Functional Characteristics.

(1) Range:

(a) Minimum ..... 250 meters

(b) Maximum ..... 5,000 meters (1 sq meter target).

(2) Minimum tracking velocity:

(a) Fixed-wing propellerless aircraft ..... 15 meters/second

(b) Propeller driven or rotary ..... 0 meter/second provided that power in doppler spectrum from rotating aircraft parts is sufficient for tracking.

(3) Power requirements:

(a) Voltage range (input) ... 22 to 30 volts (24 volts nominal).

(b) Power consumption (standby) ..... 670 watts maximum (including momentary 450-watt power consumption for antenna slewing).

(c) Power consumption (radiate) ..... 970 watts maximum (including momentary 450-watt power consumption for antenna slewing).

(4) Antenna positioning:

(a) Elevation limits ..... -10° to +95° (normal operation) -73° to +96° (stow).

(b) Traverse angle limits ... +25° (normal operation) +27.5° (stow).

(5) Antenna:

(a) Gain ..... 33 db

(b) Reflector type ..... 24-inch diameter paraboloid.

(c) Feed type ..... Split horn

(d) Height ..... 25⅛ in.

(e) Width ..... 29½ in.

(f) Depth ..... 23¾ in.

(g) Weight ..... 65 lb

d. Communication Equipment.

(1) *Radio.*

(a) Type AN/VRC-47

(b) Modulation ..... Frequency

(c) Type of emission ..... Voice

(d) Frequency coverage ..... 30 to 75.95 MHz

(e) Number of channels 920

(f) Operating range:

1. Stationary ..... 32 kilometers

2. Moving ..... 25 kilometers

(g) Power source ..... 24-volt dc battery (vehicle or battery pack).

(h) Weight ..... Approximately 128 pounds

(2) *Intercommunication set.*

(a) Model ..... AN/VIC-1(V)

(b) Stations ..... Three (squad leader, senior gunner, driver).

(c) Amplifier AM-1780

(d) Control box C-2298VRC

(3) *Target alert data display set (TADDS).*

(a) Channels 920

(b) Information source ..... RFDL from FAAR

(c) Display ..... 7 by 7 grid squares with one friend and one unknown indicator per square. Friend indicator green, unknown indicator red. A total of 49 friend and 49 unknown indicators can be displayed simultaneously.

(d) Voice communication .. One-way voice communication from FAAR to TADDS.

(e) Power Source ..... Self-contained battery

3-7. Controls and Instruments

a. Control Assembly (fig. 3-11).

(1) *SIGHT LAMP knob.* Permits light intensity of sight reticle to be varied. Rotation from center (OFF) position in either direction increases brightness of sight reticle lamp.

(2) *MODE switch.* Permit selection of one of the following operating modes:

(a) GRD (Ground)—Used for ground tar-

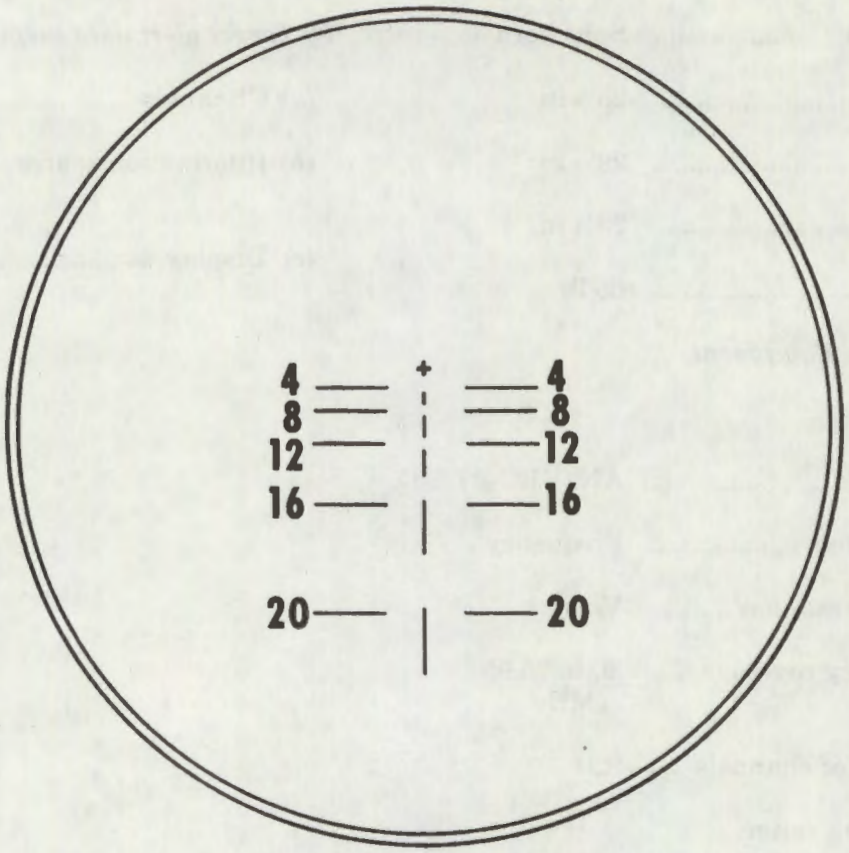


Figure 3-10. Telescope XM134 reticle.

gets. In this mode the radar and lead-computing feature of the sight are not used.

(*b*) RADAR—Used for aerial targets except when the radar is inoperable or, for any reason, cannot be used. In the radar mode, the radar provides target range and range rate data to the sight current generator. The mode switch is turned to RADAR to electrically cage the sight during boresighting.

(*c*) MAN (Manual)—Used for aerial targets. In the manual mode, range and target speed are set into the system by the senior gunner.

(*d*) EXT (External)—Used for aerial targets. In the external mode, range is set into the system through the external range control.

(*e*) TEST—Used for prefire checks. In this mode a simulated gunnery problem is presented to the sight current generator for solution.

(3) *READY WHEN LIT indicator lamp.* Lights when the radar has completed a 2-minute warmup period and is in a standby condition.

(4) *GOOD WHEN LIT indicator lamp.* Lights in TEST mode if sight current generator correctly solves simulated gunnery problem ((2)(*e*) above).

(5) *ROUNDS REMAINING counter.* Indicates number of available rounds remaining in feed system. Counts down toward zero in 10-round decrements and is reset manually.

(6) *FIRING RATE switch.* Used to select firing rate and burst length as follows:

(*a*) LO—NO BURST LIMIT—Used to select firing rate of 1,000 rounds per minute. Burst continues as long as the trigger and action switches are pressed.

(*b*) HI—BURST LIMIT—Firing rate is 3,000 rounds per minute and burst lengths of 10, 30, 60, or 100 rounds are automatically controlled, depending on position of the switch.

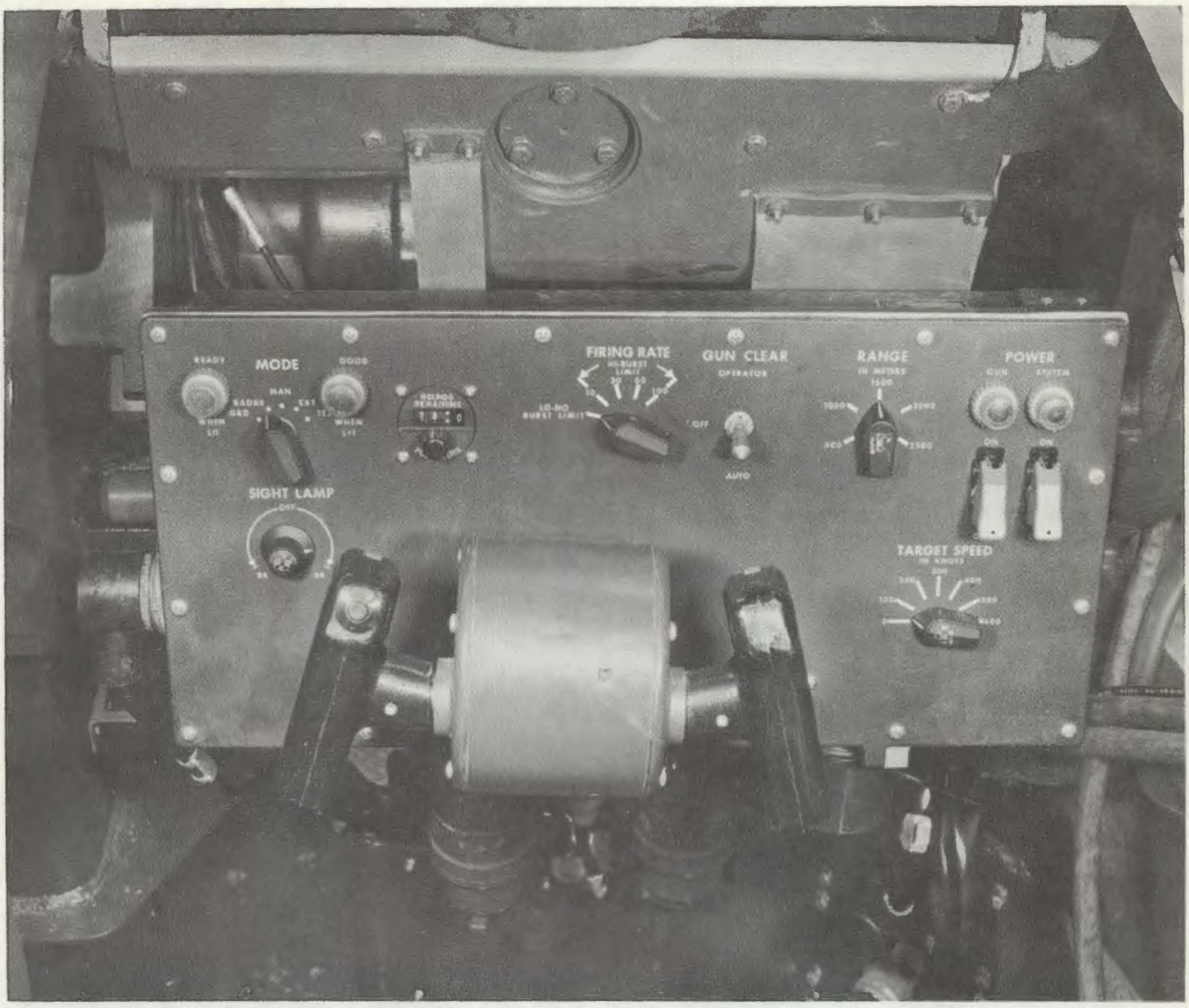


Figure 3-11. Control assembly.

(7) *GUN CLEAR switch.* Permits selection of one of the following methods of gun clearing:

(*a*) AUTO—When switch is set at this position, the gun is cleared automatically after firing.

(*b*) OPERATOR—When switch is held at this position and either action switch is closed, clearing of the gun occurs.

(*c*) OFF—When switch is set at this position the gun is not cleared after firing and must be cleared manually.

(8) *RANGE knob.* Used to set estimated target range, continuously variable between 500 and 2,500 meters, into the sight current generator.

(9) *GUN POWER switch.* This toggle switch, with guard, connects power to the cannon control circuits when set at ON.

(10) *GUN POWER indicator lamp.* Lights when power is applied to the cannon control circuits.

(11) *SYSTEM POWER switch.* This toggle switch, with guard, connects power to the sys-

tem (less chassis) and the action switches when set at ON.

(12) *SYSTEM POWER indicator lamp.* Lights when SYSTEM POWER switch is set at ON.

(13) *TARGET SPEED knob.* Used manually to set estimated target speed into sight current generator when operating in manual mode.

(14) *Elevation and azimuth control assembly.* Permits control of system functions as follows:

(*a*) Rotating the assembly clockwise or counterclockwise, causes the mount to slew in direction of rotation; when pivoted forward or back, causes the mount to follow movement of controls in elevation.

(*b*) Action switches enable azimuth and elevation servodrive circuits and firing circuits when either or both switches are pressed. They are located on the front of right and left control handles.

(*c*) The sight cage switch, when pressed, causes sight gyro to be electrically caged. It is located near the top of the left control handle.

(*d*) The dummy trigger switch has no function. It is located on top front of left control handle.

(*e*) The trigger switch fires the cannon when pressed. It is located on the top front of the right control handle.

b. BRAKE/CLEAR AND BRAKE Switch (fig. 3-12). This three-position toggle switch is spring-

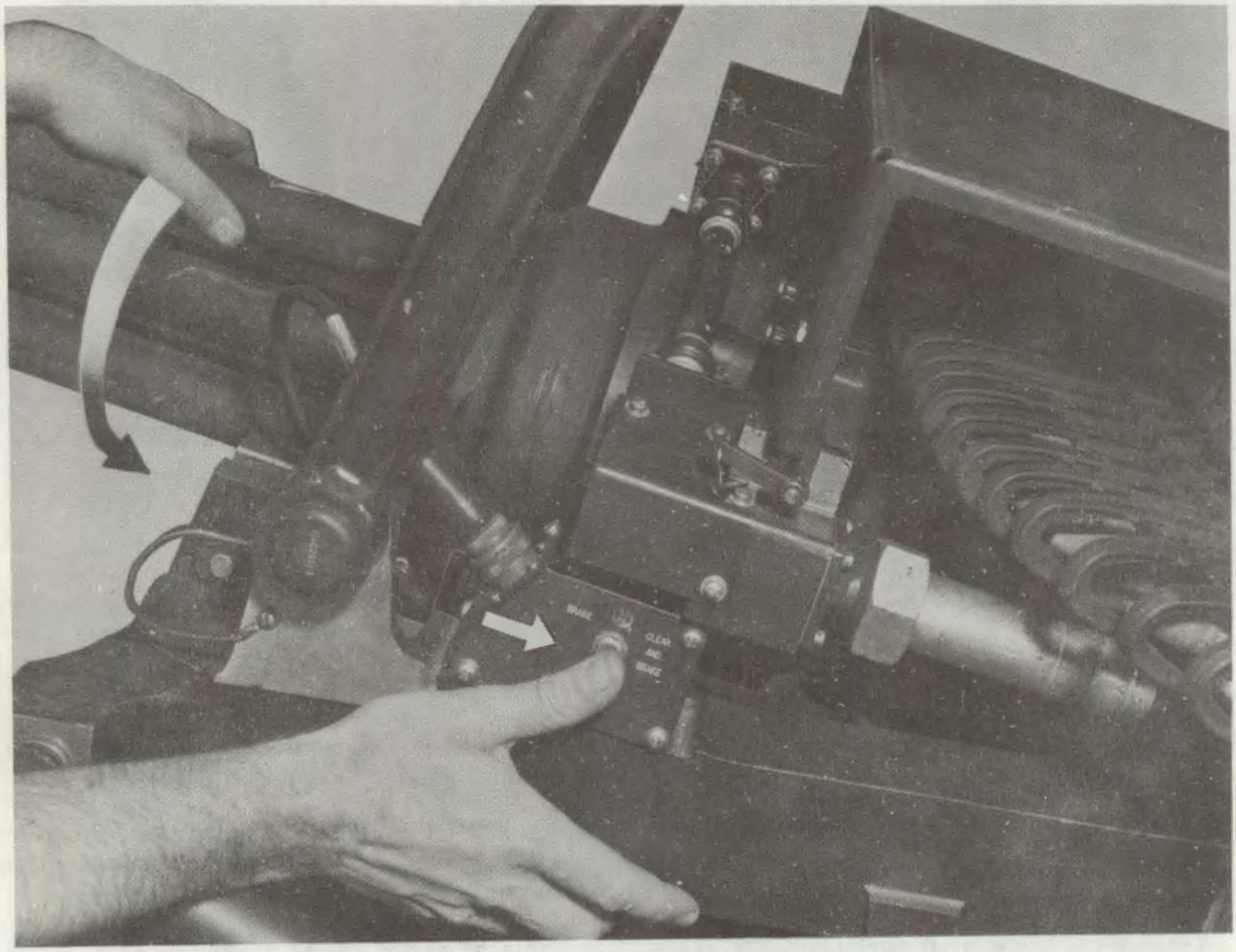


Figure 3-12. BRAKE/CLEAR AND BRAKE switch.

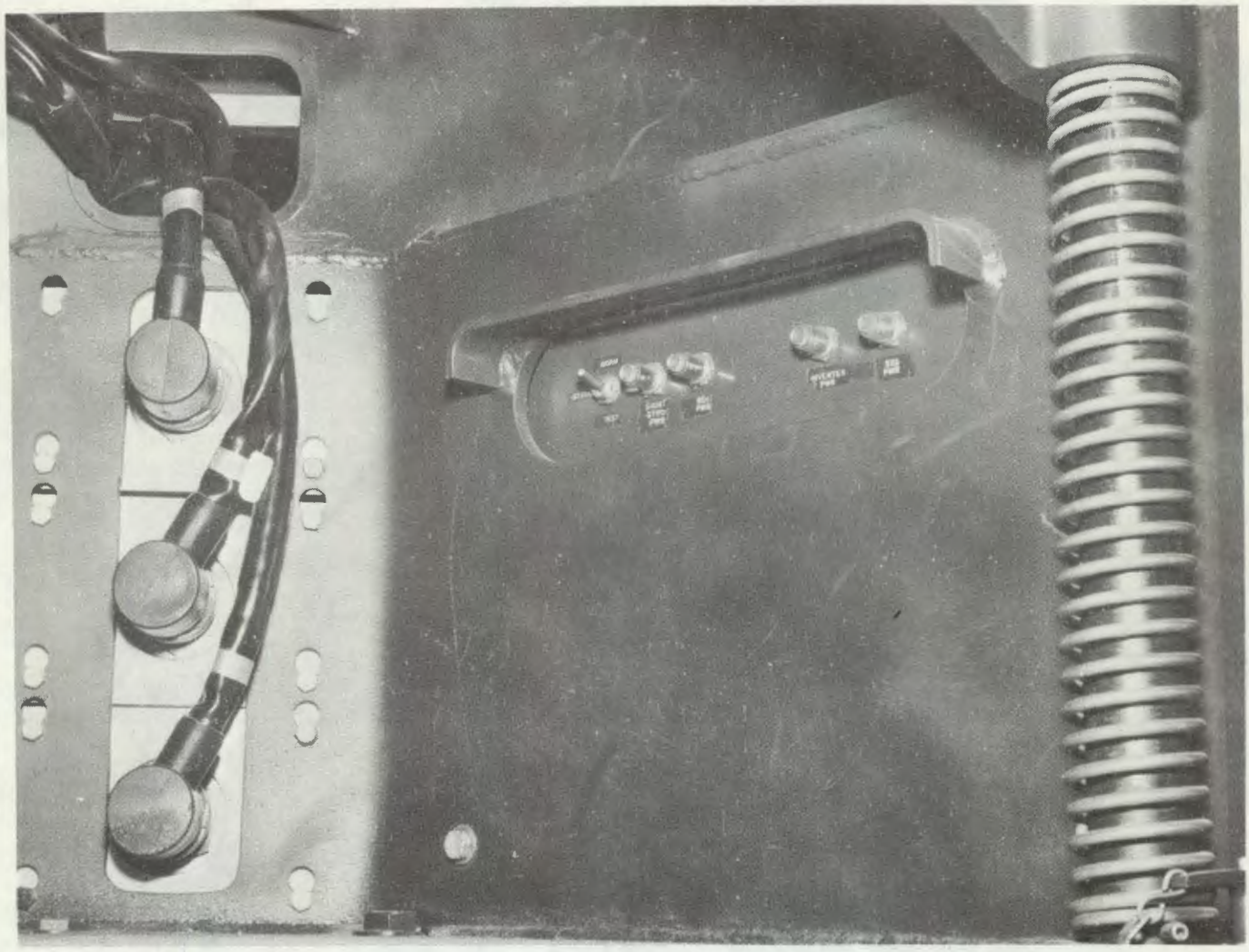


Figure 3-13. Gun distribution box.

loaded to center (off) position. When held at BRAKE, cannon barrels can be rotated manually and ammunition cycled through cannon. When held at CLEAR AND BRAKE, cannon barrels can be rotated manually, feeder is declutched, and cycling of ammunition to cannon is stopped.

c. Gun Distribution Box (fig. 3-13).

(1) *NORM/STATIC/TEST switch.* This switch permits limiting of azimuth and elevation servo-drive operation as follows:

(*a*) NORM—Servo-drive system operates to traverse, elevate, or depress the cannon in response to movement of the controls.

(*b*) STATIC—Both azimuth and elevation servo-drives are disabled. (Brakes are not electrically released.)

(*c*) TEST—Mount can be traversed (after

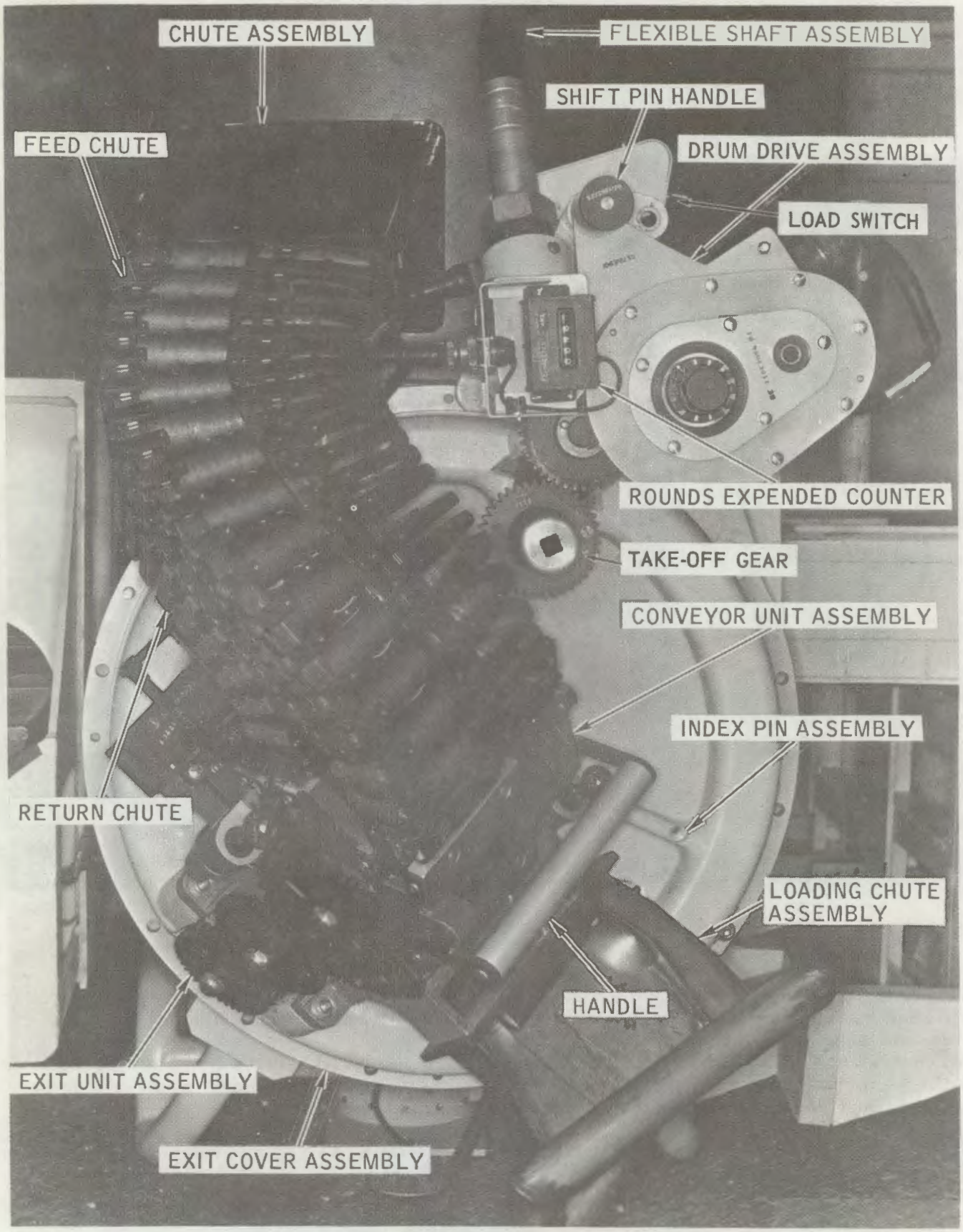


Figure 3-14. Drum drive assembly.

