WAR DEPARTMENT FIELD MANUAL

FM 44-6

This manual supersedes FM 4-106, 30 June 1943, including C 1, 21 October 1943; and Training Circular No. 32, War Department, 1944.

EMPLOYMENT OF ANTIAIRCRAFT ARTILLERY SEARCHLIGHTS

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FM 44–6, Employment of Antiaircraft Artillery Searchlights, is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

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Refer to FM 21–6 for explanation of distribution formula.

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CHAPTER 1

ORGANIZATION

Section I. BATTERY ORGANIZATION

1. BATTERY. a. 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. Fire units are equipped with radars in accordance with T/O & E 44–138.

b. The detailed organization for an AAA searchlight battery appears in T/O & E 44–138.

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

(2) 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 or five detector sections depending upon the type of radar issued.

2. BATTERY COMMANDER. The battery commander is responsible for the tactical employment of the

Note. For military terms not defined in this manual see TM 20–205; for list of training publications see FM 21–6.

battery, and its training, administration and supply. Because of the extensive area covered he will seldom be able to select all of the actual searchlight or radar positions on the ground. However, as soon as practicable the battery commander inspects and verifies all light and radar positions. Inspections of weapons, equipment, sanitary facilities, and personal cleanliness of the troops is a responsibility of the battery commander. The battery commander is assisted in his duties by the battery executive, communication officer, and two platoon commanders.

Section II. BATTALION ORGANIZATION

3. BATTALIONS. The battalion is the basic self-contained administrative and tactical unit of antiaircraft artillery. The searchlight battalion is designated as semimobile, and consists of a headquarters and headquarters battery and three searchlight batteries. (See T/O & E 44–135.) The organization of the headquarters and headquarters batteries of the searchlight battalion is contained in T/O & E 44–136. All battalions have a chaplain and medical personnel attached.

4. BATTALION COMMANDER. a. The battalion commander is responsible for the tactical employment of the elements of his command and their training, administration, and supply. By consultation and liaison with his group or force commander, he keeps informed of the general situation. The organic antiaircraft weapons within the unit and the possibilities for passive defense measures must be considered in any plan formulated.

b. The elements of his battalion may be widely scattered for extended periods of time. To maintain efficiency he must make frequent inspections covering all phases of activity engaged in by elements of his command.

c. The battalion commander must keep his battery commanders advised of the friendly and enemy situation so far as it affects the performance of their missions. He gives such instructions concerning fire action as the situation warrants, directs changes of position when necessary, and supervises the supply of ammunition and other items to the batteries.

d. In the situation where the AAA defense does not include the employment of AAA guns or automatic weapons, the searchlight battalion commander is responsible for the establishment of the AAOR and AAAIS. The personnel to operate the AAOR will be obtained from sources available to the battalion commander, normally from the operations and communication sections of the battalion headquarters battery. Detailed information on the AAOR and AAAIS is found in FM 44–8.

e. Where the searchlight battalion is part of an AAA defense employing AAA guns or automatic weapons it will contribute information for the AAAIS.

f. The senior AAA commander in any defense is responsible for the establishment and operation of an AAOR and AAAIS for that defense.

g. When the battalion commander is the senior AAA officer with a force, it is also his responsibility to advise the force commander on AAA matters. His duties in this respect will be similar to those of a brigade or group commander as outlined in FM 44–1 (when published).

5. BATTALION STAFF. The battalion staff assists the battalion commander by providing basic information and advice by which he arrives at his decisions. It develops details of the commander's plan, translates the plan into orders, transmits the orders to the batteries, anticipates future needs, drafts tentative plans, and secures unity of action throughout the command. To insure unity of action the staff members should assist and advise the battery commanders whenever possible. The detailed duties of the various staff members are described in FM 101–5 and 44–1. In addition to the usual staff, in a battalion or brigade headquarters the T/O's provide for a radar officer. (See FM 44–1.)

Section III. GROUP ORGANIZATION

6. GENERAL. Where two or more battalions are operating together they are commanded either by the senior battalion commander or are formed into a group and a headquarters provided to exercise command. The group is a tactical and administrative unit and consists organically of a group headquarters and headquarters battery. Any combination of the various type battalions or batteries may be organized as a group. For the detailed organization of the group headquarters and headquarters battery see T/O & E 44–12.

7. GROUP COMMANDER AND STAFF. For detailed discussion of the duties of the group commander and his staff see FM 44–1.

CHAPTER 2

MISSIONS

8. PRIMARY ROLE. The mission of an AAA searchlight unit, employed in its primary role, is to discover and illuminate hostile air targets operating during periods of darkness in order that they may be effectively engaged by AAA or friendly fighter aviation, and to provide its share of a continuous antiaircraft artillery intelligence service (AAAIS) for close-in, accurate warning purposes.

9. SECONDARY ROLES. In addition, searchlights may be given other specific missions such as to—

a. Assist friendly aircraft by acting as homing beacons.

b. Illuminate landing strips.

c. Create a glare barrage for the purpose of obscuring important targets which cannot be blacked out effectively.

d. Deceive the enemy through the medium of false lighting.

e. Illuminate airborne attack.

f. Illuminate hostile naval craft.

g. Illuminate, either directly or by reflection from clouds, enemy ground forces or terrain, to assist friendly ground force operations.

h. Provide illumination for construction of engineering projects.

i. Provide illumination for the loading and unloading of ships.

10. DETERRENT EFFECT. Searchlights perform another function in performance of their primary role. The dazzle effect of a searchlight beam on an aircraft makes the accomplishment of the pilot's mission very difficult. When caught in the apex of two or more beams, precision visual bombing becomes virtually impossible, and low-flying aircraft are forced to climb to avoid crashing.

CHAPTER 3

CHARACTERISTICS OF SEARCHLIGHTS AND RADARS

11. SEARCHLIGHT. The standard AAA searchlight is a 60-inch, drum type light with a metal mirror, and utilizes a high intensity arc. It may be traversed through 6,400 mils and elevated from —200 to 2,300 mils, either manually, from a central control station by means of distant electrical control, or in the case of the amplidyne equipped lights from the radar itself. The light may be traversed in azimuth at a maximum rate of about 700 mils per second. The normal beam has a spread of 1¼° and will illuminate an area approximately 350 yards in diameter at a slant range of 15,000 yards. To aid in picking up and carrying low, fast targets, the beam may be spread from 1¼° to 15°. When the beam is spread to 15° it has an effective range of approximately 1,200 yards. The AAA searchlight is transported in a trailer drawn by a 2½ ton truck and can be emplaced in 10 to 15 minutes.

12. POWER PLANTS. The power plant for the AAA searchlight is a d-c generator driven by a gasoline engine.

13. CONTROL STATION. The control station of the AAA searchlight consists of a distant electrical controller for moving the searchlight in azimuth and elevation.

Tracking may be manual or automatic on the M 1942 or later models. On older models control is manual only and is accomplished by matching pointers on zero reading voltmeters which are provided to show when the searchlight beam is directed at the azimuth and elevation indicated by the radar 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 the target once it is illuminated.

14. RADAR UNIT. a. The radar unit provides directional data for the searchlight, which data are transmitted by means of a self-synchronous data transmission system. It is also an integral part of the AAAIS (FM 44–8) and is operated so as to insure that adequate intelligence is provided. Each radar is supplied with IFF equipment which provides a means of identification of friendly aircraft.

b. The types of radar now used by searchlight units are the SCR–268 and the AN/TPL–1. Both employ similar principles; however, they differ radically in construction, size, frequency, presentation of signal, type of tracking, and mobility.

(1) *SCR–268.* This set has been in service longer than any other AAA radar. It has a 40,000 yard base line but the average range of pick-up may be materially increased by expert siting and operation. The elevation data from this set are inaccurate below 150 to 250 mils above the angle of mask because of ground interference. The operational efficiency of this set depends largely upon the state of training of the crew. The SCR–268 may be emplaced and prepared for action in about

5 hours by a well trained crew. Because of its excessive weight its mobility is limited to movement over fairly good roads and bridges. (See FM 4–176.)

(2) *AN/TPL–1.* This set is the newer type searchlight control radar. It has a 60,000 yard base line. The radar unit is transported in a trailer drawn by a 2½-ton truck. The towing vehicle carries the operating personnel and the additional equipment necessary for the unit. The lighter weight, compactness, ease of assembly and disassembly make this unit highly mobile. The AN/TPL–1 may be emplaced and prepared for action within 25 minutes. (See FM 44–77.)

15. **SOUND LOCATOR.** The sound locator may continue in use in some units in lieu of the radar unit to furnish directional data for the searchlight. It is capable of following an aircraft in azimuth and elevation under 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 upon the 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.

CHAPTER 4

COMMUNICATIONS

Section I. GENERAL

16. GENERAL. a. AAA communications comprise all means employed to transmit orders, intelligence, and commands between AAA units and for liaison with units of the other arms and services.

b. Within the AAA units, communications are needed between the various command posts and with service elements for normal command and administration.

c. The problem of furnishing antiaircraft artillery with a continuous AAAIS requires an adequate, efficient communication system. The AAAIS consists of an organization for reporting all incoming targets to an antiaircraft operations room where the target courses are plotted on an operations board for the information of the AA operations officer and an intercept officer. The organization and operation of the AAOR and AAAIS are covered in FM 44–8.

d. 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 lines or lack of time to establish a complete telephone system. Radio is provided as an auxiliary system for use in such cases.

Section II. RADIO COMMUNICATION

17. GENERAL. Of the various types of radio sets now authorized for issue to AAA searchlight units, some are intended for command purposes and others are intended to be used for warning purposes (AAAIS). In cases of emergency these sets may be interchanged. No provision is made for administrative radio nets. Administrative messages are transmitted by telephone or messenger.

18. BRIGADE AND GROUP. For discussion of AAA brigade and AAA group radio equipment and radio nets, see FM 44–1 (when published).

19. BATTALION. a. The following radio equipment is furnished per searchlight battalion:

SCR–177	1
SCR–593	3
SCR–543	5
SCR–694 (or 284)	39

b. The radio nets illustrated in figure 1 are based on the number of frequencies that can be anticipated in the theater of operations. These nets present a solution where wire has not been installed. When additional frequencies are available, or when both wire and radio communications are employed, the nets shown may be altered by local SOI. In the event of failure of any wire line a radio channel will be substituted.

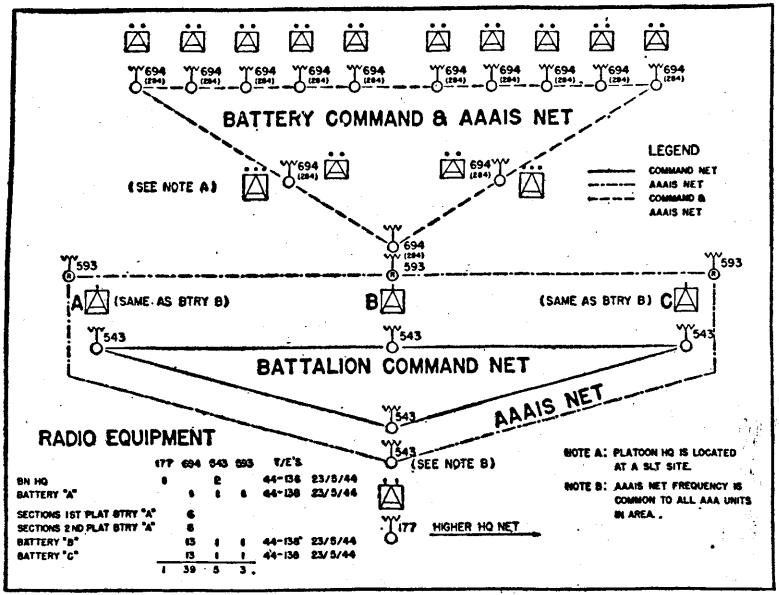


Figure 1. Searchlight battalion and battery radio nets.

Section III. WIRE COMMUNICATION

20. GENERAL. Wire communication equipment provided by the Table of Equipment is sufficient to install essential lines between the command posts, within the batteries, and for interior lines necessary for control of the various elements. Any additional equipment required may be drawn from Signal Corps supply depots. The wire communication net of a searchlight defense should be as complete and extensive as time and matériel permit. As it is the most dependable means of communication, every effort must be made to utilize it to the fullest extent. Radio should be considered the auxiliary means of communication except between higher and widely separated headquarters.

21. TELEPHONE NETS. a. 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.

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 con-

versation. 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 2.

22. 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. 2.) Normally there are 10 or 12 telephones on this net—one at each control station, one at each radar, and one at the platoon 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 radars are numbered to agree with the respective radar designations, D1 to D—. The phone at the platoon command post is designated CP. Control point lights are normally included in the platoon command net.

23. INTELLIGENCE NET. The intelligence net connects the searchlight plot observer in the AA 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 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 6 to 10 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. 3.)

