RESTRICTED

FM 4–176

WAR DEPARTMENT

ANTIAIRCRAFT ARTILLERY FIELD MANUAL

SERVICE OF RADIO SET SCR–268

30 December 1943

Dissemination of restricted matter.—The information contained in restricted documents and the essential characteristics of restricted material may be given to any person known to be in the service of the United States and to persons of undoubted loyalty and discretion who are cooperating in Government work, but will not be communicated to the public or to the press except by authorized military public relations agencies. (See also par. 18*b*, AR 380–5, 28 Sep 1942.)

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BY ORDER OF THE SECRETARY OF WAR:

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

TABLE OF CONTENTS

	Paragraphs	Page
CHAPTER 1. General.		
SECTION I. General	1–3	1
II. Instrument	4–5	2
III. Simplified explanation	6–7	3
IV. Functions of SCR–268	8	5
CHAPTER 2. Installation.		
SECTION I. Location of units	9–12	6
II. Assembly of mounts K–28–A and K–28–B	13–16	8
III. Assembly of mount K–28–C	17–23	22
CHAPTER 3. Antenna alignment.		
SECTION I. General	24–25	27
II. Antenna theory	26–27	27
III. Lobe separation	28–29	28
IV. Azimuth antenna alignment	30–37	32
V. Elevation antenna alignment	38–52	39
VI. Final check of alignment	53–54	47
VII. Summary	55–61	48
CHAPTER 4. Operation with the AA searchlight.		
SECTION I. General	62–68	49
II. Orienting and synchronizing 1941 searchlights in azimuth	69–74	56
III. Orienting and synchronizing 1941 searchlights in elevation	75–79	58
IV. Orienting and synchronizing 1941 searchlights by backsighting	80–84	59
V. Orienting and synchronizing 1941 searchlights in azimuth when control station is not used	85–89	61
VI. Orienting and synchronizing 1941 searchlights in elevation when control station is not used	90–93	62
VII. Orienting and synchronizing 1942 General Electric amplidyne system in azimuth	94–99	63
VIII. Orienting and synchronizing 1942 General Electric amplidyne system in elevation	100–104	66
IX. Orienting and synchronizing 1942 General Electric amplidyne system by backsighting on equipment	105–113	68
X. Summary	114	71
XI. Determination and application of corrections by tracking targets	115–117	72

	Paragraphs	Page
CHAPTER 5. Operation with antiaircraft gun director.		
SECTION I. General	118	75
II. Special antenna adjustments	119–120	76
III. Range system	121–127	77
IV. Orientation and synchronization with AA director M4 and M7	128–133	80
V. Determination and application of corrections	134–138	87
CHAPTER 6. Operation.		
SECTION I. General	139	90
II. Adjustments for operation	140–149	90
III. Detection of targets	150–152	103
IV. Tracking	153–155	106
V. Closing station	156	107
CHAPTER 7. Employment.		
SECTION I. General	157	110
II. Fighter-searchlight team	158–163	110
III. Firing at unseen targets	164–169	115
IV. Aircraft warning	170	120
CHAPTER 8. Service of instrument.		
SECTION I. Duties of personnel	171–172	121
II. Preliminary commands and formations	173–177	122
III. Drill of the mount	178–191	124
IV. Notes on service of instrument	192–197	133
APPENDIX I. Electrical dangers and first-aid treatment		136
II. Cables		144
III. Lubrication and maintenance		150
IV. Table of weights		173
V. Glossary of terms		174
VI. Destruction of matériel		177
VII. List of references		181
INDEX		183

ANTIAIRCRAFT ARTILLERY FIELD MANUAL

SERVICE OF RADIO SET SCR–268

(This manual supersedes FM 4–145, 5 April 1942, including C 1, 17 December 1942, and C 2, 25 January 1943.)

CHAPTER 1

GENERAL

	Paragraphs
SECTION I. General	1–3
II. Instrument	4–5
III. Simplified explanation	6–7
IV. Functions of SCR–268	8

SECTION I

GENERAL

1. SCOPE.—This manual contains a general description of radio set SCR–268 and modification SCR–268–B with mounts K–28A, K–28B, and K–28C. Included in the manual is a discussion of the service of the instrument, the operation and employment of the equipment, and the duties of the personnel required for the operation. Since the SCR–268 is employed with antiaircraft weapons, a general knowledge of the problems of antiaircraft, as covered in field manuals pertinent to that equipment, should be understood. FM 4–110 and FM 4–121 (when published) cover the gunnery problem; FM 4–106 covers the fighter-searchlight team problem, and FM 4–175 covers the searchlight problem.

2. REFERENCES.—The various references listed in appendix VII should be studied in connection with this manual. Detailed instructions for operation and maintenance of the equipment will be found in instruction manuals issued with the set.

3. WARNING.—VOLTAGES SUFFICIENT TO CAUSE DEATH ON CONTACT ARE USED IN RADIO SETS SCR–268 AND SCR–268–B. EXTREMELY DANGEROUS

POTENTIALS EXIST THROUGHOUT THE UNITS. ALL POSSIBLE PRECAUTIONS MUST BE TAKEN TO INSURE THE SAFETY OF PERSONNEL WHEN THE POWER IS TURNED ON. FIRST AID TREATMENT FOR ELECTRICAL SHOCK, AS COVERED IN APPENDIX I, SHOULD BE INCLUDED AS ROUTINE INSTRUCTION FOR THE OPERATING PERSONNEL.

SECTION II

INSTRUMENT

■ 4. GENERAL.—*a.* The SCR–268 consists of two trailers. The first trailer is the K–34–B or power van. This van contains the generator unit and the rectifier unit. The second trailer is the K–28–A, usually called the mount. This trailer contains, in general, the transmitting and receiving units.

b. The SCR–268–B, however, consists of five units as shown in figure 1. The first unit is the power van and the prime

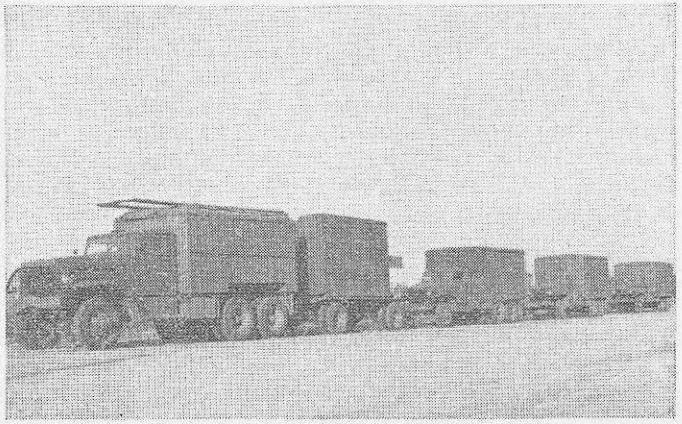


FIGURE 1.—SCR–268–B in traveling position. The fourth truck (shop truck) is not issued to all units.

mover for the second unit, the mount trailer K–28–A, K–28–B, or K–28–C. The third unit is the rectifier unit, the fourth is a carrying unit for a portion of the equipment, and the

fifth unit is a traveling workshop in which repairs to the equipment can be made in the field.

c. The differences given above are the only variations between the two sets. Once the unit is set up, the theory and operation are identical.

■ 5. COMPONENTS.—*a.* Basically, the SCR–268 can be broken into its operating systems. These are the transmitting system and the receiving system.

b. The transmitting system can be further divided into four component parts as shown in figure 2.

c. The receiving system can be further divided into six component parts as shown in figure 2.

d. A table of weights of various units is given in appendix IV.

SECTION III

SIMPLIFIED EXPLANATION

■ 6. GENERAL.—The present optical system of locating and tracking aerial targets, though accurate if the target is visible, has inherent limitations which have led to the development of radio units as detectors and trackers. The SCR–268 is one of many effective developments made to function unimpaired by smoke, haze, clouds, and darkness. It locates the target and can continuously supply present azimuth and angular height to the searchlights, enabling them to make long range pick-ups. Although not primarily designed as a gun-laying radar, the SCR–268 will also continuously supply present azimuth, angular height, and altitude to mechanical and electrical directors, enabling them to compute firing data for fire at unseen targets. If at any time the target becomes visible, it can be tracked optically at the director itself.

■ 7. PRINCIPLES OF OPERATION.—The SCR–268 generates a radio signal of short duration known as a pulse, and sends it out through a transmitting antenna which concentrates the waves into a beam. The signal will reflect from metallic objects, or other objects of considerable density and the reflection will return to the set where it is picked up by the

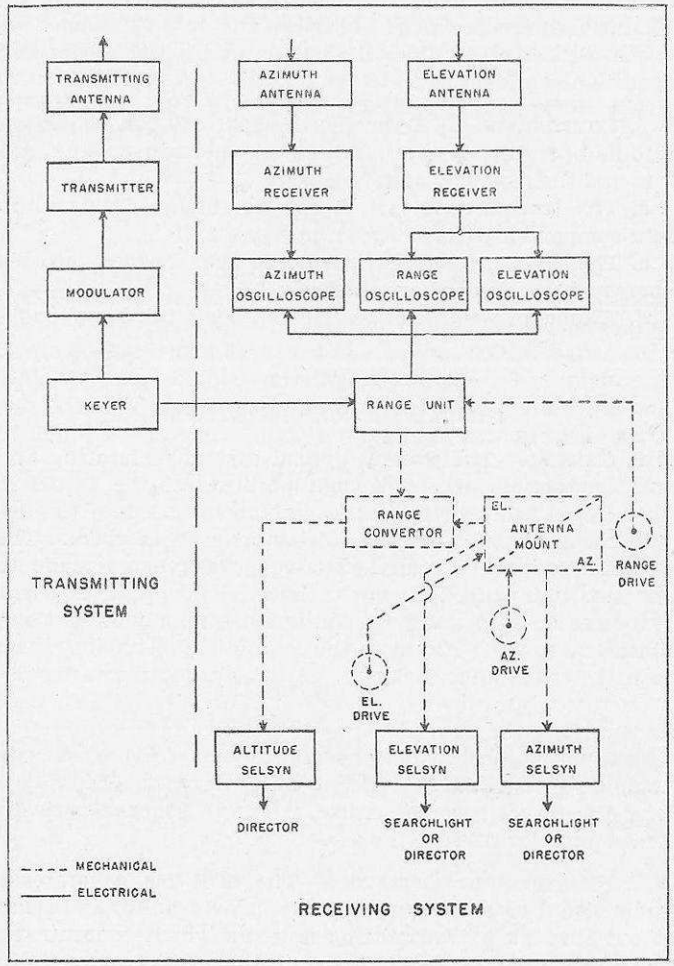


FIGURE 2.—Component diagram.

elevation and azimuth antennas. The azimuth and elevation trackers will see the echo as two peaks on the base line of their scopes. When these peaks are equal in height, the set is directed at the object causing the echo. The range operator sees the echo as a single peak and when this peak is under the hairline, the range unit is reading the correct range.

SECTION IV

FUNCTIONS OF SCR–268

■ 8. FUNCTIONS OF THE SCR–268.—The SCR–268 may be used as follows:

a. To direct a searchlight on a target until the target has been observed visually and the control taken over at the searchlight control station, at which time the SCR–268 may resume its search for other targets.

b. To warn of the approach of distant aircraft or surface ships.

c. To direct the telescopes of the gun directors on the target in order to assist the operators in making a distant pick-up.

d. To measure slant range and compute altitude when this element of data is used by the director and a height finder is not available.

e. To provide the directors with a continuous flow of azimuth, angular height, and altitude data for targets which are not visible because of darkness or adverse atmospheric conditions.

f. To provide data for plotting the course of a target, in order that fire may be directed upon it at a predicted time.

g. To follow the course of friendly aircraft, in order to direct them to an enemy target such as aircraft or ships.

CHAPTER 2

INSTALLATION

	Paragraphs
SECTION I. Location of units	9–12
II. Assembly of mounts K–28–A and K–28–B	13–16
III. Assembly of mount K–28–C	17–23

SECTION I

LOCATION OF UNITS

■ 9. GENERAL.—*a.* The location of the SCR–268 is very important if it is to be used effectively with searchlights, guns, or intelligence net.

(1) The general location is determined by the tactical situation. The director or searchlight should be located close to the SCR–268, and must be considered in selecting a site.

(2) The site will affect the electrical performance of the SCR–268. Great care must be given in satisfying the electrical requirements or the set will not function satisfactorily.

(3) It is desirable that the position should lend itself to camouflage and yet permit maneuverability.

b. Very seldom does a position satisfy all of the above requirements. Therefore, battery commanders, range officers, and chiefs of sections must utilize a great deal of initiative in an attempt to satisfy, as nearly as possible, these requirements.

■ 10. TACTICAL LOCATION.—*a.* When used with searchlights, the SCR–268 should be approximately 50 feet from the light. With the SCR–268 50 feet from the searchlight, the parallax at 5,000 yards is less than 4 mils, which is considered negligible.

b. When used with guns, the SCR–268 is located as close to the director as possible without violating the principles of dispersion or interfering with the function of that unit. Limits of the parallax correction on the director, that is, 500 yards N-S and 500 yards E-W, restrict the distance of the SCR–268 from the guns.

c. In an AAAIS system, the radar units must be so located as to give complete coverage of the area. This allows considerable freedom for individual units to comply with the electrical requirements.

■ 11. ELECTRICAL PERFORMANCE.—*a.* The most serious electrical interference arises from other sets in the area or from echoes from objects other than aircraft such as mountains, gas tanks, water tanks, metal towers, ships, or any other objects presenting a considerable density to the line of sight from the locator.

b. Objects located closer than 2,500 yards do not give trouble as interfering echoes. This means that hills, knolls, or small rises within 2,500 yards, may be used to shield the SCR–268 from interfering echoes. In general, if the defilade is sufficient to prevent seeing a source of interference, the interference is greatly reduced and may even be eliminated. However, such defilade also prevents a target from being picked up below the angle of defilade which is measured from the top dipole of the antenna.

c. The terrain should be reasonably level for 100 yards around the mount. The power plant, rectifier, and other trucks should be parked in the rear of the normal sector to be searched. Thick growths of trees, metal buildings, steel towers, and power transmission lines will affect the intensity of the transmitted energy or the received echo energy.

d. The transmitting frequency may be changed slightly by competent personnel to reduce and possibly eliminate interference from other radar units, if this condition cannot be eliminated through choice of position.

e. Inaccuracy in elevation tracking results when the antenna is depressed below approximately 300 mils. This is caused by ground reflections of the received signal. Because of this inaccuracy, care must be exercised to avoid locations where hills form defilade greater than a few degrees. The low limit of accurate elevation tracking is the angle of defilade plus approximately 25°. Search is still possible down to the angle of defilade or below. The minimum elevation that will give satisfactory operation should be used.

f. Each position must be tested before final acceptance.

12. CAMOUFLAGE.—In addition to the above requirements, maneuverability and camouflage must be kept in mind. Easy access to and from a chosen location pays dividends when time becomes a vital element. Protection must also be afforded against bomb fragments and automatic weapons fire. The camouflage problem bears considerable weight in choice of position. Cable lengths limit the dispersion of units, and the number of vehicles in the case of SCR–268–B makes the camouflage problem difficult. Camouflage as covered in FM 5–20 should be used as a guide.

SECTION II

ASSEMBLY OF MOUNTS K–28–A AND K–28–B

13. GENERAL.—Whenever the SCR–268 is to be moved from one location to another, all components must be disassembled and fastened in their assigned places for travel. The unit therefore arrives at its new destination in a packed condition (fig. 3) and must be reassembled. A great many of the operations described can be performed simultaneously, and experience will in time indicate a faster and more efficient system of procedure.

14. UNPACKING.—Pull the mount into position, set the handbrake, disconnect it from the prime mover, and drive the prime mover to its operating position. When unpacking the components, the position and placing of each component is carefully noted, particularly the method of fastening. This study is an invaluable aid later in packing the units of the set for transportation. To prevent loss, all bolts are placed back in their respective holes and the nuts and washers replaced.

15. STRIPPING MOUNT TRAILER.—*a. Framework.*—The antennas are packed on each side of the trailer and are covered with canvas covers laced with ropes (fig. 3). All members of the section assist in unfastening and removing these ropes. They then remove the canvas covers, fold and carry them to the spot chosen for placing equipment, and lay them on the ground. Each set of antenna is protected by a wooden framework attached to iron frames. This framework is

taken off by first removing the bolt fastening the frame to the center column. The bolts holding the lower inside slats to the framework are removed and the slat is taken out. Next the bolts fastening the end frame to the mount platform are removed; then the framework is removed and placed in the equipment area as an entire unit. This is done by raising the frame about 3 feet, moving it forward and outward to clear the antenna, and then carrying it back until it clears the mount. The same procedure is used on the opposite side of the mount for the other antenna. Extreme caution must be taken in each step of the above procedure

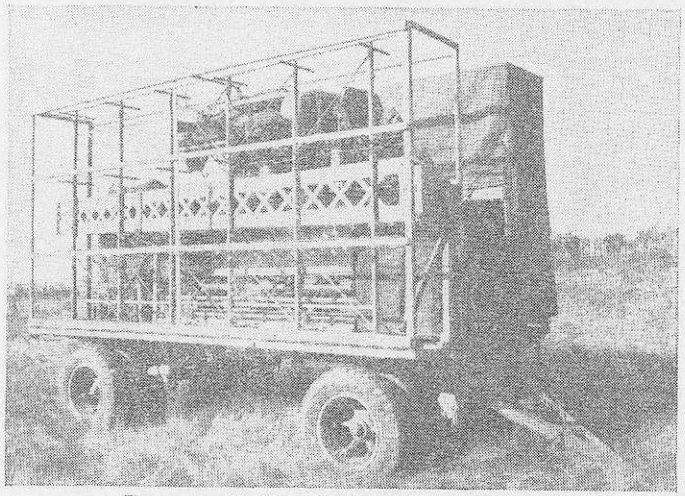


FIGURE 3.—K–28–A with one cover removed.

to safeguard the antenna. A dropped wrench or a slight jar of the framework might result in broken dipoles or insulators.

b. Azimuth and transmitting antenna.—For assembling the antenna, improvised X-supports (fig. 4), are placed conveniently near the mount. In removing the antenna beams from their supports, the azimuth antenna is removed first. The strap is unbolted from the rear support and the bolts are removed from the front support. Before removing the last

bolt all personnel take the weight of the beam. The last bolt is then removed, and the beam carefully lifted from its supports and taken from the mount. It is then lowered to a horizontal position with the antenna system on the upper side and placed on the improved X-supports clear of the mount. The transmitting antenna is now removed from the mount. Unfasten the rear supports and unbolt the flange from the front support. Lift the antenna and place it on its set of X-supports as previously done with the azimuth antenna. Remove the antenna-carrying frames from the mount.

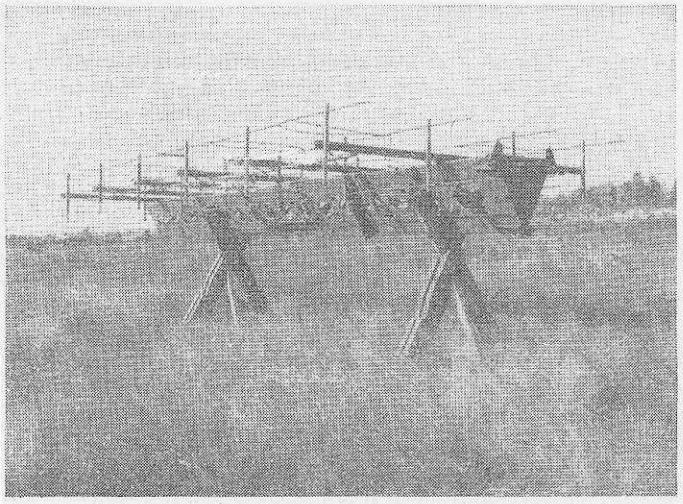


FIGURE 4.—Antenna on X-support.

c. Keyer and modulator.—Remove the canvas cover on the keyer and unbolt the straps holding the keyer in place (fig. 5). Using several men, the keyer is lifted from the modulator packing frame and placed on the ground a few feet to the left of the trailer. Remove the canvas cover on the modulator and the bars which clamp the modulator in place. The bars are slipped from their brackets. The crew removes the modulator from its packing frame and places it on the ground. Now unbolt the modulator packing frame and place it on

the ground at the left side of the mount opposite the center column. The modulator is placed on top of this frame and the keyer is placed on top of the modulator, as shown in figure 6. Remove the stand-by supports, outriggers, and outrigger jacks from the mount.

d. Terminal box JB–23.—Remove the canvas cover on the JB–23 and unbolt the strap holding it in place. Now remove the terminal box (fig. 7) and place it near the right side of the mount. Remove the low-voltage slip ring at this time.

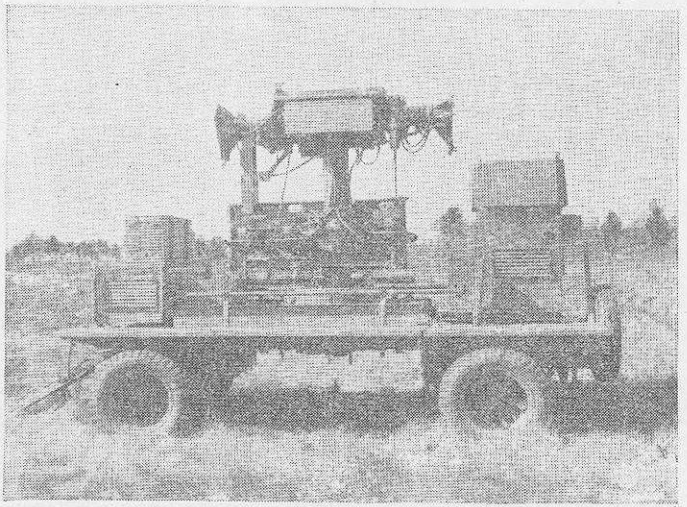


FIGURE 5.—Keyer-modulator (left) in traveling position. Canvas covers removed.

Later, when the jacks and floor plates are in place, the terminal box can be mounted as shown in figure 8.

e. Jacks and outriggers.—Lift out the removable floor plates and swing the chassis leveling jacks out and down. Place the jack bases firmly on the ground and remove most of the trailer weight from the springs by screwing down on the jacks. Set the proper ends of the outriggers in the brackets provided on the chassis and bolt in place. At the same time, place the outrigger jacks under the outer ends of the

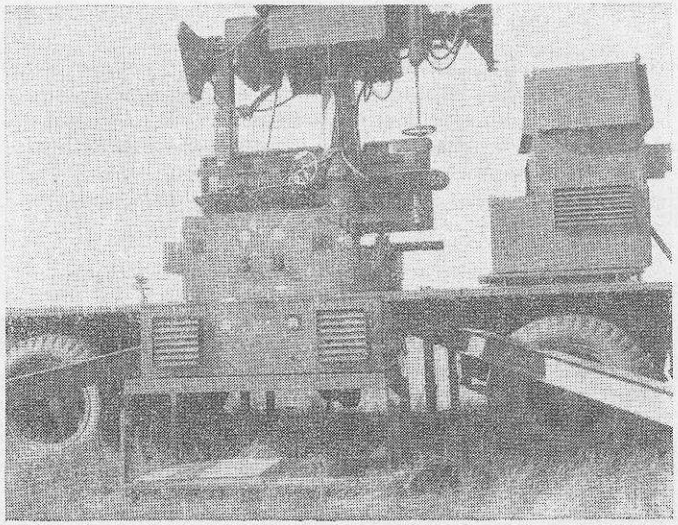


FIGURE 6.—Keyer-modulator in place without cable connections.

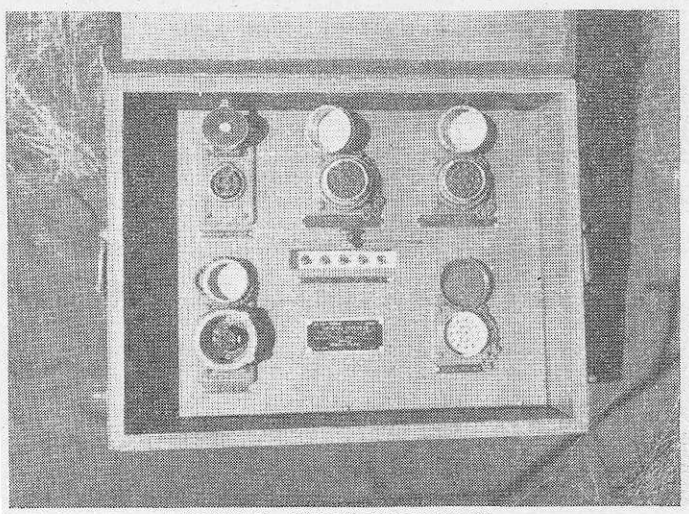


FIGURE 7.—Terminal box JB-23.

outriggers. Next adjust the outrigger jacks to stabilize the mount. Do not apply sufficient force to the jacks to make the outriggers support any appreciable weight of the trailer. Finally replace the removable floor plates.

f. Assembly of hoist.—In order to mount the transmitter and transmitter filament transformer in place, the hoist, located on the power van, is used. The necessary base blocks, guide chains, block and tackle or chain hoist, guide rope, and lifting chains are found in a carrying bag provided with the equipment.

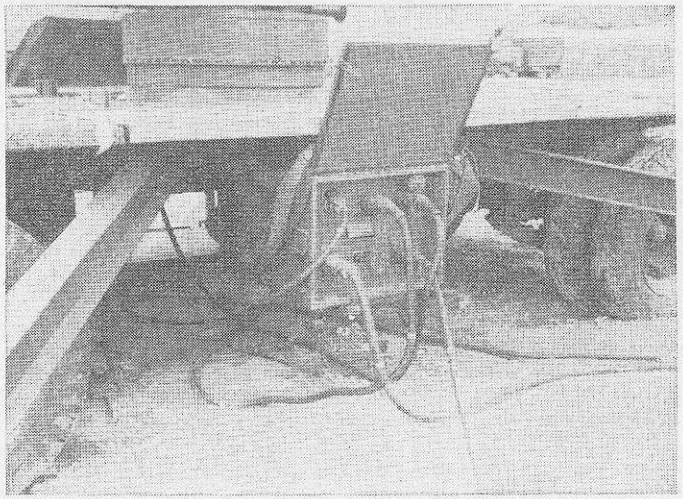


FIGURE 8.—JB-23 in position.

(1) Remove the base blocks from the carrying bag and bolt them in place on the platform in the holes provided. The transmitter and filament transformer *must* be unbolted from mount at this time.

(2) Next, remove the hoist from the power van and place it so that the hinges line with those of the base blocks. Fasten the hinges together by inserting the pins. The hoist may be supported with one of the antenna supports (fig. 9).

(3) Remove the four guide chains from the carrying bag and attach them to the hoist. The two short chains are hooked to the underneath side of the hoist and to the two eyes on either side of the rear of the trailer. The longer pair are hooked to the top of the hoist and stretched along the ground toward the front of the mount. Tie the guide rope to the center of the top cross member of the hoist and extend one-half to the front and one-half to the rear. Attach the block and tackle to the eyebolt in the top member of the hoist.

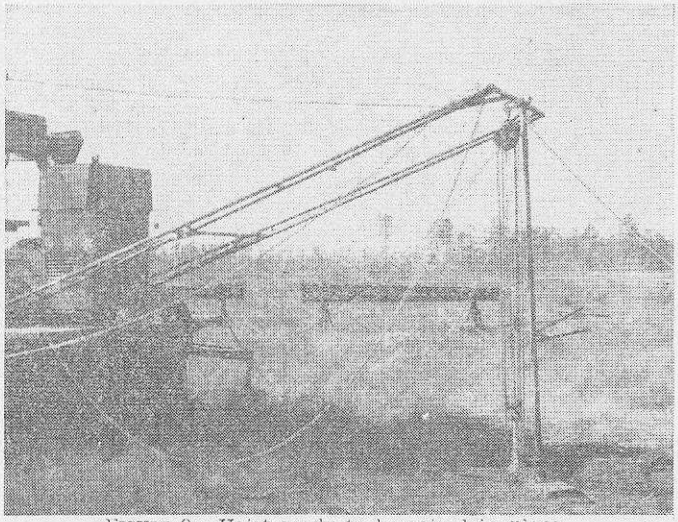


FIGURE 9.—Hoist ready to be raised in place.

g. Raising hoist.—Release the azimuth brake and rotate the column, using the azimuth handwheel, until the oscilloscope shelf is toward the front of the mount. Lock the azimuth brake. Raise the oscilloscope shelf to the horizontal position and lock the braces in place with the pins. One man stands on the oscilloscope shelf and one mounts the platform on top of the rotatable column. Pass the front half of the guide rope over the top of the rotatable column.

With one man on each front guide chain, two men on front guide rope, and two men on the side members of the hoist, raise the hoist. Pull it to the forward position, easing it in place with the rear guide rope, then snap the guide chains at the front of the mount in the eyebolts provided.

h. Raising transmitter and filament transformer.—Adjust hoist so that the long chains are taut. Hook the lifting chains to the corner lugs of the transmitter as shown in figure 10. Raise the transmitter by means of the chain hoist (fig. 11). When the transmitter is clear of the top of the rotatable

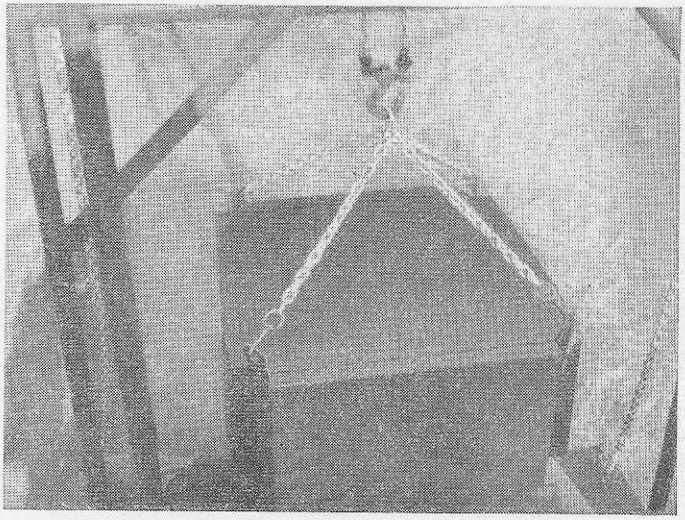


FIGURE 10.—Chain attached to transmitter.

column, swing the hoist so that the transmitter is over its position on the platform. Always maintain tension on the front and rear guide ropes to prevent a sudden jerk on the chains. The two men on the rotatable column assist each other in placing the transmitter exactly in place. Check to see that the adjusting knob of the transmitter is on the outside and toward the elevation handwheel. Bolt the transmitter in place and repeat the procedure for the filament transformer, making all electrical connections between the

transmitter and transformer including ground shield leads to the ground binding post. With this completed, remove the hoist from the mount and replace the hoist on the power van and the hoist accessories in the carrying bag. Finally, remove the transmitter-carrying platform from the mount.

i. Counterweight.—For operation, the counterweight must be shifted from the traveling position to the operating position. First, loosen the bolts on the split coupling and remove the stud bolts. Now rotate the counterweight until the holes in the antenna shaft align with those of the counterweight.

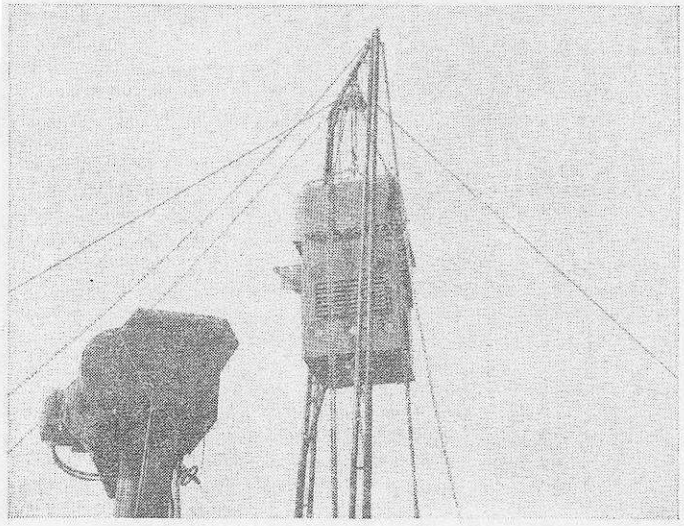


FIGURE 11.—Swinging the transmitter in place.

Replace and tighten the stud bolts and finally, retighten the split coupling.

j. Preparation of elevation antennas.—Remove the two halves of the elevation antenna from their traveling brackets. Bolt them in place on the transmitting antenna beam as shown in figure. 12. Next attach the elevation phasing section to the two sections of the antenna and then fasten the stub in place. Care must be exercised to prevent broken in-

sulators. The azimuth and elevation received brackets are fastened in place as shown in figure 13. Make certain that the circular hole is toward the flanged end of the beams

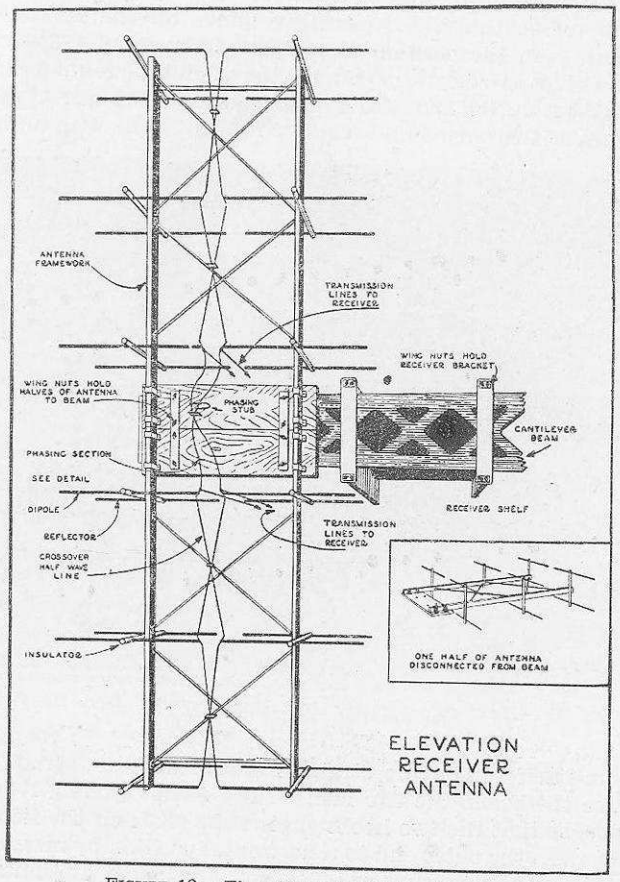


FIGURE 12.—Elevation receiver antenna.

and the receiver opening lies on the upper side of the antenna. These brackets are *not* interchangeable. Place one of the three (one spare) receivers in each of the two brackets and

strap them in place with the straps provided. Connect the receiver transmission lines to the brackets and finally to the receiver itself.

k. Mounting the antenna.—Before lifting the antenna, check to see that the supporting flange on the rotatable column is in the position of *maximum* elevation. Now all men, except two on the mount, lift the azimuth antenna beam and rest it on the end of the mount on the same side of the column as the range handwheel. In lifting, hold close to the

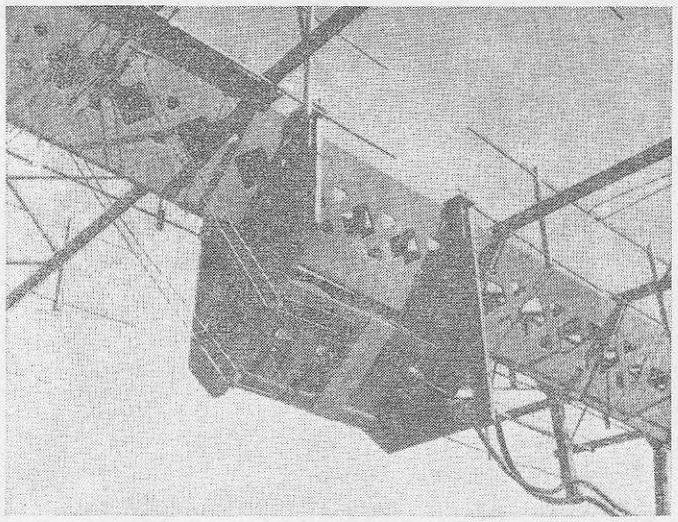


FIGURE 13.—Elevation receiver installed showing feed lines and brackets.

beam itself so that no strain is on the antenna structure. Raise the beam, the two men on the mount guiding it into place, so that the two hooks engage the studs on the flange. Now raise the outer end to a horizontal position by means of the two antenna supports. Bolt the azimuth antenna in place, then repeat the procedure for the transmitting and elevation antenna beam. Finally, attach the transmitter transmission lines as shown in figure 59.

l. Oscilloscopes.—Remove three of the four oscilloscopes (one spare) from the carrying racks in the power van or work van as the case may be. Set these in place on the oscilloscope shelf as shown in figure 14. Now remove the cables from the dummy receptacles and connect to the scopes. Finally, put the sight tubes in place.

m. Leveling.—As in the case of all fire control equipment, leveling of the SCR–268 is extremely important. In order to secure firm footings for the jacks, individual blocks approx-

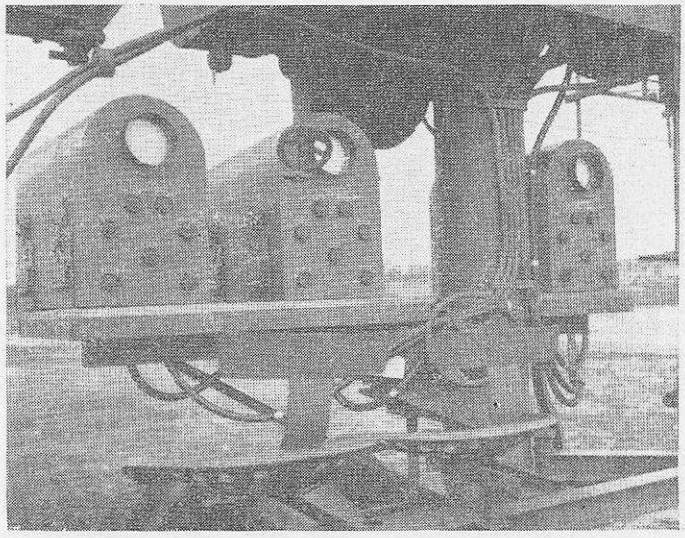


FIGURE 14.—Oscilloscopes mounted on shelf.

imately 2 by 12 by 12 inches, are inserted under the jacks. For accuracy of level each operator's seat should have a man in it throughout the entire procedure. Loosen the outrigger jacks until they are free of any load. Next, turn the antenna array until the leveling bubbles are in line with any two diagonally opposite jacks. Adjust the levels until the bubble is centered and check by rotating the antenna 180°. Repeat the above procedure for the other two jacks. Now

tighten the outrigger jacks until each is firmly seated. Care must be taken to prevent disruption of level already established. Finally check level through 360°.

n. Cables.—The cables are placed and connected as shown in appendix II. Since the low voltage slip ring has a cable permanently attached, it can be discussed here. Figure 15 shows the slip ring in the packed condition. Insert it in place underneath the mount as shown in figure 16. Connect cable No. 24 to terminal box. All cables must be installed carefully to prevent damage. Note that each cable is numbered, permitting easy and quick identification by means of the cable diagrams. In many cases the cables from the rectifier and power plant must be buried. *Make certain that all ground stakes and ground leads are properly connected.* There are three ground leads, one from the mount, one from the keyer, and one from the modulator. Figure 17 shows the mount K–28–A completely set up for operation.

o. Preparation of power plant.—Before any attempt at operation of the power plant is made the manufacturer's handbook must be read. In preparing the power plant, first open the trap door in the roof and place the muffler over the exhaust port of the engine extending through the trap door. Remove the fire extinguisher from the van and set it in a readily accessible place outside in the shade. Bring up the outside source of gasoline, usually a drum, and make the necessary connnections for the gas hose. Never insert the hose completely to the bottom of the drum. If the drum is dirty, this dirt is pumped into the gasoline line and may clog it. Finally, check water in radiator, water in battery, and the oil supply. Turn on the external gas supply valve. Turn the valve underneath the tank to the OFF position. The power plant is now ready for operation.

