FM 4–115

WAR DEPARTMENT

COAST ARTILLERY FIELD MANUAL

ANTIAIRCRAFT ARTILLERY

OPERATION OF MATÉRIEL AND EMPLOYMENT OF PERSONNEL, ANTIAIRCRAFT SEARCHLIGHT UNITS

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PREPARED UNDER DIRECTION OF THE CHIEF OF COAST ARTILLERY

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BY ORDER OF THE SECRETARY OF WAR:

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Chief of Staff.

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(The matter contained herein supersedes chapter 3 and section II, of chapter 5, part two; and Table O, chapter 2, part three, Coast Artillery Field Manual, vol. II, February 1, 1933.)

CHAPTER 1

GENERAL

SECTION I

GENERAL

■ 1. SCOPE.—This manual is designed for use by antiaircraft searchlight batteries as a guide in the handling of matériel, selection of personnel, employment of practical training methods, and service of the piece. Drills and instructions given pertain especially to the later types of matériel, but may be applied with slight modification to all matériel of searchlight units, MVI, M1934, M1937, M1939, and M1940.

■ 2. REFERENCES.—This manual should be studied in conjunction with the references listed in the Appendix.

■ 3. GENERAL PROBLEM.—The ability of the antiaircraft artillery gun (and in some cases the automatic weapon) battery to fire effectively on targets at night is dependent upon artificial illumination of the target so that continuously pointed fire may be used. This artificial illumination is furnished by searchlights.

■ 4. POSITION FINDING.—*a.* The presence of the target is disclosed by the sound of its motors, propellers, and its movement through the air. While the sound, when within the hearing of the unaided ear, will give a general idea of

its apparent direction, this is not sufficient for the pointing of the searchlight because of the inherent directional inaccuracy of the human ear. The apparent source of the sound is constantly moving, and the sound itself is subject to a lag because of the time necessary for the sound wave to travel from its source to the point of reception. It is advisable, in order that the light may be pointed properly, that the sound be detected at the greatest possible distance, that the target be followed by its sound, that corrections for sound lag and other effects be applied, and that a prediction be made of the true position of the target. Where the searchlight and the sound locator are so connected together electrically that the searchlight may be moved with the sound locator in azimuth and elevation, prediction may be continuous and automatic. Aerial sound ranging is the process of locating the aircraft by means of the sound emitted. Aerial sound ranging is used primarily at night to assist searchlights in locating targets in order that they may be illuminated with the minimum delay.

The position of the target is determined when the azimuth, angular height, and slant range are known. For searchlight direction, azimuth and angular height only are needed.

b. Any system of position finding and target illumination at night by means of sound location and searchlight illumination should—

(1) Determine with the greatest possible accuracy the angular height and azimuth of the apparent source of the sound.

(2) Determine the effect of sound lag on azimuth and elevation so that the appropriate corrections may be applied.

(3) Evaluate and apply corrections for the deviating effects on the sound wave of other known causes.

(4) Determine and apply corrections for parallax at the target, due to distance between searchlight and sound locator.

(5) Apply the corrections continuously and without any loss of time.

(6) Transmit automatically and continuously to the searchlight the corrected sound locator data.

(7) Move the searchlight continuously in azimuth and angular height so as to follow the moving point source of the sound.

c. The present standard system of target location and illumination embodies means for accomplishing all except item (3) of the requirements indicated in *b* above. No satisfactory correction device has been developed for determining and applying corrections for the deviating effects on the sound wave caused by atmospheric conditions.

d. The method of position finding by sound location is discussed in connection with the sound locator and acoustic corrector in paragraphs 7 and 26.

■ 5. EQUIPMENT.—*a.* The complete system for the detection, location, and illumination of aerial targets includes the following equipment, the arrangement of which is shown schematically in figure 19①:

(1) Searchlight.
(2) Power unit.
(3) Sound locator.
(4) Acoustic corrector (on sound locator).
(5) Control station.

b. When properly disposed in the field the searchlight is 200 feet from the power unit, the control station is 500 feet beyond the light, and the sound locator is 900 feet from the light. The connecting cables between each element are shown in figure 19①, as follows:

(1) Power cables from power unit to searchlight.
(2) Data transmission cable to searchlight from sound locator.
(3) Distant electric control cable from searchlight to control station.

SECTION II

AERIAL SOUND RANGING

■ 6. GENERAL.—See paragraph 4 for a general discussion of the position-finding problem.

■ 7. SOUND LOCATION.—Sound locators are designed to accentuate and make use of the ability of a person to deter-

mine the direction of a sound source by means of the binaural sense. When a man stands in the open where he is not bothered by echoes, he can determine by his sense of hearing alone the approximate direction of the source of a sound. He does this instinctively by turning his head so that he will face the apparent source of the sound. This is largely accounted for by the fact that the human ears are separated by about 5½ inches; hence any sound, unless originating in the perpendicular plane bisecting the line joining the two ears, will arrive at one ear before it does at the other. The human ear is sufficiently sensitive to detect this time difference, and the listener's binaural sense tells him that the sound originated on the side which the sound first reached. It is to make the sound arrive at both ears at the same time (and thus eliminate the time difference) that the head is instinctively turned until the sound is faced. When the sound locator is used, the sound source usually appears to the listener to be directly in rear of his head when the horns are pointed toward the source.

■ 8. SOUND DISTURBANCES.—Sound travels through the atmosphere, and the sound waves are affected by every change and departure from uniformity in the transmitting medium. The atmosphere itself is always in motion. Anything such as wind, density, or temperature changes which cause the sound wave to drift or bend will produce an error in the determination of the direction of the real sound source and consequently must be corrected for. The most common causes of the displacement of the sound waves, from the path and shape which they would have in a still, uniform atmosphere, are wind drift, wind refraction, and temperature refraction.

■ 9. SOUND LAG.—Sound travels through air of average temperature at about 1,100 feet per second which is less than half the muzzle velocity of the antiaircraft guns. Sound may thus be said to have a "time of flight." As the target continues to move while the sound travels to the locator, the apparent position of the source lags behind the true position. This is called the "sound lag." Sound lag depends upon the slant range of the target when the sound was emitted, the

speed of the target, and the average temperature of the air which determines the velocity of the sound. At 30° F. this velocity is 1,022 feet per second, and at 100° F. it is 1,166 feet per second. The velocity changes about 1.1 feet per second for every degree (Fahrenheit) change of temperature. For the calculation of sound lag time for various altitudes and angular heights, an average velocity of 1,100 feet per second can be used without introducing an error of any consequence. Such a velocity will not be far from the average since we deal mainly with the lower temperatures after nightfall and at the higher altitudes. Slant range in feet divided by the velocity of sound waves in feet per second gives the sound lag time in seconds.

■ 10. ATMOSPHERIC CORRECTIONS.—The effects of wind drift, wind refraction, and temperature refraction on the sound wave have been discussed. While these effects are known to exist and while their correction is highly desirable, the problem of developing a satisfactory correction device has not been completely solved. The amount of displacement caused can be computed. However, the basic information on which these computations must be based is either not available or is generally quite unreliable.

■ 11. SOUND LAG CORRECTIONS.—Corrections for sound lag are determined and applied by the acoustic corrector. The operation of the corrector in connection with the sound locator determines and applies the correction for sound lag to the azimuth and angular height as determined by the sound locator. These corrected data are transmitted electrically to the control station, enabling the controllers to point the light in the direction indicated.

■ 12. PARALLAX CORRECTIONS.—*a.* The location of the various units of the sound-locating and target-illumination system is shown in figure 19①. The distance separating the sound locator and the searchlight will introduce an error into the data determined by the acoustic corrector because of the parallax at the target caused by the separation of the two units of the system. The magnitude of the parallax effect will depend upon the distance separating the two units, upon

the slant range to the target, and upon the direction of the target with relation to the line joining the two units.

b. The azimuth parallax correction is of considerable importance in prediction by sound location. The separation of the sound locator and the searchlight by a considerable distance is necessary in order to reduce the disturbing noises which interfere with the operation of the sound locator. It is desirable that the parallax correction made necessary by such separation be introduced automatically into the corrected data. The effect of azimuth parallax may be greatly reduced by setting up the unit with the line searchlight-sound locator pointed in the direction of the targets' expected approach.

c. Instructions for computing and applying parallax corrections are given in paragraph 54*b*.

CHAPTER 2

TRAINING

SECTION I

GENERAL

■ 13. SCOPE.—This chapter contains suggested methods of selection and training of personnel designed to secure rapid and efficient illumination of suitable aircraft targets.

■ 14. IMPORTANCE.—All active countermeasures against night flying aircraft, both by pursuit aviation and antiaircraft artillery, depend on searchlights for the illumination of their targets. Without this illumination the most elaborate system of air and ground antiaircraft defense is useless.

■ 15. TARGETS.—*a.* Antiaircraft searchlights are primarily designed to illuminate aircraft flying at medium and high altitudes—normal targets for the antiaircraft gun. Their additional mission is to illuminate low-flying aircraft—those which are the normal target for automatic weapons. Primary targets must be illuminated at such a distance from the objective as will permit the fire-control instruments of the gun batteries involved to pick up the target and track it, and the guns to open fire so that the first shells burst at the maximum effective range of the guns.

b. Antiaircraft searchlights also cooperate with friendly aviation by illuminating targets for pursuit aircraft, enabling the friendly pursuit to find and attack the enemy.

■ 16. LOCATING THE TARGET.—The short time available for tracking the target prior to illuminating it makes it imperative that the methods used in locating the target be

simple, accurate, and rapid. Practice in locating targets should include training to identify, as well as locate, the target by sound. The theory underlying these methods of target location is discussed in detail in FM 4–111.

■ 17. SELECTION AND TRAINING OF PERSONNEL.—Efficient operation of searchlight matériel requires that personnel be carefully selected and thoroughly trained. In order to allow for inevitable losses due to promotion, sickness, and casualties, each keyman must have at least one understudy trained as his replacement. Selection and training of personnel are discussed in detail in the following sections.

SECTION II

SELECTION OF PERSONNEL

■ 18. LISTENER QUALIFICATIONS.—The men of the searchlight battery who must be most carefully selected are the listeners who operate the sound locators. They must have good hearing, be alert, be able to concentrate without tiring, and possess at least a normal ability to locate the direction of the source of a sound (binaural sense).

■ 19. TEST OF HEARING.—The first step in selecting listeners is to give every available man in the battery an examination in hearing. This should be performed by a medical officer using an audiometer. A record should be kept and the men classified as follows: those with 20/20 hearing in both ears, those who do not have balanced ears, and those who have poorer than 20/20 hearing. Men who do not possess satisfactory acuity of hearing in each ear, and who have not approximately the same acuity in both ears, should not be selected as listeners.

■ 20. BINAURAL TEST.—*a.* The second step in selecting listeners is to give all those men having normal or better hearing a test for their ability to locate a sound source accurately (binaural sense). This test is performed on the binaural training instrument, M1 or M2. (Fig. 1.) Before making this test, however, it is important that the candidates be given a clear idea of what is meant by locating a sound, using the binaural sense, and how it differs from lo-

cating it using the intensity sense (the difference in loudness in each ear).

b. (1) The following demonstration will show how the binaural sense functions and how it differs from the intensity sense. A group of 10 to 20 men is arranged in a large circle, facing inward, and with eyes closed. The instructor takes position just inside the circle and calls on various men by name to point to him, locating him solely by the sound of his voice. After the men have the idea, one-half the men are allowed to watch the other half locate the instructor by sound. This will not only give all an idea of what is meant by locating a sound, but will show that practically all men possess this sense.

(2) After all men have demonstrated their ability to locate a fixed sound (instructor standing still) the instructor moves around inside the ring, talking as he moves, and calling on various men to follow him with their pointing fingers as he moves. This will give the idea of following a moving target. Having one-half the class look while the other half works will show how easily all men follow the moving sound.

(3) The next step is to prove that this sound locating ability does not depend on the fact that one ear hears the sound louder than the other. One blindfolded man is directed to cover his left ear with his hand lightly, so that he can still hear with his left ear but not as well as with his uncovered right ear. The instructor speaks while on the left of the man and directs the man to point in his direction. The man will point in the correct direction (to the left). It is then explained that if we located sounds by the intensity (loudness) of the sound, the man would have located the sound as nearest his uncovered or right ear (to his right), as this ear heard the sound with greater intensity (louder) than did the covered left ear. Each man is then given the opportunity to try this test, some covering the right ear, some the left.

■ 21. DISTANT TEST.—The binaural training instrument, M2, includes a horn assembly rigged up on an elevated wire so that it may be moved back and forth at will. All candidates are given an opportunity to follow the sound at varying distances so as to get practice at a greater distance than is

possible in the circle. During all these tests the candidates should be marked on alertness, accuracy, and general ability to do what is indicated.

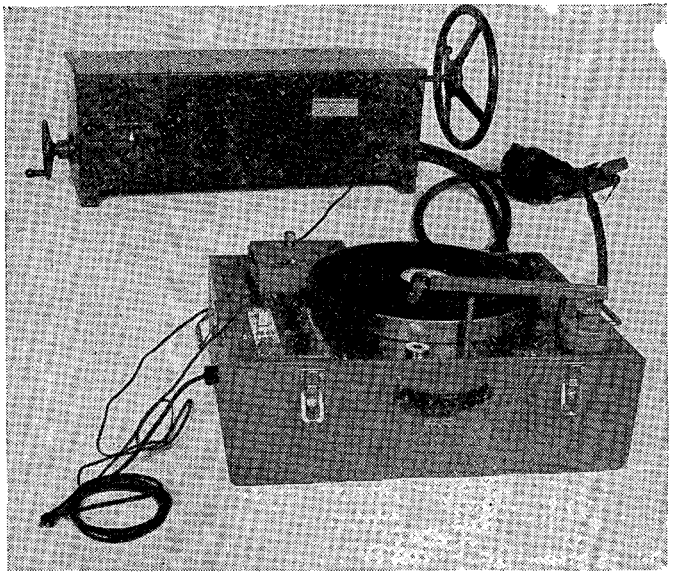


FIGURE 1.—Binaural training instrument, M1.

■ 22. BINAURAL TRAINER TEST.—The binaural training instrument (fig. 1) affords a means of measuring binaural ability numerically and therefore is very convenient for comparing the ability of the various candidates. Each candidate is given a few trial runs to make sure that he knows what is required. As the candidate turns the handwheel, the sound will seem to move across the back of the skull from one ear to the other. When the sound is properly centered, it should seem to be at the base of the skull, midway between the two ears. In some observers the sound will seem to be coming from the front—in others from the rear, but this is an individual idiosyncracy and has no effect on accuracy. The important requirement is that the sound be centered

midway between the ears and at the same place on every trial. Most learners find it helps to bracket the sound, that is, move the wheel until the sound seems to be a short distance on one side of center, then move the wheel in the opposite direction until the sound is definitely nearer the other ear, and then split the distance between the two positions. After the trial runs have been completed, the candidate should be given at least five test runs on a fixed sound source (instructor's handwheel not moved during test), and the results recorded. Next the candidate is given several trial runs at a moving sound source (instructor's handwheel slowly and evenly moved by instructor during test). The candidate endeavors to keep the sound centered during the test by moving his handwheel the proper amount and in the proper direction. At least five test runs are then made and the results recorded.

■ 23. SOUND LOCATOR TEST.—As a result of the tests leading up to and including the binaural-trainer test, the number of candidates should be cut down to about three listeners per position available. Those selected should be tested on the sound locator. As a sound source, the loud-speaker equipment of the binaural trainer, M2, or a moving truck or car at a distance of 100 yards or more affords a good substitute for an airplane, without introducing the complications of sound lag. As a result of these tests, the number of candidates should be reduced to about double the number of positions available. With these listeners, individual training is commenced.

SECTION III

INDIVIDUAL TRAINING OF PERSONNEL

■ 24. PHASES.—The training of personnel is divided into three phases: individual training, unit training, and platoon training. In the first phase, individuals are perfected in the technique of their individual duties. In the second, the men manning one searchlight unit (light, locator, power plant, and vehicles) learn to work together as a team. In the third phase, the light units composing a platoon work together as a team to pick up and carry single and multiple airplane targets.

■ 25. LISTENERS.—*a.* Having cut the number of candidates to twice the number needed to man the sound locators, the unit may proceed to individual training. The listeners should first be given further training on the "buzzer on the wire" and the binaural trainer, both of which may be used indoors if desired. This should be followed by training on the locator, first on a vehicle target at short ranges (100–500 yards) and later on airplane targets at increasing ranges. Here the instructor may use considerable initiative in securing suitable targets by setting up the locator near an airfield, near a road along which automobiles travel, or near the shore where power boats are in use.

b. Once the listeners clearly understand what is required of them, it is only necessary to afford them sufficient opportunity for practice in order to obtain efficient performance. They should listen on every conceivable target: pursuit planes, observation planes, bombing planes; one-, two,- and four-motored planes; planes flying singly and in formation.

c. As air commanders expect to "screen" their high-flying bombers by lower-flying formations of other planes, the listeners must be trained to pick up the bombers through the screen. As the screen will generally be composed of aircraft other than bombers, this operation is entirely practical.

d. Listeners should be trained to identify targets by means of the sound heard. A two-motored flying boat will make a very different sound from that made by a two-motored bomber. Two single-motored planes flying close together can be distinguished from one two-motored plane. Planes with liquid-cooled engines which have an even number of cylinders can be distinguished from those with air-cooled engines which are generally made with an odd number of cylinders. Engines of different size emit different sounds.

■ 26. ACOUSTIC CORRECTOR OPERATORS.—To permit the frequent relief of listeners, the acoustic corrector operator is normally an alternate listener.

a. The operator is given some idea of the sound lag problem so that he will understand the importance of his corrections in the transmission of accurate data to the searchlight.

(1) As shown in figure 2, the target may travel as much as a mile between the time a sound was emitted and the time it reaches the listener on the ground. So while the sound indicates that the target is at its apparent position in the figure, it is actually at its true position.

(2) The acoustic corrector determines and applies the correction for sound lag, so that, although the locator is pointed at the apparent position, the searchlight will be pointed at the true position.

b. The operator is also shown his duties in the actual operation of the corrector (pars. 54 to 56, incl.). He is practiced in the movements necessary to operate the corrector until he acquires a reasonable mechanical skill.

c. He is given a general idea of the sequence of events in picking up the aerial target, so that he will not be confused when the equipment is operated together as a unit. (See par. 36.)

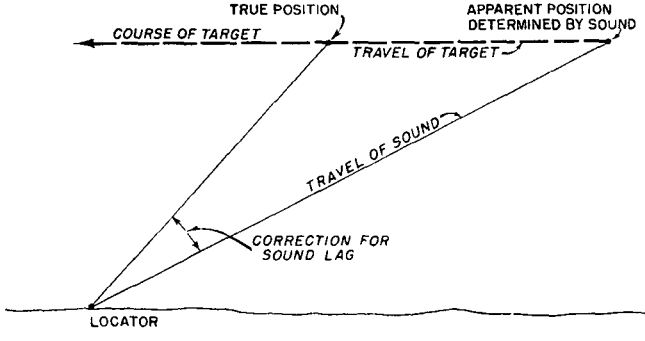


FIGURE 2.—Sound lag correction.

■ 27. TELEPHONE OPERATORS.—*a.* The primary qualifications for a telephone operator are good hearing and the ability to speak clearly and correctly. Most men do not have the second qualification naturally but must be trained in speech. The pronunciation of numbers for telephone use ("fo-wer" for four, "ni-yen" for nine, etc.), the use of words to indicate letters of the alphabet ("affirm" for A), and the general

procedure for efficient telephone operation as given in FM 24–5 should be included in the training.

b. In addition to the general training mentioned above, the operator should be afforded a great deal of practice in the use of words, commands, and warnings usually employed in the searchlight platoon. A series of hypothetical commands, warnings, and messages simulating actual operations will help the new operator to become familiar with the type language used by the searchlight organizations.

c. As speed is the most important factor in antiaircraft communication, the operator does not ordinarily record the message received, but repeats the message orally as it comes over the wire. Similarly, messages from the chief of section to the platoon command post are not recorded but are repeated as given by the chief of section. Exception is made in the case of administrative messages (messages relating to supplies, repairs, etc.) where speed is not a consideration, and a copy of the message is desired.

d. A general idea of how the telephone works and how to make simple repairs should be given the operator. He should have practice in diagnosing simple troubles in the telephone line and in recognizing the symptoms of a short circuit, an open circuit, or other source of trouble. For details see FM 24–5.

■ 28. CONTROL STATION OPERATORS.—*a.* (1) The *azimuth and elevation controllers* should be trained to keep the searchlight pointed as indicated by the sound locator. This is accomplished by using the handwheels to keep the zero readers centered. They should be cautioned to avoid radical movements and to smooth out any sudden movements called for by the zero readers. They search for the target by *slowly* and *smoothly* moving the zero reader pointers first to one side and then to the other side of the zero mark.

(2) The *searchlight commander* (generally a noncommissioned officer) looks through the binoculars and directs the search for the target. He should be instructed as to the size of the area of error through which the controllers search. This area of error may be assumed as 10° in diameter (searchlight beam is about 1¼° in diameter) for a

new locator crew and 5° for an experienced locator crew. He is then shown how to use the binoculars on the control station in an active search and how to carry the target after it is picked up. He should be instructed as to the importance of a *slow* and *careful* search, as many unseen flicks are made because the search was too fast and the flick too short.

b. The details of the actual operation of the control station are given in paragraphs 59 to 61, inclusive.

■ 29. SEARCHLIGHT OPERATORS.—*a.* The searchlight operator should be trained in all the details pertaining to the functioning of the searchlight. He should be taught the prescribed method of—

(1) Leveling the light (par. 64).
(2) Orienting the light (pars. 96 to 99, incl.).
(3) Striking the arc (par. 63*c*).
(4) Adjusting the arc length (par. 63*f*).
(5) Keeping the positive crater at the focal point of the mirror (par. 63*e*).
(6) Keeping the arc voltage and current at the proper values (par. 63*e*).
(7) Recarboning the light (par. 65).
(8) Cleaning the light (par. 155).
(9) Lubricating the light (par. 156).

b. It is important that the light operator be given sufficient instruction and drill on the manual control of the searchlight and its arc, in order that the change from automatic to semiautomatic or manual control may be made without confusion and loss of efficiency. Even though the automatic devices usually function perfectly, complete reliance must not be placed on them.

c. Detailed instructions for the operation of the searchlight will be found in paragraphs 62 to 67, inclusive.

■ 30. POWER-PLANT OPERATORS.—*a.* Each power-plant operator is first trained in the mechanics of starting, running, and stopping the power-plant engine. He is then trained to operate the power panel and to keep the power plant in good operating condition.

b. He is thoroughly trained in the manual operation of the power plant to insure its continued operation in case the

automatic devices fail. Manual operation requires frequent practice and a high degree of mechanical skill to operate the power unit efficiently.

c. Detailed directions for power-plant operation are found in paragraphs 68 to 72, inclusive.

■ 31. CHAUFFEURS.—*a.* The majority of enlisted men today have had some experience in driving an automobile. They should be first taught the difference between a passenger car and the truck they are to operate. The difference in height, length, and weight should be pointed out so that they will not attempt to drive the truck through an opening too small for it. The greater length will make it impossible to get around hairpin turns easily negotiated with a car. The greater weight calls for greater care as to bridges tried and muddy roads used.

b. New chauffeurs should be taught the care of the truck—how to replace gasoline, oil, water, battery water, and air in the tires; how often to check these items; and how to lubricate the truck. (See FM 25–10.)

c. They should be given an understanding of what *not* to do; that they should not adjust the carbureter, adjust the breaker points, clean the spark plugs, or attempt to make other repairs normally attended to by the battery maintenance section.

SECTION IV

SECTION TRAINING

■ 32. SCOPE.—The training of the section should provide instruction in the teamwork of operating one complete searchlight unit efficiently.

■ 33. METHOD.—*a.* Given proper individual training, the most important factor in unit training is practice. Practice must be at regular intervals and cover all the different situations the unit is likely to encounter in action.

b. The importance of frequent practice at regular intervals cannot be overemphasized. It has been found that a break of a few days in training seriously lowers the efficiency of a unit. To prevent these breaks in training, the unit com-

mander must use all possible ingenuity. The binaural training instrument, M2, motor vehicles, motor boats, and commercial and military airplanes must constantly be employed to fill in the periods where no regular drills on assigned targets are possible.

■ 34. CHIEFS OF SECTION.—Chiefs of section require careful training in order to be able to operate their units properly. Their training should include the subjects listed below.

a. Acoustics should be covered in enough detail so that the chief of section can understand and explain—

(1) Travel of sound in air, and how its speed varies with temperature.

