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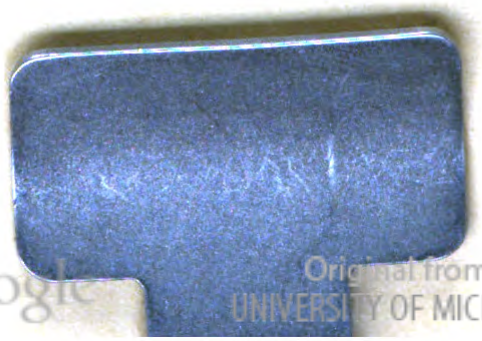
FM 23–45

WAR DEPARTMENT

BASIC FIELD MANUAL

BROWNING MACHINE GUN, CALIBER .30, HB, M1919A4, GROUND

April 12, 1943



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BASIC FIELD MANUAL

BROWNING MACHINE GUN, CALIBER .30, HB, M1919A4, GROUND

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Commanding General, Army Ground Forces

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FM 23–45, Browning Machine Gun, Caliber .30, M1919A4, Ground, is published for the information and guidance of all concerned.

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(For explanation of symbols see FM 21–6.)

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BASIC FIELD MANUAL

BROWNING MACHINE GUN, CALIBER .30, HB M1919A4, GROUND

(This manual supersedes FM 23–45, August 14, 1940; C 1, August 19, 1941; and C 2, July 13, 1942.)

Caliber .30 Browning Machine Guns, HB, M1919A4, Ground, are being replaced by Browning Machine Guns, Caliber .30, HB, M1919A6, which are the M1919A4 guns with bipods, shoulder stocks, and carrying handles. Instructions and the necessary materials for modifying the weapons now in service will be issued. FM 23–45 will be revised accordingly.

Attention is directed to FM 21–7, for details as to how appropriate training films and film strips are intended to be used and how they are made available for use during training with the Browning Machine Gun, Caliber .30, M1919A4.

CHAPTER I

MECHANICAL TRAINING

SECTION I

DESCRIPTION

■ 1. PRINCIPLE OF OPERATION.—The machine gun, caliber .30, M1919A4, is recoil-operated, belt-fed, and air-cooled. In recoil operation, the rearward force of the expanding powder gas (kick) furnishes the operating energy. The purpose of the front barrel bearing plug (see note on p. 2) is to insure the positive recoil of the barrel and barrel extension. The principle of operation is that gases expand equally in all directions. The front barrel bearing plug traps a certain

amount of gas in front of the muzzle. The force of the expanding gas acts on the muzzle, helping to force the heavy barrel to the rear. The moving parts, while locked together at the moment of the explosion, are left free within the receiver to be forced to the rear by the recoil. This movement is controlled by means of various springs, cams, and levers, and is utilized to perform the necessary mechanical operations of unlocking the breech, extracting and ejecting the empty case, feeding in a new round and loading, as well as cocking, locking, and firing the mechanism. The receiver mechanism is for all practical purposes the receiver of the Browning machine gun, M1917. (See fig. 1.)

NOTE.—FRONT BARREL BEARING PLUGS. There are three types of front barrel bearing plugs in use.

a. The M2–06 plug was made for the old gun for firing M2 or 06 ammunition. Identified by marking "M2–06."

b. The caliber .30, M1 plug with a slightly larger escape hole than the M2–06 plug, was made for the old gun for firing M1 ammunition. Identified by marking "cal. .30 M1."

c. The .718 plug was designed for the new (1941) gun with the stronger driving spring. Identified by marking "DIA. .718."

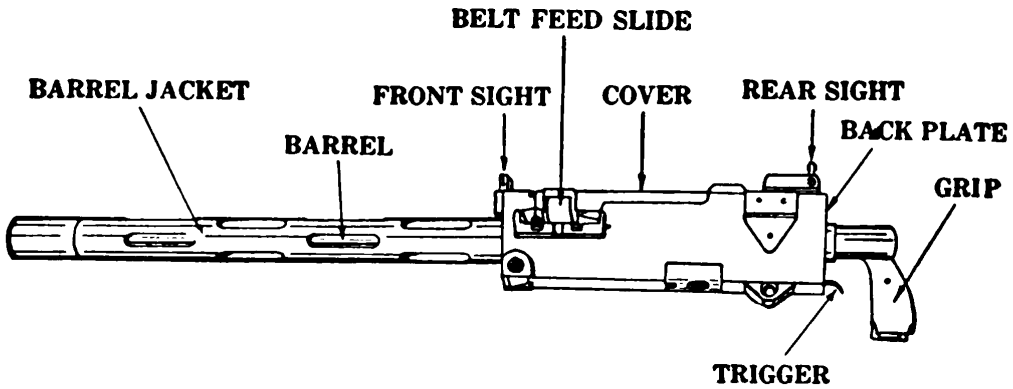


FIGURE 1.—Browning machine gun, M1919A4.

■ 2. COOLING SYSTEM.—The machine gun, caliber .30, M1919A4, is provided with a heavy barrel which is exposed to the air. This factor serves to keep the gun at operating temperatures under normal conditions which is at the rate of about 60 rounds per minute for about 30 minutes.

■ 3. AMMUNITION BELT.—Woven fabric belts of a capacity of 250 rounds (equipped with brass strips at each end to facilitate loading the gun) are normally used with the ground light machine gun.

■ 4. MOUNTINGS.—*a.* The ground light machine gun normally is mounted on the light machine gun tripod M2, a description of which is given in section VI.

b. In motorized or mechanized units, the light machine gun is mounted on vehicular mounts of several types, but a light machine-gun tripod M2 is usually carried for each gun so that it may be fired from the ground.

■ 5. GENERAL DATA.—General data for the light machine gun and mount are as follows:

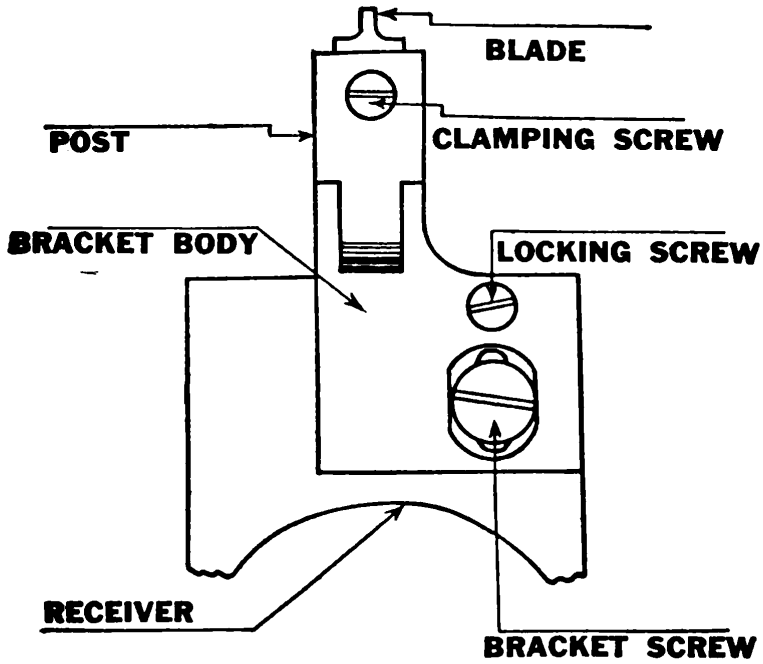
Weight of gun	pounds	31.50
Weight of gun (with pintle and combined elevating and traversing mechanism, approximate weight 4.75 pounds)	pounds	36.25
Weight of gun and tripod mount	do	48.00
Weight of tripod mount M2	do	16.50
Weight of tripod (less pintle and elevating-traversing mechanism	pounds	11.75
Length (over-all)	inches	41.11
Length of barrel	do	24.
Caliber	do	.30
Rifling:		
Number of grooves		4
R. H. twist, 1 turn in 33.3 cal. or	inches	10.
Depth of grooves	do	.004
Trigger pull	pounds	7.7
Sights graduated to	yards	2,400
Cyclic rate of fire	rounds per minute	450–625
Maximum usable rate of fire	do	150
Muzzle velocity, M2 ball cartridge	feet per second	2,800
Muzzle velocity, M1 ball cartridge	do	2,600
Capacity of ammunition chest, wooden	rounds	250
Capacity of ammunition chest M1	do	300
Weight of ammunition chest, wooden (empty)	pounds	5.5
Weight of ammunition chest M1 (empty)	do	2.43

Weight of spare parts and accessory chest M5 (with contents)_____pounds__	18. 93
Characteristics of tripod mount M2:	
Length extended_____inches__	32. 5
Length folded for transportation__do____	27.
Maximum search:	
With elevating mechanism attached:	
Above zero graduation____mils__	+265
Below zero graduation_____do__	—200
(Elevating handwheel graduated every mil.)	
Without elevating mechanism attached: Variable, but in excess of mil figures given above.	
Maximum traverse:	
With traversing handwheel___mils__	61
Additional on traversing bar:	
Right from zero graduation mils____	450
Left from zero graduation mils____	425
As a free gun_____do____	6, 400

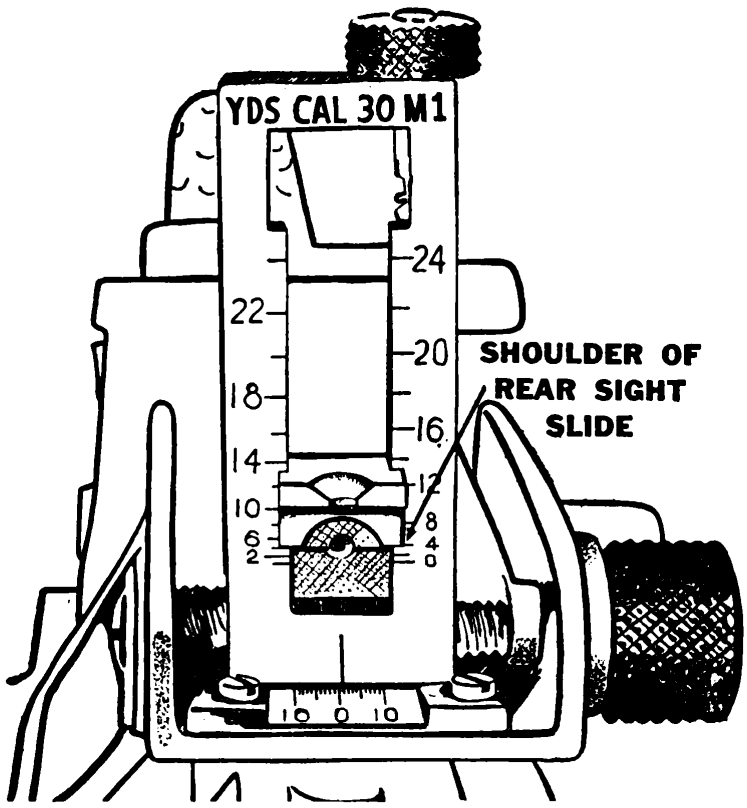
NOTE.—The above figures on search and traverse may vary slightly for different sets of equipment.

■ 6. SIGHTS.—*a. Front.*—The front sight consists of a front sight blade, a front sight body, a front sight post, and a plunger mechanism. The front sight post pivots on the front sight bearing screw when folded for convenience in packing. The plunger mechanism provides a locking device to keep the front sight post in its upright position when the gun is being fired. The front sight is attached to the front end of the receiver by means of a screw. The height of the front sight is such that when the rear sight slide is set at an elevation a bullet fired from the gun will strike a target at a distance corresponding to the elevation set on the rear sight.

b. Rear.—(1) The rear sight (fig. 2) is of conventional type. It consists of a rear sight leaf, carrying a peep in the slide mounting, pivoted on the rear sight base, and adjustable for windage. The rear sight base mounts the rear sight



① Front sight.



② Rear sight.

FIGURE 2.—Sights.

leaf and rear sight leaf spring. It is secured to the left side plate of the receiver by three screws in the flange of the base.

(2) The rear sight leaf is graduated for elevation in 100-yard divisions up to 2,400 yards. The peep of the rear sight slide is 0.081 inch in diameter. Motion of the rear sight slide is accomplished by rotation of the elevating screw knob. This elevating screw mechanism is equipped with a mil click device which may be used in conjunction with a mil scale engraved on the left side of the rear sight leaf to measure or establish angles of elevation in mils.

(3) The windage screw mechanism also incorporates a mil click device. Adjustment of the rear sight leaf in windage is accomplished by rotation of the windage screw knob. Amount of motion permitted is 10 mils right or left from zero.

(4) The sight radius is 13.94 inches.

■ 7. PINTLE.—The pintle of the light machine gun (ground), although technically not a part of the gun, is permanently assembled thereto by a bolt through the trunnions of the pintle and the trunnion hole of the receiver of the gun. Failure to keep this bolt reasonably tight will produce inaccurate fire. This pintle is tapered and mates with the corresponding tapered pintle bushing of the head of the tripod mount M2. This tapered pintle thus serves as a tight bearing union between the receiver of the gun and its mounting. The pintle is secured in its mounting by the engagement of a spring actuated pintle latch of the mounting in a corresponding annular groove of the pintle.

■ 8. ELEVATING AND TRAVERSING MECHANISM.—*a.* As with the pintle, the elevating and traversing mechanism is not technically a part of the gun. However, the elevating and traversing mechanism is permanently secured to the receiver of the gun by a bolt through the head of this mechanism and the elevating bracket of the gun. In guns of new manufacture, the elevating bracket is integral with the bottom plate.

b. The elevating and traversing mechanism, when used with the tripod M2 consists of an upper elevating screw; a

lower elevating screw; an elevating handwheel assembly secured to the head of the lower elevating screw; a housing mating with the lower elevating screw; a traversing slide mounted to the lower elevating screw housing. The new type traversing mechanism also includes a traversing screw, handwheel, and micrometer. This mechanism incorporates a mil click device.

(1) The upper elevating screw terminates at its upper end in an offset head which incorporates a recess for the bolt which assembles the entire elevating and traversing mechanism to the gun. The mechanism is properly assembled to the gun when the offset head points to the rear, thus permitting the mechanism to be folded to the rear and seated in its recess in the duralumin grip. The upper elevating screw is externally threaded to mate with the internal threads of the lower elevating screw. It is equipped with a longitudinal slot in which is seated an engraved scale. This scale is utilized to indicate plus or minus increments of elevation given the mounted gun. It is subdivided into 50-mil graduations and is read by noting the position of the upper edge of the lug of the click ring which moves in the longitudinal slot as the elevating handwheel is rotated.

(2) The lower elevating screw is threaded internally to mate with the externally threaded upper elevating screw and is threaded externally to mate with the lower elevating screw housing. Secured to its upper end is the elevating handwheel assembly.

(3) The elevating handwheel assembly incorporates a mil click device. The handwheel is of light duralumin alloy and carries around its outer periphery ten notches, each notch indicating a 5-mil increment of elevation. Engraved on the upper surface of the handwheel is a mil scale which is read directly from the indicator attached to the click ring. This scale is of 50-mil amplitude and is divided and numbered in 5-mil major divisions and single-mil subdivisions. The click ring which is carried in the elevating handwheel does not rotate with the handwheel, being prevented therefrom by engagement of a lug in the longitudinal slot of the upper elevating screw.

(4) The lower elevating screw sleeve is threaded internally to engage the external threads of the lower elevating screw. This sleeve carries at its front portion a spring actuated plunger which serves to prevent disassembly of the lower elevating screw from its sleeve. At the upper rear portion of the lower elevating screw sleeve is the male portion of a swivel joint, attaching the traversing slide to the elevating and traversing mechanism.

(5) The traversing slide mounts the traversing slide lock lever assembly. This assembly consists of the traversing slide lock lever, the traversing slide lock lever screw, the traversing slide lock lever positioning the traversing slide lock spring, the traversing slide locking screw and washer. Adjustment of the lever to the clamping screw is provided for by a spline assembly, in turn secured by a locking screw and washer. Adjustment is correct when the clamping screw is in firm contact with the traversing bar, the lever being about 45° above the right horizontal position.

(6) Movement of the gun in elevation, when mounted on the tripod M2 is accomplished by rotation of the elevating handwheel, the traversing slide being in firm contact with the traversing bar, with the traversing slide lock lever preferably engaged. (When firing on rapidly moving ground targets, the traversing slide lock is not engaged, although the traversing slide must be retained in firm contact with the traversing bar.)

(7) When mounted on the M2 tripod, the light machine gun may be traversed—

(*a*) When equipped with the old type traversing mechanism, by moving the gun right or left as desired, the traversing clamp being disengaged from the traversing bar, while the traversing slide is retained in firm contact with the traversing bar.

(*b*) When equipped with the new type mechanism: beyond 50 mils, as stated above; under 50 mils, by using the traversing hand wheel.

SECTION II

DISASSEMBLING, ASSEMBLING, AND CHANGING PARTS

■ 9. GENERAL.—*a.* Disassembling may be considered under two general headings: first, removal of groups to the extent required for ordinary cleaning and minor repairs; and, second, detailed disassembling, involving removal of all components from each group.

b. A group is a number of parts, contained in a common housing, which function as a unit.

c. The removal of the different groups from the gun and complete disassembling of the groups to be disassembled by the using services can be accomplished with the tools provided.

■ 10. REMOVAL OF GROUPS FROM GUN.—*a. Blackplate.*—(1) Pull back on latch and raise cover. With the left hand pull back bolt handle and hold it in the rearmost position.

(2) Insert rim of a cartridge in slit in end of driving spring rod. With slit horizontal, push in driving spring rod as far as it will go and turn it clockwise one-quarter turn until slit is vertical. In this position the lugs on it will engage in their recesses in the bolt.

(3) Push bolt handle forward about an inch to free the rear end of driving spring rod from backplate.

(4) Push latch forward and lift out backplate.

b. Bolt handle.—Pull bolt all the way back and remove bolt handle.

c. Bolt.—Remove bolt from rear end of receiver being careful not to handle driving spring rod.

d. Lock frame.—Insert nose of cartridge through hole in the right side of receiver and push in on trigger pin. Grasp trigger and pull lock frame, barrel extension, and barrel out of receiver. Hold barrel in one hand, lock frame in the other, and push forward on accelerator. This separates lock frame and barrel extension.

e. Barrel extension and barrel.—Unscrew barrel extension from barrel.

f. Latch.—With the left hand, palm up, against the rear of the receiver to prevent dropping the latch spring, pull latch to rear until it separates from the plate. Guns of recent manufacture have the latch spring riveted to the latch.

g. Latch spring.—If not riveted lift the latch spring from its pin in the latch.

h. Cover.—(1) *Guns of early manufacture.*—(*a*) Turn cover pin spring up and remove pin.

(*b*) Remove cover.

(2) *Guns of new manufacture.*—(*a*) Remove cotter pin from cover bolt.

(*b*) Place screwdriver blade of combination tool in slot in cover bolt to prevent it from turning and with a wrench remove the nut.

(*c*) Remove cover bolt, cover catch spring, and fixed and movable plates.

(*d*) Remove cover.

NOTE.—To prevent undue wear, the cover and latch should not be removed except when necessary for cleaning or replacement of parts.

■ 11. REPLACING GROUPS IN GUN.—In general, the groups are replaced in the gun in reverse order.

a. (1) *Guns of early manufacture.*—Replace cover. Insert cover pin and lock it by turning cover pin spring forward into its seat in trunnion block. Some models have a cover pin which is locked by inserting and spreading a cotter pin through a hole in the cover pin.

(2) *Guns of new manufacture.*—Replace cover. Place cover latch spring on bolt and position the fixed and movable plates. Insert cover bolt into cover hole. Place screwdriver blade of combination tool in slot in cover bolt to prevent it from turning, and assemble nut to cover bolt using a wrench until the desired tension is obtained. Replace cotter pin.

b. Seat rounded end of latch spring in latch seat, placing hole in spring over pin, bent side of spring away from latch. Holding spring in place with the fingers, push latch onto top plate from the rear, free end of the spring to the front, then force the latch home. *If the spring is allowed to slip from its seat, the latch will not function, and the spring will jam the latch so that it cannot be removed without breaking.*

c. Screw barrel into barrel extension until the rear end of the barrel is flush with the inside of the barrel extension.

d. Insert barrel and barrel extension into receiver until the forward end of barrel extension is opposite the rear end of receiver.

e. Holding barrel extension with one hand, take lock frame in other hand, with index finger beneath and supporting accelerator. Place claws of accelerator in front of and against T-lug. Insert front projections of lock frame into slots of barrel extension and push forward until accelerator turns backward, locking lock frame to barrel extension. Push down tips of accelerator to insure positive locking.

f. Push parts into gun, forcing trigger pin inward to clear it from right side plate, and push forward until a click is heard as trigger pin springs out into its seat in the right side plate. (If barrel hangs on front barrel bearing, reach forward under jacket and aline it.)

g. Push cocking lever forward and insert bolt, pushing down on rear end of trigger to prevent ejector from tripping accelerator.

h. Insert bolt handle through large opening at rear of slot and push it forward about 1 inch, being sure that collar on handle is inside right side plate.

i. Push forward on latch and replace backplate.

j. Hold bolt handle fully back with left hand. Place rim of cartridge in slit in end of driving spring rod, and turn rod one-quarter turn counterclockwise until slit is horizontal. This releases driving spring. Allow bolt to go forward.

k. Make head space adjustment as follows:

(1) Pull bolt to rear about ¾ inch.

(2) Screw barrel into barrel extension (by using point of a cartridge or the combination tool in barrel notches) until the action will *just close* (recoiling parts will go fully forward) without being forced.

(3) Unscrew the barrel one notch.

Caution: Care must be exercised to avoid roughening the barrel surface during the adjustment.

l. Position belt feed lever stud over cam groove in bolt and close cover.

m. Pull trigger.

NOTES.—1. HEAD SPACE.—*a*. The head space of a military weapon with a cartridge fully seated in the chamber is the distance between the base of the cartridge and the face of the bolt, when the bolt is in its locked position.

b. In Browning machine guns, the head space is adjusted by obtaining the proper distance between the forward part of the bolt and the rear end of the barrel. The head space adjustment must be checked before firing.

2. EFFECT OF HEAD SPACE ADJUSTMENT.—*a*. *General*.—The head space adjustment of the machine gun is the most important adjustment to be made. To insure continued operation of the gun, to obtain the best uniformity of shot patterns, and to prevent damage to the gun, the head space adjustment should be made as prescribed in paragraph 11*k* above, or note 4 below.

b. *Tight head space* (fig. 3).—When the head space adjustment is tight, poor functioning will result, as the breech lock will not fully enter its recess in the bolt. This condition may damage the barrel extension, bolt, or breech lock. Extraction trouble may also occur because of improper timing of locking and unlocking. Furthermore, with a tight head space adjustment the gun operates sluggishly because of the binding of the moving parts. If the head space adjustment is very tight, the notches on the rear end of the barrel can be seen, the bolt handle will not be fully forward, and the firing pin cannot be released by pressing the trigger.

c. *Loose head space* (fig. 4).—If the head space is loose, a ruptured cartridge may occur; also if there is a weakness in the cartridge case itself, such as a split case, the possibility of a ruptured cartridge is increased. If the head space adjustment is loose, the bolt can be moved slightly from front to rear independently of the barrel and barrel extension.

3. QUICK HEAD SPACE ADJUSTMENT.—After the head space adjustment has been determined by the method described in paragraph 11*k*, or by the alternate method described in paragraph 4 below, the notch in which the barrel locking spring is engaged may be marked with a center punch. Thereafter, to make the correct head space adjustment during the assembly of the gun, screw the barrel all of the way into the barrel extension and then unscrew the barrel until the barrel locking spring is in the marked notch.

4. ALTERNATE HEAD SPACE ADJUSTMENT.—Head space adjustment can be made before the moving parts are assembled in the receiver. Screw the barrel into the barrel extension until the rear of the barrel is flush with the inside of the barrel extension. Remove the extractor from the bolt. Place the bolt into the bolt guides in the barrel extension. Push the bolt fully forward. Turn the assembly so that the bolt is down. Lock the bolt to the barrel extension by pushing the breech lock fully into its seat in the bolt. Hold it firmly in that position with the thumb. Screw the barrel into the barrel extension until it is stopped by contact with the forward face of the bolt. Be certain that the barrel does not force the breech lock out of its fully locked position. Turn the assembly so that the bolt is up. Unscrew the barrel from the barrel extension just enough to cause the breech lock to fall from its recess in the bolt. Remove the bolt. Screw the barrel into the barrel extension one notch, or, if the nose of the barrel locking spring is between two notches, screw the barrel into the barrel extension one and the fraction notches. Assemble the gun.

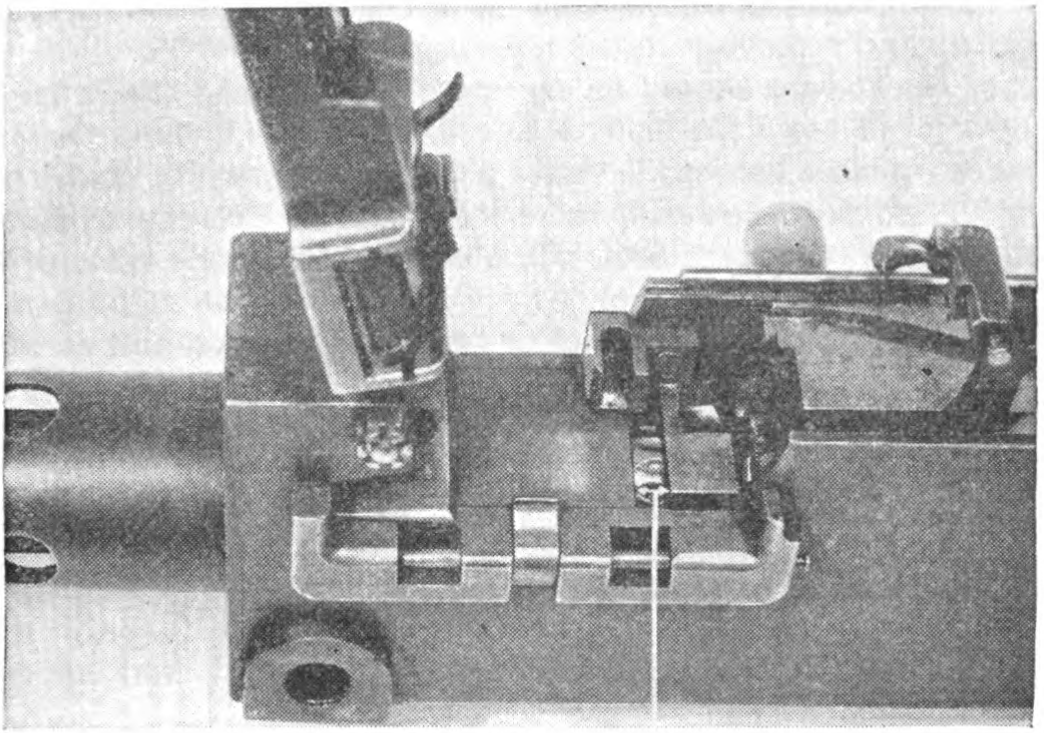


FIGURE 3.—Tight head space.

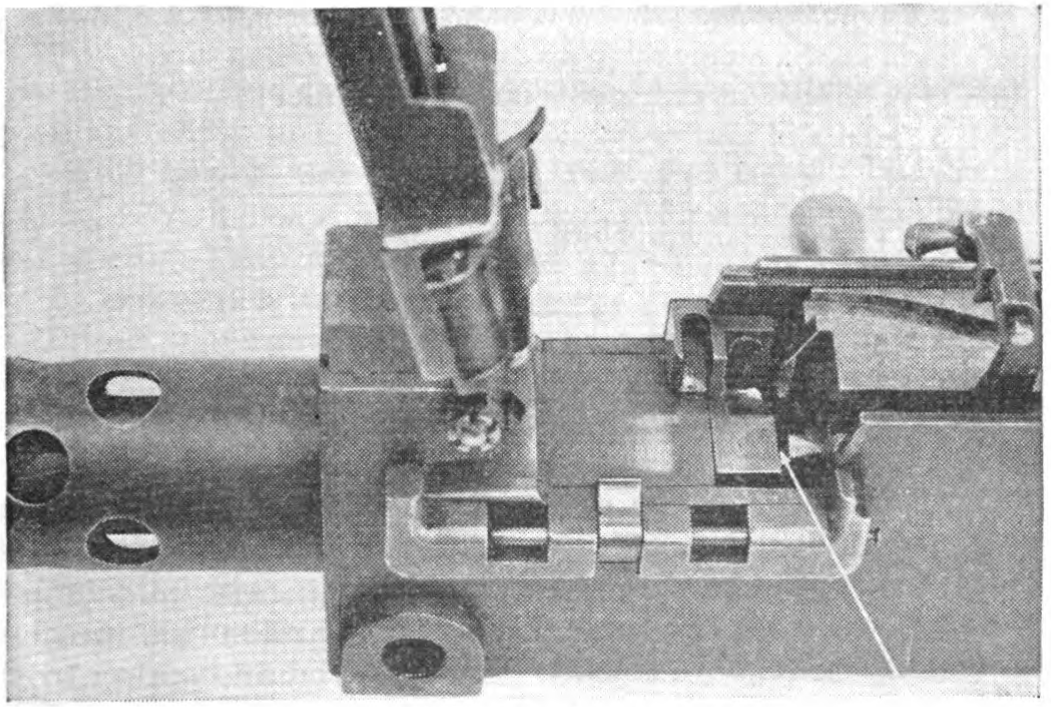


FIGURE 4.—Loose head space.

■ 12. DETAILED DISASSEMBLING OF BOLT.—*a.* Turn the extractor up and remove it to the left (fig. 5).

b. Great care should be exercised in removing the driving spring rod from the bolt as the force of the driving spring when released can easily cause the rod to slip away from the hand and possibly result in serious injury. To remove driving spring rod, place protruding end of rod on the table or a block of wood. With bolt firmly grasped by the right hand (palm of the hand over face of bolt), press down and at the

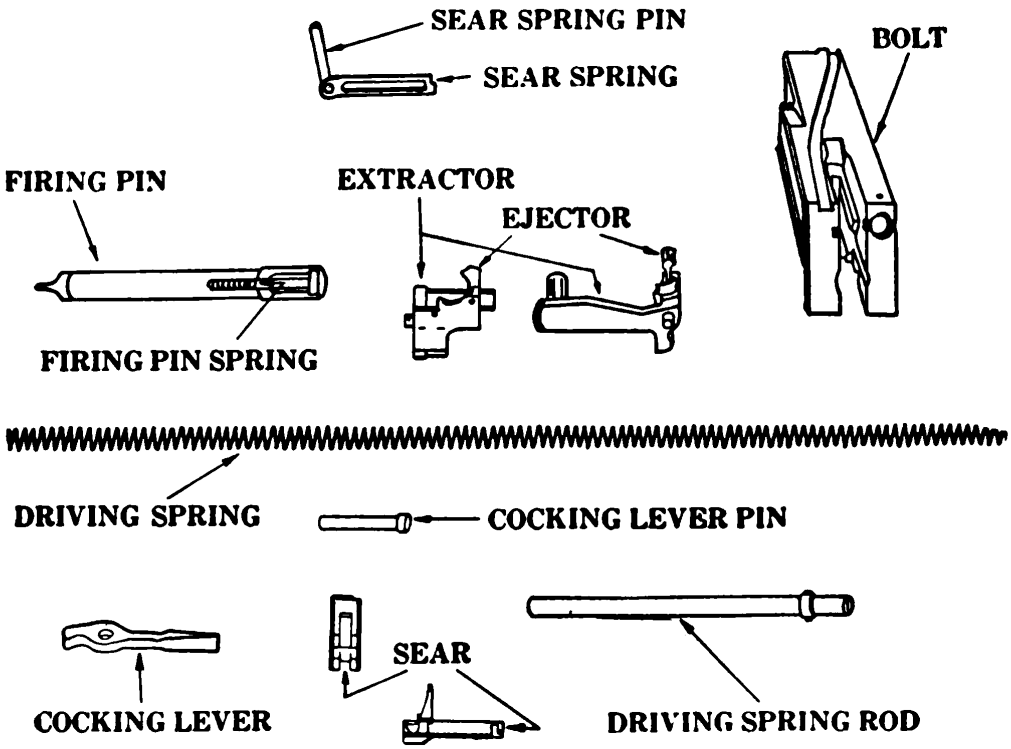


FIGURE 5.—Bolt group.

same time turn bolt one-fourth turn to the left until lugs on rod leave their recess in bolt. Slowly release pressure on bolt, allowing it to rise under the action of driving spring until about 3 inches of rod protrude. With the left hand grasp protruding portion of rod and spring; raise both hands and the bolt from the table, keeping rod and spring in their same position relative to bolt. Separate rod and spring from bolt with a quick jerk. The quick, separating jerk will not allow spring to kink. Separate driving spring rod and driving spring.

c. Turn the top of cocking lever to the rear of bolt and withdraw cocking lever pin to the left of bolt.

d. Lift out cocking lever.

e. Release firing pin by pushing down on sear. Hold bolt in the left hand, the front end toward the body, top up, with the index finger of the left hand beneath and supporting the sear. Use the nose of a cartridge, placed near the end of sear spring, to push downward and to the right on spring to seat it in cut in bolt. This releases sear which is removed at the bottom of bolt.

f. Turn sear spring back to the left to clear the cut. Push nose of a cartridge into the hole in the bottom of bolt to start sear spring pin moving. To complete the removing of sear spring, place the top end of cocking lever well under sear spring and pry down against the edge of bolt.

g. Place the palm of the right hand over the rear of bolt, tilt the rear end of bolt down, and firing pin will drop out.

■ 13. ASSEMBLING BOLT.—*a.* Place firing pin in bolt, striker downward and to the front, and tilt the front of bolt downward until striker projects through the small hole in the front of bolt.

b. Replace sear spring by pushing with a cartridge on top of pin, avoiding pressure on spring proper.

c. Hold bolt in the left hand, front end toward the body, top up. With point of a cartridge placed near the end of sear spring, push downward and to the right to seat it in cut in bolt.

d. Push sear upward from the bottom, notched projection toward the front of bolt, and hold with first finger of the left hand while pressing downward and to the left on sear spring with a cartridge to engage the end of sear spring in sear.

e. Replace cocking lever, making certain that the rounded nose on the lower end is to the rear of bolt so that it will properly engage in the recess in firing pin.

f. Insert cocking lever pin on the left side of the bolt. The upper end of the cocking lever should be to the rear of the bolt before inserting the pin. This alines the hole in the

cocking lever with the hole on either side of the bolt for the return of the cocking lever pin.

g. Cock by pressing forward on cocking lever. Turn cocking lever to the rear and press down on sear with a cartridge to release firing pin and test the correctness of the assembly. Recock the assembly.

h. The same care should be exercised in assembling the driving spring rod to the bolt that is exercised in removing it. Place driving spring on driving spring rod. With the back end of the rod resting on a table or a block of wood, gather as much of the spring on the rod as can be held compressed by the thumb and fingers of the left hand. With bolt securely held in the right hand, the front end of bolt in the palm of the hand, slip bolt over the end of spring. Push downward to compress spring and allow lugs on rod to enter

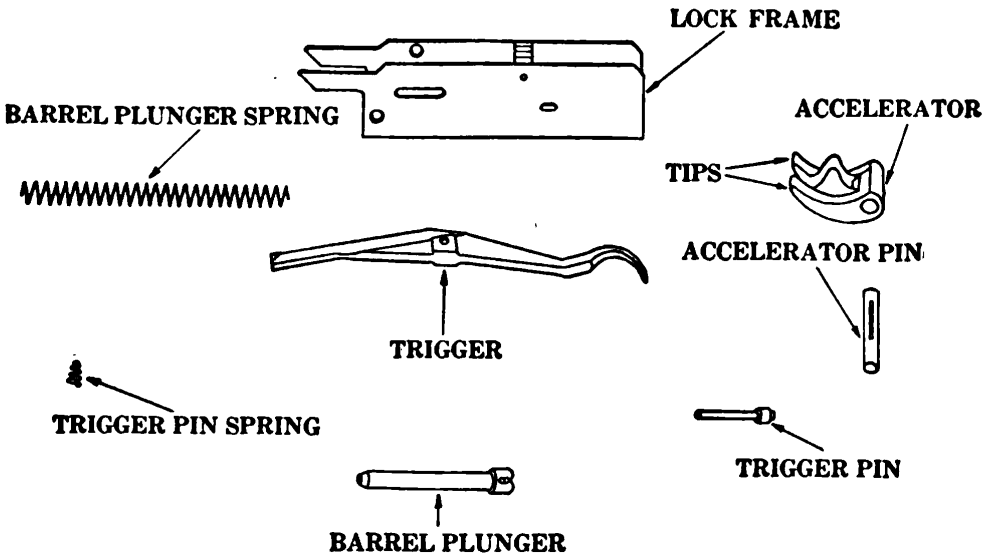


FIGURE 6.—Lock frame group.

slot in bolt. Turn bolt slowly 90° clockwise until slit in rod is crosswise to slot in bolt.

i. Insert pin on extractor into the rear one of the two large holes in the left side of bolt, extractor pointing up. Turn extractor downward toward the front to engage collar on extractor under collar cut in bolt.

■ 14. DETAILED DISASSEMBLING OF LOCK FRAME (fig. 6).—*a.* Grasp head of trigger pin between the thumb and first finger of the right hand and remove it to the right. Lift out trigger. If pin is too tight to permit its removal in this manner,

it must be drifted out. Do not remove trigger pin spring except when necessary.

b. Push out accelerator pin and remove accelerator.

c. Hold lock frame with the left hand, projections pointing upward, slot to the left, separator between the second and third fingers, first and second fingers gripping barrel plunger spring. With the thumb of the right hand, press down and out on barrel plunger to disengage plunger guide pin from slot. Allow spring, with plunger, to rise slowly. Lift out spring and remove it from barrel plunger.

■ 15. ASSEMBLING LOCK FRAME.—*a.* Assemble barrel plunger spring to barrel plunger, being careful that the more tightly fitting end of barrel plunger spring is pushed up against the head of barrel plunger. Hold lock frame with the left hand, projections pointing upward, slot to the left, lock frame separator between the second and third fingers. Seat the end of barrel plunger spring in the recess in lock frame separator, barrel plunger guide pin facing the slot in lock frame. Using the first and second fingers of the left hand to prevent spring from buckling, press down with the thumb of the right hand on the end of barrel plunger until barrel plunger guide pin can be seated in the slot. Care should be taken that the action of the spring does not cause the plunger to slip out of the hand.

b. Replace accelerator with the tips up and the rounded surface to the front. Insert accelerator pin, taking care that both ends of pin are flush with the sides of lock frame.

c. Push the front end of trigger up between separator and spacer, placing the center in its square seating. If trigger pin spring has been removed, seat spring on trigger pin, placing the small end of spring toward the head of pin. Replace pin from the right.

■ 16. DETAILED DISASSEMBLING OF BARREL EXTENSION (fig. 7).—*a.* Insert the rim of a cartridge under the front edge of barrel locking spring and pull it out to the front.

b. Push out breech lock pin and remove breech lock.

■ 17. ASSEMBLING BARREL EXTENSION.—*a.* Place breech lock in its slot, *taking care that the double beveled surface is up*

and to the front. Insert breech lock pin and insure that both ends of pin are flush with the sides of barrel extension.

b. Insert barrel locking spring in the seating in the left side of barrel extension, hook inward, and force home as far as it will go.

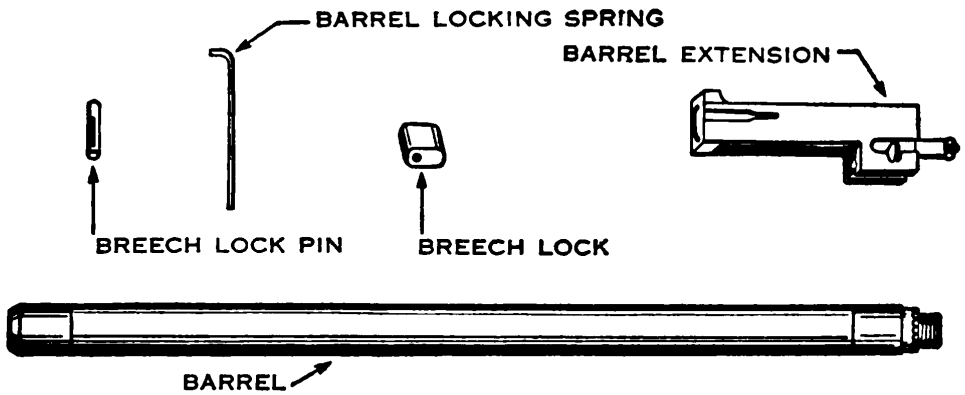


FIGURE 7.—Barrel and barrel extension group.

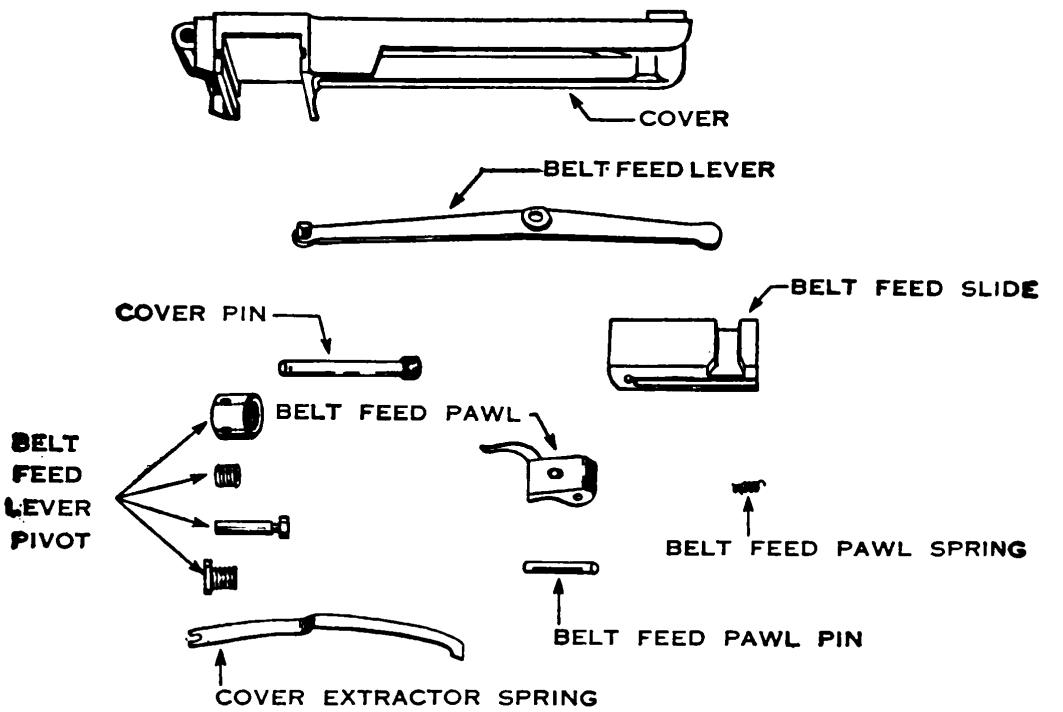


FIGURE 8.—Feed group.

■ 18. DETAILED DISASSEMBLING OF COVER (fig. 8).—*a.* Remove cap or plug from belt feed lever pivot bushing nut. Remove belt feed lever pivot.

b. Withdraw belt feed lever from belt feed slide and remove slide.

c. Insert the nose of a cartridge between cover extractor spring and the notch in cover extractor cam. With the thumb of the left hand over spring, pry out on spring to disengage from cut. Lift out spring from its seat against stud.

■ 19. ASSEMBLING COVER.—*a.* Place the forked end of cover extractor spring under stud on cover. Press downward with the thumb on the other end of spring, at the same time pushing toward stud, and seat projection of spring in the notch of cover extractor cam.

b. Replace belt feed slide in its grooves in cover, taking care that pawl is pointing to the right as cover goes on the gun.

c. Place front end of belt feed lever in the cut, stud on lever away from cover and to the rear. Insert belt feed lever pivot pin. Replace cotter pin or cap.

■ 20. DISASSEMBLING AND ASSEMBLING OF PARTS DISMOUNTED ONLY FOR REPAIR.—*a. Shock-absorbing group.*—(1) *Disassembly.*—Unscrew the adjusting screw; remove the adjusting screw plunger and screw.

(*a*) *Disk type.*—Remove the buffer disks, buffer plug, buffer ring, and the buffer plate through the rear end of the grip.

(*b*) *Spring type.*—Remove the buffer disk, stop, spring, filler, and buffer plate.

(2) *Assembly.*—(*a*) *Disk type.*—In assembling the shock-absorbing group, it must be kept in mind that part of the recoil energy of the bolt is transmitted to the buffer pile in the form of metal to metal impact of approximately 5,600 pounds. This force is absorbed by the fiber buffer disks. In order that the buffer pile may perform this function properly, the following precautions must be observed:

1. The disks must form a compact column or stack from the face of the buffer plate to the adjusting screw.
2. The disks should be clean and free from rough edges and surfaces, and should be assembled in the tube one at a time. Be sure that each disk

is firmly seated and use sufficient disks (normally 16) so that when the adjusting screw is inserted and tightened its rear face will be flush with or protrude slightly from the rear face of the grip.

3. After assembly, adjust the buffer by tightening the adjusting screw until the buffer plate can just be turned by grasping it by the end which extends through the backplate. When the gun is assembled, this adjustment can be made approximately without removing the backplate by tightening the adjusting screw as far as it will go and then loosening one-half turn.

4. These disks are used for their shock-absorbing capacity, and substitution of other material for or removal of the disks is prohibited (par. 247*b*(2)).

(*b*) *Spring type.*—Assemble in reverse order. Tighten the adjusting screw as far as possible with the combination tool and then loosen *1½ turns.* For additional data on assembling groups see paragraph 239.

b. Belt holding pawl.—(1) Hold down belt holding pawl and withdraw belt holding pawl split pin to the rear.

(2) Lift off belt holding pawl.

(3) Lift belt holding pawl spring from its seating.

(4) Replace in the reverse order.

■ 21. CHANGING PARTS.—If the time element is important, a broken minor part should be replaced by substituting a complete spare group which contains it. Thus a broken firing pin would be remedied by changing bolts. Replacement parts in the spare parts chest should be replaced as soon as opportunity permits. In the event that either the bolt, barrel, or barrel extension is changed, *readjust the head space.*

SECTION III

CARE AND CLEANING

■ 22. IMPORTANCE.—The care and cleaning of the machine gun, tripod, and accessories are a vital duty. Experience has shown that most machine guns become unserviceable from lack of proper care rather than from use.

■ 23. LUBRICANTS, CLEANING MATERIALS, AND RUST PREVENTIVES.—*a. General.*—The use of unauthorized materials, such as abrasives, is forbidden. The following are the only materials authorized and issued for cleaning these machine guns:

Cleaner, rifle bore.
Soda ash.
Soap.
Oil, lubricating, preservative, light.
Oil, lubricating for aircraft instruments and machine guns.
Compound, rust-preventive, light.
Solvent, dry-cleaning.
Decontaminating agents.
Water.

b. Rifle bore cleaner.—(1) Rifle bore cleaner is issued for cleaning the bore of the machine gun after firing. This material possesses rust-preventive properties and provides temporary protection against rust. It is better practice, however, to dry the bore immediately after cleaning it with rifle bore cleaner and then coat it lightly with light preservative lubricating oil.

(2) Rifle bore cleaner freezes at temperatures below 32° F. If frozen, it must be thawed and shaken well before using. To prevent bursting, containers should not be filled more than three-fourths full in freezing weather.

c. Soda ash.—Soda ash is a white, odorless powder which is soluble in water. For use, it is dissolved in water in the proportion of ½ to 1 pound of sode ash to 1 gallon of boiling water. If boiling water is not available, hot or cold water may be used. This solution can be used to clean the gun bore when rifle bore cleaner is not available.

d. Soap.—A soap solution may be used to clean the bore and mechanism, if neither rifle bore cleaner nor soda ash is available. The solution is prepared by dissolving soap chips in hot water in the proportion of ¼ pound to 1 gallon of water. When possible, the solution should be used while it is hot.

e. Light preservative lubricating oil.—This oil has both rust-preventive and lubricating properties but cannot be

depended upon to provide protection from rust for long periods. It is used for the lubrication of all moving parts and for *short term* protection against rust. Preservative action results partly from the oily film on the metal parts and partly from the chemical combination of inhibitors in the oil with the metal. It will protect the metal surfaces from rust even though no appreciable film of oil is present on the metal parts. When used on moving parts, however, it is necessary to maintain a thin film of oil to provide the necessary lubrication.

f. Lubricating oil for aircraft instruments and machine guns.—This oil, which is a lubricant rather than a rust-preventive agent, may be used for lubricating the machine gun when light preservative lubricating oil is not available. It is an extremely light oil which relies entirely upon the maintenance of the oil film to protect metal surfaces from rusting. *When it is used as a preservative, the parts must be inspected daily for rust.* Following this inspection, the metal parts should be wiped clean and again lightly coated with the oil.

g. Light rust-preventive compound.—This compound is issued for the protection of metal parts for long-time storage while the parts are boxed. It is a sluggish liquid at about 60° F. It can usually be applied with a brush.

h. Dry-cleaning solvent.—This is a noncorrosive, petroleum solvent which is used to remove grease, oil, or rust-preventive compound. *Dry-cleaning solvent is highly inflammable and should not be used near open flames. Smoking is prohibited where dry-cleaning solvent is used.* The solvent is generally applied with rag swabs to large parts of the gun and used as a bath for the small parts. All surfaces must be thoroughly dried with clean rags immediately after use of the solvent. Gloves should be worn when handling parts that have been cleaned, in order to avoid leaving finger marks which are usually acid and therefore induce corrosion. Cleaning solvent attacks and discolors rubber.

■ 24. CARE AND CLEANING WHEN NO FIRING IS DONE.—*a. General.*—(1) This includes the care necessary to preserve the

condition of the machine gun and mount during the time when no firing is being done.

(2) The gun must be completely disassembled for proper inspection, cleaning, and lubrication.

(3) Machine guns in the hands of troops should be inspected daily during periods of use to insure proper condition and cleanliness. Training schedules should allow time for supervised cleaning on each day that guns are used.

b. Bore and chamber.—(1) To clean the bore and chamber, assemble a cloth patch to the cleaning rod and insert the rod into the bore *at the breech end.* Move it forward and backward several times and replace it with a fresh new patch. Make sure that the patch goes all the way through the bore before the direction is reversed. This cleaning removes accumulations of dust, dirt, and thickened oil. Be sure that the chamber as well as the bore is throughly cleaned.

(2) Continue this operation until a patch comes out clean.

(3) After thoroughly cleaning, saturate a patch with light preservative lubricating oil and push it through the chamber and bore.

(4) When issue patches are not available, patches should be cut approximately 2½ inches square to permit their passage through the bore without bending the cleaning rod.

c. Receiver.—(1) Disassemble, clean, and oil all moving parts of the receiver.

(2) Clean the screw heads and crevices with a small cleaning brush or small stick.

(3) Clean moisture and dirt from the metal surfaces with a dry cloth, then wipe them with a cloth that has been dipped in light preservative lubricating oil. This protective film must be maintained at all times.

(4) Clean the dirt from outer surfaces of the machine gun with a slightly oiled cloth and then wipe with a soft dry one.

d. Accessories.—(1) The mount, spare parts, and all accessories of the gun must be cared for and cleaned as carefully as the gun itself.

(2) Ammunition must be kept clean and dry.

(3) Guns mounted in vehicles are usually locked in traveling position.

(4) Muzzle covers are provided to prevent dirt from entering the gun through the muzzle.

■ 25. PREPARATORY TO FIRING.—The following steps are taken before firing to insure efficient functioning of the gun:

a. Dismount the main groups.

b. Clean the bore and chamber with a clean dry patch. *Do not oil the bore and chamber before firing.*

c. Thoroughly clean and lightly oil all other metal parts with light preservative lubricating oil. Do not use grease. Be sure to apply a thin coating of oil to the following:

(1) All parts of bolt group.

(2) All parts of the lock frame group.

(3) All parts of the barrel extension group.

(4) All parts of the feed group.

d. Assemble the machine gun and rub all outer surfaces with a lightly oiled rag to remove dust.

e. Check head space.

f. Clean and prepare for firing all parts of tripod and other equipment necessary for firing.

■ 26. AFTER FIRING.—*a. General.*—(1) The bores of all machine guns must be thoroughly cleaned by the evening of the day on which they are fired. They should be cleaned in the same manner for the next 3 days.

(2) Firing the machine gun causes powder and primer fouling to form in the bore and chamber. This fouling absorbs and retains moisture from the air, thereby causing rust. These deposits can be removed by cleaning with rifle bore cleaner, soda ash solution, soap solution, or water.

b. Cleaning procedure after firing.—(1) Unload the gun and replace the belt in the ammunition chest.

(2) Clean the bore (*c* or *d* below) and all working parts. If this cannot be done at once, apply oil to prevent rust.

(3) Release the firing pin spring.

(4) At the first opportunity, entirely disassemble the gun, clean, oil, and inspect all parts, and make needed repairs and replacements.

(5) On assembly, check operation with dummy cartridges and release the firing pin spring after making sure that functioning and adjustment are correct.

c. Cleaning the barrel with rifle bore cleaner.—(1) Saturate a clean patch with rifle bore cleaner, attach it to the cleaning rod, insert it at the breech end of the barrel, and push back and forth through the bore of the barrel.

(2) Repeat this operation two or three times with clean patches. Be sure that the patch goes completely through the bore before the direction is reversed.

(3) Repeat this procedure with dry patches until a patch comes out clean and dry.

(4) Examine the bore and chamber carefully for cleanliness. If they are not free of all residue, repeat the cleaning process.

(5) If clean, saturate a patch in light preservative lubricating oil and push it through the chamber and bore.

d. Cleaning the barrel with soda ash or soap solution.—(1) Use soda ash solution if rifle bore cleaner is not available Use soap solution or plain water if neither rifle bore cleaner nor soda ash is available.

(2) Place the barrel, muzzle down, in a vessel containing soda ash or soap solution. (If these are not available use plain hot or cold water.)

(3) Insert the cleaning rod and flannel patch into the breech end. Move the rod up and down for about 1 minute, pumping the solution in and out of the bore.

(4) Run a brass or bronze wire brush forward and back through the barrel three or four times while the bore is wet. The brush must be pushed entirely through the barrel before it is reversed, otherwise the brush will be ruined.

(5) Using the cleaning rod and a clean patch, pump clean water through the bore as in (3) above to remove the washing material.

(6) Remove the barrel from the water and dry it with clean flannel patches.

(7) If the bore and chamber are clean, saturate a patch in light preservative lubricating oil and push it through the bore to oil the bore and chamber.

e. Cleaning parts other than barrel.—(1) Wipe the receiver clean, taking care to remove dirt from all crevices. Thoroughly clean the cover, bolt, barrel extension, lock frame, and backplate, using a small stick covered with a

flannel patch. Remove dirt and oil from all recesses and springs.

(2) Wipe all parts with an oily rag.

f. Front barrel bearing.—(1) Carbon is deposited in the front barrel bearing during firing. If this deposit is not removed periodically, it will eventually cause the barrel to bind.

(2) Unscrew the front plug with the combination tool.

(3) Soften carbon with dry-cleaning solvent.

(4) Scrape out the carbon.

(5) Replace the plug.

g. Exterior surfaces.—(1) Wipe off the exterior of the gun with a dry cloth to remove moisture and dirt.

(2) Wipe all metal surfaces with light preservative lubricating oil.

h. Accessories.—(1) Clean and oil the mount, spare parts, and all accessories with light preservative lubricating oil.

(2) Avoid leaving excess oil in the interior of the tripod head, since this will collect dirt and sand.

(3) The pintle bushing should be cleaned and lightly oiled.

(4) Oil should not be placed in the seating of the traversing dial, since this will collect dirt and interfere with easy dial adjustment.

i. Frequency of cleaning.—Machine guns should be cleaned as soon after firing as possible. *If the gun is not to be fired in the next few days, repeat the procedure outlined above for 3 consecutive days following firing.*

■ 27. ON THE RANGE OR IN THE FIELD.—Machine guns must be kept clean and properly lubricated at all times. To obtain the maximum efficiency of the gun on the range and in the field, the following points must be observed:

a. Never fire a gun with any dust, dirt, mud, or snow in the bore.

b. Keep the chamber free from oil and dirt when firing.

c. Never leave a patch, plug, or other obstruction in the chamber or bore. Failure to observe this precaution may result in serious injury.

d. If the gun gives indication of lack of lubrication and of

excessive friction, apply additional oil to the parts subjected to this friction.

e. Keep a light coating of light preservative lubricating oil on all metal parts.

f. When in the field, the gun must be disassembled to the extent necessary for proper cleaning and lubrication. Upon opportunity, and as necessary, the gun should be disassembled into its main groups, all parts thoroughly cleaned, and the operating parts lubricated before the gun is reassembled.

g. During firing, oil frequently but sparingly those parts where actual friction exists. These include the cam groove and the cocking lever. Excess oil on the moving parts generates smoke which interferes with observation and may disclose the position of the gun.

h. When the prescribed lubricants are not available, any clean, light mineral oil, such as engine oil, may be used. For cleaning the bore and chamber, clean water may be used when no other cleaner is available.

■ 28. PREPARATION FOR STORAGE.—*a.* Light preservative lubricating oil is the most suitable oil for short-term preservation of the mechanism of the machine gun. It is effective for storage for periods ranging from 2 to 6 weeks, depending on climatic conditions. However, guns which are stored and protected with light preservative lubricating oil must be inspected every 4 or 5 days, and the preservation film renewed if necessary. For longer periods of time, guns must be protected with light rust-preventive compound.

b. Light rust-preventive compound is efficient for preserving the polished surfaces, the bore, and the chamber up to 1 year, depending upon climatic and storage conditions.

c. Machine guns that are to be placed in storage should be cleaned and prepared with particular care. The bore, all parts of the mechanism, and the exterior of the gun should be thoroughly cleaned with dry-cleaning solvent and then dried completely with rags. In damp climates, particular care must be taken to see that the rags are dry. After drying a metal part, the bare hands should not touch that part. All metal parts should then be coated with either light preservative lubricating oil or light rust-preventive compound, de-

pending on the length of storage required. Application of the rust-preventive compound through the bore of the gun is best done by dipping the cleaning brush in the compound and running it entirely through the bore two or three times. The brush must be cleaned before use. Before placing the weapon in storage, the bolt should be in the forward position with the firing pin released. It is good practice to release the firing pin tension whenever the weapon is not in use. The wooden supports of the packing box must be painted with rust-preventive compound before storing the gun. Place the gun in the wooden packing box, handling it with oiled rags. *Under no circumstances will a gun be placed in storage while contained in a cloth or other cover, or with a plug in the bore.* Such articles collect moisture and cause the weapon to rust.

■ 29. CLEANING WEAPONS RECEIVED FROM STORAGE.—Weapons which have been stored in accordance with preceding paragraphs will be coated either with light preservative lubricating oil or with light rust-preventive compound. Weapons received from ordnance storage will, in general, be coated with rust-preventive compound. Use dry-cleaning solvent to dissolve and remove all traces of the compound or oil. Take particular care to see that all recesses in which springs or plungers operate are thoroughly cleaned. Failure to do this may cause malfunctioning at normal temperatures and will certainly do so when the rust-preventive compound congeals at low temperatures. After using the cleaning solvent, be sure to dry all parts with dry, clean cloths. Then follow the instructions in paragraph 24.

■ 30. CARE AND CLEANING UNDER UNUSUAL CONDITIONS.—*a. Care and cleaning in cold climates.*—(1) In extreme cold, the moving parts of the weapon must be kept absolutely free of moisture. Excess oil or rust-preventive compound on the working parts will solidify to such an extent as to cause sluggish operation or complete failure.

(2) Completely disassemble and clean all parts of the gun thoroughly with dry-cleaning solvent before use in temperature below 0° F. The working surfaces or parts which show

signs of wear may be lubricated by rubbing with a cloth which has been dipped in light preservative lubricating oil and wrung out.

(3) When the gun is brought indoors, it should be allowed to come to room temperature. It should then be disassembled, wiped completely dry of the moisture which will have condensed on the cold metal surfaces, and thoroughly oiled, using light preservative lubricating oil.

(4) If possible, this condensation should be avoided by providing a cold place in which to keep the gun when not in use. For example, a separate cold room with appropriate racks may be used or, when in the field, racks may be set up outdoors under proper cover.

(5) If the gun has been fired, it should be thoroughly cleaned and oiled. The bore may be swabbed out with an oily patch and, after the weapon reaches room temperature, thoroughly cleaned and oiled as described in paragraph 26.

(6) Before firing, the weapon should be cleaned and oiled as described in paragraph 25.

(7) *The bore and chamber should be entirely free of oil before firing.*

b. Care and cleaning in tropical climates.—(1) In tropical climates where temperature and humidity are high (or where salt air is present) and during rainy seasons, the weapon should be thoroughly inspected daily and kept lightly oiled when not in use. The groups should be dismounted at regular intervals and, if necessary, disassembled sufficiently to enable the drying and oiling of parts.

(2) Care should be taken to see that unexposed parts and surfaces are kept clean and oiled.

(3) Light preservative lubricating oil should be used for lubrication.

c. Care and cleaning in hot, dry climates.—(1) In hot, dry climates where sand and dust are likely to get into the mechanism and bore, the weapons should be wiped clean daily, or oftener if necessary. Groups should be dismounted and disassembled as far as necessary to facilitate thorough cleaning.

(2) When the weapon is being used under sandy conditions, all lubricant should be wiped from the weapon. This

will prevent sand from sticking to the lubricant and forming an abrasive compound which will ruin the mechanism.

(3) Immediately upon leaving sandy terrain, the weapon must be cleaned and relubricated with light preservative lubricating oil.

(4) Perspiration from the hands is a contributing factor to rust because it contains acid. Therefore, metal parts should be frequently wiped dry.

(5) During sand or dust storms, breech and muzzle should be kept covered if possible.

■ 31. CARE DURING GAS ATTACK.—*a. General.*—(1) It is important to prevent the chemicals used in a gas attack from getting in or on the gun and ammunition. When a gas attack is anticipated, steps are taken to cover and protect the gun, ammunition, mount, spare parts, and accessories.

(2) Apply oil to the surfaces of all the parts of the weapon, to the mount, ammunition, and spare parts.

(3) If the gun need not be used during the gas attack, cover the oiled gun with canvas gun covers or place it in a container so that it cannot come into contact with any contaminating chemicals.

(4) After the attack, clean the matériel with dry-cleaning solvent, if uncontaminated.

(5) Prepare for use as described in paragraph 25 or 26, as required.

b. Decontamination.—(1) A complete suit of impermeable clothing and a service gas mask must be worn during decontamination operations.

(2) Matériel contaminated with chemicals other than mustard or lewisite must be cleaned as soon as possible with dry-cleaning solvent or denatured alcohol.

(3) If the surface of the matériel is coated with grease or oil and has been in a mustard or lewisite attack, first remove the grease or oil by wiping with rags wet with dry-cleaning solvent.

(4) Decontaminate unpainted metal surfaces with a solution of *noncorrosive decontaminating agent*. Prepare this by mixing one part of agent to six and one-fourth parts of solvent, or 2 quarts of agent to 3 gallons of solvent. This

agent acts within 15 minutes, and a second application is recommended.

(5) Decontaminate painted surfaces with a bleaching solution. Prepare this by mixing three parts of the bleaching powder (chloride of lime) with two parts of water by volume. The chloride of lime is allowed to remain 24 hours; a second application is made, to insure complete covering, within a brief period after the first application.

(6) After decontamination, clean the matériel thoroughly and prepare for use as described in paragraph 25 or 26, as required.

(7) Do not allow the chemical agents to come into contact with the skin. Always burn or bury all rags or wiping materials used for decontamination.

c. References.—Detailed information on decontamination is contained in FM 21–40 and TM 3–220.

■ 32. POINTS TO BE OBSERVED BEFORE, DURING, AND AFTER FIRING.—The following list of points to be observed before, during, and after firing will be found useful as a guide for the proper care of the gun. It may also be used as a guide for inspection.

	Before	During	During temporary cessation	After
Bore	Look through and clean		Clean bore	Clean and lightly oil bore with a patch.
Moving parts	Oil and test for worn or broken parts. See that parts function without excessive friction.	Keep oiled	Inspect and oil; clean dirt from belt holding pawl.	Remove bolt, lock frame, barrel extension, and barrel; clean, oil, and release firing pin.
Head space	Make correct adjustment and test (note, par. 11). Examine barrel locking spring.	Tighten if several separated cases occur.	Test	Adjust correctly and test. Examine barrel locking spring.
Rear sight and wind gage.	Clean and free from grease. See that sight is in good mechanical condition. Set sight at 700 and wind gage at zero.	Keep properly set	Keep properly set	Clean and oil. Set sight at 700 and wind gage at zero.
Tripod	Set tripod firmly with no lost motion. Verify that traversing bar sleeve latch is properly seated.	Keep firmly set	Examine	Clean and oil.
Belts and ammunition.	Secure sufficient supply of ammunition. Inspect ammunition. Keep belts dry.	Keep belt in line with feed opening. Watch ammunition supply.		Clean, repair, and refill all belts. Separate live rounds from empty cases. Inspect ammunition.
Oil	See that oilcan is full		Refill oilcan	Refill oilcan.
Spare parts and tools.	Keep clean and oiled. See that kits are complete.	Keep within reach	Make repairs. Replace broken or worn parts.	Check, replace broken or missing parts, clean, and oil.

SECTION IV

MECHANICAL FUNCTIONING

■ 33. GENERAL.—The soldier should have a practical working knowledge of the mechanical operation of the machine gun so that he will be able to keep it in action during combat. Although many parts of the gun operate simultaneously, the subject of functioning is divided into phases to facilitate instruction. The explanation of mechanical functioning begins with the gun assumed to be loaded and ready to fire.

a. To half load.—With cover open or closed, enter belt through feedway from left to right. Pull belt through feedway until the first round is in place on the right of belt holding pawl. Close cover if open. Pull bolt fully to the rear and release it.

b. To load.—Load is executed the same as half load except that bolt is pulled to the rear and released twice.

c. To unload.—Raise cover, remove belt, pull bolt to the rear and hold it, look or feel to see that there is no ammunition in the gun, lower extractor, release bolt, lower cover, and then pull trigger.

d. To clear gun.—Raise cover, remove belt, pull bolt to the rear and *hang* it in its rearmost position by engaging extractor cam plunger in rear of extractor feed cam, and inspect the gun to see that there is no ammunition in it.

e. Division of functioning into phases.—For a method of dividing functioning into phases and demonstrating each phase, see paragraph 241.