16. DISASSEMBLY AND PACKING.—The disassembly of the mounts K–28–A and K–28–B and the packing of the components for transportation is done in the reverse order from assembly. The same degree of care in safeguarding the equipment from breakage, as used in assembly, is equally necessary in the disassembly and packing.

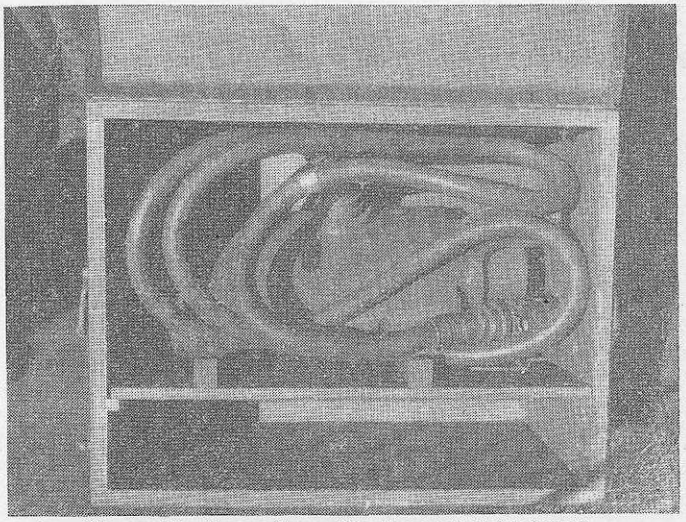


FIGURE 15.—Low voltage slip ring packed for travel.

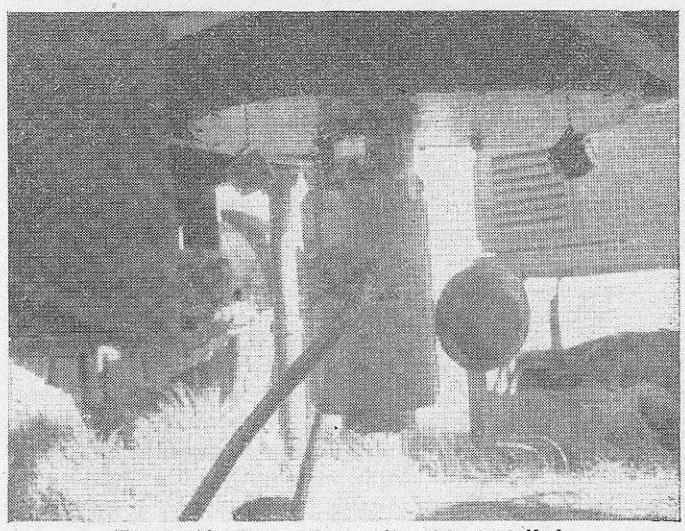


FIGURE 16.—Low voltage slip ring installed.

SECTION III

ASSEMBLY OF MOUNT K-28-C

17. PACKING TRAILER.—The packing of the mount trailer K-28-C as shown in figure 18 is slightly different from the procedure in packing the K-28-A or K-28-B. Paragraphs 18, 19, and 20 describe the method of assembly. Extreme care must be taken to prevent loss of packing bolts and breakage of antenna dipoles or other pieces of equipment.

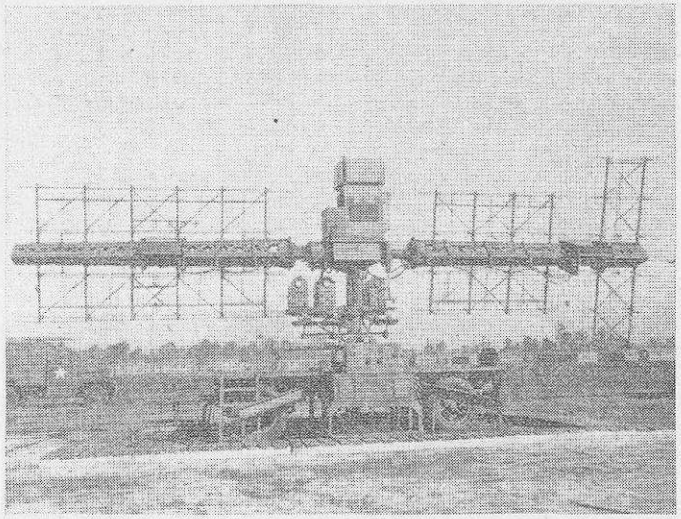


FIGURE 17.—K-28-A completely set up.

18. CANVAS COVER.—The K-28-C is covered with a single canvas cover, which is tied with ropes over the frame. The first step in the assembly of the mount is to untie the ropes and remove the canvas cover. Fold the cover and store it in one of the vans.

19. FRAMEWORK.—The framework is the next part of mount removed. Before any frame is taken off, unbolt the azimuth antenna on left side of mount and set it on the ground away from the mount. Unbolt only those bolts with chains attached. Frame is now lifted free of the mount, folded, and stored in the trucks.

20. ANTENNA.—*a.* This mount is equipped with the metal antenna. The azimuth and transmitting antenna are transported on the mount while the elevation antenna is carried in one of the vans.

b. The azimuth antenna is removed first, as in paragraph 19, since it acts as part of the frame in the traveling position. The transmitting antenna is removed, the two ends opened slightly, and the antenna placed upright in an inverted V position. Finally, remove the antenna brackets from the mount.



FIGURE 18.—K-28-C canvas cover removed.

c. In mounting the antenna for operation, the beams are first placed in position on the mount. Figure 19 shows the new type of transmitter feed line coupling. The antennas are then mounted in place. Finally, the counterbalance is attached as shown in figure 20. Figure 21 shows the elevation and transmitting antenna in place. The transmitting antenna on this mount is larger than the azimuth antenna. Note that although these antennas are of a much more rugged design than those of the K-28-A or K-28-B mount type, the

same degree of care in handling must be exercised in regard to the dipoles and insulators.

■ 21. TERMINAL BOX JB73.—The terminal box JB73 (fig. 22) differs from the JB23 in that it is permanently installed on the underside of the platform.

■ 22. OPERATOR'S SHELTER.—The only remaining change in assembly of the mount K–28–C is that of the operator's shelter. Figure 23 shows the shelter completely assembled.

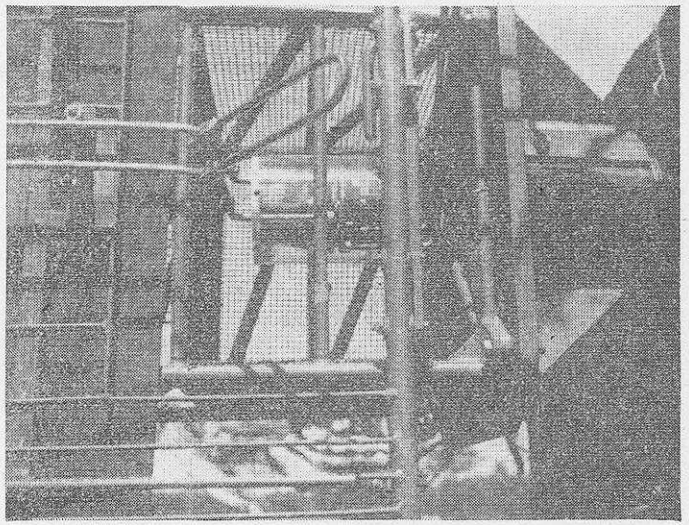


FIGURE 19.—Transmitting antenna feed lines K–28–C.

The shelter is put up last, according to the detailed instruction manual furnished with each shelter.

■ 23. DISASSEMBLY K–28–C.—The disassembly and packing for travel of the mount K–28–C is exactly in reverse of the assembly for operation. *CAUTION: Do not lock the foot brake in position,* as broken or bent dipoles on the transmitting antenna will result. The braces from the frame to the rotatable column are sufficient to hold the column steady.

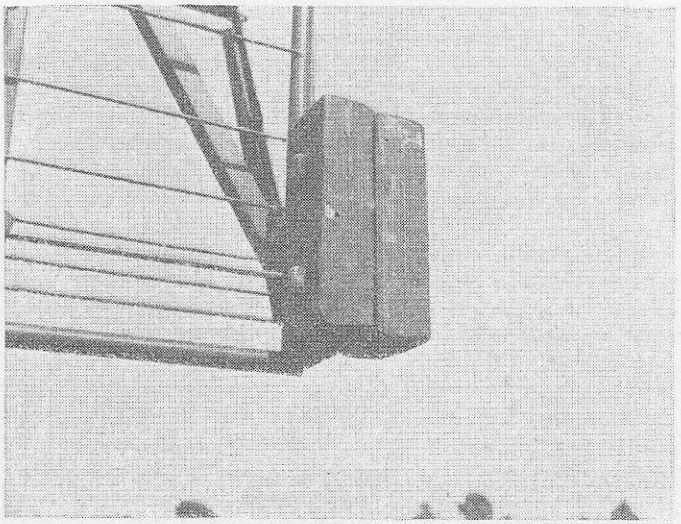


FIGURE 20.—Counterweight for K–28–C.

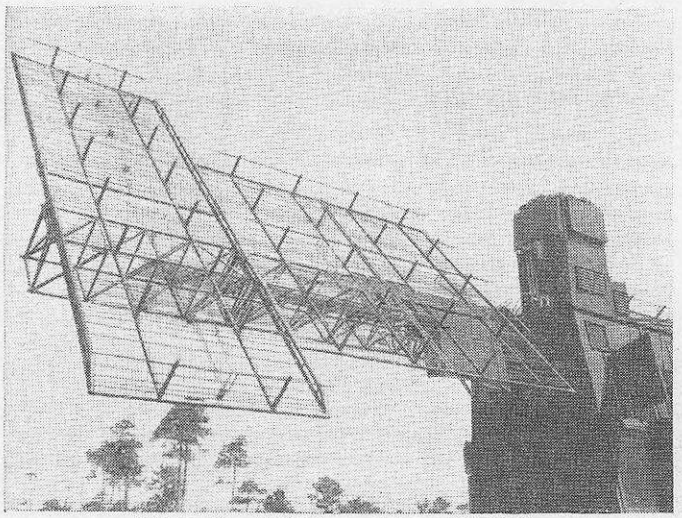


FIGURE 21.—Metal type antenna K–28–C.

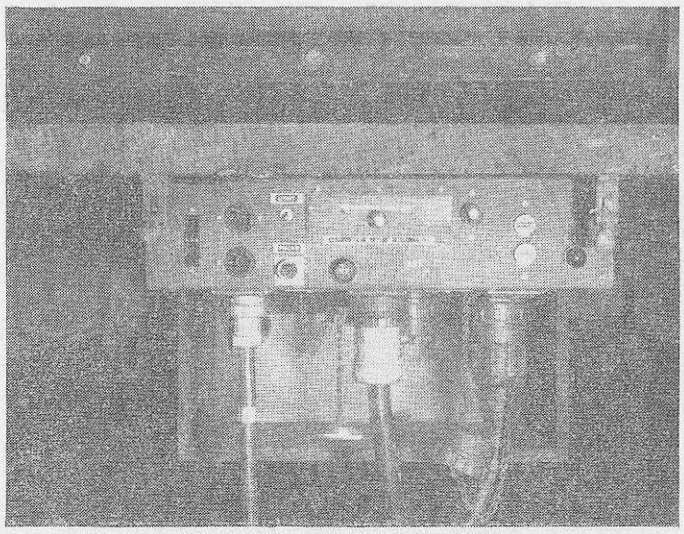


FIGURE 22.—Terminal box JB73.

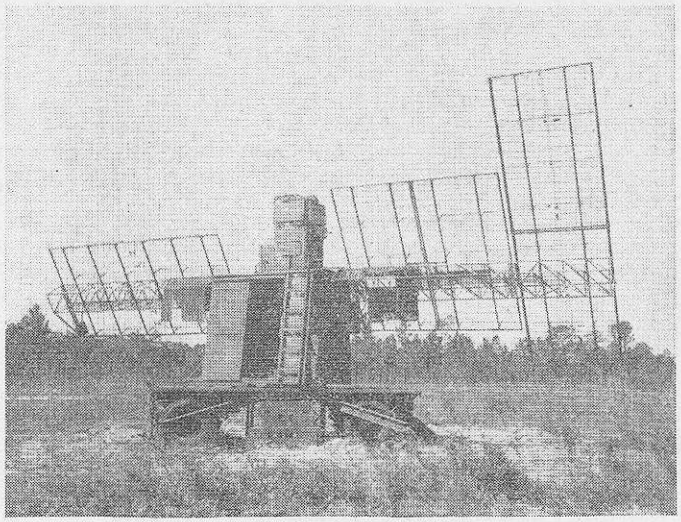


FIGURE 23.—K-28-C completely set up.

CHAPTER 3

ANTENNA ALIGNMENT

		Paragraphs
SECTION I.	General	24–25
II.	Antenna theory	26–27
III.	Lobe separation	28–29
IV.	Azimuth antenna alignment	30–37
V.	Elevation antenna alignment	38–52
VI.	Final check of alignment	53–54
VII.	Summary	55–61

SECTION I

GENERAL

■ 24. GENERAL.—The importance of careful and accurate alignment of the SCR–268 antenna system must be emphasized. In the following sections several methods are described, one of which should be usable in a given situation. EVEN THE MOST CAREFUL ALIGNMENT, HOWEVER, MUST BE FOLLOWED BY A CHECK, PREFERABLY UPON A FRIENDLY AIRPLANE OR BY USE OF A BALLOON, IF THE BEST RESULTS ARE TO BE OBTAINED.

■ 25. ALIGNMENT.—*a.* Alignment is here defined as the adjusting and tuning of the antennas and receiver feed lines to obtain maximum response and to make the electrical and optical axes parallel.

b. Adjustment of the SCR–268 sight is an essential step in alignment. Adjustment of the lobe separation (a phasing operation) is normally done during alignment procedure. Adjustment of the angular height counter to indicate the true angular height of the electrical axes, while essentially orientation, should logically follow here.

SECTION II

ANTENNA THEORY

■ 26. GENERAL.—The length and position of the antennas of the SCR–268 have been precisely computed for a particular

purpose. These antennas play a vitally important part in radio position-finding equipment and the degree of accuracy used in their tuning and alignment determines the efficiency of the unit of which they are a component.

■ 27. ANALOGY.—*a.* Antennas used with the SCR–268 are directional antennas of an array system. To explain the directional characteristics of one antenna, an analogy can be taken from an ordinary light bulb. A light bulb without any lens or reflector attached disperses light energy equally in all directions. Similarly, a single wire (no definite length) transmitting antenna accomplishes the same effect with radio energy; that is, the radio waves transmitted emanate in all directions from the wire.

b. Now suppose the length of antenna be mathematically computed with respect to the wave length of the radio energy and the number of this type increased, so that in certain directions the energy is nullified and in other directions the energy from each reinforces the other. This is analogous to placing a lens and cover on the light bulb, thereby focusing the light intensity in one direction.

c. However, all the energy is not going in one direction. The energy, by design, has been prevented from emanating in the plane of the antenna, but no means have been made to prevent the escape of waves to the rear. Similarly, some light intensity is wasted to the rear of the light bulb without a reflector. To counteract this loss of light the reflector is placed behind the bulb, and by reflecting the escaping light it thereby reinforces the beam to the front. This is exactly what was done for the SCR–268 antennas. Parasitic (no electrical connection) reflecting antennas are placed a specified distance in rear of each transmitting antenna. These reflectors catch the rearward energy and reflect it to the front in such a way as to strengthen the transmission of the emanating energy.

SECTION III

LOBE SEPARATION

■ 28. LOBES.—In the above discussion the radiation (focused beam) of the light bulb is evident. Now, although the radio

waves are invisible, the energy radiating from the SCR–268 transmitting antenna also assumes the shape of a beam, or lobe, as it is called. The shape of this lobe is shown in figure 24, which is a plot of the field intensity about the antenna. Obviously, as indicated in figure 24, in order that the maximum energy echo from the target be received, the transmitting antenna must be pointed so that the maximum (or line *OX*) transmitted energy strikes the target. *The receiving antennas are constructed similarly and have electrical characteristics similar to the transmitting antennas; then, for maximum reception of the echo energy, the receiving antennas should be directed at the target.* All that remains is to place this received energy on an oscilloscope screen and rotate the receiving antennas by the handwheels until the maximum signal is produced on the oscilloscope. The receiving antennas will then be positioned with respect to the target.

■ 29. LOBE SEPARATION.—The problem, however, is not quite so simple. Since the receiving lobe is comparatively flat at the maximum, it is evident that a turn of the handwheel effects a very slight change in the received echo intensity. This condition facilitates getting "on target", but increases the difficulty of accurate tracking. To accomplish both of the desired requirements (ease of pick-up and accurate tracking) the principle of lobe separation is utilized. For example, suppose two sets of azimuth receiving antennas are used, the electrical axis of each being separated by approximately 20°. The lobe pattern for each antenna would appear as in figure 25. Further, a target, *A*, would record a reflected intensity of *OA* on the scope from the right antenna and a reflected intensity of *OY* on the scope from the left antenna. The echoes, as viewed on the screen, would be unequal and would indicate a deviation from the original line *OX*. However, if both antennas were rotated so that the target was at *P*, the echoes as viewed on the azimuth scope would be equal for each lobe—relative value of *OP* for each lobe. This procedure is actually accomplished in both receiving antennas. Only *one* antenna is used, but with *two input channels* to the receivers and finally the scope. These channels are constructed electrically so that the effect is the same as indicated by figure 25, the lobe of each channel being separated from

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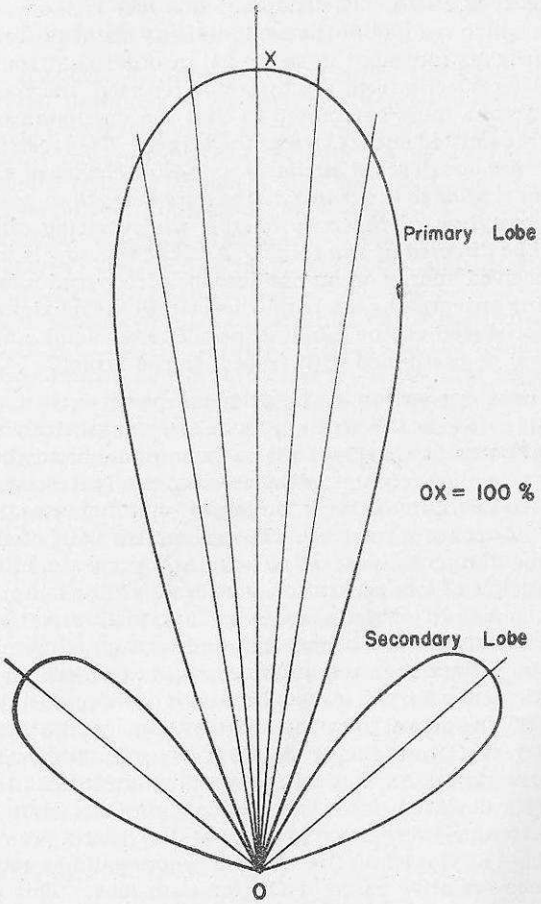


FIGURE. 24.—Lobe pattern of single antenna.

the other approximately 20°. When the radar is used with searchlights, the angle of separation is approximately 18°. Under this condition the ratio of the match-point value to maximum value of received energy is high, thereby insuring ease of pick-up. Any loss in ease of tracking is com-

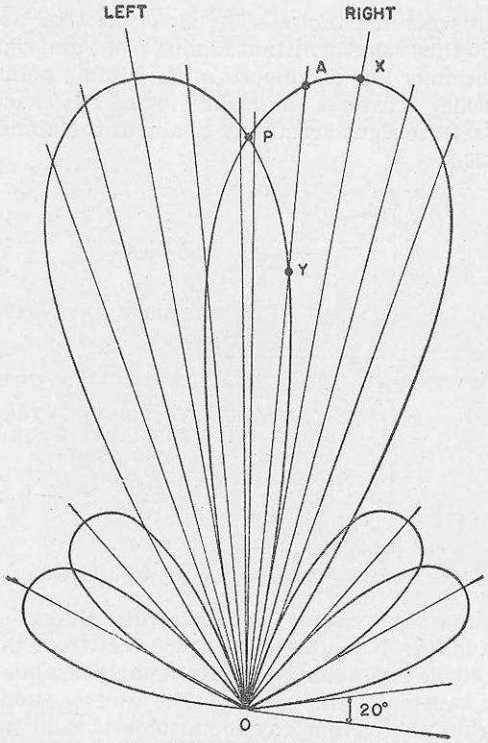


FIGURE 25.—Lobe patterns of a double antenna system.

pensated for by the width of the searchlight beam. In the case of operation with guns, accurate tracking is desired. Therefore, the ratio of match point to maximum received energy is reduced slightly, giving a lobe separation of approx-

imately 25°, a loss of received energy in this case being the sacrifice for the increased degree in accuracy of tracking.

SECTION IV

AZIMUTH ANTENNA ALIGNMENT

■ 30. ADJUSTING THE SIGHT.—The sight must be accurately set. To do this, select a distant aiming point and sight along azimuth beam or line of supports at the aiming point. Read the mil scale. Traverse the mount to the left exactly 1,600 mils and set the sight accurately to aim at the aiming point. (See fig. 26.)

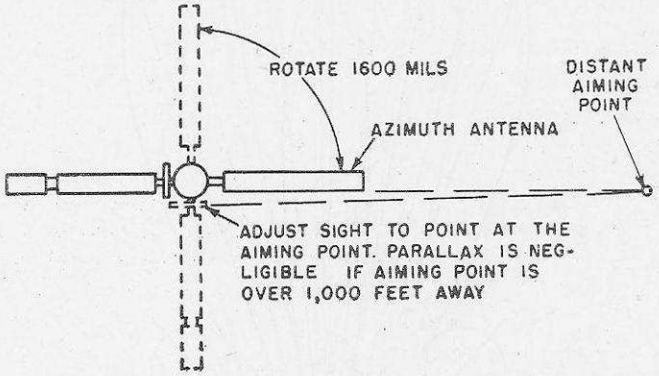


FIGURE 26.—Plan view of sight adjustment.

■ 31. PREPARING TWEETER AND SIGHTING STAKE.—*a.* The tweeter (fig. 27) is placed at least 150 feet from the mount with the dipole approximately at right angle to a line running from the tweeter to the mount. The tweeter should be on level terrain away from any metal objects, and preferably raised until it is on line with the center of the azimuth antenna.

b. Determine the distance from the center of the azimuth antenna to the open sight on the SCR–268 (about 14 feet), lay off that distance, as shown in figure 28, and place a stake as an aiming point for the open sight (fig. 29).

■ 32. LAYING MOUNT ON TWEETER USING THE SIGHT.—With the antenna depressed to zero elevation, traverse the mount so that the sight is directed at the stake, and lock the foot brake.

■ 33. TUNING RECEIVER FEED LINES FOR MAXIMUM AND EQUAL PULSES.—The object is to get the signal in both channels as high as possible by the choice of proper length stub and its location in the proper position, and at the same time obtain equal pulse heights.

a. With the mount in operation, the receivers are tuned carefully to the transmitter frequency, using a fixed echo.

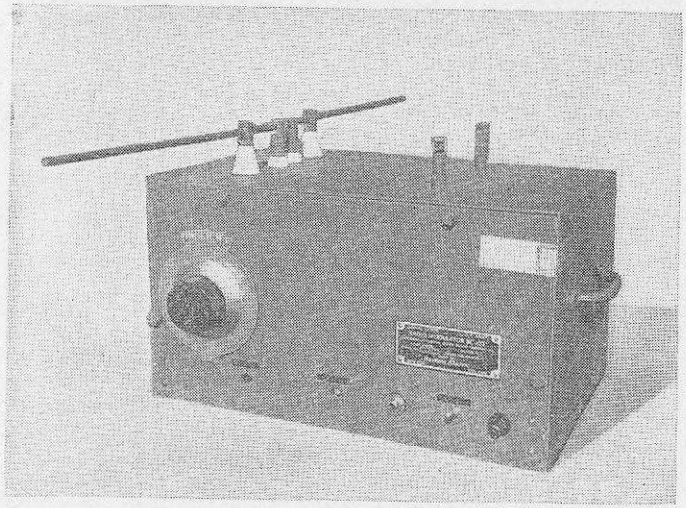


FIGURE 27.—Test modulator BC–423 (tweeter).

b. With the transmitter off, and after the tweeter has been allowed to warm up for at least 15 minutes, tune the tweeter for maximum pulses in the azimuth scope.

c. Set the receiver bias controls for maximum gain and apply spread to the azimuth scope.

d. Place a trombone on each feed line a few inches from the insulator nearest the receiver, and adjust each slide to about 10 inches.

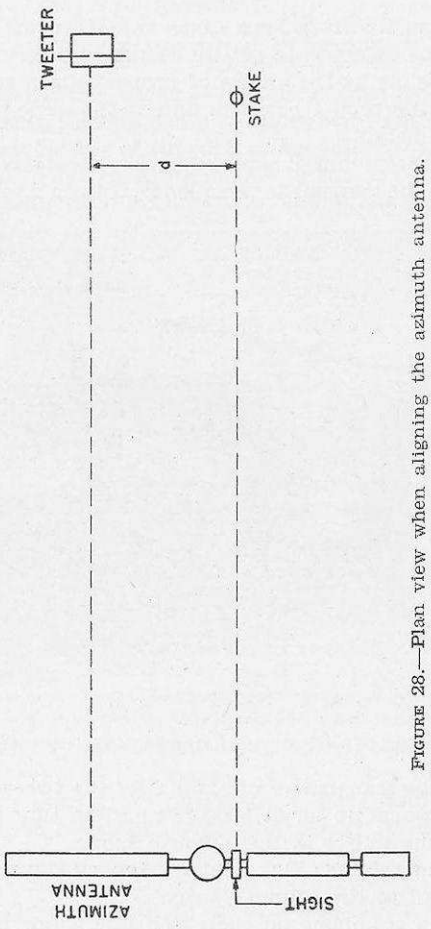


FIGURE 28.—Plan view when aligning the azimuth antenna.

e. Determine the trombone corresponding to the weaker pulse, and move that trombone to various positions along the line until the position of the maximum pulse is found. Vary the slide on the trombone within the limit of 9 to 13 inches to get the maximum pulse.

f. Now adjust the position of the second trombone along the feed line until its position for the maximum of the corresponding pulse is obtained, and adjust the slide for a maximum pulse.

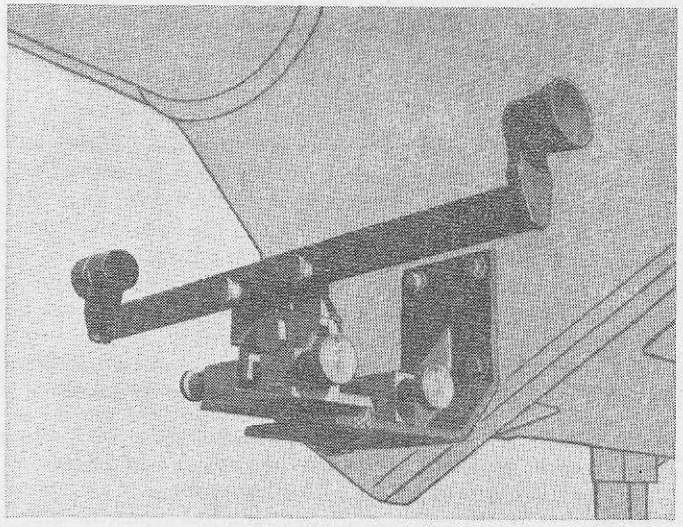


FIGURE 29.—Sight on SCR-268.

g. Return to the first trombone and adjust for a match of the two pulses. If a match cannot be obtained, adjust for a maximum of its corresponding pulse and adjust the second trombone to match the pulses. During the last careful matching, set the sensitivity control to give large pulses, just under saturation.

h. Having tuned the receiver feed lines by means of the trombones, stubs may be substituted for each trombone using the following procedures:

(1) Try several stubs of lengths near that of the trombone setting. Choose the one that gives the best response, and if more than a slight loss in pulse height occurs, try putting a short stub adjacent to the first one. A combination of a long and short stub may effectively replace the trombone.

(2) Repeat for the other trombone, and by changing the positions of the stubs on the lines, match the pulse heights. During the last careful matching, set the sensitivity control to give large pulses, just under saturation.

(3) Experienced men may save time by working directly with fixed stubs.

■ 34. CHECKING MAXIMUM HEIGHT OF PULSES.—*a.* After balancing pulses, adjust the sensitivity for pulse heights of 1 to 1½ inches. Then traverse the mount, first right and then left from the match point, keeping the sensitivity constant. Observe the maximum height of the two pulses.

b. The maximum heights should be the same within 10 percent. If they differ by more than 10 percent, adjust the sight, and retune the receiver feed lines.

c. For example, if the right pulse maximum is too large, adjust the sight by traversing it *right* before realigning.

■ 35. CHECKS OF LOBE SEPARATION.—*a.* With the pulses balanced, adjust sensitivity for pulse heights of 1 to 1½ inches. Now traverse right until the left pulse reaches a maximum, and note its height. Repeat, traversing left from the match point, until the right pulse reaches a maximum, and note its height.

b. The ratio of pulse heights at the match point to pulse heights at maximum should be from 0.5 to 0.6.

c. The figures mentioned are a general indication of the adjustment. The phasing sections in the antenna must be adjusted by trial and error until the stated conditions are met. In general, moving the shorting bars in the phasing

sections toward the front decreases the ratio of the pulse height at match point to height at maximum.

d. Note that after each adjustment of the shorting bars, the receiver feed lines must be tuned for balanced pulses.

■ 36. AZIMUTH ANTENNA PATTERN.—*a.* With the mount in operation, the receivers are tuned to the transmitter, using a convenient fixed echo. With the transmitter off, and after the tweeter has been allowed to warm up for at least 15 minutes, tune it for maximum pulses in the azimuth scope.

b. Place the tweeter at least 150 feet from the mount, dipole parallel to the azimuth antenna array. The location chosen must be on level terrain, away from any metal objects, and preferably raised until it is on line with the center of the azimuth antenna.

c. Prepare a scale on a strip of paper, fasten it over the hairline on the azimuth scope, and apply spread to the scope.

d. Rotate the antenna array until the two pulses are equal in height, and vary the sensitivity to get pulses from 1 to 1½ inches high.

e. Record the height of the two pulses. Rotate the azimuth handwheel one turn in either direction (equivalent to 3°). Record the pulse heights again. Repeat the reading every 3° until the pulses disappear. Return to the match point and repeat the readings going in the opposite direction.

f. When the readings are plotted on rectangular coordinate paper, they should appear as shown in figure 30.

g. From the graph, determine the ratio of match point to maximum, and if it is not from 0.5 to 0.6, adjust the shorting bars in the phasing section, keeping all of them in the same relative position. Retune the receiver feed lines, while directed at the tweeter, and take another pattern.

h. If the plotted graph is not similar to the antenna pattern, as illustrated in figure 30, one or both lobes being distorted, flattened, or considerably widened, the adjustments indicated in paragraphs 34, 35, and 36 are invalidated. Such distortion may arise from terrain interference on obstructions in the immediate vicinity of the radar, or from trouble

with the antenna itself. In such cases, proper phasing adjustments must be made by competent maintenance personnel or the radar position should be changed.

■ 37. CHECKING AZIMUTH ALIGNMENT ON A DATUM POINT.—*a.* If an echo is well defined in the azimuth scope and may be balanced by rotating the mount, it may be used as a quick check of alignment, provided its azimuth has been accurately determined.

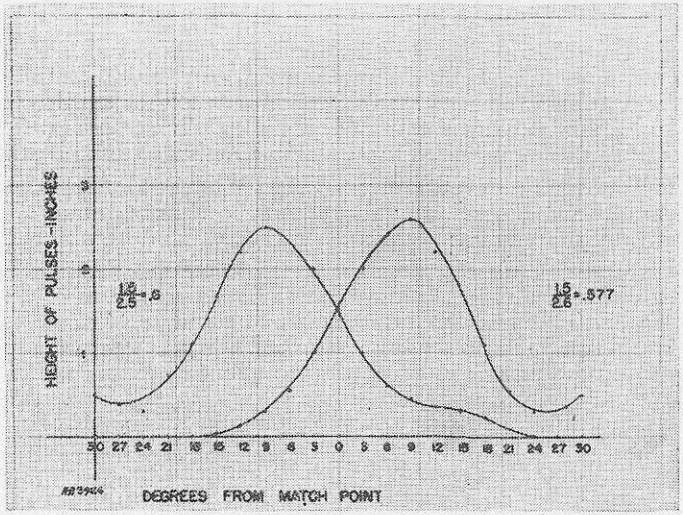


FIGURE 30.—Azimuth antenna pattern.

b. After alignment in azimuth, balance the pulses on the fixed echo and read and record the azimuth. The information should be posted in junction box (JB–22) for future reference.

c. When checking alignment, traverse the mount to the azimuth of the fixed echo and see if the pulses are balanced; if not, retune the receiver feed lines, as described in paragraph 33, until the pulses are at maximum and balanced.