(2) What sound lag is, and why we correct for it.

b. Atmospherics should include an idea of the general formation of the atmosphere, how its density varies with altitude, why winds from various directions affect the readings of the sound locator, and the corrections to apply for winds from various directions.

c. Map reading is essential, as the section commander must be able to tell from a map—

(1) How to get to a position marked on the map, or the coordinates of which are furnished.

(2) Whether a road is too steep for his light vehicles to climb.

(3) Whether a nearby knoll is high enough to blanket a prospective light position.

d. Tactics and speed of modern aircraft of the different types.

e. Selection of a good searchlight position as described in paragraph 80.

■ 35. SEARCHLIGHT COMMANDERS.—*a.* The principal emphasis in the training of the searchlight commander should be placed on the search for the target. He should know enough of illumination phenomena and sound phenomena (FM 4–111) to understand why a search is necessary, how large an area should be searched, and why it is necessary to search slowly. As a result of experience with his particular light unit crew, he should be taught exactly how large an area to

search and how to apply corrections for individual listeners' errors.

b. He should know enough about the design and functioning of the searchlight, control station, and power plant to supervise their operation and routine maintenance.

c. He should be trained to be able to take over the duties of the chief of section, should this become necessary.

■ 36. LISTENERS AND ACOUSTIC CORRECTOR OPERATORS.—*a.* On a normal course, the operators will find that events will occur in the following sequence:

(1) The listeners at advanced listening posts (several miles to the front) will report a target coming in and its general location as to azimuth and estimated altitude.

(2) Aided by this report, the chief of section directs the listeners to move the locator horns to the general direction indicated and to search (move the horns up and down, right and left) in that general vicinity. In the usual case, it will be possible to hear the target with the unaided ear before picking it up with the locator. Coached by the section chief, the listeners pick up the target in their horns. As each listener centers the sound of the target, he reports "On target." This will generally occur when the target is between 10° and 20° above the horizontal.

(3) At the section chief's command TRACK, the acoustic corrector operator operates his instruments, sending corrected sound locator data to the light.

(4) At the command IN ACTION given by the chief of section (normally by whistle), the light is turned on and a search for the target begun. This command is generally given when the target is from 30° to 45° above the horizontal. During this searching period, the listeners and corrector operators continue as before, sending corrector data to the control station.

(5) The target will next be picked up and carried. The listeners and operators cease tracking and turn the locator to the front, ready for another target.

(6) At the command OUT OF ACTION, the light is put out.

b. It is important that the listeners center the sound at the same place each time, that is, midway between the ears,

leaving the section chief to determine and apply the correction necessary for the particular individual. Every opportunity must be taken to check on this individual correction as it is subject to a gradual change especially while a listener is learning. This checking may be done whenever the listeners are tracking a target, and the target may be seen by looking through the open sight on the light. If the target is not seen at the center of the sight, and this difference (or individual correction) remains approximately constant from day to day, it should be recorded and applied whenever that listener is on duty.

c. As an aid to training the locator corrector crews, the light units can be set up (at night) close to each other. The target plane is directed to leave its running lights on. The lights are pointed on sound locator data. The amount the light beams miss the target is an indication of the error of the sections. The gradual decrease in the size of this error as training progresses is of considerable encouragement to the crews of the various units and injects a competitive spirit into the training.

d. The listeners are using a delicate sense (the binaural sense), and when operating accurately are differentiating between the time of arrival of the sound at the left and the right ears by 1/30,000 of a second. Anything that interferes with their physical and mental well-being, whether worry, alcohol, or lack of sleep, will be reflected immediately in the quality of their work.

■ 37. DETERMINATION OF INDIVIDUAL CORRECTIONS.—*a.* It is in the latter part of section training that the individual corrections for each regular and alternate listener are obtained.

b. This determination is best made at night. The searchlight is placed in action and on the target plane. The listeners, blindfolded, track the target. The acoustic-corrector operator functions normally. If the listener has no individual correction, the zero-reader needles should remain centered, as the light is kept on the target plane and the locator is indicating the direction of the target plane. Any difference is caused by the idiosyncrasies of the listener and the nonstandard condition of the atmosphere. However,

when determinations are made on several nights with differing atmospheric conditions, an average correction may be arrived at which is usable and which will increase the accuracy of the unit. The accuracy of operation may be illustrated graphically by keeping the target planes' lights on and pointing the lighted searchlight on locator data.

c. On units having zero readers, this correction can be recorded as so many "needle widths" right or left of center. The two controllers then use this point, instead of the zero of the zero reader, as the point about which they search.

d. On units employing the sound locators, M1A1 and M1A2, this correction may be applied as an arbitrary correction directly to the acoustic corrector.

e. The operation of the locator acoustic corrector combination may be tested without the presence of light and control station. The target plane keeps its lights on. The locator and corrector are operated normally. If operation is accurate, target and pantograph pointer will be lined up with the cross lines in the mirror, providing no parallax correction has been applied. The amount they are out of line is a measurement of the error.

■ 38. CHAUFFEURS.—*a.* The chauffeurs will receive most of their training as they move their vehicles from place to place during the training of the section.

b. During this training, the chiefs of section will have ample opportunity to point out the necessary expedients to the new chauffeurs. The mechanics of how best to drive when operating without lights, particularly, how to back up for 900 feet in order to pick up the blue cable, and how to turn around in a restricted space, should all be practiced during this period.

c. The importance of camouflage is pointed out, and practice is given in selecting suitable parking places where natural camouflage is sufficient. Practice in artificially camouflaging the truck should be given. For more detailed instructions see FM 4–105 and FM 5–20.

■ 39. OTHER MEMBERS.—The training of the other members of the section is devoted to fitting the skill they have acquired in individual training into the teamwork of the unit.

Their training is not dependent upon an aerial target and can be carried on almost as well indoors as out and in daylight as well as dark.

■ 40. INDOCTRINATION OF PERSONNEL.—The whole searchlight organization depends on the accuracy of the sound locators for its efficiency. To use the searchlight team at its maximum effectiveness it is necessary that all concerned place their confidence in the sound locators, and believe that the data sent from the locators are reasonably accurate. The crews must also believe that the sound-locator data are more accurate than the guesses made by personnel using the unaided ear. This matter is important enough to warrant a special daylight test or demonstration before the whole battery. For the demonstration a complete unit is set up. The listeners and several selected noncommissioned officers and privates are blindfolded. A target appears. During the course the searchlight is pointed on sound locator data, and its closeness to the target observed in the open sight on the light. At the same time, the unaided listeners stand beside the light and indicate the direction of the target. The reaction of the rest of the battery to their inaccurate efforts to point out the target will usually indoctrinate all with the idea that locator data are best. In the absence of such a demonstration and constant indoctrination by the instructors, the noncommissioned officers will tend to revert to the use of their own ears when under stress, to the complete confusion of the unit.

■ 41. DAYLIGHT PREPARATION.—*a.* In order to train the entire section to function as a unit prior to working under the handicap of darkness it has been found valuable to train the section a few times during daylight. The equipment of the entire section is set up and the listeners are blindfolded. The procedure used is the same as though the training was being carried on at night. The accuracy of the work can be judged by looking through the sights on the searchlight and seeing how near the target the light is pointed.

b. This set-up gives the battery officers and the section chiefs a chance to observe the work of each member of the

section and of the section as a whole. For this training all the sections of a platoon and all platoons of a battery may be assembled at a central location. The sections should be set up in a line with an interval of about 10 yards between sections. An airplane should fly courses starting at least 5 miles beyond listening range and passing over the line of lights on each course. The early courses should be at low altitude (4,000 ft.) and the altitude increased progressively as the training of listeners improves until service altitudes of from 12,000 to 18,000 feet are reached.

SECTION V

PLATOON TRAINING

■ 42. SCOPE.—The platoon training should instruct the light units in the teamwork of operating efficiently with other light units.

■ 43. PHASES.—The training of the platoon can be divided into two phases, primary and advanced.

a. The primary training phase affords an opportunity for the previously trained light units to work together in picking up a single target in the shortest possible time. Practice is the most important single factor. Night practice is best, but daytime practice with listeners blindfolded is valuable.

b. The advanced training phase affords an opportunity to drill the light units in functioning under more difficult service conditions. Multiple targets, interference by low flying pursuit aviation, functioning without communications, and functioning while being attacked by low flying bombardment come under this classification.

■ 44. NORMAL SITUATION.—*a.* The normal set-up for a searchlight defense is shown in figure 3. Distances between lights, and between the advanced listening posts and the forward lights, will be found in FM 4–105. The normal communication net is described in the same manual. One battery is required to afford all around defense of the objective. The platoon command post is generally located at the center light in the forward line. Reports come in from the

advanced listening posts through the forward lights to the platoon command post. Those reports necessary are relayed to the gun battery in the defended sector. The platoon commander issues orders and information over the telephone lines from the command post to the several lights.

b. The advanced listening post (observation post) is manned by an observer (or observers). The only equipment required is a field telephone.

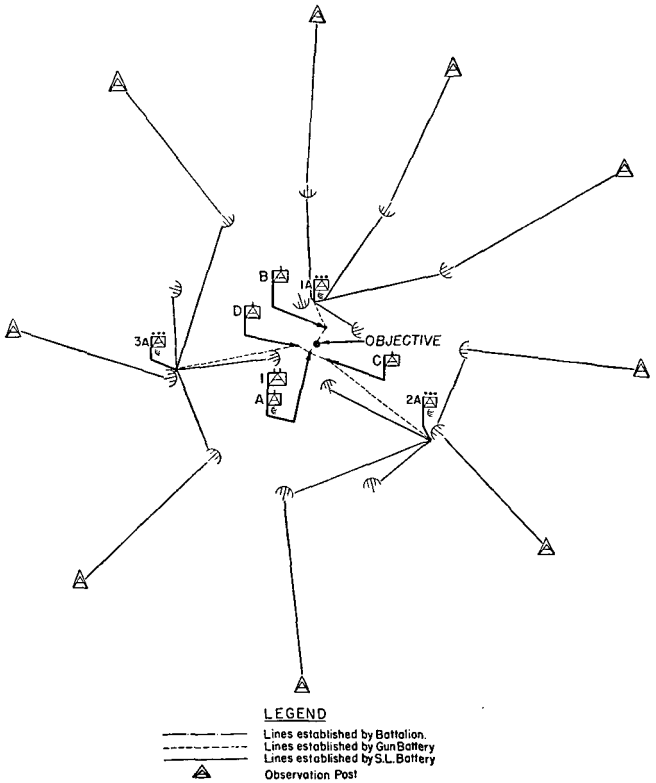


FIGURE 3.—Antiaircraft artillery defense of an objective.

■ 45. SEQUENCE OF EVENTS.—*a.* (1) If the searchlight platoon is part of a highly organized defense, it will probably secure advance information of the approach of enemy planes. If not, or if the enemy planes elude detection, the platoon must depend on its own advanced listening posts. These posts, illustrated in figure 3, should give the following data on the enemy planes heard:

(*a*) Identification number of post reporting (post No. 2).

(*b*) Number of planes heard (one or five or many).

(*c*) Type of planes heard (pursuit or bombers).

(*d*) Location of plane (to the right, overhead, or to the left).

(*e*) Estimated altitude in thousands of feet (altitude 15).

(*f*) Direction of travel (north, northeast, east, southeast, etc.).

(*g*) Time target was heard.

(2) A specimen telephone message would read, "Post No. 2, many bombers overhead, altitude 15, traveling southeast, 0939." If advanced post No. 2 reports the target as overhead, post No. 1 to its left, and post No. 3 to its right, the location of the target is fairly well fixed.

b. Soon after the advanced posts have reported, the first hum of the advancing planes will be heard at the forward light positions, when they seem to be at an elevation of 5° to 15° above horizontal. The sound locators, which have been previously traversed to the direction reported by the advanced posts, commence an active search for the target.

c. (1) When the chief of section of the nearest pick-up (forward) light estimates that the target is in a favorable position for the pick-up (at an elevation of 30°–45°), he commands: IN ACTION. The other pick-up lights in range go into action immediately and assist the first light to pick up the target.

(2) When the defense is trying to pick up two targets, the procedure is quite similar to that outlined above. The chiefs of section must be sure in assigning a target to select the target most nearly in front of them and avoid assigning targets off on their flanks. Those chiefs of section located between two targets must exercise judgment as to

which of the two targets to assign, as otherwise too many lights will be searching for one target and too few for the other.

d. After pick-up, the nearest two carry (rear) lights place their beams on the target and carry it. The pick-up (forward) lights go out of action (if no new target is heard) or change target.

■ 46. PLANNING.—*a.* After an aerial night attack commences, only a very limited time will be available in which to issue orders. Therefore to insure efficient cooperation between the lights during an attack, the procedure to be followed must be worked out before the light sections proceed to their assigned positions. Initiation of action must be based on a few simple plans.

b. After the various forms of enemy attack have been visualized, and suitable means of combating them have been devised, the light unit commanders and later the light units must be drilled over and over again until their response to a given situation is quick and without confusion.

c. The exact procedure to be adopted will depend on enemy tactics, the prevailing weather, the strength of the defense, and other factors of the moment. However, certain general rules may be laid down.

■ 47. NOTES ON OPERATION.—*a.* All pick-up (forward) lights within pick-up distance of the target and not needed elsewhere will go into action when the target comes in range.

b. After pick-up, two carry (rear) lights carry the target. All others go out of action, swing around to the front, and await the next target.

c. If two targets come in simultaneously, two or three pick-up lights search for one target and two or three for the other. If more than two are heard in a narrow sector, it is better to disregard the others and concentrate on picking up two.

d. Any pick-up light in range whose sound locator or distant electric control (D. E. C.) fails should search in the region being covered by the other lights.

e. If the distant electric control fails, the extended hand control should be immediately connected and used.

f. Where no wire communication between lights exists, lights always go into action on the initiative of the section chief. When one light starts a search, the other pick-up lights within range go into action immediately and assist.

■ 48. MOVING SITUATIONS.—*a.* Whenever the antiaircraft artillery defense is acting in a mobile situation, it is necessary to plan ahead and anticipate the next move. This is especially true in situations where no telephone lines have been laid.

b. When the antiaircraft artillery is part of the field forces in combat, it is necessary to have prepared plans for a forward and a retrograde movement. A simple signal from the command post searchlight will then direct the movement in the desired direction.

c. Roundabout communication can often be secured by sending a message via the nearest field artillery telephone net. This is likely to be rather slow if the Field Artillery is busy at the time.

d. It will often be necessary to rely on a motorcycle messenger to deliver messages and orders to the various lights. The platoon commander should visit each light unit and talk over the situation with the light unit commanders at least once during the day.

e. Situations will arise where it is not wise to have the light units take the road to a central bivouac. In this case it will generally be possible to attach the men of each light to the nearest artillery or infantry unit for rations.

f. There is scarcely any type of military work that makes greater demands on the noncommissioned officer than the command of an antiaircraft searchlight unit, especially in a moving situation. He must understand something of acoustics, electricity, gasoline motor vehicles, power plants, map reading, messing, and supply. The only way the platoon commander can be sure that the necessary knowledge is acquired is to train the unit commanders and then try them out in simulated war situations.

■ 49. CARRYING THE TARGET.—When an illuminated target flies across a defended area, it must be passed from carry light to carry light, always keeping two lights on it. This

should be done without orders. In order that all concerned may know what is expected, the maneuver should be frequently practiced.

■ 50. BOMBER FORMATIONS SCREENED BY OTHER AVIATION.—*a.* The enemy will endeavor to place his low-flying aviation between the sound locators and the high-flying bombers. A pursuit formation directly in line with the bombers and close above the sound locators will drown out the sound made by the bombers, but only momentarily. During this moment when one locator is blanketed, the other four of the platoon are little interfered with.

b. When the screening formation flies close to the bomber formation, reliance must be placed on the difference in sound between the bombers and the screening planes. Large planes will seldom if ever be used for screening, as they could be more efficiently employed to carry bombs. It is unlikely that the screening formation will be immediately below the bombers, as they would then be in danger from the falling bombs.

■ 51. GLIDING TARGETS.—*a.* The purpose of gliding in to the objective is to reduce the noise made by the motors and propellers of the attacking airplane and thereby avoid detection. If the light units are located in a very noisy area, or if the light crews are poorly trained, this gives good results. Against a well-trained crew, these tactics are almost sure to fail.

b. During the glide, the motors are not turned off and the propellers stopped, but the motors are allowed to idle, which means that the propellers will be rotating at a speed of 400 revolutions per minute or more. Each time a blade comes opposite the wing it creates a characteristic "whosh" which is easy to identify and center, using the sound locator.

c. Combating glide bombers calls for greater alertness on the part of the advanced listening posts. They must hear the gliding airplanes and report to the command post, as otherwise the planes will be over the lights before their presence is realized. As these posts are several miles in advance of the lights, they may be able to hear the planes approaching before they start their glide.

d. Once the locator is "on target," the procedure in searching, picking up, and carrying is the same as for a normal target.

■ 52. DAYLIGHT TRAINING.—*a.* It will rarely be possible to have an airplane target at the disposal of the searchlights whenever desired. After the first few days of training, flying time is most profitably employed at night. During the day, use should be made of chance targets to train the light unit crews.

b. Advantage should be taken of any nearby commercial air route, airport, military airport, or military air training area to furnish chance targets. A call to the commercial airport will ascertain the commercial schedules, student training, and other definite flying in progress. The nearby Army and Navy air fields will generally supply a copy of their training schedules in advance.

c. Failing impromptu air activity, use may be made of a nearby highway or water area where automobiles or motorboats furnish moving targets to track.

d. When weather is inclement, the "loudspeaker on a wire" at the far end of a large garage may be employed. If this is impracticable, the listeners may be drilled on the binaural trainer. This training may be enlivened by employing some outside noise such as a nearby electric fan to simulate a screen of low flying planes.

e. During daylight training, the listeners should be blindfolded as the effort to keep the eyes closed is distracting.

CHAPTER 3

OPERATION AND FUNCTIONING OF MATÉRIEL

SECTION I

SOUND LOCATION EQUIPMENT

■ 53. OPERATION OF SOUND LOCATOR, M2.—*a.* This locator has three composition horns mounted on a pedestal and base. The acoustic corrector is built into the sound locator. One horn has been eliminated by using a common horn for both elevation and azimuth. As shown in figure 4, the elevation and azimuth listeners stand, one in front of and one in rear

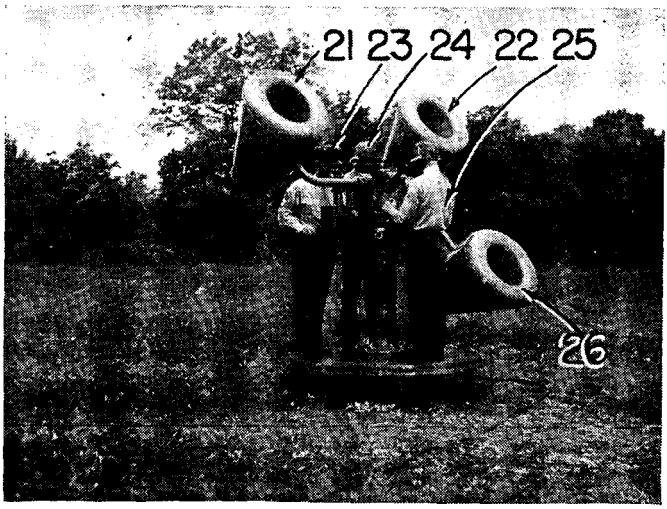


FIGURE 4.—Sound locator, M2, in operating position.

21. Azimuth horn.
22. Common (azimuth-elevation) horn.
23. Corrector operator.
24. Elevation listener.
25. Azimuth listener.
26. Elevation horn.

of the locator. They track the target by turning handwheels provided.

b. This locator incorporates several improvements based upon experience in using the M1A1 sound locator. The horns have composition walls, so that all noises coming from the sides or rear of the horns are deadened and are not heard. The mouths of the horns are rounded, so that the wind does not whistle as it blows across them.

c. The complete locator weighs 975 pounds (including case, cable, and reel) and is broken up into six loads, the heaviest of which weighs 350 pounds. It can therefore be carried in the body of any truck and can be manhandled into any operating position desired.

d. Several steps must be taken before the locator is ready to furnish data to the searchlight.

(1) The locator must be assembled in its operating position, leveled, and connected by cable to the searchlight as described in paragraph 88.

(2) It must be oriented and synchronized with the control station and the searchlight as described in paragraphs 96 to 99, inclusive.

(3) It must be prepared to track the target as described in paragraph 55.

■ 54. OPERATION OF ACOUSTIC CORRECTOR ON SOUND LOCATOR, M2.—This corrector is an integral part of the M2 sound locator and requires one operator.

a. Wind corrections.—The corrector, illustrated in figures 6 and 7, has provisions for incorporating corrections for parallax. The correction for wind effect, parallel to the target's course, is automatically taken care of when the air speed of the target is set in, and that at right angles to the target's course is disregarded.

b. Parallax corrections.—Parallax corrections are made by rotating the parallax cam. This cam is graduated in reference numbers from 0 to 10. The proper correction to be applied is determined in figure 5. For example, when using a 900-foot base line between the sound locator and searchlight, if the estimated slant range to the searchlight pick-up is 18,000 feet, the parallax offset should be 4 on the parallax scale as shown by the intersection of the dotted line with a 900-foot base line. These corrections are set in before track-

ing is begun. During tracking, the acoustic-corrector operator keeps the pantograph pointer ((11), fig. 6) centered in the cross at (12) by looking through the peep sight. He accomplishes this by turning the correction handle ((34), fig. 26) for azimuth control and by rotating the correction

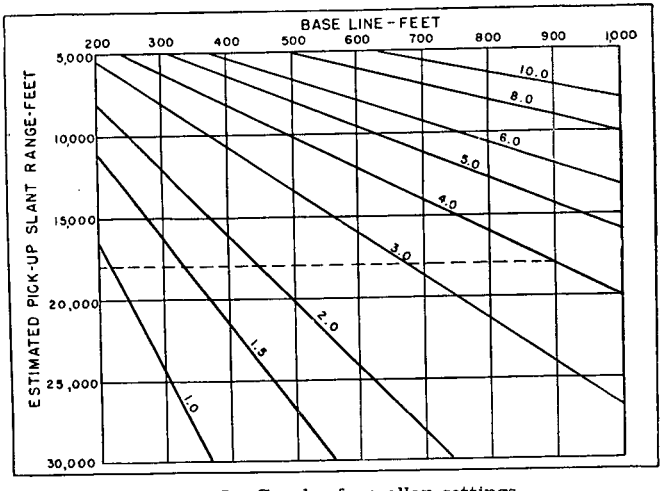


FIGURE 5.—Graph of parallax settings.

knob at the extremity of the above handle for elevation control. By keeping this pantograph pointer so centered, the operator automatically sets in the corrections for sound lag, wind, and parallax.

■ 55. PREPARATIONS BEFORE TRACKING THE TARGET.—*a.* Set in the estimated target air speed by means of knob ((2), fig. 6). This information is obtained by the battery commander from the outpost listening stations, from his knowledge of the expected type of target, or it is estimated by the chief of section.

b. Set in parallax offset on scale (15). This information is obtained by the battery commander from the graph in figure 5.

c. The corrector operator ((23), fig. 4), will then take his place at the sight.

d. The listeners will, in the meantime, don their helmets and adjust the straps to provide for maximum soundproofness compatible with comfort as follows: Adjust the chin strap and head ties until the ear cups (the large padded cups which surround the entire ear) fit snugly against the head and the earpieces are alined with the bore of the ear canal. In this position the earpieces will surround the tragus (fleshy part) of the ears but will not bend the tragus so that it blocks the passage from the earpieces to the ear canal. Screw the earpieces into the helmet until they rest firmly but comfortably against the ears.

e. When the helmets are properly adjusted, the listeners ((24) and (25), fig. 4) will step onto the platform and plug their respective tube ends into their earpieces. The sound locator is now ready for operation.

FIGURE 6.—Corrector operator in action.

1. Multiplying pantograph.
2. Target air speed setting knob.
7. Pantograph attaching stud knob.
8. Parallax cam.
9. Declutching gear.
10. Target air speed scale.
11. Pantograph pointer.
12. Sight mirror cross lines.
13. Level.
14. Elevation clamp.
15. Parallax scale.