■ 34. TRIGGER ACTION.—Since the trigger is pivoted, its forward end is lowered as its rear end is raised. The trigger cams on the front end of trigger, through their engagement with cams on sear, force sear down against the action of sear spring until the shoulder of firing pin is released by sear notch. The firing pin spring then forces firing pin forward to strike primer.

■ 35. BACKWARD MOVEMENT OF RECOILING PARTS (figs. 9 and 10).—The explosion forces the recoiling parts (barrel, barrel extension, and bolt) backward about ⅝ inch. During the

first half of this movement the parts are locked together. When the breech lock clears the breech lock cam, it is forced down by the front projections of the lock frame acting on the breech lock pin. This unlocks the bolt from the barrel extension, permitting the bolt to continue to the rear. As the barrel extension comes to the rear, the barrel plunger spring

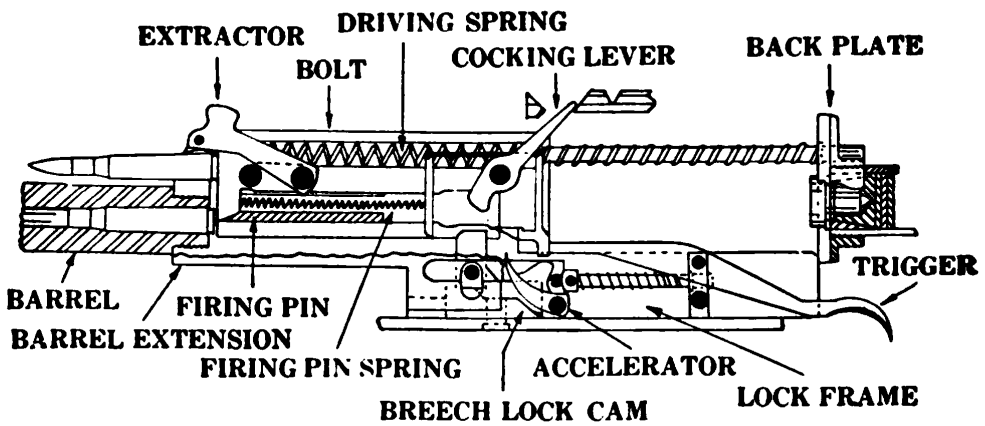


FIGURE 9.—Relation of parts in forward position.

is compressed, and the rear of the barrel extension strikes the accelerator and turns it backward.

■ 36. BACKWARD ACTION OF ACCELERATOR (figs. 9 and 10).— As the accelerator turns backward its tips strike the bottom

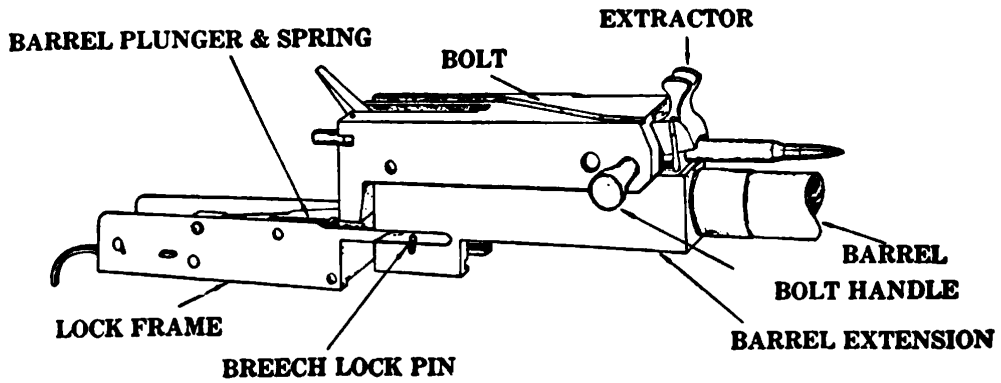


FIGURE 10.—Barrel, bolt, lock frame, and barrel extension in firing position.

projections on the bolt and accelerate it to the rear. The claws of the accelerator engage the shoulder of the T-lug and lock the barrel extension to the lock frame. The barrel plunger spring is thus held compressed. The accelerator stop prevents the accelerator from turning backward too far.

■ 37. BACKWARD MOVEMENT OF BOLT (figs. 9 and 11).—As the bolt moves backward the driving spring is compressed. The bolt brings with it a cartridge from the belt, held by the extractor, and an empty case from the chamber, held in the T-slot. The extractor cam plunger rides along the top

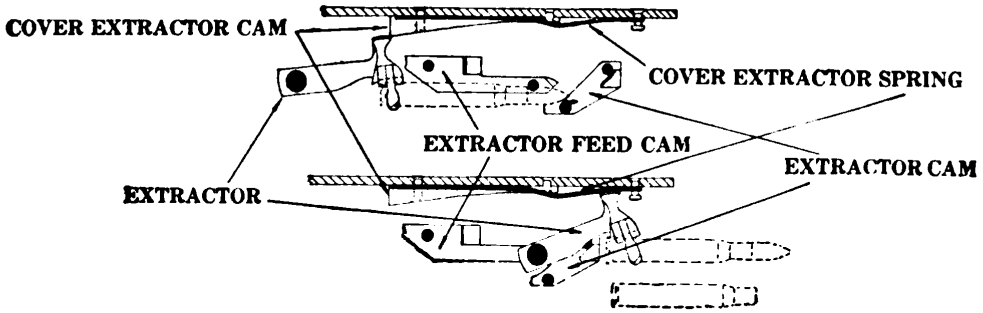


FIGURE 11.—Extracting and loading mechanism.

of the extractor cam and extractor feed cam until forced in by the beveled part of the extractor feed cam. This permits the extractor to be forced down by the cover extractor cam, and the plunger springs out behind the extractor feed cam.

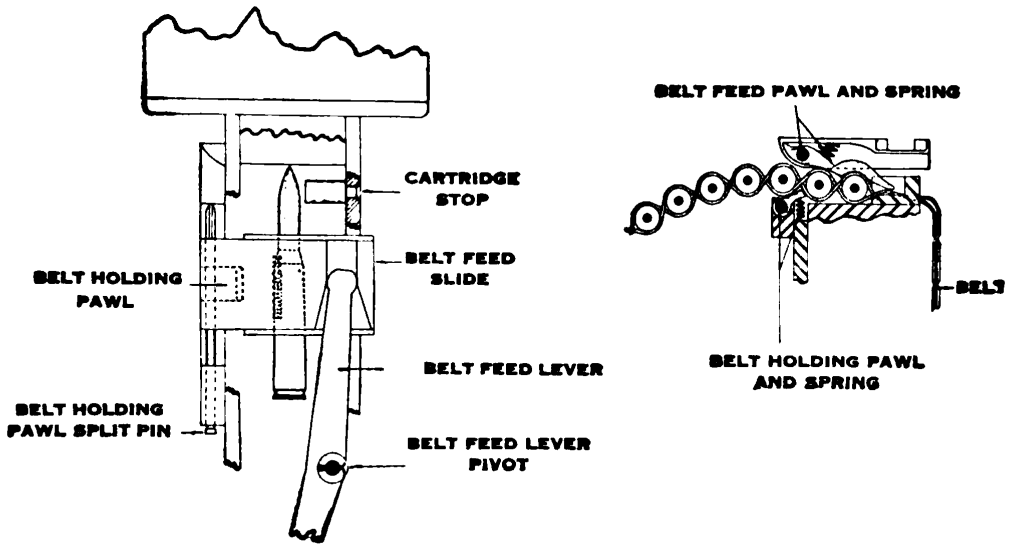


FIGURE 12.—Belt feed mechanism.

■ 38. FIRST ACT OF FEEDING (fig. 12).—As the bolt moves backward, the stud on the pivoted belt feed lever moves to the right in the cam groove, thus forcing the belt feed slide to the left. The belt feed pawl engages on the left of the first cartridge which is held in position by the belt holding pawl. In the event the extractor fails to withdraw the lead-

ing round from the belt, the finger of the belt feed pawl, riding on the top of this unextracted round, will hold the feed pawl raised in a position where it cannot engage on the left of the next cartridge. It thus prevents attempted double feeding.

■ 39. COCKING ACTION (fig. 13).—As the bolt moves backward, the upper end of the cocking lever is forced forward in the cocking lever recess, bringing the lower end to the rear. The lower end brings with it the firing pin, thus compressing the firing pin spring against the sear spring pin.

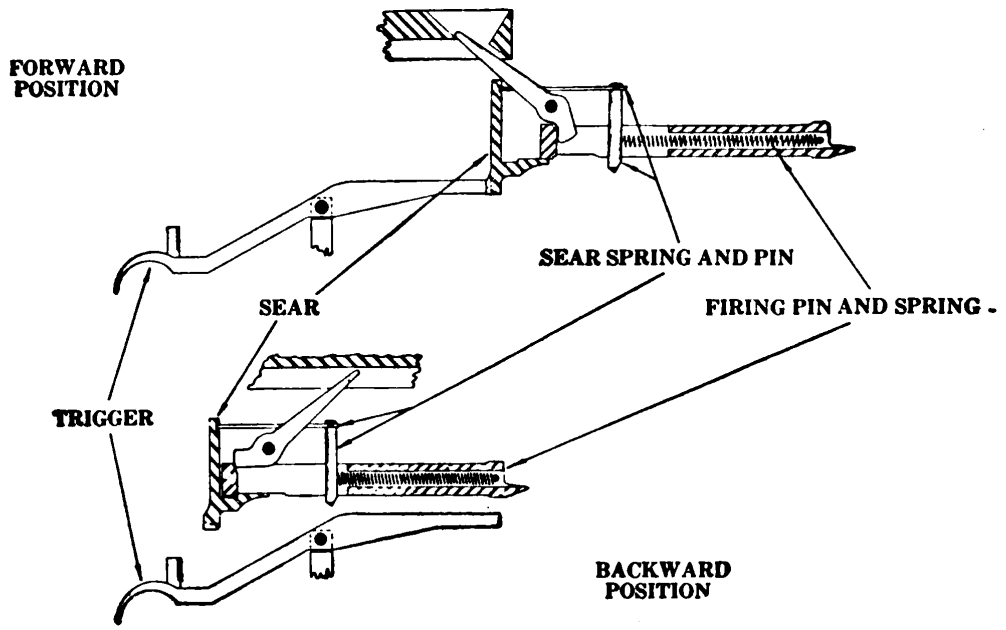


FIGURE 13.—Cocking mechanism.

The shoulder of the firing pin engages the notch in the sear, which is pulled upward by the action of the sear spring, the trigger cams now being disengaged from the sear.

■ 40. ACTION OF DRIVING SPRING (fig. 14).—When the rear of the bolt strikes the buffer plate, its remaining force is absorbed in the coiled spiral spring and the buffer disks. The force of the rearward motion of the bolt being absorbed by the buffer mechanism, the driving spring then forces the bolt forward.

■ 41. FORWARD MOVEMENT OF BOLT (figs. 11 and 13).—When the bolt starts forward, the extractor is guided downward by

the action of the extractor feed cam on the extractor cam plunger. This causes the extractor to force the cartridge down the T-slot in line with the chamber. The ejector knocks the empty case from the T-slot and holds the cartridge in line with the chamber. The upper end of the cocking lever is forced backward, causing the lower end to move forward away from the rear of the firing pin. If the firing pin is prematurely released, it is reengaged by the cocking lever and eased forward so that the striker cannot contact the cartridge primer until after the breech has been locked.

■ 42. RELEASE OF RECOILING PARTS (fig. 14).—As the bolt goes forward its bottom projections strike the accelerator and turn it forward. This unlocks the barrel extension from the lock

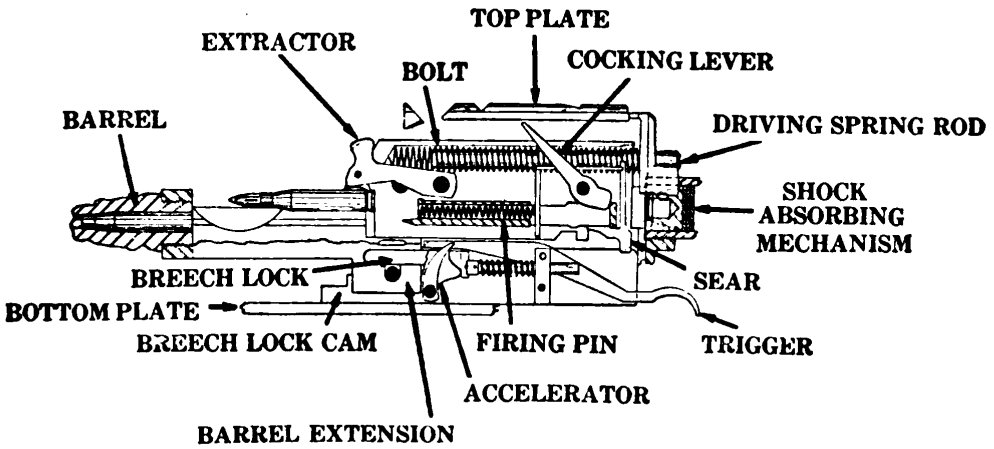


FIGURE 14.—Relation of parts in backward position.

frame and releases the barrel plunger spring. When the accelerator has been tripped, the barrel extension and the barrel are moved forward by the forward force of the bolt acting through the accelerator and by the expansion of the barrel plunger spring.

■ 43. LOADING AND LOCKING ACTION (figs. 11 and 14).—During the latter part of the forward movement of the bolt, the extractor rises as the plunger moves along the top of the extractor cam. When the extractor rises, the ejector is cammed outward, into the half-moon-shaped recess, leaving the cartridge in the chamber gripped by the T-slot. The extractor grips the first round in the belt and is held down firmly by the cover extractor spring, ready to extract the

round. The breech lock is forced upward by the breech lock cam and locks the breech just before the recoiling parts reach the firing position. The breech lock engages in a recess cut in the bottom of the bolt and thus locks the bolt firmly to the barrel extension and against the rear end of the barrel.

■ 44. SECOND ACT OF FEEDING (fig. 12).—As the bolt goes forward the stud on the pivoted belt feed lever moves to the left in the cam groove, forcing the slide to the right. The belt feed pawl carries the first cartridge to the right against the cartridge stops, ready to be gripped by the extractor. The next cartridge is carried over the belt holding pawl which rises behind it and holds it in position to be engaged by the belt feed pawl on its next movement to the left.

■ 45. TRIGGER ACTION IN AUTOMATIC FIRE (figs. 9, 13, and 14).—If the trigger is held raised, as the sear moves forward with the bolt the trigger cams engage the sear cams and force the sear down, releasing the firing pin. The gun thus fires automatically, repeating the operations of functioning already described. The release of the firing pin actually takes place about $\frac{1}{16}$ inch before the recoiling parts reach the forward position but after the breech is locked.

SECTION V

STOPPAGES AND IMMEDIATE ACTION

■ 46. DEFINITIONS.—*a.* A "stoppage" is any unintentional cessation of fire.

b. "Immediate action" is the procedure used for the prompt reduction of usual stoppages.

■ 47. STOPPAGES.—*a. Prevention.*—Stoppages will be reduced to the minimum if the gunner has a practical working knowledge of his weapon and applies the points which should be observed before firing. *Prevention is the best remedy for all stoppages.*

b. Causes.—(1) A stoppage will occur if the gun fails to feed, fails to load, fails to fire, or fails to function freely.

(*a*) If the gun fails to feed, the cause for the stoppage will be found in the ammunition belt or in the feed mechanism.

(*b*) If the gun feeds but fails to load, the cause will be found in the receiver. A broken part or an obstruction on the T-slot or in the chamber is the usual cause.

(*c*) If the gun feeds and loads but fails to fire, the cause will be found in the firing mechanism unless the primer of the cartridge is defective.

(2) The table following includes a comprehensive list of possible stoppages. It will serve as a guide during instruction in stoppages or immediate action.

TABLE OF STOPPAGES

Stoppages	Method of preparation for instruction in immediate action and stoppages
1. Misfire due to defective primer.	1. Place a dummy cartridge in belt.
2. Short round.	2. Place a short round in belt.
3. Bulged round.	3. Insert bulged round in belt.
4. Tight loop in belt.[1]	4. Do not prepare.
5. Empty loop in belt.	5. Leave an empty loop in belt.
6. Stretched or torn belt.[1]	6. Do not prepare.
7. Thin rim, permitting nose of bullet to drop below chamber.[1]	7. Do not prepare.
8. Belt imporperly loaded.	8. Pull a cartridge partially out of belt.
9. Battered or thick rim of cartridge.	9. Place a battered or a thick-rimmed cartridge in belt.
10. Failure to remove round from chamber.	10. Place a dummy cartridge with rim filed off in the chamber.
11. Set back primer.[1]	11. Do not prepare.
12. Separated case which is removed from chamber by new round when bolt is pulled to the rear.	12. Drive the front portion of a cartridge securely on a dummy cartridge. Pull bolt to the rear and place cartridge properly on the face of bolt. Ease bolt forward.
13. Separated case, which stays in chamber when bolt is pulled to the rear. (Do not set up loose head space.)	13. Insert the front end of a separated case in chamber and load.
14. Bullet loose in cartridge case. Cartridge case extracted from belt but bullet remains in belt.[1]	14. Do not prepare.
15. Short or broken firing pin.	15. Assemble bolt with a defective firing pin or place 5 or 6 successive range dummy cartridges in belt for instruction in immediate action.
16. Weak or broken firing pin spring.	16. Same as 15.

TABLE OF STOPPAGES—Continued

Stoppages	Method of preparation for instruction in immediate action and stoppages
17. Faulty engagement of firing pin and sear notch.	17. Assemble bolt with defective parts.
18. Broken sear spring.	18. Same as 17.
19. Belt feed lever pivot out, worn, or broken.	19. Assemble cover with defective part.
20. Bent or worn belt feed lever.	20. Same as 19.
21. Belt feed pawl spring out or weak.	21. Remove belt feed pawl spring.
22. Belt feed pawl pin out or partially out.	22. Remove belt feed pawl pin.
23. Cover extractor spring out or weak.	23. Remove cover extractor spring.
24. Belt feed lever bent up (stud on lever jumps out of cam groove).	24. Assemble with defective part.
25. Damaged extractor.	25. Same as 24.
26. Belt holding pawl out or spring weak.	26. Remove belt holding pawl.
27. Broken extractor or ejector.	27. Assemble bolt with defective part.
28. Broken or damaged T-slot, causing misalinement and buckling of cartridge as bolt moves forward, or failure to extract.[1]	28. Do not prepare.
29. Weak ejector spring causing misalinement and buckling of cartridge as bolt goes forward.	29. Assemble with defective part.
30. Broken barrel extension or lock frame.	30. Assemble with defective part.
31. Defective trigger mechanism.[2]	31. Do not prepare.

[1] Not prepared for instruction in immediate action.
[2] Defective trigger mechanism may cause the gun to begin firing as soon as it is loaded or to continue to fire when the trigger is released. To remedy, unlatch the cover or twist the belt, unload, dissemble the gun, and replace the defective part or parts.

(3) Sluggish operation of the gun is usually due to excessive friction caused by dirt, lack of proper lubrication, burred parts, tight head space, maladjustment of the buffer assembly, or a weak driving spring.

c. Tools used in reduction of stoppages.—The tools commonly used in the application of immediate action are the ruptured cartridge extractor, the combination tool, and the cleaning rod.

(1) (*a*) A ruptured cartridge case in the chamber prohibits the entrance of the succeeding round. The ruptured cartridge extractor, commonly called "clearing plug," is used to

remove the ruptured case. This tool is furnished in two types, the cartridge form and the Mk. IV.

1. To use the cartridge form, open cover, place ruptured cartridge extractor on feedway against cartridge stops, and engage it with extractor on bolt. Holding down on extractor, load it *slowly* and *smoothly* into chamber, being careful to see that the shoulder does not strike and bur the edge of chamber. Strike forward on bolt handle to be sure that ruptured cartridge extractor is seated in ruptured case. Pull bolt to the rear and catch ruptured cartridge extractor in the left hand as it is ejected.

2. To use the Mk. IV, draw bolt handle to the rear and hang it. Insert nose of ruptured cartridge extractor in chamber, handle up, push it forward to seat it firmly in the separated case, then pull backward on handle.

(*b*) Separated cases should be removed from the ruptured cartridge extractor so that it will again be ready for use. To do this, the end of the ruptured cartridge extractor must be unscrewed, the separated case taken off, and the end screwed on again.

(2) The use of the combination tool facilitates the removal of a round which is stuck on the T-slot. To remove a round from the T-slot, pull bolt fully to the rear and raise extractor. If the round does not fall out, remove it with the combination tool. If the round is above the bolt handle slot, insert screw driver end of tool through slot and under the rear end of cartridge and pry it up. If the round is below the slot, place screw driver end of tool through top of receiver into cannelure of cartridge and drive it down.

(3) The cleaning rod is used to remove a case from the chamber which has not been extracted by the bolt. To remove the case from the chamber, pull bolt fully to the rear and hold it. Remove the following round from the T-slot. Grasp cleaning rod about 6 inches from the end, insert it into muzzle, and force case from chamber. Care should be used not to damage the face of the bolt by striking it as the rod is shoved through the bore.

d. Inspection of feed mechanism.—In event of recurrent or permanent failure to feed, the feed mechanism must be inspected and the defective part replaced. This inspection should include the following:

(1) *Belt feed lever and slide.*—(*a*) With the bolt forward, lower cover, making sure that stud on feed lever is in cam groove in the top of bolt.

(*b*) Press to the left on belt feed slide to remove the play and note whether or not the slide protrudes to the right of the cover about 1/32 inch.

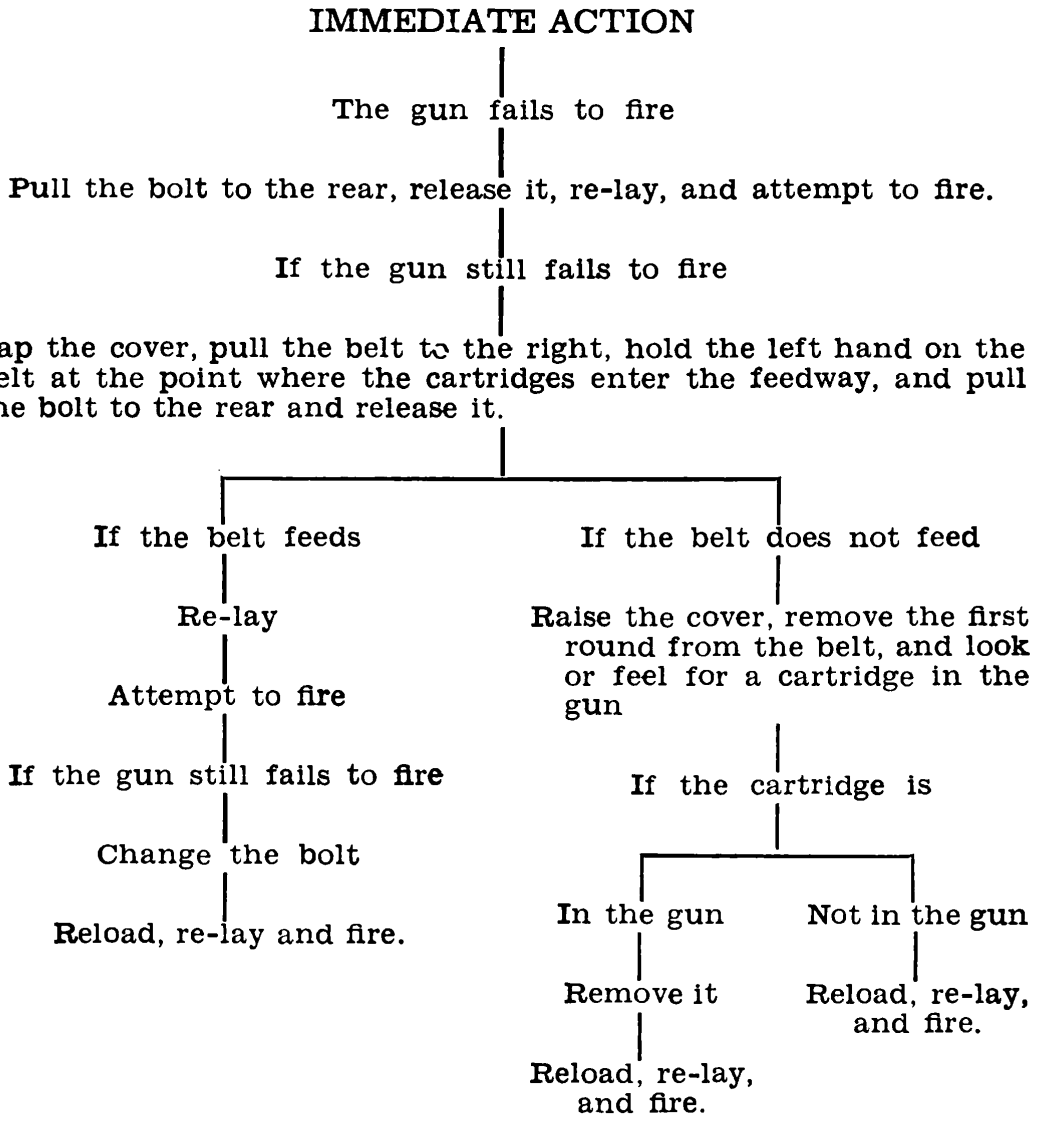
1. If it does not, change belt feed lever and pivot.
2. If it does, and the gun has occasionally failed to feed, examine belt feed lever for excessive wear at the pivot and stud. Also see that stud projects a sufficient distance from cover to insure that it is positively positioned in cam groove in the top of bolt when cover is closed. Replace defective parts.

NOTE.—If the belt feed slide does not extend 1/32 inch beyond the right side of the cover, the cartridge may not be correctly positioned and the extractor may strike the base of the cartridge, force the bullet into the case, and cause a short round. The resulting failure to load the cartridge is thus caused by a worn or bent belt feed lever, or a defective slide. The base of such a cartridge will show evidence of having been hit by the extractor.

(2) *Other parts.*—If the slide positions properly and no excessive play exists, examine cover extractor spring; belt feed pawl, spring, and pin; belt holding pawl and spring; extractor including ejector; spring and cam plunger; and T-slot, to see that these parts are there, in good condition, and that springs are sufficiently strong to actuate the parts properly.

■ 48. IMMEDIATE ACTION.—*a. General.*—The procedure prescribed in immediate action for the reduction of stoppages is based on the frequency with which the various types of stoppages occur. Execution of this procedure by the gunner will enable him to remedy the majority of stoppages immediately without attempting to analyze the cause. Immediate action is performed by the gunner. All personnel required to fire the machine gun should be proficient in immediate action. Immediate action must be carried out quickly and, with practice, should become instinctive.

b. Procedure.—The procedure for immediate action is shown in the following diagram:



NOTES.—1. If the procedure outlined above does not place the gun in action, the gunner must inspect the feed mechanism and the working parts of the gun to include inspecting the chamber for a ruptured case in order to locate and reduce the stoppage.

2. If the bolt stops just short of *home,* frequently it can be pushed fully forward and firing continued without application of immediate action. *Caution:* Release the trigger before pushing the bolt forward.

3. Stoppages caused by defective feed mechanism can sometimes be remedied temporarily by pulling the belt to the right with just sufficient force to assist the feed mechanism in positioning the leading round.

4. Immediate action is not complete until the gun has been re-layed and fired.

SECTION VI

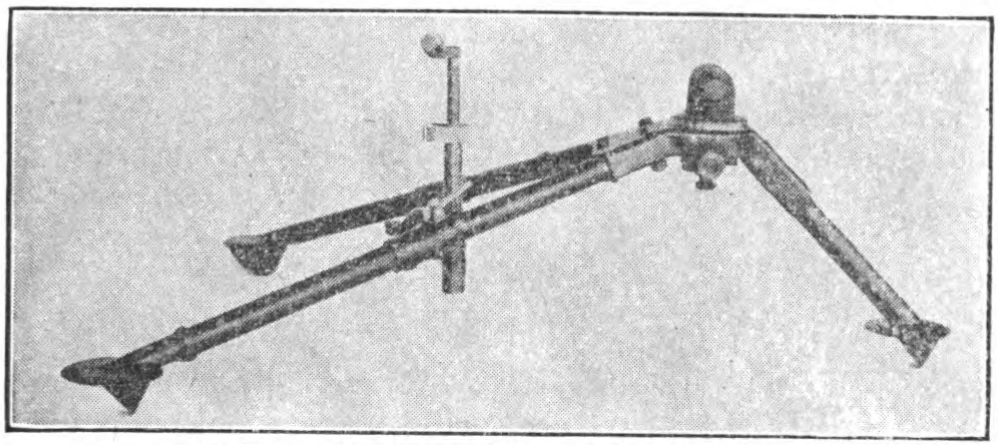
TRIPOD MOUNTING

■ 49. LIGHT MACHINE GUN TRIPOD MOUNT M2.—*a.* This tripod (fig. 15) is a simple mount for the light machine gun and is designed to furnish the gun with a stable mount embodying the maximum strength and rigidity consistent with desired light weight. It is portable, easily packed, and may be used for the delivery of accurate fire on ground targets.

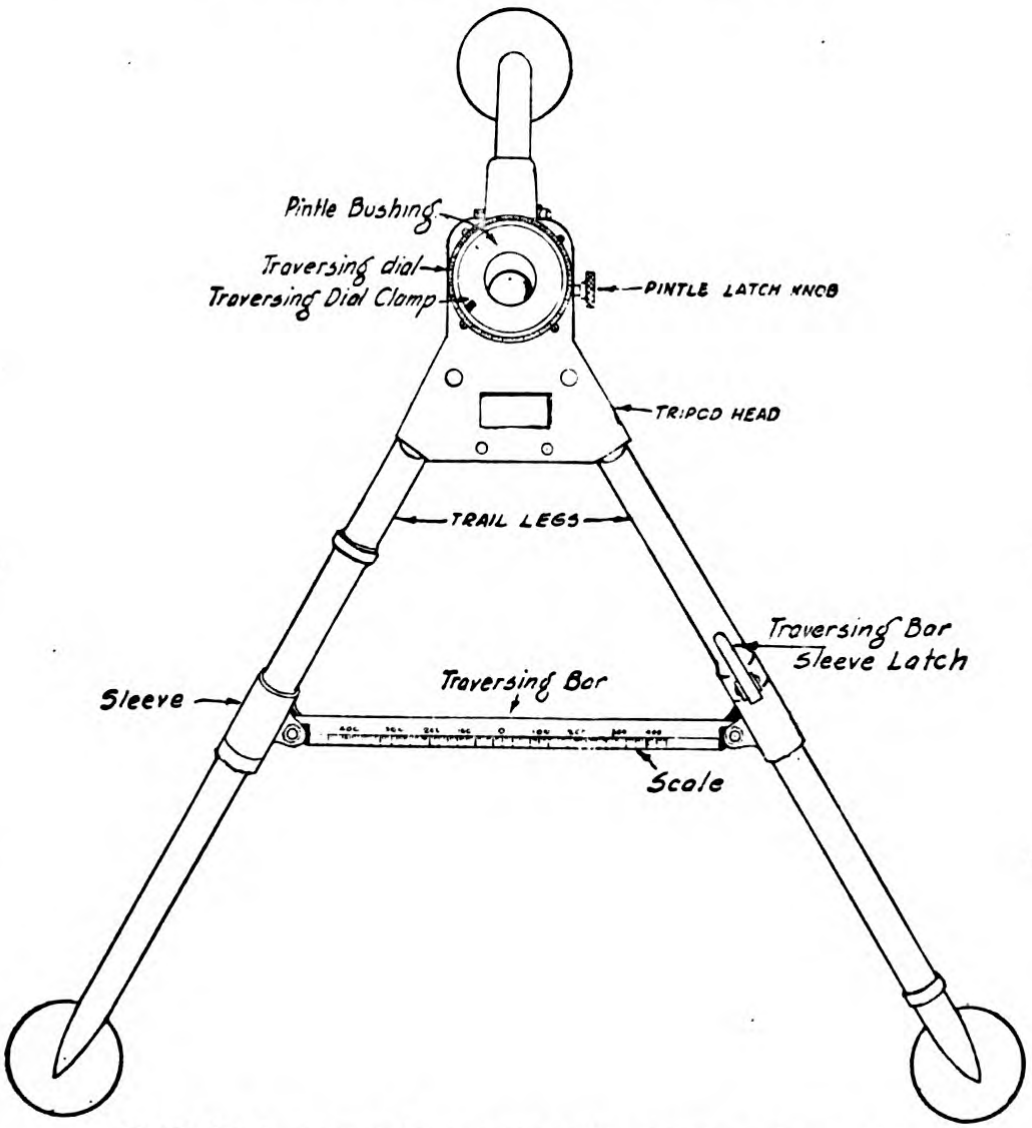
b. The tripod consists of three tubular steel legs articulating in a tripod head, the two trail legs being joined and additionally supported by a traversing bar, forming a simple A-truss, and serving as a rear support for the mounted gun. The tripod head furnishes a front support for the mounted gun, it being in turn supported by the short front leg.

c. Incorporated in the tripod head (fig. 16) is a bronze bushing, mating with the tapered steel pintle permanently secured to the receiver of the light machine gun. The pintle is secured in its union with the bushing by engagement of the pintle latch of the tripod in its corresponding annular groove of the pintle (upper groove). The pintle latch is spring actuated and is seated in its housing on the lower right surface of the tripod head.

d. Tripods manufactured prior to the summer of 1942 have a traversing dial graduated in major divisions of 100 mils and minor subdivisions of 25 mils, from zero to 3,200 mils in both directions, fitted to the head of the tripod by the flange of the bronze pintle bushing. This dial is free to rotate but may be clamped in any desired position by the traversing dial clamp. This clamp is actuated by the knurled head of the traversing dial clamp which is located under the left lower surface of the tripod head. A zero index engraved on the left rear quadrant of the pintle is utilized in conjunction with the traversing dial to establish or measure horizontal angles.

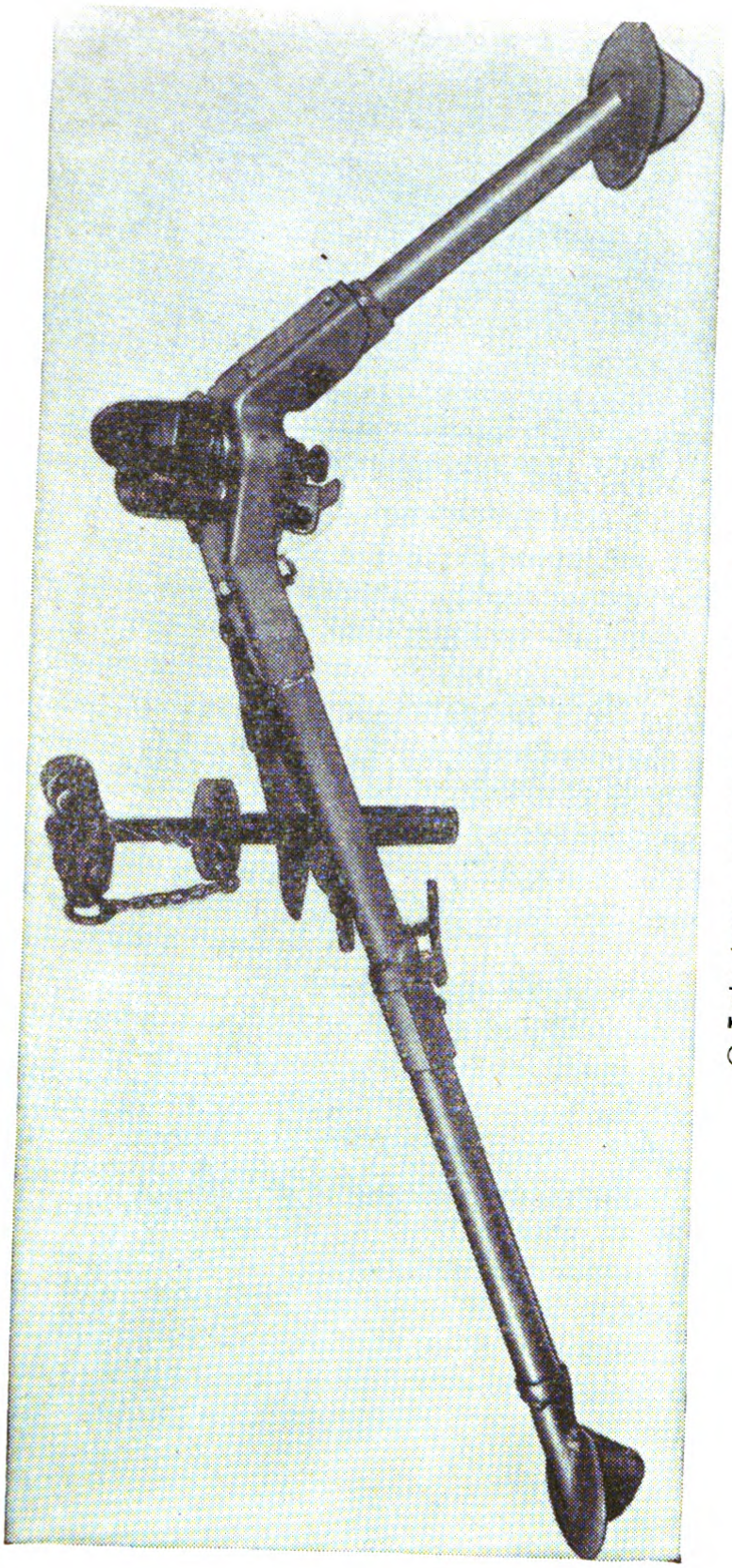


① Early type machine-gun tripod M2.



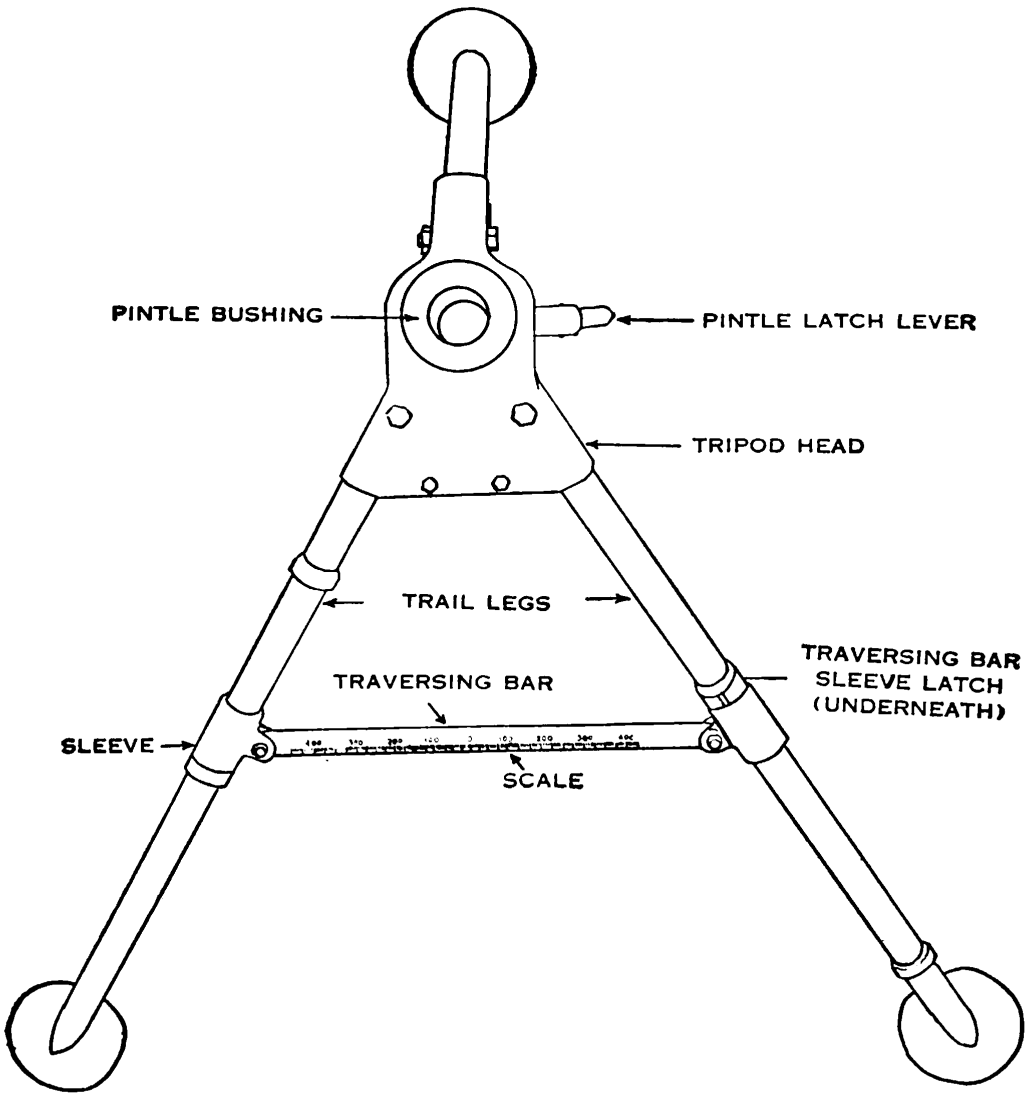
② Early type machine-gun tripod M2—schematic.

FIGURE 15.



① Late type, machine-gun tripod M2.
FIGURE 16.

e. The traversing bar provides a rear support for the mounted gun, the traversing slide of the elevating and traversing mechanism mating with the bar. An additional device for measuring or establishing horizontal angles is incorporated in the scale engraved on the traversing bar. This scale is divided into 100-mil major divisions and 5-mil



② Late type, machine-gun tripod M2—schematic.
FIGURE 16—Continued.

minor subdivisions. It has a range of 450 mils to the right and 425 left of the zero graduation.

f. The traversing bar articulates in sliding sleeve devices at each end, the sleeves moving along the trail legs in mounting and dismounting the tripod. Positioning stops are incorpo-

rated on the trail legs, positively positioning the traversing bar in both the mounted and dismounted positions of the tripod. The traversing bar sleeve latch, mounted on the right trail leg, secures the traversing bar in its proper position when the tripod is mounted.

■ 50. DISASSEMBLING AND ASSEMBLING OF LIGHT MACHINE GUN TRIPOD M2.—*a.* The disassembly and assembly of the parts of the light machine gun tripod are not essential except to replace broken or damaged parts.

b. The front leg articulation with the tripod head, the rear leg articulations with the tripod head, and the articulations of the traversing bar with its sleeves are standard commercial bolts with lock washers and nuts to fit. Spare bolts, nuts, and washers are carried in the spare parts chest. All these unions must be kept tight to insure accurate firing.

c. The pintle latch housing is secured to the tripod head by standard commercial cap screws and suitable lock washers. Spare cap screw and washer and pintle latch spring are carried in spare parts chest.

d. The traversing bar-sleeve latch is pivoted on the right trail leg by rivet assembly.

e. The pintle bushing is of bronze and is a pressed fit into the tripod head. It may be removed by pressing it out and may be replaced by new bushing. Removal of the pintle bushing frees the traversing dial. This disassembly is preferably done by Ordnance Department personnel.

f. The traversing dial clamping mechanism, seated in its recess in the tripod head, may be removed by first removing the small hexagonal lock nut on the foot of the clamp, then the knurled clamp nut. This permits the clamp being removed from the top of the tripod head. This disassembly is preferably done by Ordnance Department personnel.

SECTION VII

ACCESSORIES

■ 51. PACK EQUIPMENT.—Special pack equipment for use with the light machine gun consists of—

1 tripod and gun hanger

1 ammunition hanger
3 ammunition chests
1 spare parts chest
1 gun cover, canvas
1 spare barrel canvas case.

■ 52. HANGERS.—*a. Tripod and gun hanger.*—(1) This pack hanger is a light duralumin and steel hanger, accommodating the tripod, the light machine gun, and the spare parts chest. It fits the standard Phillips cavalry pack saddle and is carried on the right side, hung on the horizontal supporting member of the saddle by steel reinforced hooks of the main supporting members of the hanger and secured by two hold-down straps.

(2) The spare barrel canvas case with contents is habitually carried strapped to the lower horizontal member of the hanger to balance the pack load laterally. The case should be carried with the opening to the rear. When ammunition has been expended, the case with contents may be strapped to the lower horizontal member of the ammunition hanger on the left side to retain lateral balance of the pack load.

b. Ammunition hanger.—This hanger is of duralumin and steel construction, accommodating three ammunition chests, and is habitually carried on the left side of the standard Phillips cavalry pack saddle. The hanger is symmetrical longitudinally and may be used on either side of the Phillips cavalry pack saddle in case an extra ammunition pack horse is utilized to transport ammunition for the light machine guns of a horse cavalry organization.

■ 53. CHESTS.—*a. Ammunition chests.*—The ground light machine gun is provided with ammunition chest M1, or the same chest adopted for use with the machine gun M1917A1.

b. Spare parts chest.—The authorized contents of the spare parts chest are listed in SNL No. A–6.

■ 54. COVERS.—*a.* The canvas gun cover is provided to protect the gun.

b. The spare barrel canvas cover is designed to accomodate an assembled barrel and barrel extension assembly.

■ 55. BELT FILLING MACHINE (fig. 17).—*a. General.*—This machine is for the rapid filling of fabric (web) belts. It is normally fastened to a table or bench while in use.

b. To fill a web ammunition belt with cartridges.—(1)

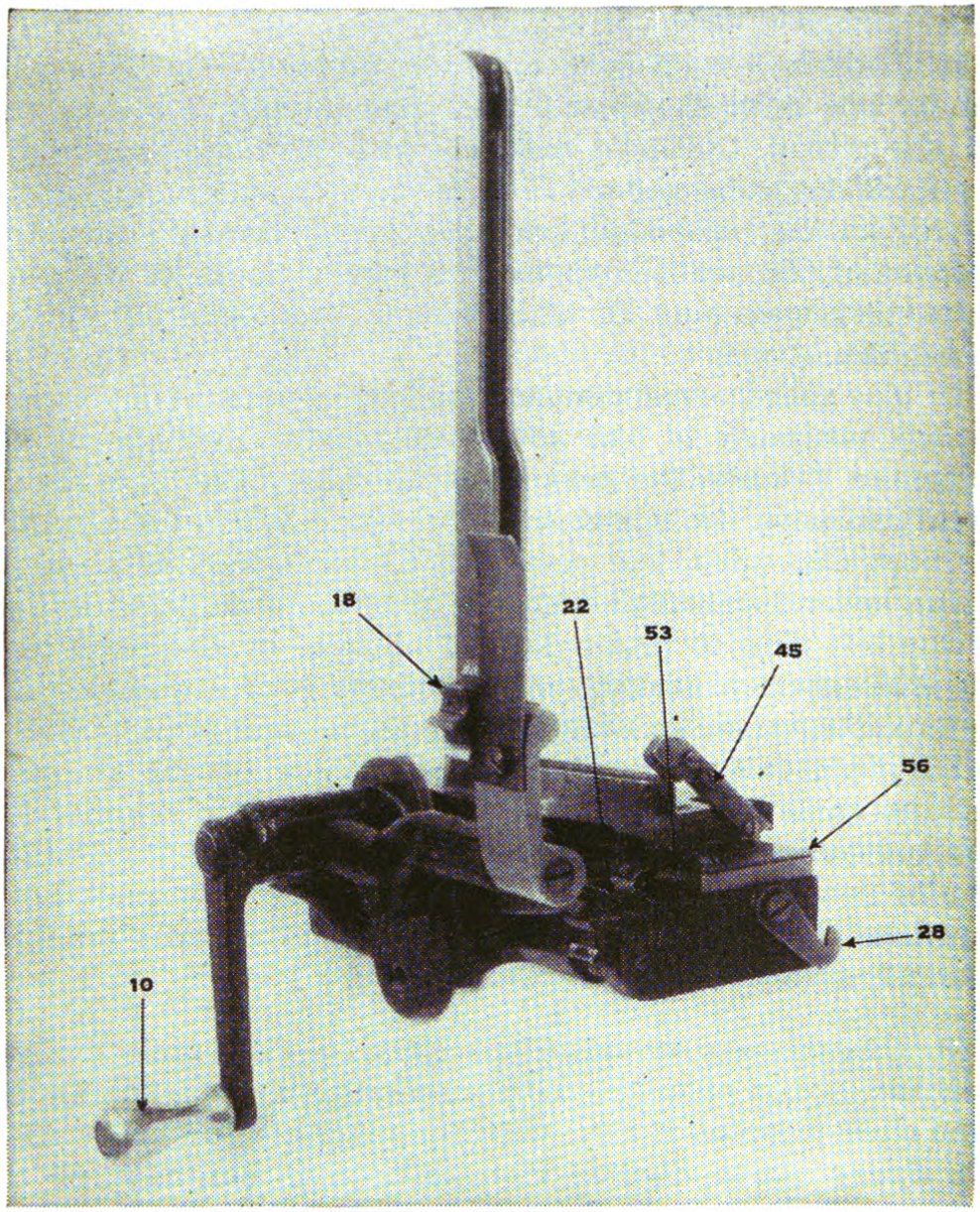


FIGURE 17.—Belt filling machine (web belts).

Fasten machine to a table or bench and turn crank (10) to the *right* until it is straight down.

(2) Release tension spring hook (28) and raise upper feed wheel (18) as far as it will go.

(3) Turn belt guide cover (56) to the right far enough to

admit belt into belt guide (53) and raise upper needle bar (45) as far as it will go.

(4) A black thread running along the side of the belt indicates the side for the entrance of the cartridge. Put two cartridges by hand into the two loops of the belt nearest the end with the brass tip, and place belt in machine with first cartridge resting in top groove of lower feed wheel (22), belt passing out at back through belt guide.

(5) Return belt guide cover to place over belt (being careful to see that the belt is free to pass under it), and lower needle bar.

(6) Turn upper feed wheel down upon belt and secure tension spring under hook.

(7) Fill feed guide with cartridges by stripping ten at a time from the paper boxes in which they are packed.

(8) Turn crank to the right and the cartridges will be fed into the belt ready for use in the gun.

(9) Place a feed box ready to receive the filled belt and at such a height that not more than 2 feet of filled belt will be suspended from the feed wheels of the machine.

c. Precautions for using the belt filling machine for web belts.—(1) Before using the machine, see that it is well oiled, that all screws are tight, and that the needles are properly set. See that the points of the upper needles are about 0.01 inch vertically above the points of the lower needles.

(2) In case of a miss in loading the belt, stop and open up machine and remove belt. Turn crank to the right until straight down, as in starting, and replace belt in machine with the *next to the last* cartridge in top groove of lower feed wheel. Close machine and proceed as before.

(3) After use, the machine should be cleaned, oiled, adjusted, and replaced in its wooden box.

■ 56. BLANK AMMUNITION ATTACHMENTS (fig. 18).—*a. General.*—The blank ammunition attachments for use with the machine gun have been developed in order to simulate fire. The attachments are designed to fire blank ammunition M1909.

(1) The *cartridge stop attachment* is inserted by withdrawing the belt holding pawl split pin about ½ inch and sliding the attachment over the cartridge stop, lining up the small hole with the belt holding pawl split pin and replacing this pin. The cartridge stop attachment acts as a guide for the blank cartridge and also as a cartridge stop. Its chief use is to hold the cartridge in position in feedway so that the extractor may engage its cannelure; it also prevents the entrance of a live round into the feedway.

(2) The *muzzle attachment* is assembled to the gun by removing the front barrel bearing, sliding the threaded end of the attachment over the barrel, and screwing it into the barrel jacket.

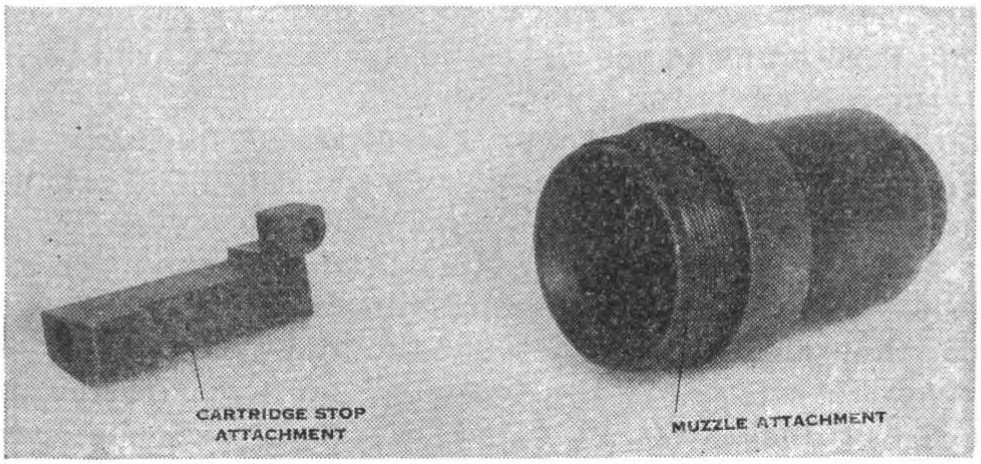


FIGURE 18.—Blank firing attachments.

b. Precautions.—(1) Never attempt to use the muzzle attachment unless the cartridge stop attachment is in its proper place in the feedway.

(2) Always remove the muzzle attachment before removing the cartridge stop attachment in order to eliminate the possibility of firing ball ammunition with the muzzle attachment still in position.

(3) See that the muzzle attachment is clean inside before using.

(4) After firing blank ammunition, clean the barrel and muzzle attachment. It is absolutely essential that this be done before firing any other type of ammunition.

■ 57. SPARE BARREL.—A spare barrel is issued for each light machine gun. In pack, this barrel is carried on the gun and tripod hanger. Under field conditions the barrel, barrel extension assembly, barrel locking spring, breech lock, and breech lock pin assembly should be assembled into one unit and carried in the spare barrel cover.

■ 58. ASBESTOS MITTENS.—One pair of asbestos mittens is issued for use with each machine gun to facilitate the handling of the gun when hot, particularly when moving to a new position by hand, and in changing barrels.

SECTION VIII

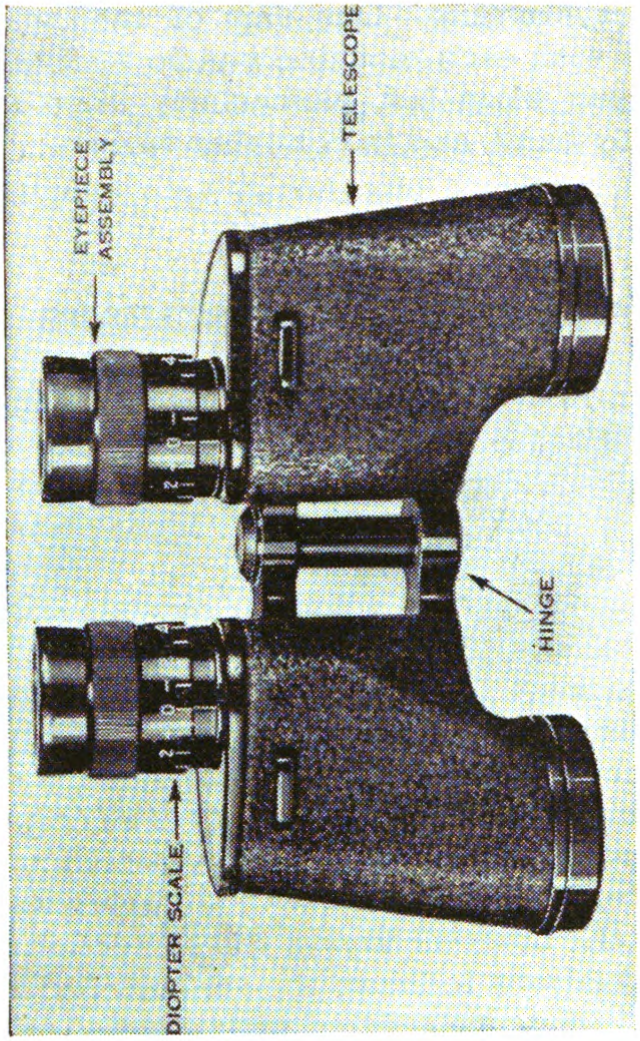
FIRE CONTROL INSTRUMENTS

■ 59. BINOCULARS.—There are two binoculars in use in the service: the M3 (fig. 19 ①) and the type EE (fig. 19 ②). The M3 will eventually replace the type EE. The paragraphs below apply to both models. Each model consists of the binocular with its carrying case.

a. Description.—(1) The binocular consists of two compact prismatic telescopes pivoted about a common hinge which permits adjustment for interpupillary distances. A scale, graduated every 2 millimeters from 56 to 74, permits the observer to set the telescope rapidly to suit his eye distance when the spacing of his eyes is known. The eyepieces can be focused independently for each eye by screwing them in or out. Each eyepiece is provided with a diopter scale for rapid setting when the observer knows the correction for his eye. The zero graduations indicate the settings for normal eyes.

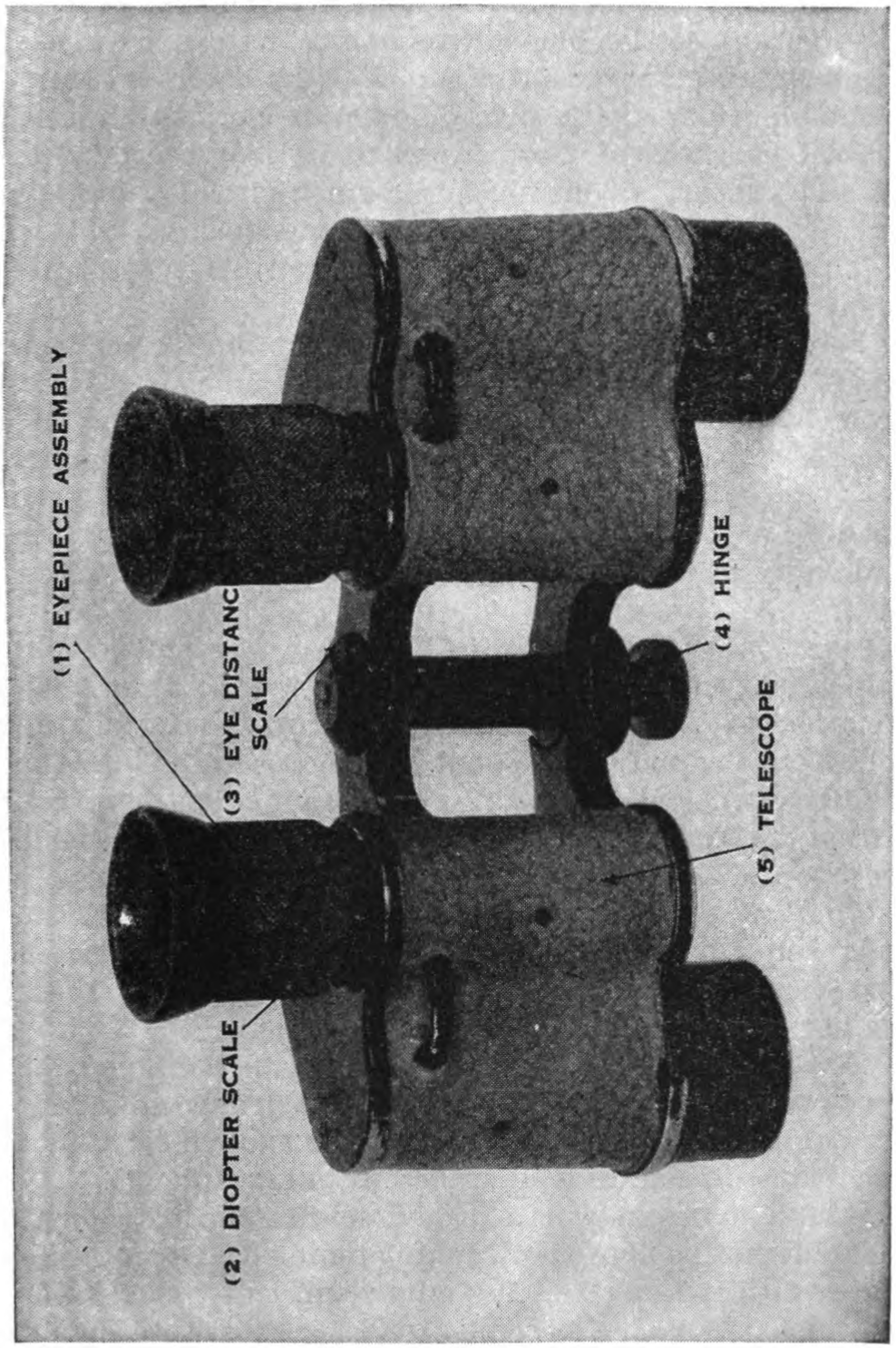
(2) The left telescope is fitted with a glass reticle (fig. 20) upon which are etched a vertical mil scale, a horizontal mil scale, and a stadia graduated similarly to the sight leaf graduation on the service rifle, but inverted.

b. Use.—The binocular is used for observations and the measurement of small horizontal and verticle angles in mils. The vertical stadia scale is used to pick up auxiliary aiming marks in direct laying and to determine troop safety for overhead fire.



① Binocular M3.

FIGURE 19.—Fire control instruments.



② Binocular type EE.

FIGURE 19.—Fire control instruments—Continued.

c. Preliminary adjustments.—(1) *Interpupillary distances.*—To adjust the binocular so that the eyepieces are the same distance apart as the pupils of the observer's eyes, point the binocular at the sky and open or close the hinged joint until the field of view ceases to be two overlapping circles and appears as one sharply defined circle. Note the reading on the scale which indicates the spacing of the eyes. This setting will be the same on any other M3 or type EE binocular for the same individual.

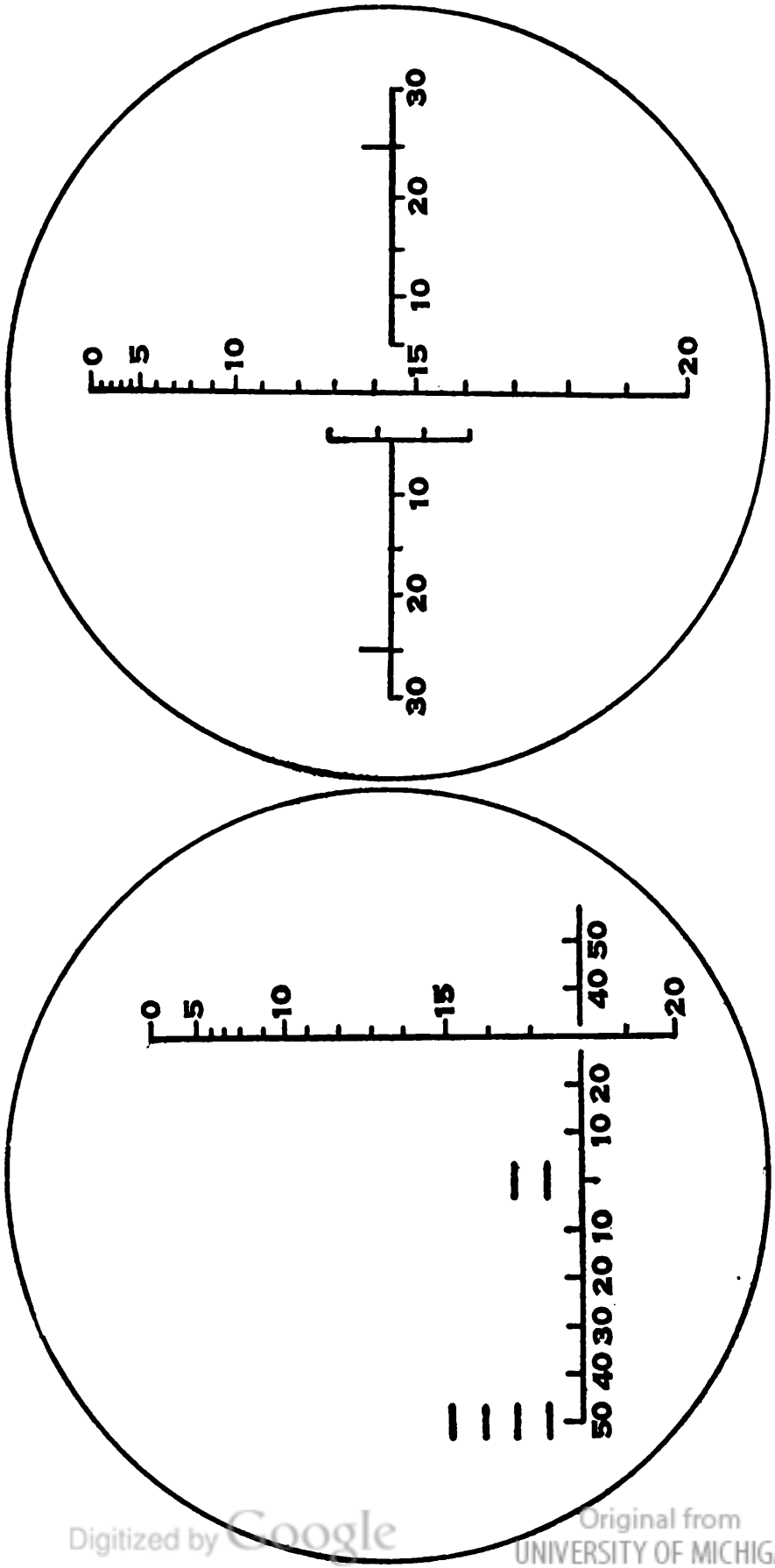
(2) *Focus of eyepiece.*—Look through the binocular, with both eyes open, at an object several hundred yards away. Place the hand over the front of one telescope and screw the eyepiece of the other in or out until the object is sharply defined. Repeat this operation for the other eye, and note the reading on each diopter scale. This setting will be the same on any other M3 or type EE binocular for a given indivual.

d. Operation.—(1) In using the binocular, it should be held in both hands and pressed lightly to the eyes so as to keep the relation with the eyes constant without transmitting tremors from the body. The bent thumb should fit into the outer edges of the eye sockets in such a manner as to prevent light from entering in rear of the eyepieces. When possible it is best to use a rest for the binocular or for the elbows.

(2) The mil scales are seen when looking through the binocular end, by superimposing them upon the selected objects, the horizontal and vertical angles between these objects may be read.

(3) The inverted sight leaf scale of the type EE binocular is used to secure range settings on sharply defined auxiliary aiming points when the target is not clear enough for direct aiming. This procedure is described in paragraph 199.

e. Care.—The binocular is a rugged, serviceable instrument but it should not be abused or roughly handled. Do not wipe the lenses with the fingers. Use only clean lens tissue paper to wipe the lenses if they become dirty. No substitute should ever be used for this purpose. The use of polishing liquids or pastes for polishing lenses is forbidden.



② Binocular type EE.

① Binocular M3.

FIGURE 20.—Reticles.

■ 60. WRIST WATCH.—The wrist watch is a timepiece of the usual construction supplied with a strap for fastening to the wrist.

