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DEPARTMENT OF THE ARMY TRAINING CIRCULAR

**20-MM GUN, M139
VEHICLE RAPID FIRE WEAPON SYSTEM**



**HEADQUARTERS, DEPARTMENT OF THE ARMY
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20-MM GUN, M139 VEHICLE RAPID FIRE WEAPON SYSTEM

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Purpose and Scope. This training circular presents principles, techniques, and training procedures for employment of the 20-mm rapid fire weapon system mounted on the M114A1E1 (series) armored command and reconnaissance vehicle (fig 1). The scope includes a description of the M139 automatic gun, the M27 commander's cupola, and the associated gun controls and sighting equipment. Ammunition, mechanical training, maintenance, conduct of fire, training, and range firing for the weapon system are also discussed. The material contained herein is applicable to both nuclear and nonnuclear warfare except as otherwise noted.

2. User Review. Users of this publication are encouraged to submit recommended changes or comments to improve the publication. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should 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 the Commandant, U.S. Army Armor School, ATTN: AH-BAAS-DL, Fort Knox, Kentucky 40121.



*Figure 1. Carrier, Command and Reconnaissance: Armored M114A1E1—
left front view.*

Section II. DESCRIPTION

3. General Description. The 20-mm rapid fire weapon system consists of the M139 automatic 20-mm gun and M27 commander's power cupola mounted on the M114A1E1 series armored command and reconnaissance vehicle. The weapon system provides the vehicle commander with the capability of attacking and defeating lightly armored vehicles at ranges out to 1,000 meters and soft targets and personnel out to 1,800 meters. The system also provides a measure of defense against low-performance, low-flying aircraft.

4. Characteristics. *a. Automatic Gun, M139.* The M139 automatic gun is an air-cooled, gas and recoil-operated weapon that fires percussion primed, high velocity, link-belt ammunition. It has five modes of fire: single shot, slow burst of five rounds, fast burst of five rounds, and fully automatic at slow and fast rates. The gun may be fired manually or electrically. The weapon has an automatic feeder placed atop the receiver that strips the cartridge from the link and positions it for chambering (fig 2). Ammunition is positioned in a feed box holding 75 rounds mounted to the right of the gun. The ammunition moves through a flexible chute holding 25 additional rounds and is automatically lubricated before entering the feeder. The ammunition box incorporates a last round limit switch that stops electrical firing to allow the

commander to place additional ammunition in the box and link it to the last round of the previous belt (fig 3).

b. Commander's Cupola M27. The commander's cupola is a hydraulically powered cupola that permits rapid and simultaneous traversing, elevating, and firing of the gun. Dual cupola control handles allow stability when operating over rough terrain. An interrupter valve precludes inadvertent traversing over the scout observer's position. An override button allows the cupola to traverse through the scout observer's position when the vehicle commander desires (fig 4). In case of electrical failure, the cupola may be operated manually by using a pump handle in conjunction with the gun controls (fig 5).

5. Tabulated Data—Automatic Gun, M139, and Cupola, M27. *a. 20MM Automatic Gun, M139.*

Weight with automatic gun feeder and recoil adapter	161.3 pounds
Weight of receiver	59.5 pounds
Overall length	100.9 inches
Rate of fire (cyclic)	800-1050 rounds per minute
Practical range	1000 to 1500 meters
Recoil movement	0.63 inch—1.00 inch
Weight of barrel assembly with flash hider	70.6 pounds

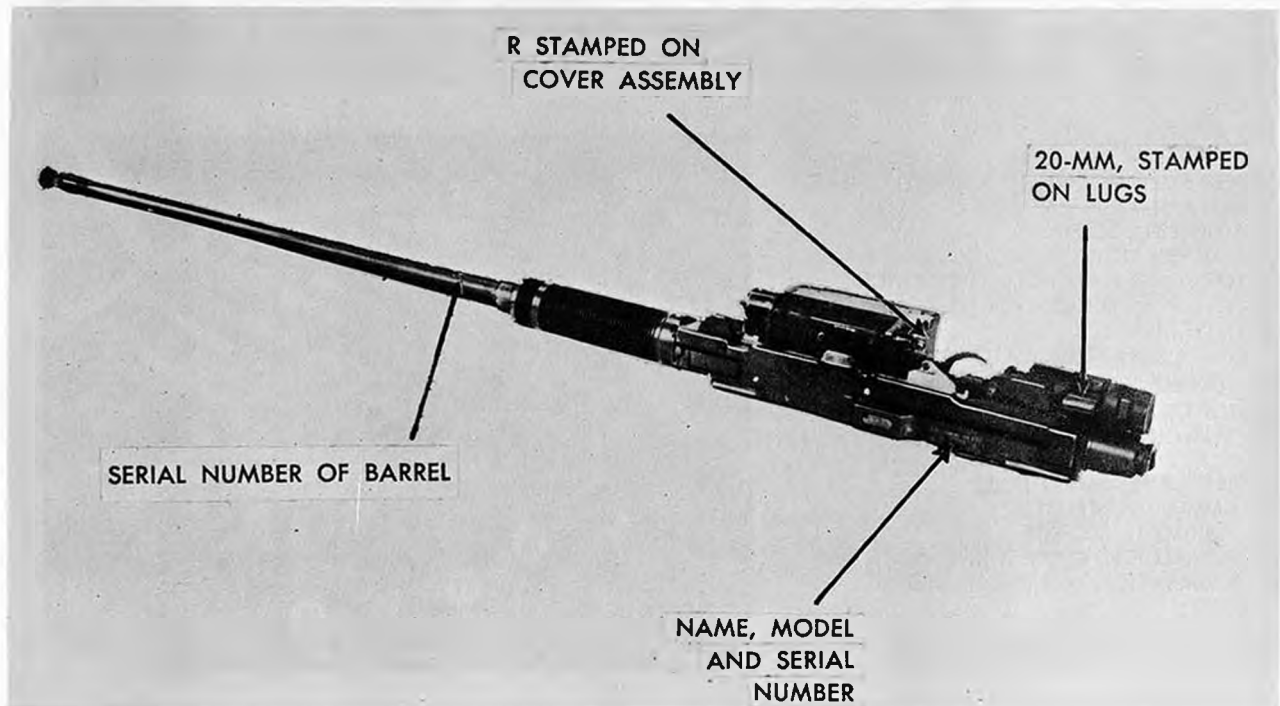
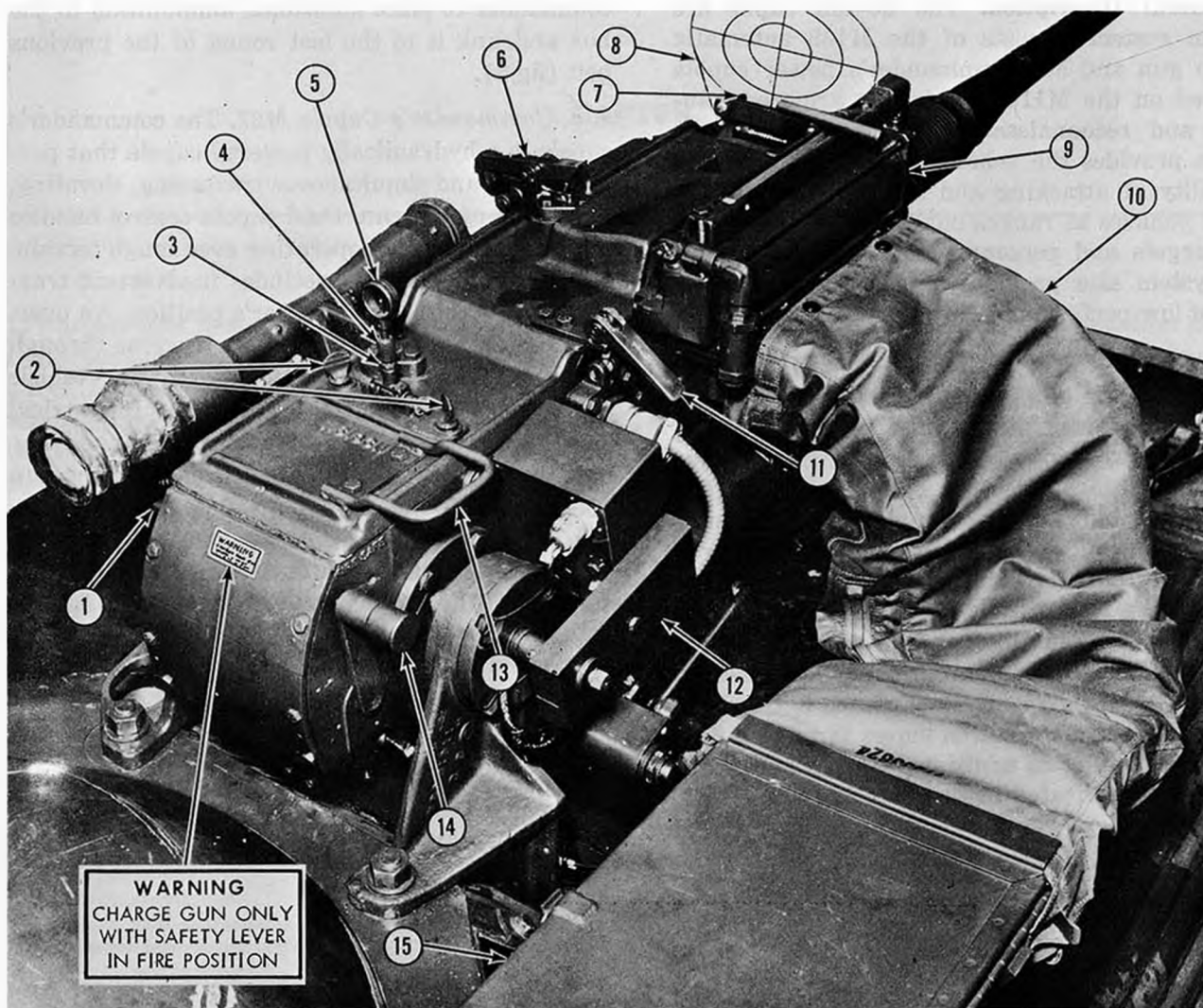
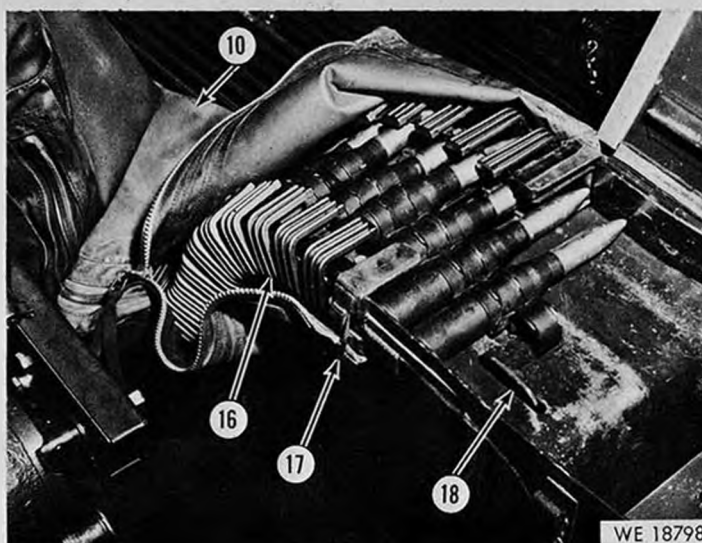


Figure 2. 20-Millimeter Automatic Gun, M139, with automatic gun feeder, recoil adapter, controls, and identification markings—left rear view.

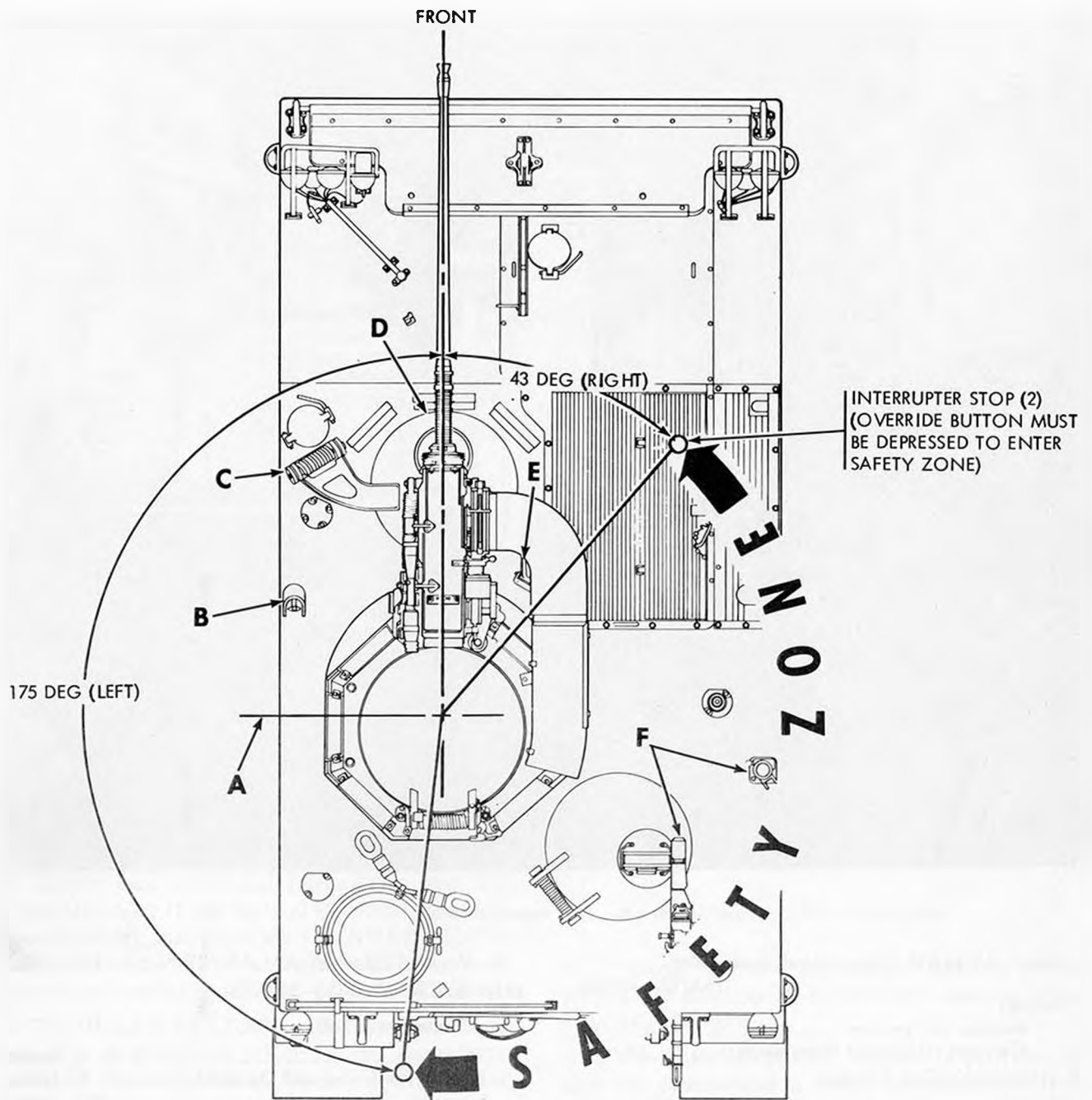


1. MANUAL FIRING LEVER
2. PEEP SIGHT MOUNTING SCREW (2)
3. JAM NUT
4. ADJUSTING SCREW
5. REAR PEEP SIGHT
6. TOP COVER PLATE HOLD-OPEN LATCH
7. SPEED RING THUMBSCREW (2)
8. SPEED RING
9. LINK ALIGNER/LUBRICATOR ASSEMBLY
10. FLEXIBLE FEED CHUTE DUST COVER
11. TOP COVER PLATE LOCKING LEVER
12. GUN CHARGING MECHANISM
13. TOP COVER PLATE HANDLE
14. "SAFE/FIRE" SAFETY LEVER
15. AMMUNITION FEED BOX
16. FLEXIBLE FEED CHUTE
17. FLEXIBLE FEED CHUTE SPRING LATCH (4)
18. AMMUNITION LAST ROUND STOP



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Figure 3. 20-Millimeter Automatic Gun, M139, and Cupola, M27—top right view.



DEPRESSION LIMITATIONS OVER FOLLOWING:

- A. LEFT SIDE OF VEHICLE (250 MILS DEPRESSION)
- B. FIRE EXTINGUISHER LEVER GUARD (51 MILS MAXIMUM DEPRESSION)
- C. HATCH COVER HINGE SUPPORT (180 MILS MAXIMUM DEPRESSION)
- D. DRIVER'S HATCH COVER (173 MILS MAXIMUM DEPRESSION)
- E. TRAVEL LOCK (FOLDED POSITION)(141 MILS DEPRESSION)
- F. 7.62MM MACHINE GUN (EITHER POSITION) (140 MILS MINIMUM ELEVATION)

WARNING:

1. WHEN TRAVERSING CUPOLA MAKE CERTAIN THAT DRIVER AND THIRD MAN ARE DOWN AND THEIR HATCH COVERS PREFERABLY CLOSED.
2. THIS ILLUSTRATION IS INTENDED ONLY AS A GUIDE. EACH COMMANDER SHOULD FAMILIARIZE HIMSELF WITH HIS OWN VEHICLE AND ITS TRAVERSE AND DEPRESSION LIMITATIONS DUE TO GUN BARREL, FLEXIBLE CHUTE, OR SPENT BRASS EJECTION CHUTE INTERFERENCE.

Figure 4. 20-mm gun traverse/depression interference zones.

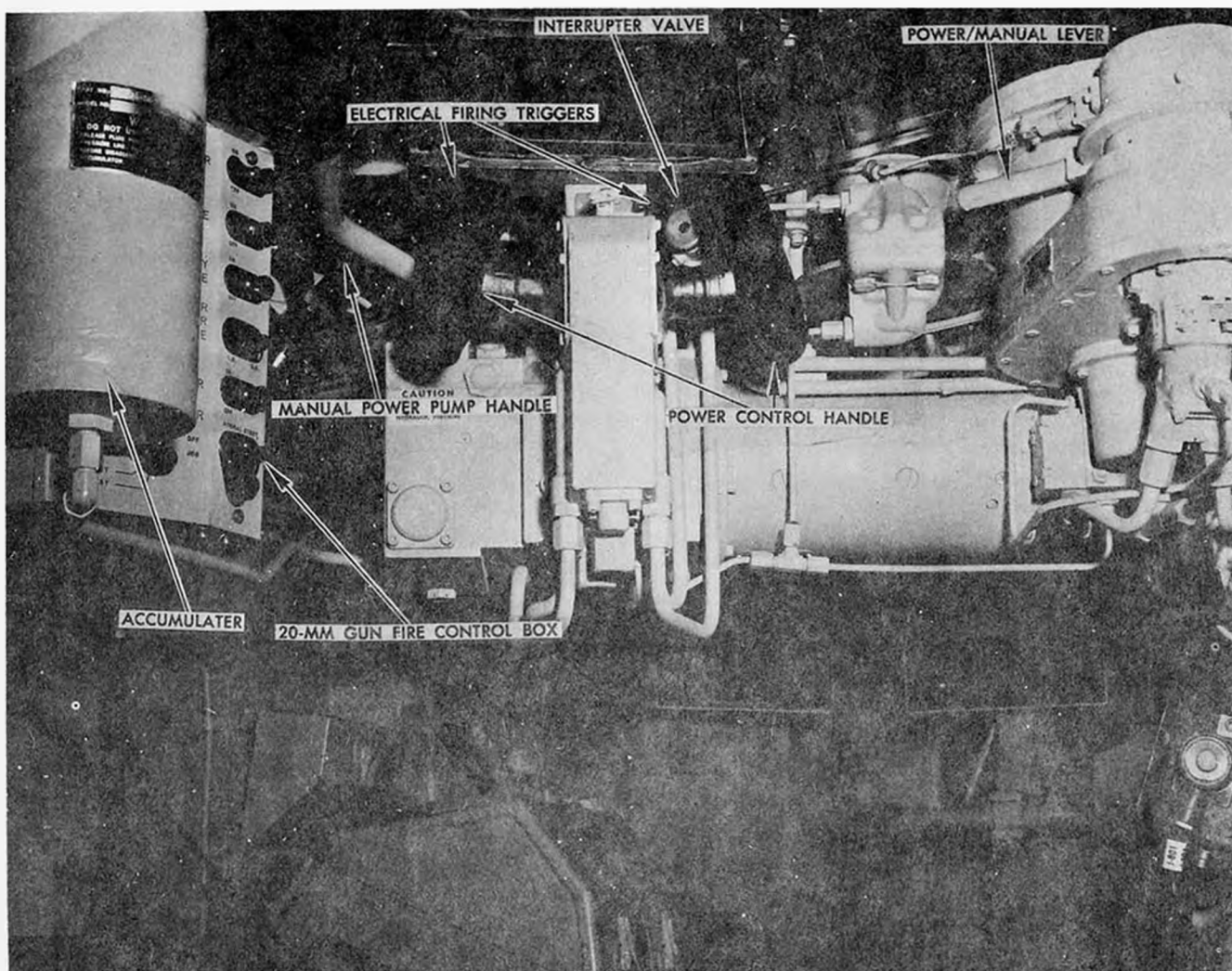


Figure 5. M27 cupola controls.

Length of barrel with/without flash hider
75.0/72.4 inches

Rifling:

Number of grooves 15
Uniform right-hand twist, slope 89 mils

b. Automatic Gun Feeder.

Weight 19.5 pounds
Overall length 12.8 inches

c. Recoil Adapter. (See TM 9-2320-224-10.)

Weight 12.5 pounds
Overall length 11.5 inches

d. 20MM Cartridges.

Authorized number 400 rounds
Weight of complete round 11 ounces
Length of complete round 8.384 inches

Tracer burn out:

HEIT and TPT 1800 meters
APIT 1200 meters
Maximum range approximately 7200 meters
Penetration at 1000 meters (APIT only):
Steel 1¼ inches
Aluminum 2¾ inches

e. XM528 Ammunition Container.

Empty 10 pounds
Packed (25 rounds) 33 pounds

f. Night Vision Sight, AN/TVS-2A. For data, refer to TM 11-5855-202-13.

g. Telescope M120.

Weight 3 lb, 4 ounces
Length (with Cap and Eyeshield) 19 inches
Diameter 2¾ inches
Power 6X
Field of View 89 mils
Temperature Operating Range -- -65°F to +160°F

h. Telescope Mount M148.

Movement (Boresight):
Azimuth (left or right) 20 mils
Elevation ±20 mils

i. Power Cupola.

Traverse 360 degrees
Traverse rate:
Maximum 1670 mils per second
Minimum 1¼ mils per second
Gun with cradle:
Maximum elevation +1,066 mils
Maximum depression -533 mils
Traverse safety zone for the scout
observer position 50° to 163° right

CHAPTER 2

CONTROLS AND SIGHTING EQUIPMENT

Section I. GUN CONTROLS

6. **Fire Control Box.** The fire control box in the commander's station has eight different switches which control electrical operation of the 20-mm gun (fig 6).

a. The **MASTER** switch controls the electrical power to the hydraulic power unit of the cupola and to the commander's control handle switches.

b. The **FIRE** switch permits flow of current from the control handle trigger to the electric solenoid on the gun. *This switch should be turned OFF during delays in firing so that the gun will not inadvertently be fired.*

c. The **EMERGENCY FIRE** switch is used to bypass the last round limit switch on the ammunition box, thereby allowing the weapon to continue to be fired even though the last linked round has left the ammunition box. When the last round switch causes the firing to cease, the commander will usually load additional ammunition into the ammunition box. If the tactical situation requires, the commander may activate the **EMERGENCY FIRE** switch and immediately have 25 rounds of ammunition available without pausing to reload.

d. The **BRAKE RELEASE** switch is used in the event of a malfunction which would necessitate rotation of the charger shaft in a counterclockwise direction (manually). Should this occur, place master switch to **ON POSITION**, all other switches **OFF**, depressing the **BRAKE RELEASE** switch to allow manual rotation counterclockwise of the charger shaft.

e. A **HEATER** switch is provided to operate a winterization kit during periods of operation in extreme cold (below -25°F).

f. The **CHARGER** switch is used during the electrical charging cycle. When the switch is in the **NORMAL** position and the **STAFF** button is depressed for about $\frac{1}{2}$ second, the charger will move through its charging cycle. With the **CHARGER** switch in the **JOG** position, the charger will only move a short distance instead of moving through the complete cycle. The **JOG** position is used when



Figure 6. Fire control box.

it is desired to move the charger pawl to an intermediate position in the receiver such as when changing the barrel.

g. The **FIRING MODE** selector is provided to give the commander a choice of one of the five modes of firing for the 20-mm gun.