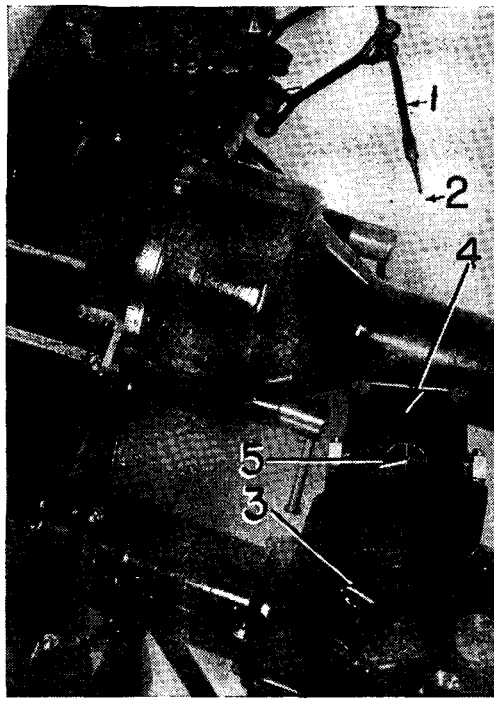


FIGURE 7.—Acoustic corrector, sound locator, M2.

1. Pantograph.
2. Pantograph pointer.
3. Sight.
4. Mirror.
5. Mirror cross lines.

■ 56. TRACKING THE TARGET.—*a.* To aid the listeners to pick up the target, the push button switch ((31), fig. 26) may be pushed in, thereby decreasing the A. C. hum of the data transmitters. As soon as the location of the target is clearly established, release the switch. DO NOT track with this switch pushed in.

b. The corrector operator will move the correction handle and knob (34) in such a manner as to keep the image of the pantograph pointer continuously on the cross lines of the mirror.

c. The listeners will rotate their respective handwheels to maintain a binaural balance on the sound source. The handwheels are turned toward the ear in which the sound predominates to achieve binaural balance.

CAUTION: In the operation of the sound locator the listeners should be cautioned against making sudden changes in the rotation of the handwheels. Such jerky operation will cause the end of the pantograph to move back and forth in the field of view of the corrector sight, thereby making it impossible for the corrector operator to apply the proper corrections to the transmitted data. The listeners should be trained to track smoothly by getting into the habit of rotating the handwheel continuously, even though they hear the target intermittently. If the listener should detect that he is lagging behind the target slightly he should accelerate his handwheel rotation speed slowly until the target is again centered. Likewise, he should retard his handwheel rotation by a slight amount if he finds he is leading the target. Such momentary deviations from true centering are not harmful as they serve to sweep the beam over a small area in the vicinity of the target, thereby assisting the search for the target in a controlled manner. Jerky tracking is a far more serious fault than slight inaccuracies in centering which are gradually corrected.

d. The corrector operator must recognize that the pantograph pointer does not oscillate or move in jerky fashion when the listeners follow the target perfectly. Therefore, when jerky operation of the pointer occurs, he should realize that it is due to the listeners and he will not attempt to follow rapid movements of the pointer but will endeavor to average out such irregularities, so that the correction he inserts will be smooth and uniform.

e. It is emphasized here that the acoustic corrector operator should be trained to develop judgment in following the pantograph pointer in his sight, rather than in the mere mechanical performance of his work. By his delicate touch he must smooth out the jerky variations introduced by the trackers as they strive to keep the sound centered. In general, the operator should endeavor to keep the pantograph pointer within the circle inclosing the cross lines ((12), fig. 6).

■ 57. OPERATION OF SOUND LOCATOR, M1A1.—*a*. This locator (sometimes called the longhorn) has four metal horns mounted on a four-wheel trailer. As shown in figure 8, four exponential horns are mounted in trunnions that are mounted on a turntable. One pair of horns (the upper and lower) determines the elevation of the sound, the other pair the azimuth. The pointing of these horns in azimuth and elevation is transmitted mechanically to the acoustic corrector which is mounted on one end of the trailer.

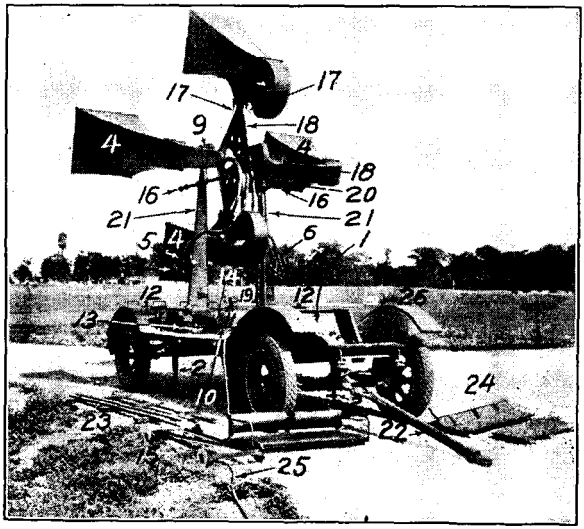


FIGURE 8.—Sound locator, M1A1

1. Acoustic corrector.
2. Jacks.
3. Front seat (removed).
4. Horns.
5. Traversing handwheel.
6. Elevating handwheel.
7. Headset (azimuth).
8. Headset (elevation).
9. Horn journal bearings.
10. Azimuth scale.
11. Turntable.
12. Seats for operators.
13. Footrest.
14. Turntable locking screws.
15. Horn locking brace (removed).
16. Traveling horn supports.
17. Hand clamp nuts.
18. Horn support yoke.
19. Elevation shaft.
20. Rubber tubes.
21. Vertical columns.
22. Drawbar.
23. Side rails.
24. Covers for acoustic corrector.
25. Cable leading to comparator.
26. Brake handle.

b. When on the road, the locator is as shown in figure 28.

c. In operating the locator, the listeners are seated on opposite sides of the turntable and operate handwheels directly in front of them. Listeners should be instructed to develop judgment in their listening and centering. In following a moving target, the handwheel should be kept moving at a constant rate, even if the target is lost from time to time. The cautions given in paragraph 56c also apply to the operation of this locator.

■ 58. OPERATION OF ACOUSTIC CORRECTOR, M1.—*a.* The estimated altitude of the target as given by the chief of section is set in by turning the altitude setting knob ((1), fig. 9).

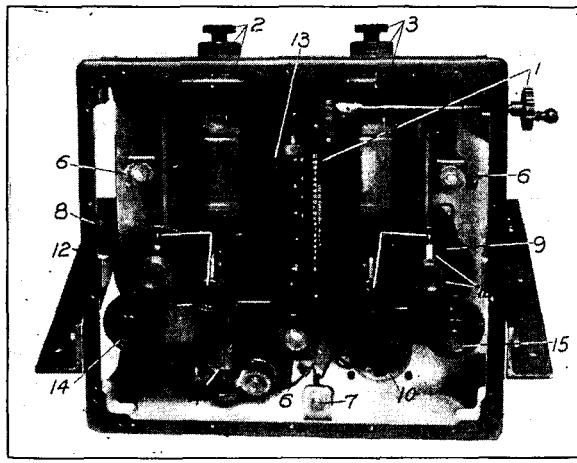


FIGURE 9.—Acoustic corrector, M1.

1. Altitude scale and setting knob.
2. Corrected azimuth scale and releasing knob.
3. Corrected elevation scale and releasing knob.
4. Differential gears.
6. Lamp.
7. Lamp switch.
8. Predicting mechanism and scale, azimuth prediction.
9. Predicting mechanism and scale, elevation prediction.
10. Plug receptacle.
11. Outer predictor scale pointers and operating knobs.
12. Inner predictor scale pointers and operating knobs and clutch operating buttons.
13. Sound lag drum and chart.
14. Spotting correction knob, azimuth.
15. Spotting correction knob, elevation.
17. Data transmitter, azimuth.
18. Data transmitter, elevation.

b. For this acoustic corrector two operators are required, one of whom must be equipped with a stop watch. The length of the interval during which a correction is to be computed is indicated by the pointer at the sound lag drum (13). The command is given: 1. READY, 2. TAKE, and the watch is started. At the expiration of the indicated time, the operator gives: 1. READY, 2. HALT.

c. Each operator insures that the prediction-scale pointer, inner, is set at zero before a prediction operation is begun. At the command TAKE, the operators apply a slight pressure with thumb or finger to the button (12) at the center of the scale. At the command HALT, the pressure is released. The operator then brings up the outer-matching pointer (11) to the position on the scale indicated by the inner pointer (12). This operation should be performed, as nearly as possible, simultaneously with the movement of the inner pointer. As soon as the pointers have been matched, the inner pointer (12) is reset to zero and the operation is repeated.

d. The outer pointer (11) actuates the frame of the transmitter and thus sends the corrected data to the comparator. Therefore it should not be returned to zero, as a correction once inserted should remain until another is determined and introduced. Experience on the part of the operators will indicate to them when an erroneous prediction has been made, in which case the former one is left in the system until the proper correction is determined by a subsequent operation.

e. Atmospheric, wind, and arbitrary corrections can be added to the readings at the transmitters by turning off the amount of the correction on the spotting dials (14) and (15). The black scales indicate an increase in azimuth or elevation, while the red scales indicate a decrease.

f. To economize in time the acoustic corrector measures the angular travel during only one-third of the actual predicted time. The sound-lag cylinder is graduated in terms of one-third the actual sound-lag time, and appropriate gearing places the correction for full sound-lag time in the transmitter.

g. The corrector operators should understand enough of the theory of the corrector to be able to use judgment in

determination and application of corrections. They should know that the corrections determined will actually change gradually, and that any radically different corrections should not be applied to the corrector. The operators must "smooth out" the corrections before applying them, insuring an even flow of data to the control station. It is emphasized again that the training of these operators must develop *judgment* rather than a mere mechanical skill in the operation of the instrument.

SECTION II

CONTROL STATION

■ 59. FUNCTION.—The control station is the device that enables the searchlight to be controlled from a distance, and to be directed at the point in the sky indicated by the sound locator as the target's position. In addition, it enables the searchlight to search the sky in the immediate vicinity of the point indicated by the locator. This is accomplished by manipulating the handwheels at the control station so as to move the light up and down and right and left from the indicated point.

■ 60. MECHANISM.—The searching mechanisms on control stations have undergone an evolution which has brought them back to the place they started in the first units equipped with distant electric control. At this time the search was wholly manual, being accomplished by manipulating the controls on the distant electric control system backward and forward and up and down in order to obtain the desired searching pattern in the sky. On the M1934 control station a mechanically operated spiral searching device was added. On the M1937 control station this was changed to provide for an automatic electrical searching device in elevation only, the search in azimuth being accomplished manually. On the M1939 unit all automatic searching devices have been eliminated, and the search is accomplished manually as on the MVI unit. All control stations having automatic searching devices were provided with means for throwing these automatic mechanisms out of gear and re-

verting to manual operation. On the M1934 and all later control stations, a pair of binoculars (or night glasses) was provided to aid in the search. These glasses are automatically directed on the point in the sky at which the searchlight is pointed. With the aid of the glasses it has proven possible to pick up targets which have been but lightly flicked, or when they have been dimly illuminated by the searchlight beam passing nearby in hunting the target. On some types of aircraft it has been possible to make a pick-up using the glasses alone as the glow of the exhaust could be seen.

■ 61. OPERATION OF CONTROL STATION, M1939.—*a.* On this control station (fig. 10) there are three operators—an azimuth controller, an elevation controller, and the searchlight commander (acting as control station chief) who looks through the binoculars. The azimuth and elevation controllers cause the searchlight to be set on the sound locator data by centering the zero reader pointers at the control station, and conduct the search by *slowly* and *smoothly* manipulating the azimuth and elevation handwheels located on the sides of the control station. As they search, the searchlight commander observes that part of the sky through his binoculars. If the sound locator is being properly operated it should place the beam within 5° of the target. The searchers operate the controls to cover this 5° "area of error." As soon as the target is picked up, the searchlight commander takes over completely from the azimuth and elevation controllers, keeping the light directly on the target by movement of his handwheels. While tracking the illuminated target, the searchlight commander keeps it on the side of the searchlight beam nearest the gun battery, so that operators at the gun battery do not have to see the target through the searchlight beam.

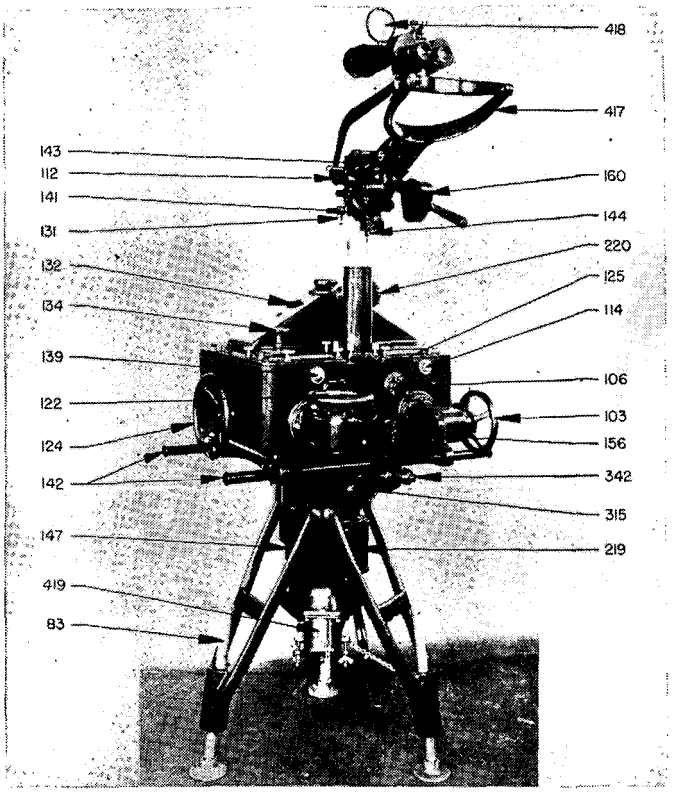


FIGURE 10.—Control station.

83. Leveling jack.
103. Elevation observer's handwheel.
106. Elevation handwheel clutch adjuster.
112. Binocular mount clutch adjuster.
114. Elevation zero search indicator.
122. Azimuth observer's handwheel.
124. Azimuth zero reader handwheel.
125. Azimuth handwheel clutch adjuster.
131. Binocular mount azimuth slip adjuster.
132. Azimuth zero reader.
134. Search knob.
139. Signal buzzer push button.
141. Binocular mount adjuster handles.
142. Carrying handles.
143. Binocular elevation zero marker.
144. Binocular azimuth zero marker.
147. Tripod.
156. Dial light switch.
160. Binocular mount counter.
219. Handhole cover plate.
220. Binocular height adjusting knob.
315. Alinement lug.
342. D. E. C. switch.
417. Binocular mount.
418. Open sight.
419. Fifteen point receptacle.

b. The three men composing the control station crew should be trained together as a team, as the successful operation of the station depends on an instinctive cooperation among all three. The azimuth controller must keep the zero reader needle on or in the vicinity of the zero point but must also search in azimuth. If the target is not picked up in a few seconds, the controller must insure that the light be again pointed on sound locator data by seeing that his zero reader needle is exactly zeroed. The elevation controller handles his controls in a similar manner. At the command FLICK, given as the light beam passes over the target, the searchlight commander takes over complete charge of the controls and keeps the light directed on the target.

c. The sequence of events at the control station on a normal course occurs as follows:

(1) The sound locator operators will report on target, and the moving of the zero reader needles will indicate that data are coming through. This report will generally be given when the target is about 10° to 20° above the horizontal in elevation.

(2) The azimuth and elevation controllers center the zero reader needles, thereby pointing the darkened searchlight on sound locator data.

(3) At the command IN ACTION (generally given when the target is about 30° to 45° above horizontal in elevation), the searchlight is lighted, and the two controllers at the control station immediately commence their search.

(4) The target will next be momentarily illuminated (flicked) by one of the lights in action. When this is noticed by the chief of section or No. 4, they report FLICK to the searchlight commander. When the searchlight commander is ready to take over the operation of the control station from the controllers, he commands: FLICK, takes over the controls, and tracks the target.

(5) At the command OUT OF ACTION, the light is put out, but all elements of the unit continue to track the target.

(6) At the command CHANGE TARGET, the controllers center the zero reader pointers, thereby pointing the light in the

direction indicated by the sound locator. Search is commenced for the new target in the usual manner.

SECTION III

SEARCHLIGHT

■ 62. OPERATOR.—The searchlight operator must be trained in the functioning of the searchlight itself. His post is at the light during operation. Due to the number of automatic devices provided, the searchlight operator has little to do during normal operation. He should be thoroughly familiar with the manual operation of all the automatic devices and fully capable of operating them efficiently when called upon.

■ 63. NORMAL OPERATION.—*a.* During normal operation, the searchlight operator assists in unloading the light, setting it up and leveling it, and connecting the cables.

b. He assists in orienting by pointing the light as directed using the orienting sight. After the light and locator are properly pointed, he centers the zero reader meters by turning the knob on the azimuth and elevation receivers (for details as to orienting the unit see pars. 97 and 99).

c. At the command IN ACTION he closes the arc switch on the light, thereby striking the arc. At OUT OF ACTION he opens the arc switch.

d. After about 45 minutes of continuous operation (or when the positive carbon is half used) the operator recarbons the light, replacing the old carbons with a new positive and new negative carbon at the first break in operation. The new positive carbon should always have a crater previously formed by a few minutes of operation at the bivouac or garage.

e. The operator constantly checks his ammeter and voltmeter to see that the searchlight is operating on correct current (145–150 amperes) and voltage (78 volts). He also checks the appearance of the arc as seen in the ground glass view finder, keeping the positive crater even with the reference line on the view finder.

f. Adjustment of the arc length should only be undertaken under the supervision of the chief of section. The length is adjusted by turning the arc length adjusting screw shown in the lower right corner of the lamp mechanism box ((27), fig. 11); the greater the arc length, the greater the voltage across the arc.

g. The thermostat control system should only be adjusted under the supervision of one of the battery electrical sergeants or of the chief of section. Directions will be found in the instruction book.

■ 64. LEVELING THE LIGHT.—The light is first lifted off the ground by means of its four leveling jacks ((83), fig. 21) and approximately leveled. The light is traversed so that one level tube is parallel with the frame of the chassis; the other will be at right angles to it. Using the leveling jacks, the light is leveled so that the bubbles are centered in their tubes. The light is then traversed 3,200 mils (180°). The bubbles should remain centered; if they do not, bring them halfway back to center using the jacks. Adjust the level tubes themselves at the first opportunity, as they are out of adjustment if the bubbles do not stay reasonably centered during 6,400 mils (360°) of traverse. This adjustment should only be performed under the supervision of the platoon commander or one of the battery staff sergeants.

■ 65. RECARBONING THE LIGHT.—*a.* To recarbon the light the operator should enter the light on the side *away* from the thermostat. He should wear gloves and should have on some sort of clothing so that his arms, shoulders, or body will not come in direct contact with hot metallic parts. The main arc switch should be "off." If at night, the recarboning light should be turned on.

b. Using the recarboning wrench, the operator forces apart the jaws that grip the positive carbon, and the carbon stub is withdrawn to the front. A new positive carbon ((15) fig. 11) with a crater already formed by a few minutes of operation is inserted from the front and the wrench is removed, allowing the jaws to grip the carbon. (It is impera-

tive that the gear teeth mesh after the wrench is removed.) When correctly placed, the positive carbon should project $\frac{5}{8}$ inch beyond the positive head.

NOTE.—In case a new carbon with no crater is used, it should project $1\frac{3}{16}$ inch.

c. To recarbon the negative head, the operator pulls down on the negative-release lever, thereby releasing the old negative carbon, which is removed. A new negative carbon (1) is inserted so as to project 1 inch beyond the negative head, and the negative-release lever is released allowing the negative mechanism to grip the carbon.

■ 66. MANUAL OPERATION.—*a.* Whenever an automatic device fails, it is necessary to change to manual operation. The operator should be drilled constantly on changing over to manual operation so that he will be ready if a failure occurs.

b. (1) When the automatic *positive feed* (thermostat) fails, it is possible to change to semiautomatic feed using the semiautomatitc feed-rate adjusting knob ((6), fig. 11). By moving the knob farther to the left it is possible to have the motor feed the positive carbon forward at a rate equal to the rate of burning.

(2) Full manual control may be exercised by turning the positive hand feed (22).

c. The *negative feed* may be hand-controlled by shifting the negative feed centralizer knob (12) from "auto" to "hand" and turning the negative hand feed (11).

d. The correct positions for the positive and negative carbons during manual control are checked by observing them in the ground glass view finder and keeping each carbon on its proper line.

■ 67. MANUAL DIRECTION.—*a.* In case the distant electric control fails, it is possible to direct the searchlight manually, either by moving the light itself or by means of the extended hand control.

b. By observing the zero reader dials, it is possible to direct the light manually using sound locator data.

c. If no sound locator data are available, it is best to connect the extended hand control and direct the light from the end of its handle.

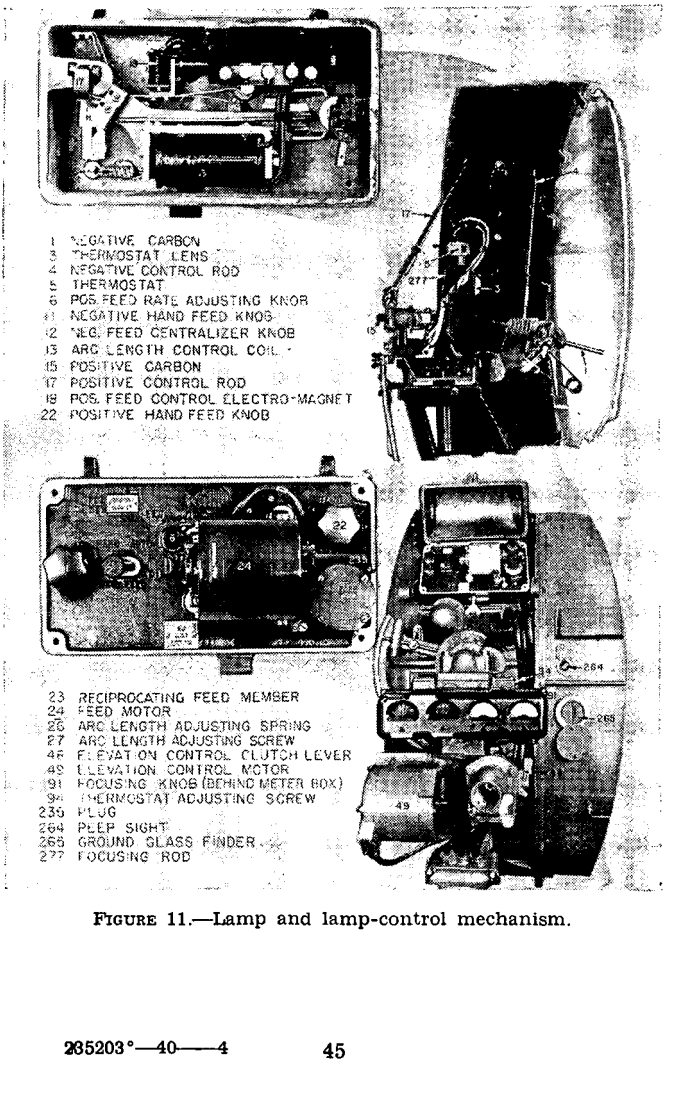


FIGURE 11.—Lamp and lamp-control mechanism.

SECTION IV

POWER PLANT

■ 68. STARTING POWER PLANT.—The operation of starting is practically the same as that of starting a car.

a. Put main switch ((20), fig. 12) and voltmeter and lamp circuit breaker (19) in the "off" position.

b. Pull out choke control (9) and throttle control (11) slightly.

c. Start the engine by turning on the ignition switch (16), press in the starter button (12), and adjust choke (9), as required for smooth operation. After the engine has warmed up sufficiently and after operating smoothly a few minutes, push choke (9) back in, and pull out throttle control to wide open position. Tachometer (6) should indicate approximately 900 revolutions per minute.

■ 69. LISTENING LOAD VOLTAGE ADJUSTMENT.—*a.* Close the voltmeter and lamp circuit breaker ((19), fig. 12) and turn the 115-volt light swith (14) to "on." This will light the switchboard lamp, and the control panel voltmeter (4) will indicate the no-load voltage, approximately 110 volts. The tachometer (6) will indicate approximately 900 revolutions per minute.

b. With the searchlight equipment properly connected, throw the main switch (20) "on." The ammeter (3) should indicate 10 to 15 amperes (listening load current). Adjust the listening load rheostat (2) so that the voltmeter reads 105 volts. No further adjustment of this rheostat should normally be required except to compensate for temperature variations.