SECTION IX

INDIVIDUAL SAFETY PRECAUTIONS

■ 61. PRECAUTIONS FOR DISASSEMBLING AND ASSEMBLING GUN.—Paragraphs 12 and 13 outline the procedure for disassembly and assembly of the driving spring rod to the bolt. In order to avoid serious injury to personnel, the precautions outlined should be carefully observed.

■ 62. BLANK FIRING ATTACHMENT.—*a.* Never attempt to use the muzzle attachment unless the cartridge stop attachment is in its proper place in the feedway.

b. Always remove the muzzle attachment before removing the cartridge stop attachment in order to eliminate the possibility of firing ball ammunition with the muzzle attachment still in position.

c. See that the muzzle attachment is cleaned inside before using.

■ 63. HOT GUN.—*a.* To avoid serious burns, care must be exercised that the barrel and jacket are not touched with bare hands. For moving the gun or disassembling a hot barrel, the asbestos mittens should be used.

b. If the barrel becomes overheated after protracted periods of firing, the gun should be cleared immediately on suspending or ceasing fire. The heat of the barrel will cause the gun to fire without pulling the trigger, if a round is left a short time in the chamber of an overheated barrel.

■ 64. SAFETY PRECAUTIONS ON THE RANGE.—Safety precautions for range firing are included elsewhere in this manual (pars. 130, 173, 252*e*) and are not repeated here.

SECTION X

AMMUNITION

■ 65. GENERAL.—The information in this section pertaining to the several types of cartridges authorized for use in the Browning machine gun, caliber .30, M1919A4, includes a de-

scription of the cartridges, means of identification, care, use, and ballistic data.

■ 66. CLASSIFICATION.—*a.* Based upon use, the principal classification of the ammunition for this machine gun is—

(1) Ball, for use against personnel and light matériel targets.

(2) Tracer, for observation of fire and incendiary purposes.

(3) Armor-piercing, for use against armored vehicles, concrete shelters, and similar bullet-resisting targets.

b. Other types provided for special purposes are—

(1) Blank, for simulated fire.

(2) Dummy, for training (cartridges are inert).

■ 67. LOT NUMBER.—When ammunition is manufactured, an ammunition lot number which becomes an essential part of the marking is assigned in accordance with pertinent specifications. This lot number is marked on all packing containers and on the identification card inclosed in each packing box. It is required for all purposes of record, including grading and use, and reports on condition, functioning, and accidents in which the ammunition might be involved. Only those lots of grades appropriate for the weapon will be fired. Since it is impractical to mark the ammunition lot number on each individual cartridge, every effort will be made to maintain the ammunition lot number with the cartridges once they are removed from their original packing. Cartridges which have been removed from the original packing and for which the ammunition lot number has been lost are placed in grade 3. It is therefore obvious that when cartridges are removed from their original packings they should be so marked that the ammunition lot number is preserved.

■ 68. GRADE.—Ordnance Field Service Bulletin No. 3–5 explains the meaning of grading for caliber .30 ammunition. This bulletin also lists numerically every lot of ammunition with its correct grade as established by the office of the Chief of Ordnance. Only lots of proper grade will be fired. Grade 3 ammunition may be fired only under special provisions of Ordnance Department Circular No. 205, 1942.

■ 69. IDENTIFICATION.—*a. Markings.*—The contents of original boxes are readily identified by the markings on the box. Similar markings on the carton label identify the contents of each carton.

b. Color bands.—Color bands painted on the sides and ends of the packing boxes further identify the various types of ammunition. The following color bands are used:

Cartridge, ball	Red.
Cartridge, ball, and cartridge, tracer, in metallic link belts.[1]	Composite band of yellow, red, and green stripes (yellow on left, red in center, green on right).
Cartridge, tracer	Green on yellow.
Cartridge, armor-piercing	Blue on yellow.
Cartridge, blank	Blue.
Cartridge, dummy	Green.

[1] Special packing for Army Air Forces, not for use in the Browning machine gun, caliber .30, M1919A4.

c. Types and models of caliber .30 cartridges.—When removed from their original packing containers, the cartridges may be identified, except as to ammunition lot number and grade, by physical characteristics described below:

(1) *Ball.*—All models of caliber .30 ball ammunition, except M2 of 1940 and earlier, and M1906, have bullets with gilding metal packets. The jacket of the M1906 bullet is cupronickel which has a silvery appearance. The gilding metal jacket of the early M2 ammunition is tin coated and hence resembles the M1906 bullet in appearance. The gilding metal jacket of the present M2 bullet is copper-colored.

(2) *Tracer.*—Caliber .30 tracer ammunition may be identified by the nose of the bullet, which is painted red for a distance of approximately ¼ inch from the tip.

(3) *Armor-piercing.*—All models of caliber .30 armor-piercing ammunition may be distinguished by the nose of the bullet, which is painted black for a distance of approximately ¼ inch from the tip. The bullets have gilding metal jackets.

(4) *Blank.*—Blank ammunition may be identified by the absence of a bullet in the cartridge case.

(5) *Dummy.*—The caliber .30 corrugated dummy cartridge

may be identified by six longitudinal corrugations and a hole in the cartridge case.

■ 70. CARE, HANDLING, AND PRESERVATION.—*a.* Small arms ammunition, as compared with other types, is not dangerous to handle. Care, however, must be observed to keep the boxes from becoming broken or damaged. All broken boxes must be immediately repaired and careful attention given so that all markings are transferred to the new parts of the box. The metal liner should be air-tested and sealed if equipment for this work is available.

b. Ammunition boxes should not be opened until the ammunition is required for use. Ammunition removed from the airtight container, particularly in damp climates, is likely to corrode, thereby becoming unserviceable.

c. Protect the ammunition carefully from mud, sand, dirt, and water. If it gets wet or dirty, wipe it off at once. Verdigris or light corrosion, if it forms on cartridges, should be wiped off. However, cartridges should not be polished to make them look better or brighter.

d. The use of oil or grease on cartridges is dangerous and is prohibited.

e. Do not fire dented cartridges, cartridges with loose bullets, or otherwise defective rounds.

f. Do not allow the ammunition to be exposed to the direct rays of the sun for any length of time. This is likely to affect its firing qualities seriously.

■ 71. STORAGE.—*a.* Whenever practicable, small arms ammunition should be stored under cover. This applies particularly to tracer ammunition which is subject to rapid deterioration if it becomes damp. It may even ignite spontaneously. Should it become necessary to leave small-arms ammunition in the open, it should be raised at least 6 inches from the ground, and the pile covered with a tarpaulin. Suitable trenches should be dug to prevent water flowing under the pile.

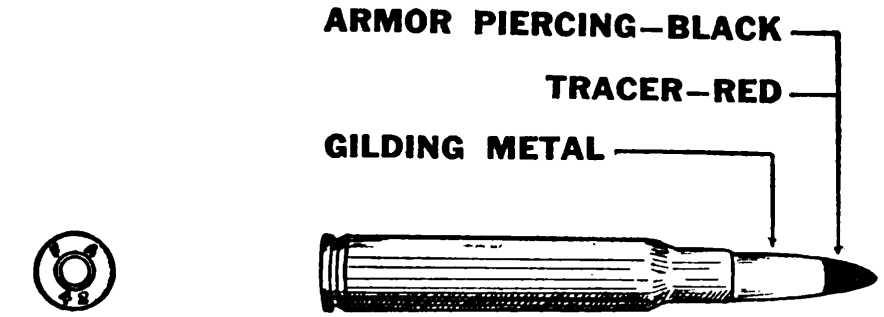
b. If practicable, tracer ammunition should be stored separately from other ammunition.

c. If fired into or placed in a fire, small arms ammunition

does not explode violently. There are small individual explosions of each cartridge, the case flying in one direction and the bullet in another. In case of fire, it is advisable to keep those not engaged in fighting the fire at least 200 yards from the fire and have them lie on the ground. It is unlikely that the bullets and cases will fly over 200 yards. Small arms ammunition of all classes should be stored away from radiators, hot water pipes, and other sources of heat, since heat not only deteriorates ammunition, but also creates a fire hazard.

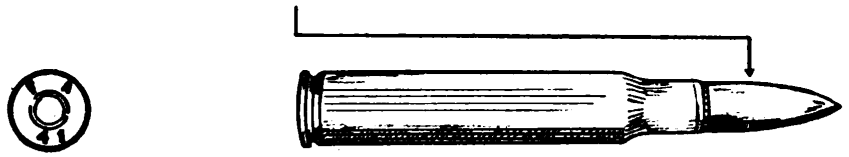
■ 72. BALLISTIC DATA.—The approximate maximum ranges and average velocities for the several types and models of caliber .30 ammunition authorized for use in the machine gun, caliber .30, Browning, M1919A4, are shown below:

Type and model of caliber .30 cartridges	Average velocity 78 feet from muzzle (feet per second)	Approximate maximum range (yards)
Ball, M2	2,800	4,000
Ball, M1	2,600	5,500
Ball, M1906	2,640	3,450
Tracer, M1	2,700	3,500
Armor-piercing, M2	2,800	4,000
Blank, M1909	----------	20
Dummy, M1906 (corrugated)	----------	----------

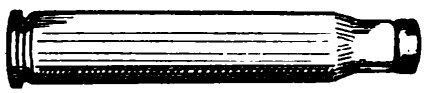


CAL. .30 ARMOR PIERCING AND TRACER CARTRIDGES

M1906—CUPRONICKEL
M1—GILDING METAL
M2—TIN COATED GILDING METAL (Prior to 1941)
M2—GILDING METAL (After 1940)



CAL. .30 BALL CARTRIDGES



CARTRIDGE, BLANK, CAL. .30, M1909

CARTRIDGE, DUMMY, CAL. .30 M1906 (Corrugated)

FIGURE 21.—Caliber .30 cartridges.

SECTION XI

CALIBER .22 TRAINING EQUIPMENT

■ 73. DESIGN AND DATA.—The caliber .22 machine-gun trainer M4 is provided for training purposes. It is used for firing the caliber .22 long rifle cartridge without modification or in any way affecting the standard gun. The caliber .22 trainer does not interfere with the mounting of the caliber .30 machine gun on the tripod M2.

a. Parts and accessories.—(1) The complete unit consists of a group of components and assemblies so designed that the caliber .30 gun may be converted to accommodate the caliber .22 long rifle cartridge merely by changing the main group assemblies (fig. 22). The following is a complete list of the component parts of the trainer and accessories for its use:

(*a*) *Parts.*

Bolt, assembly.
Firing pin, assembly.
Driving spring.
Cartridge stop.
Barrel.
Piston, actuating.
Cylinder, barrel.
Bearing, barrel, front.
Nut, barrel adjusting.
Nut, barrel locking.

(*b*) *Accessories.*

Belt, ammunition, including adapters and clips (par. 78).
Holders, cartridge.
Chute, cartridge holder.
Bag, metallic belt link.
Fixture, cartridge seating.
Tool, cartridge seating and ejecting.
Wrench, adjustable, 4-inch.

NOTE.—Safety of personnel is assured because the design is such that it is impossible to fire the caliber .30 cartridge with the caliber .22 trainer M4, assembly.

(2) Belt, adapters, and holders are loaded into a standard caliber .30 ammunition belt chest. A bag and chute are pro-

vided to catch ejected holders for the purpose of reducing the accumulation of foreign matter.

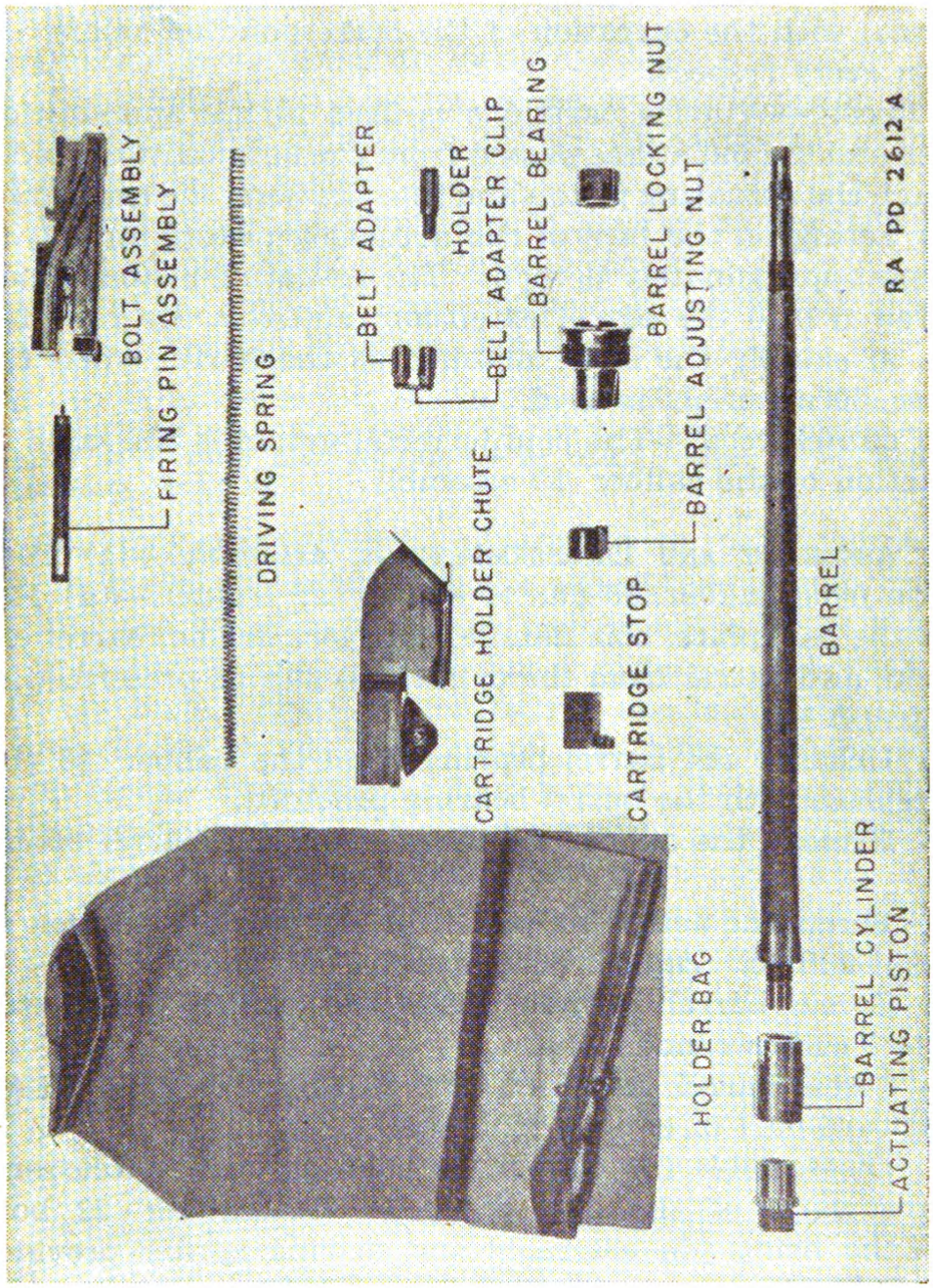


FIGURE 22.—Parts for caliber .22 machine-gun trainer M4.

b. Data.

Weight of caliber .22 gun assembly, M1919A4 (approx.) pounds	27.0
Length of barrel inches	22.5
Length of bore do	22.5
Rate of fire rounds per minute	500–600

Type of mechanism—recoil, barrel fixed.

■ 74. OPERATION AND FUNCTIONING.—*a. Operation of caliber .30 gun with caliber .22 trainer.*—The operation of the Browning machine gun equipped with the caliber .22 trainer is identical with the operation of the corresponding caliber .30 gun in every respect.

b. Recoil.—When a cartridge is fired in the ammunition holder and the bullet has passed from the ammunition holder through the actuating piston and into the bore, the expanding gases, acting on the face of the actuating piston, force it to the rear approximately ⅝ inch. The actuating piston, which is screwed into the barrel extension, actuates the recoiling parts in exactly the same manner as the barrel when the caliber .30 assembly is used.

c. Counterrecoil.—The counterrecoil action is the same as the action of the caliber .30 assembly.

■ 75. ASSEMBLY AND DISASSEMBLY.—*a. Assembly.*—(1) *Conversion from caliber .30 gun to caliber .22 trainer.*—(*a*) Remove the backplate, bolt handle, bolt, lock frame, barrel extension, and barrel from the caliber .30 gun as prescribed in paragraph 10.

(*b*) Unscrew the barrel bearing from the caliber .30 gun and replace with the barrel bearing provided.

(*c*) Remove the caliber .30 barrel from the barrel extension.

(*d*) Screw the actuating piston in the barrel extension as far as it will go. Back it off five or six notches.

(*e*) Screw barrel cylinder onto the caliber .22 barrel. Tighten with wrench.

(*f*) Screw barrel adjusting nut FULLY TO THE REAR on forward part of caliber .22 barrel.

(*g*) Disassemble the caliber .30 bolt (par. 12). Reassemble the parts of the bolt group to the caliber .22 bolt, using the firing pin assembly and driving spring provided with the trainer (par. 13).

(*h*) Assemble caliber .22 barrel assembly to the gun, using care that the adjusting nut stop is on top of the barrel.

(*i*) Assemble remaining caliber .22 groups to the gun as prescribed for the assembly of caliber .30 groups (par. 11).

(*j*) Pull out belt holding pawl split pin approximately ⅝

inch, insert cartridge stop provided with the trainer, and push belt holding pawl split pin forward into position.

(2) *Final head space adjustment.*—(*a*) Insert *empty* holder into feedway.

(*b*) Operate action once to load.

(*c*) If bolt closes easily, screw in the actuating piston one notch (by using the point of a caliber .30 cartridge or the combination tool in piston notches).

(*d*) Repeat above until bolt fails to close on empty holder.

(*e*) Back off one notch on actuating piston.

(*f*) Repeat (*a*) and (*b*) above. The bolt should just close on the holder, thereby obtaining correct head space.

NOTE.—When holder is first inserted and bolt fails to close, instead of turning actuating piston in, back actuating piston off one notch at a time and repeat above until proper head space adjustment is obtained.

(3) *Chamber space adjustment.*—(*a*) With the bolt closed, rotate the barrel clockwise with the adjustable wrench provided until the barrel extension is seen to move to the rear, away from the trunnion block, for a distance of approximately $\frac{1}{32}$ inch. Then rotate barrel one complete turn counterclockwise or until the barrel extension touches the trunnion block. Now make a half turn in the same direction (counterclockwise). The half turn will give a chamber space of about $\frac{1}{64}$ inch, which is correct for a clean gun.

(*b*) If, with this adjustment, the gun fails to function because of insufficient recoil, it may be necessary to reduce the chamber space back to the flush position.

NOTE.—When chamber spacing or whenever loosening the barrel locking nut, it is important that the barrel adjusting nut be prevented from turning. This is accomplished by inserting a screw driver or other small rod through the holes in the barrel jacket in line with the barrel adjusting nut.

(4) *Barrel adjustment.*—Screw on barrel locking nut, making sure that barrel does *not* rotate (fig. 23).

b. Disassembly.—Conversion from caliber .22 trainer to caliber .30 gun is accomplished as follows:

(1) Remove backplate, bolt handle, and bolt assembly from gun as prescribed in paragraph 10.

(2) Unscrew and remove barrel locking nut.

(3) Press in on trigger pin; at the same time, with the palm of the hand push on the muzzle of the barrel, forcing it to the rear as far as it will go.

(4) Pull out lock frame and barrel extension.

(5) Remove actuating piston from barrel extension.

(6) Remove barrel assembly from gun.

(7) Remove barrel bearing.

(8) Remove cartridge stop.

(9) Disassemble bolt group and reassemble caliber .30 bolt, using original parts.

(10) Replace groups in gun as prescribed in paragraph 11.

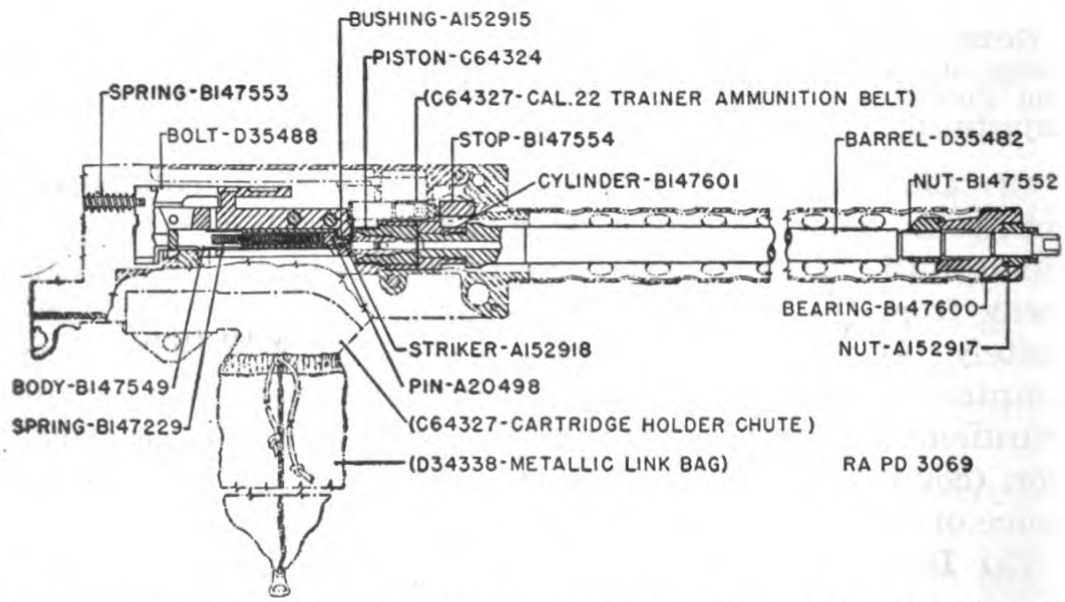


FIGURE 23.—Caliber .22 machine-gun trainer M4—sectionalized view.

■ 76. ADJUSTMENTS AND MALFUNCTIONS.—*a. Adjustments.*—In the event that a residue accumulates and causes a sticking condition, the chamber space should be increased slightly in accordance with the following procedure:

(1) Raise cover.

(2) Pull bolt back and secure in usual manner. This is important; otherwise the head space will be disturbed.

(3) Loosen barrel locking nut.

(4) Open chamber space one-half turn by turning barrel counterclockwise.

(5) Tighten barrel locking nut.

(6) Resume firing.

NOTE.—The chamber space should be increased by one-half turn only, and then only when sticking becomes so great as to result in malfunctions.

b. Malfunctions.

Malfunction	*Cause*	*Remedy*
Failure to extract. Short recoil (notes, par. 75*a* (2) and 76*a*).	Extractor badly worn; will not withdraw round from belt.	Assemble new extractor.
	Insufficient recoil power due to increased accumulation of carbon in front of actuator piston.	If the holder has become lodged in the feedway, pull the bolt to the rear and dislodge it. The chamber space may be increased but only by one-half turn (see note in *a* above). If malfunctions continue, clean and oil the bore as prescribed for the caliber .30 machine gun.

■ 77. CARE AND CLEANING.—*a.* The same care as used with the caliber .30 gun should be exercised with the caliber .22 trainer. Particular care should be paid to thorough and complete lubrication at all times. Improper head space will result in eventual injury to the holders. The head space therefore should be accurately determined, as previously prescribed, before any firing is contemplated.

b. At the conclusion of the day's firing, remove the groups, including the barrel, carefully wipe off all parts, remove all carbon deposits, and apply a light coat of lubricating oil. Wipe out the bore of the barrel, and swab the bore with oil. The same oils are to be used as are used on the caliber .30 machine gun. Carefully remove the carbon deposit from the

face of the actuating piston. Thoroughly clean the actuating piston and barrel cylinder.

Caution: Special care must be taken to see that the actuating piston and barrel cylinder are free from oil. Oil on these components results in excessive carbon deposits, causing the gun to stick, resulting in a malfunction. Avoid excessive use of oil on weapon that may get on holder bag or holders. This is necessary to prevent oil and foreign matter from being carried into the weapon by the holders.

■ 78. METHOD OF LOADING AND SEATING CALIBER .22 AMMUNITION INTO CARTRIDGE BELTS.—*a. Preparation of belts.*—Insert the belt adapters into the belt so that the tip protrudes far enough to clear the groove. The belt adapter clips are then snapped into place in the grooves, connecting the adapters in pairs, as shown in figure 24. The adapters thus fastened

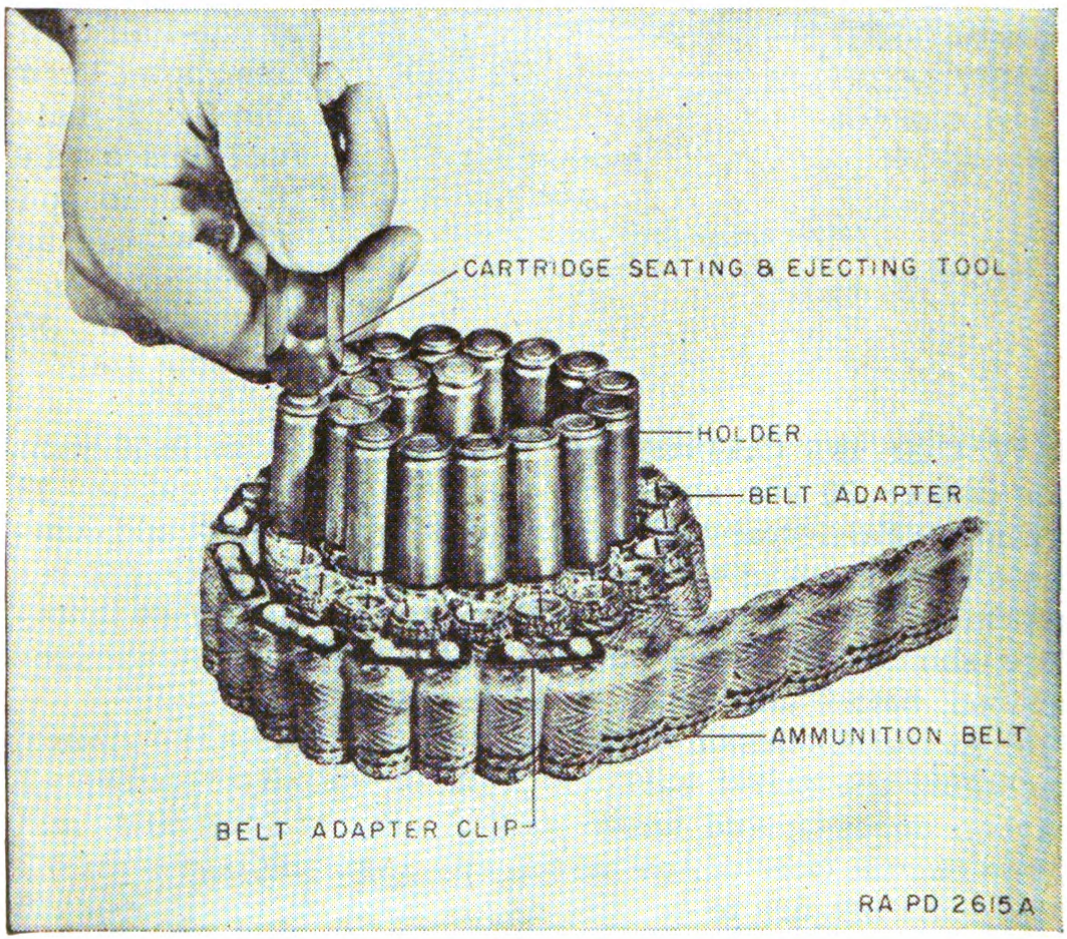


FIGURE 24.—Seating cartridges by hand.

together remain in the belt for use only with the caliber .22 trainer.

b. Loading ammunition into holders.—(1) The holders should be prepared for loading by removing the empty cases and cleaning, if necessary, to remove any grit or foreign matter which may cause the cases to stick in the holders or the holders to stick in the chamber of the actuating piston. The cartridge seating and ejecting tool or any small-diameter rod may be used to push out the empty cases.

(2) With the holders empty and clean, insert the ammunition into holders by hand as far as possible.

Caution: Pressure only should be applied to the cartridges. Never strike them.

c. Cartridge seating fixture.—(1) To use the cartridge seating fixture, hold the loaded holder in left hand with cartridge head to right, place holder against the stop pins and then move the arm to the left, bringing the arm to bear on the cartridge.

(2) Moving the arm to the right will allow the loaded holders to fall into the box, where they may be allowed to accumulate until a number of holders sufficient for contemplated firing have been loaded.

(3) The holders with cartridges properly seated are then inserted into the adapters in the ammunition belt with a slight push, making sure that the shoulder on the holder is seated solidly against the adapter.

d. Seating cartridges by hand.—(1) Coil the belt with adapters inserted and fastened with clips as shown in figure 24 with the open end of adapters upward. (The outside coil of the belt, as shown in fig. 24, has been turned over to show the clips.)

(2) Insert the loaded holders in the belted adapters, seating them with a slight push.

(3) Seat the cartridges fully by pressure on the base of the cartridge, using the handle of the cartridge seating and ejecting tool or any wooden handle. *Do not strike cartridges.*

CHAPTER 2

TRAINING FOR PLACING LIGHT MACHINE GUN IN ACTION

■ 79. GENERAL.—*a.* The object of gun drill is to give the squad complete confidence in its ability as a team to put its light machine gun into action with precision and speed.

b. Teamwork is assured by a rotation in duties during drill so that each member by practice becomes thoroughly acquainted with the duties of every other member, particularly with the more detailed actions of the numbered members of the gun crew.

c. Precision is attained by strict adherence to the prescribed procedure. Exactness is the first objective. When it has been developed, speed is emphasized.

d. No. 1 repeats all commands of the corporal, and No. 2 transmits all signals to No. 1.

e. At the completion of any ordered movements, the member of the team responsible for its correct execution calls "Up," and No. 2 signals READY.

f. Unless otherwise stated, individuals move from one position to another at a run.

g. In the field, the drill procedure of movements, such as ACTION and OUT OF ACTION, are followed as closely as the situation permits.

■ 80. TO SECURE EQUIPMENT TO PUT GUN IN ACTION.—For drill, the command is: SECURE EQUIPMENT FOR GUN DRILL. In the field, the command is: ACTION or OFF TRUCK (pack). At the appropriate command, the men secure equipment as follows:

Corporal ----------	None. When there is no ammunition bearer (No. 3), he secures the spare parts chest and spare barrel.
Gunner (No. 1)------	Tripod. When need for additional ammunition is indicated, he also secures one chest of ammunition.

Assistant gunner (No. 2).	Gun. Where there is no ammunition bearer (No. 3), he also secures one chest of ammunition.
Ammunition bearer (No. 3).	One chest of ammunition, spare parts chest, and spare barrel.
Additional numbered members.	Act as assistant ammunition bearers, carrying chests of ammunition.

For additional organizational equipment carried by members of the squad, see current Tables of Basic Allowances and SNL A–6.

■ 81. To Form Crew (Squad) With Equipment (fig. 25).—*a.* For drill, the crew (squad) forms in column at five paces distance, with No. 1 five paces in front of and facing the corporal, and takes the prone position. Each man grounds his load as follows:

(1) No. 1 with the tripod on his right, trails to the rear.

(2) No. 2 with the gun to his front, muzzle to the left, bolt handle up.

(3) No. 3 with ammunition chest, spare parts chest, and spare barrel to his front, chests 1 foot apart, ammunition chest on the right, latch to the front, spare barrel on the left of the ammunition chest.

(4) Other members, if present, with chests in front, 1 foot apart, latches to the front.

b. In the field the squad, after securing its equipment, reforms as directed. Loads are grounded as explained in *a* above and taken up at the preparatory command for a movement.

■ 82. To Change Numbers and Duties During Drill.—The command is: FALL OUT ONE.

a. At the command—

(1) No. 2 moves to the position of No. 1 and calls "One."

(2) No. 3 moves to the position of No. 2 and calls "Two."

(3) Higher numbered members move up one position as described above. No. 1 then becomes the highest number present.

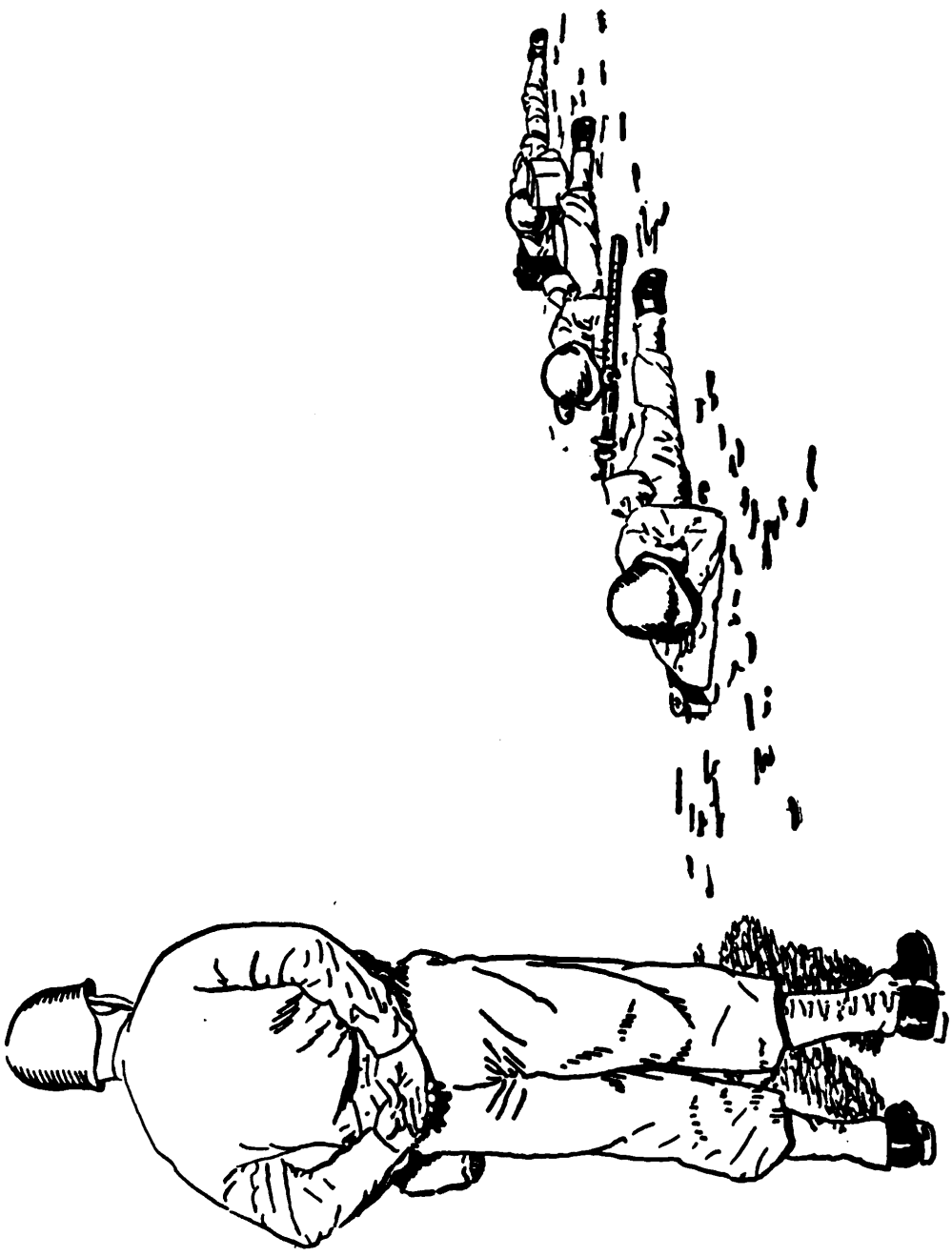


FIGURE 25.—Corporal (instructor) and gun crew with equipment.

b. As soon as each member has become thoroughly familiar with the duties involved, the command is given during the progress of a movement to cause each man to cease the execution of his duty and to take up the duty of his new number.

c. The command may be given to the squad while in any formation and is executed in a manner similar to that prescribed for the crew.

■ 83. To Examine Gun Equipment.—The equipment being grounded, the corporal commands: EXAMINE EQUIPMENT BEFORE FIRING.

a. At this command each man, keeping well down, examines the equipment constituting his load as indicated below, and reports to the corporal, naming the deficiencies, if any, which he cannot correct. The same procedure is followed both in drill and in the field, except that in drill ball ammunition is assumed.

(1) No. 1 examines the tripod and—

(*a*) Sees that the front leg and trails are closely folded.

(*b*) Tests traversing bar sleeve latch and pintle latch.

(*c*) Tests traversing dial and clamps dial on older type tripods.

(*d*) Sees that pintle socket is free from dirt.

(2) No. 2 examines the gun. He pulls back the latch, raises the front sight and the cover, pulls the bolt to its rearmost position, engages the extractor cam plunger in rear of the extractor feed cam, and—

(*a*) Sees that barrel is clear.

(*b*) Sees that the gun pintle is clean.

(*c*) Lets the bolt go forward and ascertains that—

1. The head space is correct, making any necessary adjustment.

2. The barrel-locking spring functions correctly.

3. The moving parts are oiled and function without excessive friction.

(*d*) No. 2 lowers and latches the cover, lowers the front sight, sets the rear sight at 700 (two clicks below 800, on M1 sight), lowers the sight leaf, sets the wind gage at zero, and pulls the trigger.

(3) No. 3 examines the spare barrel, ammunition chest, and spare parts chest, and sees that the—

(*a*) Bore is clear.

(*b*) Front and rear bearings are free from dirt.

(*c*) Barrel and barrel extension are properly assembled.

(*d*) Contents of spare parts chest are as prescribed and properly packed.

(*e*) The cartridges are spaced and alined correctly in the belt (if at drill, that no live ammunition is present).

(*f*) The ammunition belt is clean and dry.

(*g*) The belt is packed correctly in its chest.

(*h*) Covers of the chests are closed and latched.

(4) Other numbered members, if present, check completeness of ammunition loads.

b. Upon completing this examination of the equipment, Nos. 1, 2, and 3 take post and No. 3 reports, "Ammunition correct (or the deficiencies)"; No. 2 reports, "Gun and ammunition correct (or the deficiencies)"; and No. 1 reports, "All correct (or all the deficiencies which cannot be corrected)." A thorough examination of the gun equipment is made at the beginning and at the end of each drill period. When at drill or when live ammunition is not authorized, the initial inspection must assure that the ammunition belts are free of live rounds. Upon a change of numbers, such examination of the equipment, without report, is made as will determine that it is in proper condition for the execution of the drill.

c. As soon as each member has become thoroughly familiar with the duties involved, the command FALL OUT ONE is given (par. 82).

d. Equipment is examined immediately after the squad is formed, upon each change of numbers, and just prior to dismissing the squad at the completion of the drill, in order to familiarize the men with the equipment so that they will know when it is complete.

e. Training in examination of equipment required by the commands EXAMINE EQUIPMENT DURING (AFTER) FIRING will also be conducted.

■ **84. To Put Gun Into Action.**—The corporal indicates the point where the gun will be mounted and the general direction of fire, and commands or signals: ACTION.

a. At the command, Nos. 1 and 2 proceed as follows:

No. 1 (tripod)	*No. 2 (gun)*
In the prone position:	
Grasps the right trail near the tripod head with the right hand.	
Springs up.	In the prone position:
Carries the tripod at a run, left trail leg uppermost, to the designated point.	Grasps the grip with the right hand and passes the left hand over and under the barrel jacket.
Rests the shoes of the trail legs on the ground.	Springs to his feet.
Steadies the tripod so that it is in a vertical position with the front leg to the front.	Places the gun under his left arm, muzzle to the rear.
Lifts the front leg forward and upward into position with his left hand.	Runs to a position on the left of and facing tripod.
Grasps the left trail leg near the shoe with his left hand and the right trail leg near the shoe with his right hand.	Places his left foot in the space between the left trail leg and the front leg.
Lifts the tripod from the ground and separates the trail legs until the sleeve latch engages the traversing bar sleeve.	
Drops the tripod to the ground	
Lies down and in rear of the traversing bar:	
Grasps the grip with his left hand and assists No.	Assisted by No. 1, places the gun in position.

No. 1 (tripod)

2 in placing the gun in position.

Disengages the elevating mechanism from the slot in the grip by striking the end of the mechanism a forward and downward blow with the heel of his right hand.

Turns the lower half of the elevating mechanism through 180°, assembles it to the traversing bar, and clamps it at zero deflection.

Advances his right hand to a point opposite the belt feed exit and holds it in position ready to grasp the brass strip at the end of the belt.

Grasps the strip as it is pushed from the belt exit and gives it a quick jerk to the right.

Pulls the bolt handle to its rearmost position and releases it. (This half loads the gun. It may be fully loaded by pulling the bolt handle to the rear a second time.)

Grasps the grip firmly with the right hand, the forefinger extended to engage the trigger.

Grasps the elevating handwheel with the left hand.

No. 2 (gun)

Inserts the gun pintle in the gun pintle socket, raises the gun pintle latch lever with his *right* hand and then lowers it when the pintle is fully seated.

Lies down at the left of the gun, head in rear of the feedway.

Opens the ammunition chest placed for him by No. 3.

Grasps between the thumb and forefinger of his right hand a fold of the belt at the point where the brass strip joins the fabric and pushes the brass strip through the feed opening as far as possible. (He is responsible that the belt is straight and will feed properly, and that the cover of the gun is latched.)

No. 1 (tripod)

Upper part of the body rests on the elbows. The right elbow is drawn in close to the body, the left elbow inside of but not touching the left trail shoe.

Body is in prone position so that a line in prolongation of the axis of the bore will pass through his right shoulder and right hip pocket. Legs apart as in rifle marksmanship and heels down. Eyes focused on the target.

When in this position: No. 1 calls "Up."

b. Just as No. 2 is lying down, No. 3 arrives at the gun position with his load (ammunition chest, spare parts chest, and spare barrel).

(1) Places the ammunition chest, latch to the right, in line with the feedway, ready for loading.

(2) Places the spare barrel and spare parts chest on the left of the ammunition chest.

(3) Turns left about and returns to his original position.

c. When higher numbered members of the squad are present, they pass their ammunition chests forward to No. 4. No. 4 alines them at the position of No. 3, latches to the front.

■ 85. To CLEAR GUN.—The command is: CLEAR GUN. At this command No. 1 pulls back the latch and raises the cover. No. 2 lifts and removes the belt from the feedway (so as to avoid getting sand into the mechanism). No. 1 then pulls the bolt handle to its rearmost position and engages the extractor cam plunger behind the extractor feed cam and sees that the cartridge is ejected. No. 2 replaces any loose rounds in the belt and returns the belt to the chest.

■ 86. TO TAKE GUN OUT OF ACTION.—The gun being in action, to take it out of action the corporal commands or signals: OUT OF ACTION.

a. At the command, Nos. 1 and 2 proceed as follows:

No. 1 (tripod)

In the gunner's position:

Pulls back the latch with his right hand.

Raises the cover to the half-open position with his left hand.

Brushes his left hand across the top of the bolt to make sure the extractor is down.

Lowers the cover with his left hand.

Pulls the bolt handle to its rearmost position with his right hand and releases it.

Presses the trigger with with his right forefinger.

Grasps the grip with his left hand and, with his right hand, disengages the elevating mechanism from the traversing bar, turns the lower half through 180°, and secures it in the recess in the grip.

Places both hands on the trail legs near the shoes and presses downward until No. 2 has removed the gun.

Grasps the sleeve latch with his right hand and releases it.

No. 2 (gun)

Lying on the left of and facing the gun, legs to the rear.

(As soon as No. 1 raises the cover)

Lifts the belt and removes it from the feedway.

Packs the belt in the ammunition chest and latches the cover.

Springs to his feet.

Places his left foot on the front leg shoe.

With his left hand over and around the barrel jacket and his right hand at the grip, raises the gun pintle latch lever and removes the

No. 1 (tripod)	*No. 2 (gun)*
Springs to his feet.	gun from the tripod.
Grasps the tripod head with his right hand, knocking down the gun pintle latch lever.	Turns to the left about and runs to his original position.
Lifts the front of the tripod to the vertical position.	Lays the gun down, muzzle to the left, bolt handle up.
Grasps the front leg of the tripod with the left hand and folds it to the front and down.	Returns to the prone position.
Tilts the tripod to the right and closes the trail legs with the left hand.	Inspects the gun to see that—
Grasps the right trail leg near the tripod head with the right hand and, with the left trail leg upppermost, turns to the left about, returns to his original position.	It is unloaded, by pulling the bolt to the rear several times and releasing it.
Lays the tripod on the ground, trail legs to the rear.	The trigger is pulled.
Returns to the prone position on the left of the tripod and calls "Up."	The rear sight is set at 700 yards.
	The sight leaf is lowered.
	The windage gage is set at zero.

b. Just as No. 2 is closing the ammunition chest, No. 3 arrives at the gun position, picks up the spare parts chest and the spare barrel in his left hand and the ammunition chest in his right hand, turns left about and returns them to their original location. No. 3 then resumes the prone position and inspects his ammunition chest to see that—

(1) The cartridges are spaced and alined correctly.
(2) The ammunition belt is clean and dry.
(3) The belt is packed correctly in its chest.
(4) The chest is latched.

■ 87. To Put Gun in Action on a Slope.—The machine-gun tripod mount M2 is not adjustable for more than one position. Therefore, members of the gun crew must level the ground by cutting away the soil at the location of the trail shoes. The front leg is always pointed in the general direction of the target.

■ 88. To Move Gun.—The gun being mounted upon the tripod in firing position, the command is: TWO-MAN LOAD. At this command the gun is unloaded by Nos. 1 and 2. No. 1 seizes the right trail leg with his right hand and the left trail leg with his left hand. No. 2 seizes the front leg with his right hand and the ammunition chest in his left hand. When both are ready, No. 1 calls "Up" and they both spring to their feet and move off. The remainder of the equipment is carried by No. 3 and other members if present.

■ 89. Manipulation of Gun.—*a.* By making use of the dial and the elevating and traversing mechanisms, the gunner can measure and lay off horizontal and vertical angles.

b. Habitually before each manipulation of the gun, the traversing gear housing (new style mechanism only) is moved to the center of the traversing screw. The gunner grasps the grip with his right hand and the elevating handwheel with his left hand (par. 106). In traversing over 50 mils with the new mechanism and in all traversing with the old type mechanism, the gun is moved in the desired direction by pushing or pulling with the left hand at the elevating handwheel assisted by the right hand at the grip (par. 8). The slide clamp is manipulated with the thumb of the left hand. In traversing under 50 mils with the new type mechanism, the gun is moved entirely by means of the traversing handwheel, operated by the left hand.

c. Changes in elevation are read in mils on the micrometer dial on top of the elevating handwheel, and/or on the elevating screw scale, or by counting the number of 1-mil clicks as the wheel is turned. Changes in deflection are read from the traversing dial, or on the mil scale on the traversing bar, or by counting the number of 1-mil clicks of the traversing handwheel.

d. The traversing bar of the tripod M2 permits readings of 450 mils to the right or 425 mils to the left of the zero graduation. Likewise the elevating screw scale permits readings of plus 250 mils and minus 200 mils.

■ 90. TO ZERO TRAVERSING DIAL.—*a.* The gun being laid on a designated point, the command is: ZERO DIAL. No. 2 (or the corporal) unclamps the traversing dial, turns the dial until the zero graduation is exactly opposite the index on the pintle block, then clamps the dial.

b. M2 tripods of 1942 and later manufacture are not equipped with a traversing dial.

■ 91. TO USE THE GUN FOR LAYING OFF HORIZONTAL ANGLES.—The gun being laid on a designated point—

a. To lay off to the right (left) an angle which is an exact multiple of 25 mils, the command is, for example, RIGHT (LEFT) 600, ADD 0. No. 2 (or the corporal) zeros the dial. No. 1 loosens the traversing bar clamp, and No. 2 (or the corporal) rotates the muzzle of the gun in the desired direction until the index on the pintle block is opposite the 600 graduation of the traversing dial. The traversing bar clamp is then tightened.

b. To lay off to the right (left) an angle which is an inexact multiple of 25 mils (such as right (left) 612 mils), the command is, RIGHT (LEFT) 600, ADD 12.

(1) Using the traversing mechanism with traversing handwheel, No. 2 (or the corporal) executes RIGHT (LEFT) 600 in the manner prescribed in *a* above. No. 1 then moves the muzzle an additional 12 mils to the right (left) by means of the traversing handwheel, counting the clicks as he does so.

(2) Using traversing mechanism without traversing handwheel, No. 2 (or the corporal) executes RIGHT (LEFT) 600 in the manner prescribed in *a*, above. The fractions of 25 mils may be approximately laid off by—

(*a*) No. 1 on the windage arc.

(*b*) No. 1 on the traversing bar.

(*c*) No. 2 (or the corporal) interpolating between the graduations on the traversing dial.

c. If the size of the angle to be laid off is less than 450 mils

right or 425 mils left, it can be done similarly by No. 1 on the traversing bar.

■ 92. To Use Gun for Measuring Horizontal Angles.—Assume that the angle is to be measured between two horizontal points *A* and *B*. The command is MEASURE THE ANGLE FROM A(B) TO B(A).

a. Using the traversing dial.—No. 1 lays on point *A* (*B*) and tightens the traversing bar clamp. No. 2 (or the corporal) zeros the dial. No. 1 loosens the traversing bar clamp, turns the muzzle of the gun to the right (left) until he is laid on point *B* (*A*), and tightens the traversing bar clamp.

(1) If the angle being measured is an exact multiple of 25 mils, the index will rest exactly opposite one of the graduations on the dial. No. 2 (or the corporal) reads the angle from the dial and announces it, for example, "Right (left) 400, add 0."

(2) However, if the angle being measured is an inexact multiple of 25 mils, the index will rest between two graduations of the dial when the gun is laid on the second point. For example, assume that the index rests between the 400 and 375 graduations on the dial. To measure this angle, No. 1 loosens the traversing bar clamp and No. 2 (or the corporal) turns the gun back until the index is opposite the lesser of the two graduations, 375 in this case. No. 1 tightens the traversing bar clamp and No. 2 (or the corporal) directs No. 1, "Complete the lay." No. 1 turns the traversing handwheel until he is again laid on point *B* (*A*), counting the clicks as he does so. Assume the count to be 10. No. 2 (or the corporal) announces the angle measured by the dial and traversing handwheel, as, "Right (left) 375, add 10." If the gun does not have the traversing handwheel, the fractions of 25 mils may be approximately measured by—

(*a*) No. 2 (or the corporal) interpolating between the graduations on the traversing dial.

(*b*) No. 1 on the traversing bar.

(*c*) No. 1 on the windage gage.

b. Using the traversing bar.—If the angle to be measured is less than 450 mils right or 425 mils left (total 875 mils), No. 1 can read the angle from the scale on the traversing bar.

c. Using the traversing handwheel.—If the angle to be measured is approximately 50 mils or less, No. 1 can read this angle from the scale on the traversing micrometer.

d. Using the windage gage.—If the angle to be measured is less than 20 mils, No. 1 can read this angle from the scale on the windage gage.

■ 93. To PUT OUT BASE AND AIMING STAKES.—*a.* Distinctive stakes are often used to mark the direction of the gun with reference to its respective targets. The base stake, usually painted with alternate black and white stripes, marks the direction of the primary target. Aiming stakes, each painted preferably with a different color, mark the direction of other targets.

b. The gun being pointed in the desired direction, the command is: **BASE (RED) (WHITE) (BLUE) STAKE OUT.** No. 1 sets the rear sight at its maximum elevation and the windage gage at zero. No. 3 with a shovel and the designated stake moves to the front about 20 yards. Under the direction of No. 1, he places the stake in the line of aim, with the narrow edge toward the gun, drives it into the ground, and then moves to his original position in rear of the gun. The stake is driven below the lowest probable elevation for firing so that it will not be shot down during the delivery of fire.

c. The base stake having been put out, the gun may be laid on it at any time by the command: **LAY ON BASE LINE.** The gun is laid on any other aiming stake by the command: **LAY ON RED (WHITE, BLUE) STAKE.** When gun is re-laid on any stake, the sight is again set at the maximum elevation and the windage gage at zero.

■ 94. To USE GUN FOR LAYING OFF VERTICAL ANGLES.—The gun being laid on the designated point, the command is: **UP (DOWN) (so many) (5, 10, or any other appropriate number of mils).** No. 1 turns the elevating handwheel until the muzzle has been elevated (depressed) the required number of mils. He lays off the vertical angle as follows:

a. For a small angle: Counts the number of clicks (mils) through which he turns the elevating handwheel.

b. For a large angle: Turns the elevating handwheel sufficiently to provide for changes in multiples of 50 mils which are observed on the scale on the upper elevating screw; additional changes up to 50 mils are then added as described in *a* above. In either case, he verifies the angle set off by checking the reading shown by the scale on the elevating screw and elevating micrometer dial, before and after making the change. The range of the possible changes in elevation is from —200 mils to +265 mils (200 on the scale of the elevating screw, plus 50, plus approximately 15 obtainable by using the micrometer scale), giving a total of approximately 465 mils; larger angles should not be prescribed.

■ 95. To Use Gun for Measuring Vertical Angles.—The gun being laid on a point *C*, to measure the angle to another point *D*, the command is: MEASURE THE ANGLE FROM C TO D. No. 1 turns the elevating handwheel until he is laid on point D. He measures the angle as follows:

a. For small angles.—Counts the number of clicks through which the elevating handwheel was turned.

b. For large angles.—Reads the changes on the scale of the elevating screw for multiples of 50 mils and counts the number of additional clicks (mils) through which the elevating handwheel must be turned, as described in *a* above. In either case, he verifies the measured angle by checking the reading shown on the scale of the elevating screw and the elevating micrometer dial both when laid on points *C* and *D*. The difference in these readings is the desired measurement. He announces the angle, for example, "Up (down) 18."

Note.—On the elevating handwheel is the micrometer dial. A recess in the upper elevating screw contains a scale, which is divided into 50-mil graduations reading from +200 to —200. To record the reading on the elevating screw scale and the micrometer dial, proceed as follows: Put down the sign and the first number whose graduation is visible above the elevating handwheel on the elevating screw scale. Follow this number by an oblique character (diagonal line) and the number on the elevating micrometer dial toward which the indicator is pointing; for example, +50/25 or —100/25. This is not to be confused with the method of representing QE as described in paragraph 230, and in FM 23–55.

CHAPTER 3

MARKSMANSHIP

SECTION I

GENERAL

■ 96. SCOPE.—This chapter prescribes courses of instruction, rules, and regulations for the conduct of machine-gun marksmanship. If marksmanship is to be followed immediately by instruction in direct laying, the long-range observation and adjustment phase should be held in connection with direct laying.

■ 97. FUNDAMENTALS.—*a.* To become a good machine-gun shot the soldier must be thoroughly trained in the following fundamentals of machine-gun marksmanship:

(1) Accurate delivery of the initial shot or burst of fire.

(2) Mechanical skill in manipulating the gun to obtain proper distribution of fire over targets requiring distribution.

(3) Adjustment of fire by the following methods:

(*a*) Observation of strike.

(*b*) Observation of the flight of tracer bullets.

(*c*) Frequent re-laying of the gun during firing.

(4) Speed in combining the above-mentioned three elements in delivering fire.

b. Throughout the period of marksmanship training, the importance of fundamentals is emphasized. The machine gun reacts in direct proportion to the mechanical skill with which it is operated, and anyone who is physically and mentally fit to be a soldier can learn to fire the machine gun

well if properly instructed. Before the men are permitted to fire they must be instructed and drilled thoroughly in the mechanism of correct firing. When they begin firing, they must be coached properly; otherwise they instinctively commit errors such as an incorrect hold or riding the gun, and thus begin the development of faulty habits.

■ 98. METHOD OF INSTRUCTION.—*a.* The officer in direct charge of conducting the training acts as instructor. Each exercise is first explained and demonstrated to all of the men undergoing instruction. The demonstration should be performed by a group which has been previously trained to perform the exercise. Each man is then given practical work in the exercise. Finally, the men are examined in order to determine their progress or proficiency.

b. Upon completion of the explanation and demonstration by the instructor, in which the exact manner of conducting the exercise is covered in detail, the assistant instructors carry out the practical work phase under the supervision of the instructor. Assistant instructors usually are the various leaders of the units undergoing instruction; however, specially selected men may be used for this duty. Platoon and section leaders usually act as assistant instructors to organize and supervise the instruction within their respective units. The squad leaders usually act as squad instructors and are assigned to conduct the instruction at each gun. It is an advantage to have the assistant instructors trained in advance.

c. The instruction must be individual and thorough. A squad is the largest unit in which careful individual instruction can be supervised closely. If guns are available, it is preferable to assign a squad instructor and three men to each gun, because this assignment facilitates the use of the coach and pupil method. Each man must be brought to as high a state of proficiency as the time permits.

d. The coach and pupil method is used wherever applicable. Under this method the men are grouped in pairs and take turns in coaching each other. The man undergoing instruction is called the pupil; the man giving instruction is called the coach. When the men of a pair change places, the pupil becomes the coach and the coach becomes the pupil.

e. Upon the completion of the explanation and demonstration of any of the various exercises used in instruction in marksmanship, the instructor sends the men to their guns or equipment where the assigned squad instructors (or coaches) conduct the practical work.

■ 99. PRIOR TRAINING.—The soldier should be proficient in mechanical training and drill (chs. 1 and 2) before he receives instruction in machine-gun marksmanship.

SECTION II

PREPARATORY EXERCISES

■ 100. GENERAL.—*a.* The purpose of the preparatory exercises is to develop in the soldier fixed and correct habits of marksmanship before he begins range practice. A thorough, carefully supervised course in the preparatory exercises conserves time and ammunition during range practice.

b. The preparatory exercises consist of the following five distinct steps:

Sighting and aiming exercises.
Position exercise.
Sight setting and laying exercises.
Manipulation exercises.
Examination of men before starting range practice.

These exercises should be taught in the sequence listed above.

c. Every man who is to fire on the range, including those who have previously qualified, receive instruction in the preparatory exercises from the beginning. The instructor causes each man to be tested thoroughly in the exercises shown on the progress chart before he is allowed to fire. Men whose ratings are unsatisfactory are given additional instruction until their ratings are satisfactory.

■ 101. EQUIPMENT REQUIRED.—*a.* The following equipment is required for each group:

1 sighting bar complete (fig. 26).
1 sighting target (fig. 28).

1 frame, 3 by 5 feet, covered with blank paper and braced for mounting on the ground, to be used in making triangles.
1 light machine-gun target A (fig. 31).
Materials for blackening sights.
Pencils.
Tissue paper for copying triangles.
1 light machine gun and tripod.

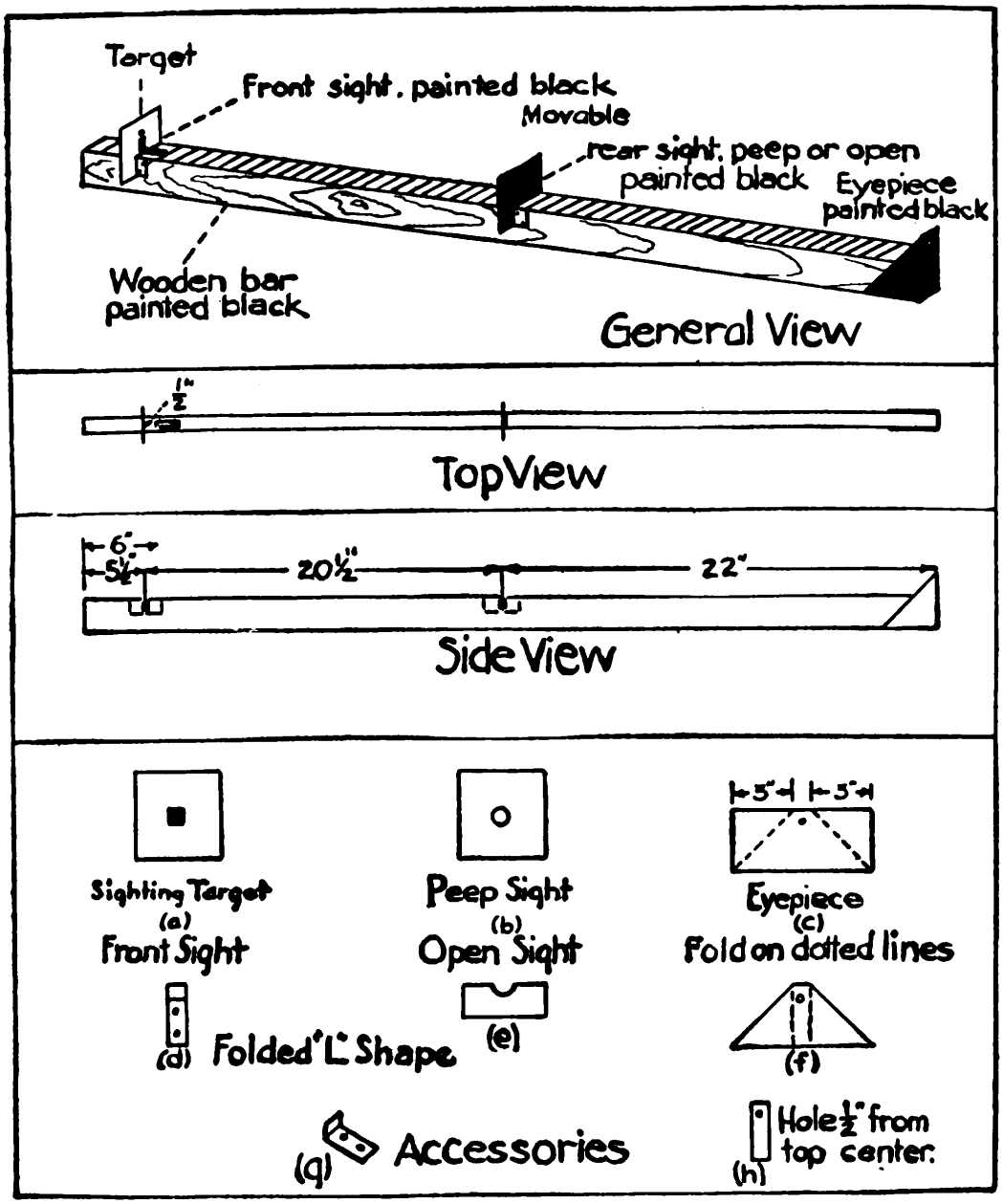


FIGURE 26.—Sighting bar.

b. The equipment should be carefully inspected for accuracy and serviceability before it is used. The shoes of the tripod should be firmly pressed into the ground, but the use of sandbags or other steadying devices or materials for holding the tripod down is prohibited.

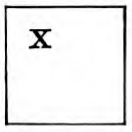
c. The sighting bar and sighting target are constructed as shown in figures 26 and 28.

d. The progress made by each man in the preparatory exercises should be recorded on the following form:

FORM FOR RECORDING PROGRESS OF MEN IN PREPARATORY EXERCISES

Names	Subjects								
	First sighting and aiming exercise	Second sighting and aiming exercise	Third sighting and aiming exercise	Fourth sighting and aiming exercise	Position exercise	Sight setting and laying exercise	Manipulating exercise, traversing	Manipulating exercise, searching	Manipulating exercise, combined traversing and searching
	Grades								

Method of grading:



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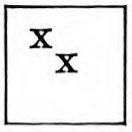

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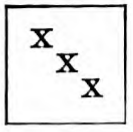

Satisfactory and has instructional ability

■ **102. First Sighting and Aiming Exercise.**—*a.* The purpose of the first sighting and aiming exercise is to teach the correct alinement of the sights on a target.

b. The instructor shows a sighting bar to the assembled men, points out its parts, and explains its use as follows:

(1) The sighting bar is used because it assists in detecting

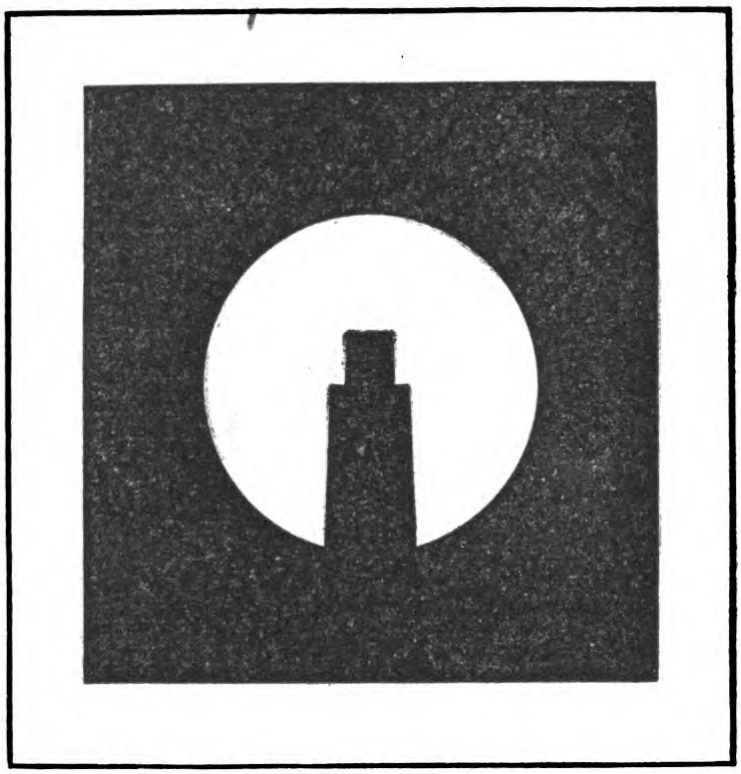

Figure 27.—Correct alinement of sights on an aiming paster.

small errors and in explaining them to the man undergoing instruction.

(2) The front and rear sights on the sighting bar represent enlarged machine-gun sights.

(3) The eyepiece causes the soldier to place his eye in such a position that he sees the sights in exactly the same alinement as they are observed by the squad instructor or coach. Although there is no eyepiece on the machine gun, the use of an eyepiece on the sighting bar assists the soldier in learning how to aline his sights properly when using the machine gun.

(4) The attachment of the removable target to the end

of the sighting bar provides a simple method of readily alining the sights on the target.

(5) The instructor then explains and illustrates by blackboard or chart the correct sight alinement (fig. 27).

c. Upon the completion of the explanation of the sighting bar, the instructor has a group of four men demonstrate the exercise as follows:

(1) One man as squad instructor (or coach) describes a correct aim, showing figure 27 to each member of the group. He explains that the top of the front sight is seen through the center of the circle and that it just touches the bottom of the target so that all of the target can be seen clearly.

(2) He explains that the eye should be focused on the top of the front sight, in order to insure that the line of sighting established is a line through the center of the peep sight and over the top of the center of the front sight. The instructor explains how a slight error in centering the front sight in the peep sight will cause the line of sighting, when it reaches the target, to diverge greatly from the desired position of the target.

