U. S. Army Military History Institute

BASIC FIELD MANUAL

Volume III
BASIC WEAPONS

PART SIX

ANTIAIRCRAFT MARKSMANSHIP
INFANTRY WEAPONS

CHAPTER 2

RIFLE AND AUTOMATIC RIFLE

Prepared under direction of the
Chief of Infantry

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WAR DEPARTMENT,
WASHINGTON, *December 5, 1933.*

Chapter 2 (Rifle and Automatic Rifle), Part Six (Antiaircraft Marksmanship—Infantry Weapons), Basic Field Manual, Volume III (Basic Weapons), is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

DOUGLAS MACARTHUR,
General,
Chief of Staff.

OFFICIAL:

JAMES F. MCKINLEY,
Major General,
The Adjutant General.

FOREWORD

Basic Field Manual, Volume III, Basic Weapons, will be published in six parts as follows:

PART ONE. Rifle company. (Each chapter of part one will be published as a separate pamphlet.)

Chapter 1. Rifle marksmanship.
2. Automatic rifle marksmanship.
3. Automatic pistol marksmanship.
4. Instruction with the bayonet.
5. Instruction with hand and rifle grenades.
6. Musketry.

PART TWO. Fire-control instruments.

Chapter 1. Machine-gun instruments.
2. 37-mm. gun and 3-inch trench mortar instruments.
3. Care, repair, and adjustment of instruments.

PART THREE. Machine-gun company.

Chapter 1. Mechanical training with the machine gun.
2. Machine-gun marksmanship.
3. Technique of machine-gun fire.
4. Barrages and concentrations.

PART FOUR. Howitzer company.

Chapter 1. Mechanical training with the 37-mm. gun and the 3-inch trench mortar.
2. 37-mm. gun and the 3-inch trench mortar marksmanship.
3. Technique of fire of the 37-mm. gun and the 3-inch trench mortar.

PART FIVE. Combat practice firing.

Chapter 1. General.
2. Rifle company.
3. Machine-gun company.
4. Howitzer company.

PART SIX. Antiaircraft marksmanship—Infantry weapons.

Chapter 1. General.
2. Rifle and automatic rifle.
3. Machine gun, caliber .30.

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BASIC FIELD MANUAL, VOLUME III

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PART SIX

ANTIAIRCRAFT MARKSMANSHIP—INFANTRY WEAPONS

CHAPTER 2

RIFLE AND AUTOMATIC RIFLE

The matter contained in this chapter, together with that contained in chapter 1, supersedes TR 300-5, November 15, 1928.

SECTION I

GENERAL

1. **Scope.**—Methods of training in antiaircraft rifle marksmanship and general rules for the conduct of antiaircraft rifle practice are covered in this chapter.

2. **Tactical doctrine.**—Infantry must be fully trained and imbued with the determination to protect itself against hostile aerial attack without reliance on special units or other arms. Concentrated rifle and machine-gun fire is the Infantry's best protection against low-flying hostile air attack.

3. **Individual training.**—*a.* In order to become a good antiaircraft rifle shot the soldier must have completed preliminary instruction in rifle marksmanship, have fired one of the courses prescribed in chapter 1, part one, BFM, volume III, and must be thoroughly trained in the following:

(1) The rapid and accurate estimation of leads.

(2) The mechanical operation of tracking aerial targets and of firing with an estimated lead.

(3) The adjustment of antiaircraft fire from tracer observation.

b. The preparatory exercises and range firing exercises prescribed in this chapter are designed to train the soldier in the

three fundamentals enumerated above. Skill in antiaircraft marksmanship can only be developed by exact and thorough instruction in the prescribed preparatory exercises.

4. Methods of instruction.—Correct methods of instruction are essential in order to obtain the best results. Instruction must be progressive, explanations clear, and procedure as prescribed in section V, chapter 1, part one, BFM, volume III.

SECTION II

PREPARATORY EXERCISES

5. General.—*a.* The preparatory exercises constitute four distinct steps of training, each to be given in an appropriate period of time and in the following sequence:

(1) Position exercises.
(2) Aiming and leading exercises.
(3) Trigger squeeze.
(4) Aiming table exercises.

b. The preparatory exercises have a twofold purpose; to teach the correct way of doing each step and to provide drill in the correct method of execution until it becomes a fixed habit.

c. The importance of careful alinement of sights, correct trigger squeeze, and rapid manipulation of the bolt will be emphasized throughout all training.

6. Position exercises.—*a.* Firing positions are those which will correspond to the natural position the rifleman assumes quickly to fire on a hostile airplane appearing suddenly and unexpectedly. These positions will generally be standing, kneeling, or sitting with the rifle in the off-hand position and the arms free to swing in any direction. They will be the same as described in chapter 1, part one, BFM, volume III, with the following exceptions:

(1) The sling will not be used.
(2) The muzzle of the rifle is elevated.
(3) In the sitting and kneeling positions, elbows will not rest on the knees.

b. These positions may be modified to accommodate the position of the body when taking advantage of available cover such as ditches, shell holes, and tree stumps.

c. Position exercises should not be in the nature of a formal drill, but rather in the form of tactical exercises, assuming the

approach of a hostile airplane from an announced direction and requiring individuals to assume positions rapidly.

7. Aiming and leading exercises.—*a.* The purpose of the aiming and leading exercises is to teach the correct method of aiming and to develop skill in estimating leads, while swinging the rifle through the angle of fire on targets approaching or passing the rifleman from all possible directions.

b. The pupil, having been placed 1,000 inches from the aiming target, takes either the standing, kneeling, or sitting position as described in paragraph 6. The coach takes position in rear of the horizontal aiming target, holding the large end of the aiming silhouette at the intersection of the cross lines of the target as shown in figure 1. The pupil, using the battle sight, alines his sights on the rear end of the silhouette and swings his rifle through the center of and beyond the front end of the silhouette the required number of leads, keeping the aim on the projected line of flight.

c. The swing of the rifle is a steady, uniform motion. As the line of aim is swung through the silhouette a mental note is made of its length, which is then mentally applied as a unit of measure the required number of times in front of the silhouette. When the aim of the rifle has reached the point estimated as the required number of leads, it is held steady in this position and the pupil directs the coach to "move" the silhouette. The coach moves the silhouette along the assumed line of flight with a steady, uniform motion and, as the forward end of the silhouette intersects the line of aim, the pupil directs the coach to "hold." The coach holds the silhouette in place and, when directed by the pupil, moves it up or down, forward or backward.

d. When the silhouette is correctly placed with reference to the aim the pupil directs the coach to "mark" and the rifle is then brought down from the firing position. The coach makes a pencil mark on the target at the center of the forward end of the silhouette as shown in figure 2. This exercise is repeated three times; the three points thus made are joined by lines, forming the outline of a shot group. The pupil goes forward where the coach discusses the size and shape of the shot group and points out errors. The pupil then plots the shot group in the appropriate place on the score card.

e. The same procedure is followed in making shot groups on the oblique and vertical aiming targets.

f. A satisfactory group is one which is the proper number of leads in front of the target and is of such size that it can be covered by a disk 2 inches in diameter.

g. Each member of the unit undergoing instruction will be required to complete satisfactorily the exercises prescribed in table I.