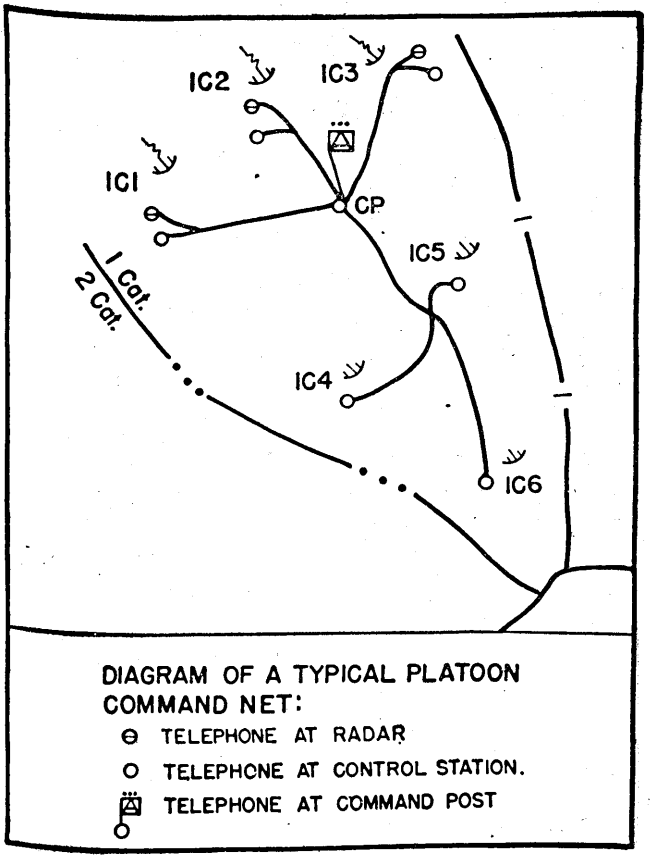


Figure 2. Diagram of a typical platoon command net.

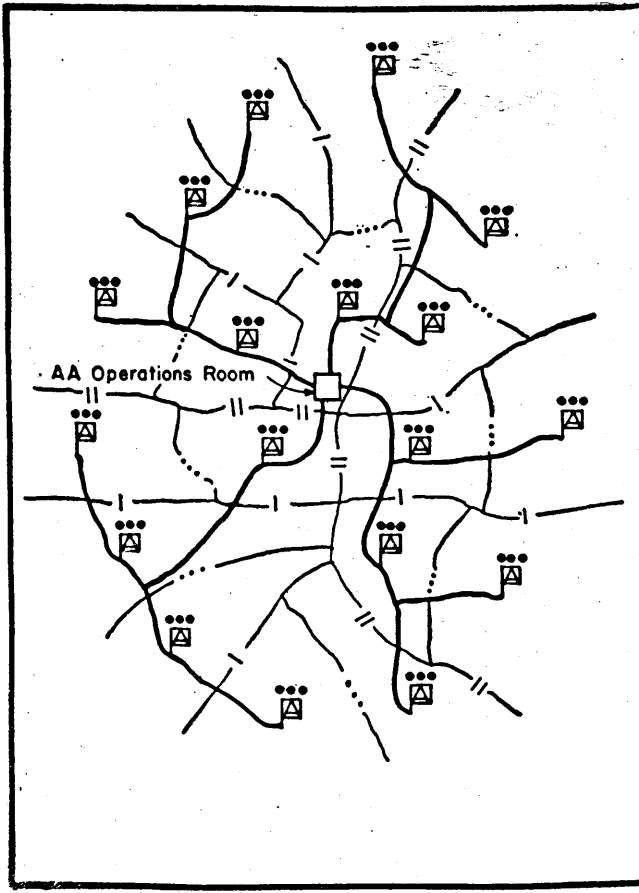


Figure 3. Intelligence net.

24. DATA LINES. The data lines provide communication between each radar in the outer row of searchlights and the corresponding plotter at the AA operations board. In addition, data lines may be provided between a few selected interior radars and the AAOR for furnishing data on targets inside the defense. Over these lines, grid coordinates are transmitted from the radar position to the AAOR for plotting purposes; information concerning IFF, number of aircraft, illuminations, and intersections are reported; and altitude data are also furnished for retransmission to fighter pilots in the air and for information of gun batteries.

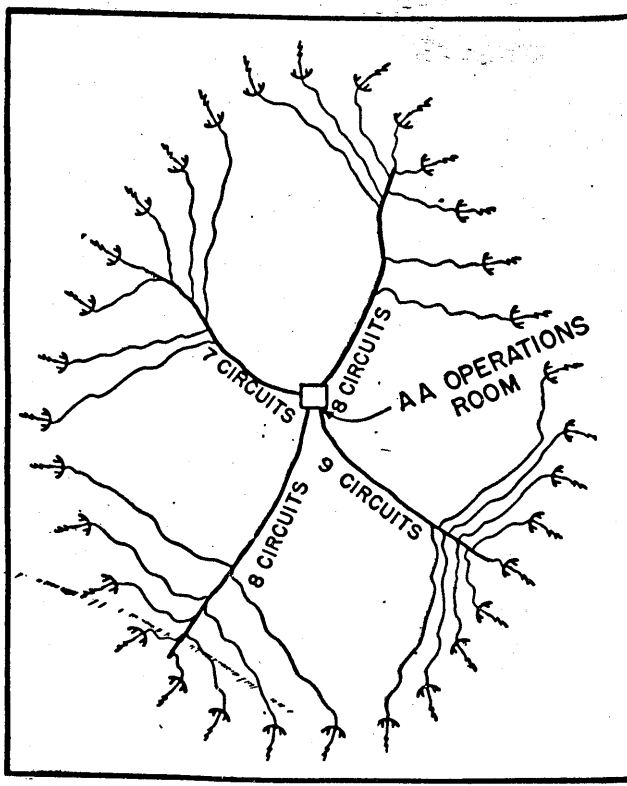


Figure 4. Data lines.

CHAPTER 5

TACTICAL EMPLOYMENT—GENERAL

25. GENERAL. The complete air defense of an objective involves the carefully coordinated employment of all active air defense means. Searchlights may be employed to provide illumination for guns, automatic weapons, fighter aircraft, or all or any combination of these means. Regardless of what active air defense means are employed in conjunction with AAA searchlights, the defense must be planned to provide the most effective opposition to the accomplishment of the enemy mission.

26. ALLOCATION OF SEARCHLIGHTS. The theater, department, or task force commander will allocate AAA searchlights to the ground and air forces as required by the situation. Such allocation is necessarily dependent upon the availability of equipment and the need for AAA searchlights in a particular operation. AAA organization and chain of command within ground forces and air forces will be discussed in FM 44–1 (when published).

27. NATURE OF EMPLOYMENT. Employment of AAA is classified as *static* or *mobile*. A mobile unit may be employed in static or mobile roles. The semimobile searchlight unit with its limited organic transportation is suitable only for static employment, unless additional

transportation is provided. Searchlights normally are used in static situations.

a. **Static employment.** The term "static employment" is used to describe the AAA protection of permanent or semipermanent installations. Depending upon the situation, searchlights may be employed statically in the combat zone, the communications zone, or zone of the interior.

b. **Mobile employment.** The term "mobile employment" is applied to AAA operations with ground combat forces in a moving situation.

28. **BASIS FOR EMPLOYMENT.** a. A searchlight defense of one or more battalions is organized in accordance with the principles set forth in this chapter. Special dispositions of searchlights necessary for cooperation with guns, automatic weapons, or fighter aircraft are discussed in chapters 6 and 7. 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. 5.)

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 of low-flying aircraft when a spacing of 6,000 yards is employed. Presence of smoke, fog, or haze may also necessitate a reduced spacing.

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

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

b. The design of this searchlight defense involves the application of general principles. These principles will serve as a guide in planning a defense and should be adhered to as closely as possible. However, local conditions such as availability of equipment or irregularities of terrain will often necessitate a compromise between the various features of a theoretically perfect defense.

c. The following principles should be adhered to as closely as possible.

(1) The desired depth of the defense is 25 miles.

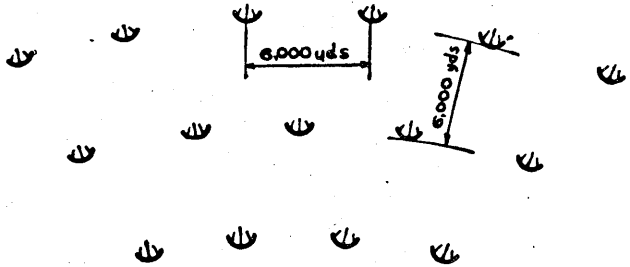


Figure 5. 6,000-yard spacing of searchlights.

This depth may be reduced to 10 miles under adverse conditions of terrain or nonavailability of equipment.

(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) Radars 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) The control points are normally located approximately 7½ miles inside the perimeter of the searchlight area and about 5 miles apart. When the objective area is on or near a coast line, or when the depth of the searchlight area is reduced to the minimum of 10 miles, the control points should be established as close to the shoreline or perimeter as the experience and ability of the fighter pilots will permit. The important consideration is that the fighter pilots will always remain within the searchlight area while orbiting so that accidental illumination of friendly fighters will be minimized.

(7) Searchlights should be grouped so that each platoon contains six lights, either six tactical lights or five tactical lights and a beacon light, whenever terrain features permit. However, do not keep the number of searchlights in the various platoons uniform when ter-

rain 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.

30. PROCEDURE IN ORGANIZATION OF DEFENSE. The steps in organizing a searchlight defense are as follows:

a. A map lay-out of the defense is prepared as explained in paragraph 31.

b. Overlays of the defense are furnished to battalion, battery, and platoon commanders. These overlays should show frequency assignments for all radars and tentative searching sectors. The battalion radar officer advises the commanding officer on the employment, locating, siting, and operation of the radar equipment.

c. 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.

d. 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.

e. Platoon commanders reconnoiter for searchlight and radar 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. The battalion radar officer advises and assists the platoon commanders on their reconnaissance for radar positions.

f. 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 radars, and a second reconnaissance by the platoon commanders affected may be required.

g. 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.

h. The searchlight portion of the AAOR is established and organized by the antiaircraft defense commander as prescribed in FM 44–8.

i. As soon as the radars have been placed in operation, platoon commanders order each chief radar operator to prepare clutter and coverage diagrams through 6,400 mils to determine the azimuth limits of sectors wherein targets can effectively be picked up and tracked. These diagrams are forwarded to the searchlight defense commander.

j. The searchlight defense commander then reassigns searching sectors for all radars on the basis of the clutter and coverage diagrams furnished him by the platoon commanders. Care should be taken to provide adequately overlapping sectors of search, without assigning to any radar a sector in which that radar cannot adequately track targets, because of permanent echoes or other interference.

k. Assignment of periods of operations and standby conditions for searchlight radars on AAAIS duty are made by the antiaircraft defense commander and coordinated with the radar operating schedule of the AAOR. Radars on the perimeter of the searchlight defense area search their normal sectors. At any one time (except during raids) every second AAAIS radar should be in operation. This may be reduced to every third AAAIS radar in operation (except during raids) if a dependable AWS system is in operation in the locality concerned.

l. 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 1 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.

31. ILLUSTRATIVE EXAMPLE OF INITIAL DISPOSITION. The following example will illustrate a practical procedure in making the initial map dispositions of searchlights. It is assumed that two searchlight battalions, equipped with SCR–268's, have been assigned to provide a searchlight defense of the three objectives

shown in figure 6. If the unit had been equipped with the AN/TPL–1, a radar would be sited with each tactical light.

a. 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 6. 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.

b. The total length of the perimeters of the curves is determined. In figure 6, 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 increased 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 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.

c. First, locate positions around or near the terrain obstacles, to insure adequate illumination in their vicinity. In figure 7, 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.

d. 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. 7.)

e. 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 8. 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.

f. The gap between lights 5 and 9 is filled in with two

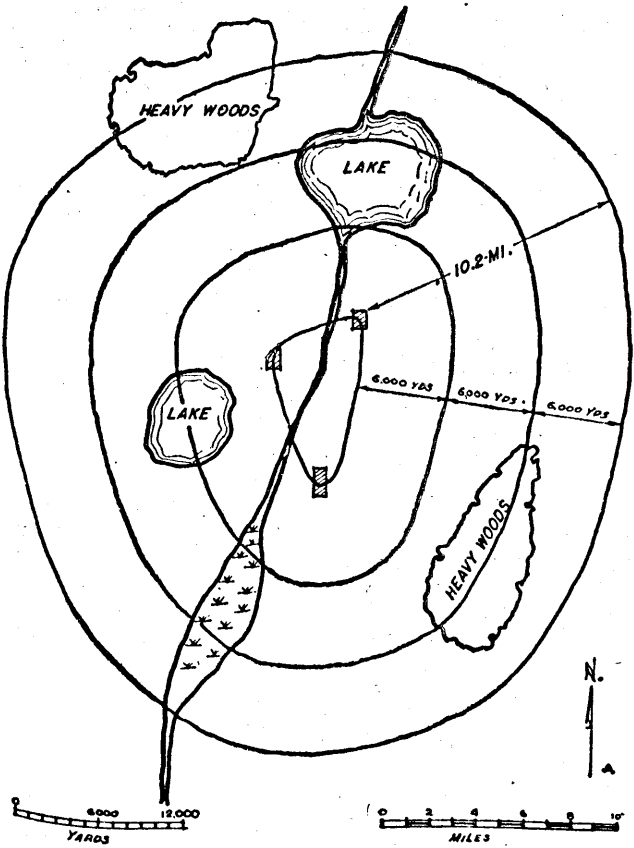


Figure 6. Design of a typical searchlight defense.

