RESTRICTED

FM 4–136

WAR DEPARTMENT

ANTIAIRCRAFT ARTILLERY FIELD MANUAL

SERVICE OF DIRECTORS M4 AND M7

13 October 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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UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1943

WAR DEPARTMENT,

WASHINGTON 25, D. C., 13 October 1943.

FM 4–136, Service of the Directors M4 and M7, is published for the information and guidance of all concerned.

[A. G. 300.7 (31 Aug 43).]

BY ORDER OF THE SECRETARY OF WAR:

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DISTRIBUTION:

R and H 44(5); IBn and IC 44(5).

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

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ANTIAIRCRAFT ARTILLERY FIELD MANUAL

SERVICE OF DIRECTORS M4 AND M7

(This manual rescinds section III, Training Circular No. 16, War Department, 1943.)

CHAPTER 1

GENERAL

■ 1. SCOPE.—*a.* This manual prescribes a systematic procedure to be followed by director squads manning antiaircraft directors M4 and M7.

b. (1) The director is the key to accurate fire for effect by the antiaircraft gun battery. It is the best mechanical instrument yet devised for computing where the swift aerial target will be at the end of the time of flight of the projectile. Without the director the AA gun battery cannot carry out its primary mission with any degree of efficiency.

(2) The director must have thorough and complete preparation of fire, smooth and accurate tracking, smooth and accurate dial matching, and a reasonable amount of care and attention to realize its maximum performance. Properly handled, the director will function with gratifying results; its capabilities have already been well established in the theaters of operation.

c. The M4 director is an earlier model than the M7. However, the improvements in the latter are essentially minor ones. Some M4 directors have been modified to include M7 improvements. Throughout this manual the instrument referred to is the director M7, unless specifically mentioned otherwise.

■ 2. REFERENCES.—References are listed in the appendix; they are recommended for further study of matériel covered in the manual and allied topics.

CHAPTER 2

DESCRIPTION

■ 3. GENERAL.—The manual will not undertake to describe the internal workings of the director. For detailed study of the director's interior mechanisms, see TM 9–1655 and 9–2655 for the M4 director, and TM 9–1658 and 9–658 (now 9–2658) for the M7 director. For a discussion of the director problem see FM 4–110.

■ 4. WHAT THE DIRECTOR DOES.—The present position of the target is obtained by either tracking or receiving data from other fire-control equipment. Altitude (or slant range) is transmitted to the director from a height finder. By a series of rapid calculations, the future position of the target is determined. Firing data are calculated for the future position. Firing data consists of firing azimuth (Af) or angle of train, quadrant elevation (QE or ϕ) fuze range (F). These firing data are sent to the guns by selsyn transmitters.

■ 5. VISUAL DESCRIPTION.—The M7 director is a series of integrated mechanisms contained in a box weighing 725 to 800 pounds. It is mounted on a tripod. There are a number of dials, knobs, handwheels, cranks, switches, and adjustment screws. Comparatively few of these handwheels and dials are used by the director crew in either simulated or actual combat. The others are used for putting in ballistic corrections, spot corrections, orienting, adjustments—functions which ordinarily take place prior to firing. The range officer, chief of section, or a specified noncommissioned officer works these handwheels and knobs and records readings on dials; it is seldom the function of any member of the director crew. In the following general description of the director, those parts *printed in italics* are the parts which are not particularly or constantly the concern of the director crew.

a. Front side.—The side of the director that faces the target is the front side. There are five dials (the altitude

and range dial, the present angular height dials, the present horizontal range counter, the altitude rate dial, and the range rate dial), three handwheels and knobs (the altitude setting handwheel, the altitude rate knob, and the range rate knob), the altitude signal lamp, the *three parallax setting screws,* and one of the prediction arresting (red) buttons.

b. Left side.—On the left side of the director are the elevation telescope, five dials (*wind and problem target velocity dials, lateral deflection dial, firing azimuth (angle of train) dial, future horizontal range dial, and wind component solver*), two handwheels (the range setting handwheel and the *auxiliary elevation handwheel*), three knobs (*two wind and problem target velocity knobs* and a *wind component solver knob*), a motor switch push button, a level bubble, and a *covered oil cup.*

c. Rear side.—On the rear side of the director are ten dials. They are the voltmeter, *four spot dials (fuze, vertical, lateral, and altitude), a fuze dead time dial,* the fuze rate drums, a *fuze dial, a vertical deflection dial,* and a *quadrant elevation dial.* There are seven handwheels. These are *four spot correction handwheels for the four spot dials,* a fuze prediction handwheel, an elevating handwheel, and an *azimuth slewing handwheel.* There are six knobs; *four trial fire correction knobs for the four spot dials, a fuze dead time knob,* and a speed shift knob on the elevating handwheel. There are two buttons, a prediction arresting (red) button and a *reticle lamp switch* (with reticle dimmer rheostat). There is also a level bubble.

d. Right side.—There are three dials on the right side of the director. These are a coarse and fine present azimuth dial, *parallax dials,* and an altitude prediction indicator. There are also the azimuth telescope, the azimuth tracking handwheel and speed shift knob, and an *orienting clutch.*

e. Base.—On the under side of the director are five receptacles for cables to the junction box, height finder, and radar, and to plug in the service lamp, and the heater. There are three switches, the altitude receiver switch marked H (height finder) and T (radar) which allows reception of data from either the height finder or the radar, the altitude follow-up motor switch, and the *deflection dials lamp switch.*

There is a *compartment* designed to hold 1½ pounds of a dehydrating agent, silica gel.

f. Pedestal.—The pedestal which supports the director has three clamping screws which fit into tapped holes in the azimuth gear in the director base. A *spring loaded locking pin* engages in any of three positions. When the pin is engaged, the clamping screws are lined up with the tapped holes and may be tightened. In the pedestal is a *storage compartment* for the service lamp and cord.

■ 6. CHIEF DIFFERENCES BETWEEN DIRECTORS M4 AND M7.—*a. Fuze prediction.*—No provision is made on the M4 director for the correction of fuze dead time. Consequently, one less operator is necessary on the M4 director.

b. Range and altitude rates.—The range and the altitude rate knobs are independent of the range and the altitude handwheels, respectively. That is, turning the handwheel on the director M4 will not change the rate, and the rate knob need not be held. If a rate is desired in either range or altitude it must be set in manually by means of two rate knobs (coarse and fine).

c. Handwheels.—The M4 has handcranks in place of the range and the altitude setting handwheels on the M7.

d. Dehydrating agent.—The M4 director has no silica gel compartment.

e. Storage compartment.—There is a storage compartment in the rear side of the M4 director. The storage compartment for the M7 is in the pedestal.

■ 7. DIRECTOR LIMITS OF OPERATION.—A comparison of limits of the M4 and the M7 directors follows:

	M4	*M7*
Present altitude	−320 to +8,350 yards	−300 to +10,000 yards
Present azimuth	No limit	No limit
Present angular height.	−175 to +1,600 mils	−175 to +1,600 mils
Present horizontal range.	250 to 15,750 yards	250 to 15,750 yards
Target speed	0 to 200 yards/second	0 to 200 yds/second
Target vertical velocity.	0 to 50 yards/second up	0 to 50 yds/second up
	0 to 50 yards/second down	0 to 200 yds/second down
Wind correction (3-inch AA gun).	0 to 50 mph	0 to 50 mph
Wind correction (90-mm AA gun).	0 to 75 mph	0 to 75 mph
Time of flight	4 to 33 seconds	4 to 32 ±1 second
Battery parallax, horizontal (in cardinal directions).	0 to 500* yards	0 to 500* yards
Battery parallax, vertical.	0 to 500* yards	0 to 500* yards
Present altitude spot	±450 yards	±500 yards
Lateral spot	±140 mils	±150 mils
Vertical spot	±50 mils	±50 mils
Fuze spot (mechanical fuze).	±2.5 fuze numbers	±3.0 fuze numbers
Future horizontal range.	250 to 15,750 yards	250 to 15,750 yards
Angle of train (firing azimuth).	No limit	No limit
Quadrant elevation	−135 to +1,600 mils	−135 to +1,600 mils
Fuze numbers	2 to 21 (powder train fuze) 2 to 32 (mechanical fuze)	2 to 32 (mechanical fuze)
Fuze dead time	----------	1 to 6 seconds
Vertical deflection	±500 mils (grad. 0 to 1,000)	±500 mils (grad. 0 to 1,000)
Lateral deflection	±1,000 mils (grad. 0 to 2,000)	±1,000 mils (grad. 0 to 2,000)

***Normal allowance of cables limits parallax to 450 yards.**

CHAPTER 3

POWER AND DATA TRANSMISSION

■ 8. GENERAL.—A data transmission system provides for the instantaneous and continuous transmission of data from other fire-control instruments to the director, from the director to the guns, and for distribution of power. Multiconductor cables connect the director to the guns and to the power plant through the main junction box. The director is connected to the height finder and radar directly. The M4 data transmission system is designed for use with the 3-inch AA gun battery. The M6 data transmission system is very similar to the M4 and is designed for use with the pointer matching 90-mm AA gun battery. The M1 and the M2 cable systems are designed for use with the remote control system M2 and the remote control 90-mm AA gun battery. These two cable systems are similar, the only difference between them being that the M1 will accommodate a four-gun battery, while the M2 is for a two-gun battery.

■ 9. M4 AND M6 DATA TRANSMISSION SYSTEMS.—*a.* The M4 or the M6 system consists of the following: twelve interchangeable, 225 foot cables, each containing 20 conductors (19 prong plugs); two M4 1,200 rpm, four cylinder gas-electric power plants, each generating 2½ kva, 115 volts, single-phase, 60-cycle, ac; a ten-sided, cast aluminum junction box with six designated cable receptacles and a removable cover; twelve cable reels, five trouble lamps, and three electrical testing meters.

b. The power plants are not operated simultaneously; one unit is used at a time, the other being available for emergency. The receptacles on the junction box are die stamped, four with the word GUN, one with the word DIRECTOR and one with POWER PLANT. In addition, they may be painted with distinctive colors to match the corresponding receptacle on the piece of equipment to which each is connected. *Red* is the color of the gun receptacles on the junction box and of the receptacles on the guns.

Yellow is the color of the receptacles for the power plant-junction box connection. *Green* is the color of the receptacles for the director-junction box connection. *Black* is the color of the receptacles for the director-height finder connection. *Olive drab* or *white* is the color of the receptacles for the director-radar connection. Improper connections may result in the synchronous units being burned out, or incorrect data transmitted to the director, possibly damaging its delicate computing mechanisms. Connecting the power plant cable directly to any other piece of equipment than the main junction box may cause particular damage.

■ 10. M1 AND M2 CABLE SYSTEMS.—The M1 cable system consists of the following: nine 225-foot cables, four of which contain 21 conductors, and five 20 conductors; four 150-foot, three-conductor cables; two six-cylinder M7 gas-electric power plants, each generating 35 kva, 125 volts, three-phase, 60-cycle, ac; a square, cast aluminum junction box with six designated cable receptacles and a removable cover; 13 cable reels, a set of trouble lamps, and electrical testing equipment. The M2 cable system is exactly the same as the M1 except that it has only two 225-foot, 21 conductor cables. As in the M4 and the M6 systems, the extra power plant supplied for the M1 or M2 cable system is for alternate, not simultaneous use. The main junction box of the M1 or M2 system is also die stamped to identify proper receptacles, and its receptacles may be painted with the same distinctive color code as those of the M4 or M6. While the M1 and the M2 cable systems are designed primarily for use with the remote control system, the gun mounts can be operated manually at the guns by means of the data transmitted to "match-the-pointer" receivers on the gun mounts. There is no possibility of making wrong connections at the main junction box of the M1 or M2 system. The cables and receptacles for the three divisions of the system are all different The 21 conductor cables can fit only the cable receptacles on the guns and the receptacles on the main junction box marked GUN. The three-conductor cable will fit only the power plant receptacles, and the 20-conductor cables will fit only the proper receptacles on the main junction box, the director, and the height finder.

■ 11. How the Systems Transmit Data.—The cables connect a self-synchronous transmitter to a self-synchronous receiver at the ends of the cables. When the rotor at the transmitter is positioned, the rotor at the receiver assumes the same respective position, thus positioning the pointer on the dial at the receiver. These self-synchronous transmitters and receivers are frequently referred to as "selsyn motors." Transmitted data are:

From—	Receptacle colors and data received	To—
Radar SCR-268	Olive drab or white present altitude (or slant range), present angular height, present azimuth.	Director (M7 or modified M4).
SCR-545 SCR-584	present altitude (or slant range), present azimuth, present angular height.	
Height finder M1 M2 SCR-547	Black present altitude or present slant range.	*Director.*
Director	Black present angular height present azimuth	*Height finder.* M1, M2, SCR-547.
Director	Green (junction box)—red firing azimuth (coarse), firing azimuth (fine), quadrant elevation (coarse), quadrant elevation (fine), fuze.	*Guns.*

On the base of the director there is a toggle switch marked T (radar) and H (height finder). This allows reception of data from either the radar or the height finder. Data cannot be received from both simultaneously.

■ 12. Synchronization.—*a.* For the cable system to be electrically synchronized, the transmitter and its receiver must read the same values. Test for synchronization follows:

(1) With power ON, set the transmitters to any convenient dial readings. Note the readings on the receiver dials. Increase the reading of each transmitter by a convenient amount and check to see that the receivers have followed accurately.

(2) Frequently the receiver disagrees with the transmitter by a small constant amount. Correction for this error is applied at the end of the cable away from the director. Slotted shafts or screws or adjusting knobs are provided on the side of each receiver on the radar, the height finder, and the guns. *Adjustment in synchronization is never made at the director by the using personnel.*

Note.—Orientation should precede electrical synchronization.

b. The data transmission system is not foolproof. Trouble may develop in the power plant (an extra power plant is provided for emergency use), in the transmitters and the receivers, or in the cables themselves. Power plant trouble is the concern of the power plant operator. Cable and selsyn troubles are the concern of the electrical staff sergeant. Director personnel may be called upon to assist in repair work.

c. Most common troubles in the data transmission system are shorting, reversing, or disconnecting of leads. Some of the possible troubles and their diagnoses are as follows:

(1) Receiver rotates in the proper direction but with a constant error of 120°. *All receiver secondary (phase) lead connections are interchanged.*

(2) Receiver rotates in the proper direction but with a constant error of 180°. *Power leads reversed at receiver.*

(3) Receiver rotates in the wrong direction. *Two secondary lead connections interchanged.*

(4) Transmitter and receiver do not maintain synchronization for a complete revolution of the dial. *Trouble may be a short between two secondary leads, a faulty transmitter or receiver, a tight dial, or one secondary lead open.*

(5) Receiver lags behind transmitter while rotating in either direction. *Trouble may be low voltage from the power plant, an open circuit at either the transmitter or the receiver, or friction at the receiver.*

(6) Receiver refuses to come to rest but swings back and forth past synchronous position. *Indicates defective damp-*

ing mechanism at the receiver. Should be replaced by ordnance personnel but if oscillation is not too great may be kept in use temporarily.

(7) Receiver spins or runs wild. *All secondary leads shorted.*

(8) Loud humming in both transmitter and receiver. *Two secondary leads shorted.*

(9) Receiver stops and reverses direction each 120°. *One open secondary lead.*

(10) Receiver refuses to move. *Open or short circuit.*

(11) Receiver has low torque. *Open power lead between transmitter and receiver.*

■ 13. COLOR CODE AND TERMINAL MARKINGS OF CONDUCTORS.—The individual conductors in the cable system have a color code and terminal markings are numerically marked to agree.

Terminal marking			Color code		Data line
M6		M4			
20	21	20	Field	Trace	
	1	1	orange	white	azimuth, fine.
	2	2	orange	black	
	3	3	orange		
	6	6	red	white	azimuth, coarse.
	7	7	red	black	
	8	8	red		
	9	9	green	white	fuze.
	10	10	green	black	
	19	19	green		
	11	11	blue	white	elevation, fine.
	12	12	blue	black	
	13	13	blue		
	16	16	yellow	white	elevation, coarse.
	17	17	yellow	black	
	18	18	yellow		
4	A4	4	white		power.
14	A4	14	white	black	
	B		red	green	
	B		red	yellow	
5	C5	5	black		
15	C5	15	black	white	
spare		spare	slate		

■ 14. CAUTIONS ON HANDLING CABLES.—*a.* The plugs and receptacles of the cable systems have alining keys and keyways to assure proper connections. When the various cables are plugged into the corresponding receptacles, the threaded collar provided for the purpose should be screwed down tightly by hand over each connection to insure a watertight and dustproof union.

b. Cables must be handled with care. Most cable failures occur within one foot of the plug, indicating that rough handling of the cable at the plug is the major source of difficulty. Observance of the following rules greatly reduces cable failures.