TABLE I

Type of target	1 target-length lead	2 target-length leads	3 target-length leads
	Groups	*Groups*	*Groups*
Horizontal (right to left)	1	1	1
Oblique (left to right)	1	1	1
Vertical	1	1	1

h. After each man completes the above exercise, he will report to the platoon leader with his score card. The shot groups are examined and if the results of any part of the exercise are unsatisfactory that part of table I will be repeated. It is not essential that the sequence given in table I be followed. Work may be begun on any one of the three types of targets. Targets are reversed to permit the aiming and leading exercises to be carried out with leads in both directions.

i. In conducting the foregoing exercises the instructor will take such measures as may be necessary to insure that individuals do not pick out shadows or marks on the aiming target for use as an aiming point. It must be borne in mind that the preparatory exercises are a means to an end; that there will be no aiming point in front of an airplane; and that the length of the target is the unit of measure and must be applied at all times.

8. Trigger squeeze.—*a.* The most important item in antiaircraft marksmanship with the rifle and automatic rifle is to squeeze the trigger in such a way as to fire the rifle without affecting its steady and uniform movement. The trigger is squeezed exactly as when firing at stationary targets except that the rifle is in motion during the entire process.

b. The sights are alined on the rear end of the target and the rifle swung so that the line of aim passes through the target and along the projected line of flight a distance ahead of the target estimated to be the correct (or announced) target length lead, and *while maintaining this lead the trigger squeeze is continued until the cartridge is fired.* This is one continuous operation and is repeated for each shot fired, except when firing with an automatic rifle. With the latter weapon, the fire is continued as

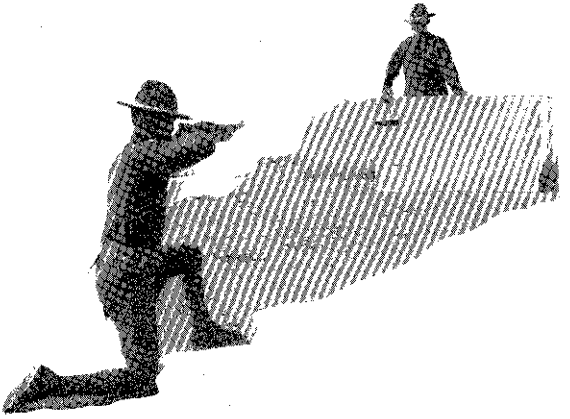


FIGURE 1.—Demonstration of the aiming exercise on the parallel target showing the correct firing position of the pupil, the position of the coach, and the initial point of the aiming silhouette.

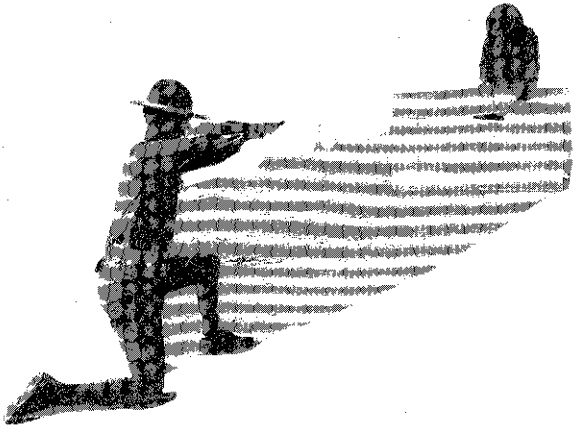


FIGURE 2.—Position of the silhouette after it has been moved to three leads. The coach is marking the point of aim.

long as the correct lead can be maintained, after which the operation is repeated.

c. There are no formal trigger-squeeze exercises.

9. Aiming-table exercises.—*a.* The purpose of the aiming-table exercises is to provide training and practice in estimating leads on aerial targets and to teach the mechanics of manipulating the rifle for antiaircraft fire. They provide not only a means of checking the soldier's estimate of leads but of impressing upon him the importance of the correct trigger squeeze and of the "follow through" after each shot.

b. The instructor explains the necessity for aiming the rifle an appropriate distance ahead of the target and in line with its direction of flight except when the target is at extremely close range or when it is moving directly toward or receding from the firer. He then explains how the trigger is squeezed, as described in paragraph 8, so that firing will be simulated when the estimated lead is reached. That the swing of the rifle is a steady, uniform motion and is continued a short distance beyond the point where the piece was fired. He will insure that the rifle is not loaded during this exercise.

c. (1) One man then takes a standing position at the rifle as shown in figure 5. Using the battle sight, he aims the rifle at the rear end of the target and swings the rifle through the center of the target and in front of it along the assumed path of flight of the target. As the line of sighting passes through the target a mental note is made of its length, which is applied as described in paragraph 7*c*. When the line of sighting intersects the assumed projected path of flight of the target at the required number of target lengths the trigger squeeze is completed without affecting the movement of the rifle. The coach records the accuracy of the estimated lead as shown by the indicator on the lead scale.

(2) The shot group is plotted on the diagram of the score card shown in figure 11. The method of procedure is as follows: The coach is seated at the aiming table where he may watch the indicator. He commands: ***Airplane, right to left, three leads, COMMENCE FIRING.*** At the command ***Commence firing*** the pupil swings his rifle as described above and squeezes the trigger so that the striker of the rifle will move forward when three leads have been obtained. The coach notes the location of the indicator at the time the striker of the rifle moves forward. He places a numeral "1" on the scoring diagram at a point this number leads in front of the target shown in the upper diagram of

the score card. (Fig. 11.) Each simulated shot is then plotted in a similar manner, five such shots forming a shot group. The same method is used for plotting the shots on the vertical target except that the vertical lead scale is used.