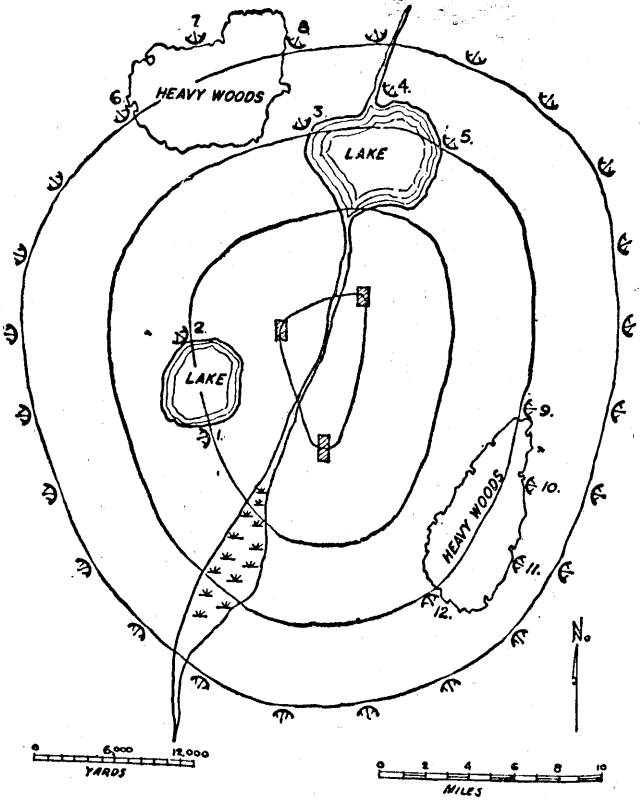


Figure 7. Design of a typical searchlight defense.

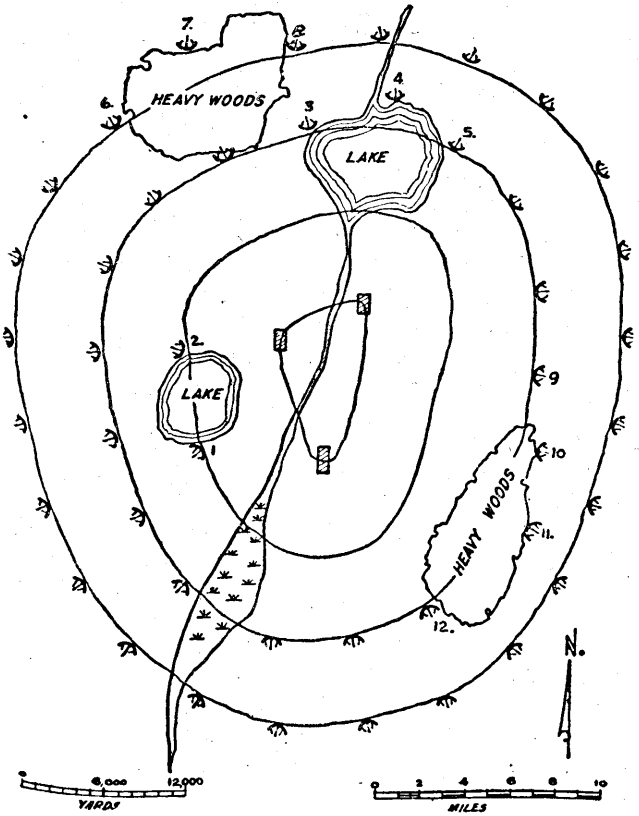


Figure 8. Design of a typical searchlight defense.

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. 8.)

g. 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 9. 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 9. 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.

h. Two lights are located near each objective for spread beam illumination. These lights will also be used for normal illumination. (See fig. 10.) Lights 16 and 17 are placed in the wide intervals between the objectives.

Note. Spread beam lights thus disposed should not be construed to be adequate for illumination of automatic weapons targets. (See ch. 6, sec. III.)

i. 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 10. 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.

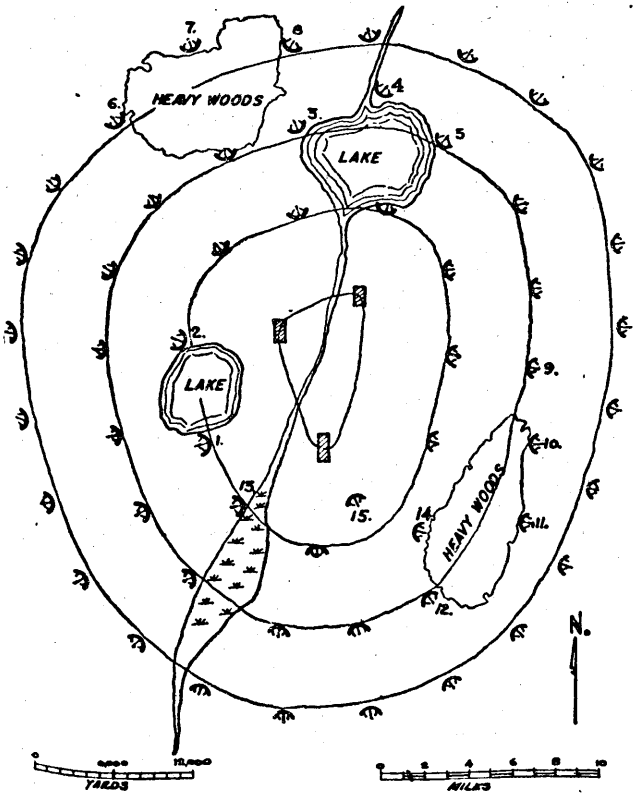


Figure 9. Design of a typical searchlight defense.

j. All 24 outer row SCR–268's are selected as AAAIS radars to furnish data to the AA operations room.

k. Frequency assignments are made for all radars with frequencies staggered at intervals over the frequency range.

l. 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.

m. 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. 11.)

n. 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 11.

o. Platoon and battery boundaries are established, and platoon command posts located, as shown in figure 12.

Note. 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 designated to fit a particular situation. These principles can be followed regardless of the number of searchlight battalions included in the searchlight defense.

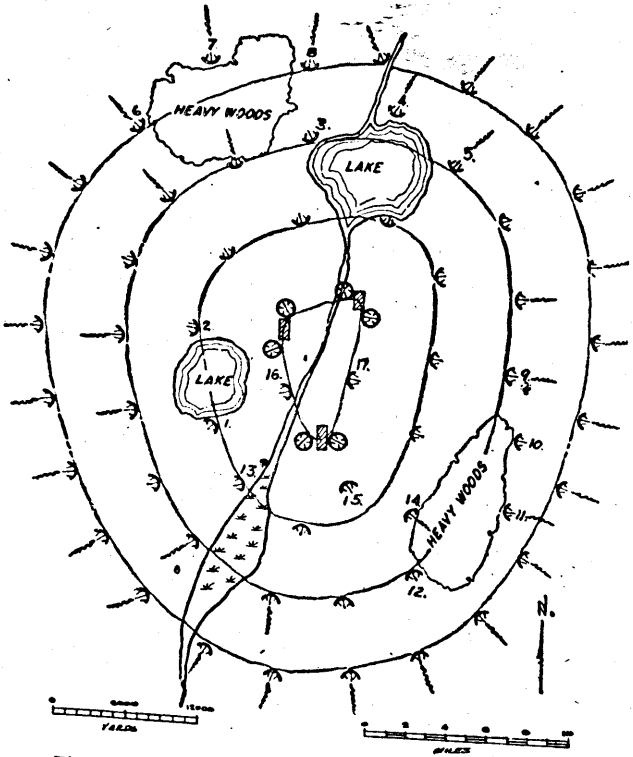


Figure 10. Design of a typical searchlight defense.

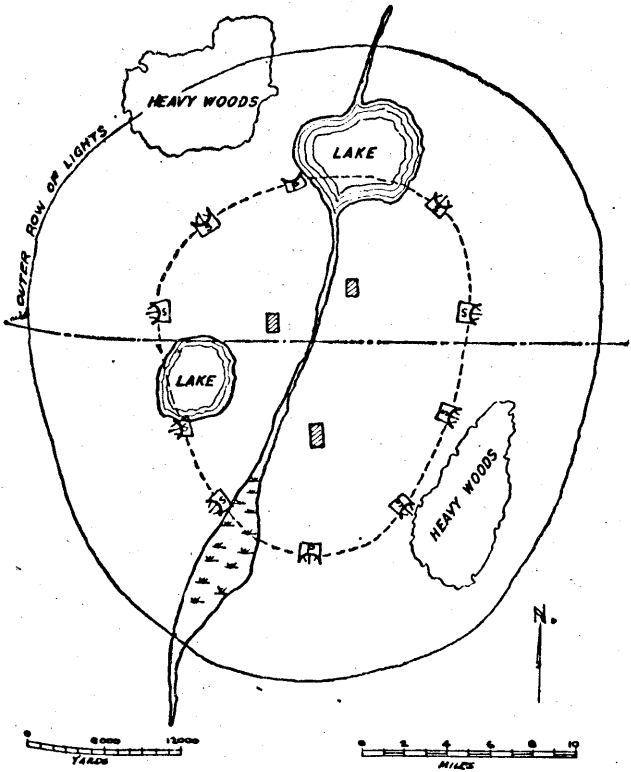


Figure 11. Design of a typical searchlight defense.

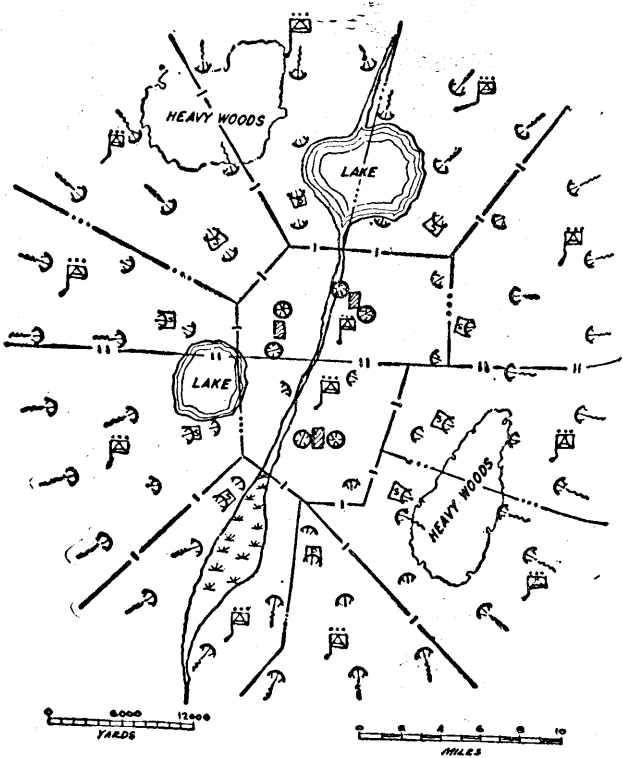


Figure 12. Design of a typical searchlight defense.

CHAPTER 6

EMPLOYMENT WITH GUNS, AUTOMATIC WEAPONS, AND OTHER USES

Section I. EMPLOYMENT WITH GUNS

32. **GENERAL.** The disposition of AAA searchlights for a large coordinated defense with guns is discussed in chapter 5. There will be certain cases where AAA searchlights in numbers less than one battalion will be employed with guns in the defense of small objectives. A small objective as considered in a gun defense is not greater than 2,000 yards in diameter.

33. **BASIC CONSIDERATIONS IN DESIGN OF SEARCHLIGHT DEFENSE FOR GUN ILLUMINATION ONLY.** a. Searchlights are operated under a general plan of illumination for the defense, there being no assignment of searchlights to gun batteries. (See FM 44–1 (when published).)

b. The defense should be capable of acting effectively against attacks from any direction. Such a result will be obtained by the uniform distribution of sufficient lights around the objective. This distribution will also insure that continuous illumination will be provided, enabling gun batteries to fire the maximum number of aimed rounds. However, accidents of terrain, particularly the presence of large water areas, may make such a distribution difficult or even impossible. When the

objective is near a large body of water, the defense must be strengthened along the shore line.

c. The searchlight defense must be able to detect and 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. The minimum distance from the objective at which the target must be illuminated to meet this requirement can be determined by applying the following distances as determined by the expected altitude and speed of the target:

(1) Distance from the objective to the initial burst lines of the gun batteries in the defense.

(2) Distance the target travels during—

(*a*) Time of flight of the projectile to the initial burst line.

(*b*) Time required for fire control instruments to furnish accurate firing data.

(*c*) Time required for visual engagement of the target by gun battery range sections.

(*d*) Time required for initial illumination by the pick-up lights and intersection by the carry lights.

(3) With the point of required initial illumination known, the distance from the objective that the outer lights must be disposed is governed by the expected slant range of the lights based on the conditions of visibility encountered.

d. Computation of the distances mentioned in c above are shown in the following example. (See fig. 13.)