(3) He so adjusts the sights of the sighting bar and the movable target as to illustrate a correct aim and then has each member of the group look through the eyepiece to observe this correct aim.

(4) He then adjusts the sights of the sighting bar so as to illustrate various small errors and has each member of the group attempt to determine them.

d. The duties of the squad instructor (or coach) are to see that the pupil understands the purpose of the exercise and to test him in making a correct sight alinement.

■ 103. SECOND SIGHTING AND AIMING EXERCISE.—*a.* The purpose of the second sighting and aiming exercise is to apply the preceding lesson to the actual alinement of the machine-gun sights on a target.

b. The instructor makes the following explanation which is demonstrated simultaneously by a demonstration group.

(1) One man as squad instructor (or coach) takes the normal position at the gun, keeping his body and hands clear

of the gun so that the eye is in the correct position for aiming (fig. 29).

(2) A second man who is to be instructed as gunner takes position near the gun where he can observe the squad instructor (or coach).

(3) A third man is posted near the gun to transmit signals to the fourth man.

(4) The fourth man is provided with the 3-inch sighting target and is posted as marker at the blank target which is placed 100 yards from the gun.

(5) The squad instructor (or coach) by improvised signals transmitted through the signal man directs the marker to

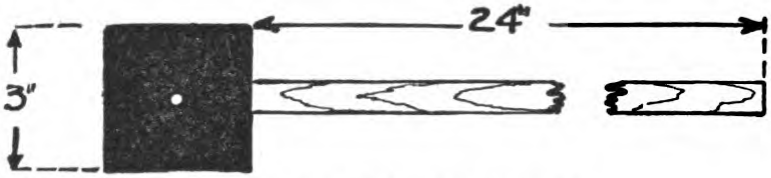

FIGURE 28.—Sighting target.

move the sighting target until it is in correct alinement with the sights, and then commands: HOLD.

(6) The marker complies, holding the sighting target in place on the blank target.

(7) The squad instructor (or coach) has the gunner take position at the gun and look through the sights.

(8) The instructor explains that, in aiming, the gunner's eye should be first focused on the target in order to ascertain that he is aiming at the proper target. His eye is then focused on the top of the front sight, in order to insure that the line of sighting established is a line through the center of the peep sight and over the top of the center of the front sight. He also demonstrates how a slight error in centering the front sight in the peep sight will cause the line of sighting, when it reaches the target, to diverge greatly from the desired portion of the target.

(9) After the gunner has looked through the sights, the squad instructor (or coach) directs the marker to move the sighting target slightly out of alinement and then requires the gunner to direct the marker to move the sighting target until it is in correct alinement with the sights.

(10) The squad instructor (or coach) checks the alinement made by the gunner and points out any errors.

(11) The squad instructor (or coach) repeats the exercise,

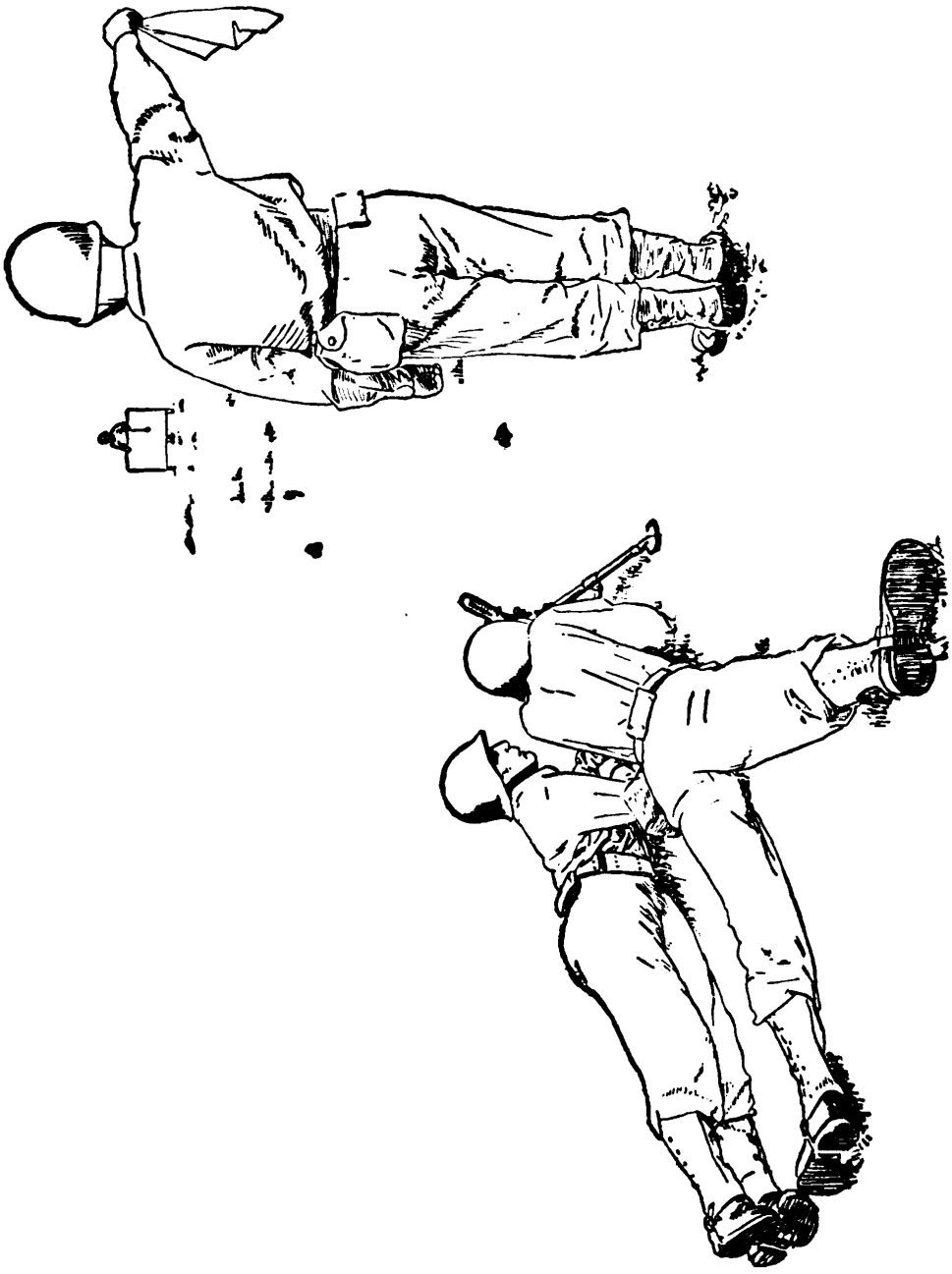

FIGURE 29.—Group executing second and third exercises.

rotating the members of the group until each man has acted as gunner.

■ 104. THIRD SIGHTING AND AIMING EXERCISE.—*a*. The purpose of the third sighting and aiming exercise is to show the

importance of uniform and correct aiming and to instill into the mind of the soldier a sense of exactness.

b. The instructor emphasizes the importance of exact and uniform aiming and makes the following explanation which is demonstrated simultaneously by a demonstration group:

(1) One man as squad instructor organizes the demonstration group as for the second sighting and aiming exercise, with the gunner in position at the gun (fig. 29).

(2) The squad instructor (or coach) has the gunner look through the sights, direct the marker to move the sighting target until it is in correct alinement with the sights, and then command: HOLD.

(3) The marker complies, holding the sighting target in place on the blank target.

(4) The squad instructor (or coach) looks through the sights to see if the alinement is correct or incorrect and then, without saying anything to the gunner, commands: MARK.

(5) The marker, without moving the sighting target, makes a dot on the blank target with a sharpened pencil inserted through the hole in the center of the sighting target. He numbers this dot "1." He then moves the sighting target to change the alinement.

(6) The gunner and squad instructor (or coach), without touching the gun or mount, repeat the operation described above until three dots have been made and numbered.

(7) The squad instructor (or coach) now explains the errors noted in the three sight alinements and the probable shape of the shot group formed by joining the three dots.

(8) The marker traces the three dots on a sheet of tissue paper, connects them with lines, writes the gunner's name at the bottom of the sheet, and hands the paper to the squad instructor (or coach).

(9) The squad instructor (or coach) discusses with the members of his group the size and shape of the shot group. He points out the errors, explaining that at 100 yards with the 3-inch sighting target a gunner should be able to place all three dots so that they can be inclosed in a circle having a diameter of 1 inch.

(10) The squad instructor (or coach) repeats the exercise, rotating the members of the group, until each man has made a satisfactory shot group.

■ 105. FOURTH SIGHTING AND AIMING EXERCISE.—*a.* The purpose of this exercise is to demonstrate the effect of canting the gun, which may be caused by mounting the tripod on uneven or sloping ground.

b. The instructor explains that if the gun is canted to the right, the bullet will strike to the right and below the point aimed at, even though the gun is otherwise correctly aimed and the sights correctly set. Similarly, if the gun is canted to the left, the bullet will strike low and to the left.

c. The men return to their equipment, where the squad instructor mounts the tripod on uneven ground so that when the gun is traversed the traverse will not be in a horizontal plane. He then requires each soldier to point out the error, explain its effect on the fire of the gun, and then make the necessary corrections in mounting the tripod.

■ 106. POSITION.—All firing with the light machine gun is done from the prone position. This position is essentially the same as that used in firing the service rifle except that the body is extended directly to the rear from the machine gun. The inside of the feet are flat on the ground, toes pointing outward and legs well separated. The eye is in position in rear of the sight. Both elbows are habitually on the ground, the right elbow close to the body. The right hand grasps the grip firmly, forefinger on the trigger. The left hand grasps the elevating handwheel firmly. Manipulation of the gun in elevation is obtained by rotating the elevating handwheel with the left hand. On guns equipped with a traversing handwheel, manipulation in traverse is obtained by turning the handwheel with the left hand. On guns without a traversing handwheel, traverse is obtained by releasing the traversing slide clamp with the thumb of the left hand and pushing the gun to the right or left, primarily with the left hand, assisted by the right hand on the grip, both elbows remaining on the ground. The lay of the gun is always completed and maintained with the right hand, the right arm being held rigid. The firing of strings (individually aimed shots) is facilitated by a snapping movement of the right forefinger, while firmly grasping the grip with the remainder of the right hand. In precision firing

FIGURE 30.—Position. ①

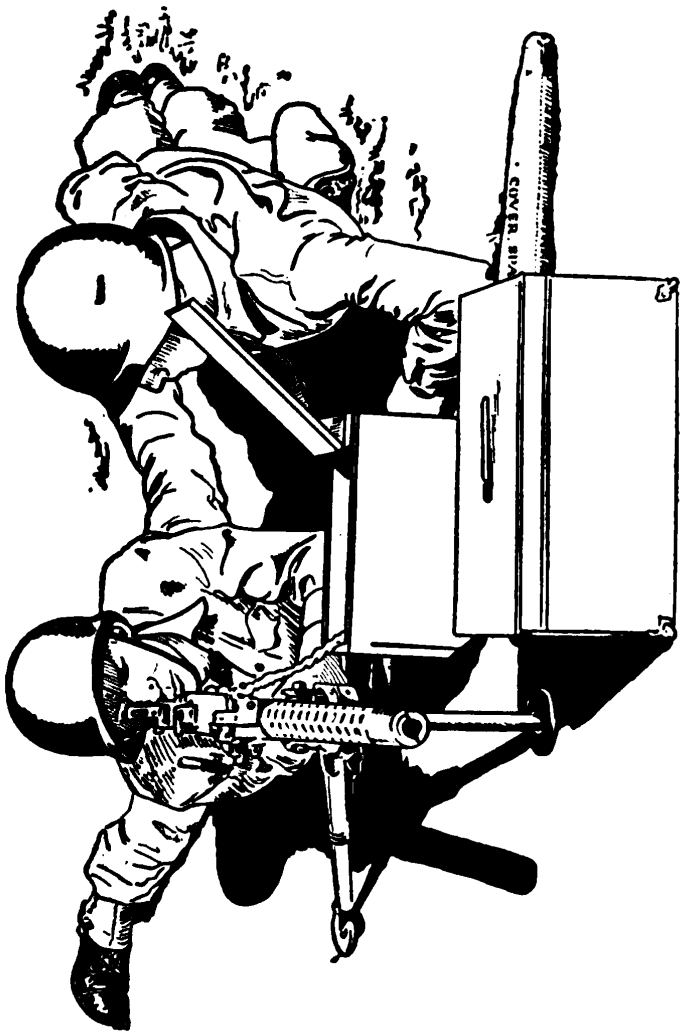

FIGURE 30.—Position—Continued.

of bursts, pressure exerted forward and downward with the left hand, while laying and firing the gun, will materially reduce the size of the beaten zone or shot group of such bursts. However, no pressure need be applied while firing at the average area target (par. 178).

■ 107. SIGHT SETTING AND LAYING.—*a.* The instructor explains that the sight slide is set at the desired range so that the gun will have the proper elevation when it is aimed and that the windage gage is set at the announced deflection.

b. The instructor has a man take his position at the gun, then explains and demonstrates the sight-setting exercise. He announces a range and a deflection as "Range 600, sight, right 4." The man at the gun sets the sight at 600 yards and turns the windage screw until the index is set at right 4. The instructor checks the sight setting. The men then, working in pairs, go through the exercise until all are proficient in rapid and accurate sight setting.

c. The instructor then explains and demonstrates the following sight-setting and laying exercise:

(1) The light machine-gun target A (fig. 31) is set up 1,000 inches from the gun position.

(2) The instructor sees that the gun is laid on the target, but that it is not aimed at the aiming point he intends to designate.

(3) A man is then placed at the gun to perform the exercise as directed by the instructor.

(4) The instructor announces the range and the aiming point as follows: "Range 800, paster No. 3 under traversing target." As soon as the range is announced, the gunner sets the sight. While he is doing this, the aiming point is announced, and he proceeds to traverse the gun and adjust the elevating handwheel until the line of aim is on the designated aiming point. As soon as he has laid the gun he announces, "Up." The instructor notes the time used in laying the gun, taken from the announcement of the range until the announcement, "Up." The instructor then checks the sight setting and the aim and points out errors, if any.

(5) The men working in pairs under the supervision of the squad instructor go through the exercise until they become proficient in sight setting and laying the gun on a designated

aiming point within a time limit of 10 seconds. Each exercise starts with the sight leaf down and the slide set at 700 yards, the windage gage at zero.

d. During these exercises, the coach sees that the proper position is maintained at the gun and pays particular attention to the hold used by the pupil. The coach checks the manipulation of the gun to see that it is done smoothly and without hesitation. He checks the sight setting and the aim at the completion of the exercise and notes the time taken.

■ 108. MANIPULATION OF GUN.—Fire in combat is not limited to a point target. Targets usually have breadth or depth and frequently both. It is therefore necessary for the light machine gunner to be able to manipulate his gun so as to place accurate fire on targets having both breadth and depth.

a. Manipulation exercise.—The following manipulation exercises are designed to develop speed and accuracy in shifting from one target to another, and also in manipulating the gun so as effectively to cover a target having breadth or depth or both. For these exercises the light machine-gun target A is mounted 1,000 inches from the gun position.

(1) The instructor explains that in firing at a target having breadth or depth, or both, the gunner aims at some convenient point on the target, usually at one end of the target, and covers the target by firing a shot or group of shots, and then changing the elevation or direction of the gun, or both the direction and the elevation, and firing another shot or group of shots, then continuing his procedure until the target has been covered.

(2) He shows the light machine-gun target A to the groups, pointing out that the arrangement of pasters is such that a target having breadth can be represented by the traversing target, one with depth by the searching target, and a line target oblique to the front can be represented by the oblique traverse target.

b. Searching exercise.—The instructor assembles the groups and has a soldier take his position at the gun for demonstrating the exercise, as follows:

(1) The instructor announces the range, the aiming point, and the amount and direction of search, as "Range 400,

searching target, search up to top of target." When the gun is properly laid, he commands: 1. STRINGS OF THREE, 2. COMMENCE FIRING.

(2) When the gunner has set the sights and laid the gun on the designated aiming point, he announces, "Up." At the command COMMENCE FIRING, he simulates the firing of three shots, checking his aim between shots, then elevates to the next scoring space above, repeating the procedure until all scoring spaces have been covered or until directed to cease firing by the instructor. The instructor calls attention to each operation as it is performed by the gunner. He may stop firing while the gun is laid on any intermediate scoring space for the purpose of checking the accuracy of the gunner's aim, pointing out any errors that have been made.

(3) Each squad then performs the exercise described above under the supervision of the squad instructor until all are proficient in manipulating the gun in searching.

c. Traversing exercise.—The instructor explains to the groups that the exercise is executed in a manner similar to the searching exercise, except that the direction is changed instead of the elevation. He has a man take his position at the gun to demonstrate the exercise.

(1) The instructor announces a range, an aiming point, and the direction and amount of traverse, as, "Range 700, paster under right scoring space, traverse left to paster under left scoring space." When the gun is properly laid he commands: 1. STRINGS OF THREE, 2. COMMENCE FIRING.

(2) The gunner sets the sight, lays the gun, and announces, "Up." At the command COMMENCE FIRING he simulates the firing of three shots at the paster under the right scoring space, checking his aim between shots, then traverses the gun to the left, repeats the firing, and so continues until three shots are fired at each scoring space, or until directed to cease firing by the instructor. The instructor calls attention to each operation as it is performed by the gunner, stopping the exercise at any point to point out errors or to check the accuracy of the gunner's aim.

(3) Each squad then goes through the exercise as described above under the supervision of the squad instructor until all are proficient.

d. Combined searching and traversing exercise.—The purpose of this exercise is to develop speed and accuracy in engaging a target requiring a change in both elevation and direction between shots or groups of shots.

(1) The instructor explains that this exercise is simply a combination of the two preceding exercises. He has a man take a position at the gun to demonstrate the exercise.

(2) The instructor announces the range and the target as, "Range 400, oblique group, traverse right (left), search up (down)." When the gun is properly laid he commands: 1. STRING OF THREE, 2. COMMENCE FIRING.

(3) The gunner sets the sight at the announced range, lays the gun, and announces, "Up." At the command COMMENCE FIRING he simulates the firing of three shots, checking his aim between shots, then traverses right and elevates his gun until it is laid on the next scoring space above and to the right. He then continues the operation until three shots have been simulated at each scoring space or until directed to cease firing by the instructor. The instructor calls attention to the operations of the gunner, pointing out errors, or requiring other members of the group to criticize the operations of the gunner.

(4) Each squad then performs the combined searching and traversing exercise under the supervision of the squad instructor, practicing manipulating the gun to the right and up and to the left and down, until every man is proficient.

■ 109. EXAMINATION.—Each man who is required to fire the marksmanship course must be examined and rated as proficient in all mechanical and preparatory training before he is allowed to fire a shot. The platoon leader examines and rates each soldier on each phase of training so that at the completion of this training he can give each man a final rating on the individual progress report. Men who are unable to pass a satisfactory final examination are given additional instruction until able to pass.

■ 110. PRELIMINARY GUNNERS' TEST.—*a.* Preliminary gunners' tests are held from time to time, keeping pace with the instruction, at the discretion of organization commanders, subject to such instructions as are given by higher authority.

Organization commanders prescribe methods of procedure. Orders announcing satisfactory completion of preliminary gunners' tests and the scores attained are issued by the organization commanders. Higher commanders exercise such supervision as will insure the maintenance of a proper standard in the conduct of these tests.

b. The test includes 16 subjects, each of which is graded on a basis of 6 or 7 points as shown below; total possible score is 100. A total score of 80 is required for satisfactory completion.

c. The test is as follows:

Subject	*Score*
Removal of groups to the extent required for ordinary cleaning and minor repairs in the field	6
Disassemble and assemble the bolt	6
Disassemble and assemble the cover	6
Disassemble and assemble the lock frame	6
Disassemble and assemble the barrel extension	6
Assemble the machine gun	6
Demonstrate and explain the making of proper head space adjustment	6
Demonstrate the application of immediate action	7
Explain why the gun will not fire with the cover unlatched	7
Explain why the belt is pulled and jerked in the first phase of immediate action	7
Explain why the first round in the belt is removed as part of the second phase in immediate action	7
Demonstrate and explain how to use the ruptured cartridge extractor	6
Demonstrate the points to be observed before firing	6
Clean and oil the bore as it should be done after firing. (Assume no metal fouling is present.)	6
Explain the care and cleaning of the remainder of the gun	6
Inspect a loaded belt and make any corrections necessary to prepare it for firing. (Belt to have at least one each of the following: short round, deformed round, loose bullet, round pushed too far into belt loop, round not pushed far enough into the belt loop, empty loop.)	6

SECTION III

RANGE PRACTICE

■ 111. INSTRUCTION, PRELIMINARY, AND RECORD PRACTICE.—*a.* Instruction practice teaches the accurate delivery of fire, mechanical skill in manipulating the gun to cover all classes

of targets, and observation and adjustment of fire. It is conducted without time limits.

b. Preliminary practice develops speed in handling the gun and prepares the gunner for record practice. It is conducted under the same time limits as record practice.

c. Record practice is the final test of the gunner's efficiency in all phases of instruction in light machine-gun qualification marksmanship and furnishes the means for classifying him according to the proficiency he has attained.

■ 112. MARKSMANSHIP COURSE.—*a.* Instruction practice consists of the firing outlined in table I, subject to the provisions of *d* below.

TABLE I

Range	Time limit	Number of shots	Target	Type of fire
1,000 inches	None	48	Light machine gun A	Strings of 3 rapid single shots.
1,000 inches	None	48	Light machine gun A	Bursts of 3.

b. Preliminary practice consists of the firing outlined in table II subject to the provisions of *d* below.

TABLE II

Range	Time limit	Number of shots	Target	Type of fire
1,000 inches	2 minutes	48	Light machine gun A	Strings of 3 rapid single shots.
1,000 inches	2 minutes	48	Light machine gun A	Bursts of 3.

c. Record practice consists of firing once the course outlined in table II.

d. The number of times each man may fire the instruction and preliminary practice outlined in tables I and II is governed by the ammunition allowance. To economize in ammunition allowances, part of instruction practice may be

fired with the caliber .22 machine gun mounted on the light machine-gun tripod. Ranges of 500 and 250 inches can be used for caliber .22 practice, with corresponding reduction in the size of the targets.

SECTION IV

CONDUCT OF RANGE PRACTICE

■ 113. OFFICER IN CHARGE OF FIRING.—The efficient conduct of 1,000-inch range practice is the responsibility of the officer in charge of firing. This officer is detailed by the regimental or other commander of the troops being trained. His principal duties are as follows:

a. To arrange, coordinate, and supervise the details with reference to the assignment of firing points.

b. To insure the application of safety precautions by all units firing in accordance with AR 750–10 and this manual.

c. To make decisions upon interpretation of the rules governing record practice which may be referred to him.

d. To make all decisions relative to the action on stoppages.

■ 114. RANGE OFFICER.—The successful operation of the range is the responsibility of the range officer. He should be appointed well in advance of range practice. The principal duties of the range officer are as follows:

a. To make timely estimates for material and labor in order to place the range in proper condition for firing.

b. To supervise and direct repairs to installations.

c. To regulate the distribution of ranges and targets.

d. To maintain a supply of the materials required.

e. When safety demands, to instruct and supervise range guards.

f. To assist the officer in charge of firing in matters of safety.

■ 115. UNIFORM AND EQUIPMENT.—*a.* The uniform and individual equipment to be worn during range practice are prescribed by the regimental or other commander of the units to be trained.

b. Each squad should be equipped with at least one ma-

chine gun and tripod mount, complete, prepared for firing. If available, two machine guns and tripod mounts, complete, similarly mounted and prepared for firing facilitate the conduct of the exercises.

c. The number of targets, the amounts of ammunition, and other equipment as prescribed for the practices should be readily available for use.

d. The use of a T-base, sandbags, or other devices for steadying the tripod is prohibited. The tripod is placed on the ground at the firing point, the spades pushed firmly into the ground, and firing started without further efforts to steady the gun.

e. The sight leaf is kept raised during all firing. Both sights of the machine gun should be blackened to overcome the glare. This is done by holding each sight for a few seconds in the point of a small flame which produces a smooth, uniform coating of lampblack on the metal. Among the most commonly used flames are those produced by a candle, a piece of camphor, shoe paste, a rag saturated with oil, or a carbide lamp.

f. Before firing, the gunner is allowed a reasonable time to prepare and inspect his gun, ammunition, and other equipment. He is required to make this inspection as a matter of training.

g. The 1,000-inch course is not suitable for teaching adjustment by observation of tracer bullets. When *observation of strike* is possible, however, the gunner must be trained to take advantage of it, bearing in mind that this training will be important when the gunner takes up field firing. Each burst and each shot in a string should be accurately aimed. Required changes in elevation are placed on the rear sight leaf by counting clicks, and for direction by movement of the windage gage in the desired direction. The gun is then re-layed. When observation of strike is not possible, the gunner depends entirely upon his sights.

■ 116. TARGETING THE GUN.—Before any barrel is used in 1,000-inch firing, it is targeted with the gun in which it is to be used. The targeting process is for the purpose of determining, and correcting for, the mechanical error of the gun

and barrel. The zero of a particular gun and barrel is the sight setting which causes the center of impact of shot groups made by it to coincide with the exact aiming point used. The procedure is as follows:

a. Check the gun and tripod and see that the—

(1) Clamping screw and the bracket screw of the front sight are tight.

(2) Head space adjustment is correct.

(3) Gun pintle bolt and the pin through the bracket are tight (they should not be tight enough to bind).

(4) Leg shoes are stamped or pounded into the ground until the tripod is well settled.

b. Proceed with targeting as follows:

(1) Set the windage gage on zero, the rear sight at a range of 400 yards, and fire a string of one to three shots at an aiming paster on a 1,000-inch machine-gun target placed 1,000 inches from the gun pintle.

(2) Clear the gun, being careful not to alter the laying of the gun.

(3) Determine by inspection the center of the shot group.

(4) When the gun is properly targeted, the center of the shot group should be at the middle point of the lower edge of the aiming paster. Whenever the center of the shot group is not properly located, place the middle point of the lower edge of another aiming paster at the center of the shot group.

(5) Lower the cover, being careful not to disturb the laying of the gun. An assistant loosens the screws on the front sight and, as directed by the gunner, manipulates the front sight bracket in elevation and the blade in deflection until the line of sighting is on the middle point of the lower edge of the new aiming paster. (Changes in deflection may also be made by moving the windage screw.)

(6) Lay the gun on another aiming paster and fire a confirming string of one to three shots. The center of impact should be exactly at the point of aim.

(7) Note and record the elevation and deflection zero.

c. To ascertain the sight setting to engage the fixed and horizontal groups, proceed as follows:

(1) With the zero as found above, lay the gun on the center of the fixed fire scoring space.

(2) Without disturbing the laying of the gun, raise the rear sight slide and manipulate the windage screw until the line of sighting is on the center of the bottom edge of the aiming paster. This will require raising the rear sight slide six mils from the 400-yard setting, and will result in a slight setting of 800 yards on the M1 sights.

(3) Note and record the elevation and deflection zero.

■ 117. CONDUCT OF EXERCISES.—*a*. All firing is initiated by definite fire orders as given in the description of the exercises. The gunner is required to repeat all fire orders.

b. During instruction and preliminary practice the squad instructor as coach, the gunner, and the assistant gunner are allowed at the gun. The instructor or any assistant instructor may be at the gun when his presence is needed.

c. The success of the instruction during instruction and preliminary practice depends to a great extent upon the thoroughness and exactness with which the squad instructor or coach performs his duties. These duties are as follows:

(1) To require the gunner to inspect and prepare his gun and equipment.

(2) To require the gunner to explain the practice he is about to perform.

(3) To require the gunner to check the traversing bar and the traversing and elevating mechanisms to insure that he has sufficient space for the total amount of manipulation required, and after laying the gun to insure that the traversing slide clamp is tight.

(4) To check the sight setting and laying, requiring them to be correct, and to lay the gun off in both elevation and deflection not less than 5 nor more than 10 mils.

(5) To observe the gunner's position, holding, and manipulation during firing; if necessary he may stop the firing to correct errors.

(6) To require the gunner to fire single shots or bursts as required for each target. (A burst is a series of shots fired by one pressure on the trigger mechanism.)

(7) To require the gunner to observe his target between shots or bursts to determine whether or not sight adjustment is necessary.

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(8) To prevent the gunner from adjusting fire without looking through the sights and alining them on the aiming paster or scoring space.

(9) To point out errors and explain their effect upon the exercise.

■ 118. INSTRUCTION PRACTICE, FIXED.—*a.* The purpose of instruction practice, fixed, is to teach skill in the correct method of delivering the initial fire.

b. The instructor demonstrates this practice using a demonstration group of four men. The equipment required is a machine gun, ammunition for one exercise, and two 1,000-inch machine-gun targets. The machine gun with sights blackened is properly mounted in front of the assembled men so that it can be fired. One of the targets is set up 1,000 inches from the gun (measured from the gun pintle). The other target is placed where the instructor can point to it.

c. The instructor makes the following explanation: The upper left-hand scoring space represents a target in the field which requires fixed fire accurately delivered with the initial shot or burst of fire (par. 97*a*(1)). If the gunner sets the rear sight at proper elevation, lays the gun accurately on the aiming paster, takes the correct position, and fires a shot or burst, that shot or burst should strike in the 2-inch by 2-inch scoring space.

d. To demonstrate the exercise the instructor has one man take position at the gun as gunner, one man to the right of the gun as squad instructor (or coach), and one man to the left of the gun as assistant gunner. The fourth man takes position in rear of the gun as observer. The instructor demonstrates the exercise as follows:

(1) The instructor directs the gunner to inspect and prepare the gun and ammunition for the exercise and then explains the exercise he is about to perform.

(2) The instructor then commands: 1. SPACE THREE, HALF LOAD, 2. RANGE 800 (the predetermined zero sight setting for this exercise), 3 FIXED AIMING PASTER.

(3) The gunner repeats the command, half loads, sets the sight, lays on the designated aiming paster, insures that the traversing bar clamp is tight, takes the correct gunner's

position, and reports, "UP."

(4) The squad instructor (or coach) checks these operations, particularly the sight setting and laying, requiring them to be correct. He then lays the gun off not less than 5 and not more than 10 mils in deflection and elevation.

(5) The instructor then commands: 1. STRING (BURST) OF THREE, 2. COMMENCE FIRING.

(6) The gunner repeats the command and after the last word of the command given by the instructor fully loads, relays the gun, takes the correct gunner's position, and fires.

(7) Prior to the firing, the squad instructor (or coach) checks the action of the gunner and the sight setting and laying, requiring the immediate correction of any errors he finds. He then directs the gunner to fire. During the firing he notes any errors in position and holds.

(8) The squad instructor (or coach) and gunner then examine the shot group. The former points out any errors in size and location and explains that any shot group to be effective must be contained within a scoring space. He further explains how the errors that appear may be overcome.

e. As soon as each man has fired one or more exercises with the squad instructor the coach and pupil method may be used.

■ 119. INSTRUCTION PRACTICE, TRAVERSING.—*a.* The purpose of instruction practice, traversing is to teach the proper distribution of fire over a wide target.

b. Instruction practice, traversing, consists of firing on the horizontal scoring group. This scoring group represents a wide target in the field, such as a line of skirmishers. The exercise gives instruction in the first three fundamentals of marksmanship prescribed in paragraph 97*a*—the accurate delivery of the initial fire; mechanical skill in manipulating the gun to obtain proper distribution of fire over targets requiring distribution; and adjustment of fire by frequent re-laying of the gun during firing, assisted by observation if the shot group can be observed. The same sight setting is used as for the fixed-fire exercise, and the aim is directed at the pasters below the scoring spaces.

c. To demonstrate the exercise the instructor uses four men as for the demonstration of instruction practice, fixed. He demonstrates the exercise as follows:

(1) The instructor directs the gunner to inspect and prepare his gun and ammunition for the exercise and then explain the exercise he is about to perform.

(2) The instructor then commands: 1. SPACE 15, HALF LOAD, 2. RANGE 800, 3. HORIZONTAL GROUP, 4. TRAVERSE RIGHT (LEFT).

(3) The gunner repeats the command, half loads, sets the sight, insures that he has sufficient space on the traversing mechanism or bar for the exercise, lays on the designated aiming paster, insures that the traversing slide clamp is tight, takes the correct gunner's position, and reports, "Up."

(4) The squad instructor checks these operations, particularly the sight setting and laying, requiring them to be correct. He then lays the gun off not less than 5 and not more than 10 mils in deflection and elevation.

(5) The instructor commands: 1. STRINGS (BURSTS) OF THREE, 2. COMMENCE FIRING.

(6) The gunner repeats the command and, after the last word of the command given by the instructor, fully loads, re-lays the gun, takes the correct gunner's position, and fires.

(7) Prior to the firing of the first shot, the squad instructor (or coach) checks the actions of the gunner and the sight setting and laying, requiring the immediate correction of any errors he finds. He then directs the gunner to fire.

(8) If the first string or burst of shots strikes within the initial scoring space, the gunner observes that fact, traverses right (left) 2 mils, sees that the sights are alined on the aiming paster, and fires another string or burst of three shots. He continues this process until he has fired five strings or bursts. If the gunner notes that the initial string (burst) did not strike within the initial scoring space, he re-lays accurately on the next paster and fires a string (burst). If this second string (burst) is displaced the same distance and in the same direction as the first, the gunner makes the necessary corrections on his rear sight and lays on the next aiming paster. After proficiency has been dem-

onstrated by the gunner, he may make corrections after the first shot (burst).

(9) During the firing, the squad instructor (or coach) observes the gunner's position, holding, and manipulation and, if necessary, stops the firing to correct errors. Upon the completion of firing, he and the gunner examine the target. He points out the errors made by the gunner and their effect upon the exercise.

■ 120. INSTRUCTION PRACTICE, SEARCHING.—*a.* The purpose of instruction practice, searching, is to teach the proper distribution of fire over a deep target.

b. Instruction practice, searching, consists of firing on the vertical scoring group. This scoring group represents a deep target in the field, such as a column of troops or a drainage line suitable for communication and movement. The exercise gives instruction in the first three fundamentals of markmanship prescribed in paragraph 97*a*—the accurate delivery of the initial fire; mechanical skill in manipulating the gun to obtain proper distribution of fire over targets requiring distribution; and adjustment of fire by frequent re-laying of the gun during firing, assisted by observation if the shot group can be observed.

c. To demonstrate the exercise, the instructor uses four men as for the demonstration of instruction practice, fixed. He demonstrates the exercise as follows:

(1) The instructor directs the gunner to inspect and prepare his gun and ammunition for the exercise and then to explain the exercise he is about to perform.

(2) The instructor then commands: 1. SPACE 15, HALF LOAD, 2. RANGE 400, 3. VERTICAL GROUP, 4. SEARCH UP (DOWN).

(3) The gunner repeats the command, half loads, sets the sight, insures that he has sufficient space on the elevating screw for the exercise, lays on the center of the designated scoring space, insures that the traversing slide clamp is tight, takes the correct gunner's position, and reports, "Up."

(4) The squad instructor checks these operations, particularly the sight setting and laying, requiring them to be correct. He then lays the gun off not less than 5 and not more than 10 mils in deflection and elevation.

(5) The instructor then commands: 1. STRINGS (BURSTS) OF THREE, 2. COMMENCE FIRING.

(6) The gunner repeats the command and, after the last word of the command given by the instructor, fully loads, re-lays the gun, takes the correct gunner's position, and fires.

(7) Prior to the firing of the first shot, the squad instructor (or coach) checks the actions of the gunner and the sight setting and laying, requiring the immediate correction of any errors he finds. He then directs the gunner to fire.

(8) If the first string or burst of shots strikes within the initial scoring space, the gunner observes that fact, searches up (down) 2 mils, sees that the sights are alined on the scoring space, and fires another string or burst of three shots. He continues this process until he has fired five strings or bursts. If the gunner notes that the initial string (burst) did not strike within the initial scoring space, he re-lays accurately on the next scoring space and fires a string (burst). If this second string (burst) is displaced the same distance and in the same direction as the first, the gunner makes the necessary correction on his rear sight and lays on the next scoring space. After proficiency has been demonstrated by the gunner, he may make corrections after the first shot (burst).

(9) During the firing the squad instructor (or coach) observes the gunner's position, holding, and manipulation, and, if necessary, stops the firing to correct errors. Upon the completion of firing he and the gunner examine the target. He points out the errors made by the gunner and their effect upon the exercise.

■ 121. INSTRUCTION PRACTICE, COMBINED TRAVERSING AND SEARCHING.—*a*. The purpose of the combined traversing and searching practice is to teach the proper distribution of fire over a target which cannot be covered by traversing alone or by searching alone.

b. This practice consists in firing at the oblique group of scoring spaces. This scoring group represents targets in the field requiring combined traversing and searching, such as may be presented, for example, by the edge of a woods. This group has a slope which requires a 2-mil traverse and a 1-mil search after each group of shots.

c. To demonstrate the practice the instructor has the men of the demonstration group take the same position as for the demonstration of instruction practice, fixed. He demonstrates the exercise as follows:

(1) The instructor directs the gunner to inspect and prepare his gun and ammunition for the exercise he is about to perform.

(2) The instructor then commands: 1. SPACE 15, HALF LOAD, 2. RANGE 400, 3. OBLIQUE GROUP, 4. TRAVERSE RIGHT (LEFT), SEARCH UP (DOWN).

(3) The gunner repeats the command, half loads, sets the sight, insures that he has sufficient space on the traversing mechanism or bar and elevating screw for the exercise, lays on the center of the designated scoring space, insures that the traversing slide clamp is tight, takes the correct gunner's position, and reports, "Up."

(4) The squad instructor (or coach) checks these operations, particularly the sight setting and laying, requiring them to be correct. He then lays the gun off not less than 5 and not more than 10 mils in deflection and elevation.

(5) The instructor then commands: 1. STRINGS (BURSTS) OF THREE, 2. COMMENCE FIRING.

(6) The gunner repeats the command and, after the last word of the command given by the instructor, fully loads, re-lays the gun, takes the correct gunner's position, and fires.

(7) Prior to the firing of the first shot, the squad instructor (or coach) checks the actions of the gunner and the sight setting and laying, requiring the immediate correction of any errors he finds. He then directs the gunner to fire.

(8) If the first string or burst of shots strikes within the initial scoring space, the gunner observes that fact, traverses right (left) 2 mils, searches up (down) 1 mil, sees that the sights are alined on the center of the next scoring space, and fires another string or burst of three shots. He continues this process until he has fired five strings or bursts. If the gunner notes that the initial string (burst) did not strike within the initial scoring space, he re-lays accurately on the next scoring space and fires a string (burst). If this second string (burst) is displaced the same distance and in the

same direction as the first, the gunner makes the necessary correction on his rear sight and lays on the center of the next scoring space. After proficiency has been demonstrated by the gunner, he may make corrections after the first shot (burst).

(9) During the firing, the squad instructor (or coach) observes the gunner's position, holding, and manipulation and, if necessary, stops the firing to correct errors. Upon the completion of firing, he and the gunner examine the target. He points out the errors made by the gunner and their effect upon the exercise.

d. Upon completion of the explanation and demonstration, the instructor explains that this oblique target may be engaged by firing initially at the center of the upper right-hand scoring space and then, by traversing left and searching down, firing at successive scoring spaces in a similar manner. As soon as each man has fired one exercise with the squad instructor, the coach and pupil method may be used.

■ 122. REPETITION OF INSTRUCTION PRACTICE.—*a*. The exercises described in paragraphs 118 to 121, inclusive, may be repeated one or more times, depending on the time and ammunition available.

b. If time is available, the gunner should be required to repeat the exercises a number of times by simulated fire prior to the firing prescribed in *a* above.

■ 123. PRELIMINARY PRACTICE.—Preliminary practice consists of the firing prescribed in paragraph 112. The manner of engaging the target is optional with the gunner, that is, he may start at the left and traverse right, or start at the right and traverse left. Similarly, a searching target may be engaged by starting either at the top or bottom. The rules governing record practice are followed, except that the duties prescribed for the assistant to the officer in charge of firing are executed by the squad instructor (or coach) and that the officer in charge of firing may designate assistant instructors to make decisions with reference to stoppages.

■ 124. RECORD PRACTICE.—*a*. Record practice consists of the firing prescribed in paragraph 112. Except as hereinafter

specifically stated, the rules for instruction and preliminary practice as set forth in section III and in this section apply to record practice as well. Any departure from the mandatory provisions governing record practice disqualifies a man for classification purposes.

b. In record practice, the gunner takes his place alone at the gun to fire the exercise with the prescribed amount of ammunition. There is a definite time limit for each target. During this practice, he must perform all of the operations required in firing, such as setting the sight, laying and manipulating the gun, and firing, without any coaching, aid, or assistance whatever.

c. The presence of an assistant gunner, a coach, or any other person except the officer in charge of firing or his assistant at or near the gun while a soldier is firing or preparing to fire record practice is prohibited.

d. When record practice is once begun, it is carried to completion before any other practice is permitted. As a rule record practice is not fired by any soldier on the same day that he fires any part of instruction or preliminary practice. However, when the time allotted to range practice is very limited, the officer in charge of firing may authorize record firing on the same day. Instruction and preliminary practice are not conducted simultaneously with record practice, except on ranges where firing takes place on a different part of the range.

e. The machine gun and tripod as issued by the Ordnance Department are used in all firing. The use of additional clamps or appliances of any kind on the gun or tripod is prohibited. The use of metal shims or washers is prohibited. This provision is not construed to prohibit the use of cloth patches or similar soft material for the purpose of keeping the gun or tripod in proper adjustment. The sights may be blackened. The ammunition used is that issued by the Ordnance Department. It is examined carefully and defective cartridges eliminated. The use of tracer ammunition during 1,000-inch range practice is prohibited.

f. The prescribed aiming point is used in laying the gun.

g. Sighting or ranging-in shots are prohibited.

h. After the gunner has taken his place at the gun for an

exercise, all shots fired by him count as a part of that exercise. The total amount of ammunition used in any exercise, including shots fired accidentally, must not exceed the amount authorized for that exercise.

i. (1) Before firing any exercise, the gunner is allowed a reasonable time to examine the gun, ammunition, and equipment.

(2) In all firing with a time limit, the gun is half loaded prior to the command or signal COMMENCE FIRING, the sight is raised and set correctly for the target to be engaged, and the gun is laid off the aiming point not less than 5 mils or more than 10 mils in both direction and elevation. The completion of the loading is effected after the command or signal COMMENCE FIRING. A warning signal may be given 5 seconds before the expiration of the time limit. Firing ceases promptly at the command or signal CEASE FIRING.

(3) In record practice, two points are deducted from the firer's score for each round fired after the command or signal CEASE FIRING.

j. During record practice when a stoppage occurs, the gunner pulls the bolt handle once to the rear, releases it, and attempts to fire.

(1) If the gun fires, the gunner continues with the exercise. He is allowed an additional 2 seconds for each stoppage of this type during the exercises.

(2) If the gun fails to fire, the gunner holds up his hand, calls "time," and without touching the gun awaits further instructions from the assistant to the officer in charge of firing. This officer notes the time at which the signal of the gunner occurs and determines the remaining time for the exercise by deducting the elapsed time from the allotted time. He then inspects the gun to determine the cause of the stoppage.

(*a*) In making this inspection he notes the scoring group upon which the gun is laid and counts the ammunition remaining for the particular exercise being fired. He then lays the gun off of the scoring group upon which it is laid and presses the trigger to determine if an actual stoppage exists. If an actual stoppage exists he directs the gunner to reduce the stoppage.

(*b*) He then reports the nature of the stoppage to the officer in charge of firing, who gives instructions as to whether or not the gunner will be permitted to complete the exercise. If the cause of the stoppage was manifestly the fault of the gunner, the exercise is not completed and the score stands. If the cause of the stoppage was not the fault of the gunner, he is permitted to complete the exercise. To complete the exercise the gunner fully loads and lays on the same scoring group that he was firing on when the stoppage occurred. At the command COMMENCE FIRING, given by the assistant to the officer in charge of firing, he fires the ammunition that remained for the particular exercise in the time remaining to complete the exercise plus 2 seconds for one stoppage. In no case is any exercise refired. Should a breakage occur, the gun is retargeted or replaced before firing to complete the exercise. When, as a result of pulling the bolt handle to the rear when a stoppage occurs, any unfired or damaged rounds are ejected from the gun, the gunner is allowed to fire the equivalent of these rounds as soon as the exercise is completed. To fire the ejected rounds, the gunner fully loads and lays on the exercise (at record practice, the entire target is one exercise) on which he was firing when the round or rounds were ejected. At the command COMMENCE FIRING, given by the assistant to the officer in charge of firing, the gunner fires on the basis of 1 second for each ejected round. This allowance of 1 second is in addition to the allowance of 2 seconds for a stoppage.

k. The rules governing the scoring of the 1,000-inch machine-gun target are as follows:

(1) Five points are scored for each scoring space hit; one point is scored for each hit in a scoring space, but not more than three hits are counted in any one scoring space. Hits touching the boundary line of a scoring space are counted. A hit touching the line between two scoring spaces is counted in only one space, but the space selected is that which gives the greater score to the gunner. The total possible score is 128 points for each exercise, making a maximum score for firing the two exercises 256 points.

(2) A score card is kept for each person firing as a record

of the scores made in each part of the preliminary practice and record practice at 1,000 inches and of the total score made in each of these practices. The date of the firing is also recorded. Entries are made in ink or indelible pencil. No erasures are made on score cards. Alterations may be made only by the organization commander or an officer acting as scorer, and each alteration is authenticated by the initials of the officer who made it.

(3) In record practice the target is scored by an assistant to the officer in charge of firing. This officer enters the score on the score card and authenticates the entry.

(4) If a man fires on another man's target in any exercise, he receives a score for such hits as are shown on the scoring group of his own target at which he was required to fire, but he is not allowed to fire the exercise again. The man on whose target he fired in error is required to fire the exercise again.

l. A number of officers sufficient to supervise record practice in strict accordance with the rules governing this practice are detailed as assistants to the officer in charge of firing. Officers for this duty are selected from companies other than the one firing. A maximum of two guns can be supervised by one officer. He performs the following duties in person:

(1) Counts the ammunition of the gunner after he takes his place at the gun.

(2) Lays the gun off in deflection and elevation not less than 5 and not more than 10 mils.

(3) Sees that the gunner does not touch the sight or alter the laying of the gun until after the command or signal to commence firing is given.

(4) Sees that the gun is not fully loaded until after the command or signal COMMENCE FIRING.

(5) Is watchful for the occurrence of stoppages and performs the duties in connection therewith as prescribed in *j* above.

(6) Makes the deduction described in *i* above for firing after the command CEASE FIRING.

(7) Counts and records the score as prescribed in *k* above.

SECTION V

CONSTRUCTION OF TARGETS, RANGES, AND EQUIPMENT

■ 125. 1,000-INCH LIGHT MACHINE-GUN TARGET.—In all firing on the 1,000-inch range, the 1,000-inch light machine-gun target A is used.

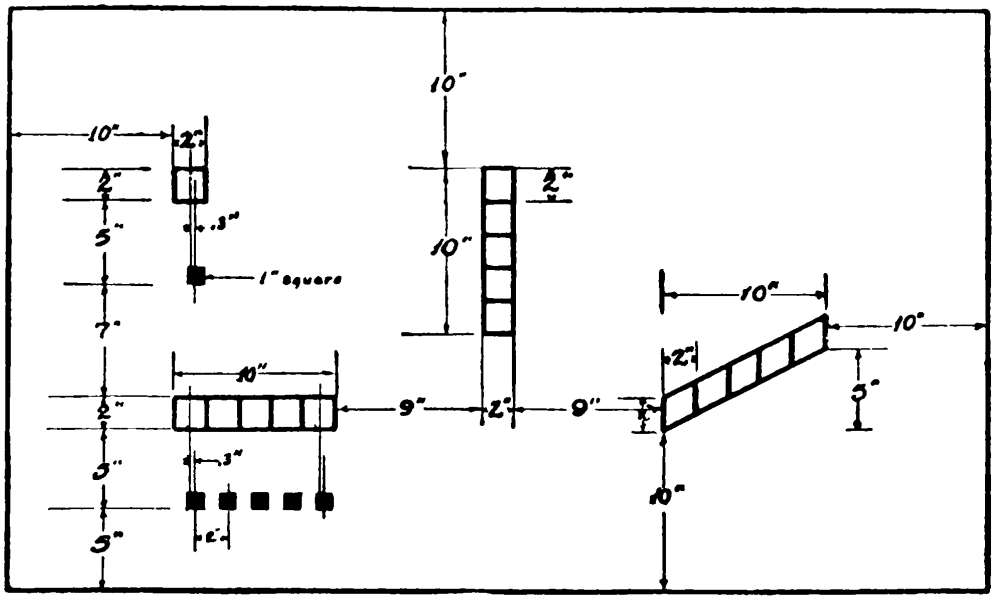

FIGURE 31.—Light machine-gun target A.

This target must conform *exactly* to the specifications set forth in figure 31. The dimensions of the groups are measured from the outer edges of the line. When regular printed targets are not available, suitable substitutes can be made on large sheets of wrapping paper.

■ 126. CONSTRUCTION OF 1,000-INCH RANGE.—*a.* The number of firing points depends upon the terrain available and the number of guns which will probably be firing at the same time. The interval between guns should be approximately 5 yards.

b. AR 750–10 prescribes the danger areas for target ranges. On account of the small size of the 1,000-inch range a location for it can usually be found easily. For each target there is required a level open space about 40 yards in length (in the direction of the line of fire) and about 5 yards in width.

If the range can be located so that the fire is delivered into a steep bank, such as the side of a ravine or an artificial bullet stop, it eliminates the necessity for range guards. On this range the interval between guns may be reduced to 3 yards when necessary.

c. On the 1,000-inch range the target frame may be carried on a car which runs on a light track leading from the firing point to the position of the target, a distance of 1,000 inches

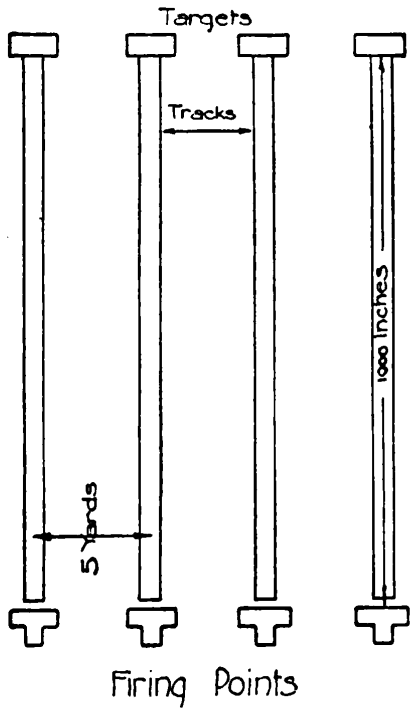

FIGURE 32.—Plan of 1,000-inch machine-gun range.

(83 feet 4 inches), measured from the gun pintle. The car and track are furnished by the Ordnance Department. Rope is furnished so that the carriage may be drawn back and forth by a man standing at the firing point. This facilitates target changes and observation of results. Carriages and tracks are not a necessity and may be dispensed with, the targets being supported by stakes driven in the ground at the required distance from the firing point. In either case, the stakes supporting the target on the carriage or on the ground should be placed at the ends of the target frame. When placed back of the target, they are soon shot out.

SECTION VI

LONG-RANGE OBSERVATION AND ADJUSTMENT PRACTICE

■ 127. PURPOSE AND SCOPE.—*a.* The purpose of long-range observation and adjustment practice is to teach the soldier the adjustment of fire by the observation of strike, and by the observation of the flight of tracer bullets.

b. This practice consists of preparatory instruction and firing exercises. It is not given the soldier until after he has completed the 1,000-inch marksmanship training, and the instruction follows the procedure outlined for that training (par. 96).

■ 128. PREPARATORY INSTRUCTION.—*a.* Preparatory instruction consists of instruction in the nature of the cone of fire and the manipulation required to move the center of impact of the beaten zone at key ranges. It is given prior to the firing exercises.

b. The instructor first explains the essential characteristics of the cone of fire and the beaten zone at the key ranges, using a sand table, charts, or actual firing on the ground for the purpose. He then explains, and, if practicable, has a gunner demonstrate by firing tracer ammunition, the manipulation required to move the center of impact of the beaten zone at the key ranges. He bases this latter explanation and demonstration on the following rules of thumb which are based on conditions where the gun and target are on level ground:

(1) A 1-mil change of direction changes the beaten zone as follows:

½ yard at a range of 500 yards.
1 yard at a range of 1,000 yards.
1½ yards at a range of 1,500 yards.

(2) A 1-mil change of elevation varies the center of impact approximately as follows:

100 yards (120–80) at ranges from 100 to 500 yards.
60 yards (80–40) at ranges from 500 to 1,000 yards.
30 yards (40–20) at ranges from 1,000 to 1,500 yards.

(3) To shift the center of impact approximately 100 yards requires the following change in elevation:

1 mil at ranges of 100 to 500 yards.
2 mils at ranges of 600 to 800 yards.
3 mils at ranges of 900 to 1,200 yards.

c. Upon the completion of the explanations and demonstrations the instructor gives exercises in theoretical adjustments based on the rules of thumb either on a sand table, a chart, or the ground.

d. As soon as the men understand and can apply the rules of thumb for conditions where the gun and target are on level ground, the instructor explains and demonstrates modifications in the rules due to conditions where the ground slopes in the vicinity of the target. The effect of slope upon the unit value of a 1-mil change in elevation can be demonstrated upon a sand table, upon any other short-range method of representing relief, or upon the ground. This explanation and demonstration is followed by exercises involving conditions requiring the use of modifications in the rules of thumb.

e. The preparatory instruction is sufficiently detailed and thorough that by the time the firing exercises are begun, the application of the rules of thumb is reduced to a routine and the firing exercises can be devoted principally to sensing.

■ 129. FIRING EXERCISES.—*a.* There are three firing exercises. In the first exercise, the gunner is required to adjust fire by observation of strikes; in the second he is required to adjust fire by the observation of the flight of tracer bullets; and in the third exercise, he is required to use speed in adjusting fire by either or both of the above-mentioned methods.

b. These exercises can be fired on any terrain available from ranges of 300 to 1,000 yards. They can be fired over water. If very short ranges are used, the guns should be raised about 10 feet above the general ground level. This serves to make the beaten zone more compact and renders sensing easier for the beginner. Elaborate facilities are not needed. The degree of training received is in direct proportion to the ingenuity of the officer conducting the firing. It must be constantly borne in mind that marksmanship train-

ing of a gunner is not complete until he has learned sensing and adjustment of fire by observation of strike and observation of the flight of tracer bullets.

c. The number of exercises to be fired depends on the ammunition allowance. After each man has fired the first and second exercises once, the remaining ammunition should be used in firing the third exercise.

d. The first firing exercise is as follows:

(1) Four to eight machine guns are mounted on the firing line with an interval of 5 yards between guns. At each gun are a No. 1 undergoing the instruction, a No. 2, and a squad instructor (or coach).

(2) The instructor directs the first gunner on the right to fire the exercise. All other gunners execute the fire order, except that they simulate load. He gives an appropriate fire order such as, 1. SPACE 20 BALL, 2. LOAD, RANGE 800, 3. SCREEN TARGET. He then directs the squad instructor (or coach) to lay the gun off 5 to 20 mils in deflection and 5 to 10 mils in elevation. He then commands: 1. BURST OF TEN, 2. COMMENCE FIRING. The gunner fires as laid.

(3) Each gunner then estimates from the strike the amount of traverse and search required to place the next string or burst of shots on the target. He explains to the squad instructor (or coach) in his own words the corrections and actually executes them for his gun.

(4) When this step is complete the gunner on the right on order from the squad instructor (or coach) fires his second string or burst. Each gunner repeats the process of sensing and applying the corrections necessary to place the fire on the target. Well-trained gunners are able to "roll" a short string of rapid single shots into the targets without varying the rate of fire.

e. The second firing exercise is conducted in a manner similar to the first, except that the ammunition used is in the proportion of one tracer to four balls and the gunner adjusts his fire by observation of the flight of the tracer bullets.

f. The third firing exercise is conducted in a manner similar to the first and second exercises, except that two gunners fire simultaneously in competition and on separate targets.

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Either ball or tracer ammunition may be used. For this exercise various types of targets may be used as follows:

(1) Falling targets may be made of heavy steel plates propped up by a stick or board.

(2) Small balloons make excellent targets and permit of a wide variety of arrangements.

(3) If pits are available or time permits their construction, standard rifle or machine-gun targets may be used. When struck they may be tripped by the pit operator.

(4) If a standard rifle range is available, intermittent or bobbing targets may be used. This introduces a time element and puts a premium on rapid and accurate sensing.

(5) Moving targets operated by the pit detail may also be used.

SECTION VII

SAFETY PRECAUTIONS

■ 130. SAFETY PRECAUTIONS.—*a. General.*—General safety measures necessary for firing caliber .30 machine-gun ammunition are contained in AR 750–10.

b. Additional.—Additional safety precautions pertaining to personnel immediately at the guns are as follows:

(1) Firing must not begin on any range until the officer in charge of firing has ascertained that the range is clear and has given his authority to fire.

(2) No firing is done except under the direct supervision of an officer.

(3) No gun is loaded or half loaded until a command to do so has been given.

(4) After machine guns are fired, and prior to dismounting or removing them from firing positions, each gun is inspected by an officer to see that it is unloaded. As part of this inspection, a cleaning rod is passed through the barrel of each gun from the muzzle and *immediately removed.*

(5) During range firing, no person is allowed in front of the gun for any purpose until directed by an officer who has ordered that all guns be cleared by *having a wooden block which protrudes a visible height above the gun inserted in each receiver* and has ascertained that the order has been completely carried out.

CHAPTER 4

MARKMANSHIP, MOVING GROUND TARGETS

■ 131. METHOD OF ENGAGING RAPIDLY MOVING TARGETS.—*a. General.*—Fire at rapidly moving targets, such as scout cars, reconnaissance cars, truck convoys, armored cars, and tanks, requires a different technique from that used against stationary or slow-moving targets, due to the relatively high rates of speed of such targets. In order to hit a target which is moving, the bore of a gun must be laid in direction and elevation so that the bullet and the target will meet.

b. Fundamentals.—To become expert at firing at moving targets, soldiers must understand that the following fundamental principles are the basis for any technique which may be developed for specific weapons:

(1) Accurate delivery of fire with the axis of the bore laid in order to compensate for the range to the target, the speed of the target, and the time of flight of the bullet.

(2) Mechanical skill in manipulating the gun in order to lay the axis of the bore correctly.

(3) Adjustment of fire from observation of strike or tracers.

(4) Maintenance of an adequate volume of fire in order to destroy the target in the shortest possible time.

(5) Rapid shifting of fire to new targets.

c. Technique of fire.—In order to become proficient gunners, men must be trained—

(1) To track fast-moving targets in elevation by means of the elevating handwheel and in traverse by sliding the traversing block along the traversing bar.

(2) To swing ahead of the target to the required lead and fire a string of shots or a burst.

(3) To continue the swing, or follow through, while firing.

(4) To re-aim rapidly on the target, if necessary, and swing out to the corrected lead.

(5) To correct the lead by observation of strike and the flight of tracers.

(6) To maintain fire on the target until it is obviously disabled or until ordered to shift.

(7) To shift the fire rapidly to new targets.

d. Methods of training.—Training in firing at moving targets should include—

(1) Preparatory training.

(2) 1,000-inch range practice.

(3) Long-range practice.

■ 132. TYPE OF FIRE.—*a.* Automatic fire against moving targets has very little effect when used as fixed fire, because when the cone of fire is fixed on a point in the path of a rapidly moving target, the target may pass through the cone without being hit, due to the time interval between the strikes of successive shots. Proper use of the cone of machine-gun fire is to manipulate the gun so that the cone of fire moves with the target, the gunner maintaining the correct lead for the target during delivery of fire. The machine gun must be "free" in traverse for firing on moving ground targets. The mechanical elevation of the gun permits sufficiently rapid manipulation in elevation.

b. In the delivery of fire on rapidly moving ground targets, the gunner uses automatic fire or the maximum rate of aimed single shot fire, adjusting his lead as observation of strike and tracers indicate. In the final stages of an assault by hostile mechanized vehicles, the maximum concentration of automatic fire is habitual.

■ 133. POSITION.—The position of the gunner for firing at rapidly moving ground targets is the same as prescribed for firing at stationary ground targets (par. 106).

■ 134. LEADS.—*a. General.*—(1) Before proceeding with the lead exercises, the instructor should explain the theory and use of leads in firing against moving targets.

(2) In order to hit a moving target, the axis of the bore of the weapon must be pointed ahead of the target at a point in line with the movement of the target. The distance that the weapon must be pointed ahead of the target is the distance which the target will travel during the time the bullet is in flight from the weapon to the target. This distance is

measured in target lengths—one target length, as seen by the gunner, being called one lead.

(3) When the distance the bullet travels from the gun to the target is so great that there is an appreciable drop in the trajectory, the axis of the bore must be given sufficient elevation to compensate for the drop of the bullet.

b. Computation of leads.—The computation of the correct lead for a moving target is a mathematical calculation based upon the speed of the target, the time of flight of the bullet, and the movement of the target with relation to the gun. Such computations are not feasible under field conditions. Leads vary greatly and it is not practicable to give a complete table of leads for all possible variations. However, the lead table shown below covers the great majority of targets:

LEAD TABLE

Speed in miles per hour	Range of the target in yards		
	300	500	900
15	½ lead	1 lead	2 leads.

For a speed of 7½ miles an hour, divide the lead by 2; of 30 miles an hour, multiply by 2.

c. Use of lead table.—The leads shown in the lead table are based on a target approximately 5 yards in length and 2½ yards high, crossing the line of fire at 90°. The lead varies with the movement of the target with respect to the gun and is decreased from that indicated above as the movement varies from 90°. If the angle between the line of fire and the line of travel of the target is less than 45°, use one-half of the lead shown in the table. For a target moving directly toward the gun, the line of aim is placed on the center or the lower edge of the target depending on the range and slope of the ground, the lower edge being used for the longer ranges and for broken ground. For a target moving directly away from the gun, the line of aim is placed similarly on the center or upper edge of the target. For a receding target, too much

lead is better than too little because the target will run into the fire.

d. Initial estimation of leads.—The initial estimation of leads for any moving ground target is based upon the application of the leads indicated in the lead table. It must be understood that these leads are only a rough approximation but that owing to the size of the target and the limited time available for firing against rapidly moving targets, the intelligent and immediate application of fire based on the lead table is absolutely essential.

e. Tracking.—Tracking consists of maintaining the correct alinement of the sights, with or without a lead, on a moving target by moving the gun at the same angular speed as that of the target.

f. Duties of gun crew.—(1) The squad leader estimates the range and speed of the target and announces the range and lead to the gunner. He observes the effect of the fire and announces corrections in lead. He switches the gunner to new targets when necessary.

(2) The gunner habitually sets his sight at 600 yards for all firing at moving ground targets. He looks through the sight and locates the target. If the range to the target is less than 300 yards, he lays on the rear end at the lower edge of the target, swings straight through to the front at the lower edge, then past the target until he arrives at the announced or estimated lead; he then opens fire. He continues to fire, maintaining the required lead until the target disappears or is disabled. If the range to the target is greater than 300 yards but less than 500 yards, the gunner proceeds in the same manner as indicated above, except that he lays on the rear center edge of the target and swings straight through the center out to the front center edge and then on out to the correct lead. If the range to the target is greater than 500 yards and less than 900 yards, the gunner proceeds as indicated above, except that he lays on the rear top edge of the target and swings straight across the top to the correct lead.

(3) No. 2 observes the feeding and functioning of the gun and watches the squad leader for signals and commands.

g. Rate of fire.—The rate of fire depends upon the range

to the target and its speed. The maximum rate, consistent with efficient tracking, is employed.

h. Adjustment of fire.—Gunners should be trained to fire with an ordered or estimated lead in the manner described in *f*(2) above. Fire may then be adjusted by—

(1) The squad leader, who "senses" the burst and orders a new lead.

(2) The gunner, who, when observation of strike is clearly discernible, automatically adjusts the lead and lays from such observation.

(3) The squad leader and the gunner, who adjust the lead and lay from the observation of the tracers when tracer ammunition is used. The proportion of tracer should be one round of tracer to every four rounds of ball or armor-piercing ammunition.

i. Distribution of fire.—Single guns or pairs of guns should engage the leading vehicle of the group. Groups of four or more guns should engage the leading vehicles, respectively, in the ratio of two guns to each vehicle.

j. Accuracy.—The greatest accuracy possible in manipulating the gun, in establishing the correct lead, and in firing is to be desired. Due to the nature of the targets, speed in opening fire and a rapid rate of fire are essential. Moving-target firing is not "bull's-eye" shooting. The size of the target makes it possible to make errors in range, speed, and lead estimations and still hit the target. Too much lead is better than too little lead. If too little lead is used the strike is behind, but if it is too great there is the possibility that the target will run into the strike. Also bullet strike is easier to observe in front of the target.

■ 135. LEADING EXERCISES, 1,000-INCH.—*a.* The gunner is required to take a position at the gun (fig. 33), swing the gun through the announced target silhouette on the 1,000-inch antitank target (fig. 34), and aim with the prescribed lead (par. 134*a*).

b. He then directs an assistant to move the marking silhouette (fig. 35) until the forward edge is at the point of aim.

c. The assistant then places a pencil dot at this point. The exercise is repeated, making triangles by marking the

point at the forward edge of the marking silhouette for each adjustment until the gunner can make at least two out of three triangles, each of which can be inclosed in a circle 1 inch in diameter.

d. This exercise should be conducted for varying leads both right and left.