(1) Plugs should be removed from receptacles by pulling on the *plug,* not on the cable. Pulling on the cable will bend and break the soldered electrical connections at the plug.

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

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

(4) Do not lay the cable where it may be run over by vehicles.

(5) Do not kink the cables.

(6) Do not be in too much of a hurry to reel in the cables when MARCH ORDER is given. A few extra minutes spent in picking up the cable may save hours of repair work.

(7) Deterioration of cables can be greatly reduced by burying them 1 foot underground, thus protecting them from rain and from direct sunlight.

(8) When a shallow channel or ditch is prepared for a cable, one sidewall of the ditch may be constructed in the form of a ledge or step 4 inches from the surface. The cable is laid on this step. The lower part of the ditch provides drainage for the cable which helps to preserve it.

(9) In cold climates it is best to leave cables above ground unless sufficient time is available to build padded troughs in which to place the cables underground. Many

cables have been rendered unserviceable while they were being removed from frozen ground.

(10) Do not oil or grease cables.

(11) Store cables in a cool, dark place.

(12) Do not use friction tape on cable conductors; use rubber tape only.

(13) Keep plugs and receptacles covered when not in use.

CHAPTER 4

FUNCTIONING

15. FRONT SIDE.—*a*. The outer altitude (or range) dial is positioned by the altitude setter, No. 4, stationed at the altitude setting handwheel which is at the bottom of the panel. The middle ring is positioned by the range setting handwheel on the left side of the director. A self-synchronous receiver, which electrically receives altitude or slant range from the radar or the height finder, operates the inner dial. The matching pointers for antiaircraft fire are marked "AA" and those for horizontal fire are marked "HOR".

b. The altitude setting handwheel is provided with an altitude rate smoother. An explanation of the functioning of the mechanism is given in *e* below. The operation of the altitude rate smoother is given in paragraph 39.

c. The inner pointers of the angular height dials are positioned by self-synchronous receivers hooked up to the radar. The middle pointers are positioned by the range setter, No. 3, at the range handwheel in "AA" fire, or the altitude setter, No. 4, at the altitude handwheel in "HOR" fire. The outer pointers are positioned by the elevation handwheel. on the rear side of the director, or the auxiliary elevation handwheel on the left side. For seen fire, the middle pointers are matched to the outer pointers. For unseen targets, the middle pointers are matched to the inner pointers. The range handwheel is also provided with a range rate smoother. See *d* below and paragraph 38 for operation of range rate smoother. The range counter is connected to the range handwheel and indicates the exact value of present horizontal range set into the director.

d. The range handwheel is connected through a slip clutch to the range rate knob. Thus, when the range handwheel is turned one revolution, present horizontal range is changed by 100 yards and range rate changes approximately 57 yards/second. If the direction of the rotation of the range handwheel is reversed, the rate is decreased a proportional amount. The slip clutch has two functions:

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(1) It allows the range rate knob to be operated independently of the range handwheel; that is, by holding the range knob, a range can be set in without changing the range rate; and by turning the range rate knob a range rate can be set in without moving the range handwheel.

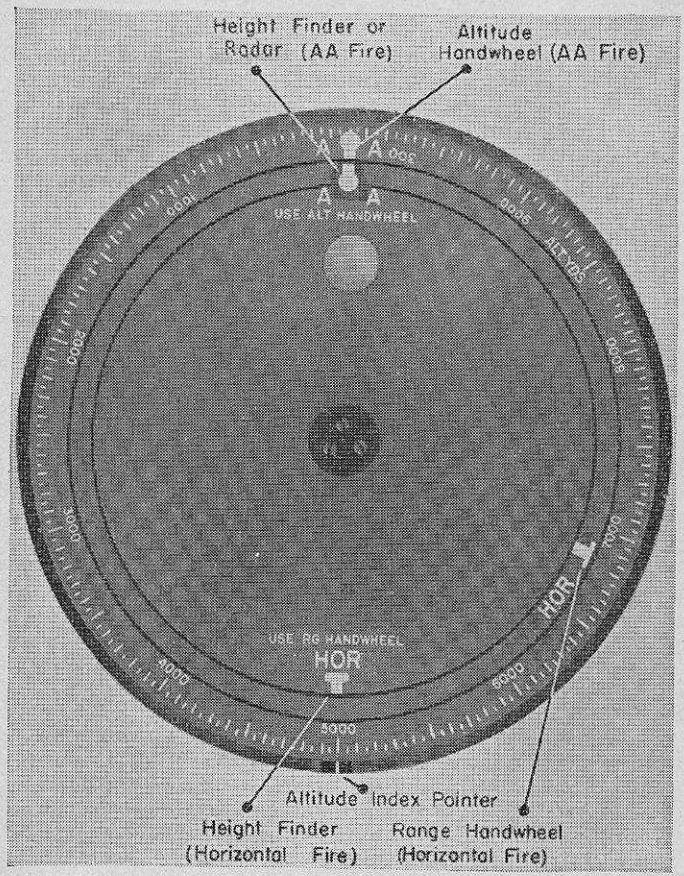


FIGURE 1.—Altitude and range dial is on the front side of the director.

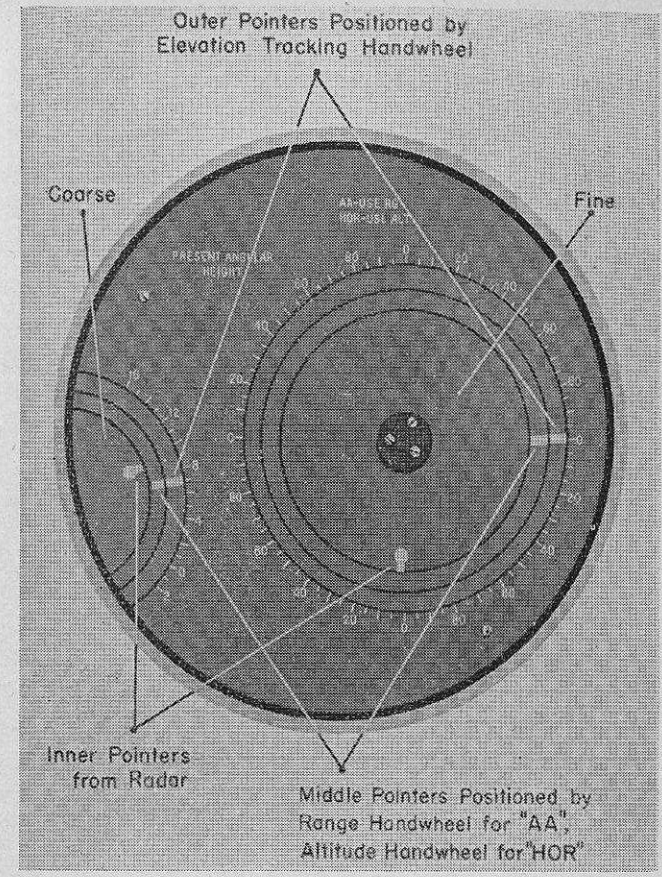


FIGURE 2.—Present angular height dials are on the front side of the director.

(2) If the range handwheel is turned so as to increase the range rate after the maximum range rate has already been set in, the clutch will slip preventing damage to the range rate mechanism. The range rate dial is connected to the range rate knob and indicates the range rate set into the director. Limit of range rate is ±200 yards/second.

e. The altitude setting handwheel is likewise equipped with a rate smoother. It is identical to the range rate smoother except in ratios and limits. One turn of the altitude setting handwheel changes altitude 80 yards and altitude rate ap-

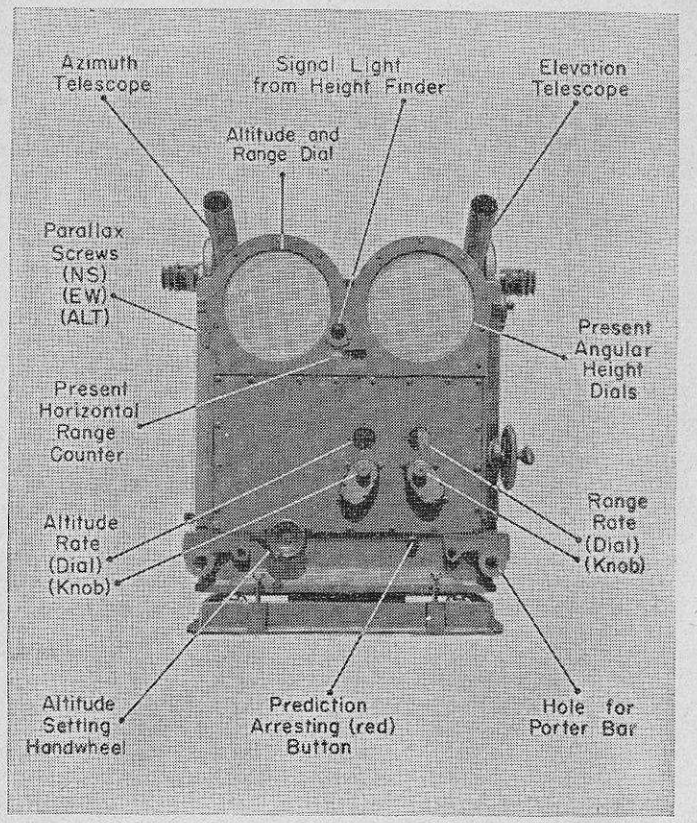


FIGURE 3.—Altitude setter, No. 4, and range setter, No. 3, stand at the front side of the director.

proximately 7 yards/second. The altitude rate dial, which indicates the altitude rate set in, has the limits of 50 yards/second increasing altitude and 200 yards/second decreasing altitude.

f. The function of the three parallax screws is described in paragraph 31.

g. The altitude signal lamp is provided to enable the operator at the height finder to signal when "on target." Although this equipment was not initially equipped with a switch to operate the lamp, it is being installed currently in the field by ordnance personnel.

h. The prediction arresting (red) button on the front, or the one on the rear, is pressed in only to freeze prediction.

(1) During slewing.

(2) During a very large change in range rate.

(3) For the insertion of a dH spot greater than 50 yards.

■ 16. LEFT SIDE.—*a.* The elevation tracking telescope is used for tracking the target in elevation, thus determining its angular height. The telescope is provided with a horizontal cross hair which may be illuminated. An adjustable headrest is mounted above the eyepiece of the telescope as a support for No. 1's head. A filter selector permits red, amber, neutral, or clear filtering.

b. No. 3, the range setter, operates the range setting handwheel to set in the horizontal range by matching the E_o dials. *The range handwheel should not be operated with motor switch OFF.*

c. The functions of the wind component solver and the wind and problem target velocity dials are explained in paragraph 32.

d. The auxiliary elevation handwheel shaft is geared to the shaft of the elevation handwheel. The auxiliary elevation handwheel is used to match the outer to middle and inner pointers on the angular height dials (unseen fire), and to set in check problems. The elevation handwheel is used to track the target optically.

e. The lateral deflection dial consists of a disk reading 0 to 2,000 mils and a drum reading 0 to 100 mils per revolution, graduated in 5-mil steps. "Zero" lateral deflection is indicated by a reading of 1,000. The lateral deflection dial, together with the vertical deflection dial and the fuze dial located on the rear side of the director, are used with guns equipped with a deflection sighting mechanism. The vertical and lateral deflections and the fuze number are read

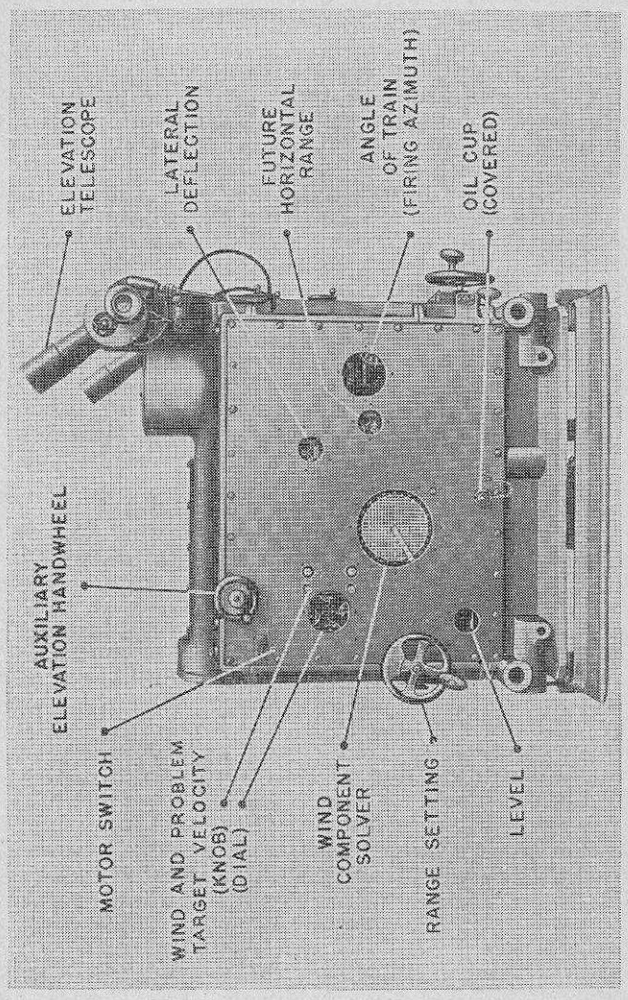


FIGURE 4.—Elevation tracker, No. 1, stands at the left side of the director.

from the dials and transmitted by telephone or other means to the guns. The dials are illuminated by pulling out the lamp switch located on the base of the director.

f. The motor switch push button is used to turn power ON and OFF.

g. The firing azimuth angle of train dial is used in the synchronization procedure. (See par. 30). The future horizontal range dial is used to set check problems in the director. (See par. 60). It is also a convenient place to check on smoothness of the output data. *When the dial moves slowly with no changes in direction data are smooth.*

■ 17. REAR SIDE.—*a.* The spotting telescope is mounted on the telescope bar so that when properly collimated it points in the same direction as the tracking telescopes. The reticle has vertical and lateral mil scales for use in determining the deviations of bursts during firing.

b. The open collimator sight is an aid in alining the director on the target. It consists of a square glass tube, with a triangle visible within it. The target is sighted over the sight, balanced at the apex of the triangle. (See fig. 18.)

c. (1) Four spot dials are provided on the rear of the director. They are for corrections in fuze, quadrant elevation, azimuth, and altitude. Each dial has two scales with a movable index between mounted concentrically. The outer scale, labeled "Trial fire correction," is fixed; the inner scale is operated by the spot handwheel which inserts the spot correction and indicates on the dial its magnitude. The movable index is rotated by means of the trial fire correction knob. Some of the spot handwheels are equipped with detents. The spot dials should be examined closely to determine the value of each click. Corrections can be put in by feel, that is, the operator counts the clicks and thereby knows the value of the spot put in without looking at the dial. This is particularly valuable in making fire adjustments when the eyes must be kept continuously on the target. The altitude spot handwheel may or may not have a detent. It should be remembered that one complete revolution puts in 100 yards altitude correction. The operator could put in a dH spot by feel. However, this is rarely done as the dH correction must usually be calculated, which means that the person

setting in dH spot is not watching the target continuously. Remember that a dH correction has two effects on the director. The first effect is direct; it causes an immediate change in firing data depending on its magnitude The second effect

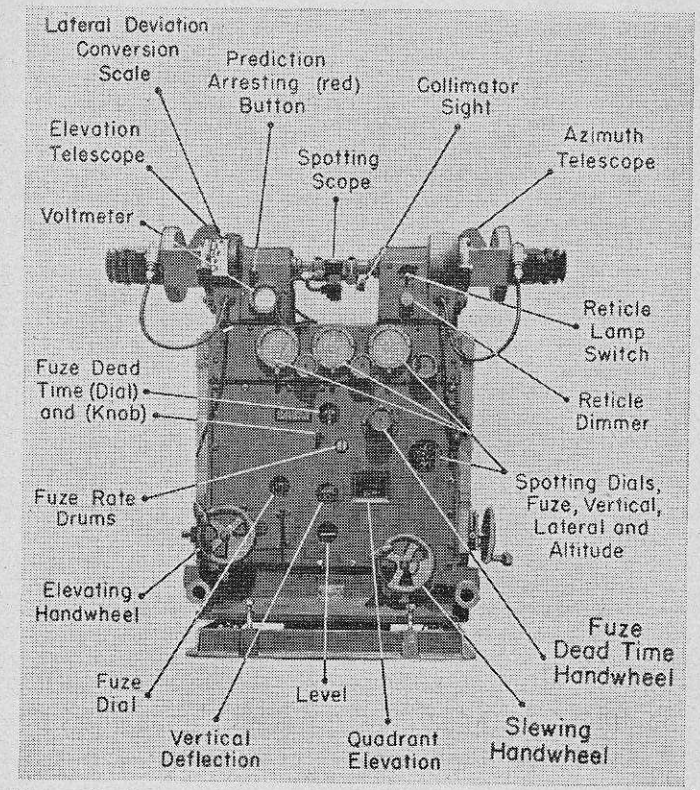


FIGURE 5.—Fuze dead time setter, No. 5, stands at the rear side of the director.

is indirect and causes more upset to the director; it causes the pointers on the E_0 dial on the front of director to be unmatched. The range setter must put in a change in range in order to keep the pointers matched.