(1) **FAST RATE:** Allows firing continuously at full cyclic rate.

(2) **SLOW RATE:** Allows firing continuously at 200 rounds per minute.

(3) **SINGLE SHOT:** Allows firing one round each time trigger is depressed.

(4) **FAST BURST:** Allows firing burst of approximately five rounds at cyclic rate.

(5) **SLOW BURST:** Allows firing burst of approximately five rounds at 200 rounds per minute.

7. **M27 Cupola Operation.** a. For power operation of the M27 Cupola the **MASTER** switch on the control box is turned **ON**, providing electric current needed for the operation of the hydraulic

system. Elevation and traversing of the cupola are controlled by use of commander's control handles (fig 3). Each handle has two switches. By depressing either of the lower switches, the magnetic brake is released allowing cupola movement. When the FIRE switch is ON, either of the upper switches will fire the gun.

Warning: The traverse brake handle must be in the POWER position for power operation of the cupola.

b. For manual operation, turn the MASTER switch off; place the traverse brake handle in the MANUAL position. Turn control handles in desired direction of traverse; then operate manual pump handle (fig 3). The switches on the commander's control handle will not function when the MASTER switch is in the OFF position. The weapon must be fired using the manual firing lever (fig 7).

Warning: Never operate pump handle prior to activating control handles.

c. The cupola will traverse 360° in manual or power operation. In either mode of operation there is a part of the vehicle deck that is protected to prevent the gun from striking the observer or objects on the deck. This is accomplished by the action of an interrupter valve, interrupter cams, and a disc brake. As the cupola is traversed right or left into the protected area, it is automatically stopped (fig 4). Before traversing through the protected area, the commander must check to see that the observer is down inside the vehicle with the hatch closed and that the gun is elevated sufficiently to clear any obstructions. The commander may then depress the override button on Interrupter Valve, allowing the cupola to traverse through the protected area.

d. The interrupter cam has no effect on the elevation of the gun, thus it is the responsibility of the commander to insure the gun will not strike any objects on the deck when depressing the gun below zero elevation.

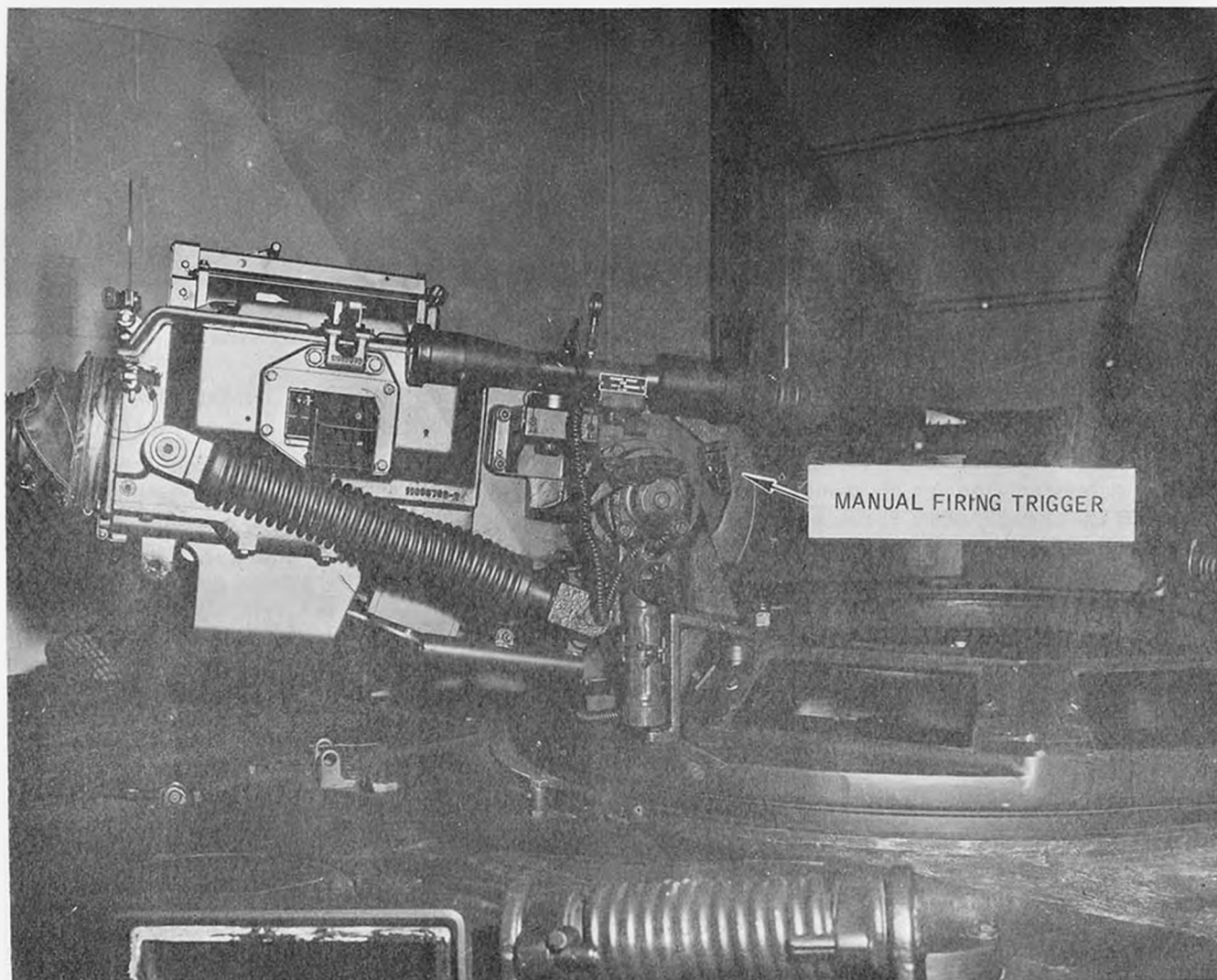
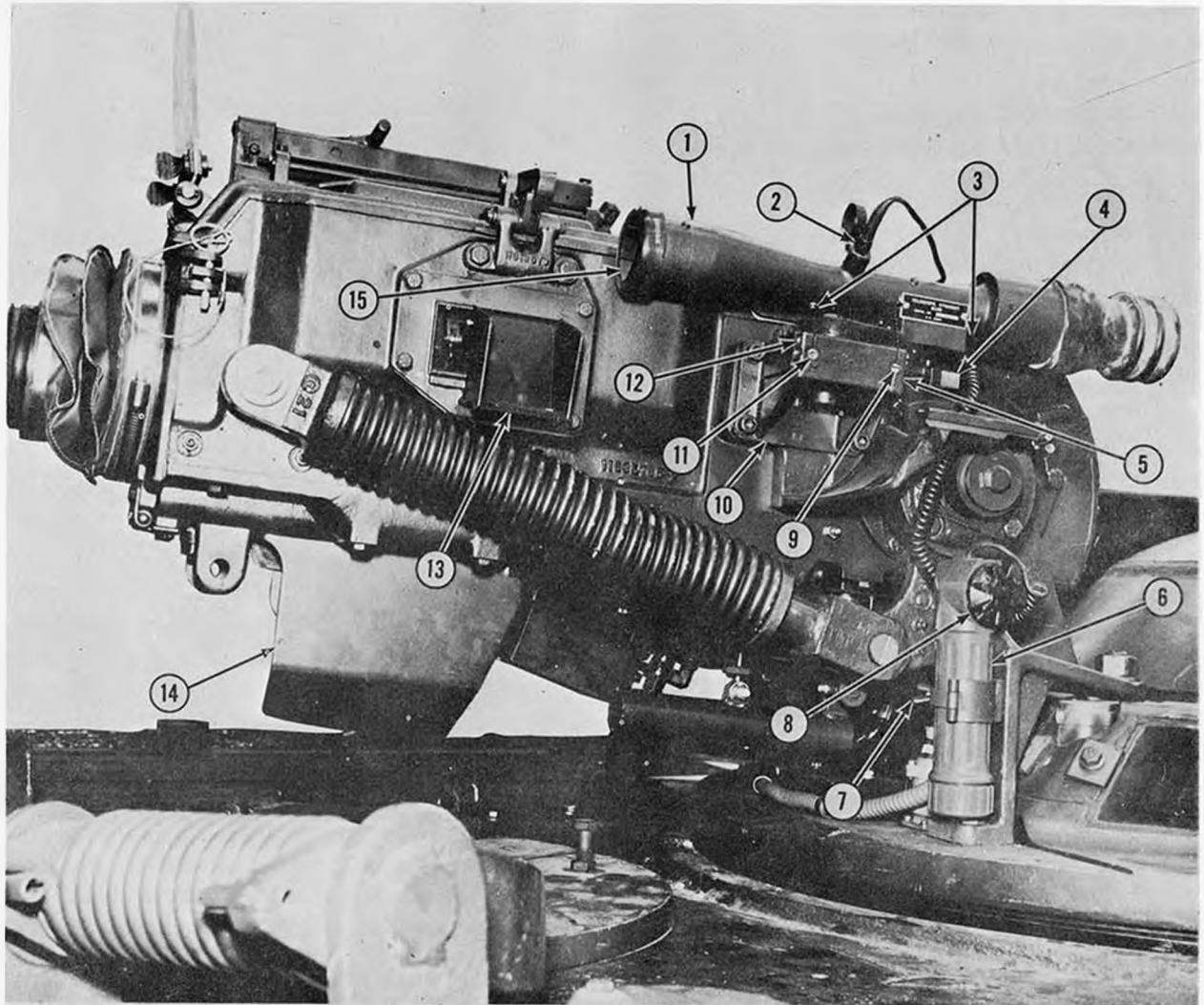


Figure 7. Manual firing trigger.

Section II. SIGHTING EQUIPMENT

8. **M120 Telescope.** The M120 telescope is the primary sight for use with the 20-mm weapon system under visible light conditions. It is a 6-power, fixed-focus, straight-tube instrument. It has a ballistic reticle matched with the 20-mm ammunition.

The telescope is supported by the M148 telescope mount. The M120 telescope has an attachment for an M52 instrument light that illuminates the M120 telescope reticle. The reticle within the telescope is etched and is graduated from 400 to 2,000

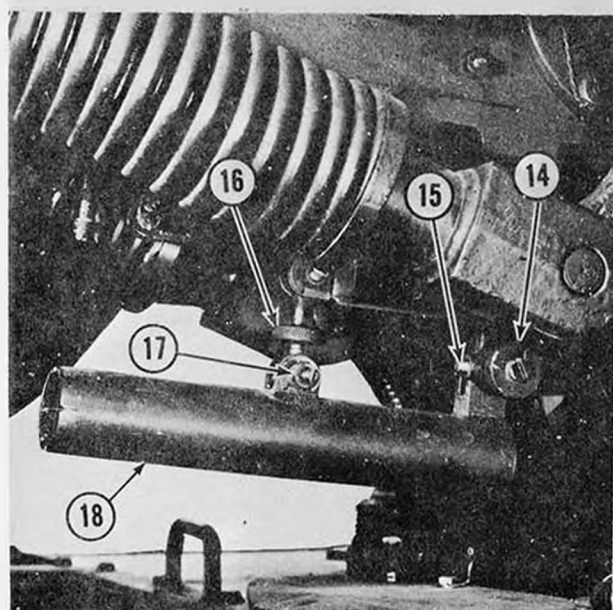
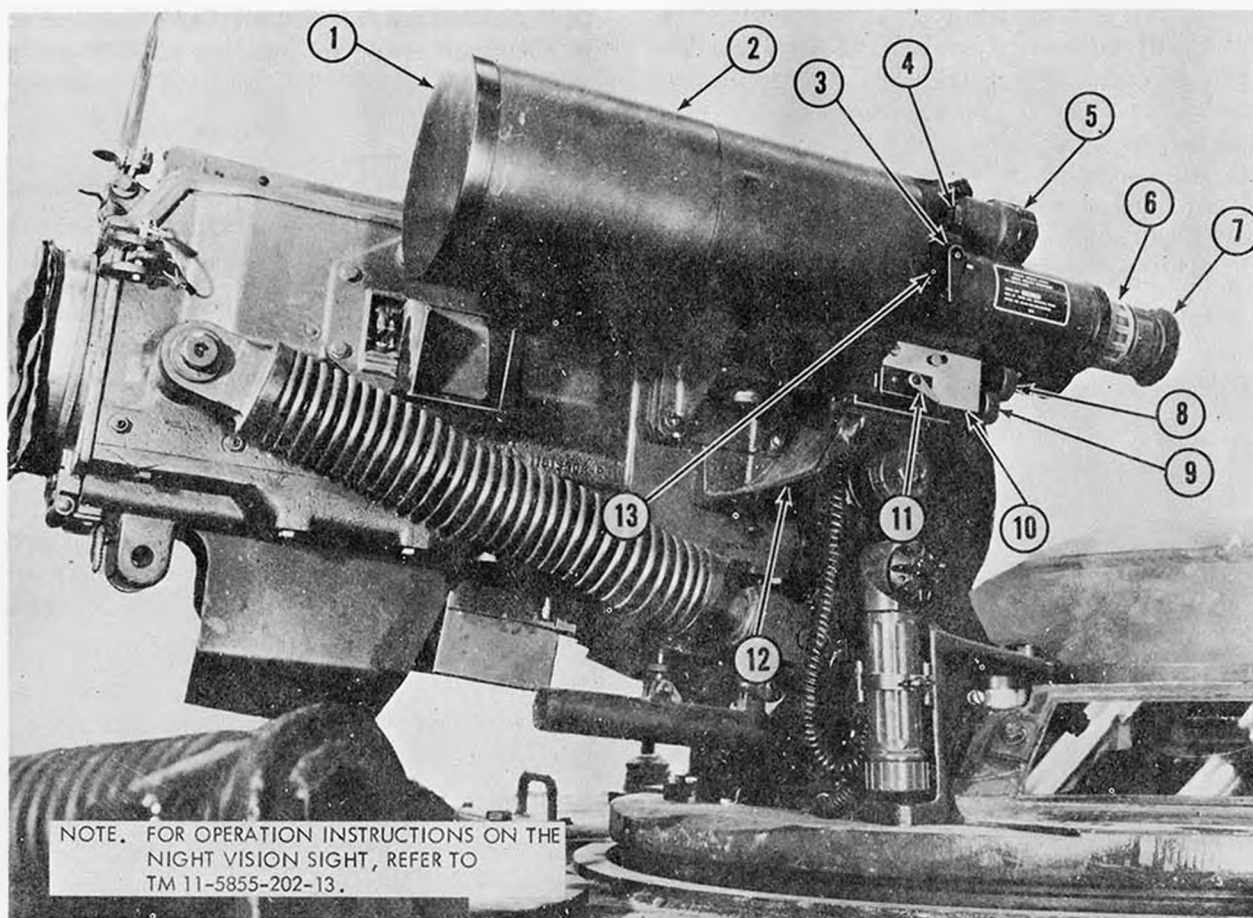


- | | |
|--|---|
| 1. M120 TELESCOPE | 8. RHEOSTAT LIGHT KNOB (CONTROLS ILLUMINATION FOR M120 TELESCOPE RETICLE) |
| 2. M52E1 INSTRUMENT LAMP HOUSING | 9. ELEVATION BORESIGHT ADJUSTMENT SCREW |
| 3. TELESCOPE NITROGEN PURGING AND CHARGING SCREW | 10. M148 TELESCOPE MOUNT |
| 4. M120 TELESCOPE MOUNT CLAMPING LEVER | 11. AZIMUTH BORESIGHT ADJUSTMENT SCREW |
| 5. ELEVATION BORESIGHT CLAMPING SCREW (HIDDEN) | 12. AZIMUTH BORESIGHT CLAMPING SCREW |
| 6. M52E1 INSTRUMENT LIGHT | 13. LINK EJECTION CHUTE |
| 7. BRACKET, CLAMP, AND WING NUT | 14. CARTRIDGE CASE EJECTION CHUTE |
| | 15. TELESCOPE LENS CAP |

Figure 8. M120 telescope and M52E1 instrument light.

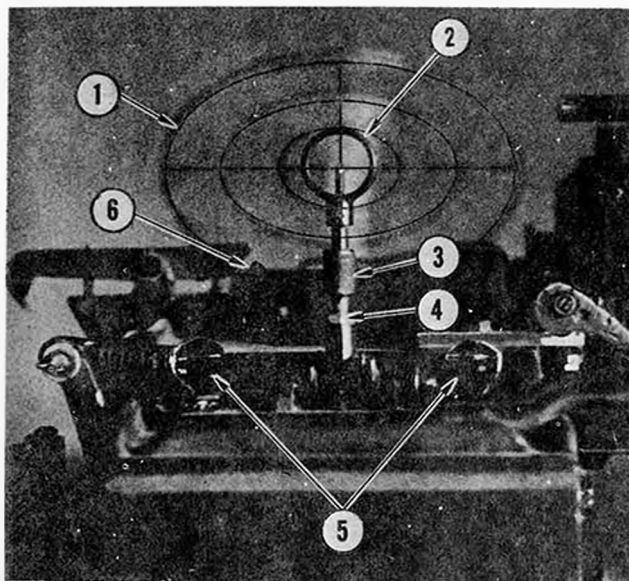
meters. The boresight cross is at the top of the reticle and is designed for a boresighting range of 1,000 meters. Lead lines are spaced 5 mils apart and 1 lead will suffice for an apparent target speed of 15 miles per hour regardless of range. Azimuth

and elevation adjustment are performed on the M148 mount rather than directly on the telescope. A lens cap is provided to protect the telescope from dirt and moisture. An accordion-type rubber eye shield allows the vehicle commander to obtain



1. LENS CAP
2. NIGHT VISION SIGHT AN/TVS-2A
3. OBJECTIVE LENS FOCUS KNOB
4. ROTARY CONTROL (6-POSITION) SWITCH KNOB
5. BATTERY CAP
6. EYEPIECE FOCUS RING
7. EYESHIELD
8. ELEVATION BORESIGHT KNOB
9. AZIMUTH BORESIGHT KNOB
10. BORESIGHT ASSEMBLY
11. SIGHT-TO-MOUNTING BRACKET LOCK KNOB
12. NIGHT VISION SIGHT MOUNTING BRACKET
13. OBJECTIVE LENS FOCUS KNOB LOCKING DEVICE
14. AZIMUTH ADJUSTMENT SCREW
15. AZIMUTH CLAMPING SCREW
16. ELEVATION ADJUSTMENT SCREW
17. ELEVATION CLAMPING SCREW
18. LOWER SIGHT ASSEMBLY

Figure 9. Night vision sight AN/TVS-2A and gun cradle lower sight assembly.



1. PLASTIC SPEED RING
2. REAR SIGHT
3. ADJUSTING SCREW
4. JAM NUT
5. REAR SIGHT MOUNTING SCREW (2)
6. THUMBSCREW (2)

Figure 10. Rear sight and speed ring alined on distant aiming point.

a good sight picture without unnecessary vibration during firing. It also eliminates distracting background light (fig 8).

9. Crew Served Weapons Night Vision Sight, Model 9927B or 9927B-1. *a.* The sight is a battery-powered, passive, and electro-optical device designed for night observation and aimed fire, using ambient light. It is a 7-power instrument with a 108-mil field of view. Focus is adjustable from 50 meters to infinity. It weighs approximately 16 pounds (fig 9).

b. The sight has a ballistic reticle graduated for use with the 20-mm gun and caliber .50 machine-

gun. Graduations for use with the 20-mm are indicated by the letters HS. It is marked every 200 meters from 0 to 1,600 meters.

c. A boresight cover and filter wheel allow boresighting during daylight. The filter wheel is a flat disc with filters of varying opacity. Rotating this disc to align the appropriate filter allows daylight boresighting under conditions varying from brightest daylight to cloudy days. The darkest filter should be selected before operating the sight in daylight.

Warning: The boresight cover must *never* be removed when operating the sight in daylight or damage to the sight will occur.

10. Gun Cradle Lower Sight. The gun cradle lower sight allows aiming of the 20-mm gun while buttoned up. It is an open tube with a sighting blade at the rear and crosshairs on the front. The sight has no magnification and is viewed through the cupola front vision block. It is attached to the bottom of the gun cradle. Two thumbscrews allow adjustment in elevation and deflection during boresighting. Since the sight moves in elevation with the cradle, its use is limited to plus or minus 10 degrees elevation (fig 9).

11. Front and Rear Gun Sights. The front and rear gun sights are placed on the gun mount and provide a nonmagnified sighting system for use when the M120 telescope is not operable or when firing against aircraft or widely dispersed targets. It may also be used to bring the gun into the general target area before using the telescope. The rear gun sight is a circle with an aiming point. It is adjustable for elevation and slight deflection. The front sight is a clear plastic plate marked with three concentric ovals and a cross. The concentric ovals are used to provide the appropriate lead when firing at low performance aircraft. The front sight is adjustable for slight deflection only (fig 10).

CHAPTER 3

AMMUNITION

12. **General.** Ammunition for the M139 gun is designed to provide a combination of high explosive incendiary tracer and armor piercing incendiary tracer rounds that can be used successfully against personnel and lightly armored vehicles. Ammunition is provided in boxes containing belts of 25 rounds each. The combat mix belt has a ratio of three high-explosive incendiary tracer rounds to two armor piercing incendiary tracer rounds. Target practice tracer rounds are available for range firing.

13. **High Explosive Incendiary Cartridge (HEI-T).** The M599 cartridge is a percussion-primed, high explosive, incendiary and tracer round. It is point detonating and is armed at a distance of 15 to 40 meters from the muzzle of the gun. The complete cartridge weighs 4.890 grains and the projectile has a muzzle velocity of 1,045 meters/second. This cartridge consists of an aluminum fuze body, a lacquered steel cartridge case, and a steel projectile body. The fuze is the M594 self-destructing, point-detonating type. The self-destruct mechanism functions after $5\frac{1}{2}(+1\frac{1}{2})$ seconds average time of flight of the projectile. The cartridge case contains a percussion primer, booster charge, and propellant. The projectile body contains an igniter and a tracer element in the rear cavity, a high explosive incendiary filler in the forward cavity. The projectile is lacquered yellow and lettered in black with the letter T in red designating the tracer. Fragmentation and blast will produce casualties to troops and damage to equipment.

14. **Armor Piercing Incendiary Cartridge (API-T).** The M601 cartridge is a percussion primed, armor piercing round with a tungsten carbide and an incendiary element behind the

windshield. The outer projectile body and the windshield are aluminum. The complete cartridge weighs 4.815 grains and the projectile has a muzzle velocity of 1,100 meters/second. The difference in weight and muzzle velocity between it and the high explosive round causes a slightly higher trajectory for the armor-piercing round. The vertical difference is $\frac{3}{4}$ - to 1-mil at 1,000 meters range. The projectile is painted black and lettered in white. The tip is red and the tracer designator is orange. The projectile imparts its high kinetic energy to the target producing penetration of light armor. The incendiary element then causes fire and target destruction (fig 11).

15. **Target Practice Cartridge (TP-T).** The M206 cartridge is used for training and range firing due to its lower cost and its lesser destructive effect on range facilities. It is constructed similar to the high-explosive round but has an inert filler plug replacing the explosive-incendiary elements. The cartridge has the same weight and velocity as the high-explosive round, and is linked in 25-round belts. The round is painted blue and marked with black letters, with the tracer designation in red (fig 11).

16. **Safety and Handling.** The 20-mm ammunition is bore safe and drop safe. The rounds should not be subjected to rough handling or exposed to extreme heat. Care must be taken when handling ammunition not to strike the primer or the fuzes. The incendiary effect should be taken into consideration when firing toward areas susceptible to brush or forest fires.

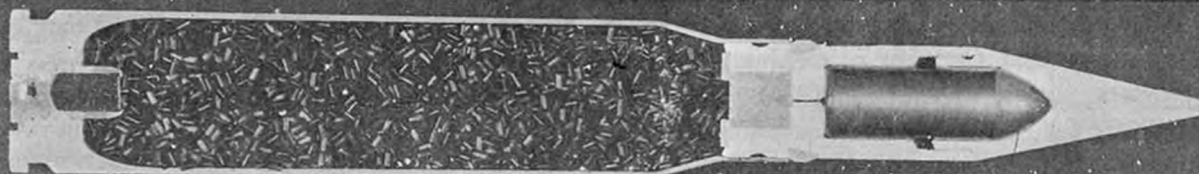
Warning: Caution should be exercised when firing through vegetation or other obstructions in the vicinity of friendly troops.