■ 136. TRACKING EXERCISES.—The gunner is required to aim at a described point on the silhouette target and to maintain

FIGURE 33.—Leading exercise.

that aim during the uniform movement of the target. As instruction progresses, the speeds used should differ during successive runs of the target and finally the target should be moved at erratic speeds. Speeds at which 1,000-inch

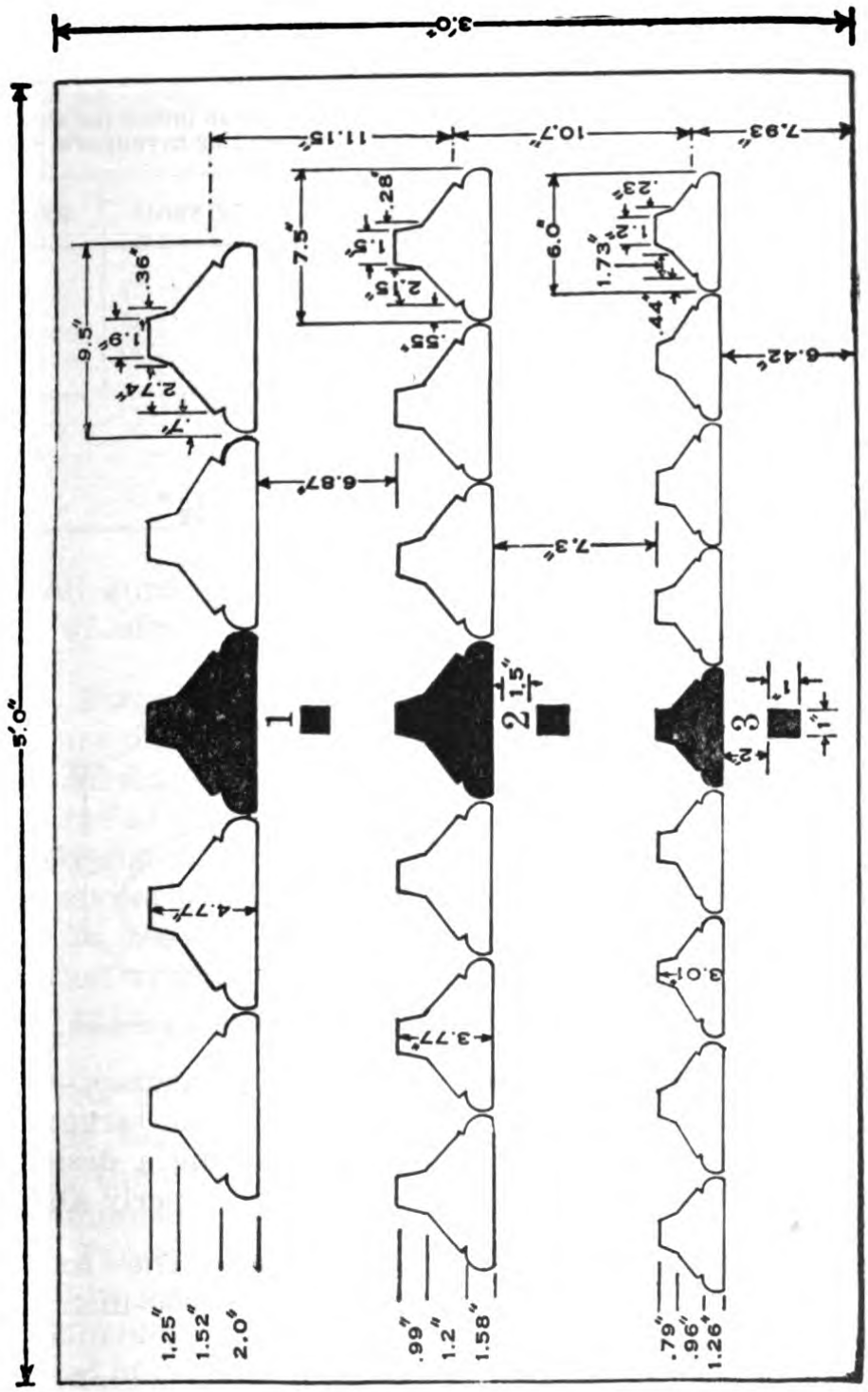


FIGURE 34.—Antitank target, 1,000 inches.

targets should be run to represent speeds at various ranges are shown in the following table:

TARGET SPEEDS, 1,000-INCH MOVING TARGET

Target speeds (miles per hour)	Target speeds in inches per second, corresponding to ranges of —		
	300 yards	500 yards	900 yards
7½	12	7	5
15	24	15	8
30	48	30	16

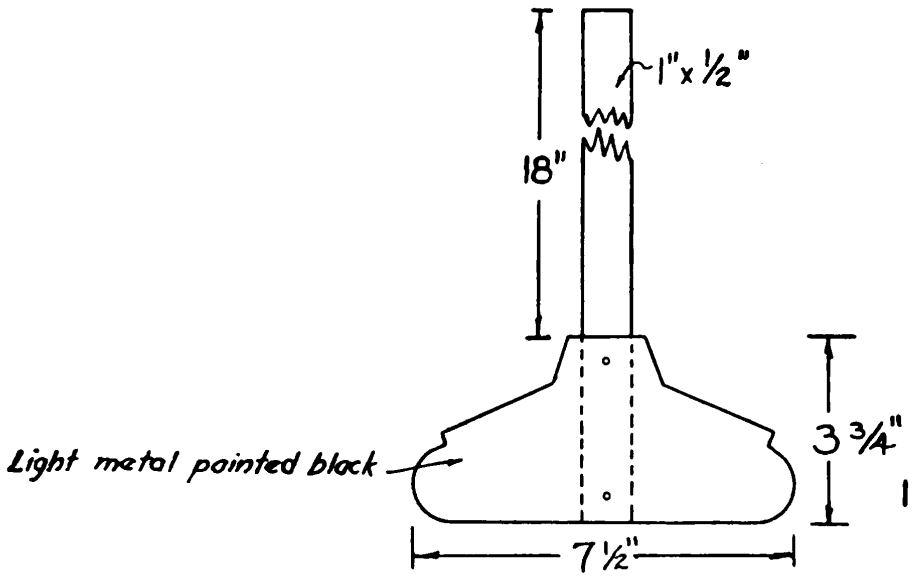


FIGURE 35.—Marking silhouette for leading exercises.

■ 137. COMBINED LEADING AND TRACKING EXERCISES.—When the gunner has gained facility in tracking the target, he is required to repeat the tracking exercise using a designated lead and to simulate firing with his sights properly alined.

■ 138. PRELIMINARY FIRING, 1,000-INCH.—*a*. The following table is suggested as suitable preliminary 1,000-inch firing, subject to ammunition allowances:

Course of aiming target	Speed of target in feet per second	Lead	Rounds per run of target	Number of runs
R to L	5	0	10	1
L to R	5	0	10	1
R to L	12	0	10	1
L to R	12	0	10	1
R to L	15	1TL	10	1
L to R	15	1TL	10	1
R to L	24	1TL	10	1
L to R	24	1TL	10	1
R to L	30	2TL	10	1
L to R	30	2TL	10	1
R to L	48	2TL	10	1
L to R	48	2TL	10	1

b. All guns should be targeted prior to firing so that the point of aim and point of hit are coincident.

■ **139. FIELD FIRING; TARGETS AND RANGES.**—*a. General.*—(1) Guns are placed on the firing line with at least 5-yard intervals. All firing commences and ceases on order of the officer in charge of firing. Fire should be delivered at the maximum rate consistent with accuracy until the command or signal **CEASE FIRING** is given.

(2) In order to obtain the maximum training with the ammunition available, the first few runs of the target should be made with only one gun firing. All other guns simulate firing.

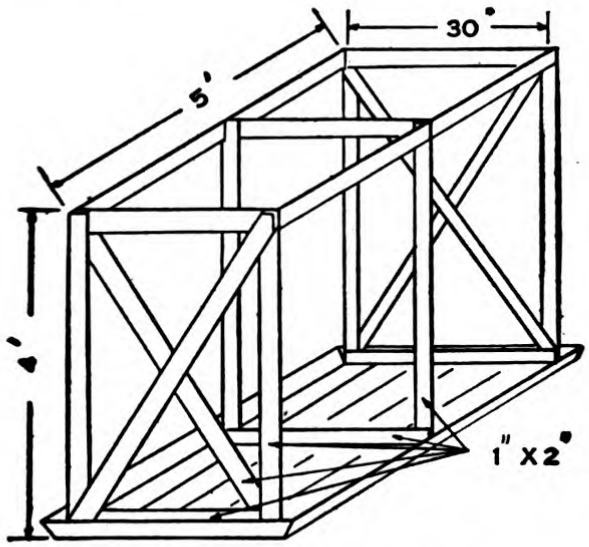
(3) As training progresses, two or more guns should be fired at the same target. If range facilities permit, fire should then be conducted with all the guns firing at an equal number of targets.

(4) Targets are scored after each run and the results should be posted.

b. Moving targets.—Targets for field firing should be constructed of target cloth, covering a frame of approximate size of a combat vehicle. Frames should be of light-weight material. Targets are placed on a sled that can be towed by a truck, or upon a narrow-gage, gravity-operated railroad

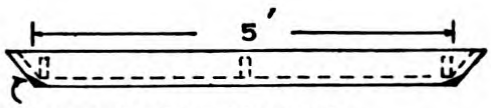
track. Figure 36 illustrates a suitable sled and target. Sufficient targets should be available so that firing is not delayed unduly by returning targets to the starting point.

c. Ranges.—(1) Ranges for field firing should permit firing up to 800 yards and should be sufficiently extensive so that safety rules can be complied with (AR 750–10).



TARGET FRAME

FRONT VIEW OF TARGET



EDGE COVERED WITH SHEET METAL

ELEVATION OF BASE

FIGURE 36.—Ground-towed target.

(2) Local facilities dictate to a large measure the actual range installation. A narrow-gage, gravity-operated railroad is an excellent arrangement but limits the number of targets that can be fired upon simultaneously. Motor-vehicle towed sleds are more practicable. A suggested range is illustrated in figure 37. Changing the positions of the pulleys permits variations in direction of movement of the target. Changes in direction of the target may be accomplished by setting pulleys at desired locations (fig. 38). A large knot or wooden ball fixed to the tow line about 15 feet in front of the sled disengages the line from the pulley,

thereby changing the direction of the target. The tow line should be ⅜-inch wire cable or of ¾-inch rope.

(3) Flags indicating the limits of safety should be installed and officers or noncommissioned officers should be detailed to insure that no gun fires beyond the safety limit.

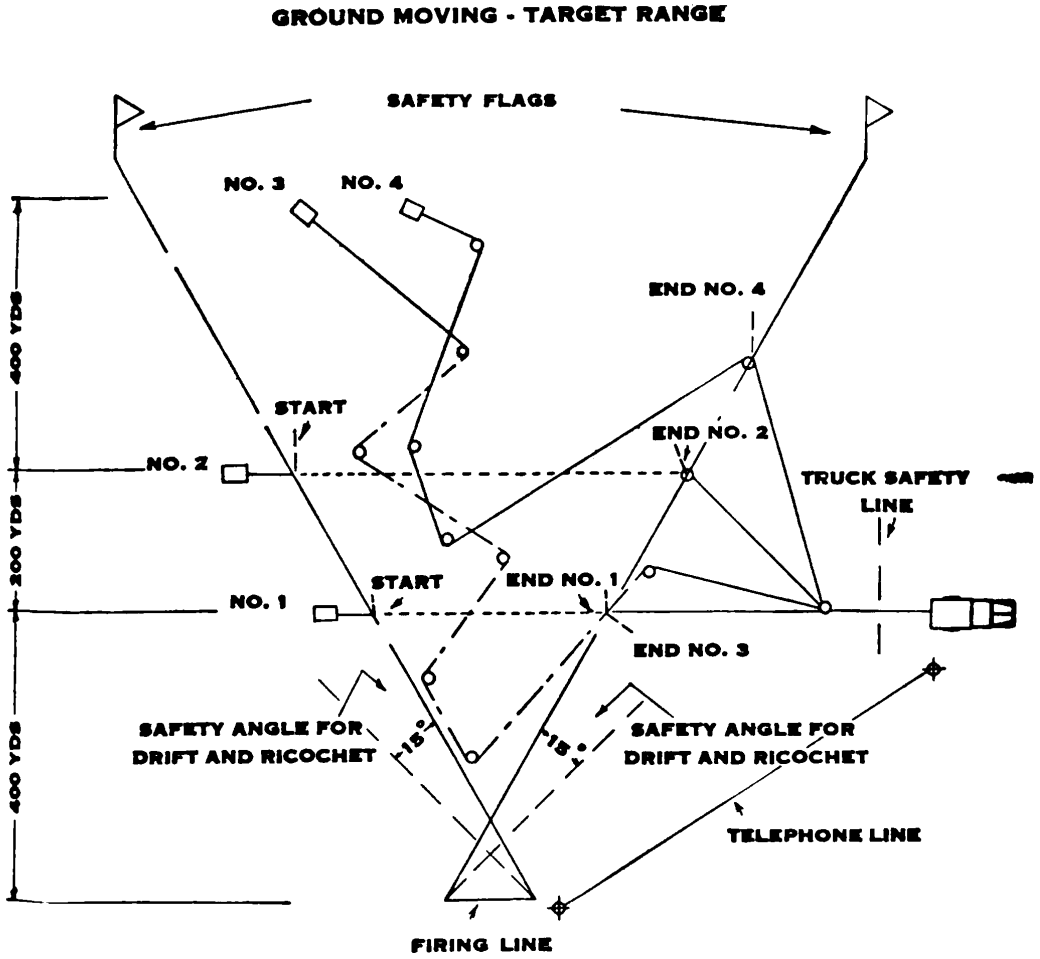


FIGURE 37.—Ground-towed target range, towing vehicle on the flank.

(4) The speed of the target should approximate the speed which might be expected of combat vehicles. Usually better speeds are obtained if the towing truck operates on a road and is not required to make changes in direction. One method of obtaining greater speed is to anchor the end of the tow line, thread it through a pulley or drum attached to the truck, and attach the other end to the sled. With this arrangement the speed of the target will be twice that of the truck.

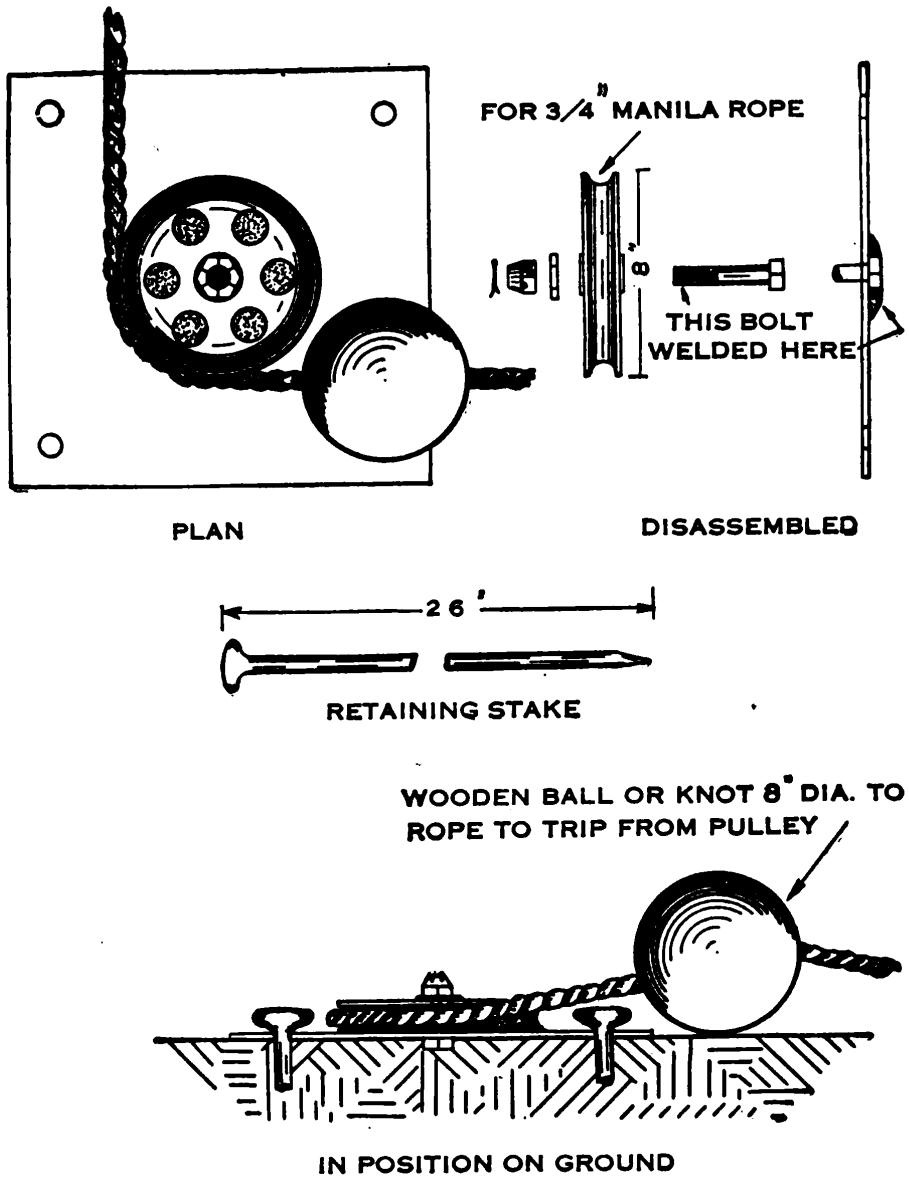


FIGURE 38.—Pulley lay-out for ground-towed target range shown in figure 37.

CHAPTER 5

MARKSMANSHIP, AERIAL TARGETS

SECTION I

ANTIAIRCRAFT GUNNERY

■ **140. TYPES OF COMBAT TARGETS.**—Aircraft present two distinct types of targets to the gunner; either type may be flying at a constant altitude or decreasing or gaining in altitude.

a. Overhead.—Those that pass directly over the gun.

b. Nonoverhead.—Those that do not pass directly over the gun.

■ **141. TO PUT THE LIGHT MACHINE GUN INTO ACTION FOR ANTIAIRCRAFT FIRE.**—*a. General.*—The light machine gun M1919A4, mounted on the tripod M2, is not well suited for antiaircraft fire. However, if a decision is made to engage hostile aircraft with light machine guns, the command is: 1. ANTIAIRCRAFT, 2. ACTION. The following expedients may be used:

(1) *First method.*—No. 2 assumes the sitting position with his left leg flat on the ground and his right knee flexed approximately to a half bend. No. 1 places the tripod head on No. 2's right knee with the trail leg shoes resting on the ground. No. 2 grasps the front leg of the tripod with his left hand and keeps the ammunition belt in line with the feedway with his right hand. No. 1 releases the traversing slide clamp, secures the elevating mechanism in the grip, and kneels on his right knee directly behind the gun, placing his left heel on the left trail leg shoe. The buttocks are dropped well down with the right buttock resting on the right heel.

The right hand grasps the pistol grip firmly with the right forefinger on the trigger; the left hand rests on top of the grip. The body is crouched well forward and the left arm rests on or around the left knee for support. From this position, No. 1 changes the direction of aim by twisting his body while pivoting on his right knee and left foot following the direction of the moving air target. If necessary, he may move either his left foot or right knee so as to follow the target. The position of the eyes may vary from 2 to 9 inches from the rear sight (fig. 39).

(2) *Second method.*—Place the front leg of the tripod on the spare parts chest. No. 2 then grasps the front leg with his left hand and holds it in place while No. 1 proceeds as described in (1) above (fig. 40).

(3) *Third method.*—If the barrel is not too hot, No. 1 loads the gun, releases the traversing bar clamp, and seats the elevating mechanism in its carrying recess. He then kneels on his right knee with his left leg bent so that the lower leg is approximately vertical, toe pointing in the general direction of the target. Having an asbestos mitten on his left hand, he grasps the barrel jacket with his left hand and the pistol grip with his right hand. He pivots the tripod on the trail leg shoes, raising the gun to the desired position to engage the target. No. 2 supports and guides the belt with his right hand (fig. 41). To change direction to the rear, No. 1 tilts the tripod to the right on the right trail leg and turns the gun and tripod to the right about. The gun normally should be turned to the right as that prevents the muzzle of the gun from turning toward No. 2 and permits No. 2 to follow the gun. However, the gun may be turned to the left about providing No. 2 moves prior to No. 1 (fig. 42).

b. Under varying conditions in battle, other expedients, such as resting the barrel jacket in a notch in a wall, may be useful. Other possible expedients are shown in figures 81 and 82.

■ 142. OBSERVATION OF FIRE.—*a.* Machine-gun antiaircraft fire generally employs individual tracer control. In this method the gunner controls his own firing as the result of his own observation of the tracers.

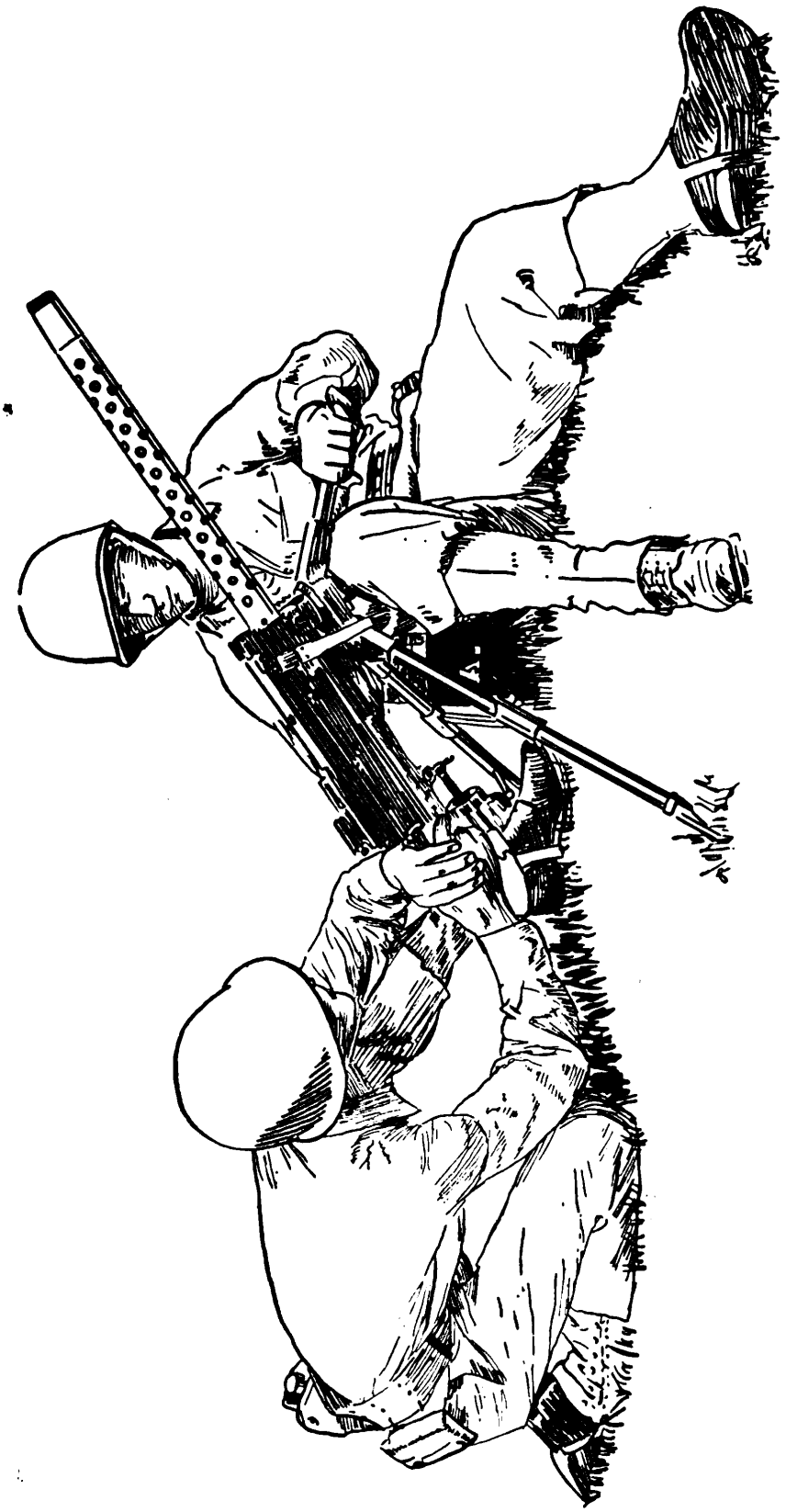


FIGURE 39.—Antiaircraft position.

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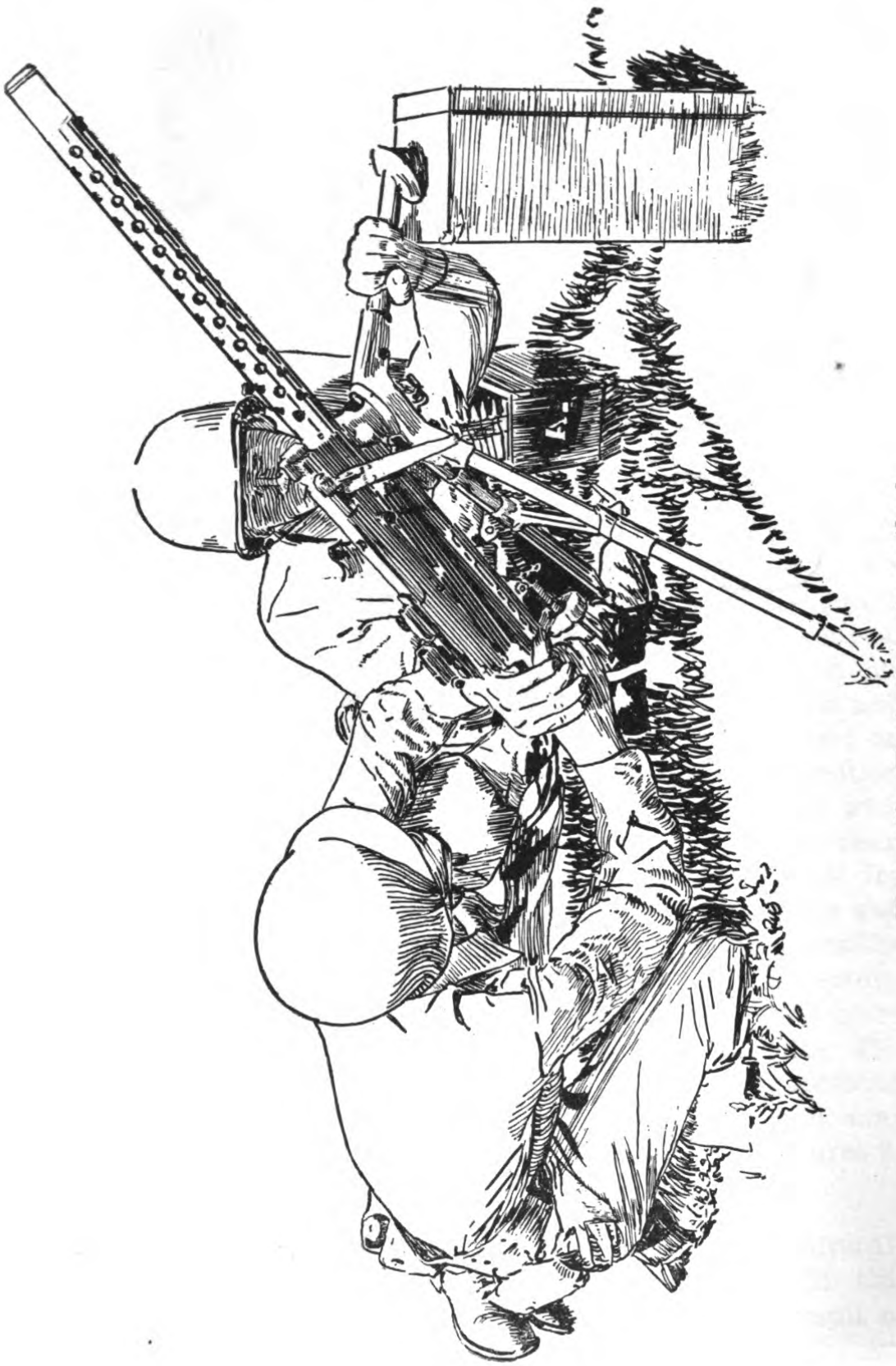


FIGURE 40.—First alternate method.

b. The gunner can observe his own firing in one or two ways.

(1) By observing the tracers in the vicinity of the target. In this method the gunner is conscious of the entire tracer stream which seems to curve sharply into the target. Considerable training is necessary to adjust fire by this method as an optical illusion must be taken into account.

FIGURE 41.—Second alternate method.

(2) By observing the tracers close to the gun. Gunners using this method observe the first part of the trajectory of the tracer bullets which appears to them as a straight and bright white streak. This method of observation is prescribed for troops whose training is primarily with ground machine guns.

c. While the length of the white tracer streak is about 90 yards, the gunner is not conscious of this length but sees the streak as extending out toward the target. The eye position of the gunner can vary from about 2 inches to 8 or 9 inches above the receiver without materially affecting the

FIGURE 42.—Second alternate method, changing direction to the rear.

accuracy of fire. When using the white tracer streak, the gunner is in effect using a line extending the axis of the bore of his weapon. By means of this streak he can manipulate the axis of the bore of his weapon to set off the required lateral lead and visual elevation. If the gunner sees the tracer as red, he is observing the farther part of the trajectory and is not applying the white tracer streak method of tracer control.

■ 143. VISUAL ELEVATION.—Visual elevation is simply the distance above the target that the white tracer streak must appear in order to compensate for the drop in the trajectory. This visual elevation is expressed in target heights.

NOTE.—The data shown in tables I and II are based upon the following types of targets:

a. Airplanes—30–47 feet long with a height of 6 feet.

b. Towed-sleeve targets—15 feet long with a diameter of 3 feet.

c. Towed-flag targets—40 feet by 9 feet, equipped with weights so that the width (9 feet) is displayed to the gunner as width and height, respectively, when the target is moving directly toward (away from) the gun, across the front.

d. Radio-controlled airplane targets—10 feet long with a height of 2 feet.

TABLE I

VISUAL ELEVATION IN TARGET HEIGHTS

Slant range (yards)	Target heights above 6-foot plane	Target heights above 2-foot radio-controlled target plane	Target heights above 3-foot sleeve	Target heights above 9-foot flag
200	0	1	1	0
300 to 500	1	3	2	½
500 to 700	2	6	4	1
1,000	6	18	12	4

■ 144. LEADS.—*a.* In order to hit a rapidly moving nonoverhead target it is necessary to direct the axis of the bore of the weapon an appropriate distance ahead of the target so that the bullet and target meet in space. The distance of the aim ahead of the target is called the "lead." It is expressed in target lengths.

b. The following lead table shows the target length leads at certain speeds for firing at airplanes and targets as far out as 700 yards in range.

TABLE II

LEADS IN TARGET LENGTHS

Slant range (yards)	Target length leads ahead of airplane (airplane speed 300 mph)		Target length leads of radio-controlled airplane (10-ft.) 100 mph	Target length leads of towed-sleeve target (15-ft.) 150 mph	Target length leads of towed-flag target (40-ft.) 150 mph
	30-foot airplane	47-foot airplane			
100	2	1	2	2	½
200	4	2	4	4	1
300	6	4	6	6	2
400	8	5	8	8	3
500	10	7	10	10	4
600	13	8	13	13	5
700	16	10	16	16	6

■ 145. TECHNIQUE OF FIRE.—*a. General.*—An airplane traveling at 300 miles per hour covers a distance of 1,000 yards in about 7 seconds. All of this time should be utilized for tracking and firing; the gunner fires in one continuous burst. Airplanes whose course will not bring them within 1,000 yards of the gun are not engaged.

b. Nonoverhead airplanes.—Airplanes whose course will bring them within 1,000 yards of the gun position become remunerative targets at a range of approximately 700 yards. Consequently, all gunners should commence tracking such an airplane and open fire immediately with a lead of 16 target lengths, directed at a point estimated to be at 700 yards slant range. As the range to the airplane decreases, the gunner reduces the lateral leads and visual elevations, until the airplane is at its closest range. Lateral leads and visual elevations are then increased to correspond to the increasing range to the airplane. If the airplane appears at a lesser range than 700 yards, fire is immediately opened with a lead based on the estimated range and the process is the same.

c. Overhead airplanes.—The variable lead method of firing as described in *b* above does not apply to overhead airplanes. Such targets are engaged as follows:

(1) *Incoming targets.*—The tracers must appear to pass just over the nose of the target.

(2) *Departing targets.*—The tracers must appear to pass just under the target.

■ 146. ESTIMATION OF RANGES.—Gunners should be trained to estimate the approximate range to hostile airplanes. Whenever possible, such training should be given by having an airplane fly at known ranges until all are familiar with the appearance of the airplane at key ranges.

TABLE III

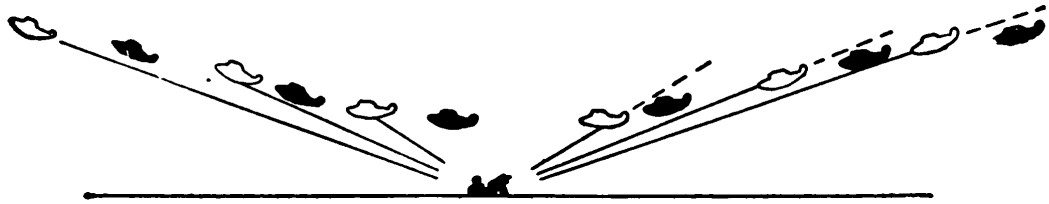
Range	Details seen
Yards	
1,000	General outline of the airplane.
700	Rudder, cockpit.
500	Small projections, guns, etc.
200	Symbols and numbers. Letters on the airplane can be seen and read plainly.

■ 147. AMMUNITION LOADINGS FOR ANTIAIRCRAFT FIRING.—All-tracer ammunition is the most desirable loading for antiaircraft firing with machine guns. However, ammunition loaded in proportions of one tracer and one ball (armor-piercing) up to one tracer and four ball (armor-piercing) gives effective results. The white tracer streak is apparent with these mixed loadings. When the proportion of tracer to ball is below one to four rounds, the effectiveness of the fire is reduced. Loadings for the field are in accordance with the tactical and supply situation. Loadings for training purposes are in accordance with available ammunition allowances.

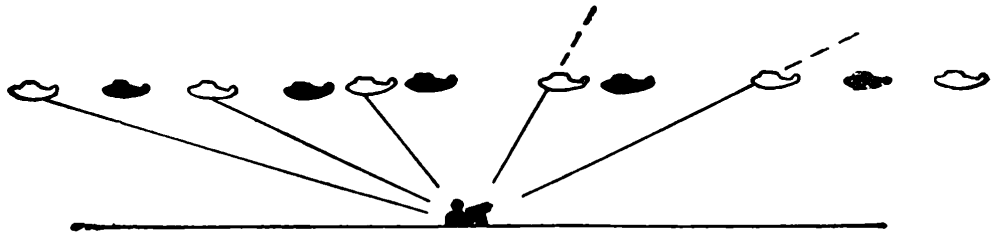
■ 148. ALL BALL OR ARMOR-PIERCING AMMUNITION.—The use of all ball or AP ammunition, while giving somewhat lower hit percentages than the tracer control method, is practica-

ble and desirable for use by troops in the field in circumstances where the tracer loadings are not readily available.

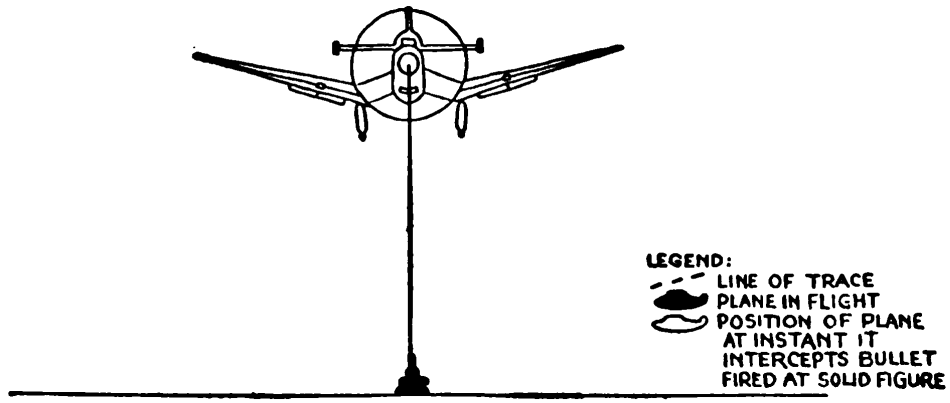
■ 149. FIRING WITH ALL BALL OR ARMOR-PIERCING AMMUNITION LOADING.—The method of firing with all ball or AP



① Overhead, decreasing and increasing in altitude.



② Overhead, constant altitude.



③ Diving, head-on.

FIGURE 43.—Types of airplane targets.

ammunition loading is generally the same as for tracer control. The eyes look over the receiver and barrel jacket. Lateral leads are established by sighting over the rear sights and the muzzle plug to lay the axis of the bore the desired lead ahead of the target. Visual elevation is obtained by laying the muzzle plug the desired height above the line of flight of the target.

SECTION II

■ 150. PURPOSE.—The purpose of preliminary training is to train the gunner to—

a. Fire the gun, free in direction, in one continuous burst.

b. Use the white tracer streak.

c. Open fire and swing out to the correct lead as quickly as possible.

d. Use the lead and visual elevation tables.

e. Estimate the range to a plane by its appearance.

f. Open fire without command with the proper lead for the range to the target.

■ 151. POSITION EXERCISE.—*a.* The purpose of this exercise is to teach the gunner to assume the antiaircraft firing position quickly and correctly.

b. The exercise consists in having the men assume the positions described in paragraph 141 expeditiously and correctly. Care must be taken by the instructor to see that the position assumed is comfortable and stable for each man. Speed in assuming the position will not be obtained at the expense of detail. The position of each man will be tested by having him swing the "free" gun in high elevation and in wide traverse without reference to any target.

■ 152. SHORT-RANGE TRAINING.—Indoor and outdoor short-range training, as described in section III, provides excellent training for the gunner in using the correct position, in the use of the white tracer streak, and in tracking.

■ 153. LONG-RANGE PRACTICE.—With proper range facilities, antiaircraft gunners can be trained on ground-towed targets within the limitations of their speed.

■ 154. LONG-RANGE PRACTICE AGAINST STATIONARY TARGETS.—Special targets need not be constructed for this exercise. A column of silhouette targets facing a gun on a hillside is satisfactory for practicing vertical manipulation, and a line of silhouette targets is suitable for traversing practice. Gunners should be required to fire individually at first so that the effectiveness of their fire can be more readily observed.

It is advisable to start with vertical manipulation. Each gunner is required to open fire, direct the white tracer streak at the base of the target, search up to the top smoothly, and then search down without ceasing fire until the ammunition is exhausted. Following this, gunners should be required to direct the white tracer streak at a designated flank of a line target and traverse to the other flank.

■ 155. LONG-RANGE PRACTICE AGAINST MOVING TARGETS.—*a.* Practice on long-range moving targets is the most effective type of training which can be employed. Units undergoing instruction should receive the maximum training on this type of target. Any suitable high-speed moving ground target may be used (ch. 4). The target path must be level and free of obstructions. It is desirable that the target move in a straight line at a constant speed.

b. If possible, the range should be so located that the target course is on the top of a hill so that the target appears against the sky.

c. It is desirable that the run at full speed be not less than 150 yards. In general, firing should start at close ranges and slow speeds. As skill in firing is attained by the gunner, the range and speed should be increased. The final stages of training should be conducted at a range of 700 yards at the top speed of the target.

d. It is usually necessary to fire several guns simultaneously in long-range moving-target firing. An instructor in rear of each gunner, observing over the gunner's right shoulder, sees the white tracer streak as it is seen by the gunner. Following each exercise the instructor should point out any errors that were made and suggest means of improving the fire.

■ 156. ALTERNATE TYPES OF TARGETS.—When the type of range discussed in paragraph 155 cannot be constructed, practice can be had by firing at free ballons, kites, and parachute flares.

SECTION III

MINIATURE RANGE PRACTICE

■ 157. INDOOR PRACTICE.—*a.* Indoor practice in tracking and leading may be conducted on miniature stationary or moving-target ranges. For such practice a flashlight may be fastened to the machine gun, the rays of the light being directed through an ordinary magnifying glass to reduce the size of the beam. The beam should be adjusted so that it strikes the target at the point of aim of the gun. Targets similar to those prescribed for outdoor range practice can be used. Gunners are taught positions, to open fire correctly, to swing out to a lead, and to continue to swing while decreasing or increasing the lead. Miniature airplanes, which can be made to move back and forth in front of a recording screen, may be used.

b. When caliber .22 ranges are available, firing with the caliber .22 machine gun trainers M4 on tripods M2 can be used (par. 73). Targets may be of the stationary type, though moving targets are preferable. The table in paragraph 160 gives the proportionate speeds in inches per second for such targets to simultate airplanes at various ranges and speeds.

■ 158. OUTDOOR SHORT-RANGE PRACTICE.—Outdoor short-range practice may be held at 1,000 inches, 500 inches, or 250 inches. The caliber .22 machine gun may be used. Whenever possible, however, such practice should be held with the caliber .30 machine gun. Gunners can learn positions and how to fire the "free" machine gun at these short ranges. When moving targets are available, practice can be obtained in opening fire, attaining a correct lead, and firing in one continuous burst. Whenever possible, solid tracer should be used for this practice.

■ 159. OUTDOOR SHORT-RANGE PRACTICE AGAINST STATIONARY TARGETS.—*a.* Figure 45 shows a set of stationary targets. These may be used for either caliber .22 or caliber .30 firing. By firing against these targets, the gunner learns to fire with the gun "free" in direction and elevation and to fire at each

target in one continuous burst. While tracking and leading cannot be taught by means of these targets, they will be found a valuable aid in teaching gunners to manipulate the gun while it is firing.

b. Each squad should be equipped with four stationary A–A targets as shown in figure 47; those having parallel panels can be placed on end and used as vertical targets. Also, each squad should be equipped with one machine gun and tripod—two, if available.

c. The targets to be used represent the path traveled by an airplane in parallel, climbing or diving, and maneuvering flight. If printed targets are not available, a satisfactory substitute can be made by drawing with black crayon on the reverse side of standard 1,000-inch targets.

d. The targets are set up as shown in figure 47. The guns are mounted 1,000 inches from the target.

e. The instructor explains the use of the target as described in *c* above. He has a man take position at each of the guns. He directs the men to traverse across the parallel target from left to right and back to their original positions, simulating fire and pointing the gun by looking over the receiver and jacket. The sight leaf will be down. The same exercise is repeated on the remainder of the targets of this series using search, and combinations of searching and traversing.

f. During these exercises the squad leader corrects the positions of the men at the guns and checks on the coaches.

g. The instructor will have these exercises repeated without firing by commands as follows:

(1) 1. SPACE 50, 2. SIMULATE LOAD, 3. TARGET, PARALLEL, LEFT TO RIGHT AND RETURN, 4. COMMENCE FIRING.

(2) 1. SPACE 50, 2. SIMULATE LOAD, 3. TARGET, VERTICAL, BOTTOM TO TOP AND RETURN, 4. COMMENCE FIRING.

(3) 1. SPACE 50, 2. SIMULATE LOAD, 3. TARGET, DIAGONAL, LEFT TO RIGHT AND RETURN, 4. COMMENCE FIRING.

(4) 1. SPACE, 2. SIMULATE LOAD, 3. TARGET, MANEUVERING, LEFT TO RIGHT AND RETURN, 4. COMMENCE FIRING.

■ **160. OUTDOOR SHORT-RANGE PRACTICE AGAINST MOVING TARGETS.**—*a.* Any simple means by which targets can be

moved across a range is satisfactory. A more elaborate set-up includes some means of producing an overhead target. The following table shows the comparative speeds to be used in order to simulate the actual speed of the plane traveling at 200 miles an hour at various ranges:

TARGET SPEEDS IN INCHES PER SECOND CORRESPONDING TO VARIOUS DISTANCES

Corresponding speed (miles per hour)	1,000 inches Corresponding range in yards						500 inches Corresponding range in yards					
	200	300	500	600	800	1,000	200	300	500	600	800	1,000
100	245	163	98	81	61	48	122	81	48	40	30	24
150	367	245	144	108	90	73	184	122	72	54	45	36
200	489	325	195	163	122	98	245	162	98	81	61	48
250	612	408	245	204	153	122	306	204	122	102	76	61

NOTE.—For 45° targets reduce speeds by 25 percent; for 10° targets reduce speeds by 50 percent.

Firing may be conducted with the caliber .22 or caliber .30 machine gun, the latter being preferable since the gunner is subjected to the full shock of recoil and the noise and flash of the weapon.

b. Lateral leads should be taken on the figures based on their visual appearance. Since it is impossible to produce miniature leads, it is necessary to use artificial leads at these short ranges. At 1,000 inches with caliber .30 ammunition and at 500 inches with caliber .22 ammunition, consideration must be given to the time of flight of the bullet when the target speed exceeds 200 inches per second. At speeds less than 200 inches per second, bullet "lag" can be generally disregarded in machine-gun fire. At the higher speeds, recording silhouettes must be located according to the speed of the target. The time of flight of the caliber .30 bullet is approximately 0.04 second at 1,000 inches. The time of flight of the caliber .22 bullet is about the same at 500 inches. Based on the above times of flight, the target will

travel during the flight of a bullet the distances shown in the following table:

1,000 inches caliber .30, M2 500 inches caliber .22		500 inches caliber .30, M2 250 inches caliber .22	
Target speed in inches per second	Target travel in inches, during flight of bullet	Target speed in inches per second	Target travel in inches, during flight of bullet
500	20	500	10
400	16	400	8
300	12	300	6
200	8	200	4
100	4	100	2

c. Figure 46 shows silhouettes for use in firing at nonoverhead and overhead targets. The latter may be used as either approaching or receding targets.

d. As range facilities permit, the length of target travel during which the gunner may fire should be as near 1,000 inches as can be obtained. Special recording targets 3 feet high and 10 feet long may be constructed, or two standard 3- by 5-foot machine-gun target frames may be joined together. Aiming silhouettes may be blacked in by any simple means available. The accuracy of fire is easily determined by laying off the number of ordered target lengths. A thin line outlining the aiming target may be used to indicate the actual number of hits obtained.

SECTION IV

RADIO-CONTROLLED AIRPLANE OR TOWED-TARGET FIRING

■ 161. GENERAL.—Firing on radio-controlled airplane targets or towed sleeve or flag targets follows the preliminary training presented in the preceding sections. In the event that this training cannot be included, the total antiaircraft ammunition allowance must be utilized in preliminary training exercises.

■ 162. COURSES TO BE FIRED.—*a.* Units authorized to fire, fire one or more of the courses outlined in the tables below. If

radio-controlled airplanes are available, they should be used in preference to sleeve or flag targets. The firing is done by groups of four or more guns. The amount of ammunition to be fired on each run varies with the range—about 35 rounds per gun at 350 yards to 60 rounds per gun at the longer ranges. Ammunition should be issued to the gunners not to exceed this amount, as a safety precaution.

(1) Sleeve or flag targets at 1,200 feet altitude:

Type of flight (course)	Ground range (to nearest 25 yards)	Slant range (yards)	Speed (mph)	Number of runs
Nonoverhead	375 300 375	Range variation 550–500–550	150	One to two runs, alternating from right to left and left to right.
Do.	575 450 575	Range variation 700–600–700	---do---	Do.
Overhead	700 150	Range variation 800–425	150	One or two runs from the front.
Maneuvering	To be flown within the angle of fire on a course at the discretion of the pilot but unknown to the firing line.			One to two runs.

(2) Radio-controlled airplane target:

Type of flight (course)	Ground range (to nearest 25 yards)	Altitude (to nearest 25 feet)	Slant range (yards)	Speed (mph)	Number of runs
Nonoverhead	300	200	300	100	Two, left to right and right to left.
Do	300	800	400	100	Do.
Do	300	1,200	500	100	Do.
Do	500	200	500	100	Do.
Do	500	675	550	100	Do.
Do	500	1,000	600	100	Do.
Overhead	700–150	800	750–300	100	Two, one incoming and one outgoing.
	150–700	800	300–750		

NOTE: Nonoverhead courses to be flown on an arc at a constant range, elevation, and speed.

(3) For further training the following courses may be fired, using the radio-controlled airplane target (fig. 44):

Type of flight (course)	Ground range (to nearest 25 yards)	Altitude (to nearest 25 feet)	Slant range (yards)	Speed (mph)	Number of runs
Nonoverhead	500–225	1,000–600	600–300	100	Two, left to right incoming and right to left incoming.
Overhead	650–125	800–250	700–150	100	One, incoming.
Do	150–700	775–250	300–700	100	One, outgoing.

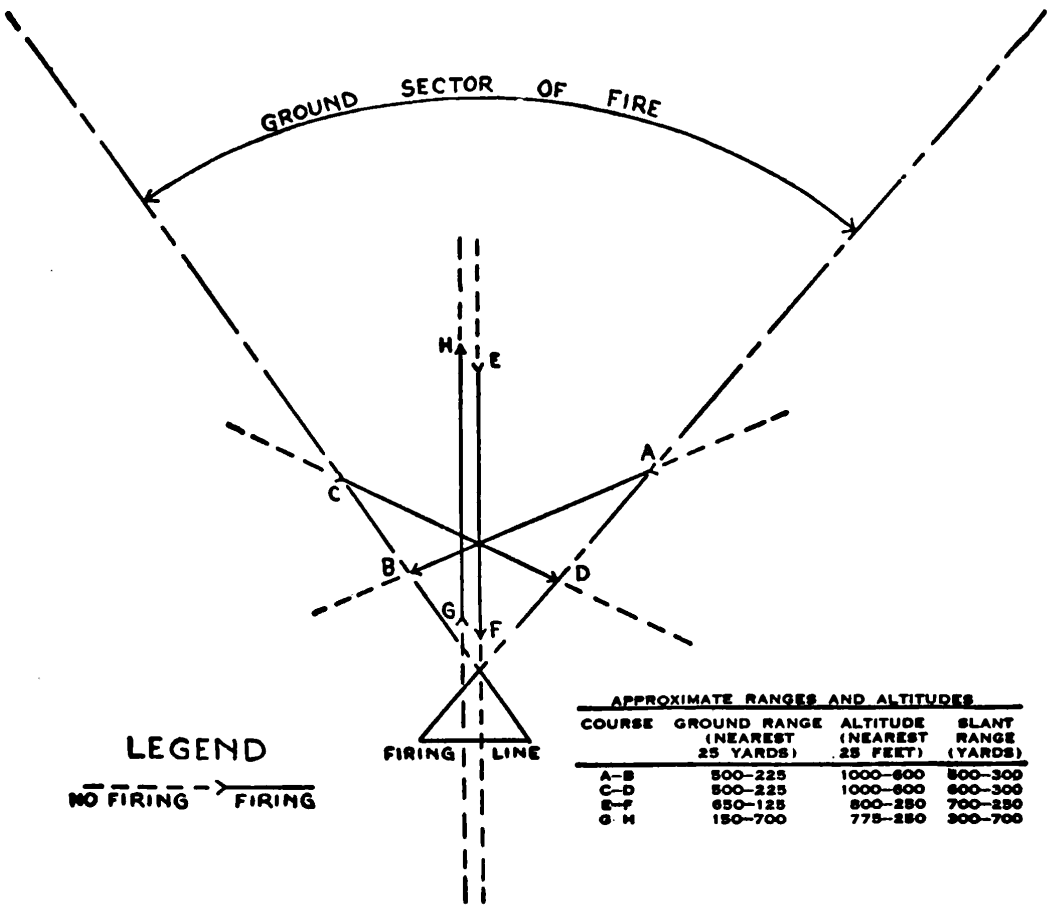


FIGURE 44.—Suggested advanced training course, radio-controlled airplane target firing.

b. When the authorized ammunition is sufficient for firing only one mission, the overhead mission is recommended.

c. During the final courses, gunners should not be given the correct amount of leads but should be required to fire on their own estimations. Excellent training may be obtained by permitting the pilot to fly such courses at his own discretion.

■ 163. LEADS FOR MOVING AERIAL TARGET FIRING.—Leads for moving aerial target firing should be computed from the leads shown in the table in paragraph 144, based upon the actual speed, length, and height of the target. A 15-foot sleeve target at a slant range of 400 yards traveling 140 miles per hour would require $^{140}/_{150} \times 8$ (leads for same range and target at 150 miles per hour) $=7.47$ or 8 leads (par. 134*c*). The number of leads required varies directly at the speed and inversely as the target length for any given slant range.

■ 164. PROCEDURE ON THE FIRING LINE.—*a.* The guns are put in position at about 5 yards' interval on the firing line. The officer in charge of firing announces the direction from which the target will approach and gives the command to load on the approach of the target. As the target passes the safety limit, one of the safety officers stationed at the opposite end of the firing line from which the target approaches gives the signal to COMMENCE FIRING. All firing ceases on a similar signal from the safety officer stationed at the other end of the firing line. The signal to CEASE FIRING is given as the target leaves the ground sector of fire. The lines indicating this sector on the ground must be located far enough inside the flank limits of fire (fig. 73) to include the maximum lateral leads for the shortest slant range to be used. A hit on certain parts of the radio-controlled target will cause the parachute to open. Firing is stopped immediately upon the opening of the parachute.

b. When the mission is completed, the signal for dropping the target is displayed, or the radio-controlled airplane target is brought in.

■ 165. FIRE ORDERS.—Fire orders are used initially in aerial target firing, including the maximum and minimum lateral leads and the visual elevation. Examples:

a. Nonoverhead target.

HALF LOAD
RADIO-CONTROLLED (TOWED) TARGET FROM LEFT TO RIGHT
LEADS 12, 10, 8, 7–8, 10, 12
VISUAL ELEVATION—2, 1, 2
LOAD
COMMENCE FIRING
CEASE FIRING
CLEAR GUN

b. Overhead target.

HALF LOAD
OVERHEAD, RADIO-CONTROLLED (TOWED) TARGET
LOAD
COMMENCE FIRING
CEASE FIRING
CLEAR GUNS

■ 166. SCORING.—The number of hits made on a double-surface target is computed by dividing the number of bullet holes in such a target by two. The score for firing on a single-surface target is the number of bullet holes shown thereon. As each bullet hole is counted, it is clearly marked so that it will not be used as a part of a subsequent score.

■ 167. ANALYSIS OF FIRE.—The officer in charge of firing records the number of hits, rounds of ammunition expended, and the actual time of firing for each run. From these data he computes the percentage of hits and the number of hits per gun per second. Hits per gun per second are based on the total firing time for each run.

SECTION V

TARGETS, RANGES, AND RANGE PRECAUTIONS

■ 168. TOWED TARGETS OR RADIO-CONTROLLED AIRPLANE TARGETS.—Towed sleeve or flag targets are furnished by the air force unit performing the air missions; radio-controlled air-

plane targets are furnished by the division or other higher commanders.

■ 169. SHORT-RANGE TARGETS.—*a. Stationary.*—Figure 45 shows a set of stationary targets.

b. Moving.—(1) Figure 46 shows the standard 1,000-inch nonoverhead and overhead targets. The guns are mounted 1,000 inches from the targets, except for the overhead course where they are placed in the most convenient location.

(2) The range facilities shown in figures 48 to 55, inclusive, are simply constructed and are entirely adequate for this training.

(3) For 500-inch and 250-inch firing, the size of the targets should be reduced proportionally.

NOTE.—500-inch and 250-inch A–A targets are not issued by the Ordnance Department at present but may be easily improvised.

■ 170. MINIATURE RANGES.—500-inch and 1,000-inch ranges for firing at stationary and moving targets should, in general, have the characteristics of ranges for towed-target firing. If a suitable back stop is available and targets are about at the same height as the gun, the safety limits may be correspondingly reduced (AR 750–10).

■ 171. RADIO-CONTROLLED AIRPLANE OR TOWED-TARGET RANGE.—*a.* The range for firing on moving aerial targets should have a field of fire sufficiently extensive to accommodate at least four machine guns deployed in line with 5 yards' interval between guns.

b. The field of fire should include a sector with a minimum angle of 75°. The depth of the area must extend 500 yards beyond the maximum ground impact range of the ammunition used. In addition to the limits of fire, the danger area must include sectors of 10° and 5° flanking, respectively, the right and left limits of fire (AR 750–10).

■ 172. INSTRUCTIONS TO PILOTS FOR TOWING MISSIONS.—*a.* Missions for towed-target firing should be carefully and specifically stated. The commanding officer requesting airplanes for towed-target firing should furnish in writing to

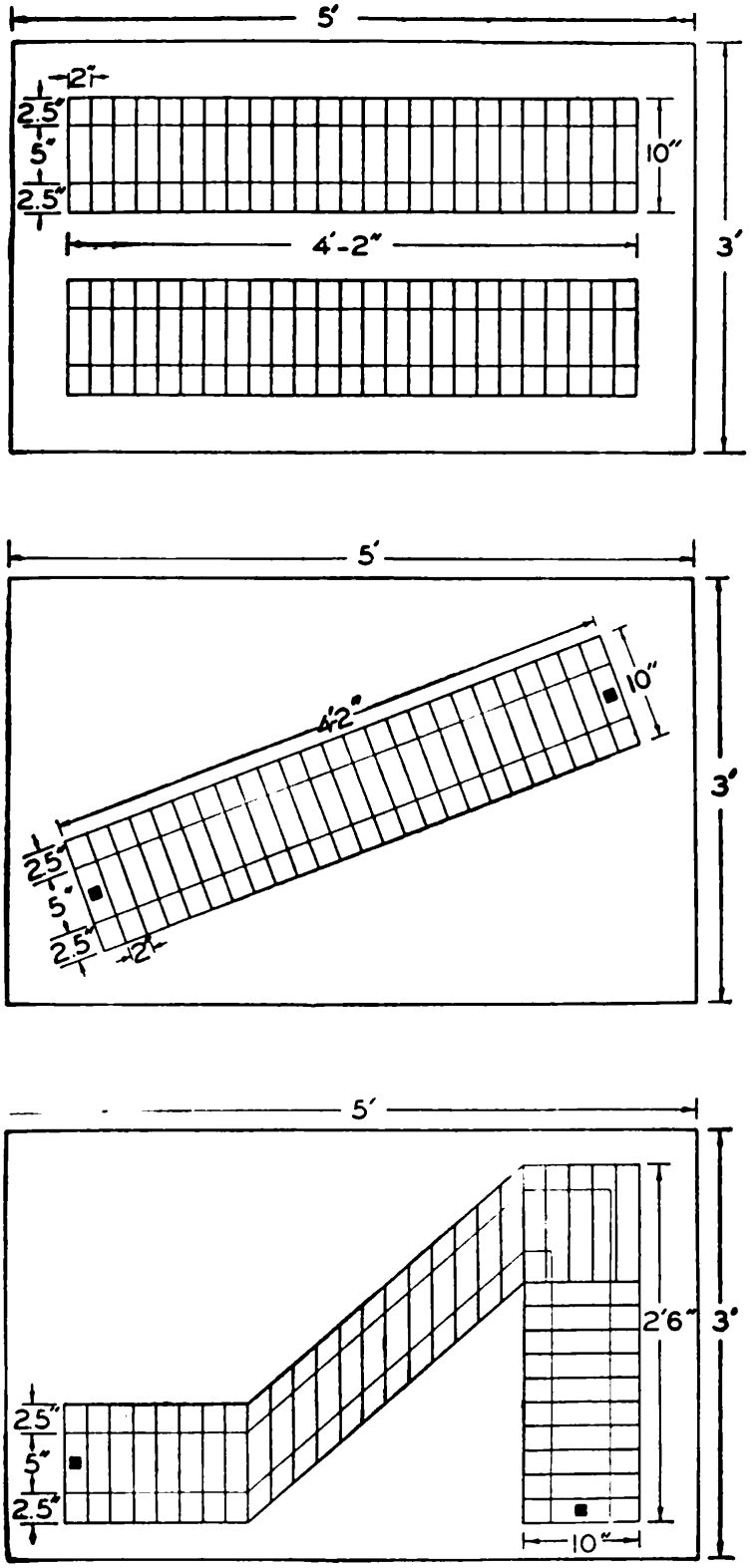
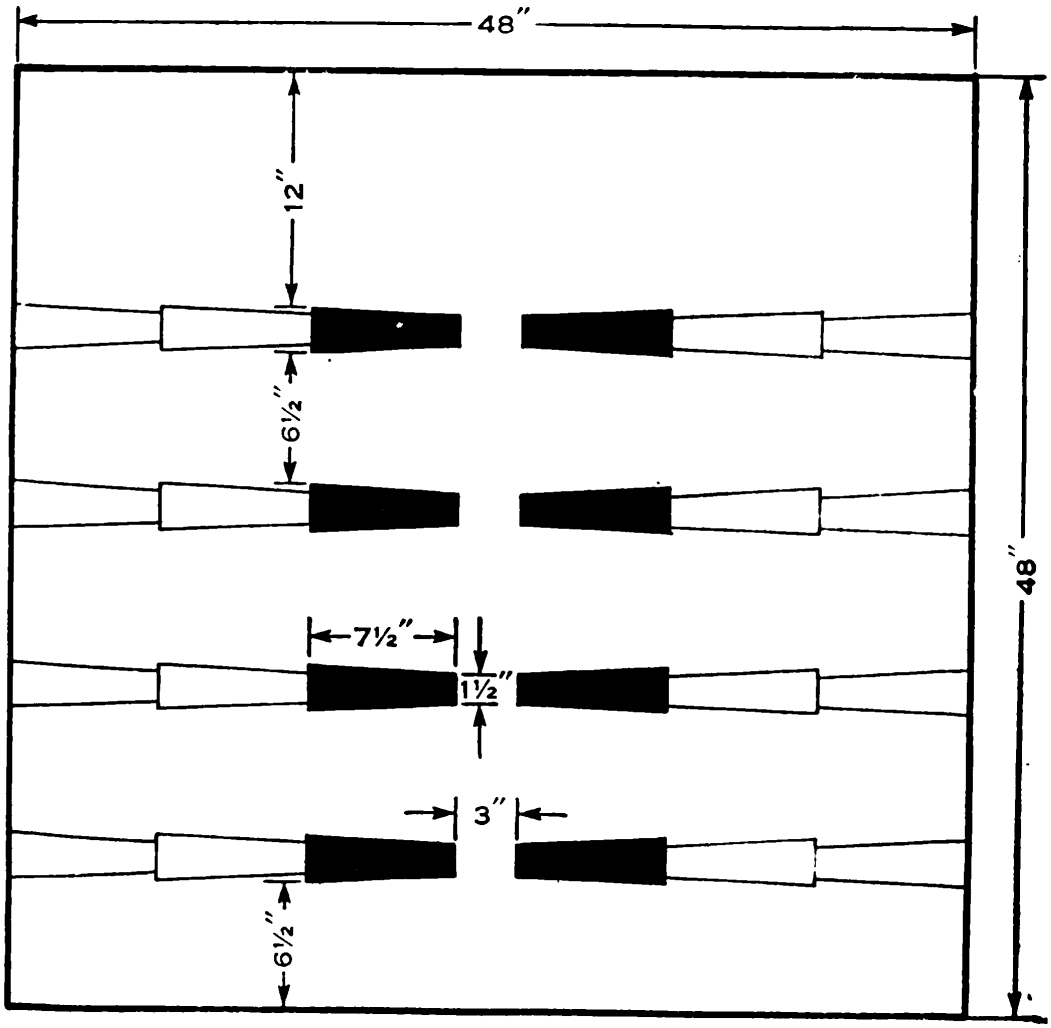
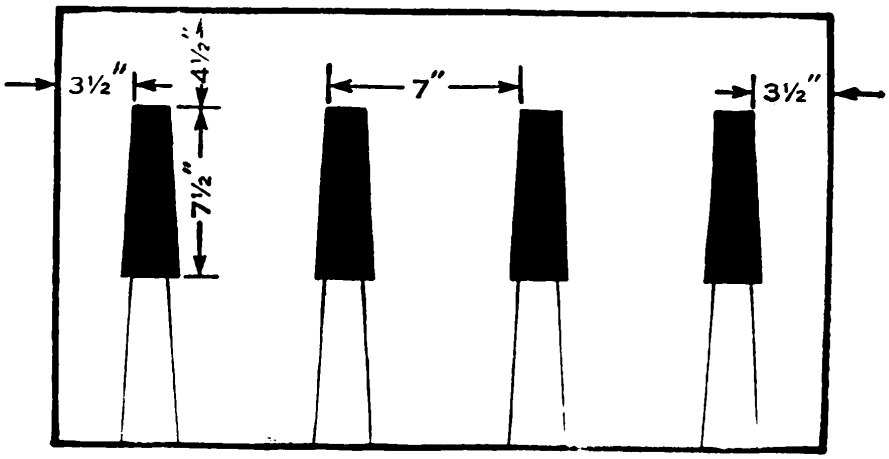


FIGURE 45.—Stationary A–A targets.



① Nonoverhead



② Overhead.

FIGURE 46.—Targets.

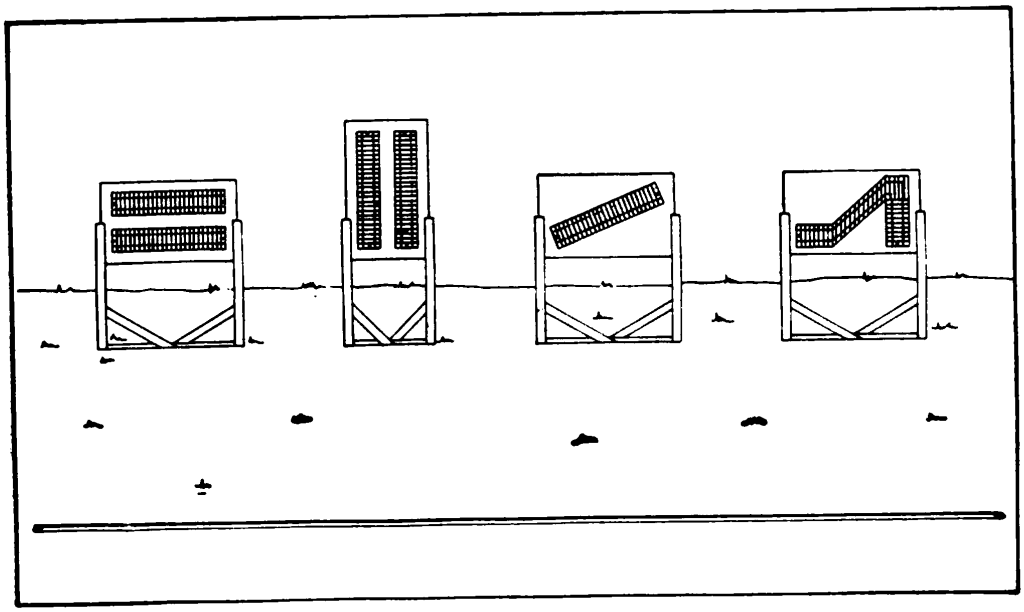


FIGURE 47.—Stationary A–A range.