SECTION V

ELEVATION ANTENNA ALIGNMENT

■ 38. GENERAL.—*a.* Alignment of the elevation antenna system is more difficult than alignment of the azimuth antenna system, and generally requires more time and effort.

b. Inaccuracy in elevation tracking usually results when the target is below about 300 mils elevation. This is caused by ground reflections of the received signal.

c. It is important to remember, however, that this 300-mil minimum angular height is measured from the ground in the immediate vicinity of the mount. Where knolls or hills adjoin the mount, accurate tracking may not be expected until the target is 250 to 300 mils above the line of sight to the hill or knoll.

d. The elevation antenna system of the latest mounts differs from the earlier type in that it is eight dipoles high. Increased accuracy may be expected as well as the ability to track accurately to somewhat lower angular heights.

■ 39. ADJUSTING THE SIGHT.—*a.* It is necessary to adjust the mechanical sight in elevation so that the sight points in a horizontal plane when the antennas are vertical.

b. Carefully level the SCR–268, depressing the antenna array until the stop is reached. The antennas should now be vertical, but if not, adjustments of the stop to the nearest ¾° may be made by loosening the housing over the elevation handwheel shaft and rotating the housing.

c. With the antenna array depressed against the stop and the SCR–268 sight approximately level, aim through it at a pole or vertical surface at least 50 yards away.

d. Make a mark on the surface where the line of sight intersects it. Without touching the sight, traverse approximately 3,200 mils and backsight through the sight, making a second mark on the same vertical line as the first. The eye should be centered in the cross hairs when backsighting.

e. If the two marks are not the same, make a *third* mark midway between them as shown in figure 31. Adjust the sight on center mark. Rotate the mount back to its original

position and check. If the line of sight does not intersect the middle mark, repeat the process.

f. Use the vertical adjustment on the SCR–268 sight to bring the horizontal cross hair on the middle mark. The sight is now parallel with the mechanical axis of the antenna.

■ 40. PREPARING BURIED TWEETER.—*a.* First, place the mount in operation and tune the receiver to the transmitter frequency, using a convenient fixed echo.

b. The tweeter should be located on level terrain, away from any metal objects, and at least 150 feet distant.

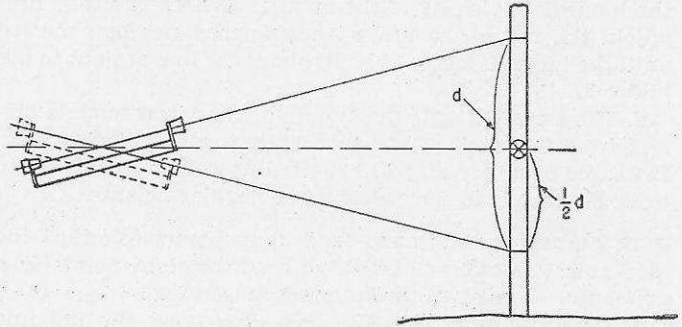


FIGURE 31.—Elevation view of sight adjustment.

c. Dig a hole larger than the tweeter and deep enough so that when the tweeter is placed in it, the dipoles will be slightly above ground level.

d. With the transmitter off and after the tweeter has been allowed to warm up for at least 15 minutes, tune it for maximum pulses in the elevation receiver. Position the tweeter so that the dipoles are at right angles to a line running from the tweeter to mount.

e. Place the screen flat on the tweeter case and level with the ground, as shown in figure 32. Ground the tweeter to the screen and the screen to the ground stake.

f. Carefully retune the tweeter for maximum pulses in the elevation receiver.

■ 41. LAYING MOUNT K–28–A AND K–28–B ON BURIED TWEETER, USING THE SIGHT.—*a.* The antenna must be adjusted so that it may be depressed below the horizontal. To accomplish this, the lower section of the transmitting antenna feed line

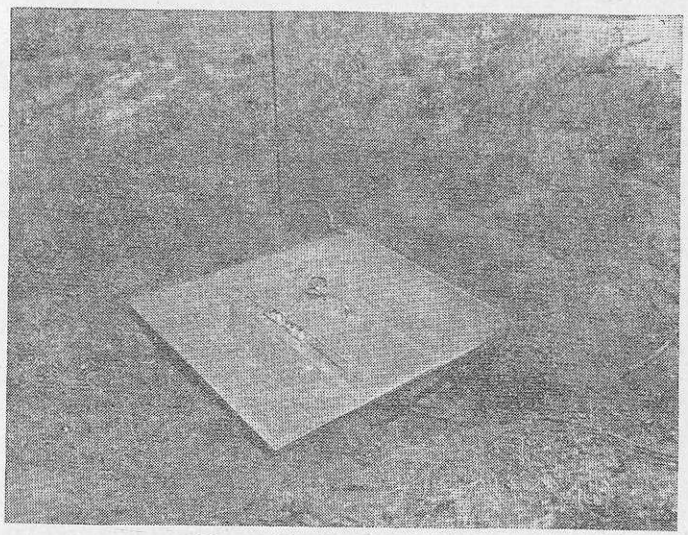


FIGURE 32.—Buried tweeter.

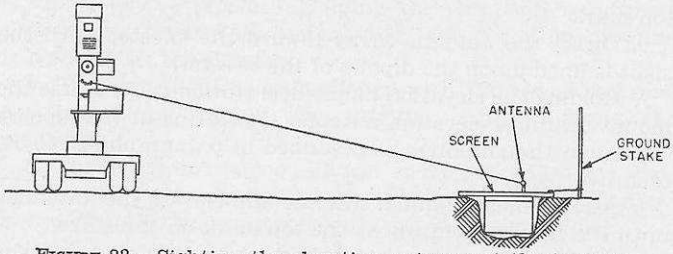


FIGURE 33.—Sighting the elevation antenna at the tweeter.

is removed. The coupling between the range converter and the elevation selsyn housing is loosened. With the antenna depressed against the stop, the housing above the elevation handwheel is unbolted and allowed to rest on the handwheel.

The receiver cables are removed from their hooks and the antenna is now ready to be depressed below the horizontal.

b. Direct the antenna array toward the tweeter until the mechanical sight is lined up on the dipoles of the tweeter. (See fig. 33.)

c. Holding the elevation handwheel *stationary,* traverse the mount until the elevation antenna is pointing at the dipoles.

d. For all practical purposes, the antenna is now directed toward the tweeter.

■ 42. LAYING MOUNT K–28–C ON BURIED TWEETER, USING THE SIGHT.—When using the buried tweeter, the mount is directed as follows:

a. The antenna must be adjusted so that it may be depressed below the horizontal. To accomplish this, the coupling between the range converter and the elevation selsyn housing is loosened and the housing above the elevation handwheel is unbolted and allowed to rest on the handwheel.

b. Drive a stake alongside the tweeter. Place two horizontal marks on the stake as far apart as the vertical distance between the SCR–268 sight and center of the elevation antenna. This is approximately 37 inches.

c. Aim the SCR–268 sight at the bottom mark, using the elevation and azimuth handwheel.

d. Hold the elevation handwheel *stationary* and use the *vertical adjustment* of the sight to make the sight aim at the top mark.

e. Direct the antenna array toward the tweeter until the sight is lined up on the dipoles of the tweeter.

f. Holding the elevation handwheel *stationary,* traverse the mount until the elevation antenna is pointing at the dipoles.

g. Align the antennas as described in paragraphs 46 to 51, inclusive.

h. After proper aligning, traverse and elevate the antennas until the sight is pointing at the top mark on the stake.

i. Hold the elevation handwheel *stationary* and use the *vertical adjustment* of the sight to make the sight point at the bottom mark. The sight is now in alignment with the electrical axis.

■ 43. PREPARING ELEVATED DIPOLES.—*a.* In this method the tweeter dipoles are suspended at the top of a pole or mast about 40 feet high, so that the SCR–268 antennas may be elevated to about 400 mils and aimed at the dipoles. The dipoles are fed by means of a length of field telephone wire from the tweeter which is placed in a hole near the foot of the mast.

b. Place the mast a distance from the mount, so that when the sight is aimed at the tweeter the angular height counter indicates at least 400 mils, and is arranged so that the dipoles are parallel to the antenna when the tuning is done.

c. Dig a hole near the base of the mast or pole large enough to contain the tweeter. Place the tweeter in the hole and connect the twisted telephone wire to the clips which ordinarily hold the dipoles.

d. Cover the tweeter with the screen, but do not allow it to touch any part of the tweeter.

e. With the mount in operation, the receivers are tuned to the transmitter, using a convenient fixed echo. With the transmitter off, and after the tweeter has been turned on and allowed to warm up for at least 15 minutes, tune the tweeter for maximum pulses in the elevation scope.

■ 44. LAYING MOUNTS K–28–A AND K–28–B ON ELEVATED DIPOLES, USING THE SIGHT.—*a.* The sight is first adjusted as described in paragraph 39. Traverse and elevate until the sight is aimed at the dipoles. Holding the elevation handwheel *stationary,* traverse the mount until the elevation antenna is pointing at the dipoles.

b. This can best be accomplished with the aid of someone on the ground behind the antenna, sighting along the insulators.

c. The errors introduced by the above procedure are negligible and, from a practical point of view, the mechanical axis of the elevation antenna is directed at the dipoles.

■ 45. LAYING MOUNT K–28–C ON ELEVATED DIPOLES.—*a.* Due to the fact that the center of the elevation antenna of the K–28–C is *not* at the center of the antenna beam, a new method of laying the mount on the dipole must be used.

b. Depress the antennas to zero elevation and set the counter to read zero. Traverse until the sight is aimed at the pole supporting the dipoles.

c. Make a mark on pole where line of sight strikes it.

d. Measure the vertical distance from the center of the elevation antenna to the sight. This is approximately 37 inches.

e. Make a mark 37 inches above the mark (*c* above) and adjust sight on this new mark with adjustment knobs on sight.

f. Lay the antenna on the dipoles with elevation handwheels, using the mechanical sight as an aiming device.

g. Proceed with antenna alignment.

h. When complete, return sight to second mark on pole, using elevation handwheel.

i. Using adjustment knob, return sight to lower mark.

j. Antenna axis and line of sight are now parallel.

■ 46. TUNING RECEIVER FEED LINES FOR MAXIMUM AND EQUAL PULSES.—With the receiver bias controls set for maximum gain, tune the elevation receiver feed lines to give maximum and equal pulses on the elevation oscilloscope. The elevation transmission lines are tuned in the same manner as the azimuth transmission lines previously described.

■ 47. CHECKING MAXIMUM HEIGHT OF PULSES.—*a.* Adjust the sensitivity for pulse heights of from 1 inch to 1½ inches, then elevate and depress from the match point. Observe the maximum height of the two pulses.

b. The maximum heights must not differ by more than 10 percent. If they differ more than this amount, the sight is reset and the antennas realigned.

c. For example, assume that the right pulse is too large. Aim the sight at the dipole by elevating or depressing the antennas, depress exactly one turn, and then, holding the handwheel stationary, adjust the sight to aim again at the dipole. Now retune the receiver feed lines for maximum and equal pulses.

■ 48. CHECKING LOBE SEPARATION.—*a.* Elevate and depress the antennas, observing the maximum heights of the pulses, and setting the sensitivity control so that the pulses do not

saturate at maximum heights. Now with the sensitivity maintained constant, observe the maximum heights of the pulses and the heights at the match point.

b. The ratio of height at match point to maximum heights should be about 0.7. With existing mounts, it is difficult to get less than 0.7; however, from 0.5 to 0.6 would be more desirable.

c. If the ratio is not within the limits mentioned, a fixed stub may be placed on the elevation antenna phasing section, adjacent to the insulator and projecting inward. If no stub was present before the check, a 10-inch stub should be tried. If a stub is in use, substitute another slightly shorter. With spread applied to the elevation scope and receiver dial controls set for maximum gain, use the sight to direct the elevation antenna at the tweeter dipoles and again match the two pulses by tuning the receiver feed lines. Check the match to maximum ratio again and, if not correct, try various stubs.

■ 49. ELEVATION ANTENNA PATTERN.—*a.* An elevation antenna pattern may be made in a manner similar to that described for the azimuth antenna in paragraph 36. It is necessary, however, to prepare the antenna system so that it may be depressed below the horizontal.

b. With the antenna properly aligned, an elevation antenna pattern is generally symmetrical about the match point; particularly, the heights of the two main lobes must not differ by more than 10 percent.

c. If the heights of the main lobes are not the same within 10 percent, the alignment is repeated, first, however, changing the position of the electrical axis with respect to the mechanical axis.

d. Alignment made after the sight has been adjusted on a reference mark, as described in paragraph 39, will effectively put the electrical axis parallel to the mechanical axis. If the pattern shows that the upper lobe is too large, the electrical axis is shifted upward. If the lower lobe is too large, the electrical axis is shifted downward. This is accomplished by moving the sight, then realigning. For example, assume that the upper lobe is too large. First aim the sight at the tweeter dipole (by elevating or depressing the antenna). De-

press the antenna about one-half turn, adjust the sight again on the dipole, and retune the receiver feed lines for balanced pulses.

e. Both the selection of the phasing section stub and the manner of turning the receiver feed lines affect the characteristics of the antenna pattern.

■ 50. SETTING ANGULAR HEIGHT COUNTER.—*a.* Adjustment of the angular height counter is a part of orientation, but is accomplished at this time for convenience.

b. After alignment, the counter is set to indicate the angular height of the electrical axis.

c. Depress the antennas against the stop and check to see that the sight aims at the reference mark used in paragraph 39*e* (when traversed correctly).

d. Set the angular height counter in the range converter to indicate zero, and tighten the coupling between the range converter and the elevated selsyn housing. Use the micrometer screw-driver adjustment to set the angular height exactly at zero.

■ 51. CHECKING ELEVATION ANTENNA ALIGNMENT ON A DATUM POINT.—*a.* A careful alignment represents considerable effort and time. By use of a fixed echo at a known azimuth, alignment may be quickly checked, particularly when changing receivers.

b. After alignment, the antennas are depressed to exactly zero elevation, and the mount is traversed in azimuth to aim at a fixed echo, matching pulses in the azimuth scope.

c. The sensitivity control is set to make the left pulse in the elevation scope exactly 2 inches high and the height of the right pulse is recorded. For example, if the right pulse is 1½ inches high, this is recorded.

d. When checking alignment it is only necessary to traverse the mount to the correct azimuth, set the sensitivity control so that the left pulse in the elevation scope is exactly 2 inches high, and note the height of the right pulse. If, for example, a receiver has been changed and the right pulse is not the same height as determined above, retune the receiver feed lines until the right pulse is the correct height *when* the left is exactly 2 inches high.

■ 52. USE OF TWEETER AS A DATUM POINT.—The tweeter may be used as a datum point, provided it is placed in *exactly* the same position each time.

SECTION VI

FINAL CHECK OF ALIGNMENT

■ 53. ADJUSTING THE SIGHT.—*a.* Ordinarily, orientation and synchronization of the set with the searchlight or gun director is accomplished before checking the sight on an aerial target. The sight may be checked without such auxiliary equipment, as described in *b* and *c* below.

b. A friendly airplane may be tracked, or reflectors suspended from balloons (pars. 115 and 116) and the sight adjusted carefully. In normal tracking the line of sight appears first above, then below, the target, and ahead or behind. The target is observed through the sight until the average deviation can be determined; then the sight is adjusted so that the average is zero.

c. Before changing the sight, observations are made with azimuth increasing and decreasing, and with elevation both increasing and decreasing. If it is then determined that the trackers lag consistently, they may be corrected. Since tracking becomes more erratic when an airplane is turning or maneuvering, no adjustment is made under those conditions.

■ 54. USE OF BINOCULARS.—*a.* When checking the sight by tracking reflectors suspended from a balloon, comparatively little time is available, after the pulse becomes visible, before the balloons are lost visually to the unaided eye.

b. To allow more time for observation, binoculars may be used. Note the sight setting and then strap or tie a pair of binoculars to the sight arm. When tracking the balloons, adjust the sight screws until the target remains in the center of the field of view of the binoculars or varies about that point.

c. Now cease tracking and traverse and depress the mount until some well-defined point is exactly in the center of the field of view of the binoculars. Without moving the mount, remove the binoculars and adjust the sight until it is exactly aimed at the same point.

SECTION VII

SUMMARY

■ 55. GENERAL.—Antenna alignment only is covered in this chapter. For convenience, however, there are listed here the logical steps taken when setting up in a new location or upon the receipt of a new set.

■ 56. PRELIMINARY STEPS.—*a.* Check transmitter frequency and stability.

b. Tune receivers on a fixed echo.

■ 57. ALIGNMENT.—*a.* Adjust sight.

b. Prepare test modulator BC–423, commonly known as the tweeter, and sighting stake.

c. Lay mount on tweeter using the sight.

d. Tune receiver feed lines for maximum and equal pulses.

e. Check maximum heights of pulses. Reset sight and retune if necessary.

f. Check lobe separation. Adjust phasing section and retune if necessary.

g. Take antenna pattern for general check.

■ 58. ORIENTATION.—Set the azimuth ring and angular height counter, and orient in range.

■ 59. SYNCHRONIZATION.—Synchronize with the searchlight or gun director.

■ 60. DETERMINE AND APPLY CORRECTIONS.—Check on aerial target and make the necessary corrections in alignment, orientation, and synchronization.

■ 61. CHECK ON DATUM POINT.—Record data on a fixed echo or the reference tweeter for future use.

CHAPTER 4

OPERATION WITH THE AA SEARCHLIGHT

	Paragraphs
SECTION I. General	62–68
II. Orienting and synchronizing 1941 searchlights in azimuth	69–74
III. Orienting and synchronizing 1941 searchlights in elevation	75–79
IV. Orienting and synchronizing 1941 searchlights by backsighting	80–84
V. Orienting and synchronizing 1941 searchlights in azimuth when control station is not used	85–89
VI. Orienting and synchronizing 1941 searchlights in elevation when control station is not used	90–93
VII. Orienting and synchronizing 1942 General Electric amplidyne system in azimuth	94–99
VIII. Orienting and synchronizing 1942 General Electric amplidyne system in elevation	100–104
IX. Orienting and synchronizing 1942 General Electric amplidyne system by backsighting on equipment	105–113
X. Summary	114
XI. Determination and application of corrections by tracking targets	115–117

SECTION I

GENERAL

■ 62. GENERAL.—*a.* The SCR–268 is seldom used as an isolated piece of equipment. However, before using it with any equipment, it is necesary to align the azimuth and elevation antennas and adjust the angular height counter (see par. 50).

b. The SCR–268 is usually employed with the antiaircraft searchlight. A multiconductor cable (No. 27) is used to transmit data from the SCR–268 to the searchlight. One end is plugged into the receptacle marked DIRECTOR at the junction box (JB–23), and the other end is plugged into a short adapter cable (No. 28), which, in turn, plugs into the receptacle at the searchlight.

c. Orientation and synchronization should be accomplished and checked by tracking during daylight hours. However, when a case arises necessitating that these operations be done

at night a celestial body may be used as an orienting point, applying one of the methods outlined in TM 4–226 (when published). Backsighting by using a flashlight to illuminate the sights is another acceptable method. Synchronization is acomplished at night as in the daytime.

■ 63. ORIENTATION.—Orientation of the SCR–268 consists of adjusting the azimuth ring, the angular height counter, and the range counter, to indicate the correct position data. This should be done before synchronization.

■ 64. AZIMUTH ORIENTATION.—*a.* Since the SCR–268 is generally used in the AAAIS, it should be oriented with true or magnetic north. North may be determined by sighting on the North Star, by use of a magnetic compass, or by use of a point of known azimuth. In the Southern Hemisphere, any of the orientation methods using bearing charts of the sun or stars as prescribed in TM 4–226 will be satisfactory.

b. The SCR–268 is directed toward the aiming point by means of the sight which has been previously adjusted. The azimuth ring is set to read the azimuth of the line of sight to the aiming point. This means the azimuth reads zero when the mount is pointed north. (See fig. 34.)

■ 65. ANGULAR HEIGHT ORIENTATION.—*a.* When the adjustments mentioned in paragraph 50 have been completed, the unit is oriented in angular height.

b. The orientation in angular height may be conveniently checked at any time by depressing the antennas until the sight points at the reference mark previously determined in paragraph 39*e*. Set the angular height counter to read zero.

■ 66. RANGE ORIENTATION BY MEANS OF REDUCED POWER.—*a.* With the SCR–268 operating, adjust the bias voltage at the keyer to maximum, and by means of the plate control handwheel, adjust the output voltage to 1,000 volts.

b. Adjust the bias voltage at the keyer and sensitivity of the scopes to produce 2-inch pulses in the oscilloscopes.

c. Adjust the controls on all oscilloscopes for base lines about 4 inches long, and position these correctly on the face of the tubes.

d. Using the range handwheel, position the peak of the pulse in the range oscilloscope under the hairline.

e. Loosen the coupling between the range converter and range unit, and without changing the range unit setting, adjust the range converter to indicate zero range by turning the range handwheel.

f. Tighten the coupling and check position of pulses. If they are not exactly under the hairlines in each scope, position them accurately, using the horizontal positioning controls.

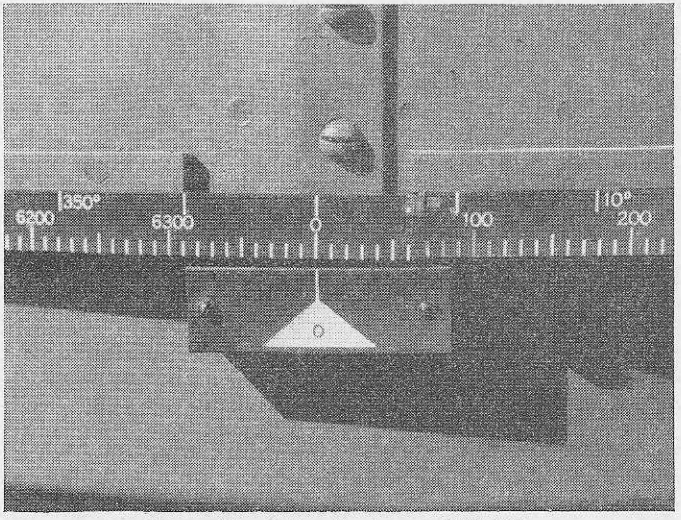


FIGURE 34.—Azimuth ring on SCR–268.

g. The SCR–268 is now oriented in range. *CAUTION:* MOVEMENT OF THE HORIZONTAL POSITIONING CONTROLS OR SWEEP CONTROL WILL DESTROY THE RANGE ORIENTATION.

■ 67. SYNCHRONIZATION.—Synchronization, used in conjunction with the searchlight, consists of adjusting the data

transmission system so that correct data are continuously transmitted.

■ 68. SYNCHRONOUS REPEATERS.—*a* Before synchronization with a searchlight or director can be accomplished, a thorough knowledge of the data transmission system is necessary. Synchronization with the director in altitude (par. 133) should be especially understood. In order to transmit azimuth, angular height, and altitude from the radio set to any desired location, use is made of synchronous repeaters. These units permit the conversion of mechanical data into voltage

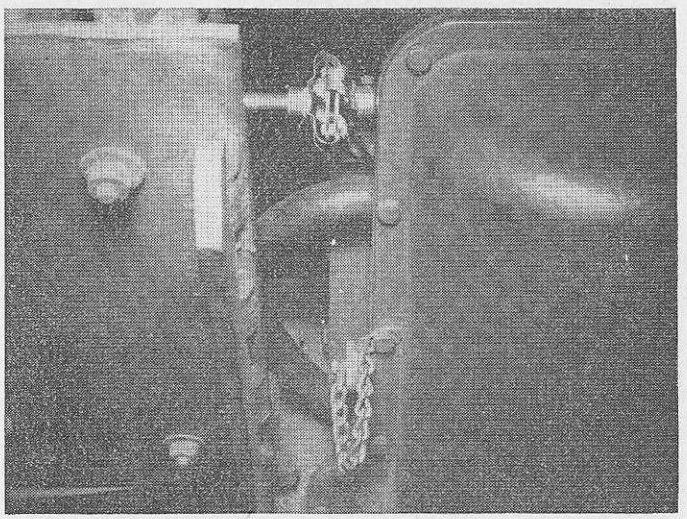


FIGURE 35.—Setscrew on shaft permits adjustment of range counter, while altitude selsyn adjustment is under knurled cap and chain.

relationships, which may then be transmitted by cable to any desired point. Here synchronous repeaters reconvert the voltages into mechanical data. In this manner, movements are effectively transmitted over large distances. In a data transmission system of this type, the sending and receiving

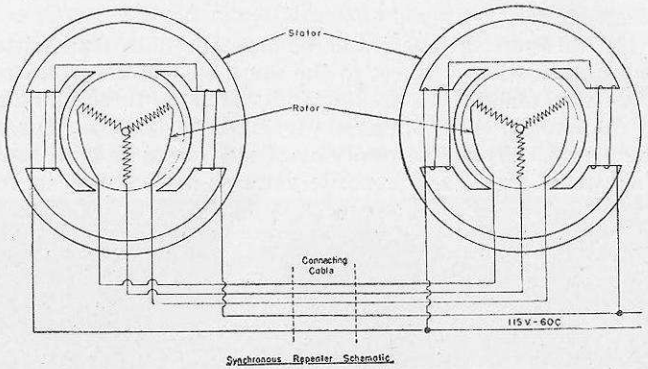


FIGURE 36.—Schematic diagram of synchronous transmitter and receivers, commonly called selsyns.

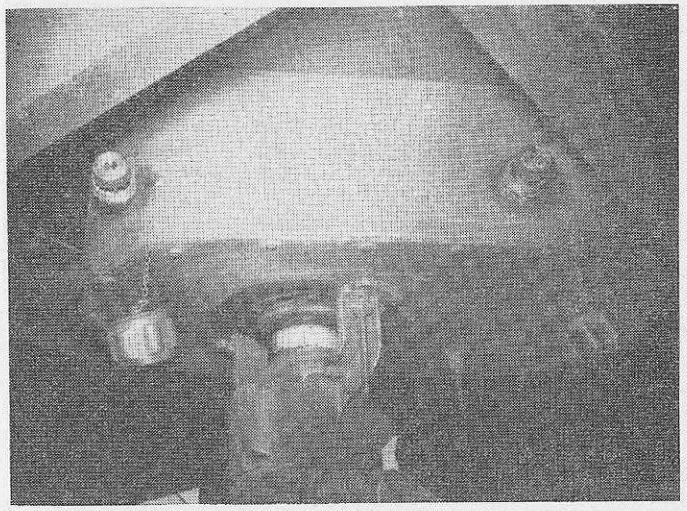


FIGURE 37.—Fine and coarse selsyn adjustments for azimuth on the K–28–A and K–28–B.

units are commonly known as data transmitters and data receivers, respectively.

(1) In figure 36, the stator of both the data transmitter and data receiver connect to the same a-c source. Voltages of unequal magnitudes are then induced in the three windings of each rotor, these voltages varying with the positions of the rotors. When the positions of the rotors of both units correspond, equal and opposite voltages are induced in the

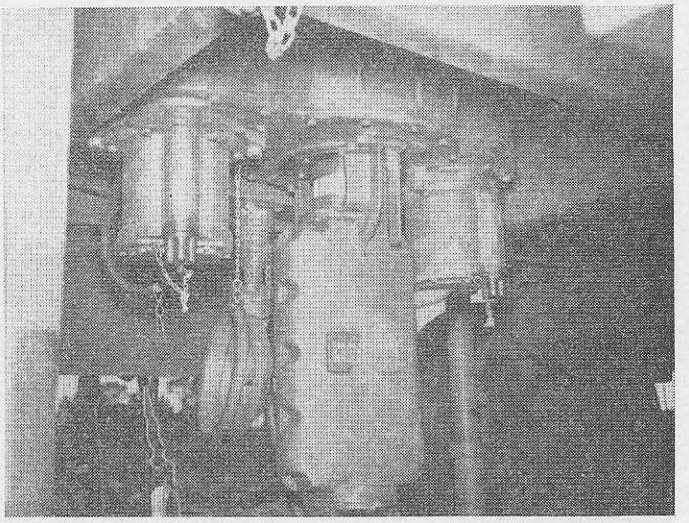


FIGURE 38.—Fine and coarse selsyn adjustments for azimuth on the K–28–C.

corresponding windings of the two rotors, and consequently no current flows.

(2) Movement of the transmitter rotor from its position of equilibrium destroys the balance of voltages in the rotor windings and produces a current flow. These currents produce torques in both rotors. With the transmitter rotor held fast in its new position, the torque on the receiver rotor causes it to move to a position of balance, which corresponds accurately to the new position of the transmitting rotor. The action is smooth and almost instantaneous, and the data receiver follows accurately the slightest movement imparted to the transmitter rotor.

(3) If the rotor of the data receiver rotates in a direction opposite that of the transmitter, two of the three rotor leads must be reversed. The two units are then correctly inter-

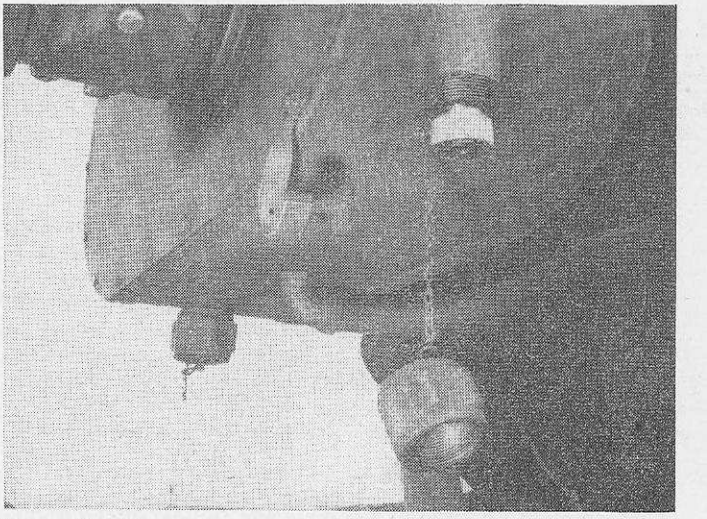


FIGURE 39.—Fine and coarse selsyn adjustments for angular height on the SCR–268.

connected. This operation is accomplished by the reversing switches in the JB–23 (see fig. 7).

b. Five synchronous repeaters are used in the radio set. They transmit the following elements of data: coarse azimuth, fine azimuth, coarse angular height, fine angular height, and altitude. If the radio set is used in connection with a searchlight instead of a gun director, the data from only the coarse azimuth and coarse angular height repeaters are used.

c. All repeater units of the radio set are provided with stator adjustments. These permit the rotation of the stators so that alignment with interconnected data receivers may be made. The locations of these adjusting screws on the SCR–268–B are shown in figures 35, 37, 38, and 39. Each screw is protected by a cap which must be removed before the locking knob is unlocked and a screw driver inserted.

d. Many of the searchlights are also provided with adjustments for synchronous data transmission system. For example, if the azimuth needs adjusting, the adjustment may be made at the searchlight or at the SCR–268. For convenience, the adjustment is usually made at the searchlight when these adjustment controls are provided.

SECTION II

ORIENTING AND SYNCHRONIZING 1941 SEARCHLIGHTS IN AZIMUTH

■ 69. AIMING.—*a.* The SCR–268 is pointed at a distant aiming point by means of the sight.

b. The searchlight is directed at the same point by the following steps:

(1) Disengage the azimuth clutch knob by pulling the azimuth clutch handle in the direction indicated as OUT on the Sperry searchlight, or indicated as HAND CONTROL on the General Electric searchlight.

(2) Turn the searchlight in azimuth by hand until it points at the aiming point, sighting by means of the orienting sight on the searchlight, and reengage the azimuth clutch by pushing the clutch lever in the direction indicated as IN on the Sperry searchlight and D. E. C. on the General Electric.

(3) On the Sperry searchlight, start the power plant, throw the main switch ON. On the General Electric searchlight, start the power plant, throw the main switch ON and be sure the dynamotor switch is ON and the dynamotor is running.

■ 70. AZIMUTH RING OF SEARCHLIGHT.—Observe the azimuth reading at the SCR–268, and set the azimuth scale at the searchlight so that the same reading appears under the pointer index.

■ 71. ZEROING AZIMUTH ZERO INDICATOR NEEDLES.—The azimuth zero indicators on the searchlight and control station may or may not show a zero reading. They are made to read zero. On the Sperry searchlight, remove the cover over the azimuth data receiver and turn the AZIMUTH SYNCHRONIZING knob. On the General Electric, turn the AZIMUTH CORRECTOR knob on top of the searchlight turntable.

■ 72. CHECKING SENSING (NEEDLE DEFLECTION) OF AZIMUTH ZERO INDICATOR.—*a.* It is possible to obtain two zero readings by rotating the azimuth stator. The correct zero reading is obtained when the needle of the azimuth zero indicator at the searchlight moves clockwise when the searchlight is manually traversed clockwise.

b. If the needle moves in the wrong direction, return it to zero by returning the searchlight to the aiming point. Then holding the searchlight on the aiming point, turn the synchronizing knob continuously in one direction until the needle moves off scale and then returns to zero reading again.

■ 73. CONTROL STATION.—Turn the D-C (Sperry), or D. E. C. (General Electric) switch at the control station to ON. Zero the azimuth zero indicator by turning the azimuth handwheel in the required direction. Adjust the binocular mount until the binoculars are pointing away from the observers' handwheels, using the azimuth reference mark if available. Slew the control unit around the tripod until the binoculars are directed at the aiming point.

■ 74. CHECKING AZIMUTH DIRECTION OF ROTATION.—*a.* Traverse the SCR–268, keeping the zero indicator needle centered at the control station by means of the azimuth controller's handwheel. The direction of traverse of the searchlight

must be the same as the SCR–268, that is, clockwise rotation of the SCR–268 must result in clockwise rotation of the searchlight.

b. If the direction of rotation is incorrect—

(1) Return the SCR–268 and the searchlight to the aiming point.

(2) Throw the COARSE AZIMUTH reversing switch in the terminal box of the SCR–268.

(3) With both units pointing exactly on the aiming point, zero the zero indicators again.

(4) Again check the sensing of the zero needles.

(5) Again check the direction of rotation.

SECTION III

ORIENTING AND SYNCHRONIZING 1941 SEARCHLIGHTS IN ELEVATION

■ 75. AIMING.—*a.* The SCR–268 and the searchlight are pointed at a distant aiming point, by means of their sights, or held at the same angular height.

b. Lock the searchlight in position by means of the elevation brake or clamp.

■ 76. ZEROING ELEVATION ZERO INDICATOR NEEDLES.—*a.* The elevation zero indicators on the searchlight and control station may or may not read zero.

b. They must be made to read zero by—

(1) Turning the COARSE ELEVATION SELSYN at the SCR–268.

(2) Or, on the Sperry, the adjustment may be made by turning the adjustment knob located on the left trunnion arm of the searchlight.

(3) Or, on the General Electric, the adjustment may be made at the searchlight by removing the cover of the elevation data receiver housing on the left trunnion arm, loosening the three screws and rotating the stator of the selsyn.

■ 77. CHECKING SENSING (NEEDLE DEFLECTION) OF ELEVATION ZERO INDICATOR.—*a.* It is possible to obtain two zero readings by rotating the elevation receiver stator. Release the elevation brake or clamp, and manually depress the searchlight. The needle of the elevation zero indicator at the searchlight should move clockwise.

b. If the needle moves in the wrong direction, return the searchlight to the aiming point and apply the brake or clamp. Turn the COARSE ELEVATION SELSYN adjustment at the SCR–268 continuously in one direction until the needle moves off scale and then returns to zero reading again.

NOTE.—The SCR–268 adjustment has a stop limiting its rotation. If the stop is encountered, rotate back to the first zero reading position, and then continue to rotate until the needle moves off scale and again returns to zero reading.

c. Release the elevation brake or clamp and turn the clutch lever to the D. E. C. position. Do not force.

■ 78. CONTROL STATION.—Turn the elevation handwheel to zero the needle of the elevation zero indicator. Slew the binocular mount in elevation only, until the binoculars are accurately aimed at the aiming point.

■ 79. CHECKING ELEVATION DIRECTION OF ROTATION.—*a.* Elevate the SCR–268 slowly, keeping the zero indicator centered by means of the elevation handwheel at the control station. The searchlight should also elevate.

b. If the searchlight depresses—

(1) Return the SCR–268 and the searchlight to the aiming point, using the elevation controller's handwheel for the searchlight.

(2) Throw the COARSE ELEVATION reversing switch in the terminal box of the SCR–268.

(3) With both units pointing exactly on the aiming point, again zero the zero indicators.

