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FM 4–106

WAR DEPARTMENT

ANTIAIRCRAFT ARTILLERY FIELD MANUAL

EMPLOYMENT OF ANTIAIRCRAFT SEARCHLIGHTS AND THE AAAIS

30 June 1943

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

TABLE OF CONTENTS

	Paragraphs	Page
CHAPTER 1. General.		
SECTION I. Mission	1	1
II. Characteristics of searchlights and detectors	2–6	1
III. Units	7–10	2
CHAPTER 2. Employment with fighter command.		
SECTION I. Fighter-searchlight team	11–15	4
II. Disposition of searchlights	16–18	6
CHAPTER 3. Employment with guns and automatic weapons and other uses.		
SECTION I. Employment with guns	19–21	22
II. Employment of spread beam	22–31	24
CHAPTER 4. AAAIS and AAA operations room.		
SECTION I. General	32	32
II. Communications	33–38	32
III. AAA operations board	39–40	37
IV. Personnel and operations of AAA operations board	41–47	41
V. Personnel and operations of AAA operations room	48–59	48
CHAPTER 5. Tactical control of searchlights.		
SECTION I. General	60–62	54
II. Tactical operations	63–68	57
CHAPTER 6. Reconnaissance, selection, and occupation of positions.		
SECTION I. General	69–74	81
II. Group reconnaissance	75–76	82
III. Battalion reconnaissance	77–83	83
IV. Searchlight battery reconnaissance and occupation of positions	84–89	85
CHAPTER 7. Security and protection.		
SECTION I. General	90–92	90
II. Camouflage and concealment	93–105	90
III. Cover	106–109	94
IV. Local security	110–116	96
CHAPTER 8. Supply and evacuation.		
SECTION I. Supply	117–124	99
II. Evacuation	125–127	101
CHAPTER 9. Estimates, plans, and orders.		
SECTION I. Estimates and plans	128	103
II. Field orders	129–135	103
INDEX		108

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EMPLOYMENT OF ANTIAIRCRAFT SEARCHLIGHTS AND THE AAAIS

(This manual supersedes FM 4–111, 6 July 1940; and Training Circular No. 42, and Training Circular No. 52, War Department, 1943.)

CHAPTER 1

GENERAL

	Paragraphs
SECTION I. Mission	1
II. Characteristics of searchlights and detectors	2–6
III. Units	7–10

SECTION I

MISSION

■ 1. MISSION.—The mission is to discover and illuminate hostile targets operating during darkness in order that they may be effectively engaged by AAA or friendly fighter aviation, and to provide a continuous antiaircraft artillery intelligence service (AAAIS) for close-in, accurate warning purposes.

SECTION II

CHARACTERISTICS OF SEARCHLIGHTS AND DETECTORS

■ 2. SEARCHLIGHT.—The standard AA searchlight is a 60-inch, drum-type light with a metal mirror, and utilizes a high intensity arc. It may be traversed through 360° and elevated to 90°, either manually or from a control station by means of distant electric control. The searchlight is capable of illuminating an airplane at *slant* ranges up to about 15,000 yards, depending on atmospheric conditions and target characteristics.

■ 3. POWER PLANT.—The power plant for the AA searchlight is a d-c generator driven by a gasoline engine.

■ 4. CONTROL STATION.—The control station of the 60-inch searchlight consists of a distance electric controller for moving the searchlight in azimuth and elevation. Indicators

are provided to show when the searchlight beam is directed at the azimuth and elevation indicated by the detector unit (or sound locator). The binoculars, especially designed for night use, are so mounted that they may be adjusted parallel to the searchlight beam. They are used primarily for visual observation of targets at extreme ranges and for following a target once it is illuminated.

■ 5. DETECTOR UNIT.—The detector unit provides directional data for the searchlight which data are transmitted electrically to the searchlight by means of a self-synchronous data transmission system.

■ 6. SOUND LOCATOR.—The sound locator may continue in use in some units in lieu of the radio detector unit to furnish directional data for the searchlight. It is capable of following an airplane in azimuth and elevation under very favorable conditions, up to 10,000 yards slant range. Its operating range may be considered to be from 2,000 to 8,000 yards, depending on atmospheric conditions. The acoustic corrector, an integral part of the sound locator, provides means to apply corrections to compensate for sound lag and to correct for parallax between the sound locator and the searchlight.

SECTION III

UNITS

■ 7. GENERAL.—The present organization of the Army is based on tailored units to perform particular missions. AAA units are assigned or attached to field forces or defense commands to meet the requirements of the situation.

■ 8. ORGANIZATION.—*a. Fire unit.*—The fire unit of the searchlight battery consists of a searchlight, with its control station and power plant, and a caliber .50 machine gun, together with the necessary personnel to man the weapons and equipment. Half of the fire units also have detectors.

b. Batteries.—(1) The detailed organization for an AA searchlight battery appears in T/O 44–138.

(2) The searchlight battery consists of a battery headquarters and two platoons.

(3) Battery headquarters is divided into a headquarters section communication section, and maintenance section.

The searchlight platoon consists of a headquarters section, six searchlight sections, and three detector sections.

c. Battalion.—(1) The organization of the AAA searchlight battalion appears in T/O 44–135.

(2) The searchlight battalion consists of a headquarters and headquarters battery and three searchlight batteries. The organization of the headquarters and headquarters battery of the searchlight battalion is contained in T/O 44–136.

(3) *Radar officer.*—The radar officer—

(*a*) Advises the commanding officer on employment, siting, relocation, operation, and maintenance of radar equipment.

(*b*) Supervises the execution of the plan for the employment and operation of radar equipment.

(*c*) Coordinates the sectors of search of radar sets prior to installation and makes such corrections as are necessary after installation due to local interference.

(*d*) Supervises the operation of radar maintenance personnel.

(*e*) Acts as liaison officer with units performing higher echelons of maintenance.

(*f*) Cooperates with battalion supply officer in procurement and maintenance of an adequate supply of spare parts for radar equipment.

(*g*) Conducts schools for officers and radar operators.

■ 9. ASSIGNMENT OF SEARCHLIGHTS (see FM 4–100).—*a. To division and corps.*—AA searchlight protection is almost never needed by the division or corps.

b. To army.—A normal attachment of AA searchlights to an army might be two battalions.

c. To defense commands.—The attachment of AA searchlights to defense commands is directly dependent upon the size and importance of the area to be protected and the quantity of searchlight matériel available.

d. To other forces.—For forces assigned to oversea possessions, bases, theaters of operation, and zones of the interior, AA searchlights are provided as required by the mission.

■ 10. CONTROL.—Both in the defense of areas and of fixed installations of field forces, AA searchlights may be assigned or attached to fighter commands.

CHAPTER 2

EMPLOYMENT WITH FIGHTER COMMAND

Paragraphs

SECTION I. Fighter-searchlight team 11–15
II. Disposition of searchlights 16–18

SECTION I

FIGHTER-SEARCHLIGHT TEAM

■ 11. DEFINITIONS.—*a. Searchlight area.*—A searchlight area is that area of a defense covered by searchlights. The outer row of searchlights and detectors constitutes the perimeter of the searchlight area.

b. Searchlight intercept unit.—The searchlight intercept unit is the largest portion of the searchlight area within which a given fighter, or group of fighters, may be directed to interceptions from a single principal control point. The maximum size of this unit is determined by the number of subcontrol points (spaced at 5-mile intervals) that can be located within 10 miles of the principal control point. The subcontrol points are normally located 7½ miles inside the perimeter of the searchlight area.

c. Orbit.—Orbit refers to the circular course flown by the friendly fighter aircraft about a fixed marker.

d. Principal control point.—The principal control point is a fixed marker, such as a distinctive terrain feature visible at night, a prominent body of water, a vertical searchlight beam, or a radio marker, and is the center of a fighter orbiting circle of 2½ miles radius. It is the *basic* control point of the searchlight intercept unit.

e. Subcontrol point.—A subcontrol point is a fixed marker, such as a distinctive terrain feature visible at night, a prominent body of water, a vertical searchlight beam, or a radio marker, and is the center of a fighter orbiting circle of 2½ miles radius. The number of subcontrol points in a searchlight intercept unit depends upon the size and shape of the unit.

■ 12. PURPOSES OF FIGHTER-SEARCHLIGHT TEAM.—The purposes of the fighter-searchlight team are—

a. To enable the defense to take advantage, at night, of the great fire power of fighters.

b. To make use, at night, of the great tactical mobility of fighter aviation.

c. To illuminate hostile targets, flying above haze, broken clouds, or a thin overcast, so that they can be effectively engaged by friendly fighters.

■ 13. REQUIREMENTS.—The basic requirements when employing the fighter-searchlight team against enemy night raids are as follows:

a. Advance warning of the approach of an enemy attack is imperative in order that our friendly fighters will have time to leave the ground, climb to the enemy's altitude, and close to the interception and attack.

b. Five minutes of continuous illumination of the target is desirable to allow the fighter pilot to see it (or at least, initially, to see its location in the intersection of accurately directed searchlight beams), proceed to the point of interception, and press home an attack.

c. A major proportion of all hostile airplanes in multiple, wave, or formation attack must be illuminated.

d. Illumination of the hostile airplanes must be such as will facilitate attack by the friendly fighter. It must not hinder the attack by blinding the fighter pilot, nor necessitate his entering the illuminated zone about the target when he closes in to effective range.

e. Illumination of the friendly fighter through error must be avoided.

■ 14. OPERATIONS OF FIGHTER-SEARCHLIGHT TEAM.—The hostile raid is picked up by the AWS and the plotted information is sent to the AAA operations room. The detector-searchlight sections of the appropriate searchlight intercept units are alerted. These detectors pick up the target and telephone the azimuth and range to the AAA operations room. In the meantime, fighter planes are ordered into the air. These fighter planes climb to a prescribed altitude and orbit their assigned principal control points. As the course of the hostile target is plotted on the AAA operations board, the

intercept officer dispatches his fighters to the subcontrol point which is nearest to the expected point of penetration of the enemy target into the area. When the hostile plane is within range of a searchlight, it is illuminated by that light. Another light makes the intersection on the airplane already illuminated, and continuous illumination and intersection follow. When the intersection is reported to the AAA operations room, the intercept officer notifies the friendly fighter that an intersection has been made. The friendly fighter locates the intersection and flies toward it in such a manner that he will attack the hostile airplane from the rear. The fighter airplane closes in on the hostile airplane and attacks it.

■ 15. BASIC CONSIDERATIONS.—The basic considerations in the tactical disposition of searchlights and detectors about a defended area for fighter cooperation are:

a. Illumination, once begun, must be maintained continuously if fighters are to be given a reasonable opportunity to reach the illuminated enemy and press home an attack.

b. The searchlight disposition should be as homogenous, closely knit, and as regular in shape as possible.

c. Most critical of all is the requirement that the friendly fighters remain always *inside* the outer boundaries of the searchlight area until an intersection of two or more searchlight beams has been formed on or near the target. Therefore, it is necessary that all parts of the searchlight area be of regular shape, and the area sufficiently large in all dimensions to allow orbiting friendly fighters a high degree of probability of being able to remain inside its boundary at all times.

d. The system of fighter-searchlight defense described herein is accordingly designed so as to be capable, when necessary, of employing groups of fighters with maximum effectiveness against concentrated attacks by multiple enemy raiders.

SECTION II

DISPOSITION OF SEARCHLIGHTS

■ 16. GENERAL.—*a.* A searchlight defense of one or more battalions is organized in accordance with the principles set

forth in this section. In a searchlight defense for fighter cooperation, either alone or in combination with a gun defense, searchlights are disposed in an area defense extending uniformly as far out from the objectives in all directions as availability of equipment permits. Normal spacing is approximately 6,000 yards between adjacent lights in a given row, and approximately 6,000 yards between adjacent rows. (See fig. 1.)

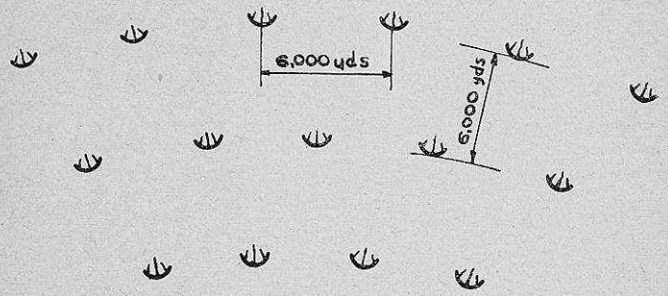


FIGURE 1.—6,000-yard spacing of searchlights.

b. Where a majority of attacks are to be expected at extremely low altitudes, this spacing may be reduced to the extent necessary to provide continuous carry. Even in comparatively flat country, the interference of normal terrain features may prevent continuous carry when a spacing of 6,000 yards or greater is employed.

c. Where the defended objective is located in the immediate vicinity of the seacoast, spacings between lights along the coastal side of the defense should be reduced to compensate for the inability to secure outward extension of the defense to seaward.

d. The final disposition of the searchlights on the ground, while approaching the normal interval, *depends on the terrain features encountered.*

e. For cooperation with fighters, a minimum of one searchlight battalion is required. One battalion can provide a *minimum* defense for a single *point* objective. Fighter-searchlight defenses are usually assigned to larger or multiple objectives requiring two or more battalions. For a normal single objective, small seaport, or city with a vital area ap-

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proximately 5 miles in diameter, a minimum of two battalions is required.

■ 17. DESIGN OF SEARCHLIGHT DEFENSE.—*a.* When two or more searchlight battalions are employed in the defense of an area, they are organized as a searchlight group. The group commander is responsible for its establishment and operation.

b. The design of a searchlight defense involves the application of general principles to the extent that local conditions, such as availability of equipment and terrain features, will allow. In practice, this will normally necessitate compromising between the various desirable features of a perfect defense.

c. The following principles should be adhered to as closely as local conditions will permit:

(1) The depth of the searchlight area should *never be less than 10 miles* from the outer row of lights to the defended objective. This depth should be increased up to 25 miles whenever availability of equipment and terrain permit.

(2) Normal spacing should be used. Situations inevitably arise in the field where the spacing between some lights must be materially greater, because of the existence of a terrain obstacle.

(3) The searchlights should be distributed as evenly as the terrain features will permit, except where lights are deliberately concentrated.

(4) The shape of the searchlight area should be as regular as the terrain features permit.

(5) SCR–268's should be located in accordance with the following priority:

(*a*) One with each outer row searchlight.

(*b*) One with each second row searchlight.

(*c*) The remainder, if any, scattered uniformly through the interior of the searchlight area.

(6) Control points should be located approximately 7½ miles inside of the outer row searchlights and about 5 miles apart. This 7½ mile figure, however, should be reduced to about 5 miles whenever the defended objective is on or near a seacoast or when the depth of the searchlight area is reduced to the minimum of 10 miles, because of the necessity of making earlier interceptions under these conditions.

The control beacons must be sufficiently inside of the outer row of searchlights so that fighter pilots can orbit without flying outside of the outer row of lights. A fighter plane at cruising speed can normally orbit on a 2½ mile radius. A couple of miles of leeway are required.

(7) Searchlights should be grouped so that each platoon contains 6 lights, either 6 tactical lights or 5 tactical lights and a beacon light, whenever terrain features permit. However, do not keep the number of searchlights in the various platoons uniform when terrain features or the increased length of communication lines indicate that better administrative and tactical supervision will result from nonuniformity. Similar considerations apply to battery and battalion boundary lines.

(8) The AAA operations room should be located as close to the center of communications as possible.

d. The steps in organizing a searchlight defense are as follows:

(1) A map lay-out of the defense is prepared as explained in *e* below.

(2) Overlays of the defense are furnished to battalion, battery, and platoon commanders. These overlays should show frequency assignments for all SCR–268's and tentative searching sectors.

(3) Tentative line route diagrams for platoon command nets are prepared by platoon commanders and assignments made to each searchlight section and platoon communication section for the part of the net each is to install.

(4) Tentative line route diagrams are prepared under the direction of the defense communication officer for all data lines and intelligence net lines. Assignments for reconnaissance of line routes and for the laying of these lines are made to the group, battalion, and battery communications sections, and *all searchlight sections*. Every available man in the searchlight defense must continue to work on the installation of the communication system until all lines are completed. It is essential that the defense communication officer coordinate the entire communication program, so that equitable assignments will be made and all details will complete their assignments at approximately the same time.

(5) Platoon commanders reconnoiter for searchlight and detector positions, making every effort to secure suitable positions within half a mile of the position indicated on their overlay. The reconnaissance should include the final determination of communication routes for the platoon command net, so that each section chief is familiar with the route of that part his section is to install.

(6) Overlays showing the positions selected by the actual ground reconnaissance are submitted to the searchlight defense commander. If any of the selected positions are more than ½ mile from the original map location (as is usually the case), it will be necessary to readjust the positions of adjacent searchlights and SCR–268's, and a second reconnaissance by the platoon commanders affected may be required.

(7) All units move into position, and each section leaves part of its personnel to emplace equipment, while the remainder, under the direction of the section chief, immediately starts to lay its assigned portion of the platoon command net.

(8) The defense S–3, assisted by personnel from the operations sections of headquarters battery, organizes the AAA operations room. When more than one battalion is present in a searchlight defense, all AAAIS personnel from the battalion headquarters batteries should be attached to group headquarters battery for the operation of the AAA operations room.

(9) As soon as the SCR–268's have been placed in operation, platoon commanders order each detector commander to search through 6,400 mils to determine the azimuth limits of sectors wherein targets can be effectively picked up and tracked. Reports of these tests are forwarded to the searchlight defense commander.

(10) The searchlight defense commander then reassigns searching sectors for all SCR–268's on the basis of the data furnished him by the platoon commander's reports. Care should be taken to provide adequately overlapping sectors of search, without assigning to any detector a sector in which that detector cannot adequately track targets, because of permanent echoes or other interference.

(11) Assignment of periods of operation and of standby

conditions for AAAIS detectors (detectors with the outer row of searchlights) are made by the searchlight defense commander. At any one time (except during raids) every other AAAIS detector should be in operation. This may be reduced to every third AAAIS detector in operation (except during raids) if a dependable AWS system is in operation in the locality concerned.

(12) On the first night after the defense is installed, if the situation permits, each light is placed in action vertically, in accordance with a prearranged schedule, for a period of one minute, in order to allow each section chief to orient his position with respect to all adjacent positions. During this orientation mission, each section chief stakes out the direction of all adjacent searchlight positions.

e. The following example will illustrate a practical procedure in making the initial map dispositions of searchlights. It is assumed that two searchlight battalions have been assigned to provide a searchlight defense of the three objectives shown in figure 2.

(1) A smooth curve is drawn connecting the centers of the objectives. A series of three additional concentric curves are drawn spaced about 6,000 yards apart, as shown in figure 2. This will place the outside curve slightly more than the 10-mile minimum from any objective. Some of these curves cross terrain obstacles such as woods, lakes, and swamps, where the siting of searchlights is impracticable.

(2) The total length of the perimeters of the curves is determined. In figure 2, the total is about 412,000 yards. Dividing 412,000 by 6,000 the normal interval between lights, approximately 70 *tactical* searchlights are required. Assuming that 6 orbiting beacons will be required (this figure may change later, when the lay-out of orbiting beacons is determined), and about 6 additional lights for spread beam illumination near the objectives, a total of about 82 searchlights will be required to complete the defense. Since 2 battalions (72 lights) have been assigned, there are not enough searchlights for the normal interval of 6,000 yards between lights. Since the depth of the defense from the outer row of searchlights to the defended objectives is already at the minimum of 10 miles, the size of the defense *must not* be changed. Therefore, the interval between lights will have to be in-

creased slightly, wherever possible, to compensate for the insufficient number of lights. However, increasing the interval beyond 6,000 yards should be done only with great

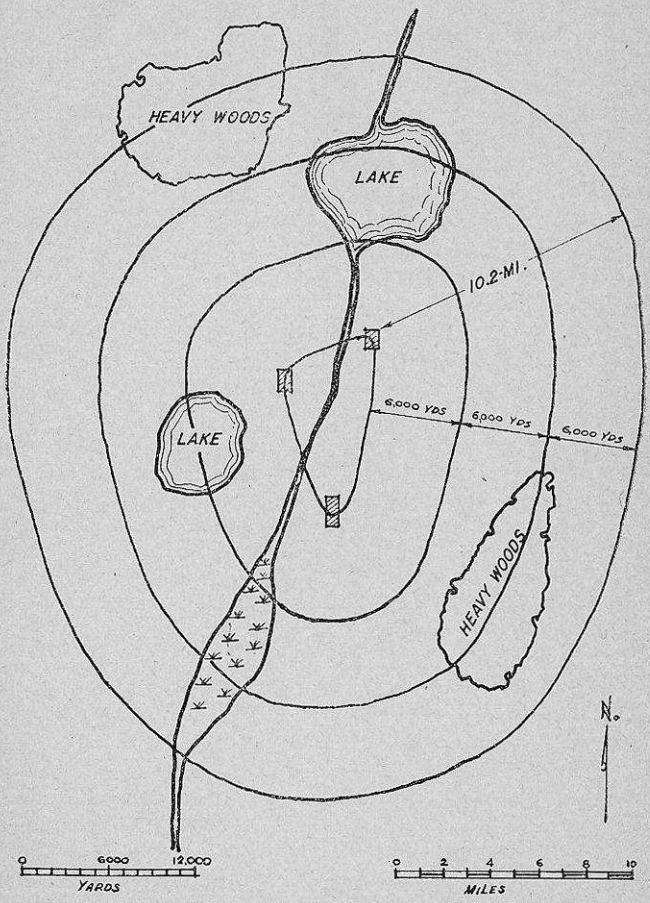


FIGURE 2.—Design of a typical searchlight defense.

caution. If the number of lights available had proved to be slightly more than the number required for the minimum defense originally outlined, the spacing would have been

reduced below the 6,000-yard figure. If the number of lights available was materially in excess of the minimum required, every effort should be made to include another row of lights around the defense, increasing its depth to about 14 miles.

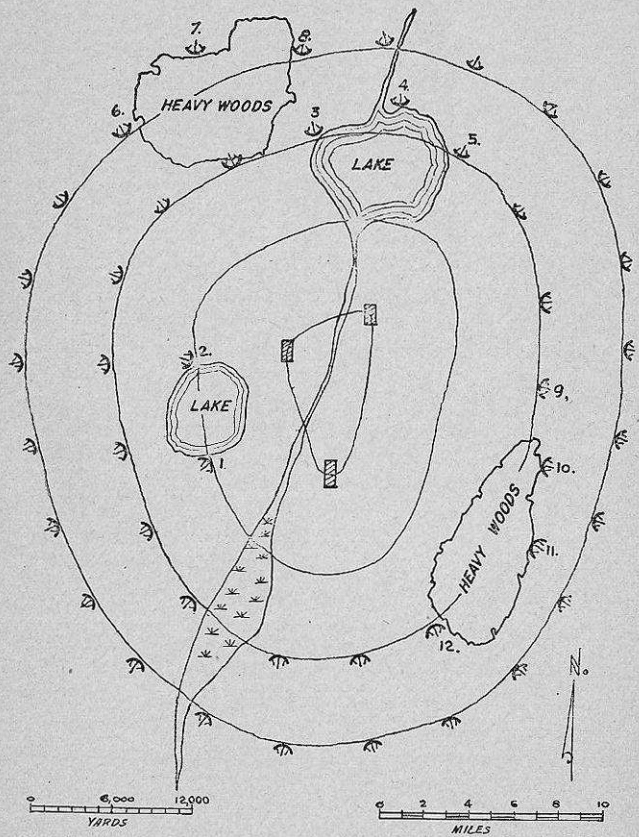


FIGURE 3.—Design of a typical searchlight defense.