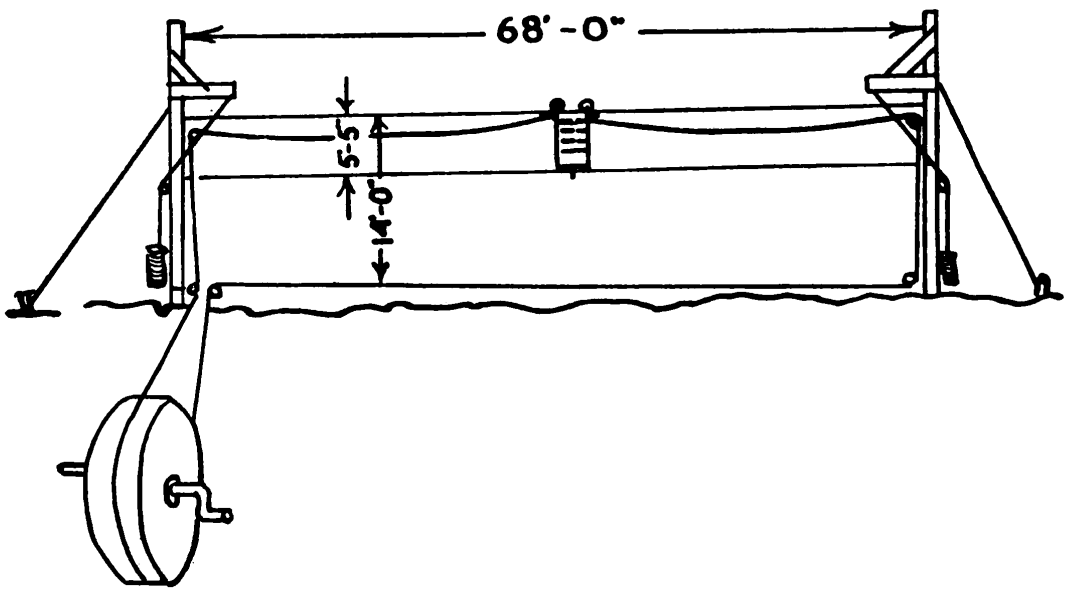


FIGURE 48.—Horizontal range.

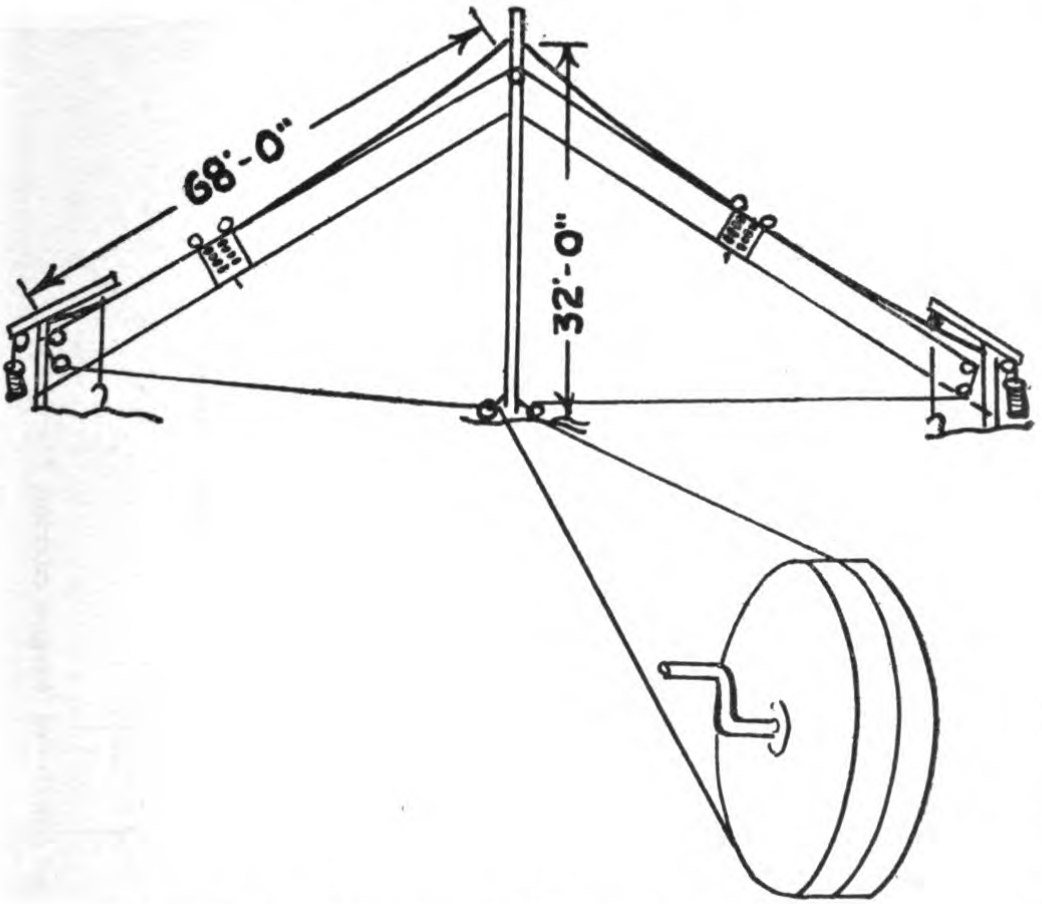


FIGURE 49.—Climbing and diving horizontal range.

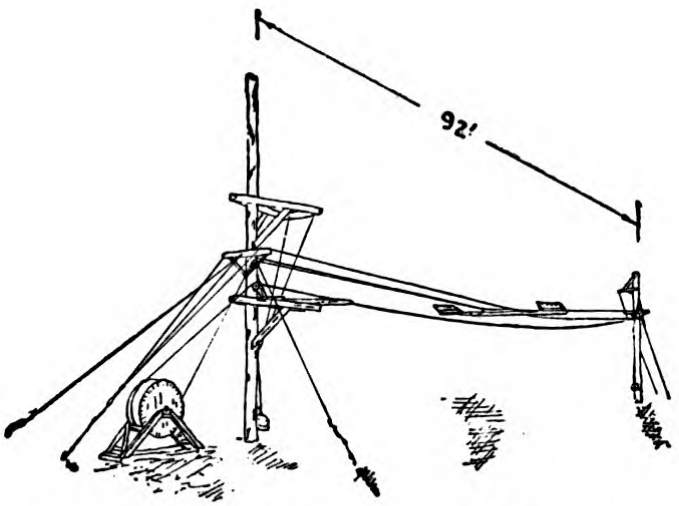


FIGURE 50.—Overhead range.

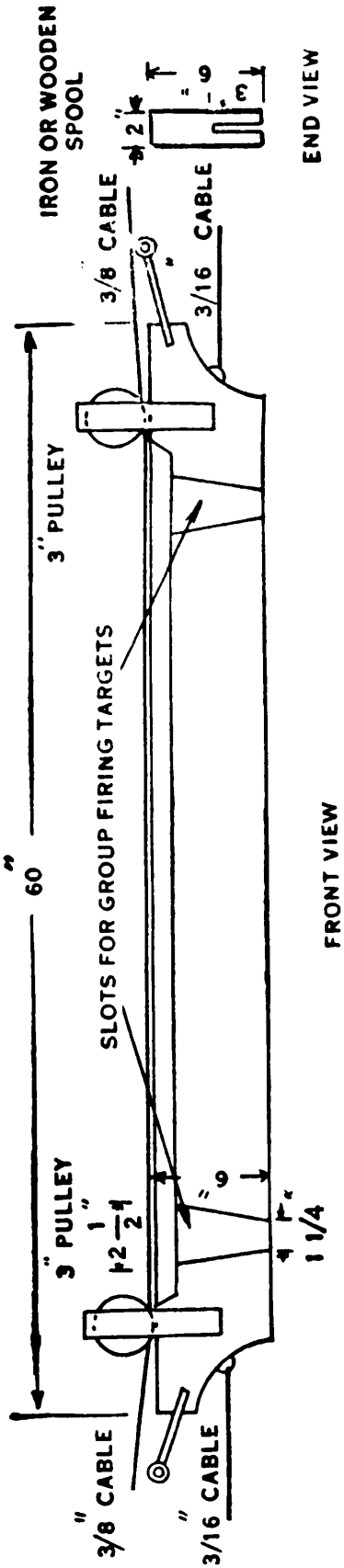


FIGURE 51.—Details of nonoverhead target carrier.

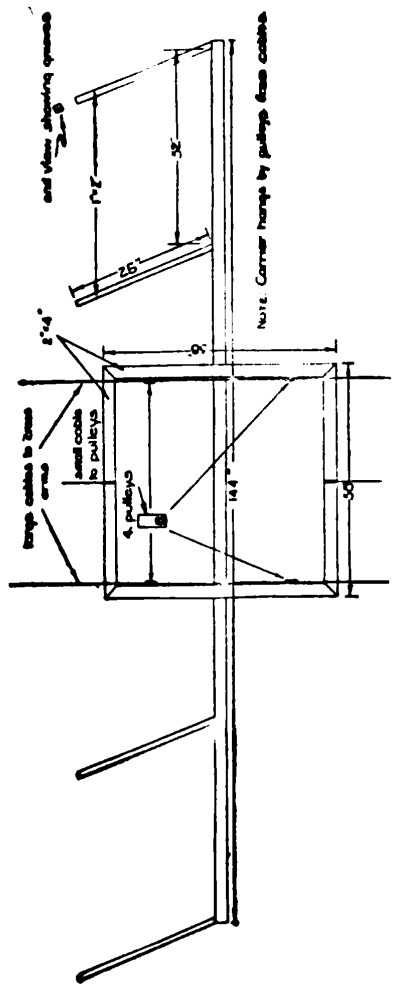


FIGURE 52.—Details of overhead target carrier.

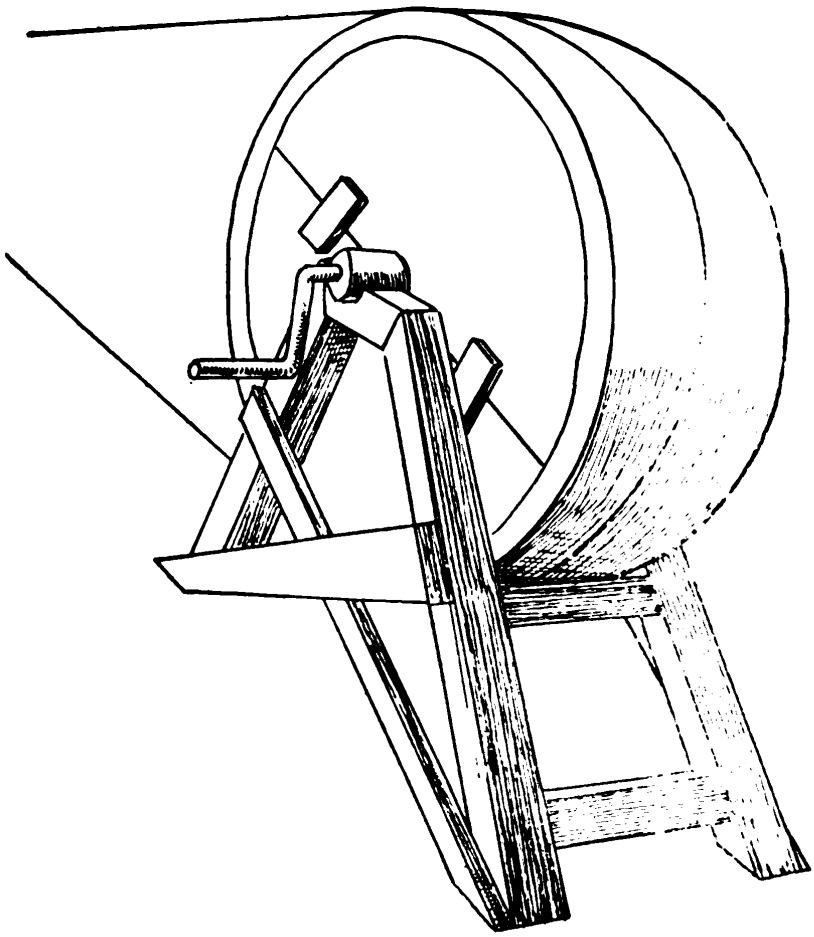


FIGURE 53.—Moving target drum; one complete turn moves target 15 feet.

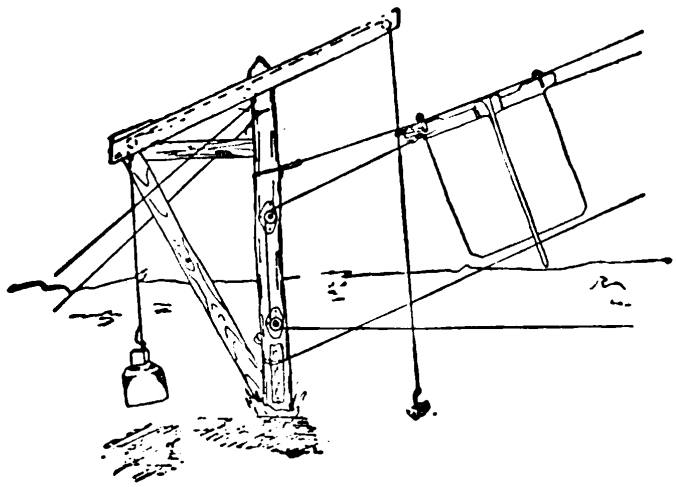


FIGURE 54.—Rear view of climbing and diving target and method of securing target to frame.

the air force unit commander concerned the following information:

(1) Place of firing.

(2) Day and hour of firing.

(3) Number of missions to be flown, including speed, altitude, course, and number of runs for each.

(4) Location of the firing line with relation to the angle of fire.

(5) Ground panel signals to be utilized, if radio is not used.

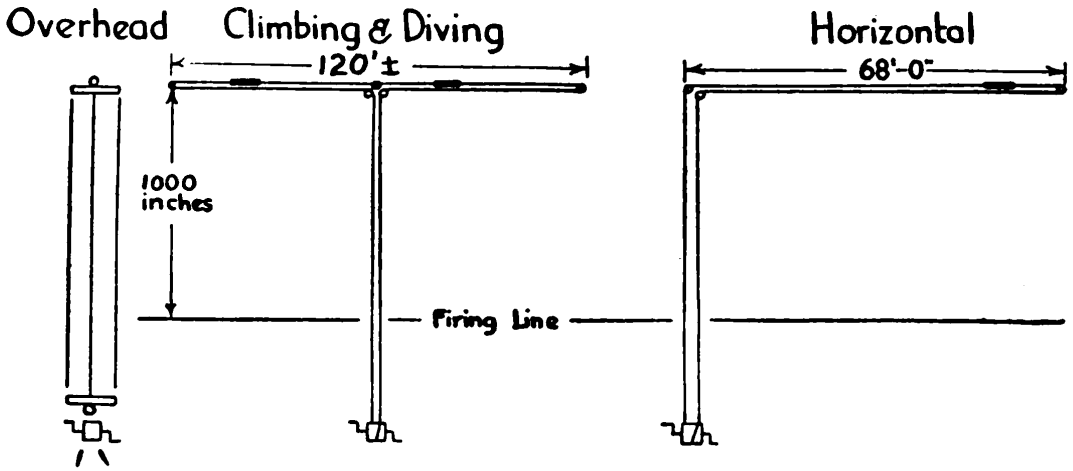


FIGURE 55.—Suggested arrangement of miniature range for machine-gun antiaircraft firing. Firing line should be 1,000 inches from target for use with caliber .30 ammunition and either 1,000 or 500 inches from target for use with caliber .22 ammunition.

(6) Map of the firing area showing the angle of fire, firing line, and course of each mission plotted thereon.

(7) Number of targets to be taken on each flight.

(8) Location of the dropping ground for dropping targets and messages.

b. The courses over which the airplane is to be flown should be distinctly marked on the ground. Panels or strips of target cloth are suitable for this purpose.

c. Whenever practicable to do so, the officer in charge of the firing goes over the ground with the pilot and points out to him the location of the firing line, the angle of fire, and the dropping ground.

■ 173. RANGE PRECAUTIONS.—*a.* Moving aerial target firing is conducted with due regard for the safety of the pilot of the

towing airplane, when used, the personnel engaged in firing, and all spectators.

b. All firing is controlled by appropriate instruction, orders, and signals. Visual signals are used for COMMENCE FIRING and CEASE FIRING.

c. The signals COMMENCE FIRING and CEASE FIRING are given at such time as to prevent stray bullets from falling outside the prescribed limits of fire.

d. For all overhead flights the signal COMMENCE FIRING is not given until the towing airplane is within 50 yards of the position of the firing line and there is no danger of stray bullets striking the airplane. The signal CEASE FIRING is given before the target passes over the position of the ground firing line and there is no danger of bullets dropping outside the ground angle of fire.

e. Whenever a towing cable breaks during an overhead or close passage of the airplane, all men engaged in the firing and all spectators are warned to lie flat on the ground until danger from the loose cable and the release has passed. Where practicable, pits should be provided at the firing line as a safety precaution against broken cables. Solid masonry barriers may be provided on permanent ranges.

f. A gun must not be pointed at or near the airplane. *All tracking is done on the towed target.*

g. At least two safety officers are designated to assist the officer in charge of firing in carrying out the safety precautions.

h. In addition to the above, to provide for the safety of the towing plane, firing is permitted only when the angle target–gun–aircraft exceeds 300 mils or 17°.

i. Additional safety precautions are covered in paragraph 254*c* and in AR 750–10.

CHAPTER 6

TECHNIQUE OF FIRE

SECTION I

GENERAL

■ 174. GENERAL.—Direct laying is pointing a machine gun for direction and elevation by directing the line of sighting on a point visible to the gunner. It is the simplest, most rapid, and most effective method of engaging a machine-gun target.

■ 175. SCOPE.—Direct laying involves a knowledge of the following subjects:

a. Characteristics of fire.
b. Classes of fire.
c. Range determination and windage.
d. Target designation.
e. Fire distribution.
f. Fire control.
g. Fire orders.
h. Overhead fire.
i. Final protective lines.
j. Range cards.

■ 176. RELATION TO MARKSMANSHIP.—Training in machine-gun marksmanship is a prerequisite to instruction in direct

laying. In marksmanship the soldier is taught to fire and serve a single gun at known ranges. Direct laying instruction gives him further practice in firing a single gun and, in addition, training in the technique and teamwork employed in the use of two or more machine guns as a unit to engage combat targets at unknown ranges.

SECTION II

CHARACTERISTICS OF FIRE

■ **177. TRAJECTORY.**—The trajectory is the path of a bullet in its flight through the air. Two forces, gravity and air resistance, cause it to follow a curved path. The curvature of this path becomes greater the farther the bullet travels.

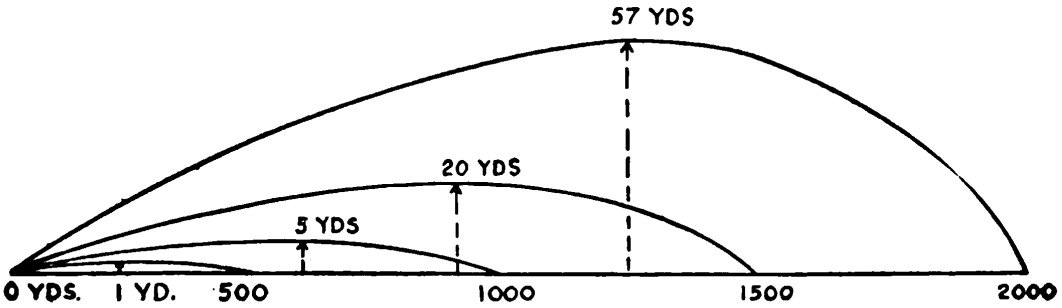


FIGURE 56.—Maximum ordinate.

As a result of these forces, the highest point on the trajectory (maximum ordinate) is at a point approximately two-thirds of the range from gun to target (fig. 56).

■ **178. BURST OR SPRING OF FIRE.**—There are two methods of firing the machine gun. One method is to press the trigger, continue the pressure until a number of shots have been fired automatically, and then release the trigger to stop the firing. This series of shots fired automatically with a single pressure of the trigger is called a "burst of fire." The other method is to press the trigger, quickly release the pressure so that only one shot is fired, and then repeat the procedure until a series of single, individually aimed shots have been fired in rapid succession. This series of rapid single shots is called a "string of fire." The number of shots in a burst or string is dependent upon the desired rate of fire, which is

affected by such factors as the nature of the target, the ammunition supply, the condition of the gun, and range to the target.

■ 179. CONE OF FIRE (fig. 57).—*a.* When a burst is fired, the vibrations of the gun and tripod, the variations in the ammunition, and the changes occurring in atmospheric conditions cause each bullet to trace a trajectory differing slightly from that of the others. The resultant group of trajectories is known as the "cone of fire." This cone may be compared to the stream of water from a hose. At ranges up to 750 yards over level or uniformly sloping ground, the

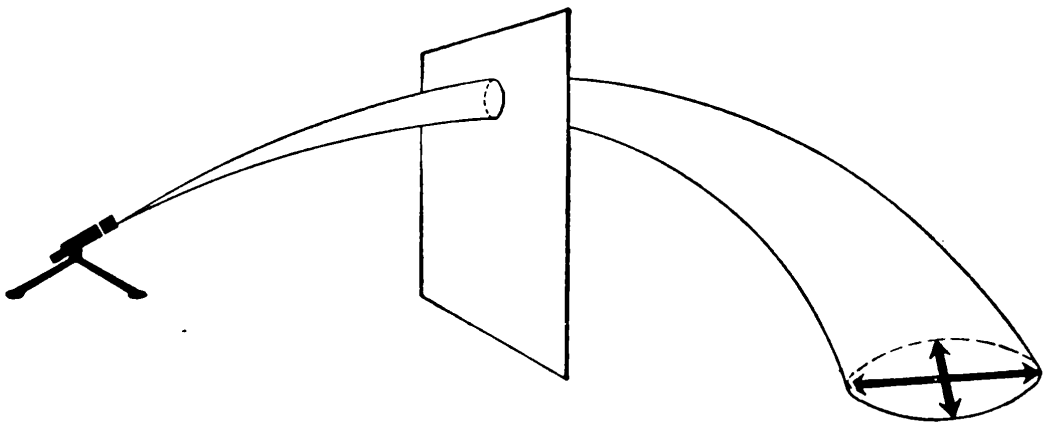


FIGURE 57.—Cone of fire.

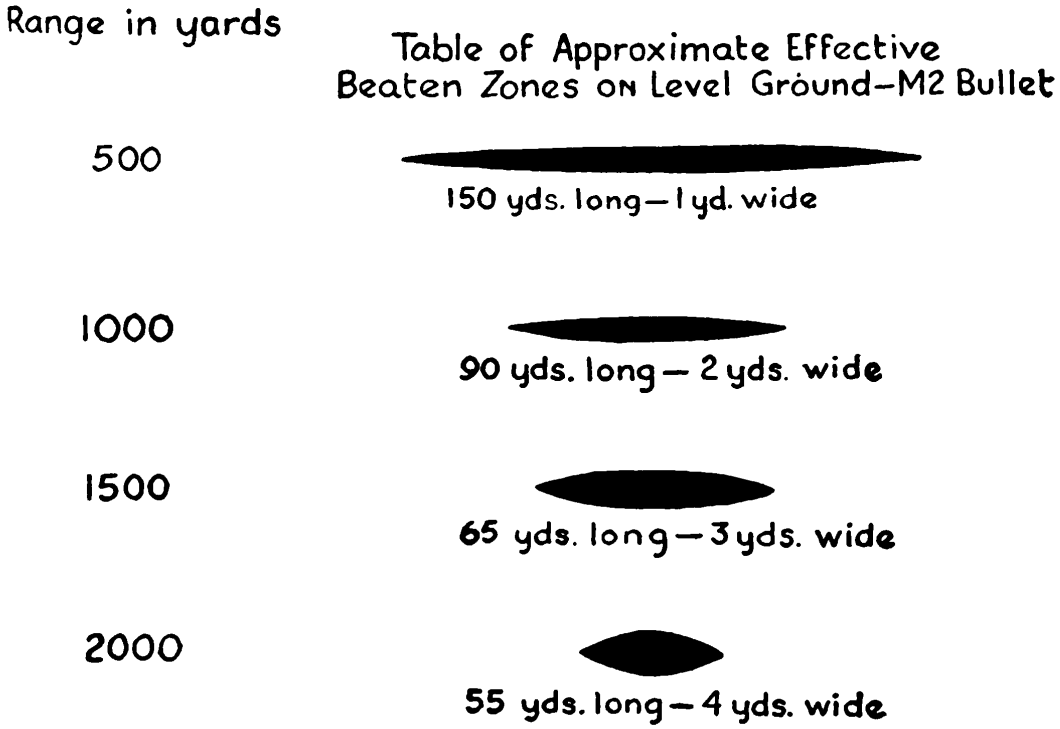
center of the cone of fire does not rise above the height of a man standing (2 yards).

b. The light machine gun may be fired as a single shot weapon, or automatic fire may be used as circumstances warrant. The same variations in trajectories of different shots, except those due to vibrations of the gun on its mount, are present in single shot fire as in automatic fire. While the bullets do not follow each other as closely in single shot fire, they follow more nearly the same path. The single-shot cone, therefore, contains fewer shots at any given instant but is smaller in dimensions than the automatic fire cone.

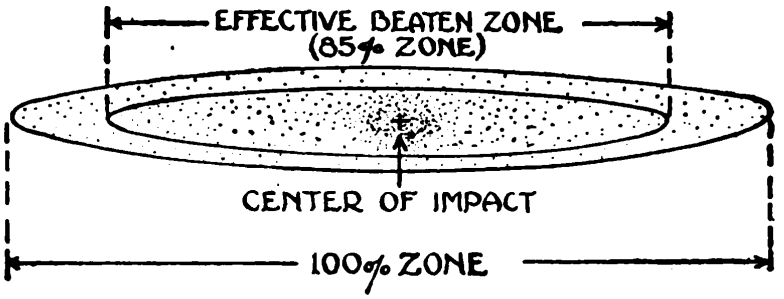
■ 180. BEATEN ZONE.—*a.* The intersection of the surface of the ground with the cone of fire forms a pattern known as the "beaten zone" (fig. 58). This pattern is elliptical with its long axis parallel to the direction of fire. The major axis

of the ellipse is shortened or lengthened on sloping ground (fig. 59).

b. The center of the beaten zone is called the "center of impact." It has been found that most of the shots are



① Beaten zone at various ranges.



② Distribution of shots in beaten zone.

FIGURE 58.—Beaten zone.

uniformly grouped about the center of impact, and that the number in a given area smaller than the beaten zone decreases gradually as the outer limits of the beaten zone are approached. The shots are so scattered along the outer edges of the beaten zone that the entire pattern is not regarded as effective. Only that part of the beaten zone in

which 85 percent of the shots fall is considered effective against machine-gun targets; this area is known as the "85 percent" or "effective" beaten zone. It is obvious that maximum effectiveness can be obtained only when the center of impact is on the target. The light machine-gun sights are graduated so that when the gun is laid on a point with the correct sight setting the mean trajectory or center of impact should strike that point. The gunner is taught to do this in marksmanship.

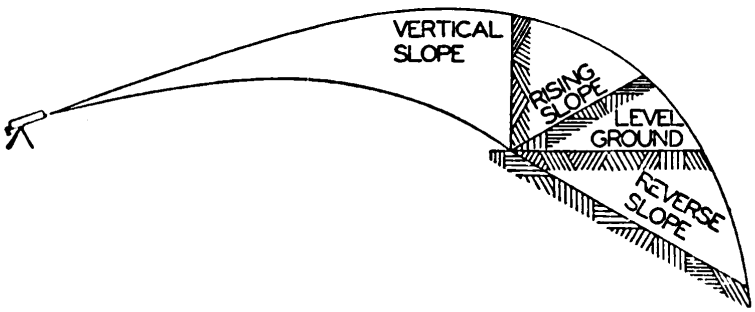


FIGURE 59.—Effect of ground slopes on beaten zone.

c. Exact figures of the dimensions of the beaten zone of the light machine gun delivering single-shot fire are not known, but the dimensions of the beaten zone in rapid single-shot fire are approximately half of the beaten zone in full automatic fire.

d. Throughout this chapter whenever reference is made to the beaten zone it means the effective beaten zone unless otherwise specifically indicated.

SECTION III

CLASSES OF FIRE

■ 181. GENERAL.—Machine-gun fire is classified with respect to the—

a. Gun.
b. Target.
c. Ground.

■ 182. CLASSES OF FIRE WITH RESPECT TO GUN.—*a. Fixed fire.*—Fixed fire is fire delivered on a point target. It is employed against small targets, such as machine guns defi-

nitely located, when it is possible to determine the range accurately. The depth of the beaten zone must be sufficient to include the target. Fixed fire may be employed successfully on small columns, groups of men, areas, bridges, and on moving targets whose direction of movement is restricted to roads, defiles, and trenches (fig. 60).

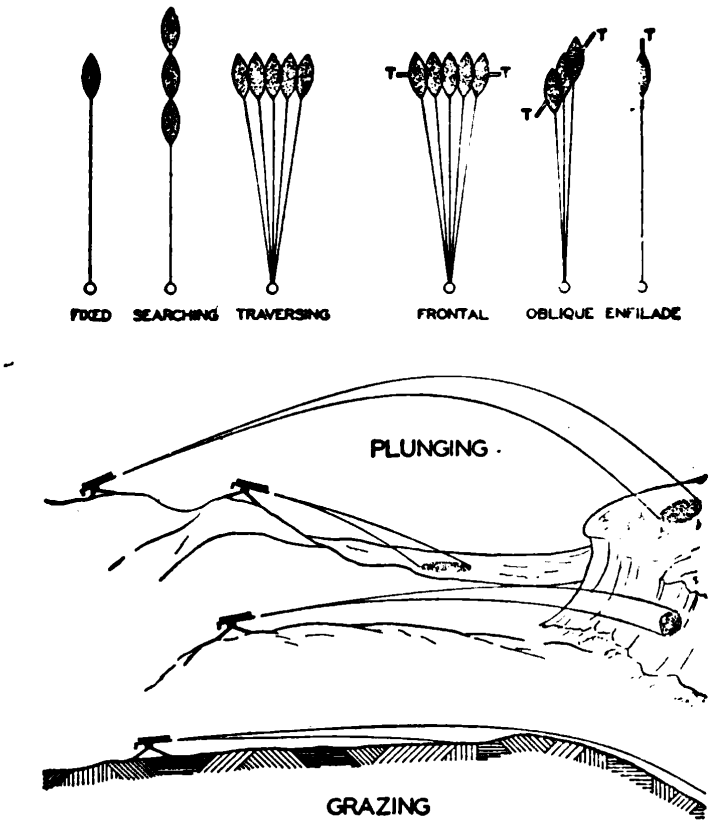


FIGURE 60.—Classes of fire.

b. Searching fire.—Searching fire is fire distributed in depth by successive changes of elevation of the gun. Changes in elevation are made by manipulating the elevating mechanism. Searching fire is used when it is desired to deepen the beaten zone. It should be employed against targets too deep to be included in the beaten zone of fixed fire, such as columns and trenches taken in enfilade. Ordinarily a burst or string of fire of from 6 to 20 rounds, depending on the rate of fire, is delivered after each change of elevation. Although the amount of change depends on the observation of strike, on level ground, with the target at the same elevation as the

gun, a change of 2 mils is usually employed, because it causes the successive beaten zones to overlap.

c. Traversing fire.—(1) Traversing fire is fire distributed in width by successive changes in the direction of the gun. It is used when it is desired to widen the beaten zone, and it should invariably be used to engage targets too wide to be included in the beaten zone of fixed fire, such as lines, trenches, edges of woods, and areas presenting frontal targets. It may be used also on oblique targets when the difference in range to the near and far ends is not greater than the depth of the effective beaten zone. To engage such an oblique target, a sight setting at a range midway between the ranges to its far and near ends is used, and the gun is laid initially on one flank. Usually in applying traversing fire, a burst or string of fire of from 6 to 20 rounds, depending on the rate of fire, is delivered after each change of direction. Although the exact amount of change in direction depends on the observation of strike, as in searching fire, a change of 2 mils will usually cause sufficient overlap of the beaten zones.

(2) At close range, dense targets of considerable extent moving rapidly toward the gun, such as infantry in relatively dense formations or cavalry attacking mounted, should be engaged by the swinging traverse method. The traversing clamp is loosened to permit the gunner to move the gun by placing the weight of the body against the grip. The gun is laid on any portion of the target and traversed while firing continuously. This method is wasteful of ammunition and should be used only under the conditions indicated above.

d. Combined traversing and searching fire.—Combined traversing and searching fire is fire distributed both in width and depth by changes in direction and elevation of the gun. It is employed against targets whose longer axes are oblique to the direction of the fire, when the difference in range to the far and near ends is greater than the depth of the beaten zone on the ground on which the target is located. Changes in direction and elevation are made successively after each burst or string of single shots. The amount of traverse and search depends on the observation of strike. The traverse is usually 2 mils; the amount of search depends on the obliquity of the target.

■ 183. CLASSES OF FIRE WITH RESPECT TO TARGET.—*a. Frontal fire.*—Frontal fire is fire delivered at right angles to the front of the objective. It is least effective against a shallow target, such as a line of skirmishers, because full advantage is not taken of the depth of the beaten zone, and is employed only when available gun positions or other restrictions make it necessary. It is most effective against narrow, deep targets; for example, a column of squads approaching the guns, thus presenting an enfilade target.

b. Flanking fire.—Fire delivered against the flank of a target is called "flanking fire." This type of fire is not very effective against column targets of little width, since very little of the target can be covered by the long, narrow beaten zone of the machine gun. It is very effective, however, against such a target as a skirmish line taken in flank, for here the long axis of the target coincides with the long axis of the beaten zone.

c. Oblique fire.—Oblique fire is that delivered from a direction oblique to the long axis of the target.

d. Enfilade fire.—Enfilade fire is fire, either frontal or flanking, in which the long axis of the beaten zone coincides with the long axis of the target. It is the most effective type of fire. Columns of troops approaching the gun, or lines engaged from positions on their flanks, are said to be taken in enfilade.

■ 184. CLASSES OF FIRE WITH RESPECT TO GROUND.—*a. Plunging fire.*—Plunging fire is fire in which the angle of fall of the bullets with reference to the slope of the ground is such that the danger space is practically confined to the beaten zone and the length of the beaten zone is materially lessened. Fires delivered from high ground on ground lying nearly at right angles to the cone of fire or against ground rising abruptly to the front with respect to the position of the gun are examples of plunging fire. As the range increases, fire becomes increasingly plunging because the angle of fall of the bullets becomes greater.

b. Grazing fire.—Grazing fire is that fire which does not rise above the height of a man standing (2 yards). Where the gun is mounted on the ground, clamped, and fired, the

trajectories of the bullets at ranges up to 750 yards over level or uniformly sloping ground produce grazing fire.

■ 185. EFFECT OF PROPER LOCATION OF GUNS.—Ordinarily, the position of the target with respect to the gun rather than the shape of the target determines its vulnerability to fire. For example, a skirmish line engaged by frontal fire is a poor target, whereas if attacked from a position on the flank, it may be a good target. As the enemy never knowingly presents deep enfilade targets, it must be expected that these usually are obtained by skillful selection of gun positions.

SECTION IV

RANGE DETERMINATION AND WINDAGE

■ 186. GENERAL.—*a.* Correct range determination is highly important for efficient machine-gun fire, since it is often impossible for the gunner or observer near the gun to adjust his fire in the event of damp ground or poor visibility. In such cases the cone of fire may miss the target completely though an error in range no greater than 100 yards exists.

b. Extreme usable ranges are governed by the visibility and by the tactical purpose of the fire.

■ 187. METHODS OF RANGE DETERMINATION.—*a.* Ranges may be determined for the light machine gun by any of the following methods:

(1) Estimating distance by eye.
(2) Firing the gun.
(3) Taking the range from a map.
(4) Obtaining the range from other units.

b. Although other means may be used, the usual method of determination of ranges for light machine-gun fire is estimation by eye with verification by fire for adjustment. The latter is possible by observation of strike of the bullet on suitable soil. If observation of strike is not possible, the use of tracer ammunition is necessary.

■ 188. TRAINING IN RANGE ESTIMATION.—*a. General.*—(1) All personnel of light machine-gun organization will be trained to estimate distance with a fair degree of accuracy. Meas-

urement on the ground is practicable only in specially prepared defensive positions and in the absence of the enemy. Accurate maps are good but require more time than is usually available. Ranges may be secured from other troops particularly when making a relief.

(2) In combat, the exact range required to hit a target is seldom known prior to the opening of fire, and a material saving of time and ammunition is effected by accurate range estimation. If fire is opened with an incorrect sight setting, the position of the gun is often disclosed before fire falls on the target, thus increasing the probability of casualties in the gun crew; and ammunition is wasted.

b. Necessity for training.—(1) As estimation by eye must be depended upon in combat, all men, and especially gun commanders, should be trained in this method.

(2) The estimation by eye of untrained men is little better than a guess, and the average errors of such men will be at least 12 percent of the range. A definite system of range estimation, frequently practiced, is the only way to make estimation by eye sufficiently reliable.

c. Method of estimation by eye.—(1) Estimation by eye consists in measuring the range by applying to it a unit of measure 100 yards long. The method is the same as that employed in measuring the length of a board with a ruler. The only difference is that the soldier's unit of measure is applied mentally. Thorough familiarity with the 100-yard unit and its appearance on different kinds of ground and at different distances enables the estimator to apply it with a fair degree of accuracy.

(2) Knowledge of terrain, life in the open, and training in scouting and patrolling are helpful in range estimation.

(3) Application of the unit of measure beyond 500 yards is difficult. For this reason, in ranges over 500 yards it is better to select a point halfway to the target, apply the 100-yard unit up to this halfway point, and multiply the estimated distance by two.

(4) The average of a number of estimates by different men is generally more accurate than a single estimate. However, in combat the gun commander must usually rely on his own estimation.

d. Conditions affecting appearance of objects.—(1) Conditions of light and terrain have considerable effect upon the appearance of objects, making them seem sometimes much nearer and at other times much more distant than they really are. The effect of these conditions on the appearance of the 100-yard unit of measure is negligible.

(2) In some cases much of the ground between the observer and the target is hidden from view, and the application of the unit of measure to the hidden portion of the ground is impossible. In such cases the appearance of objects is the only guide.

(3) If there is a considerable stretch of visible ground extending from the far edge of the depression to the target, it is best to estimate the distance to the far edge of the depression judging by the appearance of objects and then to apply the unit of measure over the remaining distance to the target.

(4) Whenever the appearance of objects is used as a basis for range estimation the observer must make allowance for the effect noted below:

(*a*) Objects seem nearer—

1. When the object is in a bright light.
2. When the color of the object contrasts sharply with the color of the background.
3. When looking over water, snow, or uniform surface like a wheat field.
4. When looking from a height downward.
5. In the clear atmosphere of high altitudes.
6. When looking over a depression most of which is hidden.

(*b*) Objects seem more distant—

1. When looking over a depression all of which is visible.
2. When there is a poor light or fog.
3. When only a small part of the object can be seen.
4. When looking from low ground toward higher ground.

■ 189. FIRING THE GUN.—*a. General.*—(1) To use the gun to determine the range, the gunner opens fire at the estimated

range, moves the center of impact into the target by means of the elevating and traversing mechanism, resets the rear sight so that the line of sighting is on the target, notes the sight setting on the rear sight, and announces it as the range to the target. All guns are then laid and fire is opened by command of the unit leader.

(2) When the ground in the vicinity of the target for any reason permits no observation or when it is desired to surprise the target with fire, the gunner adjusts on a point which does offer observation and which is the same distance away as the target by proceeding as explained above. The gunner swings his gun on the target when ordered.

(3) When engaging targets in trees or buildings, fire is adjusted on the ground at the foot of the tree or building where the strike of the bullets will be visible. The range thus determined is taken as the range to the target. The gunner announces the range and elevates his gun until it is laid on the target.

b. Limitations.—It must be borne in mind that firing the gun to determine the range may remove the element of surprise and cause a betrayal of position and intention.

■ 190. WINDAGE CORRECTION.—*a.* The amount by which the wind deflects the cone of fire from its normal path depends upon the force and direction of the wind and the range to the target. The amount of windage required to correct for a 3 o'clock or 9 o'clock wind having a velocity of 10 miles an hour, when using caliber .30 M2 ammunition, is shown in the following table:

Key range (yards)	Correction (mils)
500	1
800	3
1,000	4
1,200	5

b. The effect of winds of other velocities or at other ranges can be approximated by using this table. For practical purposes the effect of wind varies directly as its force. For example, a 20-mile wind requires twice the correction shown for the various ranges. Winds that are 1 hour from 3 o'clock

or 9 o'clock (considering 12 o'clock to be the direction of the target) require slightly less windage correction than 3 o'clock or 9 o'clock winds. Winds that are 1 hour from 6 o'clock or 12 o'clock require slightly less than one-half as much windage correction as 3 o'clock or 9 o'clock winds.

c. In the fire order, windage correction is announced immediately after range, as, "Sight right (left) 5."

SECTION V

TARGET DESIGNATION

■ 191. PRELIMINARY TRAINING.—As a preliminary to practical work in target designation, light machine gunners must have a knowledge of the military and topographical terms employed in designating targets; for example, crest, hill, cut, ridge, crossroads, right, left, flank, skirmishers, column, and patrol. They will also be instructed in the meaning and use of such terms as horizontal, vertical, above, below, rectangle, square, triangle, mil, yard, and pace. Finally, a thorough course in visual training and range estimation will be given. The light machine gunner must be taught to use his eyes and retain mental pictures of what he sees.

■ 192. METHODS OF DESIGNATING TARGETS.—The following methods are used to designate targets:

Oral designation.
Firing the gun.
Laying the gun.

The method used should be the one best calculated to permit laying of the guns on the target in the shortest possible time.

a. Oral designation.—By the oral designation method the information of the target designation element is given orally; however, arm signals and pointing, where applicable, take the place of or supplement the spoken word. The essential parts of an oral designation are announced in the following sequence:

Range.
Direction.
Description of target.

(1) *Range.*—The range is followed immediately by windage

correction, if necessary. Windage is announced, "Sight right (left), 2 (3)."

(2) *Direction.*—Wherever practicable, the direction will be given simply by pointing, using only such words as are necessary. Squad, section, and platoon leaders can often use the arm to assist in pointing out the limits of targets. When necessary, the direction in which the front leg of his tripod points is used as a basis in indicating directions to a gunner. "Front" is understood as the direction in which the front leg points, and directions varying therefrom by successive angles of 45° are designated as "right (left) front," "right (left) flank," "right (left) rear," and "rear." One of the best methods of designating very obscure targets is to use successive reference points. A clearly distinguishable reference point is first designated. Rapid recognition of such references is facilitated by previous indication of certain landmarks within the sector of fire, together with an understanding of the descriptive term to be applied to designate the landmark. This can be done conveniently during the preparation of the range card. The gunner is then led step by step to the target by naming successive reference points until his line of sighting is brought on the target; for example:

Range 700;
Reference: red-roofed house;
To right of house, a hedge;
Center of hedge, gate;
Just above gate, target: edge of wheat field.

The word "reference" precedes the first point announced.

(3) *Description of target.*—Usually a word or two is enough to describe the target; for example, "enemy column," "that hedge," "combat group." If reference points are included in the order, the word "target" precedes the descriptive words.

b. Firing the gun.—Designating a target by firing the gun is a quick, sure, and simple method. However, its use may disclose the gun position. To designate a target by this method the leader goes to a gun, loads it with ball or both ball and tracer ammunition, sets the sight at the estimated range to the target, and lays the gun on the target. He then announces to his unit orally the range and type of fire; for

example, "Range 500, watch my strike (or watch my tracers)." He may make this announcement before going to the gun. He next fires a few rounds on the target and completes the designation orally. For instance, in designating a wide or deep target he may fire successively at both extremities, announcing the flank or end of the target hit. In some situations reference may be made to the tracers fired by riflemen and it is not necessary to fire the guns.

c. Laying the gun.—Laying the gun on a target is another quick, sure, and simple method, and does not sacrifice surprise effect. To use this method the leader announces the range and direction and then goes to each gun, lays it on the target, and completes the designation orally.

SECTION VI

FIRE DISTRIBUTION

■ 193. GENERAL.—*a.* Fire, to be effective, must be distributed over the entire target. Improper distribution results in gaps between beaten zones and allows a part of the enemy to escape or to use their weapons unhindered. Moreover, because of the compactness and density of the cone, improper distribution causes wastage of ammunition by firing too many bullets into a portion of the target while the remainder of it is untouched.

b. Light machine guns may be employed singly, in pairs, or in larger groups. Whenever practicable at least two guns should be assigned the same mission. This assignment insures continuous fire if either gun is put out of action, provides a greater volume of fire on the target, and reduces the time required to cover the target.

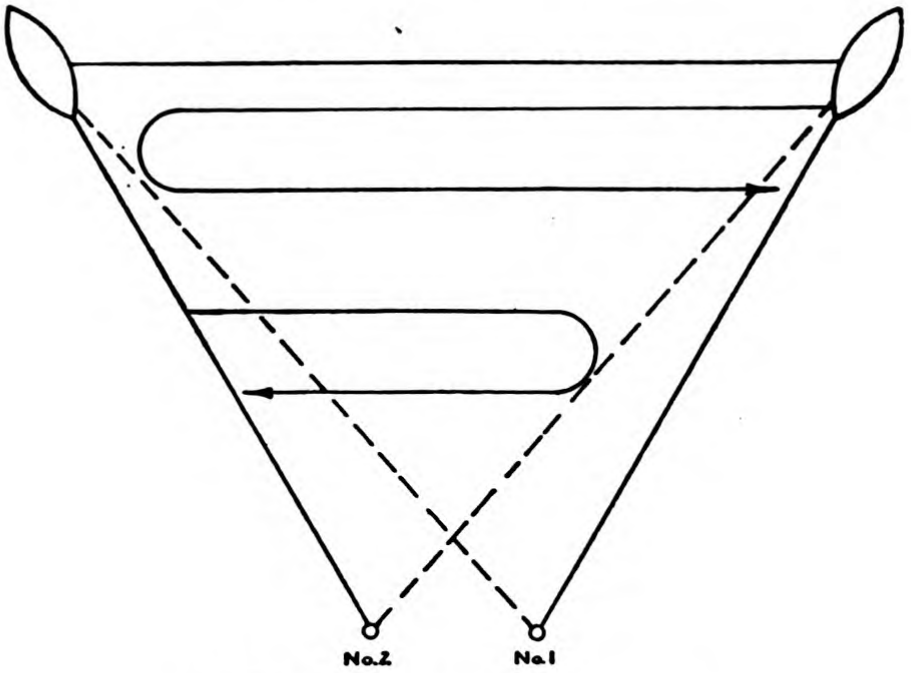
c. No general rule as to width of target that may be engaged by a single light machine gun can be given, although targets of less than 50 mils width are preferable. This favorable condition rarely exists in battle.

■ 194. METHOD OF ENGAGING POINT TARGETS, FIXED FIRE.—Targets having a width or depth no greater than the beaten zone for the ground on which they are located should be engaged by fixed fire. Gun crews are trained to follow any

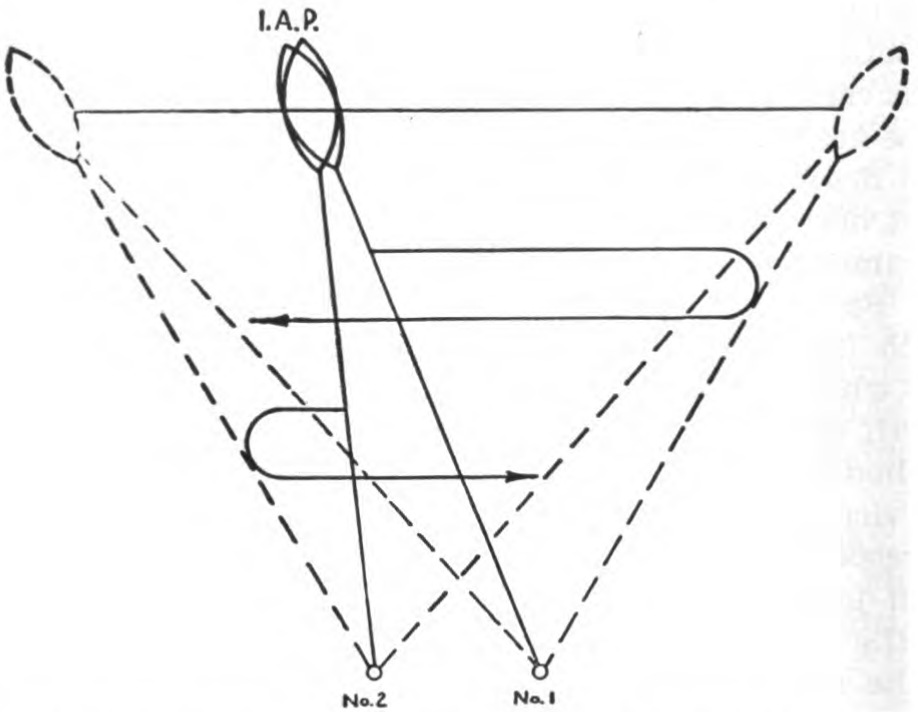
movement or change in formation made by the enemy after fire is opened.

■ 195. METHOD OF ENGAGING WIDE TARGETS, TRAVERSING FIRE.—*a. By a single gun.*—A single light machine gun engages a line target by delivering a burst or string of fire and shifting the point of aim between bursts or strings progressively to the right or to the left so that the entire target is covered. A burst or string of shots is delivered at each point of aim, adjustment being made on strike or tracer, if available, without slowing down the rate of fire. If the first shot of the string is a very close miss, no adjustment is necessary, as the variations in the trajectories of the different shots will probably produce at least one hit. Shifts to the right and left to other aiming points may be approximately 2 to 5 mils each, depending upon the density of fire desired. This in turn is dependent upon the nature of the target. If engaging an enemy skirmish line where the individuals of the target are visible, each visible target is actually aimed at. If the individuals are not plainly visible and a dense fire over the assigned front is desired, the amount of traverse may be reduced to 2 mils for each string. If a dense fire is not desired, for example fire delivered on an area, such fire being of harassing nature primarily, one shot or a short burst or string may be fired at each point of aim and the amount of traverse increased.

b. By a pair of guns.—(1) *Targets less than 50 mils in width* (fig. 61).—When a pair of guns engages frontal targets which are less than 50 mils in width and less than the length of the beaten zone in depth, the normal traversing method is used. By this method, if the flanks of the target are visible to the gunners, each gun is laid just outside its corresponding flank of the target and traversed across to a point just outside the other flank and back, each gun covering the entire target. If the flanks of the target are invisible to the gunner, the target may be designated as extending so many mils from a point which is visible to the gunner. Each gun is laid on the visible point and traversed to a point just outside its corresponding flank and back to the other flank, as described above. This is the habitual method to



① Both flanks visible to gunners.



② Both flanks invisible to gunners. Target extends from point visible to gunners.

FIGURE 61.—Traversing method by a pair of guns.

be used in covering a wide and shallow target and it is used when no mention is made of the method of fire distribution in the fire order.

(2) *Targets 50 mils or more in width* (fig. 62).—When the target measures 50 mils or more in width and is less than the length of the beaten zone in depth, the leader assigns one gun to cover one-half (or any other portion) of the target and assigns the other gun to cover the remaining half (or the remaining portion). The half or portion may or may not correspond to the position of the gun in the section. In either case the gun lays on and covers its target as described

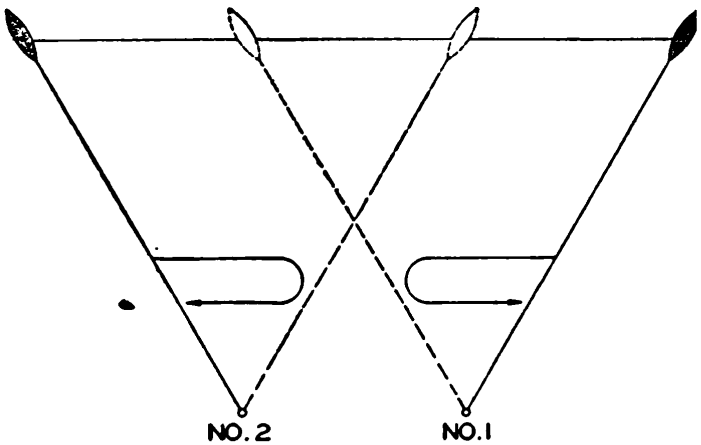


FIGURE 62.—Traversing method by a pair of guns (each gun assigned a portion of the target).

in (1) above. This method may facilitate the placing of dense fire on a particular portion of the target and of firing through gaps in the line of riflemen.

c. Swinging - traverse method.—The swinging - traverse method which is used against massed or rapidly moving targets at short range is described in paragraph 182*c*.

■ 196. METHOD OF ENGAGING DEEP TARGETS.—Any method of engaging enfilade targets, to be efficient, must be one which can be applied quickly and readily. Narrow targets which have greater depth than the length of the beaten zone for the ground on which they are located are engaged by searching fire.

a. Searching fire.—(1) *By a single gun.*—The gun is laid initially on either end of the target and the whole target is covered by searching fire.

(2) *By a pair of guns.*—Figure 63 illustrates a method of engaging a deep, narrow target by a pair of guns.

(*a*) If the target is stationary, has limited mobility, or is moving slowly, and the ends are visible to the gunners, No. 1 gun is laid on the near end and is searched up, and No. 2 gun is laid on the far end and searched down. If the depth of the target is estimated to be 200 yards or less, the range given to both guns is that to the middle of the target. When the target engaged is over 200 yards in depth a different range is announced for each gun. If the target is moving rapidly away from the guns, both guns are laid on the far end with

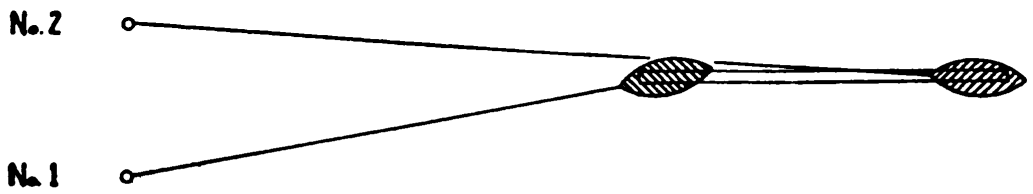


FIGURE 63.—Pair of guns engaging a deep enfilade target.

the range to that point and searched down. Similarly, if the target is moving rapidly toward the guns, the range announced is to the near end and both guns search up.

(*b*) If the ends of the target are invisible to the gunner and the target has been designated as extending so many mils from a point which is visible to the gunner, each gun is laid on that point and searched to the end which would have been initially engaged had the latter been visible. Thereafter each gun is searched as described in (*a*) above.

b. Amount of search.—Changes in elevation (amount of search) are made in 2-mil increments. If gunners or observers are able to see the strike of the bullets, the total amount of search is determined by the gun crews. The gunners keep their fire on the target by means of observation of strike. If, however, the strike cannot be seen, the amount of search may be prescribed. The total number of mils of search is computed as follows:

(1) Measure or estimate the depth of the target in yards.

(2) Divide this by the number of yards the center of impact is moved by a 1-mil change in elevation at the range

to the center of the target. This divisor can be estimated from the following table:

Range	Change
600 yards	1 mil equals 65 yards.
800 yards	1 mil equals 50 yards.
1,000 yards	1 mil equals 35 yards.
1,200 yards	1 mil equals 25 yards.

Example: A search of 10 mils is required to cover a column 350 yards long at a range of 1,000 yards to the center (350 yards divided by 35 yards equals 10 mils).

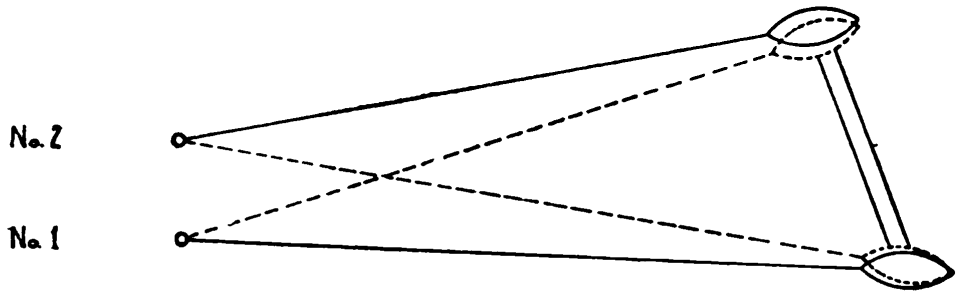


FIGURE 64.—Pair of guns engaging a shallow oblique target.

■ 197. METHOD OF ENGAGING OBLIQUE TARGETS (fig. 64).—When the difference in range to the near and far end of an oblique target is greater than the depth of the beaten zone on the ground on which the target is located, combined traversing and searching fire is used. The target is assigned as described in paragraph 195, and the command to traverse and search is given. If the difference in range to the near and far end is 200 yards or less, the guns are given the range to the middle of the target. If the difference in range to the near and far ends is greater than 200 yards, the guns are given different ranges.

■ 198. METHOD OF ENGAGING AREA TARGETS.—*a.* Targets which cannot be covered by either traversing fire or searching fire alone, or by combined traversing and searching fire as in the case of an oblique target, are called area targets. An area which can be effectively covered by a light machine-gun squad or section is small because of the time and ammunition required for this type of distribution.

b. Area targets are covered in the following manner:

(1) The area is assigned as described in paragraph 195.

(2) If the flanks of the target are visible to the gunners, the guns are laid just outside their corresponding flanks as described in paragraph 195. Each gun then fires traversing fire across its portion of the target, changes elevation the total amount prescribed in the initial fire command, and traverses back to the flank from which traversing fire was started, and ceases firing. Further firing over the area is on order of the leader. A quick method of determining elevation changes for area targets follows: For ranges less than 1,000 yards, change the elevation 2 mils; if the range is between 1,000 and 1,200 yards, change the elevation 3 mils. If the fire is plunging, the elevation change must be increased.

(3) If the flanks of the target are invisible to the gunners, the leader indicates the flanks of the target and the point at which each gun will open fire—by firing one gun, by laying the guns, or by use of a reference point. When the flanks and the point on which fire will be opened have been designated, the procedure to cover the area is as indicated in (2) above.

■ **199. Use of Auxiliary Aiming Point** (fig. 65).—*a.* In some cases where the target is invisible to the gunner or is exceptionally difficult to see, fire may be directed by use of an auxiliary aiming point.

(1) *Inverted sight leaf method.*—The leader selects a clearly defined object in the vicinity of the target. Using the binocular with the inverted sight leaf, he alines on the target that graduation which corresponds to the estimated range to the target. Keeping the binocular in that position, he reads the graduation on the scale opposite the object selected. If the auxiliary aiming point is not on the line gun-target, the deflection may be read on the horizontal mil scale of the binocular. Using these readings as the sight setting and windage—for example, Range 1,050, Sight left 10, as shown in figure 65—the gunner lays on the object selected as the auxiliary aiming point and fires, distributing the fire as ordered by the unit leader. If the reading of the scale and the original range determination are correct, the fire should strike the target.

(2) *Mil scale method.*—The leader announces the range to the target and the gunner sets the announced range on the

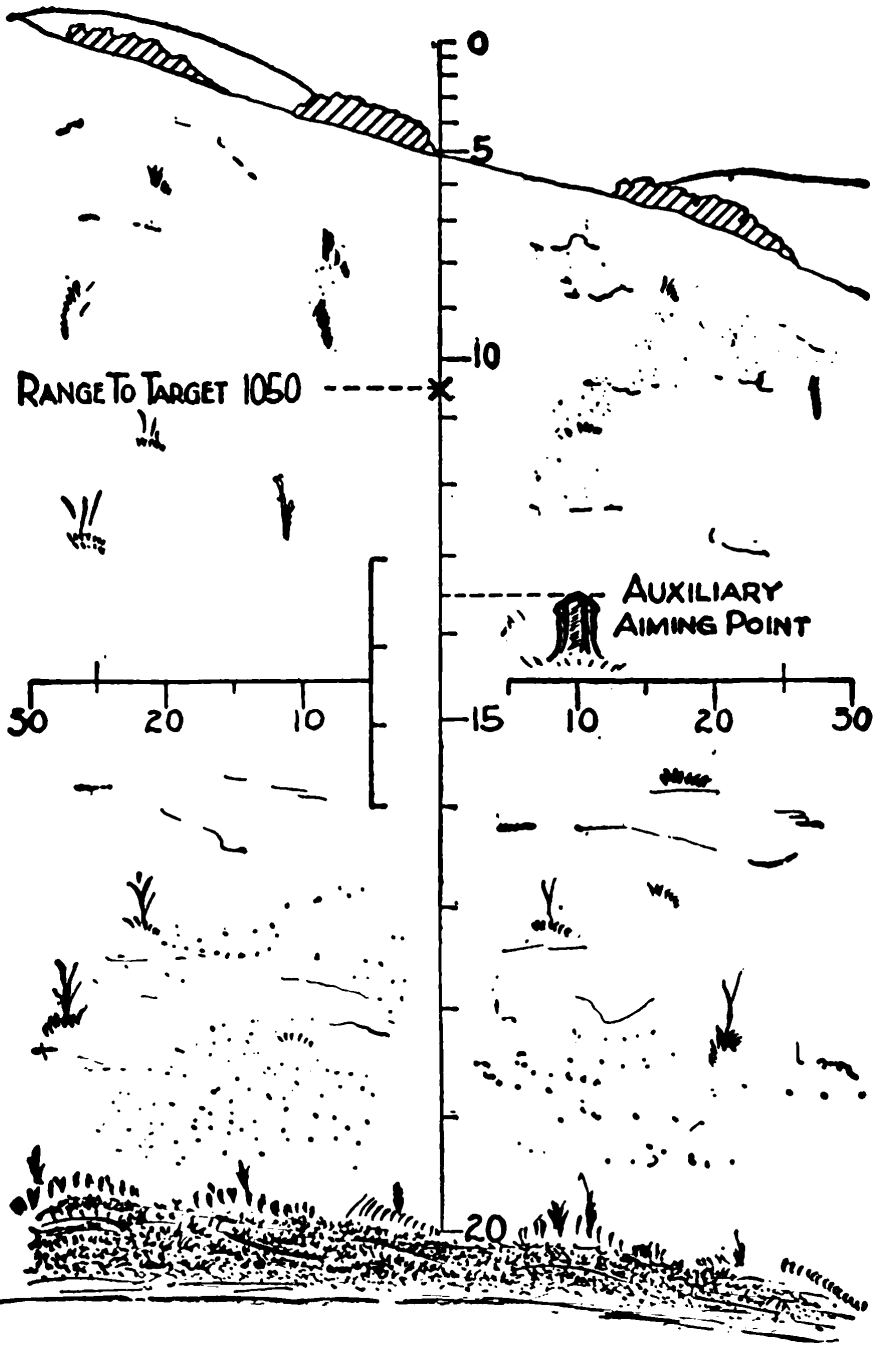


FIGURE 65.—View through binocular; use of auxiliary aiming point.

sight. The leader then selects a clearly defined object in the vicinity of the target, and with the binocular mil scale determines the vertical difference in mils between the target

and the auxiliary aiming point. Assume the reading to be 10 mils. If the auxiliary aiming point is below the target, the gunner is directed to raise the elevation 10 mils by means of the mil scale on the left side of the sight leaf. If the auxiliary aiming point is above the target, the elevation is lowered 10 mils. With the adjusted sight setting, the gunner lays on the auxiliary aiming point and fires, distributing his fire as ordered. If the readings of the mil angle, the announced range, and sight settings are correct, the fire should strike the target. Similarly, auxiliary aiming points to the right or left of the target may be selected and the proper amount of mil deflection set off on the windage gage. If the target is to the left of the auxiliary aiming point, deflection correction is announced as "Sight left" (fig. 65); if to the right, deflection correction is announced as "Sight right."

b. Similarly, data for auxiliary aiming points may be determined by means of the rear sight slide and the windage screw, thus using the gun instead of the binocular.

SECTION VII

FIRE CONTROL

■ 200. GENERAL.—*a.* Fire control of machine guns implies the ability of the leader to open fire at the instant he desires, adjust the fire of his guns upon the target, shift it from one target to another, regulate its rate, and cease firing at will. He must be able to do all of these things promptly if the fire is to be effective. Lack of proper fire control results in loss of surprise effect, premature disclosure of position, misapplication of fire on unimportant targets, loss of time in securing adjustment, and wastage of ammunition. Fire control is therefore a highly important phase in the technique of direct laying.

b. Fire control is based primarily on discipline and secondarily on correct technical training. Inasmuch as machine guns are frequently separated by wide intervals, control must often be decentralized. To this difficulty are added the excitement and noise incident to firing an automatic weapon.

Under these conditions, good fire control can be had only if all men are well disciplined and have the proper technical training to carry out fire orders promptly and efficiently.

■ 201. CHAIN OF FIRE CONTROL.—*a.* In the attack, the rifle company commander gives his orders directly to the weapons platoon leader or his representative, or transmits them by messenger. In the defense, in order to coordinate their action with the battalion plan of defensive fires, these orders will come directly from the battalion commander or the heavy weapons company commander acting for the battalion commander (pars. 177 and 182, FM 7–10). These are tactical orders which rarely prescribe the technique to be employed in carrying them out. The actual control of fire is left to the platoon or section leaders. Squad leaders may be assembled under cover for this purpose or the section or platoon leader may go to each and give him individual orders. If the squads are widely separated, as they may be in the defense, it may be necessary for the platoon or section leader to send instructions to the squad leaders.

b. Platoon or section leaders may assemble their squad leaders to issue oral fire orders, but usually go to the guns where squad leaders may be used to assist in designating targets. As soon as orders have been issued, squad leaders post themselves in a position from which they can observe the fire and where they can be seen by the No. 2 at each gun. While firing is in progress, signals (alone or combined with oral orders) are usually necessary for the control of fire.

c. Within the squad the squad leader is responsible for fire control. He concentrates on the observation and adjustment of fire. In addition to assisting in the service of the gun, it is the duty of No. 2 to watch the squad, section, or platoon leader for signals; he cannot do this if he observes the fire. He transmits all orders to the gunner or the squad leader.

■ 202. ADJUSTMENT OF FIRE.—*a.* Fire is adjusted by the following methods:

(1) By observation of strike.
(2) By observation of tracers.
(3) By frequently re-laying or checking the aim.

Observation and adjustment of fire is the most important phase of fire control. It must be continuous throughout the action. The gunner must be trained to observe and correct his own fire without command and to check his laying from time to time. He should also be instructed to anticipate the action of the enemy after fire is opened, shifting his fire to cover any changes in the formation or location of his target. If he fails to do these things the squad leader must promptly check him. This responsibility continues up through the platoon leader.

b. Corrections are announced or signaled as, "Up," "Down," "Right," or "Left," so many mils. Small changes in elevation and deflection such as "Up 5" or "Right 2" are set off by the elevating and traversing mechanisms. Large range corrections are made by announcing or signaling a new range. Signals are prescribed in FM 22–5.

c. Where it is not possible to observe the strike, tracer ammunition may be used or a small search and traverse prescribed to insure that the target is included in the beaten zone.