(4) Again check the sensing of the zero needles.

(5) Again check the direction of rotation.

SECTION IV

ORIENTING AND SYNCHRONIZING 1941 SEARCHLIGHTS BY BACKSIGHTING

■ 80. AIMING.—*a.* Carefully level the SCR–268, searchlight, and control station. Direct the SCR–268 away from the searchlight.

b. The searchlight is pointed as follows:

(1) Disengage the azimuth clutch knob by pulling the azimuth clutch handle in the direction indicated as OUT on the Sperry searchlight or HAND CONTROL on the General Electric searchlight.

(2) Turn the searchlight in azimuth and elevation until it points directly at the sight on the SCR–268. Then reengage the azimuth and elevation clutches by pushing the clutch lever in the direction IN on the Sperry and D. E. C. on the General Electric.

(3) On the Sperry searchlight, start the power plant and throw on the main switch. On the General Electric searchlight, start the power plant, throw on the main switch, and be sure the dynamotor is running.

c. At the same time, a man looks backward through the SCR–268 sight and directs the azimuth and elevation trackers until this sight is aimed on the cross hairs of the searchlight orienting sight. The SCR–268 and the searchlight are now pointed in the same direction.

■ 81. AZIMUTH RING OF SEARCHLIGHT.—Observe the azimuth reading at the SCR–268, and set the azimuth scale at the searchlight so that the same reading appears under the pointer index.

■ 82. ELEVATION.—Read the angular height counter at the SCR–268 and the angular height scale at the searchlight. These readings should be the same, indicating that they are both oriented in elevation.

■ 83. SYNCHRONIZATION.—Hold the SCR–268 and searchlight stationary, zero the zero indicators, check sensing, and check direction of rotation, as described in the preceding sections. The SCR–268 and the searchlight are now oriented and synchronized in azimuth and elevation.

■ 84. CONTROL STATION.—*a.* Traverse and elevate or depress the SCR–268 until a man looking backward through the SCR–268 sight sees that this sight is directed toward the binoculars.

b. At the same time turn ON the D-C (Sperry), or D. E. C. (General Electric), switch at the control station and turn the

controller's handwheels until both zero indicators are zero with correct sensing. Adjust the binocular mount until the binoculars are pointing away from the observers' handwheels, using the azimuth reference mark if available. Slew the control station in azimuth and elevation until the binoculars of the control station are directed at the eyepiece of the sight on the SCR–268.

c. Do not attempt to depress the SCR–268 below zero, as this requires several steps. If it should be necessary to depress below zero to align the sights as described, stop at zero, go ahead and zero the zero readers, and slew the control station in azimuth until the sights are aligned in azimuth only, and then set the binoculars at their zero reference mark in elevation.

d. The searchlight, the control station, and the SCR–268 are properly oriented and synchronized in azimuth and elevation.

SECTION V

ORIENTING AND SYNCHRONIZING 1941 SEARCHLIGHTS IN AZIMUTH WHEN CONTROL STATION IS NOT USED

■ 85. AIMING.—*a.* Direct the SCR–268 and searchlight at the distant aiming point.

b. Start the power plant and throw the main switch on.

■ 86. AZIMUTH RING OF SEARCHLIGHT.—Observe the azimuth readings at the SCR–268, and set the azimuth scale at the searchlight so that the same reading appears under the pointer index.

■ 87. ZEROING AZIMUTH ZERO INDICATOR NEEDLES.—Zero the azimuth zero reader. On the Sperry searchlight, turn the AZIMUTH SYNCHRONIZING knob. On the General Electric searchlight, turn the AZIMUTH CORRECTOR knob.

■ 88. CHECKING SENSING (NEEDLE DEFLECTION) OF AZIMUTH ZERO INDICATOR.—*a.* It is possible to obtain two zero readings by rotating the azimuth stator. The correct zero reading is obtained when the needle deflects clockwise as the searchlight is traversed clockwise (increasing azimuth).

560814°—43——3

b. If the needle moves in the wrong direction, return it to zero by turning the searchlight. Hold the searchlight and turn the AZIMUTH SYNCHRONIZING knob continuously in one direction until the needle moves off scale and then returns to zero reading again.

■ 89. CHECKING AZIMUTH DIRECTION OF ROTATION.—*a.* Traverse the SCR–268, keeping the zero indicator needle at zero by traversing the searchlight. The direction of traverse of the searchlight should be the same as the SCR–268, that is, clockwise rotation of the SCR–268 should result in clockwise rotation of the searchlight.

b. If the direction of rotation is incorrect—

(1) Return the SCR–268 and the searchlight to the aiming point.

(2) Throw the COARSE AZIMUTH reversing switch in the terminal box of the SCR–268.

(3) With both units pointing exactly on the distant aiming point, again zero the zero indicators.

(4) Again check the sensing of the zero needles.

(5) Again check the direction of rotation.

SECTION VI

ORIENTING AND SYNCHRONIZING 1941 SEARCHLIGHTS IN ELEVATION WHEN CONTROL STATION IS NOT USED

■ 90. AIMING.—The SCR–268 and searchlight are aimed at a distant aiming point, or held at the same angular height.

■ 91. ZEROING ELEVATION ZERO INDICATOR NEEDLE.—*a.* The elevation zero indicator at the searchlight may or may not read zero.

b. It must be made to read zero by—

(1) Turning the COARSE ELEVATOR SELSYN at the SCR–268.

(2) Or, on the Sperry searchlight, the adjustment may be made at the searchlight by turning the adjustment knob located on the left trunnion arm of the searchlight.

(3) Or, on the General Electric searchlight, the adjustment may be made at the searchlight by removing the cover of the

elevation data receiver housing on the left trunnion arm, loosening the three screws, and rotating the stator of the selsyn.

■ 92. CHECKING SENSING (NEEDLE DEFLECTION) OF ELEVATION ZERO INDICATOR.—*a.* It is possible to obtain two zero readings by rotating the elevation receiver stator. The correct zero reading is obtained when the needle of the elevation zero indicator deflects clockwise as the light is depressed.

b. If the needle moves in the wrong direction, return the searchlight to the aiming point and turn the COARSE ELEVATION SELSYN adjustment at the SCR–268 continuously in one direction until the needle moves off scale and then returns to zero reading again.

NOTE.—The SCR–268 adjustment has a stop limiting its rotation. If the stop is encountered, turn back to the first zero reading position, and then continue to turn until the needle moves off scale and then returns to zero reading again.

■ 93. CHECKING ELEVATION DIRECTION OF ROTATION.—*a.* Elevate the SCR–268 slowly, keeping the elevation zero indicator at zero.

b. If the searchlight depresses—

(1) Return the SCR–268 and the searchlight to the aiming point.

(2) Throw the COARSE ELEVATION reversing switch in the terminal box of the SCR–268.

(3) With both units pointing exactly on the aiming point, again zero the zero indicators.

(4) Again check the sensing of the zero needles.

(5) Again check the direction of rotation.

c. The SCR–268 and the searchlight are now oriented and synchronized in azimuth and elevation.

SECTION VII

ORIENTING AND SYNCHRONIZING 1942 GENERAL ELECTRIC AMPLIDYNE SYSTEM IN AZIMUTH

■ 94. AIMING.—*a.* Carefully level the SCR–268, searchlight, and control station.

b. Point the SCR–268 at the distant aiming point by using the sight.

c. The searchlight is directed at the same point by the following steps:

(1) With the azimuth clutch in HAND CONTROL, the elevation clutch in HAND CONTROL, and azimuth and elevation amplidyne switches OFF, start the seachlight power plant.

(2) Put the transfer switch at the control station in AUTOMATIC.

(3) Throw the main switch in the power plant to ON.

(4) Point the searchlight at the distant aiming point by sighting through the orienting sight.

■ 95. ZEROING AZIMUTH INDICATOR NEEDLES.—Zero the azimuth zero indicator by turning the AZIMUTH CORRECTOR located on top of the searchlight turntable after loosening the locking clamp. (See fig. 40.)

■ 96. CHECKING SENSING (NEEDLE DEFLECTION) OF AZIMUTH ZERO INDICATOR.—*a.* It is possible to obtain two zero readings by rotating the azimuth stator. The correct zero reading is obtained when the needle deflects clockwise as the searchlight is traversed clockwise (increasing azimuth).

b. If the needle moves in the wrong direction, return the searchlight to the distant aiming point and then turn the AZIMUTH CORRECTOR continuously in one direction until the needle moves off scale and again returns to zero reading. Again check for correct sensing.

c. When sensing is correct, traverse the light back to the distant aiming point, throw the azimuth clutch to D. E. C., and turn the azimuth amplidyne switch to the ON position.

d. Make sure the sight of the searchlight is aimed accurately at the distant aiming point. Adjust the AZIMUTH CORRECTOR if necessary.

■ 97. AZIMUTH RING OF SEARCHLIGHT.—Observe the azimuth readings at the SCR–268, and set the azimuth scale at the searchlight so that the same reading appears under the pointer index.

■ 98. CHECKING AZIMUTH DIRECTION OF ROTATION.—*a.* Traverse the SCR–268. The searchlight should follow in the same direction.

b. If the direction of rotation is incorrect—

(1) Return the SCR–268 and the searchlight to the aiming point.

(2) Turn the azimuth amplidyne switch to the OFF position.

(3) Throw the COARSE AZIMUTH reversing switch in the terminal box of the SCR–268.

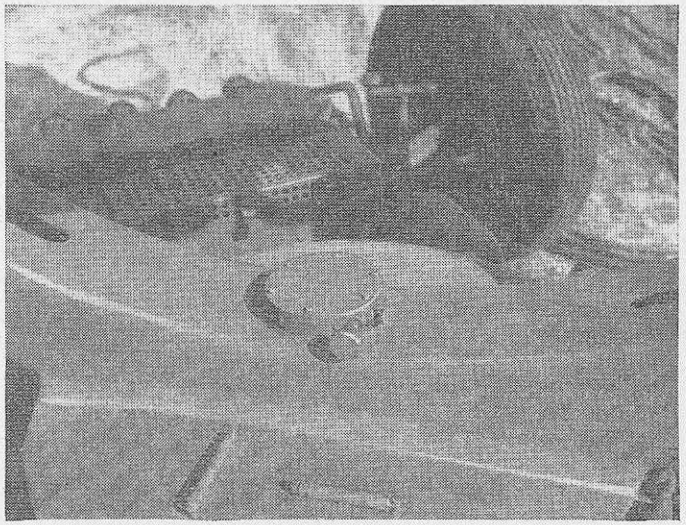


FIGURE 40.—Azimuth corrector on 1942 searchlight.

(4) Zero the azimuth zero indicator again.

(5) Throw azimuth cluth to HAND CONTROL.

(6) Again check for sensing.

(7) If sensing is correct, again aim the searchlight at the distant aiming point, throw the azimuth clutch to D. E. C., turn the azimuth amplidyne switch to ON, and accurately sight on the distant aiming point by using the AZIMUTH CORRECTOR.

■ 99. CONTROL STATION.—*a.* After the SCR–268 and searchlight have been oriented and synchronized in azimuth, the control station must be oriented and synchronized.

b. Aim the SCR–268 at the distant aiming point. With the transfer switch at the control station still in AUTOMATIC traverse the control station until the azimuth zero indicator is zeroed.

c. Check for sensing. When the azimuth handwheel is turned clockwise, the azimuth zero indicator needle should also deflect clockwise for correct sensing.

d. When sensing is correct, zero the azimuth zero indicator needle by turning the azimuth controller's handwheel.

e. Adjust the binocular mount until the binoculars are pointing away from the observer's handwheels.

f. Slew the control station on its friction clutch until the distant aiming point is accurately centered in the binocular field of view.

g. The searchlight, SCR–268, and the control station are now oriented and synchronized in azimuth.

SECTION VIII

ORIENTING AND SYNCHRONIZING 1942 GENERAL ELECTRIC AMPLIDYNE SYSTEM IN ELEVATION

■ 100. AIMING.—*a.* Carefully level the SCR–268, searchlight, and control station.

b. Point the SCR–268 at the distant aiming point by using the orienting sight.

c. The searchlight is directed at the same point by the following steps:

(1) It is assumed that power is on, the elevation clutch is in hand position, and that the elevation amplidyne switch is off.

(2) Sight the searchlight orienting sight at the distant aiming point, or set both the SCR–268 and the searchlight at the same angular height. The elevation brake on the searchlight may be used to hold it steady.

(3) Put the transfer switch at the control station in AUTOMATIC.

■ 101. ZEROING ELEVATION ZERO INDICATOR NEEDLES.—Zero the elevation zero indicator by turning the ELEVATION CORRECTOR screw located on the left trunnion arm of the searchlight after loosening the locking clamp.

■ 102. CHECKING SENSING (NEEDLES DEFLECTION) OF ELEVATION ZERO INDICATOR.—*a.* The zero indicator needle should swing clockwise as the light is depressed.

b. If the needle moves in the wrong direction, return the searchlight to the distant aiming point and find a new zero point by turning the ELEVATION CORRECTOR screw continuously in one direction. Check again for correct sensing.

c. When sensing is correct, set the light on the distant aiming point. Release the brake, turn the elevation clutch to D. E. C., and turn the elevation amplidyne switch to ON.

d. Make sure that the sight of the searchlight is aimed accurately at the distant aiming point. Adjust the ELEVATION CORRECTOR screw if necessary.

■ 103. CHECKING ELEVATION DIRECTION OF ROTATION.—*a.* Elevate the SCR–268. The searchlight should also elevate.

b. If the searchlight depresses—

(1) Return the SCR–268 and the searchlight to the aiming point.

(2) Turn the elevation amplidyne to OFF position, and throw the elevation clutch to HAND CONTROL.

(3) Throw the COARSE ELEVATION reversing switch in the terminal box of the SCR–268.

(4) Zero the elevation zero indicator again.

(5) Again check for sensing.

(6) If sensing is correct, again aim the sight at the distant aiming point, turn the elevation amplidyne to ON, and sight accurately on the distant aiming point by using the ELEVATION CORRECTOR screw.

■ 104. CONTROL STATION.—*a.* Aim the SCR–268 at the distant aiming point.

b. Turn the elevation controller's handwheel until the elevation zero indicator at the control station is zeroed.

c. Check for sensing by turning the elevation controller's handwheel clockwise. The zero indicator needle should deflect clockwise. If the needle moves in the wrong direction,

continue to turn the elevation controller's handwheel until a new zero point is found.

d. When the correct needle deflection has been found, carefully zero the needle.

e. Slew the binocular mount in elevation only until the binoculars aim accurately at the distant aiming point.

f. The searchlight, SCR–268, and control station are now oriented and synchronized in elevation.

SECTION IX

ORIENTING AND SYNCHRONIZING 1942 GENERAL ELECTRIC AMPLIDYNE SYSTEM BY BACKSIGHTING ON EQUIPMENT

■ 105. AIMING.—*a.* Carefully level the SCR–268, searchlight, and control station.

b. Point SCR–268 away from the searchlight.

c. The searchlight is pointed as follows:

(1) Place the azimuth and elevation clutches in HAND CONTROL and the azimuth and elevation amplidyne switches in OFF position, point the searchlight generally at the SCR–268, then reengage the azimuth clutch by pushing the clutch lever to D. E. C. position.

(2) Start the searchlight power plant. Put the transfer switch at the control station in AUTOMATIC. Throw the main power switch in the searchlight power plant to ON.

(3) Have a man at the searchlight carefully aim the searchlight orienting sight at the eyepiece of the SCR–268 sight, and hold the searchlight stationary.

d. At the same time, a man looks backward through the SCR–268 sight and directs the azimuth and elevation trackers until this sight is aimed on the cross hairs of the searchlight orienting sight. The SCR–268 and the searchlight are now pointed in the same direction.

■ 106. ZEROING AZIMUTH ZERO INDICATOR NEEDLE.—Hold the SCR–268 and searchlight stationary, zero the azimuth zero indicator by turning the AZIMUTH CORRECTOR located on top of the searchlight turntable.

■ 107. ZEROING ELEVATION ZERO INDICATOR NEEDLE.—Hold the SCR–268 and searchlight stationary, and zero the elevation zero indicator by turning the ELEVATION CORRECTOR screw located on the left trunnion arm of the searchlight after loosening the locking clamp.

■ 108. CHECKING SENSING OF AZIMUTH ZERO INDICATOR.—*a.* Traverse the searchlight clockwise (increasing azimuth) by hand and observe if the azimuth indicator needle deflects clockwise.

b. If the needle moves in the wrong direction, turn the searchlight back until the indicator is zero. Then turn the AZIMUTH CORRECTOR continuously in one direction until the needle moves off scale and then returns to zero reading again. Again check for correct sensing.

c. When sensing is correct, traverse the light to zero position and turn the azimuth amplidyne switch to ON.

d. Make sure that the sight of the searchlight is accurately aimed at the sight of the SCR–268. Adjust the AZIMUTH CORRECTOR if necessary.

■ 109. AZIMUTH RING OF SEARCHLIGHT.—Observe the azimuth readings at the SCR–268, and set the azimuth scale at the searchlight so that the same reading appears under the pointer index.

■ 110. CHECKING SENSING (NEEDLE DEFLECTION) OF ELEVATION ZERO INDICATOR.—*a.* The zero indicator needle should swing clockwise as the light is depressed.

b. If the needle moves in the wrong direction, turn the searchlight back until the indicator is zero. Then find a new zero by turning the ELEVATION CORRECTOR screw continuously in one direction. Check for correct sensing again.

c. When sensing is correct, return the light to zero position and turn the elevation amplidyne switch to ON.

d. Make sure that the sight of the searchlight is aimed accurately at the sight of the SCR–268. Adjust the ELEVATION CORRECTOR screw if necessary.

■ 111. CHECKING AZIMUTH DIRECTION OF ROTATION.—*a.* Traverse the SCR–268. The searchlight should follow in the same direction.

b. If the direction of rotation is incorrect—

(1) Return the SCR–268 and the searchlight to their original positions.

(2) Turn the azimuth amplidyne to the OFF position.

(3) Throw the COARSE AZIMUTH reversing switch in the terminal box of the SCR–268.

(4) Again zero the azimuth zero indicator.

(5) Throw azimuth clutch to HAND CONTROL.

(6) Again check for sensing.

(7) If sensing is correct, again aim the searchlight at the SCR–268, throw the azimuth clutch to D. E. C., turn the azimuth amplidyne switch to ON, and accurately sight on the sight of the SCR–268 by using the AZIMUTH CORRECTOR screw.

■ 112. CHECKING ELEVATION DIRECTION OF ROTATION.—*a.* Elevate the SCR–268. The searchlight should also elevate.

b. If the searchlight depresses—

(1) Return the SCR–268 and the searchlight to their original positions.

(2) Turn the elevation amplidyne to OFF position, and throw the elevation clutch to HAND CONTROL.

(3) Throw the COARSE ELEVATION reversing switch in the terminal box of the SCR–268.

(4) Again zero the elevation indicator.

(5) Again check for sensing.

(6) If sensing is correct, again aim the searchlight at the SCR–268, turn the elevation amplidyne to ON, and accurately sight on the sight of the SCR–268 by using the ELEVATION CORRECTOR screw.

■ 113. CONTROL STATION.—*a.* Traverse and elevate or depress the SCR–268 until a man looking backward through the SCR–268 sight sees that this sight is directed toward the binoculars of the control station.

b. Put the transfer switch at the control station in the MANUAL position.

c. Turn the controller's handwheels until both zero indicators are zero with correct sensing. Adjust the binocular mount until the binoculars are pointing away from the observer's handwheels. Slew the control station in azimuth

and elevation until the binoculars of the control station are directed at the eyepiece of the sight on the SCR–268.

d. Do not attempt to depress the SCR–268 below zero, as this requires several steps. If it should be necessary to depress below zero to align the sights as described, stop at zero, go ahead and zero the zero indicators, and slew the control station in azimuth till the sights are aligned in azimuth only, and then set the binoculars at their zero reference mark in elevation.

e. Turn the transfer switch to AUTOMATIC position.

f. The control station, the searchlight, and the SCR–268 are now oriented and synchronized in azimuth.

SECTION X

SUMMARY

■ 114. SUMMARY.—The essential steps in orienting and synchronizing an SCR–268 and searchlight are outlined in *a* and *b* below. This is a general summary of the specific steps outlined in sections II to IX, inclusive, of this chapter and should be used as a guide until personnel have reached proficiency.

a. Azimuth.—(1) Aim the SCR–268 and the searchlight at the distant aiming point.

(2) Slew the control station until the binoculars are on the distant aiming point.

(3) Set the azimuth ring at the searchlight.

(4) Zero the azimuth zero indicator needles.

(5) Check the sensing of the azimuth zero indicator (correct needle deflection).

(6) Check azimuth direction of rotation.

(7) If direction of rotation is wrong—

(*a*) Throw azimuth reversing switch.

(*b*) Again zero needles.

(*c*) Again check sensing.

(*d*) Again check direction of rotation.

b. Elevation.—(1) Aim the SCR–268 and the searchlight at the distant aiming point.

(2) Slew the control station in elevation until the binoculars are on the distant aiming point.

(3) Zero the elevation zero indicator needles.

(4) Check the sensing of the elevation zero reader (correct needle deflection).
(5) Check elevation direction of rotation.
(6) If direction of rotation is wrong—
(*a*) Throw elevation reversing switch.
(*b*) Again zero needles.
(*c*) Again check sensing.
(*d*) Again check direction of rotation.

SECTION XI

DETERMINATION AND APPLICATION OF CORRECTIONS BY TRACKING TARGETS

115. GENERAL.—*a.* An airplane is the best type of target to track but in many instances will not be available when needed.

b. In case there is no airplane available, a reflector can be made (fig. 41). This will serve as a radar target.

116. TRACKING.—*a.* During the day the SCR–268 tracks the target, and with power on, the azimuth and elevation controllers track zero indicator data at the control station.

b. Observe through the orienting sight on the searchlight and direct the adjustment of the AZIMUTH CORRECTOR and of the COARSE ELEVATION SELSYN adjustment until the line of sight remains on the target.

c. At the same time, adjust the sight of the SCR–268 until it is correct, and later set the angular height counter, as described in paragraph 50. Reset the azimuth ring of the SCR–268.

d. If desired, or if conditions warrant, reorientation of the searchlight and control station, instead of as in *b* above, may be accomplished after the sight of the SCR–268 has been corrected.

117. NIGHT TRACKING.—*a.* At night, the chief controller carries the target in the center of the beam while the SCR–268 tracks the target.

b. At the control station, observe the average deflections of the needles in both azimuth and elevation zero indicators. Observations are made with azimuth both increasing and decreasing, and with elevation both increasing and decreasing.

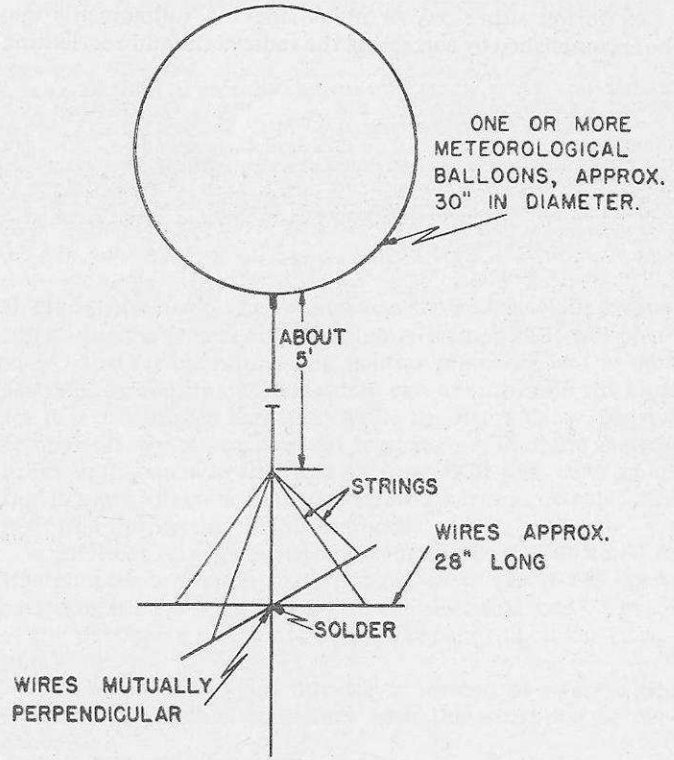


FIGURE 41.—Radar target for SCR–268.

If the trackers lag consistently, they are corrected. Since tracking becomes erratic when an airplane is turning or maneuvering, no adjustment should be made under those conditions.

c. Cease tracking, and with the SCR–268 held stationary,

traverse and elevate the searchlight to produce the same average zero indicator deflections as observed in tracking.

d. Hold both the SCR–268 and the searchlight stationary and adjust the AZIMUTH CORRECTOR and the COARSE ELEVATION SELSYN adjustments to zero the zero indicators.

e. During either day or night tracking, adjustments may be accomplished by correcting the radar sight and reorienting.

CHAPTER 5

OPERATION WITH ANTIAIRCRAFT GUN DIRECTOR

		Paragraphs
SECTION I.	General	118
II.	Special antenna adjustments	119–120
III.	Range system	121–127
IV.	Orientation and synchronization with AA director M4 and M7	128–133
V.	Determination and application of corrections	134–138

SECTION I

GENERAL

■ 118. GENERAL.—*a.* Experience has shown that with a carefully adjusted mount and thoroughly trained SCR–268 operators, director operators, and pointer matchers at the gun, satisfactory continuous firing data can be furnished the guns for firing at unseen targets. While the firing data does not compare favorably with visual tracking or later fire control radar units, such as the SCR–545 and SCR–584, continuous fire is more effective than the limited barrage or salvo fire delivered by plotting board methods.

b. Methods of orientation and synchronization outlined in this chapter are based upon the use of the SCR–268 sight, assuming it has been aligned with the electrical axis. Choice of the particular method to be used depends upon the situation.

c. In general, the gun director is located as near to the SCR–268 as possible, consistent with the principles of dispersion.

d. Parallax corrections between the directing point and the director, or between the directing point and the SCR–268, may be set in the director.

e. When the fire control plan contemplates a rapid change from SCR–268 data to visual data, it is probable that the parallax error will have to be tolerated for one of the cases, and location of the gun director near the SCR–268 minimizes the error.

f. Firing at unseen targets is practical *if the SCR–268 operators, director operators, and gun crews are thoroughly trained as a team.*

SECTION II

SPECIAL ANTENNA ADJUSTMENTS

119. AZIMUTH ADJUSTMENTS.—*a.* The lobe separation angle that gives the sharpest tracking with good sensitivity is the most desirable. Experience indicates that this lobe separation should be approximately 25°, as checked by the tweeter. At this lobe separation the ratio of pulse height at the match point to pulse height at the maximum points should be about 0.4.

b. A check of sharpness of tracking is made by checking the mismatch in echo height against angle of traverse away from the match point. With sensitivity adjusted to give a 2-inch signal from the tweeter at the match point, one-half turn of the handwheel in either direction should give a mismatch of approximately 1 inch.

c. The method of placing the tweeter for azimuth alignment is outlined in paragraph 40.

120. ELEVATION ANTENNA.—*a.* As in azimuth, the lobe separation angle that gives the sharpest tracking with good sensitivity is the most desirable. In general, the same principles hold; that is, increased lobe separation angle gives sharper tracking.

b. A match to maximum ratio (as determined on the buried tweeter) of 0.6 will give satisfactory tracking.

c. A further check of elevation antenna alignment is the tracking sharpness test. With the sensitivity adjusted so that a 2-inch signal appears on the scope, one-half turn of the elevation handwheel either way should give a pip mismatch of from ¾ to 1 inch.

d. The proper method of preparing the buried tweeter is described in paragraph 40.

SECTION III

RANGE SYSTEM

121. GENERAL.—For determining altitude accurately, it is necessary to have accurate slant range. To determine slant range most accurately, the following adjustments and checks are made:

a. Check the range oscilloscope.
b. Expand the base line of the range oscilloscope.
c. Check the range unit.
d. Check the range converter.

122. RANGE OSCILLOSCOPE.—The cathode ray tube must be checked to see that the picture is vertical. To make this check, turn the sweep control to minimum and, with the transmitter in operation, see if the resulting narrow pulse is parallel to the hairline. If not, loosen the holding screws and rotate the cathode ray tube until the pulse is parallel to the hairline. THIS ADJUSTMENT MUST BE MADE ONLY BY QUALIFIED MAINTENANCE PERSONNEL.

123. BASE LINE.—The method of expanding the base line is covered under range orientation.

124. RANGE UNIT.—The procedure for testing the range unit is outlined in the manual furnished with the range calibrator I–100.

125. RANGE CONVERTER.—*a.* The range converter is checked as follows:

(1) *Test No. 1.*—With the elevation shaft turned so that its associated counter reads zero, the altitude dial must indicate zero (plus or minus 50 yards) for all positions of the slant range shaft.

(2) *Test No. 2.*—With the slant range counter at zero, the altitude dial must indicate zero (plus or minus 50 yards) for all positions of angular height.

(3) *Test No. 3.*—Set angular height to read 533 mils. With any slant range set in, the altitude must read one-half the slant range setting (plus or minus 50 yards) between 0 and 20,000 yards slant range.

(4) *Test No. 4.*—Set in the following values of angular height and slant range.

Angular height (setting)	Slant range (setting)	Altitude (calculated)
400	10, 000	3, 827
500	10, 000	4, 714
600	10, 000	5, 556
800	10, 000	7, 071
1, 000	10, 000	8, 315
1, 200	10, 000	9, 239
400	5, 000	1, 913
500	5, 000	2, 357
600	5, 000	2, 778
800	5, 000	3, 535
1, 000	5, 000	4, 157
1, 200	5, 000	4, 619

b. The altitudes shown by the range converter must check the above calculated altitudes within 50 yards.

c. A careful analysis of the results of test No. 4 will indicate whether any errors found in the range converter are fixed errors in slant range, angular height, or altitude. Such fixed errors may be corrected by authorized maintenance personnel.

■ 126. RANGE ORIENTATION WITH EXPANDED SWEEP BY USING A FIXED ECHO.—*a.* For use of this method it is necessary that we be able to identify a fixed echo with the object causing it, and know the range to the object.

b. The horizontal positioning control of the range oscilloscope is set about midposition. On the azimuth and elevation oscilloscopes, spread is removed and sweep adjusted for about a 4-inch base line. The sweep control on the range oscilloscope is then turned to its maximum position (clockwise).

c. The sensitivity controls of each oscilloscope are set as high as possible without saturation, normally from 2 to 2½ inches for operation.

d. Using the range handwheel, position the center of the echo in the range oscilloscope under the hairline.

e. Loosen the coupling between the range converter and range unit, and without changing the range unit setting, adjust the range converter to indicate the known range to the object.

f. Tighten the coupling and check the position of the pulse in the range oscilloscope. If it has moved slightly, position it exactly under the hairline with the horizontal positioning control.

g. Using the horizontal positioning controls, set the pulse in the azimuth and elevation scopes under the hairline.

NOTE.—*If either end of the base line on the azimuth or elevation oscilloscopes extends off the edge of the scope screen, decrease the sweep control until all the base line is visible. Then readjust the horizontal positioning controls if signal is not exactly on hairline.*

h. Range orientation has now been completed. Movement of *any control* other than sensitivity or spread will destroy orientation.

■ 127. RANGE ORIENTATION WITH EXPANDED SWEEP BY MEANS OF REDUCED POWER.—*a.* With the SCR–268 operating, adjust the bias voltage at the keyer to maximum and by means of the plate control handwheel, adjust the rectifier output voltage to 1,000 volts.

b. Adjust the bias voltage at the keyer to produce a 2-inch pulse in the oscilloscope with minimum sensitivity.

c. The horizontal positioning control of the range oscilloscope is set about midposition. On the azimuth and elevation oscilloscopes, spread is removed and sweep adjusted for about a 4-inch base line. The sweep control on the range oscilloscope is then turned to its maximum position (clockwise).

d. Using the range handwheel, position the center of the peak of the main pulse in the range oscilloscope under the hairline.

e. Loosen the coupling between the range converter and

range unit, and without changing the range unit setting, adjust the range converter to indicate zero slant range.

f. Tighten the coupling and check the position of the pulse in the range oscilloscope. If it has moved slightly, position it exactly under the hairline with the horizontal positioning control.

g. Using the horizontal positioning controls, set the signal in the azimuth and elevation scopes under the hairline.

NOTE.—*If either end of the base line on the azimuth or elevation oscilloscopes extends off the edge of the scope screen, decrease the sweep control until all the base line is visible. Then readjust the horizontal positioning controls if signal is not exactly on hairline.*

h. Range orientation has now been completed. Movement of *any control* other than sensitivity or spread will destroy orientation.

SECTION IV

ORIENTATION AND SYNCHRONIZATION WITH AA DIRECTOR M4 AND M7

■ 128. GENERAL.—*a.* Orientation of the SCR–268 consists of adjusting the azimuth ring, the angular height counter, and the range counter to indicate correct position data.

b. Synchronization, used in conjunction with gun director, consists of adjusting the data transmission system so that correct data are continuously transmitted.

c. The following steps are taken at the SCR–268 before synchronization is attempted (see ch. 3):

(1) The azimuth antenna is aligned with the mechanical axis and with the sight.

(2) The elevation antenna is aligned with the mechanical axis and with the sight, and the angular height counter adjusted to indicate the true angular height of the electrical axis.

(3) Range orientation is completed. (See sec. III.)

■ 129. AZIMUTH BY USE OF A DISTANT AIMING POINT.—*a.* The SCR–268 and gun director must be carefully leveled.

b. Test for correct direction of rotation of azimuth receivers in the director by steadily traversing the SCR–268 and at the same time observing the inner dials at the director. (See fig. 42.)

c. With the SCR–268 rotating clockwise, azimuth coarse and fine inner dials should rotate clockwise. If either or both rotate in the wrong direction, throw the corresponding coarse

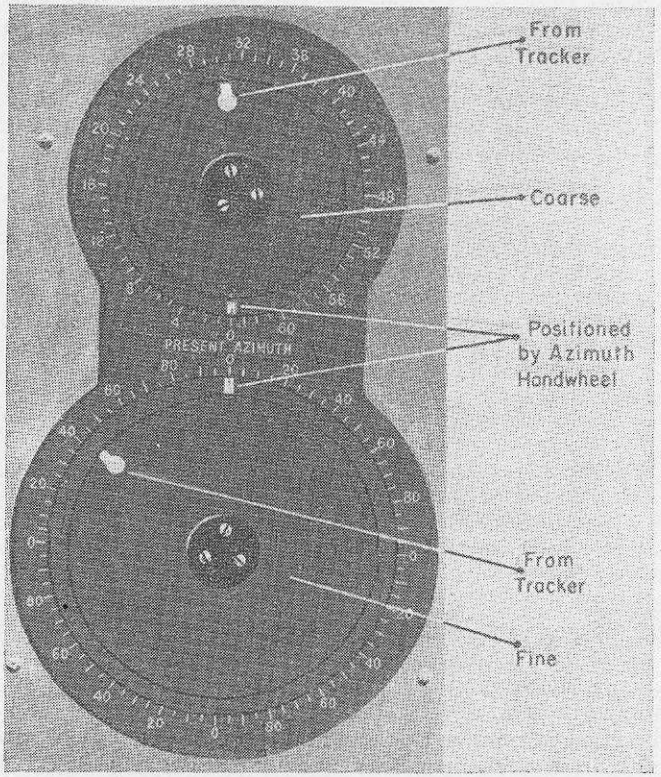


FIGURE 42.—Azimuth dials on M7 director.

or fine azimuth reversing switch in the terminal box at the SCR–268, and again check the direction of rotation.

d. An orienting point is chosen, some object visible from both director and SCR–268, and preferably at a range of several thousand yards.

e. Traverse and elevate the gun director and the SCR–268

until the azimuth telescope of the director and the sight of the SCR–268 are pointed accurately at the aiming point.

f. Orient the director in the usual manner.

g. The parallax correction depends upon the distance to the orienting point and the distance between the SCR–268 and director, measured at right angles to the line of sight.

■ 130. AZIMUTH BY BACKSIGHTING ON EQUIPMENT.—*a.* Check the direction of rotation of azimuth receivers in the director as described in paragraph 129.

b. With the director oriented, traverse and elevate the director and SCR–268 until the director is pointed at the SCR–268 and the SCR–268 is pointed away from the director. Then aim the azimuth director telescope accurately at the eyepiece of the SCR–268 sight and, looking backward through the SCR–268 sight, aim at the azimuth director telescope.

c. Match the inner and outer azimuth coarse and fine pointers at the director by using the AZIMUTH COARSE and FINE selsyn adjustments at the SCR–268.

d. Read the azimuth at the director and set it on the SCR–268 azimuth ring by loosening and moving the azimuth ring until the correct value appears under the index.