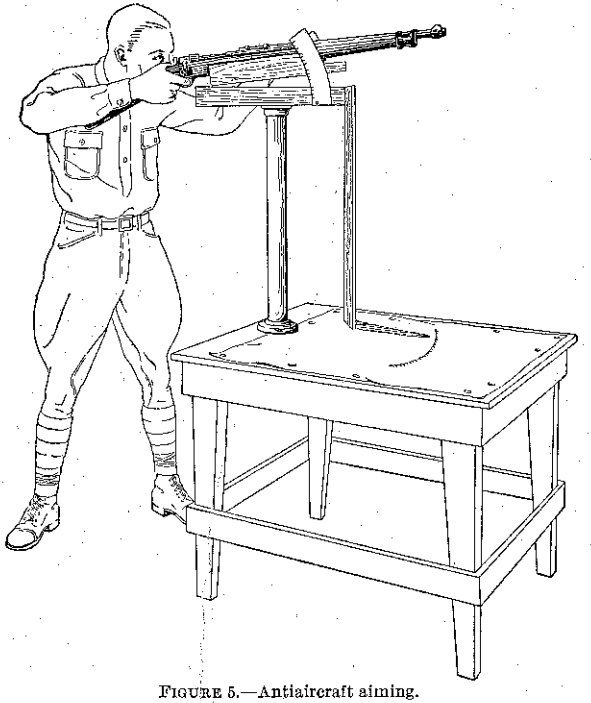


FIGURE 5.—Antiaircraft aiming.

d. Each member of the unit undergoing instruction will be required to satisfactorily complete the exercises prescribed in table II.

TABLE II

Type of flight	1 lead	2 leads	3 leads	4 leads	5 leads
	Shots	*Shots*	*Shots*	*Shots*	*Shots*
Right to left	5	5	5	5	5
Passing overhead	5	5			
Left to right	5	5	5	5	5

NOTE.—Each group of 5 shots should be fired in 30 seconds.

e. During these exercises the pupil is carefully watched to assure a steady, uniform motion of the rifle carried through a short distance beyond the estimated lead and to see that the trigger is squeezed as the rifle swings.

f. The shot group made with the aiming table represents the dispersion of the bullets in the vicinity of the target and indicates the accuracy of fire and skill in estimating leads. The size of the shot group should not be larger in diameter than the length of the target as represented on the lead scale; the center of the group should be at the announced lead in front of the target.

SECTION III

RANGE PRACTICE

10. General.—*a.* Range practice consists of firing on stationary and moving targets on the 1,000-inch range with the .22- or .30-caliber rifles. This is followed whenever possible by towed-target firing.

b. The same rules and regulations prescribed in chapter 1, part 1, BFM, volume III, will apply to the range practice prescribed herein insofar as they are applicable.

c. All ranges and range facilities will be carefully inspected by the officer in charge of firing prior to range practice to insure that targets are carefully and accurately prepared; that moving targets function smoothly and at the correct speed, and that equipment is adequate for the number of men firing.

d. Prior to firing, all rifles will be carefully targeted for 1,000-inch range firing.

e. The range firing will begin at the conclusion of the preparatory training prescribed in section II.

11. Safety precautions.—*a.* Firing will not begin on any range until the officer in charge so indicates.

b. No person will be allowed in front of the firing point until directed by an officer who has ordered all guns unloaded and bolts opened.

c. At the command ***Mark targets,*** the firing order, scorers, and target pasters move forward to the targets. After targets are scored and holes pasted the entire group returns to the firing point.

d. Rifles will not be loaded in rear of the firing line.

12. Stationary targets.—*a.* The purpose of firing on stationary targets at 1,000 inches is to give practice, and record individual skill, in firing with an announced lead which must be estimated as the rifle is swung in the path of assumed flight of the target.

b. The practice consists of four exercises fired on each of three types of stationary targets. In each exercise the rifleman aims at the rear end of the silhouette, then swings the rifle along the path of assumed flight, mentally applying the length of the silhouette the required number of leads, and squeezing the trigger as the rifle is swung so that the cartridge will explode the instant the correct lead is reached. The firing of each round is one smooth, continuous operation.

13. Moving targets.—*a.* The purpose of firing on moving targets at 1,000 inches is to give practice, and record individual skill, in estimating lead and firing on a target representing an airplane in flight.

b. (1) The practice consists of one exercise on each of three types of moving targets.

(2) The speed of the targets is regulated to correspond to the apparent speed of an airplane traveling 100 miles per hour at a range of 1,000 feet; thus, a shot fired from the .22-caliber rifle with a lead of one silhouette length will strike in the silhouette.

(3) As the velocity of the .30-caliber bullet is much greater than the .22-caliber bullet, a shot fired with the .30-caliber rifle aimed at the leading edge of the silhouette will strike in the forward half of that target.

(4) The battle sight is used with the service rifle.

14. Course to be fired.—Tables III and IV will be fired at least once with the .22-caliber rifle. Table IV will be fired once with the .30-caliber rifle whenever range facilities and ammunition allowances permit. Any one of the positions prescribed in paragraph 6 is authorized for all types of firing.

TABLE III.—*Stationary targets*

Target	At nose of target	1 lead	2 leads	3 leads
Horizontal (left to right)	5 shots, 30 seconds.	5 shots, 30 seconds.	5 shots, 30 seconds.	5 shots, 30 seconds.
Oblique (right to left)	do	do	do	Do.
Vertical	do	do	do	Do.

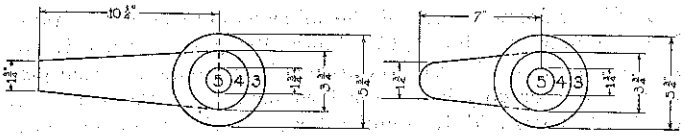
TABLE IV.—*Moving targets*

[Range, 1,000 inches]

Targets	Number of shots
Horizontal (right to left) [1]	5 shots (1 shot per passage of target).
Horizontal (left to right) [1]	Do.
Vertical [2]	Do.

[1] Speed of target, 11 feet per second. [2] Speed of target, 7 feet per second.

15. Scoring.—*a. Stationary target.*—The target will be scored by superimposing the scoring diagram shown in figure 6 over the target and recording the value of each shot which falls in a concentric circle. A score of 5 points is given to shots of the highest value.



① For parallel and oblique targets. ② For vertical targets.

FIGURE 6.—Scoring diagrams.

b. Moving target.—Each hit in the black silhouette will be given a score of 5 points; hits outside of the black silhouette are misses and are not scored.

SECTION IV

TOWED-TARGET FIRING

16. General.—*a.* Towed-target firing is the final phase of antiaircraft marksmanship.

b. It consists of firing with .30-caliber ball ammunition at a sleeve target towed by an airplane at various speeds, altitudes, and ranges, and on varied courses.

c. Towed-target firing should not be undertaken until the marksmanship training prescribed herein has been successfully completed.

17. Authority.—Corps area or department commanders will designate the troops within their respective corps area or department to fire on towed targets.