(3) First, locate positions around or near the terrain obstacles, to insure adequate illumination in their vicinity. In figure 3, lights 1 and 2 are located on both sides of the smaller lake, with an interval of about 7,500 yards between

them. Lights 6 and 8 are located similarly, but in this case the interval between them (15,000 yards) is entirely too great to be tolerated. Therefore, light 7 is spotted between lights 6 and 8, but on the outside of the woods. Lights 9, 10, 11, and 12 are similarly located. It should be recognized, however, that all these positions are tentative, and may require readjustment after the remainder of the searchlight positions have been located on the map.

(4) The distance along the perimeter of the outer curve from light 8 clockwise to light 6 is determined. This proves to be about 148,000 yards. Assuming a spacing of 6,200 yards between lights (the normal interval increased slightly), 21 lights can be located to complete the disposition of lights in this outer row. (See fig. 3.)

(5) Lights 9, 10, and 11 are now directly behind front row lights and close to them. A readjustment is made by moving lights 9, 10, and 11 until they are centered behind the intervals between the front lights, as shown in figure 4. This produces an interval of about 9,000 yards between lights 11 and 12, but this interval, although large, will be tentatively accepted (again due to limited amount of equipment) pending the completion of the disposition of the remainder of the lights.

(6) The gap between lights 5 and 9 is filled in with two lights at about 6,200-yard intervals. Using the same interval, the remainder of the lights are located in the second row, beginning at light 3 and working counterclockwise. (See fig. 4.)

(7) In the third row, the distance from light 1 to the edge of the nearby swamp is about 6,000 yards, so light 13 is placed at that point as shown in figure 5. The length of the third row curve from light 2 clockwise to light 13 is about 58,500 yards; nine lights at 5,800-yard intervals or eight lights at 6,500-yard intervals will complete the third row. Once again, for economy of equipment, the greater interval is selected, and remaining lights in the row are located as shown in figure 5. Light 14 is moved forward of the third row as near as practicable to the edge of the woods in order to cover the wide interval between lights 11 and 12, and light 15 is placed in back of the third row to compensate for the forward displacement of light 14.

(8) Two lights are located near each objective for spread beam illumination. These lights will also be used for normal illumination. (See fig. 6.) Lights 16 and 17 are placed in the wide intervals between the objectives.

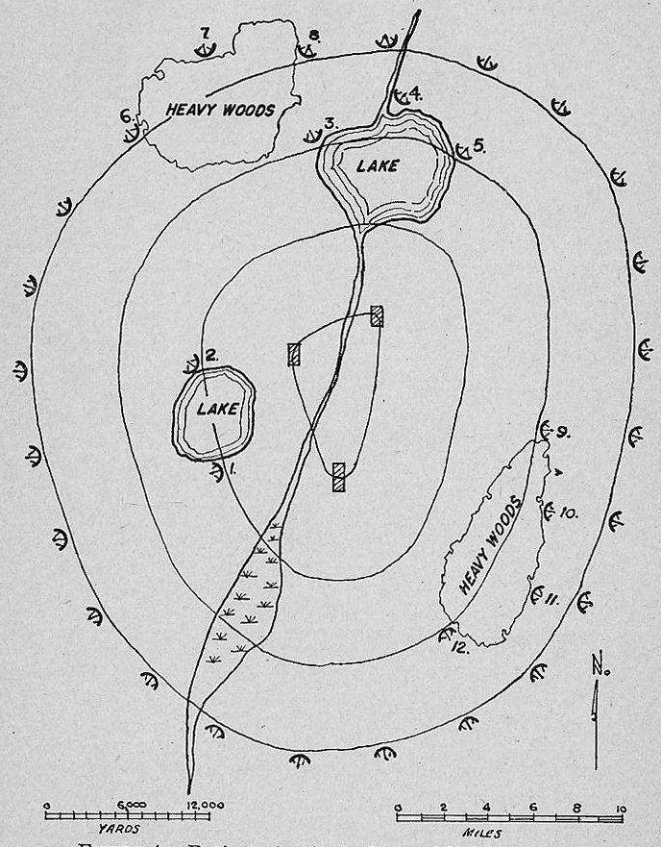


FIGURE 4.—Design of a typical searchlight defense.

(9) A total of 36 SCR–268's are available in the defense. One SCR–268 is placed with each of the 24 first row searchlights, and the remaining 12 are used in the second row, as shown in figure 6. One exception is made in the case of

light 14, which is farther back in the area than the second row, but which is covering the gap in the second row caused by the heavily wooded area.

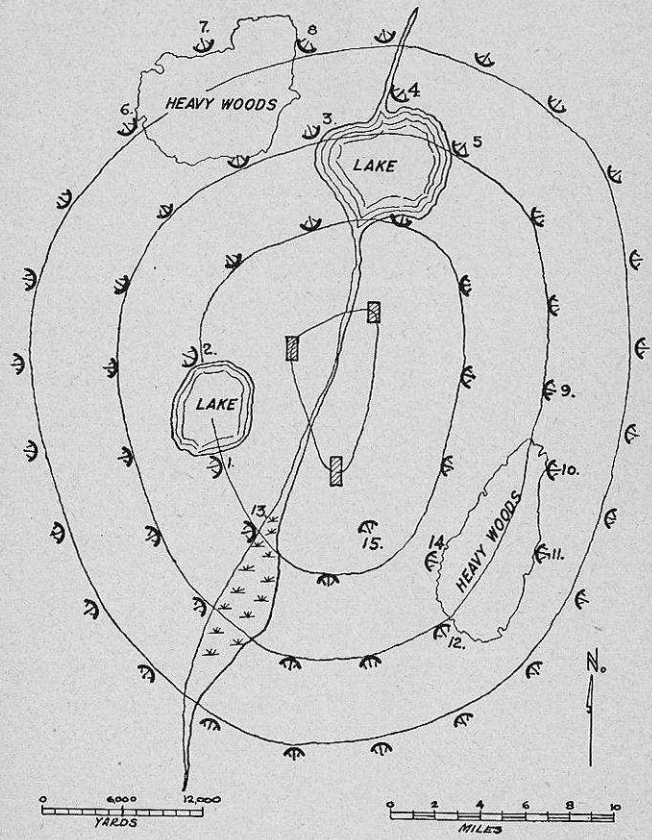


FIGURE 5.—Design of a typical searchlight defense.

(10) All 24 outer row SCR–268's are selected as AAAIS detectors to furnish data to the AAA operations room.

(11) Frequencies assignments are made for all SCR–268's with frequencies staggered at 2.5-megacycle intervals over the frequency range from about 197.5 to 210 megacycles.

The reduction from the absolute maximum of effectiveness for a given SCR–268, caused by operating it slightly off its designed frequency, is more than compensated for by the increased over-all efficiency resulting from the reduction

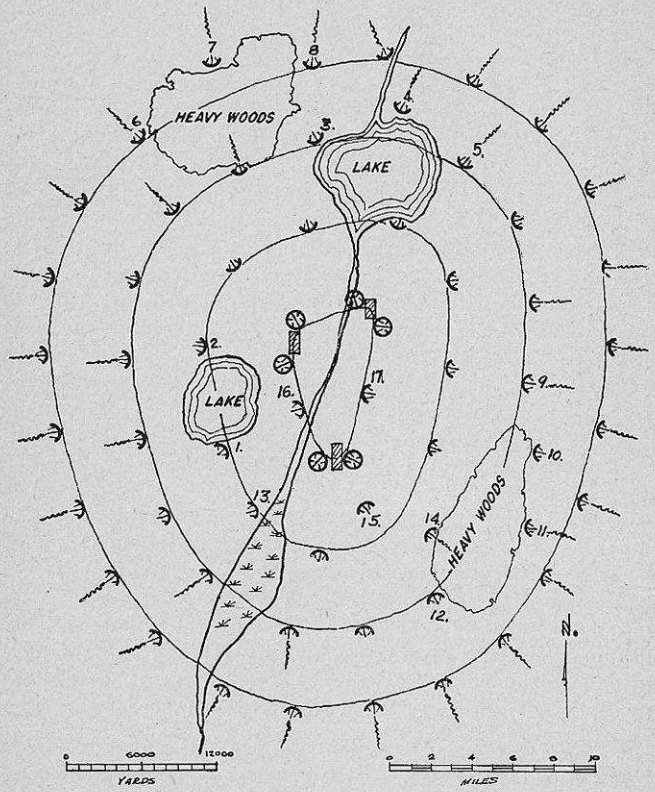


FIGURE 6.—Design of a typical searchlight defense.

of mutual interference. Keying sets together for reduction of mutual interference is impracticable when they are sited at field intervals.

(12) Tentative searching sectors are assigned to each SCR–268, pending the receipt of reports from the platoon commanders giving data on the interference conditions for

each SCR–268. For these tentative assignments, each SCR–268 is given a 90° searching sector, extending 45° on each side of a line perpendicular to the nearest border of the searchlight area.

(13) Next, the locations of the principal and subcontrol points are established. Since the defense depth is already at the 10-mile minimum, the line of control points is established closer to the outer row of searchlights than the normal 7½-mile distance. Since 62 of the 72 available lights have already been located, only 10 lights are available for control lights. Ten lights are not sufficient to establish a complete line of control points 5 miles from the outer row of lights. Since it is undesirable to remove tactical lights from the defense to augment the number of control lights, it is better in this case to shorten the line of control points. Another trial is made establishing the line of control points 6 miles inside of the outer row of lights. It is found that this will suffice. (See fig. 7.)

(14) The searchlight area is divided into two searchlight intercept units so that the principal control points will be within 10 miles of the subcontrol points in the same unit. The principal and subcontrol points are thus established as shown in figure 7.

(15) Platoon and battery boundaries are established, and platoon command posts located, as shown in figure 8.

f. It is important to realize that the above example *is not by any means a standard pattern for such a defense.* No two defenses will be exactly the same. An adequate defense must be designed to fit a particular situation. These principles can be followed regardless of the number of searchlight battalions included in the searchlight defense.

■ 18. BELT DEFENSE.—*a.* A continuous belt of searchlights intended for fighter cooperation consists of a continuous succession of searchlight intercept units. These searchlight intercept units should be approximately square, 25 miles deep by 25 miles in breadth. A line of subcontrol points is established along its outer boundary parallel to and approximately 7½ miles inside thereof. The principal control point is located at the center of the line of subcontrol points. If necessary, a second line of control points may be established

7½ miles forward of the rear boundary. (See fig. 9.) Such a belt has application only where fighter aviation is operating in general defense as opposed to local defense. Where many objectives lie comparatively close together in the interior of

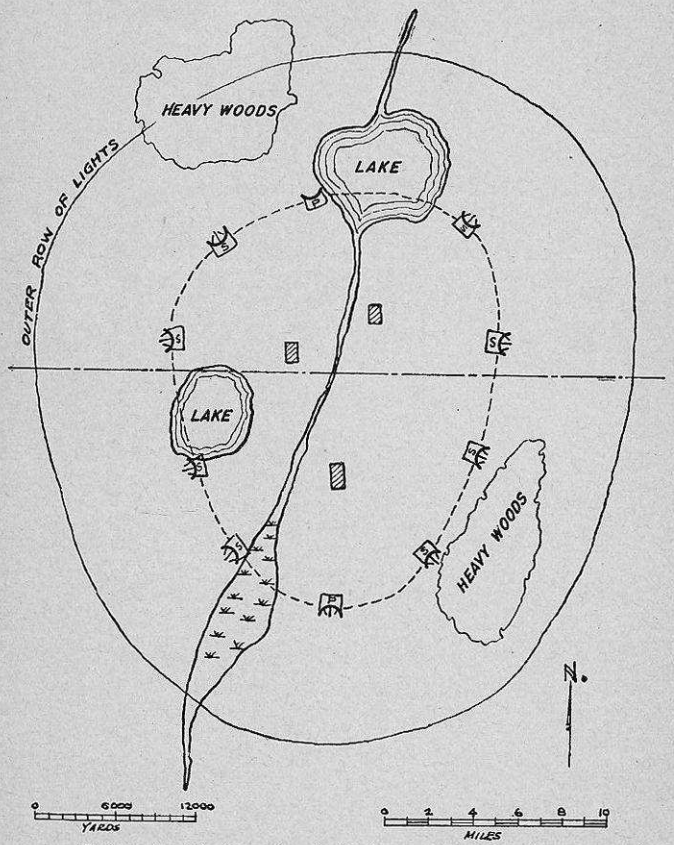


FIGURE 7.—Design of a typical searchlight defense.

an area, it is possible, with the aid of the Aircraft Warning Service, to employ fighter aviation to its greatest advantage. By suitably disposing and operating it along the frontier, it is possible to give a measure of defense to all objectives in rear

of the line of fighter operation. This makes most effective use of the outstanding advantage of fighter aviation, its tactical mobility, and constitutes the most effective manner of employment of fighter aviation.

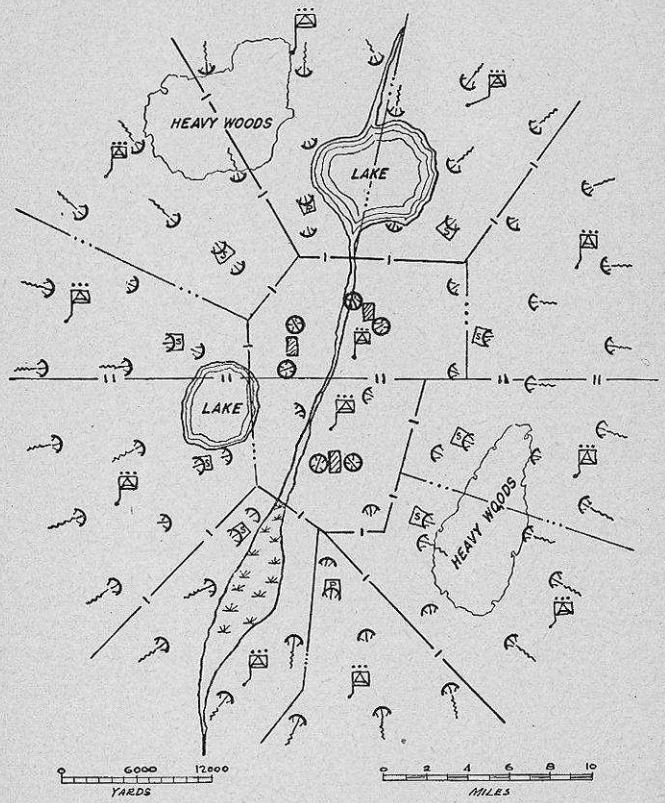


FIGURE 8.—Design of a typical searchlight defense.

b. Where fighter aviation is so employed, the establishment of a continuous belt of searchlights along the frontier is advantageous. Such a belt is located considering the locations of the existing fighter operating airdromes, preferably including such airdromes within its boundaries. The belt

should cover the frontier continuously, with its ends extending far enough beyond the limits of the defended area to make it impracticable for the enemy to avoid it by circumvention. Where an inland objective is being defended, the outer line of lights should be at least 10 miles from the objective. In

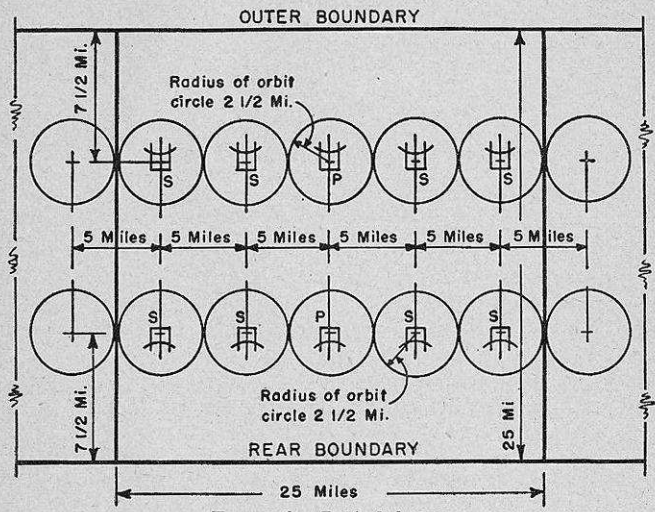


FIGURE 9.—Belt defense.

localities where it is impossible for the fighter belt to be in front of all defended objectives, as lie on the seacoast, it must be merged and coordinated with the local defenses thereof.

c. The searchlights and detectors in a belt defense are disposed at normal 6,000-yard spacings over the entire area.

CHAPTER 3

EMPLOYMENT WITH GUNS AND AUTOMATIC WEAPONS AND OTHER USES

Paragraphs

SECTION I. Employment with guns 19–21
II. Employment of spread beam 22–31

SECTION I

EMPLOYMENT WITH GUNS

■ 19. DISPOSITION.—The disposition for the employment of one or more searchlight battalions has been discussed in chapter 2. There will be certain cases where AA searchlights in numbers less than one battalion will be employed in the defense of small objectives. A small objective as considered here is not greater than 2,000 yards in diameter. The searchlights normally will follow the ring type of dispositions of lights as it is not expected that fighter aviation can successfully be employed in conjunction with less than one searchlight battalion.

■ 20. BASIC CONSIDERATIONS IN DESIGN OF SEARCHLIGHT DEFENSE FOR GUN ILLUMINATION ONLY.—*a. General.*—(1) Searchlights are operated under a general plan of illumination for the defense, there being no assignment of searchlights to gun batteries (see FM 4–100).

(2) Hostile attacks may be expected at speeds of 250 to 350 miles per hour and altitudes up to 35,000 feet. The defense must be capable of acting effectively against such attacks from any direction. Such a result will be obtained by the uniform distribution of sufficient lights around the objective. However, accidents of terrain, particularly the presence of large water areas, may make such a distribution difficult or even impossible.

(3) The effective slant range of a searchlight is dependent on conditions of visibility and may vary between wide limits. Under favorable conditions of visibility the slant range of a light is 15,000 yards. This value of 15,000 yards should be used for normal tactical planning. Under poor conditions of visibility the range will be less, and under very excellent conditions of visibility more than 15,000 yards. Tactical dispositions, therefore, must conform to the conditions of visibility encountered.

(4) The searchlight defense must be able to illuminate the target in sufficient time to permit the gun batteries to deliver fire against the target at the maximum effective range of the guns, whenever the bombing run is of sufficient duration to permit such fire.

(5) The searchlight defense set up by less than one battalion will normally consist of two concentric rings of lights.

b. Pick-up lights.—The searchlights on the outer ring are the pick-up lights. Each light is equipped with a detector which will indicate the approach and course of aircraft a few minutes prior to the arrival of the target at the effective slant range. Pick-up lights should never be separated by a greater distance than approximately 6,000 yards in order to prevent a complete break in the ring if one light goes out of action.

c. Carry lights.—The searchlights on the inner ring are carry lights. A carry light should be able to illuminate the target approximately 8 seconds after it is illuminated by the pick-up light.

d. Number of lights needed.—For satisfactory gun battery operation, it is necessary to carry the target with at least two lights. Different conditions of visibility and attacks delivered at extremely high altitudes might in some situations dictate three or more beams carrying a single target. The hostile target is carried by one pick-up light and one carry light until either the target is destroyed, the target crosses the center of the objective, or the target changes course, turns away from the objective, and passes beyond the extreme range of searchlights and guns.

■ 21. LOCATION OF SEARCHLIGHTS FOR DEFENSE OF SMALL OBJECTIVE.—Figure 10 is a plan for the gun searchlight defense of a small objective. The searchlights are placed in two concentric rings about the objective with the radius of the outer ring equal to 9,500 yards and the radius of the inner ring 8,000 yards from the center of the objective. Ten searchlight-detector sections are spaced equally on the outer

536338°—43——4

ring. Ten searchlights are spaced equally on the inner ring to cover the gaps between the lights on the outer ring. The other detectors will normally be used in the inner ring to reinforce the outer ring detectors along the most probable routes of approach. The other four searchlights will be placed near the objective to furnish illumination for automatic weapons and to assist the ring searchlights in carrying the target during periods of poor visibility.

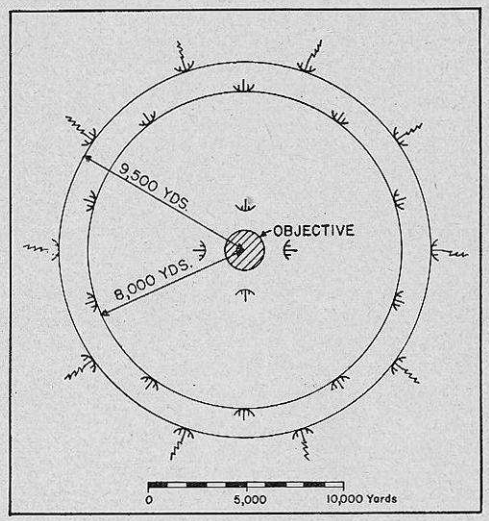


FIGURE 10.—Searchlight defense (less than one battalion) for gun illumination only.

SECTION II

EMPLOYMENT OF SPREAD BEAM

■ 22. BASIC DOCTRINE COVERING EMPLOYMENT.—*a.* All AA searchlights have means of spreading the beam from a narrow beam of 1¼° to a maximum beam of 15°. The spreading of the beam is accomplished by a modification of the lamp head and control rod which permits the lamp head to be displaced 4½ inches to the rear of the normal focal point.

b. The spread beam will normally be employed in the

illumination of low-flying targets for engagement by automatic weapons. Additional uses are illumination for defense against airborne troops; illumination of landing strips or airdromes; illumination for defense against water-borne attack and landings; and illumination of hostile low-flying enemy aviation for interception by friendly fighter aircraft.

■ 23. TACTICAL EMPLOYMENT.—*a.* The employment of the spread beam is governed by its capabilities and limitations. It must be emphasized *that the range of illumination decreases as the beam is spread.* Therefore, in order that maximum range may be obtained, the narrow beam should be used except in those cases where the angular rate of travel of the target is too high, and where close range targets over a relatively large area must be illuminated.

b. Except in the initial pick-up, detectors will normally not be used in the operation of the spread beam. The detector may track the target into the position at which the pick-up light may go into action and where the target will be illuminated with the beam spread slightly. The beam will then be widened as the plane approaches.

c. When the objective being defended is within an area containing a normal searchlight defense, the disposition of lights for spread-beam illumination must be coordinated with the general plan of searchlight defense. This will permit some lights to be placed so that they can be used either for spread beam or normal illumination.