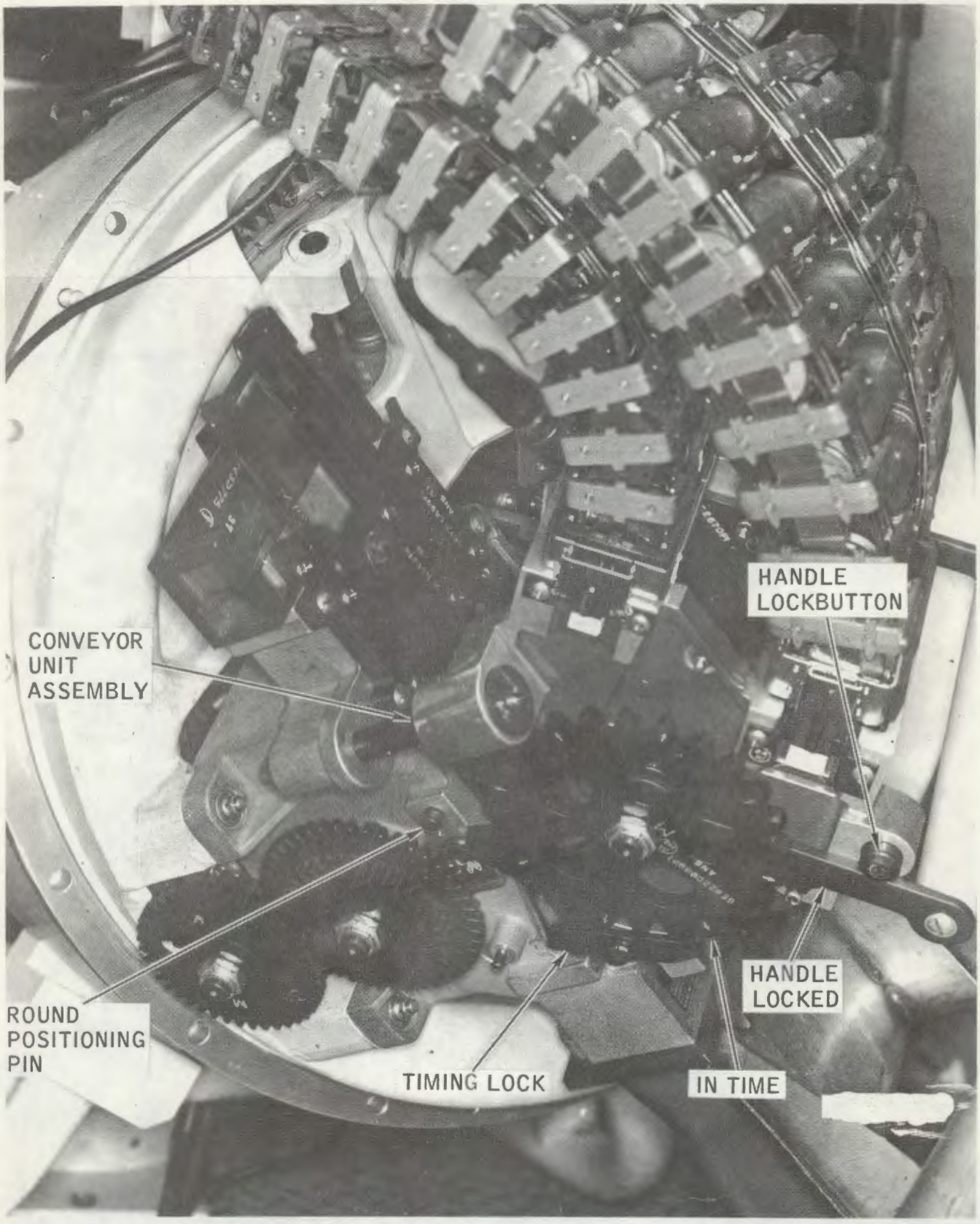


Figure 3-15. Conveyor unit assembly.

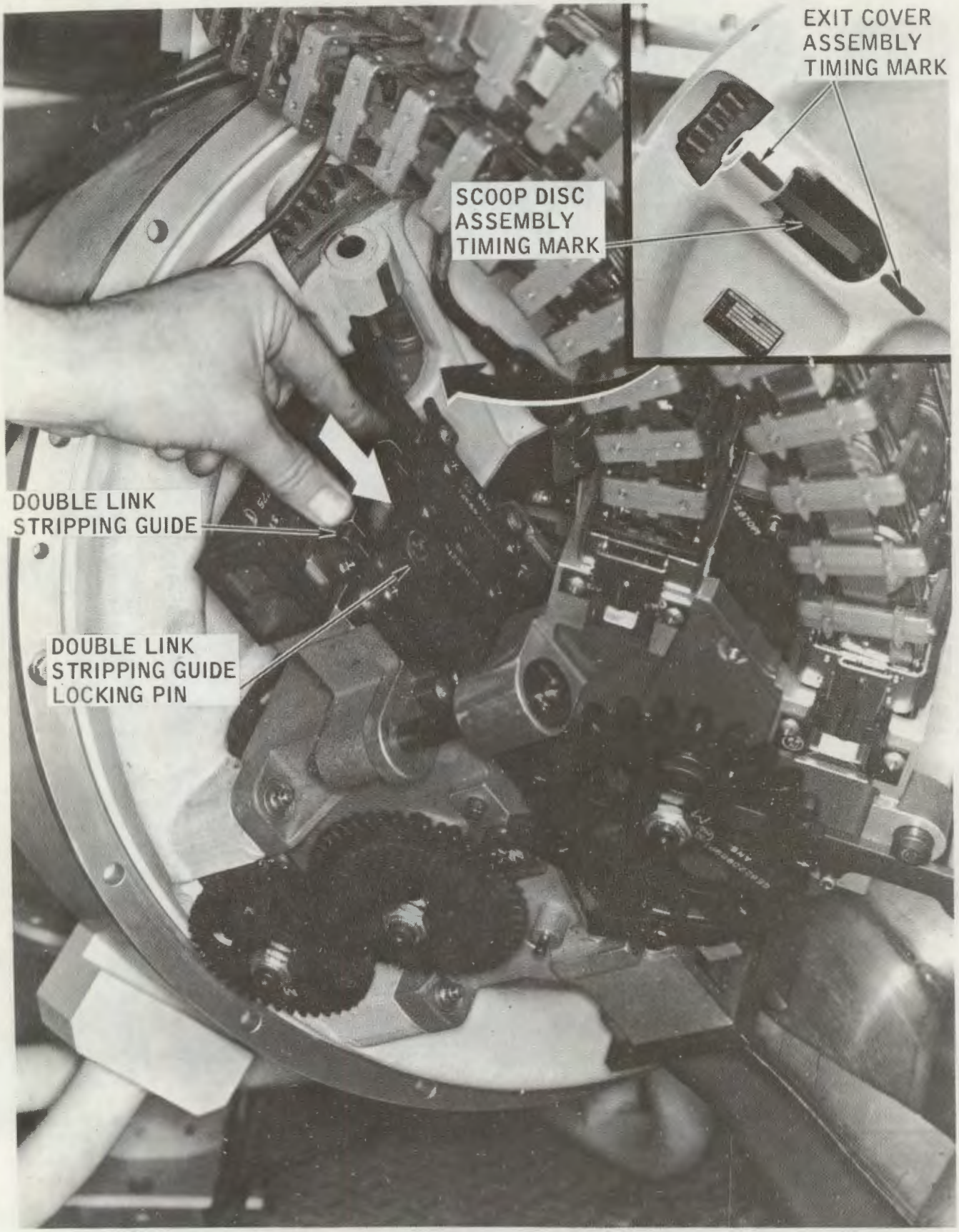


Figure 3-16. Double link-stripping guide and locking pin.

releasing azimuth drive motor brakes manually), but elevation drive is disabled.

(2) *SCG PWR circuit breaker (CB1).* Protects sight current generator from electrical overload.

(3) *SYS PWR circuit breaker (CB2).* Protects system components receiving power through the SYSTEM POWER switch.

(4) *INVERTER PWR circuit breaker (CB3).* Protects inverter from electrical overload.

(5) *SIGHT GYRO PWR circuit breaker (CB4).* Protects sight gyro motor from electrical overload.

(6) *VOLTS meter.* Voltmeter indicates output voltage of external source used to charge system batteries.

(7) *AMPS meter.* Ammeter indicates current supplied from external source to operate system and charge the batteries.

(8) *ELAPSED TIME meter.* Indicates total time system power is applied (to tenths of an hour).

d. Drum Drive Assembly (fig. 3-14).

(1) *LOAD switch.* This switch energizes the loading motor in either MOMENTARY ON or ON positions. It is spring-loaded in the MOMENTARY ON position so it will return to center (off) position when released.

(2) *Shift pin handle.* Selects drum drive as follows:

(*a*) F (fire) position—Inner drum is driven by gun drive assembly.

(*b*) N (neutral) position—Inner drum is disconnected from gun drive assembly and loading motor, but can be rotated manually with a handcrank.

(*c*) L (load) position—Inner drum is driven by loading motor.

(3) *Rounds expended counter.* Counts number of rounds cycled through the system.

e. Exit Cover Assembly (fig. 3-14).

(1) *Index pin.* Provides means of timing drum assembly.

(2) *Take-off gear.* Permits inner drum to be rotated manually with handcrank.

f. Conveyor Unit Assembly (fig. 3-15).

(1) *Timing lock.* Holds conveyor unit in timed position when conveyor unit is in loading position.

(2) *Handle (fig. 3-14).* Permits conveyor unit assembly to be moved into either loading or firing position.

(3) *Handle lockbutton.* Locks handle when conveyor unit is in either loading or firing position.

g. Exit Unit Assembly.

(1) *Round-positioning pin (fig. 3-15).* Positions first round in exit unit.

(2) *Locking pin (fig. 3-16).* Locks double link-stripping guide in either operative (loading) or inoperative (firing) position.

(3) *Double link-stripping guide (fig. 3-16).* Guides linked ammunition into the link stripper during loading.

h. Drum Assembly (fig. 3-17).

(1) *ROUNDS REMAINING TO FIRE windows.* These windows provide a visual means of checking the approximate number of rounds in the drum. The four windows are designated as 200, 400, 600, and 1,000 rounds.

(2) *Drum full switch.* Removes power from loading motor when drum is full of ammunition.

(3) *Last round switch.* Removes power from cannon when all but approximately 40 rounds have been removed from drum. Cannon will cease firing and clear automatically when last round switch is activated.

i. Sight Current Generator (fig. 3-18).

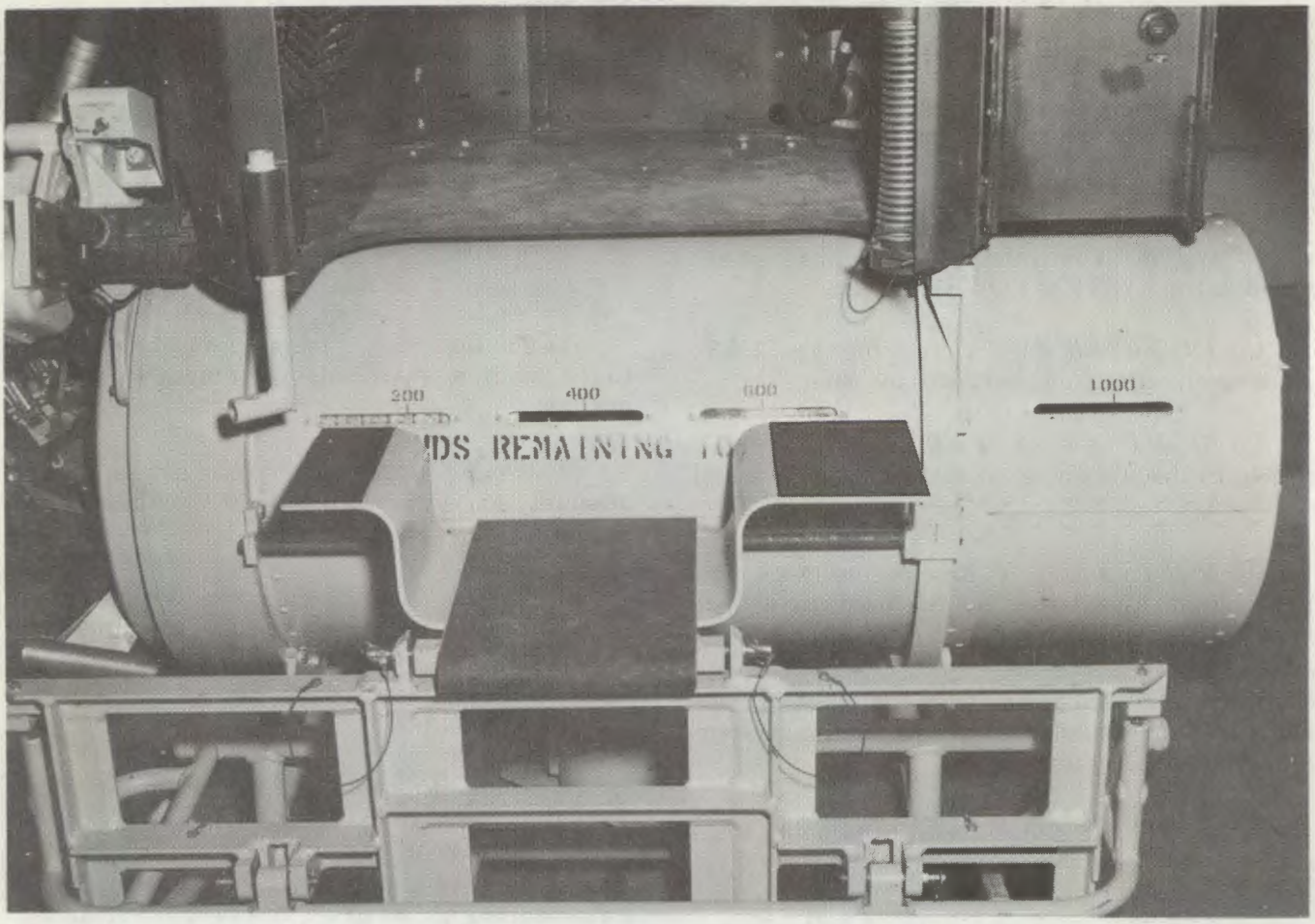


Figure 3-17. Drum assembly.

(1) *AIR DENSITY switch.* Used to set air density factor into sight current generator.

(2) *MUZZLE VELOCITY switch.* Used to set muzzle velocity factor into sight current generator.

(3) *Ballistics correction circuit card assembly.* Used to provide ballistics correction data to the sight current generator for the type of ammunition being used.

j. External Range Unit (fig. 3-19). Used to feed the pre-set range information to the sight current generator. A speed of 400 knots is automatically generated by the SCG. The normal range and speed input circuits are disabled when the external range unit is connected to the system through the remote range control assembly on the rear of the vehicle.

(1) *Range knob.* Used to set estimated target range when using external mode.

(2) *Switch.* Pressed to light ready-to-fire indicator lamp on sight when using external mode.

k. Elevation Drive Motor Brake Release Lever (fig. 3-20). Provides a means of mechanically releasing elevation drive motor brake.

l. Azimuth Drive Motor Brake Release Levers (fig. 3-21). Provide a means for mechanically releasing both azimuth drive motor brakes.

m. Declutching Feeder Assembly Index Pin (fig. 3-22). Times the declutching feeder to the gun.

n. Azimuth Indicator M38E2 (fig. 3-23). The azimuth indicator is used to calculate azimuth

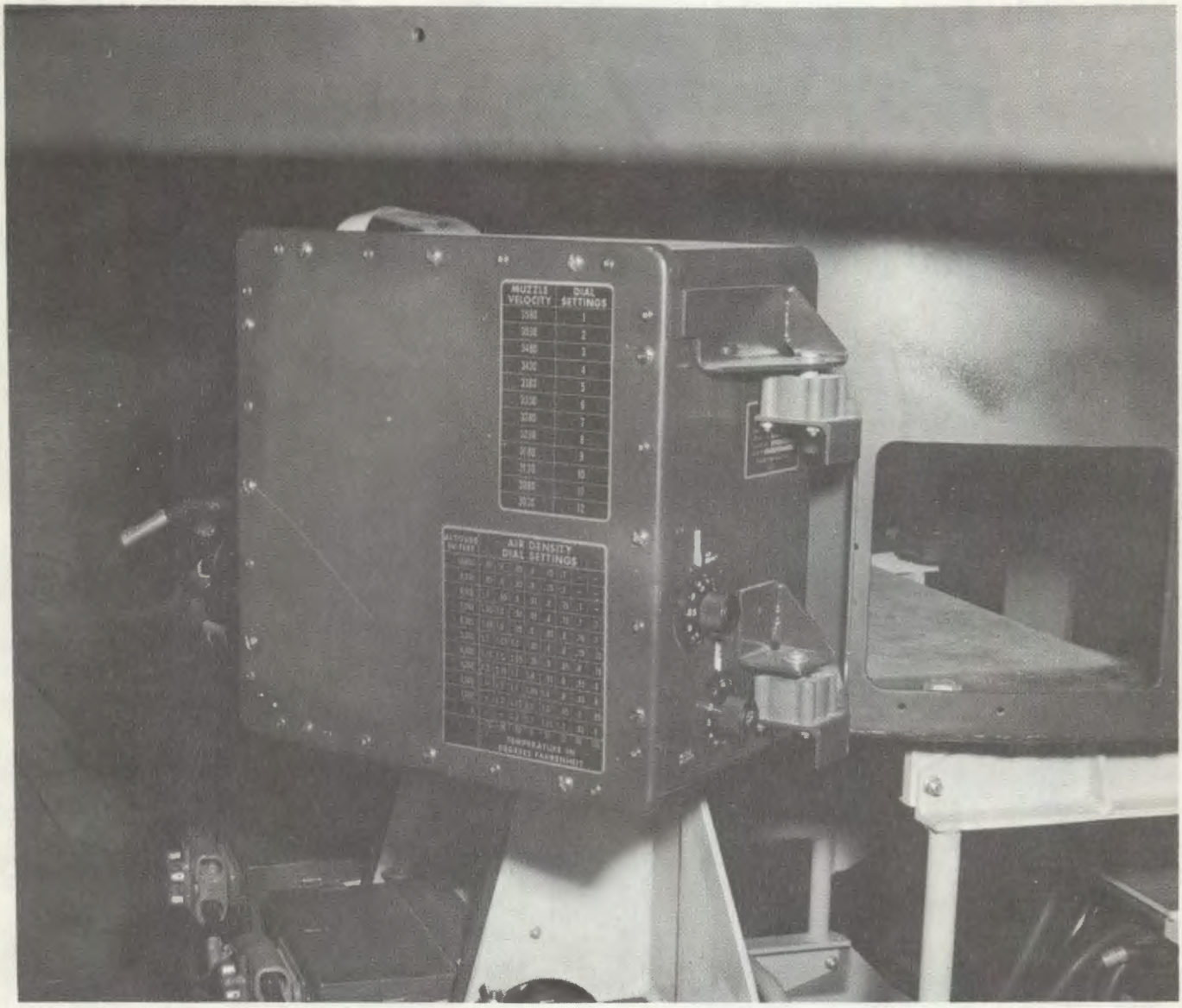


Figure 3-18. External range unit.

angles in mils, with respect to the longitudinal axis of the vehicle, during gun mount traversing. It is installed on the gun mount to the right of the control panel and is geared to the traversing ring gear. This indicator has three graduated fixed scales, three moving pointers, and a resetter knob.

(1) *Scales.* The 100-mil scale is graduated in 100-mil increments from 0 to 6,400 mils and numbered each 200 mils. The 1-mil scale is graduated in 1-mil increments from 0 to 100 mils and numbered each 5 mils. These scales are stationary with the instrument and the zero markings are in relation to the centerline of barrel No. 1 of the Vulcan cannon. The gunner's aid dial (outer scale) is graduated in 1-mil increments and numbered each 5 mils from 0 to 50 right and left. It is varied manually to provide an index to facilitate azimuth corrections.

(2) *Pointers.* The bottom pointer is not adjustable and is set in relation to the longitudinal axis of the vehicle at the time of installation of the azimuth indicator. This pointer is geared to turn in the same direction as the mount and will indicate on the 100-mil scale the number of mils the gun mount has traversed from the axis of the vehicle. The middle pointer rotates in conjunction with the top pointer. The sum of the

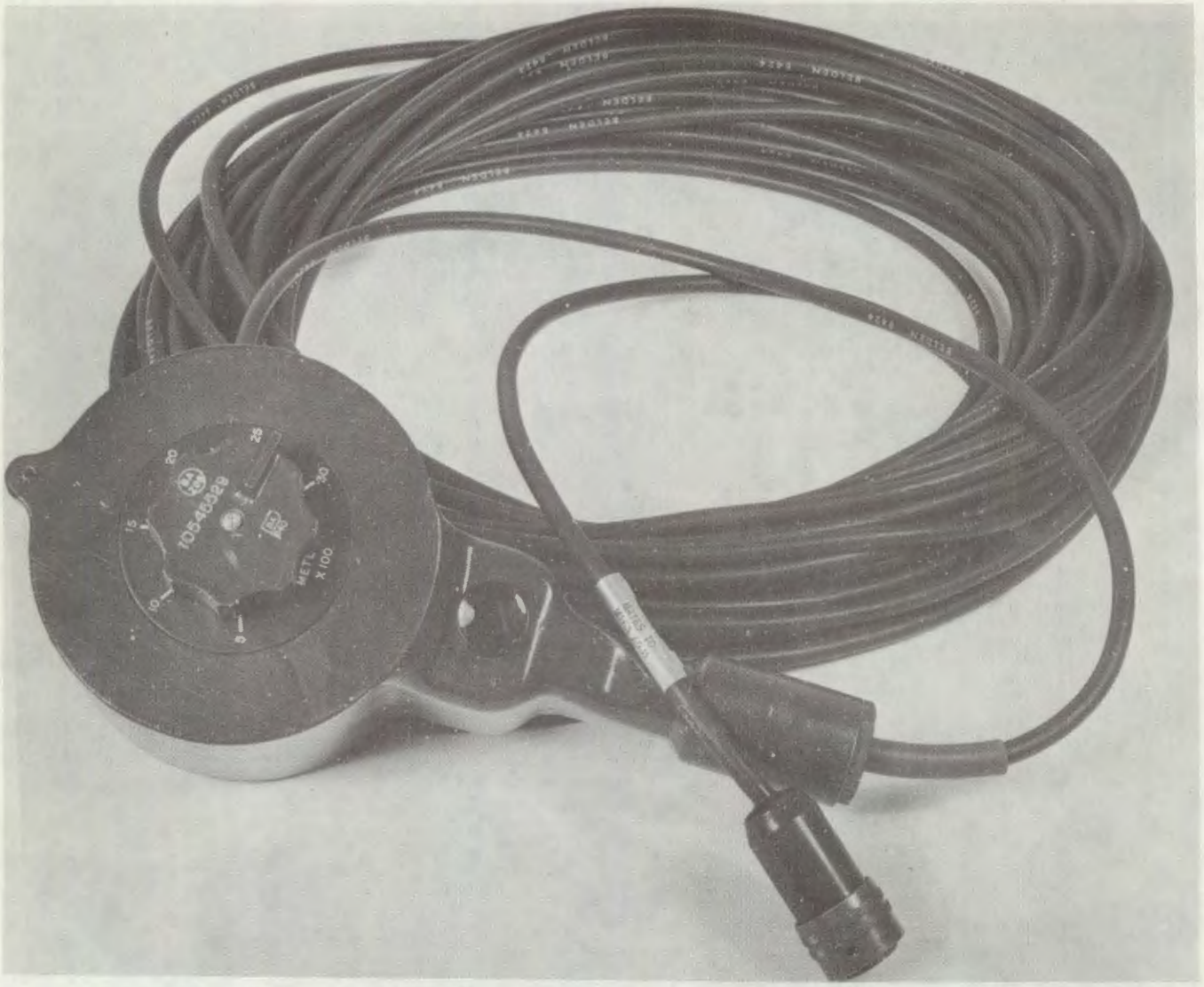


Figure 3-19. External range unit.

readings on the 100-mil scale and the 1-mil scale will indicate the number of mils the gun has traversed from a given reference point. The middle and top pointers are adjustable and may be set to indicate any desired azimuth by use of the resetter knob.