18. Requirements.—The requirements in ammunition, sleeve targets, and flying hours for towed-target missions will be computed from the following information:

a. Personnel to fire.—Whenever time, ammunition, towing facilities, and range are available, all officers and enlisted men of infantry organizations should be authorized to fire all or part of the towed-target missions prescribed in table V.

b. Ammunition.—The maximum requirements in .30-caliber ball ammunition for firing any one of the missions prescribed in table V are as follows:

Per rifle: 5 rounds of tracer, 15 rounds of ball.

Per automatic rifle: 15 rounds of tracer, 45 rounds of ball.

c. Sleeve targets.—The sleeve targets required in towed-target firing are furnished by the Air Corps unit performing the air mission. After the hits are scored, the targets are returned to the Air Corps unit.

d. Flying hours.—Each of the missions enumerated in table V will require a total of 15 minutes flying time, exclusive of flying time from the airdrome to the firing range, for each platoon to fire, or 45 minutes for 1 company of 3 platoons, or a total of 2 hours and 15 minutes for the 3 rifle companies of a war-strength battalion.

19. Firing unit.—The rifle platoon is the most suitable and economical unit for towed-target firing. However, when the size of the company does not exceed 50 men, the entire company may fire as a unit.

20. Range.—The towed-target range should consist of an area sufficiently extensive to accommodate a firing line of 50 skirmishers. The firing must be done within a ground angle of fire of at least 75°. This range will be in accordance with the requirements prescribed in TR 140-5.

21. Instructions to pilots for towing missions.—*a.* Antiaircraft rifle practice demands not only a thorough preparation of all details connected with towed-target firing but calls for the closest cooperation between the pilot of the towing plane and the officer in charge of the firing.

b. The air mission for towed-target firing should be carefully and specifically stated. The commanding officer requesting planes for towed-target firing should furnish in writing to the Air Corps unit commander concerned the following information:

(1) The place of firing.

(2) The date and hour of firing.

(3) The number of missions to be flown, altitude, course, and number of runs for each.

(4) The location of the firing line with relation to ground angle of fire.

(5) The ground signals to be used.

(6) A map of the firing area with the ground angle of fire, firing line, and course of each mission plotted thereon.

(7) The length of towline. (See TR 140-5.)

(8) The number of sleeve targets to take up on each flight.

(9) The location of the dropping grounds for dropping targets and messages.

c. The courses over which the airplane is to be flown should be distinctly marked on the ground, within the angle of fire only. Machine-gun targets placed flat on the ground about 30 feet apart or strips of target cloth are suitable for this purpose.

d. Whenever practicable to do so, the officer in charge of the firing will go over the ground with the pilot and point out to him the location of the firing line, the safety angle, the dropping grounds, and ascertain the speed at which the airplane towing the target will be flown.

22. Course to be fired.—One or more of the missions enumerated in the following table will be fired by each platoon authorized to fire:

TABLE V

Type of flight (course)	Average approximate slant range (yards)	Altitude (feet)	Speed (miles per hour)	Number of flights
Parallel to firing line	500	Varying from 100 to 500.	Maximum possible.	[1] 4
Oblique to firing line	300	do	do	[1] 4
Approaching firing line	800–100	do	do	4
Maneuvering	To be flown within the angle of fire at the discretion of the pilot but unknown to the firing line.			1–4
A combination of the parallel and approaching flight.	The target will be towed in a figure 8—that is, once across the front in parallel flight, then approaching the firing line and passing overhead. This course to be repeated the number of times specified for the firing.			1–4

[1] Runs alternating from right to left and left to right.

NOTE.—When the ammunition authorized is sufficient for the firing of only one mission per platoon, the combination parallel and approaching flight mission is recommended. All firing will be done with battle sight.

23. Safety precautions.—*a.* The rules, regulations, and safety precautions prescribed in TR 140-5 for towed-target firing will be strictly adhered to.

b. At least two safety officers will be designated to assist in controlling the fire on the firing line.

c. Whenever a towing cable is cut during an overhead passage of the plane, all men engaged in the firing as well as all spectators will be required to lie flat on the ground until the end of the cable which is dragging on the ground has passed beyond the point where there is any danger of injuring anyone.

d. All men on the firing line will be cautioned not to aim the rifle at or ahead of the towing plane at any time.

24. Procedure on the firing line.—The unit to fire is deployed as skirmishers at about two-pace intervals on the firing line. The officer in charge of firing announces the number of leads, the direction from which the target will approach, and gives the command ***Load*** on the approach of the target. One of the safety officers stationed at the opposite end of the firing line from which the target approaches gives a whistle or other signal ***Commence firing,*** as the sleeve target enters the ground angle of fire as observed from his position. All firing ceases on a similar signal from the safety officer stationed at the other end of the firing line. The signal ***Cease firing*** is given as the sleeve target leaves the ground safety angle as observed from the position of this safety officer. The officer in charge of firing watches the strike of the tracers and for the next run of the target announces such changes in the number of leads as, in his judgment, will increase the number of hits.

25. Scoring.—The number of hits made on a target is arrived at by dividing the number of bullet holes in the sleeve target by two.

26. Analysis of firing.—*a.* The officer in charge of the towed-target firing will record the number of hits, rounds of ammunition expended, and actual time of firing for each mission fired. From these data he will compute the percentage of hits and the number of hits per rifle per minute.

b. These results should be analyzed and carefully studied. If the number of hits fall below the number expected, the reason for this should be sought and explained to the men. On the other hand, when the results are satisfactory, the men should be impressed with the value of the rifle as an antiaircraft weapon. In other words, the results attained must be used as a means of

dispelling the fear of air attacks, and at the same time of building up that confidence in the infantry's ability to cope with hostile aircraft.

SECTION V

TARGETS, RANGES, AND EQUIPMENT

27. Equipment.—The following equipment is required for the training of a class not exceeding six squads:

One antiaircraft aiming table.
Two horizontal aiming targets.
Two oblique aiming targets.
Two vertical aiming targets.
Two horizontal firing targets.
Two oblique firing targets.
Two vertical firing targets.
Four horizontal aiming silhouettes, with handle.
Two vertical aiming silhouettes, with handle.
One score card per man.
Six caliber .22 rifles, with AA rear sight aperture.

NOTE—Springfield rifles may be used for the aiming exercises.