(2) Ballistic correction or total corrections, fire for effect, are put in on the same spot dials. Since these corrections are put in the director before any fire adjustment corrections, the following method is employed. The trial fire correction knob is turned until the movable index is at the value of the ballistic correction or total correction, fire for effect. The inner spot dial is next matched to the movable index by the spot handwheel, thus setting in the value of the correction. If any fire adjustment corrections are put in subsequently, they are set in *with respect to the movable index*. For example, suppose the ballistic correction in QE is —6 mils. The movable index is moved to the —6-mil mark on the outer (fixed) ring of the QE spot dial. The inner dial is matched to the movable index by the spotting handwheel. The director now has a $d\phi$=—6 set-in. As a result of firing a fire adjustment of +4 mils is indicated. The inner dial is moved by the spot handwheel until the +4 mil mark is opposite the movable index. The director now has —6+4=—2 mils set in it. Notice that the movable index provides a means of setting in two corrections without any mental arithmetic on the part of the operator.

(3) Because of the right-hand rifling of the barrel of an AA gun there is a drift of the projectile in flight to the right. To compensate for this there is permanently set into the director a left correction of seven mils. When the lateral spot dial records zero there is actually a 7-mil left azimuth correction in the director.

d. An adjusting knob and dial are provided to compensate for the "dead" time which elapses between setting the fuze and firing the round. The dial is calibrated in seconds, from 1 to 6. Parts of the associated mechanism are fuze rate drums and a handwheel, operated by No. 5. (See fig. 6.)

e. The fuze dial and the quadrant elevation dial are used in static check problems (see par. 60) and for synchronizing (see par. 30).

f. The voltmeter is used to check the power being supplied to the director. It should register 115 V or between the limits of 109 V and 121 V.

g. There is a speed shift knob connected with the elevation handwheel which is pulled to shift the handwheel "in" for low speed or "out" for high speed.

h. The azimuth slewing handwheel is used to traverse the director rapidly in azimuth. One revolution of the handwheel rotates the director 75 mils. Power should be on while slewing (if the orienting clutch is IN) and consequently a prediction arresting (red) button must be pushed in while the director is being slewed.

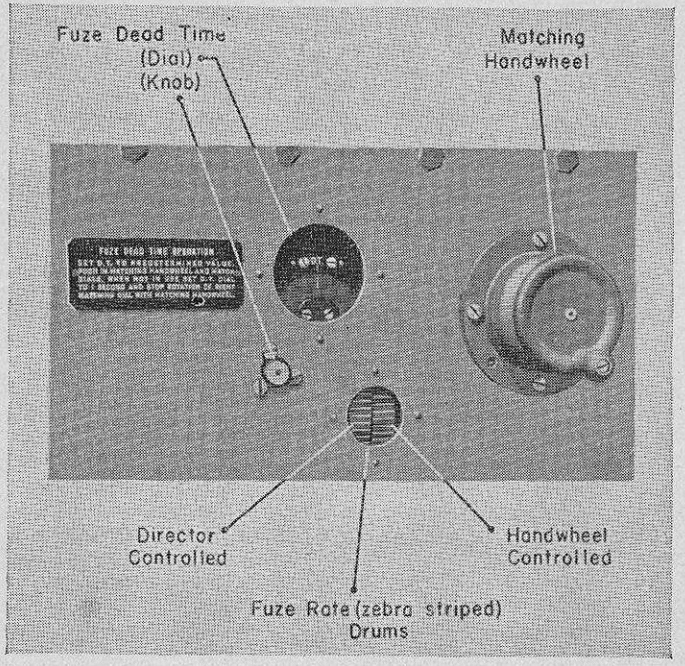


FIGURE 6.—Fuze dead time mechanisms on the rear of the director are operated by the fuze dead time setter, No. 5.

i. Reticle lights in the tracking telescopes are lighted by turning on the switch near the azimuth telescope. A rheostat below this switch controls the brilliancy.

j. A strip of adhesive tape may be placed on the elevation telescope mount and marked off into four divisions. Mark the first division, from 0 to 600 mils angular height, with the number, 1.0. Mark the second, from 600 mils

to 1,000 mils angular height, 1.5. Mark the third from 1,000 mils to 1,200 mils angular height, 2.0. Mark the fourth, from 1,200 to 1,400 mils angular height, 4.0. These are the multiplying factors used to convert lateral deviations, measured on the spotting telescope reticle, from the slant plane to the horizontal plane. (See FM 4–121 for adjustment of fire.)

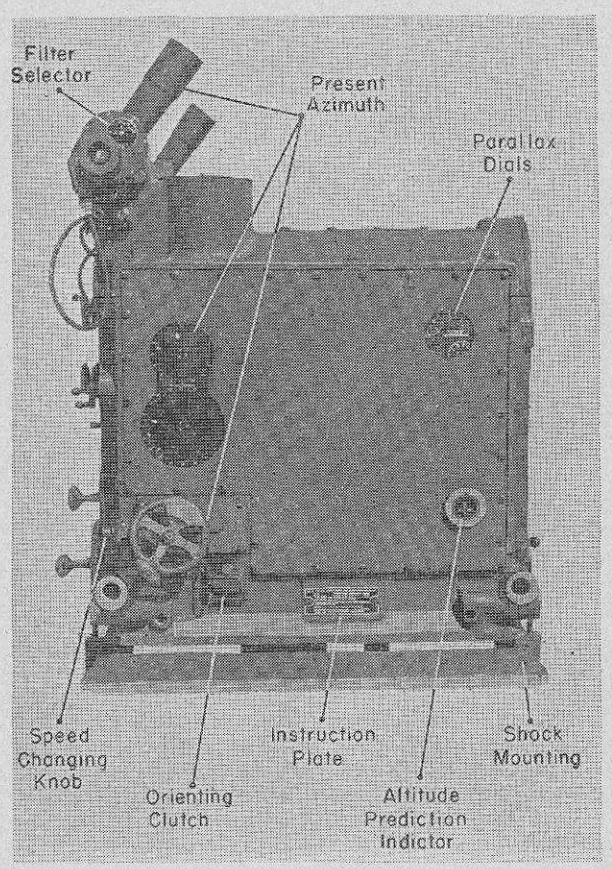


FIGURE 7.—Azimuth tracker, No. 2, stands at the right side of the director.

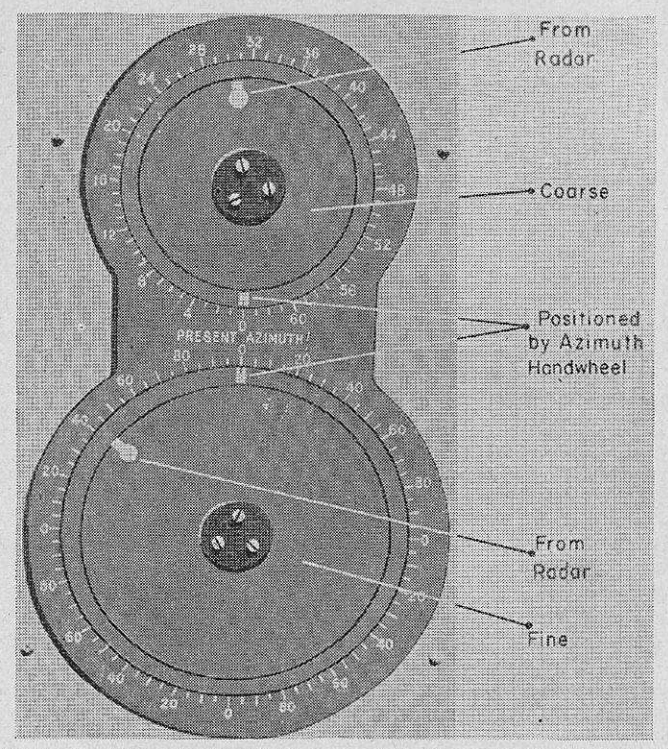


FIGURE 8.—Present azimuth dials are above the azimuth handwheel.

18. RIGHT SIDE.—*a.* The azimuth tracking telescope is used to track the target in azimuth. It is provided with a vertical cross hair. A headrest and a filter selector, similar to those on the elevation side, are provided.

b. The inner pointers on the azimuth dials are positioned by the radar. The outer pointers are positioned by the azimuth handwheel at the bottom of the panel or the slewing handwheel at the lower right corner of the rear side of the director. *The azimuth handwheels should not be operated with the motor switch OFF.*

c. The orienting clutch is used in orienting the director. When it is IN or engaged, turning the azimuth handwheel

moves the director and moves the outer pointers of the azimuth dial. When it is OUT or disengaged, turning the slewing handwheel moves the director only and does not move the outer pointers of the azimuth dial. Turning the tracking handwheel turns the dial but not the director. The clutch is IN when both arrows point up, OUT when they point down. (See fig. 14.)

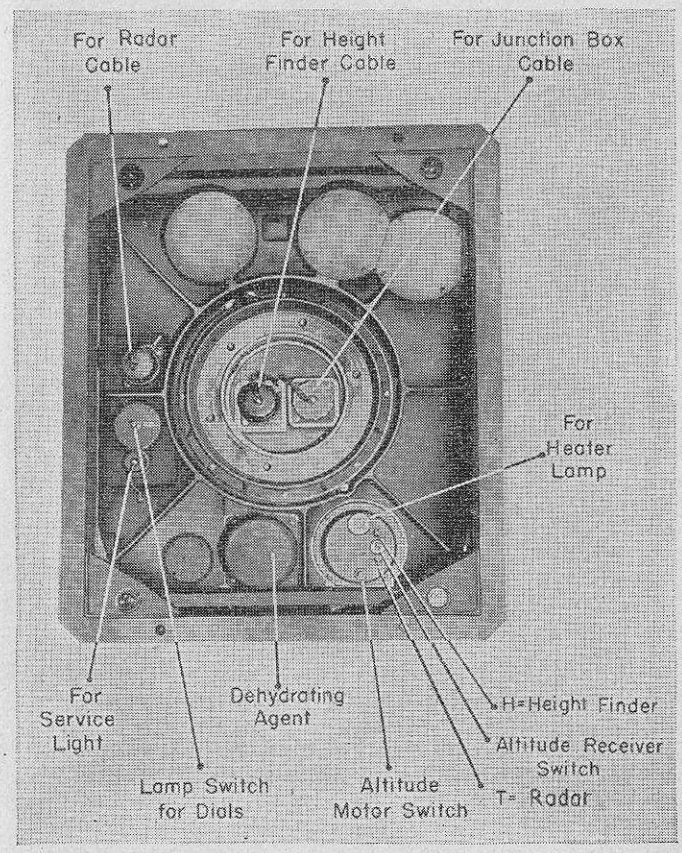


FIGURE 9.—Range setter, No. 3, plugs the cables into their receptacles in the base of the director.

d. The altitude prediction zero indicator has two indices, one of which is fixed. If the indices are *not* matched, there is an altitude prediction in the director.

e. The functions of the parallax dials are explained in paragraph 31.

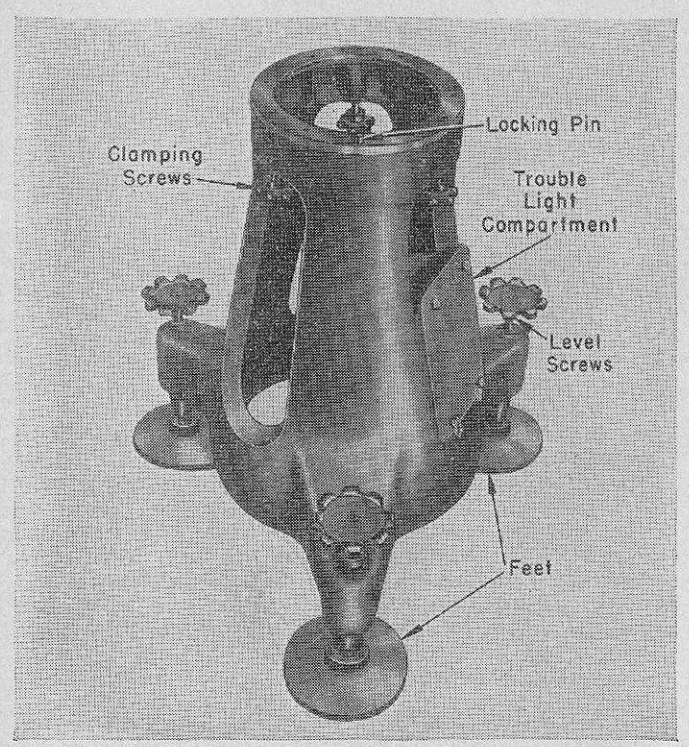


FIGURE 10.—Pedestal must be set on a firm foundation.

f. The information plate mounted on the lower right side designates the specific cams and dials in the director. The plate must be changed when the director's cams and dials are changed for use with other armament or ammunition. This plate is stowed, when not in use, in the cam carrying case.

■ 19. BASE.—*a.* Plugs on cables from the junction box, the height finder and the radar are connected to their respective receptacles on the base of the director.

b. The lamp switch on the left side of the base which illuminates the dials should be turned on by Number 5 when directed. The retical lamp switch must also be ON.

c. The altitude receiver switch and the altitude motor switch are operated by No. 4, the altitude setter. "T" position of the receiver switch allows the director to receive altitude or range from the radar; "H" position allows the director to receive altitude or range from the height finder. (In either position the director continues to send present azimuth and present angular height to the height finder.)

d. A portable 6–8 volt service lamp with flexible cord (stored in the pedestal compartment) may be plugged into the service lamp plug receptacle.

e. An electric cord (stored in the pedestal compartment) may be plugged into the receptacle for the heater lamp power supply. It will connect the heater element inside the director to any 115 volt supply of current.

f. See paragraph 59 for the functioning of the dehydrating agent.

■ 20. PEDESTAL.—*a.* Three leveling screws control the extension and retraction of the feet of the pedestal. They are used to level the director. (See par. 27.)

b. Several coils of slack of each of the cables to the junction box, and height finder should be placed inside the pedestal to "pay out" when the director is being traversed. Slack for the radar cable should be outside the pedestal.

CHAPTER 5

PERSONNEL

■ 21. RANGE-DETECTOR SECTION.—The range-detector section of the AA gun battery consists of the director squad, the height finder squad, a radar squad, and other personnel for maintenance, communication, and replacement. (See fig. 11.)

■ 22. DIRECTOR SQUAD.—*a.* The personnel of the director squad consists of—

Director, corporal.
Elevation tracker, No. 1.
Azimuth tracker, No. 2.
Range setter, No. 3.
Altitude setter, No. 4.
Fuze dead time setter, No. 5.

b. The squad is formed, at the direction of the corporal, in two ranks at close interval and 40-inch distance. At the command FALL IN, the members of the squad move at the double to their proper positions and fall in at attention. At the command DETAILS, POSTS they move at the double to their assigned places at the director. (See fig. 12.)