■ 70. ARC LOAD VOLTAGE ADJUSTMENT.—*a.* With the main switch ((20), fig. 12) "on" and the arc load rheostat (1) set at the middle of its travel, close the searchlight arc switch.

b. Adjust the arc load rheostat so that voltmeter (4) indicates 100 volts. With a cold unit it will be necessary to have the voltage slightly lower in order to maintain the proper

arc current. The instruments on the control panel (fig. 12) should indicate approximately the following:

Ammeter (3)	165
Voltmeter (4)	100
Tachometer (6)	1,200
Oil gage (7)	15–20
Temperature gage (8)	160–200

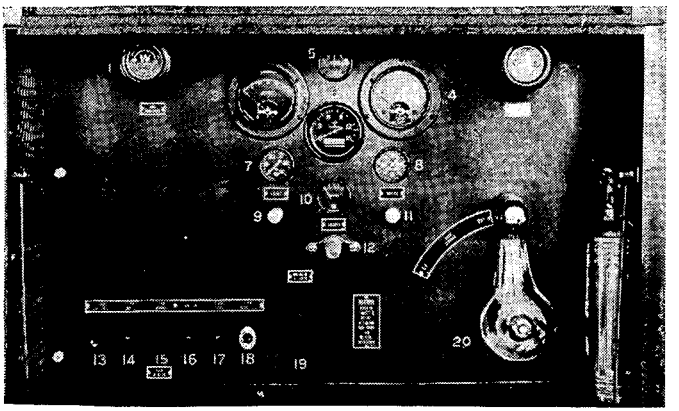


FIGURE 12.—Control panel (front view).

1. Arc load voltage rheostat.
2. Listening load voltage rheostat.
3. Power ammeter.
4. Power voltmeter.
5. Charging ammeter.
6. Tachometer and revolution counter.
7. Oil pressure gage.
8. Temperature gage.
9. Choke.
10. Gas gage.
11. Throttle.
12. Starter button.
13. 115-volt lamp receptacle.
14. 115-volt light switch.
15. Fan season switch.
16. Ignition switch.
17. 6-volt light switch.
18. 6-volt receptacle.
19. Power voltmeter and lamp circuit breaker.
20. Main switch.

c. The power plant will adjust itself automatically while changing from "listening load" to "arc load" or vice versa. The engine automatically increases speed to 1,100 revolutions per minute when the arc load is applied, and decreases to 875–900 revolutions per minute when the arc load is removed.

Arc load rheostat (1) when once set should not need to be adjusted except to compensate for temperature variations.

■ 71. MANUAL CONTROL.—*a.* The voltage and speed may be controled manually should the governor fail or manual control be desired.

b. It is necessary to block the governor arm in forward position in order to prevent interference from the mechanical governor.

c. With throttle ((11), fig. 12) set at listening speed (900 r. p. m.), the arc should be struck and at the same time the throttle adjusted to obtain the correct arc load speed of 1,100 revolutions per minute. Satisfactory operation will be obtained by maintaining settings as shown in paragraph 70.

WARNING: When changing from arc load to listening load, quickly push in throttle control simultaneously with removal of arc load to decrease engine speed to 900 revolutions per minute. This must be done to avoid overspeeding engine and excessively high voltage.

d. If the engine speed adjustments are carefully made, it will be unnecessary to change settings of listening load rheostat (2) or arc load rheostat (1) when changing from one speed to another.

e. If any part of the governor or its control mechanism fails, it is necessary to wire open the valve lever controlling the butterfly valve in the valve box assembly. This will allow the engine speed to be controlled by the throttle.

■ 72. STOPPING POWER PLANT.—To stop the engine after the arc load has been removed, open the main switch ((20), fig. 12) and turn the ignition switch (16) "off." Open the voltmeter and lamp circuit breaker (19).

NOTE.—The main switch (20) should always be opened to avoid starting a connected load.

SECTION V

VEHICLES

■ 73. SEARCHLIGHT VEHICLES.—Searchlight vehicles have changed considerably. The first modern unit, the MVI, was

carried by a combined truck-power plant (fig. 13) which towed the sound locator trailer. The next unit, the M1934 (fig. 15), had a similar arrangement employing a more powerful truck. These combined truck-power plants were called power units. Subsequent units, the M1937 and M1939, used two cargo trucks with each searchlight unit. The M1940 unit employs two trucks of special design. (See figs. 16 and 17.)

■ 74. MVI POWER UNIT (figs. 13 and 14).—*a. Description.*— Description of the automotive features will not be included in this manual. A 15-kilowatt, 150-ampere, 100-volt, 1,800 revolutions per minute, compound generator is mounted on the drive shaft of the motor with provision for engaging either the generator for supplying the searchlight or the tail shaft for locomotion. The generator clutch shifting lever is located on the left of the driver's seat. A governor is provided to maintain an engine speed of 1,800 revolutions per minute. This governor may be disengaged when traveling by means of the governor cut out control on the dash. A ½-kilowatt, 125-volt rotary converter, supplied by the main D. C. generator, furnishes the alternating current for the comparator. It is located on the right running board. A control panel is located in the driver's cab in rear of the seat. It contains two main circuit breakers, D. C. ammeter and voltmeter, generator field rheostat, rotary converter switch, A. C. voltmeter, and illuminating lamp. The truck body contains a loading winch with cable and ramps, boxes for securing comparator, comparator and controller cables, and two reels for the main power cables.

b. Operation.— (1) *Traveling.*— Before starting on the road, check for the following conditions:

(*a*) Governor control should be out (governor disengaged).

(*b*) Generator clutch lever (left of driver) should be locked forward by means of the chain provided.

(*c*) Generator ventilating doors should be clamped shut.

(*d*) The searchlight chassis should be locked in position by the three clamping devices.

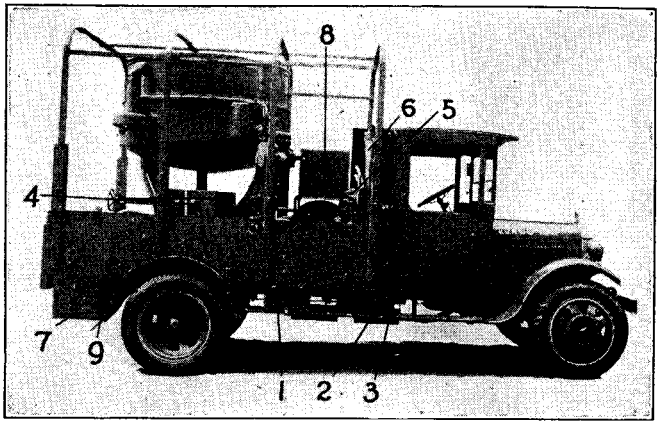


FIGURE 13.—MVI searchlight and power unit, traveling position (paulin removed).

1. Rotary converter.
2. D. C and A C. cable receptacles.
3. Power cable reels.
4. Controller and comparator cable storage boxes.
5. Controller and comparator tripod.
6. Container for spare carbons.
7. Controller storage box.
8. Comparator storage box.
9. Loading winch axle.

(*e*) The azimuth lock of the searchlight must be locked in its correct riding position.

(*f*) The steady bar should be locked in place.

(*g*) The elevation clamp on the trunnion, the elevation clutch, and the azimuth clutch should be released.

(*h*) The circuit breakers and switch on the control panel should be open and the sliding doors closed.

(2) *Unloading and connecting searchlight* (fig. 14).—(*a*) Release canvas cover and raise bows about 3 inches in their sockets.

(*b*) Place ramps; secure with pins.

(*c*) Remove reel boxes and extended hand control.

(*d*) Release devices which secure searchlight to truck body.

(*e*) Attach steering handle and loading winch cable.

(*f*) Attach cable reel handles on each side of loading winch, raise pawl from ratchet, and, with one man on each crank and one man guiding the tongue, allow searchlight to roll slowly down the ramp.

(*g*) Unreel the main power cables and attach plugs to the yellow receptacle on the power unit and searchlight, being careful to see that the guides on the plugs are properly fitted.

(*h*) Interconnect all other cables between sound locator, comparator, distant electric control, and searchlight according to the color scheme of the plugs and receptacles.

(3) *Generation of power.*—(*a*) Open ventilation ports of generator and start engine.

(*b*) With engine idling, shift generator clutch lever (left of driver) to the rear, engaging the generator to the drive shaft. If gears will not mesh, it will be necessary to depress the engine clutch, shift the transmission to low gear, and gently release the engine clutch until the generator can be engaged. The transmission should then be returned to the neutral position.

(*c*) Engage governor; depress engine clutch and put gear shift lever in high gear; release engine clutch carefully.

(*d*) Open throttle wide and advance the spark. (Speedometer should read approximately 25 miles per hour.)

(*e*) Regulate field rheostat to bring direct current voltage to 100 volts.

(*f*) When the engine has warmed up, close the circuit breakers and start the rotary converter by closing the double pole knife switch on the power panel.

(*g*) When the arc is struck, the following readings of the meters should obtain:

	Volts	*Amperes*
Searchlight operating alone	100	150
Searchlight and comparator	100	157
Searchlight, comparator, and controller	100	175

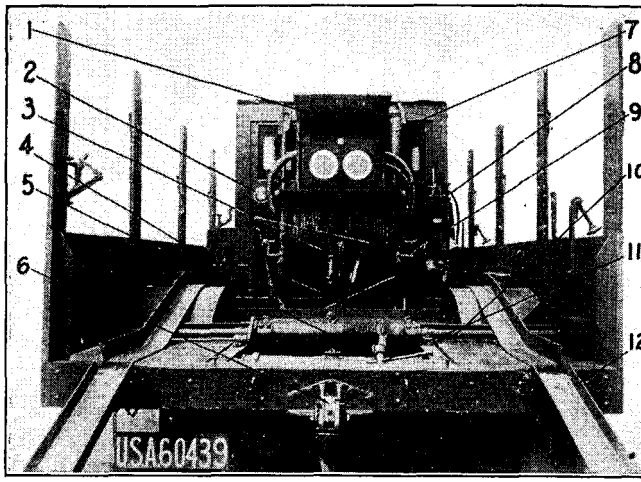


FIGURE 14.—MVI power unit (rear view), showing cables in place, comparator in box, and method of stowing tripod.

1. Comparator box.
2. Loading light.
3. Main power cables.
4. Locking pins for searchlight.
5. Loading winch with cable wound properly.
6. Coupling.
7. Carbon container.
8. Tripod.
9. Cable reel cranks in loaded position.
10. Pins for locking rear seat.
11. Turnbuckle for locking searchlight at rear.
12. Ramps in position for loading.

(*h*) After operating the arc for a time, it may be necessary to raise the voltage above 100 volts to obtain the proper arc current. This is due to the increase in resistance of the cables as they become heated.

■ 75. M1934 POWER UNIT (fig. 15).—This power unit is very similar to the power unit MVI (par. 74) except that it has a more powerful motor. It has a generator and switchboard equipment designed to supply current for 150-ampere, 200-ampere, or 250-ampere operation of the searchlight. The unit is designed to run at two engine speeds, a slow (quiet) speed for the listening load and a 1,100 to 1,400 revolutions per minute operating speed. The unit automati-

cally speeds up as the arc is struck and the heavier current is needed.

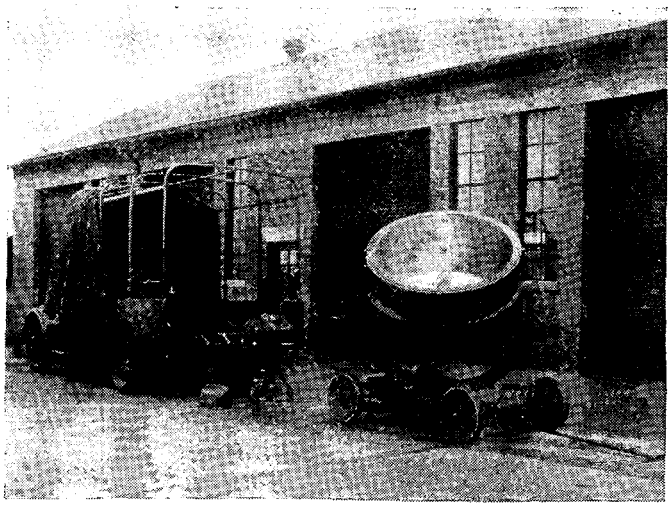


FIGURE 15.—M1934 searchlight unit, showing power unit.

■ 76. M1937 AND M1939 VEHICLES.—*a*. These units were designed to employ cargo trucks with a minimum of extra equipment. Two trucks were required per unit; almost any cargo truck of sufficient carrying capacity and large enough body could be used.

b. A block and tackle was furnished for pulling light and power plant into the truck; ramps for each truck allowed the light and power plant to be drawn up into the truck body; some form of hold-down device kept the equipment from shifting when the truck was in motion. The crew rode where they could in the truck cabs and bodies.

■ 77. M1940 VEHICLE (fig. 16).—The vehicles furnished with the M1940 units are special vehicles. They are of the cab-over-engine type and drive through four rear wheels. The special double cabs (fig. 17) accommodate the entire crew of the searchlight unit.

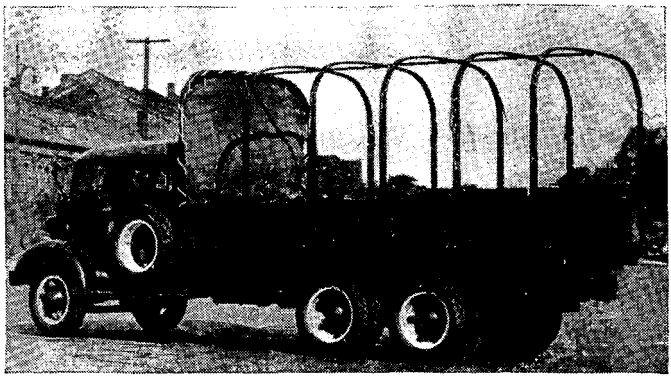


FIGURE 16.—Truck, M1940 searchlight.

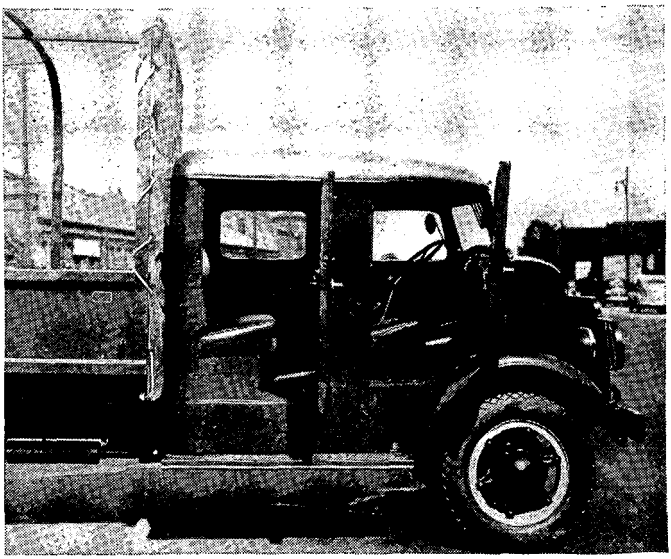


FIGURE 17.—Cab, M1940 searchlight truck.

CHAPTER 4

PREPARATIONS FOR ACTION AND FOR MOVEMENT

SECTION I

PREPARING FOR ACTION

■ 78. SCOPE.—This section describes the setting up of the equipment from traveling position on the road to operating position ready for action.

■ 79. TRAVELING POSITION.—*a*. When on the road, one complete searchlight unit uses two trucks—the first carrying the searchlight, control station, and the sound locator; and the second truck the power plant and the cables.

b. The personnel and equipment are in places on the trucks as indicated in figure 18.

■ 80. SELECTION OF SEARCHLIGHT POSITION.—The position selected should be—

a. On or near a road good enough to permit use by the trucks in all kinds of weather. (In terrain permitting trucks to move cross country in all kinds of weather, this provision may be disregarded.)

b. Fairly open, so that light and locator can operate down to an elevation of $+10°$.

c. Away from main highways, railways, factories, and other sources of noise.

d. On level ground or on an elevation rather than in a depression, so that sound waves will not be distorted by surrounding hills before reaching the locator.

e. At least a mile from the nearest antiaircraft gun battery, to avoid drawing enemy fire to the gun battery.

■ 81. GOING INTO POSITION.—On arrival at the searchlight position, the chief of section indicates the location of the power plant, searchlight, control station, and sound locator, and gives the necessary instructions to have the matériel prepared for action.

■ 82. ACTIONS OF TRUCK NO. 1 AT PREPARE FOR ACTION.—*a.* At the command PREPARE FOR ACTION, truck No. 1 proceeds to the indicated searchlight position where the searchlight is released from its hold-down devices, unloaded, set up, and leveled.

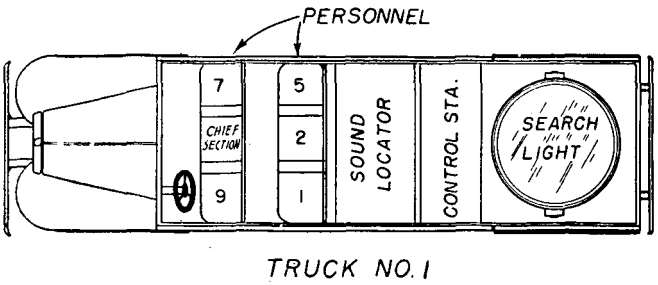


FIGURE 18.—Loading of trucks Nos. 1 and 2, modern searchlight unit.

b. The truck then moves to the control station position where the control station is unloaded and set up.

c. From the control station the truck proceeds to the sound locator position, where the sound locator parts are unfastened from their hold-down devices, unloaded, assembled, and the locator is leveled.

d. After the unloading and assembling of the sound locator are completed, the truck is driven to the concealed parking area previously designated by the chief of section. There the chauffeur assures himself that the truck is hidden from ground and air observation.

■ 83. ACTIONS OF TRUCK NO. 2 AT PREPARE FOR ACTION.—*a.* At the command PREPARE FOR ACTION, truck No. 2 proceeds to the power plant position. The power plant is unloaded and prepared for action.

b. The truck is then driven slowly from the power plant position to the searchlight position, laying the two power (yellow) cables as it goes.

c. From the searchlight position the truck proceeds slowly to the control station and sound locator positions, laying the control station (red) and the sound locator (blue) cables as it goes.

d. After all cables are laid, the truck is driven to the concealed parking area previously designated by the chief of section. There the chauffeur assures himself that the truck is hidden from ground and air observation.

■ 84. NORMAL SET-UP FOR LATER MODEL SEARCHLIGHT UNITS.—*a.* The normal set-up for the later model units (M1937 and later) is shown in figure 19 ①.

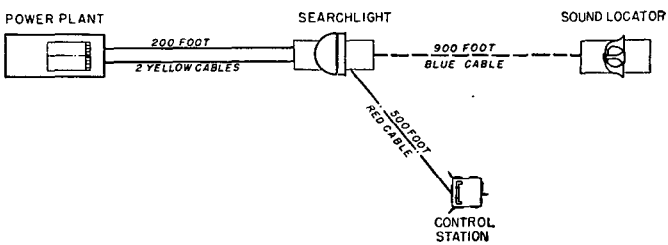
b. This set-up is employed by all units equipped with zero readers (M1937 and later). The control station may be located anywhere within the length of the red cable from the searchlight (500 feet on the M1939 unit), and the locator may be placed anywhere within the length of the blue cable from the searchlight (900 feet on the M1939 unit). Usually, however, the sound locator is set up on the opposite side of the searchlight from the power plant in order to have the maximum possible distance between the two.

c. The ideal set-up is afforded when a little-used road, pointing in the direction of the target's expected approach, is available. In this situation the equipment is located as shown in figure 19 ②. The equipment should be set up well to the side of the road and the cables thrown completely off the road, if practicable.

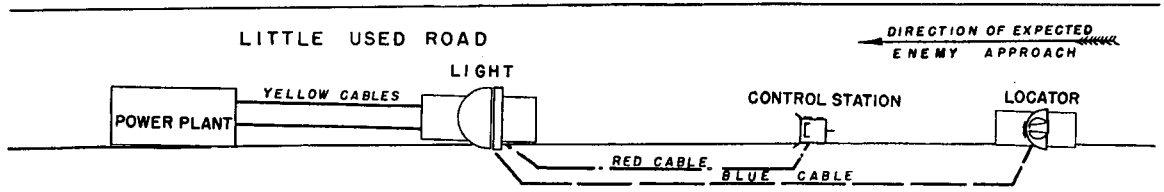
■ 85. NORMAL SET-UP FOR OLDER MODEL SEARCHLIGHT UNITS.— *a.* The older model units (M1934 and earlier) employ the comparator instead of the zero reader as a means of pointing the searchlight on sound locator data. A normal set-up for these units is shown in figure 19 ③. It should be noted that the 200-foot white cable is not furnished with the M1934 unit but only on earlier models.

b. In these units, the power plant, light, control station, and locator are generally set up in a straight line. In contrast with the later units, where locator and control station are each connected to the searchlight, the locator is connected by cable with the control station, and the control station with the light. As may be seen from figure 19 ③ the cables afford a maximum separation of locator and power plant of 1,000 feet.

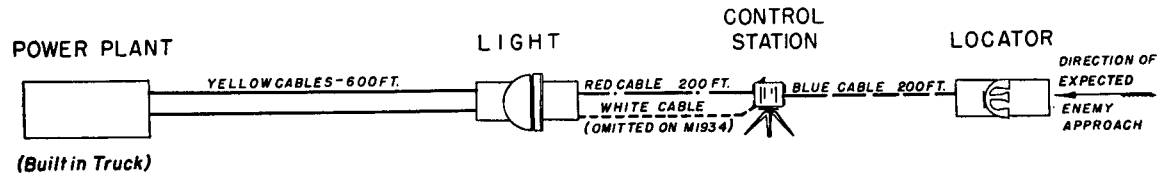
c. As with the later models, the ideal arrangement is possible when a little-used road is available. The unit is set up in the formation shown in figure 19 ②.



① M1939 unit.



Unit along a road.



③ Earlier unit.

FIGURE 19.—Set-up of antiaircraft searchlight units.

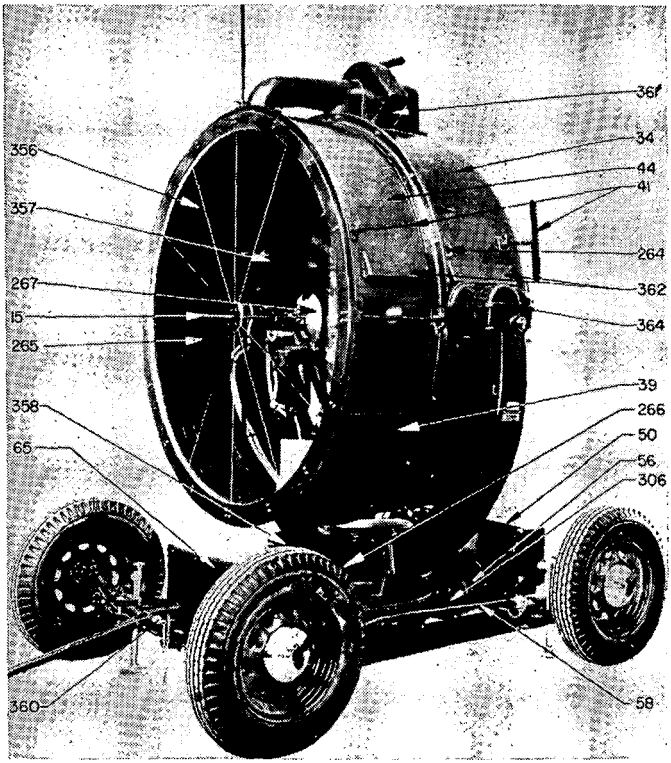


FIGURE 20.—M1939 60-inch antiaircraft searchlight (front view).

15. Positive carbon.
34. Rear drum.
39. Sliding panel.
41. Elevation daylight sights.
44. Front drum.
50. Junction box.
56. Azimuth motor.
58. Transportation bar.
65. Ballast resistor.
264. Arc view peep sight.
265. Ground glass finder.
266. Handhole plate.
267. Lamp.
306. Azimuth clutch lever.
356. Front door glass.
357. Recarboning lamp.
358. Azimuth scale lamp.
360. Steering tongue lug.
361. Ventilating fan exhaust vent.
362. Ventilating fan intake vents.
364. Elevation data receiver housing.