20 x 139 mm Hispano Suiza (INDEX # 18)
W.A.

**AMMUNITION
FOR M139 GUN**



CTG, 20 MM
TARGET PRACTICE,
TRACER,
XM206



CTG, 20 MM
ARMOR PIERCING
INCENDIARY, TRACER
XM601



CTG, 20 MM
HIGH EXPLOSIVE
INCENDIARY, TRACER,
M599

Figure 11. 20-mm ammunition.

CHAPTER 4

MECHANICAL TRAINING, OPERATION, AND MAINTENANCE

Section I. MECHANICAL TRAINING

17. General. This chapter discusses the procedures to be followed during disassembly and assembly, loading, firing, and clearing of the weapon. Immediate action and crew maintenance for the weapon system are also presented. This information may repeat parts of the technical manual where emphasis or clarification is desirable.

18. Removal of the Gun From the Cupola Cradle.
a. Whenever gun is to be removed from cupola cradle, certain preliminary precautions should always be taken:

(1) Be sure that chamber is clear and that bolt is forward.

(2) Check for excess lubricant accumulation; flush and clean as necessary.

(3) Use asbestos gloves when removing a hot barrel.

b. Before gun can be removed from gun cradle, circuit breaker on cupola power control box must be off and cupola power switch must be in the OFF position.

c. To remove gun from cupola cradle, release clamp that secures front dust cover to gun barrel.

Remove barrel by pressing latch on left front corner of receiver and turn barrel in a counter-clockwise direction. Remove two pins, one on either side of front of cradle, and open front cover plate (fig 12).

d. Open gun cradle top cover plate by releasing top cover plate lock lever, then lift gun latch lever and remove automatic gun feeder (fig 13).

e. Remove recoil adapter as follows:

(1) Insert a screwdriver or similar thin-bladed tool between charger pawl and side of gun receiver.

(2) While depressing charger pawl so that it does not pick up bolt, cycle charging mechanism until pawl is at forward edge of clamp that secures two electrical connectors to charging mechanism limit switch.

(3) Leave charger mechanism pawl in this position for installation of gun. Pull out two locking pins that secure recoil adapter lugs to gun cradle bosses, and lift out recoil adapter (fig 14).

f. Slide receiver forward and lift from gun cradle once it is clear of front and rear recoil

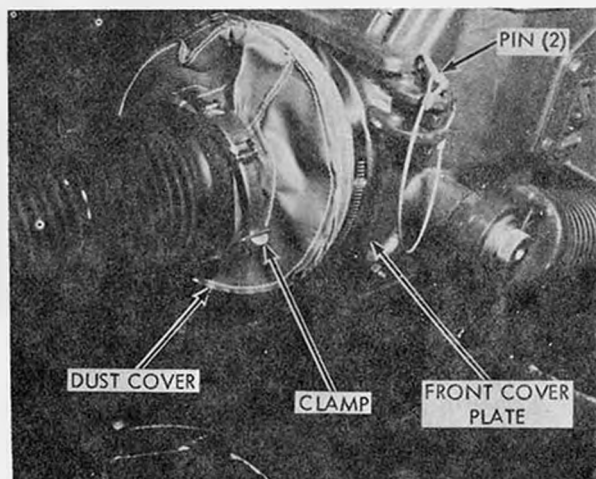


Figure 12. Front dust and cover plate.



Figure 13. Front cover plate and automatic gun feeder.

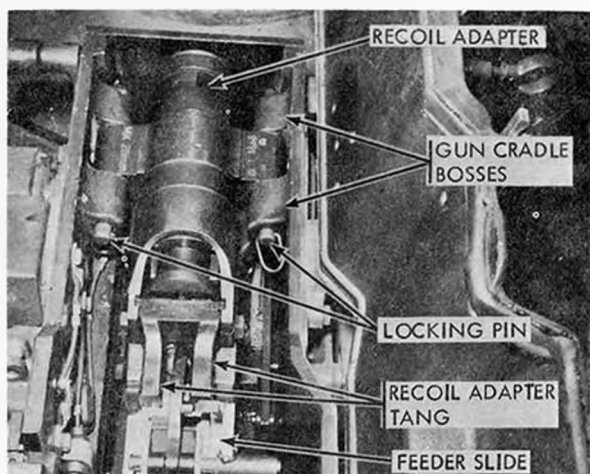


Figure 14. Recoil adapter.

guides. Use care when removing the gun so as not to damage recoil guides (fig 15).

19. Disassembly of the 20MM Automatic Gun, M139. After the gun has been removed from the cradle the following sequence should be used during disassembly (fig 16). Use sequenced white arrows in upper left corner. Arrow numbers are indicated in figure references by the number following the 1.

a. Automatic Gun Feeder. Raise release lever and lift off automatic gun feeder.

b. Recoil Adapter. Lift recoil adapter off receiver.

c. Barrel Assembly.

(1) Do not release bolt unless barrel is assembled to receiver.

(2) Be sure bolt is in forward position.

(3) Press barrel retaining latch and turn barrel counterclockwise until reference mark on barrel is aligned with reference mark on front of receiver ((1), fig 16①).

(4) While holding barrel in alignment, pull barrel forward and remove it from receiver.

(5) Remove gas port plug retaining clip from barrel ((2), fig 16①).

(6) Remove two gas port plugs from barrel ((3), fig 16①).

d. Driving Spring Assembly.

(1) Using assembled spanner and recoil spring dismantling device, consisting of the rod, stop block, and device, insert threaded rod through hole in stop block and spanner. Turn rod to screw front end into front guide tube.

(2) Push stop block forward against device and tighten winged nut ((4), fig 16①).

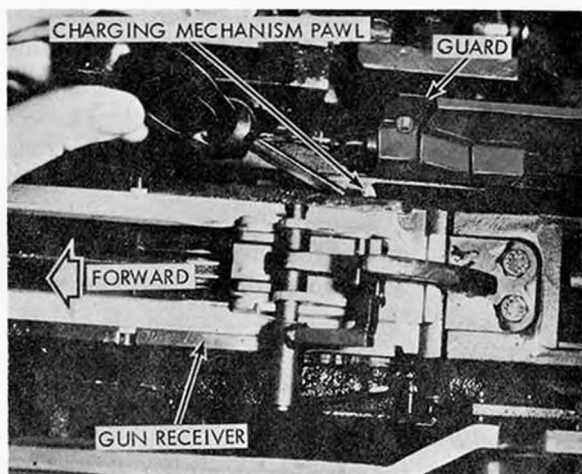


Figure 15. Gun charging mechanism pawl.

(3) Rotate device counterclockwise to unscrew driving spring group from rear buffer. Brace rear of dismantling device with the body to prevent sudden expansion of spring ((5), fig 16①).

(4) Withdraw and remove driving spring assembly on dismantling device.

(5) Remove front driving spring and retainer from its guide tube.

(6) Place tip of forward guide tube against a firm surface and, while holding device firmly with one hand, release wing nut with other hand to release spring tension slowly ((6), fig 16①).

(7) Unscrew and remove threaded rod from front driving spring guide tube.

e. Rear Buffer Assembly.

(1) With one hand holding buffer assembly, pull plunger cap rearward to disengage latch.

(2) Lift or lower rear buffer assembly from receiver ((7), fig 16②).

f. Feeder Latch and Cartridge Ejector.

(1) Compress split end of shouldered pin and remove.

(2) Apply latch dismantling device under tank of slide and against feeder latch; then press down on device to compress feeder latch springs ((8), fig 16②).

(3) Remove hollow pin.

(4) Remove release lever.

(5) While holding feeder latch, remove feeder latch dismantling device ((9), fig 16②).

(6) Remove feeder latch and two springs.

(7) Remove ejector and inner and outer ejector spring assemblies by sliding ejector forward ((10), fig 16②).

g. Trigger Lever Assembly.

(1) Turn receiver upside down.

(2) Using a small screwdriver, or studs on end of feeder latch dismantling device, push down and turn sear lever spring housing counterclockwise $\frac{1}{4}$ turn and remove it ((11), fig 16③).

(3) Slide trigger plate assembly rearward to align disassembly notches with lugs, and lift it off receiver ((12), fig 16③).

(4) Remove straight headless pin (trigger) and separate trigger lever assembly and spring from plate.

h. Sealing Plate. Slide sealing plate to rear, align disassembly notches, and lift it off receiver.

i. Sear Buffer Assembly.

(1) Attach sear buffer assembly dismantling device to front sear buffer block so that two pins fit into holes in block and tang on the compressor engages rear sear block ((13), fig 16③).

(2) Place square opening of recoil spring dismantling device on stud of sear group dismantling device and rotate it $\frac{1}{4}$ turn clockwise ((14), fig 16③).

(3) Remove sear buffer assembly from receiver.

(4) While firmly holding sear buffer assembly, turn recoil spring dismantling device $\frac{1}{4}$ turn counterclockwise and separate device from sear buffer assembly ((15), fig 16④).

(5) Separate front and rear sear buffer blocks and three sear buffer springs.

(6) Remove straight headless pin and sear from rear buffer block.

j. Retaining Plate Assembly. Remove retaining plate assembly and turn receiver upright ((16), fig 16④).

k. Breech Bolt Assembly.

(1) Apply small end lug of the recoil spring dismantling device in recess of receiver engaging the unlocking plate lug. Contact center lug of device with lug recess on receiver ((17), fig 16④).

(2) Holding receiver with one hand, push top of device forward to force unlocking plates rearward, unlocking bolt assembly.

(3) Use device to pull bolt assembly rearward until bolt lug protrudes $\frac{5}{8}$ inch from rear of receiver ((18), fig 16④).

(4) Apply hook end of bolt mounting device to square lug on unlocking plate. While holding one hand under bolt, place round end of tool against rear face of bolt body and press tool to apply leverage ((19), fig 16④).

(5) Remove bolt from receiver.

(6) Remove bolt lock.

(7) Pull left and right unlocking plates away from key and bolt body separately ((20), fig 16⑤). Make sure the springs do not expand too rapidly.

(8) Separate counter slides, springs, and plugs from unlocking plates by prying apart with driving pin ((21), fig 16⑤).

(9) Separate springs and plugs from counter slides.

(10) Remove unlocking plate key from either side of bolt.

(11) Using a hammer and drift, drive out straight headless pin (extractor) and remove extractor and extractor spring ((22), fig 16⑤).

(12) While holding one hand at rear end of bolt, elevate front end of bolt and allow firing pin to slide out the rear.

e. Receiver Group.

(1) Remove gas transfer plug retaining clip ((23), fig 16⑥).

(2) Using gas transfer extractor, remove gas transfer plugs ((24), fig 16⑥).

(3) Push out unlocking pistons and unlocking rods by using rods of multipurpose tool ((25), fig 16⑥).

This completes general disassembly of the weapon.

20. Assembly. The gun is assembled in reverse order to disassembly (fig 16). Use sequenced dark arrows found in lower right hand corner. Arrow numbers are indicated in figure references by the number following the 1.

a. Receiver Group.

(1) Insert unlocking rods into piston holes.

(2) Insert unlocking pistons.

(3) Insert gas transfer plugs, and replace gas transfer plug retaining clip ((1), fig 16⑥).

b. Breech Bolt Assembly.

(1) Insert flat end of extractor spring into hole in bolt.

(2) Place extractor against round end of extractor spring.

(3) Using hammer and drift, align extractor pin holes in bolt and extractor. Place small end of drift into bolt and through extractor; then tap the drift until flush with the side of bolt. Using straight headless pin (extractor), pin tap drift through bolt ((2), fig 16⑤).

(4) Elevate rear end of bolt and drop firing pin, striker end first, into bolt.

(5) Replace unlocking plate key through bolt and firing pin.

(6) Replace springs and plugs into counter slides.

(7) Place plug of counter slide into indentation of unlocking plate.

(8) Grasping unlocking plate with counter slide in one hand, strike unlocking plate on a solid surface. At the same time press counter slide into its recess in unlocking plate. Repeat this action with other counter slide ((3), fig 16⑤).

(9) Place spring in recess of unlocking plate with small end of spring to the rear.

(10) Place small end of spring against lug on bolt and press unlocking plate rearward, compressing spring until hole in unlocking plate is alined with unlocking plate key. Press unlocking plate flush against bolt. Repeat this action with other unlocking plate bolt ((4), fig 16⑤).

(11) Insert bolt into receiver until bolt lug recess is even with rear of receiver.

(12) Place hook end of bolt mounting device on square lug of unlocking plate. Place round end of device against rear face of bolt body and press device to apply leverage ((5), fig 16④).

(13) Insert bolt lug into its recess in bolt, and while holding it in place, slide bolt assembly into receiver and remove the device.

(14) Using rod or recoil spring dismantling device, push bolt assembly fully forward into receiver.

c. Retaining Plate Assembly. Turn receiver upside down and replace retaining plate assembly ((6), fig 16④).

d. Sear Buffer Assembly.

(1) Replace sear on rear sear buffer block with nose of sear downward; replace straight headless pin.

(2) Replace three sear buffer springs in holes of rear sear buffer block; replace front sear buffer block on buffer springs.

(3) Place sear buffer assembly over its recess in bottom of receiver.

(4) Attach sear buffer assembly dismantling device to sear buffer assembly ((7), fig 16④).

(5) Apply pressure to device in same manner as in disassembly until sear buffer assembly drops into recess in receiver. Remove device ((8), fig 16③).

(6) Tap front and rear buffer blocks to fully seat them into recesses of receiver ((9), fig 16③).

e. Sealing Plate. With rounded corners forward, aline disassembly notches with lugs on receiver; drop sealing plate into recess of receiver and slide plate fully forward.

f. Trigger Lever Assembly.

(1) Aline disassembly notches with lugs on receiver; while slightly raising sear, slide trigger lever assembly forward ((10), fig 16③).

(2) Place sear lever spring housing assembly in hole in trigger assembly; using a small screwdriver or studs on end of feeder latch dismantling device, push down and turn sear lever spring housing $\frac{1}{4}$ turn clockwise ((11), fig 16③).

g. Feeder Latch and Cartridge Ejector.

(1) Place outer ejector springs assemblies into outer holes of ejector with flat end of springs rearward. Place center ejector spring assembly into center hole.

(2) Place ejector with springs into track of feeder slide.

(3) Place feeder latch with two springs into track of feeder slide ((12), fig 16②).

(4) Insert feeder latch dismantling device against front of feeder slide and against feeder latch; press down on device to compress feeder latch springs and aline holes for hollow pin ((13), fig 16②).

(5) Replace release lever with cam lug in square hole in feeder latch.

(6) Insert hollow pin from right side through holes in feeder slide and release lever.

(7) Insert split pin in hollow pin from left side and fully seat pin.

(8) Remove feeder latch dismantling device ((14), fig 16②).

h. Rear Buffer Assembly.

(1) Pull plunger cap rearward to disengage latch.

(2) Place rear buffer assembly into tracks of receiver.

(3) Lower rear buffer assembly until latch is alined with latch recess.

(4) Release plunger cap. To prevent dropping buffer, be certain the catch enters the recess before releasing the rear buffer assembly ((15), fig 16②).

i. Driving Spring Assembly.

(1) Using assembled spanner and recoil spring dismantling device, insert rod of device through rear guide tube, rear drive spring and front guide tube. Screw rod into front guide tube.

(2) Place tip of front guide tube against a solid surface and press downward on device to compress spring approximately 6 inches. Tighten wing screw of stop block ((16), fig 16①).

(3) Place front spring with its retainer over front guide tube.

(4) Insert assembly into rear buffer and screw rear guide tube in tightly ((17), fig 16①).

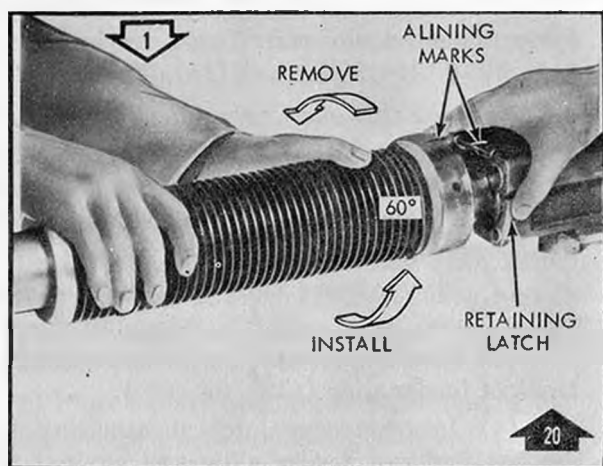
(5) Loosen stop block wing screw, unscrew rod, and remove device ((18), fig 16①).

j. Barrel Assembly.

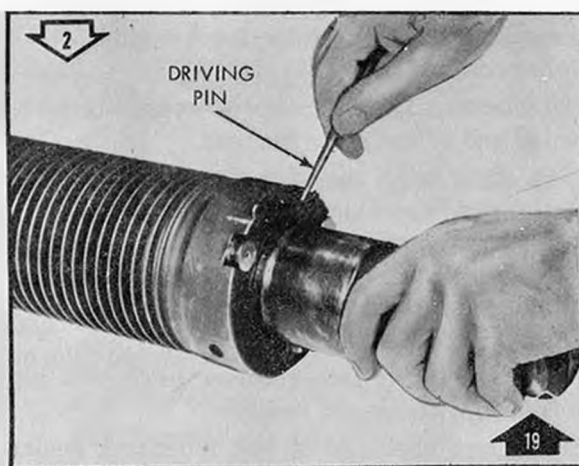
(1) Replace two gas port plugs into gas ports of barrel.

(2) Replace gas port plugs retaining clip into small holes in barrel ((19), fig 16①).

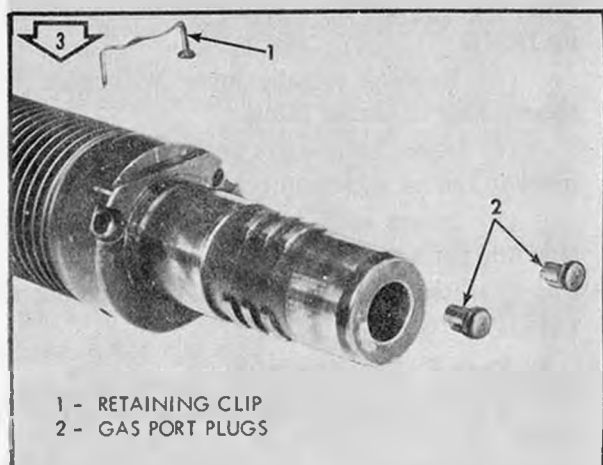
(3) Insert barrel into receiver and align



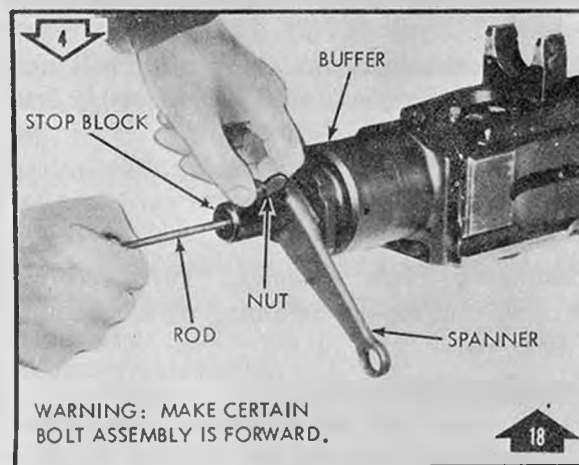
A. BARREL ASSEMBLY.



B. GAS PORT PLUG RETAINING CLIP.



C. GAS PORT PLUGS.



D. SPRING DISMANTLING DEVICE.



E. SPRING DISMANTLING DEVICE.



F. REMOVE/INSTALL DRIVING SPRING GROUP.

Figure 16. Disassembly/assembly of automatic gun.

reference mark on barrel with reference mark on receiver.

(4) Turn barrel clockwise until barrel retaining latch on receiver snaps into locking recess of barrel ((20), fig 16①).

k. *Recoil Adapter*. Place front end of recoil adapter under release lever, securing two hooks in recess of feeder slide, and place cylindrical section on recoil adapter bracket.

l. *Automatic Gun Feeder*. Place automatic gun

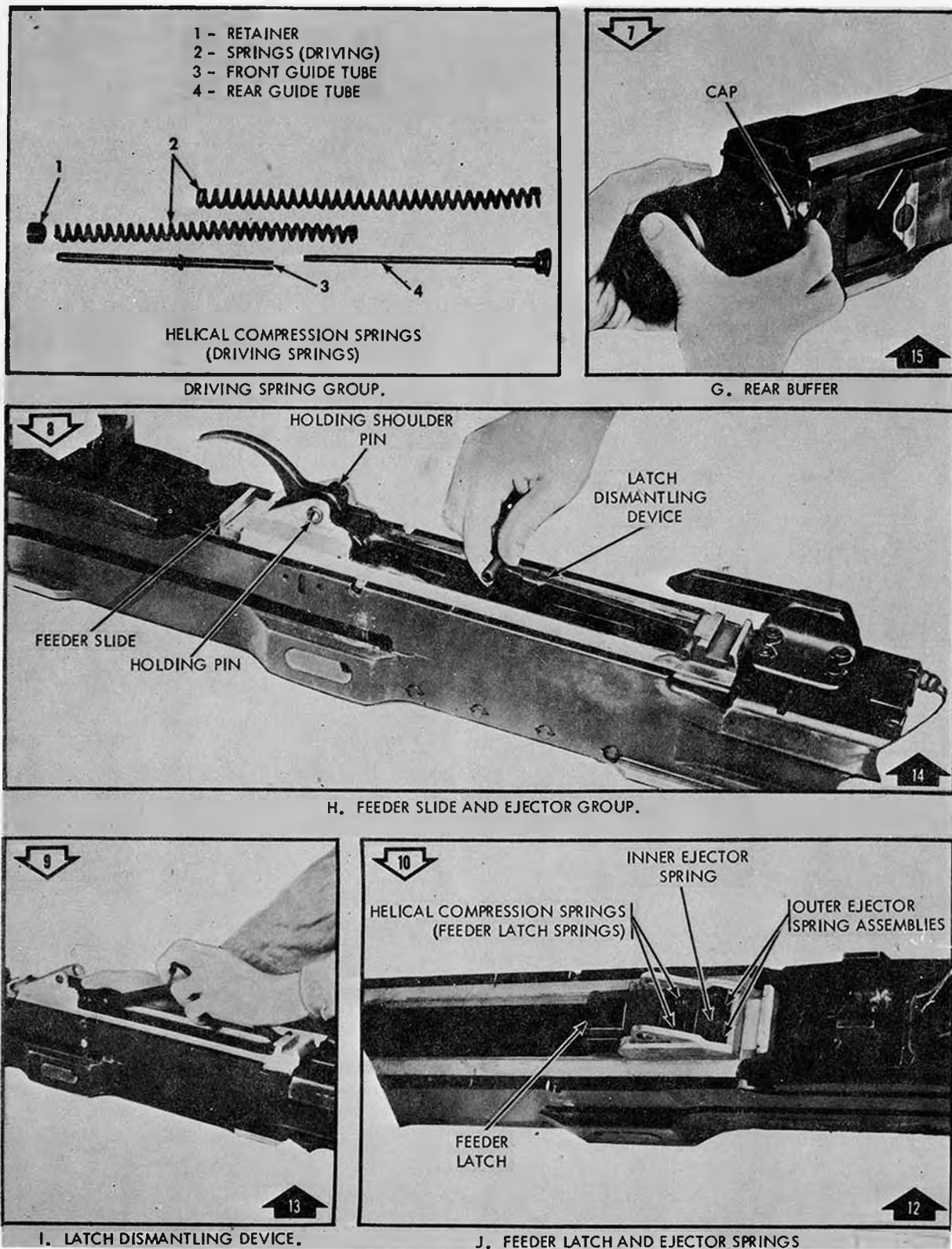
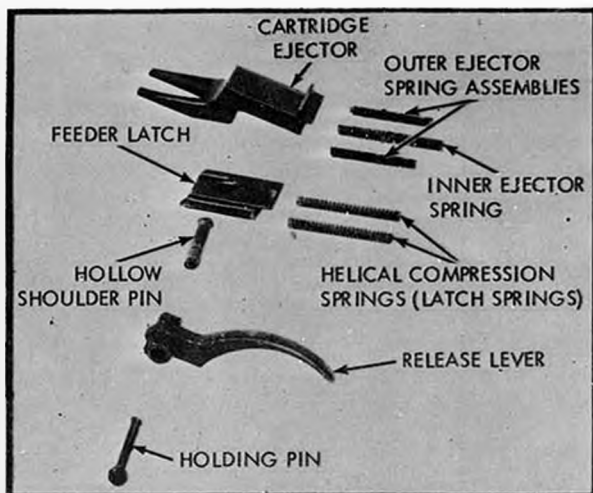


Figure 16—Continued.