■ 24. LOW ALTITUDE ATTACK.—*a.* Employment of the spread beam against this type of attack requires illumination of medium bombers operating at low altitudes, and of low-flying strafing airplanes. Illumination of hostile fighter and bombardment planes flying low in an attempt to escape radio detection may be required. In all cases the object of illumination is to provide maximum time of illumination for automatic weapons fire.

b. In the automatic weapons defense of a small objective, searchlights used for spread beam illumination should be placed from 850 to 1,250 yards outside the outer ring of automatic weapons. This disposition will provide sufficient illumination to enable the automatic weapons to engage the hostile targets at about 1,500 yards if the targets are illuminated at

a distance of about 3,000 yards from the guns. Ordinarily, a platoon of six lights will provide adequate illumination for two or three times that number of automatic weapons. (See fig. 11.)

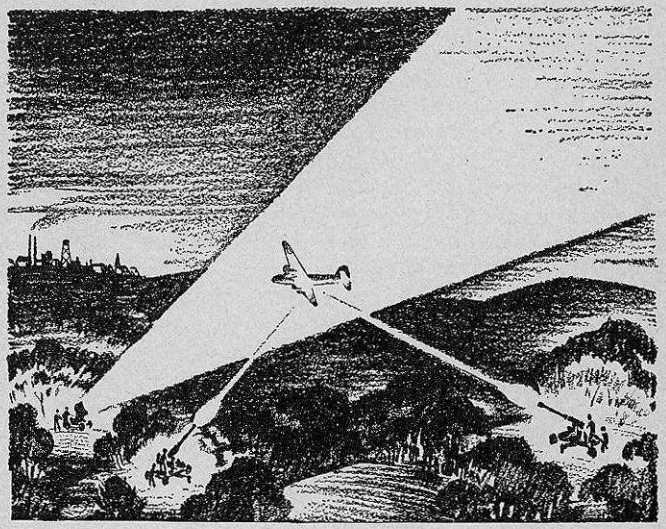


FIGURE 11.—Spread beam searchlight defense against low altitude attack.

■ 25. LOW ALTITUDE FIGHTER INTERCEPTION.—*a.* Advantage will be taken of every opportunity to assist fighter interception by the use of the spread beam against low-flying enemy aircraft. Each searchlight must pick up the target and carry it over its position, passing it to the next light in the direction of which the enemy is flying. The initial pick-up should be made at the maximum range and the beam should be spread gradually to maintain illumination on the target as it approaches the searchlight. The spread should be diminished as the target flies away from the light. The searchlight should continue illumination until another light relieves it by engaging the target. The minimum angular height at which a searchlight should engage an incoming target *already*

illuminated is approximately 1,200 mils. Targets that will pass between adjacent lights are illuminated at relatively lower angular heights, depending on the altitude and the angle of approach. This plan of target pick-up and illumination is specified so as to provide the longest period of illumination and, at the same time, to insure against the beam projecting below and to the rear of the incoming target. If this is not done, the friendly fighter coming in for the attack might be illuminated and visible to the rear gunner of the enemy plane. (See fig. 12.)

b. The spread beam should be used to carry targets for fighter interception at altitudes below 5,000 feet.

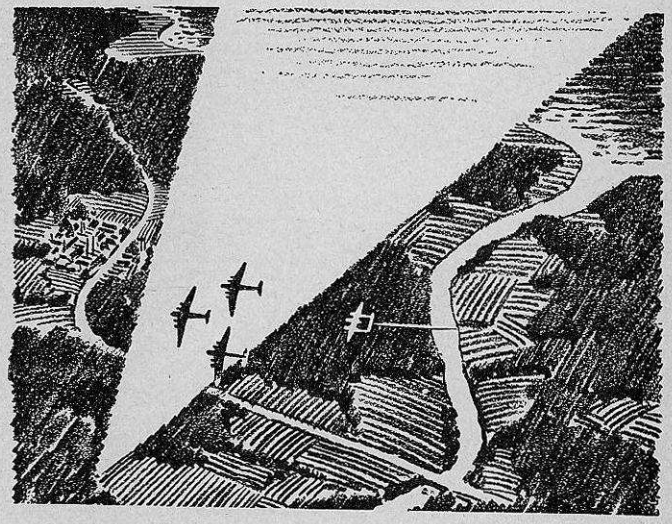


FIGURE 12.—Spread beam searchlight assisting fighter interception.

■ 26. AIR-LANDING TROOPS.—In spread beam defense against this form of hostile attack, searchlights may be used around landing fields or airdromes. In searchlight defense against this type of attack, the beam should be spread to the maximum degree that provides adequate illumination. This will enable the maximum fire power to be employed.

■ 27. PARACHUTE TROOPS.—When employing the spread beam against an enemy aircraft from which parachute troops are jumping, the illumination of these troops in descent becomes the first priority mission for the nearest searchlights. The beam should be spread to the maximum possible degree which will clearly illuminate the men swinging in the air. As these troops may jump from altitudes of from 250 to 500 feet at night, and require only 15 seconds or less to descend to earth, a very short time is available for picking up the parachute troops with the searchlight beam and firing upon them with the automatic weapons, machine guns, and small arms. (See fig. 13.)

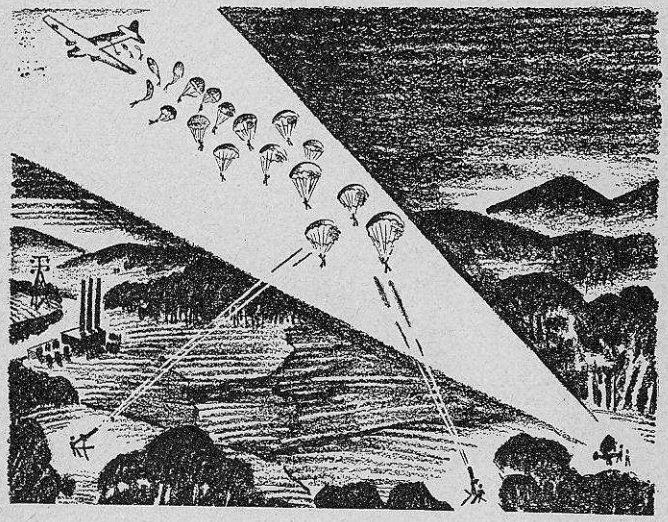


FIGURE 13.—Spread beam searchlight defense against parachute troops.

■ 28. ILLUMINATION OF LANDING STRIPS.—*a.* Searchlights may be used in two ways to illuminate landing strips or fields:

(1) The better plan incorporates the use of the searchlight from a position 100 feet or more beyond the end of the runway over which planes will be coming in to land, and to one side of the center of the runway. The searchlight is towed

to the end of the landing strip *down wind.* The searchlight beam will then be spread to the degree preferred by the pilots (approximately 8° to 10°). (See fig. 14.)

(2) Another plan which may be employed for the illumination of landing strips is to place the searchlight 100 feet beyond the *down wind end* and on one side of the strip. The searchlight is set at zero elevation, and in normal in-focus position for the narrow beam. The narrow pencil of light stretching along the strip will provide the pilot with a valuable guide for his landing or take-off.

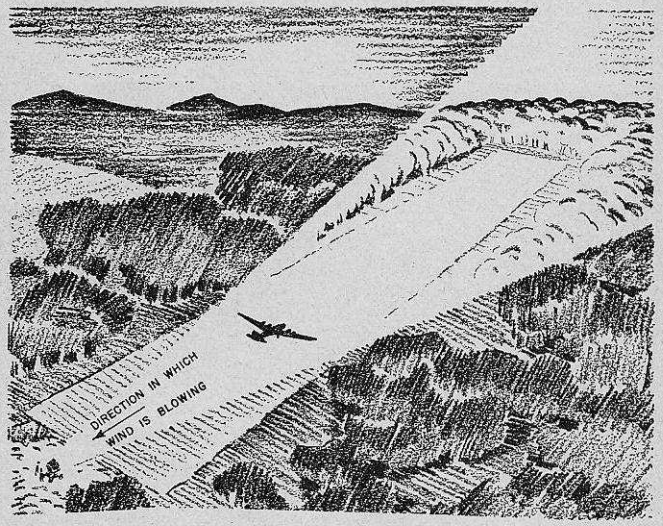


FIGURE 14.—Spread beam searchlight illumination on a landing strip.

b. Direct communication should be available at the searchlight position, so that the light may be ordered into action when a plane is approaching for a landing and out of action when a plane is taxiing in the direction of the searchlight for the turn-about and take-off.

■ 29. WATER-BORNE ATTACK AND LANDING PARTIES.—*a.* In repelling water-borne or landing parties, the function of the

spread beam searchlight is to sweep the surface of the water to detect and illuminate vessels or landing attempts.

b. In meeting the attack of large numbers of landing barges, the beam is spread to the degree which will provide sufficient illumination of a maximum number of the hostile vessels and yet afford maximum possible range.

c. When employed against these forms of attack, the searchlights will be emplaced along the beach at distances of 2,500 yards apart. The lights should be located as near to the water as practicable so that detrimental reflections from the water may be reduced to the minimum. Care must be exercised that no defensive works and probable areas of friendly operations are illuminated. (See fig. 15.)



FIGURE 15.—Spread beam searchlight defense against water-borne attack.

■ 30. TORPEDO PLANES AND BOATS.—*a.* When the spread beam searchlight is utilized for antiaircraft and harbor defense missions, it will probably be placed in a semisheltered position with camouflage near the shore line in as low a position above the surface of the water as possible. The spread

beam may be used to great advantage against single or multiple attacks by torpedo boats, or by torpedo-carrying aircraft. In defense against such an attack, the narrowest possible beam which will cover the area of the target's attack must be used.

b. If the approach of the torpedo plane is detected by a radio detector, directional data will be fed to the searchlight. When the target is still several thousand yards out on the incoming leg, the light will pick up the torpedo plane with the narrow beam. As the plane goes into its very low altitude torpedo run, the beam is spread to the necessary degree.

c. In searchlight defense against motor torpedo *boats,* it is highly desirable that the target be continuously illuminated, for such a boat usually carries six to eight torpedoes, and after launching its first torpedo may be expected to return and renew the attack.

d. When the spread beam searchlight is put into action against torpedo planes and boats, the utmost care must be exercised to prevent the accidental illumination of friendly vessels near the area of the attack. *Even if the target is lost as a result,* friendly naval vessels must not be illuminated. A practical method by which this principle can be carried out is to "jump" the friendly craft with the sweep of the searchlight beam.

■ 31. SPECIAL TACTICAL EMPLOYMENT.—Occasionally the spread beam may be used to form a glare barrage cover over a relatively small area, such as an industrial plant or a railway center. A limited number of spread beam searchlights dispersed throughout the area, and elevated to positions approximately vertical, will assist in screening from aerial observation a ground installation which is not completely blacked out, or which may be readily recognized because of an outstanding geographical feature.

536338°—43——5

CHAPTER 4

AAAIS AND AAA OPERATIONS ROOM

		Paragraphs
SECTION I.	General	32
II.	Communications	33–38
III.	AAA operations board	39–40
IV.	Personnel and operations of AAA operations board	41–47
V.	Personnel and operations of AAA operations room	48–59

SECTION I

GENERAL

■ 32. GENERAL.—*a.* The responsibility of furnishing antiaircraft artillery with a continuous AAAIS is assigned to the searchlight defense if present. Where no searchlight defense exists, the other AAA units must organize and operate an AAAIS (see FM 4–102 and 4–104).

b. The AAAIS consists of an organization for reporting all incoming targets by personnel at detector-equipped searchlight positions to an antiaircraft artillery operations room where the target courses are plotted on an operations board for the information of the intercept officer and AAA operations officer.

c. A system of relief for normal alert conditions is established among the detector positions, so that the area will be covered throughout the 24 hours of the day, and no detector will normally operate more than 12 hours in 24. Detectors at front line searchlight positions are employed.

SECTION II

COMMUNICATIONS

■ 33. GENERAL.—*a.* The normal means of communication in the searchlight defense is telephone. There are times when such communication will be impossible, due either to disruption of the lines or to lack of time to establish a complete telephone sytem. Radio is provided as a standby system for use in such cases.

b. For purposes of rapid identification, batteries, platoons, and searchlight sections are assigned code designations.

Batteries are assigned code words which can be easily understood, such as: Cat, Dog, Fox. Platoons within a battery are designated by preceding the battery code word by the platoon number. Thus 1 Cat or 2 Dog. Sections within the platoon are designated by the platoon code designation followed immediately by the section number. Thus 1 Cat 3, 2 Dog 5. The full code designation should be pronounced in conversation. The abbreviated form such as 1 C 3 for 1 Cat 3 may be used on maps and overlays. For intraplatoon communication it is necessary to use only the section number, or detector designation as shown in figure 16.

■ 34. RADIO.—The following radio equipment is furnished per separate searchlight battalion:

SCR–177	1
SCR–284	45
SCR–543	5
SCR–593	10

a. SCR–177.—This radio is used for communication with higher headquarters.

b. SCR–284.—These radios are used in two separate nets; the battery command net which includes the battery command post and the two platoon headquarters, and the platoon command net which includes the platoon command post and each searchlight unit. In an emergency, both of these nets are used for intelligence purposes. Thus intelligence from the radars is transmitted through the platoon, battery, and battalion nets to the AAA operations room. This relaying is necessary due to the short range of the SCR–284. The SCR–284 can also be used to bridge short gaps in the normal telephone circuits.

c. SCR–543.—These radios are used in the battalion command net, one set being with each battery and one set at the battalion headquarters. An additional set at the battalion headquarters is used in the intelligence net for warning purposes to the elements of the battalion.

■ 35. TELEPHONE NETS.—A searchlight area telephone system has three components: the platoon command net, the intelligence net, and the data lines. These three nets are entirely independent, there being no direct telephonic connection whatsoever. These lines may be commercial wires, army

field wires, or a combination of both. The telephones used by the platoons are usually standard field types.

■ 36. PLATOON COMMAND NET.—The platoon command net normally connects the six sections of a platoon with each other and with the platoon command post. (See fig. 16.) Normally there are ten telephones on this net—one at each control station, one at each detector, and one at the platoon

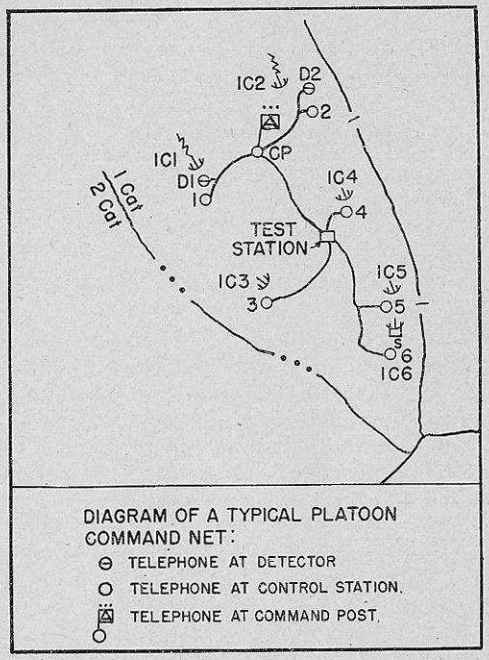


FIGURE 16.—Diagram of a typical platoon command net.

command post. The phones at the control stations are numbered to agree with the lights in their respective sections, that is, 1 to 6, while the phones at the detectors are numbered to agree with the respective detector designations, D1 to D3. The phone at the platoon command post is designated CP. Control point lights are normally included in the platoon command net.

■ 37. INTELLIGENCE NET.—The intelligence net connects the searchlight plot observer in the AAA operations room with the platoon command posts in the area. This net is used principally to advise the platoons of the approach of enemy aircraft. Like the platoon command net, it is an open net, with all telephone operators wearing head and chest sets so

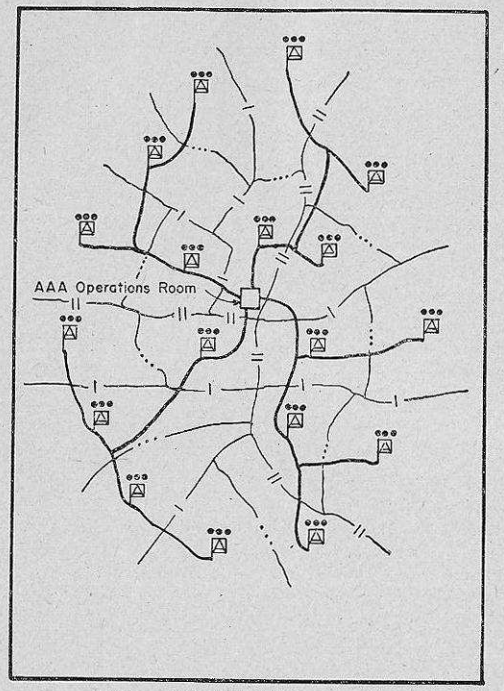


FIGURE 17.—Intelligence net.

that ringing is unnecessary. In larger installations it may be necessary to divide the intelligence net into several sections, each with its own searchlight plot observer, in order to obtain satisfactory transmission of data. Normally no more than six to ten platoons should be connected on one intelligence net. The platoon phone on this net takes the platoon code designation, such as 2 Fox, this designation being used in calling or answering this phone. (See fig. 17.)

■ 38. DATA LINES.—*a*. The data lines provide communication between each detector in the outer row of searchlights and the corresponding plotter at the AAA operations board. Over this line, azimuth and range data from the detector are furnished the plotter, who uses the data to plot on the board the course of the target being tracked. Altitude data are also furnished over this line for transmission to the fighter

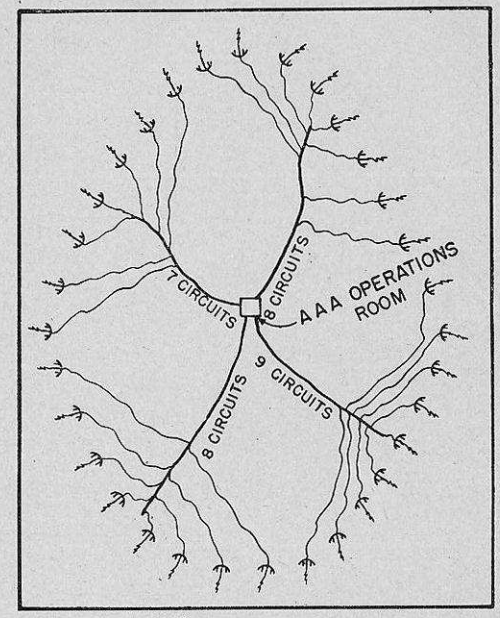


FIGURE 18.—Data lines.

pilots in the air, and for the information of gun batteries. At the detector end of the data line two telephones are provided, one for the azimuth reader and one for the range reader. The range reader also transmits altitude data. Both of these readers, as well as the plotter, wear head and chest sets during operation. (See fig. 18.)

b. As an emergency measure, two adjacent 268's may be tied into the same data line. However, this is definitely

undesirable since it will result in throwing two SCR–268's out of action so far as AAAIS is concerned whenever the one data line goes out of action.

SECTION III

AAA OPERATIONS BOARD

■ 39. GENERAL.—The information on enemy targets needed by AA personnel for the purpose of alerting their units and furnishing them with the location and direction of attack is displayed on an operations board known as the AAA operations board. The information consists of a visual display of the position and course of enemy targets based on data furnished by the detectors operating in the AAAIS system. This information is also used for the operations of the fighter-searchlight team.

■ 40. PHYSICAL CONSTRUCTION OF OPERATIONS BOARD.—*a*. The operations board will normally consist of two or four separate segments which cover the entire searchlight area. The operations board is divided into segments for convenience in plotting and observation of data. The operations board will be a flat surface on which china or charcoal pencil marks can be made and removed, of sufficient dimensions to show an outline of the searchlight area with a surrounding border extending 45,000 yards beyond the edge of the searchlight defense. A convenient operational scale for the board is: 1 inch equals 1,200 yards. The following items will be permanently shown on the board:

(1) A map of the searchlight area including the outline of its perimeter, objective, important terrain features such as large lakes, cities, and airdromes.

(2) All light positions with their code designations.

(3) All platoon, battery, and battalion boundaries.

(4) All principal and subcontrol points.

(5) Boundaries of searchlight intercept units.

(6) Location of all gun, automatic weapons, and barrage balloon installations.

(7) Azimuth arcs for each detector operating in the AAAIS.

(8) Range arms pivoted at the center of each AAAIS detector.

(9) Standard air defense grid.

b. Single battalion operations board.—An operations board for a single battalion defense should be divided into two segments. In some cases a two-battalion searchlight defense may use a two-segment board. An overlap of at least two detector positions should be provided along the inner edge of each segment of the board. One segment of the operations board is shown in figure 19. The other segment of the board is similar. The appropriate standard air defense grid for the geographical location of the installation is drawn on the operations board. (See fig. 20.) The surface of the board should be about 2½ feet above floor level. Figure 21 is an enlargement of the area within the searchlight defense. It will be noted that the standard symbols for searchlights are not used on this map, as symbols on the map must be readily visible to the operations officers and the intercept officer. Azimuth circles are constructed to any convenient radius such as those shown in figure 22. Where azimuth circles are close together over a portion of their arc the radii may be changed to avoid confusion. Adjacent azimuth circles should be painted different colors for clarity. The azimuth circles are graduated in units of 10 mils with each 100-mil point indicated by its number in hundreds of mils. The range arm is constructed of a transparent material, such as plexiglass approximately 1/16 inch thick, and shaped as shown in the figure. One edge of the range arm is graduated in units of 500 yards with each thousand-yard point indicated by its number in thousands of yards. A color strip should be drawn down the center of each range arm to agree with the color of its respective azimuth circle. (See fig. 22.)

c. Operations board for units less than battalion.—When less than a battalion is disposed for gun illumination, the operations board may consist of a single circular board.

d. Larger operations boards.—A larger operations board is required when the searchlight defense consists of several battalions. The board consists of four segments. Figure 23 shows one segment of such a board.

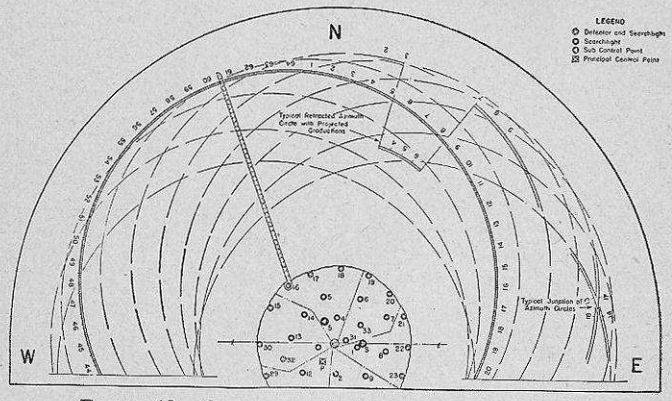


FIGURE 19.—One segment of a two-segment board.