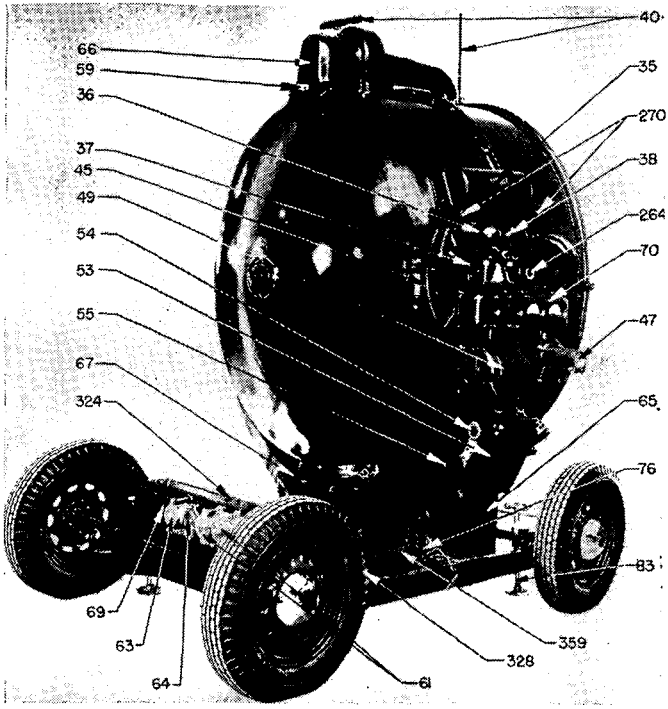


FIGURE 21.—M1939 60-inch antiaircraft searchlight (rear view).

35. Lamp control mechanism box.
36. Elevation scale lamp.
37. Elevation scale.
38. Recarboning lamp switch.
40. Azimuth daylight sights.
45. Elevation gear sector.
47. Hand controller socket.
49. Elevation motor.
53. Arc switch box.
54. Extension lamp receptacle.
55. Scale and meter light switch.
59. Transportation lock bar lug.
61. Power cable receptacles.
63. Controller cable receptacle.
64. Sound locator cable receptacle.
65. Ballast resistor.
66. Ventilating motor housing.
67. Azimuth data receiver housing.
69. Signal buzzer.
70. Meter box.
76. Azimuth lock.
83. Leveling jack.
264. Arc view peep sight.
270. Orienting sights.
324. Dynamotor pilot light.
328. Dynamotor behind wheel.
359. Azimuth scale.

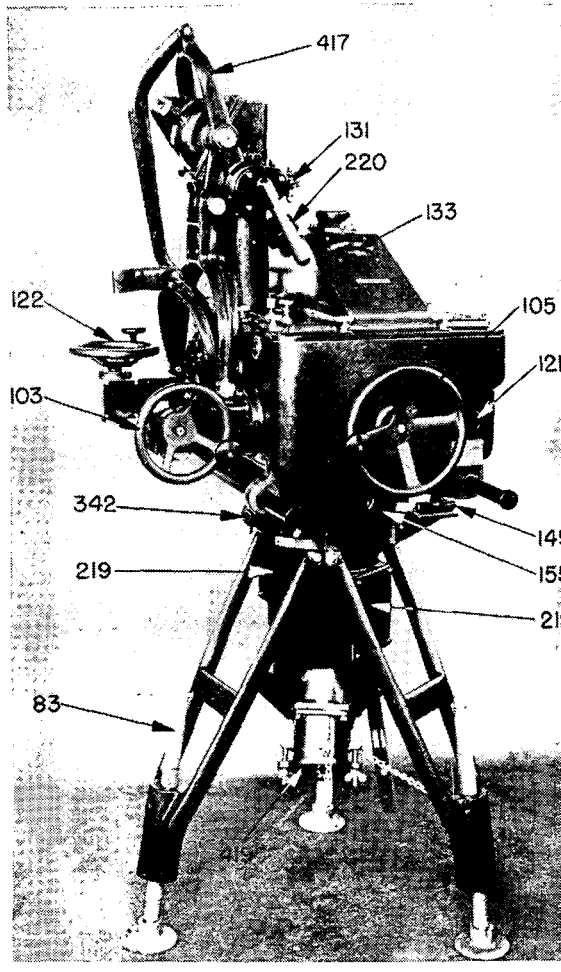


FIGURE 22.—Control station with binocular mount folded down.

83. Leveling jacks.
103. Elevation observer's handwheel.
105. Elevation zero reader handwheel.
121. Zero search knob.
122. Azimuth observer's handwheel.
131. Azimuth slip clutch (binocular adjuster).
133. Elevation zero reader.
149. Spirit levels.
155. Clamp knob.
219. Handwheel cover plate.
220. Binocular height adjusting knob.
342. D. C. switch.
417. Binocular mount.
419. Cable receptacle.

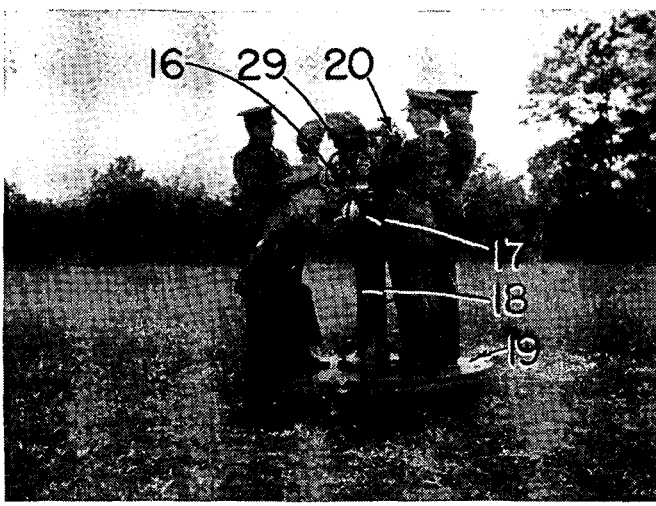


FIGURE 23.—Placing main assembly and correction unit of sound locator, M2, on pedestal.

16. Main assembly.
17. Cable plug.
18. Pedestal.
19. Platform.
20. Transportation bracket.
29. Azimuth handwheel clamp knob.

■ 86. SETTING UP SEARCHLIGHT.—*a.* At the command PREPARE FOR ACTION, the first truck drives up to the location indicated for the searchlight. The ramps are placed in position, the four hold-down turnbuckles are released, the block and tackle placed, and the searchlight is lowered down the ramp. The hook on the end of the block and tackle rope should be hooked securely to the light. *It is important that the crew stand clear,* so that in the event the light breaks away no one will be injured.

b. The transportation lock is unpinned, the transportation bar ((58), fig. 20) lowered to its horizontal position, and the searchlight is depressed to the horizontal. Since the searchlight is transported with the elevation clutch on "hand" position and with the elevation clamp free, the drum may readily be lowered to zero elevation.

c. Remove the azimuth pin and note that the searchlight revolves freely. CAUTION: Do not replace the pin for locking the searchlight in its transporting position at this time, as the pin will foul the lock when the searchlight is rotated.

d. The light is then leveled by means of the four leveling jacks until the level bubble stays centered while the light is traversed 360° as described in paragraph 64.

■ 87. SETTING UP CONTROL STATION.—*a.* The first truck then proceeds to the location chosen for the control station.

b. The control station is arranged to be transported in three parts—the binocular mount, the control unit, and the tripod. (Figs. 10 and 22.) Assemble these three parts for operation as described below:

(1) The tripod should be set in place within 500 feet of the searchlight and its protective cap removed.

(2) The control unit is properly positioned with respect to the tripod turntable by means of a slot in its skirt which

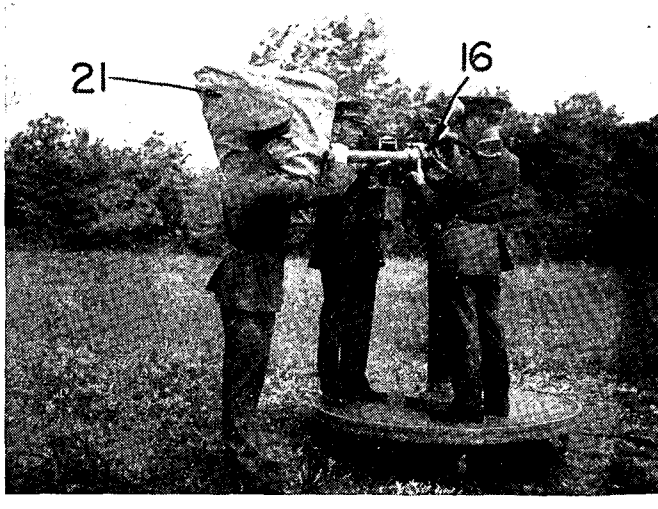


FIGURE 24.—Attaching azimuth horn of sound locator, M2, to main assembly.

16. Main assembly. 21. Azimuth horn.

fits a lug on the tripod. Make sure that the lug is in alinement with the slot when performing the next step.

(3) Lift the control unit to a position over the tripod and lower it slowly in a plane parallel with the top of the tripod. Take care not to strike the control station on the contact plate of the tripod.

(4) A pinion located under the skirt of the control unit must mesh with the external tripod gear as the control unit is lowered to its seat. This pinion drives its shaft through a friction coupling to allow the control box to be swung in azimuth without disengaging the pinion or turning the azimuth handwheels.

(5) When the control unit is seated, take up on the clamp knobs so that they apply equal pressure. These clamp

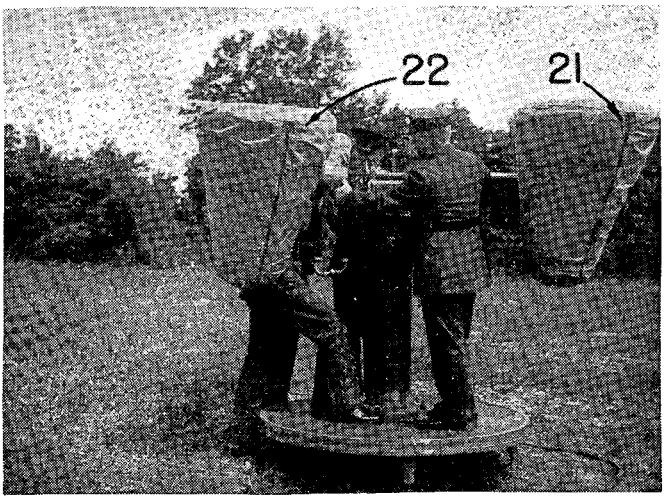


FIGURE 25.—Attaching elevation and common horn unit of sound locator, M2, to main assembly.

21. Azimuth horn. 22. Common horn (azimuth and elevation).

NOTE.—Some horn covers are closed with clips (figure shows zippers).

knobs are located on opposite sides of the skirt of the control unit.

(6) Remove the binocular mount from its box.

(7) Remove the cover plate and insert the column in its place on top of the control unit turning it slightly in azimuth to be sure the coupling on the bottom engages.

(8) Attach the column to the control unit by means of the four screws provided.

(9) Open the binocular mount to its operating position, making sure that its locking pin is inserted from the proper side so as to hold it in place.

(10) Place the binoculars (night glasses) in position at the top of the binocular mount.

(11) Adjust the leveling jacks so that the control station can make a complete traverse without apparent displacement of the level bubbles.

■ 88. SETTING UP SOUND LOCATOR, M2.—*a*. After unloading the control station, the truck moves to the location indicated for the sound locator.

b. The complete sound locator is broken down into six component parts for transportation. These parts, with their approximate weights, are listed below:

	Pounds
Two-horn assembly	90
Single-horn assembly	55
Main assembly and corrector (with carrying case and spare parts)—total	310
Pedestal	30
Platform	140
Cable and reel	350

c. The crew unloads the equipment and assembles the sound locator as follows:

(1) Carry the platform to the sound locator position, set it up, and level it approximately. Place the platform so that the footing is firm for the leveling jacks.

(2) Place the pedestal on the platform and bolt it down. (See fig. 23.)

(3) Place the main assembly and corrector on the pedestal, the cable connections (17) being first dropped down

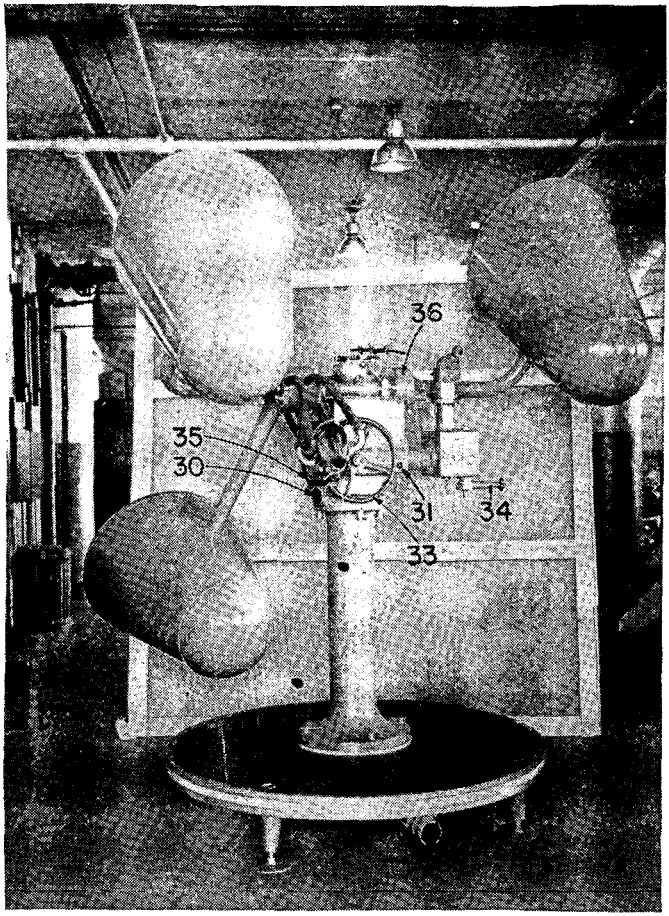


FIGURE 26.—Sound locator, M2 (including corrector).

30. Portable lamp receptacle.
31. Self synchronous push button switch.
33. Elevation handwheel.
34. Sight correction handle and knob.
35. Azimuth scale.
36. Elevation scale.

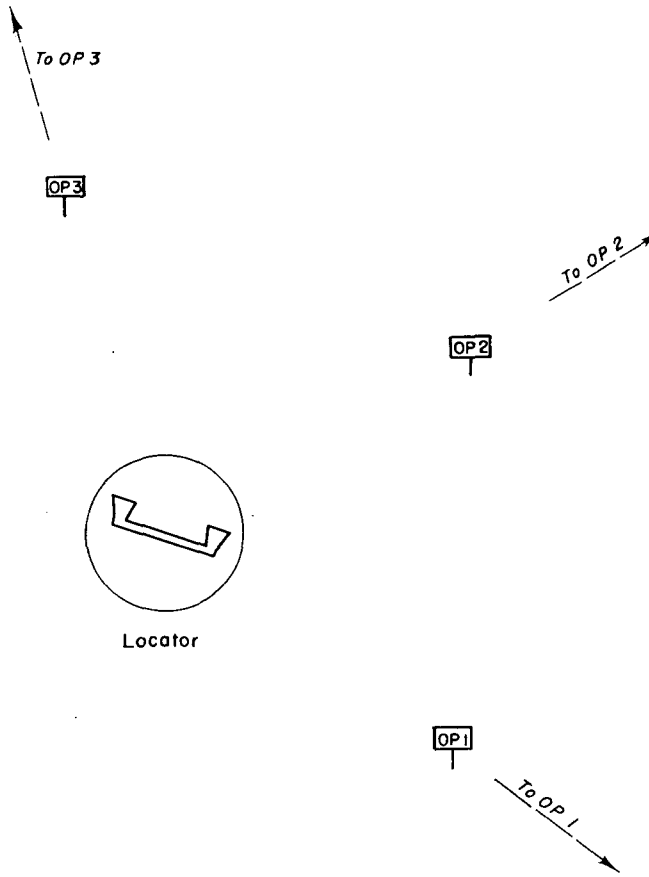


FIGURE 27.—Arrangement of stakes around sound locator.

through the pedestal (18), as shown in figure 23. Bolt this unit in place. Remove the transportation bracket (20), then loosen elevation friction clamp ((14), fig. 6), turn to maximum elevation, and set up the elevation clamp tightly. Markers on the base of the main assembly show the location of the dowel pins.

(4) Bolt the horn assemblies in place as shown in figures 24 and 25, assembling the single horn (21) first. The horns are more easily handled if the canvas covers are not removed until after they are assembled in place. Markers on the hubs of the horn arms show the location of the holes for the dowel pins.

(5) Mount the pantograph on the corrector case as shown in figure 6; secure the pantograph in place by means of knob (7).

(6) Connect the receptacle end of the blue cable to the plug underneath the sound locator platform (fig. 26), and then clamp this joint to the under side of the platform. Connect the plug end of the cable to the blue receptacle on the searchlight.

(7) Adjust the leveling jacks until the level ((13), fig. 6) indicates that the platform is horizontal. The bubble should remain centered while the locator is rotated 360°. All four jack pads must bear firmly against the ground. Check this condition by walking around on the platform to detect any tendency to rock. The locator is now ready for orienting.

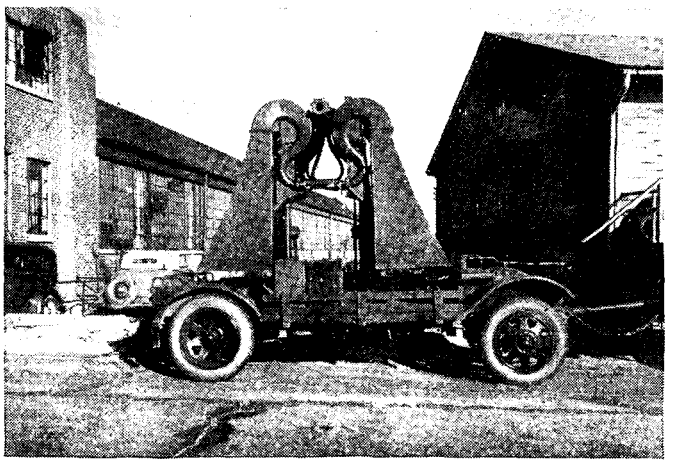


FIGURE 28.—Sound locator, M1A1, in traveling position.

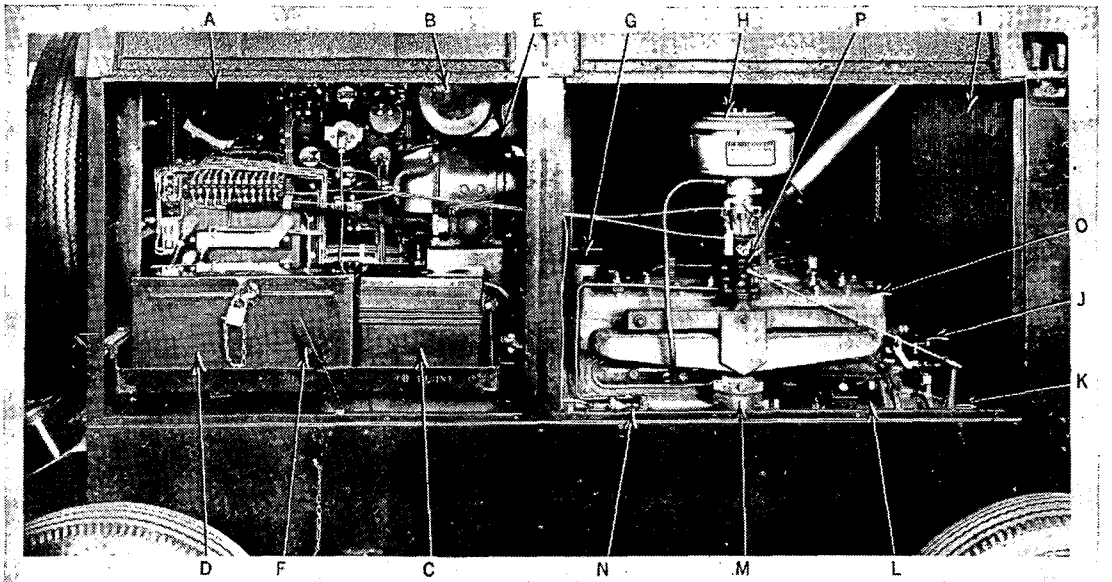


FIGURE 29.—Right side of power plant (doors open).

A. Listening load rheostat.
B. Arc load rheostat.
C. Battery.
D. Spare parts and tool box.
E. Fan motor.
F. Engine door release lever.
G. Engine oil clarifier.
H. Air filter.
I. Radiator.
J. Solenoid.
K. Governor.
L. Charging generator.
M. Exhaust manifold.
N. Fuel pump.
O. Engine.
P. Carburetor.

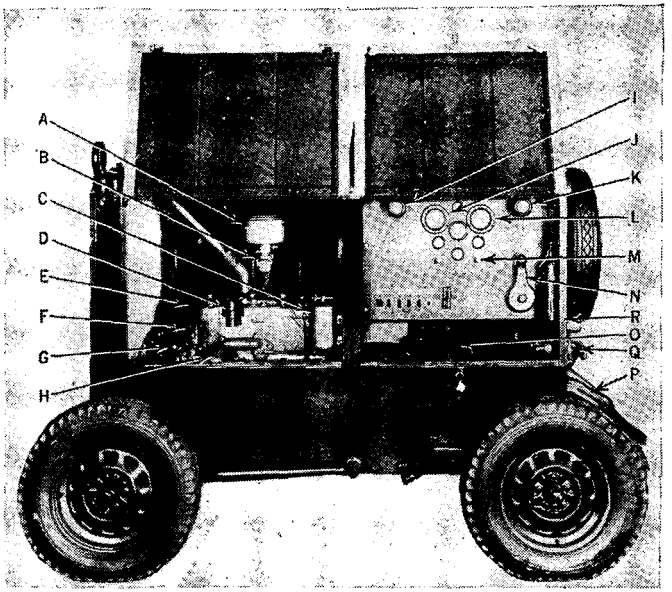


FIGURE 30.—Left side of power plant (doors open).

A. Air cleaner.
B. Carburetor.
C. Oil filter.
D. Ignition coil.
E. Engine.
F. Distributor.
G. Solenoid.
H. Water pump.
I. Arc load voltage rheostat.
J. Power ammeter.
K. Listening load voltage rheostat.
L. Power voltmeter.
M. Throttle.
N. Main switch.
O. Power generator.
P. Gas tank.
Q. Power cable receptacles.
R. License mounting holes.

d. After the locator has been completely set up, a stake should be driven in the ground in the direction of each advanced listening post and of each of the other four lights of the platoon. The arrangement of stakes, shown in figure 27, enables the chief of section to point the locator in accordance with information received by phone from these points.

■ 89. SETTING UP SOUND LOCATOR, M1A1.—With the locator in traveling position (fig. 28), to go into operating position—

a. Remove the horns from the traveling position supports by releasing the horn locking brace and pins. Then clamp the horns into place on the horn support, which is in a position corresponding to 90° elevation, by means of the double hooks and horn clamping screws. Be sure that the numbers on the horns and supports correspond.

b. Unlock the turntable by loosening the three locking screws, and level by means of the four jacks suspended from the chassis of the trailer. Two levels are provided on the turntable for leveling purposes.

■ 90. UNLOADING POWER PLANT.—*a.* When using M1937 and later equipment, the second truck drives to the location indicated for the power plant. The ramps are placed in position, the block and tackle hooked up, the hold-down devices disconnected, and the power plant (figs. 29 and 30) unloaded. It is important that personnel be cautioned to stand clear of the power plant while on the ramp, in case the block and tackle should fail.

b. The power plant is always placed in operating position with the gasoline motor end *away* from the rest of the unit, in order to decrease the amount of sound reaching the locator, light, and control station.

■ 91. PREPARING POWER PLANT FOR OPERATION.—*a.* After the power plant is unloaded, the operator should first check to see that it has sufficient—

(1) Water in the radiator.

(2) Oil in the crankcase. The oil should never be allowed to fall below the halfway mark on the dip stick. In summer use SAE 30 and in winter (if temperature falls below 30° F.) use SAE 10. The capacity of the crankcase is 7 quarts.

(3) Gasoline in the tank.

b. Both radiator doors should be fastened open. For quick warming up of plant in cold weather, doors may be kept closed until desired motor temperature is reached.

c. Fasten the switchboard door open with the chain. This door must be open to insure proper cooling, as the cooling

fan draws its air through this opening. Leave the other hood side doors closed.

■ 92. CABLES.—*a.* (1) Multi-conductor cables connect the power plant, light, control station, and sound locator. For identification the plugs of these cables are painted different colors as follows:

(*a*) *Yellow*—two single-conductor main power cables connecting light and power plant. These carry the power for the searchlight, the distant electric control system, and the rotary converter.

(*b*) *Red*—a 15-conductor cable connecting the control station with the light. It transmits the distant electric control impulses from the control station to the elevation and azimuth training motors on the light. It transmits the zero reader data from the light to the control station. It also connects a push button on the control station with a buzzer on the searchlight.

(*c*) *Blue*—a 10-conductor cable connecting the sound locator and the searchlight. It transmits the azimuth and elevation as determined by the locator and acoustic corrector to the searchlight.