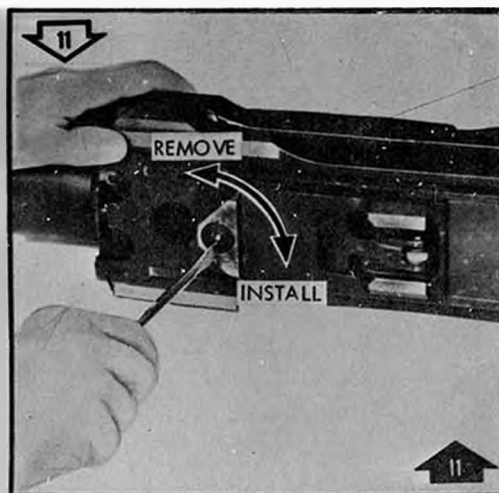
feeder over feeder slide of receiver. Push gun feeder forward, placing actuating lever of receiver in slot of feeder. Press rear of feeder down to displace feeder latch, locking feeder to gun.

21. Placing Gun in Cupola Cradle. *a.* To install gun in cupola cradle:

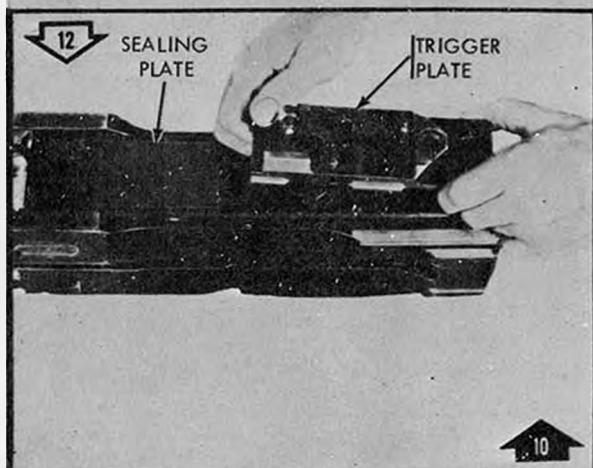
(1) Cycle charging mechanism until charging pawl has traveled to its rearward position and



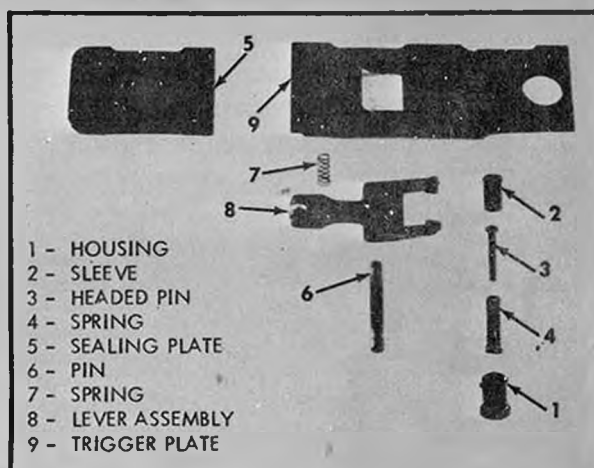
FEEDER SLIDE AND EJECTOR GROUP



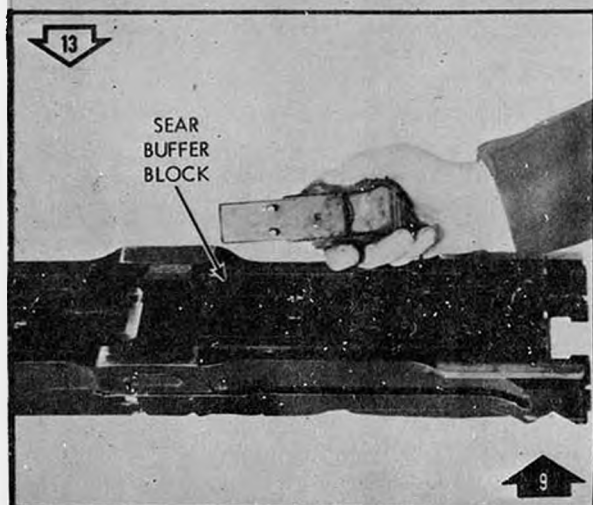
K. MECHANICAL TRIGGER ASSEMBLY.



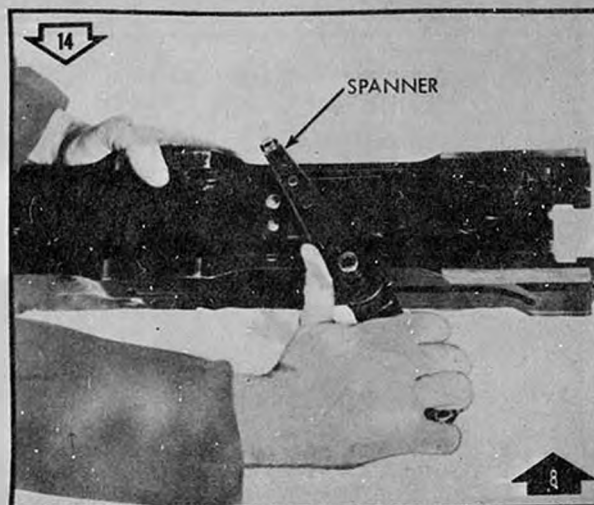
L. MECHANICAL TRIGGER ASSEMBLY



MECHANICAL TRIGGER ASSEMBLY



M. SEAR BUFFER ASSEMBLY DISMANTLING DEVICE.



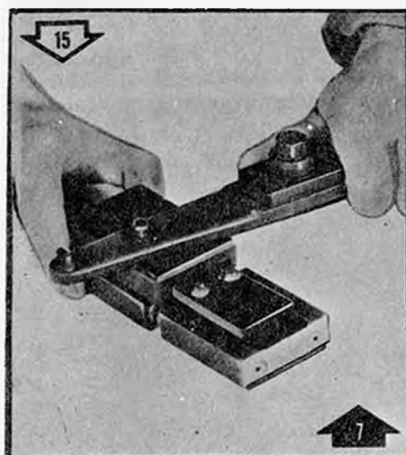
N. REMOVE/INSTALL SEAR BUFFER ASSEMBLY.

back to forward edge of clamp that secures two electrical connectors to charging mechanism limit switch.

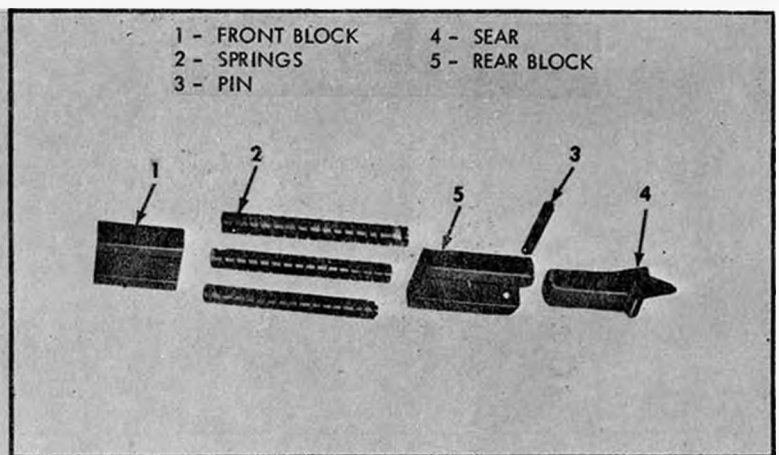
(2) Receiver is installed by canting and low-

ering into gun cradle, engaging slot in receiver with charging pawl (fig 15).

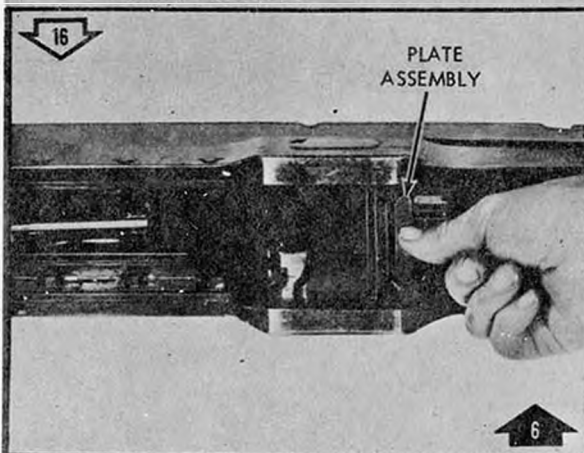
(3) Engage recoil guides and slide the receiver to the rear.



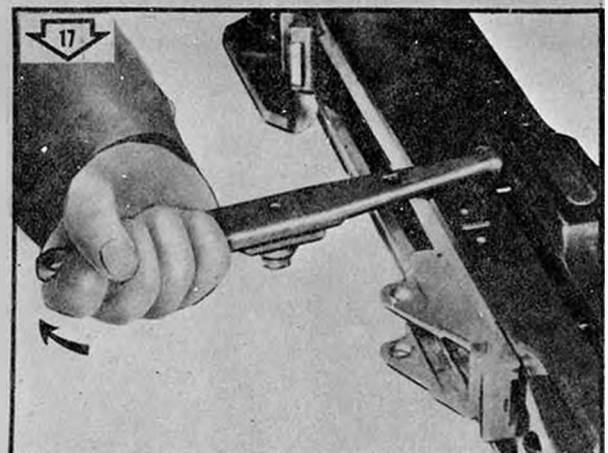
O. DISASSEMBLE/ASSEMBLE BUFFER ASSEMBLY.



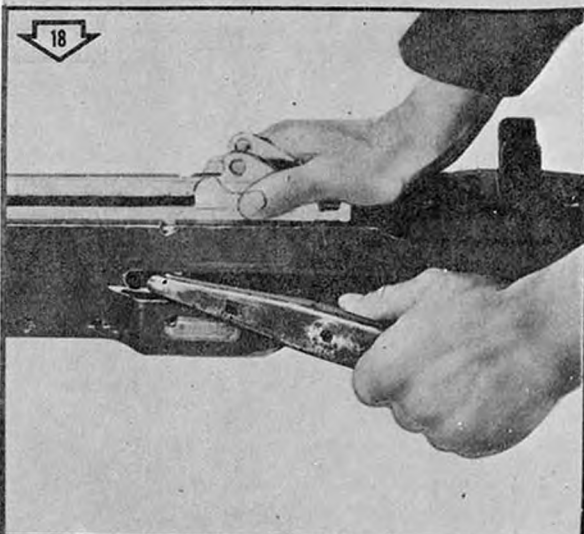
SEAR BUFFER ASSEMBLY.



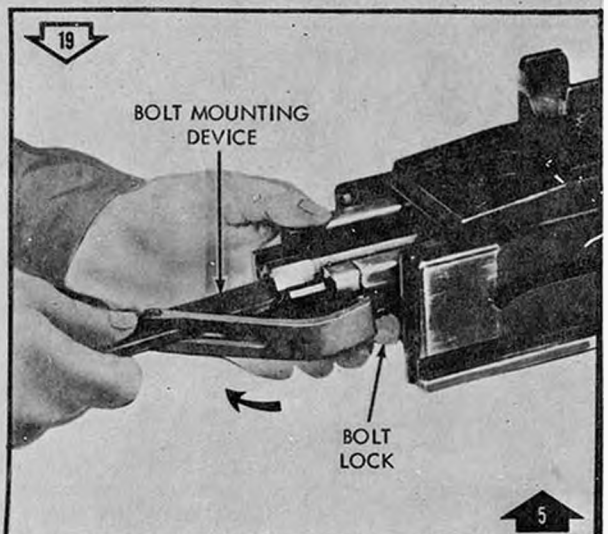
P. RETAINING PLATE ASSEMBLY.



Q. UNLOCK BOLT ASSEMBLY.

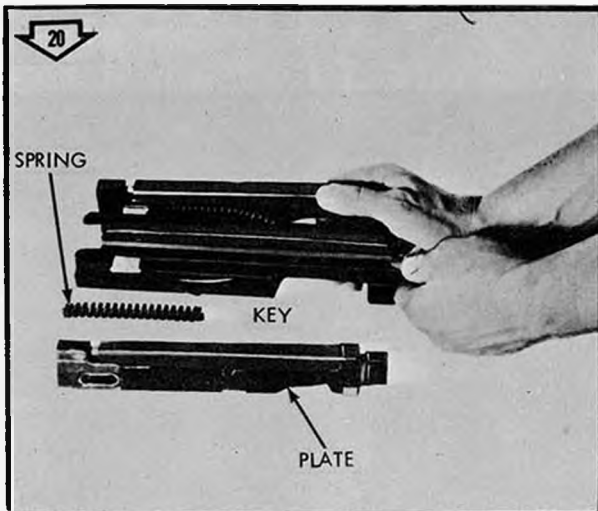


R. PULL BACK ON BOLT ASSEMBLY.



S. REMOVE/INSTALL BOLT ASSEMBLY.

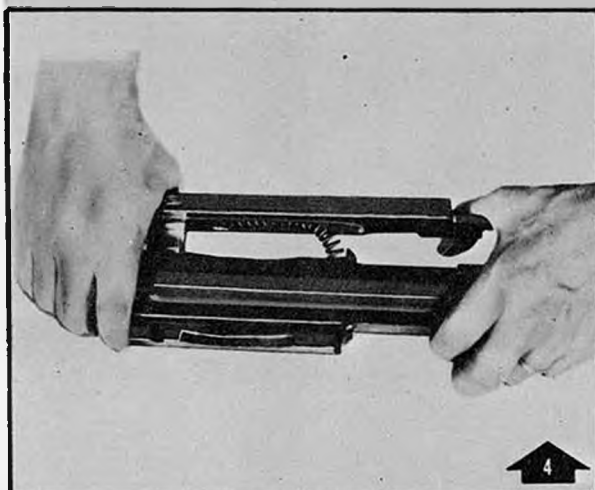
Figure 16—Continued.



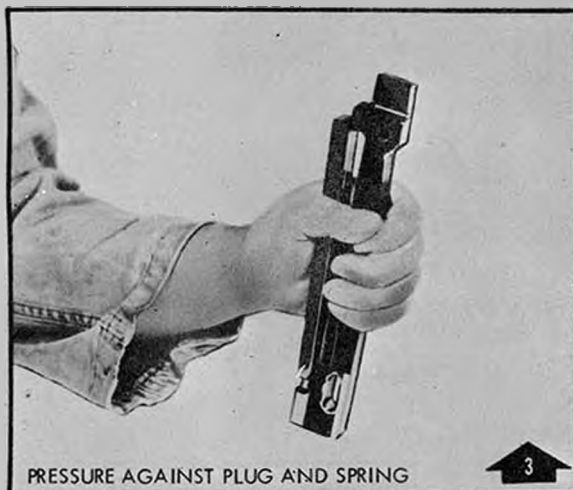
T. UNLOCKING PLATES.



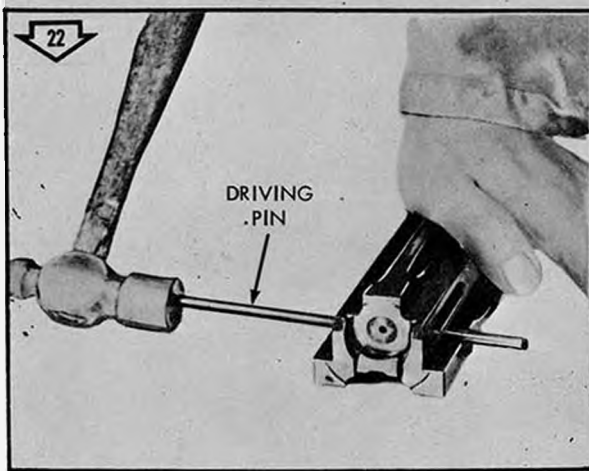
U. REMOVE COUNTER SLIDES.



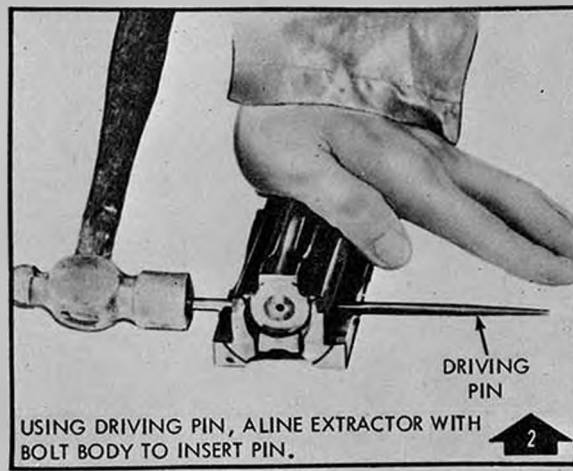
INSTALL UNLOCKING PLATES



INSTALL COUNTER SLIDES

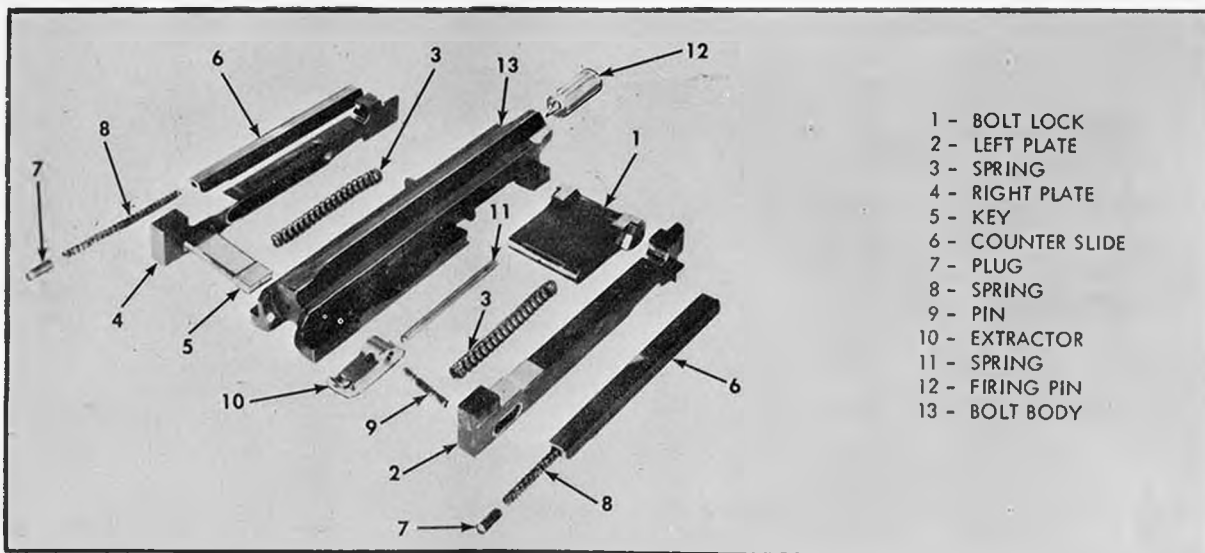


V. REMOVE STRAIGHT HEADLESS PIN (EXTRACTOR).

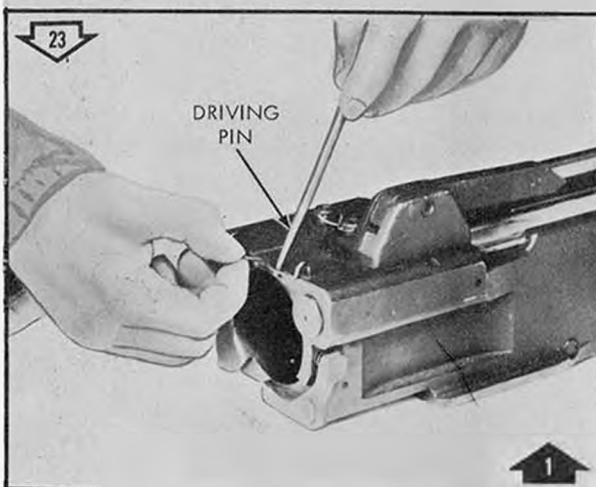


INSTALL STRAIGHT HEADLESS PIN (EXTRACTOR).

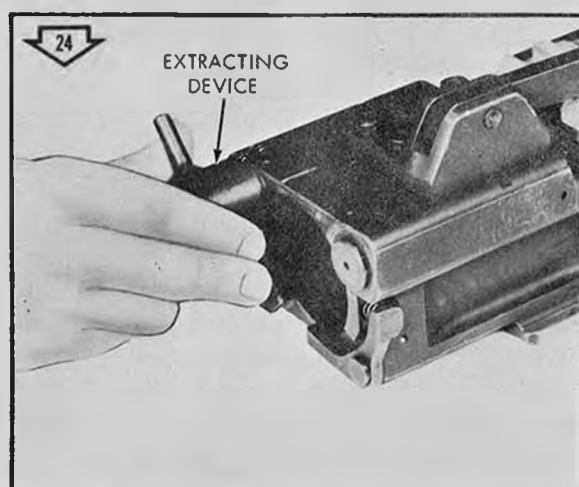
Figure 16—Continued.



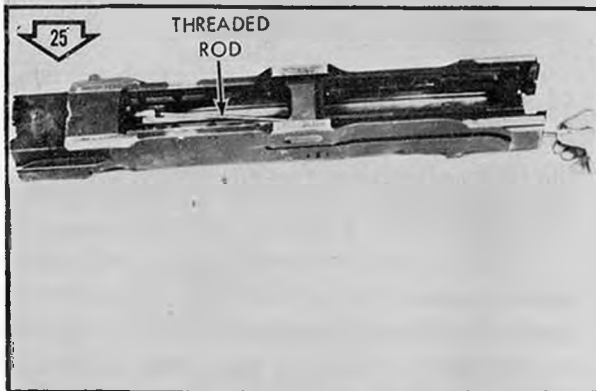
BOLT ASSEMBLY - EXPLODED VIEW.



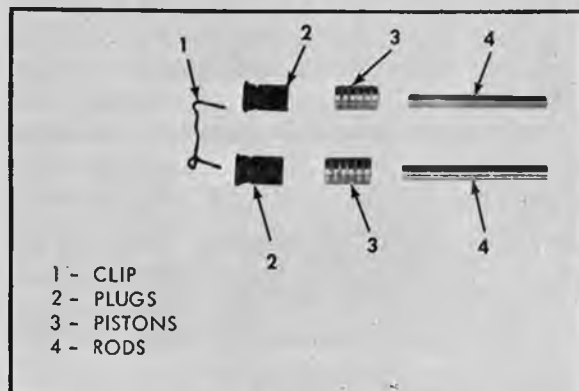
W. GAS TRANSFER PLUG RETAINING CLIP.



X. GAS TRANSFER PLUGS.



Y. UNLOCKING PISTONS AND UNLOCKING RODS.



RECEIVER GROUP

Figure 16—Continued.

b. Install recoil adapter and secure it with two locking pins (fig 14).

c. Continue to cycle charging mechanism until charging pawl returns to its forward position.

d. Automatic gun feeder is installed by lifting gun latch lever and inserting feeder into gun cradle. Close gun cradle top cover plate and secure it by engaging top cover plate lock lever (fig 13).

e. Close front cover plate and secure it with two pins.

f. To install barrel, align mark on barrel with mark on receiver. Insert barrel and turn it clockwise until engaging retaining latch (fig 17). Insure barrel is locked to receiver by attempting to rotate barrel in both directions without depressing barrel release latch.

g. Secure front dust cover to barrel (fig 12).