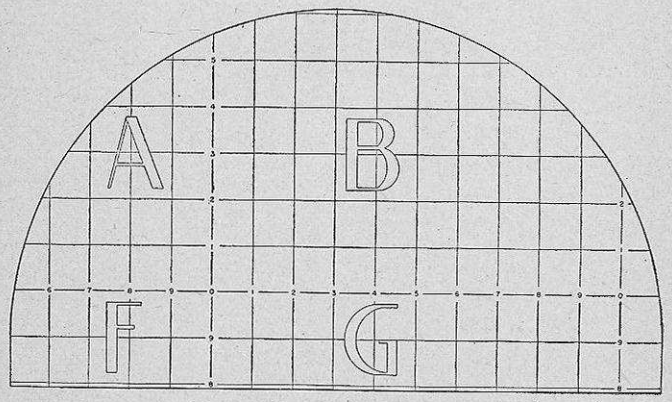


FIGURE 20.—Air defense grid.

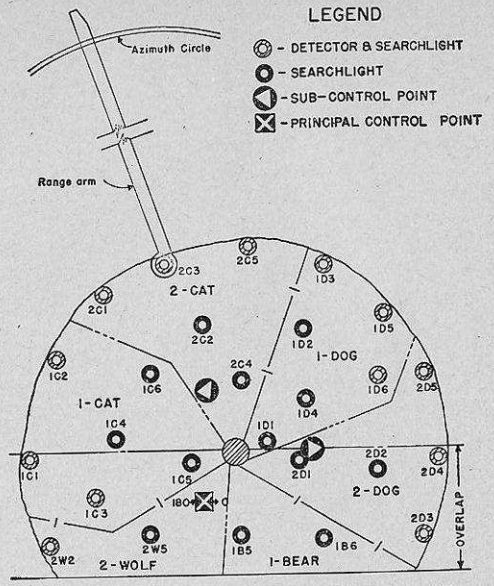
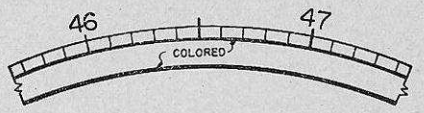
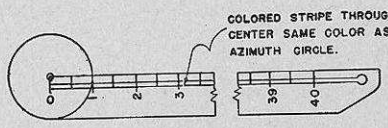


FIGURE 21.—Enlargement of searchlight positions.



DETAIL OF AZIMUTH CIRCLE

GRADUATED IN UNITS OF 10 MILS EACH



DETAIL OF RANGE ARM

GRADUATED IN UNITS OF 500 & 1000 YDS

FIGURE 22.—Range arm and azimuth circle.

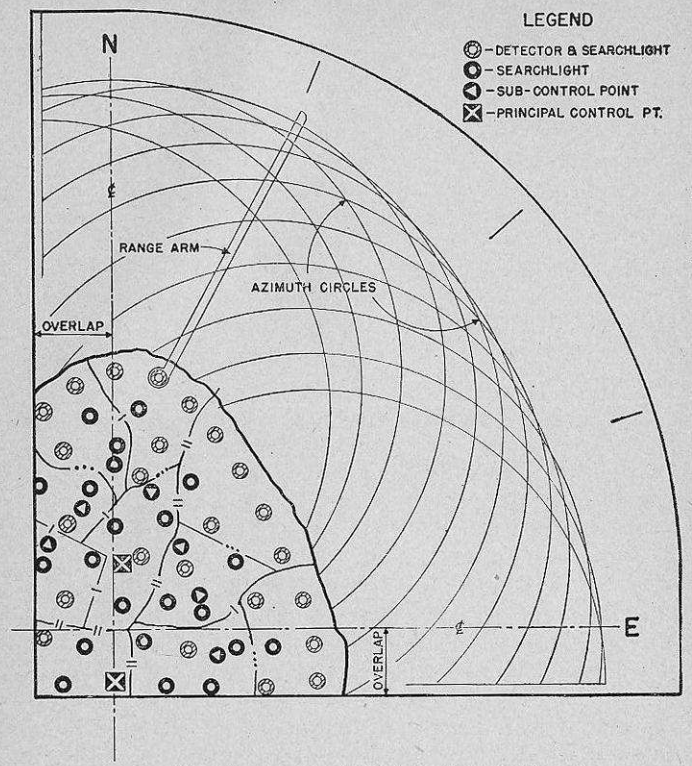


FIGURE 23.—One segment of a four-segment board.

SECTION IV

PERSONNEL AND OPERATIONS OF AAA OPERATIONS BOARD

■ 41. GENERAL.—The personnel who furnish the basic data for the operation of the AAAIS are located at the detectors on the perimeter of the searchlight area. The remainder of the personnel of the AAAIS are located at the AAA operations room. The detector section is responsible for reporting to the AAA operations room the number of planes in the attack and the identification of any planes that are picked up. This section describes the duties of the personnel of the AAAIS.

■ 42. AZIMUTH DATA READER.—The azimuth data reader is a member of the detector section, and is stationed at the detector in a position from which he can read the azimuth scale of the detector. His duties are to read and transmit over the data line azimuth data on targets being tracked by the detector, and to repeat over the data line all information concerning number and identification (such as IFF) of targets as announced by the oscilloscope operators. He transmits over the data line announcements such as "Contact," "On target," "Off target," "Change target," "Target illuminated," and "Intersection." Another duty is to repeat to the detector commander the information "Cease giving data" when so announced by the plotter at the direction of the searchlight plot observer.

■ 43. RANGE DATA READER.—The range data reader is a member of the detector section and is stationed at the detector in a position from which he can read the range counter and altitude dial. It is necessary to improvise mirrors and a seat to enable the range data reader to secure these data. His duties are to read and transmit over the data line range and altitude data on targets being tracked.

■ 44. PLOTTER.—A plotter is stationed at the outer edge of the AAA operations board for each detector. His duty is to plot on the AAA operations board the azimuth and range data received over the data line. He also marks the altitude on the AAA operations board when received. He repeats aloud all information received over the data line except azimuth and range. When so directed by the searchlight plot observer, he transmits "Cease giving data" over the data line.

■ 45. SEARCHLIGHT PLOT OBSERVER.—The searchlight plot observer is stationed on the floor overlooking the AAA operations board. His duty is to give intelligence on incoming targets direct to the interested searchlight platoon command posts. He supervises the operation of all plotters. When more than one detector is tracking the same target, he selects the one to continue to furnish data and orders the other plotters to transmit "Cease giving data" over their data lines.

■ 46. RAID ORDERLY.—*a.* The raid orderly is stationed on the floor close to or behind the searchlight plot observer. He

is responsible for providing the searchlight plot observer with correct display equipment. He prepares display stands, and assigns a number on each new raid. This number is ordinarily taken from the number of the same raid shown on the fighter control area operations board, and is indicated by a number on a blue rectangle. In the case of a raid which does not appear on the fighter control area operations board, the raid orderly assigns to the raid a number of the AAA operations room series, which number will be shown on a white rectangle. He also selects a yellow rectangle showing the number of aircraft in the raid and a red rectangle showing the altitude. The information on number of planes and altitude is taken from the fighter control area operations board until similar information is obtained from the AAAIS, at which time the AAAIS data will be used. The raid orderly hands the properly prepared stand to the searchlight plot observer who places it on the AAA operations board behind the position of the detector plotting the course. The stand is placed in such a position that it is always visible to the intercept officer. The raid orderly makes changes in the information shown on the display stand and removes the display stand when directed by the searchlight plot observer.

b. Display stands.—The display stand consists of an inclined wooden block which will receive three colored plastic rectangles. In the top space a *blue* or *white* rectangle showing the raid number is displayed. In the second space a *yellow* rectangle showing number of aircraft is displayed. In the lower space, a *red* rectangle showing the altitude of the raid is displayed. On the altitude rectangle, one side is marked with altitude in *hundreds of yards* as it comes from the detector, while the other side is marked with the corresponding altitude in *thousands of feet* as it is shown on the display stands. (See fig. 24.)

■ 47. OPERATION OF AAAIS SYSTEM.—*a.* The detector units on the perimeter of the searchlight area search through their normal searching sectors for a target. In order to cut down mutual interference between mounts and provide for relief during the 24-hour day, it is desirable to operate alternate mounts during the searching phase. When early warning from the Aircraft Warning Service has alerted the defense, those detectors not in action will start generators and

will be prepared for operation, but transmitter switches will remain open. Upon pick-up by a searching detector, the searchlight plot observer in the AAA operations room gives appropriate warning and intelligence to the commanders of all threatened searchlight platoons. The platoon commanders thereupon order all detectors to search and all transmitter switches closed.

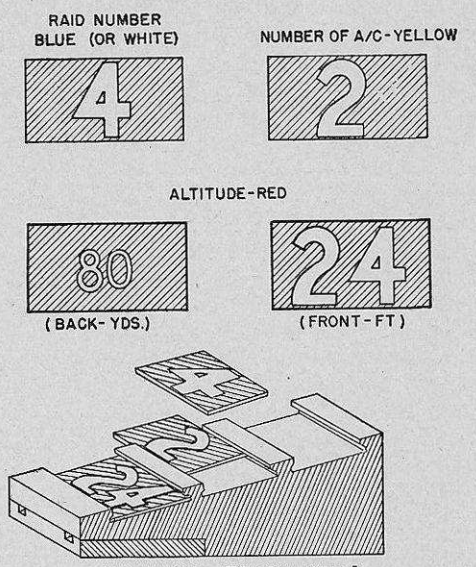


FIGURE 24.—Display stand.

b. When one of the oscilloscope operators picks up a target and announces "Contact," the azimuth reader immediately repeats "Contact" over the data line to alert the plotter. When the detector commander calls "On target," the azimuth reader reports "On target" to inform the plotter that accurate data in azimuth and range are available, and also reports any information announced by the oscilloscope operators concerning number of planes being tracked and IFF indications. Altitude data may not be accurate at the beginning of the plot, since the detector commander announces "On target" as soon as azimuth and range are correct, without waiting for accurate altitude data. The azimuth data reader,

having informed the plotter that accurate azimuth and range data can be furnished, commands: TAKE. At the command TAKE, the azimuth reader reports over the data line, *to the nearest 10 mils,* the azimuth indicated by the azimuth scale; the range reader then reports over the data line, *to the nearest hundred yards,* the range indicated by the range counter. The range data should be read immediately after the azimuth data have been transmitted. Upon hearing the azimuth of the plot, the plotter positions his plotting arm at that azimuth. Upon hearing the range, he makes a mark with a charcoal pencil on the plotting surface opposite the proper range mark on the range arm. Two or three seconds after the range reader has finished transmitting the initial range and altitude, the *azimuth reader* again gives the command TAKE and immediately reads and transmits the next azimuth. When the azimuth has been transmitted over the data line, the range reader reads and transmits the range. This process is repeated continuously until the target has been illuminated, lost, or the searchlight plot observer directs "Cease giving data."

c. When a target which is being tracked by a detector is illuminated, the chief controller announces "Target illuminated," and this announcement is transmitted over the platoon command net by the telephone operator, and repeated to the detector commander by the detector phone operator. The detector commander calls "Target illuminated" so that it can be heard by the detector crew, and the azimuth reader immediately repeats this information over the data line. "Target illuminated" is announced by the first two lights making the illumination.

d. As soon as any *other* light forms an intersection on his beam, the detector commanders of the first two detectors whose lights are forming the intersection announce "Intersection," which is repeated over the data line by the azimuth reader to the operations room. If the detector commander then orders CHANGE TARGET, the azimuth reader also repeats this command for the information of the plotter.

e. If the detector loses the target while a plot is being made, the azimuth reader repeats "Off target" over the data line as soon as it is announced by the detector commander and no more data are transmitted to the operations room.

f. Data are supplied over the data line in the following order: azimuth, range, altitude. Altitude data are furnished with the first three or four readings *after the altitude data have become accurate,* and with every fourth or fifth reading thereafter. Angular elevation, and therefore altitude, is inaccurate below angular elevations of 150 to 250 mils above the angle of mask. When the angular elevation rises above this minimum angle, the altitude data can be considered accurate, and should then be read. If the angular elevation is lower at the beginning of a plot, the range reader should follow his first range reading with the announcement "altitude unknown," and should repeat this announcement every fourth or fifth reading until the altitude data become accurate, at which time he will begin to furnish altitude data to the plotter as outlined above. Altitude data are always preceded by the word "altitude," but azimuth and range data are given directly, without using the words "azimuth" or "range." Altitude is read in yards *to the nearest hundred yards.* In reading data, each digit is pronounced separately. For example, if, at the command TAKE, the azimuth were 3,617 mils, the range 42,740 yards, and the altitude 4,820 yards, the data would be read as follows:

"Three–six–two; four–two–seven; altitude four–eight."
Numerals will be announced as prescribed in FM 24–5.

g. An example of the complete transmission of data that might be heard by a person tapped in on a data line during a typical plot is as follows:

Azimuth reader: "Contact."
Azimuth reader: "On target; one plane."
Azimuth reader: "Take."
Azimuth reader: "Four–zero–eight."
Range reader: "Three-five-one; altitude unknown."
Azimuth reader: "Take, four–one–zero."
Range reader: "Three-three-seven."
Azimuth reader: "Take, four-one-two."
Range reader: "Three-two-five."
Azimuth reader: "Take, four-one-four."
Range reader: "Three-one-one."
Azimuth reader: "Take, four-one-seven."
Range reader: "Two-nine-eight; altitude unknown."
Azimuth reader: "Take, four–two–one."

Range reader: "Two–eight–two."
Azimuth reader: "Take, four–two–four."
Range reader: "Two–seven–zero."
Azimuth reader: "Take, four–two–eight."
Range reader: "Two–five–eight; altitude five–one."
Azimuth reader: "Take, four–two–seven."
Range reader: "Two–four–six; altitude five–one."
Azimuth reader: "Take, four–three–six."
Range reader: "Two-three-five; altitude five-one."
Azimuth reader: "Take, four-four-one."
Range reader: "Two–two–five."

* * * * * * *

Azimuth reader: "Target illuminated."
Azimuth reader: "Intersection."
Azimuth reader: "Changing target."

h. The plotter in AAA operations room, upon hearing the azimuth after hearing "Take," swings his range arm until the index of it is at the proper azimuth. Opposite the proper range, he marks a circle about ½ inch in diameter on the operations board, using a china or charcoal pencil. This plotting process is repeated until the target has been illuminated or lost.

i. Searchlight plot observer.—When an initial contact is made and a plot begins, the searchlight plot observer, over the intelligence net, at once calls the platoons concerned and notifies them that a target is approaching them from a certain general direction, as "West" or "South-south-east." As soon as several plots are made and the course of the target is established, the plot observer steps to one side or the other, if necessary, in order to spot its line of approach quickly by eye, and gives its course by a line determined by the two searchlight positions most nearly in line therewith, as:

"One Jay—Two Jay—Two Fox:
"Target approaching you on line—One Jay Three—To Fox One."

j. The function of the AAAIS—to provide close-in and relatively precise intelligence concerning the approach of enemy aircraft which is necessary for effective employment of friendly fighters and AAA weapons—is completed when a plot of the target's course is displayed on the operations board. The dissemination of this intelligence is a function of the organizations requiring it.

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SECTION V

PERSONNEL AND OPERATIONS OF AAA OPERATIONS ROOM

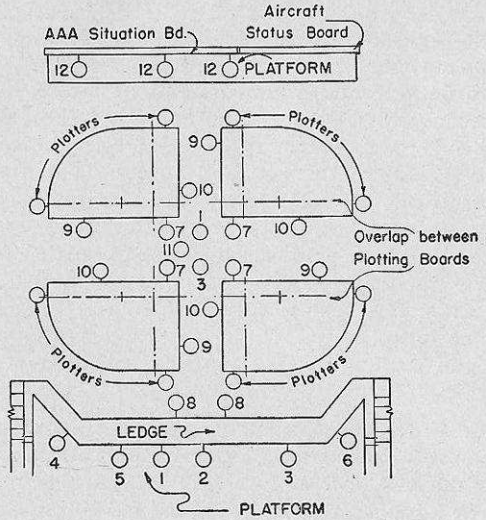
■ 48. GENERAL.—In the combined defense wherein the searchlight area set up in a fighter control area for fighter cooperation includes within its boundaries gun defended areas, the AAA operations room is, by its nature, suited to all the requirements of fighter-searchlight team control and to those of the antiaircraft artillery elements of the defense for intelligence and control. For this reason the AAA operations room is located whenever possible in the fighter control area operations room. The AAA operations room of such a fighter control area operations room is shown in figure 25.

■ 49. INTERCEPT OFFICER.—*a.* The intercept officer is an air force officer stationed on the balcony overlooking the AAA operations board and fighter control area operations board. While controlling fighters during fighter-searchlight team operations at night, he takes a station on the floor overlooking the AAA operations board. His principal duty is to control the movements of fighter airplanes from the principal control points to the proper subcontrol points by means of VHF (very high frequency radio used for air-ground communication) and to dispatch the fighters from the subcontrol point to an interception after the searchlights have reported an intersection. During heavy raids more than one intercept officer may be necessary. The intercept officer has a telephone line direct to the area controller. He also has a hand microphone and receiver for communications with fighter pilots by means of VHF.

b. In the daytime, with the AAAIS operating, targets may be picked up by the AAAIS before interception has been accomplished. The intercept officer can obtain the altitude of these targets from the raid stand on the AAA operations board and can adjust the altitudes of his fighters accordingly.

■ 50. AAA OPERATIONS OFFICER.—The AAA operations officer is the representative of the commander of all the AAA units operating in the fighter control area, and supervises all AA operations in the AAA operations room. He keeps the wing

AAA liaison officer informed of the status of all AAA in the area. He maintains liaison with AAA operations officers in adjacent areas. He also transmits to the wing filter officer intelligence on enemy targets initially picked up by the AAAIS. His station is on the balcony overlooking the fighter control area operations board and AAA operations board.



PERSONNEL

Intercept officer	1	Searchlight plot observers	7
AAA operations officer	2	Raid orderlies	8
Gun operations officer	3	Gun plot observers	9
AAA communication officer	4	Wing AAAIS tellers	10
Searchlight operations officer	5	D/F plotter	11
Balloon barrage liaison officer	6	Situation board plotters	12

FIGURE 25.—AAA operations room.

He has direct communication with the wing AAA liaison officer, the wing filter officer, the area controller, and the AAA operations officers in adjacent areas.

■ 51. AAA COMMUNICATION OFFICER.—The communication officers of the various AAA groups and AAA battalions in the area will normally be rotated as the AAA communication officer, acting as the representative of the communication

officer of the responsible AA commander. His station is in the AAA operations room at a position where he can monitor all communication lines. His duties are to monitor all communication lines, to check telephone procedure and to supervise trouble shooting when necessary. He is responsible for the conduct of the prescribed communication checks and for the maintenance of records on communication checks.

■ 52. GUN OPERATIONS OFFICER.—The gun operations officer is normally stationed on the balcony. However, with a large, all around defense and a split operations board, he should have a secondary station in the center of the floor. His principal duty is to transmit the grid coordinates of approaching targets to the gun and automatic weapons batteries concerned. He may detail this duty to the gun plot observer. He also transmits orders governing restriction and release of fire when ordered by the AAA operations officer. He receives tactical reports from the gun and automatic weapons units. He has *direct lines* to all gun and automatic weapons batteries. These lines are tapped and extended into the gun and automatic weapons battalion and group headquarters for their information.

■ 53. GUN PLOT OBSERVER.—The gun plot observer is an assistant to the gun operations officer and is stationed on the floor near the AAA operations board. His duty is to transmit grid coordinates of raids to the appropriate gun and automatic weapons batteries. His telephone is tapped and extended to those lines of the gun operations officer which go to the gun and automatic weapons batteries.

■ 54. SEARCHLIGHT OPERATIONS OFFICER.—The searchlight operations officer is stationed on the balcony overlooking the AAA operations board, and is the representative of the commander of the searchlight defenses. He is responsible for the efficient operations of the AAAIS system. He carries out the orders of the searchlight defense commander concerning the number of AAAIS detectors in operation at any one time. He transmits orders to the appropriate platoon command post regarding general restriction or release of searchlight action as ordered by the AAA operations officer. He keeps the AAA operations officer informed of the status of the searchlights and detectors in the searchlight area. He has direct communication with each platoon command post, with the searchlight plot observers on the floor, and with the searchlight operations officers of adjacent searchlight areas.

■ 55. BARRAGE BALLOON LIAISON OFFICER.—The barrage balloon liaison officer is stationed on the balcony. He transmits to the barrage control room orders of the AAA operations officer concerning the balloon barrage. He keeps the AAA operations officer informed of the status at all times of the balloon barrage. He has direct communication with the barrage control room.

■ 56. WING AAAIS TELLER.—One wing AAAIS teller, a member of the air defense wing, is stationed at each segment of the AAA operations board. His duties are to transmit grid coordinates of raids to the wing filter room using the air defense grid which is superimposed on the AAA operations board, and to situation board plotters of adjacent searchlight areas. He has direct connection to the wing filter room and to adjacent area AAA situation boards over the same line.

■ 57. D/F PLOTTER.—The D/F (direction finding) plotter, a member of the air defense wing, is stationed on the floor near the AAA operations board. His duty is to plot, when necessary, the position of friendly aircraft on the AAA operations board. He has communication with the D/F plotting room.

■ 58. SITUATION BOARD PLOTTERS.—Situation board plotters are stationed at the AAA situation board.

a. A situation board plotter has communication with the wing AAAIS teller of each adjacent searchlight area which line is multiplied to the wing filter board. His duty is to plot on the AAA situation board information of hostile raids furnished by AAAIS in adjacent areas.

b. In those cases where the AAA operations room is in a separate room rather than in the fighter control area operations room, two additional situation board plotters are required. One of these plotters has communication with the wing filter room land teller and the other with the wing filter room sea teller (when both tellers are used in the wing

filter room). Their duties are to plot on the AAA situation board all plots told to them from the wing filter room.