Assume:

Target speed .... 300 mph
H ..... 21,000 feet
Objective ..... 2,000 yards in diameter

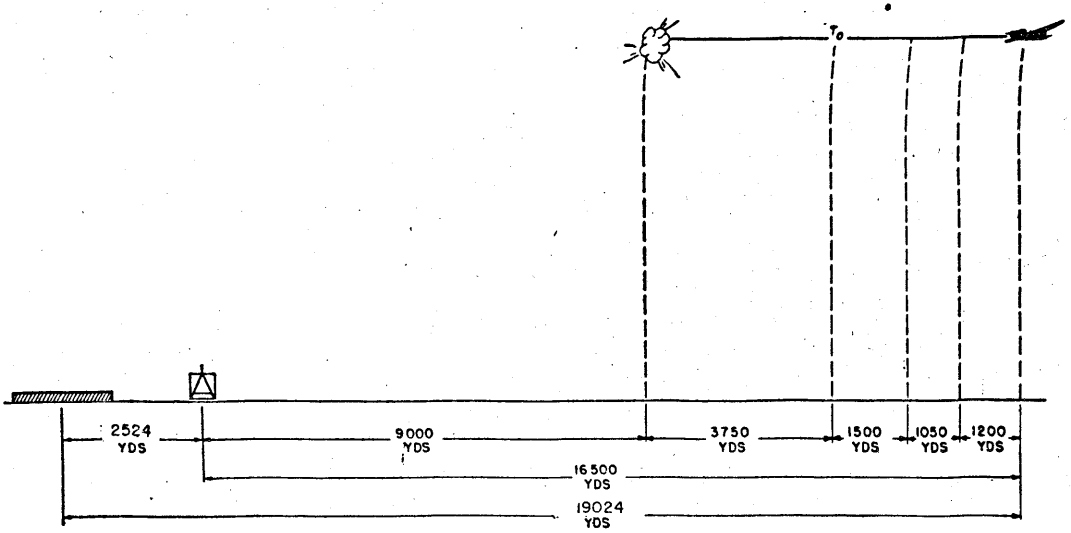


Figure 13. Distances from center of objective to required point of initial illumination. (Illustrative example, par. 33.)

(1) 2,524 yards—distance from center of objective to gun battery site.

(2) 9,000 yards—horizontal range from gun battery to initial burst line from 90-mm trajectory chart using a 25 second fuze.

(3) 3,750 yards—150 yards per second (ground speed of plane) × 25 seconds time of flight of the projectile.

(4) 1,500 yards—150 yards per second × 10 seconds time for director rates to settle.

(5) 1,050 yards—150 yards per second × 7 seconds required for visual engagement by gun battery range section.

(6) 1,200 yards—150 yards per second × 8 seconds for pick-up and intersection by searchlights.

Adding above distances, the horizontal range from the center of the objective to the required point of initial illumination would be 19,024 yards (also indicated in fig. 13). Average times for the factors involved were used.

34. DISPOSITION OF SEARCHLIGHTS AROUND SMALL OBJECTIVE. a. (1) In order to use the available material with maximum effectiveness when employing less than a battalion of lights, the lights are disposed on two concentric rings about the objective. The radius of the outer ring is governed by—

(*a*) The point of required initial illumination.

(*b*) Availability of equipment.

(*c*) Mutually supporting distances between lights conforming to local conditions of visibility.

(*d*) Terrain.

(*e*) Effective accomplishment of the AAAIS mission by radar.

(2) The radius of the inner ring is governed by availability of equipment and terrain. The inner ring must be within mutually supporting distance of the outer ring. All sections on the outer ring will be searchlight-detector sections. Any additional searchlight-detector sections may be placed on the inner ring to strengthen any weak spot in the outer ring or to reinforce outer ring radars on the probable routes of approach. The carry lights are disposed on the inner ring to cover the gaps between

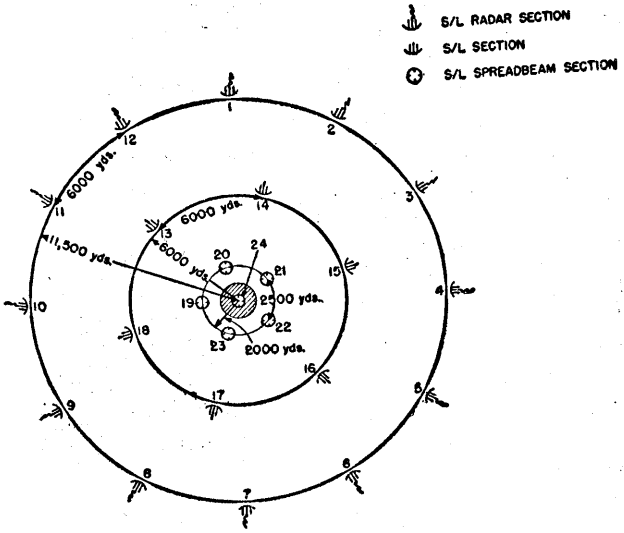


Figure 14. Two-battery searchlight defense for gun illumination only.

the lights on the outer ring. Any additional lights may 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.

b. Figure 14 shows a two-battery defense set up under

ideal conditions. The lights are spaced at 6,000-yard intervals on the inner and outer rings. The inner ring is within mutually supporting distance of the outer ring. There are five mutually supporting spread beam lights 1,000 yards from the edge of the defended area and one spread beam light on the objective for automatic weapons illumination. If poor visibility is encountered it would be necessary to reduce the number of lights for automatic weapons illumination and increase the distance of the inner ring from the objective thereby providing additional lights for the inner ring.

35. OPERATION OF SMALL SEARCHLIGHT-GUN DEFENSE. a. The searchlights on the outer ring are the pick-up lights. Each light is equipped with a radar which will indicate the approach and course of aircraft prior to the arrival of the target at the effective slant range. Pick-up lights should not be separated by a greater distance than approximately 6,000 yards in order to prevent a complete break in the ring if one goes out of action.

b. The searchlights on the inner ring are carry lights. A carry light should be able to illuminate the target as soon as possible after it is illuminated by the pick-up light.

Section II. EMPLOYMENT WITH AUTOMATIC WEAPONS, AND OTHER USES

36. GENERAL. a. All AAA 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 normally is 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, and illumination for defense against waterborne attack and landings.

37. MISSION. The primary mission of searchlights in the searchlight-automatic weapons defense is twofold:

a. To provide maximum time of continuous illumination for automatic weapons fire.

b. To lessen the effectiveness of hostile minimum and low level horizontal air attack through the blinding effect of searchlight beams on pilots and crews.

38. TACTICAL EMPLOYMENT. a. General. In addition to comprising a single defense, the searchlight-automatic weapons defense may be part of a larger fighter-searchlight defense, or part of a general defense made up of searchlights, guns, and automatic weapons. The disposition of elements of the searchlight-automatic weapons defense is not altered by the presence of guns and friendly fighters. One or more searchlight-automatic weapons defenses may be established within a large fighter-searchlight area, or a general antiaircraft artillery defense area. When so established, they become a part of the largest defense installation. In such defense, radars normally used with lights of the automatic weapons defense are placed in the outer rings of lights of the entire defense.

b. Searchlight dispositions. (1) In disposition of searchlights, the angle of mask must be given primary

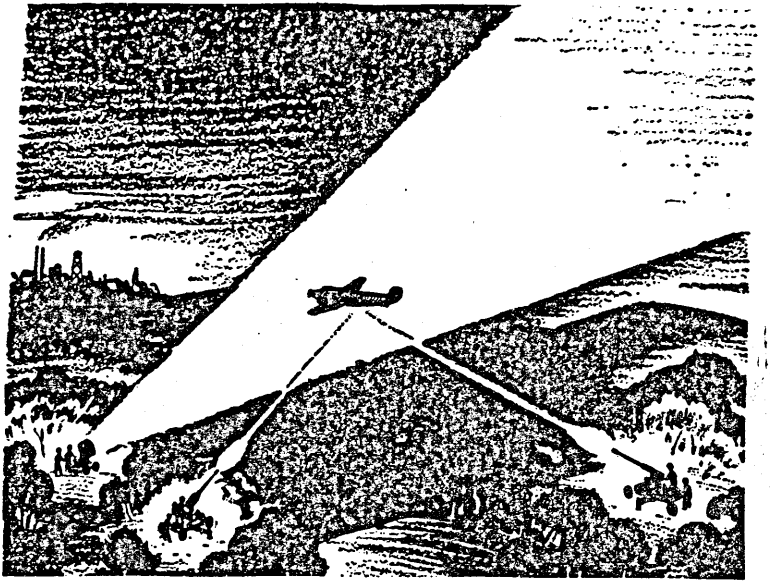


Figure 15. Spread beam searchlight defense against low altitude attack.

consideration, and the defense must be as widespread as possible. A battery of 12 searchlights and 6 radars is considered the minimum required to furnish illumination for the automatic weapons defense of an area 2,000 to 3,000 yards in diameter. If additional searchlights are available, the defense is extended radially. When areas larger than 2,000 to 3,000 yards in diameter are to be defended, additional lights are disposed, in accordance with the following principles:

(*a*) Lights are placed in two generally concentric circles about the defended area.

(*b*) Nine lights, six with radars, are placed on the outer circle, and the remaining three lights on the inner circle.

(*c*) In a typical defense, the radii of the two circles are approximately 1,500 and 3,000 yards.

(*d*) Lights are spaced as equally as terrain and artificial obstacles permit.

(*e*) Each searchlight position should be chosen so as to permit unrestricted illumination between adjacent lights during action against low-flying targets. Lights should not be spaced farther than 3,000 yards apart in this type defense if it can be avoided.

(*f*) Lights and control stations will be so disposed that a target at 300 feet altitude can be carried over any adjacent lights.

(2) In some operations, equipment will not be available in sufficient number to install 12 searchlights in the searchlight-automatic weapons defense. In such instances, whatever the number, the principles enumerated in (1)(*d*), (*e*), and (*f*) above, are applicable. In any event, to accomplish the mission it is necessary that the target be illuminated in sufficient time for the

automatic weapons to get on target and engage at maximum effective range.

39. OPERATIONS ROOM. Control of the searchlight-automatic weapons defense is centered in an AAOR. (See FM 44–8.)

40. LOW ALTITUDE FIGHTER INTERCEPTION. Normally, fighter aircraft will not attempt interceptions on low-flying enemy targets at night. These targets will be engaged by automatic weapons.

41. 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.

42. 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. 16.)

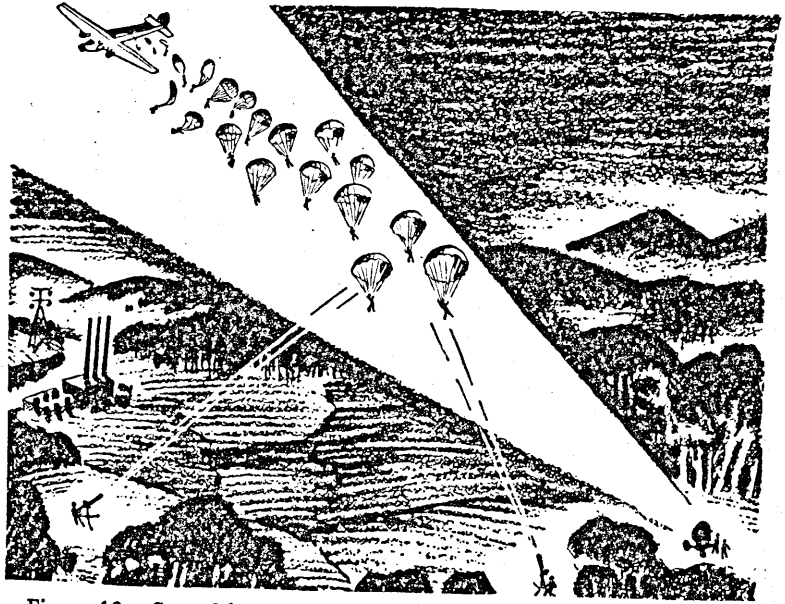


Figure 16. Spread beam searchlight defense against parachute troops.

43. ILLUMINATION OF LANDING STRIPS. Searchlights may be used in two ways to illuminate landing strips or fields:

a. The better plan incorporates the use of the searchlight from a position 100 feet or more beyond the end of the runway over which aircraft will be coming in to land, and to one side of the center of the runway. The searchlight is located at the down wind end of the landing strip. The searchlight beam will then be spread to the degree preferred by the pilots (approximately 8° to 10°).

b. Another plan which may be employed for the illumination of landing strips is to place two searchlights about 50 feet beyond the down wind end, one on each side of the strip. The power plants are placed outside the lights so that nothing stands in line with the center of the runway. The lights are controlled by direct communication with the air field control tower. When the tower calls for illumination the right-hand light goes into action at 1,600 mils elevation. As the aircraft nears the field the left-hand light goes into action with a normal in-focus beam illuminating the left edge of the runway. As the aircraft makes the approach for landing, the right-hand light depresses and illuminates the right edge of the runway in the same manner. The aircraft lands between the two beams and incidental illumination from the two lights is adequate for the pilot to see the runway. This plan may be modified to use one light operating in the same manner as the left-hand light in the dual light setup. (See fig. 17.)