(2) On the earlier model searchlight units (M1934 and earlier), cables have the same general function as described in (*a*), (*b*), and (*c*) above. On the MVI unit, an additional cable with white plugs connects control station and light. For details see TM 4–210.

b. These cables are carried on reels and are transported in truck No. 2, the power plant truck. The reels are equipped with small wheels so that they may be pushed around like longshoremen's hand trucks. However, they are not suitable for cable laying for long distances except on paved roads.

c. Where it is practicable, cable is laid from the body of the truck. Where impracticable, the cable is laid by placing the reel on the ground near the searchlight, and pulling the cable off the reel and to the piece of equipment. Where the cable is very long or must go around curves, it is necessary to place additional men along the cable to keep it from binding or becoming snagged.

■ 93. CAUTIONS IN HANDLING CABLES.—*a.* As about 90 percent of searchlight matériel failures are caused by cable difficulties, it is imperative that cables be handled with great care. Most cable failures take place within a foot of the plugs, which indicates that rough handling of the cable at the plug is a major source of difficulty. It has been found by actual experience that the observance of the rules given in *b* below greatly reduces cable failures.

b. (1) Plugs should be removed from sockets by pulling on the *plug,* not on the cable. Pulling on the cable will bend and break the delicate electrical conductors at the plug.

(2) When moving the cables, pull on the *cable,* not on the plug. Pulling on the plug will rupture the delicate electrical conductors.

(3) When moving the cables, do not allow the plugs to drag along the ground, catching on rocks, bushes, and other obstructions. Carry the cable so the plug is clear of the ground.

(4) Do not lay the cable so that it is likely to be run over by vehicles.

(5) Do not kink the cables.

(6) Do not operate the searchlight with the main power cable (the one with yellow plugs) on the cable reels. Insufficient ventilation may cause the cables to overheat and destroy the rubber insulation.

(7) Do not be in too much of a hurry to reel up the cables when march order is given. A few minutes saved the night before may cause hours of repair work the next day.

(8) Do not put cable plugs into sockets until cables are completely laid and off the cable reels.

■ 94. LAYING CABLES.—*a.* Cables are carried on truck No. 2, the power plant truck. While on the road, the cable reels are fastened to the truck body by the hold-down devices. When ready to lay a cable, it is first necessary to unfasten the reel from its hold-down device and move it to the rear of the truck.

b. The two power (yellow) cables are laid first. Truck No. 2 goes to the power plant position. After unloading the

plant, the yellow cable reel is moved to the rear of the truck. Both yellow cables are laid at the same time as the truck moves slowly from the power plant to the light. *Do not put cable plugs in sockets on power plant until cable is completely laid and off the truck.*

c. Both the control station (red) cable and the sound locator (blue) cable are laid at the same time. Both reels are moved to the rear of the truck when it is at the searchlight. The plugs are passed to a man on the ground who holds them, and the cables are unreeled as the truck moves slowly ahead to the control station, where the red cable ends. The truck then moves on to the sound locator, completing the laying of the blue cable. During the laying operation there should be at least one man for each reel on the truck and a man on the ground to guide the cable or cables as they are unreeled.

d. At the power plant, light, control station, and locator, the cable plugs are connected to their proper sockets. These sockets are painted the same color as the plugs to facilitate identification. The plugs should not be connected until the cables are completely laid and off the reels.

SECTION II

ORIENTING AND SYNCHRONIZING

■ 95. SCOPE.—This section describes methods of orienting and synchronizing the various elements of the searchlight unit.

■ 96. GENERAL.—The searchlight and sound locator must be oriented and synchronized in azimuth and elevation. Orientation may be accomplished using true azimuth or an arbitrary zero. In the description following, an arbitrary zero is used. It is assumed that the searchlight and sound locator have been set up and proper electrical connections made. Before commencing the operations listed below, if the control station is equipped with a searching mechanism make sure that the searching control is at zero position as directed in the manufacturer's instructions supplied with that equipment.

■ 97. ORIENTING IN AZIMUTH ON DISTANT POINT.—*a.* The easiest method of orientation is by the use of a celestial body (moon, sun, or star) or a distant object. In this method, sound locator, searchlight, and control station are pointed at the celestial body or distant object by means of their sights. While so pointed, the azimuth scales on the searchlight and sound locator are given the same reading (generally zero). The power is turned on and the azimuth zero readers adjusted to read zero as described in (3) below.

b. The details of the operation follow:

(1) *Searchlight.*—(*a*) Disengage the azimuth clutch knob by pulling the azimuth clutch handle in the direction indicated as "out."

(*b*) Turn the searchlight in azimuth until it points at the celestial body (or distant point), sighting by means of the orienting sight on the searchlight ((270), fig. 21).

(*c*) Re-engage the azimuth clutch by pushing the clutch lever in the direction indicated as "in."

(*d*) Start the power plant and turn the red D. C. switch at the control station "on."

(*e*) Recheck the searchlight azimuth position, using the distant electric control to obtain a vernier adjustment.

(*f*) Set the searchlight azimuth scale to zero. To do this, loosen the azimuth scale located at the base of the searchlight and turn it until zero on the scale is under the pointer index. Tighten the screw.

(2) *Sound locator, M2.*—(*a*) Set the target speed to zero by means of knob ((2) fig. 6).

(*b*) Set the parallax scale (15) to zero.

(*c*) Loosen the azimuth handwheel clamp knob ((29), fig. 23), and point the sound locator at the celestial body (or distant point). To do this, use the corrector sight and get the images of the pantograph pointer and the celestial body (or distant point) to coincide on the cross lines of the mirror. Be careful not to disturb the correction handle thereafter until the control station is oriented in azimuth.

(*d*) Take up on the azimuth clamp to hold the sound locator in this position.

(*e*) Set the sound locator azimuth scale to zero. (Slip scale around.)

(*f*) Push down declutching gear ((9), fig. 6) and rotate the parallax cam (8) until the arrow on top of the cam points directly at the celestial body (or distant point). Then remesh the gearing.

(*g*) With the power on, the azimuth zero readers are adjusted to read zero as described in (3) below.

(3) *Data receiver adjustment.*—(*a*) When the searchlight and sound locator have been oriented as described in (1) and (2) above, the azimuth zero readers on the searchlight and control station may or may not show a zero reading. They should be made to read zero by removing the cover on the azimuth data receiver at the base of the searchlight and turning the adjustment knob.

(*b*) It is possible to get two zero readings on the azimuth zero reader meters 180° apart. The correct zero reading is obtained when the needle of the azimuth zero reader at the control station moves to the "right" when the zero reader handwheel is rotated clockwise and to the "left" when the handwheel is rotated counterclockwise.

(4) *Control station.*—Hold the azimuth handwheels from turning and slip the control station until it is directed at the celestial body (or distant object). This is accomplished by sighting through the binoculars.

c. When searchlight, sound locator, and control station are all pointed at the same celestial body (or distant point); the azimuth scales of light and locator read the same; and the zero reader meters read zero; the unit is in orientation, has been synchronized, and is ready for action.

■ 98. ORIENTING IN AZIMUTH WHEN DISTANT POINT IS NOT AVAILABLE.—When a distant point is not available, the unit is oriented on itself as described below:

a. Searchlight.—(1) Disengage the azimuth clutch knob by pulling the azimuth clutch handle in the direction indicated as "out."

(2) Turn the searchlight in azimuth until it points at the pedestal of the sound locator, sighting by means of the orienting sights on the searchlight.

(3) Re-engage the azimuth clutch by pushing the clutch lever in the direction indicated as "in."

(4) Start the power plant and turn the red D. C. switch at the control station to "on."

(5) Recheck the searchlight azimuth position, using the distant electric control to obtain a vernier adjustment.

(6) Set the searchlight azimuth scale to 3,200 mils. To do this, loosen the azimuth scale located at the base of the searchlight and turn it until 3,200 on the scale is under the pointer index. Tighten the screw and, using the distant electric control, swing the searchlight in azimuth to the zero position. In this way the distant electric control system is used to lock (electrically) the searchlight in the zero position in which it has just been set.

b. Sound locator, M2.—(1) Set the target speed to zero by means of knob ((2), fig. 6).

(2) Set the parallax scale (15) to zero.

(3) Loosen the azimuth handwheel clamp knob ((29), fig. 23) and point the sound locator at the searchlight. To do this, use the corrector sight and get the images of the pantograph pointer and the rear drum of the searchlight to coincide on the cross lines of the mirror. Be careful not to disturb the correction handle thereafter until the control unit is oriented and synchronized in azimuth.

(4) Take up on the azimuth clamp to hold the sound locator in this position.

(5) Set the sound locator azimuth scale to zero. (Slip scale around.)

(6) Push down declutching gear ((9), fig. 6) and rotate the parallax cam (8) until the arrow on top of the cam points directly at the searchlight. Then remesh the gearing.

(7) With the light and locator oriented as described above, and the power on, the azimuth zero readers are adjusted to read zero as described in paragraph 97.

c. Control station.—(1) After completing the orientation of searchlight and sound locator, direct the searchlight at the control station using the distant electric control. Sight the searchlight exactly on the control station using the light's orienting sight.

(2) Hold the azimuth handwheels from turning and slip the control station until it is backsighted on the searchlight. This is accomplished by sighting *backward* through the open sight on the binoculars.

(3) The control station is now oriented, that is, pointed in the same direction as the searchlight. Movements of the azimuth handwheels will move both control station and searchlight the same amount and direction.

■ 99. ORIENTING AND SYNCHRONIZING IN ELEVATION.—*a. Searchlight.*—(1) Turn the searchlight elevation control clutch lever to hand position and set the searchlight to zero elevation by hand.

(2) Then lock (electrically) the searchlight in the zero elevation position by turning the clutch lever to the distant electric control position. *Do not force the clutch lever;* if it will not move easily into distant electric control position, keep a slight pressure on the lever and slowly rock the searchlight a few mils in elevation until it does.

b. Sound locator, M2.—Lock the sound locator at zero elevation by means of lock ((14), fig. 6). With zero speed and parallax settings, center the pantograph pointer on the cross lines of the mirror. Be careful not to disturb the correction handle thereafter when orienting and synchronizing.

c. Control station.—The binocular mount on the control station should be set at zero elevation. However, check to see that the binocular elevation zero marker ((143), fig. 10) is on the zero mark, thereby indicating zero elevation.

d. Data receiver adjustment.—(1) When the searchlight and sound locator have been oriented as described above, the elevation zero readers on the searchlight and control station may or may not show a zero reading. They should be made to read zero by turning the housing of the elevation data receiver located on the left trunnion arm of the searchlight.

NOTE.—The elevation receiver will usually not require adjustment, but it is advisable to check it for correctness of setting at this time.

(2) It is possible to get two zero readings on the elevation zero reader meters 180° apart. The correct zero reading is

obtained when the needle of the elevation zero reader at the control station moves to the right when the zero reader handwheel is rotated clockwise and to the left when the handwheel is rotated counterclockwise.

SECTION III

PREPARING FOR THE ROAD

■ 100. SCOPE.—This section describes the disassembling and loading of the equipment preparatory to a move by road. Some of the duties require modification when loading sound locator, M1A1.

■ 101. OPERATING POSITION.—When the command MARCH ORDER is given, the light unit is in operating position with the crew distributed as shown in figure 33. The two trucks are in the parking area hidden from observation.

■ 102. ACTIONS OF TRUCK NO. 1 AT MARCH ORDER.—*a.* At the command MARCH ORDER, truck No. 1 leaves its parking area and goes to the sound locator position. The sound locator is disassembled and loaded on the truck, and the parts fastened in their proper places by the hold-down devices.

b. The truck then proceeds to the control station position, where the control station is disassembled, loaded on the truck, and fastened in place by the hold-down devices.

c. The truck leaves the control station position and proceeds to the searchlight position. The searchlight is placed in traveling position, loaded on the truck, and fastened in its place by means of the four hold-down turnbuckles provided.

d. Truck No. 1 then proceeds to its designated position on the road and awaits further orders.

■ 103. ACTIONS OF TRUCK NO. 2 AT MARCH ORDER.—*a.* At the command MARCH ORDER, truck No. 2 leaves its parking area and proceeds to the control station position where it picks up two men and then proceeds to the sound locator position. Starting at the sound locator, the truck proceeds slowly (backing up) toward the control station, picking up the sound locator (blue) cable as it moves. From the control

station the truck continues moving slowly (backing up) to the searchlight position, picking up both the red and the blue cables en route.

b. Starting from the searchlight the truck slowly backs up toward the power plant position, picking up the power (yellow) cables as it moves.

c. When all cables have been reeled in and the reels fastened in place by the hold-down devices, the ramps are placed in position for loading the power plant, and the power plant is pulled up into the truck body by means of the block and tackle. The plant is fastened in place by means of the hold-down devices.

d. Truck No. 2 proceeds to its designated position on the road and takes place behind truck No. 1.

e. When ready to move off, the equipment and personnel should be loaded in the two trucks as shown in figure 18.

■ 104. LOADING SOUND LOCATOR.—*a.* At the command MARCH ORDER, the blue cable is disconnected from the short cable attached to the locator.

b. The pantograph is removed from the locator and placed in its carrying box.

c. The horns are elevated to approximately 90° and the canvas covers replaced. The double horn and then the single horn are removed.

d. The main assembly is unbolted, removed from the pedestal, and placed in its box.

e. The pedestal is unbolted from the platform and detached from it.

f. The five parts are placed on the forward end of truck No. 1 in their proper places and secured in position by means of the hold-down devices.

■ 105. LOADING CONTROL STATION.—*a.* At the command MARCH ORDER, the red cable is disconnected, and the binoculars are removed from the mount and placed in their carrying case.

b. The binocular mount is removed from the control unit and replaced in its carrying box.

c. The control unit is lifted from the tripod.

d. The tripod is collapsed.

e. The subdivisions of the control station are then loaded in their proper places on truck No. 1 and secured by means of the hold-down devices.

■ 106. LOADING SEARCHLIGHT.—*a.* At the command MARCH ORDER, the blue, red, and yellow cables are disconnected; the leveling jacks are run up; the light is traversed to the proper position and the azimuth pin replaced; the searchlight is elevated to approximately 90°, and the transportation lock pinned in place.

b. The ramps are placed in position and the light drawn up into the body of truck No. 1 by means of the block and tackle.

c. The light is then secured in position by means of the hold-down devices.

d. The extended hand control and the ramps are replaced in position on the truck.

■ 107. LOADING CABLES.—*a.* At the command MARCH ORDER, truck No. 2 proceeds to the sound locator. Here the blue and red cable reels are moved to the rear of the truck. As the truck *backs* up from the locator to the control station, the blue cable is reeled in. As it backs up from the control station to the searchlight, both blue and red cables are reeled in. When completely reeled in, the blue and red cable reels are moved to their traveling positions in the truck and secured by means of the hold-down devices.

b. The yellow cable reel is next brought to the rear of the truck. As the truck *backs* up from light to power plant, the two yellow cables are reeled in. When completely reeled in, the yellow reel is moved to its traveling position on the truck and secured by means of the hold-down devices.

■ 108. LOADING POWER PLANT.—*a.* At the command MARCH ORDER, the switchboard and radiator doors are lowered and fastened.

b. The ramps are placed in position, and the power plant is drawn up into the body of truck No. 2 by means of the block and tackle. *All personnel should stand clear of the power plant* while it is being loaded in order to avoid injury in case the plant breaks loose while going up the ramp.

c. The power plant is secured in position in the body of truck No. 2 by means of the hold-down devices.

SECTION IV

PROTECTIVE MEASURES

■ 109. CAMOUFLAGE.—*a.* Camouflage is employed to prevent enemy air or ground (principally air) observers from locating matériel and personnel or from realizing their presence.

b. Camouflage discipline is necessary to prevent disclosing the location of matériel or personnel by the paths made by men or vehicles as they move around. (See FM 5–20.)

■ 110. PROTECTION OF MATÉRIEL AND CREW.—*a.* When searchlight units are operating in one location for a time, it is desirable to protect matériel and crew by means of earthworks and trenches.

b. Personnel should be protected by providing slit trenches (2 feet wide and 6 feet deep) at the locator, control station, light, and power plant. The crew takes refuge in these trenches whenever, during a bombardment, it is not necessary to operate the unit.

c. Matériel is protected by sandbagging when practicable or by partially sinking the equipment in the ground. (See FM 5–15.)

■ 111. GAS DEFENSE.—*a.* Searchlight matériel and personnel may be gassed by means of shell, bombs, or spray from the air. When gas is placed on the unit at the time of an aerial attack, it will ordinarily be possible to illuminate the targets for the duration of the attack. As soon as the aerial attack is over, the unit should be moved to another ungassed position nearby.

b. After personnel has been under a persistent gas (mustard) attack it is necessary to decontaminate (clean) their clothing, and it is important that the men be required to bathe.

c. Matériel should be kept covered as much as possible when under gas. A canvas cover will prevent drops of liquid gas from coming in contact with the matériel. Bright

surfaces should be especially protected. A light coating of grease should be given bright surfaces.

d. After a gas attack, matériel must be decontaminated before using, both to avoid corrosion of the matériel and injury to the using personnel. This is generally accomplished by the use of solutions or pastes of certain chemicals. For details on decontamination see *FM 3–5.

*See Appendix.

CHAPTER 5

ORGANIZATION

SECTION I

SEARCHLIGHT BATTERY

■ 112. COMPOSITION.—*a.* The antiaircraft searchlight battery (T/O 4–18 and T/O 4–118) consists of a battery headquarters section, a maintenance section, and three searchlight platoons. The searchlight platoons are the tactical units of the searchlight defense.

b. The battery headquarters section contains the personnel necessary for battery administration.

c. The maintenance section contains the personnel required for battery messing, supply, and transportation, and for the operation of the repair facilities.

■ 113. BATTERY COMMANDER.—*a.* The battery commander is responsible for the efficiency, training, administration, and supply of the battery and for the condition of the matériel assigned to it.

(1) He supervises the maintenance, technical operation, and supply of searchlight and sound locator equipment.

(2) Under the battalion commander, he is responsible for the illumination of all aerial targets operating within effective range of the lights.

b. He selects and coordinates the general locations for the lights. The selection of the exact locations for the lights is made by the platoon commanders concerned.

SECTION II

SEARCHLIGHT PLATOON

■ 114. COMPOSITION.—*a.* The antiaircraft searchlight platoon is composed of a platoon headquarters and five searchlight sections.

b. The platoon headquarters contains the platoon commander and the personnel necessary to furnish technical advice and assistance to the searchlight sections on the operation, maintenance, and repair of searchlight matériel; personnel to establish and operate the platoon wire communication net; and chauffeurs for platoon headquarters vehicles.

■ 115. FORMATION.—The searchlight platoon assembles with the platoon headquarters on the right, the searchlight sections in numerical order on the left at 4-pace intervals. The platoon commander takes post 6 paces in front of the center of the platoon (fig. 31).

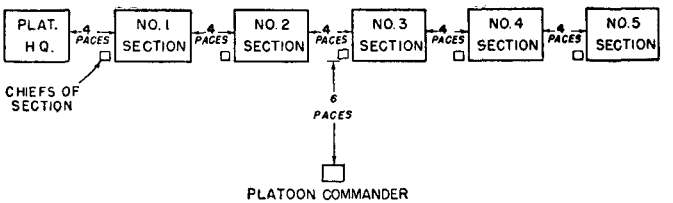


FIGURE 31.—Formation of antiaircraft searchlight platoon.

SECTION III

SEARCHLIGHT SECTION

■ 116. COMPOSITION.—The searchlight section consists of a sound locator squad and a searchlight squad, and comprises the personnel necessary to man one complete searchlight unit—sound locator, control station, searchlight, power plant, and vehicles. The mobile section at war strength is organized as follows:

a. The chief of section.

b. The sound locator squad consisting of the chief of section, acting as chief of the sound locator squad, and Nos.—

1. Listener, azimuth.
2. Listener, elevation.
3. Operator, acoustic corrector.
4. Operator, telephone.

c. The searchlight squad consisting of the searchlight commander, acting as control station chief, and Nos. —

5. Controller, azimuth (operator, control station).
6. Controller, elevation (operator, control station).
7. Operator, searchlight.
8. Operator, power plant.
9. Chauffeur, truck No. 1.
10. Chauffeur, truck No. 2.

NOTE.—The mobile searchlight section at peace strength and the semimobile searchlight section at peace and war strengths are discussed in paragraphs 141 to 143, inclusive.

■ 117. FORMATION.—*a.* Each section assembles in two ranks with 4 inches between files and 40 inches between ranks. Within each squad, men form in numerical order with odd numbers in the rear rank and even numbers in the front rank (fig. 32). The post of the searchlight commander is in the front rank, uncovered and 4 inches to the right of No. 6. The post of the chief of section is in the front rank 1 pace to the right of No. 2.

b. When setting up, operating, and loading the equipment, the men normally move at ease and in such formation as permits the most efficient handling of the equipment. The posts of the crew in operating position are shown in figure 33.

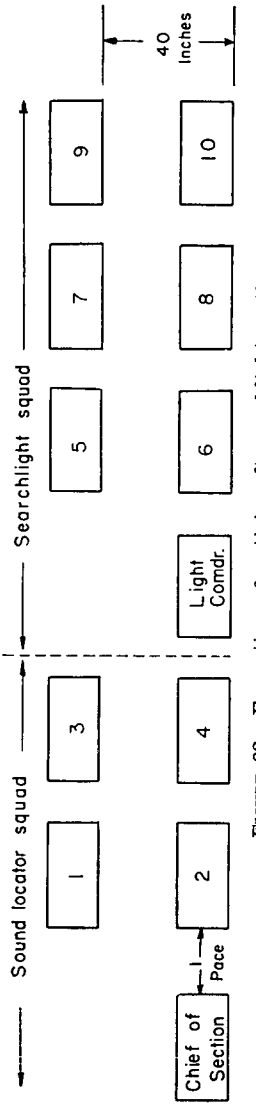
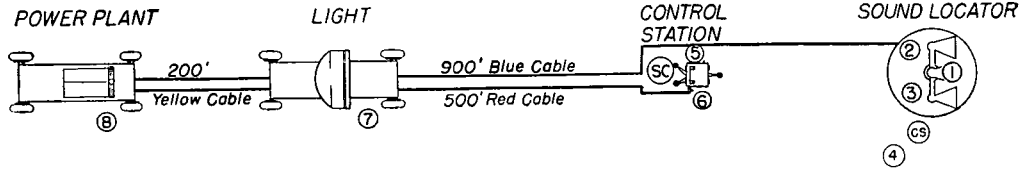


FIGURE 32.—Formation of antiaircraft searchlight section.



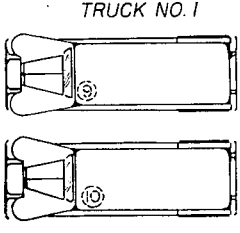


FIGURE 33.—Searchlight unit in operating position, showing posts of crew.

CS. Chief of section. SC. Searchlight commander.

CHAPTER 6

SERVICE OF THE PIECE

SECTION I

SEARCHLIGHT PLATOON ACTION

■ 118. CONTROL OF SEARCHLIGHT ACTION.—Control of searchlight action may be retained by the platoon commander or decentralized to the chiefs of section. It is normally decentralized.

■ 119. DECENTRALIZED CONTROL.—When control is decentralized, the responsibility for the selection, pick-up, and carry of targets belongs to the chiefs of section. In this case the chiefs of section each act independently in selecting, tracking, and illuminating targets.

■ 120. SELECTION OF TARGETS.—The platoon commander, chief of section, and searchlight commanders should be thoroughly familiar with types and formations of aircraft and their identification by sound characteristics. In each situation the platoon commanders and the chiefs of section should know the mission of the antiaircraft defense and the general location of all adjacent elements involved.

■ 121. WARNING COMMAND.—On receiving information of the presence or approach of a possible target from a listening post, a chief of section, or higher echelons, the platoon commander sends to all sections the command STAND BY.

■ 122. TRACKING.—*a. Centralized control.*—As soon as the target has come within tracking range, it will be assigned to all sections and they will be ordered to commence tracking. The assignment of target will include, when known,

the locality over which the target is flying, number and type of aircraft, direction of flight, and estimated altitude. For example, a complete assignment of target command would be TARGET; BIGLERVILLE; FORMATION BOMBERS; FLYING NORTH, HIGH.

b. Decentralized control.—As soon as one target has come within tracking range, each chief of section assigns the target to his section.

■ 123. LIGHT ACTION.—*a.* (1) *Centralized control.*—As soon as the target is within range of one or more lights that have been reported "Ready," the platoon commander puts such lights as he may elect in action by the command NOS. —— IN ACTION, or ALL LIGHTS IN ACTION.