■ 23. LEADERS' RESPONSIBILITIES.—The range officer commands the range-detector section of the AA gun battery. He is responsible to the battery commander for the computation of accurate firing data and their transmission to the guns. His responsibilities include—

a. Training and efficiency of the personnel of the range-detector section.

b. Maintenance of matériel under his charge.

c. Selection of positions for units of the section; emplacement, camouflage, removal of units, and manning details for conditions of readiness.

d. Communication net within the section.

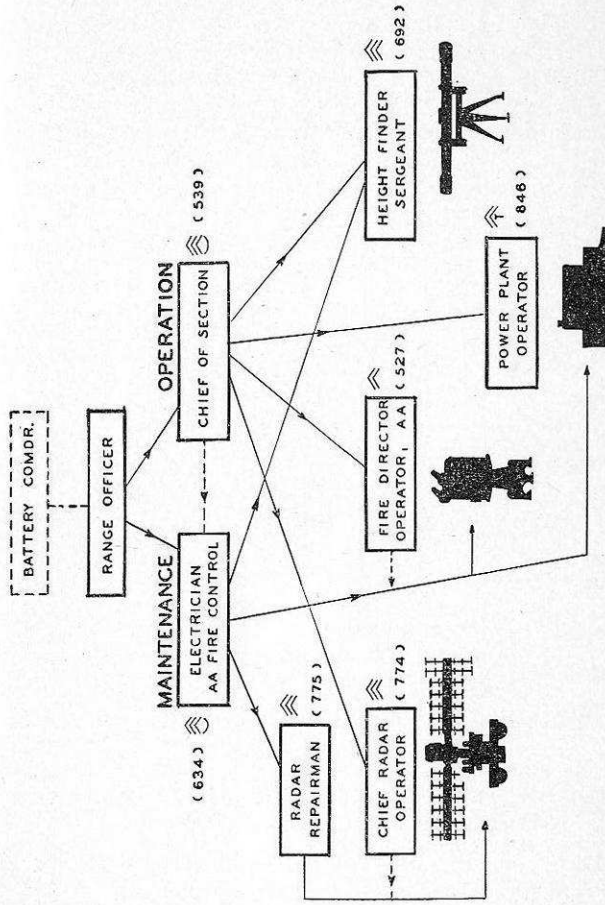


FIGURE 11.—Organization of range-detector section.

e. Close supervision of the following operations:

(1) Cable hook-up.

(2) Leveling, orienting and synchronizing.

(3) Running check problems.

(4) Computing calibration, constant matériel error, ballistic, trial shot, and parallax corrections.

(5) Establishment of any or all flank spotting stations and observation posts.

(6) Use of spotting instruments, slide rules, and firing tables.

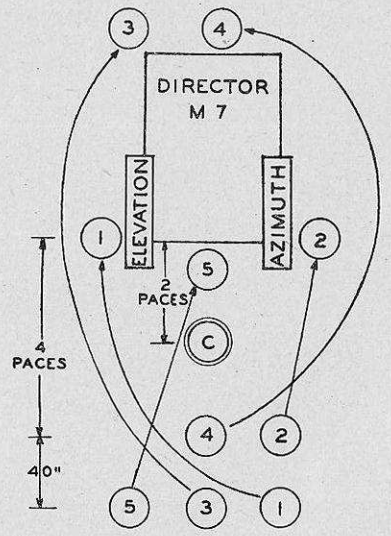


FIGURE 12.—DETAILS, POSTS from squad formation.

(7) Standard operating procedures, so far as they affect the range section, for selection of targets, firing at unseen targets, horizontal fire, and destruction of equipment.

■ 24. CHIEF OF SECTION.—The chief of section is in charge of the range-detector section under the range officer. He is responsible to the range officer for—

a. Training and combat efficiency of the range personnel.

b. Condition, care, and preparation for action of all equipment under his charge.

c. Selection (either alone or in conference with the range officer), usually, of the exact locations for the director, height finder, director power plant, radar power plant, junction box, telephones, radios, fox holes, and communicating trenches or concealed paths.

d. Direction of setting up or taking down matériel, connecting cables, orienting and synchronizing units, and service of the instruments.

e. Construction and camouflage of positions, and enforcement of camouflage and gas discipline.

f. Correlation of power and data flow between the various units of the section.

g. Preparing himself to assume the duties of the range officer should a situation arise requiring it.

■ 25. DIRECTOR CORPORAL.—The director corporal is in charge of the director.

a. He is responsible for—

(1) Setting up the director.

(2) Proper connection of cables.

(3) Orientation and synchronization (under supervision of chief of section).

(4) Putting director on the indicated target.

(5) Carrying out instructions as to field fortification and camouflage.

(6) Compliance of the director crew with operational SOP.

(7) Operation of director.

b. He assists the chief of section or range officer in—

(1) Making fire adjustments if required.

(2) Setting ballistic (or fire for effect) corrections in director.

(3) Target recognition.

(4) Making checks on operation of director.

(5) Instruction and training of director squad.

c. He makes reports to and assists the electrician, AA fire control, in making necessary checks, adjustments, and maintenance.

CHAPTER 6

PREPARATION AND SERVICE

		Paragraphs
SECTION I.	Requirements before firing	26–36
II.	Requirements during firing	37–45
III.	Conclusion of tracking	46

SECTION I

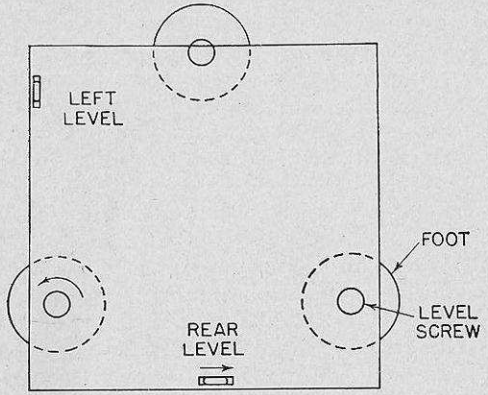
REQUIREMENTS BEFORE FIRING

■ 26. SETTING UP.—Set the pedestal firmly in place and level it approximately by the three level screws. If the ground is soft, it may be necessary to construct a foundation. Place the director carefully on the pedestal using the eight porter bars. Hold the slewing handwheel steady. Rotate the director very slowly with the orienting clutch OUT until the locking pin in the pedestal clicks in place into the hole in the azimuth ring in the base of the instrument. Tighten the three clamping screws in the pedestal into the three clamping holes in the base of the director.

■ 27. LEVELING.—*a.* Level bubbles are on the left and rear sides of the director. Slew the instrument with the orienting clutch in the OUT position until one of the bubbles is parallel to two leveling screws on the pedestal. Level the bubble by adjusting the screws. Without moving the director, level the other bubble by means of the third screw. (See fig. 13.) Traverse the instrument 1,600 mils and check both bubbles. Traverse it two more quarter turns, checking each time.

b. If the bubbles do not remain centered in making the check through 6,400 mils of traverse, it is most likely that the bubble itself is out of adjustment. See TM 9–1658 for procedure to set the levels. It should be remembered that the director is level if the bubble *remains at the same position* when the director is traversed through 6,400 mils. The levels should be properly set at the first opportunity.

■ 28. CHECKING TELESCOPE.—*a. In elevation.*—(1) *Elevating telescope.*—Turn the orienting clutch to the OUT position. Set angular height to zero with the auxiliary elevation handwheel. With the slewing handwheel, rotate the director to a distant point, at least 1,000 yards away, and carefully spot where the horizontal cross hair intersects the point. Traverse the director 3,200 mils. Elevate telescope through 3,200 mils. Sight through the elevation telescope and put the horizontal cross hair on the point previously picked. Note the angular height dial reading.



ANY SIDE WITH LEVEL MUST BE PARALLEL TO ANY TWO LEVEL SCREWS. TO CENTER BUBBLE, TURN NEARER SCREW COUNTER CLOCKWISE.

FIGURE 13.—Leveling the director is fundamental and simple.

If the reading on the angular height scale when the horizontal cross hair intersects the distant point is within 2 mils of 3,200 mils, the telescope setting is satisfactory. If not, the telescope must be adjusted. Rotate the telescopes by the auxiliary elevation handwheel *one-half* of the distance toward 3,200 mils. Wedge the handwheel in this position with a wooden block between the handwheel and the director base. Remove and place the telescope in its carrying case. Loosen slightly the four telescope clamping screws on the telescope mounting disk. Replace the telescope and adjust it by tapping it gently

of the battery requiring orientation be able to see the same point.

(2) Remove the cover over the orienting clutch and turn to the IN position. Turn the motor switch ON. Turn the azimuth tracking handwheel (red button pushed in) until the present azimuth dial reads the correct azimuth. Release red button. Turn the motor switch OFF. Turn the orienting clutch to the OUT position. With the slewing handwheel put the vertical cross hair of the azimuth telescope on the center of the aiming point. Return the orienting clutch lever to the IN position. Check to see that the azimuth dial still reads the designated azimuth. Replace the orienting clutch cover.

b. Orienting director in elevation.—The director is oriented in elevation when it is level and the telescopes are parallel and properly set. (See par. 28.)

30. SYNCHRONIZING.—*a. Guns with director.*—Apply power to the data transmission system. Turn the director motor switch ON. Set into the director (by operating the azimuth handwheel, the range handwheel, and the altitude handwheel) convenient values in round numbers of firing azimuth, quadrant elevation, and fuze range. The values of the data appear on their respective dials at the director. Check them with electrical dial readings of the azimuth receiver, the elevation receiver, and the fuze receiver, respectively, at each gun. Synchronization adjustments are made at the guns.

b. Height finder with director.—(1) *Azimuth and angular height.*—With power on the data transmission system, check the values shown at the director on the present azimuth dial and the present angular height dial with the electrically positioned receiver dials at the height finder. Synchronization adjustments are made at the height finder.

(2) *Altitude.*—Throw the altitude receiver switch to "H" with power on the data transmission system, check the synchronization between the transmitting altitude dial at the height finder and the receiving altitude dial at the director. Any adjustment necessary to make the height finder read the same as the director is made with the height finder adjusting knob.

(3) *Vertical parallax between height finder and director.*—(*a*) If the height finder is higher than the director by a

certain amount, the altitude dials are synchronized when the values registered on the altitude dial at the director constantly exceed those on the height finder transmitting dial by that amount.

(*b*) If the director is higher than the height finder by a certain amount, the altitude dials are synchronized when the values registered on the altitude dial at the director are constantly less than those on the height finder transmitting dial by that amount.

(*c*) This adjustment is made at the height finder by setting in a vertical parallax correction.

c. Radar with director.—(1) Synchronization in altitude is checked by radar personnel.

(*a*) Check and adjust, if necessary, that the readings on the altitude dial at the director increase when altitude settings at the radar are increased.

(*b*) Set in on the radar a combination of angular height and slant range that gives an altitude at which targets are commonly expected. (For example, 533 mils angular height and 10,000 yards slant range=5,000 yards altitude.)

(*c*) The altitude setting handwheel at the director is turned until that altitude is opposite the index on the altitude dial.

(*d*) The AA pointers should agree within ±50 yards when SCR–268 is used and ±14 yards when the SCR–584 or 545 is used. If limit is exceeded the radar is adjusted until the inner dial conforms to the outer.

(2) Allowance must be made for vertical parallax between the radar and the director when the radar is transmitting altitude. This adjustment, similar to the vertical parallax adjustment between the height finder and the director (see *b*(3) above) is made at the radar. The radar personnel, by making an adjustment at the radar, rotate the "AA" pointers on the altitude dial at the director until they are mismatched the correct amount of vertical displacement. However, when the radar transmits azimuth and angular height (unseen fire) the vertical parallax adjustment must be removed by the radar personnel. Vertical parallax between the radar and guns must then be set in. (See par. 31*d*.)

(3) Synchronization in azimuth is checked and adjusted by radar personnel at the radar.

of the battery requiring orientation be able to see the same point.

(2) Remove the cover over the orienting clutch and turn to the IN position. Turn the motor switch ON. Turn the azimuth tracking handwheel (red button pushed in) until the present azimuth dial reads the correct azimuth. Release red button. Turn the motor switch OFF. Turn the orienting clutch to the OUT position. With the slewing handwheel put the vertical cross hair of the azimuth telescope on the center of the aiming point. Return the orienting clutch lever to the IN position. Check to see that the azimuth dial still reads the designated azimuth. Replace the orienting clutch cover.

b. Orienting director in elevation.—The director is oriented in elevation when it is level and the telescopes are parallel and properly set. (See par. 28.)

■ 30. SYNCHRONIZING.—*a. Guns with director.*—Apply power to the data transmission system. Turn the director motor switch ON. Set into the director (by operating the azimuth handwheel, the range handwheel, and the altitude handwheel) convenient values in round numbers of firing azimuth, quadrant elevation, and fuze range. The values of the data appear on their respective dials at the director. Check them with electrical dial readings of the azimuth receiver, the elevation receiver, and the fuze receiver, respectively, at each gun. Synchronization adjustments are made at the guns.

b. Height finder with director.—(1) *Azimuth and angular height.*—With power on the data transmission system, check the values shown at the director on the present azimuth dial and the present angular height dial with the electrically positioned receiver dials at the height finder. Synchronization adjustments are made at the height finder.

(2) *Altitude.*—Throw the altitude receiver switch to "H" with power on the data transmission system, check the synchronization between the transmitting altitude dial at the height finder and the receiving altitude dial at the director. Any adjustment necessary to make the height finder read the same as the director is made with the height finder adjusting knob.

(3) *Vertical parallax between height finder and director.*—(*a*) If the height finder is higher than the director by a

certain amount, the altitude dials are synchronized when the values registered on the altitude dial at the director constantly exceed those on the height finder transmitting dial by that amount.

(*b*) If the director is higher than the height finder by a certain amount, the altitude dials are synchronized when the values registered on the altitude dial at the director are constantly less than those on the height finder transmitting dial by that amount.

(*c*) This adjustment is made at the height finder by setting in a vertical parallax correction.

c. Radar with director.—(1) Synchronization in altitude is checked by radar personnel.

(*a*) Check and adjust, if necessary, that the readings on the altitude dial at the director increase when altitude settings at the radar are increased.

(*b*) Set in on the radar a combination of angular height and slant range that gives an altitude at which targets are commonly expected. (For example, 533 mils angular height and 10,000 yards slant range=5,000 yards altitude.)

(*c*) The altitude setting handwheel at the director is turned until that altitude is opposite the index on the altitude dial.

(*d*) The AA pointers should agree within ±50 yards when SCR–268 is used and ±14 yards when the SCR–584 or 545 is used. If limit is exceeded the radar is adjusted until the inner dial conforms to the outer.

(2) Allowance must be made for vertical parallax between the radar and the director when the radar is transmitting altitude. This adjustment, similar to the vertical parallax adjustment between the height finder and the director (see *b*(3) above) is made at the radar. The radar personnel, by making an adjustment at the radar, rotate the "AA" pointers on the altitude dial at the director until they are mismatched the correct amount of vertical displacement. However, when the radar transmits azimuth and angular height (unseen fire) the vertical parallax adjustment must be removed by the radar personnel. Vertical parallax between the radar and guns must then be set in. (See par. 31*d*.)

(3) Synchronization in azimuth is checked and adjusted by radar personnel at the radar.

(*a*) Check, and adjust if necessary, that the readings on the present azimuth dials at the director increase when azimuth settings at radar are increased.

(*b*) Both the radar and the director are pointed at the aiming point.

(*c*) Since each instrument has been properly oriented, their two indicated azimuths will agree after making allowance for any parallax between them. If the indicated azimuths of the two instruments do not agree, the inner (positioned by the radar) pointers on the azimuth dials are brought into agreement with the outer (positioned by director handwheel) pointers by radar personnel.

(4) Synchronization in angular height is checked and adjusted by radar personnel.

(*a*) Check, and adjust if necessary, so that the readings on the present angular height dials at the director increase when angular height setting at radar are increased.

(*b*) The radar is zeroed in angular height; the telescopes of the director are set at zero angular height.

(*c*) The pointers on the coarse and fine present angular height dials at the director are matched by adjustment at the radar.