(3) *Resetter knob.* The resetter knob, located on top of the azimuth indicator, turns the top pointer. Pushing down and turning the knob will turn both the middle and top pointers. The top and middle pointers may be placed at zero regardless of gun mount position.

(4) *Illumination.* Illumination for the azimuth indicator dial is furnished by four 28-volt lamps built into the housing. Power is furnished by the mount batteries.

o. Sight XM61 (fig. 3-2).

(1) *CAGED knob.* When index mark on knob is alined with index mark on sight housing the sight is mechanically caged.

(2) *Filter knob.* Used to place filter over sight to obtain improved contrast against bright background.

(3) *Ready-to-fire indicator lamp.* In radar and external modes, this lamp lights to inform gunner when to fire. In radar mode, it lights when range is less than 2,200 meters inbound

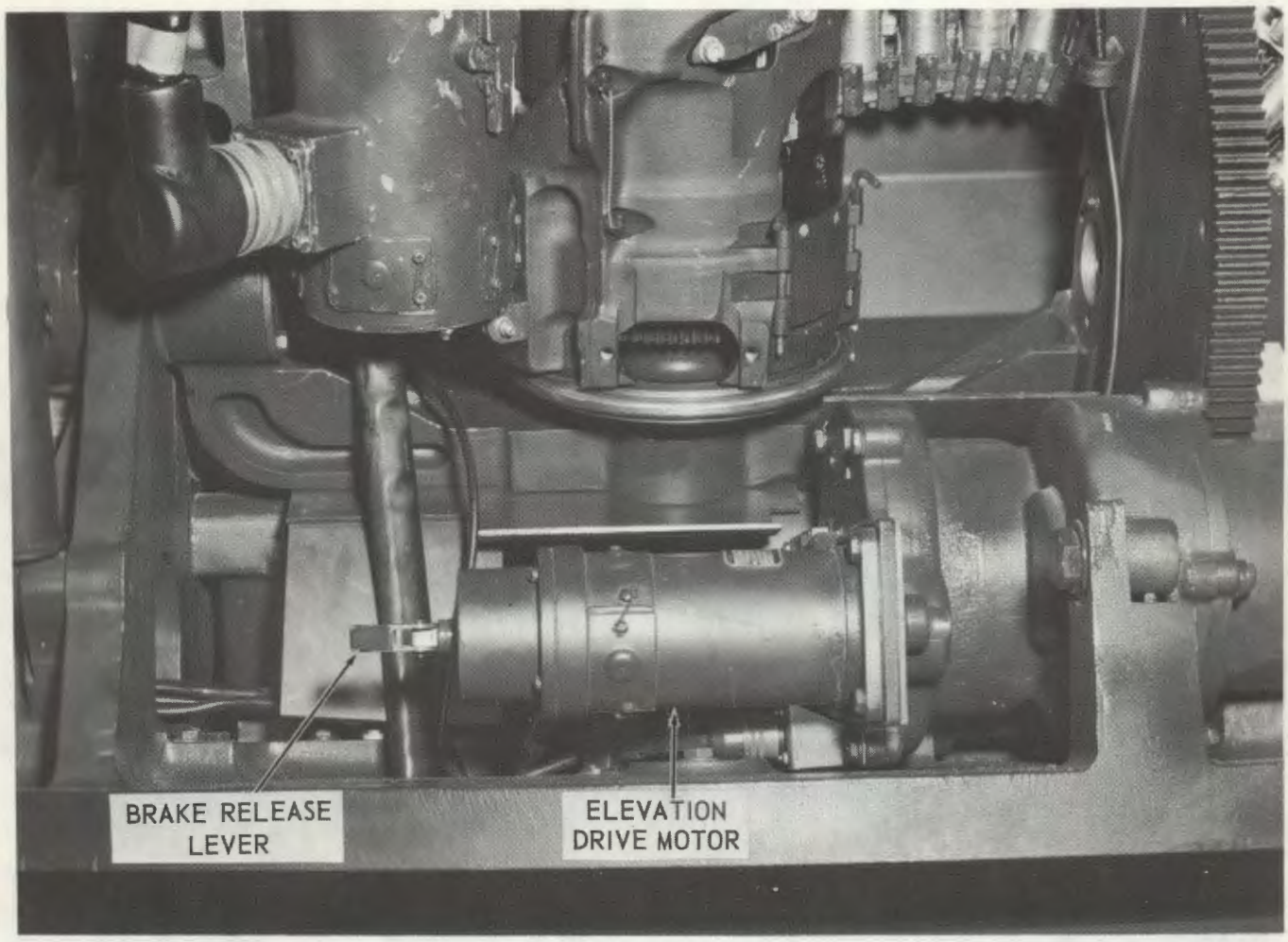


Figure 3-20. Elevation drive motor brake release lever.

or 1,600 meters outbound, radar is locked on, acquisition time delay is complete, elevation angle is less than 1,424 mils, and lead angle is less than 445 mils. If the radar detects electronic countermeasures, the ready-to-fire indicator lamp will blink. In the external mode, the lamp will light when the switch on the external range unit is closed. In the manual mode, the lamp lights whenever an action switch is pressed.

(4) *Sight reticle.* The sight reticle pattern (fig. 3-24) consists of two concentric circles of 15- and 60-mils diameter. A gap at the bottom of the inner circle is used as an aiming reference point when engaging targets at ranges greater than 700 meters in the ground mode.

(5) *Lead angle marks.* Five calibrated marks (200, 100, 0, 100, and 200) are used in conjunction with the lead angle index to indicate lead angle in mils.

(6) *Lead angle index.* Indicates lead angle zero reference point.

p. Radar.

(1) *Antenna (fig. 3-3).*

(*a*) Traverse boresight adjustment is used to aline the antenna with the optical line of sight in azimuth.

(*b*) Elevation boresight adjustment is used to aline the antenna with the optical line of sight in elevation.

(2) *RF indicator lamp.* Lights when the radar is radiating.

(3) *Receiver-transmitter (fig. 3-4 and 3-5).*

(*a*) MODULATOR OVERLOAD indicator

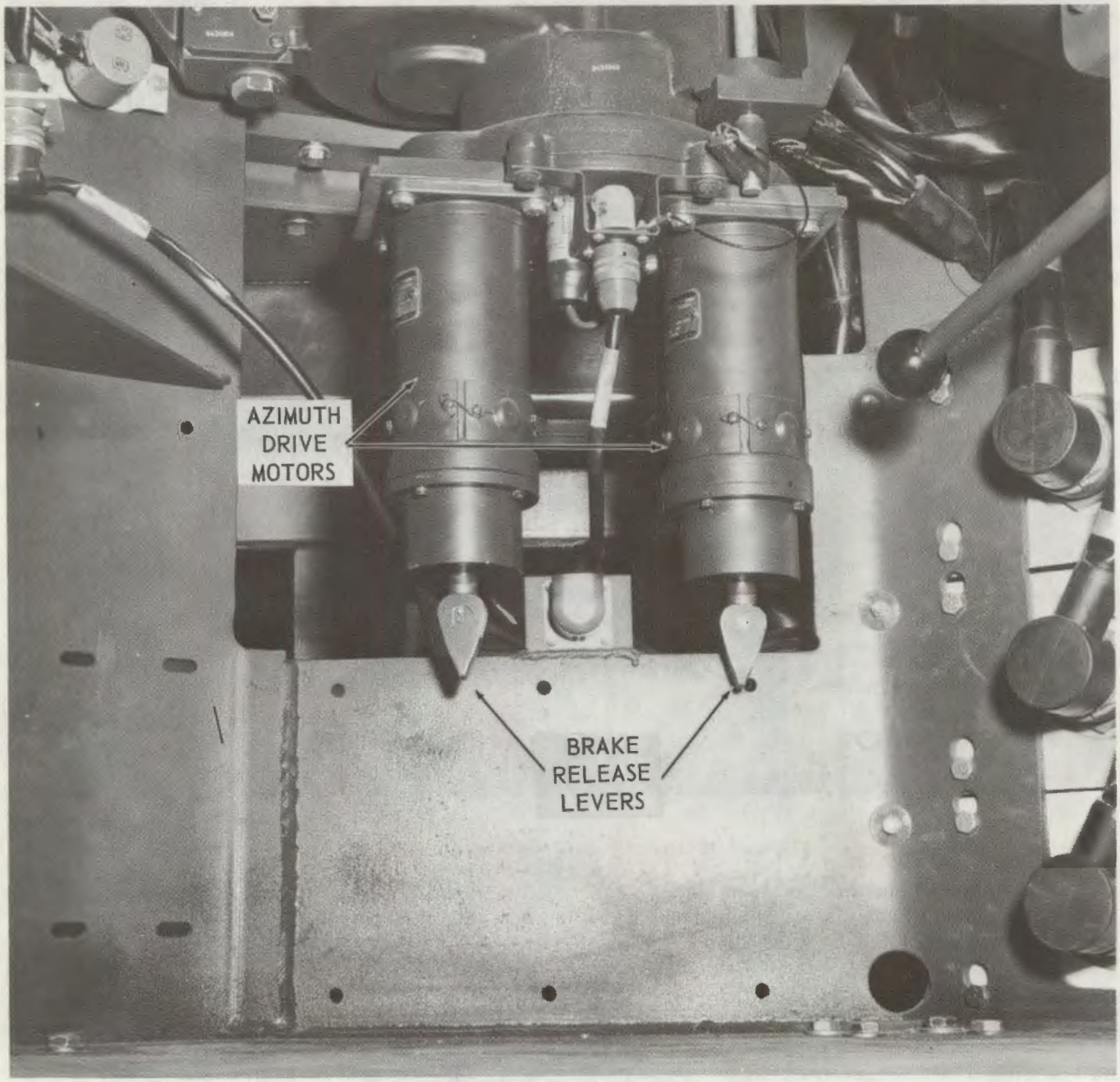


Figure 3-21. Azimuth drive motor brake release levers.

lamp—indicates overload in radar modulator circuit.

(*b*) HIGH VOLTAGE POWER SUPPLY OVERLOAD indicator lamp—indicates overload in radar high-voltage power supply.

(*c*) OVERLOAD RESET switch—resets modulator and high-voltage power supply overload sensing circuits (spring-loaded to OFF position).

(*d*) CLUTTER LOCKON switch—in TEST position activates built-in test circuitry to enable radar to lock on a stationary target for clutter lock-on test. In NORMAL position, disables the test circuitry.

(*e*) Interlock switch—removes power from

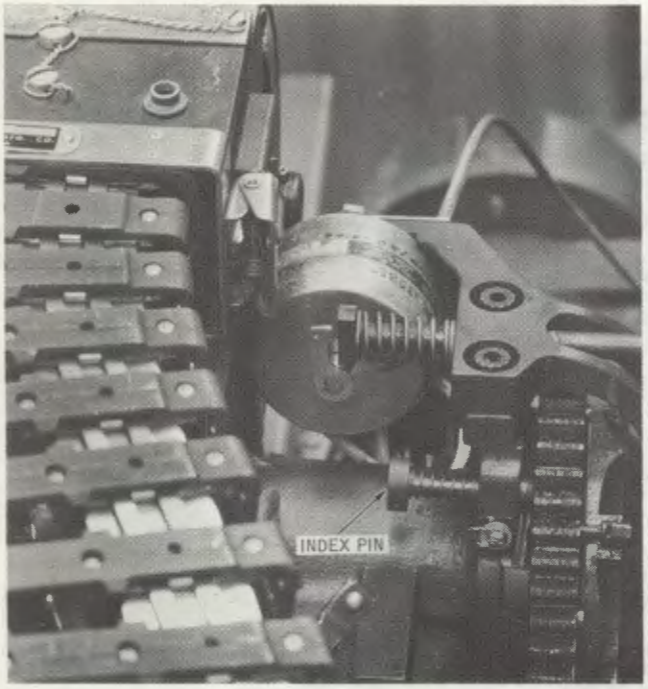


Figure 3-22. Declutching feeder assembly.

transmitter-receiver unit when front panel is opened. Power can be restored by placing this switch in the service position.

(*f*) Power indicator lamp—indicates that power is applied to transmitter-receiver.

(*g*) SERV RAD CONT switch—when set at ON, bypasses radiate foot switch, causing radar to radiate.

(*h*) Filament hours meter—indicates total time that filament power has been applied to klystron power amplifier.

(*i*) RF power meter—indicates relative magnitude of RF power produced by the radar transmitter.

(*j*) Klystron power amplifier cavity tuning adjustments—provide means for tuning klystron power amplifier.

(4) *Range computer (fig. 3-7).*

(*a*) Midrange calibration pushbutton switch—activates midrange calibration check.

(*b*) Midrange calibration indicator lamp—lights continually when midrange calibration check is made and the radar range prediction is correct. Under normal conditions indicator flashes once per second.

(5) *Power supply (fig. 3-8).*

(*a*) CONVERTER circuit breaker (CB1)—protects converter from overload.

(*b*) TRAV circuit breaker (CB2)—protects traverse servo-drive circuits from overload.

(*c*) ELEV circuit breaker (CB3)—protects elevation servo-drive circuits from overload.

(*d*) CONTROL CKT circuit breaker (CB4)—protects radar control circuits from overload.

(*e*) BLOWERS circuit breaker (CB5)—protects blowers from overload.

(*f*) 6.3 VDC circuit breaker (CB6)—protects 6.3-volt dc power supply from overload.

(6) *Radar set distribution box (fig. 3-9) (sometimes called stow box).*

(*a*) MODE switch—in NORMAL position, allows antenna to be positioned by sight XM61. In STOW position, antenna is positioned by ELEV and TRAV switches.

(*b*) ELEV switch—used to position antenna in stow mode. This switch has UP, DOWN, and center (off) positions, and is spring-loaded to the center position.

(*c*) TRAV switch—controls antenna traverse in stow mode. This switch has L, R, and center (off) positions and is spring-loaded to the center position.

(*d*) MAINT switch—energizes the antenna servo-drives without use of the action switches on the control handgrips.

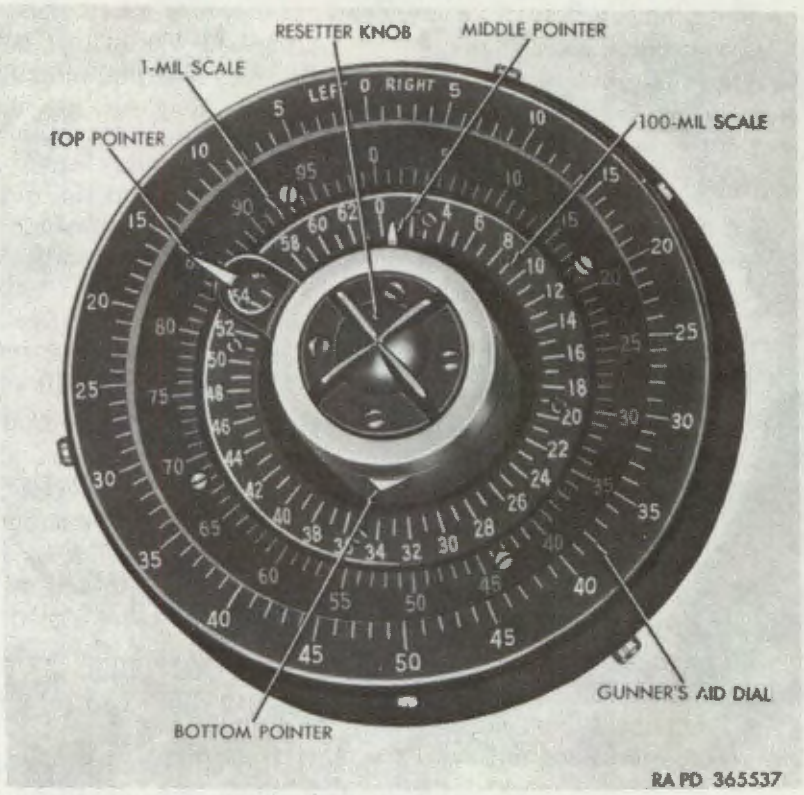


Figure 3-23. Azimuth indicator.

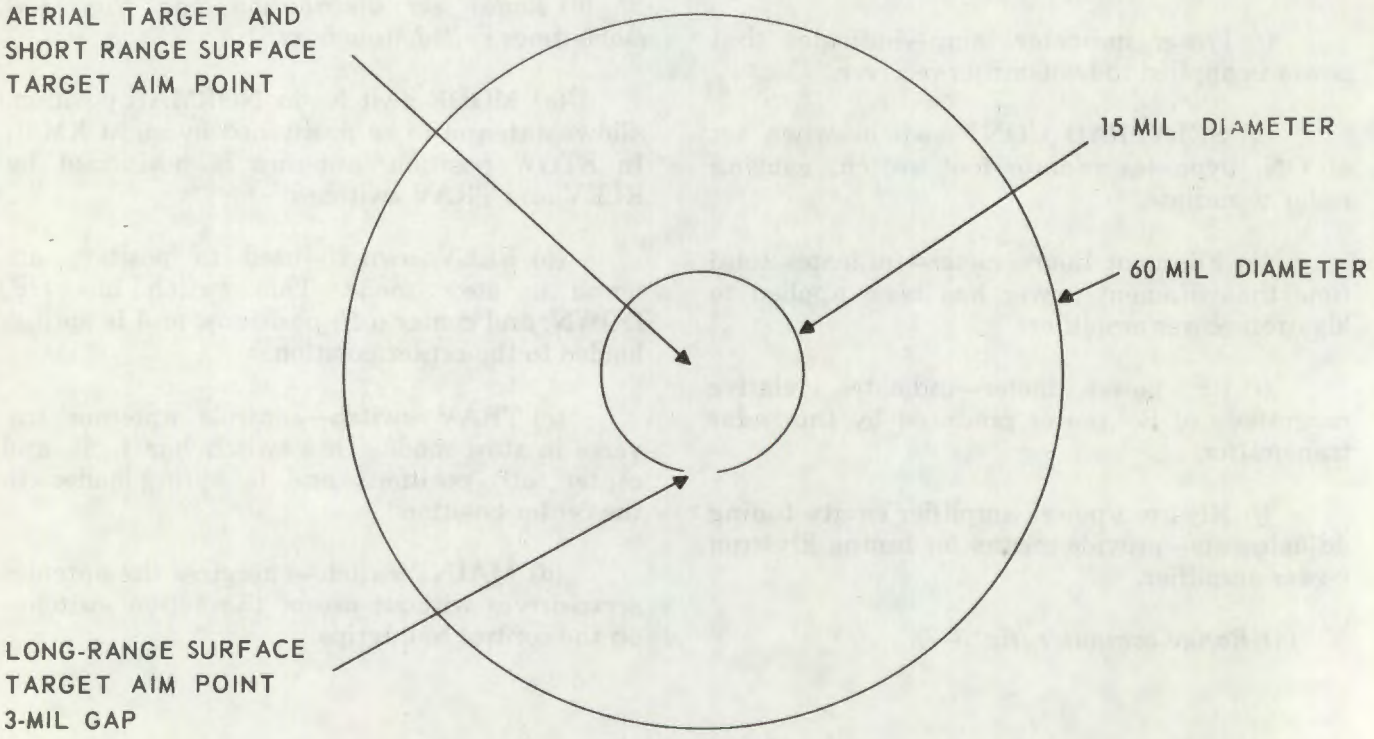


Figure 3-24. Sight XM61 reticle pattern.

CHAPTER 4

OPERATING PROCEDURES

Section I. GENERAL

4-1. Scope

This chapter contains instruction for operating the Vulcan XM163 self-propelled weapon system.

4-2. Chassis XM741

A detailed discussion on operation of the chassis XM741 is contained in TM 9-2350-300-10.

4-3. Charging System Batteries

A detailed discussion on charging and servicing batteries using the vehicle generator and the auxiliary power unit is contained in TM 9-2350-300-10.

4-4. Ammunition Loading and Unloading

a. Detailed procedures for loading and unloading ammunition are contained in TM 9-2350-300-10.

b. When the last round switch activates and shuts off the gun drive and ammunition feed systems, approximately 105 rounds remain in the weapon system.

c. If live rounds are in the system and it is desired to remove them, the following procedures contained in TM 9-2350-300-10 should be followed.

(1) Manually empty the drum.

(2) Prepare a belt of at least 105 dummy rounds.

(3) Load the dummy rounds into the drum.

(4) Prepare the system for cycling ammunition through the feed system.

(5) Cycle ammunition through the weapon system, without firing, until at least one of the dummy rounds previously loaded into the drum is cycled out.

Caution: **Do not cycle rounds out of the feed system after the drum is empty. To do so may cause damage to the feed system.**

Section II. SQUAD COMMUNICATIONS

4-5. General

The self-propelled Vulcan squad is equipped to communicate between members and with platoon headquarters and other squads in the platoon. It can also monitor the supported unit command radio net, receive aircraft position and identification data from the forward area alerting radar (FAAR), and be connected by wire telephone lines to the platoon switchboard or an adjacent unit switchboard. The purpose of the communication nets and equipment used in each net is as follows:

a. Platoon Command Net (FM). This two-way, voice radio net contains stations at platoon headquarters and all Vulcan squads in the platoon. When the situation prevents installation of wire lines, this radio net is the only communication channel between platoon headquarters and the fire units. The receiver-transmitter of radio set AN/VRC-47 is operated in this net.

b. Supported Unit Command Net (FM). Vulcan squads may monitor the command net of the supported unit as directed. The auxiliary re-

ceiver of radio set AN/VRC-47 is used for this purpose.

c. Platoon Switchboard Line. Telephone communication between the squad and the platoon switchboard is provided by a telephone TA-312/PT supplied by platoon headquarters.

d. Intrasquad Communications. Members of the squad can communicate with each other when the weapon system is moving and when it is emplaced by means of intercommunication set AN/VIC-1(V). A telephone TA-312/PT can be connected into the intercommunication set to afford communications between the weapon and the squad leader's command post when the weapon is emplaced.

e. Target Alert Data Display Set (TADDS) (Fig. 4-1). This set provides a one-way, digital data and voice radio circuit from a designated FAAR to the fire unit.