(2) *Decentralized control.*—As soon as the chief of section of the pick-up light nearest the target estimates that the favorable moment for commencing the search has arrived, he commands: IN ACTION. Other pick-up lights in range immediately go into action.

b. While friendly aircraft, and in some situations certain types of hostile aircraft, should not be illuminated, the commander should not wait for positive identification by sound to go into action. If at any time after the searchlights go into action the target is identified, either by sound, visually, or by telephone, as one that should not be illuminated, all lights are put out of action.

■ 124. FOLLOWING THE TARGET.—After the target is picked up, two carry lights follow the target until it is shot down or flies out of range, or until other carry lights located in the direction of flight have commenced to follow it.

■ 125. SEARCHING WITH OTHER LIGHTS.—When the lights from an adjacent platoon go into action, the platoon commander commands: STAND BY.

■ 126. COORDINATION OF DEFENSE.—When the platoon is a part of a larger unit, the commander of the larger unit will issue such orders involving the functioning of the platoon as are necessary to make it a part of a coordinated defense.

SECTION II

DUTIES OF PERSONNEL

■ 127. PLATOON COMMANDER.—*a.* The platoon commander is responsible for the technical training and efficiency of the personnel and for the condition of the matériel assigned to his platoon.

b. He is sometimes responsible for the tactical handling of the platoon. This involves the choice of which target to illuminate, how many lights to use for searching and how many for carrying, when to change targets, and when to decentralize control to the chiefs of section.

c. The platoon commander normally selects the positions for the individual lights and the advanced listening (observation) posts (fig. 3).

d. He specifies the communication net that will be laid.

e. For details as to tactical handling, selection of positions, and communication nets, see FM 4–105.

■ 128. CHIEF OF SECTION.—*a.* The chief of section (a sergeant) is in command of one searchlight unit and is responsible for the efficiency of the personnel and the condition of the matériel under his charge.

b. The chief of section will ordinarily select targets and determine the proper time for illuminating them. It is important that he assure himself that the locator listeners are definitely tracking the target before giving IN ACTION. In case of failure of telephone communications, he will always go into action on his own initiative. If the command SECTION LEADER'S ACTION has been given or if telephone communication has failed, the chief of section will assume the responsibility of selection and illumination of targets. In such cases he will be guided by the same considerations as the platoon commander.

c. He normally selects the exact locations for the sound locator, control station, searchlight, and power plant (either alone or in conference with platoon commander).

d. He supervises the service of the piece, including going into and out of position. He gives the commands PREPARE FOR ACTION, EXAMINE EQUIPMENT, TRACK, and IN ACTION.

e. He personally directs the work of care and preservation of equipment assigned to the unit.

f. He acts as sound locator chief, in addition to his duties as chief of section.

g. He directs the orienting and synchronizing of the searchlight unit.

h. He selects the parking place of the trucks, and after all equipment is unloaded he orders the chauffeur to park them at this designated place.

■ 129. SEARCHLIGHT COMMANDER.—*a.* The searchlight commander (a corporal) commands the searchlight squad. He is responsible for the efficiency of the control station crew, the searchlight operator, and the power plant operator; and for the condition of the control station, searchlight, and power plant.

b. Acting as control station chief, he supervises the search for the target, and carries the target after it is picked up.

c. He is responsible for orienting and synchronizing the searchlight and control station with the sound locator.

SECTION III

DRILL OF SEARCHLIGHT SECTION

■ 130. SCOPE.—This section outlines a drill for an antiaircraft searchlight section, mobile, at war strength. Modifications made necessary by the smaller numbers of men provided in semimobile units and units at peace strength are described in paragraphs 141 to 143, inclusive.

■ 131. PREPARE FOR ACTION.—*a.* As the vehicles of the section reach the vicinity of the searchlight position, the chief of section commands: PREPARE FOR ACTION, and indicates the locations for the sound locator, control station, searchlight, power plant, and the parking area for the vehicles. No. 9 drives truck No. 1 to the searchlight position, where Nos. 1, 2, 5, and 9 assist No. 7 in unloading, setting up, and leveling the light (par. 86). No. 7 remains at the light, connects up the yellow, blue, and red cable plugs to the light, removes the extended hand control and places it near the light, and prepares the searchlight for action.

b. Truck No. 1 is driven to the control station position where Nos. 1, 2, and 5 unload and set up the control station (par. 87). No. 5 removes the automatic rifle from the truck and places it near the control station. No. 5 remains with the control station, levels it, connects up the red cable, and prepares the station for action.

c. Truck No. 1 is then driven to the sound locator position where Nos. 1, 2, and 9 unload and set up the sound locator (par. 88). No. 1 connects the blue cable to the locator. No. 3 removes the pantograph from its case and connects it in place on the locator. Nos. 1 and 2 level the locator. Under the supervision of the chief of section, No. 2 drives stakes indicating the direction of the advanced listening posts and the other lights (fig. 27).

d. No. 9 then drives the truck to a position on the road near the searchlight and awaits orders.

e. No. 4 leaves truck No. 2 at the searchlight position and proceeds to the telephone connection (end of wire line), connects his telephone, calls the platoon command post, and if communication thereto is satisfactory, reports "Communication in order" to his chief of section. If communication cannot be established with the platoon command post, he reports that fact to the chief of section immediately.

f. No. 10 drives truck No. 2 to the indicated power plant position. No. 8 removes the automatic rifle from the truck and places it in a location convenient to the power plant operating position. Under the supervision of the searchlight commander, Nos. 3, 6, 8, and 10 unload the power plant and place it in its operating position. No. 8 remains at the power plant, connects the yellow cables, and prepares the plant for action (pars. 90 and 91).

g. Nos. 3 and 6 move the yellow cable reel to the rear end of the truck (No. 2) and pay out the two yellow cables as the truck is slowly driven from the power plant to the searchlight position. When the cable has been unreeled, its reel is replaced by Nos. 3 and 6 in its traveling position in the truck.

h. At the searchlight position, Nos. 3 and 6 move the red and blue cable reels to the rear of the truck. No. 3 pays

out the blue cable and the searchlight commander the red cable as the truck slowly moves from the searchlight to the control station. No. 6 walks along in the rear of the truck, guiding the cables as they come off the reels, and directing them to the side of the road. No. 6 remains at the control station and assists in preparing it for action.

i. The searchlight commander pays out the blue cable as the truck slowly moves from the control station to the sound locator position. No. 3 walks along in rear of the truck directing the cable to the side of the road. After the blue cable is laid, No. 3 returns the cable reel to its traveling position in the truck, dismounts, and remains at the locator.

j. The searchlight commander returns to his post at the control station, and No. 10 drives the truck to a position on the road near the searchlight and awaits orders.

■ 132. EXAMINE EQUIPMENT.—*a.* The chief of section commands: EXAMINE EQUIPMENT, as soon as all items of equipment are in their proper positions and all cables are connected. At this command, he verifies the proper functioning of all equipment and supervises the orientation and synchronization of the complete unit.

b. Nos. 1 and 2 examine the locator, verify its level, and the functioning of the elevating and traversing apparatus. After their examination is completed, they orient the locator as described in detail in paragraphs 96 to 99, inclusive. No. 3 examines the acoustic corrector, sets in the parallax correction, and assists Nos. 1 and 2 in orienting the locator. Nos. 1 and 2 then examine their helmets for proper fit and adjustment.

c. No. 4 tests communication with the platoon command post and with the advanced listening post to his front (if any). If communications are not functioning properly, he reports the fact to the chief of section.

d. The searchlight commander inspects the power plant, searchlight, and control station, paying special attention to the latter. He supervises the orientation of the light with the locator and the control station with the light as described in paragraphs 96 to 99, inclusive. He supervises the synchronizing of the elevation and azimuth zero reader sys-

tems, making sure that movements of the control station handwheels cause the zero reader needles to move in the proper direction.

e. Nos. 5 and 6 examine the control station. They test the functioning of the distant electric control by elevating and traversing the light from the control station. They assist in orienting the control station with the light as described in paragraphs 97 and 98. No. 5 examines the automatic rifle to see that it is in operating condition. He is responsible that a proper supply of ammunition is on hand.

f. No. 7 (searchlight operator) examines the searchlight and sees that all plugs are properly connected to sockets; that the searchlight is leveled and properly connected for distant electric control; that spare positive and negative carbons are on hand; and that new or nearly new carbons are in place in the lamp mechanism. If the tactical situation permits, he strikes the arc, and observes the voltmeter, ammeter, and ground glass finder to see that the arc is functioning normally. He extinguishes the arc as soon as possible. He examines the extended hand control. Under the supervision of the searchlight commander, he orients the light with the locator as described in paragraphs 96 to 99, inclusive, synchronizes the zero reader system by adjusting the azimuths and elevation receivers on the light, and orients the light with the control station.

g. No. 8 (power-plant operator) examines the power plant, sees that the gasoline, oil, and water supply is correct, and that the yellow cable plugs are properly connected (par. 94). He starts the motor and builds up the voltage to the required no-load value (110 volts). (See pars. 68 to 71, incl.) With the searchlight unit equipment all connected, he closes the main switch ((20), fig. 12). The instruments should now indicate the proper listening load values (105 volts and 10–15 amperes). If the arc is struck, he notes that the instruments indicate the proper arc load values (100 volts and 160–165 amperes). He examines the automatic rifle to see that it is in operating condition. He is responsible that a proper supply of ammunition is on hand.

h. Nos. 9 and 10 drive the trucks to the parking places designated by the chief of section. There they insure that

the trucks are hidden from ground and air observation. They inspect their trucks, seeing that the supply of gasoline, oil, and water is correct, and that the trucks are in proper operating condition.

i. When all equipment is in order, the chief of section directs No. 4 to report "No. ——— in order" to the platoon command post.

■ 133. REST.—*a.* When no action is imminent, or when ordered by the platoon commander, the chief of section commands: REST. The command is repeated by the searchlight commander. For rest periods, the chief of section arranges the men in reliefs for the various necessary posts, as follows:

(1) Listener at or near locator.

(2) Telephone operator.

(3) Power-plant operator at or near power plant.

b. The chief of section will divide the hours of darkness with the searchlight commander, so that one or the other is definitely in command at all times.

c. Nos. 1, 2, and 3 take turns as listeners at or near the locator. They search the sky for enemy aircraft, and if any are seen or heard they immediately report to the chief of section. They also look for the beams of nearby searchlights.

d. Nos. 4, 5, and 6 take turns as telephone operator. No. 5 carries the automatic rifle to the telephone position. Whoever is on duty as telephone operator mans the rifle during an attack.

e. No. 8 opens the switches on the power plant and turns off the motor. Nos. 7 and 8 take turns as power plant operators. Whoever is on duty at the time of an attack mans the automatic rifle.

f. Nos. 9 and 10 fill duties as assigned by the chief of section. They may be used as vehicle guards at the trucks or as reliefs for other men of the section.

g. Those members of the unit crew not on duty remain in the vicinity of the equipment they man in order to be able to go into action with a minimum of delay.

■ 134. STAND BY.—*a.* STAND BY is given by the chief of section when a target is detected, an adjacent searchlight goes into action, or when orders are received from the platoon command post. The command is generally followed by a target designation. The chief of section sees that all men are alerted and at their posts and supervises preparations to go into action. He directs the locator crew in the direction of the target's approach, as received from the advanced listeners or the platoon command post. He gives to the acoustic corrector operator the estimated air speed of the target. He reports to the platoon command post "No. ——— on target" when the target has been definitely located by the locator listeners.

b. The searchlight commander repeats the command STAND BY. When power is on all lines, and power plant, searchlight, and control station are ready for action, he reports "Light standing by" to the chief of section. When the locator is definitely following the target, he causes the elevation and azimuth controllers to direct the darkened searchlight by means of the distant electric control.

c. Nos. 1 and 2 take post at the locator and put on their helmets. No. 2 presses the button decreasing the hum of the data transmitters. They move their locator horns as directed by the chief of section so as to pick up the sound of the target. When the target has been definitely located, No. 1 reports "On target" to the chief of section. No. 3 sets the estimated air speed of the target into the acoustic corrector.

d. No. 4 repeats the command and stays at the telephone ready for further messages.

e. Nos. 5 and 6 stand at their posts at the control station. As soon as the zero reader pointers move consistently, indicating that the locator is tracking the target, they center the zero reader pointers by moving their handwheels the necessary amount and direction.

f. No. 7 takes post at the searchlight and awaits orders. He checks the voltmeter reading. If it is not at approximately 100 volts, he notifies the power plant operator.

g. No. 8 starts the power plant motor; builds up the voltage to the proper no-load value (110 volts); closes the

switches; and when the instruments read 105 volts and 10–15 amperes at listening load, he reports "Power plant ready" to the searchlight commander.

h. Nos. 9 and 10 perform duties assigned by the chief of section.

■ 135. TRACK.—*a.* The command TRACK is given by the chief of section when the locator crew reports "On target." When the chief of section estimates that the most favorable moment for going into action has arrived, he reports to the platoon command post "No. ——— ready."

b. The searchlight commander repeats the command and causes the azimuth and elevation controllers to point the darkened light by continuously centering the zero readers.

c. Nos. 1 and 2 track the target, centering the sound by turning their handwheels. No. 1 gives the chief of section such details as to the number and types of planes and their direction of flight as he may determine from time to time. This information is forwarded to platoon headquarters only on request. No. 2 releases the button on the locator so that the data transmitters will operate at full voltage. No. 3 operates the acoustic corrector so as to keep the pantograph pointer centered on the cross wires in the mirror.

d. No. 4 stands by at the telephone for further messages.

e. Nos. 5 and 6 continuously center the zero readers by turning the azimuth and elevation handwheels on the control station.

f. No. 7 stands by at the searchlight ready to strike the arc. He observes his instruments, noting that the voltage is at the proper value.

g. No. 8 keeps the power plant operating on listening load, checking his instruments to see that the voltage and current remain at the proper value. Nos. 9 and 10 perform any duties assigned by the chief of section.

■ 136. IN ACTION.—*a.* The command IN ACTION is given by the chief of section (or received over the phone from the platoon command post). The chief of section continues to supervise the operation of the sound locator and acoustic corrector; looks for the target, and reports illumination or

flicks (very brief illuminations of the target) to the searchlight commander.

b. The searchlight commander repeats the command IN ACTION and causes Nos. 5 and 6 to commence an immediate search for the target, using their respective handwheels. He observes the light beam through the binoculars, being especially watchful for flicks. He calls "Data" whenever he wishes Nos. 5 and 6 to center the zero readers exactly. When the target is flicked, he commands: FLICK, takes over personal operation of the control station from the controllers, and carries the target until it is out of range or until directed otherwise. If he receives the command IN ACTION before the sound locator has found the target, he causes the controllers to search at the intersection of the beams of the other lights until the locator picks up the target.

c. Nos. 1 and 2 continue to track the target. No. 3 continues to operate the acoustic corrector by centering the pantograph pointer on the cross lines on the mirror.

NOTE.—After target is illuminated, pantograph pointer, cross lines and target should be alined. The amount the target is off this line is a measurement of the inaccuracy of the locator corrector system.

d. No. 4 stands by at the telephone. He watches the sky, reporting all flicks and illuminations to the searchlight commander.

e. Nos. 5 and 6 search by moving their zero reader pointers first to one side and then to the other of the zero position, centering exactly when the searchlight commander calls "Data." When the airplane is illuminated, they withdraw from the control station so as to avoid interference with the control of the beam.

f. No. 7 closes the main arc switch. He keeps watch on his instruments, seeing that the arc operates at 78 volts and 145–150 amperes. He recarbons the arc (par. 65) at the first break in operations after the positive carbon is about half consumed (after about 45 minutes of operation).

g. No. 8 continues to operate the power plant, checking to insure that the current and voltage are at the proper full-load value (160–165 amperes and 100 volts).

h. Nos. 9 and 10 perform any duties assigned by the chief of section.

■ 137. OUT OF ACTION.—*a.* The command OUT OF ACTION is given by the chief of section (or received from the platoon command post).

b. The searchlight commander repeats the command and causes the control station crew to continue centering the zero reader pointers.

c. Nos. 1 and 2 continue to track the target. No. 3 continues to operate the corrector. No. 4 stands by at the telephone. Nos. 5 and 6 continue to center the zero readers.

d. No. 7 opens the main arc switch, extinguishing the arc, stands by the light, ready to close the arc switch on command, and observes the voltmeter to see that proper listening load voltage is maintained (100 volts). He recarbons if necessary. No. 8 continues to operate the power plant, checking to see that the proper voltage (105 volts) and current (10–15 amperes) for the listening load are maintained.

e. Nos. 9 and 10 perform duties assigned by the chief of section.

■ 138. CHANGE TARGET.—*a* The command CHANGE TARGET, followed by the designation of the new target, will be given by the chief of section (or received from the platoon command post). The chief of section directs the locator crew to point the locator at the new target. If the target is not already illuminated, he causes the personnel to search for and pick up the new target in the usual manner.

b. The searchlight commander repeats the command. He causes the control station crew to center their zero readers, thereby pointing the light in the direction of the new target.

c. Nos. 1 and 2 cease tracking the old target and point the locator in the direction of the new target as directed by the chief of section. If the target is not already illuminated, they search for, pick up, and track the target (by sound) in the usual manner. No. 3 operates the acoustic corrector in the usual manner as soon as the listeners pick up the target. No. 4 stands by at the telephone.

d. Nos. 5 and 6, at the direction of the searchlight commander, center their zero readers, thereby pointing the light at the new target. During search, pick-up, and carry they operate in the usual manner.

e. Nos. 7 and 8 stand by for further orders.

f. Nos. 9 and 10 perform duties as assigned by the chief of section.

■ 139. MARCH ORDER.—*a.* When it is desired to prepare the light unit for movement on the road, the chief of section commands: MARCH ORDER. The command is repeated by the searchlight commander.

b. At this command No. 9 drives truck No. 1 to the locator position. No. 3 removes the pantograph and places it in its carrying box. Nos. 1, 2, 4, and 9 disassemble the locator, load it on the truck, and fasten it in its traveling position (par. 104).

c. Truck No. 1 next proceeds to the control-station position. Nos. 1, 2, 4, and 5 disassemble the control station, load it on the truck, and fasten it in its traveling position (par. 105).

d. Truck No. 1 then moves to the searchlight position. Here Nos. 1, 2, 4, 5, 7, and 9 prepare the light for traveling, load it on the truck, and fasten it in traveling position by means of the hold-down devices provided (par. 106).

e. The chief of section posts No. 5 as automatic rifleman in the forward end of the truck body overlooking the cab. The chief of section and Nos. 1, 2, 7, and 9 enter the cab, and the truck is moved to its designated place on the road.

NOTE.—The automatic rifleman is relieved from time to time by other men on truck No. 1.

f. When truck No. 1 starts for the locator position, truck No. 2 is moved to the control station position by No. 10, where he picks up the searchlight commander and No. 6, and then proceeds to the locator position. At the locator position, the blue and red cable reels are moved to the rear of the truck. The blue cable is reeled in by No. 3 as the truck slowly *backs* to the control station. No. 6 walks along ahead of the truck, freeing the cable from any entanglements, and insuring that it is fed evenly to No. 3 on the

truck. At the control station the red cable is started on its reel, and it is reeled in by No. 6 as the truck slowly *backs* to the light. No. 3 continues to reel in the blue cable. The searchlight commander walks along ahead of the truck, freeing both cables, and insuring that they are evenly fed to the reels on the truck. On arrival at the searchlight, both red and blue cable reels are replaced in their traveling positions on the truck, and fastened in place by means of the hold-down devices.

g. At the searchlight position the yellow cable reel is moved to the rear of the truck. Nos. 3 and 6 reel in the yellow cables, assisted by the searchlight commander on the ground, as truck No. 2 slowly *backs* from the light to the power plant position. On arrival at the power plant, the full yellow reel is replaced in traveling position on the truck and fastened with the hold-down device.

h. At the power plant, Nos. 3 and 6 are joined by No. 4. No. 8 (the power plant operator) places the power plant in traveling condition (par. 108). Nos. 3, 4, 6, 8, and 10, supervised by the searchlight commander, load the power plant into the truck body, and fasten it in place by means of the hold-down devices.

i. The searchlight commander posts No. 8 as automatic rifleman in the rear of the truck body. The searchlight commander and Nos. 3, 4, 6, and 10 enter the cab, and the truck takes its place on the road behind truck No. 1, ready to move.

NOTE.—The automatic rifleman is relieved from time to time by other men on truck No. 2.

■ 140. DRILL FOR SEARCHLIGHT SECTION, MOBILE, WAR STRENGTH.—The drill for the searchlight section as given in this chapter and in chapter 8 is for a section (12 enlisted men) of a mobile searchlight battery at war strength. (T/O 4–18.)

■ 141. DRILL FOR SEARCHLIGHT SECTION, MOBILE, PEACE-STRENGTH.—Under the peace-strength organization only 11 men are authorized for a mobile unit. At this strength, one chauffeur (No. 10) is eliminated. The duties of No. 10 are assigned to No. 8 (power-plant operator). In this organiza-

tion, truck No. 2 is driven by No. 8 and is parked near the power-plant position. At EXAMINE EQUIPMENT, No. 8 devotes all his attention to the power plant, and No. 9 checks both trucks. (T/O 4–18.)

■ 142. DRILL FOR SEARCHLIGHT SECTION, SEMIMOBILE, WAR STRENGTH.—Under the war-strength organization only 10 men are authorized for a semimobile unit. At this strength both chauffeurs (Nos. 9 and 10) are eliminated. The duties of No. 9 are taken over by No. 7 (searchlight operator), and the duties of No. 10 by No. 8 (power-plant operator). As semimobile units are not designed to move rapidly and frequently, this adjustment can be made without great loss of efficiency. (T/O 4–118.)

■ 143. DRILL FOR SEARCHLIGHT SECTION, SEMIMOBILE, PEACE STRENGTH.—Under the peace-strength organization only 9 men are authorized for a semimobile unit. No. 4, the telephone operator, and Nos. 9 and 10, the two chauffeurs, are eliminated. No. 7 (searchlight operator) assumes the duties of No. 9, and No. 8 (power-plant operator) the duties of No. 10. The duties of No. 4 (telephone operator) are assumed by No. 3 (acoustic corrector operator). (T/O 4–118.)

SECTION IV

NOTES ON THE SERVICE OF THE PIECE

■ 144. GENERAL.—*a.* The service of the piece for antiaircraft searchlights *cannot* be conducted with the snap and precision of a formal drill. There are so many delicate mechanisms involved that an attempt greatly to speed up the operations of PREPARE FOR ACTION and MARCH ORDER will result only in a great number of matériel failures.

b. It will rarely be necessary to execute PREPARE FOR ACTION or MARCH ORDER with great speed. In all training, stress should be laid on the saving of time during the operation of locating and picking up the target—between the time a target is first heard and the moment it is picked up.

c. The service of the piece is conducted at ease and with as few orders as possible. Except for the necessary orders, reports, and instructions, no talking is permitted.

d. The service of the piece as described in the previous section and tabulated in the drill table, chapter 8, gives only an outline of the duties of each man at the various commands. A knowledge of what to do must be supplemented by continued practice until the unit can operate, if necessary, without commands. The procedure in locating, picking up, and carrying the target must become second nature if the platoon is to be capable of coping with multiplane attacks, pursuit-plane interference, and other stratagems of an attacking air force.

■ 145. MARCH ORDER.—It is necessary to exercise special care at MARCH ORDER, as this command is generally given at dawn, when crews are tired, hungry, and anxious to get back to bivouacs. Noncommissioned officers must exercise the supervision necessary to prevent damage to the matériel, both during the preparation of the matériel for the road and the securing of the matériel in the vehicles.

■ 146. COMMANDS AND SIGNALS.—Commands are given in the prescribed form, signals (buzzer, flashlight, or whistle) being substituted for commands wherever practicable.

■ 147. SAFETY PRECAUTIONS.—*a.* Searchlight operators should not enter the light when the main arc switch is on. When entering the light and the parts of the light are heated, the operator should be fully clothed and should wear gloves to avoid injury.

b. Crews loading and unloading the light and power plant on and off the trucks must keep clear of the equipment being loaded, so that no one will be hurt if a block and tackle, winch, or cable fails.

■ 148. HANDLING EQUIPMENT.—*a.* Since much handling of equipment takes place under cover of darkness, special care must be exercised to avoid injury to personnel and damage to matériel.

b. As soon as matériel is unloaded from trucks it should be moved off the road. Matériel disassembled for loading should not be left in the road unless under guard. Cables should be thrown to the side or off the road so as to avoid

damage by vehicles; tractors or tanks passing over a cable will completely destroy it.

c. Chauffeurs must exercise special care when moving without lights to avoid damage to equipment or injury to personnel. When backing the truck, the chauffeur should be assisted by another member of the crew who walks in advance of the truck.