28. Aiming targets.—The aiming target consists of a machine-gun target pasted on the 5- by 3-foot machine-gun target frame. The blank side of the target is exposed. At the upper left end and the lower left end heavy cross lines are drawn as shown in figure 7. Two light pencil lines are drawn across the

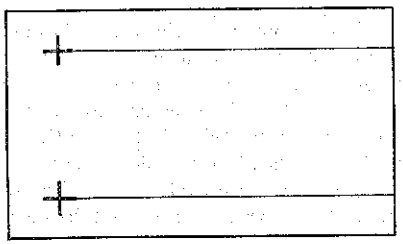


FIGURE 7.—Aiming target.

target from the intersection of the cross lines and parallel to the upper edge of the target. These lines represent the direction of flight but should not be visible from the firing line. On this line mark off distances equal to 1, 2, and 3 target lengths from the intersection of the cross line.

29. Aiming silhouette.—The aiming silhouette for use in the aiming exercises is made from any suitable material according to the details given in figure 8.

30. Aiming table.—*a. Description.*—This table is made according to the details given in figure 9. The essential features of the table are the revolving mount for the rifle and the scales for recording the leads.

b. Target.—The target for the aiming table is made of a piece of target cloth about 4 feet wide and 15 or 20 feet long. The target cloth is tacked on the side of a tower or building with its length parallel to the ground and in such a way as to face the aiming table. The full length of the target is used as a unit of measure for estimating horizontal leads. The width of the target cloth will be used as the length of the target when estimating

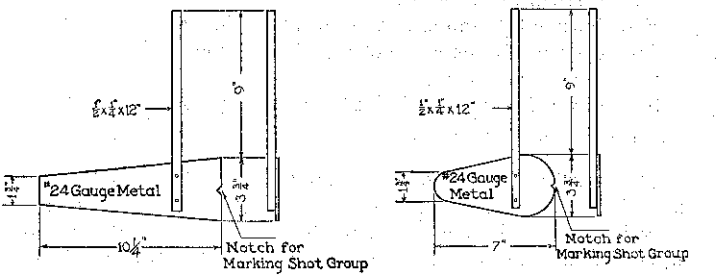


FIGURE 8.—Aiming silhouette.

vertical leads. For indoor work the target is made proportionately smaller and tacked on the wall of the room about midway between the floor and the ceiling. For outdoor work, if a tower or tree is suitable, it will not be necessary to use the target cloth. When this training is conducted out of doors the target is placed 100 or more yards from the aiming table and sufficiently above the skyline so that the firer has no reference point to assist him in estimating leads. The target is assumed to be moving in the indicated direction.

c. Construction of lead scales.—With the target in place and the aiming table set up where the training is to be done, the instructor constructs the lead scales as follows:

(1) *Horizontal scale.*—A piece of ordinary drawing paper is tacked to the top of the table. The rifle is placed in the bracket as shown in figures 5 and 9 and the sights alined on one end of

the target. With the rifle held in this position the table is adjusted so that the indicator is approximately equidistant from the right and left edges of the table. A pencil dot is then made

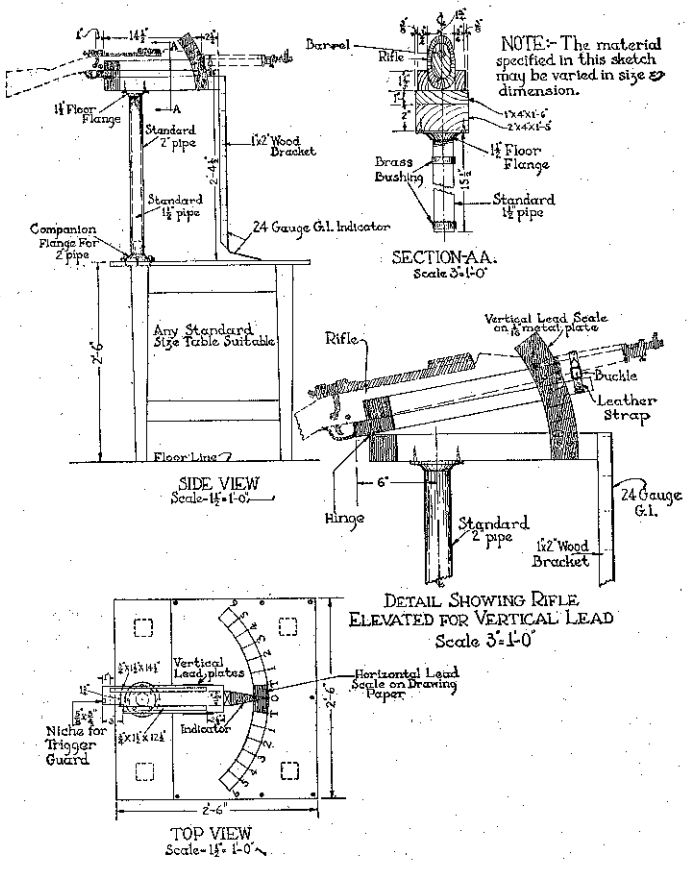


FIGURE 9.—Antiaircraft aiming table.

on the drawing paper at the end of the indicator and the sights alined on the other end of the target. A second pencil dot is placed on the paper. The distance between the two dots represents the length of the target or the unit of measure, as

represented on the lead scale. Then with the pencil point bearing on the paper and held at the point of the indicator, describe an arc by revolving the gun bracket. With a pair of dividers, space the length of the target as represented by the two dots; step off a number of equal spaces on this arc. Then complete the scale by adding the letters and numerals as shown in "Top view" in figure 9. When the scale is completed, it is readily seen that the distance from 0 to T represents the length of the target; that the distance from T to 1 represents one lead; and from T to 2 two leads, etc.

(2) *Vertical scale.*—The vertical scale is constructed on the vertical lead plates as shown in figure 9 in a manner similar to that used in making the parallel scale. The under side of the gun bracket is used as the indicator for reading the vertical leads.

31. Range for aiming exercises.—This range is for the purpose of carrying out the preparatory exercises described in

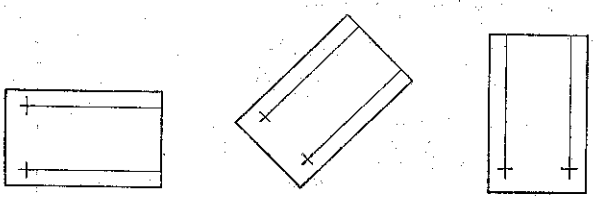


FIGURE 10.—Aiming targets.

section II. Any number of targets may be used on this range to correspond with the size of the class. The firing line is directly in front of these targets and 1,000 inches away. The targets are firmly braced so as not to permit any movement when the aiming silhouette is moved from the cross lines over the face of the target. The aiming targets are arranged on the range as shown in figure 10 so as to represent various types of flight.