■ 31. OFFSET PARALLAX.—The director transmits one common set of data to all the guns which it serves; it does not send an individual set to each gun. The present azimuth, angular height, and altitude by which it computes firing data are measurements from the director (or radar for unseen fire) to the target. The battery directing point is the center of the geometrical pattern formed by the guns, or the center of the mass of metal. Allowance must normally be made in computing the firing data for the displacement of the director (or radar for unseen fire) from the directing point.

NOTE.—Director offset parallax is always considered as director from guns (DFG).

a. Horizontal parallax.—Parallax may be computed in three ways:

(1) (*a*) With the orienting clutch IN, sight the director on the directing point and read the present azimuth dials.

(*b*) Set the back azimuth (azimuth ±3,200 mils) of (a) on the wind component solver.

(*c*) Measure the horizontal distance in yards between the director and the directing point by tape or by pacing.

(*d*) Divide the distance measured (c) by 10 and read, opposite this value on the arm of the solver, the north-south and east-west components. Follow the horizontal grid line near-

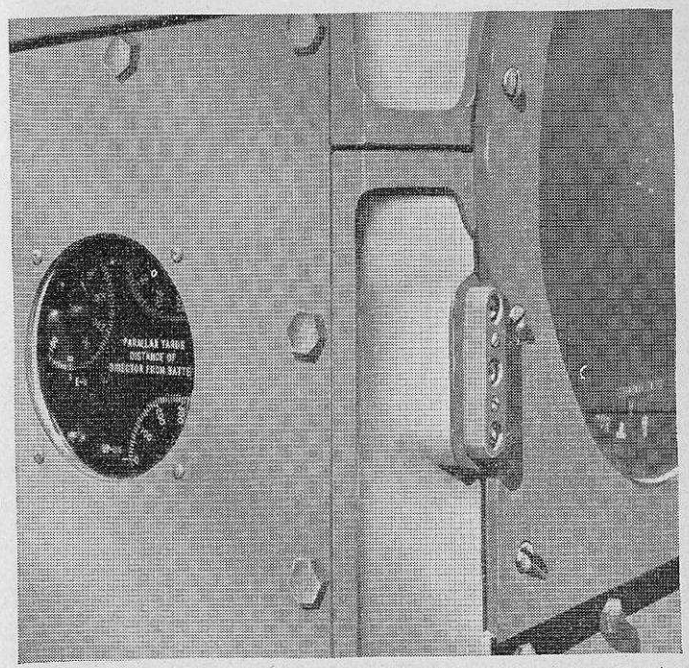


FIGURE 15.—Parallax dials are on the right side of the director and parallax screws are on the front side. Before turning the bottom screw to put in vertical parallax pull ON the altitude follow-up motor switch.

est the value over to the vertical scale and read the north or south component. Follow the vertical grid line nearest the value up or down to the horizontal scale and read the east or west component.

(*e*) Multiply each of these components by 10 and set results on the north-south and east-west parallax dials.

(2) (*a*) Measure the azimuth and distance director from gun as in (1) above. Using the slide rule M1 (or other mathematical aids) compute the components.

(*b*) Set results on the N-S and E-W parallax dials.

(3) (*a*) Measure or pace off directly the north-south and east-west components of the directing point-director line.

(*b*) Set these values in yards on the parallax dials.

b. Vertical parallax.—Vertical parallax can be computed by use of slide rule M1 (or other mathematical aid) from the ground distance and angle of depression or elevation. The vertical parallax of director from guns is set on the vertical parallax dials. If the director is above the guns set in UP. Turn on the altitude follow up switch (on base of director) before setting in the vertical parallax.

c. Setting parallax.—(1) Set in parallax on the parallax dials by the three screws on the upper left edge of the front side of the director. A coin can be used in lieu of a screw driver. Turning the screws will turn the dials in the upper right corner of the right side of the director. The dials are graduated in red and in white numbers. If the director is above or north or east of the directing point use the white figures. If the director is below or south or west of the directing point use the red figures.

(2) Make a notation of the parallax measurements, label it DIRECTOR and glue it to the right side of the director near the parallax dials.

(3) Set in these values every time the toggle switch on the underside of the director is thrown to H (height finder).

d. Radar tracker offset parallax.—(1) If the elements of basic data—present azimuth, angular height and altitude—originate at the radar rather than at the director and height finder, that is if the toggle switch on the under side of the director is thrown from H (height finder) to T (radar), then the parallax relationship is between the radar and the battery directing point. This is the case in firing at unseen targets.

(2) Measure the parallax displacements between the radar and battery directing point in the same manner as the directing point. Director parallax displacements were measured in *a* above.

(3) Make a notation of these measurements, label it RADAR and glue it to the right side of the director near the parallax dials.

(4) Set in these figures every time the toggle switch is thrown to T (radar).

■ 32. SETTING WIND CORRECTIONS.—*a.* Wind blowing on a projectile affects its speed and direction. Allowance must be made in the prediction of the director for wind effects.

b. The wind direction and speed are obtained from the proper zone of the meteorological data.

(1) The north-south and east-west components are found by setting the arm of the wind component solver to the ballistic wind azimuth. Azimuth in mils is graduated around the perimeter of the solver. (See fig. 16.)

(2) Trace down the arm to the ballistic wind velocity. From this point follow the nearest horizontal line on the face of the solver to find the north or south wind component on the vertical scale. Follow the nearest vertical line to find the east or west wind component on the horizontal scale.

(3) Set in the respective wind components on the wind dials on the left side of the director. For north or east components use white figures. For south or west components use red figures.

■ 33. BALLISTICS CORRECTIONS.—Previous to any firing ballistic corrections are computed by the range officer and applied to the director by him or by a designated noncommissioned officer under his supervision. These corrections for nonstandard conditions are applied to the spot dials (see par. 17*c*) and to the wind dials (see par. 32).

■ 34. CALIBRATION FIRE.—*a.* Calibration fire is conducted at the discretion of the battery commander and under the close supervision of the range officer and the executive officer whenever—

(1) One or more new guns are received, or

(2) Analysis of fire indicates that former calibration corrections are no longer effective.

b. The director is prepared for calibration fire in the same manner as for trial fire (see par. 35). Calibration corrections are applied directly to the guns.

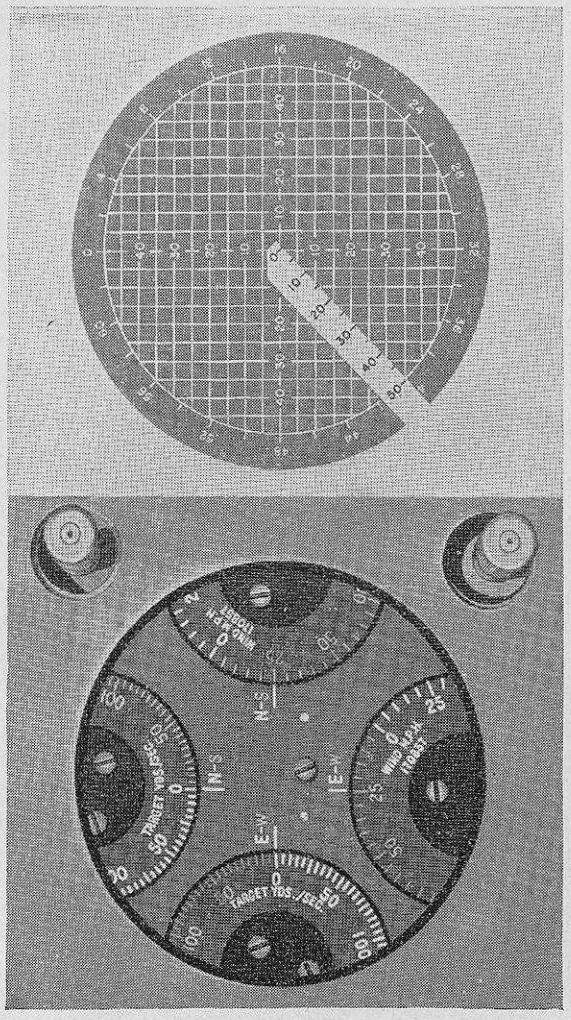


FIGURE 16.—Wind dials are set at 25 west and 25 south because the wind component solver breaks down a 35 mph southwest wind into these two factors.

35. TRIAL FIRE.—*a.* To correct for errors in firing data due to unknown conditions, trial fire *may be* conducted at the discretion of the battery commander or when directed by higher authority. The range officer and the executive officer conduct the fire. The range officer computes the corrections.

b. To set the trial shot data into the director—

(1) Pull out the motor switch.

(2) Set the components of the ballistic wind on the wind rate dials.

(3) Apply any ballistic corrections to the spot dials. If there are any constant matériel corrections, they should be added algebraically to the ballistic corrections and applied.

(4) Apply the appropriate drift correction for the trial shot point used.

(5) Set the fuze dead time to 1.

(6) Traverse the director until the present azimuth dial reads the azimuth of the trial shot point.

(7) Set in the necessary offset parallax to the director from the gun selected to fire the trial shot problem (not from the battery's directing point).

(8) Set the altitude of the trial shot point on the altitude dial.

(9) Pull out the altitude follow-up motor switch for a short time to insure the removal of any altitude prediction. Check the altitude prediction zero indicator and push in the switch.

(10) Elevate the director telescopes until the angular height dial indicates the angular height of the trial shot point. Match pointers on the angular height dials.

(11) Check and remove any creep in range rate or altitude rate.

(12) When all the dials have come to rest push the motor switch in.

(13) All necessary data are now available on the dials at the guns to lay the gun on the trial shot point.

(14) The determination of the trial fire corrections is made by the range officer and applied under his supervision to the azimuth and quadrant elevation spot dials on the director. The altitude spot (dH) cannot be applied until altitude of target is determined.

■ 36. TOTAL CORRECTIONS, FIRE FOR EFFECT.—*a.* Total corrections, fire for effect, are the algebraic sum of constant matériel error corrections (from the battery's gun books), trial fire corrections, and the latest ballistic corrections. They are applied to the director under the supervision of the range officer. In many cases only ballistic correction data are available.

b. For AA fire the corrections are dϕ, dA, dF, and dH. The correction for a particular spot dial can be zero.

c. For HORIZONTAL FIRE or terrestrial fire, the same corrections are applied except that a dH spot is ineffective since it is removed by the operation of matching the angular height dials. There are two methods of applying the dH correction. In both methods the dH correction must be converted to an equivalent d Range correction. Since we are dealing with similar triangles d % H is numerically equal to d % Range. Multiplying d % Range × Range=d Range. This d Range correction is applied in one of two places.

(1) The vertical parallax dial on the height finder. The height finder is transmitting slant range, hence the d Range correction is applied. This is the preferable method.

(2) The inner dial of the altitude-range dial may be equipped with a scale on either side of the HOR index. The scale is graduated the same as the dial and appropriately colored to differentiate between plus and minus d Range corrections. The d Range correction is applied by mismatching the HOR pointers by the amount of the d Range correction.

SECTION II

REQUIREMENTS DURING FIRING

■ 37. NORMAL SETTINGS ON DIRECTOR.—When the director is initially placed in operation and thereafter at the command CEASE TRACKING, the various dials and switches should be habitually set at certain settings.

a. Director should be tarversed to the midazimuth of the primary zone of fire.

b. Altitude of expected targets should be set in on the altitude dial. Zero altitude rate is set in. Altitude motor switch ON. If tactics of enemy targets are not known, an average altitude should be set in.

c. Telescope should be elevated to the angular height at which targets are normally picked up. If no data on angular height are available the telescopes should be set at about 300 mils unless the presence of a mask indicates that a greater angular height should be used.

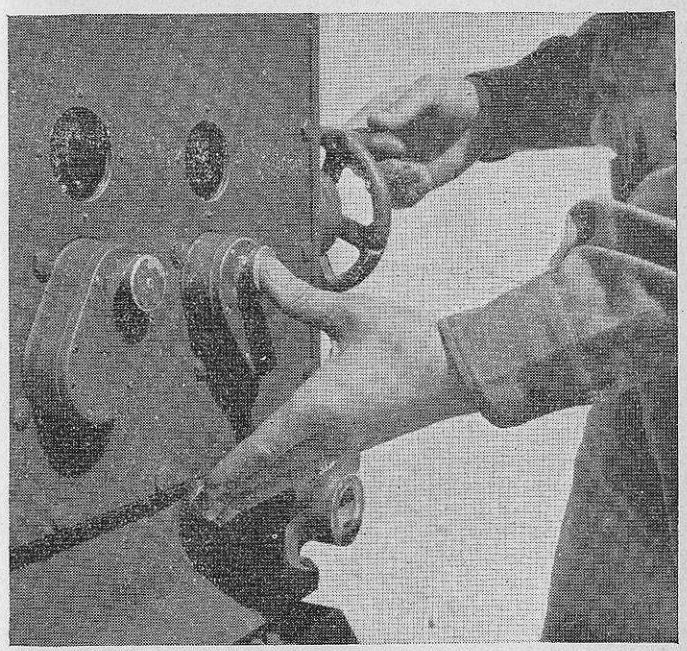


FIGURE 17.—With his left hand the range setter presses in the prediction arresting button and keeps the range rate knob from turning, while simultaneously matching pointers with his right hand. Trial and practice will reveal the most comfortable position in which to perform all three functions efficiently.

d. Horizontal range should be left at 14,000 to 15,000 yards. Zero range rate is set in. In any case the horizontal range should be such that the middle pointers on the E_o dial indicate a *greater* angular height than the outer pointers.

e. Parallax should be set in for the most likely type of fire. For example, at night, unseen fire may be the general rule, hence the parallax set in the director should be *radar from*

551953°—43——4

guns. During daylight, seen targets are more likely, hence parallax set in the director should be *director from guns.*

f. Total corrections, fire for effect, should be computed each time a new meteorological message is received or available data change. They should be computed for each zone of the meteorological message, and the values along with the wind components for each zone displayed prominently on a blackboard or chart at the director pit.

g. Total corrections, fire for effect, and wind components should be set in on the director *for the zone* in which it is anticipated that enemy targets will appear. This includes the dH correction which is for the anticipated altitude of target. In case no information on enemy targets is available, an average altitude should be assumed and all corrections based on this altitude.

h. Value of dead time for the battery at the quadrant elevation anticipated for COMMENCE FIRING should be set in.

i. The purpose of putting these various settings in ahead of time is twofold. First, when a target does appear it takes less time since the corrections are either correct (if target appears at anticipated altitude) or only small changes in corrections are necessary. Second, since the corrections are placed in when the operators are not under the strain of working against time, there is much less chance of corrections being applied in the wrong direction.