SECTION VIII

FIRE ORDERS

■ 203. GENERAL.—A light machine-gun leader, having made a tactical decision to fire on a target from a certain position, conveys this information to his subordinates in a brief order. This order includes certain technical instructions as to how the target is to be engaged. The technical data by which the fire of a squad, section, or platoon is directed on targets form the fire order.

■ 204. BASIC ELEMENTS OF FIRE ORDER.—A correct fire order is one which is as brief as clarity permits and which conveys, in the sequence they must be performed, the actions necessary for its accomplishment. Three basic elements are announced or implied in every case. Although only such parts of these as are essential are included, the sequence must always be as follows:

Target designation element.

Fire distribution element.
Fire control element.

These elements are more fully treated in sections V, VI, and VII.

a. Target designation element.—The target designation element includes the following information as to the target:

Range.
Direction.
Description of target.

This information is always given in the sequence listed above. Although the target designation element may be conveyed by different methods, as described in section V, each method includes the information listed above. For example, the target designation element of a fire order might be given orally as follows:

RANGE 900
RIGHT FRONT
SKIRMISH LINE

b. Fire distribution element.—The fire distribution element includes the subdivision of the target, if necessary, and the type of distribution. For example, the light machine-gun squad or section leader desires to cross the fire of his guns on a frontal target, using the traversing method; the distribution element of his order might be given orally as follows:

NO. 1, LEFT HALF
NO. 2, RIGHT HALF
TRAVERSE

c. Fire control element.—Depending on the situation, the fire control element may include the following:

Instructions as to overhead fire.
Rate of fire.
Time of opening fire.
Commands or signals to commence firing and to cease firing.

The inclusion of instructions as to overhead fire and the rate of fire depends on the situation. The rate of fire is usually given, but if omitted, the medium rate is implied. The commands or signals to commence firing and to cease

firing must be included. In a situation not involving overhead fire, the fire control element might be given as follows:

RAPID
UPON COMMAND
COMMENCE FIRING

(1) *Rate of fire.*—The following are the prescribed rates of fire; when automatic fire is used, these rates may be increased by about 50 percent for short periods.

(*a*) *Slow,* about 40 rounds per minute.

(*b*) *Medium,* about 75 rounds per minute.

(*c*) *Rapid,* about 150 rounds per minute.

(2) *Time of opening fire.*—(*a*) It is often of great importance that light machine-gun fire be withheld until the proper moment to secure maximum effect and that all guns open at the same instant. The greatest surprise and shock effect are thus obtained. To insure this condition, the leader may preface the command or signal for commencing fire by the words "Upon signal" or "Upon command," depending on which method he desires to use. Either method permits him to check all guns to see that they are properly laid or, in case of overhead fire, that there is sufficient clearance, and enables him to hold the fire until the critical moment.

(*b*) If fire is to be opened immediately, the command or signal COMMENCE FIRING is given immediately after the other elements of the order. Gunners open fire individually as soon as guns are laid.

■ 205. EXAMPLES OF FIRE ORDERS.—In fire orders for squads equipped with one gun, the term "No. 1" refers to the gun assigned to the first squad; the term "No. 2" refers to the gun assigned to the second squad. For squads equipped with two guns, the terms "No. 1" and "No. 2" refer, respectively, to the first and second gun in each squad. A fire order may consist of the simple statement of one or more of the three basic elements that constitute a fire order as given in paragraph 204, or it may require a lengthy order, depending on the difficulty in describing the target.

a. Examples of simple orders.

(1) RANGE 700
COMMENCE FIRING

(2) RANGE 600
LEFT FRONT
ANTITANK GUN
COMMENCE FIRING

b. Example of a lengthy order.—An order of this length is very unusual in the field.

RANGE 700
SIGHT LEFT 5
RIGHT FRONT
REFERENCE: LONE PINE
TO LEFT, SMALL OAK
LEFT 20 MILS
CORNER OF DITCH
TARGET: MACHINE GUN
FIXED
RAPID
UPON COMMAND
COMMENCE FIRING

■ 206. ORDERS FOR WIDE TARGETS.—Orders for firing on wide targets may be as follows when—

a. The target measures less than 50 mils in width.

(1) RANGE 600
RIGHT FRONT
NEAR EDGE OF WOODS
TRAVERSE
MEDIUM
UPON SIGNAL
(Signal for commence firing)

(2) RANGE 600
WATCH MY STRIKE (OR TRACERS)
RIGHT FLANK
LEFT FLANK
HEDGE
TRAVERSE
MEDIUM
COMMENCE FIRING

(3) RANGE 600
FRONT
REFERENCE: LONE TREE
TARGET: SKIRMISH LINE EXTENDING RIGHT 20 MILS AND LEFT 24 MILS
TRAVERSE
RAPID
UPON COMMAND
COMMENCE FIRING

b. The target measures 50 mils or more in width, the flanks are visible to the gunners:

RANGE 700
FRONT
SKIRMISH LINE, SHED EXTENDING RIGHT TO HEDGE
NO. 1, RIGHT (LEFT) HALF
NO. 2, LEFT (RIGHT) HALF
TRAVERSE
MEDIUM
UPON SIGNAL
(Signal to commence firing)

c. The target measures 50 mils or more in width, the flanks are not visible to the gunners, and it is desired to place the heavier fire on the right portion of the target:

RANGE 800
RIGHT FRONT
REFERENCE: BARE SPOT
TARGET: SKIRMISH LINE, EXTENDING RIGHT 20 MILS AND LEFT 40 MILS
NO. 1, RIGHT THIRD
NO. 2, LEFT TWO-THIRDS
TRAVERSE
RAPID
COMMENCE FIRING

d. The target is dense and moving rapidly toward the gun at short range:

LEFT FRONT
SWINGING TRAVERSE
COMMENCE FIRING

■ 207. ORDER FOR POINT TARGET.—If the target has width and depth no greater than the beaten zone, the order may be given as follows:

RANGE 700
FRONT
MACHINE GUN
FIXED
RAPID
UPON SIGNAL
(Signal to commence firing)

■ 208. ORDERS FOR DEEP TARGETS.—Orders for firing on deep targets may be as follows when—

a. The target is 200 yards or less in depth:

(1) RANGE 800
RIGHT FRONT
REFERENCE: LONE BUSH
TARGET: DITCH, EXTENDING SHORT 2 MILS AND OVER 4 MILS
SEARCH
MEDIUM
COMMENCE FIRING

(2) RANGE 900
FRONT
COLUMN
SEARCH
RAPID
UPON SIGNAL
(Signal to commence firing)

Or, if the target is moving rapidly away from (or toward) the guns:

BOTH GUNS ON FAR (NEAR) END, SEARCH
RAPID
UPON COMMAND
COMMENCE FIRING

b. The target is more than 200 yards in depth:

NO. 1, 500
NO. 2, 900

LEFT FRONT
RIGHT EDGE OF WOODS
SEARCH
RAPID
COMMENCE FIRING

■ 209. ORDERS FOR OBLIQUE TARGETS.—Orders for firing on oblique targets may be as follows when—

a. The target measures less than 50 mils in width and has more depth than the beaten zone but less than 200 yards:

RANGE 500
RIGHT FRONT
EDGE OF ORCHARD
TRAVERSE AND SEARCH
MEDIUM
COMMENCE FIRING

b. The target measures 50 mils or more in width, has more depth than the beaten zone but less than 200 yards:

RANGE 600
FRONT
RED BANK
NO. 1, RIGHT HALF
NO. 2, LEFT HALF
TRAVERSE AND SEARCH
MEDIUM
COMMENCE FIRING

c. The target measures 50 mils or more in width, and has a depth greater than 200 yards:

NO. 1, 600
NO. 2, 900
FRONT
RIGHT EDGE OF WOODS
NO. 1, RIGHT HALF
NO. 2, LEFT HALF
TRAVERSE AND SEARCH
RAPID
COMMENCE FIRING

■ 210. ORDERS FOR AREA TARGETS.—Orders for firing on areas may be as follows when—

a. The area measures less than 50 mils in width:

(1) RANGE 800
FRONT
REFERENCE: BLACK STUMP
TARGET: AREA EXTENDING RIGHT 20 MILS AND LEFT 24 MILS
TRAVERSE; SEARCH DOWN 2
MEDIUM
COMMENCE FIRING

(2) If there is no reference point along the near or far edge of the target, the leader must lay the guns for the initial burst and complete the fire order orally.

(3) RANGE 900
FRONT
AREA: PLOUGHED FIELD
TRAVERSE; SEARCH UP 2
SLOW
COMMENCE FIRING

b. The area measures 50 mils or more in width:

RANGE 500
FRONT
AREA: RED CLAY BANK
NO. 1, RIGHT HALF
NO. 2, LEFT HALF
TRAVERSE; SEARCH UP 2
MEDIUM
COMMENCE FIRING

■ 211. ORDER REQUIRING USE OF AUXILIARY AIMING POINT.—Order for firing on targets using an auxiliary aiming point may be as follows:

RANGE 1,000, SIGHT RIGHT 8
RIGHT FRONT AT DISTANCE OF 600 YARDS, BLACK STUMP
AIMING POINT
FIXED
RAPID
COMMENCE FIRING

■ 212. ORDERS REQUIRING OVERHEAD FIRE.—Orders for firing over the heads of friendly troops may be as follows:

a. If the range is 900 yards or less:

RANGE 850
LEFT FRONT

CREST OF SMALL KNOLL
TRAVERSE
OVERHEAD
TROOPS IN DITCH TO FRONT
TEST FOR SAFETY
(Gunners report)
MEDIUM
COMMENCE FIRING

b. If the range is greater than 900 yards:

RANGE 1,200
FRONT
EDGE OF WOODS
NO. 1, RIGHT HALF
NO. 2, LEFT HALF
TRAVERSE
OVERHEAD
TROOPS IN DRAW TO FRONT
SAFETY LIMIT, THAT LINE OF SCRUB BRUSH
MEDIUM
COMMENCE FIRING

■ 213. ORDER REQUIRING FIRE TO DETERMINE RANGE.—An order requiring fire to determine range, preparatory to engaging a target, may be as follows:

NO. 1, 600
SIGHT RIGHT 3
FRONT
POINT WHERE ROAD ENTERS WOODS
ADJUST
COMMENCE FIRING
(Gunner reports range to target (par. 189))
ALL GUNS 700
EDGE OF WOODS
TRAVERSE
MEDIUM
COMMENCE FIRING

SECTION IX

OVERHEAD FIRE

■ 214. EMPLOYMENT.—*a. General.*—Overhead fire is fire delivered over the heads of friendly troops. A machine gun is capable of delivering this type of fire because of the small and uniform dispersion of the cone of fire resulting from the use of a fixed mount. The use of overhead fire increases the radius of action of the machine gun, and since the latter is not confined to positions on line with the troops that it is supporting it can utilize positions in rear which afford a greater use of the fire power of the weapon. In the attack, the use of overhead fire permits the machine gun to give support during the advance of rifle units.

b. Limitations.—Use of the light machine gun in the delivery of overhead fire has decided limitations, inherent in the characteristics of the weapon. Being an air-cooled weapon, overheating of the gun results in considerable dispersion in range. If the weapon is used after reaching this condition for the delivery of overhead fire, it endangers friendly troops. However, due to its being equipped with a relatively stable mount, the gun may be used for this type of fire without danger and will deliver accurate and effective overhead fire up to the time overheating occurs. When employed in the delivery of overhead fire, *single shot fire is habitual.* In this case, the size of the strings of shots employed should follow the general rule: number of shots in the string equals the number of hundreds of yards in range. To further preclude overheating, the rate of fire should not exceed medium rate. Firing tests have indicated that the light machine gun will retain accuracy at the rate of 60 rounds per minute for a period of approximately 30 minutes, or for the expenditure of about 1,800 rounds. Further tests indicate that accuracy is lost more rapidly as the rate of fire increases, the gun becoming inaccurate from overheating at approximately 800 rounds' *continuous* automatic fire. To insure against accuracy decreasing to the extent that friendly troops may be endangered, it is a mandatory provision that any light machine gun delivering overhead fire shall change barrels at every 750 rounds fired, regardless of the rate of fire.

c. Means of delivering overhead fire.—Overhead fire with the light machine gun should be delivered only when the gunner or observer can see the friendly troops being fired over.

d. Minimum clearance.—The center of the cone of fire must clear the friendly troops by a prescribed distance. This distance, known as "minimum clearance" and usually expressed in mils, is found by adding together the following elements:

(1) The height of a man standing, taken as 2 yards.

(2) Half the vertical dimension of the 100 percent cone of fire at the range to the troops (Firing Tables 0.30–A–4, firing ball ammunition M2 (150-grain bullet).

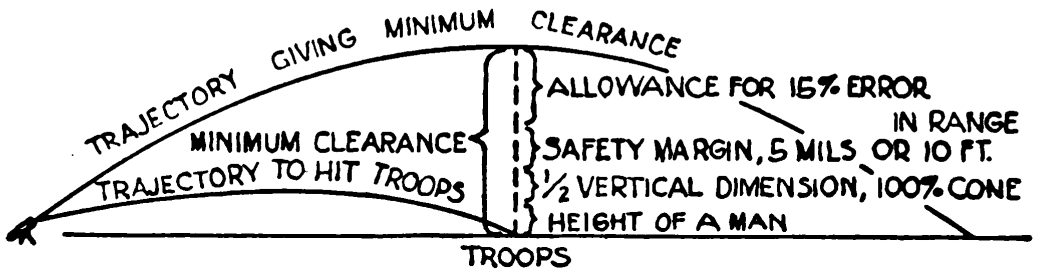


FIGURE 66.—Components of minimum clearance.

(3) An additional allowance to compensate for a 15 percent error in range determination. This may be disregarded when fire has been adjusted.

(4) A margin of safety of 5 mils, or the number of mils subtended by 10 feet, whichever is greater.

e. Safety angles and corresponding ranges.—(1) In order to obtain this minimum clearance, the center of the cone of fire which will strike at the feet of the friendly troops must be elevated through an angle equal to the minimum clearance expressed in mils. This required angle is known as the "safety angle." Thus the safety angle for direct laying is the difference between the angle of elevation required to obtain minimum clearance and the angle of elevation required to hit at the feet of the friendly troops.

(2) The point where the trajectory giving minimum clearance will strike on level or uniformly sloping ground marks the shortest range on such ground at which fire can safely be delivered over the head of troops located at the point for

which minimum clearance was computed. This range is known as the "corresponding range." Another way of expressing the safety angle is to say that it is the difference between the angle of elevation for the corresponding range and the angle of elevation to hit the feet of the troops.

(3) The safety angles for all ranges on level or uniformly sloping ground have been computed and are contained in Firing Tables 0.30–A–4.

(4) To permit overhead fire on any target, the cone of fire must pass over the heads of friendly troops by at least the minimum clearance. In order to have a quick and simple means of insuring this condition, two rules of thumb have been devised by means of which safety angles may be measured with the rear sight. However, the application of these two rules will be useless if the feet of the friendly troops are on or above the line gun–target.

f. Gunner's rule.—The gunner's rule is used when the range to the target is 900 yards or less. It is applied by the gunner unless the safety limit has been determined and announced by the platoon or section leader. The rule is as follows:

(1) Lay the gun on the target with the correct sight setting to hit the target.

(2) Without disturbing the laying of the gun, set the rear sight at 1,500 yards.

(3) Look through the sights and note the point where this new line of sighting strikes the ground.

(4) If this point is beyond the feet of the friendly troops, overhead fire can be delivered safely until the troops reach it.

(5) If this point does not clear the feet of the friendly troops, it is not safe to fire (fig. 67).

g. Leader's rule.—The leader's rule is used by the platoon or section leader only in case the range to the target is greater than 900 yards. The rule is as follows:

(1) Select a point on the ground to which it is believed friendly troops can advance with safety.

(2) Determine the range to this point by the most accurate means available.

(3) Lay the gun on the target with the correct sight setting to hit the target.

(4) Without disturbing the laying of the gun, set the rear sight at 1,500 or the range to the *selected point* plus 600, whichever is greater. *Under no conditions should this sight setting be less than 1,500 yards.*

(5) Note the point where the new line of aim strikes the ground.

(*a*) If it strikes short of the selected point, it is safe for troops to advance to the point where the line of aim strikes the ground and to an unknown point beyond. This point must be determined by testing new selected points until the line of aim and the selected point coincide.

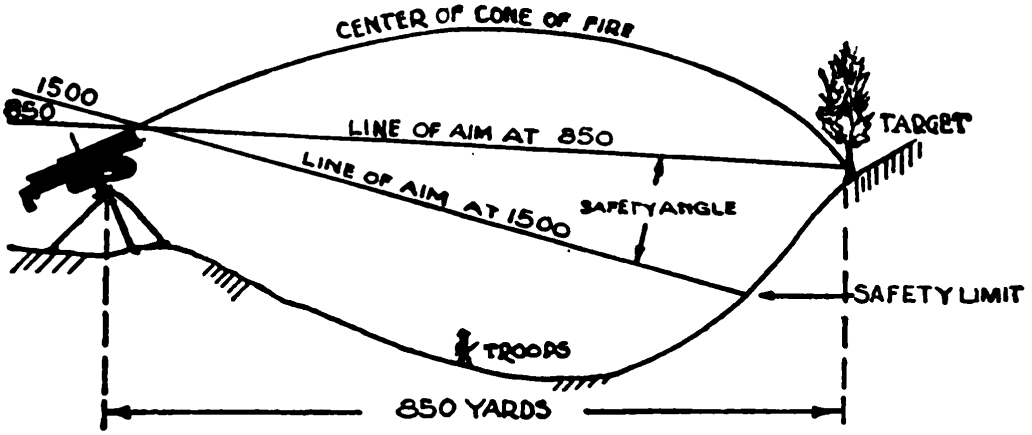


FIGURE 67.—Application of gunner's rule.

(*b*) If it strikes at the selected point, the selected point marks the limit of safety.

(*c*) If it clears the selected point, it is safe for the troops to advance to the selected point and to an unknown point beyond. This point must be determined by testing new selected points until the line of aim and the selected point coincide. This point of coincidence marks the limit of safety (fig. 68).

h. Procedure before friendly troops reach limit of safety.—(1) *Safety limit identified on the ground.*—The safety limit having been determined, the gunners and all leaders must note some terrain feature by means of which the limit may be identified on the ground. In case safety has been determined by the platoon or section leader, the limit of safety is announced so that the gunners and squad leaders are able to identify it. If necessary, the limit is indicated with the

rear sight of each gun, care being taken not to change the laying of the gun on the target.

(2) *Report by gunners.*—In case the gunner's rule is applied, gunners report "Clear" or "Not clear" to indicate whether or not it is safe to fire.

(3) *Checking laying while firing.*—After determining or noting the safety limit, the gunner moves the sight back to the range to the target in order, while firing, to check the laying on the target.

i. Procedure after friendly troops reach limit safety.—When the friendly troops reach the limit of safety, gunners cease firing.

j. Use of binoculars in applying safety rules.—It is frequently desirable to determine safety for overhead fire before

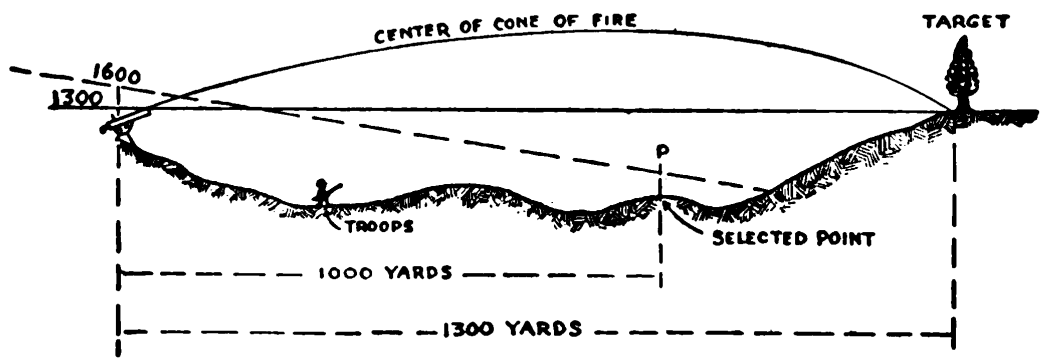


FIGURE 68.—Application of leader's rule.

guns are placed in position. Safety may be approximately determined by means of the inverted sight leaf in the type EE or M3 binocular. After the guns are emplaced, safety should be checked where possible with the gun sights.

■ **215. PRECAUTIONS.**—The following precautions must always be observed when overhead fire is used:

a. If safety has been checked *only* by application of the leader's or gunner's rule, overhead fire is not delivered if the troops are less than 300 yards from the guns, unless the vertical interval of the troops below the line gun–target is such as to make safety obvious.

b. A barrel which gives evidence of excessive muzzle flash is not used for overhead fire (par. 214*b*).

c. The tripod is firmly mounted.

d. Except when time and where facilities in combat do not permit, depression stops are used to prevent the muzzle of the gun being accidentally lowered below the limit of safety.

e. Overhead fire is not delivered through woods which are likely to deflect bullets into friendly troops.

f. Tracer ammunition will not be fired in overhead fire at ranges greater than 900 yards.

g. Friendly troops are informed when fire is to be directed over them, except when impractical in combat.

h. The rate of fire employed in the delivery of overhead fire does not exceed medium rate (75 rounds per minute).

SECTION X

FINAL PROTECTIVE LINES

■ 216. DEFINITION.—A final protective line (FPL) is defined as a predetermined line along which, in order to stop assaults, is placed grazing fire, often fixed as to direction and elevation, and capable of delivery under any condition of visibility. Some searching or traversing may be employed when it is desirable to cover more ground than is possible with fixed fire.

■ 217. ASSIGNMENT OF FINAL PROTECTIVE LINES.—When final protective lines are assigned, the light machine guns are sited so as to deliver grazing fire over terrain where the entire continuous danger space may be utilized to advantage.

■ 218. SECTORS OF FIRE.—Front-line machine guns on the defensive are assigned sectors of fire, the inner limits of which are usually, but not always, the bands of grazing fire placed along the final protective lines. The machine-gun fire unit is responsible for engaging the enemy within its sector, subjecting him to fire as he approaches, and finally forcing him to pass through coordinated bands of grazing fire before he can deliver his assault.

■ 219. INFLUENCE OF TERRAIN.—On level or uniformly sloping ground up to a range of 750 yards, the center of the cone does not rise above the height of a standing man (2 yards) at any

point from the muzzle of the gun to the point of impact. The length of the forward half of the beaten zone should be added to the range 750 yards, making the total possible danger space on level or uniformly sloping ground approximately 800 yards. The great length of danger space on such terrain is the most important characteristic of machine-gun fire with reference to the final protective line. However, ground that slopes uniformly for 750 yards or level stretches of that length are not often found. Two cases are given in paragraph 220 to illustrate the different types of terrain on which final protective lines may be placed and the methods of laying the gun for elevation and direction in order to get the maximum amount of grazing fire in each case.

■ 220. METHODS OF LAYING ON FINAL PROTECTIVE LINES.—*a.* Lay the gun for direction by sighting in the desired direction.

b. Obtain proper elevation as follows:

(1) *Case 1.*—If the ground is level or slopes uniformly for a distance of 750 yards or more from the gun, select an aiming point on the ground at a range of approximately 750 yards and with a sight setting of 750 yards (800 yards minus 1 click on M1 sights) lay the gun on this point.

(2) *Case 2.*—If the ground slopes uniformly for a distance less than 750 yards, select an aiming point on the ground near the break in the uniform slope. Then with a sight setting to hit the selected point lay the gun on that point and elevate it 2 mils by means of the elevating handwheel.

c. Whenever the tactical situation permits, the laying should be verified by firing.

d. If a depression exists between the gun and the ground on which the final protective line is placed, the depression is dead space in the band of machine-gun fire and must be covered by other weapons.

■ 221. PROCEDURE IN FIRING.—*a.* Prior to switching to a final protective line mission, light machine guns deliver aimed fire at visible enemy targets or at locations where the enemy is thought to be concealed within their assigned sector. Attempts to cover areas with fire to deny it to the enemy are not a proper use of the weapon and result in an exorbitant ex-

penditure of ammunition. However, in case smoke is used by the enemy, harassing fire over small areas may be used, the fire being delivered within the limiting boundaries of the sector assigned each gun as checked by previously recorded data on the tripod. When this is done, ammunition must be conserved for the final phase of the action.

b. When light machine guns switch to final protective line missions, the fire is in the nature of an emergency. Its usual duration is such as to cause overheating of the gun, if automatic fire is used. If it is observed that the enemy is advancing to cross the final protective line and by such a maneuver will present a dense target for enfilade fire, full automatic fire may be used. For low visibility firing, the battalion order may specify the rate of fire. In the absence of such instructions the normal section rate is 150 rounds per minute for the first 2 minutes and 60 rounds per minute thereafter. Fire on the final protective line mission, when there is visibility, is aimed and adjusted fire covering the general locality of the final protective line. When there is no visibility, such fire is fixed, the gun being clamped in elevation and traverse (par. 190*a*, FM 7–10).

■ 222. LAYING GUN AT NIGHT AND DURING FOG OR DARKNESS.—The gun having been laid by any of the foregoing methods of direct laying, provision must be made to enable the crew to lay the gun during darkness, smoke, or fog. The gun having been properly laid for elevation and direction, place an aiming stake at a short distance in front but offset slightly from the line of fire. Without disturbing the laying, manipulate the rear sight until a line of sighting is obtained on a designated mark on the aiming stake. To lay the gun properly at any time, set the sights according to the readings previously recorded and aim at the mark on the aiming stake.

SECTION XI

RANGE CARDS

■ 223. GENERAL.—*a.* The range card is an oriented sketch of a sector of fire showing predetermined data which will facilitate the accurate delivery of fire, especially during

periods of poor visibility and at night. Cards are prepared for each gun covering its own sector of fire. One limit of the sector in a defensive situation will usually comprise a final protective line. Within the sector, firing data is determined to all probable targets and keypoints, such as road junctions, high ground, streams, woods, and other landmarks. The data consist of a simple drawing or description of each object, with notations as to direction, range, and elevation necessary to place fire on them. Cards are prepared in duplicate immediately upon occupying a primary gun position, and are made subsequently for alternate and supplementary positions. One card is kept at the gun position, the duplicate being provided for the higher commander who consolidates the essential information on his tactical map.

b. The employment of range cards permits decentralization of command without loss of fire control, an advantage which is important in highly organized defensive positions where guns may be widely separated. They are used by the higher commander in planning coordination of defensive fires since they show what he can expect his guns to do and indicate where rearrangement and the placing of fires by other weapons are necessary. The cards also form a record for relieving gun crews and are always considered a part of the orders for a position.

■ 224. PREPARATION.—The following information is habitually noted on the range card (see fig. 69).

a. The designation of the squad, section, platoon, and company of the occupying gun (this may be in code) ①; the date of occupation ②; and the location of the gun ③.

b. (1) If the sector includes a final protective line, it will be drawn on the card and that part of the line which provides grazing fire will be shown by means of a wide line ④. The setting of the traversing block on the traversing bar scale is noted, and the elevation is determined and recorded from the settings on the scale on the elevating screw and the micrometer on the elevating handwheel ⑤.

(2) If the sector of fire does not include an FPL, a broken "zero" line is put on the card. It is desirable that this line

approximately bisect the sector, and that it point toward a clearly defined landmark in the area. In case there is no satisfactory landmark in the area, the line is pointed on an aiming stake. The gun is so laid on this line that the traversing block is set at zero on the traversing bar scale.

c. Targets are numbered from right to left. The direction to each target within the normal sector of fire is indicated by the proper reading on the traversing bar scale. The direction to the target is lined in on the card; the conventional sign, or sketch and name, of the object is entered at the

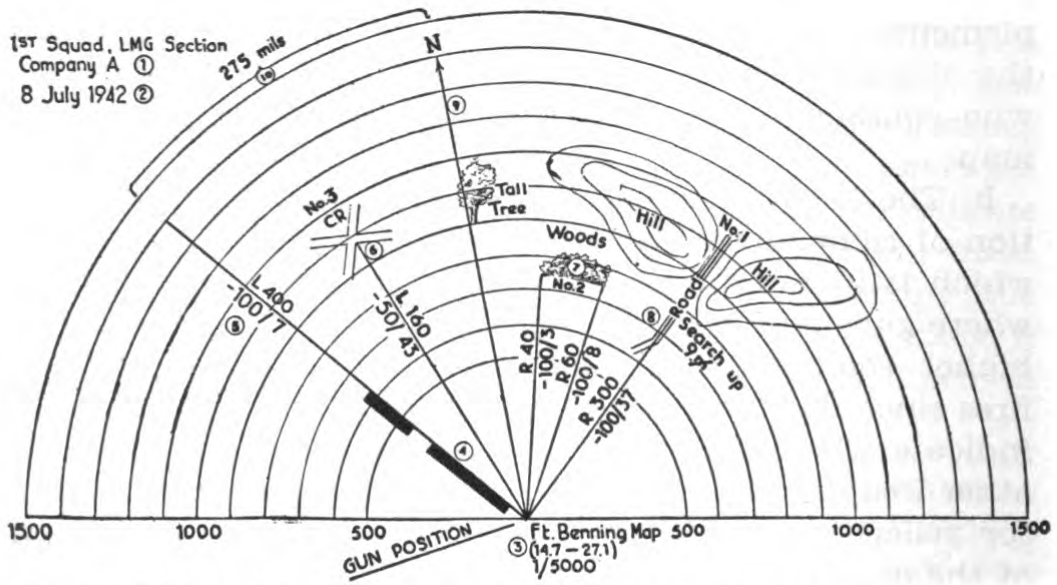


FIGURE 69.—Range card, 1st squad, LMG section, Company "A."

proper range ⑥. These directional lines extend only from the gun to the target.

d. If the target has width, the traversing bar scale and elevation readings for both flanks are shown ⑦, or the exact amount of traverse can be indicated. If it is desired to search an area, the direction and amount of search are shown ⑧.

e. The range card can be oriented by indicating the azimuth of the FPL or the "zero" line or by indicating the angle between the FPL or the "zero" line and a prominent landmark or a cardinal direction ⑨ ⑩.

■ **225. OBTAINING DATA.**—The tactical situation permitting, the data for range cards are obtained by firing the gun

along the FPL and at the various targets, the recordings being determined from the sight settings, traversing bar and micrometer scale readings, and elevating screw and micrometer scale readings. Otherwise, the data are obtained by laying the gun for direction and elevation with correct sight settings and recording the data.

a. To obtain the data for the FPL, the gunner centers the traversing handwheel mechanism and zeroes the traversing micrometer. Upon determining which limit of the sector is to comprise the final protective line, the gunner sets the traversing block toward that end of the traversing bar opposite to the direction of the FPL; he then lifts the rear legs of the tripod and alines the muzzle in the approximate direction of the line. By so doing he obtains the maximum angle of traverse away from the FPL in the direction of the targets in his sector. (Observe that directional layings of the gun to the left require that the traversing block be set to the right of the zero mark on the traversing bar, and vice versa; that is, when the block is set on the 400 mark to the right of zero the muzzle of the gun is to the left, and the reading is recorded as "Left 400." For all readings of the traversing bar scale, the *left edge* of the traversing block is used.) To lay the gun for elevation so as to obtain the maximum of grazing fire, the range is determined by firing, or is estimated with the rear sight properly set, and the elevation is read from the elevating screw scale and micrometer. For example, if the first major graduation and index mark below the graduation on the elevating screw scale, which can be seen above the top of the elevating handwheel, is the 100 above the zero mark, and the indicator on the elevating handwheel is pointing to 7, the setting is recorded as "+100/7" (read as "plus 100 diagonal 7").

b. If a "zero" line is used instead of a final protective line, the gunner centers the traversing mechanism and sets the traversing block at zero on the traversing bar scale; he then lifts the rear legs of the tripod and alines the gun on the designated line. The traversing bar reading of zero is indicated on the range cards.

c. To obtain the data to the targets, the gunner centers

the traversing handwheel mechanism and slides the block along the traversing bar until the target is alined through the sights. If the left edge of the block falls on a graduation on the bar, it is clamped. If it does not fall on a graduation, the gunner moves the block until the left edge falls on the next minor graduation, clamps it, and adds the necessary mils with the traversing handwheel to aline the gun on the target (par. 92). The traversing bar scale reading plus the added mils are recorded on the card. Range and elevation are then determined and recorded.

d. To orient the card, the corporal may move back of the gun far enough so that the metal will not affect the compass needle and take the azimuth of the FPL or the "zero" line, which will then be entered along the line. If a cardinal direction is used for orientation, the corporal determines this line with his compass and identifies some object on this line which is visible to the gunner. The gunner then points his gun on the object and measures the angle from the FPL or "zero" line by means of the traversing bar scale. When a prominent landmark is used for orientation, the angle between this and the FPL or "zero" line is measured in the same manner.

e. To indicate the gun position, the distance and azimuth from some feature which will appear on the commander's map (CR, RJ, woods) are measured and recorded.

■ 226. USE OF THE CARD AT THE GUN POSITION.—*a.* When the card is used to direct fire on a target, the bar scale reading and the setting of the elevating screw scale and micrometer may be announced, for example, "Left 160, —50/43," or the target number only may be given.

b. Every precaution should be taken to insure the usefulness of the card by identifying the gun position on the ground and pointing out the direction of fire. The gun position should be marked with a stake or similar device, and aiming stakes may be used to indicate the final protective line and principal targets.

c. When the gun is not being fired, it is habitually laid on its FPL, with the proper data to deliver fire on this line.

If the gun is moved or replaced by another gun, the range card for its sector is left at the old position.

SECTION XII

FIRING FROM DEFILADED POSITIONS

■ 227. GENERAL.—Light machine-gun positions are selected to permit direct fire on the target or targets assigned, or to cover an assigned sector of fire. If possible, locations for light machine guns should permit fire, with only a slight change of position, on actual or suspected locations of hostile machine guns sited to take advancing units of the company under cross fires. The location of the front-line troops and the target must be visible from the firing positions (par. 173, FM 7–10). However, this does not preclude fire from defiladed positions where an observer at or near the gun can directly observe the fire with respect to the target and the safety of friendly troops. In such a position, because of high weeds, grass, or intervening ground, hostile troops can see little or none of the gun and its crew, yet the effectiveness of the machine-gun supporting fire is not reduced nor is the safety of friendly troops impaired. Vegetation, such as high weeds, grass, or grain, provides concealment defilade; whereas intervening ground provides concealment, and, in addition, protection from hostile flat-trajectory fires.

■ 228. FIRING POSITIONS.—*a. Partial defilade.*—If the intervening vegetation or ground hides all parts of the gun except the sight from the target, partial defilade is obtained. For example, a gun can be moved uphill until the target is just visible through the sights. Since the target can then be used as an aiming point, the technique employed is that of direct laying.

b. Position defilade.—A gun is in position defilade when the gun and its crew are hidden from the target (preferably from all enemy view), but an observer at or near the gun position, or the gunner sitting upright, kneeling, or standing in the immediate rear of the gun, can see the target. Such firing positions, which normally imply protection from flat-trajectory fire as well as concealment, may be on a reverse slope,

or on the forward slope of the next crest in rear, or may be behind small folds in the ground. Firing from position defilade requires the use of simple indirect laying methods.

■ 229. FUNDAMENTALS.—In order to engage a target with the light machine gun by simple indirect laying methods, four essentials must be considered—direction, elevation, mask clearance (if the mask is sufficient to stop or deflect the bullets), and adjustment of fire.

■ 230. POSITION DEFILADE PROCEDURE.—*a. To establish direction.*—The gun is dragged into position, pointed generally at the target by shifting the trail legs, and seating the trail leg shoes well into the ground. If time permits, the tripod is leveled.

(1) *Direct alinement method* (fig. 70).—The traversing bar slide is unclamped, and, under the direction of an observer stationed behind the gun on the line gun-target and so located that he can see the target, the gun is tapped right or left until it is alined on the target. This alinement may be made by the gunner if he can see the target by half rising at his position behind the gun.

(2) *Aiming point method* (fig. 71).—If an aiming point (top of tree, spire, etc.) can be located which is visible to the gunner through the sights and on the line gun-target, the gun can be laid initially for direction by aiming at that point. Such an aiming point should preferably be at or beyond the target. When using the binocular for measuring deflection, the aiming point may be off the line gun-target. In this case, the gunner sets off the measured deflection on his windage gage and lays on the aiming point.

(3) *Aiming stake method.*—In the event no natural aiming point is available, an artificial point such as an aiming stake may be placed near the gun, on or near the line gun-target. The gun is then laid for direction by aiming at the aiming stake.

b. To establish mask clearance.—Mask clearance is established when the gun is laid so that the prolongation of the axis of the bore clears the mask by at least 2 mils. With the gun laid for elevation, this can be verified by depressing the muzzle two mils, then sighting along the right side of

the barrel jacket, or more accurately, if time is available, by "bore sighting" the gun. If by looking along this line, or by looking through the bore, the mask is not visible, mask clearance was established. To re-lay, elevate the muzzle 2 mils. Where the mask consists only of vegetation, and such vegetation will not deflect the bullets, this detailed procedure is not necessary.

c. To establish elevation.—Initial elevation may be established by one or a combination of the following methods:

(1) *Measured QE method.*—When speed is paramount and especially when concealment is available on the mask, the gun may be dragged into the concealed position on the mask and laid on the target with the proper sight setting to hit the target. The angle of quadrant elevation (QE) is then measured by depressing (elevating) the muzzle until the gun is leveled, counting the change in mils (clicks). The QE is the vertical angle between the horizontal and the axis of the bore with the gun laid to hit the target. The gun may be leveled under the direction of an observer who takes a quartering view from the right (left) rear of the gun and directs the gunner to elevate or depress the muzzle until the gun appears to be horizontal. Another means of leveling the gun is to place a clean empty cartridge case across the cleaned cover of the gun, then elevate or depress the muzzle until the cartridge case remains stationary. The gun is then dragged down into position defilade, again leveled, and the measured QE is placed on the gun by elevating (depressing) the number of mils measured. The muzzle is then elevated one or two additional mils to compensate for the difference in elevation between the firing position and measuring position on the mask. The gunner then verifies mask clearance and re-lays. This is a quick method of laying the gun in elevation to fire on a target from position defilade and is practicable on most terrain.

(2) *Aiming point method* (fig. 71).—If an aiming point, visible to the gunner through the sights, can be located on the line gun-target, the gunner lays on that point with a sight setting corresponding to the range to the *target*. An observer, so located that he can see the target, measures with his binocular the vertical angle from the aiming point down

(up) to the target and then directs the gunner to depress (elevate) the muzzle the corresponding number of mils by means of the elevating handwheel. The gunner then verifies

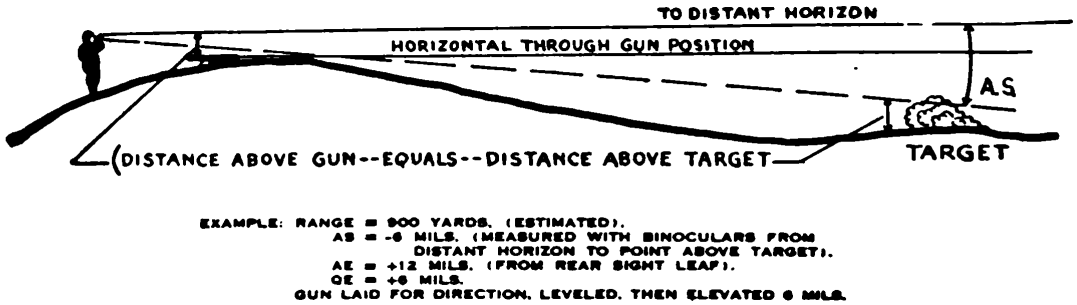


FIGURE 70.—Direct alinement (direction) and calculated QE (elevation) method.

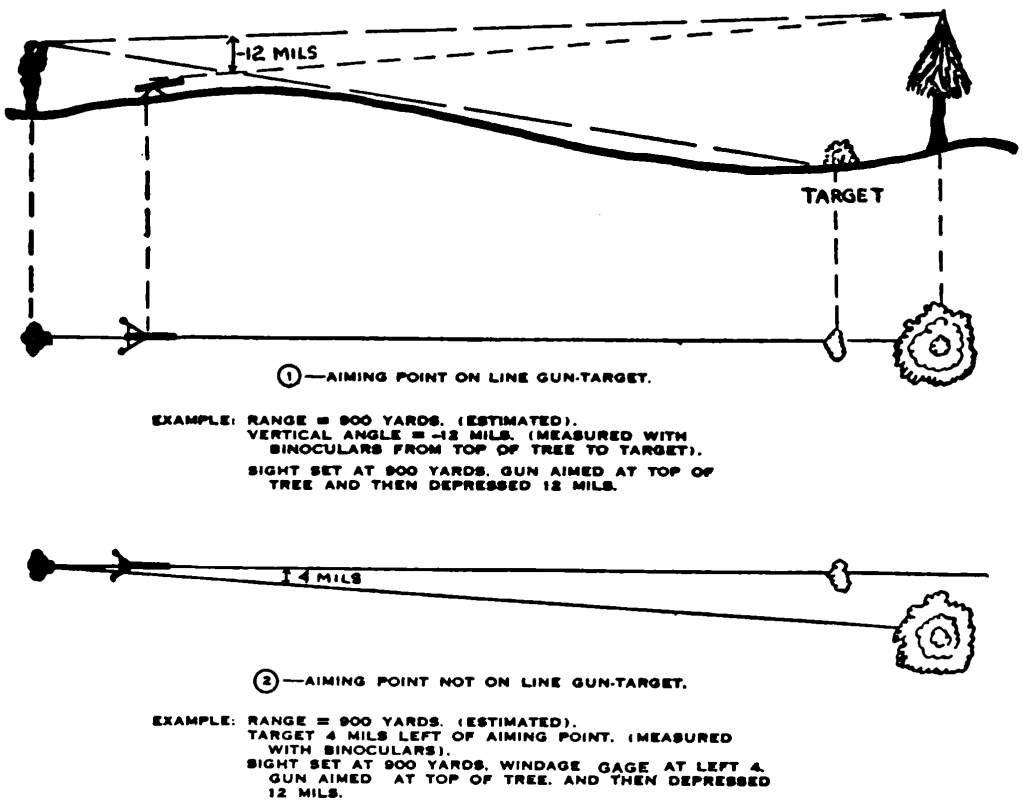


FIGURE 71.—Aiming point method (elevation and/or direction).

mask clearance. The aiming point used in this method should preferably be at or beyond the target.

(3) *Calculated QE method* (fig. 70).—(*a*) The angle of site (AS) is the vertical angle between the horizontal and the line

gun-target. If the gun and target are at the same elevation, the AS is zero. If the difference in elevation between the gun and target is appreciable, the AS must be determined. An observer, equipped with a binocular, moves to a position where he can see the target, estimates the vertical distance his eye is above the gun, and selects a point which is the same distance above the target. This compensates for the difference in elevation between his eye and the gun. The AS is then measured down (up) from the horizontal to the selected point above the target by means of the mil scale in the binocular.

(*b*) The angle of elevation (AE) is the vertical angle through which the axis of the bore must be elevated above the line gun-target to compensate for the drop in trajectory caused by gravity and air resistance. The observer estimates the range to the target and causes that range to be set on the rear sight leaf of the gun so that the AE corresponding to the estimated range to the target can be read directly on the mil scale on the left-hand side of the rear sight leaf. The gunner announces the AE.

(*c*) The observer then adds algebraically the AS and the AE to obtain the QE which is used to lay the gun in elevation (fig. 70). For example, if the AS is −6 and the AE is +12 (range 900 yards), the QE is +6 (−6+12). The gun is leveled as described in (1) above, and the required QE is then put on by elevating (depressing) the muzzle the corresponding number of mils by means of the elevating handwheel. The gunner then verifies mask clearance and re-lays.

(4) *Minimum clearance method.*—With the gun placed on a reverse slope in minimum position defilade with respect to the target, initial elevation may be approximated by laying the gun so that the prolongation of the axis of the bore just clears the mask, then elevating the muzzle two mils. This establishes the AE to hit a target at about 700 yards. For ranges beyond 700 yards, the muzzle should be elevated through an additional angle equal to the difference between the AE for the range to the target and the AE for 700 yards (gun as laid). There are other practicable minimum clearance methods which can be used by experienced gun crews.

d. Adjustment of fire.—Fire, opened with the initial laying, is adjusted immediately for both range and direction by the observer (squad leader, section leader), and thereafter controlled by observation of strike or tracer flight. The gunner may also be able to adjust his own fire by rising slightly from his position.

e. Fire orders.—Initial fire orders will contain the information necessary to lay the gun for direction and elevation; for example, DIRECTION AS LAID, QE, PLUS 6 (fig. 70); RANGE 900, (SIGHT LEFT 4), TOP OF TALL TREE, DOWN 12 (fig. 71). When mask clearance has been checked and the gun re-laid, No. 2 signals READY, and the command or signal is given: AS LAID, FIXED (TRAVERSE 20), RAPID (MEDIUM), COMMENCE FIRING. Fire, once opened, is adjusted by announcing or signaling the necessary corrections; for example, UP (DOWN) TWO (FOUR), RIGHT (LEFT) FOUR (SIX). Extensive use is made of arm-and-hand signals in transmitting fire orders and subsequent corrections thereto.

f. New targets.—New targets may be engaged by any of the preceding methods or by the following method: The angle of shift from the old target to the new target is measured in mils by means of the binocular or approximated by the finger. The corresponding angle is set off on the traversing bar scale. Changes in elevation are estimated and applied to the gun.

g. Theory of indirect laying.—The light machine gun may be fired from the heavy machine-gun tripod. Under such circumstances it can readily be used for more involved indirect fire missions. For the theory of indirect laying and further refinement of methods, refer to FM 23–55.

■ 231. TO SUPPLEMENT DIRECT LAYING BY INDIRECT LAYING METHODS.—*a.* When light machine guns are assigned missions which may be interfered with by smoke, dust, or darkness, the targets that may be expected in the assigned sectors of fire should be engaged by direct fire methods when possible, but precautions must be taken to insure that they may be engaged by indirect methods if this becomes necessary. Ordinarily, if it is feasible to adjust fire on such targets during daylight hours, this is done. The deflection

and elevation data are recorded for each target. These data in elevation and deflection, being reset for any particular target, provided the tripod has not been moved since fire was originally adjusted on the target, will obviously be accurate. To insure that the tripod has not moved or settled in firing, it should be firmly staked at all three shoes.

b. If data have been obtained in daylight but have not been checked by firing, the gunner should fire at the estimated elevation, as well as 1 mil more and 1 mil less, and with the measured deflection, as well as 2 mils right and 2 mils left. Where time and facilities permit, aiming stakes corresponding to the different targets that are to be engaged by indirect methods may be installed, supplementing other means of establishing direction.

SECTION XIII

FIRING AT FIELD TARGETS

■ 232. GENERAL.—*a. Purpose.*—The purpose of this phase of training is to instruct leaders in the control of their units under simulated battle conditions and the individual soldier in the performance of his duties as a member of a fighting team, so as to secure the maximum fire efficiency.

b. Place in training.—Before a unit receives training in firing at field targets, all men should be given instruction in mechanical training, gun drill, marksmanship, and the technique of machine-gun fire.

c. Scope.—Training in firing at field targets includes instruction in range estimation, selection and occupation of positions, the use of cover and concealment, and firing exercises.

■ 233. PREPARATORY EXERCISES.—*a. General.*—(1) Before a unit is presented a field firing exercise, it should receive preparatory instruction. This instruction may include conferences, demonstrations, and practical work using nonfiring exercises. These exercises are valuable because they eliminate to a great degree the question of safety and allow the troops to give undivided attention to the instruction.

(2) Officers conducting preparatory exercises receive valu-

able experience. They learn quickly to present and conduct exercises, to judge solutions, and to conduct critiques. They may give their entire attention to these important points by the elimination of the distraction caused by enforcing necessary safety precautions when ball ammunition is used.

b. Range determination.—The effectiveness of machine-gun fire depends largely on range determination. In the firing exercises economy of time and ammunition is greatly enhanced by correct range determination. It is, therefore, advisable during this phase of instruction to review the methods of range determination described in section IV.

c. Selection of gun position.—(1) The selection of a gun position is governed by the mission, field of fire, cover and concealment while firing, routes of approach, fire control, and time available for occupancy.

(2) These factors may be pointed out in a demonstration showing several different positions and discussing the favorable and unfavorable points of each position.

(3) This should be followed by exercises in which the instructor designates a number of possible gun positions and requires the men to choose one of the positions designated and to state the reason for their selection. The advantages and disadvantages of each position are discussed to insure that the men consider all of the important factors before deciding which position to occupy.

d. Use of natural cover and concealment.—(1) When a machine gun can be located definitely by the enemy, it is soon put out of action. It is necessary, therefore, that the gun crew take advantage of all natural cover and concealment available both in approaching and occupying the gun position.

(2) In training men in the use of natural cover and concealment, the following rules are stressed:

(*a*) Unnecessary movement after getting into position is eliminated.

(*b*) Shiny articles or sharply contrasting colors are not worn.

(*c*) Steel helmets are camouflaged so as to break the regular curved outline of the helmet.

(*d*) When crawling into a position in sight of the enemy,

move straight toward him. Do not move sideways or zigzag.

(*e*) When crawling keep the body well down. Do not let the arms and legs wave around.

(*f*) Avoid quick or jerky movements.

■ 234. FIRING EXERCISES.—*a. Units to fire.*—Each light machine-gun squad or section engages in field firing exercises when local facilities permit.

b. Terrain.—(1) The availability of ground and consideration for safety determine the selection of terrain for field firing. Where possible, varied ground suitable for the employment of light machine-gun fire should be selected. It is a great advantage from the instructional standpoint to use ground that is unfamiliar to the unit to be trained.

(2) In the absence of other facilities, a known-distance range may be used by arranging the exercises so that they begin off the range, and require the delivery of fire on the range, in a safe direction.

c. Targets.—(1) Field targets may be improvised from available material or they may be obtained from the Ordnance Department.

(2) With the field targets furnished by the Ordnance Department, a stationary target may be represented by E or F targets placed on staves and driven into the ground.

(3) A surprise target that can appear and disappear may be made by using either E or F targets fastened to an I-beam and operated by a man in a pit.

(4) A movable field target may be made by fastening E or F targets to a sled (fig. 72).

(5) In the field, targets should be placed in locations that would be used by an intelligent enemy. They should not be exposed prominently nor placed in a regular line. The exposure of targets kept out of sight at the beginning of an exercise may be indicated by the firing of blank ammunition or the operation of other noise- or smoke-producing equipment in the vicinity of the target when it appears. Targets may be placed so as to be visible with a binocular but entirely invisible to the naked eye so that skill is necessary in designating the target and adjusting fire.

(6) The appearance of targets to the gunners depends

to a great extent upon their location with regard to the direction of the sun, the background of the targets, and the angle at which the targets are placed. These factors should be taken into consideration when placing the targets for an exercise.

d. Shelter.—(1) Ranges for field firing exercises can be operated efficiently without an elaborate system of shelters and dugouts. Simple pits to accommodate the target operators are sufficient.

(2) Every effort should be made to avoid altering the natural appearance of the terrain when locating and constructing pits.

(3) When targets are placed in the rear or to one side of a pit, the likelihood of ricochets falling into the pit is minimized.

e. Safety.—(1) AR 750–10 states the general safety measures to be observed when firing live ammunition.

(2) The officer in charge of a field firing exercise is responsible for the safe conduct thereof. He insures that the guns are not loaded or that firing is not begun before the range is clear. He also sees that the direction of fire conforms to local requirements for safety and that firing ceases immediately upon appearance of a signal from the pits.

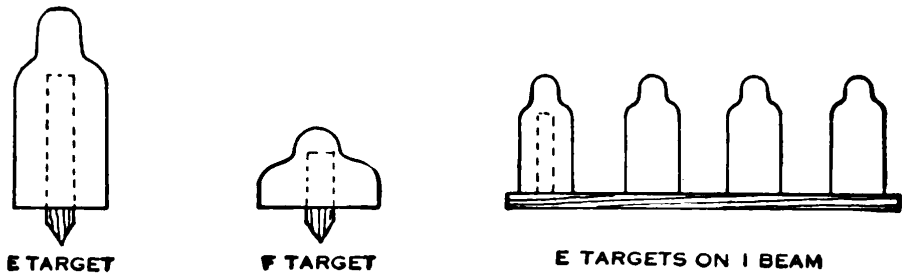
(3) Pit details should be cautioned to keep close to the forward protecting wall and well down below the parapet of the pit.

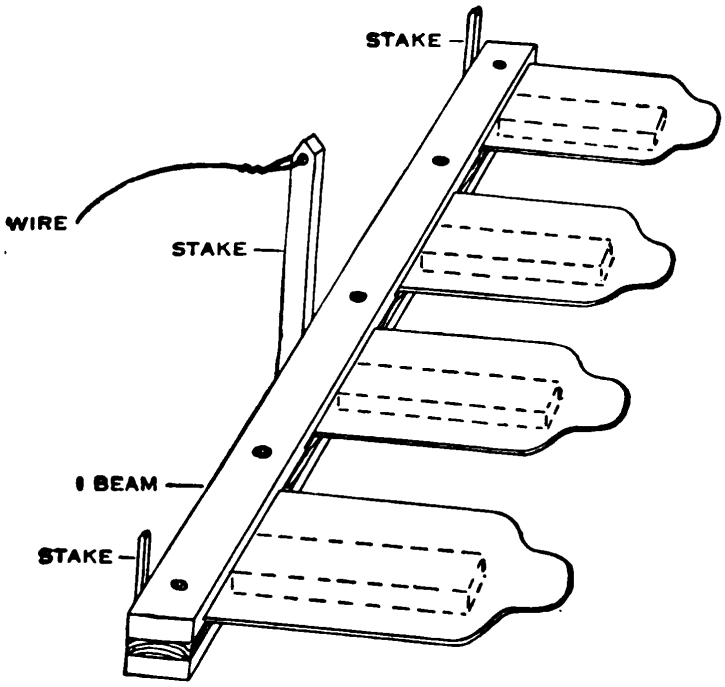
f. Communication.—(1) The officer in charge of a field firing exercise should take the necessary steps to insure proper communication between the firing positions and the pits, so as to facilitate the expeditious conduct of the exercise.

(2) On extemporized ranges the communication between the firing positions and the pits may be by temporary wire lines, by flags, by rocket signals, or by bugle signals.

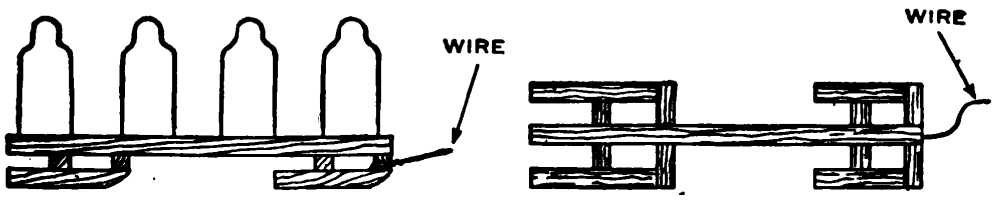
g. Administrative arrangements.—(1) Instruction in field firing requires ranges, equipment, and supplies that must be prepared or obtained in advance. The time required for this preparation depends largely on the conditions and facilities at the post or camp where the instruction is to be given.

(2) Necessary supplies and ranges should be requisitioned





ARRANGEMENT FOR SURPRISE TARGET



E TARGETS ON SLED TOP VIEW OF SLED

FIGURE 72.—Field targets.

early enough to prevent any interruption in the training schedule.

h. Suggested exercises (par. 255).—These exercises may be amplified as conditions permit.

i. Critique.—At the completion of all exercises the instructor should conduct a critique covering the following points:

(1) Use of cover and concealment.

(2) Actions of the platoon, section, and squad leaders in getting their units on the ground without delay.

(3) Reconnaissance by the platoon, section, and squad leaders.

(4) Orders of platoon, section, and squad leaders.

(5) Suitability of firing positions.

(6) Fire action of unit (all elements of technique used in delivering fire).

j. Ammunition.—Ammunition allowances for field firing are prescribed in AR 775–10.

CHAPTER 7

ADVICE TO INSTRUCTORS

SECTION I

GENERAL

■ 235. PROVISIONS NOT MANDATORY.—The information and suggestions contained in this chapter are not mandatory unless so specifically stated. They are furnished as a guide for the personnel responsible for the instruction of troops in the subjects contained herein.

■ 236. METHOD OF INSTRUCTION.—The applicatory system of instruction is normally used for instruction in subjects of the nature found in this manual. This system consists of explanation, demonstration, application (practical work), and examination.

a. Explanation.—The initial explanation and demonstration of any particular phase of the instruction are presented to the assembled units by the instructor, assisted by essential demonstration personnel. The general purpose of the entire course or period of instruction should be explained first. The various phases or steps of the course should then be presented in a series of explanations and demonstrations.

b. Demonstration.—(1) Demonstrations which are skillfully conceived and executed expedite and simplify instruction as well as stimulate interest. Successful demonstrations are usually short and concise. They leave the student with an exact impression stripped of superfluous details. The demonstrations incident to all subjects should be arranged in progressive sequence and, where practicable, should alternate with practical work to permit the student to fix these successive phases of instruction in his mind.

(2) The men who constitute the demonstration unit should be carefully selected for their intelligence, ability, and appearance. They should be thoroughly trained and rehearsed in the duties they are to perform so that the demonstration will proceed smoothly and illustrate clearly and simply the phase of instruction being presented.

(3) The equipment used for demonstrations should be the best available. A demonstration platform or an area in which the students can be assembled quickly in a position from which they can see and hear every part of the demonstration is essential.

(4) Interest is added and valuable instruction given by repeating demonstrations, including common errors and requiring the students to detect these errors.

c. Application (practical work).—(1) This phase of instruction is of primary importance since it gives the students an opportunity actually to do that which has been previously explained and demonstrated.

(2) During this phase best results are obtained if the unit is divided into groups. Each group is provided with a set of equipment and placed under the direct supervision of a trained assistant instructor. The group then executes the previously demonstrated phase of instruction, and individuals rotate within the group until all men have mastered the instruction.

(3) The initial allotment of time and equipment should be made carefully. However, the instructor should not hesitate to alter this allotment if the majority of the men fail to master the instruction within the allotted time or are kept at one exercise to the point of boredom. The frequent rotation of duties within each group is preferable to keeping each man in one position for a long time.

d. Examination.—Informal oral or practical examination should be conducted upon completion of each phase of instruction. In addition to the required preliminary gunner's test, organization commanders should conduct such additional examinations as are necessary to insure that all men are satisfactorily trained.

e. Critique.—Upon the completion of each practical exercise, the instructor should conduct a critique, during which

he covers all the details of the exercise. All groups undergoing instruction should be assembled. The instructor calls attention to errors which have been committed and explains how they should be corrected or avoided. He should not fail to commend work well done.

SECTION II

MECHANICAL TRAINING

■ 237. GENERAL.—Mechanical training lends itself readily to the use of the applicatory system. The groups of the entire unit, each with its set of equipment and under the direct supervision of an assistant instructor, are assembled in a suitable area. The unit instructor supervises the instruction of the groups. Explanation and demonstration are concurrent, each assistant instructor demonstrating the elements of the phase of instruction as the instructor explains it. For short periods of practical work the instruction is decentralized under the assistant instructors. Groups should consist of from 3 to 6 men, depending upon the number of men undergoing instruction, the number of assistant instructors, and the equipment available.

■ 238. DISASSEMBLY AND ASSEMBLY OF GUN.—*a. Equipment necessary for each group.*

1 gun.
1 tripod.
1 ammunition belt.
1 combination tool.
Several dummy cartridges.

b. Procedure.—(1) Have assistant instructors disassemble and assemble the gun while the instructor is explaining the procedure.

(2) Turn the guns over to the students for practical work.

(3) Ask questions.

c. Head space adjustment.—The necessity for making

proper head space adjustment can be shown in the following manner:

(1) For loose head space adjustment—

(*a*) Screw the barrel into the barrel extension until the breech end is flush with the inside of the barrel extension.

(*b*) Place the bolt in its guides, push it fully forward, and lock by holding up on the breech lock.

(*c*) Holding the parts locked together, work the bolt backward and forward and notice the independent movement of the bolt.

(2) For tight head space adjustment—

(*a*) Release the breech lock and screw the barrel in as far as it will go.

(*b*) Push the bolt as far forward as possible and attempt to push up the lock.

(*c*) Notice that the bolt does not go far enough forward to permit the lock to rise into its recess in the bolt.

■ 239. DISASSEMBLY AND ASSEMBLY OF GROUPS.—*a. Equipment.*—Same as in paragraph 238*a*. Spare bolts, lock frames, shock-absorbing groups, and covers are desirable, if available.

b. Procedure.—(1) Explain and demonstrate the disassembly and assembly of all the groups.

(2) During the practical work, distribute the groups among the men so that four can work simultaneously. After one individual has completed the disassembly and assembly of a group, he should pass it to the next man.

(3) Ask questions.

■ 240. CARE AND CLEANING.—*a. Equipment.*—Same as in paragraph 238*a*, plus additional equipment necessary for special demonstrations.

b. Procedure.—(1) Explain and demonstrate the cleaning of the gun, including accessories.

(2) Turn the gun over to the students for practical work.

(3) Ask questions.

c. A conference accompanied by a demonstration of the points to be observed before, during, and after firing should prove valuable.