32. Score cards.—The score cards used in the preparatory exercises and range firing are shown in figures 11 and 12.

33. Firing targets.—The firing target consists of a machine-gun target pasted to the 5- by 3-foot machine-gun target frame. The blank side of the target is exposed. Two black aiming silhouettes are pasted on the left end of the target as shown in figure 13. Two light pencil lines are drawn from the silhouettes and parallel to the upper edge of the target. These lines represent the direction of flight but should not be visible from the

firing line. On this line mark off distances equal to 1, 2, and 3 target lengths from the silhouette. The black aiming silhouettes are cut from old target centers. The silhouettes for the hori-

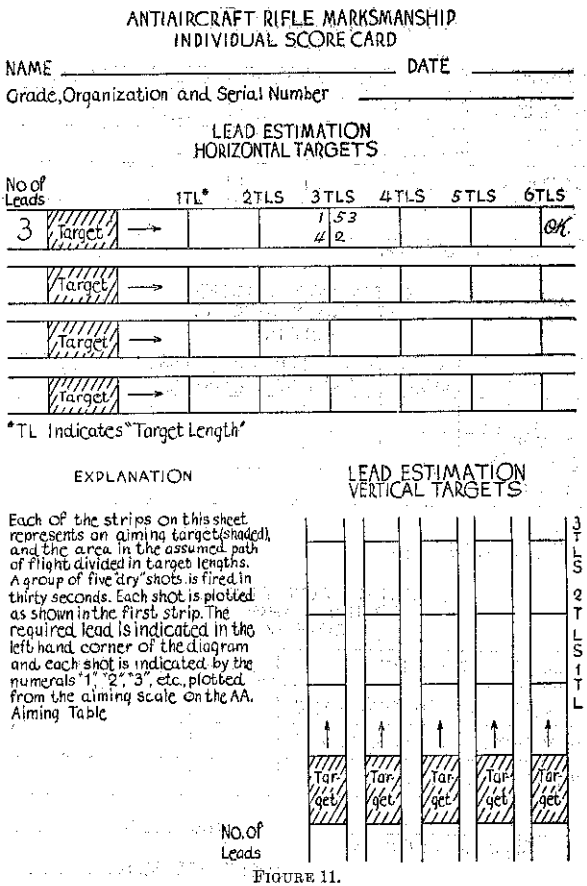


FIGURE 11.

zontal and oblique targets are 10¼ inches long, 1¾ inches wide at one end, and 3¾ inches at the other end. The silhouettes for the vertical targets are 7 inches long over all; the small end is cut to a radius of seven eighths inch and the large end to a

radius of 1⅞ inches. The firing targets are arranged on the range as shown in figure 13 so as to represent various types of flight.

AIMING EXERCISES
TABLE I

TARGET	1TL Lead	2TL Leads	3TL Leads	COACH
HORIZONTAL				
OBLIQUE				
VERTICAL				

Signature of Officer

INSTRUCTION FIRING
STATIONARY TARGETS
TABLE III

TARGET	At Target 5 Shots 30 Seconds	1TL Lead 5 Shots 30 Seconds	2TL Leads 5 Shots 30 Seconds	3TL Leads 5 Shots 30 Seconds	SCORE
HORIZONTAL (left to right)					
OBLIQUE (right to left)					
VERTICAL					

TOTAL SCORE _____

Signature of Officer

INSTRUCTION FIRING
MOVING TARGETS
TABLE IV

DIRECTION OF FLIGHT	22 Caliber	30 Caliber	TOTAL
HORIZONTAL 5 Shots (left to right)			
HORIZONTAL 5 Shots (right to left)			
VERTICAL 5 Shots			

TOTAL SCORE _____

Signature of Officer

AGGREGATE SCORE _____

FIGURE 12.

34. Target ranges.—*a. Stationary target range.*—The range for firing on stationary targets as required in section III may be set up at any convenient place for small-bore firing. The tar-

gets are arranged as shown in figure 13. The number of targets is increased to suit the size of the class. The firing line is 1,000 inches away.

b. Moving target range.—The moving target range consists of moving targets, each one of which is so constructed, arranged, and operated as to represent an airplane in flight. The following is a description of the targets representing the two principal types of combat targets:

(1) *Horizontal moving target.*—The horizontal moving target group consists of a 1,000-inch machine-gun target carrier and a track. The track is 74 feet long and laid parallel to the firing line and at a range of 1,000 inches. The extremities of the track are raised 5 or 6 feet so that the carrier is moved by gravity at the required speed. A flag or other marker is placed 15 feet from each end of the track. As the carrier passes between these two markers it should have a speed of 11 feet per second. A machine-

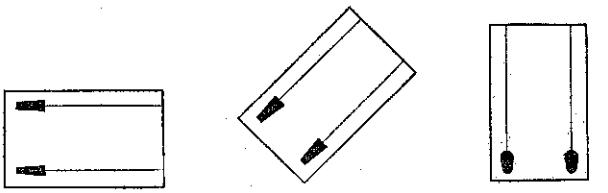


FIGURE 13.—Arrangement of firing targets.

gun target is placed on the carrier as shown in figure 14. The target is fired at as it passes between the markers. When the range facilities are limited, a backstop will be constructed in rear of this target. The carrier is operated by man power by means of ropes and pulleys. A ¼- or ½-inch rope is attached to one end of the carrier and then passed through a pulley at the extremity of the track. To fire at the target going in the opposite direction the rope is attached to the other end of the carrier. The carrier is pulled to the top of the inclined part of the track and when released moves by gravity. The ends of the track are raised or lowered so as to give the carrier the required speed of 11 feet per second as it passes between the markers. Full details of this target are given in figure 14.

(2) *Vertical moving target.*—The vertical moving target consists of two 40-foot poles with two cross arms and guide wires attached to the arms so that a 3- by 5-foot target frame can be