■ 38. PICK-UP WITH RADAR.—*a.* When warning of an approaching target is received from the AAAIS or the battery radar, all personnel take their battle stations. The power plant is started and power switch thrown ON. The power at the direction is turned ON by No. 3 (range setter). No. 4 (altitude setter) throws H–T switch (under director) to T. Director crew stands by awaiting signal from radar that target has been picked up and is being tracked.

b. No. 1 (elevation tracker) from a post opposite the left front corner of the director matches the outer pointer on the E_o dial to the inner pointer using the auxiliary elevation handwheel. No. 2 (azimuth tracker) stands at his customary spot and matches the pointers on the A_o dial. The elevation tracker hunts within ±50 mils of the inner pointer on the E_o dial if necessary when angular height is less than 300 mils.

c. When altitude data from the radar begin to register smoothly, No. 4 (altitude setter) sets in the average altitude (holding altitude rate knob stationary) and calls out "Approximate altitude ——— yards."

d. Based on the announced approximate altitude the range officer or designated noncommissioned officer changes the total corrections, fire for effect, and wind components to conform with the altitudes. These values are posted in the director pit. (See par. 37*f.*)

e. The middle pointer on the E_o dial will normally indicate an angular height greater than the angular height of the telescope. No. 3 (range setter) does nothing until the inner pointer on the E_o dial catches up with his middle pointer. When the middle and inner pointers are matched he turns the range handwheel to keep them matched. As the range handwheel turns it sets in an R rate, which requires less and less turning of the range handwheel to maintain the match. In a few seconds, the R rate will be built up to the required magnitude and thereafter only small changes in the range handwheel will be necessary to maintain the match. Notice that neither the red button nor rate knob was held in this operation. *Holding in the red button will not help the director in this PARTICULAR operation.* The proper use of the range rate smoothing mechanism requires proper instruction and practice.

f. Meanwhile the trackers at the height finder match the pointers at their receivers. The observer at the height finder, using the observer's eye piece, and the director corporal at the spotter's scope on the director search for the target. Whoever picks up target first calls, "Target." If the director is first, the director corporal calls over his chest set phone, "Director sighting target." If height finder is first, the altitude setter at the height finder blinks the signal light at the director or otherwise informs the director. Trackers at both height finder and director cease matching pointers and go to the tracking telescopes. The director corporal aids the trackers in getting on target accurately by such appropriate commands as TRAVERSE RIGHT, ELEVATE.

g. As soon as the trackers at the director are on the target optically, No. 4 reaches under and throws the H–T switch to H. As soon as the height finder indicates data O. K., he

matches the AA pointers and announces, "Altitude ——— yards." If called for, the range officer or designated noncommissioned officer may make a change in the dH setting. Normally this is not necessary since dH correction based on the approximate altitude from the radar has already been set in. As this is a constant altitude problem, the altitude setter holds the altitude rate knob whenever he adjusts the altitude handwheel. If the total change in altitude in switching over from radar data to height finder data is greater than 50 yards he uses the red button also.

h. The operations of the other director crew members may have caused the pointers on the E_0 dial to become unmatched. The range setter holds the red button and range rate knob as shown in figure 17 and rematches the pointers. As soon as the pointers are rematched he releases the range rate knob but holds on to the red button for at least 3 seconds longer. Further matching of the pointers is done by adjustment of the range handwheel.

i. The fuze dead time setter matches the fuze rate (zebra-stripe) drums. To do this, he pushes in on the fuze dead time handwheel and turns it. Normally the left drum does not rotate at a constant rate. Hence the operator can only set up a rate in the right drum which rotates at the same *average* rate.

j. The range officer watches the future horizontal range dial on the left side of the director. When it moves at a fairly constant rate *with no reversals of direction* it is an indication of smooth data being sent to the guns. He reports, "Firing data in order."

■ 39. AA FIRE—CLIMBING OR DIVING TARGET.—The altitude motor switch located on the base of the director is habitually left ON. The altitude setter carefully adjusts the altitude handwheel, without holding the rate knob, to set in the correct "Up" or "Down" value. Altitude received from the height finder is somewhat erratic, but the altitude rate set in the director smooths out the altitude data. Further adjustments may be made with the altitude setting handwheel to match AA pointers on the altitude dial. See description in paragraph 38*g*. The elevation and azimuth trackers keep the target centered in their telescopes. The

range setter keeps the angular height pointers matched with his range setting handwheel. The fuze dead time setter matches the "zebra-striped" drums. Speed in getting on target and in transmitting smooth firing data are especially necessary in tracking a diving target. There are very few seconds for effective firing before the diving target releases its bombs or accomplishes its purpose and swerves into a maneuver on which the director cannot predict accurately.

■ 40. AA FIRE WITH RADAR TRACKER—UNSEEN TARGETS.—*a* When the SCR–268 is used—

(1) A telephone line between the director and the radar is a requisite for firing at unseen targets. At the director two head and chest sets are attached to the hand set, one for the azimuth tracker and one for the range setter. The hand set is used by the director corporal who takes over the duties of the altitude setter in this type of firing.

(2) The director corporal sets the RADAR FROM GUNS parallax on the parallax dials.

(3) The azimuth tracker matches pointers on the present azimuth dials smoothing out the data from the radar. The range setter matches the middle to the inner pointers on the present angular height dials, also smoothing out data from the radar. The elevation tracker has no assigned duties.

(4) At low angular heights the SCR–268 angular height is usually less than the correct value. Above 300 mils the data should be smooth and accurate. When the SCR–268 indicates angular heights above 300 mils, the director corporal asks the range and elevation trackers at the SCR–268 to inform him when they are exactly on target. When they are exactly on target at the same time, the altitude should be correct. The director corporal 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. However, most unseen targets fly at a constant altitude so that the practice of setting in the altitude when data are good and then leaving it alone gives good results. If the target is diving, the altitude pointers must be matched, smoothing out the data as much as possible.

(5) Director personnel must realize that SCR–268 tracking data may be erratic and eccentric. Effective firing data are obtained by a continuous and cumulative process. Director operators must remember that an airplane cannot reverse direction instantaneously or suddenly change its angular rate of travel. "Pendulum" action in pointer matching must be avoided. Pointers must be matched by a continuous movement smoothly in the same direction, until the operator is certain that the target has reversed its direction as indicated by the data received on his dial from the radar. Telephone communication between radar operators and the director operators assists in smoothing data. The radar range operator should inform the director operators when range is increasing, decreasing, or changing from a decreasing to an increasing rate. Azimuth and elevation men at the radar should notify director matchers when the radar is lagging or leading the target. Then when they make their corrections the operator 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 pointers. Three seconds after the pointers are matched, and a steady rate is resumed, the red button is released and normal procedure is followed.

b. When the SCR–545 or SCR–584 is used—

(1) Telephone communication is desirable between the radar and the director, but the head and chest sets for the azimuth tracker and the range setter are not necessary. The azimuth tracker, range setter, and fuze dead time setter match their dials at the director. The elevation tracker has no assigned duties. The director corporal assumes the duties of the altitude setter and supervises the operation of the director.

(2) Settings on the parallax dials must read values RADAR FROM GUNS.

(3) Matching of the dials on the director is relatively simple since the flow of data from the radar is generally quite smooth. However, any fluctuations in data which may occur are smoothed out.

(4) Angular height data above 200 mils are dependable. The procedure in *a*(4) above to determine the altitude is not

followed. The matching of the dials on the director is all that is necessary.

(5) Because the data from the radar to the director is smooth and accurate, the precautions in *a*(5) above are applicable only in a limited sense. The radar should immediately notify the director position of any change in the target course or actions. Likewise, any change in operational procedure at the radar should be reported to the director position, for example, when the radar switches over from manual operation to automatic.

■ 41. AA FIRE WITHOUT RADAR.—The altitude receiver switch is always in the H position when no radar is assigned to the battery. Target warning comes via AAAIS or lookout. In picking up a target for tracking, the open collimater sight is used to direct the azimuth and elevation telescopes to the target. It is to be sighted over, not through, and the target should be balanced on the triangle visible within the sight. (See fig. 18.) The director corporal stands behind the director with his eye about 8 inches from the sight. He positions the target with the slewing handwheel until the trackers can see it through their telescopes and take over the tracking.

■ 42. HORIZONTAL FIRE—AERIAL TARGETS.—*a.* As in paragraph 38, all personnel take their manning positions when warned of an approaching target. Total corrections, fire for effect, are applied for zone one or zone two. The power plant is started, the data transmission system is energized, and the motor switch at the director is turned ON by the range setter. The altitude setter throws the altitude receiver switch to T or H, depending upon whether the radar or the height finder is tracking the target in range. (Range may be telephoned from the SCR–268.) Range setter at the director must be informed whether the range is greater or less than 10,000 yards. (14,000 yards range will be indicated on the altitude-range dial at the director by the same setting as 4,000 yards.)

b. The range setter must first check that the range counter shows less or greater than 10,000 yards depending on advice received from the height finder or radar. He then matches the outer HOR pointers on the altitude dial to the

inner HOR pointers. He does this as early as possible when the range from the height finder begins to register smoothly on the inner HOR pointers. It is quite possible that the first ranges received from the height finder or radar may be considerably less than the value set in on the range counter. (See Par. 37*d*.) In this case he holds in the range rate knob and red button while matching pointers initially, thereafter proceeding as outlined in paragraph 38*h*.

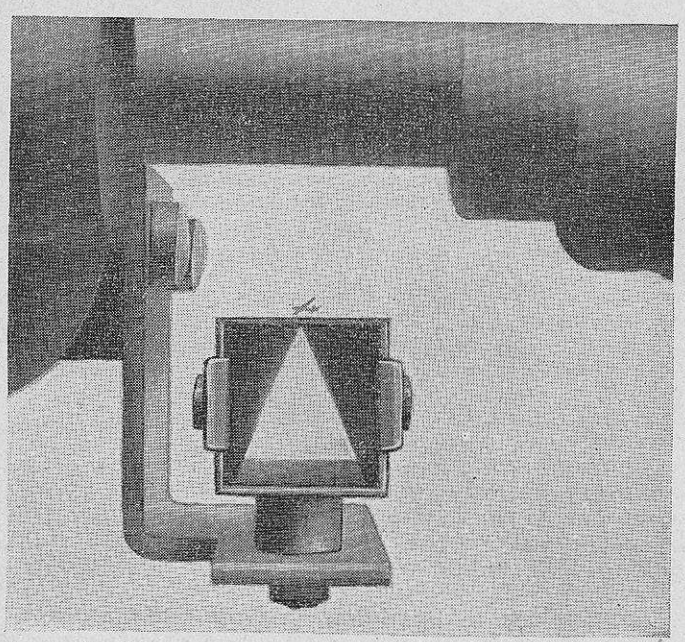


FIGURE 18.—Sight on the target over, not through, the open sight.

c. The altitude setter matches the middle to the inner pointers on the present angular height dials.

d. When the director corporal picks up the target through his spotting telescope he calls, "Target." The azimuth tracker and the elevation tracker begin tracking the target through their telescopes. If it has been the radar which originally reported the target, as soon as the height finder

is on target and sending consistent ranges the altitude setter, at the order of the chief of section, throws the altitude receiver switch to H. The fuze dead time setter begins matching the fuze rate drums with the fuze dead time handwheel.

e. As the future horizontal range dial settles down to a consistent and constant movement, the range officer reports, "Firing data in order."

43. HORIZONTAL FIRE—TERRESTRIAL TARGETS.—*a*. Cam limits in the director prevent its use under 3,500 yards as a computing instrument. *The director will not be used as a tracking instrument in antimechanized fire.* Antimechanized fire with direct fire sights is not conducted at ranges in excess of 1,000 yards. In horizontal fire at terrestrial or naval targets (motor torpedo boat, for example) the target remains at a constant altitude; that is, the target is either at 0 altitude or a constant number of yards below or above the director. The method is to use the director to compute this altitude initially and then leave the value of altitude in the director without change. This is accomplished as follows:

(1) Range setter matches the HOR pointers on the range-altitude dial as smoothly as possible using the range handwheel and rate smoother.

(2) Altitude setter matches the E_o dial using the altitude handwheel. The altitude setter notes the readings of altitude on the altitude dial and mentally averages them. (See fig. 1.) (Readings of altitude are on the outer ring at the altitude index pointer.) *The average altitude is then set by the altitude setter on the altitude dial and left at that setting.* The altitude setter should watch the match of the pointers on the E_o dial. They should remain approximately matched. If not, it indicates that the altitude determined and set in is in error. The above procedure should be repeated, determining a new average altitude which is set in.

(3) Range corrections can be put in by three methods:

(*a*) Apply a flat range correction plus or minus to the vertical parallax dial on the height finder.

(*b*) Equip the inner dial of the range altitude dial with a paper scale. Correction in range is put in by mismatching the HOR pointers by the amount of the correction.

(*c*) Apply a $d\phi$ spot. This will raise or lower the trajec-

tory increasing or decreasing the range to point of impact. *However, it does not change time of flight.*

(4) Of the three methods, (*a*) is the best and gives the most accurate and fastest results. Spotting in this type of firing is extremely difficult. The range spotter should be given as high a height of site as practical. The bracketing method of fire adjustment should be used to determine magnitude and direction of range corrections.

b. An alternate method is to set altitude at zero, determine and set in an initial range and range rate, and adjust by $d\phi$ corrections.

c. In all cases lateral corrections are put in by dA corrections on the director.

d. This method can also be used as an alternate method to that given in paragraph 42.

e. The guns are very likely to be seriously thrown out of level and orientation by horizontal fire.

■ 44. TERRESTRIAL FIRE AT UNSEEN TARGETS.—When the range to the target exceeds 3,500 yards, the director may be used to compute firing data. Azimuth, range, and altitude measured on an accurate contour map, or calculated by other means, are applied to the present azimuth dial, to the present horizontal range counter, and to the altitude dial. Total corrections, fire for effect, are computed and applied to the director as they are in paragraph 42 or 43. Parallax displacements are applied to the parallax dials. Spot corrections are applied to the spot dials from observation of registration fire (if conducted). The director corporal and the range setter are the only men required at the director position. They receive orders and instructions pertaining to adjustments and corrections from the observation post via radio or telephone.

■ 45. FIRING WITH DEFLECTION ANGLES.—Vertical and lateral deflections are displayed on the director for use when the data transmission system is inoperative. They are used only with guns equipped with a deflection sighting system. The vertical deflection dial is located on the rear of the director. The lateral deflection dial is on the left side. The deflections and the fuze numbers are read from the dials and communicated to the gun crews by telephone or other means.

SECTION III

CONCLUSION OF TRACKING

■ 46. STEPS TO BE TAKEN.—*a.* See paragraph 37.

b. In addition the following settings should be made. At, REST or MARCH ORDER and any other time when *0 rate is not required,* the altitude rate and the range rate dials should be set slightly off zero.

c. After prediction has settled out (it takes approximately 10 seconds) turn OFF director motor switch.

d. If further action is not imminent, the telescopes should be depressed and the director covered with the canvas cover provided.

e. Power plant should be shut OFF.

CHAPTER 7

DRILL

		Paragraph
SECTION I.	General	47–50
II.	Preliminary commands and formations	51–58
III.	Prepare for action	59–74
IV.	Action	75–90
V.	March order	91–95

SECTION I

GENERAL

■ 47. INSTRUCTIONS.

The drill is presented in chronological sequence of action. Each command is followed by the individual actions performed under that command. The drill will be adhered to strictly. It is conducted in silence, except for commands and reports. Commands and reports are given in a clear and positive manner. Errors are corrected instantly and on the spot. Drill is practiced until all reactions to commands are automatic, instant, and effective.

■ 48. RESPONSIBILITY.

The director corporal is personally responsible for the efficiency of the squad in drill and action. The chief of section is personally responsible for the coordination of the elements of the range section in drill and action. The range officer is personally responsible for the supervision and overseeing of functional drill and action preparedness of the entire fire control section of the gun battery.

■ 49. ABBREVIATIONS.

The members of the range section are referred to in this publication by the following numbers and letters:

CS, chief of section.
C, director corporal.
1, elevation tracker.
2, azimuth tracker.

3, range setter.
4, altitude setter.
5, fuze dead time setter.
S, height finder sergeant.
H1, elevation tracker, height finder.
H2, azimuth tracker, height finder.
H3, altitude setter, height finder.
H4, first alternate observer, height finder.
H5, second alternate observer, height finder.
SS, fire control electrician, staff sergeant.
E1, general electrician.
Pp, power plant operator.
T1, first telephone operator.
T2, second telephone operator.
H Ch, chauffeur of height finder truck and assistant power plant operator.
D Ch, chauffeur of director truck.

■ 50. TRAVELING POSITIONS.

The range section and its equipment are carried in three trucks. These are a 6- (or a 7½-) ton truck (prime mover), one of the two 15-foot 2½-ton, special body trucks, and a ¼-ton truck. Radar transportation is considered separately. The director squad, plus the staff sergeant electrician, the private electrician, two telephone operators, and the power plant operator ride in the director truck (prime mover), which tows the power plant trailer.

The height finder squad rides in the special body truck which carries the height finder matériel, the director and height finder cables, and other equipment. (See fig. 19.)

SECTION II

PRELIMINARY COMMANDS AND FORMATIONS

■ 51. FALL IN.

See paragraph 22.

■ 52. COUNT OFF.

The squad being in formation,
C commands: COUNT OFF.
1 to 5 report their numbers consecutively.

53. CALL OFF.

The squad being in formation,
C commands: CALL OFF.
Each member of the squad reports his assignment:
1 reports, "Elevation tracker."
2 reports, "Azimuth tracker."
3 reports, "Range setter."
4 reports, "Altitude setter."
5 reports, "Fuze dead time setter."