■ 149. ACTION ON THE MARCH.—*a.* Members of the searchlight section are given instructions relative to the action to be taken if attacked while on the march. A single searchlight unit is *not* a profitable target for low-flying light bombardment aviation, but units the size of a platoon or larger are profitable targets.

b. The two automatic riflemen are kept on the alert whenever the unit is on the road. In truck No. 1, the automatic rifleman riding in the forward end of the truck body overlooking the cab keeps watch to the front and sides. In truck No. 2, the automatic rifleman riding in the rear end of the truck body keeps watch to the rear and sides. When the unit stops along the road, the riflemen leave the trucks and take position where they can best defend the unit. On arrival at the bivouac area, the riflemen stay on guard until all trucks are under cover and they are dismissed by the chief of section. For further details see FM 25–10.

■ 150. FALL OUT.—At drills and practice and in the field when ample warning of the approach of targets may be expected, the platoon commander may give the command FALL OUT. At this command all members of the section may leave their posts except the telephone operator who remains within hearing of the telephone bell or buzzer.

■ 151. DISMISSED.—When searchlights are to occupy the same positions on successive nights, the platoon commander at daylight gives the chiefs of section instructions as to the securing of equipment, posting of guards, or use of vehicles as may be necessary, and commands: DISMISSED. The personnel of the platoon is assembled at its bivouac, usually with that of the gun battery, for meals and rest.

CHAPTER 7

MAINTENANCE

■ 152. SCOPE.—Maintenance includes inspections, cleaning, servicing, lubrication, and tightening. For motor vehicles, this subject is discussed in detail in FM 25–10. Much of the information given in that manual will apply to the power plant.

■ 153. INSPECTIONS.—*a.* The chauffeurs of vehicles should make periodic inspections as discussed in FM 25–10. These inspections should be made with the idea of finding and correcting defects so as to prevent the break-down of equipment while operating.

b. Power-plant operators inspect their power plants closely following the prescribed routine for motor-vehicle drivers as given in FM 25–10.

c. Inspections of the searchlight should include a check on the—

(1) Tires.
(2) Leveling jacks and bubble tubes.
(3) Traversing mechanism and azimuth lock.
(4) Elevating mechanism and transportation bar.
(5) Carbons.
(6) Positive and negative heads.
(7) Thermostat lens.
(8) Fan motor.
(9) Mirror.
(10) Front door glass.
(11) Lamp control box.
(12) Ground glass finder.
(13) Extended hand control.
(14) Main arc switch.
(15) Rotary converter.

d. Inspections of the control station should include a check on the—

(1) Binoculars.
(2) Fit of the binoculars in the binocular mount.

(3) Binocular mount (including azimuth and elevation slip clutches).
(4) Elevation drive (including slip clutch).
(5) Azimuth drive (including slip clutch).
(6) Distant electric control (with power on).
(7) Zero reader system (with power on).
(8) Level screws and bubble tubes.

154. GENERAL CARE OF SEARCHLIGHT.—*a.* The searchlight, particularly the lamp mechanism and mirror, should be protected against damage from dust and dirt. It should be maintained in serviceable condition in accordance with the best electrical and mechanical equipment practice.

b. All exposed surfaces of insulation should be kept free from oil, grease, dust, or moisture.

c. All electrical contacts should be kept clean and bright and free from oil, grease, dust, or moisture. Particular attention should be paid to motor commutators and collector rings. A check should be made to insure that all brushes ride freely in their holders and that they are held by sufficient pressure in order to minimize sparking.

d. Carbons must be kept dry and protected against any jarring that might crack the carbons or their cores. Until required for use, the carbons should be kept sealed in their containers to prevent absorption of moisture. This requirement pertaining to cracked carbons should be considered during the lamp operating period as well as during the handling period indicated above. If a positive carbon protruding beyond the plane of the front door should be hit accidentally, the operator should assure himself that the carbon has not broken between its feed rollers and brush contacts.

155. CLEANING SEARCHLIGHT.—*a.* After every *third* change of carbons: Clean the negative contact surfaces by wrapping a piece 00 sandpaper once around a negative carbon stub and working the stub back and forth in the negative head, with minimum practicable pressure between the negative contacts. Use the abrasive only to the extent of brightening the surfaces. After cleaning be sure to wipe off all sand that might be deposited.

b. After every *tenth* change of carbons: Clean the positive contact surfaces. Remove the positive contacts or brushes from the lamp by releasing the spring retainer hook from the upper positive brush, and then removing the current-carrying ribbons for both brushes from the positive casting.

The contact blocks can then be removed and polished by working a positive carbon stub, wrapped with a layer of 00 emery paper or cloth back and forth through them until the inside surfaces are clean. Use the abrasive only to the extent of brightening the surfaces. After cleaning wipe off all dust that might be deposited. When replacing the ribbons, polish the surfaces where they make contact with the positive main frame casting and be sure that they are tightly fastened at that location.

c. After every *10 hours* of operation:

(1) If the lamp has been lubricated with a graphite and oil mixture, the procedure in (2) below applies. That procedure will be unnecessary if the lubricant described in the operator's manual is used.

(2) Place a few drops of a mixture of equal parts of machine oil and kerosene on the bearings and gears in the lamp mechanism. This mixture of oil and kerosene loosens the hardened graphite and carries it into the bearings.

(3) Clean off any dust or dirt that may have gathered on the thermostat lens. Use only a soft cloth which is free from lint.

d. After every *50 hours* of operation:

(1) After 50 hours of operation and not less frequently than once every 2 months, the entire lamp mechanism should be washed thoroughly with gasoline to remove all hardened graphite. Let the gasoline evaporate and relubricate the wearing parts as directed in paragraph 156. This cleaning is not necessary if the lubricant described in the operator's manual is used.

(2) Clean all motor brushes by removing them and washing them in gasoline. Make sure the brushes slide freely in their holders when replacing them.

e. Due to the irregular periods of operation and the variation of location, no periodic cleaning schedule can be de-

veloped for the following parts. However, they can be readily inspected and cleaned when necessary.

(1) Clean the thermostat contact points as follows (under supervision of noncommissioned staff officer):

(*a*) Disconnect the two wire leads from the thermostat terminal block and then remove the thermostat holding bolts. Take the thermostat out of the drum and place it on a suitable flat surface, preferably a desk or workbench.

(*b*) Remove the four cover screws and the cover.

(*c*) Loosen the nuts holding the two terminal block screws and disconnect the wires.

(*d*) Unscrew the two contact assembly holding screws and remove the contact assembly.

(*e*) Clean the points with crocus paper, being very careful not to bend the contact arms and to avoid excessive rubbing with the abrasive. When finished cleaning, draw a piece of white paper between the contacts to wipe off any abrasive that might be left on the points.

(*f*) Reassemble the thermostat and replace in its position in the drum in the reverse order to that described above.

(2) The supply and control slip rings should be kept clean and bright using 00 sandpaper when necessary. Access to these rings is through the handhole plate in the top of the base.

(3) The elevation and azimuth zero reader follow-up system slip rings should be kept clean and bright. Access to these rings is through the covers of their respective housings.

(4) The drum should be cleaned to prevent an accumulation of carbon dust or other dirt. Keep the inside of the drum dry.

(5) Do not allow dust or dirt to accumulate on the lens of the ground glass finder. When cleaning, use only a soft cloth which is free from lint.

(6) As its reflecting surface is of precious metal, extreme care should be employed in cleaning the metal mirror. It should be cleaned only with the solution especially prepared for the purpose by the manufacturer. Directions for its use are provided with the solution. Only clean cotton pads should be used for applying and removing the cleaning agent. Do not allow this solution or other moisture or dust

to accumulate on the mirror supporting clips. Before using the cleaning agent, and also at times as determined by inspection, accumulations of dust on the mirror should be removed with the camel hair brush supplied. Use the brush *lightly* in order to avoid scratching the polished surface. Never wipe the mirror with a rotary motion. Pass the pad over the surface of the mirror in a radial direction from the center toward the rim.

■ 156. LUBRICATION OF SEARCHLIGHT.—*a. General.*—Due to the fact that the searchlight is operated at irregular intervals and under wide variations of climatic conditions, it is impossible to state the exact intervals of time which should elapse between successive oilings. The various parts of the equipment should be oiled as necessary. Applying an excessive quantity of oil must be avoided, especially where a film of carbon dust might form and cause a breakdown of the electrical insulation. From time to time any excess oil and grease that may work out of the parts should be wiped off the operating and control mechanisms, special attention being given to the edges of the insulating plates on the lamp. Make sure that there is never any oil or grease on motor brushes, brush holders, commutators, or field coils. Never put oil or other lubricant on the slip rings and slip ring brushes in the base nor on any other electric conducting surfaces. The parts should be lubricated as instructed below.

b. (1) If the lubricant described in the operator's manual cannot be obtained, the lamp may be lubricated with powdered graphite thinned with sufficient oil to make the lubricant run into the bearings. Never use plain machine oil on the bearings of the lamp, because at the high operating temperature of this equipment it would quickly vaporize and leave a deposit which in time would cause the bearings to bind. When the lubricant described in the operator's manual is used, it should be applied when the lamp heads are hot, by means of the spray gun to be found in the spare parts box. Particular attention will be paid to the lubrication of all pinions, gears, and universal joints of the positive and negative heads.

(2) The *blower motor bearings* are accessible after removing the blower motor and ventilation fan housing. They are grease-sealed bearings and do not require frequent attention. A small quantity of medium motor oil should be added at the time the motor is inspected for condition of brushes, brush holders, commutator, etc.

(3) The *feed motor bearing* ((24), fig. 11) should be oiled with a good grade of light machine oil. The oil point is painted red and covered over by a small protective cap. The ball bearing at the drive end receives grease from the worm gear housing. As this motor is located on the drum, lubrication of its ball bearings should be given frequent attention.

(4) The *feed motor worm gear housing* (near (235), fig. 11) should be filled with a suitable high temperature grease which can be applied by removing the cover.

(5) The *feed mechanism bearings* contained within the control box located on the side of the drum should be lubricated by placing a few drops of light machine oil in the oil holes provided (near (22) and (235), fig. 11). These holes, which are marked with red paint, are accessible when the door of the control box is opened.

(6) The *eccentric, fork, and pawl guide* is oiled normally through the hole under (6), figure 11, using light machine oil.

(7) The *trunnion bearings* located at the upper end of the trunnion arms are greased by means of alemite fittings. The fitting on the right trunnion arm is clearly marked by red paint. The left trunnion arm bearing does not have an alemite fitting and may be greased only after removing the elevation data receiver housing and associated bearing plate.

(8) The *azimuth bearings,* on which the trunnion arms' unit is pivoted, are packed with grease when the searchlight is assembled at the factory and need not be supplied with additional grease for several years.

(9) The *chassis steering gear bearings* are greased by means of standard alemite fittings. These fittings are all easily accessible.

(10) The *elevation control mechanism* located on the right trunnion arm should be greased through the alemite fitting provided (marked with red paint).

(11) The *azimuth worm housing* located between the azimuth gear in the base and the azimuth control motor should be greased occasionally through the alemite fitting provided.

(12) The *azimuth and elevation control motors* ((49) fig. 11) are provided with oil holes covered by plug caps. Remove these caps and oil the bearings occasionally with a good grade of medium motor oil.

(13) The *dynamotor (rotary converter) bearings* are accessible after removing the cover plates at each end of the machine. These bearings are packed with grease which should be replenished occasionally as determined by inspection. (See (328), fig. 21.)

(14) The *chassis wheel bearings* are packed with grease at the factory and will not need much attention as they are grease-sealed. The outside bearings are accessible after removing the hub cap and bearing cap. To grease the inner bearings remove the thrust bolt and wheel from the axle.

c. The bearings not mentioned in *b* above have been checked and greased at the factory and will probably not need any additional attention for the life of the equipment.

■ 157. TIGHTENING OF BOLTS, NUTS, AND SCREWS.—There is little likelihood that nuts, bolts, or screws will work loose during the actual operation of the searchlight. However, while being transported, the searchlight parts are subjected to stresses which may cause some nuts and screws to become loose. It is important that a check be made periodically and that loose parts be tightened. This check should be made at the end of a rough trip and after every 500 miles of transport. In tightening, excessive pressure should not be applied on the tightening wrenches or tools so as to strip threads, deface the nut surfaces, or mar screw slots.

■ 158. CLEANING OF CONTROL STATION.—*a.* All working parts of the control station are inclosed except the azimuth gear and pinion which should be cleaned with a brush and gasoline every month. These latter parts should not be greased

as greasing will cause dust to gather in the gear teeth. Alcohol should be used for cleaning the elevation and azimuth transmitter rings. If these rings are rough, smooth them with 00 sandpaper.

b. The *contacts* on top of the tripod and those on the under side of the control unit should be cleaned with alcohol as needed.

c. The *slip ring and brush assemblies* in the tripod are accessible after removing the handhole cover plates ((219), fig. 10). The brush assemblies (not the individual brushes) should be removed to clean the slip rings. These rings should be cleaned with alcohol every 6 months.

d. The *distant electric control transmitter rings and segments* should be cleaned with alcohol every 3 months. Use 00 sandpaper, if necessary, to clean any burned spots.

e. (1) If the cover has been removed a number of times in the field, the control unit should be given a general dusting and cleaning.

(2) All electrical contacts should be clean and bright. Clean these contacts with alcohol where necessary. Wipe off all contacts carefully after using an abrasive (00 sandpaper). Do not permit oil to gather on the insulation.

(3) About once a month extend the column to its maximum height and clean off any dirt or foreign material that may have accumulated.

(4) If the apparatus is used in a warm or tropical climate, remove the cover about once a month and clean, removing all moisture and any sign of fungus growth.

■ 159. LUBRICATION OF CONTROL STATION.—Due to the fact that most of the control unit mechanism bearings are grease-sealed at the factory, little attention to these parts will be required. When the control unit cover is removed for cleaning operations, the gear teeth and bearings should be inspected and a few drops of light machine oil applied as necessary.

■ 160. CLEANING OF SOUND LOCATOR, M2.—*a.* (1) The surface of the metal sight mirror should not be cleaned any oftener than necessary because of the danger of scratching the highly polished surface. However, dust which settles on

this surface may be removed by absorbent cotton. If the mirror becomes greasy, it may be cleaned with absorbent cotton moistened with alcohol.

(2) In the event that the mirror surface becomes exceptionally dirty during servicing or field operations, the surface may be cleaned by mixing 3 ounces of precipitated chalk with 8 ounces of a good grade of denatured alcohol. Place a small amount of this mixture on a piece of absorbent cotton which has been previously moistened with alcohol, and rub lightly over the surface of the mirror using a circular motion. After the paste is partly dry, remove with clean, dry, absorbent cotton. Precipitated calcium carbonate may also be used for this purpose.

b. Surfaces of the slip rings should be inspected periodically and, if necessary, cleaned with alcohol and a soft cloth.

c. The rubber eye-shield on the sight should be removed periodically, washed in lukewarm water, and dusted over with French chalk or equivalent as a preservative.

d. The horns and acoustical system should be kept free of water, dirt, or other foreign matter at all times. This does not mean that the equipment may not be used during rain, but that it should be checked prior to packing or storage.

e. Plugs and receptacles should be kept clean and when not in use should have their protecting caps bolted on tightly.

■ **161. Lubrication of Sound Locator, M2**—*a.* Referring to figure 34, points (38) are lubrication points. Periodic inspection and lubrication will insure proper functioning of the equipment. It is recommended that light machine oil be used for this purpose.

b. Points (40) and (41), figure 34, indicate chain drives for operating the pantograph drive assembly. Periodic inspection and greasing of these chains should be made to insure proper operation. Removal of the cover plate will provide access to this section.

CAUTION: Care should be exercised to prevent application of too much grease during this operation, to lessen any

possibility of the excess lubricant being thrown onto the slip ring assembly.

c. Differential gears and ball races have been lubricated at the factory and no attention need be given these points except by authorized ordnance personnel during overhaul periods.

CAUTION: Particular care should be taken to prevent inclusion of any foreign matter within the main case during servicing operations.

d. All operating personnel should be cautioned against tampering with the mechanisms of the sound locator, especially those of the corrector drive assembly and the pantograph drive assembly.

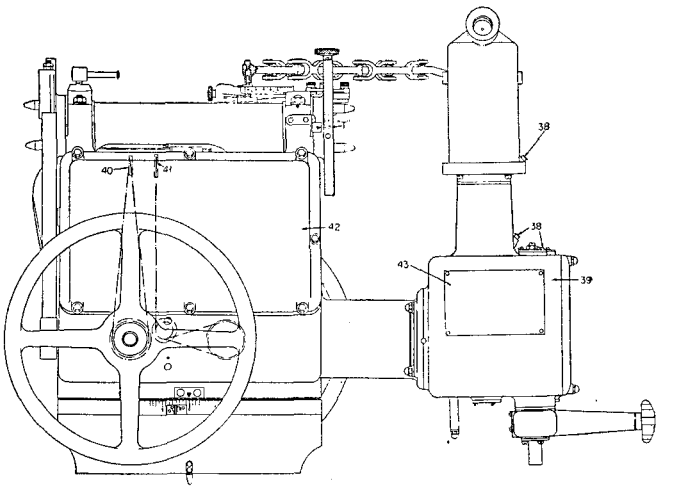


FIGURE 34.—Lubrication, sound locator, M2.

■ 162. LUBRICATION FOR POWER PLANT.—*a.* The more important points of lubrication and the methods are given in *b* below. (See fig. 35.) More detailed instructions will be found in the instruction manual for the particular power plant concerned.

b. (1) *Air cleaner.*—Clean once every week or more frequently if operated in dusty or insect laden atmosphere.

(2) *Charging generator.*—Add only 2 or 3 drops of light oil every 50 hours of operation.

(3) *Distributor.*—Add a few drops of light oil every 50 hours of operation.

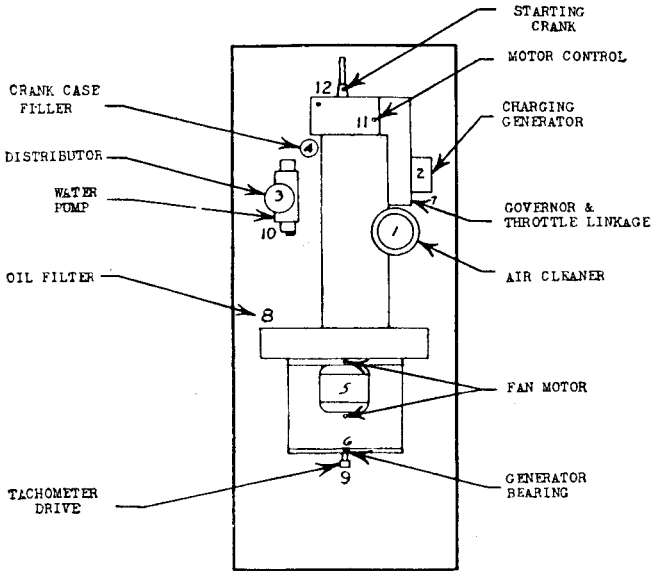


FIGURE 35.—Power plant lubrication chart.

(4) *Engine crankcase.*—Check and maintain oil level between the three-fourths and full mark.

(5) *Fan motor bearings.*—Add a small amount of cup grease every 6 months.

(6) *Generator bearings.*—Add a small amount of cup grease as required.

(7) *Governor linkage.*—Add a few drops of light oil every 50 hours of operation to ball joints and other moving parts.

(8) *Oil filter.*—Change the filter cartridge as soon as black streaks appear in the oil.

(9) *Tachometer drive.*—Add cup grease every 6 months.

(10) *Water pump.*—Give grease cup one turn every 50 hours of operation.

(11) *Motor control.*—Add a few drops of light oil to solenoid hinge pins every 50 hours of operation.

(12) *Starting crank.*—Add a few drops of light oil when required.

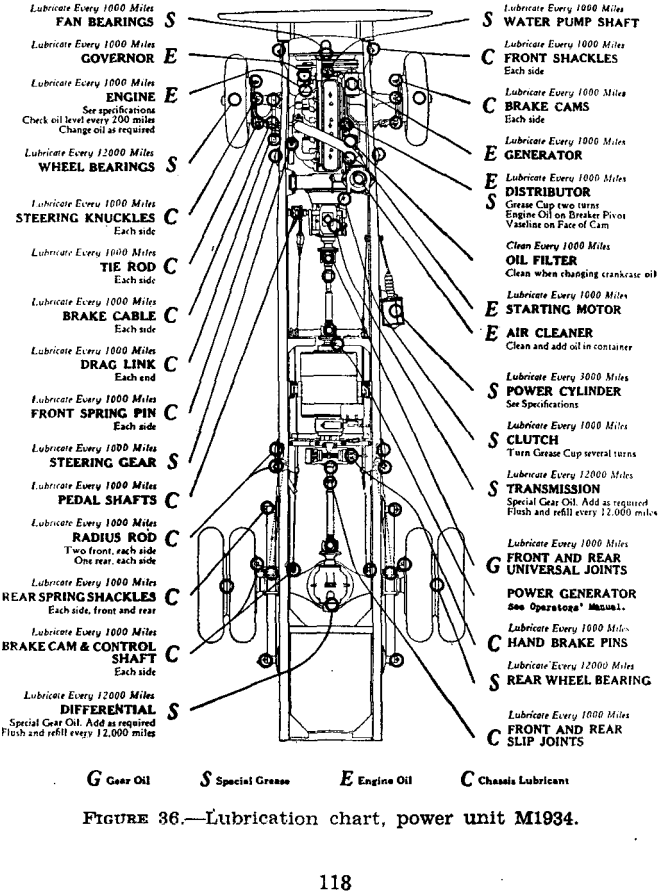


FIGURE 36.—Lubrication chart, power unit M1934.

■ '163. LUBRICATION OF VEHICLES.—*a.* Searchlight vehicles should be lubricated according to instructions issued by their makers in the handbook pertaining to the vehicle. Methods of lubrication and types of lubricants are given in FM 25–10. A specimen lubrication chart for the M1934 power unit (truck) is shown in figure 36.

b. Where practical, lubrication is performed by a central agency using power guns. When lubrication must be performed by platoon personnel in the field, the hand gun must be used. It is important that lubrication be performed at frequent intervals, when using the hand gun, in order to keep old grease from hardening in the bearings and preventing the entrance of new grease.

c. The proper grease and oil as recommended in the vehicle's handbook should be used for each fitting. Avoid mixing different brands of oil and grease.

d. In cases where no lubrication chart or instructions are available, use one for a vehicle of similar type.

APPENDIX

LIST OF REFERENCES

■ 1. GENERAL REFERENCES.

Aerial sound ranging	FM 4–111
Automatic rifle	FM 23–20
Camouflage and protective measures	FM 4–105 FM 5–20
Care of matériel	FM 4–120
Chemical attack, defense against	FM 21–40
Commands	FM 4–105
Communications	FM 24–5 FM 4–105
Distance between lights, and lights and listening posts	FM 4–105
Examination for gunners	FM 4–150
Formations	FM 4–120
Inspections	FM 4–120
Motor transportation	FM 25–10
Organization	FM 4–105
Reference data	FM 4–155
Service of matériel	FM 4–120
Tables of Organization:	
Mobile	T/O 4–18
Semimobile	T/O 4–118
Tactical employment of searchlights	FM 4–105
Tactics and Technique of the Chemical Warfare Service	FM 3–5 (now published as CWSFM, vol. I)
Theory of illumination and sound location	FM 4–111
Training	FM 4–160
Training publications, list of	FM 21–6

■ 2. REFERENCES APPLYING TO PARTICULAR MATÉRIEL.—*a.* For instructions for the following matériel, see the operator's manual which is issued with the equipment:

(1) *MVI unit.*—Antiaircraft searchlight, 60-inch mobile type.

(2) *M1934 unit.*—(*a*) Searchlight and control station, 60-inch antiaircraft searchlight, mobile and portable, M1934.

(*b*) Mobile power plant.

(*c*) Portable power plant.

(3) *M1937 unit.*—60-inch antiaircraft searchlight equipment, M1937.

(4) *M1939 unit.*—60-inch antiaircraft searchlight equipment, M1939.

(5) *Sound locator, M2.*—Instructions pertinent to the sound locator, M2, are also included in TM 9–360.

b. Sound locator, M1A1 to M1A8.—See "Notes on Matériel, Sound Locators, M1 Series—Ordnance Department, U. S. Army, Frankford Arsenal, February 1936."