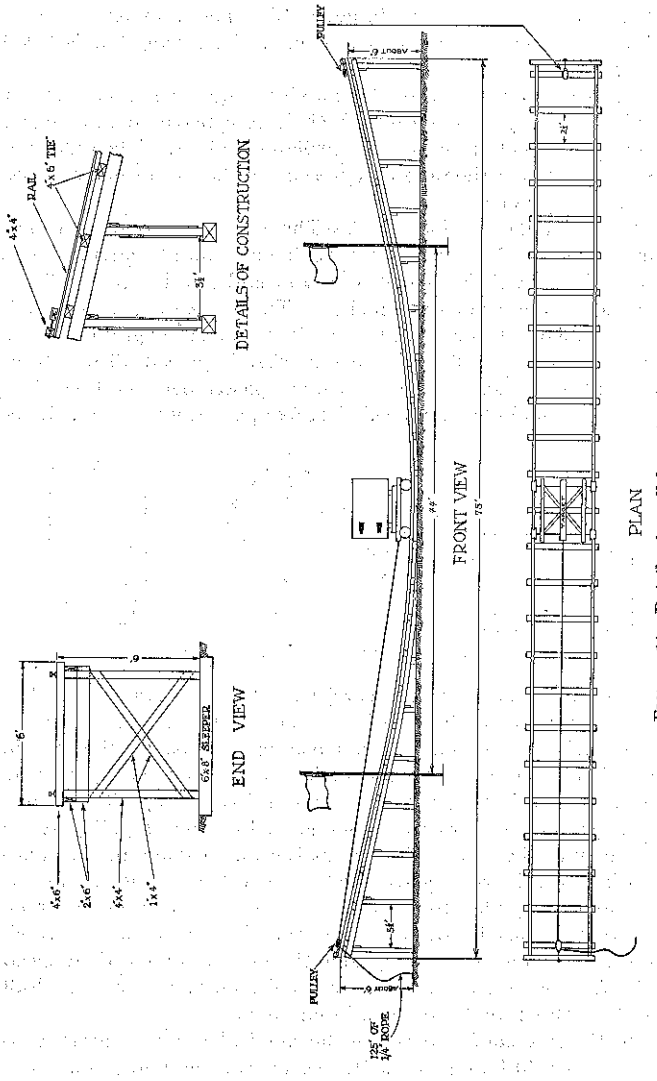


FIGURE 14.—Details of parallel moving target.

raised and lowered a distance of 30 feet. Wire loops attached to the four corners of the target frame keep the target in proper alinement and at the same time allow it to be easily pulled upward. The lifting device consists of a guy wire stretched from the top cross arm to a convenient anchorage near the foot of the poles so that the guy wire is nearly vertical. A weight, consisting of a 4-foot piece of 3-inch cast-iron pipe, is slipped over the guy wire before the latter is drawn taut; a bolt is installed in the top of the pipe and to this a rope is attached which passes through a pulley on the top cross arm and down from it to the target frame; another rope attached to this bolt and passed through a second pulley on the top cross arm is used to raise the counterweight and release it when desired. The upward speed of the target frame is easily regulated by varying the height of the counterweight before releasing it, or by varying the weight of the counterweight. The vertical silhouette on the target represents a target approaching the firer so as to pass overhead. The speed of the vertical target should be 7 feet per second, thus making the difference in the point of aim and the strike of the bullet approximately 7 inches, or one target length. This target is shown in detail in figure 15.

35. Plan of range.—A suggested arrangement of targets and equipment for an antiaircraft rifle range is shown in figure 16.

SECTION VI

ADVICE TO INSTRUCTORS

36. Theory.—*a.* This section describes the theory of antiaircraft marksmanship and the practical application of rifle and automatic rifle fire on hostile aircraft.

b. In order to hit a rapidly moving target, such as an airplane in flight, it is necessary to direct the aim of the weapon an appropriate distance ahead of the target and in line with its direction of flight so that the target and bullet will meet in space. This holds true for all firing except when the target is at extremely close range or when it is diving toward or receding from the gunner, when the aim is directed at the target without lead.

37. Leads.—The distance of the aim ahead of the moving target is called the "lead" and as used in this manual denotes one or more target lengths.

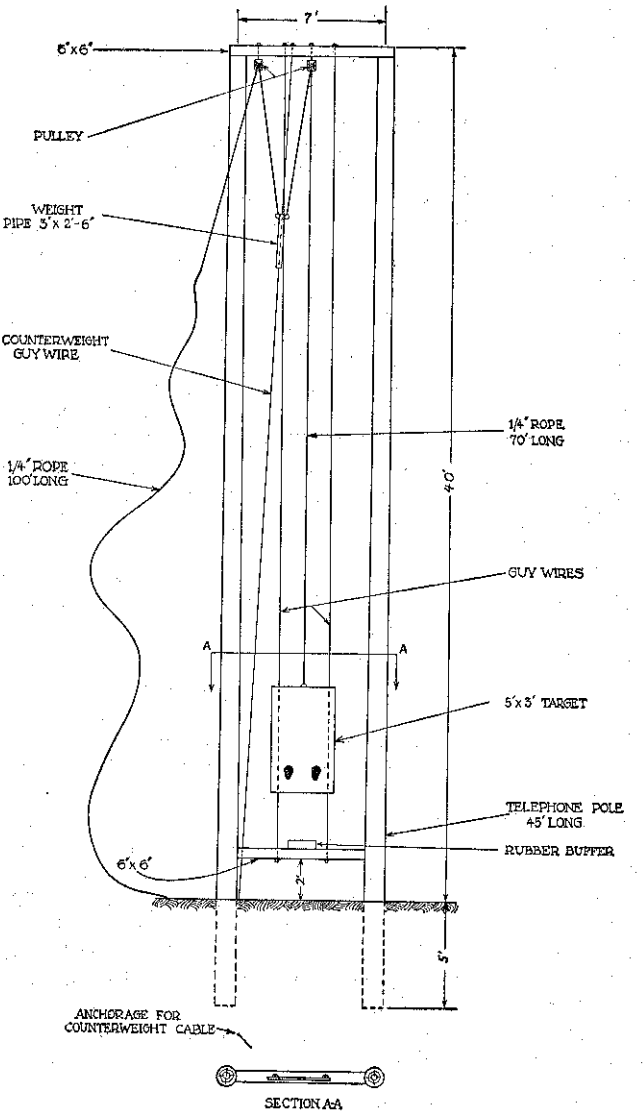


FIGURE 15.—Details of vertical moving target.