■ 59. OPERATIONS OF AAA OPERATIONS ROOM.—*a.* As soon as the first few plots of an enemy raid appear on the AAA operations board, the gun plot observer alerts the gun and automatic weapons batteries which seem likely to be affected by the raid. He gives them the actual position of the enemy target in grid coordinates, using the air defense grid which is superimposed on the AAA operations board. The gun operations officer supervises this action and may give specific orders to the gun plot observer concerning which gun and automatic weapons batteries should receive this information.

b. At the same time, the wing AAAIS teller, also using the air defense grid, transmits the coordinates of the raid to the wing filter room, so that it may be checked with the plots already on the filter board, to determine whether or not the raid has already been picked up and reported by the AWS.

c. The raid orderly checks the coordinates of the new raid against the coordinates of the raids appearing on the fighter control area operations board. It is usually found that this raid already appears on the area operations board, having already been reported by AWS. If this is the case, the raid orderly assigns to the raid the same number which was assigned to that same raid on the area operations board. He puts the proper raid number on the raid stand, and hands the stand to the searchlight plot observer, who places it on the AAA operations board at a position near the detector which is reporting the data. When information is received from the detector and announced by the plotter concerning the number of planes and the altitude, the appropriate placard displaying these data is selected by the raid orderly and handed to the searchlight plot observer for display on the raid stand.

d. Meanwhile, the searchlight plot observer contacts the searchlight platoon command posts of the platoons in line with the apparent direction of the raid. As the plot of the enemy raid progresses inward on the AAA operations board, the gun plot observer continues to transmit the grid coordinates to the gun batteries unless otherwise ordered by

the gun operations officer. In transmitting the coordinates to the gun batteries, he specifies the raid number, which he obtains from the placard in the raid stand.

e. In the event that the raid is a new one which does not appear on the area operations board, the wing AAAIS teller continues to transmit the grid coordinates of the raid to the wing filter room until ordered otherwise. The intercept officer, observing the plots on the AAA operations board, determines the subcontrol point nearest in line with the direction of the enemy raid. Using VHF, he dispatches the fighter from the principal control point to the appropriate subcontrol point, using the standard phraseology called for by Standing Operating Procedure. The pilot reports back to the intercept officer after he has arrived at the designated subcontrol point. The searchlight plot observer, as soon as he is able, informs the affected searchlight platoons of the exact course of the enemy raid.

f. Meanwhile, the AAA situation board plotters in adjacent areas have received the grid coordinates of the raid at the same time they were received at the wing filter room, since the teller's line to the wing filter room is tapped and extended to the plotter's position at the AAA situation board in adjacent areas. The raid is plotted on these AAA situation boards. The gun operations officer, during this period, transmits to the gun batteries any necessary orders concerning their action. The AAA operations officer gives to the barrage balloon liaison officer any orders concerning a change in status of the balloon barrage which might be dictated by the raid. The barrage balloon liaison officer, in turn, transmits these orders to the barrage control room.

g. When the target has reached the searchlight area and an intersection of two or more searchlight beams is formed on the target, this fact is reported to the plotter at the AAA operations board, who calls aloud, "Intersection." The intercept officer, upon hearing this information immediately dispatches the fighter from the subcontrol point to make the interception. In order to insure that the intercept officer does not miss the announcement "Intersection," the searchlight plot observer crosses his arms above his head as a signal, as soon as the announcement is made by the plotter.

CHAPTER 5

TACTICAL CONTROL OF SEARCHLIGHTS

	Paragraphs
SECTION I. General	60–62
II. Tactical operations	63–68

SECTION I

GENERAL

■ 60. GENERAL.—*a.* This chapter deals with the phases of searchlight operation which directly affect the illumination of targets. It covers technique and methods of operation essential to the one basic requirement—the illumination of targets, regardless of the use to which the illumination is to be put.

b. In addition, certain simple, special features of illumination required for fighter cooperation are stressed. Illumination produced in accord with the principles contained herein is equally suitable, however, for the needs of guns or of fighter aircraft.

■ 61. CONTROL.—Control by all higher echelons is limited to that of the broader decisions as to "Conditions of Readiness for Action" or of general restriction or release. That is, detectors and lights are ordered either to remain out of action beginning at a certain time, or, at a certain time, are released to take such action as the situation may require. The normal condition for searchlights, in the absence of reasons to the contrary, will always be that of being released unless and until specifically restricted. The reverse policy, that of normal restriction unless and until specifically released, could easily prove disastrous by nothing more than a communications failure, whether by sabotage or accident. Beyond the above, communication between the searchlight platoons and higher commanders consists primarily of the downward flow of intelligence. The highest tactical commander who is capable of exercising effective control, and who is close enough to a given place of action to know to any material degree what action is required, is the lieutenant

commanding the platoon. Even he, however, cannot possibly make all the tactical decisions required in the case of a multiple plane attack over his platoon, even if he could be informed rapidly enough of the situation existing at each of his light sections to enable him to make correct decisions in the time available. There are occasions when choices must be made which the platoon commander is in the best position to make, and to give orders accordingly, However, a light or detector commander who has to be given many orders is not properly trained or not qualified. Tactical control during action by individual detector and light commanders, previously thoroughly trained and indoctrinated, is the only control adequate to handle the problem. This requires that the light and detector commanders have the qualifications of intelligence, decision, and good judgment, and that they be given thorough training and indoctrination in the principles of tactical control.

■ 62. LIGHT COMMANDER.—*a.* The most important job from a tactical point of view in a searchlight section is that of the light commander since he is required to make the important tactical decisions. The light commander must be free from all duties which interfere with his tactical control of lights.

b. The light commander's post should be in the vicinity of the control station, and about 10 or 15 feet from it, where he will not be distracted by the operation of the control station itself. He must watch the skies for signs of action, so that he can keep himself constantly aware of the general situation. He must *never* make the mistake of confining his attention to his own searchlight beam when it is in action, but rather should be sizing up the situation in general, including frequently scanning the sky *behind* him, so as to prepare himself in advance for the next action which will be necessary. He will receive from the telephone operator at the control station information on targets which are contacted and tracked by his own detector, and also general information concerning the operation of all the other sections in his platoon. The platoon command post will relay to him, also through the control station telephone operator, information on approaching targets which are being plotted on the AAA operations board but which have not yet been

illuminated. All orders, instructions, and information transmitted over the platoon command net will be preceded by the number of the originating telephone.

c. The searchlight should be put in or out of action *only* on direct orders from the light commander. He gives the command IN or OUT and the chief controller relays the commands to the lamp operator by means of the buzzer system connected between the control station and the searchlight. Even when the telephone operator at the control station receives the command IN or OUT from the platoon CP and repeats it aloud for the benefit of the light commander, the chief controller still must wait for the light commander to give the order himself before he (the chief controller) signals the lamp operator. The same principles apply to the command CHANGE TARGET. Likewise, when the detector has been tracking a target, and the control station telephone operator receives the announcement "Range" and repeats it aloud, the light must not be put in action until the light commander himself gives the order.

d. When the command CHANGE TARGET is given, the chief controller may not know to which of several possible targets he should swing the searchlight beam. Since he is already following one target through his binoculars, his field of view will be so small that in general he will not know that there *are* other targets in the vicinity until he hears the command. In order that the command CHANGE TARGETS may be executed with a minimum of delay, and that the searchlight beam be traversed to the proper target selected by the light commander, the latter, upon giving the command CHANGE TARGET, should immediately run over to the chief controller and actually point out to him the target selected, so that there can be no mistake or delay. In the event that the new target has not yet been illuminated by any searchlight beams, but is being tracked by the detector and is within searchlight range, the light commander should follow the CHANGE TARGET command with the announcement "On data," to inform the controllers that they should go back on detector data by zeroing the azimuth and elevation needles.

e. The light commander should know the direction of all adjacent searchlights, as this information is sometimes very

important in making tactical decisions. In order to locate definitely these adjacent lights, he should set stakes out around the position he occupies during action, to indicate their direction. These stakes should be marked with the appropriate light designations which he can see with the aid of a flashlight; cat's eye reflectors with the designations painted on them make excellent markers, which can easily be fastened to the stakes.

f. The light commander should see that the chief controller watches the sky through the binoculars when the detector is on the target even before the searchlight goes into action. Since the binoculars, by means of the data transmission system and zero readers, will be trained in the direction of the target being tracked, the chief controller occasionally may be able to pick up a target by spotting its exhaust or by seeing it blot out stars or seeing it in a moonlit sky. If the chief controller should happen to pick up a target in this manner before the light is put in action, he should immediately take over the controls and continue to track the target; he should not, however, give the signal to put the light in action unless the light commander so orders.

g. The light commander is responsible for informing the platoon command post of any available information on the recognition of aircraft. He receives his information from the chief controller who, due to his use of binoculars, has the best view of illuminated airplanes of anyone in the section .

SECTION II

TACTICAL OPERATIONS

■ **63. INITIAL PICK-UP.**—*a.* (1) The initial pick-up is made by those lights in the first or second row which have detectors. When initial illumination has been effected, the nearest light in the first or second row will complete the intersection.

(2) The range at which a searchlight should go into action in an attempt for an initial pick-up should not exceed 15,000 yards. When the range of the incoming target has dropped below 15,000 yards, and the angle of elevation has risen to the minimum angle at which the altitude data become accurate, the detector commander announces

"Range," the detector telephone operator repeats it over the platoon command net, and the control station telephone operator repeats "Range" to the light commander. The minimum angle of elevation at which altitude data become accurate varies with different detectors, but will be between 150 and 250 mils if the normal front of the detector is over level ground or the ocean. If a terrain or other type mask exists in the normal front, then the minimum angle of elevation at which altitude data become accurate will be 150 to 250 mils *above the angle of mask*. The minimum angle can be determined for each radio locator by tracking an outgoing illuminated target with the detector and determining the angle of elevation at which the elevation needle of the zero reader on the searchlight begins to materially deviate from zero.

(3) The light commander, if he is satisfied that his controllers have their needles at zero and that the chief controller is ready for action, should then immediately order IN. The chief controller notifies the lamp operator by the buzzer signal system and the lamp operator puts the light into action. The controllers continue to keep the azimuth and elevation needles at zero; *there should be no searching by the controllers in a detector-searchlight section.*

(4) When the light goes into action, the detector commander should then watch for the formation of an intersection by another light, and as soon as he sees that one has been formed he calls "Intersection." "Intersection" is announced whether or not the target is actually illuminated; the two lights may still be searching for the target, or they may be illuminating a target which cannot be seen from the ground due to poor visibility. The azimuth data reader repeats the announcement "Intersection" over the data line, and it is called aloud in the AAA operations room by the plotter. The same announcement "Intersection" is made to the AAA operations room by the section completing the intersection.

(5) When the chief controller can see the illuminated target he announces "Target illuminated," and this announcement is repeated by the telephone operator over the platoon command net. The detector telephone operator then

repeats aloud the announcement "Target illuminated" and the azimuth data reader immediately transmits this information over the data line. "Target illuminated" is announced by the first two sections making the illumination.

b. (1) When a searchlight goes into action for an initial pick-up, the chief controllers of all adjacent lights in the first and second rows should intently watch the beam to see whether it is illuminating a target. Due to angles of reflection, the chief controllers of adjacent lights will sometimes be able to see a target which has just been picked up in a beam before the chief controller of the searchlight which is illuminating the target sees it. The chief controller of an adjacent light may spot the target more easily by scanning with his binoculars up and down the other searchlight beam.

(2) As a target is observed, the chief controller should, without delay, inform the light commander, who should immediately put his light in action to form the intersection even though his own detector may be sending in data on another target. The *formation* of an *intersection* should be given *priority* over the *picking up* of an additional *target*. However, after other beams go into action on the target, the light commander of the forward light should then change to the new target, if it is at the proper position, by going back on data. If his detector is tracking a target which has *not yet* reached the proper position, the light commander should continue to illuminate the first target until the new target *does* get within 15,000 yards and reaches an angle of elevation of 150 to 250 mils above the angle of mask, or until he is properly relieved by other lights. Although it is highly desirable to keep three or four beams on each illuminated plane, this should not be done at the expense of losing a new incoming target. In summation, the priority for the first and second rows of lights is as follows:

(*a*) To make initial pick-up.
(*b*) To produce and maintain a two-beam intersection.
(*c*) To pick up succeeding targets.
(*d*) To maintain the prescribed maximum number of beams on each target.

■ 64. NUMBER OF BEAMS REQUIRED ON SINGLE TARGET.—*a.* The number of beams required for illumination of a single target depends upon the following factors:

(1) Illumination must be sufficient to enable the fighter pilot to locate the target, proceed to the point of interception, and press home the attack.

(2) The illumination should be provided in such a manner that it in no way interferes with the fighter as he makes his attack.

(3) Illumination must be sufficient to render the target visible to the chief controller in the searchlight section, so that he can track the target visually.

b. (1) Sufficient illumination for the fighter pilot to locate the target, proceed to the point of interception, and press home the attack, can normally be met with two searchlight beams.

(2) The fighter pilot does not have to see the target itself in order to locate it; if he can see the intersection, that will be all he needs to direct him to the target. As he approaches the intersection, the illuminated target will become visible to him, and the illumination produced by two searchlight beams is sufficient to enable the fighter pilot to press home the attack.

(3) As more and more beams are directed at the target, the apex of the cone of lights becomes coarser and coarser, with a larger ball of light being built up around the target, as shown in figure 26. Also, the more beams there are on the target, the greater will be the possibility that one or more of them are not exactly alined with the binoculars, or that one of the chief controllers will track a little off the target—which tends further to increase the diameter of the ball of light around the illuminated plane. This condition may reach the point at which the fighter pilot will have to fly into the illuminated zone around the target in order to close to effective range, which would have the adverse effects of not only blinding the pilot, but also illuminating the fighter so that it becomes an easy target for the rear gunner in the enemy plane.

(4) Therefore, *as far as the fighter pilot is concerned,* two beams on a target, or possibly three at high altitudes, are all that is desired.

c. However, on a well camouflaged plane at altitudes greater than 15,000 feet, three searchlights may *not* provide sufficient illumination to insure that the chief controllers will be able to track the target visually. Therefore, since the fighter pilot requires only two beams, as explained above, the total number of searchlights required to illuminate any given target will be *the minimum number which will enable the chief controller to track the target visually.* With well camouflaged planes at 15,000 feet altitude, four beams will usually be sufficient. At higher altitudes, or under conditions of poor visibility, one or more additional beams may be required. But in any case, the important thing to remember is that the number of lights used should be kept to the *minimum* which will insure adequate visibility to the chief controllers.

d. Based on the above considerations, the searchlight commander in each locality prescribes the maximum number of lights to be employed in the illumination of a single plane in that locality. Usually this authority is delegated to the platoon commanders since atmospheric conditions may vary in the different parts of the searchlight area. The prescribed maximum number will normally be three or four beams.

■ 65. GOING INTO ACTION.—*a. Initial pick-up.*—(1) Initial pick-ups should be limited to the *first two rows of lights.* Lights in the third row and beyond should act as carry lights and should illuminate *only* those targets picked up by the outer rows and passed in. This principle must be rigidly enforced, as it is the means which enables friendly fighters to fly through the searchlight area unilluminated. The fighters stay within the boundaries of the searchlight area at all times, in order to avoid being picked up and illuminated. If the inner lights attempt to pick up unilluminated planes flying inside of the searchlight area, they are certain to illuminate friendly fighters which are orbiting around the control points, or flying from one control point to another.

(2) The outer lights (first two rows) should make new pick-ups on only those targets which are *approaching the area.* Occasionally, a fighter may be pursuing an illuminated enemy target which has passed through the area and is about to leave it. Having reached its near vicinity, he

may be able to continue to follow it after illumination ceases, and should be permitted to do so.

(3) The oscilloscope operators should be taught that if a target suddenly appears on their scopes at close range behind another target which has been tracked in from long range, then the second target is a friendly fighter which has gone out too far, and should not be illuminated.

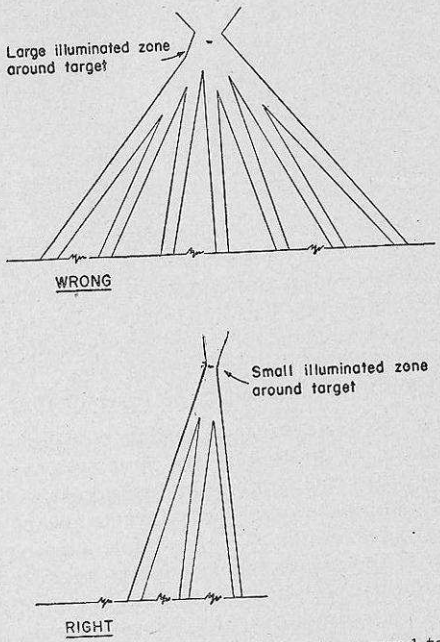


FIGURE 26.—Size of illuminated zone around target.

b. Carry.—(1) Lights in the first or second row should go into action on an illuminated target as soon as possible after it has been picked up. However, if any of these lights are receiving data on a second target from their respective detectors, they should not pass up the new target when it gets to the proper position in order to maintain the prescribed number of beams on the first target. The light

commander should continue to illuminate and carry the first target until he hears the telephone operator announce "Range," at which time he should immediately order CHANGE TARGET—ON DATA; upon receipt of this command, the elevation and azimuth controllers take over the DEC from the chief controller, and swing the searchlight beam, *without putting it out of action,* to the direction indicated by the radio detector data. (See fig. 27.)

(2) If one of the beams illuminating an enemy plane changes target in order to pick up a second incoming plane, the next nearest light in the first or second row should go into action, to replace the one which changed target, thereby maintaining illumination. In other words, until the target has passed into the third row of lights, the first two rows should endeavor to keep the prescribed number of beams

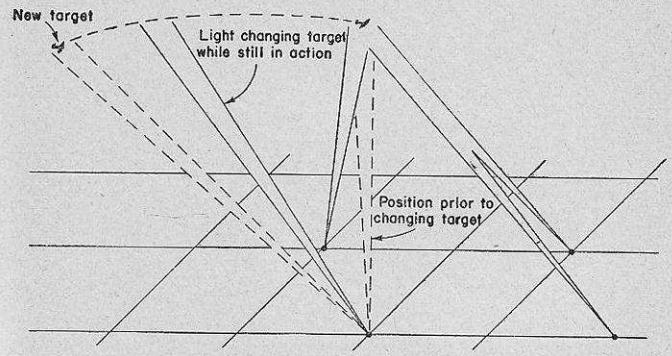


FIGURE 27.—Searchlight beam changing target.

on the target at all times, but should not pass up new targets in order to do so.

(3) The interior lights, beginning at the third row, are *strictly carry lights.* These lights should *never attempt initial pick-up.* They have a single criterion for going into action; that the approaching target be at a proper point in relation to the position of the light, as explained in the following paragraph. The number of searchlight beams already illuminating the target should have *no bearing whatsoever* on the time at which a carry light goes into action. When

an illuminated plane becomes a legitimate target for any particular light, that light *must* go into action and commence its carry, *regardless* of the number of beams already in action on it.

(4) The point at which an approaching plane becomes a legitimate target for a carry light is based upon the necessity of illuminating targets in such a manner that the illumination produced does not interfere in any way with the ability of the fighter pilot to make the interception and press home the attack. A fighter pilot should have a large unilluminated zone in the rear of the target, as shown in figure 28, to enable him to close in for the attack without

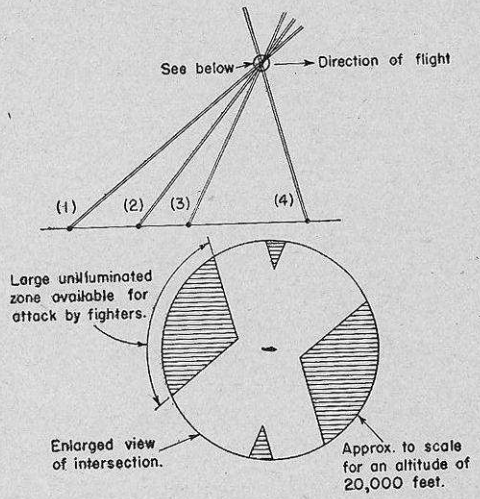


FIGURE 28.—Correct method of carrying target.

Beam No. 4 in action too soon, projecting behind and above bomber, thereby reducing unilluminated zone available for attack by fighter.

being illuminated himself. This unilluminated zone in the rear of the target should be as large as possible, so that the movements of the friendly fighter will not be hampered.

(5) If a carry light goes into action at low angles of elevation on a target directly approaching it, or nearly so, the light beam will strike the front of the approaching plane

and project out beyond the rear of the plane into the zone in which the fighter is moving. (See fig. 29.) For this reason, when an illuminated plane is approaching directly toward a carry light, the light commander of that light should wait until the angle of elevation of the light reaches about 70° to 75° before he orders his light into action. Then, when the light goes into action, it will strike the bottom of the plane and project up above it, and thus will be in a position where it will not interfere with the fighter pilot who may be maneuvering in the rear of the enemy plane. If the approaching

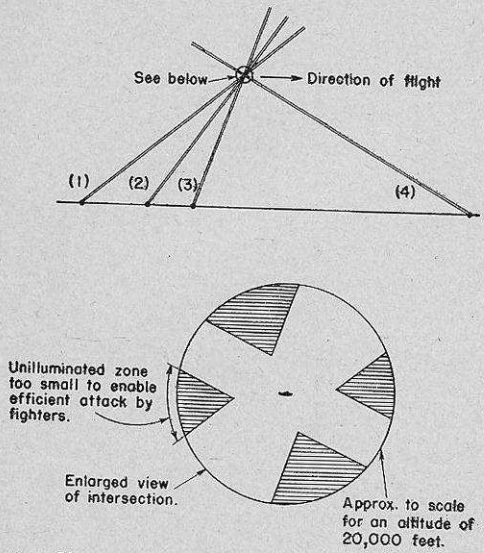
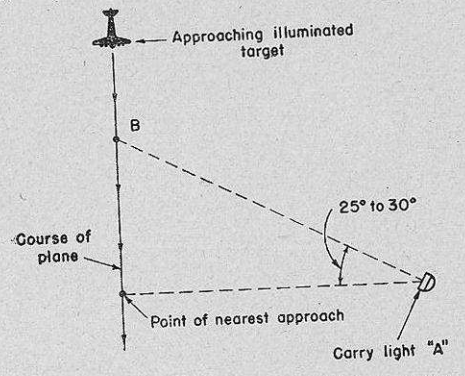


FIGURE 29.—Searchlight going into action too soon.

illuminated target is flying such a course that it will pass to one side or the other of the carry light which is waiting to go into action, the light commander may put his light into action at a somewhat lower angle of elevation, since in this case the light beam will be striking more or less against one side of the plane and projecting out beyond the other, rather than striking it from the front and projecting out to the rear. In this case, however, the light should not be

put into action until the plane has reached a point where the light beam will be at a horizontal angle of 25° or 30° to a line from the light to the nearest point of approach, as shown in figure 30.



(1) Light A is one of the four or five lights nearest to the target when the latter reaches point B.
(2) Light A should go into action when target reaches point B, *regardless* of the number of beams already illuminating it.

FIGURE 30.—Carry light going into action.

(6) The angles mentioned in (5) above are merely for illustrative purposes and should not be construed as being rigid requirements for the proper time for a light to go into action. They are figures which in general should produce good results, but the light commander should have a thorough understanding of the *principles* of illumination involved, rather than memorize a specific set of angles of elevation, or angles of approach, at which he should put his light into action. The two principles that should be remembered and applied when putting a carry light into action are these:

(*a*) That a carry light must illuminate a target in such a manner that there is no interference with friendly fighter aviation.

(*b*) That a carry light must go into action when the target arrives at the proper *position, regardless* of the number of beams already on the target.

■ 66. GOING OUT OF ACTION.—*a*. Except for the special cases concerning lights in the first two rows, as explained in paragraph 65*b*, a searchlight, once it has gone into action and is carrying a target, should *continue to carry* the target until *both* of the following conditions exist simultaneously:

(1) There are more beams on the target than the minimum number required.