■ 131. ANGULAR HEIGHT.—*a.* Carefully level the SCR–268 and director. Check the direction of rotation of the angular height receivers by slowly elevating the antennas of the SCR–268 and at the same time observing the inner angular height dials at the director. (See fig. 43.)

b. As the SCR–268 antennas are elevated, the inner angular height dials at the director should indicate increasing angular height. If either or both dials rotate in the wrong direction, throw the corresponding coarse or fine elevation reversing switch in the terminal box and again check for direction of rotation.

c. The SCR–268 antennas are set at some convenient angular height, as read on the angular height counter in the range converter (for example, 400 mils), and held stationary, the director telescopes being set at the same angular height.

d. Pointers of the inner and outer angular height dials at the director are made to match by changing the coarse and fine elevation selsyn adjustments at the SCR–268.

■ 132. ALTITUDE SYNCHRONIZATION.—*a.* Check the direction of rotation of the altitude selsyn receiver in the director by

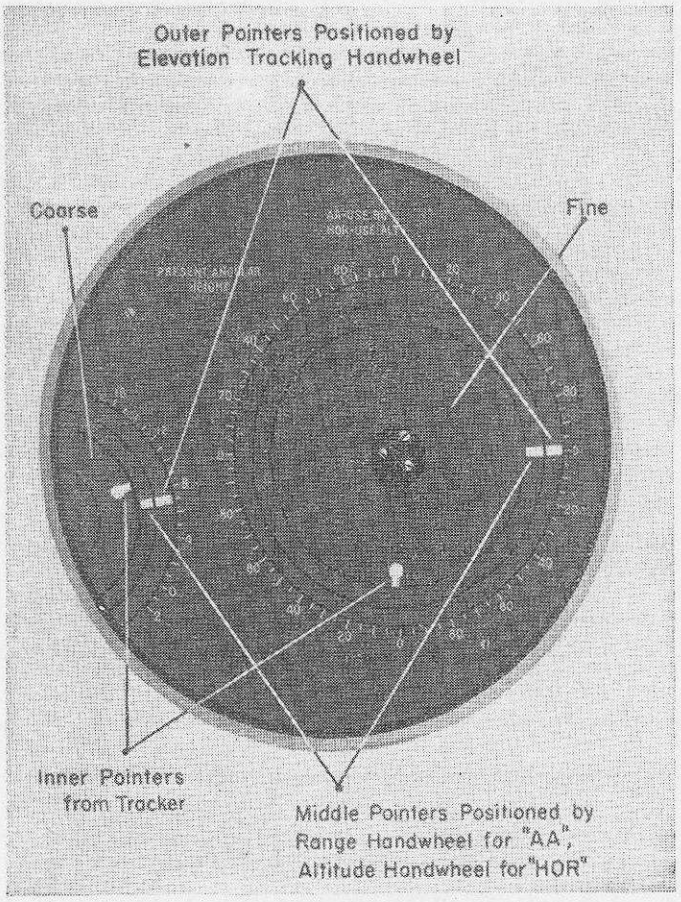


FIGURE 43.—Angular height dials on M7 director.

steadily increasing the altitude reading at the SCR–268, and at the same time observing the inner altitude dial on the

director. (See fig. 44.) The dial should rotate clockwise, indicating that altitude is increasing. If the direction of rotation is wrong, throw the altitude reversing switch in the

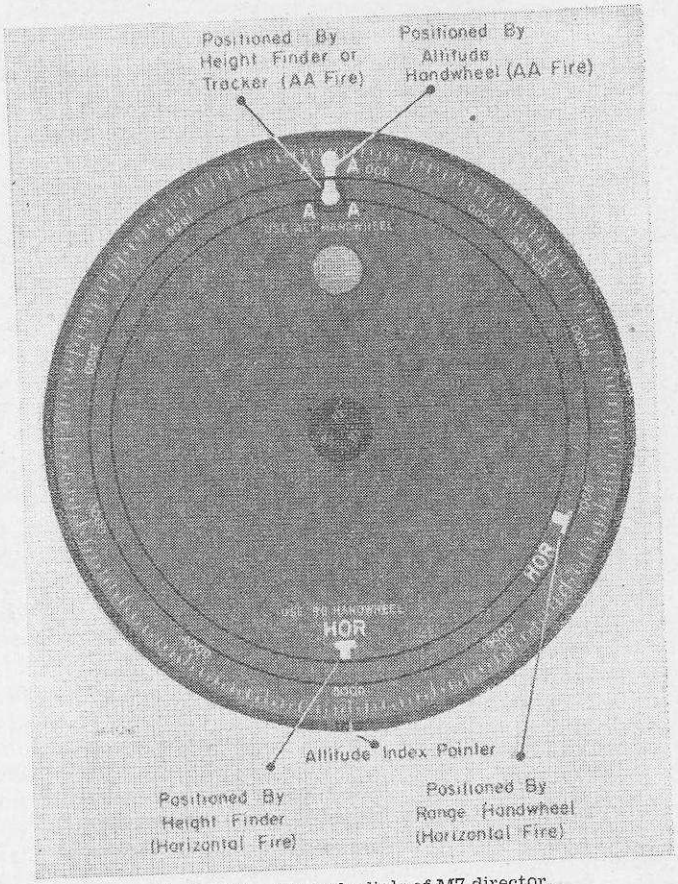


FIGURE 44.—Altitude dials of M7 director.

terminal box at the SCR–268, and again check for correct direction of rotation.

b. To make the altitude steadily increase at the SCR–268, set a slant range of several thousand yards and steadily elevate the antennas.

c. The range handwheel is turned and the antennas elevated until the altitude dial indicates 5,000 yards. (In place of 5,000 yards, the altitude at which targets are expected may be used.)

d. The altitude-setting handwheel on the front of the di-

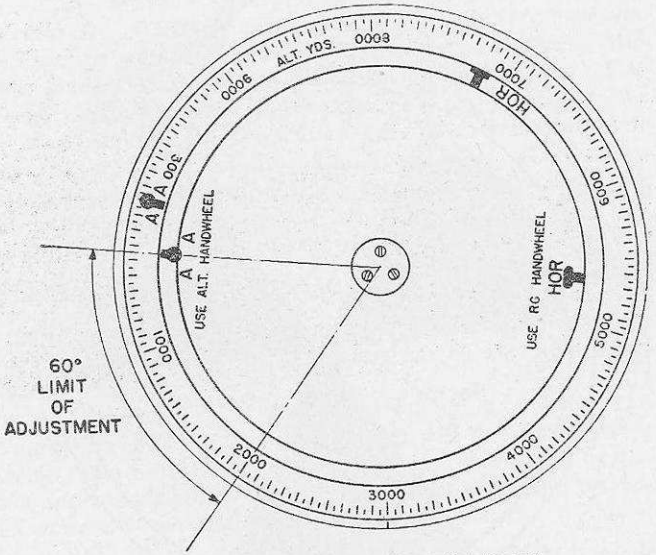


FIGURE 45.—Limit of altitude adjustment.

rector is turned until the 5,000-yard mark (or altitude chosen) is opposite the index.

e. The pointers on the inner and outer dials marked AA are made to match by changing the altitude selsyn adjustment in the range converter on the SCR–268.

f. As issued with the SCR–268, the altitude selsyn transmitter in the range converter has two stops which limit adjustment to about 60°.

■ 133. SPECIAL SYNCHRONIZATION ADJUSTMENTS IN ALTITUDE.—*a.* If the range converter of the SCR–268 reads 3,000 yards and the director reads as shown in figure 45, the limits of the stops prevent adjustment. In this case it is necessary to modify the range converter. This work must be done by qualified maintenance personnel.

b. As discussed in paragraph 68, there are in each repeater, two power stator leads and three phase rotor leads. The

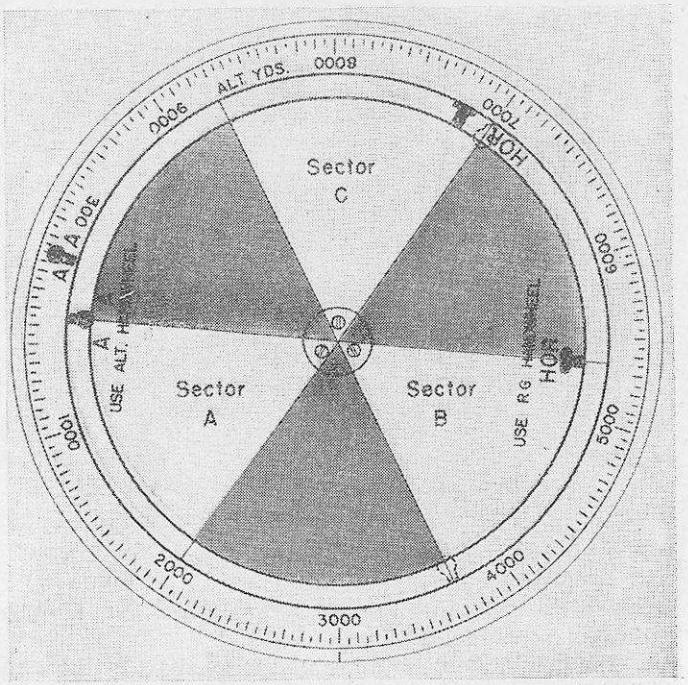


FIGURE 46.—Altitude dial.

lead numbers for the altitude selsyns are 14 and 15 for power and 9, 10, and 19 for phase leads. Figure 46 shows three unshaded sectors, A, B, and C, each a 60° sector of correction limits. Obviously, sector A cannot be used since the

pointer cannot be matched. However, by rotating the phase leads in the JB–22, that is, placing 9 on 10, 10 on 19, and 19 on 9, the pointer is moved into either sector B or C 120° from A, as shown in figure 46.

c. The sector desired, in this case, is sector B. If the pointer, after rotating leads, positions itself in sector C, the altitude setter at the director directs one more rotation, that is, 9 to 19, 10 to 9, and 19 to 10. After this has been accomplished the altitude setter notes that the pointer (finally in sector B) is 180° from the desired sector. To position the detector pointer in the desired sector, he directs the power leads (14 and 15) in the JB–22 to be reversed. The present altitude pointer is then matched by means of the adjusting screws on the range converter. A thorough knowledge of the entire procedure given above is necessary for a complete understanding of the altitude synchronization problem.

SECTION V

DETERMINATION AND APPLICATION OF CORRECTIONS

■ 134. GENERAL.—*a.* An airplane is the best type of target to track, but in many instances will not be available when needed.

b. In case there is no airplane available, a reflector can be made, as shown in figure 41. This will serve as a radar target. The number of balloons will be determined by the wind and the visibility. Ideally, the reflectors should be carried upward at an angular height of from 400 to 800 mils.

■ 135. TRACKING BALLOON.—*a.* Point the SCR–268 at the balloons and as soon as the echo emerges from the main pulse, commence tracking with the SCR–268 and director. (A strong signal may be expected.)

b. Using improvised forms and upon signal, record the differences in azimuth and elevation between the SCR–268 (inner dials) and the director (outer pointers), as read at the director.

c. Azimuth readings are taken upon command of the azimuth tracker. He signals "Azimuth take" when his pulses are exactly matched.

d. In a similar manner record angular height errors. Angular height readings are taken upon command of the elevation tracker. He signals "Elevation take" when his pulses are exactly matched.

e. After a series of readings, comparisons are made to determine the average errors. Readings are taken in one sector and the average parallax angle computed and considered in determining the average error.

■ 136. TRACKING AN AIRPLANE.—*a.* Record data as described in paragraph 135.

b. Certain precautions must be taken to minimize errors. The ranges at which the airplane is tracked and readings or observations are made must be great enough to make parallax errors negligible.

c. Observation of recordings is made with azimuth both increasing and decreasing, and with elevation both increasing and decreasing. If the trackers are then found to lag consistently, they are corrected.

d. Exclude readings or observations made when the target is turning, or maneuvering, or where azimuth or angular height is changing rapidly.

■ 137. AZIMUTH.—*a.* If an error in azimuth is determined, hold director and SCR–268 stationary and, by changing the AZIMUTH FINE selsyn adjustment at the SCR–268, move the inner dial in the correct direction.

b. Now, with pointers matched, the azimuth ring of the SCR–268 is changed to indicate the azimuth read at the director.

c. The SCR–268 sight may be reset by use of a distant aiming point. Point the director at the distant aiming point, match pointers by traversing the SCR–268, and then adjust the SCR–268 sight to aim at the distant point. Allow for parallax.

■ 138. ANGULAR HEIGHT.—*a.* If a definite error in angular height is determined, a correction is applied. The following general steps are taken:

(1) Reset the angular height counter in the range converter to indicate the true angular height.

(2) Synchronize again in angular height. It is necessary to reset the angular height counter in order that true altitude may be computed.

b. While tracking a balloon or airplane, the SCR–268 pointer at the director and the angular height counter at the SCR–268 may indicate too great a value. If the angular height counter is changed to compensate for this error without resetting the stop in the housing on the elevation handwheel shaft, the next time the antennas are depressed against the stop, the counter will stop at zero and the angular height shaft to the range converter will slip or the coupling will break.

c. If the SCR–268 pointer at the director and the angular height counter indicate too small a value, increase the counter to the correct reading. It is not necessary to change the stop in this case.

d. The steps to be taken in making a correction when the SCR–268 pointer at the director is 20 mils *low* are outlined below.

(1) Depress the antennas against the stop.

(2) Holding the antennas stationary, and using the micrometer adjustment, increase the reading of the angular height counter by 20 mils.

(3) Synchronize again in angular height.

e. The steps to be taken in making a correction when the SCR–268 pointer at the director is 20 mils *high* are outlined below:

(1) Depress the antennas until the angular height counter indicates 20 mils.

(2) Holding the antennas stationary, use the micrometer adjustment to change the counter reading to zero.

(3) Elevate the antennas a few turns of the handwheel.

(4) Remove bolts holding the housing above the elevation handwheel, and rotate the housing one complete turn, clockwise, as viewed from below.

(5) Replace and tighten bolts.

(6) Synchronize *again* in angular height.

f. Moving the stop up one complete turn allows a correction to 53 mm. Raising the stop one-fourth turn allows approximately 13 mm correction to be put in.

CHAPTER 6

OPERATION

	Paragraphs
SECTION I. General	139
II. Adjustments for operation	140–149
III. Detection of targets	150–152
IV. Tracking	153–155
V. Closing station	156

SECTION I

GENERAL

■ 139. GENERAL.—This chapter describes the procedure for operation of the SCR–268. No specific reference to any AA component is inferred, the operation only for general tracking being outlined. Since the radar can be operated in conjunction with searchlights, gun batteries, and aircraft warning or intelligence systems, the tactical employment and methods of operation differ. These differences in operation are discussed in chapter 7, which describes the exact procedures for operation with the various components. The procedures below apply to the unit itself and can be utilized to advantage for instructional purposes only. These procedures form merely a basis for the more complicated procedures under each type of tactical employment used.

SECTION II

ADJUSTMENTS FOR OPERATION

■ 140. INSPECTION OF COMPONENTS AND CONNECTIONS.—Before any power is turned on, make certain that—

a. The cases of all components are grounded (ground straps connected).

b. Ground stakes are driven firmly into the ground.

c. Antennas are not bent, there is no broken tubing, missing insulators, loose joints, or bad connections.

d. Transmission lines are correctly connected.

e. All cables are properly connected and fastened.

f. All components are firmly held in place.

g. Sufficient gasoline is available for operation of the unit.

■ 141. POWER UNIT.—*a.* After preparation of the power unit for service, as directed by the manufacturer's instruction book, put it into operation. Turn the field exciter rheostat

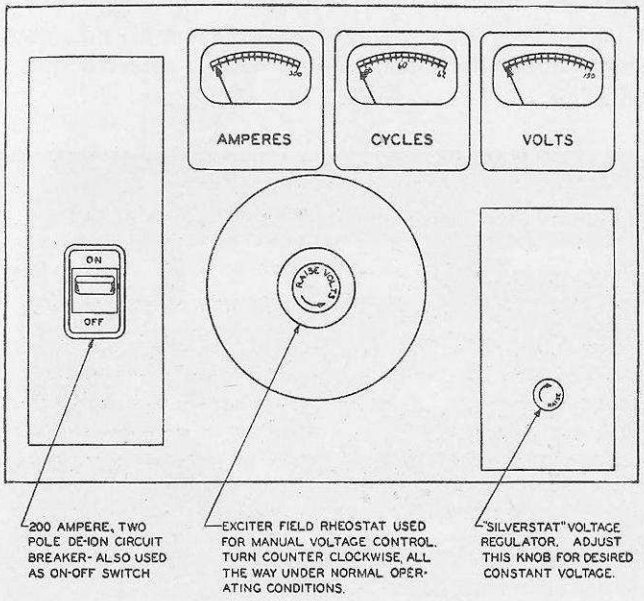


FIGURE 47.—Power unit panel.

on the power unit panel counterclockwise as far as possible. Then adjust the voltage regulator knob to make the voltmeter above it read 118 volts. This operation keeps the voltage substantially constant. It may be necessary, however, to vary this voltage later so that the correct voltage is supplied to the filaments in the modulator.

b. Next turn on the main power switch on the power unit panel. (See figs. 47 and 48.) If the frequency does not remain between 59.5 and 60.5 cycles under load, the governor

of the gasoline engine must be adjusted. In that case, refer to the instruction manual for the unit, adjusting to 60 cycles under full-load conditions.

c. Power plant life can be extended and repairs reduced by making use of 60-cycle commercial power when it is available. In any fixed defense or semipermanent set-up, effort should be made to provide such power.

■ 142. RECTIFIER.—*a.* In order to set the rectifier into operating readiness, the following procedure is observed (figs. 49 and 50):

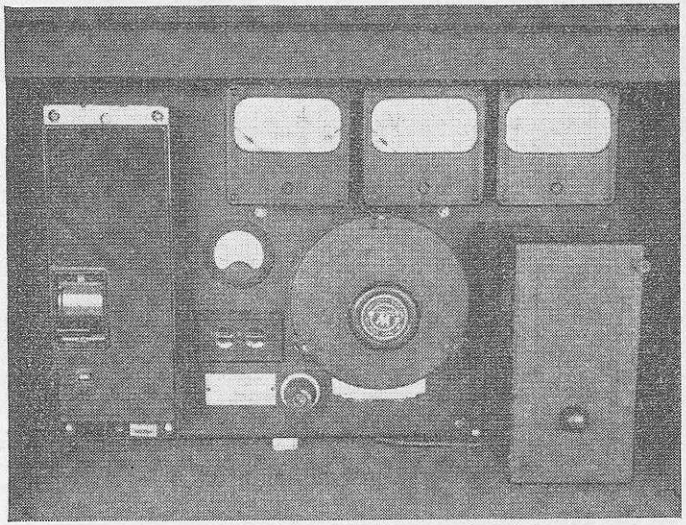


FIGURE 48.—Photograph of power unit panel (new type).

(1) With key No. 1 unlock lockswitch *C*, and remove key No. 2 from lock *D*; then with key No. 2, unlock lockswitch *E*.

(2) Press line ON button and filament ON button.

(3) Adjust the filament voltage to the red mark on the filament voltmeter by means of the filament control handwheel.

(4) The remote control cable permits the rectifier to be

thrown on or off at the keyer. This can be done, however, only after the time delay system has operated.

b. When first setting the rectifier into operation, the plate control handwheel is set at zero. The plate voltage may

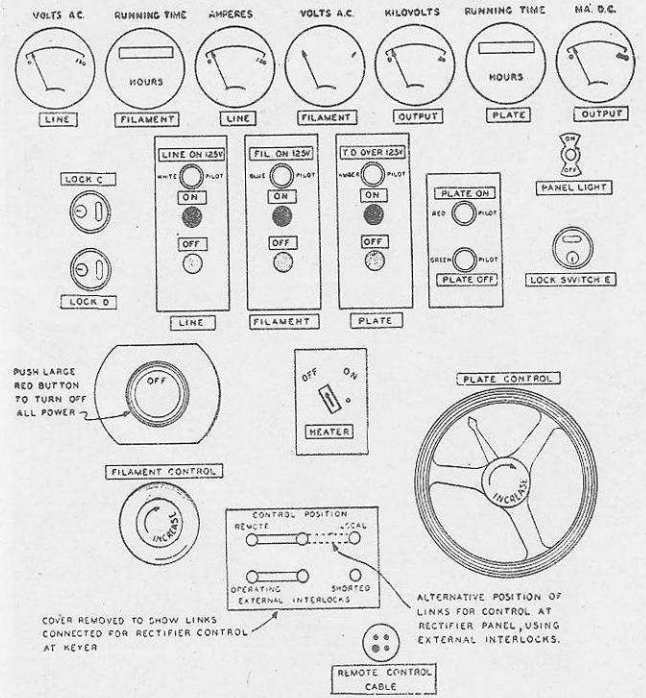


FIGURE 49.—Rectifier panel.

later be increased to the correct value if all other components are operating normally. Reference should be made to the manufaturer's instruction book for further details on the rectifier.

■ 143. JUNCTION BOX (JB–22).—With the power unit in operation, turn on the main power switch at the keyer. Then throw on all switches of the junction box (figs. 51 and 52), except the heater switch.

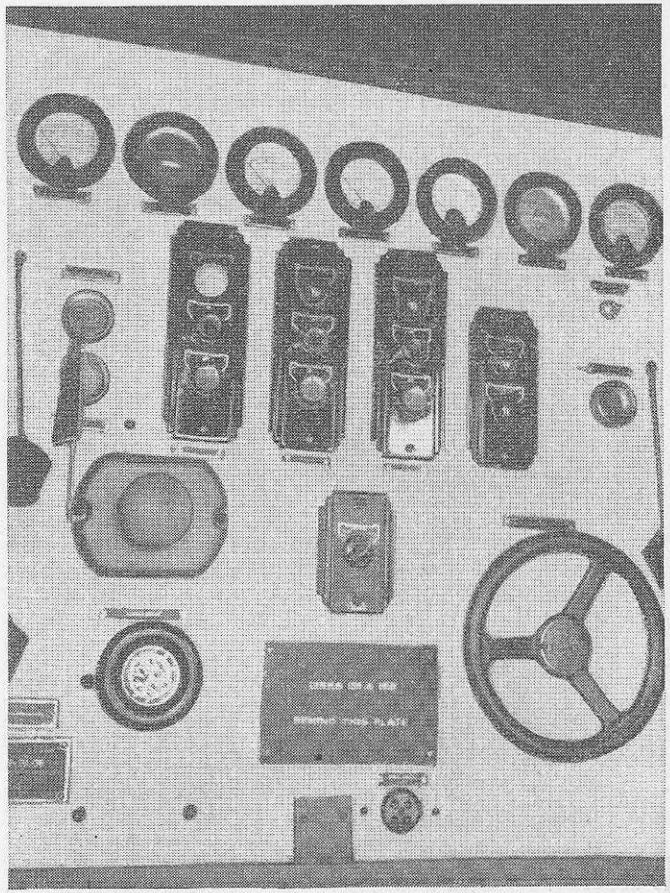


FIGURE 50.—Rectifier panel.

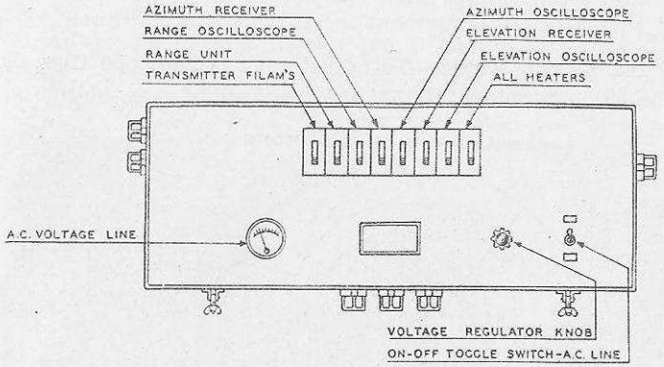


FIGURE 51.—Junction box JB–22.

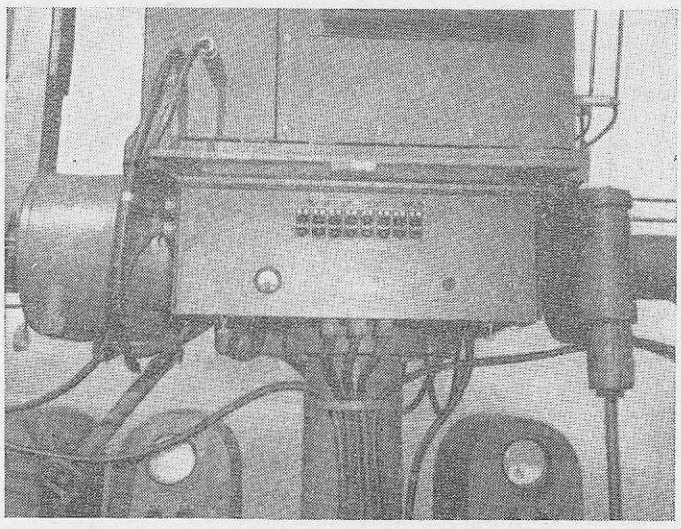


FIGURE 52.—Junction box JB–22.

Adjust the voltage regulator control so that the pointer of the transmitter filament meter is on the red line.

■ 144. OSCILLOSCOPES.—To adjust each oscilloscope (figs. 53 and 54) proceed as follows:

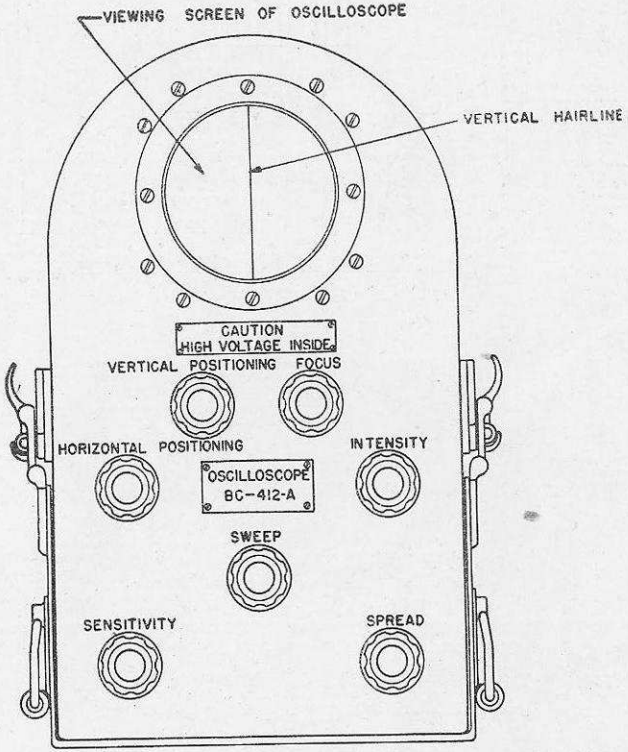


FIGURE 53.—Panel showing controls of oscilloscope BC–412–A.

a. Note the existence of sweep which manifests itself as a base line on the oscilloscope. This indicates operation of the keyer and range unit.

b. Adjust the intensity control so as to secure a sufficiently bright trace on the oscilloscope screen.

c. Adjust the focus control so that the trace on the screen is as clear cut as possible.

d. Adjust the sweep control so as to secure a 4-inch base line.

e. Adjust the vertical and horizontal positioning controls

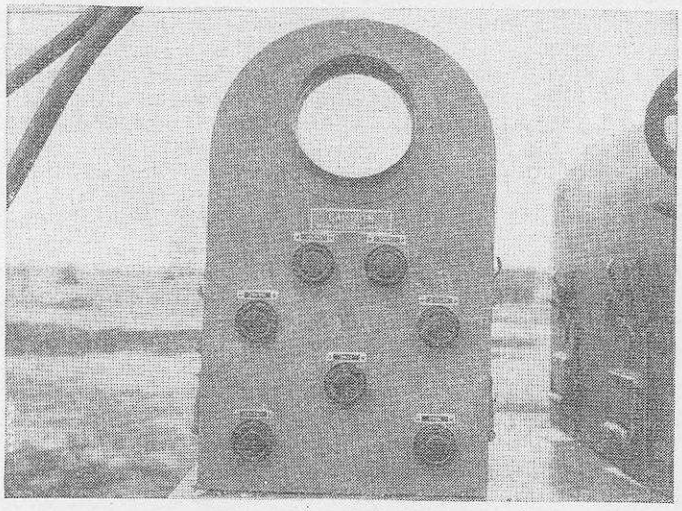


FIGURE 54.—Oscilloscope.

so that the base line is somewhat below center on the oscilloscope screen.

f. Note, with the sensitivity control at a maximum, that a high noise level appears above the base line. (Exists only when receivers have been properly tuned.)

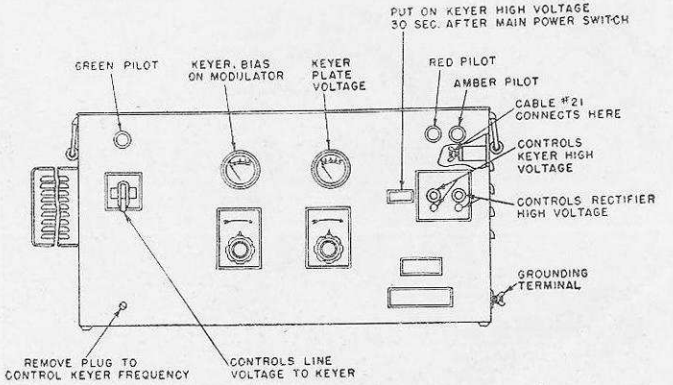
g. Vary the spread control and note that the base line expands and contracts laterally.

■ 145. KEYER.—*a.* Thirty seconds after closing the keyer main switch, the keyer high voltage may be applied (figs. 55 and 56). Check is made of the modulator filament voltage at this time and the voltage at the power unit panel readjusted, if necessary, to give proper filament reading.

b. With the keyer bias control at maximum, and the keying

supply voltage control at minimum, press the start button marked "Keyer high voltage." Adjust the keying supply voltage to read 3,000 volts on the meter directly above the control.

c. Push the start button marked RECTIFIER at the keyer. Red pilot light at rectifier panel must go on before turning



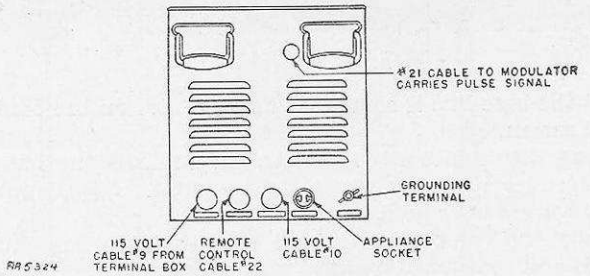


FIGURE 55.—Keyer.

plate control handwheel from REMOTE control. By means of the plate control handwheel at the rectifier panel, bring the voltage slowly up to 5,000 volts. Reduce the bias at keyer slightly, if necessary, to bring the transmitter grid current up to approximately 20 milliamperes, and tune the trans-

mitter rack by turning the TUNING KNOB (figs. 58 and 59) for minimum grid current. If all components are functioning properly, return bias control to maximum and bring the rectifier voltage up to 11,000 volts. Then adjust the bias at the keyer to bring the transmitter plate current gradually up to 300 milliamperes, and retune rack on the transmitter for minimum grid current.

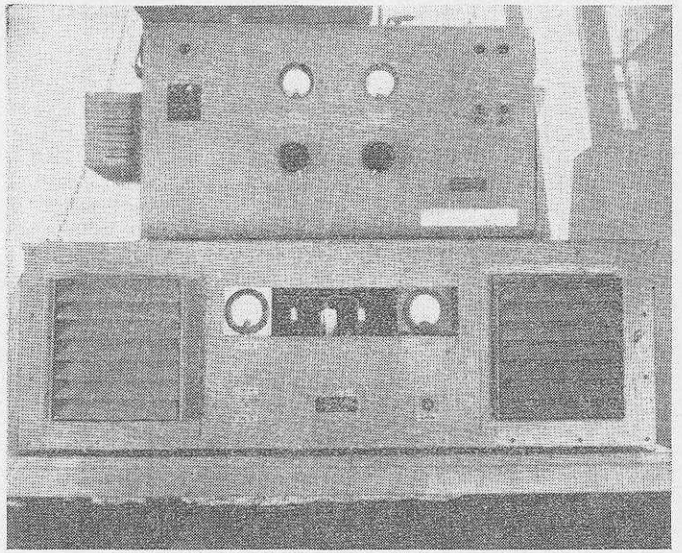
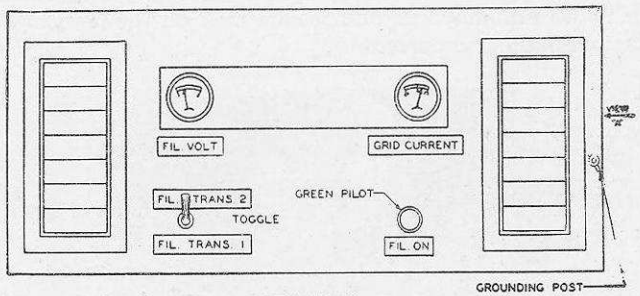


FIGURE 56.—Keyer and modulator.

146. RANGE UNIT.—Check the range unit for proper operation through the complete range by means of the range handwheel.

147. TRANSMITTER.—*a.* The tuning knob at the side of the transmitter is adjusted for the minimum grid current. The correct position of the stub on the transmission line gives the correct ratio between plate current and grid current. This position has been marked with paint and should require no adjustment. The keyer bias is reduced to produce a trans-

mitter plate current as close to 300 milliamperes as possible. The transmitter should then be operating with the following values (fig. 58):



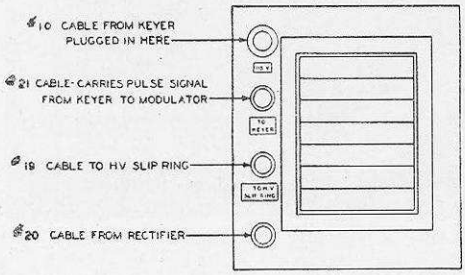


FIGURE 57.—Modulator BC-435-A.

Transmitter
filaments____ 5.1 volts (readjust voltage regulator knob at junction box if necessary)
Plate current___ 300 milliamperes (approximate)
Grid current___ 60 milliamperes

b. The transmitter must not ordinarily be operated with the grid current appreciably under 60 milliamperes, or one-fifth of the plate current.

c. The values as given in *a* above do not necessarily apply to all units. Some units will have tags specifying values for

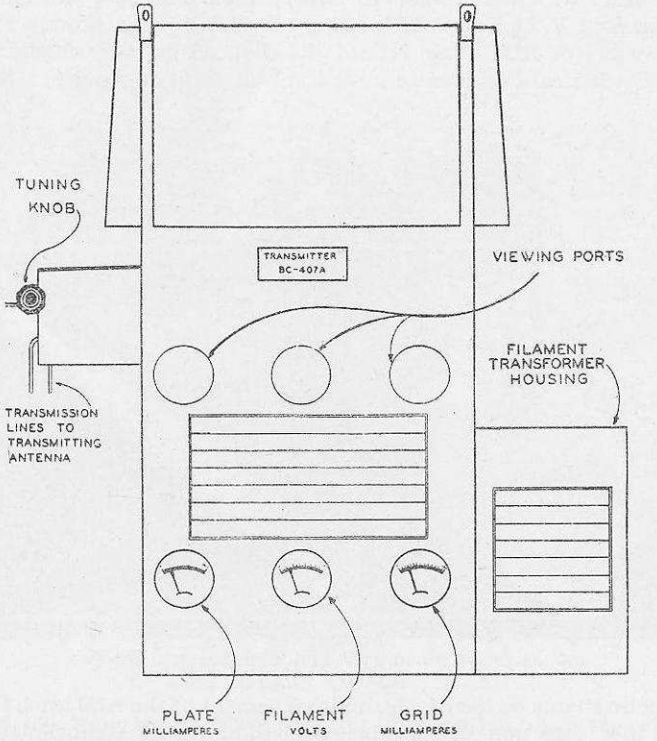


FIGURE 58.—Transmitter and filament transformer.

correct operation of that particular unit. Those specified values are followed in such special cases. An example of such a case is found in later models of the B mount, which have been made to operate with 275 milliamperes plate current, 55 milliamperes grid current, and 5.1 volts on the filament.