44. WATERBORNE ATTACK AND LANDING PARTIES. a. In repelling waterborne attack or landing parties, the function of the spread beam searchlight

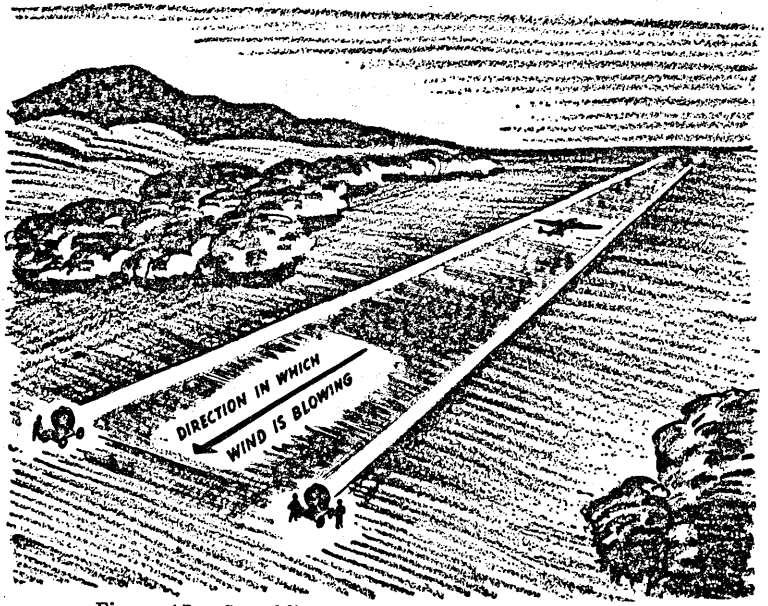


Figure 17. Searchlight illumination on a landing strip.

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 aircraft and boats, the utmost care must be exercised to prevent the 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.

46. 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.

CHAPTER 7

EMPLOYMENT WITH FIGHTER AIRCRAFT

47. DEFINITIONS. a. Searchlight area. A searchlight area is that area of a defense covered by searchlights. The outer row of searchlights and radars 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.

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 shape of the unit.

48. 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 day fighters.

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

c. To illuminate hostile aircraft at night, so that they can be effectively engaged by the friendly fighters.

49. 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 aircraft in multiple, wave, or formation attack must be illuminated.

d. Illumination of the hostile aircraft 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.

50. OPERATIONS OF FIGHTER-SEARCHLIGHT TEAM. The hostile raid is picked up by the AWS and the information is sent to the AAOR. The detector-searchlight sections of the appropriate searchlight intercept units are alerted. These radars pick up the target and telephone the grid coordinates to the AAOR. In the meantime, fighter aircraft are ordered into the air. These fighter aircraft climb to a prescribed altitude and orbit their assigned principal control points. As the course of the hostile target is plotted on the AA 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 aircraft is within range of a searchlight, it is illuminated by that light. Another light makes the intersection on the aircraft already illuminated, and continuous illumination and intersection follow. The intersection is reported to the AAOR, and the intercept officer notifies the friendly fighter. The friendly fighter then locates the intersection and closes for the attack.

51. BASIC CONSIDERATIONS. The basic considerations in the tactical disposition of searchlights and radars 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 homogeneous, 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 nea the target. Therefore, it is necessary that all parts o 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.

52. 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. 19.) 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 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.

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

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

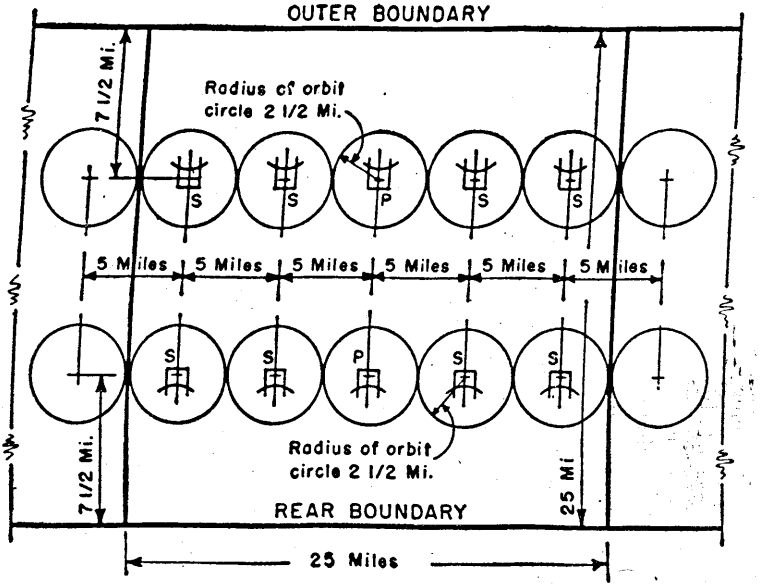


Figure 19. Belt defense.

CHAPTER 8

ILLUMINATION TECHNIQUE

Section I. GENERAL

53. GENERAL. 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. Illumination produced in accord with the principles contained herein is equally suitable, however, for the needs of guns, automatic weapons, and fighter aircraft. Special features of illumination required for cooperation with guns, automatic weapons, and fighter aircraft are discussed under the appropriate headings in the following sections of this chapter.

54. CONTROL. Control by all higher echelons is limited to the broader decisions as to states of readiness for action or of general restriction or release. (See FM 44–1 (when published).) That is, radar 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 specifi-

cally 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 aircraft 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 searchlight control chief or chief radar operator who has to be given many orders is not properly trained or not qualified. Tactical control during action by individual searchlight control chiefs and chief radar operators, previously thoroughly trained and indoctrinated, is the only control adequate to handle the problem. This requires that the searchlight control chiefs and chief radar operators have the qualifications of intelligence, decision, and good judgment, and that they be given thorough training and indoctrination in the principles of tactical control.

55. SEARCHLIGHT CONTROL CHIEF. a. The most important job from a tactical point of view in a searchlight section is that of the searchlight control

chief since he is required to make the important tactical decisions. The searchlight control chief must be free from all duties which interfere with the tactical control of his light.

b. The searchlight control chief'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 radar, 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 AA 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 searchlight control chief. He gives the command IN or OUT and the chief controller relays the commands to the lamp operator by means of the buzzer system connecting 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 searchlight control chief, the chief controller still must wait for the searchlight control chief 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 radar 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 searchlight control chief 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 searchlight control chief, 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 radar, and is within searchlight range, the searchlight control chief should follow the CHANGE TARGET command with the announcement, "On data," to inform the controllers that they should go back on radar data without putting the light out of action.

e. The searchlight control chief 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 searchlight control chief should see that the chief controller watches the sky through the binoculars when the radar 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 searchlight control chief so orders.

g. The searchlight control chief 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 aircraft of anyone in the section.

56. IN ACTION AND INITIAL PICK-UP FOR GUNS AND FIGHTER AIRCRAFT (for Automatic Weapons see sec. III). a. (1) The initial pick-up is made by those lights in the first or second row which have radars. 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 chief radar operator announces, "Range," the radar telephone operator repeats it over the platoon command net, and the control station telephone operator repeats, "Range," to the searchlight control chief. The minimum angle of elevation at which altitude data become accurate varies with different radars but will be between 150 and 250 mils *above the angle of mask.* The minimum angle can be determined for each radar by tracking an outgoing illuminated target with the radar 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 searchlight control chief, 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 radar-searchlight section.*

(4) When the light goes into action, the chief radar operator 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 announcement, "Intersection," is repeated over the data line to the AAOR. The same announcement, "Intersection," is made to the AAOR 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 radar telephone operator then repeats aloud the announcement, "Target illuminated," and this information is immediately transmitted 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 be 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 searchlight control chief, who should immediately put his light in action to form the intersection even though his own radar 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 searchlight control chief 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 radar is tracking a target which has *not yet* reached the proper position, the searchlight control chief 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. 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.

57. CARRY. a. 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 radars, 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 searchlight control chief 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. At this command, control of the light reverts to radar data. *The light does not go out of action.* (See fig. 20.)

b. If one of the beams illuminating an enemy aircraft

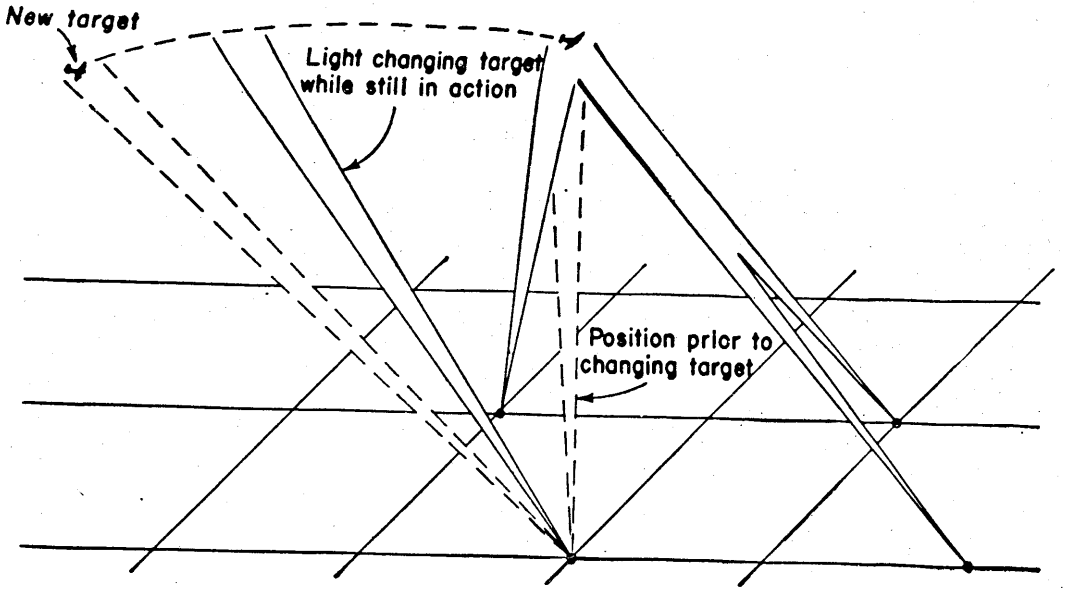


Figure 20. Searchlight beam changing target.

changes target in order to pick up a second incoming aircraft, 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 on the target at all times, but should not pass up new targets in order to do so.

58. GOING OUT OF ACTION. a. Except for the special cases concerning lights in the first two rows, as explained in paragraph 57, a searchlight, once it has gone into action and is carrying a target, should *continue to carry* the target until the prescribed number of other beams, all more effective then the light in question, will still be on the target if this light is extinguished.

(1) It is important that lights go out of action in order from the rear 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.

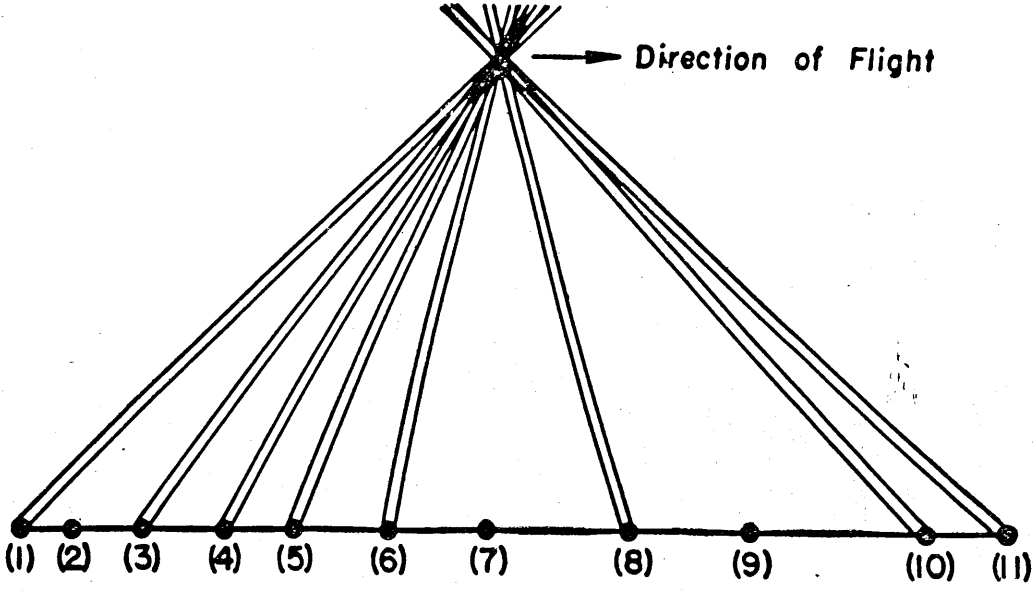
(2) When illuminating targets which are *leaving the area,* the chief controller should continue to track as long as the target is visible, except that the searchlight control chief should order CHANGE TARGET at the proper time if another target approaches which is still within the area. Targets which 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.

b. However, on a well camouflaged aircraft 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 or guns normally require 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 aircraft 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.

c. 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 aircraft 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 normally will be three or four beams.

59. ILLUMINATION OF MULTIPLE AIRCRAFT 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 aircraft attack becomes merely a problem of the practical application of these principles.


Direction of Flight
(1)
(2)
(3)
(4)
(5)
(6)
(7)
(8)
(9)
(10)
(11)

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. 3 should go out of action since there are enough properly directed lights on the target.