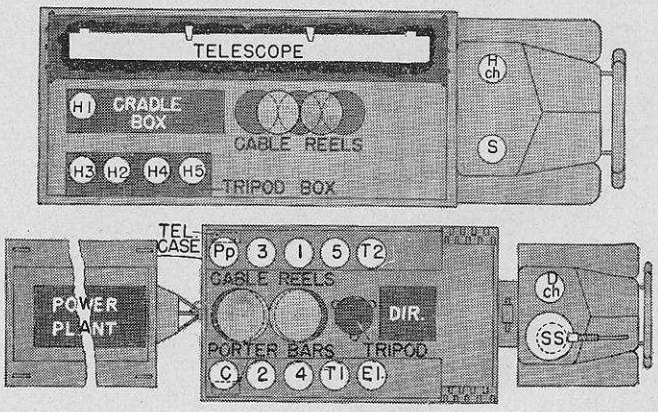


FIGURE 19.

54. CHANGE ORDER.

The squad being in formation.
C commands: CHANGE ORDER.
1 falls out to rear, takes place of 5.
2 through 5 move to position of next lower number.
All members move simultaneously to new positions and dress right.

55. MOUNT.

(It is assumed that the other personnel assigned to ride in the director truck have already mounted.)
The squad being in formation,
C commands: MOUNT.
5, 1, 3 and Pp mount director truck at left rear in order named.

4, 2 and C mount truck at right rear in order named.
D Ch raises and locks tailgate.
3 or C fastens safety strap.
D Ch takes driver's seat.
SS takes seat beside D Ch.

56. DISMOUNT.

C unfastens safety strap.
D Ch lowers tailgate.
C commands: DISMOUNT.
3, 1 and 5 dismount from left rear in order named.
C, 2 and 4 dismount from right rear in order named.
All members, having dismounted, form as at the command, FALL IN.

57. LOAD EQUIPMENT.

The squad being dismounted and in formation,
C commands: LOAD EQUIPMENT.
All members take posts and load equipment as prescribed in MARCH ORDER, (par. 91).

58. UNLOAD EQUIPMENT.

The squad being aboard the truck, or being dismounted and in formation,
C commands: UNLOAD EQUIPMENT.
All members take posts and unload equipment as prescribed in PREPARE FOR ACTION (sec. III).

SECTION III

PREPARE FOR ACTION

59. GENERAL.

The procedure for preparing the various elements of the range section for action from traveling positions is designed so that—

a. The instruments and pieces of equipment are emplaced, oriented, powered, and synchronized with the least possible delay, so that the guns may be fired under director control as early as possible.

b. The unloading of the several trucks is simultaneous and so synchronized that, so far as possible, no crew completes the

functional preparation for action of its equipment long in advance of the remainder of the range section.

c. The director drill is coordinated with the gun drill, the height finder drill, and the radar drill.

NOTE.—In the following drill, it is assumed that the battery commander, the range officer and CS have completed their reconnaissance of position, and that CS has indicated to C the approximate location for the director, the required field of fire and line of sight, and if possible, the general extent of the mission. It is assumed that the location for unloading the truck is over 50 feet from the location where the director is to be emplaced. It is assumed that local protection is furnished during emplacement by the machine gun section and by the machine gun on the cab of the director truck, manned by the staff sergeant electrician, senior noncommissioned officer aboard the truck.

■ 60. UNHITCH POWER PLANT

D Ch, arriving at the location for the battery's emplacement is directed to the position for the power plant.
C unfastens safety belt and dismounts.
C commands: UNHITCH POWER PLANT.
Pp and 3 dismount from left.
2 dismounts from right.
2 sets hand brake on trailer.
Pp and 2 lower front jacks on trailer.
3 disconnects break-away chain and electric jumper cord.
3 opens pintle hook and stands ready to disconnect lunette from pintle hook.
C signals D Ch, when trailer jacks have raised lunette enough to clear hook, to drive truck forward, clear of trailer.
D Ch drives forward about 6 feet.

■ 61. UNLOAD CABLE.

C commands: UNLOAD TWO REELS.
2 and 3 lower tailgate.
1 and 4 on truck unload two cable reels to Pp, 2, and 3.
3, 2, and C mount truck.
D Ch fastens tailgate.
Pp starts to lower rear jacks on trailer.
D Ch drives truck to location of second power plant.

NOTE.—It is assumed in this drill that the two power plants are emplaced sufficiently far apart to observe a dispersal safety factor. Each is no further from the junction box than two cable lengths

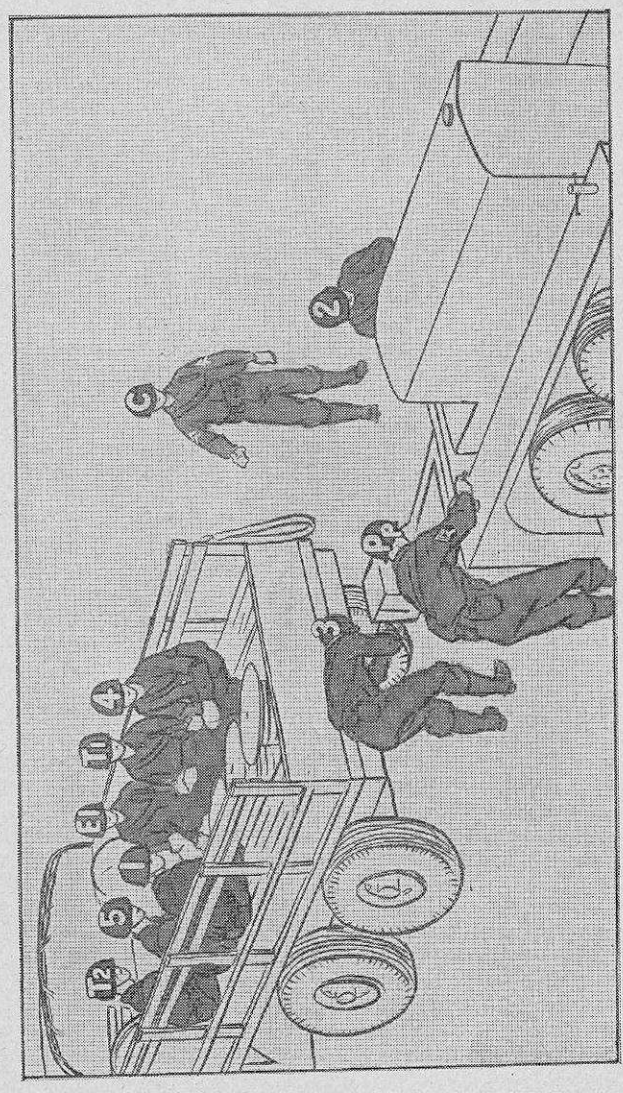


FIGURE 20.

or 100 yards. Both are in the same general direction from the junction box so that Pp may easily move from one to the other.

D Ch lowers tailgate.
C, 2, 3, and 1 dismount.
C commands: UNLOAD TWO REELS.
5 and 4 on truck unload remaining two cable reels to 1, 2, and 3.
Pp rejoins truck.
1, 3, Pp, 2, and C mount truck.
D Ch fastens tailgate.
D Ch drives truck to position for unloading director, designated by CS.

62. Unload Tripod.

D Ch lowers tailgate.
C dismounts and commands: UNLOAD TRIPOD.
Pp, 3, and 2 dismount.
4 hands telescope case down to 2.
4 and 1 move tripod to rear of truck.
4 dismounts.
1 opens porter bar box, hands two bars to T1 and two bars to T2.
1 places two bars on each side in rear end of truck.
5 unbolts director from truck floor at rear end of truck.
E1 unbolts director from truck floor at front end of truck.
2 carries telescope case to director position.
Pp, 3, and 4 unload tripod and carry it to director position, designated by C.
1 carries empty porter bar box to director position.
T1 inserts two porter bars in end of director nearest rear end of truck.
T2 inserts two porter bars in end of director nearest front end of truck.

63. Unload Director.

C commands: UNLOAD DIRECTOR.
T1 and 5 grasp rear porter bars.
T2 and E1 grasp front porter bars.
T1, 5, T2, and E1 slide director to rear of truck.
T1 and 5 dismount.
1 and 2 grasp rear porter bars.

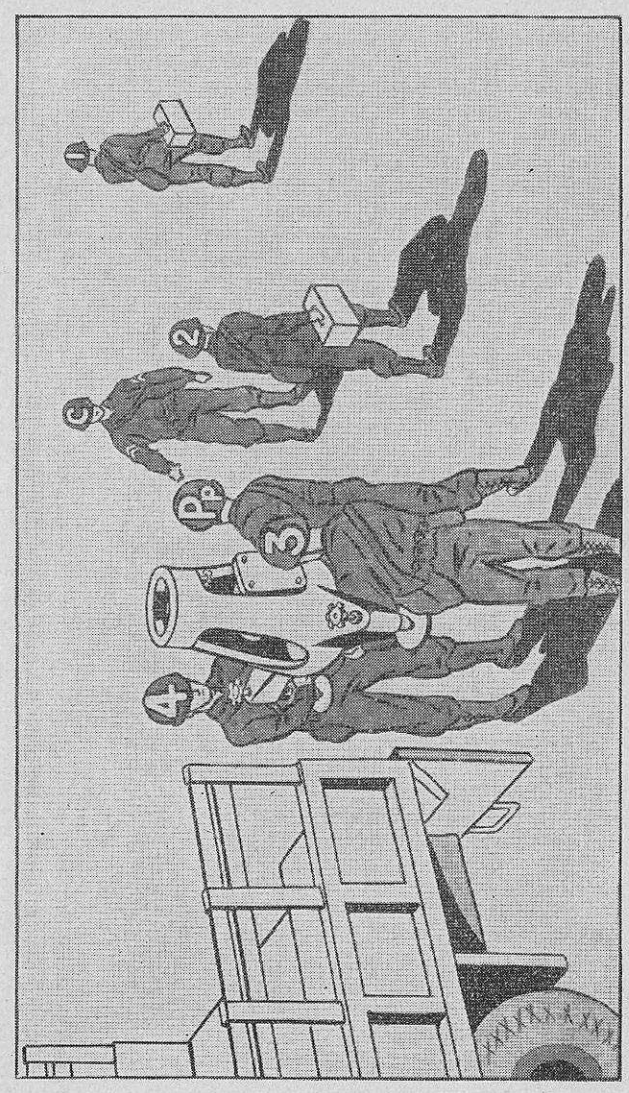


FIGURE 21.

3 and 4 each picks up a bar from truck floor and inserts it in rear side hole.

1, 2, 3, 4, T2, and E1 slide director further off truck.

Pp and D Ch each picks up a bar from truck floor and inserts it in front side hole.

1, 2, 3, 4, Pp, D Ch, T2, and E1 lift director off truck.

T2 and E1, in truck, carefully transfer front porter bars to 5 and T1, respectively, on ground.

1, 2, 3, 4, Pp, D Ch, 5, and T1 carry director to tripod at the direction of C.

■ 64. Place Director.

C makes sure the orienting clutch is OUT.

C commands: PLACE DIRECTOR.

C feels for slewing handwheel through canvas cover and holds it steady as crew lowers director onto pedestal.

C rotates the director slowly until pedestal locking pin clicks into place.

While 1, 2, 3, 4, and 5 participate in Unload Telescope (see par. 65),

D, Ch and T1 remove and fold canvas cover.

Pp, T2, and E1 return to power plant position to lay power plant—junction box cable.

D, Ch and T1 remove porter bars, replace them in box.

C tightens three clamping screws in pedestal into holes in base of director.

D Ch carries porter bar box back to truck.

C levels director.

D Ch and T1 unload any remaining equipment or parts CS or C require at position.

■ 65. Unload Telescope.

Note.—It is assumed that the height finder truck has arrived at the battery location at the same time as the director truck. The two instruments are being set up simultaneously. Approximately at this point in the establishment of positions, the height finder squad has fastened the cradle to the height finder tripod and is prepared to unload the telescope. Ten men are required to support the M1 telescope and carriage, 12 men the M2 and carriage.

CS commands: UNLOAD TELESCOPE.

1, 2, 3, 4, and 5 (Pp if the height finder is an M2) go to the height finder truck. They work under the super-

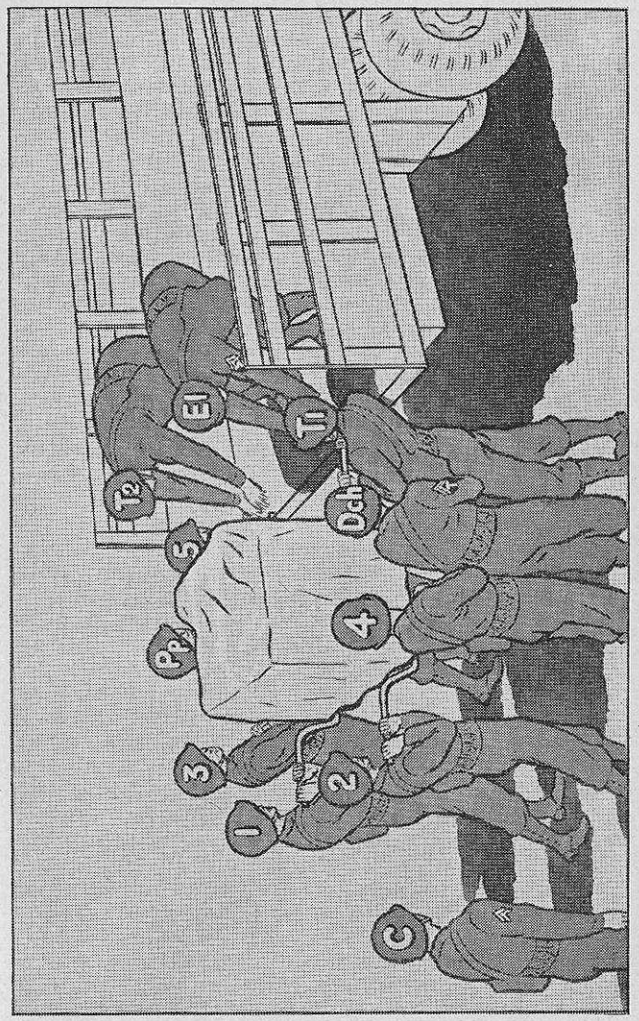


Figure 22.

vision of the height finder sergeant until dismissed.
1 and 2, when dismissed, carry a cable reel from beside the height finder truck to the director position.
3, 4, and 5, when dismissed, carry a second cable reel from beside the height finder truck to the director position.

■ 66. Mount Telescopes.

C commands: MOUNT TELESCOPES.
1 removes the elevating telescope from the telescope carrying case, mounts it on the left side of the director.
2 removes the azimuth telescope from the case, mounts it on the right side of the director.
3, 4, 5, and T1 start to lay director-junction box cable.

■ 67. Check Telescopes.

C commands: CHECK TELESCOPES.
1 checks elevating telescope. (See par. 28.)
2 carries telescope case to truck.
D Ch fastens tailgate, drives truck to motor park.
2 policies unloading position.
2 returns to check azimuth telescope.
C adjusts the spotting telescope.

■ 68. Lay Cable.

C commands: LAY CABLE.
1 and 2 join 3, 4, and 5, the detail from the height finder squad and other personnel assigned by CS in laying the director-junction box cable and the power plant-junction box cable.
When sufficient cable has been laid from the director and from the power plants to the position designated by CS for the junction box, 5 connects the cables at the junction box, Pp connects the cable at the power plant and 3 connects the cables at the director.

■ 69. Orientation.

See paragraph 29.
It is assumed by this time in the drill, the power plant-junction box cable and the director-junction box cable are laid and connected.
C checks the elevation orientation.

C obtains from the range officer or from CS the location and azimuth of the orienting point from the director.
C turns orienting clutch to the IN position.
3, at the direction of C, turns motor switch ON.
3, at the direction of C, pushes red button in.
C turns azimuth tracking handwheel until present azimuth dial reads correct azimuth.
3, at the direction of C, turns motor switch OFF.
C turns orienting clutch to the OUT position.
3, at the direction of C, turns the slewing handwheel to aim the director at the orienting point.
1, at the direction of C, elevates the telescopes to aim the director at the orienting point.
C puts the vertical cross hair of the azimuth telescope on the center of the orienting point, commanding: LEFT, RIGHT, ELEVATE, and DEPRESS as required.
C turns orienting clutch to IN position.
C checks the azimuth dial for the correct azimuth.

■ 70. Synchronization.