■ 148. FREQUENCY METER.—In order to check the transmitting frequency of the unit, use is made of the frequency meter BC–438 (fig. 60). To operate the meter, plug the lead cable into the 115-volt (a-c) socket at the keyer. Next, plug the phones in the socket marked PHONE at the meter. Turn switch at lower center to ON position and also switches marked V. O. and XTAL. Now set dial to read exactly 50. By use of ADJ knob, left of the dial, adjust the whistling that is heard in phones until the null point is reached. No

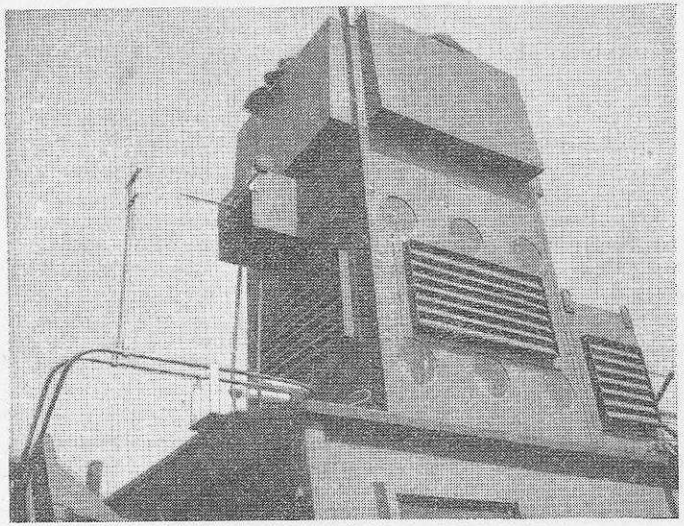


FIGURE 59.—Transmitter and filament transformer.

noise should be heard. A slight movement of the ADJ knob in either direction will produce whistling. Next (transmitter must be operating) turn OFF switch marked XTAL, and turn center dial until loud rushing noise is heard. Read the vernier and apply this reading to graph (pasted in top cover) to obtain transmitting frequency.

■ 149. RECEIVERS.—Point the antenna arrays at any object with a range sufficient to provide a suitable fixed echo. Adjust the tuning of both the elevation and azimuth receivers

until the greatest height of echo is obtained on the screens of their respective oscilloscopes. (See figs. 61 and 62.) This is done by placing a screw driver in slot marked OSCILLATOR TUNING CONTROL (fig. 61) and turning the tool as directed by the scope operator. Figure 63 shows receiver mounted in K–28–C.

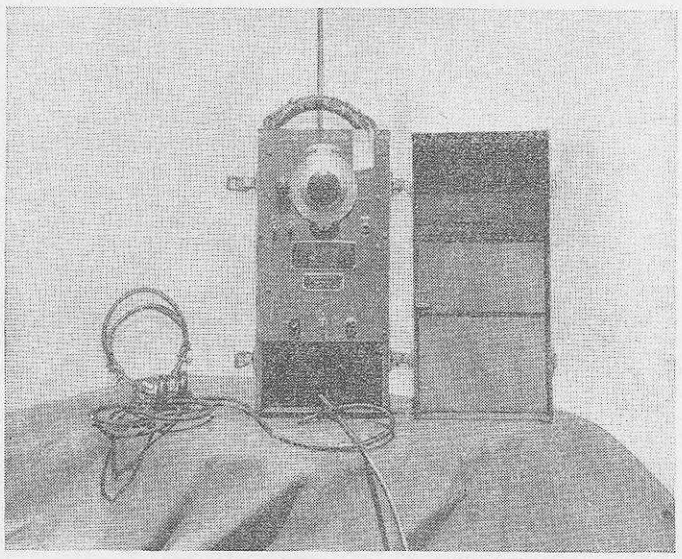


FIGURE 60.—Frequency meter BC–438.

SECTION III

DETECTION OF TARGETS

■ 150. SEARCHING.—With the unit in operation, properly oriented and synchronized with the associated equipment, the azimuth operator adjusts the sensitivity control to a high level and slowly traverses the antennas back and forth across the sector to be searched. At the same time the elevation operator adjusts his sensitivity control and sets the angular height at 100 and 300 mils above the mask for alternate azimuth sweeps. When more than one echo appears on the

screen of the oscilloscope, the range operator designates the one to be tracked.

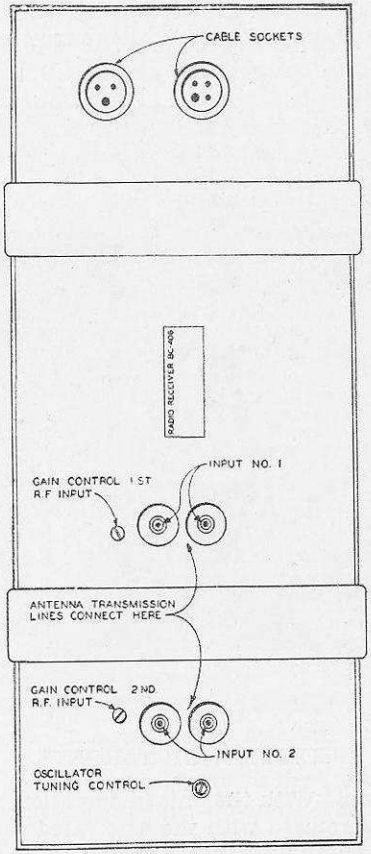


FIGURE 61.—Control panel of receiver BC–406.

■ 151. AZIMUTH AND ELEVATION.—With the target designated, the azimuth and elevation operators match the echoes on the screens of their respective oscilloscopes, pointing the antenna

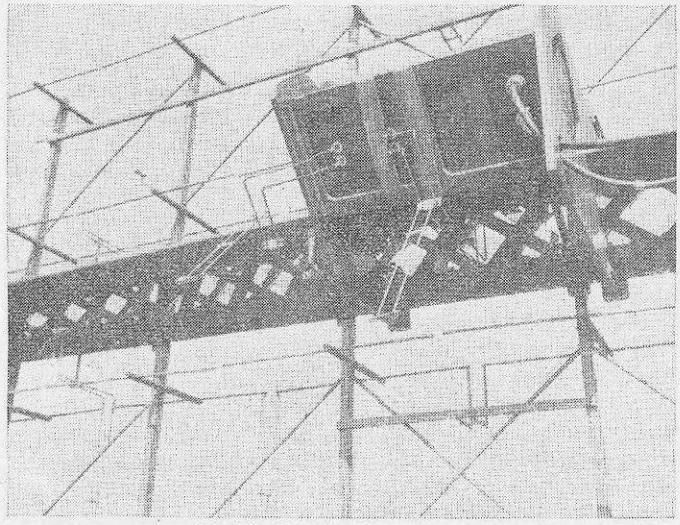


FIGURE 62.—Receiver mounted in K–28–A and K–28–B.

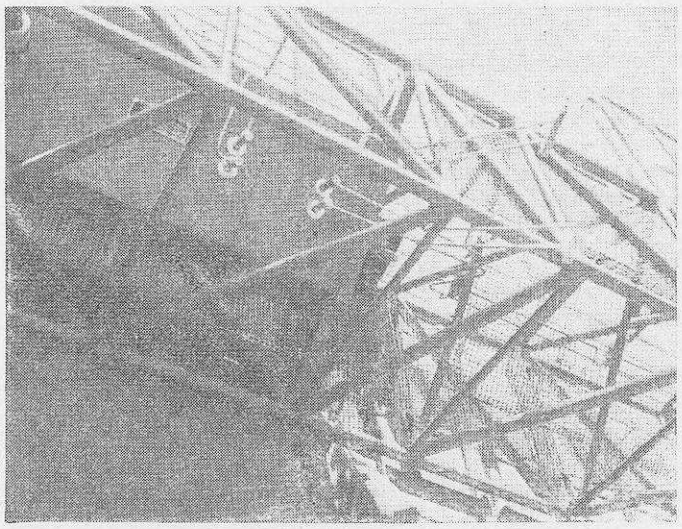


FIGURE 63.—Receiver mounted in K–28–C.

arrays directly at the target, and thus transmit azimuth and angular height data to the searchlight or director.

152. ALTITUDE.—The range operator meanwhile moves the peak of his echo to the vertical hairline, thus measuring the slant range which is mechanically combined with angular height to compute altitude. Altitude, in turn, is transmitted electrically to the gun director.

SECTION IV

TRACKING

153. SMOOTH TRACKING.—*a.* The tracking operations are carried out continuously. When tracking a target, it is absolutely essential to track smoothly in order to provide correct information for the director. There must be no sudden bursts of speed "to catch up." Instead, the various handwheels are turned at a smooth enough rate to keep the split echoes always equal. Smooth tracking of this type enables the director to predict the future position of aerial targets with greater accuracy.

b. When operating with searchlights, the split echoes are alternately raised and lowered slightly from the match point to counteract any tendency on the part of the operator to lag the target. The difference in height of the split echoes should not exceed ¼-inch in either direction for a 2-inch echo, and should be correspondingly less for an echo of a lesser height. This slight oscillation of echoes is obtained *by increasing and decreasing the rate of rotation of the handwheels, and not by a reversal of rotation.*

154. MOVING OBJECTS.—Ordinarily there are several different echoes indicated on the oscilloscope screen, some fixed objects and some aircraft. In most cases the operator is able to distinguish between fixed and moving echoes. Fixed echoes are found to maintain a more or less constant height and are positively identified by constant azimuth, elevation, and range. Moving objects, such as airplanes, produce echoes which vary in height continually.

155. TRACKING DIFFICULTIES.—*a.* During normal operation, one of the split echoes on the elevation oscilloscope screen

grows larger and the other smaller when the elevation handwheel is turned one way, while the opposite is true when rotating this handwheel in the opposite direction. If this correspondence of handwheel rotation with echo variation reverses—that is, the wrong echo grows larger—then the arrays are not on target, and false information is being sent to the searchlight or gun director. When a condition of this sort occurs, the antenna arrays are rotated in elevation until the correct tracking point is found. This false tracking point usually manifests itself in angular height determinations only, but it may sometimes occur in azimuth tracking. Both the elevation and azimuth trackers must be always alert to these possibilities.

b. In tracking, one other difficulty may occur. If the target is beyond the maximum of the range scale, the echo returns after *two* pulses have been omitted by the transmitter. The equipment of the radio set cannot assimilate this information properly. Therefore, false information is sent to the gun director regarding altitude. However, the operators of the radio set can usually determine this condition. If it is found that the angular height of the target is close to zero, that the slant range reading of the converter is small, and that the echo received is of small magnitude, then the actual slant range of the target is probably beyond the maximum of the scale.

c. With a very close approach of a target, the echo grows very strong and disappears into the main pulse. Under these conditions the sensitivity is decreased, and the spread increased to a point where equalization of the echoes can be carried out as soon as their emergence from the main pulse becomes evident.

SECTION V

CLOSING STATION

156. TEMPORARY CLOSING.—If it is desired to close the station and no change of location is contemplated before the next operation of the set, the following procedure is carried out:

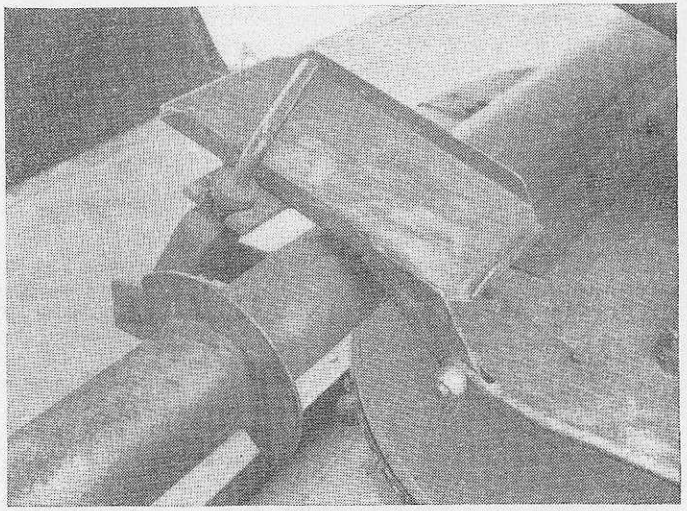


FIGURE 64.—Azimuth foot brake.

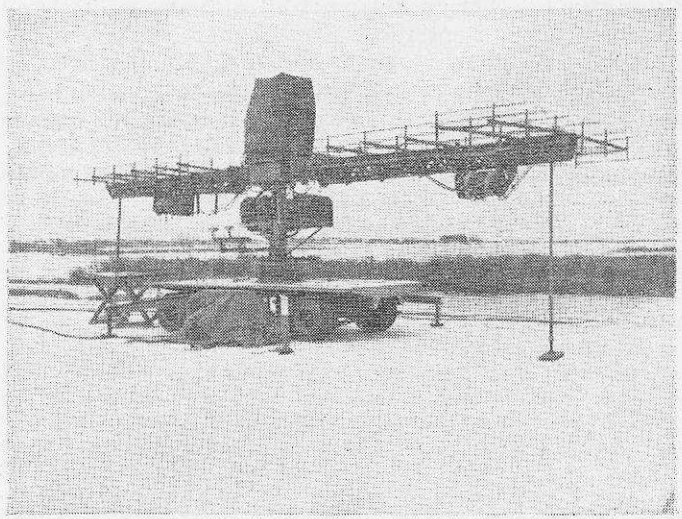


FIGURE 65.—SCR–268 in temporary close station.

a. Turn BIAS VOLTAGE to maximum and press rectifier STOP button.

b. Turn KEYING SUPPLY VOLTAGE to minimum and press keyer STOP button.

c. Throw keyer main switch to OFF position.

d. Turn off the filaments and line power to the various components at the junction box.

e. Return plate handwheel to zero setting and press filament and line STOP buttons to remove voltage from rectifier. Remove key No. 2 from lockswitch E, insert in lock D and turn. Remove key No. 1 from lockswitch C and lock the control panel door.

f. Throw off the main switch at the power panel.

g. Shut down the power plant.

h. Place canvas covers over the various units of the radio set.

i. Elevate the antenna arrays so that their plane is parallel to the earth. Tighten the azimuth brake on the footrest. (See fig. 64.)

j. Place the antenna stand-by supports in place as shown in figure 65. These supports should each be inclined at the same angle so that their thrusts oppose each other. This prevents rotation of the mount if the foot brake fails to hold.

k. If the stand-by period is to be for a short time, the power unit and heaters for the various components are left in operation.

CHAPTER 7

EMPLOYMENT

		Paragraphs
SECTION. I.	General	157
II.	Fighter-searchlight team	158–163
III.	Firing at unseen targets	164–169
IV.	Aircraft warning	170

SECTION I

GENERAL

■ 157. TYPES OF EMPLOYMENT.—*a.* This chapter deals with the more important types of employment of the SCR–268 arising from possible functions as listed in section IV, chapter 1. Specifically, these types may be listed as follows:

(1) With searchlights for illumination of targets for fighter aircraft.

(2) For furnishing data to gun batteries for unseen targets.

(3) Solely for warning purposes.

b. Actual tactics of the employment of the primary unit with which the radar is operating are omitted. Such tactics are found in pertinent Field Manuals pertaining to those units. References in appendix VII give complete information.

SECTION II

FIGHTER-SEARCHLIGHT TEAM

■ 158. GENERAL.—The operation discussed in the paragraphs below includes only the employment of the radar within the fighter-searchlight team. FM 4–106 covers the complete tactical functions of the team itself.

■ 159. ORGANIZATION OF DETECTOR SECTION.—The following list serves as a guide to the personnel required for efficient operation of the radar section of radar-searchlight section:

CRO Chief radar operator.
1 Range operator.
2 Azimuth tracker.

3 Elevation tracker.
4 Keyer-modulator attendant.
5 Power plant-rectifier operator.
6 Azimuth data reader.
7 Range data reader.
8 Telephone operator.

■ 160. DUTIES OF CHIEF RADAR OPERATOR.—The CRO, under the supervision of the section chief, is responsible for the *tactical* operation of the radar. During action, he stations himself on the radar platform where he supervises the selection of targets and tracking by the oscilloscope operators. The radar telephone operator on the platoon command net keeps the CRO informed of action being taken by other sections in the platoon by repeating all information transmitted over the net. Information on approaching targets being plotted on the AAAIS plotting board is also relayed to him through the platoon CP. The CRO must *never* allow himself to be distracted from his primary concern of keeping in touch with the whole aspect of the situation and possible future action in the area, by becoming absorbed in watching the searchlight beam in his own section while it is in action.

■ 161. OPERATION FOR WARNING.—*a. Searching.*—Normally, only certain radars of the outer ring are in operation at one time. The remainder stand by with power on with the exception of the high voltage. Those units designated as searching units traverse continually back and forth over the sector assigned. When *any scope operator* detects a target he immediately calls, "Contact" loudly enough for the other scope operators, the data readers, the telephone operator, and the detector commander to hear. The azimuth data reader repeats, "Contact" over the data line to the AAAIS plotting room. The telephone operator reports, "Contact" over the platoon net. Each scope operator locates the target in his oscilloscope and commences tracking.

b. Operation while tracking.—When each scope operator gets accurately on target he announces, "Range (azimuth or elevation) on target." Due to low angular heights being inaccurate at long ranges, the elevation tracker in most cases is the last to get on target. However, for relocation boards,

only azimuth and range are initially necessary. The two elements of data are sufficient for determining the position of the enemy. Friendly fighters can be dispatched on these data and later receive the altitude of the enemy upon which is based the altitude of the interceptor attack. The data are continuously read and transmitted to the plotting room, giving a plot of the course of enemy approach. At various intervals, the radar telephone operator transmits range readings over the platoon net, thus informing the light commander when searchlight action is imminent.

c. Change target.—The radar ceases tracking a target only on the order of the CRO, when the intersection is established, or when the target passes beyond the searchlight range. The notice from the AAAIS plotting room, "Cease sending data", should not be interpreted by the CRO to change target, as this merely indicates that the plotting room is using plotted data from another radar.

■ 162. TRACKING FOR ILLUMINATION.—When the range drops below 15,000 yards and the angular height is above 300 mils, thus insuring accurate data, the CRO calls, "Range" and the detector telephone operator repeats "Range" over the platoon net. Thus the information that the target is within range is transmitted to the control station telephone operator. The *light* commander then knows that the target can be tracked. Satisfied then that the data are correct, the *light* commander immediately orders the light "IN." The CRO watches for an intersection and upon seeing this condition calls, "Intersection." This command is given only when the target is illuminated in that intersection. The azimuth data reader at the detector repeats, "Intersection", on the AAAIS line which, in turn, is called aloud in the plotting room by the plotter.

■ 163. SELECTION OF TARGETS.—The selection of targets is primarily the responsibility of the CRO. Since he cannot maintain constant supervision of the oscilloscope operators and, at the same time, efficiently perform his tactical duties, the oscilloscope operators must be trained in the selection of targets in accordance with the following principles:

a. Targets in column.—When several targets approach in

column on the same flight path, they are usually spaced far enough apart (20 seconds to a minute) so that there is a good chance to pick up all of them, one at a time. Therefore, the nearest target is selected by the range operator and tracked until it is illuminated; then, the next nearest is selected, and so on.

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

c. Targets stacked in altitude.—(1) When several targets stacked in altitude approach, one directly above the other, the target at the highest altitude is selected by the elevation tracker. The elevation tracker is in the best position to make this selection, since the individual airplanes in such a formation fail to appear as separate echoes on the azimuth oscilloscope screen, and produce echoes very close together or even overlapping on the range oscilloscope screen, because the differences in range and azimuth between the individual airplanes are small. The elevation tracker can tell which is at the highest elevation by elevating the antenna and noting

which echo is the last to rise. The echo which rises last, that is, increases its height at the highest angle of elevation of the antenna, is the airplane at the highest altitude. From its position in relation to the center line on the oscilloscope, he can judge whether the range operator must increase or decrease the range in order to center that particular echo on the center line of the oscilloscope; if the echo is on the *left* of the center line, the range must be *decreased*, while if it is on the *right* of the center line the range must be *increased*. Upon the approach of airplanes stacked up in altitude, then, the elevation tracker must first determine which of the several echoes he sees is from the airplane at the highest altitude; he then must call directions to the range operator, so that the latter can align that echo with the center line of the elevation scope; finally, all three oscilloscope operators must track that target.

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

d. Loose formations.—Airplanes attacking in loose formation, separated by several hundred yards, present a special case of the laterally spaced attack discussed in *b* above. The general solution is the same: each radar tracking the formation centers on the target closest to its normal front, but the actual selection of the target by the azimuth trackers may be more difficult because the echoes from the individual targets may blend together into a single multipeaked echo due to the relatively small separation of the airplanes. The azimuth tracker, in this case, must be extremely careful in scrutinizing the multipeaked echo as he traverses the radar, so that he can determine which peak is closest to the center of his normal front and direct the range operator accordingly. The greatest chance for error in handling a formation of this sort, in which the airplanes are close enough together so that

the entire formation can pass between two adjacent first line lights, is the possibility of the first line radars tracking the airplanes on the nearest side of the formation and allowing the front, or point, of the formation to enter the area unilluminated. This is likely to happen unless the formation directly approaches one of the lights, so that the center of the formation is dead ahead. In order to decrease the possibility of the point of a loose formation slipping through unilluminated, the second line radars pay particular attention to the *center* of such a formation until the first line lights have gone into action and it can be seen whether or not any of the first line lights are directed at the center of the formation. If all the first line lights are apparently working on the *sides* of the formation, then the second line radars direct their lights to the *center* of it. After the formation has been illuminated and the total number of airplanes involved becomes more evident, the tactical problem of maintaining proper illumination is handled in accordance with the tactical principles of searchlight employment.

e. Close formations.—When airplanes attack in close formation, the oscilloscope operators are unable to track individual airplanes, but are able to determine from the appearance of the echo that there is more than one airplane approaching. No attempt is made to select individual targets in this case, but the formation as a whole is tracked.

SECTION III

FIRING AT UNSEEN TARGETS

164. GENERAL.—*a.* As a standard method, all antiaircraft artillery gun batteries equipped with the SCR–268 set are trained to use this set connected to the M4, M7, M9, or M10 directors for delivering fire at unseen targets.

b. Experience has shown that by care in training the SCR–268 operators and gun-pointer matchers, satisfactory firing data can be furnished to the guns for firing at unseen targets. While the firing data do not compare favorably with the data obtained from visual tracking or improved radar sets, continuous fire is considered much more effective than the limited barrage or salvo type of fire delivered by plotting

boards. This training must include careful alignment and orientation of the SCR–268 and careful synchronization with the director.

c. The orientation in range may be checked by observing trial fire bursts. When conducting trial fire, the radar unit is laid on the TSP in azimuth, angular height, and range as computed for the detector position. A narrow strip of cross section paper is held in place near the range oscilloscope cross hair and a mark is made as the pip due to burst occurs. The scale factor of the range oscilloscope near the center of the screen is determined by checking on the main pulse; hence the distance between the center of the marks and the cross hair is a measure of the range deviation. The true range of the burst is determined from O_1 and O_2 visual observation. If necessary, the range orientation of the SCR–268 is changed to agree with actual range obtained. This insures that the whole system is working on equal ranges. This procedure is followed whenever firing trial fire in a battery equipped with radar.

■ 165. INDIVIDUAL PERSONNEL TRAINING.—*a.* Effective firing data are obtained by a continuous and cumulative smoothing process. This process requires special effort on the part of each individual in the three distinct steps of the data computing and transmitting chain. These three steps take place at the SCR–268, the director, and the gun receivers.

b. Smoothness in tracking by the range, azimuth, and angular height operators at the SCR–268 is absolutely necessary to provide usable data for the director. Smoothness can be achieved only by careful and precise training. Azimuth and elevation operators must be trained to keep the split echoes on the oscilloscope screen equalized in height by turning their respective handwheels smoothly in the same direction, except when it is obvious from the echoes that the angular direction has changed. In equalizing the echoes a "pendulum effect must be avoided." Great care must be taken to overcome the tendency of the trackers to lag slightly.

c. On the directors, the trackers must be trained thoroughly in the same smooth-tracking procedure. This is particularly true of the azimuth tracker and range setter in matching pointers with the SCR–268 data. The director operators must remember that an airplane cannot reverse direction of travel instantaneously or suddenly change its angular rate of travel. Again, "pendulum" action in pointer matching must be avoided. Pointers must be matched by a continuous movement smoothly in the same direction as indicated by the data received from the SCR–268. Telephone communication between SCR–268 trackers and director operators assists in smoothing data. The SCR–268 range operator informs director operators when range is increasing, decreasing, or changing from a decreasing to an increasing rate. Azimuth and elevation trackers at the SCR–268 notify director matchers when their pips indicate a lead or lag.

d. Gun pointers must be carefully trained to disregard sudden oscillations of director data. If such oscillations occur, a steady rate is maintained by the gun pointers until the director data have again settled to a comparatively smooth rate. Manual operation of the guns is necessary to incorporate this third essential step of the smoothing process. *The remote control system should not be used for this type of firing.*

■ 166. DRILL.—*a. Communication.*—(1) A telephone line is established between the SCR–268 and the director with a hand set at each end. At the SCR–268, three head and chest sets are connected to the hand set. This provides a head and chest set for the azimuth tracker, elevation tracker, and range operator, leaving the hand set for the CRO.

(2) At the director, two head and chest sets are connected to the hand set. This provides a head and chest set for the azimuth tracker and a head and chest set for the range setter. The hand set is used by the chief of range section who sets in altitude.

b. SCR–268 operators.—(1) Searching is done in the usual manner by the azimuth and elevation trackers. As soon as they pick up a target the range operator sets his echo under the hairline by turning the range handwheel. In most cases the echo is not visible in the range oscilloscope because of the expanded sweep. At night, the range operator observes in the azimuth oscilloscope while turning the range handwheel. During daylight, the azimuth tracker prompts the range operator until the echo appears in the range oscillo-

scope. As soon as the pulse appears on the range oscilloscope, final adjustments in range are made.

(2) At long ranges the elevation tracker may not be able to match echo heights, due to ground reflections. However, as range decreases, a point is reached where the echo heights can be matched. As soon as the elevation tracker can match the echo heights, he establishes a steady rate and reports, "Elevation on target".

(3) The azimuth tracker keeps the echo heights matched as nearly as possible, trying to turn at a constant rate. He reports, "Azimuth on target" when the rate is steady.

(4) When the azimuth and elevation trackers have reported, the range operator reports, "On target" as soon as his pulse is properly positioned.

c. Director operators.—(1) The operation of the director is the same as for visual tracking except—

(*a*) The azimuth tracker matches pointers of the two inner dials of the present azimuth indicator, attempting to smooth out the data from the SCR–268.

(*b*) The range setter matches pointers of the inner dials on the present angular height indicator, also smoothing out the data from the SCR–268.

(2) When the angular height to the target is below 300 mils, the SCR–268 angular height output is in error. At low angular heights, the SCR–268 data are usually less than the correct value. Above 300 mils, the altitude and angular height data normally are smooth and accurate.

(3) When the SCR–268 indicates angular heights above 300 mils, the chief of range section at the director asks the range operator and elevation tracker of the SCR–268 to inform him when they are exactly on target. When these two operators are exactly on target at the same time, the altitude should be correct. The chief of range section at the director sets this altitude into the director and leaves it alone unless he is convinced that the target is changing altitude. Variations of plus or minus 100 yards are to be expected, due to inaccuracies and wandering of the SCR–268. However, as most unseen targets fly at a constant altitude, the practice of setting in the altitude when data are good and then leaving it alone gives good results. If the target is diving, then an

attempt must be made to match the altitude pointers, smoothing out the data as much as possible.

d. Telephone conversation.—The range operator at the SCR–268 keeps repeating the range changes, such as "Range decreasing," "Range decreasing slowing," "Range changing," "Range increasing," "Range increasing," "Range increasing." He keeps this up for the entire course. This helps the other trackers, since on a straight and level course the angular height increases for decreasing range, reaching a maximum at the center of the course when the range stops decreasing, and then decreases for an increasing range. The azimuth rate increases on a decreasing range, reaching a maximum at the center of the course, and then the rate decreases on increasing range. If for any reason, the azimuth or the elevation tracker of the SCR–268 finds considerable difference in the height of the echoes from the airplane, he reports, "Azimuth (or elevation) leading (or lagging)", and makes the necessary change to balance the echoes. The pointer matcher concerned at the director having been warned, does not attempt to follow the sudden change. He continues his present rate until he has determined how far off he is. He presses the red button to arrest prediction and then matches the pointers. When pointers are matched and a steady rate is resumed, the red button is released and normal procedure is followed.

■ 167. UNIT TRAINING.—Organizations which have scrupulously followed the above methods have been able to produce satisfactory firing data. Effectiveness of this method of fire at unseen targets is dependent almost solely on the degree of training attained. A minimum of 100 hours of carefully supervised drill of the SCR–268 director-gun team, while actually tracking an airplane target, should be completed before actual firing is attempted. These hours do not include time spent in orienting and aligning the SCR–268, maintenance of equipment, assembly and disassembly of units, or any kind of training other than actual target tracking. All antiaircraft artillery gun organizations equipped with SCR–268's must emphasize training in conduct of fire at unseen targets, using the methods described above. Every gun battery should conduct one or more firings, using this method on

completion of satisfactory preliminary training. Radar tracking of a towed sleeve is not considered practical for this type of firing. The radio-controlled airplane target is most satisfactory for practice firings.

168. RELOCATION.—In some situations, antiaircraft artillery gun batteries are unable to conduct fire at unseen targets, using the standard method of continuous fire based on radar tracking as outlined in this section G. In some cases only one radar set is available per gun battalion, or the radar equipment is out of service. It is essential that every gun battery be prepared to conduct fire *at all times* against unseen targets. Emergency methods must be used when lack of available equipment prevents use of the standard method. (See FM 4–122.)

169. USING SCR–268 DATA FOR MORE THAN ONE BATTERY.—The battery having the radar conducts fire as prescribed in this section G. For other batteries in this system, the SCR–268 data are used to plot the horizontal course of the target. The present position data are transmitted to each gun battery not having radar (or whose radar is out of order) and relocated for that particular battery. Predictions are made on the plotted course, and future data are then telephoned to the director of guns for conducting salvo fire on the predicted point. (See FM 4–122.)

SECTION IV

AIRCRAFT WARNING

170. GENERAL DISCUSSION.—Cases arise in which the SCR–268 might be utilized solely as an aircraft warning device, as, for example, in the defense of some important rear area installation where early warning is extremely necessary. In such cases the radar must be accurately oriented with respect to the common orienting point used. The data, in general, are furnished to some type of relocation boards at definite intervals, in order that a plot be made and relocated information sent out to various coordinated groups such as gun batteries, searchlights for night operation, and fighter aviation. Employment and operation follow very closely the operation for warning as covered in FM 4–106.

CHAPTER 8

SERVICE OF INSTRUMENT

		Paragraphs
SECTION I.	Duties of personnel	171–172
II.	Preliminary commands and formations	173–177
III.	Drill of the mount	178–191
IV.	Notes on service of instrument	192–197

SECTION I

DUTIES OF PERSONNEL

171. GENERAL.—This chapter covers procedure for operation of the SCR–268 and also an outline of a drill for personnel. *The drill is a basic method especially adaptable for instructional purposes.* The drill is designed for operation with searchlights when the SCR–268 is used to transmit AAAIS data to the AAA operations room. Tactical employment of the detector with searchlights (but not to send AAAIS data to the operations room), or with gun batteries, will dictate such changes as become necessary.

172. PERSONNEL.—*a.* The normal manning table for the SCR–268 alone is as follows:

CRO, Chief radar operator
1, Range operator
2, Azimuth tracker
3, Elevation tracker
4, Keyer-modulator attendant
5, Power plant-rectifier operator
6, Azimuth data reader
7, Range data reader
8, Telephone operator

NOTE.—6, 7, and 8 act as relief oscilloscope operators when the radar is not used to transmit AAAIS data. They also act as the chauffeurs for the section.

b. The CRO is in command of the radar unit. He supervises the operation and gives all commands. When tactically employed with other equipment he is responsible to the senior of that unit for the efficient operation of the radar.

SECTION II

PRELIMINARY COMMANDS AND FORMATIONS

173. GENERAL.—Throughout this drill the terms "RIGHT", "LEFT", "FRONT", and "REAR" are used as follows:

a. With mount in traveling or emplaced position, these terms are used to refer to the chassis only. The drawbar end is the FRONT and the spare tire end is the REAR.

b. With vehicles in formation, the terms are used to refer to the vehicle itself and the radiator is FRONT.

174. FALL IN.

The crew assembles in two ranks facing the CRO. The intervals are 4 inches between files and 40 inches between ranks. CRO takes his post 3 paces in front of the center of the line on which the front rank is to form.

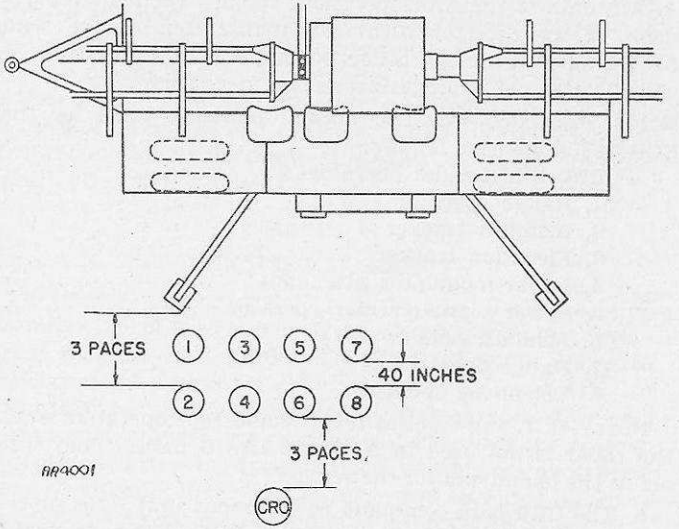


FIGURE 66.—Positions at command FALL IN.

CRO Commands: FALL IN.

2 takes his post on the right as guide facing CRO.
2, 4, 6, and 8 form the front rank,
1, 3, 5, and 7 form the rear rank.

NOTE.—With the *mount emplaced* 2 takes a position three paces from the forward outrigger jack on the left side, facing away from the mount. (See fig. 66.)

175. COUNT OFF.

The radar crew being in formation,
CRO commands: COUNT OFF.
1 to 8 report their numbers consecutively.

176. CALL OFF.

The radar crew being in formation.
CRO commands: CALL OFF.

Each member of the crew reports his assignment as follows:

1 reports, "Range Operator."
2 reports, "Azimuth Tracker."
3 reports, "Elevation Tracker."
4 reports, "Keyer-modulator Attendant."
5 reports, "Power plant-rectifier Operator."
6 reports, "Azimuth data reader" ("Assistant range operator" in gun batteries).
7 reports, "Range data reader" ("Assistant azimuth tracker" in gun batteries).
8 reports, "Telephone Operator" ("Assistant elevation tracker" in gun batteries).

177. CHANGE ORDER.

The radar crew being in formation,
CRO commands: CHANGE ORDER.

All members of the crew change positions as follows:

1 falls out to rear, takes place of 8.
2 takes place of 1.
3 takes place of 2.
4 takes place of 3.
5 takes place of 4.
6 takes place of 5.
7 takes place of 6.
8 takes place of 7.

All members move simultaneously to new positions and dress right.

SECTION III

DRILL OF THE MOUNT

■ 178. DETAILS POSTS.

The radar crew being in formation, as described for paragraph 174,

CRO commands: DETAILS POSTS.

The individual members of the crew take their posts as follows:

1 on oscilloscope shelf near transmitter.
2 on mount facing oscilloscopes.
3 on ground facing terminal box (JB–23) (right side of mount).
4 on ground facing keyer (left side of mount).
5 at power van facing toward CRO.
6, 7, and 8 as directed by CRO.

■ 179. EXAMINE EQUIPMENT.

CRO commands: EXAMINE EQUIPMENT.

1 checks connection of cable No. 1, filament and grid leads between the filament transformer and the transmitter, checks cables No. 2 and No. 18 to the filament transformer, and ground strap connections.
2 checks all cables and connections of all scopes, receivers, range unit, and range converter.
3 checks all cable connections at the terminal box (JB–23). Checks level of mount, assisted by 4.
4 checks all cables and connections at the keyer and modulator. Assists 3 checking level of mount.
5 checks gas, water, oil, battery, and sediment bowl. Checks all cables and connections at the power plant and rectifier. Checks the tubular leads of rectifier (SCR–268–A).
6 checks cables and connections between power plant, rectifier, and mount.
7 checks cables and connections between terminal box (JB–23) and searchlight or detector.
8 assists as directed by CRO.

■ 180. REPORT ON EQUIPMENT.

If the equipment is in proper operating condition the members of the crew report as below. Otherwise, deficiencies noted are reported.

CRO commands: REPORT.