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

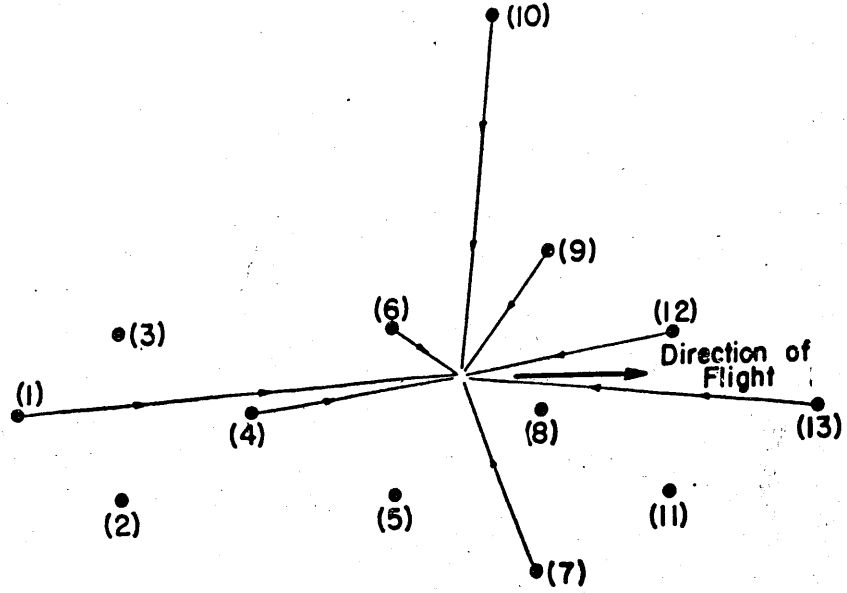
b. Correct tactics illustrated above. (1) Light No. 2, which went out of action because there were a sufficient number of beams, all closer than light 2, on the target, executed the proper action.

(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 21. Tactical handling of searchlight beams—vertical projection.


(10)
(9)
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(3)
Direction of Flight
(1)
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(13)
(2)
(5)
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(7)

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) 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.

(3) 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.

(5) Lights Nos. 2 and 3 have properly gone out of action since lights 4, 6, 7, and 9 are properly in action.

Figure 22. Tactical handling of searchlight beams—horizontal projection.

The searchlight control chiefs 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. An aircraft 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 aircraft 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 (par. 54) is of absolute necessity during a multiple aircraft attack. The principles of tactical operation have been discussed previously, and their application to multiple aircraft attacks is exactly the same as for attacks by a single aircraft. The question of proper selection of targets is discussed in d and e below.

d. The selection of targets is primarily the responsibility of the chief radar operator, but since he cannot maintain constant supervision of the scope operators

and at the same time efficiently perform his tactical duties as chief radar operator, the scope 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, etc. (See fig. 23.)

(2) *Targets spaced laterally.* When several targets which are separated laterally approach, the one *nearest to the normal front* should be selected by the azimuth operator, leaving the other targets to adjacent radars. 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 scopes, provided they are not all at exactly the same range. The azimuth scope operator can determine which target is nearest to the center of the normal front by traversing the radar in azimuth and watching to see which echo gives the most response when the radar 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 scope. The azimuth operator should give directions to the range operator to increase or decrease the range in order to align the selected echo with the center line of the range scope. If the selected echo is to the left of the center line, the range must be decreased;

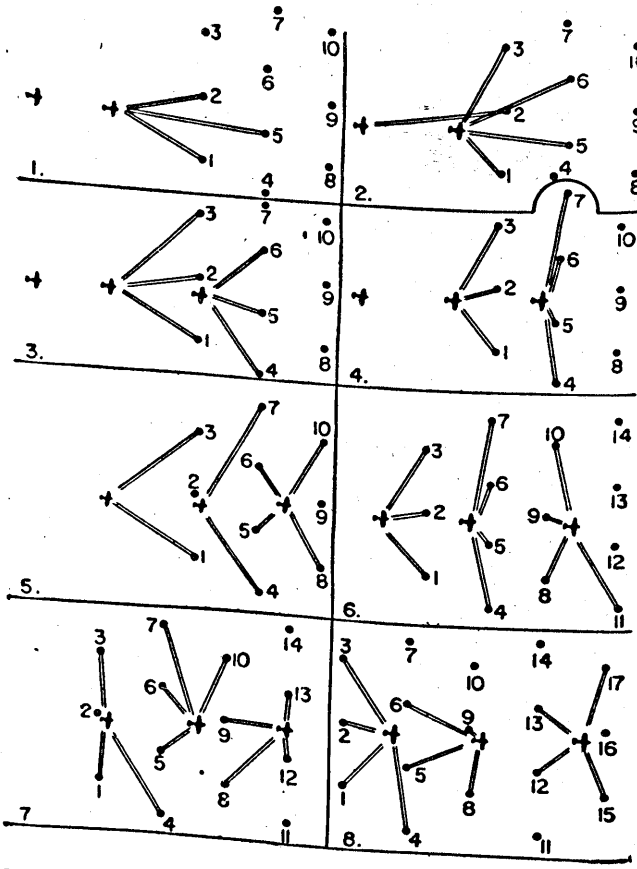
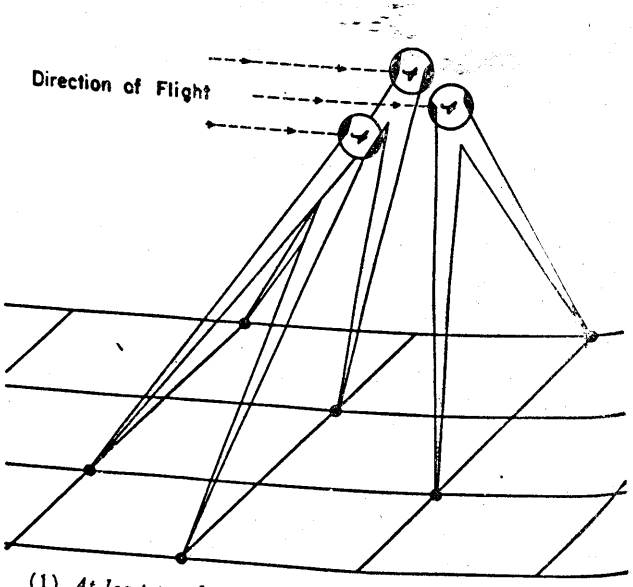


Figure 23. Attack by three aircraft in column. (Maximum number of four beams per target has been prescribed in this case.)

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.* When several targets stacked in altitude, one directly above the other, approach, the target at the highest altitude should normally be selected. Usually, the heavy bombers with the greatest bomb-carrying capacity are flown at higher altitudes, to afford them greater protection from anti-aircraft fire; therefore, if targets approach simultaneously at low, medium, and high altitudes, the chances are that the highest altitude aircraft 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.* Aircraft 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 radar tracking the formation should center on the target closest to its normal front. The greatest chance for error in handling a formation of this sort, in which the aircraft are close enough together so that the entire formation can pass between two adjacent first line lights, is the possibility of the first line radars tracking the aircraft 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 radars should pay particular attention to the *center* of such a



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

Figure 24. Illumination of loose formation.

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 radars should direct their lights to the *center* of it. After the formation has been illuminated and the total number of aircraft 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 aircraft attack in close formation, the scope operators will be unable to track individual aircraft, but should be able to recognize from the appearance of the echo that there is more than one aircraft 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 aircraft attacks than they are for single aircraft attacks, with the exception of a few additional rules to take care of attacks in formation.

(2) If aircraft attack in a *loose* formation, each aircraft being separated by a few hundred yards, it will generally be impossible to keep the prescribed number of beams on each aircraft in the formation due to the concentration of aircraft over a relatively small area. At *least two* beams must be maintained on each target, however, as shown in figure 24, even at the cost of allowing some of the aircraft 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 aircraft nearest to it, as shown in figure 24.

(3) If aircraft attack in *close* formation, it will usually be found that several aircraft 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 aircraft*. A three-aircraft 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 aircraft. (See fig. 25.) In order to prepare for the possible sudden "exploding" of a formation, each chief controller should select one individual aircraft as his particular target, even though his light is illuminating several of them simultaneously. Then, if the formation breaks, each chief 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 aircraft, so that some of the targets would escape if the formation suddenly breaks, each chief controller should select an aircraft 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 aircraft on the left, and the lights in the center take the aircraft in the center, as shown in figure 25.

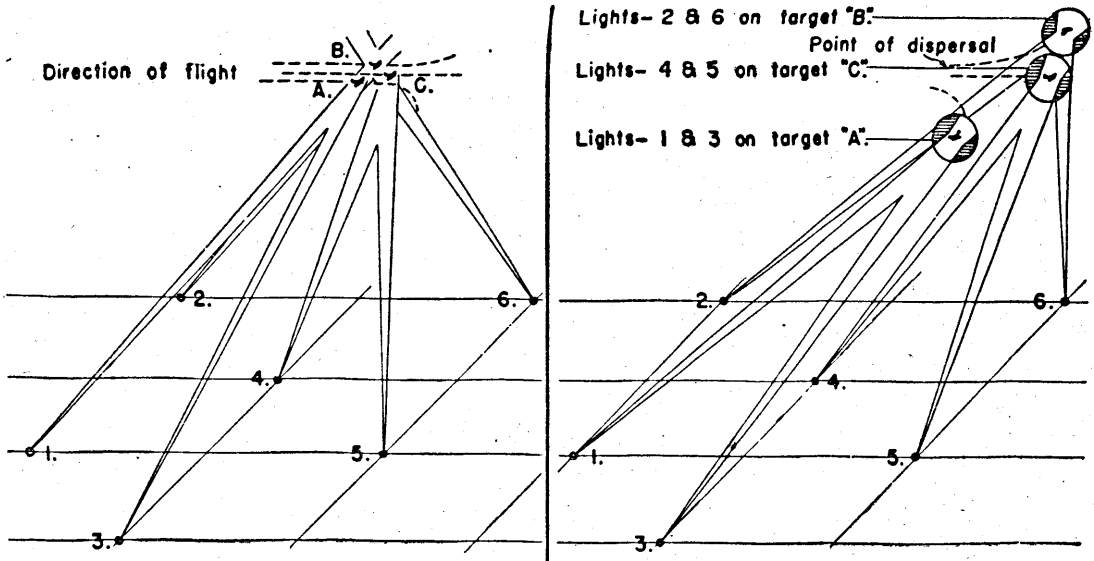


Figure 25. Illumination of a multiple aircraft formation.

Section II. GUNS

60. GENERAL. In addition to the general technique and methods of operation essential to the illumination of all targets as discussed in the preceding section, the following special requirements are necessary for the illumination of targets for AAA gun fire.

61. CARRY LIGHTS. For satisfactory gun operation, it is necessary to carry the target with at least two lights. Different conditions of visibility and attacks delivered at high altitudes might in some situations dictate three or more beams carrying a single target. Targets are chosen by pick-up lights and are carried by them until two carry lights are on the same target. The pick-up lights then disengage and remain ready to illuminate new incoming targets. Carry lights remain on the original target until the target is destroyed, or flies out of searchlight range, or the carrying lights are properly relieved by other lights, or a more suitable target not already adequately illuminated presents itself.

62. TARGET SELECTION. A number of factors are involved in the determination of a suitable target. Some of these are as follows:

a. A target that has not yet dropped its bombs is more suitable than one which has.

b. A target entering the defense is more suitable than one leaving the defense.

c. A heavy bomber is more suitable a target than a light bomber or fighter.

d. A target at low or medium altitude (0–15,000 feet) is more suitable than a target at high altitude (15,000–35,000 feet).

63. MULTIPLE AIRCRAFT FORMATION. If a very large formation should approach the defended area—a formation too large to illuminate all aircraft in the formation—priority should be given to the aircraft at the front, since these will be the aircraft normally illuminated for engagement by AAA guns. Bases of selection of individual targets should be the same as explained in paragraphs 56 and 59.

Section III. AUTOMATIC WEAPONS

64. GENERAL. In order to provide the maximum time of illumination necessary for automatic weapons fire on minimum and low-altitude night attack, certain special features of illumination, in addition to those discussed in section I, are necessary. These special features are discussed in the following paragraphs.

65. SEARCH AND PICK-UP. a. Three beams are employed during search. When one light goes into action, it is immediately assisted by two adjacent lights.

b. Elevation data determined by radar at low altitude may be inaccurate or unreliable. Accordingly, when searching on radar data at less than 8,000 yards' range, the azimuth zero indicator at the control station is matched with the fixed index on the azimuth indicator and search is conducted in elevation only. When radar elevation is reported "On target," the elevation zero indicator pointer is matched with the fixed index on the elevation indicator. Lights will go into action at 15,000 yards when both azimuth and elevation radar data are accurate, at 8,000 yards when only azimuth

radar data are accurate, or immediately upon aural detection when no radar data are available.

66. CARRY. a. Generally, outer ring (pick-up) lights are relieved by inner ring (carry lights), as soon as the target is picked up. However, initial pick-up may be made by any light.

b. Not more than three beams are used to carry a single target.

c. Lights are relieved as in normal searchlight procedure.

d. Continuous illumination must be maintained to permit automatic weapons tracking.

e. Distant electric control is normally employed against targets above an altitude of 500 feet. If the situation indicates that continued attacks may be made at altitudes below 500 feet it may often be advantageous to previously install the extended hand controller. When using extended hand control, one control station controller reports to the light to take control, while light operator adjusts spread of beam.