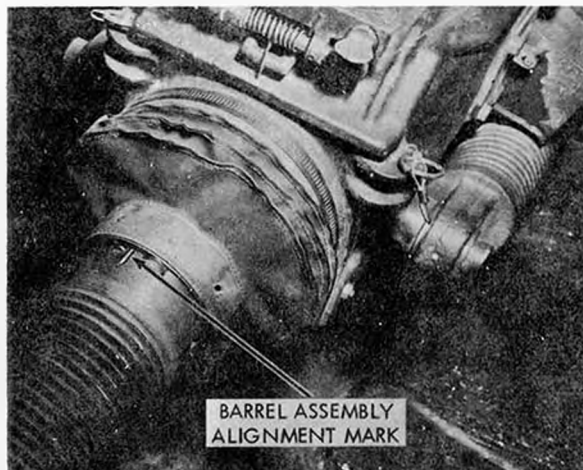


Figure 17. Barrel assembly positioned for reassembly to receiver (alignment mark up).

Section II. OPERATION

22. Clearing. The weapon is cleared when source of ammunition is removed, feeder is removed and cleared, safety is in SAFE or forward position, and bolt is forward.

a. Move safety to SAFE position and open mount cover and feed cover (fig 18).

b. Remove ammunition belt by raising actuating lever on front of feeder and then pulling out belt.

c. Lift latch lever and remove feeder (fig 13).

Warning: Note number of rounds remaining in feed lips of feeder. If a malfunction has occurred, there may be a loose round in the lips of discharge opening. Care must be taken that this round is not dropped when feeder is removed.

d. Removal of cartridges from lips of the feeder:

(1) If belt is fully expended, bolt will be closed and one round will be held in feeder by last round stop assembly. When depressed, the last round stop control lever will cause round to drop into the lips, and it can then be removed from feeder (fig 19).

(2) If belt is *not* fully expended, bolt will be to the rear, and two rounds will remain in feeder. After feeder is removed, the first round must be pushed from feeder lips. When depressed, the last round stop control lever will cause the last round to drop into lips, from which it can be removed.

Warning: Keep fingers out of receiver when the bolt is to the rear as an accidental triggering could cause serious injury.

e. Release bolt to forward position by depressing trigger. Weapon is now clear. Unloading is the same as clearing.

23. Loading. a. Before loading gun, remove muzzle protection cap. Fill ammunition lubricator with LSA.

b. Location of each cartridge on its link must be checked by using 20-mm hand linkers. This will insure minimum drag of belt on link aliner. Links should be arranged so that double links will be facing down and to the left.

c. Raise cradle cover and top cover lever of feeder and remove feeder cover.

d. Inspect to make sure that feeder is securely latched to feeder slide of receiver, barrel locked to receiver, and bolt is in forward position.

e. Insert ammunition belt through flexible chute until *second* round lies in tooth gap on driven shaft in feeder. Replace feeder cover and lower the feed cover lever (fig 20). Place safety lever in FIRE position.

f. Using ratchet wrench, extension, and 9/16 socket, place on lug at the rear of feeder and turn clutch shafts as far as possible. This will position two rounds in feed lips and eject one link. When bolt is charged, the first round will be in position to be chambered by bolt when trigger is depressed.

g. Connect ammunition belts, as shown in figure 21.

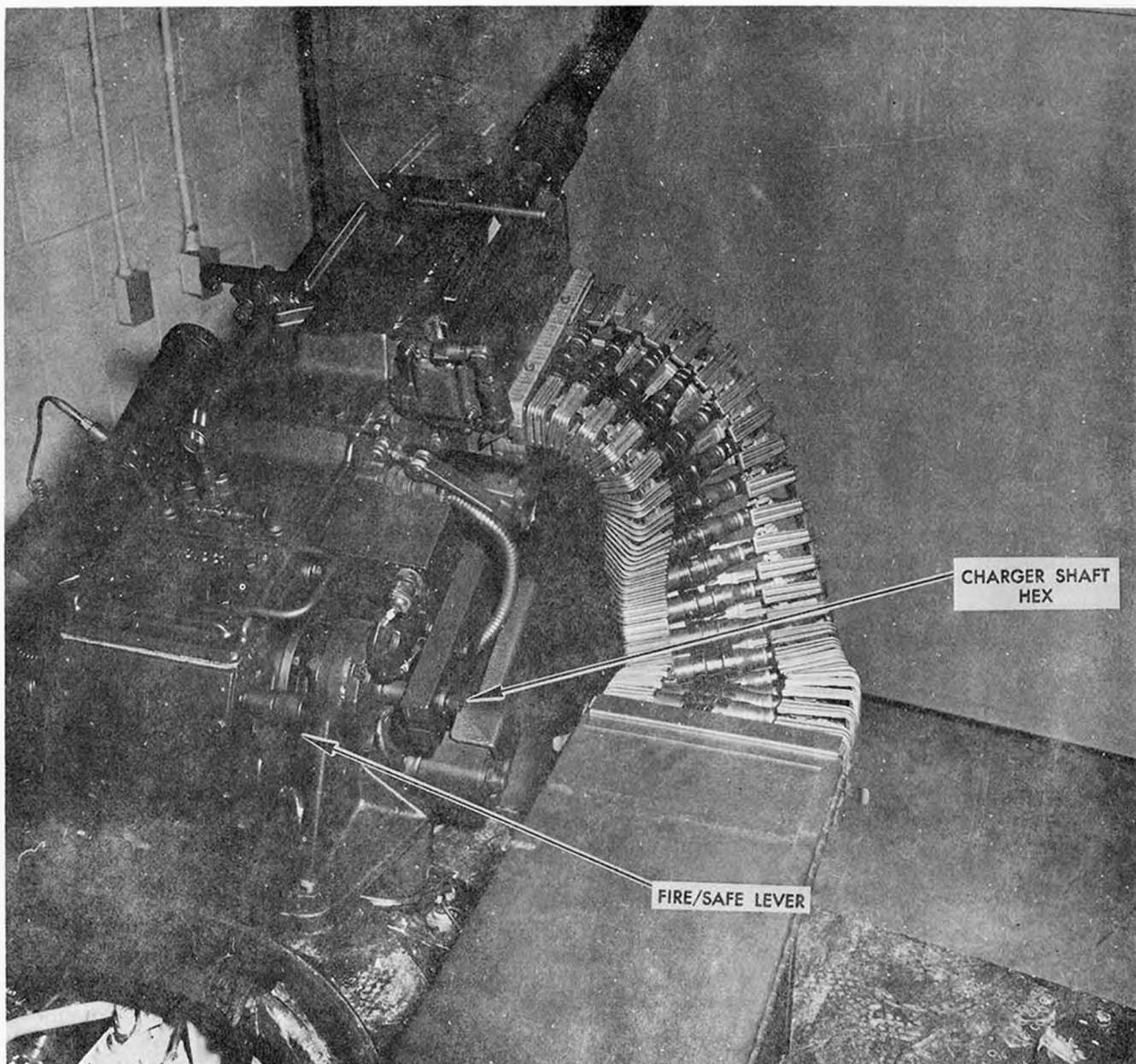


Figure 18. Charger shaft and FIRE/SAFE lever.

h. Place safety lever in the FIRE position to charge gun.

(1) To charge gun electrically, position CHARGER switch in NORMAL position and depress adjacent START button for approximately $\frac{1}{2}$ second.

(2) To charge gun manually, use ratchet wrench and ratchet charger shaft rearward as many times as necessary to catch bolt (fig 18). When bolt is caught by sear, a distinct click is heard, and charging should be continued until charger clog is in its most forward position. Do not attempt to charge weapon when safety lever is in SAFE position.

i. After charging, if gun is *not* to be fired immediately, insure that safety is in SAFE position and that safety catch on the manual trigger is engaged.

24. Firing. a. To fire weapon electrically:

(1) Make sure that both MASTER and FIRE switches on gun fire control box are in ON position.

(2) Position FIRING MODE SELECTOR switch to correspond to desired rate of fire (FAST RATE, SLOW RATE, SINGLE SHOT, FAST BURST, or SLOW BURST). When firing in either the FAST BURST or SLOW BURST modes, gun

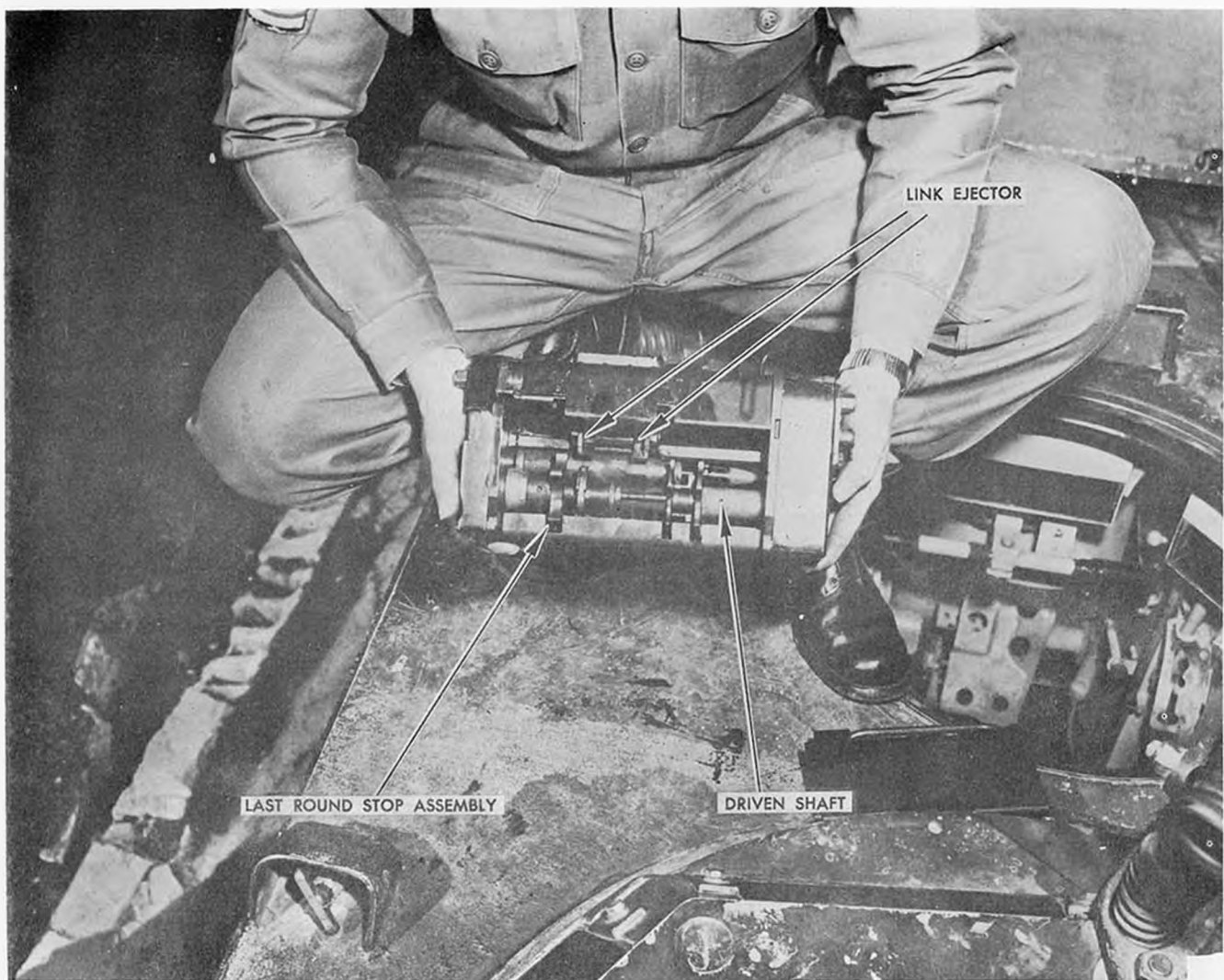


Figure 19. Automatic gun feeder.

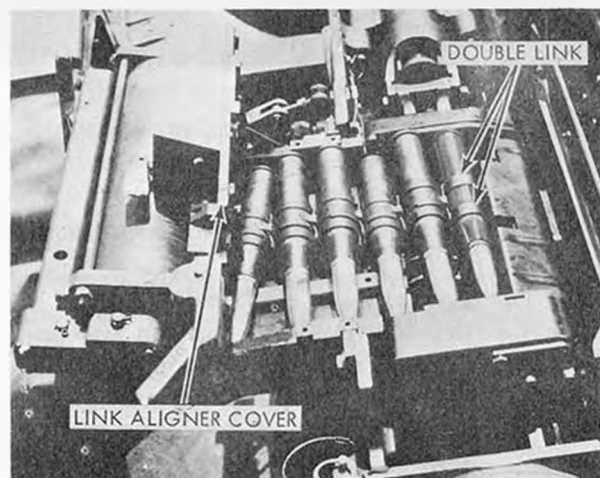
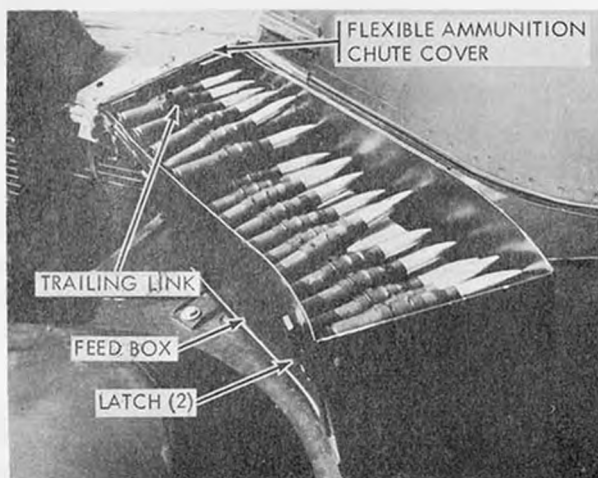


Figure 20. Ammunition feed box, flexible chute and automatic gun feeder.

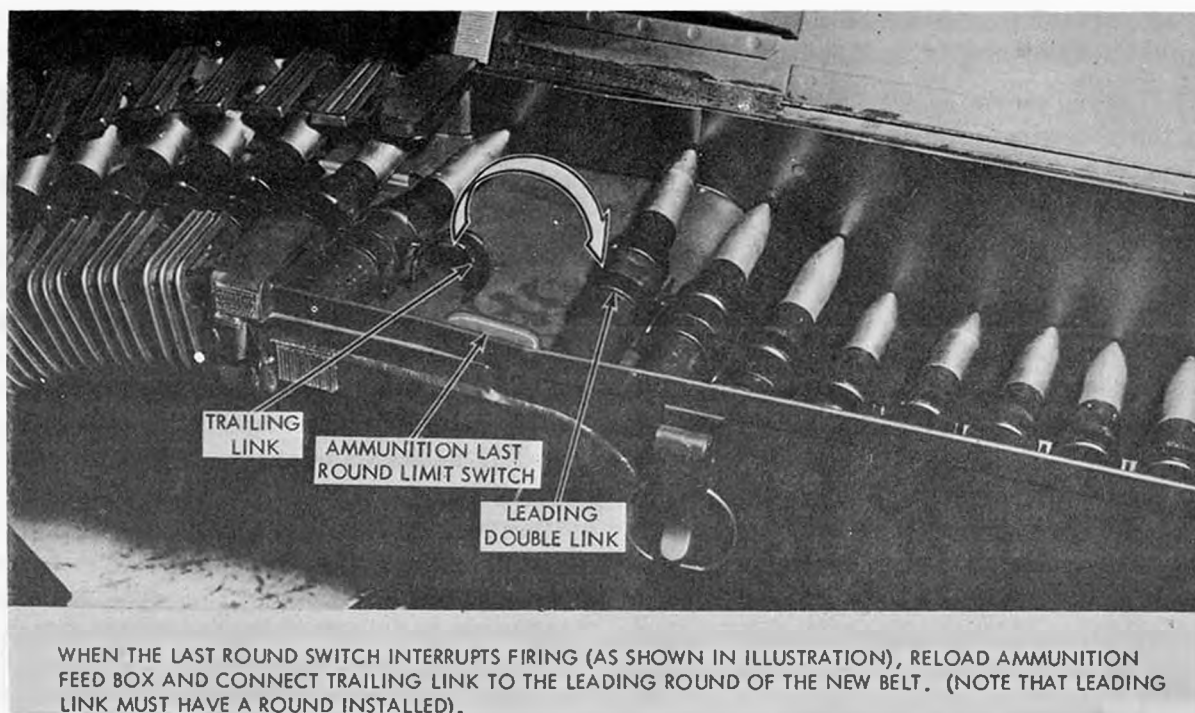


Figure 21. 20-mm ammunition loading.

will fire approximately five rounds and stop. To fire another burst, trigger must be released and then depressed (fig 6).

(3) Lay on target, release safety, and depress either trigger.

b. To fire weapon manually:

(1) Move safety to FIRE position.

(2) Raise safety catch on manual firing lever and pull lever to the rear (fig 22). When fired manually, the gun will fire automatically, at FAST RATE, with no last round stop functioning in the ammunition feed box.

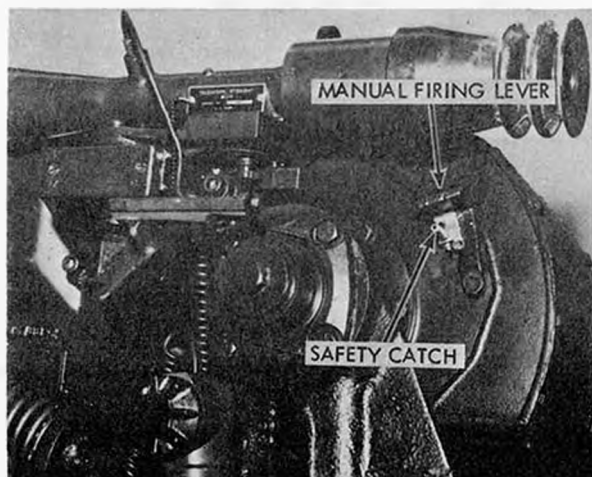


Figure 22. Manual firing lever.

Warning: When engaging target with 20mm, vehicle commander will insure that driver's hatch is closed. Care should be exercised that ejected rounds do not hit the driver's periscope as the velocity of ejection causes severe damage to periscopes.

25. Immediate Action. A *stoppage* is an unintentional interruption in the cycle of operation. *Immediate action* is the unhesitating application of a probable remedy without concern as to actual cause of the stoppage.

a. When firing electrically, if gun fails to fire, depress electrical firing trigger in rapid succession for 5 seconds. If clicks from firing solenoid are *not* audible, the malfunction is attributed to the electrical firing mechanism, and firing should be attempted by means of manual trigger.

b. If clicks from solenoid *are* audible or if a failure to fire occurs during manual operation, the stoppage is probably due to a malfunction of the gun or of ammunition and the following procedure should be employed: First after a 5-second wait, cycle bolt to the rear. If chambered round drops through cartridge case ejection chute, relay, fully charge feeder, and attempt to fire.

c. When firing electrically or manually, and a round is stuck in the chamber, elevate gun and cycle bolt to the rear. Using a screwdriver, cau-

tiously attempt to remove round from chamber through cartridge case ejection chute.

(1) If round cannot be removed with a screwdriver, the following procedure should be used: Open top cover assembly of feeder and remove ammunition belt. Remove feeder from gun, taking care not to drop any loose rounds in feeder. Charge bolt to the rear position, engage safety, and attempt to remove round with a screwdriver.

(2) If the round still cannot be removed, assemble marker rod, cleaning tool rods, and cleaning equipment loop to cleaning equipment

handle. Insert assembled rod into barrel until the round is engaged, and *gently* push the round from the chamber. Do *not* tap the round or rammer. The cleaning equipment loop is designed so that it will not touch the fuze part of the round, and the cleaning equipment handle is designed to keep personnel clear of the line of fire.

d. In order to avoid a cookoff when the gun is hot, immediate action for removal of a stuck round must be completed within 1 minute. If this cannot be accomplished, it is necessary to wait 15 minutes before removing the round as described above.

Section III. MAINTENANCE

26. Crew Maintenance. a. Due to the complexity of the 20mm gun M139, it requires diligent maintenance on the part of the user. The majority of stoppages on the M139 can be attributed to improper or insufficient user maintenance.

b. The following chart provides information useful in diagnosing and correcting unsatisfactory operation or failure of the automatic gun and its components. Each malfunction stated is followed by list of probable causes and corrective action recommended.

Troubleshooting—Operator/Crew

Malfunction	Probable cause	Corrective action
Interruption of firing, insufficient recoil of the breech bolt due to:	a. Jamming of the breech bolt parts..... b. Presence of a foreign body in receiver.. c. Blocking of gas port plugs..... d. Sticking of the cartridge cases in chamber. e. Load on feeder too high or too low....	a. Clean and lubricate. If damaged, replace bolt assy. b. Clean and oil. c. Clean plugs. If damaged, notify organizational maintenance personnel. d. Clean cartridge chamber. e. Replace feeder.
No ammunition feed.....	Insufficient recoil of the gun.....	Check for dirt obstruction in cradle. If recoil adapter is damaged, notify organizational maintenance personnel.
Jamming of live cartridge in receiver.	a. Insufficient spring strength of the feeder. b. Insufficient recoil of the gun..... c. Dirt in feeder.....	a. Replace feeder. b. Clean out dirt in cradle. c. Clean and oil feeder.
Failure to extract.....	a. Lack of oil on cartridge..... b. Extractor spring too weak or broken..	a. Correct ammo oiler operation. b. Replace bolt assy.
Failure to eject.....	a. Ejector damaged or broken..... b. Inner and outer ejector spring too weak. c. Insufficient recoil of breech bolt.....	a. Replace. b. Check. If necessary, replace. c. Clean breech bolt and receiver.
Percussion cap not being struck.....	a. Insufficient protrusion of firing pin... b. Broken firing pin..... Cap defective.....	a. Clean breech bolt and receiver. b. Replace bolt assy. Replace cartridge.
Percussion cap indented normally but not being fired. Percussion cap being struck too weakly.	a. Firing pin dirty..... b. Cartridge chamber dirty..... c. Driving springs are too weak if they are shorter than the long slot on the side of the receiver. Gun dirty.....	a. Clean bolt assembly and receiver. b. Clean chamber. c. Replace springs.
Irregular firing sequence..... Breech bolt remains in open position.	a. Sear damaged or broken..... b. Trigger mechanism jammed.....	Clean. a. Notify organizational maintenance personnel. b. Clean. If necessary, replace damaged parts.
Excessive recoil of the breech bolt...	a. Driving springs too weak..... b. Buffer springs too weak.....	a. Check; if necessary, replace. b. Check; notify organizational maintenance personnel.

c. The following preventive maintenance checks and services are to be accomplished as required:

(1) *Complete gun*. Inspect for cracked, bent, loose, or missing part.

Weapon will be cleaned and lubricated after firing is complete, or after 400 rounds, whichever occurs first.

(2) *Barrel assembly*. Check for obstructions in barrel, receiver, feeder, and recoil mechanism. Be sure barrel is locked to receiver. Check rifling for wear and erosion.

(3) *Receiver*. Manually charge bolt and release it to check for smoothness of operation. Note burrs on the buffer end of bolt.

(4) *Automatic gun feeder*. Check ease of rotation of driver shaft.

(5) *Recoil adapter*. Check for leakage of hydraulic fluid.

(6) *Receiver*. During firing, note changes in rhythm, recoil distance, shock, or firing rate.

d. Cleaning and lubricating instructions:

(1) *Barrel assembly*. Before firing, wipe bore dry. After firing, clean with bore cleaner, wipe dry, and oil all surfaces.

(2) *Receiver*. After firing, disassemble gun, clean and coat internal rails and feeder slide surfaces with LSA. Using LSA coat sliding surfaces where counter slides and unlocking plates mate with bolt body.

(3) *Rear buffer*. After firing, wipe clean with a dry, clean cloth; then coat lightly parts with oil. *Do not immerse buffer in oil or solvent.*

(4) *Recoil adapter*. After firing, wipe clean and coat lightly all exterior surfaces with oil. *Do not immerse adapter in solvent.*

(5) *Automatic gun feeder*. After firing, wipe parts dry with a clean cloth. Normally, oil for the cartridges will lubricate feeder sufficiently. However, if the rounds are not lubricated, oil should be applied to oil holes in the transmission shaft bearings. *Do not immerse feeder in solvent.*

e. Points of application:

(1) Wipe surfaces clean before and after a lubricant is applied. Protect open holes by keeping cover on or temporarily use a cloth to prevent entrance of dirt. Wipe off excess lubricant.

(2) Clean and lubricate bearing surfaces. Brush and rinse old lubricant away with mineral spirits or paint thinner, and dry parts thoroughly. Lubricate with a light coat.