4-6. Operation of Radio and Intercommunication Equipment

a. General. Radio set and intercommunication equipment are interconnected to function as an integrated system. Each crewman except the gunner has a control box C-2298/VRC and a helmet CVC-12 with built-in earphones and microphone at his station on the weapon.

b. Control Box Locations. Intercommunication set control boxes C-2298/VRC are located as follows:

(1) The squad leader's control box is located on the right inner hull wall just to the right of audio amplifier AM-1780. The squad leader plugs his CVC-12 helmet connector into J802 of the control box.

(2) The driver's control box is mounted on a bar located on the inner hull wall to the left of the driver's seat. The driver connects his CVC-12 helmet to J802 of the control box.

(3) The senior gunner's control box is located in the gun turret to the right of the gunner's seat. The senior gunner connects his CVC-12 helmet to J802 of the control box.

c. Operation of Control Boxes.

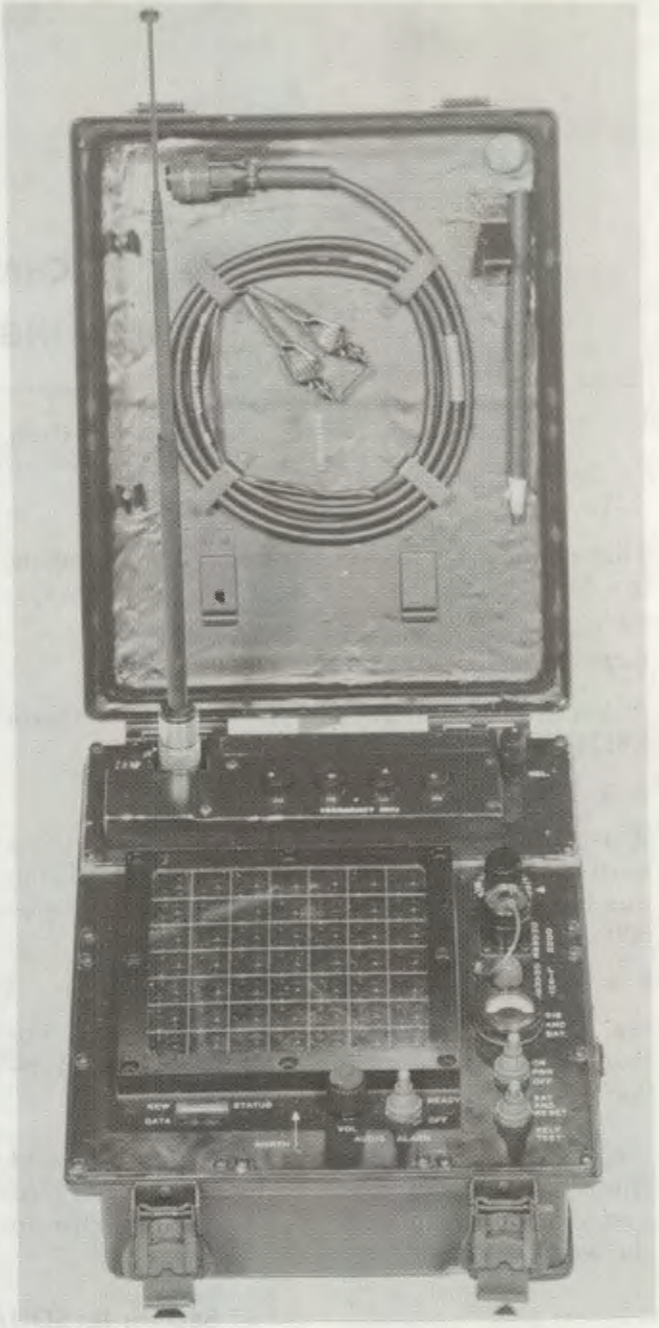


Figure 4-1. Target alert data display set.

(1) *Description.* The intercommunication set control box provides connections between the radio set and the audio accessories used by the crew members. All operating controls and connectors are external. Power and control cable connectors are located at the sides of the box. Audio connectors and a volume control are located along the bottom. A five-position switch, located on the face of the box, provides a means of selecting the mode of operation desired by the crewman.

(2) *MONITOR switch positions.* Table 4-1 lists communication options that may be selected by the MONITOR switch on the face of the control box. The senior gunner's intercommunication station will function only with the MONITOR switch in the ALL position.

Table 4-1. C-2298/VRC MONITOR Switch Positions

Switch position	Talk to—	Listen to—
ALL	Rcvr-Xmtr	ALL (Aux-Rcvr, Rcvr-Xmtr, intercom).
A	Rcvr-Xmtr	Rcvr-Xmtr
B		Aux-Rcvr
INT ONLY	Intercom	Intercom
C	Not used	Not used

(3) *Operation.* The following procedure is used to operate the intercommunication set:

(*a*) *Transmit.*

1. To transmit over the radio, turn the MONITOR switch to ALL, or A, and speak into the microphone.

2. To talk to other members of the crew over the intercommunication set, turn the MONITOR switch to INT ONLY and speak into the microphone.

(*b*) *Listen.*

1. To listen to both radio receivers and the intercommunication system simultaneously, turn the MONITOR switch to ALL.

2. To listen to the radio receiver-transmitter only, turn the MONITOR switch to A.

3. To listen to the auxiliary receiver only, turn the MONITOR switch to B.

4. To listen to the vehicle intercommunication system only, turn the MONITOR switch to INT ONLY.

4-7. Radio Communication Equipment

a. Purpose and Use. The radio set AN/VRC-47 provides for two-way radiotelephone communication between the Vulcan squad, platoon headquarters, the other Vulcan squads in the platoon, or with a supported or adjacent unit as required. An auxiliary receiver, issued as a part of the set, provides a means for monitoring the command net of an adjacent or supported unit without interfering with radio communications between the squad and its headquarters. An audiofrequency amplifier and three intercommunication set control boxes extend the use of the radio to crew members.

b. Description of Radio Set AN/VRC-47.

(1) Receiver-transmitter RT-524/VRC is used for two-way radiotelephone communication in the platoon command net.

(2) Mount MT-1029/VRC provides support for the receiver-transmitter and connections to the vehicle power system and control cables.

(3) Receiver R-442/VRC is an auxiliary receiver used to monitor supported or adjacent unit command net.

(4) Mount MT-1898/VRC serves as a mount for auxiliary receiver R-442/VRC.

(5) The receiver-transmitter antenna AS-1729/VRC consists of antenna elements AS-1730/VRC and AT-1095/VRC and an antenna matching unit base MX-6707/VRC. The antenna is about 10 feet long when assembled.

(6) The auxiliary receiver antenna consists of mast base AB-15/GR, mast sections MS-116-A and MS-117-A and adapter UG-237/U. The three mast sections, when assembled, make up a whip antenna, which is screwed into the AB-15/GR mast base. The adapter UG-237/U makes connections between the receiver antenna cable and the antenna. The overall length of the assembled antenna is approximately 11 feet.

(7) The audiofrequency amplifier AM-1780/VRC amplifies the radio receiver and vehicle intercommunication set outputs and is the main junction box for the components of the AN/VRC-47 radio set.

c. Radio. Operation of radio communication equipment listed in *a* above is described in detail in TM 11-5820-401-10.

Section III. MAINTENANCE

4-8. General

Maintenance procedures are described in detail in the technical manuals supporting each item of equipment.

4-9. Vulcan XM163

a. Operator maintenance of the Vulcan armament system is described in TM 9-2350-300-10.

b. Organizational maintenance of the Vulcan armament system is described in TM 9-2350-300-20, and LO 9-2350-300-10.

c. Maintenance of detection and sighting equipment is described in the following publications:

(1) Target alert data display set AN/GSQ-137(XO-1)—TM 9-1430-589-12.

(2) Telescopic sight XM134—TM 9-1240-318-35.

(3) Night sight AN/TVS-2—TM 11-5855-202-13.

4-10. Auxiliary Power Unit

Maintenance and operating procedures for the auxiliary power unit are described in TM 5-6115-323-15.

4-11. Communication Equipment

Maintenance of communication equipment is described in the following publications:

a. Radio set AN/VRC-47—TM 11-5820-401-10.

b. Intercommunication set AN/VRC-1(V)—TM 11-5830-340-12.

c. Telephone set TA-312/PT—TM 11-5805-201-12.

Section IV. PREPARATION FOR TRAVEL

4-12. Administrative Movement

When the self-propelled Vulcan is to make an administrative move, it should be prepared for travel as follows:

a. Perform before-operation services on the chassis.

b. Stow and secure all items of equipment on the system as prescribed in paragraph 5-6*k*.

c. Place cannon barrels in travel lock according to the following procedure:

(1) Remove the quick-release pin from the travel lock base, raise the travel lock, and reinstall pin. Open travel lock clamp.

(2) Release elevation and azimuth drive motor brakes and manually position cannon barrels in travel lock.

(3) Close and lock the travel lock clamp with knob. The pin in the travel lock clamp must fit between two of the barrels. If necessary, rotate the cannon by hand, in the CLEAR AND BRAKE position, until the pin will fit.

(4) Release drive motor brakes.

d. Install covers on system.

4-13. Tactical Movement

When making a tactical move, the manner in which the Vulcan weapon system is conditioned for travel is largely determined by the tactical situation. If Vulcan must fire on the move or if attack is imminent, the system should travel in a condition that will allow immediate response to the threat. In this case, the system should be completely energized and the cannon free to traverse and elevate.

Section V. PREPARATION FOR FIRING

4-14. General

This section contains the prefiring checkout procedures that must be performed to insure that the Vulcan weapon system is conditioned to engage targets and that all components are operating properly.

4-15. Prefiring Checks and Procedures

a. Remove weapon covers.

b. Unlock and lift travel clamp from cannon barrels.

c. Lay travel bracket on vehicle deck, toward mount, and secure travel lock clamp to bracket with knob.

d. Check amount of ammunition ready to fire by means of the ROUNDS REMAINING counter and by observing ammunition through the ROUND REMAINING TO FIRE windows.

e. Check that drive selector is set at F.

f. Check that double link-stripping guide is pulled out.

g. Check that conveyor unit assembly is locked in the firing position.

h. Check that 12 rounds are visible in the exposed portion of the feed chute between the conveyor unit assembly and the chute bracket assembly on the mount drum.

i. Check security of the following connectors:

(1) Gun drive assembly connector.

(2) Firing contact assembly connector.

(3) Declutching feeder assembly connector.

j. Check that gun shield assembly is in place and secure.

k. Check that both hatches are closed.

l. Check that vehicle suspension system is locked out (unless firing on the move).

m. Check that arming connector is connected to receptacle on distribution box or (if it is to be used) the arm-safe switch is properly installed.

n. Check mount operation as follows:

(1) Check that vehicle engine is operating or the APU is running to charge batteries.

(2) Set sight CAGED knob index mark to index mark on sight housing.

(3) Check that GUN POWER switch is set at OFF.

(4) Turn MODE switch to GRD.

(5) Set SYSTEM POWER switch at ON.

(6) Press action switch on right-hand control and check that gun elevates and depresses, and mount traverses left and right. Repeat, using left-hand control action switch.

(7) With action switch pressed, check that upper and lower limit switches halt elevation drive at -89 mils and ±1,423 mils.

(8) Open driver's and commander's hatches. With gun at 0 mils elevation, check that azimuth drive stops as gun approaches either open hatch from either direction.

(9) With gun at 356 mils elevation, check that gun drives across both open hatches. Close hatches.

(10) With both hatches closed and gun at 0 mils elevation, check that mount drives over both hatches.

(11) While moving the gun in elevation, release action switch. The elevation drive motor brakes should be applied automatically, halting gun motion. Repeat the check in azimuth.

o. Check sight current generator as follows:

(1) Check that the ballistics correction assembly, A21A12, is inserted properly for the ammunition being used. The double-ended plug-in board provides proper ballistics correction for M2220 ammunition on one end and M246E3

ammunition on the other end. For M56A3 ammunition used in the ground mode see table 4-5.

(2) Record the settings on the AIR DENSITY and MUZZLE VELOCITY dials for future reference. Set AIR DENSITY and MUZZLE VELOCITY switches to 0.85 and 5, respectively, if M220 ballistics are used and 1 and 5, respectively, if M246 ballistics are used.

(3) Check that GUN POWER switch is set at OFF and SYSTEM POWER switch is set at ON.

(4) Turn MODE switch to TEST and check that GOOD WHEN LIT indicator lamp lights.

(5) Set the AIR DENSITY and MUZZLE VELOCITY dials to the readings recorded in (2) above or determined as follows for the particular ammunition being used.

(*a*) Obtain or estimate altitude and ambient temperature readings.

(*b*) Determine the setting for the AIR DENSITY dial. Refer to table 4-2 or 4-3 as applicable.

1. Select the altitude line and temperature column which most nearly represent the current altitude and ambient temperature. Note the numerical value where they meet.

2. Set the AIR DENSITY dial to the indicated value.

(*c*) Determine the setting for the MUZZLE VELOCITY dial. Refer to table 4-4.

1. Refer to the system logbook and determine the number of rounds that have been fired through the installed barrel cluster.

2. Select the applicable line on table 4-4 for the ammunition being used, the rounds fired category, and the applicable temperature column. Note the numerical value where they meet.

3. Set the MUZZLE VELOCITY dial to the indicated value.

Note. Tables 4-2, 4-3, and 4-4 should be used until such time as the air density and muzzle velocity charts affixed to the XM163 and XM167 systems are replaced.

Table 4-2. Air Density Settings for M220 and M55A2 Ammunition

Altitude in feet	Air density dial settings							
10,000	0.9	0.85	0.8	0.75	0.7			
9,000	0.9	0.85	0.8	0.75	0.7			
8,000	0.95	0.9	0.85	0.8	0.75	0.7		
7,000	1.0	0.95	0.9	0.8	0.75	0.7		
6,000	1.0	0.95	0.9	0.85	0.8	0.75	0.7	
5,000	1.05	1.0	0.95	0.9	0.85	0.75	0.7	0.7
4,000	1.1	1.05	1.0	0.9	0.85	0.8	0.75	0.7
3,000	1.15	1.1	1.05	0.95	0.9	0.85	0.8	0.75
2,000	1.2	1.15	1.05	1.0	0.95	0.85	0.8	0.75
1,000	1.2	1.15	1.1	1.05	0.95	0.9	0.85	0.8
0	.....	1.2	1.15	1.05	1.0	0.95	0.9	0.85
Temperature in degrees Fahrenheit.	-70	-50	-30	0	+30	+70	+90	+130

Table 4-3. Air Density Settings for M246 and M56A3 Ammunition

Altitude in feet	Air density dial settings							
10,000	0.95	0.9	0.85	0.8	0.75	0.7		
9,000	0.95	0.9	0.85	0.8	0.75	0.7	0.7	
8,000	1.0	0.95	0.9	0.85	0.8	0.75	0.7	
7,000	1.05	1.0	0.95	0.85	0.8	0.75	0.7	0.7
6,000	1.05	1.0	0.95	0.9	0.85	0.8	0.75	0.7
5,000	1.1	1.05	1.0	0.95	0.8	0.8	0.75	0.75
4,000	1.15	1.1	1.05	0.95	0.9	0.85	0.8	0.75
3,000	1.2	1.15	1.1	1.0	0.95	0.9	0.85	0.8
2,000	.....	1.2	1.1	1.05	1.0	0.9	0.85	0.8
1,000	.....	1.2	1.15	1.1	1.0	0.95	0.9	0.85
0	.....	.....	1.2	1.1	1.05	1.0	0.95	0.9
Temperature in degrees Fahrenheit.	-70	-50	-30	0	+30	+70	+90	+130

Table 4-4. Muzzle Velocity Dial Setting Chart

Barrel cluster rounds fired*	Dial setting (muzzle velocity)							
M246 or M56								
M246 or M56A3								
0 - 36,000	9	9	8	8	7	6	6	5
36,000 - 72,000	8	8	7	7	6	5	5	4
M220 or M55A2								
0 - 36,000	5	5	4	3	3	2	2	1
36,000 - 72,000	4	4	3	3	2	1	1	1
Temperture in degrees Fahrenheit.	-70	-50	-30	0	+30	+70	+90	+130

*Refer to system logbook.

p. Check sight XM61 as follows:

(1) Check that GUN POWER switch is set at OFF and SYSTEM POWER switch is set at ON.

(2) Rotate SIGHT LAMP knob fully clockwise and then fully counterclockwise. Light intensity of sight reticle image should increase as knob is moved either way from center.

(3) Turn MODE switch to MAN and press either action switch. Ready-to-fire lamp on sight should come on.

(4) Uncage sight.

(5) Turn RANGE knob to 500 and TARGET SPEED knob to 0.

(6) Aim cannon so bottom of sight reticle image rests on a distant point.

(7) Release action switch and set NORM/STATIC/TEST switch at STATIC.

(8) Press action switch and turn RANGE knob to 1,700. Sight reticle image should move down so that top of image is approximately on same distant point ((6) above).

(9) Press sight cage switch on left control handle. Reticle image should move up.

(10) Turn TARGET SPEED knob to 600 and RANGE knob to 2,500.

(11) Release sight cage switch. Sight reticle image should move down so top of image is approximately on same distant point.

(12) Set NORM/STATIC/TEST switch at NORM.

(13) Turn RANGE knob to 500 and TARGET switch to 300.

(14) With cannon at 0 mils elevation, traverse weapon at a rate that will hold a 200-mil lead (extreme right or left dot in sight). Time for one revolution should be approximately 18 seconds.

Table 4-5. Range Table for HEI Cartridge M56A3

Muzzle velocity, 1045 M/S — Ctg, HEI, M56A3; Fuze, PD, M505 series

Range	Elev	Change in— For 100 m Range / Change in— Range Elev	Change in— For 5 mils Elev / Change in— Range Elev	Time of Flight	Drift	Maximum ordinate	Remaining velocity	Angle of fall
Meters	Mils	Mils	Meters	Sec	Mils	Meters	M/S	Mils
0	0	0	740	0	0	0	1045	0
100	0	0	730	0	0	0	975	1
200	1	1	718	0	0	0	906	1
300	2	1	703	0	0	0	839	2
400	2	1	685	0	0	0	775	3
500	3	1	662	1	0	0	713	4
600	4	1	632	1	0	1	653	5
700	5	1	590	1	0	1	596	7
800	6	1	509	1	0	1	543	9
900	7	1	436	1	0	2	492	11
1000	8	1	372	1	0	3	443	15
1100	10	2	315	2	1	4	398	19
1200	12	2	267	2	1	5	358	24
1300	14	2	226	2	1	6	329	30

Table 4-5. Range Table for HEI Cartridge M56A3.

Muzzle velocity, 1045 M/S — Ctg. HEI M56A3, Fuze, PD, M505 series

Range	Elev	Change in Elev For 100 m Change in Range	Change in Range For 5 mils Change in Elev	Time of Flight	Drift	Maximum ordinate	Remaining velocity	Angle of fall
Meters	Mils	Mils	Meters	Sec	Mils	Meters	M/S	Mils
1400	16	3	194	3	1	8	311	38
1500	19	3	169	3	1	11	297	45
1600	22	3	150	3	1	14	283	54
1700	26	4	135	4	2	17	271	64
1800	30	4	123	4	2	22	259	74
1900	34	4	112	4	2	26	248	85
2000	39	5	103	5	2	32	237	97
2100	44	5	95	5	3	38	227	111
2200	49	6	88	6	3	45	217	125
2300	55	6	81	6	4	54	208	141
2400	62	7	75	7	4	63	199	159
2500	68	7	70	7	5	73	191	178
2600	76	8	64	8	6	84	183	200
2700	84	8	60	8	6	97	175	223
2800	93	9	55	9	7	112	168	248
2900	102	10	51	10	8	128	162	275
3000	112	11	47	10	9	146	156	305
3100	123	11	44	11	10	167	150	338
3200	135	12	41	12	12	190	145	373
3300	148	13	37	12	13	215	140	410
3400	162	15	34	13	15	244	136	451
3500	177	16	32	14	16	276	132	495
3600	193	17	29	15	18	313	129	542
3700	212	19	26	16	20	354	126	592
3800	231	21	24	17	23	401	124	645
3900	253	23	21	18	26	454	122	701
4000	278	26	19	19	29	516	121	761
4100	306	30	17	21	33	589	120	824
4200	339	36	14	22	37	675	120	891
4300	378	45	11	24	43	783	121	964
4400	429	68	8	26	50	928	122	1046
4500	515		4	30	63	1178	126	1157

q. Check radar as follows:

(1) Check that READY WHEN LIT indicator lamp is lit.

(2) Set MAINT switch at ON and turn MODE switch to STOW.

(3) Hold ELEV switch at UP and check that antenna drives into upper electrical limit.

(4) Set MAINT switch at OFF and turn MODE switch to NORMAL. Press action switch and check that antenna positions on cannon axis.

(5) Repeat steps (2) through (4) above except drive antenna to lower, left, and right lim-

its. At completion of tests, insure that MAINT switch is set at OFF and STOW switch is set at NORMAL.

(6) Press action switch and foot switch simultaneously. The RF power indicator lamp should light.

(7) Release action and foot switches.

(8) Set CLUTTER LOCK-ON switch at TEST.

(9) Connect headset to jack on receiver-transmitter front panel.

(10) Locate a large fixed target (preferably metal) at a distance of 2,500 to 5,000 meters.

(11) Aim above the target and slowly move the cannon down until the sight reticle image is on the target.

(12) Press action switch and foot switch. An audible 1.5-kilohertz tone in headset verifies radar lock-on.

(13) Release action and foot switches, remove headset, and set CLUTTER LOCK-ON switch at NORMAL.

(14) Check that READY WHEN LIT indicator lamp is lit.

(15) Press MID RANGE CALIBRATION pushbutton and observe that MID RANGE CALIBRATION indicator lamp remains lit.

(16) Set SYSTEM POWER switch at OFF.

4-16. Boresighting

a. Distant Aiming Point Method. This method will normally be used for weapons on site.

(1) Check that GUN POWER switch is OFF.

(2) Set SYSTEM POWER switch at ON and turn MODE switch to RADAR.

(3) Check that the cannon is clear. To clear cannon, hold the BRAKE-CLEAR AND BRAKE switch to CLEAR AND BRAKE and rotate the barrels two complete revolutions. Release the switch. Remove any rounds remaining in the case chute.

(4) Time the cannon with barrel No. 1 in the firing position.

(*a*) Hold the BRAKE/CLEAR AND BRAKE switch at CLEAR AND BRAKE, depress the cannon index pin and locate the No. 1 barrel (marked on the muzzle clamp) in the firing position, which is at the 4 o'clock position when viewed from the muzzle end.

(*b*) Release the BRAKE/CLEAR AND BRAKE switch and index pin.

(*c*) Check that the index pin has returned to normal.

(5) Unstow the radar antenna if stowed.

(*a*) Set MAINT switch at OFF.

(*b*) Set MODE switch at NORMAL, and press either action switch until the antenna drives out of stow and is positioned to the cannon axis.

(*c*) Set MAINT switch at ON.

(6) If the radar antenna was unstowed, check to see that MODE switch is set at NORMAL and MAINT switch at ON.

(7) Select a distant aiming point (at least 2,500 meters away), press an action switch, and train the cannon to the approximate position for boresighting.

(8) Pull out the shift pin handle on the drum drive assembly and shift to N. This places the drum drive in neutral and interrupts electrical circuits to prevent the elevation, traversing, and firing of the cannon.

(9) Insert the muzzle adapter from the boresight kit into the muzzle of No. 1 barrel.

(10) Install the boresight telescope in the mandrel assembly and secure with socket-head screws on the mandrel assembly.