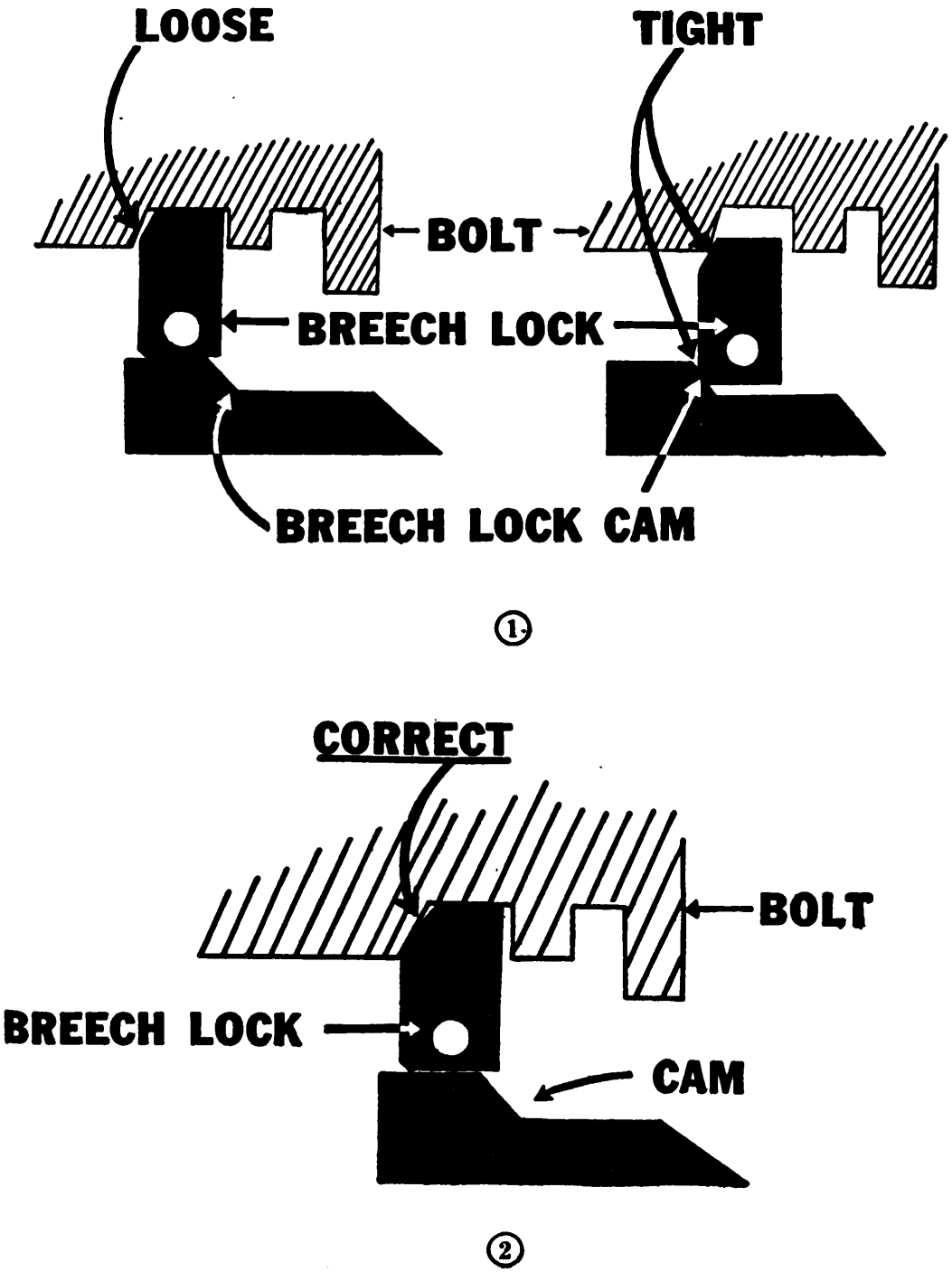
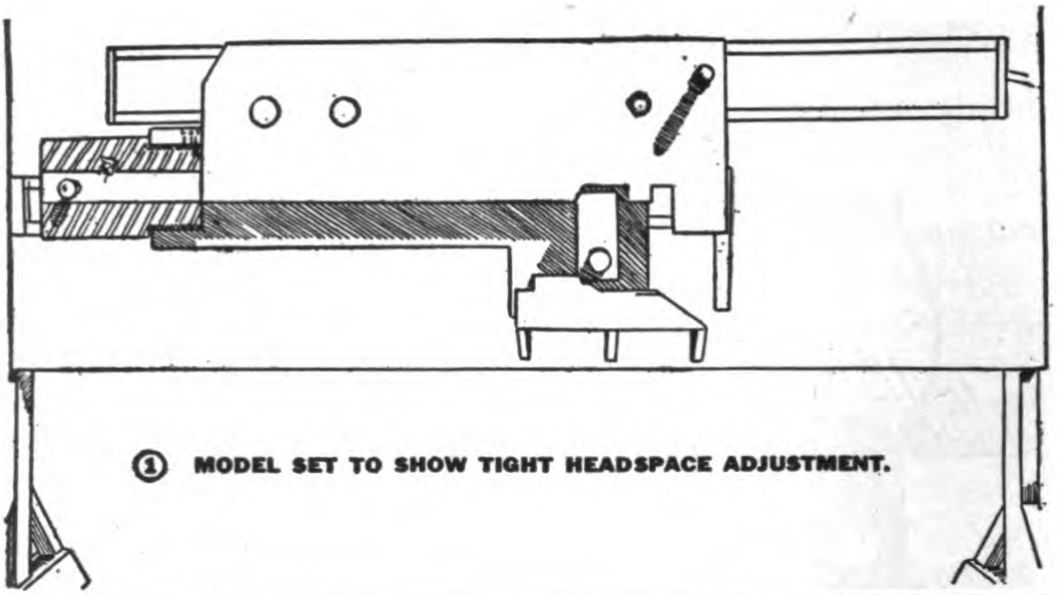
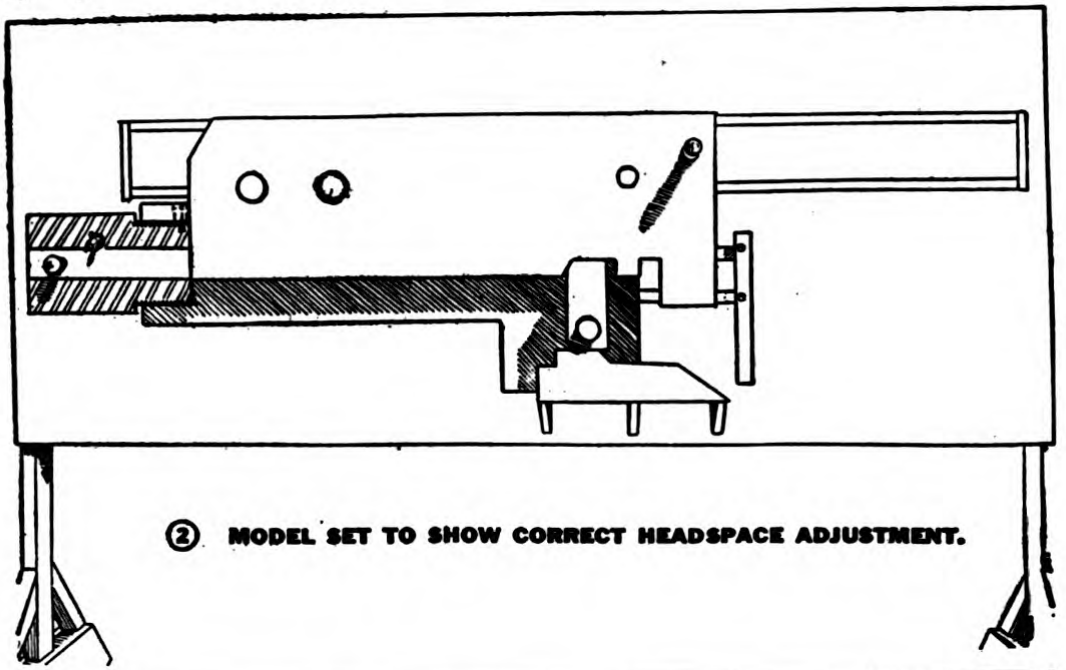


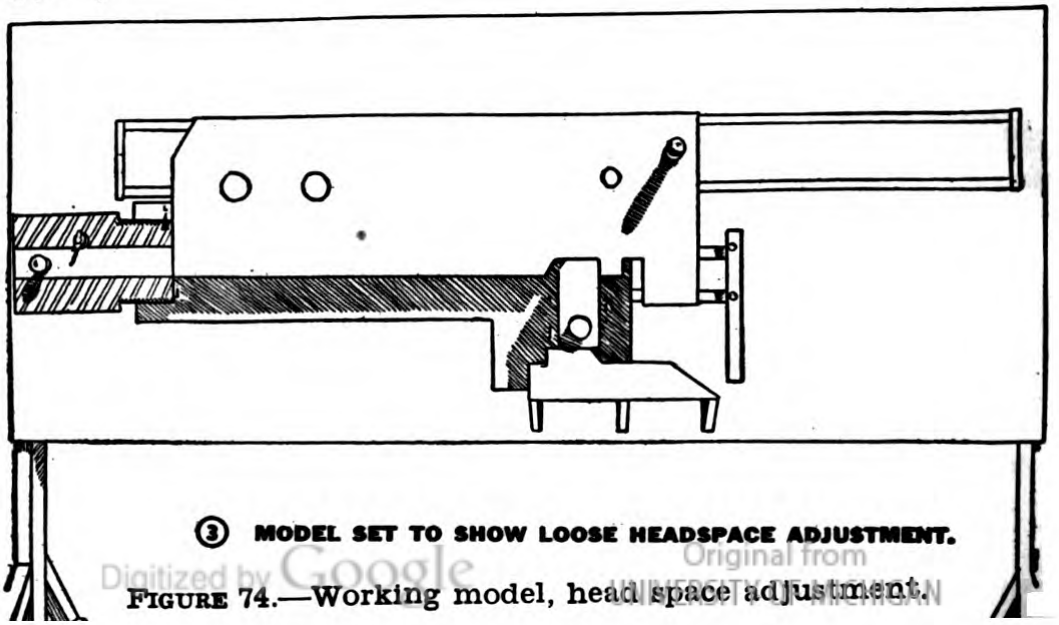
FIGURE 73.—Head space adjustment.



① MODEL SET TO SHOW TIGHT HEADSPACE ADJUSTMENT.



② MODEL SET TO SHOW CORRECT HEADSPACE ADJUSTMENT.



③ MODEL SET TO SHOW LOOSE HEADSPACE ADJUSTMENT.

FIGURE 74.—Working model, head space adjustment.

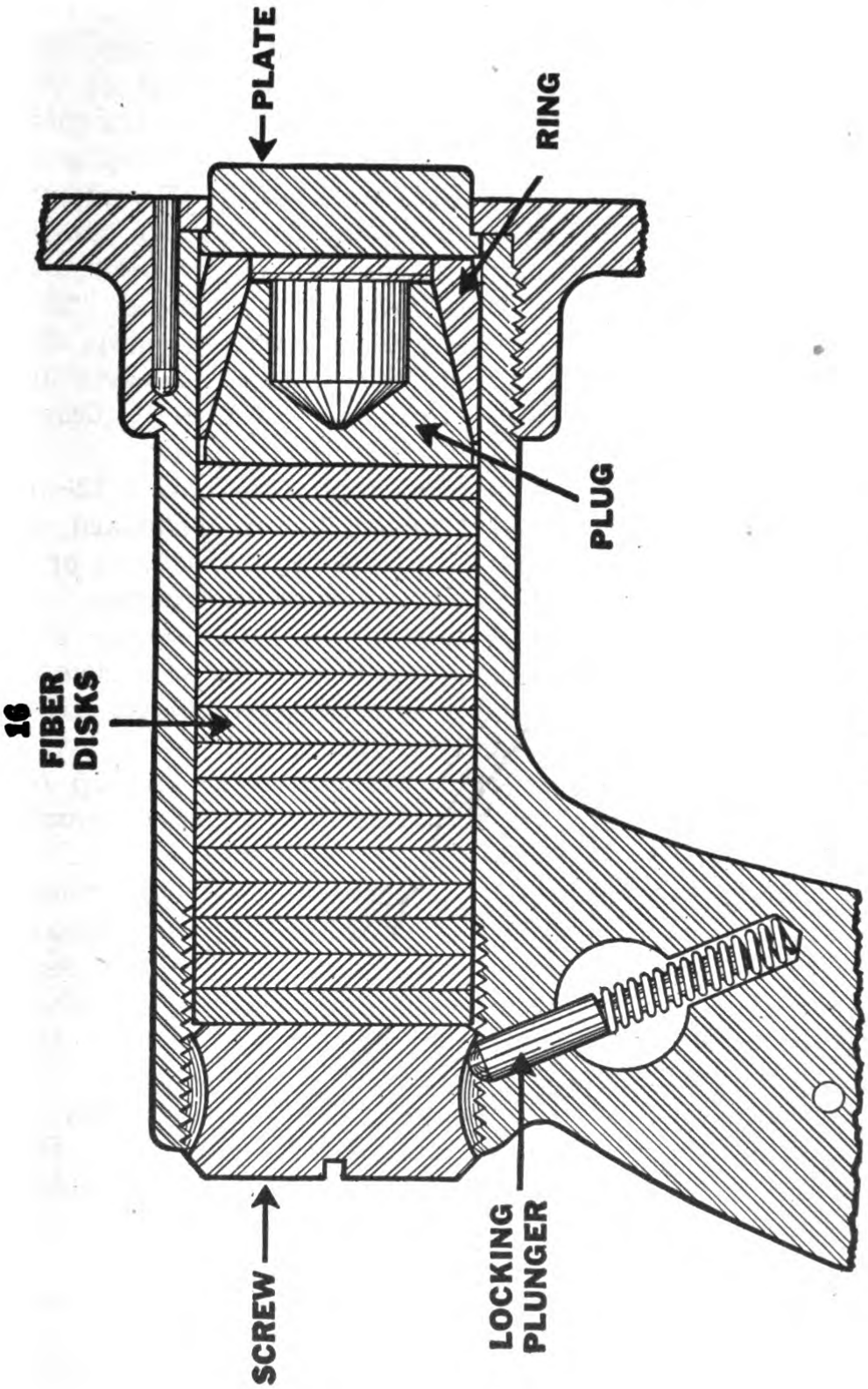


FIGURE 75.—Buffer assembly.

■ 241. FUNCTIONING.—Although the application of immediate action will remedy the majority of stoppages, the gunner must have a practical working knowledge of the functioning of the gun if he is to exact its best performance. Men should be encouraged to visualize the functioning of the parts rather than to memorize the text. The student's ability to visualize the continuity of the functioning can be tested by asking questions which require answers combining parts of several phases of functioning, for example: "The first cartridge is positioned against the cartridge stop, the bolt is forward. What is the functioning of the parts involved in loading this round into the chamber?" Other similar questions may be asked.

a. Equipment.—Same as in paragraph 238*a* plus a 12- or 14-inch square piece of beaver board, heavy cardboard, or plywood on which to make set-ups. A "cutaway" gun or a functioning board, if available, facilitates instruction.

b. A method of dividing functioning into phases and demonstrating each phase is given below. (Any reference to the gun as partly assembled means less backplate, cover latch, driving spring, and driving spring rod.)

(1) *Trigger action, first shot* (fig. 76).—(*a*) *Set-up on gun.*—Gun partly assembled, bolt all the way forward, muzzle depressed.

(*b*) *Demonstration on gun.*—Observe the sear cams being cammed down by the trigger cams as the trigger is raised.

(*c*) *Set-up on the board.*—Trigger, trigger pin, sear, sear spring and pin, and the firing pin (firing pin spring removed) placed in correct relative position as they would be in the gun, with the bolt forward, gun cocked.

(*d*) *Demonstration on board.*—Hold the trigger pin in place and pull up on the rear end of the trigger until the sear notch is lowered away from the firing pin shoulder. Move the firing pin forward until the shoulder is on the edge of the sear platform.

(*e*) *Explanation.*—Since the trigger pivots, if its rear end is raised, its forward end is lowered. The trigger cams on the front end of the trigger, through their engagement with the cams on the sear, force the sear down against the action of the sear spring, until the shoulder of the firing pin is

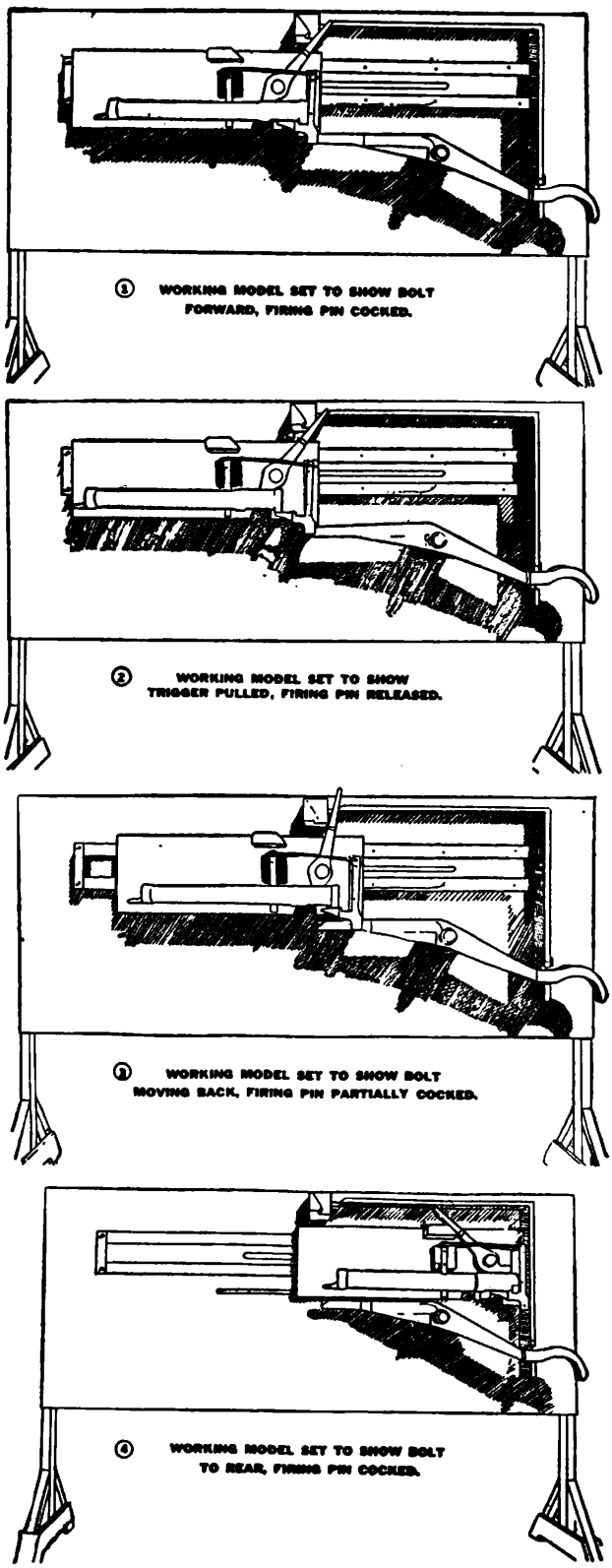


FIGURE 76.—Working model, trigger action.

released by the sear notch. The firing pin spring acting against the sear spring pin then forces the firing pin forward to strike the primer.

(2) *Unlocking of breech* (figs. 9, 10, and 74).—(*a*) *Set-up on gun.*—Barrel, barrel extension, and lock frame pulled from the gun until the lower rear lugs of the barrel extension are just in rear of the bottom of the receiver. Separate the lock frame from the barrel extension. Remove the trigger pin and trigger from the lock frame. Place the bolt, less the extractor, all the way forward on the barrel extension.

(*b*) *Demonstration on gun.*—Hold up on the breach lock with one finger. For demonstration purposes, allow the accelerator to hang down, place the lock frame in its relative position behind the barrel extension, and push forward. Observe the front projections of the lock frame camming down the breech lock pin, thus forcing the breech lock downward.

(*c*) *Explanation.*—The explosion forces the recoiling parts (barrel, barrel extension, and bolt) backward about $\frac{5}{8}$ inch. During the first half of this movement, the parts are locked together. When the breech lock clears the breech lock cam, it is forced down by the front projections of the lock frame acting on the breech lock pin. This unlocks the bolt from the barrel extension, permitting the bolt to continue to the rear.

(3) *Extraction.*—(*a*) *First set-up on gun.*—Same as set-up in (2) (*a*) above.

(*b*) *Demonstration on gun.*—With accelerator in normal position, hold the barrel extension stationary and push forward on the lock frame. Observe how the accelerator, acting on the lower projections of the bolt, accelerates the bolt to the rear and accomplishes the initial extraction of the empty case from the chamber. Also observe that the barrel plunger spring is compressed and that the accelerator stop prevents the accelerator from turning too far to the rear.

(*c*) *Explanation.*—As the barrel extension comes to the rear, the rear end strikes the accelerator and turns it to the rear. This slows down the barrel and barrel extension. The tips of the accelerator strike the rear projections on the bottom of the bolt and accelerate it to the rear. This added

impetus to the bolt thus accomplishes the initial extraction of the empty case from the chamber. The barrel plunger spring is compressed by the barrel plunger stud and is held compressed as the claws of the accelerator engage the T-lug and lock the barrel extension to the lock frame. The accelerator stop prevents the accelerator from turning too far to the rear.

(*d*) *Second set-up on gun.*—Gun partly assembled with bolt all the way forward. One dummy round in the chamber and one on the feedway gripped by the extractor.

(*e*) *Demonstration on gun* (fig. 77).—Holding down on the

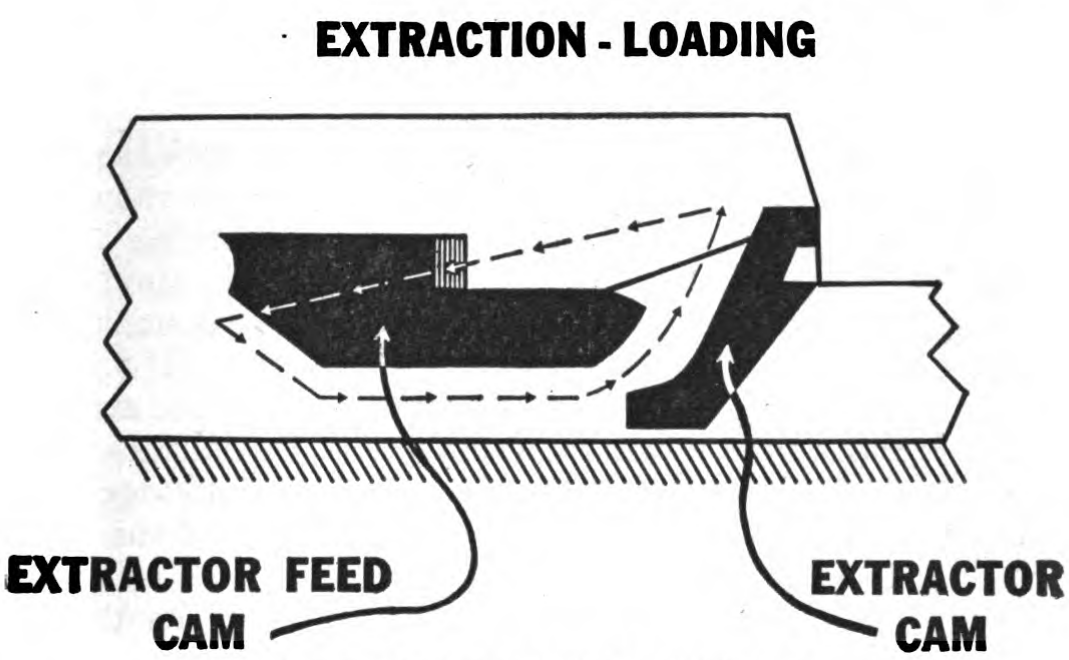


FIGURE 77.—Extraction and loading.

extractor, pull the bolt slowly to the rear about an inch. Observe how the extractor brings a cartridge with it from the belt. Notice the empty case being drawn from the chamber by the T-slot. Also observe how the extractor cam plunger rides over the top of the extractor cam onto the extractor feed cam. Move bolt to rear until the extractor cam plunger is forced in by the beveled portion of the extractor feed cam. Observe the cover extractor cam, seeing by its shape that it would now be pressing the extractor down. Holding down on the extractor, move the bolt all the way to the rear

showing how the extractor cam plunger springs out below the ramp on the bottom of the extractor feed cam.

(*f*) *Explanation.*—As the bolt moves backward, the driving spring is compressed. The bolt brings with it the cartridge from the belt, held by the extractor, and an empty case from the chamber, held in the T-slot. The extractor cam plunger rides along the top of the extractor cam and extractor feed cam until it is forced in by the beveled surface of the extractor feed cam. This permits the extractor to be forced downward slightly by the cover extractor cam, and the plunger springs out behind the ramp of the extractor feed cam.

(4) *Ejection.*—(*a*) *Set-up on gun.*—Gun partly assembled, bolt all the way to the rear, one dummy round held by the extractor.

(*b*) *Demonstration on gun.*—Move the bolt forward about 1 inch. Observe how the extractor cam plunger rides down under the ramp of the extractor feed cam, forcing the extractor down so that it places the rim of a new round in the T-slot. Observe the action of the ejector on the empty case, if it has not already fallen out.

(*c*) *Explanation.*—As the bolt starts forward, the extractor cam plunger rides down the ramp under the extractor feed cam, and the extractor places the rim of the cartridge in the T-slot. At the same time, the ejector kicks out the empty case, if it has not already fallen out.

(5) *Action of the driving spring* (fig. 14).—As the bolt moves to the rear, the driving spring is compressed. The remaining force of the bolt is absorbed by the buffer mechanism as the bolt strikes the buffer plate. The driving spring then forces the bolt forward.

(6) *Loading* (fig. 11).—(*a*) *Set-up on gun.*—With gun partly assembled, pull bolt to the rear. Then push bolt forward approximately 1 inch, one dummy round in the T-slot and another on the feed-way against the cartridge stop.

(*b*) *Demonstration on gun.*—Push the bolt forward showing the action of the ejector as it holds the new round up in line with the chamber. Then, as the extractor cam plunger rides up over the extractor cam, observe the ejector

being cammed out into the half-moon-shaped section of the barrel extension by the cartridge case. Also observe the action of the cover extractor spring after the extractor has gripped the leading round in the belt.

(*c*) *Explanation.*—As the bolt goes forward, the ejector holds the new round up in line with the chamber. The extractor rises as the extractor cam plunger is forced upward by the extractor cam. As the extractor rises, the ejector is cammed outward by the cartridge case, leaving the new round in the chamber gripped by the T-slot. When the bolt reaches its forward position, the extractor grips the first round in the belt and is held down firmly by the cover extractor spring, ready to extract the round.

(7) *Feeding in a new round* (fig. 12).—(*a*) *First act of feeding.*

1. *Set-up on gun.*—Gun partly assembled, with bolt forward. With stud of belt feed lever to the left, close the cover, being sure that the stud on the belt feed lever is engaged in the belt feed lever cam groove.
2. *Demonstration on gun.*—Pull the belt, with two dummy rounds, through the feedway. Jerk to the right to place first round to the right of the belt holding pawl. Hold the cover down with the left hand. With right hand, pull bolt slowly to the rear and look on left side of the receiver to observe the action of the belt feed slide. Raise the cover and observe the position of the stud on the belt feed lever and the position of the belt feed pawl.
3. *Explanation.*—As the bolt moves backward, the stud on the pivoted belt feed lever moves to the right in the cam groove, thus forcing the belt feed slide to the left. The belt feed pawl engages on the left of the first cartridge, which is held in position by the belt holding pawl.

(*b*) *Second act of feeding.*

1. *Set-up on gun.*—Same as last set-up except the bolt is to the rear.
2. *Demonstration on gun.*—Hold cover down with left

hand. Push the bolt forward with the right hand and watch the belt feed slide and ammunition belt. Raise the cover and observe the position of the stud on the belt lever, the belt feed pawl, first round, and second round.

3. *Explanation.*—As the bolt moves forward, the stud on the pivoted belt feed lever moves to the left in the belt feed lever cam groove, forcing the slide to the right. The belt feed pawl carries the first cartridge to the right against the cartridge stop, ready to be gripped by the extractor. The next cartridge is carried over the belt holding pawl, which rises behind it and holds it in position to be engaged by the belt feed pawl on its next movement to the left.

(c) *Function of the finger on the belt feed pawl.*

1. *Set-up on gun.*—Gun partly assembled. Extractor removed from the bolt. Bolt forward. Cover closed. Pull belt with two dummy rounds into the feedway. Jerk the belt to the right to position the first round on the right of the belt holding pawl.

2. *Demonstration on gun.*—Pull bolt to rear and push it forward several times, observing that the belt does not move.

3. *Explanation.*—In event the extractor fails to withdraw the leading round from the belt, the finger of the belt feed pawl riding on top of the unextracted round holds the belt feed pawl in a raised position where it cannot engage on the left of the next cartridge. It thus prevents attempted double feeding.

(8) *Cocking* (fig. 13).—(a) *Set-up on gun.*—Gun partly assembled with bolt all the way forward.

(b) *Demonstration on gun.*—Pull bolt slowly to the rear, showing how the top of the cocking lever is forced forward in the cocking lever recess. With the bolt to the rear, point out the sear cams, showing that when the gun is being cocked the sear cams cannot be engaged by the trigger cams.

(c) *Set-up on board.*—Same as for trigger action, first

shot, with addition of cocking lever and cocking lever pin. The sear cams engaged with the trigger cams and the shoulder of the firing pin disengaged from the sear notch. Top of cocking lever to the rear.

(*d*) *Demonstration on board.*—To simulate movement of bolt to the rear, hold down on the cocking lever pin and move the top of the cocking lever forward so as to bring the firing pin to the rear and engage the shoulder of the firing pin in the sear notch. Also, disengage trigger cams from sear cams. (Trigger actually is stationary in the gun.)

(*e*) *Explanation.*—As the bolt moves backward, the top of the cocking lever is forced forward in the cocking lever recess, bringing the lower end to the rear. The lower end brings with it the firing pin, thus compressing the firing pin spring against the sear spring pin. The shoulder of the firing pin engages in the notch of the sear which is pulled upward by the action of the sear spring, the trigger cams now being disengaged from the sear cams.

(9) *Safety action of cocking lever* (fig. 13).—(*a*) *Set-up on gun.*—Gun partly assembled, bolt to the rear.

(*b*) *Demonstration on gun.*—Push the bolt forward, showing how the top of the cocking lever is forced to the rear.

(*c*) *Set-up on board.*—Same as trigger action, first shot, with addition of cocking lever and cocking lever pin, shoulder of the firing pin engaged in the sear notch, top of cocking lever forward, and trigger cams disengaged from sear cams.

(*d*) *Demonstration on board.*—To simulate movement of the bolt forward, turn the top of the cocking lever to the rear and also engage trigger cams in the sear cams.

(*e*) *Explanation.*—When the bolt moves forward, the top of the cocking lever is forced to the rear, causing the lower end to move forward away from the rear of the firing pin, leaving the shoulder of the firing pin engaged by the sear notch. However, if the firing pin is prematurely released, it is re-engaged by the cocking lever, and eased forward so that the striker cannot engage the primer until after the breach has been locked.

(10) *Timing action of accelerator* (fig. 14).—(*a*) *Set-up on gun.*—Barrel, barrel extension, and lock frame removed

from the gun until the lower rear lugs of the barrel extension are about 1 inch from the end of the receiver. Remove the trigger pin and trigger from the lock frame. Place the bolt, with the extractor removed, on the barrel extension about 1 inch from its forward position.

(*b*) *Demonstration on gun.*—Holding the lock frame stationary with the left hand (as it is in the gun), push forward on the bolt, pointing out the lower projections of the bolt as they trip the accelerator; the barrel plunger spring as it pushes the barrel and barrel extension forward; and the accelerator as it transfers some of the forward motion of the bolt to the barrel extension and slows down the bolt.

(*c*) *Explanation.*—As the bolt starts forward under the impetus of the driving spring, the lower projections strike the tips of the accelerator turning the accelerator forward. This unlocks the barrel and barrel extension from the lock frame and releases the barrel plunger spring, allowing this spring to force the barrel and barrel extension forward. At the same time, some of the forward motion of the bolt is transferred through the accelerator to the barrel extension and the bolt is slowed down. Thus the accelerator acts as a timing device to time the arrival of the breech lock recess in the bolt over the breech lock, and also times the arrival of both over the breech lock cam, so that the breech lock can ride up on the cam and into the recess in the bottom of the bolt.

(11) *Locking* (fig. 9).—(*a*) *Set-up on gun.*—Barrel, barrel extension, and lock frame assembled in gun. Trip the accelerator.

(*b*) *Demonstration on gun.*—Look into the receiver while pushing in repeatedly on the muzzle and observe the breech lock riding up and down on the breech lock cam in the bottom of the receiver. ***Caution:*** Do not push in so far that the barrel extension becomes locked to the lock frame.

(*c*) *Explanation.*—As the recoiling parts move forward, the breech lock rides up onto the breech lock cam in the bottom of the receiver and into the breech lock recess in the bottom of the bolt. The bolt is thus locked to the barrel extension and against the rear end of the barrel about 5/16 inch

before the recoiling parts (barrel, barrel extension, and bolt) are fully forward.

(12) *Firing automatic.*—(*a*) *Set-up on gun.*—Gun partly assembled with bolt forward and muzzle depressed.

(*b*) *Demonstration on gun.*—Draw bolt to the rear. Hold up on trigger and slowly push bolt forward, showing the trigger cams as they engage the sear cams and cam down the sear.

(*c*) *Explanation.*—If the trigger is held raised, as the sear moves forward, the trigger cams engage the sear cams and force down the sear, releasing the firing pin. The gun thus fires automatically, repeating the operation of functioning already described. The release of the firing pin actually takes place about 1/16 inch before the recoiling parts reach the forward position, but after the breech is locked.

■ 242. STOPPAGES AND IMMEDIATE ACTION.—*a. Equipment.*—Same as in paragraph 238*a*, plus ruptured cartridge extractors and cleaning rods.

b. Speed, so essential in the application of immediate action, is largely the result of smooth teamwork by the gun crew, particularly the gunner and assistant gunner. Consequently all members of the gun crew should be given training both as gunner and assistant gunner.

c. Whenever it is impracticable to prepare actual stoppages, the gun crew should be required to perform the proper phase of immediate action, simulating the use of ammunition. Immediate action is practiced slowly and accurately at first. The element of speed must be allowed to enter only when it can naturally follow as a result of familiarity gained by repetition of accurate practice. It is desirable to conclude the training in immediate action with actual firing of a belt containing a number of prepared stoppages.

■ 243. ACCESSORIES.—Instruction in the use of accessories is accomplished in the same manner as in preceding instruction.

SECTION III

TRAINING FOR PLACING MACHINE GUN IN ACTION

■ 244. PROCEDURE.—*a.* Squad equipment is indicated in paragraph 80.

b. It is advisable to start the training with a lecture explaining the purpose and scope of the training in gun drill, followed by an explanation and demonstration with a trained demonstration gun crew. Training of individuals is conducted in groups with assistant instructors in charge. Individuals should be assigned a number and should become thoroughly acquainted with the duties of that number before rotating to a different number. As training progresses numbers should be changed frequently.

c. This training may be conducted concurrently with training in technique of fire.

SECTION IV

MARKSMANSHIP

■ 245. GENERAL.—*a.* Marksmanship is the basic step in training the gunner successfully to employ his weapon in combat. A gunner will subconsciously apply in combat the fundamentals he has been taught in marksmanship, hence these fundamentals must be sound. *This fact should be kept uppermost in the mind of the instructor, and constant effort made to eliminate artificialities which tend to creep in for the purpose of obtaining scores.*

b. During instruction in the preparatory exercises, the entire unit is initially assembled and attention focused on the instructor and a single demonstration unit. Following the demonstration, the groups move to their individual sets of equipment for practical work under the direct supervision of the assistant instructors.

c. Firing exercises on the 1,000-inch range are best conducted under centralized control.

■ 246. PREPARATORY RANGE TRAINING.—*a. General.*—A thorough course in preparatory range training is essential. During this period the gunner learns all of the mechanics of engaging a target (except actually firing). All preparatory training, except actually targeting the gun, may be done in barrack or other nonfiring areas. Adequate time should be allowed and ample supervision provided for the preparatory training to insure that each man has thoroughly mastered the instruction before he is permitted to fire.

b. Equipment per group.—

1 sighting bar complete.
1 sighting target (spotter).
1 leading target (silhouette).
1 3-foot by 5-foot target covered with blank paper, with rack or braces for mounting.
1 1,000-inch machine-gun target of each type used.
1 machine gun complete with mount.
1 1,000-inch moving target range for leading and tracking exercises.
Material for blackening sights.
Tissue paper for copying shot groups (triangles).
Pencils.
Additional equipment, such as blackboard, charts, and drawings, at the option of the instructor.

c. Methods for targeting the gun.—(1) Guns may be targeted for field ranges by using a target 1,000 inches from the gun with a spotter offset from the center of impact so that the line of aim and the trajectory will intersect at the field target. The amount of offset of the spotter from the scoring space varies with the range and the lateral and vertical distances of the axis of the sight from the axis of the bore.

(2) To establish the offset necessary for a particular gun mount and sight—

(*a*) Accurately target the gun at the desired field range.

(*b*) Place a spotter on a screen target 1,000 inches from the gun.

(*c*) Aim at the spotter and fire several rounds, single shot.

(*d*) Measure the offset from the spotter to the center of impact.

(3) Guns may then be targeted for the same field range on targets 1,000 inches from the gun as follows:

(*a*) Establish an aiming point by placing an aiming spotter on a blank target.

(*b*) Using the aiming spotter as the point of aim, target the gun so that the point of strike is at the desired offset point of impact.

■ 247. FIRING OF COURSES.—*a. General.*—Local conditions, including the number of men to fire and the range facilities

available, will determine to a great extent the details of administration and supply incident to firing the courses. These matters should be anticipated so that men who are engaged in firing are not distracted. Men who are waiting to fire may be perfecting their preparatory exercises by using nonfiring guns. They may also derive valuable instruction from watching others fire and listening to the critiques on the firing exercises of other men.

b. Equipment.—(1) *Guns and mounts.*—Instruction in marksmanship is facilitated by having the guns and mounts in perfect mechanical condition, since this simplifies the detection and correction of individual errors. Full advantage should be taken of the facilities of the local Ordnance Department representatives for repair and adjustment of this equipment.

(2) *Adjustment.*—An unusually slow or rapid cyclic rate of fire may increase or decrease the dispersion of a particular gun. Changes in the cyclic rate obtained by adjusting the shock-absorbing group should be made only when all factors tending to affect dispersion have been eliminated. Adjustment of the buffer is made by turning the adjusting screw in the rear end of the grip. Adjustment of the buffer to a point where the recoil of the bolt is sustained by the backplate rather than the buffer plate must be carefully avoided in order to prevent injury to the backplate (par. 20*a*). Adjustment by removal of or substitutiion of other material for a portion of the disks or for part of the spring type assembly is prohibited.

(3) *Ammunition.*—(*a*) Ammunition should be carefully inspected so as to save time and to secure best training results.

(*b*) During moving target firing at field ranges, the number of men who can fire on any one target simultaneously can be increased by "painting" about ½ inch of the tips of the bullets with a material of different colors so that the shots fired by different men on the same target can be identified. Any material which is *noninjurious* to the guns and which leaves a definite record of identification on the target is suitable for this purpose. Mixtures containing lithographic ink have been found satisfactory (see T/A, Targets

and Target Equipment). Complete instructions are found in "Instructions for Marking AAMG Bullets With Printer's Ink for Identification of Hits on Aerial Towed Targets," published by the Office, Chief of Coast Artillery. When large amounts of ammunition are to be used, "painting" is facilitated by rolling the belts up and dipping the tips of the bullets in a shallow pan containing about ½ inch of the coloring material.

■ 248. CONSTRUCTION OF TARGETS AND RANGES.—*a. General.*—For detailed information relative to targets and target accessories, see AR 760–400.

b. Targets.—When regular printed targets are not available, suitable substitutes can be made on large sheets of wrapping paper. The dimensions must compare accurately with those prescribed. These targets can be made in large numbers with the aid of an improvised stencil or a stamp cut out from heavy linoleum.

c. Ranges.—(1) *1,000-inch.*—(*a*) The length of the firing line is determined by the terrain available and the number of guns to be fired simultaneously. The gun interval should be about 5 yards. The depth should be not less than 40 yards. The area should be open and level. When practicable the range should be located so that fire is delivered into a steep bank. There should be adequate space in rear of the firing line to permit supplementary instruction in preparatory training and to accommodate conveniently the details incident to administration and supply.

(*b*) Changing targets is facilitated by placing the targets in a frame carried on a car which runs on a light track from the firing point to the target position. A rope attached to the target carriage and run through a pulley on the target line permits the target to be operated from behind the firing line. Material may be drawn from the Ordnance Department.

(2) *Combat ranges.*—(*a*) An approximately level or gently rising piece of ground should be selected for the moving target range. It should be at least 800 yards in depth and of sufficient length to permit convenient operation of the moving target. A suggested lay-out for a moving target range, including two methods of towing the target, is shown in figure 37. Other methods may prove equally satisfactory.

(*b*) Pits conveniently placed for the scoring and target details, with telephone communication with the firing point, and targets which are rapidly mounted and dismounted from the sled or carriage, facilitate scoring and changing targets. These pits must be constructed so that they are impervious to the type and caliber ammunition used. A sufficient number of pits should be provided to permit efficient functioning of the scoring details.

SECTION V

TECHNIQUE OF FIRE

■ 249. GENERAL.—*a*. Paragraph 248 describes range lay-outs and matters pertinent thereto. However, where these facilities do not exist, a limited firing course may be conducted on the standard rifle range, using the space between the 500- and 300-yard firing points for ground-towed-target firing to avoid damage to permanent firing points.

b. Paragraph 255 contains suggested exercises. Innumerable modifications of these exercises serve as well and should be used where more suitable or to supplement those listed.

c. Advantage should be taken of all suitable exercises to practice the control of fire by the issuance of initial and fragmentary fire orders. Feasible use should be made of code designations, signals, and other means of fire control.

d. The ammunition allowances for training in the technique of fire are contained in AR 775–10.

e. The safety precautions for the firing of service ammunition, contained in AR 750–10 and in other sections of this manual, are supplemented in this section only to the extent deemed necessary.

f. Where firing is done with service ammunition, the targets are examined, and in all applicable cases scored, and scores are posted on bulletin boards. Interest is stimulated greatly by letting gunners know the results of their markmanship and fire distribution. A number of exercises lend themselves to competitive firing between the crews of different guns.

g. In scoring the competitive and other appropriate exer-

cises, the following formula provides a means of evaluating the results:

$$V=a\times\frac{h}{s}\times T\times\frac{1}{t}$$

V=score value.
a=arbitrary value assigned to the particular type of target to indicate its importance in comparison with others used in the exercise.
h=number of hits on the particular type of target.
s=number of rounds fired in the exercise.
T=number of targets of each type.
1=minimum time used, estimated proper time, or 1.
t=time used by the particular gunner or crew.

h. As a step between marksmanship and field firing, the use of landscape targets on the 1,000-inch range is beneficial in conducting instruction in target designation, fire distribution, and fire control. Numerous exercises can be fired on these targets to determine the gunner's application of the technique of fire.

i. To save time, the firing of more than one gun simultaneously on the same target, such as in towed-target firing, may be accomplished by painting the tips of the bullets a different color for each gun, care being exercised to see that the coloring substance does not cover enough of the bullet to foul the bore.

■ 250. FREE FIRING RANGE LAY-OUT (fig. 78).—This range permits each gun to engage all designated targets within the target area by various prescribed methods of fire distribution. This range may be combined, if the terrain is suitable, with the ground-towed-target range described in paragraph 139.

■ 251. GROUND-TOWED-TARGET FIRING.—Firing at ground-towed targets at the ranges expected in combat may be accomplished by towing the target or by operating it on a narrow-gage track under the force of gravity. Motor-operated targets are preferable generally in order to give variety to target speeds and courses. Ricochet bullets from tracks require the use of larger danger areas. For ground-towed

targets, the towing vehicle may be placed at a safe distance on the flank of the firing line or operated in rear of it. Where adequate shelter exists a stationary motor and drum may be installed on the flank of a straight target course, the target being moved back and forth along its course by the forward and reverse gears of the motor.

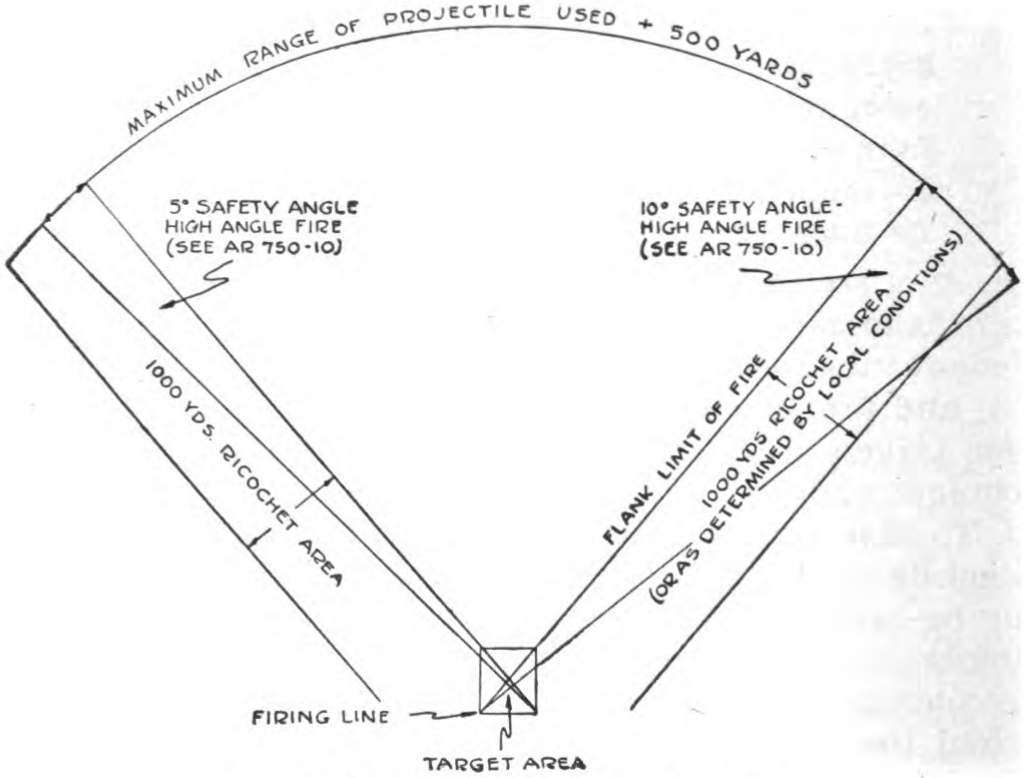


FIGURE 78.—Free firing range lay-out.

■ 252. RANGE LAY-OUT USING A FLANK TOWING VEHICLE (see figs. 36, 37, and 38).—*a. Course.*—The terrain must permit target changes in elevation as well as direction. In laying out such a course, special emphasis should be given to firing at ranges below 500 yards.

b. Towrope and accessories.—(1) A ¼-inch wire cable may be used for towing; however, it is difficult to splice. Unless the ground is rocky, a ¾-inch manila hemp rope is better.

(2) Figure 38 shows the pulley lay-out to create changes in the direction of the target. In the absence of pulleys, a piece of 4-inch pipe, driven into the ground until 5 or 6 inches protrude, will serve. With the pulley arrangement,

the towrope is attached to the top edge of the target sled, and a large knot about 8 inches in diameter, or preferably a wooden ball, is placed in the rope approximately 15 feet ahead of the target to cause the towrope to jump off the pulley. If the pipe is used, the towrope is attached to the target on a special bracket about 18 inches from the ground.

(3) A drum similar to that shown in figure 80 is installed at each curve in the road traveled by the towing vehicle.

c. Operation of the range.—(1) After the personnel has been trained, an exercise can be fired every 6 or 8 minutes provided two towing trucks with crews and targets, respectively, are used. This assumes that the first truck will be used for towing the target after it has been placed on the range and that the operator of this truck will disconnect the tow rope on successive target runs from the truck immediately after a run has been completed. Also, it assumes that the second truck will proceed from the safety line to the point where the used target comes to rest after a given run and carries with it a new target to be used for the next run.

(2) Thus, the second truck, as soon as safety permits after a run has been made, is moved to the old target (fig. 37), the towrope is unhooked from the old target and fastened to the new target. The second truck is then driven around the course in reverse order while personnel following in rear of the truck engage the towrope over the successive pulleys. Upon arrival at the starting point for the target, it is removed from the truck and placed in position for being towed. The truck is moved to the starting position, the forward end of the tow is hooked on to the truck, and the firing line is notified that all is ready for that run.

(3) In the meantime, the first truck is returned to the point where the old target was stopped; this target is placed in the body of the truck and taken to the scoring point after which it then may be used for a third run. The truck is returned to the starting point and the procedure is repeated.

(4) The starting and finishing positions of the towing vehicle are marked by flags.

d. Additional safety precautions.—(1) The permissible extent of the firing angle must be determined accurately by

laying off a line from the left gun through the extreme right of the target course and another line from the right gun to the extreme left of the target course (fig. 37). Then add the safety angles and the ricochet danger areas on the right and left of the established firing angle as shown in figure 78. The ricochet angles should be determined by test firing in doubtful cases.

(2) Markers are placed so as to define clearly the right and left limits of fire.

(3) The starting point of the towing vehicle must be at a safe distance on the flank opposite to that on which the target appears.

(4) Vehicles and personnel working on the course are equipped with red flags and must be directed by definite signals or commands.

(5) There must be a safety officer or noncommissioned officer for each firing point who sees that the gunner—

(*a*) Never endangers the target detail.

(*b*) Never fires outside the prescribed safety limits.

(*c*) Ceases firing upon command.

(*d*) Clears his gun and stands away from it before the target detail moves onto the range.

(*e*) Does not load until the range is clear.

■ 253. RANGE LAY-OUT WITH TOWING VEHICLE IN REAR (fig. 79).—*a.* (1) This lay-out permits firing only at targets moving parallel to the firing line. For this reason, the target placed on the target sled may be a vertical screen. The target sled moves back and forth opposite the direction of movement of the towing vehicle. Two or even more sleds may be coupled in tandem. The ends of the towrope are unhooked and refastened, respectively, to the towing vehicle, before and after it turns around at the end of each run.

(2) The length of the target run, the range to the target, and the frontage of the firing line depend on the limits of the firing and on safety angles.

(3) The safest, quickest firing instruction can be conducted with the guns grouped with minimum intervals in a stationary position near the middle of the firing line.

b. Where adequate shelter exists on one flank of the tar-

get course, the continuous cable may run only on the two corner pulleys (near the target) (fig. 79). For this lay-out,

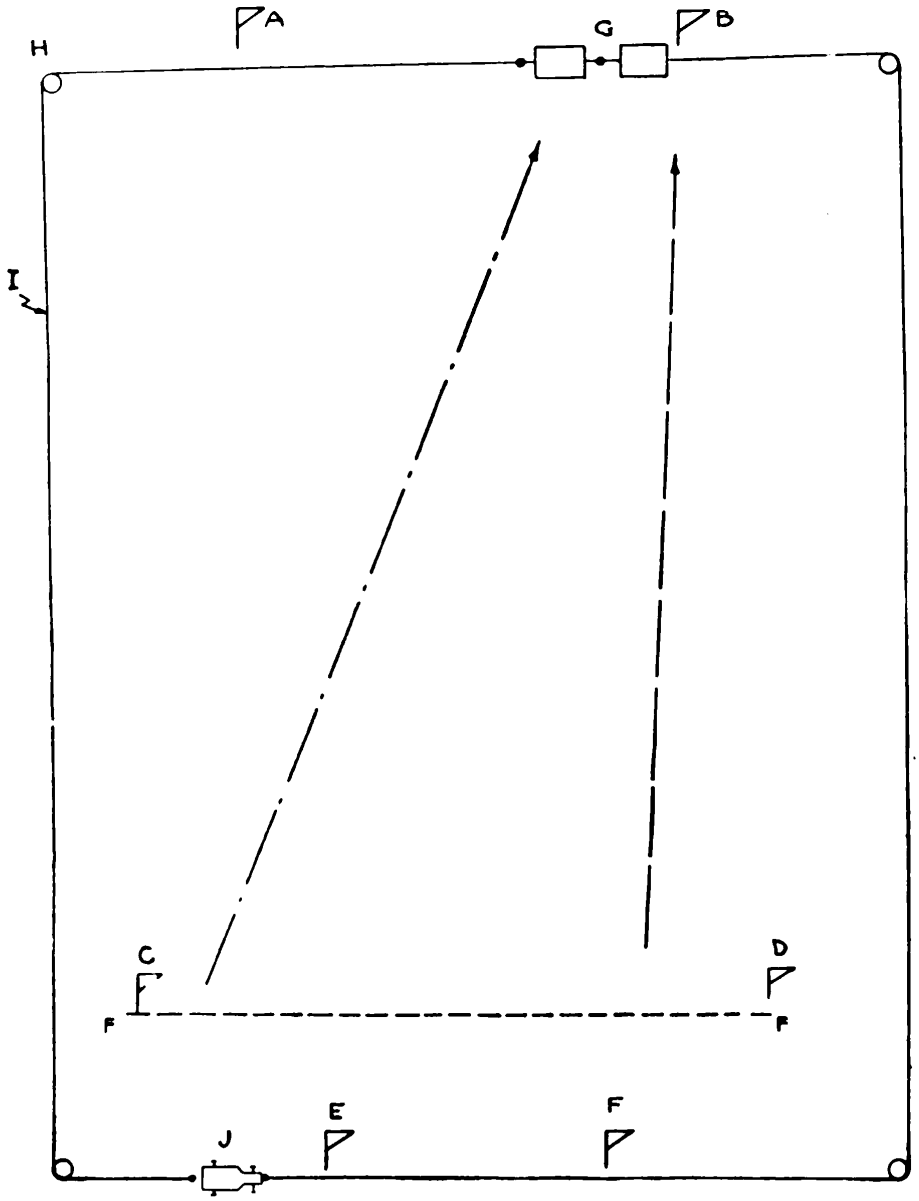


FIGURE 79.—Ground-towed-target range, towing vehicle in rear.

one end of the cable is attached to the target sled; the cable is then passed around a motor-operated drum, through one

pulley, under the sled, through the second pulley at the other end of the target course, and thence to the opposite end of the sled where it is tied. The target sled is moved back and forth along its course by the forward and reverse

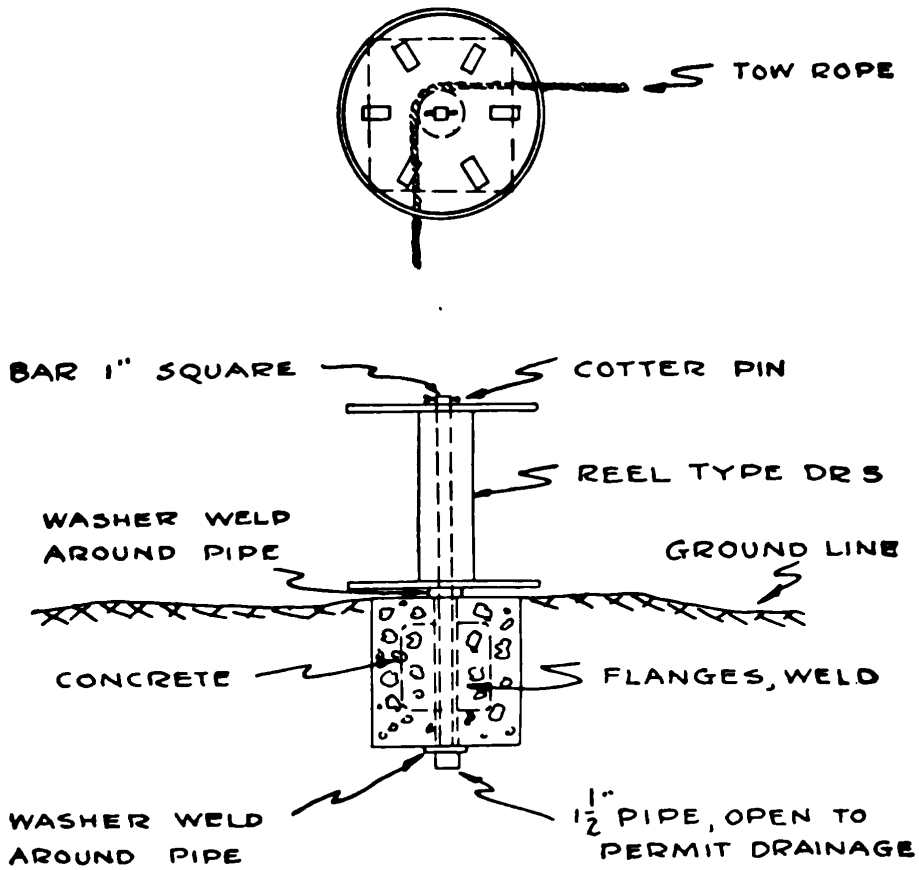


FIGURE 80.—Roadway drum, ground-moving-target range.

gears of a stationary motor which operates the drum. The targets should be detachable from the sled to facilitate scoring.

■ 254. ANTIAIRCRAFT FIRING (AR 750–10).—*a.* For effective training the lateral firing angle should not be less than 75°. The safety angles added on the right and left of the firing angle must be wide enough to cover the maximum lateral leads used, or firing must be stopped at an appropriate point inside the pertinent flank of the firing angle.

b. (1) Radio-controlled airplane target courses laid across a firing sector of 75°, on an arc from the firing line at ground distances of approximately 300 and 500 yards, require the

following lateral leads for a 10-foot airplane target traveling at the speeds and the vertical heights indicated.

Ground range (nearest 25 yards)	Altitude (nearest 25 feet)	Slant range (yards)	Lateral leads at 100 mph
275	350	300	6
475	475	500	10
300	800	400	8
500	675	550	12
300	1,200	500	10
475	1,100	600	13

NOTE.—A field of fire greater than a 75° sector may be used with the radio-controlled airplane target. However, safety on the firing line and the ground safety limits must govern the size of any sector used.

(2) Leads are computed, as shown in paragraph 163, to compensate for the actual speed, length, and height of the target.

c. Additional safety precautions.—(1) All firing is controlled by appropriate instructions, orders, and signals.

(2) (*a*) In training, the control of firing on nonoverhead targets is effected by fire orders which include the maximum and minimum lateral leads and the target-height elevation. Example:

HALFLOAD
RADIO-CONTROLLED (TOWED) TARGET FROM LEFT TO RIGHT
LEADS 15, 13, 15.
ELEVATION 2, 1, 2.
LOAD (as target is about to enter firing zone)
CEASE FIRING (as target leaves the ground sector of fire)
(Have assistant on the alert to stop each gunner by slapping his back.)
CLEAR GUNS

(*b*) For the overhead towed target, a fire order similar to the following will serve:

HALFLOAD
OVERHEAD, TOWED (RADIO-CONTROLLED) TARGET, FRONT TO REAR

LOAD (as the towing airplane is about 100 yards from the firing line)

COMMENCE FIRING (as the towing airplane is within 50 yards of the firing line)

CEASE FIRING (as the target is about 50 yards from the firing line)

CLEAR GUNS

(3) A gun on the firing line must not be pointed in the direction of the towing airplane.

(4) Should the towline break during the close passage of the airplane, all personnel lie flat until the danger of the dangling towline has passed.

(5) Two safety officers or noncommissioned officers assist the officer in charge of firing. One signals the arrival of the target within the firing angle and the other its approach to the exit flank.

■ 255. EXERCISES.—*a. No. 1.*—(1) *Purpose.*—To show trajectories.

(2) *Method.*—Fire a few tracer bullets over comparatively level ground at targets at suitable ranges, such as 300, 600, and 800 yards. Point out the flatness of the trajectories and the danger space.

b. No. 2.—(1) *Purpose.*—To show determination of the range by firing the gun.

(2) *Method.*—Mount the machine gun with the sight set at a range known to be at least 100 yards more or less than that of the target. Fire a burst or a string of shots with the gun on the target as to direction. By observation of strike or tracer, place the strike on the target by operating the traversing and elevating mechanism. Then, without disturbing the laying of the gun, adjust the sight leaf slide and the windage screw so that the line of aim is on the target at the point of strike. Announce the range for the gun to the target by giving the range set on the sight leaf. Explain that the windage correction is that necessary to zero the gun for direction or to compensate for the deflection of the bullet by the prevailing wind.

c. No. 3.—(1) *Purpose.*—To familiarize men with the 100-yard unit of measure for use in estimating distances by eye.

(2) *Method.*—Stake out previously, on diversified terrain, markers which will be visible up to 500 yards. Impress men with the appearance of the unit of measure at various ranges from the prone, crouching, and standing positions. To do this, move the men away from and in prolongation of the units staked out and cause them to study the appearance of the unit of measure from distances of 100, 200, 300, and 400 yards.

d. No. 4.—(1) *Purpose.*—To apply the unit of measure in estimating distance by eye.

(2) *Method.*—(*a*) Mark ranges up to 900 yards by placing large markers or target frames at every 100 yards of the distance, each marker bearing a number to indicate its range. Place the soldiers undergoing instruction about 25 yards to one side of the prolonged line of markers and have each man hold a blind beside his eyes so as to hide all the markers from his view. Then direct the men to apply the unit of measure three times along a straight line in the general direction, but slightly to one side, of the markers. Have the eye cover removed as soon as the man has applied the unit of measure to the ground the required number of times by mental process. Check the estimations of the successive 100-yard points and the final 300-yard point against the markers. Repeat the exercise to gain accuracy.

(*b*) Next use ranges over 300 yards. Have the men first determine the 300-yard range, then apply it as a unit to the total range. Stress the 300-yard point because of its use in the table of leads for moving ground targets, and the 900-yard point because of its use in the table of leads and because of its application to the gunner's rule for overhead fire.

(*c*) Require estimations from the prone, crouching, and standing positions.

e. No. 5.—(1) *Purpose.*—To give practice in range estimation after accomplishing exercises Nos. 3 and 4.

(2) *Method.*—From a suitable point, measure the range to objects within 900 yards. Conduct the men to the selected point and require them to write on paper their estimates of the ranges. Allow 30 seconds for each estimate with the men standing, sitting, and prone. Collect the papers and

announce the true ranges. Post individual and crew averages on a bulletin board accessible to all participants.

f. No. 6.—(1) *Purpose.*—To teach the recognition of distinct and indistinct targets in their logical locations under varying conditions of combat.

(2) *Method.*—(*a*) Select two or more pieces of terrain, suitable as infantry rifle company or battalion defense areas. One piece should be comparatively open and another covered with diversified vegetation and trees. Indicate several combat groups with prone silhouettes, and put at least four machine guns and two antitank guns with crews in their probable forward and rear locations. In one exercise have targets and guns indistinct by use of natural or artificial concealment.

(*b*) Have the gunners locate and point out the targets.

g. No. 7.—(1) *Purpose.*—To point out the military and topographical terms used in designating targets.

(2) *Method.*—Assemble the personnel undergoing instruction at a suitable point or points where the greatest number of terrain features and terms can be pointed out or applied. The use of set-ups for exercises Nos. 9 and 11 will add to the training in the meaning of military terms.

h. No. 8.—(1) *Purpose.*—To teach oral target designation.

(2) *Method.*—Use the set-up for exercise No. 7. Have each man designate various targets.

i. No. 9.—(1) *Purpose.*—To illustrate target designation by firing, and pointing a gun; and by using stakes.

(2) *Method.*—Use the set-up of exercise No. 2. Demonstrate the three methods and test the men in their use by having them convey the information pointed out by means of oral designation.

j. No. 10.—(1) *Purpose.*—To show the proper engagement of a point target.

(2) *Method.*—Set up silhouette targets at 300 and 600 yards. Fire for adjustment, then place a concentration of rapid single-shot fire on the targets using tracer or ball and tracer ammunition.

k. No. 11.—(1) *Purpose.*—To practice the delivery of fire in appropriate sequence on known targets within an area.

(2) *Method.*—Use comparatively open, level terrain with

several groups of appropriate field targets. First fire by gun, later by platoon.

l. No. 12.—(1) *Purpose.*—To illustrate methods of conducting a unit forward by covered routes, the use of cover, and orders for the occupation of the initial firing position.

(2) *Method.*—Use various types of terrain with limited cover. Place several groups of appropriate field targets. The initial targets are indicated to the platoon (section) leader. As soon as he determines the general location in which the guns are to be placed, he sends for the squad leaders and directs that the platoon (section) move forward to a location near by. Upon arrival of the squad leaders, the platoon (section) leader issues his order, assigning targets and position areas. Squad leaders reconnoiter for definite gun positions, conduct their units forward under cover, and issue orders for the occupation of the firing positions. The guns are placed in position.

m. No. 13.—(1) *Purpose.*—To demonstrate and practice the estimation of vehicle speeds, ranges, and leads.

(2) *Method.*—On a fairly level piece of ground, place the soldiers undergoing instruction so that they can observe vehicles moving on cross courses 300, 500, and 900 yards away, on oblique courses from respective far corners to opposite near corners and vice versa, and on a perpendicular course from front to rear and vice versa. Have a vehicle move over each course a sufficient number of times at speeds of 7½, 15, and 30 miles an hour. Initially, announce each speed prior to the run; later, diversify the runs and speeds unannounced. Stress the importance of estimating speeds, direction of movement, and ranges. Have estimates of unannounced speeds recorded and published as prescribed for exercise No. 5.

n. No. 14.—(1) *Purpose.*—To practice the delivery of fire on moving targets.

(2) *Method.*—See the suggested set-ups and procedures outlined in paragraph 139.

o. No. 15.—(1) *Purpose.*—To practice the determination of slant ranges to aircraft.

(2) *Method.*—Where an antiaircraft range is available, the cooperating airplane should fly at known distances from the men in order that the instructor may determine the

accuracy of the estimates. The distinguishable parts of the airplane should be pointed out at the various ranges.

p. No. 16.—(1) *Purpose.*—To practice the application of visual leads and elevations and to fire at sleeve targets.

(2) *Method.*—Use a range lay-out similar to that suggested in paragraph 250. First, conduct a sufficient number of nonfiring exercises in which the gunners estimate the ranges and apply appropriate leads and elevations by sighting along the top of the gun. Follow with controlled firing exercises.

q. No. 17.—(1) *Purpose.*—To teach the application of the gunner's rule in overhead fire.

(2) *Method.*—Set up, on diversified terrain, silhouette and screen targets at various ranges from 600 to 1,200 yards. Place flags to mark the assumed location of friendly troops at different distances between the gun position and the targets, with some locations safe and some unsafe for overhead fire. Require an understanding of the limiting 900-yard range, and have an adequate amount of firing on targets under 900 yards where the gunner's rule permits the fire.

r. No. 18.—(1) *Purpose.*—To teach the preparation of range cards and the use of the card in laying the gun.

(2) *Method.*—Place a gun in a defensive or outpost position. Designate points which may become targets. Show the method of preparing and require the preparation of the range card. Have the men apply the range card data to the gun and fire under the following conditions:

(*a*) Good visibility.

(*b*) Smoke on the target.

(*c*) Smoke on the gun position.

s. No. 19.—(1) *Purpose.*—To demonstrate the use of an auxiliary aiming point.

(2) Use a target set-up similar to that suggested in exercise No. 17. Determine sight settings and have fire delivered on several targets using auxiliary aiming points. Explain the method to men undergoing instruction.

BROWNING MACHINE GUN, CAL. .30, M1919A4, FIRING DATA FOR M2 BALL AMMUNITION

Range	AE	Tr Safe	Msk Clear	Drift Right	Center of impact moved by 1m search	Max ords	Beaten zones		Windage correction 10 mph at 3 or 9 o'clock	Antiaircraft	
							Appx. 1th.	Wth.		6′ plane target	47′ plane 300 mph
yd	m	m	m	m	yd	yd	yd	m	m	Heights	Leads
100	1	86	2	------	134	------	-----	-----	-----	0	1
200	2	44	3	------	118	------	-----	-----	-----	0	2
300	2	32	4	------	105	------	-----	-----	-----	1	4
400	3	27	5	.1	91	------	-----	-----	-----	1	5
500	5	25	6	.1	77	1	150	2	1	1	7
600	6	24	8	.2	65	1	-----	-----	-----	2	8
700	8	25	10	.2	56	2	-----	-----	-----	2	10
800	10	27	12	.2	48	2	-----	-----	-----	Troop Safety Zone Troops on or below line G–T	
900	12	31	14	.3	40	4	-----	-----	-----		
1000	15	35	17	.4	34	5	90	2	4		
1100	18	40	20	.5	30	7				Yd.	
1200	21	45	24	.6	26	9				500 to 700	
1300	25	51	28	.8	24	12				400 to 800	
1400	30	58	33	.9	21	16				300 to 1000	
1500	35	66	38	1.1	19	20	65	2	7		
1600	40	75	44	1.3	17	25				300 to 1100	
1700	47	86	50	1.5	15	31				200 to 1200	
1800	53	97	57	1.8	14	39				200 to 1300	
1900	61	111	65	2.2	13	47				200 to 1400	
2000	69	126	74	2.6	11	57	55	2	10	200 to 1500	
2100	79	144	85	3.0	10	68				RATES OF FIRE (per minute)	
2200	89	165	96	3.6	9	82					
2300	101	190	109	4.2	8	97					
2400	114	218	123	5.0	7	116					Rds. per
2500	128	252	139	5.8	7	137	75	2	13	Rds.	Bursts Burst
2600	144		157		6	163					
2700	162		178		5	193				S 40	10 3 to 5
2800	183		202		5	228				M 75	15 4 to 6
2900	206		230		4	270				R150	15 8 to 12
3000	233		262		4	320	110	2	18		

GUNNER'S RULE: RANGE TO TARGET 900 YARDS OR LESS.—(1) Lay on target with correct sight setting; (2) W/o disturbing lay, set sight at 1500; (3) Note point where new line of sighting strikes ground; (4) This point **must be beyond** feet of friendly troops for safe overhead fire.

LEADER'S RULE: RANGE TO TARGET GREATER THAN 900 YARDS.—(1) Lay on target with correct sight setting; (2) Select farthest point on ground believed safe; (3) Determine **accurately** range to selected point; (4) W/o disturbing lay, set sight at 1500 **or** range selected point plus 500 (600 for M1 sight) **whichever** is greater; (5) Note where new line of sighting strikes ground reference selected point; (a) If short, troops safe to sighting point plus; (b) If on, troops safe there; (c) If beyond, troops safe selected point plus; (6) Except (5) (b), to determine exact limit of safety, test new selected points.

AUXILIARY AIMING POINT: WITH GUN.—(1) Lay on target with sight setting to hit target; (2) W/o disturbing lay of gun, manipulate rear sight and windage until line of sight is on AAP.

WITH BINOCULAR.—(1) Aline on target graduation of inverted sight leaf scale which corresponds range to target; (2) Keep binocular in position; read graduation on scale opposite AAP and announce as range; (3) Measure deflection by horizontal mil scale and announce as deflection. If target is right of AAP, windage deflection is right, and vice versa.

MIL FORMULA: (Where M = AS, W = VI),

$$W = \frac{R \times M}{1000} \quad ; \qquad M = \frac{W \times 1000}{R}$$

COMPUTE SEARCH: (1) Estimate depth of target in yards. (2) Divide this by number of yards center of impact will be moved by 1m search for range to center of target.

NOTE: The letter m denotes mils.