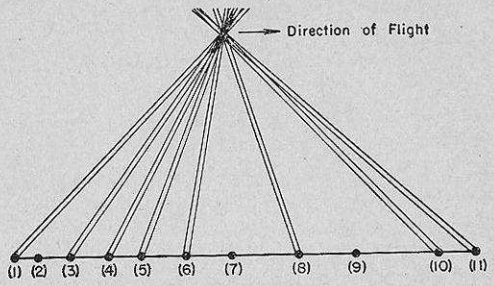
(2) The light in question is the farthest removed from the target.

b. (1) If only one, but not both, of the above conditions exists, then the light should *continue to carry* the target. For example, if there are too many beams on a target, it is the responsibility of the light commander whose light is *farthest* from the target *to go out of action first;* the other lights *must continue to carry* the target until each in turn becomes the one carrying at the greatest distance. No light should go out of action when there is a more distant light in action on the same target. Referring to figure 31, light No. 1 should go out of action since there are too many beams on the target, and it is the light which is farthest away. Light No. 3, on the other hand, should continue to carry the target, even though there are too many beams in action, until light No. 1 goes out.

(2) At times, a situation may arise where two lights, such as lights Nos. 1 and 10 in figure 32, are so located with respect to each other that it may be difficult for the light commanders to decide which of the two is the more distant from the target. In this case, since *both* lights are carrying at long range, it will usually be found that there are other lights carrying the target at much closer range, such as lights Nos. 4, 6, 7, and 9 in figure 32. If the light commanders of lights Nos. 1 and 10 are doubtful as to *which of the two* is the more distant, but each can see that there is a sufficient number of beams on the target, each of which is closer, such as lights Nos. 4, 6, 7, and 9, than the two carrying at long range, then the light commanders of lights Nos. 1 and 10 should *both* order their lights out of action without attempting to decide who should go out first. It is in such cases that platoon commanders, who may be in a more advantageous position to see the situation, should exercise corrective control and

order the lights out if the light commanders delay taking the proper action.

(3) It is important that lights go out of action in order from the rear, and accordingly, that an intermediate light *not* go out until after those behind it have gone out, in order



Numbered dots represent searchlights.

a. Errors in tactics illustrated above.

(1) There are too many beams on the target.

(2) Light No. 1 should *not* be in action, since there are too many beams on the target and light No. 1 is the rearmost light.

(3) Light No. 2, which went out of action because there were too many beams on the target, should *not* have gone out until light No. 1, *the rearmost light, went out first.*

(4) Light No. 7, which did not go into action because there were too many beams on the target, *should* have gone into action when the target reached the proper point, *regardless of the number of beams on it.*

(5) Light Nos. 10 and 11 have gone into action entirely too soon.

b. Correct tactics illustrated above.

(1) Light No. 3 is properly continuing to carry the target while waiting for light No. 1 to go out, *even though there are too many beams on the target.*

(2) Lights Nos. 4, 5, and 6 are properly carrying the target.

(3) Light No. 8 (assuming it has *just* gone into action) has started its carry at the proper time *even though there are too many beams on the target.*

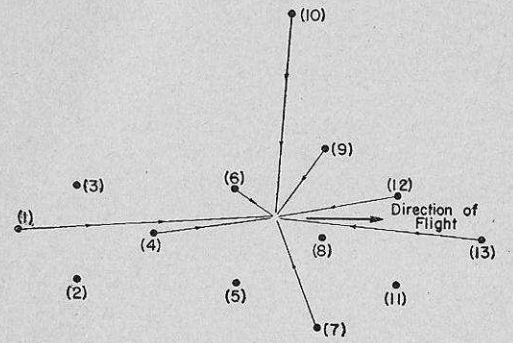
(4) Light No. 9 is properly waiting before going into action, until the target gets a little closer.

FIGURE 31.—Tactical handling of searchlight beams—vertical projection.

to obviate a sudden, inadvertent, extinguishing of too *many* beams, thereby causing the losing of the target. Unless this rule is followed it often happens in practice that the commanders of two or more intermediate lights decide to go out of action at almost the psychological moment that the commanders of the rearmost lights also decide to go out of action.

This results in so *few* beams remaining on the target that it may be lost.

(4) When illuminating targets which are *leaving the area,* the chief controller should continue to track as long as the



Numbered dots represent searchlights.

a. Errors in tactics illustrated above.

(1) Light No. 1 and light No. 10 should *not* be in action, since there are too many beams on the target and lights Nos. 1 and 10 are farthest away.

(2) Lights Nos. 2 and 3 should *not* have gone out of action, since light No. 1, which is more distant from the target, is still in action.

(3) Light No. 5 *should* be in action, even though there are too many beams on the target, since the plane is a legitimate target for this light.

(4) Lights Nos. 12 and 13 have gone into action *too soon.*

b. Correct tactics illustrated above.

(1) Lights Nos. 4 and 6 are properly carrying the target.

(2) Lights Nos. 7 and 9, assuming they have *just* gone into action, have started their carry at the proper time. Their greater lateral displacement from the target permits them to go into action before light No. 8, even though the latter is closer to the target, since their beams project past the *side* of the target plane rather than to the *rear.*

(3) Light No. 8 is correctly staying out of action until the target gets a little closer in order to get a greater angle of elevation for the searchlight beam.

(4) Light No. 11 is correctly staying out of action until the target plane gets closer.

FIGURE 32.—Tactical handling of searchlight beams—horizontal projection.

target is visible, except that the light commander should order CHANGE TARGET at the proper time if another target approaches which is still within the area. Targets which are just leaving the area, or which will leave the area soon if

they continue on their course, should have priority over targets which are already a considerable distance away, and still moving out.

■ 67. ILLUMINATION OF MULTIPLE PLANE ATTACKS.—*a.* Once the principles of tactical operation of searchlights, discussed in the preceding paragraphs, are thoroughly understood, the illumination of targets during a multiple plane attack becomes merely a problem of the practical application of these principles. Light and detector commanders should be thoroughly indoctrinated with the *principles* of tactical operation, rather than taught a method of handling some specific form of attack. Due to the difficulty of maintaining accurate time schedules, of flying precise courses for long distances, and of maintaining given lateral or column spacing, no two attacks will be *exactly* alike even if the two attack plans are identical. Several seconds' difference in time, or a few hundred yards' difference in course may change the situation as it concerns any particular searchlight. A plane which is a proper target for some particular light might not be a proper target if it approached several seconds later or on another course several hundred yards away. Therefore, as mentioned above, the *principles* of tactical operation must be learned, and applied to each situation as it arises.

b. The efficient illumination of targets during a multiple plane attack involves the following three requirements:

(1) Decentralization of control.

(2) Proper selection of targets.

(3) Correct application of principles of tactical operation.

c. Decentralization of control (see par. 61) is of absolute necessity during a multiple plane attack. The principles of tactical operation have been discussed previously, and their application to multiple plane attacks is exactly the same as for attacks by single planes. The question of proper selection of targets is discussed in the following paragraph.

d. The selection of targets is primarily the responsibility of the detector commander, but since he cannot maintain constant supervision of the oscilloscope operators and at the same time efficiently perform his tactical duties as detector commander, the oscilloscope operators must be trained

in the selection of targets in accordance with the following principles:

(1) *Targets in column.*—When several targets approach in column on the same flight path, they will usually be spaced far enough apart (20 seconds to a minute) so that there is a good chance to pick up all of them, one at a time. Therefore, the nearest target should be selected by the range operator, and tracked until it is illuminated; then the next nearest selected, and so on. (See fig. 33.)

(2) *Targets spaced laterally.*—When several targets which are separated laterally approach, the one *nearest to the norml front* should be selected by the azimuth operator, leaving the other targets to adjacent detectors. Targets approaching simultaneously on different flight paths, spaced laterally far enough apart so that they could not be considered a loose formation, will show up as separate echoes on both the range and the azimuth oscilloscope screens, provided they are not all at exactly the same range. The azimuth oscilloscope operator can determine which target is nearest to the center of the normal front by traversing the detector in azimuth and watching to see which echo gives the most response when the detector is facing closest to the center of the normal front. Usually, it will be found that the target nearest the center of the normal front will be the one at shortest range and, therefore, its echo will be the one at the extreme left on the oscilloscope screens. The azimuth operator should give directions to the range operator to increase or decrease the range in order to aline the selected echo with the center line of the azimuth oscilloscope screen. If the selected echo is to the left of the center line, the range must be decreased; if it is to the right, the range must be increased. When the selected echo has been centered on the scope, all three operators will track in the normal manner.

(3) *Targets stacked in altitude.*—(*a*) When several targets stacked in altitude, one directly above the other, approach, the target at the highest altitude should normally be selected by the elevation operator. The elevation operator is in the best position to make this selection. He can tell which is at the highest elevation by elevating the antenna and noting which echo is the last to rise. The echo which rises last, that is, which increases its height at the highest angle of elevation

of the antenna, will be the plane at the highest altitude. From its position in relation to the center line on the oscillo-

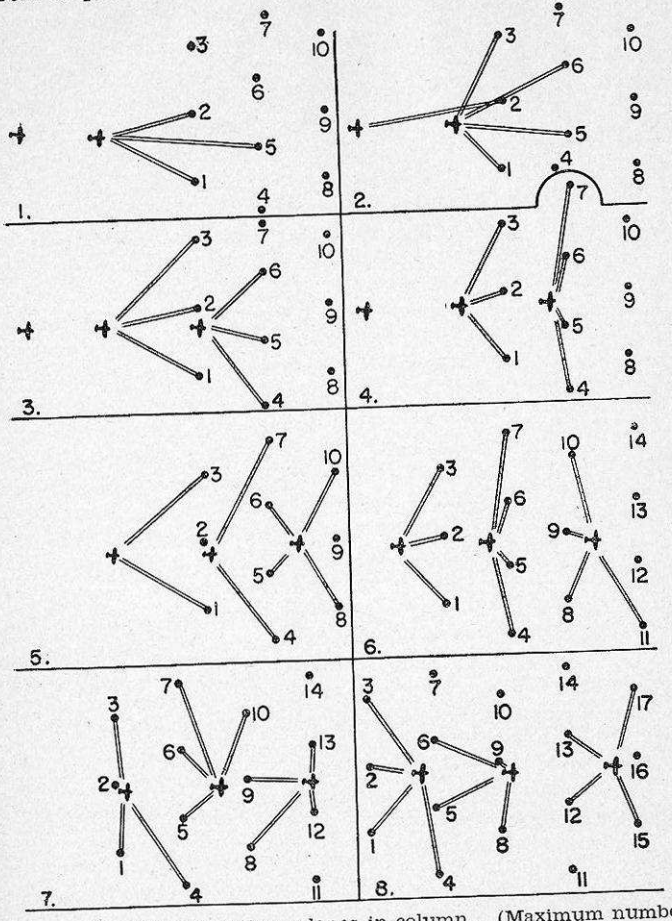


FIGURE 33.—Attack by three planes in column. (Maximum number of 4 beams per target has been prescribed in this case.)

scope, he can judge whether the range operator should increase or decrease the range in order to center that particular echo on the center line of the oscilloscope—if the echo is

on the *left* of the center line, the range must be *decreased*, while if it is on the *right* of the center line the range must be *increased*. Upon recognition of the approach of planes stacked up in altitude, the elevation operator must first determine which of the several echoes he sees is from the plane at the highest altitude; he then must call directions to the range operator, so that the latter can aline that echo with the center line of the elevation scope; finally, all three oscilloscope operators must track that target.

(*b*) Normally, the heavy bombers with the greatest bomb-carrying capacity are flown at higher altitudes, to afford them greater protection from antiaircraft fire; therefore, if targets approach simultaneously at low, medium, and high altitudes, the chances are that the highest altitude plane will be the most profitable target. However, if the enemy adopts the practice of flying his major bombardment extremely low, the above-described tactics of selection should be modified accordingly.

(4) *Loose formations.*—Planes attacking in loose formation, separated by several hundred yards, present a special case of the laterally spaced attack discussed in (2) above. The general solution is the same—each detector tracking the formation should center on the target closest to its normal front—but the actual selection of the target by the azimuth operators may be more difficult because the echoes from the individual targets may blend together into a single multiple-peaked echo due to the relatively small separation of the planes. The azimuth operator, in this case, must be extremely careful in scrutinizing the multiple-peaked echo as he traverses the detector so that he can determine which peak is closest to the center of his normal front, and direct the range operator accordingly. The greatest chance for error in handling a formation of this sort, in which the planes are close enough together so that the entire formation can pass between two adjacent first line lights, is the possibility of the first line detectors tracking the planes on the nearest side of the formation and allowing the front, or point, of the formation to enter the area unilluminated. This is likely to happen unless the formation directly approaches one of the lights, so that the center of the formation is dead ahead. In order to

decrease the possibility of the point of a loose formation slipping through unilluminated, the second line detectors should pay particular attention to the *center* of such a formation until the first line lights have gone into action and it can be seen whether or not any of the first line lights are directed at the center of the formation. If all the first line lights are apparently working on the *sides* of the formation, then the second line detectors should direct their lights to the *center* of it. After the formation has been illuminated and the total number of planes involved becomes more evident, the tactical problem of maintaining proper illumination should be handled in accordance with the principles explained in *e* below.

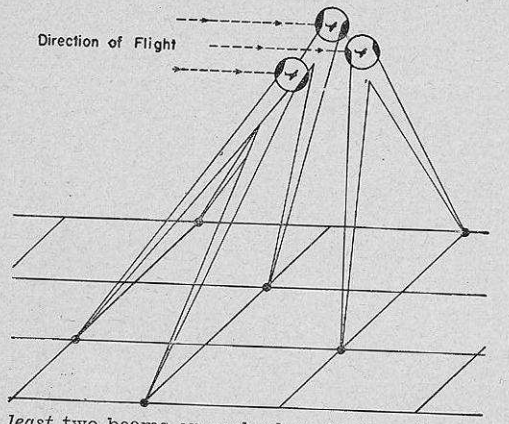
(5) *Close formations.*—When planes attack in close formation, the oscilloscope operators will be unable to track individual planes, but should be able to recognize from the appearance of the echo that there is more than one plane approaching. No attempt can be made to select individual targets in this case, but the formation as a whole can be tracked. After the formation is illuminated, the principles explained in *e*(3) below, should be applied.

e. (1) As far as actual illumination is concerned, the tactical principles involved, as mentioned previously, are no different for multiple plane attacks than they are for single plane attacks, with the exception of a few additional rules to take care of attacks in formation.

(2) If planes attack in a loose formation, each plane being separated by a few hundred yards, it will generally be impossible to keep the prescribed number of beams on each plane in the formation due to the concentration of planes over a relatively small area. *At least two* beams must be maintained on each target, however, as shown in figure 34, even at the cost of allowing some of the planes to enter the defended area unilluminated. If more than two beams can be maintained on each target, it should, of course, be done. Each light in action on a loose formation of this sort should illuminate the plane nearest to it, as shown in figure 34.

(3) If planes attack in *close* formation, it will usually be found that several planes in the formation can be illuminated by the same searchlight beam. Nevertheless, the formation

should *not* be treated as a single target, even if one beam *can* encompass the whole formation; there should be a total of *two* beams *per plane*. A three-plane formation should be illuminated by *six* beams. The purpose of this is to provide a sufficient number of beams so that if the formation should suddenly break, there will be two beams carrying each individual plane. (See fig. 35.) In order to prepare for the possible sudden "exploding" of a formation, each chief controller should select one individual plane as his particular target, even though his light is illuminating several of them simultaneously. Then, if the formation breaks, each chief



(1) *At least* two beams on each plane in formation.
(2) Each searchlight illuminates plane which is nearest to it, to eliminate the crossing of beams below formation.

FIGURE 34.—Illumination of loose formation.

controller continues to track the target he has previously selected. In order to insure that all the chief controllers are not concentrating on one or two of the planes, so that some of the targets would escape if the formation suddenly breaks, each chief controller should select a plane which occupies the same relative position in the formation that his searchlight occupies in relation to the other lights which are in action. In other words, the lights on the left take the planes on the left, and the lights in the center take the planes in the center, as shown in figures 35 and 36.

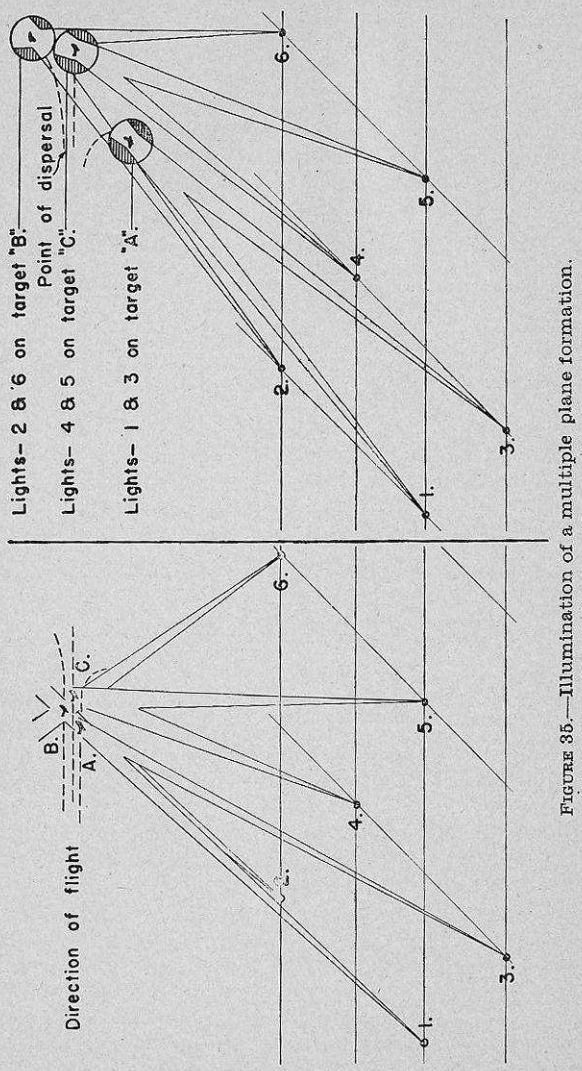
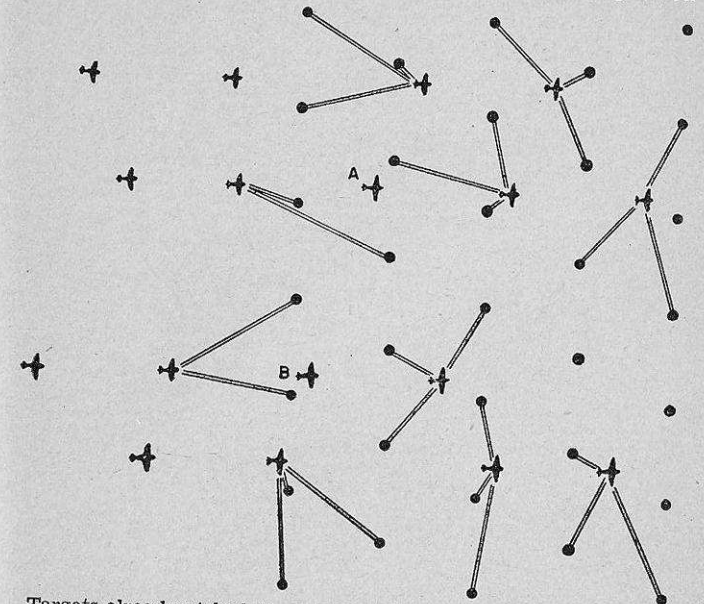


FIGURE 35.—Illumination of a multiple plane formation.

(4) If a very large formation should approach, too large to illuminate all planes in the formation simultaneously, then priority should be given to the planes at the base, or rear, of the formation, since these will be the planes which will be attacked first by the fighters. The basis of the selection of individual targets should be the same as explained



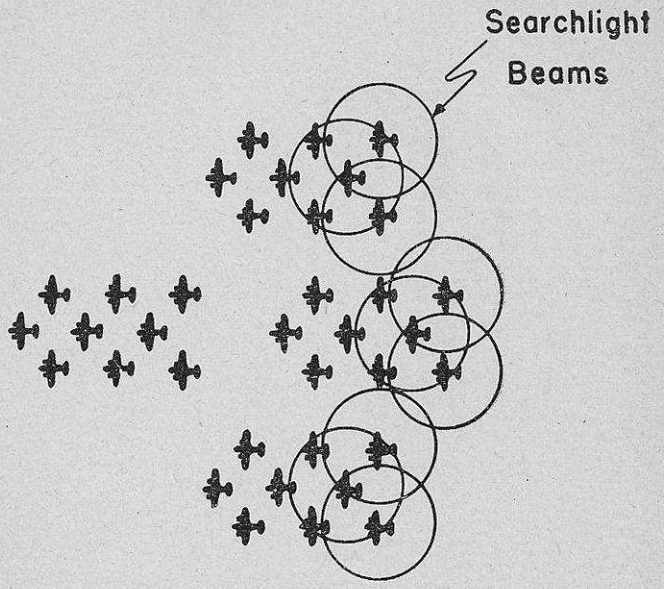
Targets already picked up and illuminated are given priority over succeeding, unilluminated targets. Targets A and B are disregarded in order to maintain sufficient illumination on targets which preceded them.

FIGURE 36.—Illumination of multiple plane attack.

in (3) above, that is, lights on the left take the planes on the left. (See fig. 37.)

■ 68. OPERATION OF ORBITING BEACON.—*a.* In order to identify to the fighter pilot the various principal and subcontrol points, a searchlight with the glass door covered with colored transparent material is used. Further use may be made of the orbiting beacon to assist the fighter pilot in determining

which of several newly formed intersections is his proper target. The fighter pilot orbiting around the beacon may receive the announcement "Intersection" while he is at any point on his orbiting circle; he may be facing at the moment toward any point of the compass, and therefore may be momentarily confused as to the direction of the normal



(1) Base of formation illuminated so that fighters may attack from rear.
(2) As many elements of formation illuminated as available lights within range will allow.

FIGURE 37.—Illumination of large formation.

front. This may result in loss of time, rendering interception more difficult.

b. In order to assist the fighter pilot by guiding him to the proper intersection, the light commander of the beacon light should depress the beacon and point it directly at the intersection as soon as one is formed in the sector covered by fighters orbiting about that particular beacon. (See figs. 38 and 39.) This sector is an area the width of the diameter

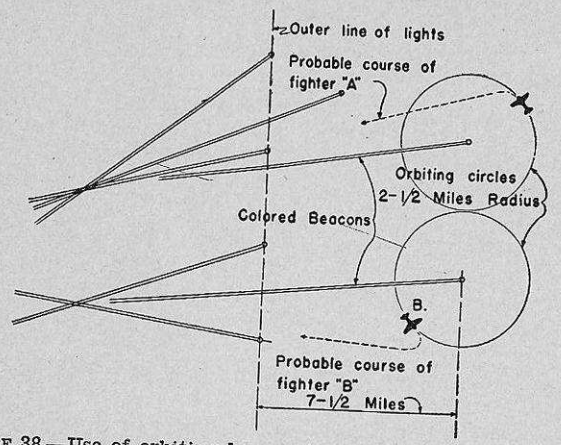
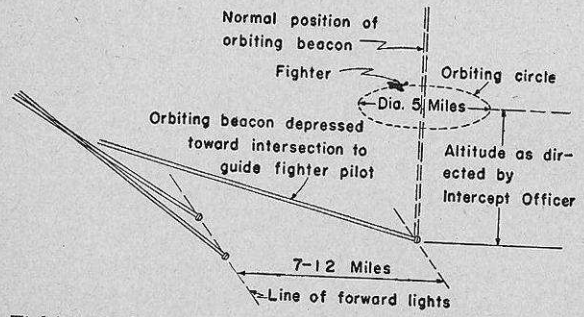


FIGURE 38.—Use of orbiting beacon to guide fighter pilot to proper intersection.