(11) Insert the mandrel assembly into the

muzzle adapter with the eyepiece of the telescope in the horizontal position and press to tighten the adapter and mandrel assembly in the barrel.

(12) Release the azimuth and elevation drive motor brakes.

(13) Sight through the boresight telescope on a distinct distant point. Rotate the mandrel assembly and boresight telescope 180° to the horizontal position on the opposite side of the barrel. Sight through the boresight telescope to determine that the point sighted on previously is still on the crosshairs. If the point is not on the crosshairs, the boresight kit is defective.

(14) Manually position the cannon so the crosshairs of the boresight telescope are level with, and 3.5 mils to the right of, the distant aiming point.

(15) Lock the asimuth and elevation drive motor brakes and check that the cannon is still properly aimed.

(16) Manually uncage the sight.

(17) Adjust the LAMP control assembly for a clear reticle image in sight XM61.

(18) Remove only the front and right caps on top of the sight XM61.

(19) Adjust the socket-head bolts on top of the sight to center the inner reticle circle of the sight XM61 on the distant aiming point. The front adjustment is for elevation and the right adjustment is for azimuth. Move the eye up and down, and right and left to check for parallax. If excessive parallax is experienced, notify organizational maintenance.

Note. Another crew member must check through the boresight telescope while the adjustments are being made to assure that the cannon does not move.

(20) Install the caps on the sight.

(21) Boresight telescope XM134 to the cannon as follows:

Note. To turn boresight adjusting screws, it is necessary to release the clamping screws in front and rear end of left wall of the mount XM164.

(*a*) View through the telescope eyepiece and adjust the AZ boresight adjusting screw to bring the cross of the reticle XM134 (fig 3-10) into horizontal alinement with the distant aiming point.

(*b*) Release the elevation drive motor brake and lower the cannon so the crosshairs of the boresight telescope are 4 mils below the distant aiming point. *Do not change azimuth.* Lock the elevation drive motor brake.

(*c*) View through the telescope eyepiece and adjust the EL boresight adjusting screw to bring the cross of the reticle into vertical alinement with the distant aiming point.

(*d*) Tighten clamping screws.

(*e*) Release the elevation drive motor brake and raise the cannon so the crosshairs of the boresight telescope are on the distant aiming point. Lock the elevation drive motor brake.

(22) Remove the boresight telescope and mandrel assembly and install the telescope in the mount provided in the antenna. *Remove muzzle adapter from No. 1 barrel.*

(23) Loosen the elevation coupling clamp screw located on the gun elevation input shaft coupling to the radar antenna. Rotate the radar input shaft to move the horizontal crosshair of the telescope reticle on the distant aiming point. Tighten the screw.

Note. Another crew member must check that sight XM61 is centered on the distant aiming point.

(24) Remove the access cover from the traverse boresight adjustment located on the reflector and feed housing assembly. Loosen the lock and turn the adjustment screw until the vertical crosshair on the telescope reticle intersects the distant aiming point; then tighten the lock.

Note. Another crew member must check that sight XM61 is centered on the distant aiming point.

(25) Repeat steps (23) and (24) above if necessary to center the reticle crosshairs.

(26) At the antenna stow control, set MODE toggle switch at STOW.

(27) Using the TRAV toggle switch, drive the antenna to the left approximately 180 mils (10%).

(28) Set MODE toggle switch at NORMAL.

(29) At the boresight telescope mounted on the antenna, observe that the crosshairs within the reticle are positioned on the distant aiming point.

(30) Repeat steps (26) through (29) above except in step (27) drive the antenna to the right.

(31) At the stow control, set the MODE toggle switch to STOW.

(32) Using the ELEV toggle switch, drive the antenna up approximately 10%.

(33) Set the MODE toggle switch to NORMAL.

(34) At the boresight telescope mounted on the antenna, observe that the crosshairs within the reticle are positioned on the distant aiming point.

(35) Repeat steps (31) through (34) except in step (32) drive antenna down approximately 10%.

Note. When performing steps (26) through (35) above, if the antenna does not reposition on the aiming point, a malfunction exists.

(36) Replace the access cover on the traverse boresight adjustment.

(37) On the antenna stow control, set MAINT switch at OFF.

(38) Remove the boresight telescope from the antenna reflector.

(39) Cage the sight.

(40) Set SYSTEM POWER switch at OFF.

(41) On the drum drive assembly, pullout the shift pin handle and place the drum drive in the fire position (shift to F position).

(42) *Recheck that nothing is in the muzzle.*

b. Testing Target Method. This method may be used when more practical.

(1) Choose a level unobstructed area.

(2) Check that GUN POWER switch is OFF.

(3) Set SYSTEM POWER switch at ON and turn MODE switch to RADAR.

(4) Check that the cannon is clear. To clear cannon, hold the BRAKE/CLEAR AND BRAKE switch at CLEAR AND BRAKE and rotate the barrels two complete revolutions. Release the switch. Remove any rounds remaining in the case chute.

(5) Time the cannon with barrel No. 1 in the firing position.

(*a*) Hold the BRAKE/CLEAR AND BRAKE switch at CLEAR AND BRAKE, depress the cannon index pin and locate the No. 1 barrel (marked on the muzzle clamp) in the firing position, which is at the 4 o'clock position when viewed from the muzzle end.

(*b*) Release the BRAKE/CLEAR AND BRAKE switch and index pin.

(*c*) Check that the index pin has returned to normal.

(6) Unstow the radar antenna if stowed.

(*a*) Set MAINT switch at OFF.

(*b*) Set MODE switch at NORMAL, and press either action switch until the antenna drives out of stow and is positioned to the cannon axis.

(*c*) Set MAINT switch at ON.

(7) If the radar antenna was unstowed, check to see that MODE switch is set at NORMAL, and MAINT switch at ON.

(8) Position the target (fig 4-2) approximately 1,000 inches from the muzzle of the cannon. (This distance may be paced as 34 paces.)

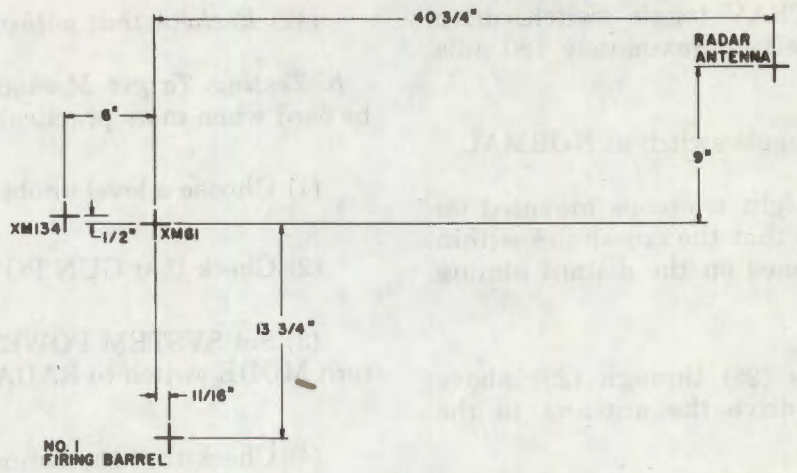


Figure 4-2. Boresight target.

(9) Press an action switch, and train the cannon to the approximate target location.

(10) Position the cannon at 0 ±10 mils elevation using the parallelogram linkage scribe marks.

(11) Pull out the shift pin handle on the drum drive assembly and shift to N. This places the drum drive in neutral and interrupts electrical circuits to prevent the elevation, traversing, and firing of the cannon.

(12) Insert the muzzle adapter from the boresight kit into the muzzle of No. 1 barrel.

(13) Install the boresight telescope in the mandrel assembly and secure with socket-head screws on the mandrel assembly.

(14) Insert the mandrel assembly into the muzzle adapter with the eyepiece of the telescope in the horizontal position and press to tighten the adapter and mandrel assembly in the barrel.

(15) Release the azimuth and elevation drive motor brakes.

(16) Sight through the boresight telescope on a distant point. Rotate the mandrel assembly and boresight telescope 180° to the horizontal position on the opposite side of the barrel. Sight through the boresight telescope to determine that the point sighted on previously is still on the crosshairs. If the point is not on the crosshairs, the boresight kit is defective.

(17) Manually position the cannon so that the No. 1 barrel is alined on its cross on the boresight target. Check to see that the cannon elevation is at 0 ±10 mils. If necessary, reposition the target.

(18) Lock the azimuth and elevation drive motor brakes and check that the cannon is still properly aimed.

(19) Manually uncage the sight.

(20) Adjust the LAMP control assembly for a clear reticle image in sight XM61.

(21) Remove only the front and right caps on top of sight XM61.

(22) Adjust the socket-head bolts on top of the sight to center the inner reticle circle on the sight cross on the boresight target. The front adjustment is for elevation and the right adjustment is for azimuth. Move the eye up and down, and right and left to check for parallax. If excessive parallax is experienced, notify organizational maintenance.

Note. Another crew member must check through the boresight telescope while the adjustments are being made to assure that the cannon does not move.

(23) Install the caps on the sight.

(24) Boresight telescope XM134 to the cannon as follows:

Note. To turn boresight adjusting screws, it is necessary

to release the clamping screws in front and rear end of left wall of mount XM164.

(*a*) View through the telescope eyepiece and adjust the AZ boresight adjusting screw to bring the cross of the XM134 reticle (fig. 3-10) into horizontal alinement with the XM134 cross on the target.

(*b*) View through the telescope eyepiece and adjust the EL boresight adjusting screw to bring the cross of the reticle into vertical alinement with the XM134 cross on the target.

(*c*) Tighten clamping screws.

(25) Remove the boresight telescope and mandrel assembly and install the telescope in the mount provided in the antenna. *Remove muzzle adapter from No. 1 barrel.*

Note. A metal ring located approximately one-fourth inch from the end of the telescope must be repositioned before the telescope can be installed into the mounting bracket the first time. Loosen the three setscrews, slide the ring against the shoulder nearby. Retighten the three setscrews. Leave the ring in this position.

(26) Loosen the elevation coupling clamp screw located on the gun elevation input shaft coupling to the radar antenna. Rotate the radar input shaft to move the horizontal crosshair of the telescope reticle to intersect the center of the radar antenna cross on the target. Tighten the screw.

Note. Another crew member must check that sight XM61 is centered on the XM61 sight cross on the target.

(27) Remove the access cover from the traverse boresight adjustment located on the reflector and feed housing assembly. Loosen the lock and turn the adjustment screw until the vertical crosshair on the telescope reticle intersects the center of the radar cross on the target; then tighten the lock.

Note. Another crew member must check that sight XM61 is centered on the distant aiming point.

(28) Repeat steps (24) and (27) above if necessary to center the reticle crosshairs.

(29) At the antenna stow control, set MODE toggle switch at STOW.

(30) Using the TRAV toggle switch, drive the antenna to the left approximately 180 mils (10%).

(31) Set MODE toggle switch at NORMAL.

(32) At the boresight telescope mounted on the antenna, observe that the crosshairs within the reticle are positioned on the center of the radar antenna cross on the target.

(33) Repeat steps (29) through (32) above except in step (30) drive the antenna to the right.

(34) At the stow control, set the MODE toggle switch at STOW.

(35) Using the ELEV toggle switch, drive the antenna up approximately 10°.

(36) Set the MODE toggle switch to NORMAL.

(37) At the boresight telescope mounted on the antenna, observe that the crosshairs are positioned on the center of the radar antenna cross on the target.

(38) Repeat steps (34) through (37) except in step (35) drive the antenna down approximately 10°.

Note. When performing steps (29) through (38) above, if the antenna does not reposition exactly on the boresight target, a malfunction exists.

(39) Replace the access cover on the traverse boresight adjustment.

(40) On the antenna stow control, set MAINT switch at OFF.

(41) Remove the boresight telescope from the antenna reflector.

(42) Cage the sight.

(43) Set system power switch at OFF.

(44) On the drum drive assembly, pull out the shift pin handle and place the drum drive in the fire position (shift to F position).

(45) *Recheck that nothing is in the muzzle.*

c. Check and aline the night sight as follows (use the column for the sight in use) (fig 4-4).

<table>
<tr><th>9927</th><th>9927A AN/TVS-2</th><th>9927B AN/TVS-2A</th><th>AN/TVS-2B</th></tr>
<tr><td colspan="4">Install in accordance with TM 9-2350-300-10.</td></tr>
<tr><td colspan="2">Insure that boresight cover is properly installed.</td><td colspan="2">Insure that boresight cover is properly installed and that small aperture is closed.</td></tr>
<tr><td colspan="4">*Caution:* **Always leave the boresight cover on the sight during daylight hours when the sight is turned on.**</td></tr>
<tr><td colspan="2">*Caution:* **Do not boresight during daylight hours.**</td><td colspan="2">*Caution:* **Do not let the sun shine directly into the small aperture in the cover.**</td></tr>
<tr><td colspan="2">Remove boresight cover (1) at night.</td><td colspan="2">Remove boresight cover (1) if at night, or open aperture during daylight hours.</td></tr>
<tr><td>Place four position control control switch (2) in second (cant level) position.</td><td colspan="3">Place three position control switch (2) in third (sight and reticle) position.</td></tr>
<tr><td>Pull slide pin (15) to forward position and observe cant level bubble through cant level view port (14).</td><td colspan="3">Check vertical alinement of reticle pattern. If pattern is not vertical, loosen reticle cell retaining nut (13) and rotate cell until pattern is vertical.</td></tr>
<tr><td>Center cant level bubble using cant level adjustment (13).</td><td colspan="3">Tighten reticle cell retaining nut (13).</td></tr>
<tr><td>Place four position control switch (2) in fourth (sight and reticle) position.</td><td colspan="2"></td><td>Place three position control switch (2) in third (sight and reticle) position.</td></tr>
<tr><td colspan="4">Look through eyeshield (7) for proper image and reticle pattern.</td></tr>
<tr><td colspan="4">Adjust eyepiece focus ring (6) for sharp reticle pattern.</td></tr>
<tr><td colspan="2">Unlock objective lens locknut (12) and adjust objective lens focus knob (11) for clear image.</td><td colspan="2">Adjust objective lens focus knob (11) for clear image.</td></tr>
<tr><td colspan="2">Lock objective lens locknut (12).</td><td colspan="2"></td></tr>
<tr><td colspan="4">Adjust reticle intensity adjustment (3) for desired reticle brightness.</td></tr>
<tr><td colspan="2">Position cannon so that the crosshair mark of the XM134 sight (fig 3-10) is on a distant object, such as a star.</td><td colspan="2">Position cannon so that the crosshair mark of the XM134 sight is on a distant object, such as a star (at night) or building, vehicle, etc.</td></tr>
<tr><td colspan="4">*Note.* The center of the XM61 sight 15-mil circle (fig 3-24) may be substituted for the crosshair mark when the XM134 sight is not properly mounted and alined with the cannon.</td></tr>
<tr><td colspan="4">Look through the eyepiece and adjust the elevation boresight screw (8) and the azimuth boresight screw (9) until the crosshair mark of the night sight reticle (fig 4-3) is on the same distant object.</td></tr>
<tr><td colspan="4">Recheck that the XM134 sight is still on the distant object. If not, repeat the previous three steps.</td></tr>
<tr><td colspan="4">Turn off the night sight by placing the control switch (2) in the first (off) position.</td></tr>
<tr><td colspan="2">Replace the boresight cover (1)</td><td colspan="2">Replace the boresight cover (1) and/or close the aperture.</td></tr>
</table>

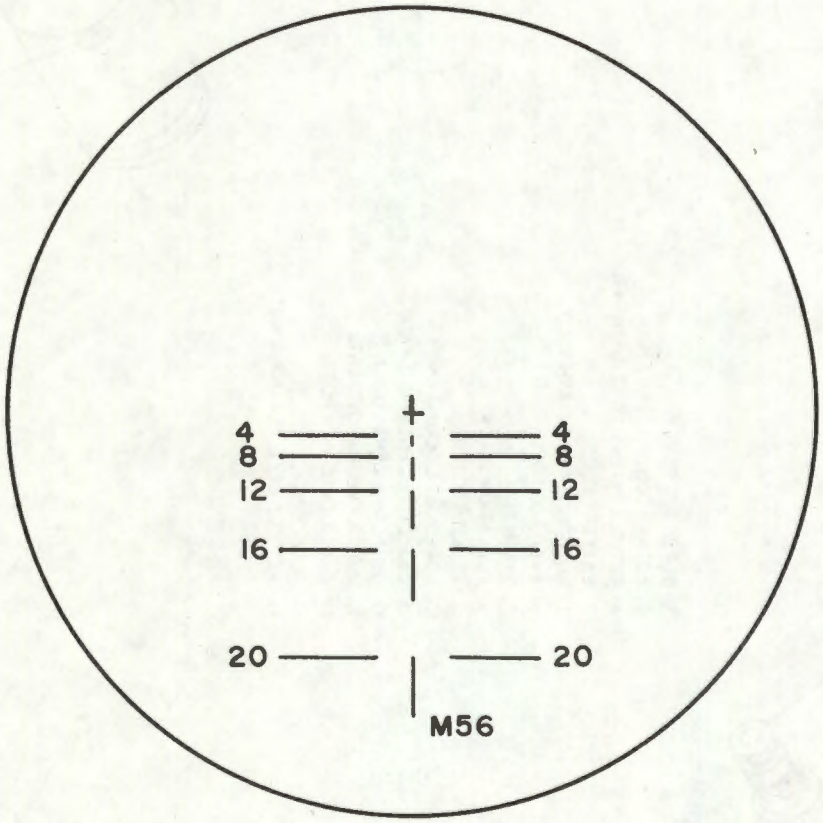
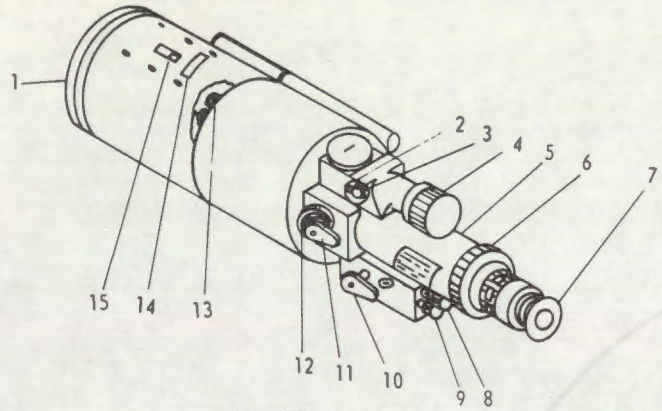
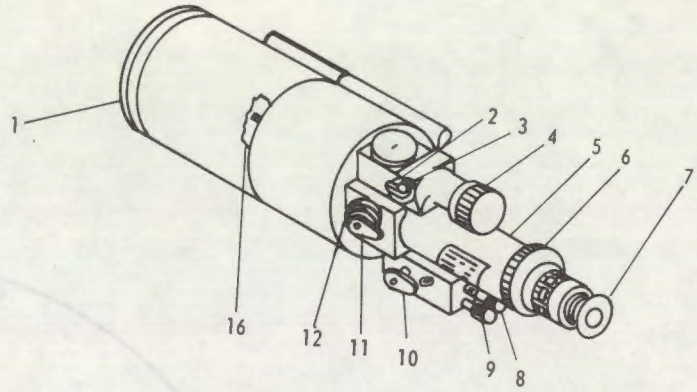


Figure 4-3. Night sight reticle.

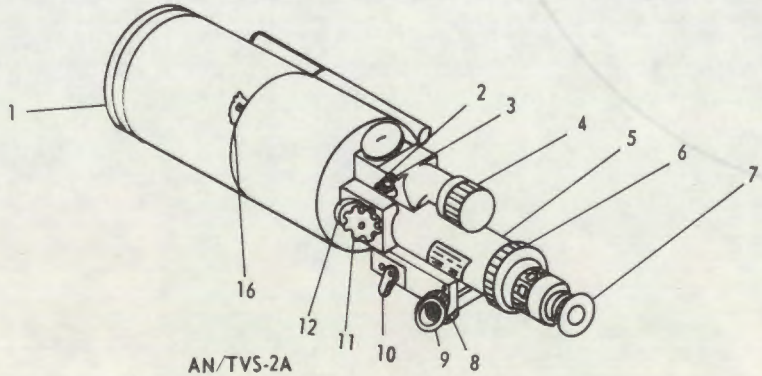


MODEL 9927

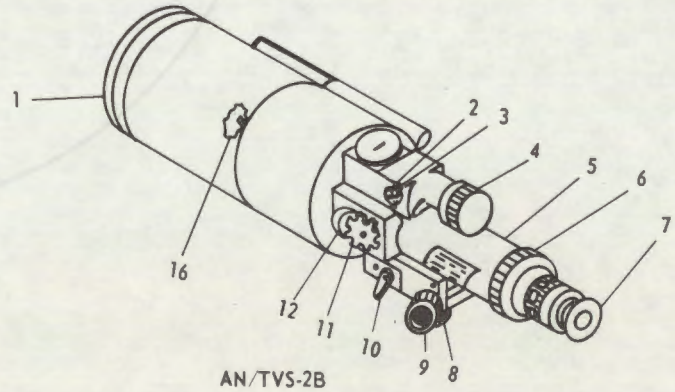


AN/TVS-2
(MODEL 9927A)

1. BORESIGHT COVER.
2. ROTARY CONTROL SWITCH.
3. RETICLE INTENSITY ADJUSTMENT.
4. BATTERY CAP.
5. IMAGE INTENSIFIER ASSEMBLY.
6. EYEPIECE FOCUS RING.
7. EYESHIELD.
8. ELEVATION SCREW.
9. AZIMUTH SCREW.
10. BORESIGHT LOCKING KNOB.
11. OBJECTIVE LENS FOCUS KNOB.
12. OBJECTIVE LENS LOCK NUT.
13. CANT LEVEL ADJUSTMENT.
14. CANT LEVEL VIEW PORT.
15. SLIDE PIN.
16. RETICLE CELL RETAINING NUT.



AN/TVS-2A
(MODEL 9927B)



AN/TVS-2B

Figure 4-4. Night sights.

Section VI. FIRING

4-17. General

The Vulcan system can be fired in the radar, manual, external, or ground modes. The radar mode is normally used against aerial targets as the radar set automatically provides the fire control system with range and range rate information. The manual mode may be used against aerial and ground targets with estimated target range and speed set into the system by the senior gunner. The external mode may be used against aerial and ground targets with estimated range set into the system by means of the external range control operated by the squad leader. The ground mode is normally used against slow moving or stationary ground targets in either direct or indirect fire. Table 4-6 shows the recommended mode selection, firing rate, and bursts for engaging aerial and ground targets.

Table 4-6. Vulcan Firing Standards

Weapon Modes	LOW-PERFORMANCE (Single-engine propeller and helicopter).	MEDIUM-PERFORMANCE (Multiengine propeller and high-speed, single-engine propeller).	HIGH-PERFORMANCE (Jet)
Radar—3,000 rounds/ minute	30-round burst	60-round burst	60-round burst
Manual, and External—3,000 rounds/ minute	30-round burst	60-round burst	100-round burst
Ground — 1,000 or 3,000 rounds/ minute	Shoot short bursts of 10-30 rounds		

Notes. 1. When slewing the gun mount to acquire a target in manual and external modes only, electrically cage sight XM61 to prevent generation of extreme lead angles (sight XM61 is automatically caged in radar mode and mechanically caged in ground mode). Release the sight cage switch after smooth tracking begins.

2. When firing in any mode with a remote safe switch assembly, instead of the normal arming connector, connected to the distribution box J6, the remote safe switch assembly pushbutton must be pressed and held before the cannon will fire.