1 reports, "Transmitter in order."
2 reports, "Scopes, receivers, range unit and converter in order."
3 reports, "Terminal box and level in order."
4 reports, "Keyer and modulator in order."
5 reports, "Power plant and rectifier in order."
6 reports, "Power cables in order."
7 reports, "Searchlight (or director) cable in order."
8 has no report.

■ 181. TEST OPERATION.

After equipment has been inspected and is in order,

CRO commands: TEST OPERATION.

5 at power plant removes fire extinguisher and starts the engine, checks frequency on panel (59.5 to 60.5 cycles), adjusts voltage to read 118 volts, and then throws main line switch to ON position. Calls to 4, "Power on." Moves to rectifier and applies line and filament voltage. Calls to 4, "Time delay over," when time delay signal lights.
4 secures frequency meter, plugs it in at the keyer, and turns it on. Throws main switch on signal from 5 that power is on. Signals 3 that keyer is on. Sets BIAS at MAXIMUM, and SUPPLY at MINIMUM. Waits 30 seconds after throwing keyer main switch, then presses keyer START button. Raises SUPPLY voltage to 3,000 volts. After time delay over signal from 5 presses rectifier START button and signals with right hand, all fingers extended, to 5 for 5 kv.
3 at the junction box on signal from 4, turns on main switch at the JB–22. Turns OFF heater switch and throws all remaining switches ON from left to right. Directed by 1, adjusts voltage regulator knob until 1 places filament meter needle on red line.

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5 at rectifier panel, when "plate on" light is red, watches 4 for 5-kv signal. Raises high voltage to 5 kv by plate handwheel and signals back to 4 by hand that voltage is 5 kv.

1 on scope platform now observes grid meter and directs 4 to reduce bias until grid is between 15 and 25 mils. Tunes transmitter with tuning knob until "dip" or MINIMUM grid reading is reached. Calls to 4 when transmitter is tuned.

4 at keyer reduces BIAS as directed by 1 (above). Returns BIAS to MAXIMUM after transmitter is tuned and signals 5 with the forefinger of each hand raised and extended for 11 kv.

5 at rectifier, on signal from 4, raises high voltage to 11 kv. Signals back to 4 when voltage is 11 kv, and carefully maintains this value as plate current is brought up.

1 on scope platform (high voltage now 11 kv) directs 4 to reduce BIAS until plate current meter reads 300 milliamperes. Makes refined adjustment of tuning rack for minimum grid meter reading. Reports fact if grid reading is not 60 when plate reads 300.

4 receives 11-kv signal from 5 and then reduces BIAS as directed by 1. Checks modulator grid meter for a reading to the right of zero and less than 25 milliamperes.

2 on mount platform tests all scopes for focus, intensity, sweep, main pulse, and sensitivity. Checks range unit by rotating range handwheel and noting motion of main pulse on scope.

1 after tuning transmitter, checks the transmitting frequency with the frequency meter. Assisted by 3, checks frequency as antenna is lowered from maximum to minimum elevation.

3 in elevation tracker's seat, lowers antenna from maximum to minimum as directed by 1.

NOTE.—If range orientation by reduced power method is done, it should be accomplished at this time.

2 in azimuth tracker's seat, traverses mount until a fixed echo appears in scope. Directs 3 to lock foot brake.

3 now in elevation tracker's seat, directs 4 in tuning of elevation receiver by observing echo in elevation scope.

2 operating azimuth scope, directs 4 in tuning azimuth receiver observing the echo in azimuth scope.

4 secures tuning screwdriver and tunes receivers as directed by 3 and 2 above.

CRO before receiving reports, secures log book and enters readings of all meters listed. (The transmitter must be finally tuned before any readings are taken.)

■ 182. REPORT ON OPERATION.

After unit has been placed in operation as above,

CRO commands: REPORT.

1 reports, "Transmitter in operation."
2 reports, "Scopes, receivers, and range unit in operation."
3 reports, "Junction box in operation."
4 reports, "Keyer and modulator in operation."
5 reports, "Power plant and rectifier in operation."
6, 7, and 8 have no report.

NOTE: Above reports are given only if equipment is satisfactory; otherwise existing deficiencies are reported.

■ 183. OPERATION DETAIL, POSTS.

The crew being in formation on left of mount, or at examine equipment posts on mount.

CRO commands: OPERATION DETAIL, POSTS.

1 takes position at range operator's seat.
2 takes position at azimuth tracker's seat.
3 takes position at elevation tracker's seat.
4 takes position at keyer.
5 takes position at rectifier and power plant.
6 takes position from which he can read azimuth data.
7 takes position from which he can read range and altitude data.
8 takes position at telephone.

■ 184. SEARCH SECTOR.

The operating crew being in position,

CRO commands: SEARCH SECTOR. CRO gives this command in case of instructions from higher authority or in compliance with SOP instructions currently in force.

2 and 3 turn sensitively on scopes UP and remove spread.

3 elevates antenna to approximately 100 mils above mask, 300 mils above mask for each alternate sweep of the assigned sector by 2.

2 traverses the assigned sector at the rate of one turn of the azimuth handwheel per second.

4 observes all meters on keyer and modulator and checks for deficiencies in operation.

5 observes all meters on power van panel and rectifier panel and checks for deficiencies in operation.

During search, the first operator to observe target calls, "Contact" and directs 1 in placing that echo under the hairline.

2 and 3 immediately apply spread control and track by balancing "pips."

8 reports, "D——, contact" immediately over the command net to alert the searchlight section, other sections of the platoon, and the platoon CP.

2 reports, "Azimuth on target" to CRO when the radar is centered on the target in azimuth.

3 reports,"Elevation on target" to CRO when radar is centered on the target in elevation.

1 reports, "Range on target" to CRO when range data are accurate.

CRO reports, "On target" when the oscilloscope operators have reported, "On target" (altitude data may not be accurate at first).

8 reports, "D——, on target" over command net.

6 reports, "On target" over the data line, and also reports any information announced by the oscilloscope operators concerning the number of airplanes being tracked and IFF indications. As soon as the plotter at the AAA operations board has received this report, 6 commands:

TAKE and immediately reads azimuth of target over the data line to plotter.

When the radar has thus been centered on the target and accurate data are being furnished, the target is *tracked* without specific command.

After the command, TAKE, given by 6,

6 reads azimuth (to nearest 10 mils) over the data line.

7 reads range (to nearest 100 yards) over the data line. The range reader will not normally read elevation data during the first 4 or 5 reports over the data line; in those initial readings he reports, "Altitude unknown." When altitude data become more accurate and after 3 has balanced pips and reported "Elevation on target," he reads the altitude to the nearest 100 yards to the plotter. Altitude is repeated for the next 3 or 4 readings and on every 4 or 5 readings thereafter.

NOTE.—In all these reports over the data line, numerals are pronounced as prescribed in FM 24-5. Immediately after the range reader has transmitted the initial range and altitude, the azimuth reader gives the command, TAKE again and the azimuth and range readers read their respective data *simultaneously*. The azimuth reader reports the azimuth reading, followed by the range reader reporting the range (and altitude) reading. This process is repeated continuously until the target is illuminated or lost.

1, 2 and 3 continue tracking the target accurately.

4 and 5 continue checking for deficiencies in operation at their respective positions.

CRO announces, "Off target," if the radar looses the target and is no longer supplying accurate data. The report is immediately transmitted over the data line by 6 and over the command net by 8.

NOTE.—The plotter at the AAA operations board (on direction by the searchlight plot observer) relays the command, CEASE DATA if the target is identified as friendly, if the target is outgoing, or if the target is carried out of the normal front and is picked up by another radar. In this case 6 and 7 no longer read data to the plotter. However, the tracking of the target continues unless a new target is assigned by CRO, or sector search is resumed.

CRO announces, "Range" to indicate the radar is on the target and that the target is at the proper range for the searchlight to go into action for an initial pick-up.

8 reports, "D—, range" over the command net.

NOTE.—When the searchlight has illuminated the target the radar section is notified "——, target illuminated" over the platoon command net.

---

8 receives this message and repeats "——, target illuminated" to CRO.

CRO calls, "Target illuminated," so that announcement can be heard by radar crew.

6 transmits same message over data line.

CRO (if his section has transmitted data on the target) calls "Intersection" as soon as intersection of two searchlight beams has been formed on or near the target.

6 transmits "Intersection" over the data line to the plotter.

■ 185. CHANGE TARGET.

The command, CHANGE TARGET, followed by the designation of the new target will be given by CS or CRO when he desires the light or the radar to drop one target and pick up another. The command is immediately repeated over the platoon command net and, for CRO, over the data line.

NOTE.—CHANGE TARGET will normally be given by CRO when target is held securely by minimum number

of beams specified. However, if atmospheric conditions are such as to require continuation of radar data to hold target in beam, CS commands: D——, CONTINUE TRACKING. This command is repeated over the platoon command net for the benefit of CRO.

CRO commands: CHANGE TARGET. He then commands: TRAVERSE RIGHT (LEFT) or ELEVATE (DEPRESS) to indicate the direction of the new target.

8 reports, "D——, Changing target" over the platoon command net.

6 reports, "D——, Changing target" over the data line.

1, 2 and 3 search for the new target.

4 and 5 continue normal duties.

■ 186. CEASE TRACKING.

In preparation to go out of action, to change trackers, or to provide a short rest period.

CRO commands: CEASE TRACKING.

Operating detail ceases tracking and remains at its station pending further command by CRO.

■ 187. OUT OF ACTION.

CRO commands: OUT OF ACTION.

4 turns BIAS to MAXIMUM and presses rectifier STOP button. Turns SUPPLY to MINIMUM and presses keyer STOP button. Throws keyer main switch to OFF position.

3 waits for keyer main switch to be thrown to OFF by 4, then throws heater switch on JB–22 to ON and all other switches to OFF. Turns OFF main switch at JB–22.

5 returns high voltage to zero setting by turning plate handwheel counterclockwise when red light goes out. Presses filament and line STOP buttons to remove voltage from rectifier.

1, 2, 6, 7 and 8, as directed by CRO.

■ 188. IN ACTION.

To place unit in operation after a temporary shutdown in response to the command, OUT OF ACTION—

CRO commands: IN ACTION.

1, 2, 3, 4 and 5 execute duties as under command, TEST OPERATION, to place set back on the air.

■ 189. POWER OFF.

In order to place unit from a stand-by status, as in OUT OF ACTION, *to shut down status—*

CRO commands: POWER OFF.

5 removes key from lockswitch *E* and place it in lock *D*. Removes key from lockswitch *C* and places it in rectifier door lock. Throws main switch to OFF position on power panel and shuts down power plant.

1 sets transmitter tuning adjustment to the full IN position.

2 traverses mount so that trackers' seats are on opposite side of mount from keyer-modulator and antennas run along front-rear axis of mount platform. Locks azimuth brake. Sets azimuth antenna stand-by support in place.

3 elevates antenna to 1,600 mils and sets elevation antennas stand-by support in place.

4 returns frequency meter to van.

6, 7 and 8 as directed by CRO.

■ 190. CLOSE STATION.

If equipment is to be unmanned for long periods—

CRO commands: CLOSE STATION.

5 replaces muffler in rack, rolls up gas line, replaces fire extinguisher, and locks all doors. Rolls gas drum away from equipment.

1, 2, 3, 4, 6, 7, and 8 assist in replacing all covers.

■ 191. REST.

When no action is imminent—

CS commands: REST.

For rest periods CRO arranges relief schedules for the section according to the status of alert ordered.

2 and 3 normally remain on the radar.

The other members of the section not on duty remain in the vicinity of the equipment so that they may go into action with the minimum delay.

SECTION IV

NOTES ON SERVICE OF INSTRUMENT

■ 192. GENERAL.—*a.* The drill prescribed in this chapter for the radio set SCR–268 *cannot* be conducted with the snap and precision of a formal drill. There are so many delicate mechanisms and electrical devices involved that careless attempts to speed up the operations of emplacing the mount and of placing it in traveling position result only in a great number of matériel failures. The time required for these operations can, however, be greatly reduced by careful training.

b. In the drill, stress is laid on the saving of time during the operation of locating the target, that is, between the time the first echoes are received and the time the set is smoothly tracking the target and transmitting data to its associated equipment.

c. The drill is conducted with as few orders as possible.

d. The drill, as described in section III, 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 of locating, isolating, and tracking the target must become second nature if the section is to be capable of coping with multiplane attacks, fighter-plane interference, and other stratagems of an attacking air force.

■ 193. DISASSEMBLING EQUIPMENT.—It is necessary to exercise special care when the equipment is to be disassembled and placed in traveling position. This work may frequently be done when the crews are tired, hungry, and anxious to get 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. It must be remembered that the care with which the equipment is placed in

the trailers determines to a large extent the facility with which it can be assembled and placed in operation

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

195. SAFETY PRECAUTIONS.—*a.* It must be remembered that dangerous voltages exist in many parts of the equipment. It is absolutely essential that all safety rules and regulations be rigorously adhered to. It is particularly important that cables carrying high voltages be handled with the greatest care, even when they are disconnected. During operation all personnel should avoid touching or stepping on any cables.

b. In loading and unloading the various parts care must be exercised that no one will be hurt if a block and tackle or a cable fails.

196. HANDLING EQUIPMENT.—*a.* Since much handling of equipment may take place under the cover of darkness, special care must be exercised at such times to avoid injury to personnel and damage to matériel.

b. Since most of the instruments used on the radio set are extremely delicate in nature, it cannot be overemphasized that the maximum care should be exercised under all conditions. Careless handling of an instrument may well cause the equipment to be inoperative for a considerable length of time.

c. As soon as matériel is unloaded from the trailers or trucks, it is moved off the road. Matériel disassembled for loading is not left in the road unless under guard. Cables are laid 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. If a truck must be driven over a cable, the cable must be protected by planks laid on each side of it or by covering it over in a shallow trench.

d. Chauffeurs must exercise special care when moving without lights, to avoid damage to equipment or injury to personnel. When backing the truck, the chauffeur must be assisted by another member of the crew who directs the movement from an advantageous position. Backing of the trailers

is facilitated by use of the pin which locks the steering action.

197. FALL OUT.—At drills and practice and in the field when higher authority authorizes discontinuance of operation, the chief of section may command: FALL OUT. At this command all members of the section may leave their posts except any communication personnel that may be on continuous duty.

APPENDIX I

ELECTRICAL DANGERS AND FIRST-AID TREATMENT

■ 1. ELECTRIC SHOCKS.—*a.* Most persons who have worked with electrical apparatus have from time to time experienced an electric shock. Some of these shocks may have been severe enough to cause pain, and occasionally they may have resulted in powerful muscular spasms sufficient to throw the victim off his balance. Persons often invite electric shock by feeling for the presence of electric current at various points of circuits under inspection. THIS IS DANGEROUS AND MUST NOT BE DONE.

b. Electric shocks are never wholly without danger. Relatively small electric currents are liable to cause death if they pass through certain vital organs of the body. Alternating currents, at the usual commercial frequencies, are somewhat more dangerous than direct currents. Thus a 60-cycle alternating current, at about $\frac{1}{10}$ ampere, in passing from head to foot, or from arm to leg, or between the two arms in such a manner as to include the lungs and heart in the circuit, will cause death in 1 or 2 seconds. Smaller currents may render a victim unable to release himself, since electric current always causes muscular contractions which at times forces victims to hang on to live circuits. A person caught on an electric circuit in this manner may find himself unable to get away except by going through strange contortions and using much strenuous effort. Such persons are fully aware of the almost hopeless situation in which they seem to find themselves under such conditions. If such a current, in addition to "freezing" the victim to the circuit, passes through the chest and stops natural breathing functions, or passes through the heart and stops its action, it is readily appreciated how soon death may result.

■ 2. DANGEROUS VOLTAGES.—The amount of current which a person may receive from an electric circuit depends upon the voltage of the circuit and how good a contact there is

between himself and the circuit. Normally, dry skin is a reasonably good insulator, offering a hand-to-hand resistance of the order of 100,000 ohms or more. The opposite is true of wet skin, however, whether wet from applied moisture or from excessive perspiration. Persons in hot, damp locations have often been killed from the current resulting from 120-volt, 60-cycle circuits, since their body resistance under these conditions is not more than a few thousand ohms at the most. On the other hand, it is well to know that if very dry hands are touched to such a circuit, the fact that the circuit is "alive" often can hardly be determined.

■ 3. PRECAUTIONS.—*a.* The presence of high voltage in electric equipment using vacuum tubes creates a somewhat more serious hazard than it does in many other kinds of electric apparatus. Most amplifying equipment is quite compact and "live" wiring and terminals are common. These danger spots DO NOT LOOK DANGEROUS TO THE EYE, BUT MUCH OF THE EQUIPMENT IN THE SCR–268 OPERATES AT VOLTAGES SUFFICIENTLY HIGH TO BE DANGEROUS. Consequently, persons working around equipment of this sort must have the highest respect for the danger involved. The voltages, however, are not sufficiently high to "jump" through any appreciable air gap.

b. Protective switches have been provided in the SCR–268, which open and ground some of the electrical circuits when high-voltage wiring is exposed. These safety devices as well as high-voltage components themselves, are conceivably subject to failure, either because of intentional tampering, or because of mechanical break-down. The correct way to work on this apparatus is: ALWAYS DEENERGIZE AND GROUND THE HIGH-VOLTAGE CIRCUITS BEFORE BEGINNING TO WORK AND BE SURE THAT CONDENSERS ARE THOROUGHLY DISCHARGED. Occasionally, this is not practicable because of the necessity of testing under operating conditions. When it is necessary to work on live equipment, every precaution is taken to follow well-established safety practices and to use the greatest amount of care. BOTH SIDES OF A LIVE CIRCUIT SHOULD NEVER BE TOUCHED, AND IF FOR A GOOD REASON ONE SIDE IS TO BE TOUCHED, THE INDIVIDUAL SHOULD MAKE ABSO-

LUTELY SURE THAT HE IS WELL INSULATED FROM THE GROUND. Failure of these safety mechanisms or precautions, for any cause whatsoever, may result in electric shock to the personnel.

■ 4. RESCUE.—In all cases of electric shock, shut off the high voltage at once and ground the circuits. If for any reason, the high voltage cannot be shut off, the victim must be freed of contact with the live conductor as promptly as possible. The rescuer himself must exert great care to prevent direct contact with either the live conductor or the victim's body by using a dry stick, dry board, dry clothing, or other nonconductor.

■ 5. SYMPTOMS.—*a.* In electric shock, the current may pass through the breathing center at the base of the brain and cause this center to stop sending out the nervous impulses which act upon the muscles responsible for breathing. In consequence, breathing stops abruptly. If the shock has not been too severe, the breathing center recovers after a time and resumes the vitally necessary duty of sending impulses to the muscles of breathing, provided that a sufficient supply of air has been furnished the body meanwhile by artificial respiration. Cases are recorded where 8 hours' work was necessary before the breathing center recovered and the patient began to breathe of his own accord. Therefore, the ordinary and general tests for death should never be accepted.

b. The patient is usually blue, although occasionally he may be very white. The pulse is weak or entirely absent. Unconsciousness is complete. Burns may be present. Occasionally the body becomes rigid or stiff in a very few minutes. This is due to the action of the electricity, and is not to be considered "rigor mortis." This stiffness is not a sign to stop artificial respiration, as a few such cases are reported to have been revived.

■ 6. TREATMENT FOR ELECTRIC SHOCK.—*a.* Lay the patient face downward, one arm extended directly overhead, the other arm bent at the elbow, and the face turned outward and resting on hand or forearm so that the nose and mouth are free for breathing. (See fig. 67.)

b. Kneel, straddling the patient's thighs, with your knees placed at such a distance from the hip bones as will allow you to assume the position shown in figure 67. In many cases (due to the size of the patient) it may be more convenient to straddle only one leg. Place the palms of the hands on the small of the back with fingers resting on the ribs, the little finger just touching the lowest rib, with the thumb and fingers just out of sight. (See fig. 67.)

c. With arms held straight, swing forward slowly, so that the weight of your body is gradually brought to bear under



FIGURE 67.—First position of artificial respiration.

the patient. The shoulders should be directly over the heel of the hand at the end of the forward swing. (See fig. 68.) Do not bend your elbows. Do not apply more than 60 pounds of pressure. This operation should take about 2 seconds.

d. Now immediately swing backward so as to remove the pressure completely and suddenly. (See fig. 69.)

e. After 2 seconds, swing forward again. Repeat this double movement of compression and release. A complete respiration should take 4 or 5 seconds and should be repeated twelve to fifteen times a minute.

f. Continue artificial respiration without interruption until natural breathing is restored, 4 hours or longer, if necessary, or until proper medical personnel declares the patient dead.

g. As soon as artificial respiration has been started and while it is being continued, an assistant should loosen any tight clothing about the patient's neck, chest, or waist. KEEP THE PATIENT WARM. If at all possible, the artificial respiration should be performed while the patient is wrapped in a blanket. Do not give any liquids whatever by mouth until the patient is fully conscious.

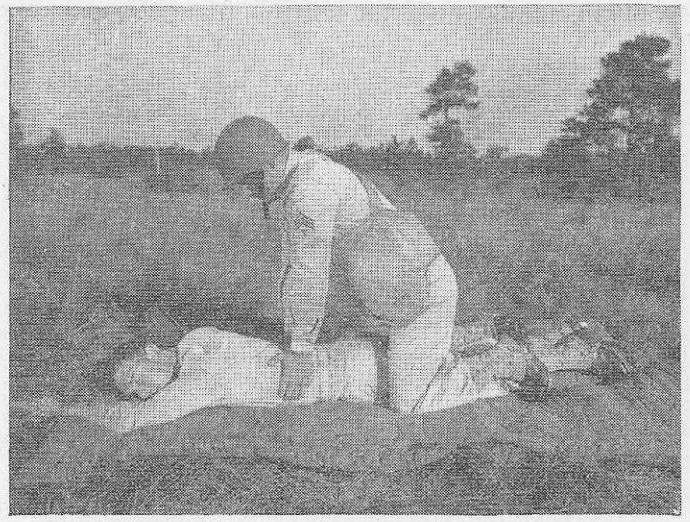


FIGURE 68.—Second position of artificial respiration.

h. To avoid strain on the heart when the patient revives, he should be kept lying down and not allowed to stand or sit up. If the medical personnel has not arrived by the time the patient has revived, the patient should be given a stimulant, such as one teaspoonful of aromatic spirits of ammonia in a small glass of water, or a drink of hot coffee or tea. The patient should be kept warm.

i. Resuscitation should be carried on at the nearest possible point where the patient received his injuries. He should

not be moved from this point until he is breathing normally, of his own volition, and then moved only in a lying position. Should it be necessary, due to extreme weather conditions, etc., to move the patient before he is breathing normally, resuscitation should be carried on during the time he is being moved.

j. A brief return of natural respiration is not certain indication for stopping the resuscitation. Not infrequently the patient, after a temporary recovery of respiration, stops breathing again. The patient must be watched and if nat-



FIGURE 69.—Third position of artificial respiration.

ural breathing stops, artificial respiration should be resumed at once.

k. In carrying out resuscitation, it may be necessary to change the operator. This change must be made without losing the rhythm of respiration. By this procedure, no confusion results at the time of change of operator and a regular rhythm is kept up.

7. EXPLANATORY NOTES ON RESUSCITATION.—*a.* If it is evident that air is not being drawn into the patient's chest, examine the mouth for a possible obstruction and remove any foreign body, such as false teeth, chewing gum, or tobacco. An assistant, if present, should watch the patient's face and wipe out from the mouth any frothy mucous or saliva that may collect and interfere with respiration.

b. If the operator is large and the patient is small, then the operator will not swing forward until all the weight of his body is brought to bear on the patient, but only until firm resistance is met beneath his hands. Sixty pounds pressure is sufficient for even a large adult. Damage has been done by too great pressure.

8. TREATMENT DURING RECOVERY.—*a.* The patient may show no sign of beginning recovery for some time and then may gradually begin to regain a more normal color, indicating that the blood is getting more oxygen and that the circulation is improving. Then he may show slight muscular effort, such as a slight twitching, or a scratching or clutching motion of the fingers. The first attempt to breathe may be a catch of the breath or a faint sigh. The operator should watch very carefully at this point so as not to exert pressure as the patient attempts to take his first spontaneous breath.

b. Artificial respiration should be withheld when the first breathing begins. This breathing may be very slow—four to six times per minute—but should not be assisted by artificial respiration. Artificial respiration must be resumed at once if breathing does not continue.

c. As breathing is resumed, the patient may attempt to get up, or even become violent in his semiconscious efforts to help himself. He must be restrained and kept in the prone position.

d. A person who has been resuscitated has been through one of the most severe strains that can be experienced. His heart has been under extreme exertion, and the regulation of rhythm and the volume of heart action may not return to normal for some time.

e. The patient must be kept lying down. Permitting him to

get up and walk may cause sudden heart failure and death. Shock treatment must be continued long after the patient begins to breathe. He must be carefully watched, as some patients apparently breathing normally will suddenly stop breathing and need additional artificial respiration. Never leave a resuscitated person alone until it is certain that he is normal again.

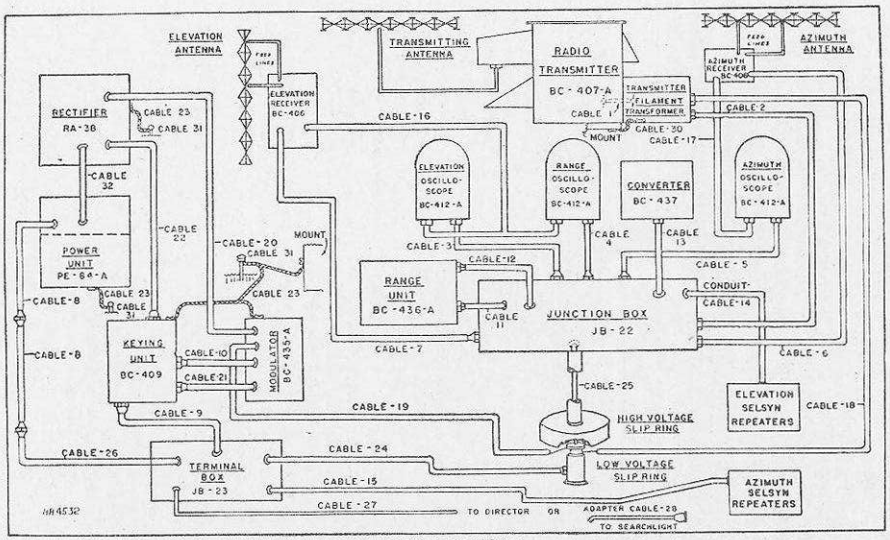
APPENDIX II

CABLES

1. DISCUSSION.—This section contains a list of cables with the associated cable diagram of the connections within the SCR–268–B. A thorough understanding of each cable, its function in the unit, and the connections is an invaluable aid in "trouble shooting." Cable 32 is not included in the first models, as this connection is in a permanent conduit within the van K–34–B.

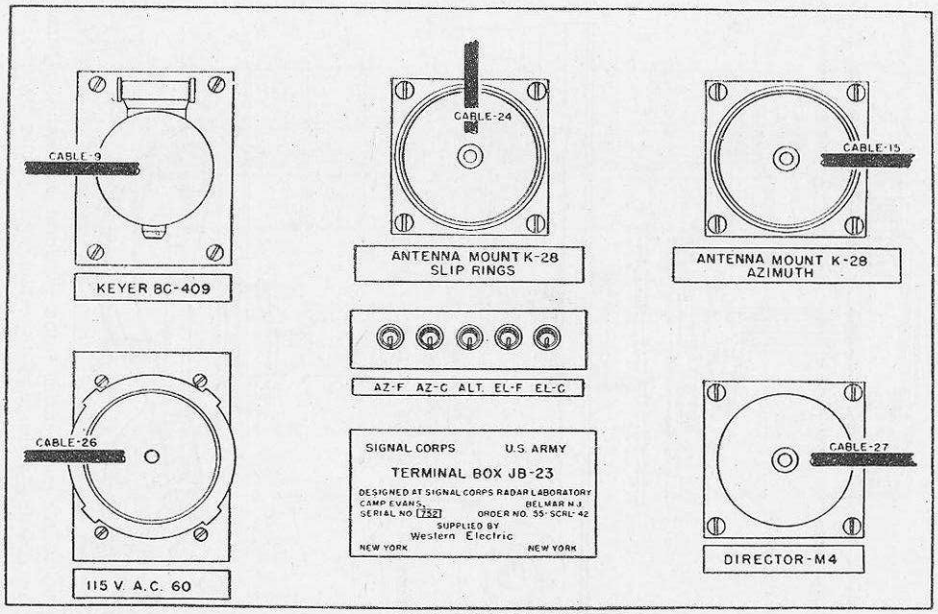
Cable No.	Description	Purpose
1	5-ft., 3-conductor	Ground, a-c, interlock.
2	3-ft., 3-conductor	Ground, a-c, interlock.
3	5-ft., 4-conductor	Ground, a-c, heater and sync.
4	6-ft., 4-conductor	Ground, a-c, heater and sync.
5	5-ft., 4-conductor	Ground, a-c, heater and sync.
6	12-ft., 3-conductor	Ground, a-c, heater.
7	18-ft., 3-conductor	Ground, a-c, heater.
8	2 lengths, 50-ft., 2-conductor	Ground, a-c.
9	12-ft., 3-conductor	Ground, a-c, sync., interlock.
10	3-ft., 4-conductor	Ground, a-c, heater, interlock.
11	3-ft., 3-conductor	Ground, a-c, heater.
12	3-ft., 3-conductor	Ground, sync. IN, sync. OUT.
13	10-ft., 12-conductor	Altitude repeater circuits.
14	12-conductor	Elevation repeater circuits, "coarse" and "fine" (within mount).
15	10-ft., 12-conductor	Azimuth repeater circuits, "coarse" and "fine."
16	24-ft., 3-conductor	Split cable, elevation receiver to elevation and range scopes, receiver output, spread, sensitivity, ground (in shield).
17	18-ft., 3-conductor	Azimuth receiver output, spread, sensitivity, ground (shield).
18	15-ft., 2-conductor	High voltage (within mount).
19	15-ft., 2-conductor	High voltage.
20	150-ft., 2-conductor	High voltage.
21	3-ft., 2-conductor	Keyer pulse signal.
22	150-ft., 4-conductor	Remote control (start, stop, common, ground).

Cable No.	Description	Purpose
23	5-ft., 1-conductor	Ground wire.
24	19-conductor	Low voltage, slip-ring circuits.
25	19-conductor	L. V. slip-ring circuits (part of mount).
26	50-ft., 2-conductor	Ground, a-c.
27	250-ft., 19-conductor	Data transmission to director.
28	10-ft., 19-conductor	Adapter to No. 27 for searchlight.
29	250-ft., 4 conductor	Tweeter cable.
30		Wire, ground.
31		Ground stake.
32	80-ft., 2-conductor	Ground, a-c. (power plant to rectifier).



CABLE DIAGRAM

FIGURE 70.—Cable diagram for SCR–268.



CABLE CONNECTIONS-JB-23

FIGURE 71.—Cable connection JB–23.

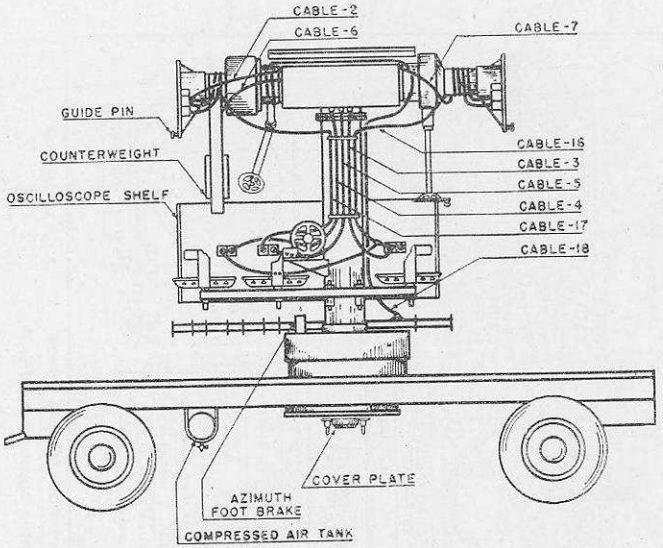


FIGURE 72.—Rotatable column in packed mount trailer.

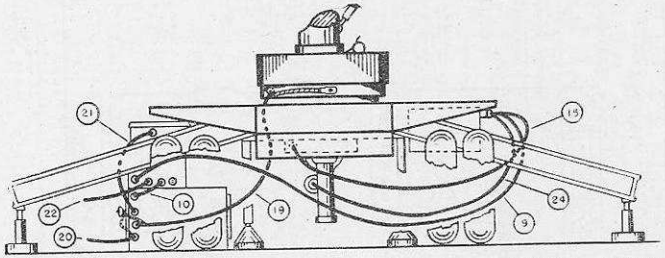


FIGURE 73.—Cable connections below platform on mount. (Numbers on drawing correspond to cable tags. Cables 20 and 22 terminate in power trailer.)

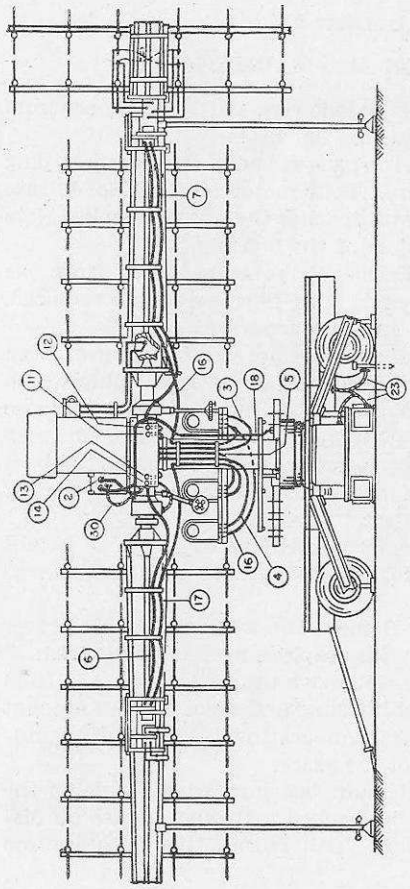


FIGURE 74.—Cable connections on mount. (Numbers on drawing correspond to cable tags.)

APPENDIX III

LUBRICATION AND MAINTENANCE

■ 1. ANTENNA MOUNT.—The following parts of the antenna mount require lubrication (see fig. 75):

a. Elevation handwheel drive.—Remove the overflow plug at the rear of the housing. Pour motor oil SAE No. 40 into the oil cup until the oil level reaches the overflow hole. Note the drain plug at the bottom of the housing.

b. Range handwheel drive.—Remove the cover from the level gear housing and pack with fiber grease as required. Replace the locking wire in cover screws.

c. Azimuth handwheel drive.—Remove both the cover from the oil cup near the handwheel, and the overflow plug which is placed a trifle lower down on the housing. Fill the case to the level of the overflow with motor oil SAE No. 40.

d. Azimuth shaft drive.—Remove the pipe plug at the base of the vertical azimuth shaft drive and pack with fiber grease as required.

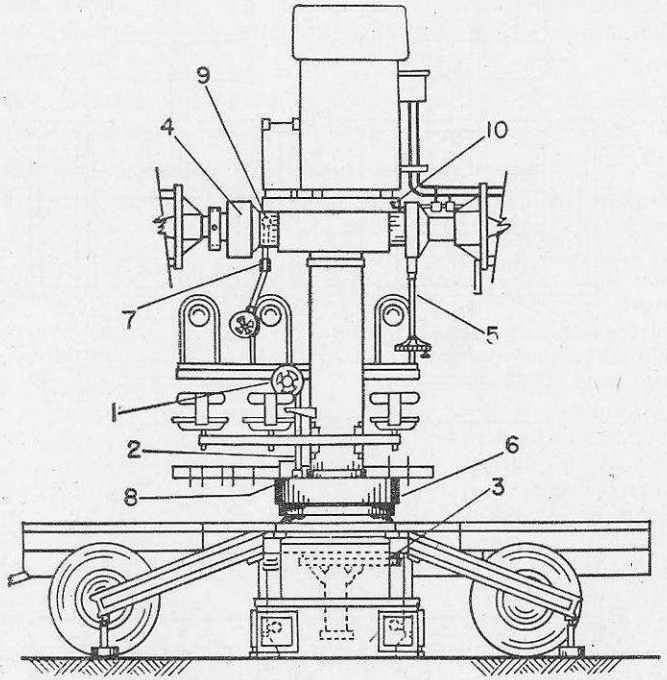
e. Angular height repeaters.—Remove the angular height repeater cover and place graphite grease on the gears as required.

f. Azimuth repeaters.—Remove the azimuth repeater cover and lubricate the gears with graphite grease as required.

g. Azimuth drive gears.—Remove the handhole cover from the high voltage slip-ring housing, and place a small amount of fiber grease on the gears, operating the azimuth handwheel to reach all parts of the gears.