67. BEAM SPREAD. a. The spread handwheels should be calibrated to indicate amount of spread.

b. During the readiness period, the spread handwheel is habitually set at a total spread of 4°.

c. Initial spread of 4° is used during aural detection.

d. When radar contact is made at range beyond 8,000 yards, and azimuth and elevation data have settled on the target, the in-focus beam is used initially.

e. When radar contact is made within 8,000 yards slant range and elevation data are not accurate, the light is put in action with an initial beam spread of 2°.

f. During illumination, the lamp operator varies the beam spread as directed by the chief controller in order

to provide the most satisfactory illumination of the target. Trained lamp operators may perform this operation without direction. When directors are used by automatic weapons units, there may be a glare in the telescope which handicaps tracking. The beam spread is adjusted to that point which produces minimum glare and filters are used in the director telescopes. The adjustment of beam spread is determined by experience.

68. CONTROL. a. Control of searchlights is decentralized to chiefs of section (searchlight control chiefs) who are trained and indoctrinated in methods of immediate action and teamwork with adjacent lights.

b. The searchlight platoon commander at the CP maintains control through the platoon command net. During action, he exercises only minimum correctional control.

c. The searchlight operations officer exercises restrictional control established by higher authority. He is responsible for the execution of prescribed plans for radar search and for the maintenance of alert and readiness for action.

Section IV. FIGHTER AIRCRAFT

69. GENERAL. This section contains special features of illumination in addition to those in section I, which are necessary for cooperation with fighter aircraft.

70. INITIAL PICK-UP. a. 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 aircraft 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.

b. 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.

c. The scope 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.

71. **CARRY LIGHTS.** a. 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 b below. 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 aircraft becomes a legitimate target for any

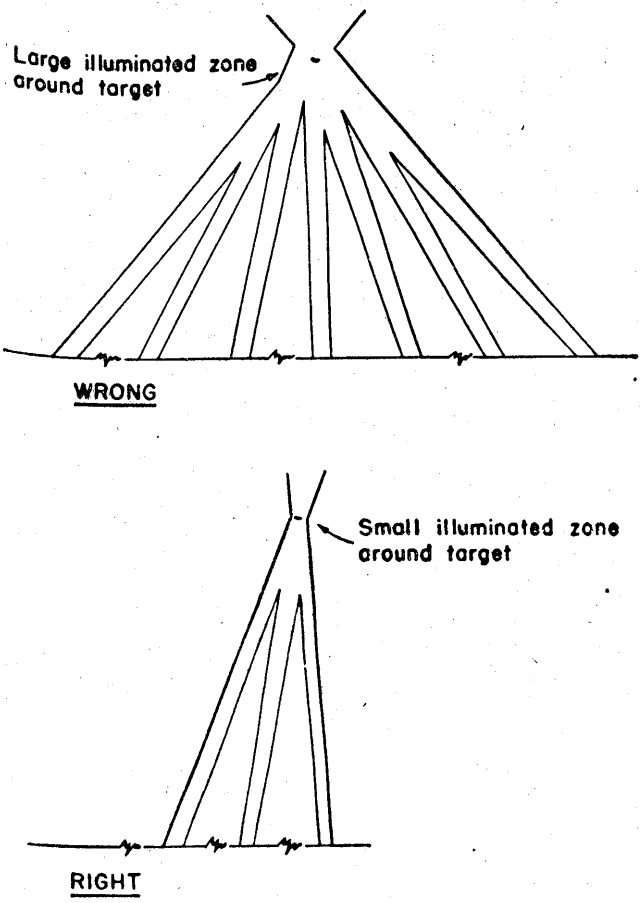


Figure 26. Size of illuminated zone around target.

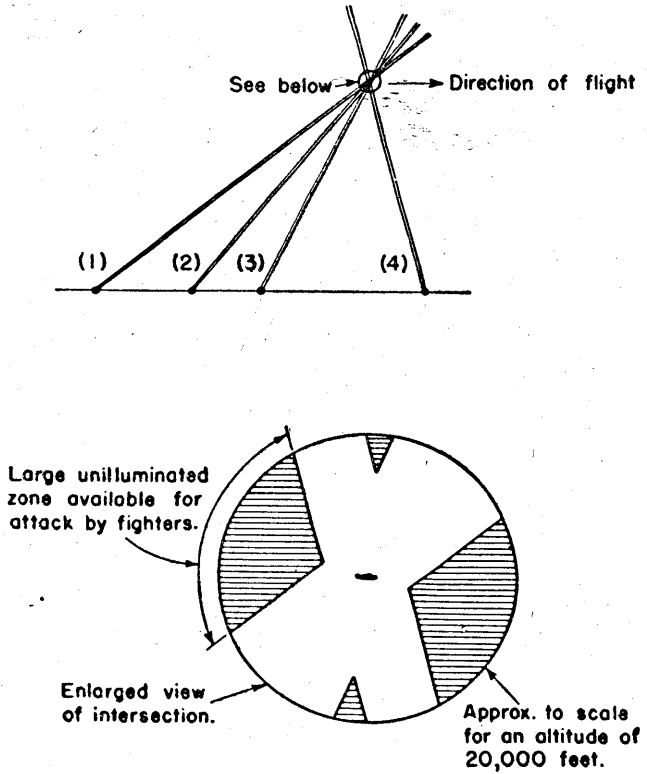
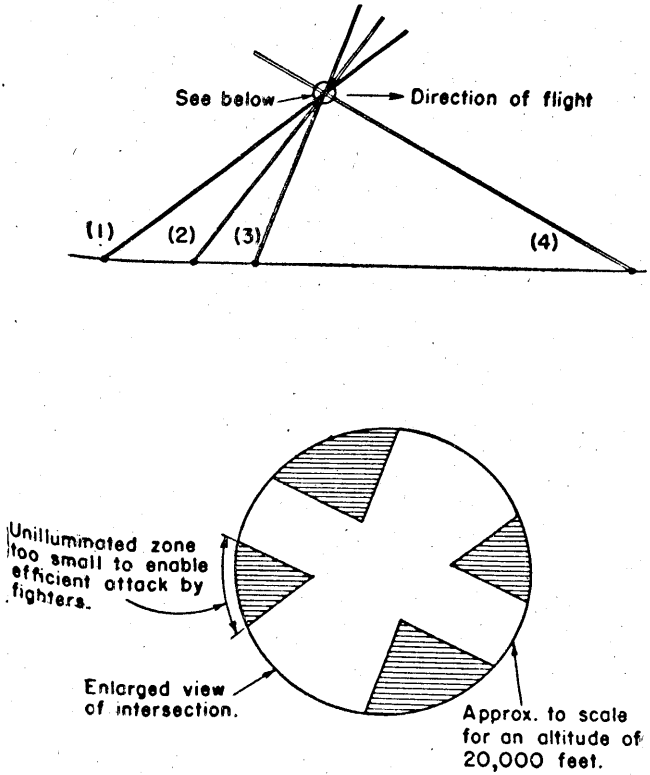


Figure 27. Correct method of carrying target.



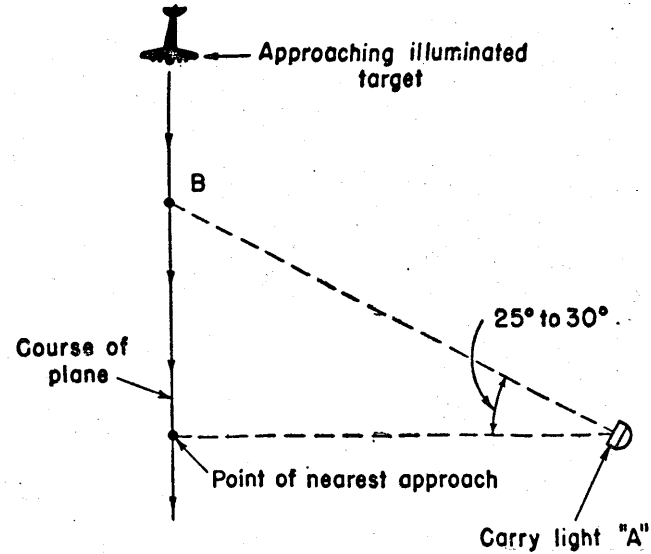
Beam No. 4 in action too soon, projecting behind and above bomber, thereby reducing unilluminated zone available for attack by fighter.

Figure 28. Searchlight going into action too soon.

particular light, that light *must* go into action and commence its carry, *regardless* of the number of beams already in action on it.

b. The point at which an approaching aircraft 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 27, to enable him to close in for the attack without 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.

c. 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 aircraft and project out beyond the rear of the aircraft into the zone in which the fighter is moving. (See fig. 28.) For this reason, when an illuminated aircraft is approaching directly toward a carry light, the searchlight control chief 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 aircraft 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 aircraft. If the approaching 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 searchlight control chief may put his light into action at a somewhat lower angle of elevation, since in this



(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 number of beams already illuminating it.

Figure 29. Carry light going into action.

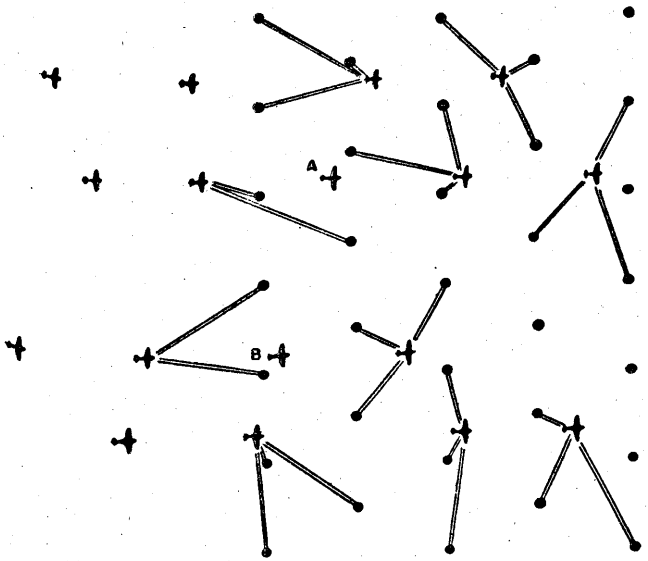
case the light beam will be striking more or less against one side of the aircraft and projecting out beyond the other, rather than striking it from the front and projecting out to the rear. In this case, however, the light should not be put into action until the aircraft has reached a point where the 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 29.

d. The angles mentioned in c 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 searchlight control chief 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:

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

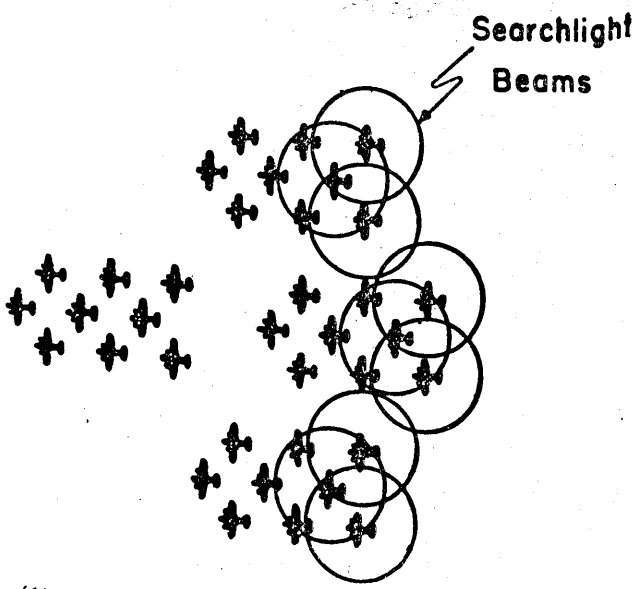
(2) That a carry light must go into action when the target arrives at the proper *position, regardless* of the number of beams already on the target.

72. ILLUMINATION OF A LARGE FORMATION. If a very large formation should approach, too large to illuminate all aircraft in the formation simultaneously, then priority should be given to the aircraft at the base, or rear, of the formation, since these will be the aircraft which will be attacked first by the fighters. The basis of the selection of individual targets should be the same as explained, that is, lights on the left take the aircraft on the left. (See figs. 30 and 31.)



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 30. Illumination of multiple aircraft attack.



(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 31. Illumination of large formation.