3. If the radar antenna servo-drive system is inoperative for any reason, inputs necessary for computation of lead angle will not be available to the sight current generator. In this case all targets must be engaged in the ground, external, or manual mode. In the manual mode connector W7P2 must be disconnected from the radar distribution box and the shorting plug installed on the open end of the cable to prevent erroneous lead angle information from the radar entering the sight current generator.

4-18. Firing in Radar Mode

The most accurate firing against aerial targets can be accomplished by firing in the radar mode. In the radar mode accurate target speed and range data are computed automatically by the fire control system. To fire in the radar mode proceed as follows:

a. Turn FIRING RATE switch to HI—BURST LIMIT (10, 30, 60, or 100) as desired.

b. Set GUN CLEAR switch at AUTO.

c. Turn MODE switch to RADAR and set SYSTEM POWER and GUN POWER switches at ON.

d. Adjust SIGHT LAMP knob for desired sight reticle light intensity and uncage sight gyro.

e. When the target is sighted, acquire it in the center of the sight reticle image and establish smooth tracking.

Note. When acquiring the target, the senior gunner should traverse the mount so as to approach the target from its rear.

f. Press and hold the radar foot switch while continuing to track the target.

g. When the ready-to-fire lamp lights, press and hold the trigger. The fire control system requires that the target be tracked smoothly within the small reticle circle of the sight for 3 seconds at ranges from 1,500 to 1,700 meters, 2 seconds at ranges from 800 to 1,500 meters,

and at least 1 second at ranges up to 800 meters before firing. This allows the sight time to develop the proper lead angle. Firing while there is relative movement between the target and sight reticle image will result in an improper lead angle and a miss. Continue tracking and firing bursts until the target is destroyed, the ready-to-fire lamp goes out, or cease fire is ordered.

Note. The trigger must be released at the end of each burst.

h. Cease firing, cease tracking, check that cannon is cleared, and clear it manually if required.

Warning: **If cannon is not cleared immediately after firing, danger of a cookoff exists. Keep cannon aimed at the target area until clearing has been accomplished.**

i. Cage sight and set GUN POWER and SYSTEM POWER switches at OFF.

4-19. Firing in Manual Mode

The manual mode normally is used against aerial targets, but it can also be used against ground targets. It will provide lead for moving targets and superelevation for fixed or moving targets. In this mode, the gunner must estimate target speed and range. To fire in the manual mode, proceed as follows:

a. Turn FIRING RATE switch to HI—BURST LIMIT (10, 30, 60, or 100) as desired.

b. Set GUN CLEAR switch at AUTO.

c. Turn MODE switch to MAN and set SYSTEM POWER and GUN POWER switches at ON.

d. Adjust SIGHT LAMP knob for desired reticle light intensity and uncage sight gyro.

e. When a target is sighted, estimate target speed and the range at which it is intended to open fire and turn TARGET SPEED and RANGE knobs to these values.

f. Press the sight cage and action switches on the control handle and slew mount to acquire target in the sight reticle image. Bring the sight reticle image on target while moving the mount in the same direction that the target is moving.

Note. In the manual mode, the ready-to-fire indicator lamp lights when the action switch is pressed.

g. Perform one of the following operations:

(1) If target is beyond 800 meters range, release sight cage switch immediately upon acquiring target in the sight reticle image and bring the target smoothly into the inner circle of the reticle image.

(2) If target is at a range less than 800 meters, keep sight cage switch pressed until target is slightly ahead of the center of the reticle image. Release sight cage switch and smoothly bring target into the center of the inner circle of the reticle image.

h. Continue to track the target smoothly for at least 1 second if range is 800 meters or less, 2 seconds if range is from 800 to 1,500 meters, and 3 seconds if range is from 1,500 to 1,800 meters; then press and hold the trigger. Continue to fire bursts until target is destroyed, target is out of range, or until cease fire or cease tracking is ordered.

i. After cease fire, keep cannon aimed at target area, check that it is clear, and clear it manually if required.

Warning: **If cannon is not cleared immediately after firing, danger of a cookoff exists. Keep cannon aimed at the target area until clearing has been accomplished.**

j. Cage sight and set GUN POWER and SYSTEM POWER switches at OFF.

4-20. Firing in External Mode

The external mode of firing requires two operators, a senior gunner to operate the gun and a range setter to operate the external range unit. Firing is accomplished as follows:

a. Prepare system for firing as stated in paragraph 4-19*a* through *d*, except turn MODE switch to EXT.

b. Connect external range unit to receptacle and place unit at desired location.

c. Manually uncage sight.

d. When a target is sighted, range unit oper-

ator estimates target range and sets the range at which he desires to open fire on the external range unit dial.

e. Press sight cage switch and action switches on control handles and slew mount to acquire target in sight reticle image.

f. When target can be seen in sight, release sight cage switch and track target smoothly in the inner circle of the sight reticle image.

g. When the external range unit operator estimates that the target is at the range set on the external range unit, he presses the switch on the external range unit, causing the ready-to-fire indicator lamp on the sight to light. He continues to set estimated range on the external range unit dial until the engagement is completed.

h. When the ready-to-fire indicator lamp lights, the senior gunner commences firing and continues tracking and firing bursts until target is destroyed or ready-to-fire indicator lamp goes out.

i. After the cannon stops firing, keep it aimed at the target area, check that it is clear, and clear it manually if required.

Warning: **If cannon is not cleared immediately after firing, danger of a cookoff exists. Keep cannon aimed at the target area until clearing has been accomplished.**

4-21. Firing in Ground Mode

a. General. Engagement of surface targets in the ground mode can be accomplished by direct fire, static fire, and indirect fire procedures. Either sight XM61, telescope sight XM134, or sight AN/TVS-2 can be used in direct fire, depending on visibility conditions and accuracy of fire desired.

(1) *Sight XM61.* Sight XM61 remains mounted on the weapon and is mechanically caged when the weapon is fired in the ground mode regardless of which sight is being used to control fire. Using sight XM61, if the target is 1,000 meters or less from the gun, aline the center of the reticle image (fig 3-24) on the target. If the target is beyond 1,000 meters, aline the gap at the bottom of the inner circle of the reticle image on the target. Fire is adjusted by observing the splash of rounds and correcting aim accordingly.

(2) *Telescope sight XM134.* To use telescope sight XM134, aline the vertical center line of the sight reticle on the target and elevate the cannon until the proper horizontal line of the sight reticle for the target range is alined on the target. The sight reticle (fig 3-10) has horizontal lines for 4, 8, 12, 16, and 20 (hundreds of meters). Adjust fire by observing the splash of rounds and correcting aim accordingly.

(3) *Night sight AN/TVS-2.* Prepare the night sight for operation by following the procedure in paragraphs (4-16*c*(3) through 4-16*c* (12). The sight may be used for area or possible target searching. When a target is selected, aline the cross mark of the reticle with the target. Elevate the cannon until the proper mark in the center vertical row is alined with the target. The marks in the center row represent 0, 400, 800, 1,200, 1,600, and 2,000 meters. Adjust fire by observing the splash of rounds and correcting aim accordingly.

b. Direct Fire in Ground Mode. In the normal engagement of ground targets, the weapon servo-drive system remains energized so that aim can be adjusted and a rapid change to any new target can be made. To engage ground targets, proceed as follows:

(1) Set FIRING RATE switch at LO—NO BURST LIMIT (or HI—BURST LIMIT 10 or 30).

(2) Set GUN CLEAR switch at AUTO.

(3) Check that sight XM61 is caged.

(4) Set SYSTEM POWER and GUN POWER switches at ON, and turn MODE switch to GRD.

(5) When a target is sighted, slew mount to acquire target in sight.

(6) Fire by pressing trigger. Fire short bursts of 10-30 rounds each, observe splash of rounds, and adjust aim accordingly.

(7) Continue firing bursts until target is destroyed.

(8) Cease fire, keep gun aimed at target area, check that gun is clear, and clear gun manually if necessary.

Warning: **If cannon is not cleared immediately after firing, danger of a cookoff exists. Keep cannon aimed at the target area until clearing has been accomplished.**

c. Static Fire in Ground Mode. This method of firing is used for firing at a specific ground target or area when the target is not visible because of smoke, darkness, or intervening mask. The aim of the gun is adjusted by firing during a period when the target is visible to an observer, then the servo-drive system is disabled, locking the gun in the firing position. To engage ground targets by the static firing method, proceed as follows:

(2) While target area is visible, establish the proper aim by adjusting fire, using the procedure stated in *b* above.

(2) When the gun is aimed so that rounds impact on target, set NORM/STATIC/TEST switch at STATIC.

(3) Set GUN POWER and SYSTEM POWER switches at OFF.

(4) To fire for effect, set GUN POWER and SYSTEM POWER switches at ON and press action switch and trigger.

(5) To cease fire in low—no burst limit firing, release trigger. Burst length is determined by the length of time that trigger is pressed.

(6) In high—burst limit firing, automatically stops at the end of the selected burst. Release and repress the trigger to fire another burst.

(7) Check that weapon is clear and clear manually if required.

d. Indirect Fire in Ground Mode. Indirect fire differs from static fire in that the gun is laid in azimuth and quadrant elevation on date computed from range and direction to target and information contained in firing tables. Either of two procedures, direct command or target grid, is used in indirect fire. In direct command procedure, an observer communicates corrections direct to the gun; whereas, in target grid procedure, spottings by the observer are received at a fire direction center (FDC) which, in turn, issues fire commands to the gun. (For detailed explanation of indirect fire methods, see FM 44-62.)

(1) *Direct command procedure.*

(*a*) Perform steps *b*(1) through (4) above.

(*b*) Sight on an aiming point and set azimuth indicator to azimuth of the aiming point.

(*c*) Establish an observation post distant from the gun by not more than 10 percent of the target range.

(*d*) Observer computes firing data and telephones the call for fire (to include quadrant elevation) to the gun.

(*e*) The gun is traversed to the firing azimuth, as indicated on the azimuth indicator, and elevated to the proper elevation as indicated on the gunner's quadrant.

(*f*) Fire is adjusted by the observer who telephones corrections to the gun in the form of new azimuth and quadrant elevation until fire is brought to bear on the target. During adjustment, bursts of 10 to 30 rounds should be fired.

(*g*) Fire for effect is accomplished by firing longer bursts (number of rounds stated) on command of the observer.

(2) *Target grid procedure.* This procedure is used when the observer must be located farther from the gun than 10 percent of the target range. The gun must be oriented and accurately located on the map or grid. The observer calls for fire to a fire direction center (either at the Vulcan platoon headquarters or supported unit) and fire commands are issued to the gun by the fire direction center. Firing is accomplished in the same manner as in the direct command procedure.

CHAPTER 5

SQUAD ORGANIZATION AND DRILL

Section I. ORGANIZATION AND DUTIES

5-1. General

The self-propelled Vulcan squad is organized for optimum employment of the weapon system. In order that the weapon be operated and maintained effectively, each member of the squad must be trained thoroughly in his duties and those of all other squad members. The drills and procedures described are designed to produce teamwork, speed, and efficiency in performing the tasks necessary for effective employment of Vulcan in a combat situation. To be effective, the drills and procedures described must be—

a. Performed with enthusiasm.

b. Conducted in silence except for commands and reports.

c. Repeated until actions become automatic and are performed rapidly and efficiently.

d. Supervised so that any mistakes are detected and corrected immediately.

e. Conducted so that each squad member can perform all duties within the squad.

5-2. Squad Organization and Designations

The Vulcan self-propelled weapon system is manned by a squad consisting of four men: squad leader, senior gunner, driver, and gunner. For the purpose of describing crew drill procedures, the squad members will be assigned designations as follows:

a. Squad leader ..... SL

b. Senior gunner ..... No. 1

c. Driver ..... No. 2

d. Gunner ..... No. 3

5-3. Duties of Squad Members

a. Squad Leader. The squad leader is responsible to the platoon sergeant for—

(1) Exercise of command over the Vulcan squad.

(2) Training of squad personnel.

(3) Site selection, preparation, and occupation.

(4) Emplacement and firing of the Vulcan weapon.

(5) Planning and construction of field fortifications.

(6) Camouflage and camouflage discipline.

(7) Squad local security from ground attack.

(8) Establishing and maintaining communications with the platoon or supported unit as required and for the observance of communication security.

(9) Operation of the Vulcan system in support of the platoon mission.

(10) Final and positive identification of aircraft.

(11) Performance of other duties as assigned by the platoon sergeant.

Note. DA Pam 350-12 may be helpful to the squad leader.

b. Senior Gunner. The senior gunner is responsible to the squad leader for—

(1) Operating the Vulcan armament and fire control systems.

(2) Maintaining the Vulcan armament and fire control systems.

(3) Delivering effective fire on hostile targets designated by the squad leader.

(4) Assuming all duties and responsibilities of the squad leader during the squad leader's absence from the squad.

(5) Performing other duties as assigned by the squad leader.

c. Driver. The driver is responsible to the squad leader for—

(1) Operating the Vulcan vehicle XM741.

(2) Operating the auxiliary power unit.

(3) Maintaining the vehicle and auxiliary power unit.

(4) Assisting the squad leader in operating the squad communication equipment.

(5) Performing other duties assigned by the squad leader.

d. Gunner. The gunner is responsible to the squad leader for—

(1) Maintaining spare ammunition in a ready-to-load condition.

(2) Reloading the Vulcan ammunition feed and storage system.

(3) Maintaining the Vulcan ammunition feed and storage system.

(4) Maintaining squad communication equipment.

(5) Assisting the senior gunner in operating and maintaining the Vulcan armament and fire control system.

(6) Assisting the driver in operating and maintaining the vehicle and auxiliary power unit.

(7) Performing other duties as assigned by the squad leader.

Section II. CREW DRILL

5-4. Formations

a. General. The terms, *left, right, front,* and *rear,* are used as follows:

(1) When used to refer to the vehicle, these terms relate to directions from the driver's seat looking toward the forward end of the vehicle.

(2) When used to refer to the mount or any of the items mounted on it, the terms relate to directions from the gunner's seat looking in the direction the cannon is pointed.

b. Dismounted Posts. Squad members take dismounted posts at any time that the squad must be assembled as a unit. This is the initial formation for performance of crew drill. Squad members assume dismounted posts as follows:

(1) *SL.* Four paces in front of the front center of the vehicle.

(2) *No. 1.* Two paces in front of the vehicle right track.

(3) *No. 2.* On line with and to the left of No. 1, at close interval.

(4) *No. 3.* On line with and to the left of No. 2, at close interval.

c. Mounted Posts. Mounted posts are assumed from the dismounted post positions whenever the squad is preparing for movement. Under noncombat conditions, vehicle fore and aft hatches will be open and the ramp and personnel door closed when the squad is at mounted posts. Mounted posts are as follows:

(1) *SL.* Standing inside the vehicle in a position to observe through the open aft hatch.

(2) *No. 1.* Seated in the Vulcan turret.

(3) *No. 2.* Standing in the vehicle driver's station in a position to observe through the forward hatch.

(4) *No. 3.* Inside the vehicle seated on the personnel seat.

d. Action Posts. Action posts are assumed whenever combat is imminent or anticipated, or for the purpose of conducting action drill in a training situation. Action posts differ, depending on whether the weapon is to be fired while moving or while emplaced. Action posts are as follows:

(1) *Posts during movement.* Action posts are similar to mounted posts described in *c* above except that the driver and squad leader are seated and the forward and aft hatches may be closed.

(2) *Emplaced posts.* When the weapon is to be fired from an emplaced position, specific posts are selected and designated by the squad leader. Posts will vary with the terrain features of the position and the tactical situation except that a gunner will always man the weapon. If the position is exposed to ground fire and is to be occupied for only a short period of time, the squad may remain at mounted posts with hatches and ramp closed or take cover close to the vehicle, as the situation demands. If the position is to be occupied for a long period and cover is available, the squad leader, driver, and gunner may deploy away from the vehicle to act as observers.

5-5. Safety Precautions

a. The observance of safe operating procedures is necessary for the protection of personnel and equipment. The precautions listed below should be observed in all phases of Vulcan operations and should be standard procedure.

b. The squad leader must know all safety precautions applying to the operation of all items of squad equipment and must strictly enforce observance of these precautions.

c. Any individual who becomes aware of any unsafe condition or hazard that will endanger the squad or equipment will immediately inform all concerned.

d. The senior gunner will—

(1) Alert the squad by voice before traversing the turret (the ammunition storage drum rotates with the turret and a squad member could be injured by being caught between the drum and the side of the vehicle) and await a report of all clear from a squad member (who has made a visual check) before proceeding.

(2) Always insure that the cannon is clear of all live ammunition after firing by manually rotating the cannon and visually checking that the weapon is clear.

(3) Always check that no obstructions will strike the cannon or turret before traversing the mount or elevating or depressing the cannon.

e. The gunner will—

(1) Insure that the ammunition drum safety guard is in place any time the cannon is free of its travel lock, except when loading ammunition or performing maintenance requiring guard to be removed.

(2) Examine each round of ammunition carefully before loading to see that it is clean; not bulged, denied, or nicked; and is properly seated in its link.

(3) Insure that spare ammunition is properly stowed.

(4) Insure that the interior of the vehicle is free of loose equipment or debris.

(5) Insure that nothing blocks rotation of the ammunition drum before allowing the mount to be traversed.

f. The driver will—

(1) Operate the vehicle in a manner that will minimize shock, vibration, and bouncing.

(2) Be on the alert for the presence of carbon monoxide, gasoline or diesel fumes, or other noxious fumes within the vehicle.

(3) Warn other squad members by voice and get an all-clear indication before moving the vehicle. In bivouac areas and training or maintenance areas, a guide on foot will direct the driver.

5-6. Crew Drill

The following charts show the actions of each squad member by column, and the sequence in which the actions are performed.

Movement	SL	No. 1	No. 2	No. 3
a. FALL IN. Assume dismounted posts. Squad members take dismounted posts at any time that the squad must be assembled as a unit. This is the initial formation for crew drill.	Assumes position four paces in front of the front center of the vehicle facing vehicle and commands, FALL IN.	Assumes position two paces in front of the vehicle right track, with back to vehicle, at attention.	Assumes position on line with and to the left of No. 1, at close interval, at attention.	Assumes position on line with and to the left of No. 2, at close interval, at attention.
b. FALL OUT. This command is used to break formation when the squad is to remain in the immediate vicinity of the equipment. It is always given with the squad at dismounted posts at attention.	Commands, FALL OUT.	Breaks formation and moves to the right of the vehicle unless otherwise directed by SL.	Breaks formation and moves to the right of the vehicle unless otherwise directed by SL.	Breaks formation and moves to the right of the vehicle unless otherwise directed by SL.
c. COUNT OFF. This command is used to cause each squad member except the SL to identify himself by number.	With the squad formed at dismounted posts, commands, COUNT OFF.	Counts off ONE.	Performs eyes right and counts off TWO in turn, at the same time returning to eyes front.	Performs eyes right and counts off THREE in turn, at the same time returning to eyes front.
d. CALL OFF. This command is used to cause each squad member to identify HIMSELF BY TITLE.	With the squad formed at dismounted posts, commands, CALL OFF.	Calls off, SENIOR GUNNER.	Performs eyes right and calls off, DRIVER, in turn, at the same time returning to eyes front.	Performs eyes right and calls off, GUNNER, in turn, at the same time returning to eyes front.
e. CHANGE POSTS. This command is used to rotate squad positions for the purpose of training squad members to perform all duties in the squad.	With the squad at dismounted posts, commands, CHANGE POSTS.	Takes one pace to the rear, faces left, takes two paces forward, halts, faces right,	Faces right, steps forward to the dismounted post of No. 1, faces left, and as-	Faces right, steps forward to the dismounted post of No. 2, faces left, dresses on No. 1, and as-

Movement	SL	No. 1	No. 2	No. 3
		dresses on No. 2, and assumes the duties of No. 3.	sumes the duties of No. 1.	sumes the duties of of No. 2.
f. MOUNT. This command is used to cause the squad to take mounted posts.	With the squad at dismounted posts, commands, PREPARE TO MOUNT—MOUNT.	Executes about face. Moves rapidly to the top of the vehicle, enters the mount, and takes his post.	Executes about face	Executes about face. Moves at double time around the left side of the vehicle, opens the personnel door, and takes his mounted post.
	Follows No. 3 around the left side of the vehicle, enters vehicle, closes the personnel door, and takes his mounted post.		Follows No. 1 to the top of the vehicle, opens the forward hatch, and takes his post.	
g. CLOSE HATCHES. This command is used to secure the vehicle by closing the ramp (if open) and hatches.	With the squad at mounted posts, commands, CLOSE HATCHES.	Surveys weapon to determine that nothing obstructs the closing of hatches. If an obstruction exists, he reports, FORWARD (or AFT) HATCH BLOCKED, and directs No. 2 or No. 3 (as required) to remove obstruction. When hatches are clear, reports, HATCHES CLEAR.	Starts engine	Checks that ramp is clear and personnel door closed. If ramp is down, reports, RAMP DOWN.
				Commands, CLOSE RAMP, when report, HATCHES CLEAR, is given by No. 1.
			Closes ramp on command of No. 3.	
			Closes and secures the forward hatch when: report, HATCHES CLEAR, is given by No. 1.	
			Reports, FORWARD HATCH CLOSED.	
	After receiving reports from Nos. 1, 2, and 3, closes and secures the aft hatch.			
h. OPEN HATCHES. This command is used to open the vehicle hatches preparatory to leaving vehicle.	With squad at mounted posts (hatches closed), commands, OPEN			

Movement	SL	No. 1	No. 2	No 3
	HATCHES. (Command may be worded to included lowering ramp or opening personnel door if desired.)	Insures that the cannon or other equipment does not block the hatches or ramp and reports, HATCHES CLEAR.	Starts vehicle engine.	
			After hearing report of HATCHES CLEAR, sounds horn, and lowers ramp (if necessary), then opens forward hatch and reports, FORWARD HATCH OPEN.	
				Checks that ramp is down and secure or opens personnel door and reports, RAMP DOWN or DOOR OPEN.
	After receiving reports from Nos. 1, 2, and 3, opens the aft hatch.			
i. DISMOUNT. This command is used to move the squad from mounted to dismounted posts.	Commands, PREPARE TO DISMOUNT—DISMOUNT.		Leaves vehicle through the forward hatch and falls in at his dismounted post.	Leaves the vehicle through the personnel door or ramp, moves at double time around the left side of vehicle, and falls in at his dismounted post.
	Follows No. 3 through personnel door or ramp, moves at double time around right side of vehicle and falls in at his dismounted post.	Leaves the mount, follows No. 2 off the vehicle and falls in at his dismounted post.		
j. EMERGENCY DISMOUNT. This command is used to clear the vehicle when an emergency situation, such as a fire, occurs.	When the SL determines that emergency dismount procedures are required, he commands, EMERGENCY—DISMOUNT.			
		Leaves mount, climbs or jumps off nearest side of vehicle and	Opens forward hatch (if closed), climbs out through hatch,	Leaves vehicle through the ramp opening (or opens personnel

Movement	SL	No. 1	No. 2	No. 3
		moves to a point of safety.	climbs or jumps off vehicle and joins No. 1.	door if the ramp is closed) and joins No. 1.
	Follows No. 3 out the ramp opening (or personnel door) and, when clear, takes whatever steps are necessary to overcome the emergency.			
k. MARCH ORDER. This command means "prepare the equipment for movement." It can be given with the squad at action posts, at rest, or at dismounted posts.	Commands, MARCH ORDER. (If any special instructions are necessary, commands, FALL IN. After completing instructions, commands, MARCH ORDER.)			
	Supervises crew in preparing the system for travel.	Climbs to top of vehicle, enters mount, and prepares armament system for travel as follows:	Perform before-operation checks and services on the vehicle.	Enters vehicle through personnel door or ramp.
		Checks that sight is mechanically caged.		
		Requests No. 3 to release and lock drive motor brakes when ready.		Release and lock azimuth and elevation drive motor brakes on request of No. 1.
		Manually positions cannon barrels in travel lock and secures them.	Checks that required on-vehicle equipment is present and secure.	
		Moves ROR antenna to stow position.	Raises vehicle ramp on request of No. 3.	Insures that ramp is closed and secure. If necessary, requests No. 2 to raise ramp.
		Checks that radio antennas are secure.		Checks that the following are present and properly secured: 1. Adequate spare ammunition. 2. Auxiliary power unit. 3. Radio, intercom, telephones. 4. TADDS. 5. Binoculars and other miscellaneous equipment.
				Insures ammunition drum safety guard is in place.
				Checks that gasoline container is full and in place.
	Falls in at dismounted posts.	Falls in at dismounted post.	Falls in at dismounted post.	Falls in at dismounted post.
	Commands, REPORT.			
	Receives reports from squad members.	Reports, ARMAMENT SYSTEM READY.		