CHAPTER 5

BORESIGHTING AND ZEROING

27. **General.** Accurate marksmanship with the 20-mm weapons system depends upon proper boresighting and zeroing.

28. **Boresight.** *a.* Position vehicle on level ground approximately 1,000 meters from a well defined aiming point.

b. Insert boresight adapter with caution streamer attached into muzzle of gun.

c. Insert shank of boresight telescope into socket of adapter (fig 23).

d. View through the boresight device and direct *manual* elevation and traversing of the gun to place crosshair of boresight on upper left corner of aiming point or panel.

e. Refer reticle of M120 telescope to boresight device crosshair (fig 24).

(1) Remove the night vision sight, AN/TVS-2A before adjusting the M120 telescope.

(2) Loosen M148 telescope mount azimuth and elevation boresight clamping screws.

(3) Without disturbing lay of the gun, move the reticle boresight cross to aiming point with boresight adjustment screws.

(4) Tighten clamping screws.

(5) Recheck sight pictures of the telescope and muzzle boresight device.

(6) Repeat procedure if necessary.

f. Refer reticle of night vision sight AN/TVS-2A to boresight device crosshair (fig 25).

(1) Install the AN/TVS-2A sight and place it into operation with the lens cap on.

(2) Without disturbing lay of the gun, move azimuth and elevation knobs until reticle bore sight point coincides with aiming point defined in the M120 telescope and muzzle boresight device.

(3) Recheck sight pictures.

g. The upper sight assembly must be alined with other sights.

(1) Without disturbing lay of the gun, center

plastic speed ring sight in sight bracket and secure with thumbscrews.

(2) Loosen rear sight mounting screws and adjust sight horizontally until it is alined with vertical center line of speed ring and designated aiming point. Tighten the rear sight mounting screws.

(3) Loosen jam nut on rear sight and turn adjusting screw until top of rear peep sight is alined with center of speed ring and aiming point. Tighten the jam nut.

(4) Recheck sight picture.

h. The lower sight assembly must also be alined with other sights.

(1) Loosen the lower sight assembly clamping screws.

(2) Without disturbing lay of the gun, adjust sight, using azimuth and elevation adjustment screws, until upper edge of rear peep sight is alined with center of front crosshair and aiming point.

(3) Tighten lower sight assembly clamping screws.

(4) Recheck sight pictures.

i. Remove boresight device. The 20-mm weapons system is now boresighted.

29. **Boresighting Alternate Method.** Boresighting may be accomplished at a near target, or indoors, by using target picture in figure 26. Place target 40 feet from centerline of gun trunnion. The same procedure is followed as in paragraph 28.

30. Zeroing Procedure.

- Notes.* 1. Always boresight before zeroing.
2. Avoid zeroing in heavy cross winds.

a. Locate a target at 1,000 meters; elevate and traverse until 1,000-meter range line and center vertical line in the M120 telescope reticle are laid on center of designated target.

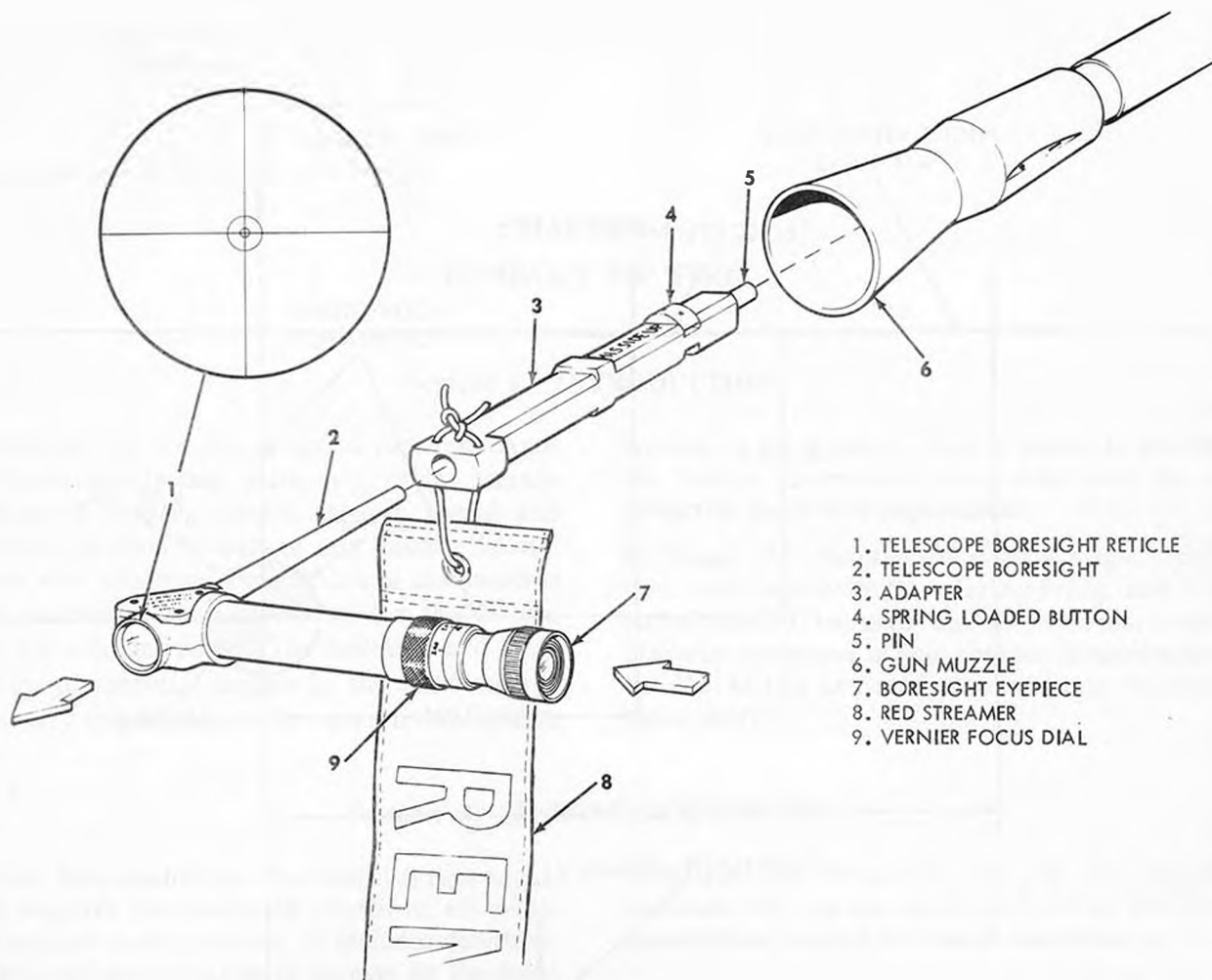


Figure 23. Boresight device.

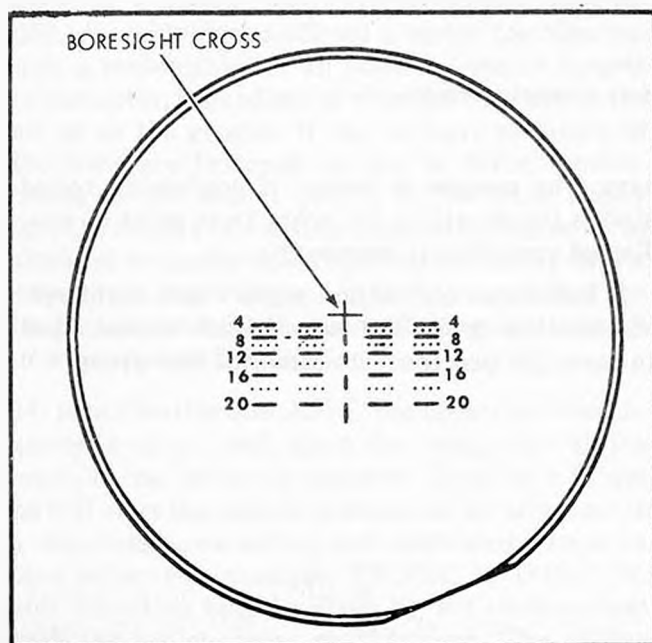


Figure 24. Telescope M120 reticle pattern.

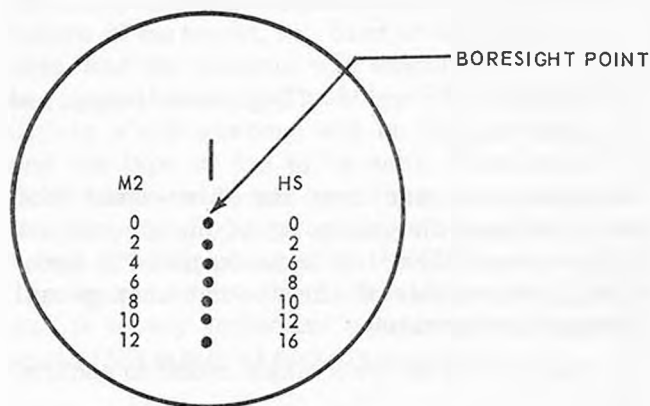


Figure 25. Night vision sight reticle pattern.

b. With firing mode switch set on SINGLE SHOT, fire one warmup round. Use API-T or TP-T ammunition to zero.

c. Relay gun on target center. Fire three rounds single shot, relaying the gun from the same direction after each round.

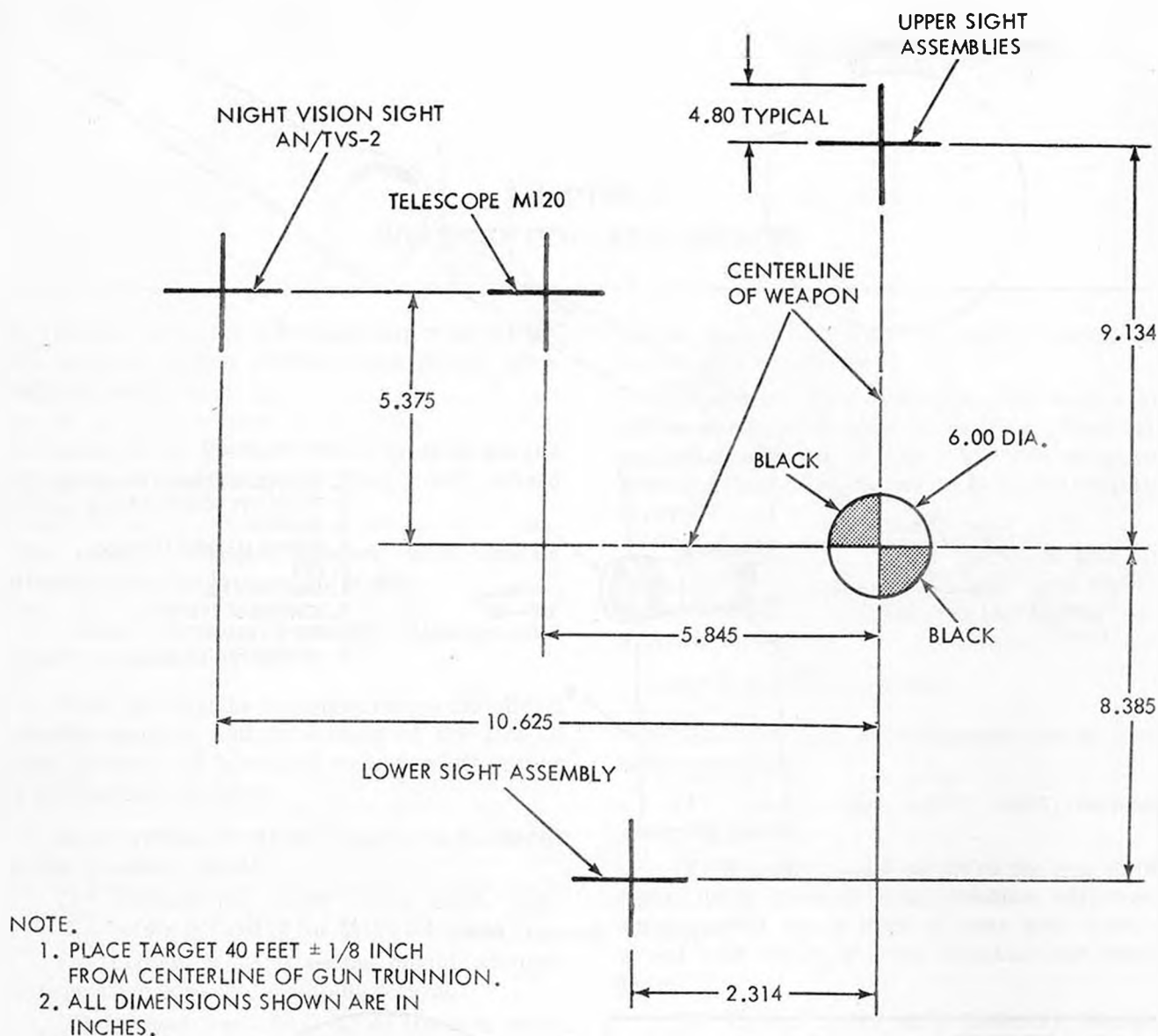


Figure 26. Weapon system indoor boresight target.

d. Relay gun and note the *three-round* shot group. Without disturbing lay of the gun, adjust M120 telescope sight reticle, as described in boresighting, to center of three-round shot group. Tighten locking screws.

e. Relay gun and fire a single round to confirm

zero. The weapon is zeroed if confirming round strikes target within 24 inches from point of aim. Repeat procedure if necessary.

f. Relay gun and adjust night vision sight reticle and the upper and lower sights as described in boresight procedure, to center of shot group.

CHAPTER 6

CONDUCT OF FIRE

Section I. INTRODUCTION

31. General. By nature, armored reconnaissance operations usually take place over varied terrain and against varying combat targets. Rapid and responsive actions to engage and destroy hostile targets with minimum expenditure of ammunition is the essence of conduct of fire for the 20-mm rapid fire weapon system. The detection and identification of potential targets by the scout crew is of primary importance to its own survival and to

success in its mission. Once a target is acquired the vehicle commander must determine the appropriate method of engagement.

32. Scope. This chapter will discuss target acquisition, crew responsibilities during firing, and firing techniques to be used against various targets. Material contained in this chapter is applicable to the M114A1E1 armored command and reconnaissance carrier.

Section II. TARGET ACQUISITION

33. Crew Responsibilities. Successful target acquisition requires the combined efforts of all vehicular mounted scout crewmen. It includes detection, location, and identification of targets by the scout crew. This is not an easy task, because enemy positions and weapons will often be concealed and camouflaged. To assist the vehicle commander in target acquisition the driver and observer will be assigned a specific sector for continual observation. An individual assigned a sector for observation is responsible for all potential enemy targets in his sector, regardless of whether they are in the air or on the ground. If one or more members of the crew are buttoned up due to firing requirements of the 20-mm gun or to incoming enemy fire, the sectors of viewing responsibilities must be adjusted to insure 360° observation. After target acquisition the vehicle commander analyzes the target to determine the most effective employment of weapons and ammunition.

34. Identification and Alert. The crewman who observes a target will alert the remainder of the crew. If the driver or observer acquires a target he will alert the vehicle commander by announcing a description, direction, and estimated range, in that order. For example, TRUCK, 12 O'CLOCK, 800. Direction may be given by the clock system with the vehicle front as 12 o'clock. The vehicle commander, if he decides to engage a target, will alert the remainder of the crew by issuing an ap-

propriate fire command. So far as possible, crewmen will use standard terminology and brief descriptions to alert the rest of the crew.

35. Target Analysis. Analysis of targets by the vehicle commander begins once he acquires a target or one of the crew members designates a target. Three major factors must be considered in this analysis: degree of threat the target presents, nature of the target, i.e., hard or soft and point or area, and the weapons and ammunition available to engage the target. The nature of the target will dictate which weapons will be used to engage it and the type of fire to be used. For example, a lightly armored target would require accurate 20-mm gun fire for destruction; whereas dispersed troops are best engaged by the M60 machinegun. The limited ammunition available for the 20-mm gun is a very important consideration in determining the means of target engagement.

36. Range Determination. Ranges to enemy targets are seldom known in advance. Because of this the effectiveness of fire largely depends upon the accuracy of range determination. Scout crewmen determine range by the most practical and accurate means available:

- a. Estimating by eye.
- b. Binoculars and mil relation.
- c. Appearance of objects.

- d. Measuring the range from a map or photo.
- e. Securing data from other units.
- f. Firing the 20-mm gun or the M60 machinegun.
- g. Estimation by flash and sound.

FM 17-12 contains detailed information on range determination.

37. Night Target Acquisition. Night target acquisition is accomplished by using the same principles applied to daylight target acquisition. However, the crewman's reduced ability to detect targets makes the following techniques necessary.

a. *Protection of Night Vision.* Each crewman must protect his ability to see at night. The vehicle should be blacked out and eyes should be protected when the enemy illuminates the area or when other weapons are firing.

b. *Off Center Vision.* Objects observed at night can be defined more easily by looking slightly (6-10°) away from the normal line of sight to the object.

c. *Scanning an Area.* Shifting the eyes abruptly and at brief intervals aid the crewman in detecting movement.

d. *Magnified Optics.* The ability to detect targets at night is increased by using binoculars or magnifying sights. These instruments gather the available light and magnify the target image.

e. *Use of Gun Flash.* Weapons fired at night may produce a visible flash that will aid the crew

in target detection. Range (in meters) may be estimated by multiplying the number of seconds from observation of the flash to the report or bang by 400. Identification of particular weapons is also possible with experience.

f. *Artificial Illumination.* The use of tank mounted searchlights, mortar or artillery illumination may be desirable when enemy movement or occupation of an area is suspected. Caution must be taken to protect the night vision of the crew. Except when the enemy possesses infrared detection devices, infrared illumination is superior to visible light since the observer's position is not revealed.

g. *Night Vision Devices.* The night vision sight, crew served weapons AN/TVS-2A, organic to the 20-mm weapons system, is designed primarily for use of crewmen as a supplement to other methods of detection during target acquisition and night firing. It uses ambient light, thereby protecting the position of the observer. Sight glow will decrease the natural night vision capabilities of the observer and may cause facial illumination. Since the AN/TVS-2A is mounted on the 20-mm gun, the gun must be traversed across the area under observation in an established and regular pattern to cover the area completely. Also available to the crew is the night vision sight, individual weapon AN/PVS-2 (starlight scope). It is mounted either on the M16A1 rifle or the M60 machinegun and will increase the crew's night vision capabilities. Its operation is similar to the AN/TVS-2 and the same precautions should be taken.

Section III. FIRING DUTIES

38. General. To insure target destruction with a minimum expenditure of time and ammunition, the scout crew must work together as a team. Each member of the crew must be proficient in his particular job so that orders from the vehicle commander will produce automatic responses. All the crewmen must be able to perform in all positions so that loss of one member will not destroy the effectiveness of the fighting vehicle. Each crew member must fire the crew qualification tables specified for his crew position at least annually. This is essential in order to produce a crew capable of functioning as an integrated team and to insure a high degree of gunnery proficiency. Normal attrition and personnel turnover makes this an essential requirement. Listed below are the

general firing duties performed by the scout vehicle crew members.

Crew member	Firing duties
Driver -----	Observes in assigned sector and moves vehicle as directed by vehicle commander.
Observer -----	Aims and fires M60 machinegun and M79 grenade launcher; inspects, cleans, stows, and loads ammunition; observes in assigned sector.
Vehicle commander ---	Controls movement of the scout vehicle and crew; observes terrain and selects targets; gives fire commands and fires the 20-mm gun; controls volume and placement of all fire.

Section IV. FIRE COMMANDS

39. Initial Fire Commands. Fire commands for the scout vehicle commander contain five basic elements: *alert, target description, direction, range, and execution.* Any of these elements unnecessary for target engagement will be omitted. Examples of the elements of the initial fire command follow:

a. Alert—CREW, OBSERVER-MACHINE-GUN, OBSERVER-GRENADE LAUNCHER, CREW 20-MM.

(1) CREW—all weapons fire.

(2) OBSERVER-MACHINE GUN—observer fires M60.

(3) OBSERVER-GRENADE LAUNCHER—observer fires M-79.

(4) CREW 20-MM—vehicle commander fires 20-mm gun. Remainder of fire command is deleted.

b. Description—TROOPS, TRUCK.

c. Direction.

(1) FRONT.

(2) LEFT (RIGHT) FRONT.

(3) REAR.

(4) LEFT (RIGHT) REAR.

d. RANGE—TWO HUNDRED (announced to nearest 100 meters).

e. EXECUTION.

(1) FIRE.

(2) AT MY COMMAND.

40. Abbreviated Fire Command. In the event target location is known by the observer or the vehicle is involved in an ambush an abbreviated fire command is used. It consists of three elements: *alert, description, and execution.* Examples of the abbreviated fire command follow:

a. ALERT—CREW, OBSERVER.

b. DESCRIPTION—TROOPS, TARGETS OF OPPORTUNITY.

c. EXECUTION—FIRE.

Section V. SENSINGS

41. General. Sensing is noting mentally where the round appears in relation to the target. Every round fired is sensed, when possible, for deflection and range. Tracer equipped rounds are sensed where the tracer strikes short of, passes, or hits the target. Some rounds cannot be sensed because of obscuration and velocity, which causes the round to pass the target before either the smoke and dust dissipate or the sights settle from the recoil of firing. At times, the gunner may be able to see the tracer through the haze of the obscuration but will not be able to see the target or he may be able to see the tracer only after it passes the target. In such cases he only has an observation and not a sensing. Also a residual cloud of dust produced by a projectile striking the ground may indicate the general location of the strike and provide an observation.

42. Deflection Sensings. Deflection sensings are mental notations of whether the round is on line with or to the side of the target. There are three deflection sensings: right, left, or line. Deflection sensings are not announced but form the basis of deflection corrections in adjusting fire.

43. Range Sensings and Observations. There are five sensings: TARGET, OVER, SHORT, DOUBTFUL, and LOST. Although these sensings are mental, they will be announced at times. There are two observations—over and short—that are made by the gunner when he observes some evi-

dence of the round being over or short, but cannot accurately sense the round. If the gunner senses the round or burst, he will remain silent and adjust his fire. If he does not sense the round, he announces LOST and may request a sensing from an observing crewman. The five range sensings are defined as follows:

a. TARGET. A round is sensed as TARGET only when the round is observed to actually strike the target, causing the target to change shape, pieces to fly off, or the target to completely disappear.

b. OVER. A round is sensed as OVER when the burst appears beyond the target or the tracer passes above the target.

c. SHORT. A round is sensed as SHORT when the point of strike is observed between the gun and the target.

d. DOUBTFUL. A round is sensed as DOUBTFUL when the burst appears to be correct for range but off in deflection, or when the tracer passes to the right or left of the target but apparently is correct for range. A range change is not made on a DOUBTFUL sensing; a deflection correction is normally sufficient to secure a target hit.

e. LOST. A round is sensed as LOST when the gunner fails to observe the point of strike, burst, or tracer. The gunner can accurately engage a target only when he actually senses the round in relation to the target.

Section VI. FIRING AT STATIONARY TARGETS

44. Adjustment of Direct Fire, Primary Method.

The primary method of adjustment is burst-on-target (BOT), in which the gunner, observing through his direct-fire sight, notes the point on the sight reticle where the burst or tracer appears in relation to the target before firing the next round. This method of adjustment provides a quick, accurate means of obtaining second-round target hits and should be used whenever possible. Gunners must be continually aware of the ballistic difference between the HEI-T and API-T ammunition when firing combat mix. Using BOT at ranges beyond 1000 meters may require applying a small amount of Kentucky windage in order to achieve a target hit with the desired ammunition type.

a. Situation 1. M120 telescope, stationary target, combat mix ammunition.

(1) The gunner immediately re-laid after firing the first round so that the burst appeared on his sight reticle in its proper relation to the target. This round was off in deflection to the right (fig 27).

(2) The gunner mentally noted the point on the sight reticle where the burst appeared and, with the cupola controls, moved that point to the center of the target (fig 28). He fired a second round and obtained a target hit.

b. Situation 2. Gun cradle lower sight, stationary target, combat mix ammunition.