73. 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 the beacon may receive notification of an 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 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 searchlight control chief 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. This "sector of dip" is determined by drawing a straight line connecting adjacent beacon lights and bisecting the line with a perpendicular extending to the outer row of searchlights. The point of intersection of the perpendicular and the line of outer row searchlights marks the limit of the sector. (See fig. 33.) This is approximate and can be varied to suit local conditions. The section chief, given the azimuth limits of his sector of dip, 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,

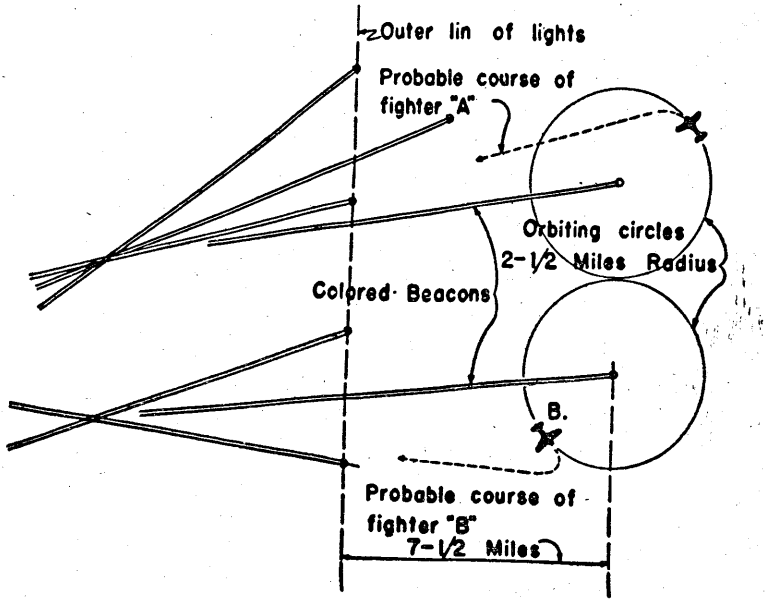
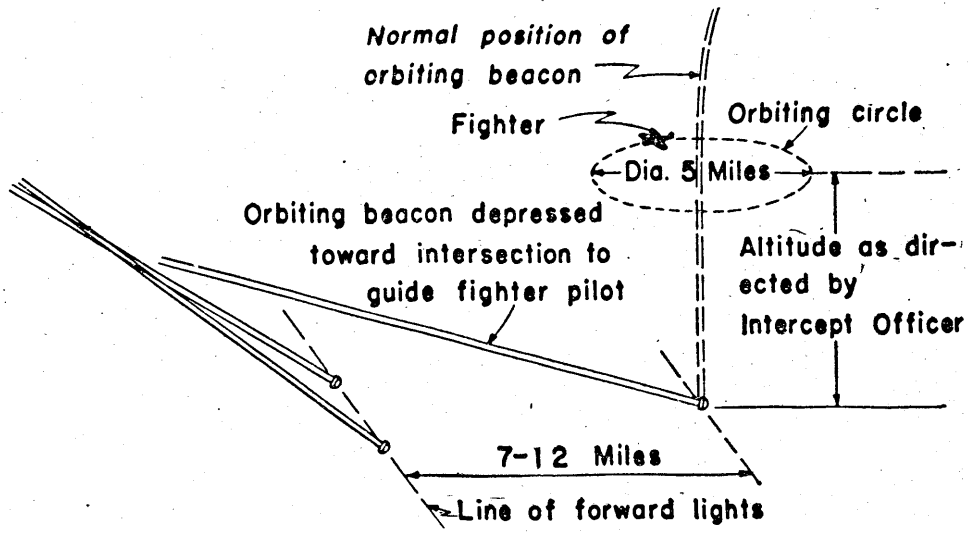


Figure 32. Use of orbiting beacon to guide fighter pilot to proper intercept



(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 33. Use of orbiting beacon to guide fighter pilot to proper intersection.

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 searchlight control chief should select and point out to the fighter pilot the one *nearest* to the center of the sector.

c. The searchlight control chief 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 9

RECONNAISSANCE, SELECTION, AND OCCUPATION OF POSITIONS

Section I. GENERAL

74. GENERAL. This chapter covers the reconnaissance, selection, and occupation of positions by antiaircraft searchlight units. See FM 44–1 (when published) for discussion of reconnaissance by higher echelons.

75. DUTIES OF COMMANDERS. Unit commanders, whenever possible, precede their commands to the position to be occupied. When searchlight units are a part of the ground 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 air defense or similar commands, the senior searchlight commander must be prepared to advise the air defense or similar commander on the employment of searchlights.

76. 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.

77. 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 and radars must be selected by an actual reconnaissance of the ground.

78. 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.

79. 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. BATTALION RECONNAISSANCE

80. 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.

81. 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.

82. 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. The advice and assistance of the battalion radar officer are desirable for a reconnaissance. Through maximum use of his technical knowledge, radars can be initially placed in the best available positions.

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.

83. 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.

84. BATTALION COMMAND POST. In a single battalion searchlight defense, the battalion command post is in the AAOR. In a defense of more than one battalion, observation posts, rather than command posts, are established for the battalion commanders in their respective areas.

85. BATTALION HEADQUARTERS. Battalion headquarters and headquarters battery will be established in the battalion area; conveniently located for the distribution of supplies.

Section III. SEARCHLIGHT BATTERY RECONNAISSANCE AND OCCUPATION OF POSITIONS

86. 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 and radar positions on the ground. As soon as practicable, the battery commander inspects and verifies all light and radar positions. In addition, the battery commander selects, first on the map and finally on the ground, positions for the battery headquarters, 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 and radar 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.

87. 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 radar units, control stations, searchlights, power plants, and machine guns. The battalion radar officer should be consulted in regard to locations for radar units.

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

(1) Section chiefs.

(2) Communication sergeant.

(3) Chief radar operators, 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.

88. BATTERY HEADQUARTERS. The battery headquarters of the searchlight battery is centrally located with reference to its platoons. It may be desirable to locate the searchlight battery headquarters at or near one of the platoon command posts.

89. PLATOON COMMAND POST. The command post of the searchlight platoon is located in the vicinity of a searchlight position from which all of the lights in the platoon may be seen and identified.

90. CONSIDERATIONS AFFECTING SELECTION OF SEARCHLIGHT POSITIONS. a. Field of illu-

mination. 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°. Sites for radar-controlled lights, however, should be selected on the basis of radar, rather than searchlight requirements, except in automatic weapons defense.

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 roads. In an automatic weapons defense pick-up lights should be 500 yards from roads and railroads to facilitate aural detection.

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 10.

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. Since searchlights are likely to draw hostile fire, they should be located as far as practicable from the personnel and matériel of other organizations.

91. 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 are selected and the battery is divided into platoon serials for movement by separated routes to the general platoon areas.

As each platoon approaches its area, each section proceeds separately to its position.

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 chief radar operator in those sections containing a detector section) selects and designates the exact position for the radar 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 radar units operate in the intelligence system and are in position both day and night.

c. **Radar units.** The choice of positions for the radar 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 radar. 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 radar 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 radars 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 and 44–77.) Not only must the location be satisfactory electrically, but it must be made inconspicuous from the air. Enough space about the radar unit should be available to permit easy assembly and manipulation. Available cables for uses between the searchlight and radars are 260 feet long but the searchlight should be placed within 50 feet of the radars. The power plant which is a part of the radar unit is carried on a trailer or power truck. It is connected to the radars by 150-feet electrical cables and should be displaced from the radars 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 varies from 250 to 500 feet; 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 is located near some installation where it can be quickly manned by a designated machine gunner.

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. 10, and FM 44–1 (when published).)

CHAPTER 10

PROTECTION AND SECURITY

92. GENERAL. See FM 44–1 (when published) for general discussion of passive defense means, cover, concealment, camouflage, and local security.

93. IMPORTANCE OF CAMOUFLAGE. AAA searchlight units are 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, radar, power plant, control station, and cables, presents a peculiar pattern on the ground. These considerations emphasize the necessity for artificial concealment.

94. CONCEALMENT OF SEARCHLIGHTS AND ACCESSORIES. The radar section operates during daylight hours as well as at night, and is therefore left in its position. In order to prevent loss of synchronization with the radar, 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.

95. COVER FOR MATERIEL AND PERSONNEL. a. Searchlights. When time is available, limited protection may be given to AAA 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 AAA 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. For all command posts, location may be restricted by communication requirements.

96. DETAILS OF CAMOUFLAGE AND COVER. For details of materials and erection of camouflage and cover, see FM 5–15 and 5–20.

97. 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 may 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.

98. ACTIVE LOCAL DEFENSE AGAINST AIR ATTACK. A searchlight unit, in accomplishing its primary mission, must provide incidental protection for its own elements against air 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 AAA equipment, and when firing has not been prohibited, all individuals fire their small arms on hostile low-flying aircraft upon command of responsible non-commissioned officers.

99. PASSIVE LOCAL DEFENSE AGAINST AIR ATTACK. a. As far as is consistent with the accomplishment of the searchlight mission, the troops employ passive means of defense against air attack and observation in addition to appropriate active means.

b. On receiving a warning of an approaching air 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 air 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.

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

CHAPTER 11

SUPPLY AND EVACUATION

Section I. SUPPLY

101. GENERAL. This section covers the supply searchlight units. Basic supply procedures and defin tions are contained in FM 100–10 and 101–10.

102. SUPPLY AGENCIES. a. Searchlight battalio have the personnel and transportation required to dra and deliver all classes of supplies. AAA groups do n carry any supplies for the battalions, but do coordina the supply activities of subordinate units. The supp section of an AAA group headquarters battery dra and delivers supplies for the group headquarters batte only.

b. All supplies which are procured by requisition a first requisitioned by the batteries. The battalion supp officer consolidates these requisitions and forwards the through appropriate supply channels. When the ba talion is under an AAA group, a copy is sent to th group headquarters for follow up and information.

c. When requisitioned supplies become available, eac supply unit is notified in turn down to the battalion The drawing and distribution of supplies are covere by the supply plan of the higher echelon. The battalio supply sections distribute supplies to subordinate unit

103. CLASS I SUPPLIES (RATIONS). The forward flow of rations normally is 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.

104. CLASS II SUPPLIES (SUPPLIES AND EQUIPMENT PRESCRIBED BY TABLES OF EQUIPMENT). These supplies are requisitioned, drawn, and distributed as described in paragraph 102.

105. CLASS II SUPPLIES (GASOLINE AND OIL). The army quartermaster establishes gasoline and oil supply points at all railheads and depots or at convenient locations 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.

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

107. CLASS V SUPPLIES (AMMUNITION). a. For replenishment of ammunition, battery commanders submit periodic expenditure reports to the battalion muni-

tions 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 section 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 section may be used to bring ammunition to an intermediate supply point, from which the battery vehicles will supply the batteries.

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

b. When the searchlight battalion is operating in a harbor defense or in the 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 depot.

Section II. EVACUATION

109. MEDICAL PERSONNEL ATTACHED TO AAA. Present T/O's make no provision for a medical detachment with the headquarters and headquarters battery of either the brigade or the group. However, each AAA battalion has attached medical personnel organized as a medical detachment. For purposes of command, administration, and supply, the battalion medical detachment is an integral part of the battalion. (See FM 44–1 (when published).)

110. ORGANIZATION. a. Except during initial training and during rest periods, the battalion medical detachment is organized into a battalion aid station detail and battery aid details. The battalion aid station detail is composed of the officer personnel of the medical detachment and the medical enlisted men required to set up and operate an aid station. The battery aid details are made up of aid men attached to batteries.

b. Two aid men are attached to each searchlight battery (one per platoon) to provide emergency medical aid.

111. FUNCTION. a. The senior medical officer of the medical detachment is the battalion surgeon. He supervises the medical service, evacuation, and medical training in the battalion; and advises the battalion commander upon matters pertaining to the health and sanitation of the command.

b. The battalion aid station detail provides medical and dental service for the entire battalion, furnishing medical supplies to the aid men and caring for troops of the battalion located in the immediate vicinity of the aid

scribed by the commander whenever possible. This pro
cedure covers those features of operations which len
themselves to a definite or standardized procedure with
out loss of effectiveness. The adoption of such pro
cedures will save time in the preparation and issuan
of orders, minimize the chances of confusion and erro
when under the stress of combat, and greatly simplif
and expedite the execution of operations in the field
(See FM 44–1 (when published).)

115. GROUP CHECK LIST.

1. *a.* Enemy situation—information of hostile aerial ac
tivity to include types of aircraft, character an
method of attack, locations of airdromes, land
ing fields, and probable route of approach.

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

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

3. *a.* Mission for each searchlight battalion—to provid
protection for certain units, areas, or establish
ments:

   Detachment of units or reversion to battalion con
trol of detached units.

   When applicable, the general location of one o
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.

x. 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 movement; 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 and AAOR).

Axes of signal communication for group and battalions when applicable.

Command posts for group and battalions.

116. BATTALION CHECK LIST.

1. *a*. Enemy situation.

b. 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 AAA 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 and AAOR.

Axes of signal communication for the battalion, when applicable.

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

117. BATTERY CHECK LIST.

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

b. Battalion commander's plan, plan of action of supported unit, including zone of action, sectors, or

bivouac areas, and missions of supported units; locations 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, radars.

Routes to positions.

x. Special instructions—sectors of search, 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.

5. Location of maintenance section.

Plan of signal communication, including at least one alternate.

Special instructions relating to the AAAIS and AAOR.

Command post or posts (platoon).

118. 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 comma the battalion commander's order may be quite br and may be issued orally. Check list for march orde follows:

1. Enemy and own situation.
2. Order of march.
   - Time of departure.
   - Initial point.
   - Exact route to be followed (use map overlays).
   - Statement as to maximum allowable spee
   - Destination of unit or daily run.
3. Instructions for various organizations of t convoy.
   - Instructions applicable to all organizatio are included in the last subparagrap lettered "*x*."
4. Administrative details, such as supply a messing.
5. Information and instructions as to means a maintenance of communication betwe units of the convoy.
   - Time of closing old command post and opening the new one, and positions route.

119. WARNING ORDERS. A warning order shou precede the march order. It should be issued as soo as information of a move is received. The proper us of warning orders will allow subordinates time to pre pare for a contemplated move and will avoid keepin them alerted over an extended period.

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