(1) Fighter directed to subcontrol point by intercept officer.
(2) Fighter orbits about colored beacon light at assigned altitude until he receives announcement "Intersection."
(3) Orbiting beacon is depressed and pointed at intersection on its normal front to guide pilot to proper intersection.
(4) Orbiting beacon resumes normal vertical position after approximately 15 seconds.

FIGURE 39.—Use of orbiting beacon to guide fighter pilot to proper intersection.

of the orbiting circle and extending from the beacon light out to the front of the searchlight area. The light commander should determine the azimuth limits of this sector from the beacon light to the points where sides of the sector intersect the front of the searchlight area. He should then mark these directions by the use of stakes driven into the ground to enable him to determine whether an intersection which he may see is within the azimuth limits of that particular beacon. Out in front of the searchlight area the azimuth limits will overlap, and an intersection may be within the limits of *two* beacon lights. However, no harm will be done if *both* beacons point out the intersection, since a fighter pilot at only *one* of them will receive orders to make the interception. When two or more intersections are visible at the same time within the azimuth limits of a beacon light, the light commander should select and point out to the fighter pilot the one *nearest* to the center of the sector.

c. The light commander should point out the proper intersection by depressing the beacon until it points directly at the intersection, keeping it depressed for 15 seconds, and then raising it to vertical position again.

d. It is emphasized that the beacon light signals *do not* constitute an *order* for the fighter pilot to proceed to the intersection indicated. The responsibility of making the interception rests upon the pilot, and he may make such use as he sees fit of the directions shown him by the beacon.

e. In addition to the main positions, alternate positions for the principal and subcontrol points should be selected. These alternated positions should be approximately a mile from the main positions selected. Besides the alternate positions, a complete set of colored covers for the door of the searchlight should be furnished to each of the orbiting beacons. This will permit the use of alternate positions and colors nightly for the beacon lights and thus prevent the enemy from using the beacon light as a navigational marker.

CHAPTER 6

RECONNAISSANCE, SELECTION, AND OCCUPATION OF POSITIONS

		Paragraphs
SECTION I.	General	69–74
II.	Group reconnaissance	75–76
III.	Battalion reconnaissance	77–83
IV.	Searchlight battery reconnaissance and occupation of positions	84–89

SECTION I

GENERAL

■ 69. GENERAL.—This chapter covers the reconnaissance, selection, and occupation of positions by antiaircraft searchlight units.

■ 70. DUTIES OF COMMANDERS.—Unit commanders, whenever possible, precede their commands to the position to be occupied. When searchlight units are a part of the field force, the senior searchlight commander should be in close touch with the force commander and his staff, and should keep informed regarding the tactical situation and plan of action. He makes whatever reconnaissance is necessary to enable him to prepare the plan for searchlight illumination. When searchlight units are employed with fighter commands, the senior searchlight commander must be prepared to advise the fighter commander on the employment of searchlights.

■ 71. PLANNING DEFENSE.—Searchlight units establish an area defense. A thorough map and ground reconnaissance must be made so that the location of all elements will be coordinated. In rear areas, when time is available, the entire plan of illumination will be prepared by the senior searchlight commander and his staff. This plan may even be so detailed as to give locations for all searchlight positions.

■ 72. RECONNAISSANCE OF GROUND.—The purpose of reconnaissance of the ground is to verify the suitability of routes both into and out of positions selected as a result of the map reconnaissance, to determine alternate routes and positions in conformity with the tentative plan, and in some cases,

to determine the suitability of one or more positions before preparing a plan of illumination. The exact locations of searchlights must be selected by an actual reconnaissance of the ground.

■ 73. INSTRUCTIONS TO UNITS DURING RECONNAISSANCE.—When a commander goes forward on reconnaissance, he instructs the officer left in command (normally the executive) on the following points as far as may be desirable or practicable:

a. The tactical situation.
b. Probable route of reconnaissance party.
c. Troop movements desired, if any.
d. Time when and place where further orders will be issued.

■ 74. TIME AVAILABLE FOR RECONNAISSANCE.—Although the time available for reconnaissance varies with different situations, searchlight units must be able to go into position promptly, and their employment must not be delayed by undue reconnaissance. Reconnaissance must be as thorough as time permits, but must be completed in time to permit the batteries to march to their positions without halting. Whenever possible, commanders must allow sufficient time to subordinates so that their reconnaissance can be completed during daylight hours.

SECTION II

GROUP RECONNAISSANCE

■ 75. PURPOSE.—The purpose of the group commander's reconnaissance is usually general in nature and consists chiefly of a map reconnaissance based primarily on the character, location, and plans of action of the forces or elements to be protected. Information of the terrain is generally obtained from the map. This is a matter of necessity since the area covered by a searchlight group is too large for a thorough personal reconnaissance. As a result of this reconnaissance the group commander selects the location of—

a. Sufficient searchlight units within each battalion area to insure coordination between the battalions.
b. Command post.
c. Bivouac of headquarters battery.
d. Rear echelon.

■ 76. CONSIDERATIONS GOVERNING SELECTION OF POSITIONS FOR GROUP INSTALLATIONS.—*a. Command posts.*—(1) A command post should be well protected, concealed, and established to facilitate the transmission of orders and the conduct of official business required in the tactical operations. It includes the commander's station, telephone central, and message center.

(2) In forward areas, AA command posts are located near those of the army or force commanders.

(3) In rear areas, the command post of AAA defenses of an area should be located at a center of communication, and should be such as to facilitate the establishment of communication with the fighter command, with subordinate units, with AWS, and with adjoining defenses.

b. Headquarters battery.—The group headquarters battery, less detachments, is located under cover in the vicinity of the group command post.

c. Rear echelon.—The rear echelon is the place where the supply, maintainance, and administrative units perform their work. The position selected should give the rear echelon maximum concealment and protection consistent with the exercise of its functions. In forward areas, the rear echelon is usually located with the corps troops. In rear areas the forward and rear echelons will normally be combined.

SECTION III

BATTALION RECONNAISSANCE

■ 77. PURPOSE.—*a.* (1) The purpose of the battalion commander's reconnaissance is to enable him to verify the suitability of positions chosen from the map for the elements of his battalion. He will verify the suitability of the following, selected tentatively by map reconnaissance:

(*a*) Positions of battalion command post and observation posts.

(*b*) Position of service elements of headquarters battery.

(*c*) Some, or all, of the routes to positions.

(2) The searchlight battalion commander will rarely be able to visit each searchlight position before the position is occupied, because of the large number of searchlights and the distances involved. He may, however, be able to inspect one or more key light positions.

b. The battalion commander should visit each position at the earliest opportunity. In making his reconnaissance, the battalion commander should satisfy himself that the general locations selected are such as to permit his subordinate commanders to select and occupy the best obtainable positions under the circumstances.

■ 78. ANTICIPATION OF FUTURE MOVEMENTS.—When the situation is such as to indicate the probable character of displacement to be made, the battalion commander makes, or causes to be made, such reconnaissances as are necessary to permit the prompt issue of orders when movements to new positions are required.

■ 79. METHODS.—*a.* Battalion commanders employ such members of their staff and such personnel from the organizations of their units as they may desire for assistance in their reconnaissance. Personnel accompanying the battalion commander on his reconnaissance are called the battalion commander's party.

b. Reconnaissance may be made in whole or in part by the battalion commander, by members of the battalion staff, by battery commanders, or by the battalion commander accompanied by the battery commanders, depending on time available and extent of reconnaissance required. In general, reconnaissance is made by one of the methods given below. In each case the reconnaissance must be preceded by a map study to select tentative positions.

(1) The battalion commander makes all reconnaissance.

(2) The battalion commander, assisted by his staff, makes the entire reconnaissance. This or the foregoing method may be employed if time permits. Under certain circumstances, it may be necessary or desirable for the battalion staff to make all reconnaissance.

(3) Each battery, platoon, or unit commander reconnoiters a particular area for his own positions. This method is employed when the time is very short.

(4) The battalion commander, accompanied by the battery commanders, visits all sites.

■ 80. PROCEDURE WHEN TIME IS AVAILABLE.—The following procedure by the battalion commander in making a reconnaissance when considerable time is available is outlined as

one method. It must be varied as the situation demands. He—

a. Makes a map reconnaissance to select locations for all elements.

b. Makes decision as to when movement of troops is to begin. This decision is based on orders from higher commanders, mission, time, and availability of routes.

c. Makes decision as to how the ground reconnaissance is to be made and determines the party to accompany him.

d. Gives or sends orders to the battalion executive and to battery commanders covering—

(1) Enemy and friendly situations.

(2) Troop movements desired, if any.

(3) Time when and place where further orders will be issued.

e. Makes reconnaissance.

f. Returns to point where officers have been directed to assemble and issues his order for occupation of the positions.

■ 81. BATTALION COMMAND POST.—The command post of the searchlight battalion will generally be located in the vicinity of group headquarters.

■ 82. REAR ECHELON.—*a.* The battalion rear echelon may be located near the battalion command post or with the rear echelon of the group.

b. Bivouacs of supply section.—The supply section of the headquarters battery may be bivouacked in the vicinity of the railhead or truck head or with that portion of the headquarters battery located in the rear echelon.

■ 83. OBSERVATION POSTS.—The observation posts, when desired, should be located so that they can function continuously.

SECTION IV

SEARCHLIGHT BATTERY RECONNAISSANCE AND OCCUPATION OF POSITIONS

■ 84. BATTERY COMMANDER'S RECONNAISSANCE.—*a. Purpose.*—Because of the extensive area covered, one individual seldom will be able to select all of the actual searchlight positions on the ground. As soon as practicable, the battery com-

mander inspects and verifies all light positions. In addition, the battery commander selects, first on the map and finally on the ground, positions for the battery command post, motor park and maintenance section (centrally located with reference to the platoons, concealed, near good roads, and beyond hostile artillery range), and the location of the rear echelon of battery headquarters (usually near the motor park). The general plan of illumination for the searchlight battalion is prepared by the searchlight battalion commander and his staff. If more than one battalion of searchlights are included in the defense, the coordination of light positions will be accomplished by the senior commander present.

b. Procedure.—When the searchlight battery commander receives the orders of the battalion commander, or his plan, he communicates the plan, including tentative routes of wire communication if used, to the platoon commanders and directs them to select the actual positions of the lights on the ground.

■ 85. PLATOON COMMANDER'S RECONNAISSANCE.—*a. Purpose.*—The purpose of the searchlight platoon commander's reconnaissance is to—

(1) Verify the suitability of the searchlight positions selected from the map.

(2) Select routes to positions.

(3) Decide on method of establishing communication.

(4) Select location for platoon command post.

(5) Select, with the chiefs of section, locations for detector units, control stations, searchlights, power plants, and machine guns.

b. In making his reconnaissance, the platoon commander should take the following personnel:

(1) Section chiefs.

(2) Communication sergeant.

(3) Detector commanders, if practicable.

c. Procedure.—(1) The platoon commander, having received his battery commander's plan for the disposition of the searchlights, proceeds to each light position and, with the chiefs of section, selects the actual positions of the lights on the ground. At the same time he makes such other decisions and selections as are indicated in *a* above.

(2) Whenever practicable, all reconnaissance is completed during daylight hours.

■ 86. BATTERY COMMAND POST.—The battery command post of the searchlight battery will be centrally located with reference to its platoons. It may be desirable to locate the searchlight battery command post at or near one of the platoon command posts.

■ 87. PLATOON COMMAND POST.—The command post of the searchlight platoon is located in the middle of the forward area of the platoon sector and on suitable high terrain.

■ 88. CONSIDERATIONS AFFECTING SELECTION OF SEARCHLIGHT POSITIONS.—*a. Field of illumination.*—Searchlights should be so located that they have an unobstructed field of illumination of 360° in azimuth. When requirements of security from hostile artillery fire make it necessary, they may have a minimum elevation of 15°. Otherwise they should be able to illuminate the entire area.

b. Low-lying mists.—Low-lying mists interfere with the operation of the light, and areas in which these mists collect at night should be avoided.

c. Distance from gun batteries.—Searchlight positions, in general, should not be closer than about 1,000 yards to any gun battery. Pick-up lights should be at least 500 yards from roads and railroads upon which there is considerable traffic.

d. Facility of movement.—In order to facilitate change in location, supply, and administration, it is important that the position of the light be such that it may be moved readily.

e. Concealment of position and approaches.—See chapter 7.

f. Noninterference with operation of other troops.—Searchlights must not be located where they will illuminate any friendly elements which may be observed by the enemy. Inasmuch as searchlights are likely to draw hostile fire, they should be located as far as practicable from the personnel and matériel of other organizations.

■ 89. OCCUPATION OF POSITIONS.—*a. General.*—Because of the extensive area covered by a searchlight battery when in position, it is not practicable to move to positions as a battery. Routes to positions will be selected and the battery will be divided into platoon serials for movement by sep-

arated routes to the general platoon areas. As each platoon approaches its area, it will be further subdivided into smaller detachments. Three of these detachments will each contain a detector section and a searchlight section, and will be commanded by a section sergeant, while the other three will each consist of a searchlight section under the command of a searchlight sergeant. These detachments will proceed separately to the positions selected.

b. Procedure at position.—If the procedure is as indicated in *a* above, the section chief reports to the platoon commander and receives orders which include instructions as to position, route, and communication. If the position has not been previously marked, the section chief (assisted by the detector commander in those detachments containing a detector section) selects and designates the exact position for the detector unit, control station, searchlight, power plant, and machine gun. He then prepares the detachment for action, directs the movement of trucks to unloading points, and supervises unloading and preparation of equipment. Lights may be kept in position, camouflaged and under cover, during daylight hours. The detector units will be operating in the intelligence system and will also be in position both day and night.

c. Detector units.—The choice of positions for the detector units is of utmost importance. Successful operation in one or more parts of the sector may be prevented by interference which could be eliminated or reduced by a careful choice of positions. The most serious interference arises from other sets in the area or from echoes from objectives other than aircraft, such as mountains, gas tanks, water tanks, metal towers, ships, office buildings, or factories presenting a large surface to the line of sight from the detector. Objects do not give trouble when located closer than 2,000 yards except those objects within 100 yards which may introduce errors in tracking. While an elevated position for the detector would give greater effective ranges, consideration should also be given to fixed echoes and interference between mounts, which usually exist from such a position. Protection from fixed echoes or from interference from other sets may be provided by utilizing features of the local terrain or by constructing artificial

protection if terrain protection is inadequate. Considerable care is required in the selection of a position which will give protection from ground echoes and protection from other detectors in the area, without causing loss in sensitivity or introducing errors in tracking. Each position must be tested before final acceptance. See FM 4–176 (now printed as FM 4–145). Not only must the location be satisfactory electrically, but it must be made inconspicuous from the air. Enough space about the detector unit should be available to permit easy assembly and manipulation. Available cables for uses between the searchlight and detector are 250 feet long but the searchlight should be placed within 50 feet of the detector. The power plant which is a part of the detector unit is carried on a trailer or power truck. It is connected to the detector by 150-feet electrical cables and should be displaced from the detector by the distance conveniently allowed by the cables. If possible, it should be placed under nearby trees, concealed from hostile observation, and protected against bomb fragments and small-arms fire.

d. Control station.—The control station should be placed to provide an unobstructed view at least equal to that of the searchlight. Its maximum distance from the searchlight is limited by the cable length which is 500 feet in the latest equipment; its minimum distance should not be less than 50 feet.

e. Power plant.—The power plant should be placed under concealment and should be protected against bomb fragments and small-arms fire. Present equipment provides two 200-foot cables to connect the power plant with the searchlight.

f. Local defense machine gun.—Each searchlight section contains a caliber .50 machine gun for local defense. This weapon will be centrally located with reference to the elements to be protected, preferably in an elevated position with an all around field of fire.

g. Cover.—As soon as possible after a position has been selected, steps should be taken to provide cover for the men and matériel against blast and fragmentation from aerial bombs and artillery shells. (For a discussion of passive measures of defense, see ch. 7.)

CHAPTER 7

SECURITY AND PROTECTION

		Paragraphs
SECTION I.	General	90–92
II.	Camouflage and concealment	93–105
III.	Cover	106–109
IV.	Local security	110–116

SECTION I

GENERAL

■ 90. EXPLANATION OF TERMS.—Throughout this manual the term "cover" is used to indicate the means employed for the prevention of injuries to personnel or matériel; the term "concealment" is used to indicate the means taken, by utilizing natural concealment or erecting camouflage, to prevent hostile discovery of installations or personnel. Both terms are included in the term "protection."

■ 91. OBSERVATION.—Observation is direct or indirect.

a. Direct observation is by direct vision, aided or unaided by field glasses or telescopes. It may be terrestrial or aerial, obtained from observation posts, balloons, or airplanes.

b. Indirect observation, by far the more effective, is the study of aerial photographs. The camera registers all details in exact relation to each other. The expert interpreter is remarkably skillful in translating apparently insignificant details in such photographs into important military intelligence.

■ 92. CONCEALMENT.—Concealment in the case of AAA is sought from hostile observation from high points within the enemy lines (terrestrial), or from hostile aerial observation, photography, and attack. In addition, positions should be made inconspicuous from possible ground approaches.

SECTION II

CAMOUFLAGE AND CONCEALMENT

■ 93. GENERAL.—Camouflage is the work done to deceive the enemy as to the existence, nature, or location of troops, establishments, and matériel. Deception of the enemy is the

prime object of camouflage. Concealment from view is not essential, provided the object camouflaged appears as a natural part of its surroundings. Confusion rather than concealment may sometimes be the more effective camouflage.

■ 94. MEANS OF CAMOUFLAGE.—Deception of the enemy is gained by—

a. Suppressing all signs of unusual activity in the area, or deceiving the enemy as to the purpose of such activity.

b. Blending the object into its surroundings, or making it appear to be something else.

■ 95. RELATIVE IMPORTANCE OF FACTORS.—In general, effective camouflage depends on the following factors in the priority indicated:

a. Proper choice of position.
b. Camouflage discipline.
c. Proper erection of camouflage materials.
d. Suitability of camouflage materials.

■ 96. IMPORTANCE OF CAMOUFLAGE.—AA searchlight units will be subject to attacks from the air and ground. All personnel must realize the importance of making their positions inconspicuous by concealment and camouflage. The problem is made more difficult because of the need for a clear overhead field of illumination. Also the searchlight installation, with its searchlight, detector, power plant, control station, and cables, presents a peculiar pattern on the ground. These considerations emphasize the necessity for artificial concealment.

■ 97. CONCEALMENT FROM OBSERVATION.—*a. Terrestrial.*—Searchlight elements should always be made as inconspicuous as possible from ground observation. When emplaced within range of hostile artillery, this is of utmost importance. In such cases, not only should equipment be concealed but also the searchlights should be given defilade.

b. Aerial.—In addition to concealment from ground observation, concealment from aerial observation and photography is essential in both forward and rear areas. It is obtained by the use of natural concealment and artificial camouflage. Positions of searchlight units must be con-

cealed, and they should, whenever practicable, be changed when there is reason to believe that they have been located by the enemy.

c. Night movements.—Movements of units may be made more secret by marching at night without lights. In forward areas this will be the rule rather than the exception, particularly when hostile aviation is active.

■ 98. CONCEALMENT OF SEARCHLIGHTS AND ACCESSORIES.—The dectector section will be operating during daylight hours as well as at night, and is therefore left in its position. In order to prevent loss of synchronization with the detector, the searchlight is also left in its location. Precaution must be taken to make the position of both of these units of equipment as inconspicuous as possible by using existing roads whenever possible and by selecting positions which will provide the best opportunity for camouflage, consistent with the accomplishment of the assigned mission.

■ 99. DUMMY INSTALLATIONS.—*a. Employment.*—The construction of dummy positions will aid in the concealment of active positions. Also, areas containing no actual objectives may be made to resemble important areas with a view to confusing the enemy and diverting his attacks. Dummy installations are most effective when employed on a large scale to lead the enemy to false objectives. Hence, dummy positions and installations must not be constructed indiscriminately, but must be controlled under a general plan.

b. Character and location.—Dummy positions must be designed to present the appearance of improperly camouflaged installations, as otherwise they are promptly identified for what they are, and care should be exercised in their construction. No serviceable or valuable equipment should be used in dummy positions, and such positions should be located at least a quarter of a mile from genuine installations so that fire attracted will not injure elements of the defense. *Evidences of activity about dummy positions, as paths and movements of personnel, must be present to increase apparent reality.* Abandoned positions left intact as to camouflage may conceal the departure of the occupying unit and also serve as dummy positions.

■ 100. SERVICE AND OTHER INSTALLATIONS.—Headquarters and service units in the vicinity of searchlight units should be located in concealed positions. However, when practicable, such units, motor parks, and similar installations should be located at such distance from searchlight units that the discovery of the former will not reveal the latter, and so that fire meant for one will not fall on the other. In such locations, cover for service units and installations may not be required, but in any event, they should be concealed and dispersed.

■ 101. NATURAL CAMOUFLAGE MATERIALS.—Natural vegetation, cut at points remote from the installation and supported in its normal position, can be used to make excellent camouflage. However, vegetation laid flat reflects light and is conspicuous from above; also, the use of such materials is limited by the natural growth of the locality in which it is employed.

■ 102. NETS.—*a.* Chicken wire, although heavier and bulkier than lighter types of net, holds its form better and is more durable and hence is more satisfactory for use in permanent positions, as in rear areas. Ordinarily, the standard cord or fish net, because of its portability, is used with mobile units.

b. Both types of nets should be supported flat on wire tightly stretched, as a sagging net seen from above presents the appearance of a round hole. Either net may be garnished with natural or artificial material, the former being replaced at the first sign of wilting. The garnishing should create a pattern corresponding to the terrain. Edges of nets should be hidden along such natural lines as hedges, roads, paths, or ditches. If no such lines are available, extreme irregularity of edges becomes necessary, not irregularities of 2 to 6 feet, but of 20 to 30 feet. Also, an essential idea in weaving nets with burlap is to thin the material irregularly toward the edges on a large pattern in order to avoid a regular outline or visible shadow. The object sought is a bristly texture with contained shadows on top fading irregularly to transparent edges. Activities must be kept under the thicker portion.