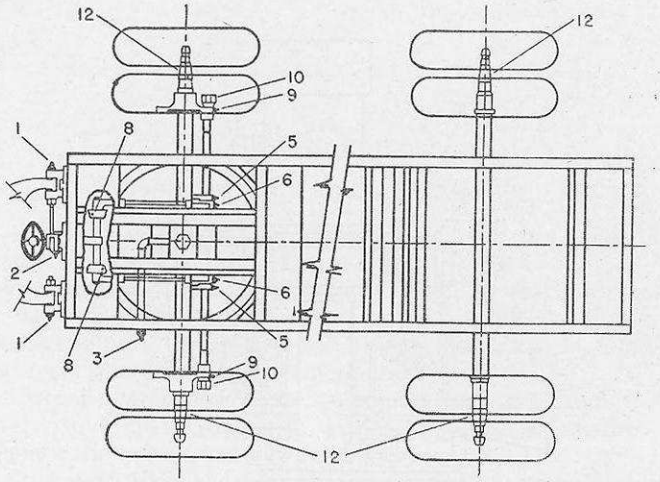
h. Main bearings.—All main bearings which support the rotatable column should be packed with fiber grease on disassembly or repair only. Otherwise, they require no attention.

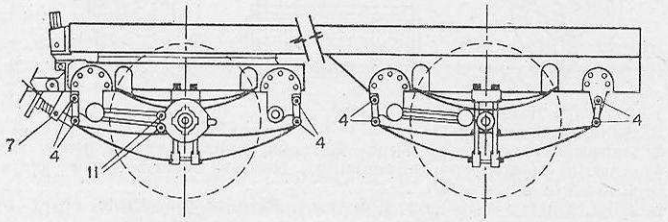
■ 2. CHASSIS.—Figure 76 indicates the points requiring lubrication on the mount trailer. The power trailer should be greased in the same manner as any car or truck.



1. Azimuth handwheel and drive.
2. Azimuth drive shaft.
3. Azimuth repeater housing. Remove cover to grease gears.
4. Angular height repeater housing. Remove cover to grease gears.
5. Elevation drive shaft.
6. High voltage slip-ring housing. Remove handhole cover to grease azimuth gears.
7. Range drive shaft.
8. Grease plug.
9. Grease hole cover.
10. Oil plug.

FIGURE 75.—Lubrication chart for antenna mount.





No.	Location	Type lubricant	How often
1.	Draw bar bolts	Standard chassis lubricant.	Every 2,000 miles.
2.	Gear lock socket		
3.	King post		
4.	Spring shackles		
5.	Cam shaft bracket bearing.		
6.	Slack adjuster		
7.	Hand parking brake screw		
8.	Brake cross shaft bearing		
9.	Cam shaft bearing		
10.	Brake cam	Brake cam grease	
11.	Anchor pin bushing	Penetrating oil	
12.	Axle wheel bearings	Wheel bearing grease	Every 8,000 miles

FIGURE 76.—Lubrication chart for mount trailer.

■ 3. POWER UNIT.—The power unit should be lubricated in accordance with instructions contained in the power unit operator's manual.

■ 4. OTHER PARTS.—Fans, exposed screw threads, and similar parts should be oiled occasionally with light machine oil.

■ 5. SCR–268 MOUNT AND RECTIFIER.

PREVENTIVE MAINTENANCE CHECK LIST

a. Maintenance by operators.

Battery_____ Platoon_____ Section_____

Item	*Interval*	*Maintenance required*
Equipment _____	Daily _____	Examine equipment at least once per day in accordance with the prescribed section drill, and for such daily checks as are listed herein.
External surfaces ___	Continuously_	Clean with cloth. Remove rust spots with sandpaper or steel wool and repaint, using first a coat of good primer.
Altitude dial mirror _	Daily _____	Clean with damp cloth.
Azimuth scale and mirror.	Daily _____	Clean with damp cloth.
All windows _____	Daily _____	Clean with damp cloth.

Item	*Interval*	*Maintenance required*
Transmitter, rectifier, modulator tubes.	Daily	Inspect for even loading as indicated by uniform brightness of tubes in operation. If loading is not uniform, or if modulator grid current reads negative, go out of action. Notify maintenance sergeant.
All panel lights	Daily	Check for operation.
Operator's shelter	Daily	Sweep and dust inside.
Oscilloscopes	Daily	Clean glass with dry cloth. Orient. Report any deviation from perfect working condition to maintenance sergeant. Check for smooth operation of all controls. Focus should be sharp, ground braid contacts clean and tight.
Receivers	Daily	Tune oscillators each time mount is put into operation. Repeat after one hour of operation, and as often as necessary thereafter.

Item	*Interval*	*Maintenance required*
Transmitter frequency.	Daily	Check frequency. A sharp response must be noted. Maximum variation of 0.25 m. c. or 5 m. a. grid current allowed for 0° to 90° elevation. Allow all components, including frequency meter, to warm 15 minutes.
All cable contacts and ground leads.	Weekly	Clean all contacts with cloth and steel wool if necessary. Be sure all ground leads and braids are replaced tightly.
Transmitter matching section.	Weekly	Clean rods and sliding contacts between transmitter coupling coils and antenna feed lines.
Transmission lines of transmitting antenna.	Weekly	Clean all insulators with dry cloth, including those in antenna beam. Tighten insulator connections and transmission line couplings.

Item	*Interval*	*Maintenance required*
Elevation, azimuth, transmitting antennae.	Weekly_____	Clean porcelain insulators, feed line insulators, dipole insulators, and dipoles weekly with dry cloth or solvent, dry-cleaning, if necessary. Bent and broken dipoles and insulators should be replaced immediately.
Tuning stubs, azimuth, elevation and transmission.	Weekly_____	Clean transmission lines at point of contact, and contacts of the stubs. Clean phasing stubs whenever moved.
Orienting sight_____	Weekly_____	Tighten all nuts to remove "play." Lubricate adjusting screws with SAE 30 oil as required.
Leveling jacks, outrigger jacks, standby jacks.	Weekly_____	Clean with solvent, dry-cleaning. Dry, apply SAE 30 oil.
Operator's shelter bolts.	Weekly_____	Tighten all bolts that may have worked loose due to vibration.
Bolts, counterweight collar, surface, antenna clamps, receiver clamps.	Weekly_____	Lubricate all exposed bolts, nuts and threaded surfaces not specifically mentioned herein with SAE 30 oil.
Azimuth and elevation drive gears.	Weekly_____	Lubricate in accordance with paragraph 1. Drain all water.

Item	*Interval*	*Maintenance required*
Azimuth, elevation repeaters.	Weekly_____	Remove cap from adjusting screw, drain condensation, relubricate if necessary with graphite grease.
Tires _____	Weekly_____	Maintain tires in accordance with existing War Department directives.
Range converter couplings.	Monthly _____	Examine for proper working condition and tightness to shaft.
Range converter bolts.	Monthly _____	Check tightness of bolts holding cover.
Operator's shelter heaters.	Monthly _____	Blow out with air hose.
Outrigger beam_____	Monthly _____	Lubricate outrigger beam anchor bolt with SAE 30 oil.
Scope table supports_	Monthly _____	Lubricate pins and hinges with SAE 30 oil.
Seats _____	Monthly _____	Lubricate all four supporting bar hinges with SAE 30 oil.
Azimuth brake, locking bolt, hinge, brake rod pins, adjusting buckle.	Monthly _____	Lubricate with SAE 30 oil.
Floor flanges_____	Monthly _____	Clean out grease and dirt. Lubricate threaded portions with SAE 30 oil.
Antenna mount_____	Monthly _____	Lubricate in accordance with paragraph 1.

560814°—43——6

Item	Interval	Maintenance required
Chassis	Monthly, or 2,000 miles	Lubricate in accordance with paragraph 2.
Wheel bearings	Quarterly, or 8,000 miles	Lubricate in accordance with paragraph 2.

NOTE.—Do not lubricate electrical connections.

b. Maintenance by platoon maintenance personnel.

Battery ____ Platoon ____ Section ____

Item	Interval	Maintenance required
All meters	Weekly	Adjust zero reading when necessary and check for correct reading during operation.
Interlocks	Weekly	Check interlocks for freedom of operation. Lubricate with powdered graphite if necessary. Do not oil. Rectifier (4), Modulator (1), Transmitter (2), Filament Transformer (1).
Rectifier:		
Contactor 105	Weekly	Condenser discharge contacts inspected and changed if necessary. Must make contact when switch is open. *Vital to safety of anyone working in rectifier.*

Item	Interval	Maintenance required
Rectifier—Con.		
Contactors 110, 111.	Weekly	Inspect and clean contacts of surface dirt.
Insulators and spark gaps of transformer retard coil.	Weekly	All insulators are white. Wipe clean with dry cloth. ***Caution:*** *Be sure condenser 107 is thoroughly discharged.*
Wiring	Weekly	Inspect for loose or burned connections.
Keyer:		
Insulators	Weekly	The interior of the keyer should be cleaned, using an air hose if necessary. (*Always disconnect cable No. 9 before opening keyer.*) The following insulators should be cleaned with a dry cloth: cable 21 insulator; resistor strip terminals 28–1, 28–2; bushings of transformer 53; base of 304TL; condenser bushings 14–1, 14–2, 14–3; stand off insulators for condensers 12 and 13.

Item	Interval	Maintenance required
Keyer—Continued.		
Wiring	Weekly	Check for loose or broken wiring; 304-TL plate lead should not be loose nor touch any wire on way to meter; 866 plate lead should touch no wire on way to transformer 53. Wire from resistor 38 to 28–1 should not touch resistor 39.
Heater	Weekly	If loose from vibration, tighten.
Blower motor	Weekly	Lubricate with SAE 10 oil, wipe off excess. Tighten hub setscrews.
Relays 45, 46	Weekly	Inspect and clean contacts if necessary.
Modulator:		
Insulators	Weekly	Interior of modulator may be cleaned, using an air hose if necessary. Clean following insulators with dry cloth: terminal insulators 1, 2 of reactor No. 3; terminal insulators *K, Hv, P* on condenser No. 2; bushings of condenser No. 2.
Heater	Weekly	If loose from vibration, tighten.

Item	Interval	Maintenance required
Modulator—Con.		
Plate leads	Weekly	If loose from vibration, tighten.
Condenser grounding switch.	Weekly	Test for reliable operation in grounding condenser. Firm contact must be made when closed.
Blower motor	Weekly	Lubricate with SAE 30 oil. Wipe off excess. Tighten fan blade screws and hub setscrews.
Transmitter:		
Plate and grid line pigtails.	Weekly	Arrange symmetrically. Check tightness of connections (work loose due to vibrations).
Corona balls	Weekly	Balls must fit tight and be at least 1/32 inch away from glass stem of tube. Clean with solvent, dry-cleaning.
Insulators	Weekly	Clean all white porcelain insulators with dry cloth.
Internal wiring	Weekly	Check for loose or broken wiring.
Operator's shelter blower motor.	Weekly	Oil with SAE 30 oil.

Item	Interval	Maintenance required
All air filters	Monthly	Remove, tap gently with intake side down to shake loose dirt. If collection of dirt is too great, replace. If no replacement is available, wash in gasoline, dry thoroughly, apply light coating of SAE 10 oil, and replace with airflow in same direction.
Rectifier blower motor.	Monthly	Oil with SAE 30 oil, remove excess. Blade screws and hub setscrews must be tight.
Rectifier relay 112	Monthly	Oil in dashpot must cover plunger.
Rectifier fuses 150, 151, 152.	Monthly and when moved.	Clean contacts and seat firmly.
Rectifier resistors 123, 143B, 148, 153.	Monthly and when moved.	Clean contacts and seat firmly.
Transmitter blower motor.	Monthly	Remove top cover-plate of transmitter and, with improvised fitting of 3/16-inch tubing and zerk fitting with ball removed, reach lubricating holes. Use grease gun and standard chassis lubricant.

Item	Interval	Maintenance required
Azimuth and elevation repeaters.	Monthly	Remove cover and lubricate gears with graphite grease as required.
Rectifier transformer and retard coil.	Quarterly	Remove plugs, check oil level with gauge provided on center brace to left of resistor 153. If low, add *transformer oil.*
Rectifier plate and filament transtats 103, 104.	Quarterly	Clean commutator with crocus cloth. Check for even brush tension and worn brushes. Replace only with brushes of same material.
Range unit:		
Deviation	Quarterly	Check deviation of range unit over full scale with range calibrator. Call battalion radar sergeant to make necessary changes in condenser No. 1 and resistor No. 7.
Slip rings	Quarterly	Clean carefully with solvent, dry-cleaning. Abrasive must not be used to remove spots. Call battalion radar sergeant.

Item	Interval	Maintenance required
Range unit—Con.		
Shaft	Quarterly	Outside shaft bushing needs no lubricant. If lateral play, remove cover to worm gear housing and adjust collars. Lubricate with small amount of chassis lubricant.
Heater	Quarterly	Tighten if loose.
Resistor 22	Quarterly	If burned out, probable cause is accumulated dirt in LV slip ring, causing 110 V to short to sync. line.
Range converter:		
Selsyns	Quarterly	Tighten setscrews and all internal mechanism. Do not lubricate selsyns.
Cam	Quarterly	Inspect, and if rust spots are found notify battalion radar sergeant who will assume responsibility of removing rust with thinner or eraser, and recoat with petroleum jelly. Utmost care must be used to keep dust and dirt out of this mechanism.
Lights and wiring	Quarterly	Check wiring and terminal block for loose connections.

Item	Interval	Maintenance required
Range converter—Con.		
Veeder counters	Quarterly	Use one drop SAE 10 oil on outside brass bushing around shaft.
Gears	Quarterly	Lubricate with graphite grease as required.
Antenna mount:		
Azimuth brake drum.	Quarterly	Remove Hv housing. Clean brake drum of accumulated grease and oil.
High voltage slip ring.	Quarterly	Remove housing. Clean slip ring insulators, trolleys, and bottom of housing. Test for high resistance spots (maximum allowable 10 ohms). Put small amount of powdered graphite in trolleys supporting shaft. Test freedom of operation of trolley wheels.
High voltage cable	Quarterly	Remove outside pipe bushing, inspect condition of cable and internal connections. Avoid sharp bends.
Low voltage slip ring.	Quarterly	Open and check for loose leads, worn braids, dirty contacts, and continuity. Relubricate.

Item	Interval	Maintenance required
Antenna mount—Con.		
JB23 (73)	Quarterly	Remove cover. Blow out with air hose, especially transtat. Inspect for loose and burned connections.

■ 6. SCR–268—POWER PLANT.

PREVENTIVE MAINTENANCE CHECK LIST

a. Maintenance by operator.

Battery_____ Platoon_____ Section_____

Item	Interval	Maintenance required
Radiator	Daily	Add coolant when needed.
Fuel tank	Daily	Keep full, but run down once a month.
Oil level	Daily	Maintain at full on dip stick. Use SAE 30 oil above 32° F. and SAE 10 oil below.
Storage battery	Daily	Keep vent holes on cap open. Add distilled water to cover plates ¼ inch.
Air cleaner	Daily	Maintain oil level to bead; use same oil as used in motor.
Sediment bowl	Daily	Inspect for dirt and water. Clean when necessary.
Surfaces	Daily	Wipe with cloth dampened with solvent, dry-cleaning.

Item	Interval	Maintenance required
Water pump	4 hours	Turn grease cup till grease is extruded from bearing or pressure is felt at cup.
Fan belt	Daily	Adjust to prevent slippage; ½-inch to ¾-inch loose play.
Fan pulley assembly	Daily	Check for looseness. If loose, notify maintenance sergeant.
Ground stake	Daily	Inspect for firm grounding and tight leads. Keep contacts bright.
Cables	Daily	Inspect for clean snug contacts. Report burned or pitted contacts to maintenance sergeant.
Air cleaner	Weekly	Remove dirt accumulations from sediment bowl. Clean filter element with solvent, dry-cleaning. Dry thoroughly, reassemble, and refill.
Cylinder head and crankcase breathers.	Weekly	Remove, wash in solvent, dry-cleaning. Dry thoroughly, and replace.
Cylinder head, cylinder block, manifold, coupling.	Weekly	Tighten studs and nuts and bolts when necessary. Do not snap bolts.
Muffler	Weekly	Remove and clean all carbon accumulations.

Item	*Interval*	*Maintenance required*
Radiator hose	Weekly	Be certain hose connections are tight.
Motor wiring	Weekly	Check connections for tightness and corrosion.
Governor operating mechanism.	Weekly	Lubricate following parts with SAE 30 oil: cross shaft lever clevis pins, governor cross shaft, governor control spring and rod, governor control rod guide.
External gasoline hose.	Weekly	Inspect. If hose emits green fluid, replace hose.
Run engine	Weekly	Operate engine at least ½ hour weekly.
Oil change	150 hours	Change when lubricant becomes badly discolored or diluted. Interval depends upon operating condition and quality of oil. Change when hot.
Radiator core	Monthly	Clean with air hose if necessary.

b. Maintenance by platoon maintenance personnel.

Battery Platoon Section

Item	*Interval*	*Maintenance required*
Meters	150 hours	Set zero reading on ammeter and voltmeter. Check to see that frequency, voltage, and amperes are correct during operation.

Item	*Interval*	*Maintenance required*
Ignition switch	150 hours	Lubricate with powdered graphite if necessary. Control lever pin must open ignition switch in OFF position. Butterfly valve shaft must move with lever.
Valves	150 hours	Check and adjust clearance to .015 inch hot, or .018 inch cold.
Spark plugs	150 hours	Remove, clean, adjust to .025 inch to .030 inch.
Magneto interrupter contacts.	150 hours	Adjust opening to .014 inch to .016 inch; clean and file contacts if necessary.
Timing	150 hours	Check and adjust if necessary in accordance with instructions in manufacturer's operators manual.

Item	*Interval*	*Maintenance required*
Governor	150 hours	Check operation and cycle regulation. If necessary, adjust external low limit adjusting screw if frequency at full load is not 60.0±0.5 cycles. Adjust speed droop adjustment if motor hunts. No load frequency not more than 61.0±0.5 cycles. Readjust carburetor.
Carburetor	150 hours	Adjust main jet to give 61.0∓0.5 cycles on frequency meter with main line circuit breaker OFF and engine warmed for ½ hour. Also make this adjustment when governor or timing is adjusted.
12 volt generator	150 hours	Add 8 to 10 drops SAE 30 oil to oilers.
Alternator and excitor.	150 hours	Inspect commutator, slip rings, and brushes for sparking. Clean commutator, slip rings, and brushes with solvent, dry-cleaning. Test spring tension. Replace worn brushes.

Item	*Interval*	*Maintenance required*
Storage battery	150 hours	Maintain specific gravity at or above 1.250 corrected to 80° F. Clean battery surface and terminals. Apply light coat of vaseline to battery terminals.
Oil filter	150 hours	Replace filter element when oil begins to get black and dirty.
Compression	600 hours	Crank slowly to test compression. If only one or two cylinders show poor compression, check valve and tappet clearances. If all cylinders show poor compression, repairs must be effected by authorized maintenance personnel.
Oil pan	600 hours	Drain oil, remove handhole covers, and wash with brush and solvent, dry - cleaning. *Do not use cloth or waste.*
Oil pump strainer screen.	600 hours	Remove and wash in solvent, dry-cleaning.
Magneto	1200 hours	Relubricate cam lubricating wick with small quantity of SAE 50 or 60 oil.

Item	*Interval*	*Maintenance required*
Starting motor	1200 hours	Check spring and brush tension. Clean commutator with No. 00 sandpaper if necessary. *Do not lubricate bearings.*
12-volt generator	1200 hours	Check brushes and commutator as above.
Magnetic switch	1200 hours	Check for loose mounting screws and connections. (If starting button fails, remove cover and press button in magnetic switch.)
Alternator	6 months	Bearing housing should be one-third to one-half full of grease. Add 3 ounces of Freesoleum #250, Poyco #6A or equal. Clean old grease from sump.
Cooling system	6 months	Drain, add 2½ pounds of washing soda in 9 gallons water; run till hot with cap off, drain, flush.

APPENDIX IV

TABLE OF WEIGHTS

1. GENERAL.—The following data give weights and measurements of various components of SCR–268. These are especially significant in regard to bridges, underpasses, road travel, and going into and out of position.

SCR-268

Vehicle	Weight (lbs.)	Height	Width	Length	Clearance		Tire size	Tire pressure (lbs.)
					Axle	Diff. or Spring		
Truck, prime mover.	24,000	11′ 2″	8′	23′ 10″	10″	10″	10.00–22	70
Trailer K–34–B.	16,700	10′	8′	23′ 6″	16″	10″	Heavy duty 7.50–20.	75
Trailer K–28–A.	12,150	11′	8′	19′ 11″	16″	10″	Heavy duty 7.50–20.	75

SCR-268-B

Power truck K–56–B.	34,700	11′ 6″	8′ 2″	23′ 10″	11″	10″	10.00–22	70
Rect. truck K–60–C.	15,070	9′ 10″	8′	21′ 2″	11″	10″	7.50–20	55
Ant. truck K–60–B.	15,100	9′ 10″	8′	21′ 2″	11″	10″	7.50–20	55
Work truck K–60–B.	15,070	9′ 10″	8′	21′ 2″	11″	10″	7.50–20	55
Trailer K–28–B.	12,800	11′	8′	19′ 11″	16″	10″	Heavy duty 7.50–20.	75
Trailer K–28–C.	12,000	11′	8′	19′ 11″	16″	10″	Heavy duty 7.50–20.	75

APPENDIX V

GLOSSARY OF TERMS

Array.—An assembly of dipoles for the purpose of attaining directivity.

Azimuth operator.—The person who matches height of pulse echoes from same target on the azimuth oscilloscope by turning the azimuth handwheel.

Bias.—The d-c voltage applied to the grid circuit of an electron tube.

Carrier frequency.—The radio frequency upon which a radio transmitter operates.

Dipole.—A half-wave antenna.

Echo.—The reflected signal received by the SCR–268 from the surface of metallic objects or other objects of considerable mass in the field of a transmitted pulse.

Electrical axis.—An imaginary line connecting the center of the antenna array and the source of received signal when the pips are matched in both the azimuth and elevation oscilloscopes.

Elevation operator.—The person who matches pulse echoes on the elevation oscilloscope by turning the elevation handwheel.

Filament.—An element within an electron tube in the form of a metal wire heated by current passing through it.

Fixed echo.—The echo received from the surface of a fixed object such as a water tank or a steel bridge.

Focus control.—The control on the front of the oscilloscope which concentrates the electron beam of the cathode ray tube in order to give a sharp image on the screen of the oscilloscope.

Gain.—The ratio of the output to the input of an electrical system.

Grid.—An element within an electron tube designed to control the flow of electrons.

Grid voltage.—The voltage applied to the grid of an electron tube.

Intensity control.—The control on the front of the oscilloscope which determines the brightness of the visual image.

Interlocks.—Safety switches placed in the doors of the transmitter, filament transformer, and rectifier, and in the cover plate of the modulator. These units must be completely inclosed before the switches make contact and permit the high voltage to be thrown on.

Keyer, keying unit.—A unit used in the radio set SCR–268 to control the output of the modulator.

Mechanical axis.—The imaginary line perpendicular to the plane of the antenna arrays.

Milliampere.—One one-thousandth of an ampere.

Modulator.—A unit used to control or shape the output of the transmitter.

Oscillator.—An electron tube circuit generating a given frequency.

Oscilloscope.—A unit employing a cathode-ray tube, the fluorescent screen of which indicates the presence of high frequency impulses. These indications are used for the purpose of tracking targets.

Phasing section.—A set of connecting lines between the halves of an antenna array.

Plate.—An electrode within an electron tube to which the electrons flow.

Plate voltage.—The voltage applied to the plate of an electron tube.

Pulse.—A radio signal of short duration.

Range operator.—The person who adjusts the position of the pulse echo on the range oscilloscope by turning the range handwheel.

Rotatable column.—That rotatable member of the mount which supports the operators' seats, oscilloscopes, the transmitter, the antennas, and several other units.

Sensitivity control.—The control on the front of the oscilloscope which determines the amplification of the receiver.

Sight tube.—A hood placed over the oscilloscope screen for daylight viewing of the image.

Slip ring.—A device for making electrical connections between stationary and rotating contacts.

Spread.—The adjustment of the lateral spacing on the oscilloscope between the split echoes which are the result of the two input channels from the antennas.

Stub.—A tuning or matching unit composed of a U-shaped length of conductor, which is connected across a two-wire transmission line to adjust its efficiency.

Sweep control.—The control on the front of the oscilloscope which determines the length of horizontal line seen on the screen of the cathode-ray tube.

Tracking.—The process of moving the antenna arrays of the radio set so that the split echoes on the oscilloscope screen are matched.

Transmitter.—A unit which produces radio-frequency signal energy under the control of the modulator.

Trombone.—A phasing stub equipped with a movable shorting bar inserted between half sections of antenna arrays.

APPENDIX VI

DESTRUCTION OF MATÉRIEL

■ 1. GENERAL PRINCIPLES.—*a.* Tactical situations may arise when, owing to limitations of time or transportation, it becomes impossible to evacuate all equipment. In such situations it is imperative that all matériel which cannot be evacuated be destroyed to prevent—

(1) Its capture intact by the enemy, thereby disclosing information which may be unknown to the enemy.

(2) Its use by the enemy, if captured, against our own or allied troops.

b. The working principles to be followed are:

(1) Methods for destruction of matériel subject to capture or abandonment in the combat zone must be *adequate, uniform,* and *easily followed* in the field.

(2) Destruction must be as complete as the available time, equipment, and personnel permit. Since complete destruction takes some time, a priority must be set up so that the more important classified features are destroyed first. Then if the operation is interrupted before its completion, the requirements set forth in (1) above are met. Next in priority of destruction are essential parts. While these parts are not necessarily secret, they are difficult to procure, and the lack of them will prevent the equipment from being operated. *All essential parts must be destroyed on all like units to prevent the enemy from constructing one complete unit from several damaged ones by "cannibalization."* Next in priority is the complete destruction of the equipment, including such features as chassis, structural members, and wiring.

(3) Spare parts and accessories must be given the same priorities as the parts installed on the equipment.

c. The destruction of matériel, subject to capture or abandonment in the combat zone, *will be undertaken only upon authority delegated by division or higher commander.*

d. To accomplish the adequate, uniform destruction of matériel, it is necessary that—

(1) All units know thoroughly the plans for destruction, including the priority of destruction.

(2) All echelons be trained in the several procedures for destruction. *Training will not involve actual destruction of matériel.*

■ 2. METHODS.—*a.* The destruction procedures outlined below are arranged in the order of effectiveness. No. 1 method should be used whenever *time permits and the necessary equipment is available.* If Method No. 1 cannot be used, switch to No. 2 or No. 3 in order named.

b. No matter which method is used, it is imperative that the order indicated be followed. This will result in uniformity of destruction regardless of whether the destructior is carried to completion or not.

c. Certain of the methods require special equipment which may not be items of issue normally, such as explosives and incendiary grenades. The issue of these items, the equipment for which issued, and the conditions under which destruction is effected *are command decisions in each case,* according to the tactical situation.

■ 3. DESTRUCTION OF PRINTED MATTER.—All manuals, charts, or any written matter pertaining to the equipment is destroyed by burning. Pages are torn out of books before setting them on fire.

■ 4. DESTRUCTION OF MOUNT.—*a. Method No. 1.*—(1) Knock down antenna beams, and thoroughly smash receivers and antenna with an ax.

(2) Place TNT charges as follows:

(*a*) One pound in each separate compartment of radio on the mount. Place 2 pounds inside the base of the rotatable column.

(*b*) Two-pound charges over the axle inside each wheel.

(3) Insert an electric cap and join all TNT charges with primacord (see FM 5-25).

(4) Explode charges simultaneously from cover.

(5) Destroy tires in accordance with procedure given in paragraph 6.

b. Method No. 2.—(1) Knock down antenna beams and thoroughly smash receiver and antenna with an ax.

(2) Remove covers from all radio and control components. Smash thoroughly all components using a sledge, jack handle, or any heavy club available.

(3) Ignite an incendiary grenade in each of the components previously smashed.

(4) Destroy tires in accordance with procedure in paragraph 6.

c. Method No. 3.—(1) Carry out steps in *b* (1) and (2) above.

(2) Heap smashed components on platform of trailer.

(3) Douse the trailer and smashed components with gasoline, oil, or distillate, and ignite with a piece of burning waste or other material.

(4) Destroy the tires in accordance with procedure in paragraph 6.

NOTE.—If there is any doubt that Method No. 1 cannot be completed in time, it should not be attempted. Method No. 1 will give the complete results desired *only* if carried to completion.

■ 5. DESTRUCTION OF PRIME MOVER.—*a. Method No. 1.*—(1) Place TNT charges as follows:

(*a*) Two-pound charge on top of clutch housing.

(*b*) Two-pound charge on left of prime mover engine as low as possible.

(*c*) Two-pound charges on each side of generator driving engine.

(*d*) Two-pound charge inside generator frame.

(2) Insert electric caps and join charges with primacord.

(3) Puncture gas tanks.

(4) Remove and discharge portable fire extinguisher.

(5) Pour gasoline, oil, or distillate over the prime mover.

(6) Explode the charges simultaneously from cover.

(7) Destroy the tires in accordance with procedure in paragraph 6.

b. Method No. 2.—(1) With a sledge or other heavy club, smash the vital elements on prime mover and generator engine (such as distributor, carburetor, radiator, engine block, crank case, transmission).

(2) Puncture the gas tanks.

(3) Smash the generator with a sledge.

NOTE.—Generator can be burned out by shorting the terminals while it is operating.

(4) Pour gasoline, oil, distillate over the vehicle (remove fire extinguisher and discharge) and set fire to the prime mover.

(5) Destroy the tires in accordance with procedure in paragraph 6.

■ 6. DESTRUCTION OF TIRES. *a. General.*—(1) Rubber is such a critical item that attempts to destroy the tires should be made, *even though it is not possible to completely destroy the remainder of the vehicle.*

(2) Tires can usually be destroyed at the same time that the remainder of the vehicle is destroyed by careful planning and training.

b. Method No. 1.—(1) Ignite an incendiary grenade under each tire.

(2) When explosives are used for the destruction of the vehicle and contents, allow the tires to become well ignited before exploding the charges.

c. Method No. 2.—Damage the tires with an ax, a pick, or machine-gun fire (deflate first, if possible). Pour gasoline over each tire and ignite.

d. Provided that the fire is permitted to get a good start, the tires will probably set the entire vehicle on fire.

■ 7. DESTRUCTION OF OTHER VEHICLES.—The rectifier, antenna (shop truck in some units), with equipment, is destroyed by methods given in paragraphs 4, 5, and 6.

a. Spare parts are destroyed as in paragraph 4.

b. Vehicles are destroyed as described in paragraphs 5 and 6.

c. Although the spare parts are considered last, they should receive the same priorities given the parts when installed in the radio set.

APPENDIX VII

LIST OF REFERENCES

■ 1. GENERAL.

Communications	FM 4–106
	FM 24–5
Radio set SCR–268	TM 11–1106
	TM 11–1106B
Searchlight, service of the	FM 4–175
Tactical employment of searchlights	FM 4–106
Tactical employment of antiaircraft guns	FM 4–104

■ 2. PARTICULAR MATÉRIEL.

Power unit	Operator's Manual and Parts List, Engine—Generator Unit, U. S. Type PE–84–A.
Rectifier	Instructions for Rectifier RA–38.
Trailers	Handbook—Parts List—Lubrication Charts for U. S. Army Four-wheel Trailer, Model R–H–4.

INDEX

	Paragraph	Page
Aircraft warning	170	120
Alignment, final check of	53, 54	47
Antenna adjustments, special	119, 120	76
Alignment:		
Azimuth	30–37	32
Definition	25	27
Elevation	38–52	39
Importance	24	27
Summary	55–61	48
Mounting	15	8
Pattern, azimuth	36	37
Elevation	49	45
Theory	26, 27	27, 28
Assembly:		
K28A and K28B	13–16	8
K28C	17–23	22
Azimuth antenna, unloading:		
K28A and K28B	15	8
K28C	20	23
Brackets, receiver	15	8
Cables	15	8
Camouflage:		
Limitations	12	8
Principles	24, 25	27
Chief radar operator, duties of	161	111
Closing station	156	107
Commands	173–177	122
Components:		
Inspection	140	90
Of instrument	5	3
Converter, range	125	77
Counterweight, adjustment:		
K28A and K28B	15	8
K28C	20	23
Description, general	4	2
Dipoles, elevated, preparing	43	43
Disassembling equipment	193	133
K28A and K28B	16	20
K28C	23	24
Drill	178–191	124
Unseen targets	166	117
Duties of personnel	171, 172	121
Elevation antenna, assembly of	15	8
Emplacement:		
Choice	9–12	6
Of K28A and K28B	13–16	8

	Paragraph	Page
Employment:		
Types of	157	110
Fighter searchlight team	158–163	110
Explanation	6	3
Feed lines, receiver	15	8
Fighter searchlight team	158–163	110
Detector section	161	111
Filament transformer	15	8
Formations	173–177	122
Framework, unloading:		
K28A and K28B	15	8
K28C	19	22
Frequency meter, operation of	148	102
Functions of instrument	8	5
General description	4	2
Handling equipment	196	134
Hoist:		
Assembly	15	8
Raising	15	8
Illumination, tracking for	162	112
Instrument components	5	3
Service	171–197	121
Jacks and outriggers, unloading	15	8
Junction box JB22, operation	143	93
Keyer:		
Operation	145	97
Unloading	15	8
Leveling	15	8
Lobe:		
Definition	28	28
Separation	29	29
Check of	35, 48	36, 44
Location:		
Choice	9–12	6
Of K28A and K28B	13–16	8
Mechanical sight, adjusting	30, 39	32, 39
Modulator, unloading	15	8
Operation:		
Adjustments for	140–149	90
Closing station	156	107
Detection of targets	150–152	103
Of instrument	139–156	90
Principles	7	3
Tracking	153–155	106
With director	118–138	75
Operator's shelter	22	24

	Paragraph	Page
Orientation	63–66	50
Corrections	115–117	72
Summary of	114	71
With director	128–133	80
With 1941 searchlights	69–93	56
With 1942 searchlights	94–113	63
Oscilloscopes:		
Adjusting	144	96
Mounting	15	8
Oscilloscope operator's tracking procedure	151, 152	104, 106
Oscillator tuning control	149	102
Personnel:		
Chief radar operator	160	111
Duties	171–173	121
Training	165	116
Power plant	15	8
Unit, operation of	141	91
Principles of operation	7	3
Purpose of instrument	8	5
Range orientation with expanded sweep	126, 127	78, 79
System	121–127	77, 79
Unit, check of	146	99
Receivers, adjustment of	149	102
Receiver brackets	15	8
Feed lines	15	8
Rectifier, adjustment of	142	92
Repeaters	68	52
Safety precautions	195	134
Searchlight, operation with	62–117	49
Service of piece	171–197	121
Notes on	192–197	133
Site:		
Choice	9–12	6
Of K28A and K28B	13–16	8
Slip ring, low-voltage	15	8
Stubs, use of	33	33
Synchronization	67	51
Corrections	115–117	72
	134–138	87
Special adjustments in altitude	133	86
Summary of	114	71
With director	128–133	80
With 1941 searchlights	69–93	56
With 1942 searchlights	94–113	63
Targets:		
Detection	150–152	103
Firing at unseen	164	115
Selection	163	112
Terminal box:		
JB–23, unloading	15	8
JB–73, description	21	24

	Paragraph	Page
Theory	6	3
Tracking:		
Difficulties	155	106
Moving objects	154	106
Smooth	153	106
Training:		
Personnel	165	116
Unit	167	119
Transmitter:		
Adjusting	147	199
Raising	15	8
Transmitting antenna, unloading:		
K28A and K28B	15	8
K28C	20	23
Transmitting frequency, check of	148	102
Trombone slide, adjustment of	33	33
Tuning rack, adjustment of	147	99
Tweeter:		
Buried, preparing	40	40
Preparing	31	32
Unpacking instrument:		
K28A and K28B	14, 15	8
K28C	17	22
Firing	164	115
Unseen targets:		
Drill	166	117
Radar relocation	168, 169	120
Uses of instrument	8	5
Warning, aircraft	170	120
Operation for	161	111