(1) The gunner noted that the first round

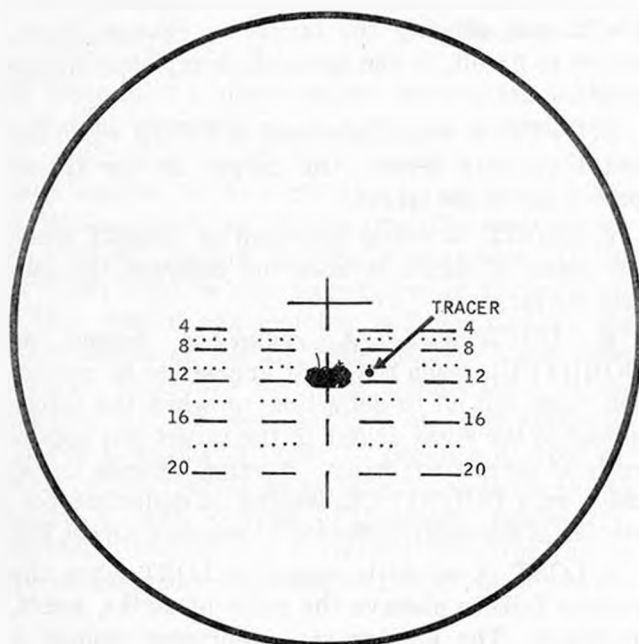


Figure 27. Stationary target, first round sight picture.

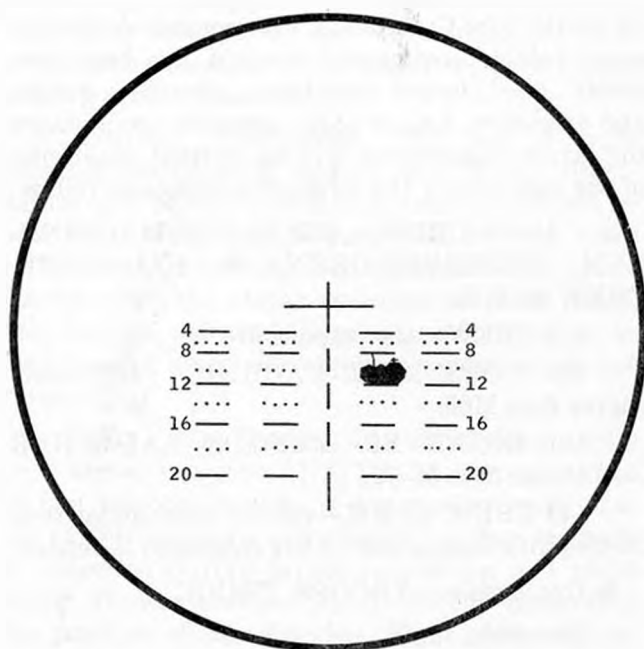


Figure 28. Stationary target, second round sight picture.

fired (fig 29) struck short of the target and on line with the center of the target.

(2) The gunner mentally noted the point where the burst appeared in relation to the vertical and horizontal lines and, with the cupola controls, moved that point to the center of the target (fig 30). He fired a second round and obtained a target hit.

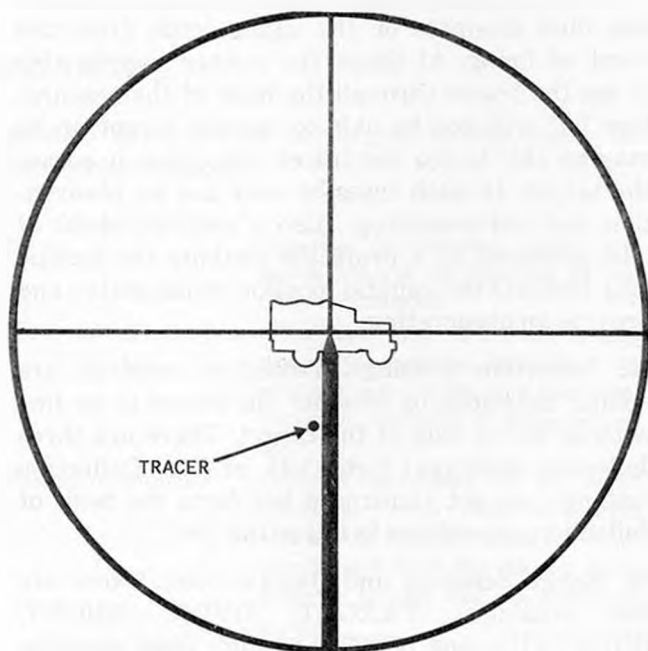


Figure 29. Stationary target, first round sight picture, using gun cradle lower sight.

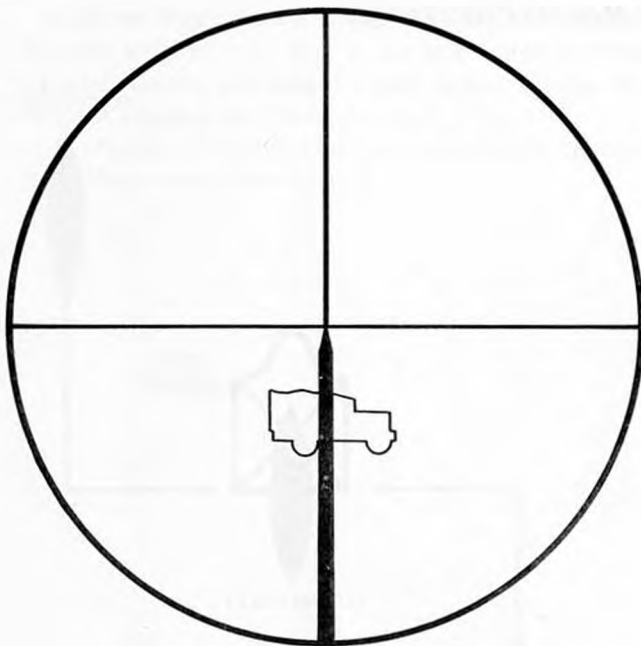


Figure 30. Stationary target, second round sight picture, using gun cradle lower sight.

Section VII. FIRING AT MOVING TARGETS

46. General. When firing at moving targets, the scout vehicle crew has relatively the same duties as when engaging stationary targets. A moving target is one that has apparent speed. Targets moving across the line of sight, either horizontally or diagonally, have apparent speed. Targets moving directly toward or directly away from the scout vehicle have no apparent speed and are not treated as moving targets. Proper leading and tracking are of utmost importance when firing at moving targets.

47. Leading. If the gunner fires a round while the gun is aimed directly at a moving target, the target will move out of the path of the projectile, causing the projectile to miss the target. To compensate for this movement of the target, the gun must be aimed ahead of the target so that the target and projectile will meet. This technique is called leading. To aim ahead of the target, the gunner will use the lead lines in his direct-fire sights. A lead equals 5 mils regardless of the range to or speed of the target and is measured from the center of the target. Lead lines in the M120 sight reticle are 5 mils in length. A target with an apparent speed of 15 miles per hour, regardless of range, will require an initial lead of one.

Note. The gun cradle lower sight should not be used for

45. Adjustment of Fire, Alternate Method. The alternate method of adjustment is used when burst on target cannot be effectively used due to obscuration or terrain. The alternate method of adjustment involves the use of standard range changes. If the sensing for the round is LOST, the gunner will drop 200 meters on the sight reticle regardless of range to the target. If the gunner observes the second round he will apply burst on target; if the second round is LOST the 200-meter drop is repeated. Deflection errors can be measured by another crew member using a binocular and the corrections can then be given to the gunner.

moving targets except in an emergency situation. However, if it must be used place the aiming point on the leading edge of the target.

48. Tracking. In order to maintain the proper lead, the gunner must cause the movement of the gun to keep pace with the movement of the target. This is called tracking and is a combination of traversing and changing elevation in order to maintain proper sight alinement. In tracking, the aiming point on the sight reticle must be traversed through and ahead of the target center until the proper lead is applied. The gunner tracks with a smooth, continuous motion, maintaining a constant sight picture before, during, and after firing. In order that proper sensings and adjustments can be made, the gunner will not stop the movement of the gun while he fires; nor will he attempt to ambush the target by moving ahead of it, stopping, and firing when the target reaches the proper lead on the M120 sight reticle.

49. Adjustment of Fire, Moving Target. *a.* The burst-on-target method of adjustment for moving targets is the same as for stationary targets, and will be used when the gunner is able to sense the rounds fired.

b. The alternate method of adjustment for moving targets is the same as for stationary targets.

Section VIII. FIRING THE M60 MACHINEGUN

50. General. The M60 machinegun is fired by the scout observer from either the right flank or right rear of the scout vehicle. It is used to engage ground targets out to a range of 1,100 meters. The scout observer must be trained in the proper use of the M60 machinegun and should fire the M60 machinegun qualification course as outlined in FM 23-67 at least once during his training.

51. Fire Adjustment. *a.* All scout observers must strive for an accurate initial burst from the M60 machinegun (10-20 rounds). However, an accurate initial burst may not always be obtained. M60 gunners must have a means of rapidly and accurately adjusting their fire into the target area. This can be achieved by using the adjusted aiming point method of fire adjustment.

b. If the gunner misses the target with his initial burst, he must select a new aiming point on the ground, i.e., the same distance from the target as the center of impact of the initial burst but in the opposite direction, and fire a second burst (fig 31).

c. An alternate method of fire adjustment is to walk or adjust the tracer stream into and throughout the target area. This method is a faster method of adjustment but due to the long

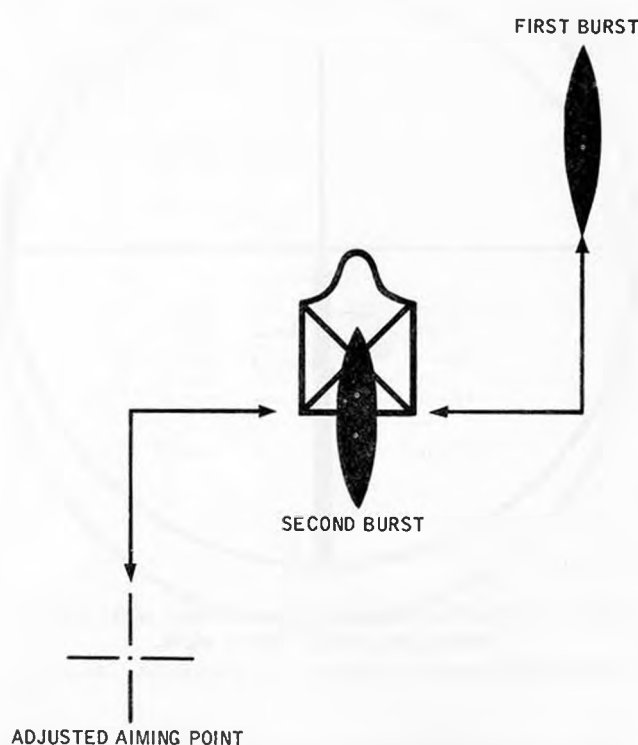


Figure 31. Adjusted aiming point.

bursts fired, consumes more ammunition than the adjusted aiming point method.

Section IX. METHODS OF ENGAGEMENT

52. General. When the 20-mm gun is to be used against ground targets, there are certain considerations that govern its employment.

a. The combat mix ammunition gives the vehicle commander the ability to engage soft targets or lightly armored vehicles without an ammunition change.

b. The SINGLE SHOT mode is the most accurate and least costly method of firing. Single shot will be used for adjustment to the target.

c. The SLOW BURST mode is the second most accurate method of fire and in most instances will provide a sufficient number of rounds to cause either target dispersion or destruction. In this firing mode single shot can be achieved for target adjustment by trigger manipulation.

d. The FAST BURST and FAST RATE modes are the least accurate and most costly of all firing modes. They should be used in emergencies where immediate fire superiority is required, or for their possible psychological value if there is sufficient

ammunition. FAST RATE or FAST BURST are also used in anti-aircraft gunnery—see appendix C.

53. Targets. Those targets that are encountered under combat conditions can be divided into five categories: point, wide, deep, oblique, and area. To insure the best use of the 20-mm gun against these targets, the following methods of employment are used.

a. Point Targets. For greater accuracy, single shot fire should be employed. If a volume of fire is desired, the slow burst rate of fire should be used. Moving point targets are engaged by adjusting to the target, using single shot, and then achieving target destruction with the SLOW BURST mode.

b. Wide Targets. The gunner lays on either flank, fires, and adjusts. To cover the entire target when using single short fire, the gunner makes small deflection changes between shots. If the target is extremely concentrated and a greater volume of fire is desired, the slow burst (rate) may be used.

c. Deep Targets. In engaging deep targets, the gunner will initially lay on the near edge and manipulate to the far edge. Again either single shot or slow burst (rate) may be used.

d. Oblique Targets. Oblique targets are engaged as if they were wide targets.

e. Area Targets. Because of the inability to deliver automatic fire for prolonged periods of time, area targets are not covered as such by the 20-mm gun. For coverage of area targets, refer to FM 6-135.

CHAPTER 7

CREW GUNNERY TRAINING, AND QUALIFICATION

Section I. INTRODUCTION

54. **General.** Vehicle crewmen will fire all or parts of the gunnery qualification course annually as outlined in AR 622-5. The gunnery qualification course consists of the tables 1 through 5 and the crew proficiency exercise. Its purpose is to train and to provide a measurement of the proficiency of the individual crewman and crew. All training and testing must emphasize proficiency, not numerical scores. Each vehicle crewman must satisfactorily complete the preliminary gunnery examination before firing tables 1 through 5. He must

qualify on these tables before undertaking table 6—the crew proficiency exercise. An exception may be made to this requirement if crew members are assigned to a unit after tables 1 through 5 have been conducted, but before the crew proficiency exercise is fired. In such cases, these persons may participate as drivers after satisfactorily completing the preliminary gunnery examination.

55. **Ammunition Requirements.** Figure 32 indicates the ammunition requirements for the annual gunnery qualification course.

Exercise	Ammunition per exercise and per crew						
	M79 40-mm HE		M60 7.62-mm TR 4-1 MLB		M139 20-mm TP-T		TNT ¼-lb block
	Per ex	Per crew	Per ex	Per crew	Per ex	Per crew	Per crew
Tables							
Table 1.....			125	375			
Table 2.....			200	600			
Table 3.....					25	75	
Table 4A.....					36	*110	
Table 4B.....					36	*110	
Table 5.....					44	*134	
Table 6.....		**4		***220		*26	4
TOTAL		4	325	1,195	141	455	4

*Includes 2 rounds for one crew member to confirm zero.

**Includes 1 round for one crew member to confirm zero.

***Includes 20 rounds for one crew member to confirm zero.

Figure 32. Ammunition requirements.

Section II. Preliminary Gunnery Examination

56. **General.** The preliminary gunnery examination is designed to assist the commander in determining whether his vehicle crewmen are sufficiently trained to perform the functions necessary for firing the qualification tables. Each member of the crew is required to perform each test satisfactorily before he is permitted to participate as a member of the crew while firing the qualification tables. Failure of any part of the test means that the crewman fails the examination and, after any necessary retraining, must be reexamined on the test(s) he has failed. The examination is con-

ducted, under the direction of an officer, by examiners who may be officers or noncommissioned officers. Results will be recorded on an examination record (fig 33).

Note. Examiner acts as an assistant when tasks performed require two men.

57. **Test 1—Dismounting the M139 Automatic Gun.** *a. Procedure.* The M139 is mounted with feeder recoil adapter, link aliner-oiler, and flexible link chute attached. Examiner commands DISMOUNT 20-MM. Crewman is required to dismount

the M139 within 2 minutes, using prescribed procedure.

b. *Examiner's Guide.*

(1) Examiner: DISMOUNT 20-MM (starts time).

(2) Crewman: Dismounts M139 automatic gun and announces COMPLETE.

(3) Examiner: Stops time.

(4) Time: 2 minutes.

UNIT _____ NAME _____

DATE _____ GRADE _____ SERVICE NO. _____

M114A1E1 CREWMAN PRELIMINARY GUNNERY EXAMINATION RECORD

TEST NO.	TITLE	SAT	UNSAT	REMARKS*	EXAMINER'S INITIALS
1.	Dismounting M139.				
2.	Field disassembly and assembly M139.				
3.	Mounting M139.				
4.	Performing firing checks.				
5.	Identification and use of 20-mm ammunition.				
6.	Boresighting and zeroing M139.				
7.	Boresighting and zeroing M139 w/AN/TVS-2.				
8.	Preparing M139 for loading.				
9.	Charging and firing gun electrically.				
10.	Charging and firing gun manually.				
11.	Dismounting, disassembly, assembly and mounting M60 machinegun.				
12.	Loading and zeroing M60 machinegun.				
13.	Identification and use of 7.62-mm ammunition.				

*P--procedure incorrect; T--time limit exceeded; A--accuracy not attained; X--requires much more training.

COMMENT: _____

QUALIFIED Yes ☐ No ☐

OFFICER IN CHARGE

Figure 33. M114A1E1 Crewman preliminary gunnery examination record.

58. Test 2—Field Disassembly and Assembly of M139 Automatic Gun. a. Procedure. All necessary tools and devices are present. Examiner commands **DISASSEMBLE 20-MM**. Crewman is required to field disassemble the M139 automatic gun within 4 minutes, using prescribed procedures. Examiner then commands **ASSEMBLE 20-MM**. Crewman is required to assemble the M139 automatic gun within 7 minutes.

b. Examiner's Guide.

- (1) Examiner: **DISASSEMBLE 20-MM** (starts time).
- (2) Crewman: Disassembles M139 automatic gun and announces **COMPLETE**.
- (3) Examiner: Stops time.
- (4) Time: 4 minutes.
- (5) Examiner: **ASSEMBLE 20-MM** (starts time).
- (6) Crewman: Assembles M139 automatic gun, manually cycles the gun, and announces **COMPLETE**.
- (7) Examiner: Stops time.
- (8) Time: 7 minutes.

59. Test 3—Mounting M139 Automatic Gun. a. Procedure. Crewman is required to mount the M139 automatic gun within 3 minutes, using prescribed procedures.

b. Examiner's Guide.

- (1) Examiner: **MOUNT 20-MM** (starts time).
- (2) Crewman: Mounts M139 automatic gun and announces **COMPLETE**.
- (3) Examiner: Stops time.
- (4) Time: 3 minutes.

60. Test 4—Performing Firing Check. a. Procedure. Crewman is required to perform a firing check of the M139 automatic gun in all five modes of fire within 2 minutes.

b. Examiner's Guide.

- (1) Examiner: **PERFORM FIRING CHECKS** (starts time).
- (2) Crewman: Electrically charges gun, performs firing checks in all five modes of fire, and announces **COMPLETE**.
- (3) Examiner: Stops time.
- (4) Time: 2 minutes.

61. Test 5—Identification and Use of Ammunition. a. Procedure. The three standard rounds of ammunition are displayed before crewman. Crewman is required to identify all rounds and state their primary use within 1 minute.

b. Examiner's Guide.

- (1) Examiner: **IDENTIFY THESE ROUNDS OF 20-MM AMMUNITION AND STATE THEIR PRIMARY USE** (starts time).
- (2) Crewman: Identifies all three rounds and states their primary use.
- (3) Examiner: Stops time.
- (4) Time: 1 minute.

62. Test 6—Boresighting and Zeroing M139 Automatic Gun. a. Procedure. For this test a 7½- x 7½-foot target with an 8-inch bullseye is set as close as possible to the direct boresighting and zeroing range of 1,000 meters. A three-round shot group is shown by three holes (or dots) on the target. To conduct exercise, examiner places the M120 sight out of adjustment. Crewman will use the M120 sight to boresight and zero the gun.

b. Examiner's Guide.

- (1) Examiner: **BORESIGHT 20-MM** (indicates target and range to target).
- (2) Crewman: Inserts boresight device in muzzle of M139 automatic gun and instructs examiner to move the gun to bring crosshair of boresight reticle to bear on the upper left corner of the target. Crewman then adjusts M120 sight to place boresight cross on upper left corner of target and announces **COMPLETE**.
- (3) Time: No time limit.
- (4) Examiner: **SIMULATE ZEROING 20-MM**.
- (5) Crewman: Lays on the target and simulates firing three rounds single shot. Announces **COMPLETE**.
- (6) Examiner: **THE LOCATION OF YOUR SHOT GROUP IS INDICATED BY THE DOTS ON THE TARGET. COMPLETE THE ZEROING PROCEDURE**.
- (7) Crewman: Lays on aiming point, moves aiming cross to center of shot group, re-lays on aiming point by using gun controls, simulates firing check round and announces **COMPLETE**.
- (8) Examiner: Checks accuracy of lay.
- (9) Time: No time limit.

63. Test 7—Boresighting and Zeroing M139 Automatic Gun With AN/TVS-2. a. Procedure. For this test a 7½- x 7½-foot target with an 8-inch bullseye is set as close as possible to the desired zeroing range of 1,000 meters. A three round shot group is shown by three holes (or dots) on the target. To conduct this exercise the crewman must mount and zero the AN/TVS-2 on the M139 automatic gun.

b. Examiner's Guide.

(1) Examiner: MOUNT AND BORESIGHT AN/TVS-2A

(2) Crewman: Mounts AN/TVS-2A and lays the M120 sight on target. He adjusts the AN/TVS-2A to M120 sight laid on target, simulates firing three rounds single shot, and announces COMPLETE.

(3) Examiner: THE LOCATION OF YOUR SHOT GROUP IS INDICATED BY THE DOTS ON THE TARGET. COMPLETE THE ZEROING PROCEDURE.

(4) Crewman: Lays on aiming point, moves sight to center of shot group, re-lays on aiming point by using gun controls, simulates firing check round, and announces COMPLETE.

(5) Examiner: Checks accuracy of lay.

(6) Time: No time limit.

64. Test 8—Preparing M139 Automatic Gun for Loading. *a. Procedure.* The crewman being tested will prepare the M139 automatic gun for loading within 2 minutes.

b. Examiner's Guide.

(1) Examiner: PREPARE THE 20-MM FOR LOADING (starts time).

(2) Crewman: Insures commander's MASTER and FIRE switches are in OFF position. Insures bolt is forward and safety lever is in SAFE position. Opens feed box and gun cradle covers. Raises feeder mechanism cover locking lever and removes cover. Announces COMPLETE

(3) Examiner: Stops time.

(4) Time: 2 minutes.

65. Test 9—Loading and Firing Gun Electrically. *a. Procedure.* The crewman being tested will load the system with 25 rounds of dummy ammunition. He will then charge the weapon (feeder and gun) and fire the gun electrically in SINGLE SHOT mode within 2 minutes.

b. Examiner's Guide.

(1) Examiner: LOAD AND ELECTRICALLY FIRE THE 20-MM IN SINGLE SHOT MODE (starts time).

(2) Crewman: Loads 25 rounds of dummy ammunition, turns commander's cupola MASTER switch to ON position, and charges gun by depressing CHARGE button, selects SINGLE SHOT mode of fire with FIRING MODE control dial, moves safety lever to FIRE position, depresses firing trigger, and announces COMPLETE.

(3) Examiner: Stops time.

(4) Time: 2 minutes.

66. Test 10—Charging and Firing Gun Manually.

a. Procedure. The crewman being tested will charge and fire the gun manually within 2 minutes.

b. Examiner's Guide.

(1) Examiner: MANUALLY CHARGE THE 20-MM AND FIRE (starts time).

(2) Crewman: Rotates hex on end of charging shaft clockwise until gun is charged and charger pawl returns to its forward position. Insures safety lever is in FIRE position, raises safety catch on manual firing lever and pulls rearward, and announces COMPLETE.

(3) Examiner: Stops time.

(4) Time: 2 minutes.

67. Test 11.—Dismounting, Disassembly, Assembly, and Mounting M60 Machinegun. *a. Procedure.* The crewman being tested will dismount, disassemble, assemble, and remount the M60 machinegun at the observer's position within 7 minutes.

b. Examiner's Guide.

(1) Examiner: DISMOUNT AND DISASSEMBLE M60 MACHINEGUN (starts time).

(2) Crewman: Clears, dismounts, and disassembles M60 machinegun, as outlined in FM 23-67, and announces COMPLETE.

(3) Examiner: ASSEMBLE AND REMOUNT M60 MACHINEGUN.

(4) Crewman: Assembles and remounts M60 machinegun, performs test for correct assembly as outlined in FM 23-67, and announces COMPLETE.

(5) Examiner: Stops time.

(6) Time: 7 minutes.

c. The following preventive maintenance checks and services are to be accomplished as required:

(1) *Complete gun.* Inspect for cracked, bent, loose, or missing parts.