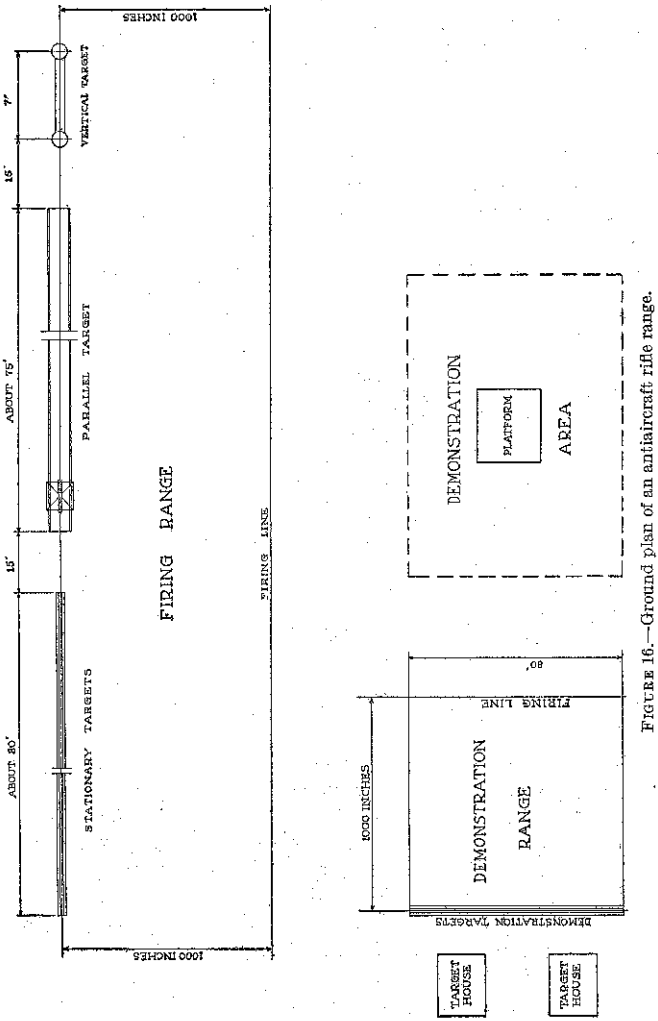


FIGURE 16.—Ground plan of an antiaircraft rifle range.

38. Application of fire.—*a. General.*—Antiaircraft rifle firing resembles duck shooting to a marked degree, and, like duck shooting, skill in estimating leads and accuracy of fire are developed by practice and experience.

b. Mechanical operation.—The soldier must be taught to perform with precision the following three distinct mechanical operations in firing at aerial targets:

(1) Rapidly elevating the rifle to the proper angle so that the line of aim intersects the target.

(2) Swinging the rifle with and ahead of the target to the estimated lead.

(3) While maintaining the correct lead and elevation, to squeeze the trigger until the cartridge is fired.

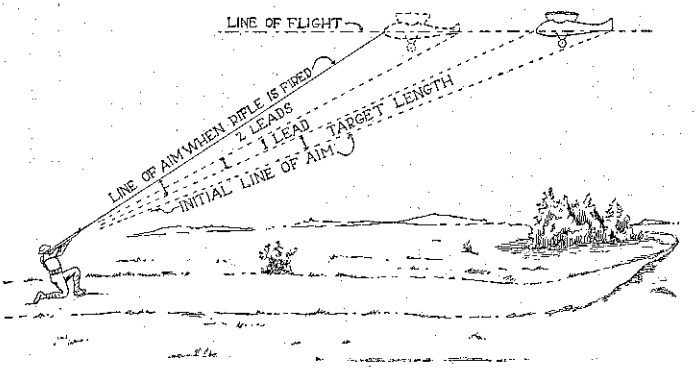


FIGURE 17.—Airplane passing vertically overhead. (Soldier swings his rifle with and ahead of target two leads and fires.)

c. Determination of leads.—The speed of the target, the range, and the time of flight of the bullet are factors which determine the lead to be used. The range to the target is the distance from the muzzle of the rifle to the target, and, since the target is constantly moving, the range and therefore the lead are constantly changing. However, due to the small increment of each change and the rapidity with which they occur, a lead based on the average range for the time of firing has been found to be sufficiently accurate to insure the largest percentage of hits and is immeasurably simpler than changing the lead for each shot. The lead for any range and speed of target is the same, no matter what the direction of flight with reference to

the firer. The following table of leads is computed on the basis of a 30-foot sleeve target moving at a speed of 100 miles per hour:

Average range in yards	Lead in target lengths
100	2
200	2
300	3
400	4
500	5
600	6
700	7
800	8

Such a table may be computed for the known speed of any hostile aircraft. In using lead tables the average of the range at which fire is opened and range at which it is expected the target will pass closest to the firer should be used.

d. Opening of fire.—Fire should be opened at the maximum range of approximately 800 yards and continued as long as the target is within that range. All firing is done with the battle sight.

e. Tracer ammunition.—(1) *Use.*—Tracer ammunition mixed with ball in the proportion of one to four (one round of tracer in each clip) will generally be used for antiaircraft fire.

(2) *Adjustment of fire.*—Tracer ammunition fired at aerial targets appears to curve laterally as it approaches the target. At ranges of 300 yards and over, the apparent curve made by the projectile gives the impression that the target is being struck when the bullet is passing in rear of the target. This must be taken into account when adjusting fire from observation. The apparent strike of the tracers should be ahead of the target one target length, *at ranges of 300 yards and over*, in order to obtain the maximum fire effect.

39. Fire control.—A hostile air attack is of such short duration, from 10 to 20 seconds, that adjustment of fire must be made by individual riflemen. The leader must note the fire effect of his unit from observation of the tracer ammunition and in his fire order for subsequent attacks allow for errors noted in the previous attack.

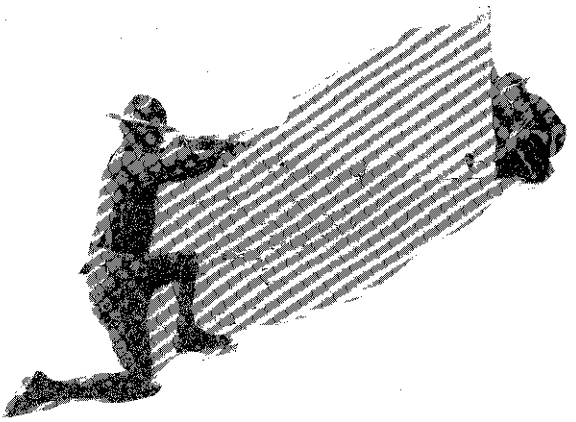


FIGURE 3.—Demonstration of the aiming exercise on the vertical target, showing the correct firing position of the pupil, the position of the coach, and the initial position of the aiming silhouette held by the coach.

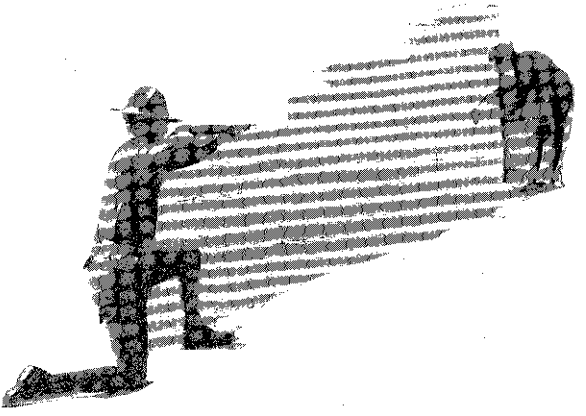


FIGURE 4.—Position of the silhouette after it has been moved to three leads. The coach is marking the point of aim.

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