Movement	SL	No. 1	No. 2	No. 3
			Reports, VEHICLE READY.	Reports, AMMUNITION AND EQUIPMENT READY.

5-7. Road March

Movement	SL	No. 1	No. 2	No. 3
After the system has been in march order, the squad moves to another location.	With squad at dismounted positions, commands, PREPARE TO MOUNT—MOUNT.			
	Takes mounted post.	Takes mounted post.	Takes mounted post.	Takes mounted post.
	Puts on helmet and plugs into control box.	Puts on helmet and plugs into control box.	Puts on helmet and plugs into control box.	
	Sets MONITOR switch at INT ONLY.	Sets MONITOR switch at ALL.	Sets MONITOR switch at INT ONLY.	
	Energizes intercom and radio sets.			
	Makes communication check with Nos. 1 and 2.			
	Turns MONITOR switch to ALL and makes communication check with platoon headquarters.			
	Turns radio off and commands, START ENGINE.		Starts engine, checks instrument panel, warms up engine and reports, DRIVER READY.	
	Turns radio on as soon as engine is running, then commands, CLOSE DOOR (or RAMP).		Closes ramp if open	Closes door if open, reports, DOOR (RAMP) CLOSED.
	Commands, CLOSE HATCHES, if desired.			
	Gives any necessary instructions and commands, MOVE OUT.			
During movement	Directs operation of vehicle.	Searches for aerial and ground targets to sides and front.	Operates vehicle as directed.	Remains seated at mounted post.
	Maintains communication with platoon headquarters.			
	Searches for aerial and ground targets (if hatch is open) to sides and rear.			

5-8. Preparation for Action

Movement	SL	No. 1	No. 2	No. 3
a. Emplacement	When the vehicle nears the position selected for em-			

Movement	SL	No. 1	No. 2	No. 3
	placement, commands, HALT VEHICLE AT (designates spot).			
			Stops vehicle on spot designated by SL.	
	Dismounts, selects the ground position of the vehicle, and stations No. 3 at the selected spot.	Searches for targets and provides local security during movement into position.		Dismounts and moves to spot designated by SL.
			Moves vehicle into selected position as guided by No. 3.	Acts as guide in placing vehicle in selected position.
b. PREPARE FOR ACTION. After emplacing the vehicle, the system must be prepared for action.	Falls in at dismounted position. Commands, FALL IN.			
		Dismounts and falls in at dismounted post.	Dismounts and falls in at dismounted post.	Falls in at dismounted post.
	Gives any desired special instructions and then commands, PREPARE FOR ACTION.			
	Supervises squad in preparing the system for action.	Assisted by No. 3, performs prefire checks and procedures listed in paragraph 4-15.	Locks out vehicle suspension system.	Assists No. 1 in performing prefire checks and procedures listed in paragraph 4-15.
	Surveys position and selects observer posts and SL command post.		Lowers ramp if required.	Checks that ammunition storage drum is loaded.
	Connects field wire and external range unit into appropriate jacks. Installs telephone and external range unit at SL command post.		Using vehicle engine, charges batteries if requested by No. 1. Performs after-operation services and checks on vehicle.	Checks that equipment is stowed out of the way.
	Emplaces TADDS at SL command post. Orients TADDS and plots squad position on display matrix.		Emplaces and starts auxiliary power unit if so directed by SL.	
	After procedures are completed, falls in at dismounted post.	Upon completion of checks, falls in at dismounted post.	Upon completion of procedures, falls in dismounted post.	Upon completion of checks, falls in at dismounted post.
	When squad has formed at dismounted posts, commands, REPORT.			
		Reports, ARMAMENT SYSTEM READY.	In turn, reports, VEHICLE READY.	In turn, reports, AMMUNITION READY.
	Briefs squad as to the tactical situation, probable avenues of target approach, sectors of fire, location of observer posts, and observer zones of responsibil-			

Movement	SL	No. 1	No. 2	No. 3
	ity. After briefing is finished, commands, ACTION POSTS.			
	Takes action post and begins search for targets.	Takes action post and begins search for targets in assigned area.	Takes post designated by SL and begins search for targets in assigned area.	Takes post designated by SL and begins search for targets in assigned area.
	Monitors actions of all crew members.	Puts on helmet and prepares for communication check.	Puts on helmet and prepares for communication check.	
	Conducts communication check with Nos. 1 and 2.	Aims cannon in center of primary sector of fire.	Operates vehicle engine or APU as required to keep batteries charged.	
	Makes radio check with platoon headquarters and reports, SQUAD NO. ____ READY FOR ACTION.			

Section III. ENGAGEMENT OF TARGETS

5-9. General

Effective engagement of the enemy is the goal of all training. Drill in acquiring, tracking, identifying, and firing at aerial and ground targets should be conducted regularly and as realistically as possible so that proper procedures become second nature to the crewmen. Smooth tracking of aerial targets is a requirement for obtaining hits, and it depends entirely on the senior gunner's skill. Drill on engagement of targets begins with the weapon emplaced, the MODE switch in proper position for the mode to be employed, equipment prepared for action and energized, and the squad at action posts.

5-10. Engagement of Aerial Targets

a. Radar Mode.

(1) The squad member first sighting a target or obtaining knowledge of the approach of a target, from TADDS or other source of warning information, announces over intercommunication set, TARGET, AZIMUTH _____, LOW (HIGH).

(2) SL acquires target visually without binoculars and then with binoculars.

(3) No. 1 slews the cannon to the azimuth announced and searches for the target. (It is not necessary to press the sight cage switch as the sight is automatically caged in the radar mode.)

(4) SL makes a tentative identification of the aircraft as friendly or hostile and, if more than one aircraft, selects for engagement the one that presents the greatest threat.

(5) SL commands No. 1, TARGET, AZIMUTH _____. (If multiple target, indicates which aircraft by adding, LEFT, RIGHT, etc., as appropriate.)

(6) No. 1 acquires target in sight and announces, ON TARGET.

(7) SL makes positive identification. If aircraft is friendly, he commands, FRIEND—CEASE TRACKING; if hostile, he correlates it with the one being tracked by No. 1. If they are the same, he commands, HOSTILE—ENGAGE.

(8) No. 1, upon the command, FRIEND—CEASE TRACKING, ceases tracking the target and trains the cannon to the center of the primary sector.

(9) No. 1, upon the command, HOSTILE—ENGAGE, presses the radar foot switch and continues tracking the target. When the ready-to-fire indicator lamp on sight XM61 lights and tracking is smooth, he presses the trigger.

(10) No. 1 continues to fire bursts until the target is destroyed, the ready-to-fire indicator

lamp goes out, or he is ordered to cease firing or cease tracking. If he receives the command, CEASE FIRE, he releases the radar foot switch and continues to track the target but does not fire again unless he again receives the command, ENGAGE.

(11) SL tracks target through binoculars and observes results of firing. If target is destroyed, he commands, CEASE TRACKING. If the target flies out of range, he may command, CEASE TRACKING or CEASE FIRE. CEASE FIRE would be given in case the SL feels that the target will turn and make another pass, and No. 1 can continue to track it until it again comes in range.

(12) At termination of the engagement, SL commands, CEASE TRACKING—REPORT.

(13) When cease tracking is ordered, No. 1 trains cannon near center of primary sector, checks that it is clear, and clears it manually if necessary.

(14) Nos. 1, 2, and 3 report any damage, casualties, or other information affecting the operation of the squad. No. 1 includes a report on number of ready rounds remaining in the weapon.

(15) SL gives squad any orders necessary and commands, RELOAD, if required.

(16) SL reports the action and results to platoon headquarters.

b. Manual Mode.

(1) Squad is alerted to presence and direction of target and SL acquires target (*a*(1) and (2) above).

(2) No. 1 presses cage switch on top of left control handle, slews cannon to azimuth of target, releases cage switch, and searches for target.

(3) SL estimates target speed, decides range at which to fire, and announces to No. 1, SPEED _____, RANGE _____.

(4) SL identifies and assigns target to No. 1 (*a*(4) and (5) above).

(5) No. 1 turns TARGET SPEED and RANGE knobs to the values ordered, repeating aloud when each setting is made, SPEED _____, RANGE _____.

(6) No. 1 holds cage switch and acquires target in the sight reticle image, releases cage switch, and announces, ON TARGET.

(7) SL makes positive identification of target, correlates target with one tracked by No. 1, and commands, FRIEND—CEASE TRACKING, or, HOSTILE—ENGAGE.

(8) No. 1 tracks target smoothly for at least 1 second if range is up to 800 meters, 2 seconds if range is from 800 to 1,500 meters, or 3 seconds if range is from 1,500 to 1,800 meters.

(9) After smooth tracking for the time stated in (8) above, No. 1 presses trigger and fires bursts until the target is destroyed, target is out of range, or cease fire or cease tracking is ordered.

(10) SL observes target through binoculars and commands, CEASE FIRE, or CEASE TRACKING, as appropriate.

(11) Squad proceeds as stated in *a*(12) through (16) above.

c. External Mode.

(1) Squad is alerted, SL acquires target, and No. 1 slews cannon to target azimuth (*b*(1) and (2) above).

(2) SL identifies and assigns target to No. 1 (*a*(4) and (5) above).

(3) SL sets range at which he desires to fire on external range unit.

(4) No. 1 acquires target in sight and reports, ON TARGET (*b*(6) above).

(5) SL makes positive identification of target, correlates, and commands, FRIEND—CEASE TRACKING, or HOSTILE—ENGAGE.

(6) SL observes target and, when it reaches the range set on the external range unit, presses the switch on the external range unit. He con-

tinues to set estimated range on the external range unit until the target is destroyed or out of range.

(7) No. 1 tracks target smoothly and, when the ready-to-fire indicator lamp lights and he has maintained smooth tracking for the required length of time (*b*(8) above), fires bursts until the ready-to-fire indicator lamp goes out, the target is destroyed, or he is given the command to cease fire or cease tracking.

(8) SL commands, CEASE FIRE, or CEASE TRACKING, as appropriate.

(9) End of engagement procedures are the same as in *a*(12) through (16) above.

5-11. Engagement of Ground Targets

a. Direct Fire.

(1) The first squad member seeing a target announces, GROUND TARGET, AZIMUTH _____, RANGE _____ METERS, TROOPS (description of target).

(2) SL acquires target, identifies it as friendly or hostile, and makes decision whether or not to fire on it.

(3) No. 1 manually cages sight XM61, turns FIRING RATE switch to LO—NO BURST LIMIT (or HI—BURST LIMIT 10 or 30), turns MODE switch to GND, and slews cannon to bring center of sight reticle image on the target.

Note. Sight XM61 telescope XM134, or night vision sight AN/TVS-2 can be used for aiming the cannon in direct fire. Which sight is used depends on unit SOP, nature of the target, range to the target, and visibility conditions. When the night vision sight is used, only No. 1 will be able to see the target. Close coordination between SL and No. 1 is required so that SL is able to identify the target and decide whether to fire or not. The night vision sight may be used by No. 1 to search for possible targets.

(4) If SL decides target is not suitable for engagement, he may command, CEASE TRACKING. If target is to be engaged, SL commands, GROUND TARGET, AZIMUTH _____, RANGE _____, TROOPS (description of target)—ENGAGE.

(5) No. 1 aims, alining the sight pattern on the target in accordance with the announced range, and fires a short burst of 10-30 rounds.

(6) SL spots impact of rounds and directs No. 1 to adjust fire accordingly. When fire has been brought on target, he directs No. 1 to fire additional bursts as necessary to destroy the target.

(7) No. 1 fires bursts and adjusts aim at the command of SL.

Note. After fire has been adjusted, fire for effect should be conducted with the NORM/STATIC/TEST switch on the gun distribution box set at STATIC, which prevents the cannon from moving off target during firing.

(8) When target has been destroyed, SL commands, END OF MISSION—REPORT.

(9) Squad completes after action procedure described in paragraph 5-10*a*(13) through (16).

b. Indirect Fire. For preplanned static fire and for direct command procedure, the Vulcan weapon can be oriented by using an assumed azimuth to any aiming point. However, for target grid procedure, the azimuth to the orienting point must be a true grid azimuth to conduct firing. Actions of squad members in indirect fire are as follows:

(1) *Static fire and indirect fire by direct command.*

(*a*) SL commands, PREPARE FOR GROUND FIRE, DIRECT COMMAND.

(*b*) SL designates aiming point and directs senior gunner to orient on the point at 0 mils azimuth.

(*c*) SL with binoculars, compass, telephone, and firing tables, moves to observation post and checks communications with senior gunner.

(*d*) No. 1 cages sight XM61, turns MODE switch to GND, and turns FIRING RATE switch to LO—NO BURST LIMIT (or HI—BURST LIMIT 10 or 30).

(*e*) No. 1 traverses cannon, aims center of sight (telescope XM134 is most accurate for orienting) on aiming point, and sets azimuth indicator to read 0 mils.

Note. To insure that cannon does not move while setting azimuth indicator, set NORM/STATIC/TEST switch at STATIC. Return it to NORM after the azimuth indicator is set.

(*f*) No. 1 checks communications with SL and reports, NO. 1 READY.

(*g*) SL estimates range and azimuth to target and computes firing data from firing tables.

(*h*) SL commands No. 1, AZIMUTH ____, QUADRANT ____.

(*i*) No. 1 repeats the command and traverses weapon to the required azimuth as indicated on the azimuth indicator, sets quadrant elevation on gunner's quadrant, and places quadrant on the quadrant seat on left side of sight support.

(*j*) No. 3 holds quadrant on its seat while No. 1 elevates or depresses the cannon until the quadrant bubble is centered.

(*k*) No. 3 removes gunner's quadrant and stands clear of cannon.

(*l*) No. 1 sets NORM/STATIC/TEST switch at STATIC and fires a short burst (10–30 rounds).

(*m*) SL spots center of burst, computes corrected data, and announces corrected data to No. 1.

(*n*) SL, No. 1, and No. 3 repeat steps (*i*) through (*m*) above until fire is on target.

(*o*) If firing registration for static fire, SL continues to correct until burst is on target; then commands, END OF MISSION, and records firing data for that target.

(*p*) If firing to destroy target, SL adjusts until burst is on target, then commands, FIRE FOR EFFECT, _____ ROUNDS. If the SL desires more fire for effect, he commands, REPEAT FIRE FOR EFFECT. After each series of bursts, assesses damage to target, and, when it has been destroyed, commands, END OF MISSION.

(*q*) End of mission procedures are the same as those in paragraph 5-10*a*(12) through (16).

(2) *Indirect fire by target grid procedure.* Indirect fire by target grid procedure is conducted in the same manner as indirect fire by direct command procedure, except that the SL will remain at the gun and receive fire commands from the Vulcan platoon or supported unit fire direction center (FDC). Orienting and survey data will be furnished by the FDC. The gun will be oriented by alining the sight on the aiming point and setting the azimuth of the point on the azimuth indicator.

CHAPTER 6

RECONNAISSANCE, SELECTION, AND OCCUPATION OF POSITION

6-1. General

Reconnaissance, selection, and occupation of position (RSOP) is a sequence of actions taken by commanders and unit representatives at all levels to select and occupy positions. RSOP may be accomplished under circumstances that allow weeks or months to design defenses and select positions for command posts and weapons, but in combat situations a few hours or less may be available to complete the procedure. In any case, the same principles apply and the same steps, no matter how abbreviated, should be taken. To complete the RSOP, the following basic steps should be taken.

a. Receive orders or realize the necessity to move.

b. Plan deployment of fire units on a map.

c. Plan the reconnaissance.

d. Issue orders to the units concerned.

e. Make a ground reconnaissance and select positions.

f. Plan the occupation.

g. Prepare the positions for occupation.

h. Move the units to the selected positions.

i. Occupy, organize, and improve the positions.

6-2. Reconnaissance and Selection of Position

a. General. The positions of fire units are determined in designing the defense. These positions are plotted on a map and represent the best locations for defense, considering mutual support between weapons, optimum use of weapons available, any weighting of the defense desirable, and nature of terrain so far as can be determined from the map. Actual positions must be selected after a ground reconnaissance and may vary within narrow limits from positions selected by map reconnaissance.

b. Map Reconnaissance. After the weapon positions have been plotted on a map, positions for battery and platoon command posts and primary and alternate routes to these positions are selected and plotted. From this study of the map, plans can be made for the conduct of the ground reconnaissance to include routes, release points, assembly points, and assembly times for the reconnaissance party. If time is limited to the extent that the units must move up before the reconnaissance party returns, road guard positions and guide positions are selected and the necessary personnel for these jobs are included in the party.

c. Ground Reconnaissance. Actual inspection of the chosen routes and positions on the ground is necessary to prove out selections made from the map or to make necessary changes in plans.

(1) The commander selects personnel and equipment to accompany him on the reconnaissance and assigns tasks to the reconnaissance party personnel. The unit SOP will establish the normal composition of the party and assign responsibilities. The party should include the platoon leader, platoon sergeant or assistant platoon sergeant, and a representative of each squad.

(2) Before departing on reconnaissance, the commander (and platoon leaders) brief the next in command. Information covered must include, but not be limited to, the following:

(*a*) Tactical situation.

(*b*) Location of new position area.

(*c*) Route that reconnaissance party expects to follow.

(*d*) How orders for the movement to the position will be given.

(*e*) Who will control the movement.

(*f*) How route will be marked.

(*g*) Order of march if at variance with the SOP.

(*h*) Estimated time of displacement.

(3) Selection of the platoon command post and weapon positions is normally done by platoon leaders subject to the battery commander's approval. The platoon leader usually delegates reconnaissance for selection of fire unit positions to the squad representatives. Initial positions plotted during the map reconnaissance should be adhered to as closely as possible. Squad representatives reconnoiter the positions assigned to their fire units, select tentative locations for the weapons and observation posts, and submit these locations to the platoon leader for approval. The platoon leader reconnoiters the platoon area and selects the site for the platoon command post. If time permits, he visits each proposed fire unit position and supervises and assists the squad representative. After approving the fire unit locations, the platoon leader informs the battery commander or battalion S3, as appropriate, of the fire unit and platoon command post locations.

d. Selection of Positions. Positions selected must be the best available for fields of fire, communications, accessibility, and survivial. Specific characteristics that must be considered in selecting sites for command posts and fire units are as follows:

(1) *Battery and platoon headquarters.*

(*a*) Centrally located in respect to battery and platoon units.

(*b*) Cover and concealment available.

(*c*) Sufficient area for dispersion.

(*d*) Alternate entrance and exit routes.

(*e*) Defendable against ground attack.

(*f*) Communications with higher, lower, and lateral units.

(2) *Fire units.*

(*a*) Primary and secondary fields of fire must be clear; 6,400-mil field of fire desired.

(*b*) Field of observation should be 6,400 mils if possible.

(*c*) Clear radio communication with platoon command post, all other fire units in platoon, and FAAR.

(*d*) Good access and exit routes.

(*e*) Defendable against ground attack.

(*f*) Must be within stated distance (SOP) of plotted position in original defense design.

(*g*) Maximum use of available cover and concealment.

(*h*) The signature of the Vulcan can be expected to disclose the fire unit's position during each engagement; therefore, frequent shifting of position is required. Primary, alternate, and supplementary positions must be selected during the ground reconnaissance. Routes into and out of these positions must also be selected and prepared as necessary.

6-3. Preparation, Occupation, and Improvement of Position

a. Planning Occupation. As soon as command post and weapon positions have been selected, the battery commander and platoon leaders plan the occupation of these positions. These plans should include—

(1) Routes for movement to battery area.

(2) Order of march of unit during displacement.

(3) Release points for headquarters elements and fire units.

(4) Number of guides required and points where incoming units will be met by guides.

(5) Exact location of message center, mess, maintenance, ammunition storage, and vehicle routes within the battery headquarters area.

(6) Exact locations of weapon, prime mover, squad leader's command post, and observer post at fire unit positions.

(7) Concealment, camouflage, and cover at command posts and fire unit positions.

(8) Alternate weapon positions.

(9) Local security of battery, platoon, and fire unit positions.

b. Preparation for Occupation. The extent of preparation that can be made before occupation of positions depends on time, personnel, equipment, and materials available. Preparation should always include marking the location of each major piece of equipment at all positions and familiarization of guides with the routes into the positions. As circumstances permit, the following preparations should be made:

(1) Prepare range cards for primary and alternate weapon positions (*e* below).

(2) Excavate as necessary to prepare defilade for weapon and prepare a level spot on which to emplace it.

c. Occupation of Position. During the reconnaissance and selection of position, the platoon leader must formulate a plan for occupying the positions selected. This plan must be coordinated with the plan for the occupation of battery and battalion positions if these elements are involved in the move.

(1) The occupation plan must consider—

(*a*) The time that the platoon is required to be operational in the new positions.

(*b*) Routes and travel time from the release point or old position, as appropriate.

(*c*) Communications during the displacement.

(*d*) Security during the move and occupation.

(2) When the platoon is released to the platoon leader for occupation of position, he issues the necessary orders to carry out the occupation plan. The displacement and occupation should be accomplished as rapidly as possible to minimize the time that fire units are out of action. When occupying platoon positions, first priority should be given to emplacing fire units and bringing them to a ready-for-action condition. When all fire units have reported that they are ready, the platoon leader will report the platoon ready for action.

d. Improvement of Position (Fire Unit). Organization and improvement of position starts during the planning and preparation phase and continues until displacement of the Vulcan weapon. The squad leader establishes certain priorities for the initial phase of organization of position. Normal sequence is as follows:

(1) Personnel prone positions are prepared at the earliest possible opportunity and replaced by foxholes and dugouts as time permits.

(2) Natural camouflage is supplemented where possible, using artificial materials, such as garnished nets.

(3) The Vulcan weapon system is protected from blast, fragmentation, and small arms fire by digging it in or constructing revetments. Care must be taken to insure that revetments do not impede full movement of the gun and must be low enough to allow fire at close-range ground targets.

(4) Ammunition must be protected by being dug in or revetted and protected by overhead cover.