(2) *Barrel assembly.* Check for obstructions in barrel, receiver, feeder, and recoil mechanism. Be sure barrel is locked to receiver and that gas plug is not loose. Check rifling for wear and erosion.

Note. Clean gas cylinder plugs approximately every 250-300 rounds.

(3) *Receiver.* Manually charge bolt and release it to check for smoothness of operation. Note burrs on the buffer end of bolt.

(4) *Automatic gun feeder.* Check ease of rotation of driver shaft.

(5) *Recoil adapter.* Check for leakage of hydraulic fluid.

(6) *Receiver*. During firing, note changes in rhythm, recoil distance, shock, or firing rate.

d. Cleaning and lubricating instructions:

(1) *Barrel assembly*. Before firing, wipe bore dry. After firing, clean with bore cleaner, wipe dry, and oil all surfaces.

(2) *Receiver*. After firing, disassemble gun, clean and coat internal rails and feeder slide surfaces with LSA. Using LSA, coat sliding surfaces where counter slides and unlocking plates mate with bolt body.

(3) *Rear buffer*. After firing, wipe clean with a dry, clean cloth; then coat lightly parts with oil. *Do not immerse buffer in oil or solvent.*

68. Test 12—Loading and Zeroing M60 Machinegun. *a. Procedure.* Crewman will load a belt of dummy ammunition and simulate zeroing M60 machinegun. A zeroing target is placed at 500 meters. Target must have a 10-inch bullseye and holes (or dots) representing the burst.

b. Examiner's Guide.

(1) Examiner: LOAD M60 MACHINEGUN.

(2) Crewman: Raises cover, pulls bolt to the rear, places safety on SAFE, inserts belt of dummy ammunition and closes cover, and announces COMPLETE.

(3) Examiner: ZERO M60 MACHINEGUN.

(4) Crewman: Simulates firing burst.

(5) Examiner: THE LOCATION OF YOUR SHOT GROUP IS INDICATED BY THE DOTS ON THE TARGET. COMPLETE THE ZEROING PROCEDURE.

(6) Crewman: Refers sight to burst, simulates firing check rounds, and announces COMPLETE.

(7) Time: No time limit.

69. Test 13—Identification of 7.62-MM Ammunition. *a. Procedure.* The crewman being tested will be required to identify and explain the primary use of 7.62-mm ammunition within 2 minutes. The six standard rounds will be displayed: ball, tracer, armor piercing, armor piercing incendiary, blank, and dummy.

b. Examiner's Guide.

(1) Examiner: IDENTIFY THE SIX STANDARD 7.62-MM ROUNDS AND STATE THEIR PRIMARY USE (starts time).

(2) Crewman: Identifies the six rounds and states their primary use.

(3) Examiner: Stops time.

(4) Time: 2 minutes.

Section III. GUNNERY QUALIFICATION TABLES

70. General. The firing tables prescribed herein are designed to develop crew coordination and skills, so that the crewmen can effectively engage moving or stationary targets. The crewman should fire the required tables in sequence from the same vehicle. Many of the exercises are timed and the crewman will be penalized if he fails to complete

the requirement within the allotted time. Time notwithstanding, all exercises will be completed.

71. Table 1—M60 Machinegun Zero and Stationary Target. *a.* This table is designed to test the crewman's ability to field zero and fire the M60 machinegun at stationary targets. Exercises are fired from a stationary vehicle by all crewmen.

Table 1

Exercise	Target description	Range in meters	Time	Number of rounds	Vehicle mode of operation
1	3 x 5-ft zero panel	500	No time limit	20	Stationary
2	3 x 5-ft panel	500-800	20 sec	30	Stationary
3	20 E-type silhouettes	200	30 sec	75	Stationary

b. Exercises are conducted as follows:

(1) *Exercise 1.* Examiner points out a target at 500 meters and instructs gunner to zero M60 machinegun. Gunner will then apply a field zero, using following sequence:

(a) Zero windage index.

(b) Index 500 meters on rear sight range scale.

(c) Fire a six to nine-round burst at target and note where burst strikes. Ten rounds are allowed for exercise.

(d) Make corrections by moving windage knob and range scale.

(e) Fire a confirming burst at target.

(f) Repeat procedure if confirming burst does not strike target.

UNIT _____

NAME _____

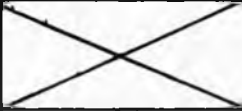
DATE _____

GRADE _____

SCORE CARD: TABLE I--M60 MACHINEGUN ZERO AND STATIONARY TARGET

Possible score: 70

Minimum satisfactory score: 49

EXERCISE	PROCEDURE	TIME	TARGET COVERAGE	TOTAL POSSIBLE	SCORE
1				20	
2				25	
3				25	
TOTAL				70	

Scoring Instructions

15 points for target area coverage in exercises 2 and 3.

Figure 34. Score card and scoring instructions—table 1.

(2) *Exercise 2.* Examiner issues an initial fire command for a point-type target at 500 to 800 meters. Gunner engages and adjusts his fire, using adjusted aiming point method. Thirty rounds are allowed for exercise.

(3) *Exercise 3.* Examiner issues an initial fire command for an area-type target at 200 meters. Gunner engages target and adjusts his fire by ob-

serving the tracers. Seventy-five rounds are allowed for exercise.

c. Instructions and a sample scorecard are shown in figure 34.

72. Table 2—Moving Vehicle Firing—M60 Machinegun. *a.* This table is designed to test the crewmen's ability to engage stationary targets and to load the M60 machinegun while on a moving vehicle. All crewmen will fire the exercises.

Table 2

Exercise	Target description	Range in meters	Time	Number of rounds	Vehicle mode of operation
1	20 E-type silhouettes	600	30 sec	100	Moving
2	20 E-type silhouettes	60	30 sec	100	Moving

b. The exercises are conducted as follows:

(1) *Exercise 1.* Examiner issues an initial fire command for an area-type target at 600 meters. Gunner engages target with 80–100 rounds of ammunition.

(2) *Exercise 2.* Examiner issues an initial fire command for an area-type target at 60 meters. Gunner engages target with 80–100 rounds of ammunition.

UNIT _____

NAME _____

DATE _____

GRADE _____

SCORE CARD: TABLE 2—MOVING VEHICLE FIRING--M60 MACHINEGUN

Possible score: 50

Minimum satisfactory score: 35

EXERCISE	PROCEDURE	TIME	TARGET COVERAGE	TOTAL POSSIBLE	SCORE
1				25	
2				25	
TOTAL				50	

Scoring Instructions

5 points for procedure, 5 points for time, and 15 points for target coverage in both exercises.

Figure 35. Score card and scoring instructions—table 2.

c. Instructions and a sample score card are shown in figure 35.

73. Table 3—20-MM Gun Zero and Stationary Target. *a.* This table is designed to test each crewman's ability to zero the 20-mm gun with the M120 telescope, gun cradle lower sight, and night vision sight, crew served weapons, AN/TVS-2A,

and to accurately manipulate the gun for stationary target engagements. After zeroing, each crewman engages two panels placed approximately 500 meters apart. Range to panels is 1,000 meters. Method of engagement is single shot, alternating targets after each shot. Exercise is first fired with the M120 telescope, then repeated with the gun cradle lower sight.

Table 3

Exercise	Target description	Range in meters	Time	Number of rounds	Type of exercise	Sight
1	7½ x 7½-ft panel	1,000	No time limit	5	Zero—stationary target	A11
2	7½ x 7½-ft panel	1,000	2 min	10	Stationary target	M120
3	7½ x 7½-ft panel	1,000	2.5 min	10	Stationary target	Gun cradle lower sight

b. Exercises are conducted as follows:

(1) *Exercise 1.* Examiner directs gunner to zero the 20-mm gun with the M120 telescope, AN/TVS-2A, and the gun cradle lower sight. Gunner zeroes the 20-mm gun and announces ZERO COMPLETE. Five rounds allowed for zero.

(2) *Exercise 2.* Examiner directs gunner to

engage two panels at 1,000 meters. Gunner announces CREW 20-MM and engages panels, single shot, using the M120 telescope. He alternates panels after each shot until five rounds have been fired at each panel.

(3) *Exercise 3.* Repeat exercise 2, table 3, using gun cradle lower sight.

UNIT _____

NAME _____

DATE _____

GRADE _____

SCORE CARD: TABLE 3 -20-MM GUN ZERO AND STATIONARY TARGET

Possible score: 50

Minimum satisfactory score: 35

EXERCISE	PROCEDURE	TIME	TARGET HITS	TOTAL POSSIBLE	SCORE
1				10	
2				20	
3				20	
TOTAL				50	

Scoring Instructions

- 10 points for correct zeroing procedure in exercise 1.
- 1 point for each target hit in exercise 2 and 3. 5 points for procedure and 5 points for time in exercises 2 and 3.

Figure 36. Score card and scoring instructions—table 3.

c. Instructions and a sample scorecard are shown in figure 36.

74. Table 4A—20-MM Gun Stationary Target (Day). a. This table is designed to test the crewmen's ability to fire the 20-mm gun with the M120

telescope, at stationary targets using burst on target method of adjustment. Zero of the gun will be confirmed by one crewman (2 rounds) before firing table. This table will be fired from a stationary vehicle by all crewmen.

Table 4A and 4B

Exercise	Target description	Range in meters	Time	Number of rounds	Type of exercise	Sight
Confirmation of zero*	-----	-----	-----	2		
1	3 x 5-ft panel	600	30 sec	6	Stationary target	M120 or AN/TVS-2
2	7½ x 7½-ft panel	1,600	30 sec	6	Stationary target	M120 or AN/TVS-2
3	7½ x 7½-ft panel	800	50 sec	12	Stationary target	M120 or AN/TVS-2
4	7½ x 7½-ft panel	1,100	50 sec	12	Stationary target	M120 or AN/TVS-2

*Fired by one crew member.

b. Exercises are conducted as follows:

(1) *Exercise 1 and 2.* Examiner directs gunner to engage designated targets. Gunner announces CREW 20-MM and engages a panel, single shot, applies burst on target, and fires a slow burst.

(2) *Exercise 3.* Examiner directs gunner to engage designated targets. Gunner announces CREW 20-MM and engages a panel, single shot, applies burst on target, and fires a slow burst. He immediately relays on a second panel approximately 500 meters to the left or right of the first panel and repeats the engagement.

UNIT _____

NAME _____

DATE _____

GRADE _____

SCORE CARD: TABLE 4A AND 4B --20-MM GUN STATIONARY TARGET (DAY)(NIGHT)

Possible score: 74
Minimum satisfactory score: 50

EXERCISE	TIME	TARGET HITS	PROCEDURE	POSSIBLE	SCORE
1				14	
2				14	
3				23	
4				23	
TOTAL				74	

Scoring Instructions

- 1 point for each target hit in exercise 1 thru 4.
- 6 points for time and 2 points for procedure in exercise 1 and 2.
- 7 points for time and 4 points for procedure in exercise 3 and 4.

Figure 37. Score card and scoring instructions—tables 4A and 4B.

(3) *Exercise 4.* Repeat exercise 3, table 4A, using *manual* traverse.

c. Instructions and sample score card are shown in figure 37.

75. Table 4B—20-MM Gun Stationary Target (Night). This table is designed to test the crewmen's ability to fire the 20-mm gun at stationary targets during hours of darkness. The AN/TVS-2 will be used and burst on target method of adjust-

ment will be applied. Zero of gun will be confirmed by one crewman (two rounds) before table is fired. Exercises fired and score card are the same as used in table 4A.

76. Table 5—20-MM Gun Moving Target. a. This table is designed to test the crewman's ability to lead, track, and adjust fire on moving targets. Zero of gun will be confirmed by one crewman (two rounds) before table is fired. This table will be fired from a stationary vehicle by all crewmen.

Table 5

Exercise	Target description	Range in meters	Time	Number of rounds	Type of exercise	Sight
Confirmation of zero*	-----	-----	-----	2		
1	7½ x 7½-ft panel with 2-ft bull's-eye	600	45 sec	11	Moving target	M120
2	7½ x 7½-ft panel with 2-ft bull's-eye	800	45 sec	11	Moving target	M120
3	7½ x 7½-ft panel with 2-ft bull's-eye	1,000	45 sec	11	Moving target	M120
4	7½ x 7½-ft panel with 2-ft bull's-eye	1,200	45 sec	11	Moving target	M120

*Fired by one crew member.

b. Exercises are fired from a stationary tank at a moving 7½ by 7½-foot target with bullseye 2

feet in diameter. Target is exposed for 300 meters and travels at a speed of 8 to 15 miles per hour.

UNIT _____

NAME _____

DATE _____

GRADE _____

SCORE CARD: TABLE 5 -20-MM GUN MOVING TARGET

Possible score: 112

Minimum satisfactory score: 25

EXERCISE	TIME	TARGET HITS	PROCEDURE	TOTAL POSSIBLE	SCORE
1				28	
2				28	
3				28	
4				28	
TOTAL				112	

Scoring Instructions

1. 1 point for each hit on target.
2. 8 points for time and 8 points for procedure in each exercise.

Figure 38. Score card and scoring instructions—table 5.

c. Exercises 1 through 4 are conducted in the following manner: For each exercise, examiner directs gunner to engage designated target. Gunner announces CREW 20-MM and engages target single shot, applies burst on target, and fires two slow bursts.

d. Instructions and a sample score card are shown in figure 38.

Note. EXERCISE COMPLETE will be announced by gunner at completion of each exercise, with the exception of exercise 1, table 3.

Section IV. CREW PROFICIENCY EXERCISE

77. **General.** The crew proficiency exercise is a live-fire exercise designed to test the ability of a scout crew to function as a team using all vehicular mounted weapons under simulated combat conditions. This exercise is the final phase of the gunnery qualification course and is standard for crew classification.

78. **Table 6—Crew Proficiency Exercise.** a. The purpose of these exercises is to test the crew's ability to engage moving and stationary targets with all vehicular-mounted weapons. There will be no dry or practice runs. The crew is required to move over a designated course and engage a series of targets. All firing crews are briefed on conduct of the course and tactical situation, including mission of vehicle crew. Tactical situation must portray the scout crew as being a single vehicle, trav-

eling a given route, and engaging various targets. The briefing will also include range safety limitations, what each target represents, general course layout, and control procedures. Sequence of exercises may be varied to fit available range facilities. Targets, except in exercises 2 and 3, are marked by a demolition charge when firing vehicle is in a position to safely engage target. If crew fails to identify target before opening fire time has elapsed, examiner will point out target and crew will then engage it, but lose points for opening fire time. Exercises are described in table 6 and scoring instructions and a sample score card are shown in figure 39.

b. The vehicle commander is given the opportunity to confirm zero of his weapons before negotiating course. Rounds allowed are 20 for M60

UNIT _____ VEHICLE NUMBER _____
 DATE _____ GRADE _____
 COMMANDER _____ OBSERVER _____ DRIVER _____

SCORE CARD: TABLE 6 --CREW PROFICIENCY EXERCISE

Possible score: 430
 Minimum satisfactory score: 300

EXERCISE	ITEMS AND POSSIBLE POINTS	SCORE
1 Stationary light armored vehicle	Open fire in 15 sec 15 Completed within 60 sec 5 Correct procedure and technique of fire 15 Target hits--10 points per hit up to 5 hits 50 Total possible	_____ _____ _____ _____ EXERCISE TOTAL _____
2 Suspected area	Open fire in 20 sec 15 Completed within 50 sec 5 Fire command and procedure 15 Technique of fire and area coverage 40 Total possible	_____ _____ _____ _____ EXERCISE TOTAL _____
3 Moving truck	Open fire in 20 sec 15 Completed within 50 sec 5 Correct procedure and technique of fire 15 Target hits--10 points per hit up to 5 hits 50 Total possible	_____ _____ _____ _____ EXERCISE TOTAL _____
4 Stationary truck and bunker	Open fire in 20 sec 15 Completed within 2 min 5 Fire commands and procedure 10 Technique of fire 10 Targets hits--10 points per hit up to 5 hits (20-mm) . . 50 Area coverage (40-mm) 20 Total possible	_____ _____ _____ _____ _____ EXERCISE TOTAL _____
5 Troops	Open fire in 25 sec 15 Completed within 1 min 5 Fire commands and procedure 15 Technique of fire and area coverage 40 Total possible	_____ _____ _____ _____ EXERCISE TOTAL _____

TOTAL 430

Figure 39. Score card and scoring instructions—table 6.

machinegun, one for M79 grenade launcher, and 2 for M139 guns. After confirmation of zero, the vehicle commander moves his track to the starting point as directed by range personnel.

c. The exercises are conducted as follows:

(1) *Exercise 1 (stationary light armored vehicle)*. Vehicle commander observes target, halts his vehicle, and gives alert. He engages target with 6 rounds of 20-mm at the SLOW BURST or single shot rate. The first round must be fired within 15 seconds after demolition blast. Entire exercise must be completed within 45 seconds.

(2) *Exercise 2 (suspected area)*. Examiner designates a suspected area to the commander. Commander gives a fire command, and observer engages the area with 80-100 rounds from the M60 machinegun as vehicle continues to move. The firing must begin within 20 seconds after vehicle commander has acquired the target area and entire exercise must be completed within 50 seconds.

(3) *Exercise 3 (moving truck)*. After vehicle commander identifies target, he halts his vehicle and gives alert. He engages target with 12 rounds of 20-mm at SLOW BURST or single shot rate. The first round must be fired within 20 seconds of target acquisition, and entire exercise must be completed within 50 seconds.

(4) *Exercise 4 (stationary truck and bunker)*. Demolition blast designates a stationary truck to vehicle commander. He halts the vehicle and gives alert for a 20-mm engagement. As the vehicle commander is engaging the truck with 6

rounds SLOW BURST or single shot, a second demolition blast discloses an enemy bunker at a range of 100 meters. The vehicle commander issues a fire command, and observer engages target with 3 rounds from the M79 grenade launcher. Initial truck engagement must occur within 20 seconds and the firing must be completed on both targets within 2 minutes.

(5) *Exercise 5 (troops)*. A demolition blast indicates presence of enemy troops to the rear of the firing vehicle. Vehicle commander issues a fire command and observer engages target area with 80-100 rounds from the M60 machinegun while vehicle continues to move. Firing must begin within 25 seconds after the target is acquired and entire exercise must be completed within 1 minute.

79. Crew Classification. Classification of vehicle crews is based on the score attained by the crew during the crew proficiency exercise. Crews attaining 70 percent or more of total possible score will be classified as *marksmen*. The minimum satisfactory score on each table must be attained by each crewman in order for a classification above *marksman* to be awarded. Arms qualification badges are not awarded for crew classification. However, notations indicating crew position and crew qualification will be entered on individual qualification records. Crew classification scores follow:

	Score
Total possible	430
Expert	350
Sharpshooter	325
Marksmen	300
Unqualified	Below 300

Table 6

Exercise	Target description	Range in meters	Time		Number of rounds	Vehicle mode of operation	Sight
			Start	Complete			
Confirmation of zero*							
M60 Machinegun.....					20, 7.62-mm		
M79 grenade launcher.....					1, 40-mm		
M139 gun.....					2, 20-mm		
1	Stationary light armored vehicle (hard target)	1,200	15 sec	45 sec	6-20-mm 1-TNT ¼ lb block	Stationary	M120
2	Suspected area	700	20 sec	50 sec	100-7.62-mm	Moving	NA
3	Moving truck (7½ x 7½-ft panel)	1,000	20 sec	50 sec	12-20-mm	Stationary	M120
4	Stationary truck and bunker	Truck— 800 Bunker— 100	20 sec	2 min	6-20-mm 3-40-mm 2-TNT ¼ lb blocks	Stationary	NA
5	Troops (silhouettes)	500	25 sec	1 min	100-7.62-mm 1-TNT ¼ lb block	Moving	NA

* Fired by one crew member.

APPENDIX A

REFERENCES

AR 310-3	Preparation, Coordination, and Approval of Department of the Army Publications.
AR 385-63	Regulations for Firing Ammunition for Training, Target Practice, and Combat.
AR 622-5	Qualification in Arms: Qualification and Familiarization.
FM 6-135	Adjustment of Artillery Fire by the Combat Soldier.
FM 17-12	Tank Gunnery.
FM 23-31	40-mm Grenade Launcher, M79.
FM 23-65	Browning Machinegun, Caliber .50 HB, M2.
FM 23-67	Machinegun 7.62-mm, M60.
TM 9-1005-224-10	Operator's Manual: Machine Gun, 7.62-MM, M60 and Mount, Tripod, Machine Gun, M122.
TM 9-1300-206	Care, Handling, Preservation and Destruction of Ammunition.
TM 9-2320-224-10	Operator's Manual; Carrier, Command and Reconnaissance, Armored, M114/M114A1/M114A1E1.
TM 11-5855-202-13	Organizational and DS Maintenance Manual: Night Vision Sight, Crew Served Weapons, AN/TVS-2.

APPENDIX B

DESTRUCTION

1. General. The decision to destroy ordnance materiel to prevent its capture and use by the enemy is a command decision and will be ordered and carried out only on authority delegated by the division or higher commander.

2. Principles Governing Destruction. The following are fundamental principles to be observed in the execution of an order to destroy weapons:

a. Destruction must be as complete as circumstances will permit.

b. Lacking time for complete destruction, parts essential to operation of the weapon must be destroyed. Parts that would be most difficult for the enemy to duplicate will be destroyed first.

c. The same essential parts of each weapon must be destroyed to prevent reconstruction of a complete weapon from several damaged weapons.

3. Training. Before arrival in a combat zone, men will be trained in proper methods of destruction. They must be able to quickly and effectively destroy, in an established and uniform sequence, the weapon(s) with which they are armed. Destruction should be based on principles stated in paragraph 2 above. Training will not involve actual destruction of materiel.

4. Methods. *a. 20-mm Automatic Gun.*

(1) Field strip gun and use barrel as a sledge.

(2) Destroy completely all sights, feeder mechanism, and ammunition boxes.

(3) Deform and crack the receiver by striking barrel against the side. Destroy, scatter, or bury any loose parts.

b. Spare Parts.

(1) Destroy bolt, barrel, firing pins recoiling groups as outlined in *a* above. Break or deform all other parts.

(2) Destroy, scatter, or bury small parts.

c. Ammunition. When time and material are available, ammunition can be destroyed as follows:

(1) Remove all packed ammunition from boxes or cartons.

(2) Stack ammunition in a central area and stack wood, brush, or rags on the ammunition.

(3) Pour gasoline or oil over the pile; use enough flammable material to insure a very hot fire.

(4) Ignite the flammable material and take cover quickly.

(5) Thirty to 60 minutes are required to destroy ammunition normally carried in basic load.

APPENDIX C

20-MM AUTOMATIC GUN IN THE ANTI-AIRCRAFT ROLE

1. Normal Targets. Troop carrier aircraft, helicopters, and liaison-type aircraft are normal targets for ground combat units equipped with the 20-mm gun. Ground combat personnel will not normally engage high performance aircraft unless attached by these aircraft.

2. Rules of Engagement. *a.* Passive defense measures may be ordered within specific areas when a major operation is impending. Fire from one or more weapons may attract an enemy pilot's attention and invite artillery, mortar, or air attack that could disrupt major tactical operations. Rules of engagement are passed to vehicle commanders in the form of operating procedures or special instructions.

b. When 20-mm weapons are incorporated into an anti-aircraft defense, gunners adhere to rules for engagement announced by the anti-aircraft defense commander.

3. Effective Range. When the 20-mm automatic

gun is used against aerial targets, maximum effective range is 2,000 meters. Aerial targets should not be engaged at ranges in excess of 2,200 meters.

4. Method of Fire. *a.* Aircraft that will pass within 2,000 meters of the 20-mm automatic gun position can be engaged by placing continuous fire at a point in the sky that will intersect the aircraft's line of flight. The FAST RATE or FAST BURST firing mode should be used if ammunition is available. If ammunition is critical, SLOW RATE should be used.

b. If more than one vehicle is available for aerial target engagement, the same technique of fire is employed. All weapons will fire at a point in the sky ahead of the aircraft. The more weapons involved in this type of fire, the more effective the curtain.

c. With proper training gunners can be taught to track, engage, and destroy low performance aircraft using either FAST RATE or FAST BURST.

By Order of the Secretary of the Army:

Official:

KENNETH G. WICKHAM,
*Major General, United States Army,
The Adjutant General.*

W. C. WESTMORELAND,
*General, United States Army,
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