■ 103. DETAILS OF CAMOUFLAGE.—For details of materials and erection of camouflage, see FM 5–20.

■ 104. SUPERVISION.—Camouflage must be judged from the point of view of the enemy which, with respect to AAA camouflage, is generally from the air. Hence, frequent flights should be made prior to and after the erection of camouflage. The prior flights furnish a basis for the planning of camouflage installations and the later a check on the effectiveness of the installations and on camouflage discipline. A study of aerial photographs of an area made before and after occupation and camouflage therein furnishes the best criterion for the concealment of installations.

■ 105. DISCIPLINE.—Next to the proper choice of position, camouflage discipline is the most important factor in the effective value of camouflage. Camouflage discipline involves confining movements to designated routes, closing nets when not firing, repairing or changing covering material when necessary, keeping men under concealment when enemy airplanes are overhead, not allowing smoke to appear near the position, keeping ammunition covered, not allowing trucks or other vehicles to stop in daylight on the road near the position, and not permitting transportation to turn around near the position. Confining movements of personnel to designated routes, thereby preventing the forming of new paths which are easily spotted on aerial photographs, is the requirement most difficult to enforce. Under the fatigue and strain of active conditions, effective camouflage discipline can be maintained only with the most thoroughly trained personnel. The plan for enforcement of camouflage discipline must include the roping or wiring in of open paths or trails and camouflaging them where necessary, and the requiring of all personnel to remain under concealment so far as practicable.

SECTION III

COVER

■ 106. GENERAL.—Cover is the means employed for the prevention of injuries to personnel and matériel. Normally, cover is required for protection against the blast effect of shells and bombs and against the splintering or penetrating effect of fragments or small caliber projectiles. The requirements for a bombproof shelter (5 feet of concrete

to withstand a 6-inch shell or equivalent bomb) are such that unless natural cover is available, complete overhead protection will never be provided. Dependence for protection must be placed on dispersion and concealment, foxholes, and parapets. Combat experience has shown that for protection of personnel the foxhole is best. For the weapons themselves, protection is provided by dispersion and concealment. Excavation and parapets will provide additional lateral protection from blast and fragmentation.

■ 107. DETAILS OF DESIGN AND CONSTRUCTION.—For details of design and construction of overhead and other cover, see FM 5–15.

■ 108. COVER FOR MATÉRIEL AND PERSONNEL.—*a. Searchlights.*—When time is available, limited protection may be given to AA searchlight matériel and personnel by the digging of circular pits or erecting parapets of such depth or height as will not obstruct the operation of the equipment. The power plant may be given protection by locating it in woods, ravine, or depression, with defilade from enemy fire. If, because of limited cable length, cover is not available for the power plant, it should be given artificial protection.

b. Machine guns.—In areas where AA machine guns may be taken under fire by ground weapons, the emplacements may consist of pits about 7 to 8 feet in diameter, and of such depth that the gun can be fired at ground targets. Parapets at least 3 feet high should be constructed wherever antipersonnel bombs may be used. Part of the material required for constructing a parapet may be obtained from the earth excavated in digging the pit. Trenches should be dug for the protection of personnel, the storage of ammunition, and the water chest operator.

c. Command posts.—Because of the wide dispersion of searchlight units, group and battalion command posts can generally be located under natural cover and concealment. The same may be true of the searchlight battery command post. For all command posts, location may be restricted by communication requirements.

■ 109. DISPERSION.—Dispersion is an effective means of minimizing the effects of bombardment attack or artillery shell-

ing. The massing of vehicles and personnel should be avoided. On the march, a column having no more than 10 or 12 vehicles per mile affords an unprofitable target for bombardment. In bivouc or in occupying a position the maximum use should be made of dispersion, consistent with the accomplishment of the mission and considering other defense measures.

SECTION IV

LOCAL SECURITY

■ 110. GENERAL.—Security, as applied to AAA, is the all around protection of a command by the adoption of effective measures to prevent surprise and interference by the enemy and to minimize the effect of an attack from the land or from the air. The necessity for security is basic in every action in war from the time of the first possible encounter to the final battle and must be uppermost in the minds of the commanders of all echelons. Every commander is responsible at all times for the security of his command.

■ 111. PHASES.—*a. When beyond striking distance of hostile main forces.*—AAA units not in the vicinity of hostile main forces are not subject to an attack by infantry supported by other arms. Such units are, however, subject to aerial attacks, to attacks by mortorized or mechanized forces, and to attacks by airborne troops.

b. When within striking distance of hostile main forces.—When AAA units are located in forward areas or in the vicinity of the hostile main forces, they may be subject, in addition to the attacks mentioned above, to attacks by infantry supported by field artillery and other arms.

■ 112. MEANS OF ATTAINING.—*a. Information.*—In either phase, timely, accurate, complete, and continuous information as to the location, strength, composition, and capabilities of the enemy is the most effective means of attaining security against surprise.

b. Concealment.—The most effective means of minimizing the effect of attack from land or air is concealment from enemy observation as discussed in section II.

c. Organization of the ground.—Security against land attacks by foot troops, cavalry, or mechanized units, and the protection of the command from gunfire or air attack is increased by such organization of the ground as the situation permits. This organization includes the construction or improvement of obstacles, planting of antitank mines, clearing of fields of fire, preparation of defensive positions to include the siting of AAA weapons for ground fire, and the construction of splinter-, bomb-, and gas-proof shelters.

d. Other means.—Other means of security, when not in concealed positions, include dispersion of troops and matériel when halted and rapidity of movement and extended intervals between vehicles when on the road. The final active means of security is the readiness for employment, in position or on the march, of all available AAA weapons.

■ 113. DEFENSE AGAINST GROUND FORCES.—As the mission of AAA is the defense of personnel and ground establishments against the attack of hostile aircraft, it will generally be located well within the security lines established by other ground forces. However, searchlight units will be subjected to ground attack by foot troops, cavalry or motorized units, mechanized forces, or airborne troops. Where it can be done without interfering with their normal missions of firing on hostile aircraft, the machine guns will be so sited that they may be employed against mechanized or other form of ground attack. In the event of attack, searchlight units and detachments protect themselves with weapons furnished them for local protection.

■ 114. ACTIVE LOCAL DEFENSE AGAINST AERIAL ATTACK.—A searchlight unit, in accomplishing its primary mission, must provide incidental protection for its own elements against aerial attack.

a. Searchlights.—Searchlights, like guns, must be sited in exposed positions in order to operate effectively. While in operation there is no concealment of their positions from hostile aircraft and in the event of low-flying attack against the position, their defense must be furnished by the organic machine guns.

b. Small-arms fire.—When not actively engaged in manning AA equipment, and when firing has not been prohibited,

all individuals fire their small arms on hostile low-flying aircraft.

■ 115. PASSIVE LOCAL DEFENSE AGAINST AERIAL ATTACK.—*a.* As far as is consistent with the accomplishment of the searchlight mission, the troops employ passive means of defense against aerial attack and observation in addition to appropriate active means.

b. On receiving a warning of an approaching aerial attack, troops in position and not actively engaged in manning searchlight equipment, or in bivouacs or billets, seek the nearest concealment or cover and remain motionless.

c. Troops must be prepared to accept casualties rather than to permit aerial attacks to be effective. Troops engaged in manning searchlight equipment must remain at their posts and continue to perform their duties, relying on such cover as has been provided for their protection. When the situation is such as to indicate the necessity for continued movement and a command is subjected to frequent air attacks, maximum advantage is taken of dispersion and available concealment and cover without unduly delaying the movement.

■ 116. DEFENSE AGAINST CHEMICAL ATTACK.—Details of defense against chemical attack are given in FM 21–40.

CHAPTER 8

SUPPLY AND EVACUATION

	Paragraphs
SECTION I. Supply	117–124
II. Evacuation	125–127

SECTION I

SUPPLY

■ 117. GENERAL.—This chapter covers the supply of searchlight units. Officers detailed on supply duty should refer to FM 100–10 for definitions and basic supply procedure.

■ 118. SUPPLY AGENCIES.—*a.* Searchlight battalions have the personnel and transportation required to draw and deliver all classes of supplies. The group does not carry any supplies for the battalions. The supply section of the group headquarters battery draws and delivers supplies for the group headquarters battery only.

b. All supplies which are procured by requisition are first requisitioned by the batteries. The battalion supply officer consolidates these requisitions and forwards a consolidated requisition to the group or other higher echelon supply officer. This supply officer in turn forwards his consolidated requisition to the next higher supply echelon.

c. When requisitioned supplies become available, each supply unit is notified in turn down to the battalions. The battalion supply sections then draw and distribute the supplies from the nearest depot.

■ 119. CLASS I SUPPLIES (RATIONS).—The forward flow of rations is normally automatic, based on daily battalion, or group consolidated reports of actual strength. A daily train carrying the needed supplies from depots in the communications zone is sent forward for each division and for corps and army troops. Upon arrival at the railhead, the rations are picked up by the battalion supply sections.

■ 120. CLASS II SUPPLIES (SUPPLIES AND EQUIPMENT PRESCRIBED BY TABLES OF EQUIPMENT).—These supplies are requisitioned, drawn, and distributed as described in paragraph 118.

■ 121. CLASS III SUPPLIES (GASOLINE AND OIL).—The army quartermaster establishes gasoline and oil supply points at all railheads and depots or at convenient locations, such as civilian gasoline filling stations, on the main supply routes. Each vehicle sent to an army supply point replenishes its supply at a convenient gasoline supply point at or en route to the army supply point. Vehicles remaining in the forward areas are resupplied by exchanging empty containers for full ones brought forward from gasoline and oil supply points by unit transportation.

■ 122. CLASS IV SUPPLIES (ARTICLES OF MISCELLANEOUS NATURE).—Supplies such as construction material are normally requested through special requisitions. The receipt and delivery of such supplies are the same as for class II supplies.

■ 123. CLASS V SUPPLIES (AMMUNITION).—*a.* For replenishment of ammunition, battery commanders submit periodic expenditure reports to the battalion supply officer. A consolidated report is transmitted to the group or other higher echelon munitions officer who forwards it to the proper requisitioning or procuring authority. The unit reports are made by telephone, if possible, and later confirmed by written reports. Extra ammunition normally is ordered forward by higher authority whenever an increased supply appears necessary.

b. The battalion supply platoon is employed to draw and distribute ammunition from the supply point to searchlight positions. However, when ammunition expenditure is rapid or the distance to the supply point great, the battalion supply platoon vehicles may be used to bring ammunition to an intermediate supply point, from which the battery vehicles will supply the batteries.

■ 124. VARIATIONS IN SUPPLY CAUSED BY TACTICAL EMPLOYMENT.—*a.* When the searchlight unit is operating as part of an army, the foregoing methods of supply will normally be applicable.

b. When the searchlight battalion is operating in a harbor defense or in its immediate vicinity, quartermaster supplies will be obtained from the harbor defense quartermaster. Medical, ordnance, or other supplies will likewise be obtained through corresponding harbor defense supply officers to the

extent available or obtainable; otherwise, by special requisition or call on higher supply echelons.

c. When operating in the communications zone or zone of the interior and at a considerable distance from an army post, camp, or station, the battalion, group, or other unit may receive its supplies direct from a railhead and by local purchase.

SECTION II

EVACUATION

■ 125. MEDICAL PERSONNEL ATTACHED TO AAA.—There is no medical detachment with the headquarters and headquarters battery of the searchlight group, but each battalion in the group has a medical detachment. For command purposes, and for administration and supply, the battalion medical detachment is an integral part of the battalion.

■ 126. ORGANIZATION DURING COMBAT.—*a.* For combat the battalion medical detachment is broken down into a battalion aid station detail and battery aid details for attachment to each battery. The battalion aid station detail supervises the medical service of the battalion. It is organized to provide an administrative, supply, and evacuation service for the battery aid details; for establishment and maintenance of battalion aid stations and dispensaries; for care and treatment of troops located in the vicinity of battalion headquarters; and for direction and supervision of the dental service of the battalion.

b. A battery aid man is assigned to each battery to provide dressings and first aid.

■ 127. FUNCTIONING DURING COMBAT.—*a.* In general, the tactics employed by combatant units determine the tactics to be employed by attached medical units, and the tactics employed by medical detachments in the field should have as their objective the rendering of support and assistance to combat troops.

b. In the field, the battalion aid station is established at or near the rear echelon of the searchlight battalion headquarters. From this position, the surgeon maintains contact with battalion headquarters and with each battery aid detail,

supervising, reinforcing, and to a limited degree, supplying these latter units with medical supplies and materials.

c. Aid stations should not be established near ammunition dumps nor in proximity to the designated parking places for artillery vehicles. They may be established near roadways, but never at important points such as road intersections and crossroads. A road in the immediate vicinity of an aid station is desirable to insure evacuation by ambulance.

d. During periods of activity the battery aid men live with the batteries to which attached, and return to their sections only at such times as the battalion is brought together for rest or training. When a battery remains in one position for a considerable period of time, battery aid men obtain a small surplus of medical supplies with which to establish local aid posts near the battery positions. Battery aid men care for the casualties occurring in the battery and take post in the vicinity of the guns when the battery is firing or receiving hostile fire. Casualties are promptly removed to a place of safety, given first aid, tagged, and carried or directed to an aid station. Evacuation from the battalion is as directed by higher headquarters. In stabilized or partially stabilized situations, the battery aid men are required to report at least once daily to the battalion aid station for the purpose of giving information and receiving instructions.

CHAPTER 9

ESTIMATES, PLANS, AND ORDERS

	Paragraphs
SECTION I. Estimates and plans	128
II. Field orders	129–135

SECTION I

ESTIMATES AND PLANS

■ 128. GENERAL.—For a form for an AAA commander's estimate of the situation and plan see FM 4–100.

SECTION II

FIELD ORDERS

■ 129. GENERAL.—For general information on orders and annexes, as well as for the technique of preparation of a field order, see FM 101–5. Ordinarily, AA commanders will issue either oral or dictated orders which may later be confirmed by written orders. In the paragraphs below are given check lists which may be used as reminders in the preparation of AAA field orders, for units assigned or attached to the field forces. It is not to be inferred that all items listed must be included nor that other items are unnecessary. However, those items which are included should be expressed in the proper sequence. A trained commander or staff officer prepares an order to fit the situation, not a form.

■ 130. STANDING OPERATING PROCEDURE.—In every unit, Standing Operating Procedure should be prescribed by the commander whenever possible. This procedure covers those features of operations which lend themselves to a definite or standardized procedure without loss of effectiveness. The adoption of such procedures will save time in the preparation and issuance of orders, minimize the chances of confusion and errors when under the stress of combat, and greatly simplify and expedite the execution of operations in the field. (See FM 4–100.)

■ 131. GROUP CHECK LIST.

1. *a.* Enemy situation—information of hostile aerial activity to include types of airplanes, character and method of attack, locations of airdromes, landing fields, and probable route of approach.

b. Tactical plan of the supported unit and locations of elements to be protected—locations of adjacent aviation units, if known; locations of balloon barrages; activity of friendly aviation affecting the employment of the AAA; location of adjacent AAA, and, if the group is part of a brigade, the plan of the brigade and mission of other groups of the brigade.

2. Decision of the group commander—to provide searchlight illumination for certain areas, units, or establishments.

3. *a.* Mission for each searchlight battalion—to provide protection for certain units, areas, or establishments:

Detachment of units or reversion to battalion control of detached units.

When applicable, the general location of one or all of the batteries.

Movements or routes—regulation by divisions of movements through their areas or assignment of routes to positions.

Special instructions as to searchlight control.

b. Instructions applicable to all battalions—time when ready to go into action; displacement; camouflage; instructions to accomplish coordination between or among the battalions and with aviation units, balloon barrages, and adjacent AAA units; secrecy; restriction of movements; priority on roads.

4. Locations of service elements if they can be prescribed at the time and instructions relative to rations.

x. Ammunition supply points; special instructions as to ammunition supply.

Aid station or instructions covering evacuation.

5. Special instructions relating to signal communication.

Antiaircraft artillery intelligence service (AAAIS).

Axes of signal communication for group and battalions when applicable.

Command posts for group and battalions.

■ 132. BATTALION CHECK LIST.

1. Enemy situation.

Plan of action of supported unit, including zones of action, sectors, or bivouac areas, and missions of subordinate units; locations of troops and establishments requiring protection; plans of friendly aviation as they affect the employment of the organic fire units; location of adjacent AAA, balloon barrages and aviation units, if known; plan of action and mission of adjacent AA battalions.

2. Decision of the battalion commander—to provide searchlight for certain units, areas, or establishments.

3. Position, route, mission, normal and contingent sectors, detachment of units or reversion to battalion control of detached units.

x. Instructions applicable to more than one battery—time when ready to go into action; withholding action; instructions as to control; camouflage, instructions to accomplish coordination with aviation, with balloon barrages and with adjacent AAA units; secrecy; restriction of movement; priority of targets, priority on roads.

4. Location of service elements if it can be prescribed at the time and instructions relative to rations; location of and instructions for ammunition train when applicable; location of aid station, or instructions covering evacuation.

5. Plan of signal communication.

Special instructions relating to the AAAIS.

Axes of signal communication for the battalion, when applicable.

Command posts of the battalion and each battery, when applicable.

■ 133. BATTERY CHECK LIST.

1. Enemy situation—special information regarding enemy aerial tactics.

Battalion commander's plan, plan of action of supported unit, including zone of action, sectors, or bivouac areas, and missions of supported units; location of troops and establishments requiring protection; plans of friendly aviation as they affect employment of the battery; location of balloon barrages; location of adjacent and/or other AAA units.

2. Decision of the battery commander based on his mission.
3. Position for each fire unit, and instructions for its internal protection.

Instructions on special employment of particular matériel, for example, detectors.

Routes to positions.

x. Special instructions as to fire control—sectors of fire; method of occupying position; secrecy; camouflage; cover; restriction of movement; local defense; when to be ready to go into action; priority of targets; withholding action; priority on roads; alternate position.

4. Supplies; aid station, or instructions covering evacuation.

Location of trucks not required at positions.

Location of maintenance section.

5. Plan of signal communication, including at least one alternate.

Location of spotting stations.

Special instructions relating to the AAAIS.

Command post or posts (platoon).

■ 134. MARCH ORDERS.—All march orders should follow the prescribed form of the five-paragraph field order. If the convoy is large or if the march is to require several days, the march order may be accompanied by a march table. (See FM 101–5.) In a small unit such as a battalion, especially when part of a larger command, the battalion commander's order may be quite brief and may be issued orally. Check list for march orders follows:

1. Enemy and own situation.
2. Order of march.

Time of departure.

Initial point.

Exact route to be followed (use map or overlays).

Statement as to maximum allowable speed.

Destination of unit or daily run.

3. Instructions for various organizations of the convoy.

Instructions applicable to all organizations are included in the last subparagraph lettered "*x*."

4. Administrative details, such as supply and messing.
5. Information and instructions as to means and maintenance of communication between units of the convoy.

Time of closing old command post and of opening the new one, and positions en route.

■ 135. WARNING ORDERS.—A warning order should precede the march order. It should be issued as soon as information of a move is received. The proper use of warning orders will allow subordinates time to prepare for a contemplated move and will avoid keeping them alerted over an extended period.

	Paragraph	Page
AAAIS:		
General	32	32
Operations	47	43
AAA operations center:		
General	48	48
Operations	59	52
Action:		
Going into	65	61
Going out of	66	67
Air-landing troops, spread beam defense against	26	27
Assignment, searchlight	9	3
Attack, low, spread beam defense against	24	25
Azimuth data reader	42	42
Balloon Barrage liaison officer	55	51
Battalion check list	132	105
Battery check list	133	105
Belt Defense	18	18
Camouflage:		
Discipline	105	94
Importance	96	91
Materials	101	93
Means	94	91
Nets	102	93
Supervision	104	94
Carry lights	65	61
Check list:		
Battalion	132	105
Battery	133	105
Group	131	104
Command net, platoon	35	33
Commander, searchlight	62	55
Communication officer	51	49
Communications	34	33
Concealment	92, 97, 98	90, 91, 92
Control point	11	4
Control, searchlight	52	50
Control station, description	4	1
Cover:		
For matériel and personnel	108	95
General	106	94
Data lines, telephonic	38	36
Data reader:		
Azimuth	42	42
Range	43	42
Defense against—		
Aerial attack	114, 115	97, 98
Ground forces	113	97
Defense belt	18	18
Defense, planning	71	81
Definitions	11	4
Direction finding (D/F) plotter	57	51
Dispersion	109	95

	Paragraph	Page
Disposition—		
Of searchlights	15–18	6
With guns	19	22
Dummy installations	99	92
Duties of searchlight commander	62	55
Emplacement of searchlights	16–21	6
Evacuation	125–127	101
Field orders, general	129	103
Fighter-searchlight team:		
Purpose	12	5
Requirements	13	5
Glare barrage	31	31
Group check list	131	104
Gun operations officer	52	50
Guns, searchlight defense for	20	22
Initial pick-up	63, 65	57, 61
Intelligence net, area	37	35
Intercept officer	49	48
Intercept unit	11	4
Interception, low, spread beam assistance for	25	26
Landing strips, spread beam illumination of	30	30
Liaison officer, balloon barrage	55	51
March orders	134	106
Mission, searchlight	1	1
Multiple target, illumination	67	70
Objective, defense of small	21	23
Observer:		
Plot, gun	53	50
Plot, searchlight	45	42
Operations board	39–47	37
Personnel	41–46	41
Operations officer:		
AAA	50	48
Searchlight	54	50
Orbit	11	4
Orbit beacon	68	77
Paratroops, spread beam defense against	27	28
Pick-up, initial	63	57
Plot observer:		
Gun	53	50
Searchlight	45	42
Plotter	44	42
Direction finding (D/F)	57	51
Situation board	58	51
Positions:		
Occupying	89	87
Selecting group	76	83
Selecting searchlight	88	87
Raid orderly	46	42
Range data reader	43	42

	Paragraph	Page
Reconnaissance, battalion:		
Methods	79	84
Procedure	80	84
Purpose	77	83
Reconnaissance, battery	84	85
Ground	72	81
Group, purpose of	75	82
Instructions during	73	82
Platoon	85	86
Time for	74	82
Searchlight area	11	4
Description	2	1
Searchlight disposition	15–18	6
With guns	19	22
Searchlight mission	1	1
Unit assignment	9	3
Unit control	10	3
Security:		
Attaining	112	96
General	110	96
Single target, illumination	64	60
Situation board plotter	58	51
Sound locator, description	6	2
Spread beam	22	24
Against air-landing troops	27	28
Against low attack	24	25
Against paratroops	27	28
Against water-borne attack	29	29
Assist low interception	25	26
Employment of	23	25
For landing strips	28	28
Standing Operating Procedure	130	103
Supply	117–124	99
Targets:		
Multiple	67	70
Single	64	60
Warning orders	135	107
Warning, telephone	37	35
Water-borne attack, spread beam defense against	28	28
Wing AAAIS teller	56	51