(5) Work on alternate and supplementary positions is initiated as early as possible to expedite displacement in the event the primary position becomes untenable.

e. Range Cards. After marking the location of each Vulcan weapon site with a stake, if time permits, the platoon leader or squad representative should construct range cards (fig. 6-1) for use by the weapon crew for the delivery of effective ground fire immediately upon their arrival. The card should indicate ranges to critical points on all likely avenues of approach,

whether inside or outside the primary sector of each Vulcan weapon. If no prominent features are in the sector, range stakes should be used for references. Hasty range cards prepared by the platoon leader must be improved, when possible, by the Vulcan crew by replacing the estimated data with accurate data obtained by firing, pacing, surveying, or map measurements.

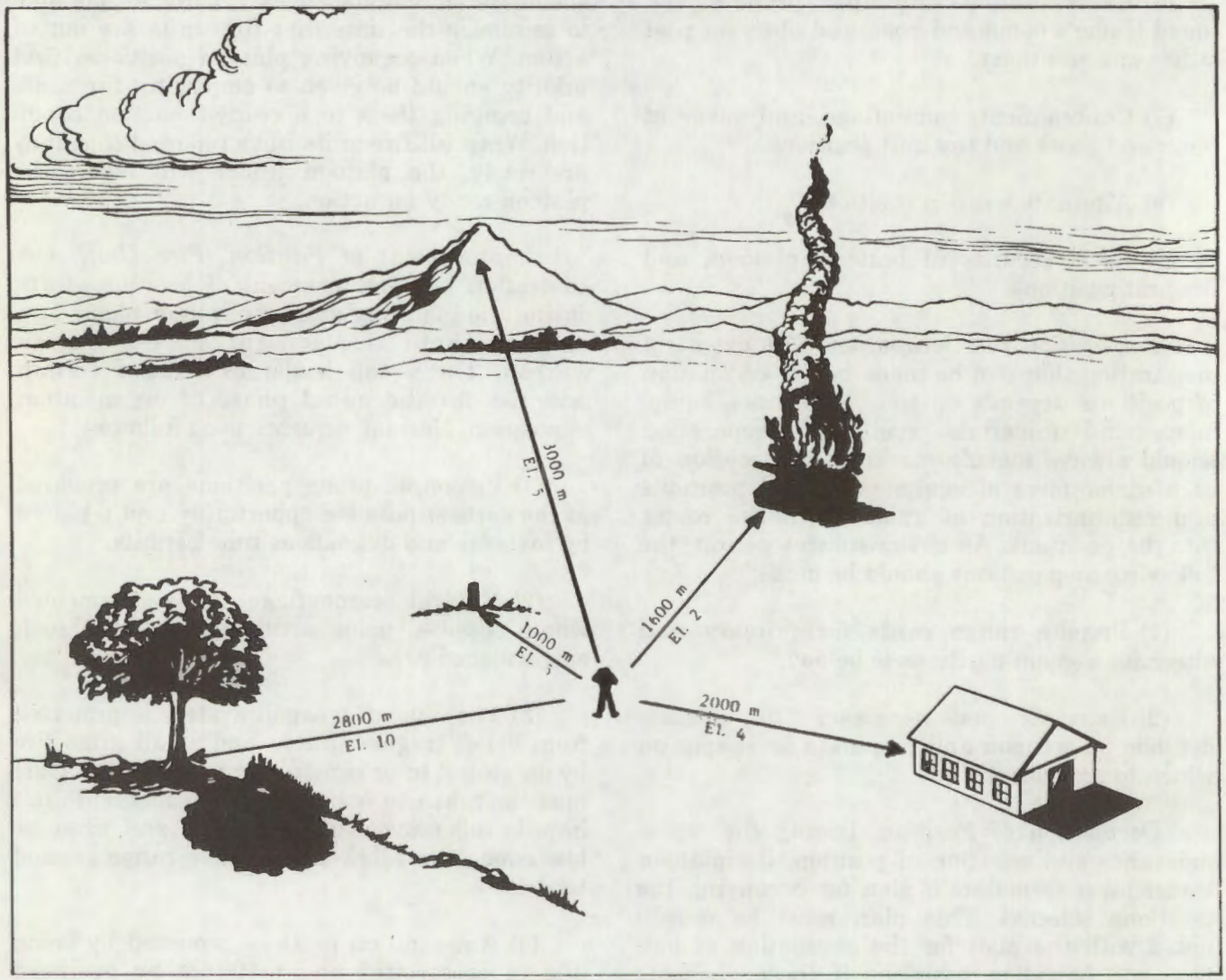


Figure 6-1. Typical range card.

CHAPTER 7

WATER-CROSSING OPERATIONS

7-1. General

During some operations it may be necessary for the Vulcan squad to cross rivers and streams. This chapter outlines techniques and procedures for water-crossing operations.

7-2. Considerations Before Crossing

Before crossing a river or other water obstacle, the following actions must be taken to insure a successful crossing:

a. Determine the characteristics of the stream.

b. Determine bank conditions at the entrance to the stream.

c. Select landing points on the far shore and determine the bank conditions at those points.

d. Determine the entrance points at which the vehicles must enter the stream so that they will arrive at the selected landing points. Vehicle speed, stream velocity, and stream width are factors in determining the distance the vehicles will drift downstream as they cross.

e. Insure that the Vulcan vehicles are checked properly before they enter the water and after leaving the water. A flotation kit has been mounted on the XM741 chassis (fig. 3-1) to maintain proper vehicle position when operating in water. The kit consists of seven buoyancy pods, three attached to each side of the vehicle and one attached to the trim vane on the front of the vehicle.

(1) In addition to the procedures in paragraph 2-17 of TM 9-2350-300-10, the following should be accomplished before entering water:

(*a*) Center cannon over the rear of the vehicle. If commanders hatch is to be closed, fully elevate the cannon to allow escape through the commanders hatch.

(*b*) Check the security and condition of the buoyancy pods.

(2) Service after water-crossing operations must be performed as prescribed in TM 9-2350-300-10.

7-3. Stream Characteristics

Stream characteristics that must be considered are velocity, changes in velocity, channels, and debris that may be present.

a. Velocity. Velocity is measured in feet per second and converted to miles per hour or knots as explained in paragraph 7-4.

b. Changes in Velocity. A sluggish stream or river may become a torrent in a few hours or minutes as a result of a heavy rainfall. This is quite likely in tropical regions or mountainous areas. Stream velocities must be checked at frequent intervals to provide warning of changes that may endanger the crossing.

c. Channels. Velocities of the stream may vary in different parts of the stream. The rate of flow is usually slow near the shore and fast in the main channel.

d. Debris. Fast-moving streams often carry large quantities of logs, brush, and other debris. In cold climates, chunks of ice may be floating in the streams. Debris can be a serious hazard to the Vulcan vehicle in river crossing, as a single piece can foul a track and put the vehicle out of control.

7-4. Stream Velocity

The maximum velocity of a stream in which the Vulcan vehicle can be operated safely depends

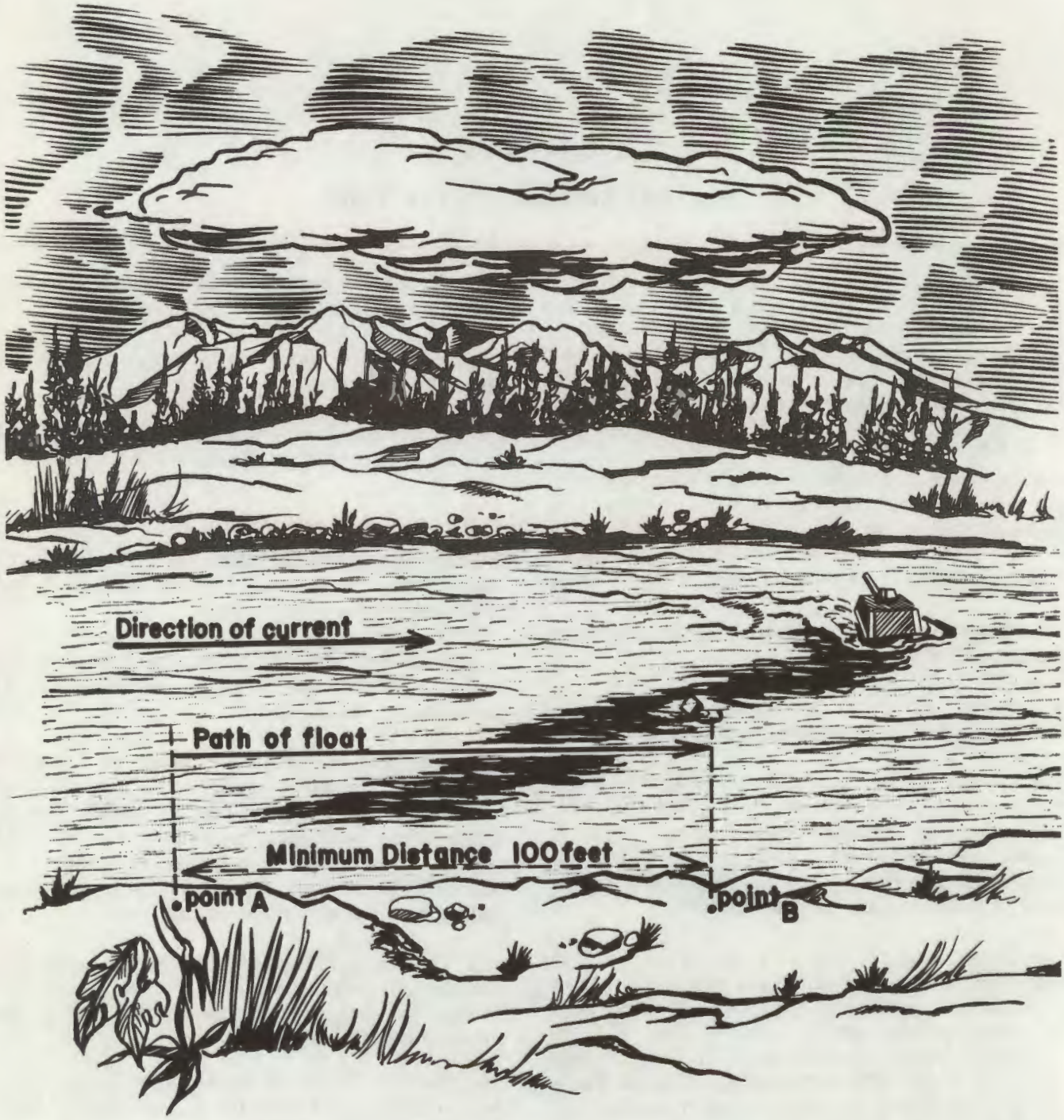


Figure 7-1. Determining stream velocity.

on such factors as the choppiness of the water, the amount of debris or ice in the water, and the maximum downstream drift distance that the unit can accept. When the rate of flow is greater than 4 miles per hour, the leader must pay particular attention to drift distance, balance of loads on the vehicles, entry into the water, and ability of the drivers. A simple way to determine stream velocity is to observe the time required for a floating object, such as wood, cork, or empty ammunition can, to move a measured distance. Measure a distance of at

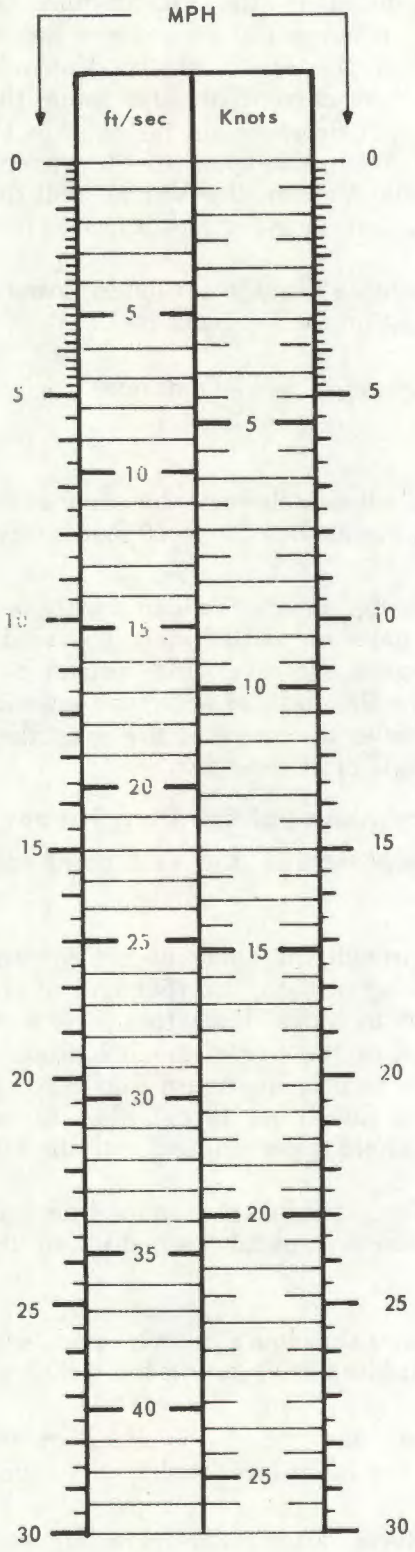


Figure 7-2. Velocity conversion chart.

least 100 feet along the near river bank. Designate the upstream end as point A, and the downstream end as point B. At point A, throw any object that will float into the fastest part of the stream. Using a stopwatch, or the second hand of a watch, determine the time it takes for the floating object to travel from point A to point B (fig. 7-1). Divide the number of feet that the object travels by the number of seconds of elapsed time. For example, if it takes 20 seconds for the object to travel the 100 feet, the rate of flow of the stream is 100 feet/20 seconds = 5 feet per second. This figure in feet per second must then be converted into miles per hour or knots, using the conversion chart shown in figure 7-2. To convert feet per second to miles per hour without using the table, multiply feet per second by 0.67; for knots, multiply feet per second by 0.6. At least two tests should be made with floating objects and the average rate of flow in feet per second used. Stream velocity will be used to determine the landing point.

7-5. Bank Conditions and Slope at Entrances and Exits

The condition of the banks and slope at entrance and exit points must be determined.

a. Slope of Entrances and Exits. Gently sloping entrances and exits are desirable. However, even on the most gradual slopes, the Vulcan vehicle must enter the water slowly (approximately 2 mph) to avoid a large bow wave. When descending banks, the vehicle tends to dive unless the approach is slow enough to allow the bow to float. The most common way to express slope is in percent (fig. 7-3). For example, a 1 percent slope rises or descends 1 foot in 100 feet of horizontal distance; a 10 percent slope rises or descends 10 feet in 100 feet. The formula to determine percent of slope is—

$$\frac{\text{Vertical distance}}{\text{Horizontal distance}} \times 100 = \text{Slope in percent.}$$

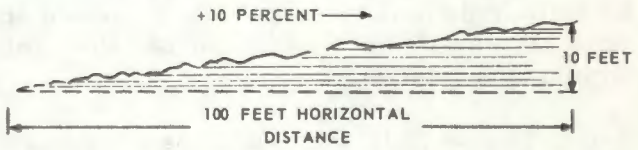


Figure 7-3. Percent of slope.

b. Bank Conditions. Banks can often be improved by using pioneer tools issued as part of the Vulcan equipment, or by using earth-moving equipment if engineer support is available. Entrance into the water may be improved by laying logs (corduroying).

7-6. Determination of Landing Point

The point on the far bank at which the Vulcans will arrive must be determined.

a. The Vulcan should always be pointed directly across the stream, perpendicular to the river current, except when the maximum speed of the Vulcan, in water, is *twice* the speed of the current. Then the Vulcan may be pointed against the current at an angle of not more than 30°. When the speed of the Vulcan and the speed of the current are the same, the Vulcan drifts 1 foot downstream for each foot it moves forward. When the speed of the current is twice that of the Vulcan, the Vulcan will drift downstream 2 feet for every foot it moves forward.

b. A simple formula for determining the point of landing on the far bank is—

$$\frac{\text{Stream velocity (mph)}}{\text{Speed of Vulcan (mph)}} \times \text{Distance across stream in feet} = \text{Distance}$$

of downstream drift of Vulcan in feet.

For example, a Vulcan traveling at 4 miles per hour, in a stream that has a velocity of 4 miles per hour and a width of 100 feet, will land 100 feet downstream from the point of entry into the water.

c. The maximum speed of the Vulcan in water is approximately 4 miles per hour. When traveling at approximately 4 miles per hour in water the speedometer should indicate approximately 12 miles per hour. This difference of 3 to 1 is caused by the difference of traction on land and in water.

7-7. Techniques of Entrance and Procedures During Crossing

Streams may be crossed in echelon or in column.

a. Echelon. If the mission requires that Vulcan units cross in one move, the best method is echelon. Echelon left is used when the stream flows left to right and echelon right is used when the stream flows right to left. The vehicle farthest downstream moves out first, followed by the next farthest downstream, and so on; the vehicle farthest upstream moves out last. Vehicles should be separated by at least 25 feet laterally and front to rear. This formation insures that upstream vehicles do not drift into downstream vehicles.

b. In Column. If there are insufficient entrances and exits to allow echelon crossing, the column method should be used. In a column crossing, all vehicles use the same entrance and exit and maintain a 25- to 60-foot interval.

c. Passing. If one Vulcan overtakes another it may pass on either side, provided there is ample space. However, the Vulcan being overtaken has the right of way. The passing vehicle should leave the wake of the overtaken vehicle at an angle of at least 45°.

7-8. Techniques of Exit from Stream

When approaching the exit point, the driver must:

a. Approach the shore at a right angle. In a fast-moving stream, the rear end of the vehicle will tend to move downstream as soon as the front end of the tracks touch bottom. This can head the vehicle upstream and throw it out of control if the driver is not alert to take quick action to hold it perpendicular to the bank.

b. Before striking the shore line, ease up on the accelerator pedal and shift to the lowest range.

c. Climb the bank slowly and squarely to avoid skidding or spinning the tracks.

d. When the vehicle is clear of the water, move to the point indicated by the squad leader.

e. Perform after-water-operation services as specified in TM 9-2350-300-10 on the Vulcan as soon as the situation permits.

CHAPTER 8

DESTRUCTION AND DECONTAMINATION

8-1. Destruction

Destruction of the Vulcan weapon system and related materiel will be effected, upon orders, when its capture or abandonment is imminent. The conditions under which equipment will be destroyed involve command decisions related to the tactical situation. Destruction of materiel will be effected by the using troops only when so directed by their unit commander or higher commander. Specific destruction procedures are outlined in the appropriate technical manual as indicated in the appendix. This paragraph discusses general techniques and procedures for destruction of the Vulcan weapon system.

a. Vulcan 20-mm Gun, Mount, and Radar. Using the 6-pound sledge, axe, and crowbar issued with the system:

(1) Smash the gun sights and boresight telescope.

(2) Smash the electronic controls on the control panel.

(3) Smash the sight current generator, batteries, and all radar units.

(4) Smash the cannon housing assembly and deform bolts and cams.

(5) Remove barrels and deform bushings.

(6) Smash and deform the declutcher-feeder, feed chutes, and ammunition storage drum after emptying the ammunition on the floor of the mount.

(7) Smash the gun drive motor.

b. Ammunition. Uncase all available 20-mm ammunition and dump it onto the floor of the chassis. The ammunition will be destroyed when the system is burned.

c. Communications Equipment.

(1) Using a sledge, smash radio, intercommunication equipment, TADDS, and wire equipment.

(2) Destroy, by burning, all written material, such as SSI, SOI, frequency charts, and communications information.

d. Chassis.

(1) Discharge fire extinguishers.

(2) If available, place hand grenades on each side of engine block and detonate.

(3) Pour fuel into driver's compartment, engine compartment, and hull. Take cover, then ignite fuel by remote means; e.g., firing tracers, lighting a long fuze to an opened cartridge, or throwing a Molotov cocktail into the chassis.

8-2. Decontamination

Decontamination is the process of covering, removing, destroying, or changing contaminating agents into harmless substances. Generally, only equipment contaminated by persistent agents need be decontaminated. The procedure for removing chemical agents from equipment is to wipe off visible contaminant with rags, apply DANC (decontamination agent, noncorrosive, M4) solution, wipe with solvent-soaked rags, and then dry (FM 21-40). If DANC is not available, the equipment should be scrubbed with soap and hot water and all parts carefully dried. If the equipment cannot be decontaminated in the battery area, it must be evacuated to the support facility where decontamination or disposal can be accomplished.

APPENDIX A

REFERENCES

Department of the Army pamphlets of the 310-series should be consulted for the latest changes or revisions of references given in this appendix and for new publications relating to material covered in this manual.

AR 75-1	Malfunctions Involving Ammunition and Explosives.
AR 310-25	Dictionary of United States Army Terms.
AR 310-50	Authorized Abbreviations and Brevity Codes.
AR 350-1	Army Training.
AR 385-63	Regulations for Firing Ammunition for Training, Target Practice, and Combat.
DA Pam 350-12	Guide for Squad Leaders.
FM 5-15	Field Fortifications.
FM 5-20	Camouflage.
FM 21-40	Chemical, Biological, Radiological (CBR), and Nuclear Defense.
FM 44-1	U.S. Army Air Defense Artillery Employment.
(S) FM 44-1A	U.S. Army Air Defense Artillery Employment (U).
FM 44-1-1	U.S. Army Air Defense Artillery Operations.
FM 44-3	Air Defense Artillery Employment, Chaparral/Vulcan.
*FM 44-6	Procedures and Drills for Forward Area Alerting Radar (FAAR).
FM 44-21	Service Practice for Air Defense Artillery Automatic Weapon Units.
FM 44-62	Air Defense Artillery Automatic Weapon Gunnery.
TM 5-6115-323-15	Operator Organizational, DS, GS, and Depot Maintenance Manual Including Repair Parts and Special Tools Lists: Generator Set, Gasoline Engine Driven, Air-Cooled, Skid Shock-Mounted, Tubular Frame (Less Engine) Military Design 1.5 kw, ac, 60 Hz.
TM 9-1240-318-35	Direct Support, General Support, and Depot Maintenance Manual Including Repair Parts and Special Tools List: Telescope, Straight, M120.
TM 9-1240-319-35	Direct Support, General Support, and Depot Maintenance Manual Including Repair Parts and Special Tools List: Mount, Telescope M148.
TM 9-1290-200-15	Operator, Organizational, Direct Support, General Support, and Depot Maintenance Manual (Including Repair Parts and Special Tools List): Quadrant, Fire Control (Gunner's) M1 and M1A1.
TM 9-1300-206	Care, Handling, Preservation, and Destruction of Ammunition.
*TM 9-1430-589-12	Operator and Organizational Maintenance Manual: Target Alert Data Display Set, AN/GSQ-137 (XO-1).
TM 9-2350-300-10	Operator's Manual for Gun, Antiaircraft Artillery, Self-Propelled: 20-mm, XM163 (Vulcan Air Defense Artillery System).
TM 9-2350-300-20	Organizational Maintenance

*To be published.

Manual for Gun, Antiaircraft Artillery, Self-Propelled: 20-mm, XM163; Cannon XM168, Mount XM157, and Sight XM61 and Radar Set AN/VPS-2.

TM11-5805-201-12 Operator and Organizational Maintenance Manuals Including Repair Parts and Special Tool Lists, Telephone Set TA-312/PT.

TM11-5820-401-10 Operator's Manual, Radio Sets AN/VRC-12 and AN/VRC-43, -44, -45, -46, -47, -48, and -49.

TM11-5830-340-12 Operator and Organizational Maintenance Manual, Intercommunication Set, AN/VIC-1(V).

TM11-5855-202-13 Operator, Organizational and DS Maintenance Manual (Including Repair Parts and Special Tools Lists) Night Vision Sight, Crew Served Weapons AN/TVS-2 and AN/TVS-2A.

LO 9-2350-300-10 Lubrication Order, Gun, Antiaircraft Artillery, 20-mm, Self-Propelled, XM163.

*To be published.

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