See paragraph 30.
It is assumed that by this time in the drill, all cables are laid and connected, each piece of equipment is ready for synchronization and telephone communication has been established in the gun and range-detector sections. This includes "open" lines from the director position to the locations of the height finder, the power plant, the radar and each of the guns. For synchronization, CS takes post at the telephone at the director's position.

■ 71. Synchronize With Guns and Height Finder (M1 or M2).

CS, over telephone, commands: PREPARE FOR POWER.
CS checks that director rates are zeroed, that toggle switch in base of director is thrown to "H."
Gun commanders check that selector switches are in automatic position and transfer levers are in manual position.
CS commands: REPORT.
Gun commanders report by number: "No. 1 ready, No. 2 ready, No. 3 ready, No. 4 ready."

CS commands: POWER ON.
Pp turns on power.
CS sets into the director convenient amounts in round numbers of azimuth, angular height, and fuze.
CS reads azimuth from director's azimuth dial (to S): "Azimuth, — mils."
S turns azimuth mechanical pointer with azimuth handwheel to — mils.
CS reads angular height from director's angular height dial (to S): "Angular height, — mils."
S turns elevation mechanical pointer with elevating handwheel to — mils.
CS reads firing azimuth, quadrant elevation and fuze range (to gun commanders). "Azimuth, — mils. Quadrant elevation, — mils. Fuze range, ——."

Gun commanders instruct trackers and fuze setters to set mechanical pointers to correct figures.

CS commands: ADJUST POINTERS.

If height finder's electrical pointers do not match mechanical, S adjusts them.

If gun pointers do not match, gun commanders have trackers and setters adjust them.

S and gun commanders report, "Pointers adjusted."
CS sets into the director new azimuth, angular height, and fuze.
CS does not read new settings. As a check he has S and gun commanders report individually the new settings of their electrical pointers.
CS calls for a recheck on receiver indicator that does not correspond to the director's transmitter indicator.

When receivers at height finder and guns have been synchronized with transmitters at director,

CS commands: SYNCHRONIZE IN ALTITUDE.
S uncovers the vertical parallax correction knob.
S sets the vertical parallax dial on the height finder at zero.
S sets the transmitter scales to a convenient round number.
S reports, "Dial, zero. Scale (for example), 2,000 yards."
CS checks transmitted altitude on director's altitude and range dial.

If the pointer on the director's inner (electrical) dial

indicates, for instance, 1,900 yards instead of the correct reading, 2,000 yards,

CS commands: CORRECT, PLUS 100.
S sets in a plus correction of 100 yards on the vertical parallax dial.
S repeats, "Altitude 2,000 yards."
CS commands: CHECK.
S sets transmitter scales to another number.
S reports, "Dial, plus 100. Scale, 3,500 yards."
CS repeats, "Altitude 3,500 yards."

NOTE.—The vertical parallax, if any, between the height finder and the director may be set in at this time. The range officer has figured how much higher or lower the height finder is than the director and told the CS the amount in yards and the direction.

When the height finder and director have been synchronized in altitude,

CS commands: CORRECT FOR PARALLAX.

Assume, for example, that the height finder is 20 yards higher than the director.

CS commands: CORRECT, PLUS 20.
S sets in an additional plus correction of 20 yards on the vertical parallax dial.

Or, for instance, the height finder is 10 yards lower than the director.

CS commands: CORRECT, MINUS 10.
S changes the vertical parallax dial in a minus direction by 10 yards.
CS reports, "Parallax O. K."
S replaces the cover on the vertical parallax correction knob.

■ 72. SYNCHRONIZE WITH SCR–547.

CS commands: SYNCHRONIZE IN AZIMUTH, sets toggle switch to "H."
CS instructs SCR–547, "Report azimuth."
Height finder reports azimuth reading. "Azimuth, — mils."
CS compares reported reading with reading on director's azimuth dial.

If director's dial does not agree with reported height finder reading,

CS instructs height finder operators to adjust.
CS commands: SYNCHRONIZE IN ELEVATION.
CS instructs SCR–547, "Report angular height."
Height finder reports angular height reading. "Angular height, — mils."
CS compares reported reading with reading on director's angular height dial. If director's dial does not agree with reported height finder reading,
CS instructs height finder operators to adjust.
CS commands: SYNCHRONIZE IN ALTITUDE.
CS asks SCR–547 for reading of altitude dial.
CS compares reading of director's receiver pointer with height finder's reading.
If values do not agree,
CS directs radar operators in adjusting altitude transmitter until director's receiver pointer agrees with height finder's reading.
CS commands: CORRECT FOR PARALLAX.
CS directs SCR–547 in adjusting altitude transmitter until indicator pointers on altitude dial are mismatched, in right direction, correct amount of vertical displacement (measured from level of director's line of sight to level of height finder's line of sight.)

■ 73. Synchronize With SCR–545 or SCR–584.

CS commands: SYNCHRONIZE IN AZIMUTH, sets toggle switch to "T."
CS reports to CRO (chief radar operator) azimuth to reference point. "Azimuth to reference point (indicating) — mils."
CRO directs radar operators to traverse and elevate or depress radar onto point.
CS checks reading of azimuth receiver indicators.
If indicators do show correct value,
CS directs CRO to adjust azimuth transmitters (coarse and fine) until accurate azimuth of reference point is indicated on receivers.

Note.—Radar operators orient in azimuth at this time by setting radar azimuth indicators to correct azimuth.

CS directs CRO to traverse radar to new definite azimuth value as precautionary check.

CS commands: SYNCHRONIZE IN ELEVATION.
CS directs CRO to have antenna elevated or depressed to any definite angular height value. "Elevate to — mils."
CRO directs radar operator to elevate to correct value on elevation dial and hold steady.
CRO checks dial and reports "Angular height set."
CS checks angular height coarse and fine receiver indicators.
CS directs CRO, if either reading is incorrect, to turn proper selsyn until pointer at director indicates correct reading.
CS directs CRO to have antenna elevated or depressed to new angular height value as precautionary check.
CS commands: SYNCHRONIZE IN ALTITUDE.
CS asks CRO for reading of radar's altitude dial.
CS compares reading of director's receiver pointer with radar's reading.
If values do not agree,
CS directs CRO in turning radar's altitude adjusting screw, until director's receiver pointer agrees with radar's reading.
CS commands: CORRECT FOR PARALLAX.
CS directs CRO in turning altitude adjusting screw until indicator pointers on altitude dial are mismatched, in right direction, correct amount of vertical displacement (measured from level of director's line of sight to level of center of radar's reflector.)

■ 74. Synchronize With SCR–268.

CS throws toggle switch in base of director to "T."
CS commands: SYNCHRONIZE IN AZIMUTH.
CRO (chief radar operator) directs radar azimuth tracker to traverse mount right or left.
CRO reports to CS, "Increasing azimuth" or "Decreasing azimuth."
CS notes direction of rotation of azimuth coarse and fine dials. He reports sensing correct or incorrect.
CS directs CRO, if sensing is incorrect, to throw appropriate (coarse or fine) azimuth reversing switch.

When sensing is correct,

CS directs CRO to have mount traversed to any definite azimuth value. "Traverse to — mils."

CRO directs radar azimuth tracker to traverse to correct azimuth and lock foot brake.

CRO checks azimuth indicator and reports, "Azimuth set."

CS checks azimuth coarse and fine receiver indicators.

CS directs CRO, if either reading is incorrect, to turn proper adjusting screw until pointer at director indicates correct reading.

CS directs CRO to have mount traversed to new definite azimuth value as precautioning check.

CS commands: SYNCHRONIZE IN ELEVATION.

CRO directs radar elevation tracker to elevate or depress antenna.

CRO reports to CS, "Increasing elevation" or "Decreasing elevation."

CS notes direction of rotation of angular height coarse and fine dials.

He reports sensing correct or incorrect.

CS directs CRO, if sensing is incorrect, to throw appropriate (coarse or fine) elevation reversing switch.

When sensing is correct,

CS directs CRO to have antenna elevated or depressed to any definite anguar height value. "Elevate to — mils."

CRO directs radar elevation tracker to elevate to correct value (noted on angular height counter on range converter) and hold steady.

CRO checks counter and reports "Angular height set."

CS checks angular height coarse and fine receiver indicators.

CS directs CRO, if either reading is incorrect, to turn proper adjusting screw until pointer at director indicates correct reading.

CS directs CRO to have antenna elevated or depressed to new angular height value as precautionary check.

CS commands: SYNCHRONIZE IN ALTITUDE.

CRO directs elevation tracker to set in a definite angular height.

CRO directs range operator to increase or decrease range.

CRO reports to CS, "Increasing altitude" or "Decreasing altitude."

CS notes direction of rotation of altitude dial. He reports sensing correct or incorrect.

CS directs CRO, if sensing is incorrect, to throw the altitude reversing switch.

When sensing is correct,

CS directs CRO to have definite altitude value set in as indicated on the altitude counter on the range converter. "Set altitude — yards."

CS sets same altitude value on altitude dial at director.

CS directs CRO in turning altitude adjusting screw on range converter until indicator pointers on altitude dial at director agree.

NOTE.—If limit is reached before pointers match, see FM 4–176 for detailed procedure of adjustment.

CS commands: CORRECT FOR PARALLAX.

CS directs CRO in turning altitude adjusting screw until indicator pointers on altitude dial are mismatched, in right direction, correct amount of vertical displacement.

NOTE.—When the radar transmits azimuth and angular height as well as altitude this adjustment must be removed.

SECTION IV

ACTION

75. BATTLE STATIONS.

See paragraph 22.

1 is stationed at the elevating handwheel prepared to track the target or, at the auxiliary elevation handwheel prepared to match pointers.

2 is stationed at the azimuth handwheel prepared to match pointers or track the target.

3 is stationed at the range handwheel prepared to match pointers on the angular height dials (for AA fire) or on the altitude and range dial (for HOR fire).

4 is stationed at the altitude handwheel prepared to match "AA" pointers on the altitude dial (for AA fire) or on the angular height dials (for HOR fire).

5 is stationed at the fuze dead time handwheel prepared to match rotational speeds of the fuze rate (zebra-striped) drums.

C is stationed at the collimator sight to assist in putting the director on target or at the spotting scope prepared to set in spot corrections.

■ 76. Lookout Stations.

CS commands: STAND BY.
C checks all settings quickly. See paragraph 37.
3 turns power ON.
All take position at their regular battle stations and scan sky for target.

■ 77. Target.

The first member of the squad to see a plane calls, "Target" and points toward it.
C traverses the director to the target and looks for it over the collimator sight.
1 elevates or depresses the telescopes at the direction of C.
2 watches for the target through the azimuth telescope.
2 calls, "Target" when he sees it and takes over tracking.
1 calls, "Target" when he sees it.
C reports, over phone, "Director sighting target."

Initial target pick-up may be peformed by the radar. In that case the director is positioned by matching pointers on the azimuth and elevation indicators.
C commands: MATCH POINTERS.
4 throws "H–T" switch to "T."
1 matches the outer pointers to the inner on the angular height indicators.
2 matches the mechanical pointers to the electrical on the azimuth indicators.
C watches for the target through the spotting scope.
If C (or S at the height finder) calls, "Target,"
1 and 2 immediately look into their telescopes and begin visual tracking.
4 throws "H–T" switch to "H."

Initial target pick-up may be performed by the height finder or the BC scope.
S or BC scope corporal reports exact azimuth and elevation to the director squad.

1 and 2 set values on their dials while C searches through the spotting scope.

When both trackers are on target,
C reports, over telephone, "Director sighting target."

■ 78. Height Finder Data (M1 or M2)—Level Altitude.

It is assumed that director and height finder have just gotten on target.
C reports, "Director on target."
S reports, "Height finder on target."
4 throws "H–T" switch to "H."
3 matches middle to outer pointers on the angular height dials.
4 matches AA pointers on the altitude dial smoothing erratic jumping of inner dial. He holds altitude rate knob.
4 reports "Altitude —— yards," when signal light blinks.
5 adjusts the right fuze rate drum to match the average rate of the left drum.
C or CS adjusts spot dials and wind dials to improve "fire for effect corrections" in respect to reported altitude.
CS reports to range officer, "Firing data in order," when future horizontal range dial moves at fairly constant rate.

■ 79. Height Finder Data (M1 or M2)—Changing Altitude.

1 or 2 reports, "Target diving" or "Target climbing", or H3 blinks altitude signal button twice.
4 matches AA pointers on the altitude dial without holding altitude rate knob.

■ 80. Height Finder Data (M1 or M2)—Range.

See paragraph 42.
H3 blinks altitude signal lamp three times.
1 and 2 keep target centered on crosshairs.
H3 reports initial approximate range.
3 checks report against range counter.
3 matches outer HOR pointers to inner HOR pointers on altitude dial, holding red button and range rate knob to match them initially. He releases the knob, 3 seconds later the button.

4 matches middle to outer pointers on angular height dials.
5 matches rates of fuze rate drums.
C or CS adjusts spot dials to conform to zone one or zone two.
CS reports to range officer, "Firing data in order," when future horizontal range dial moves at fairly constant rate.

81. Height Finder Data (M1 or M2)—Terrestrial.

See paragraph 43.
1 and 2 track target.
3 matches HOR pointers on altitude dial.
4 matches middle to outer pointers on angular height dials.
4 notes several altitude readings opposite index on altitude dial while matching angular height dials.
4 averages readings, sets average reading opposite index, and removes hand from handwheel.
S at height finder's observing eyepiece notes "overs" and "shorts," reports them to H3 at height finder.
H3 corrects in range, plus or minus, on vertical parallax dial.
4 changes altitude setting, once spotting adjustments have started, only with permission of CS.
5 has no assigned duties.

82. Height Finder Data (547)—Aerial.

1 and 2 keep target centered on crosshairs.
C checks director-d. p. parallax setting on parallax dials.
4 throws "H–T" switch to "H".
3 matches middle to outer pointers on the angular height dials exactly.
4 matches AA pointers on the altitude dial, holding rate knob.
4 reports "Altitude —— yards," when signal light blinks.
5 matches fuze rate drum rates.
C or CS adjusts spot dials and the wind dials to conform to correct altitude.
4, if inner AA pointers start steady one-way movement, carefully sets in an altitude rate.
CS reports to range officer, "Firing data in order," when future horizontal range dial moves at fairly constant rate.

Range spotting on AA fire may be made at the 547, the range operator calling, "Over," "Short," "Way Over," or "Way Short."

At low altitude targets,
CS may direct 547 to send range, "Send range."
Height finder range operator throws switch, blinks altitude signal light with foot switch.
3 matches HOR pointers on altitude dial.
4 matches middle to outer pointers on angular height dials.
5 matches fuze rate drum rates.

83. Height Finder Data (547)—Terrestrial.

CS directs 547 to send range, "Send range," sets toggle switch to "H."
Height finder range operator throws switch, blinks altitude signal light with foot switch.
3 matches HOR pointers.
4 matches angular height pointers.
5 has no assigned duties.
CS spots at spotting scope.
CS makes range spot corrections by directing 3 to mismatch in proper direction. "Down — yards. Up — yards."

84. Radar Data (268).

See paragraph 40.
4 throws "H–T" switch to "T."
C sets radar-d. p. parallax on parallax dials.
3 matches middle pointers to inner on angular height dials.
2 matches pointers on azimuth dials.
1 has no assigned duties.
C assumes duties of 4.
C asks radar range and elevation trackers to report when they are exactly on target.
C matches AA pointers when they report.
Radar operators keep 2, 3, and C constantly informed, via phone, of corrections and fluctuations in their tracking.
2, 3, and C make changes to match only when data have settled to consistency, using red button to arrest prediction momentarily.

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5 matches fuze rate drum rates.

■ 85. Radar Data (545 or 584).

4 throws "H–T" switch to "T."
C sets radar-d. p. parallax on parallax dials.
1 has no assigned duties.
4 has no assigned duties.
C assumes duties of 4. Matches AA pointers on altitude dial.
2 matches pointers on azimuth dials exactly.
3 matches middle pointers to inner on angular height dials exactly.
5 matches fuze rate drum rates.

■ 86. Fire.

At the command FIRE, all continue their duties.

■ 87. Cease Firing.

At the command CEASE FIRING, all continue their duties.

■ 88. Target, Direct-Fire.

At the command TARGET, DIRECT-FIRE, all continue their duties.

■ 89. Cease Tracking.

See paragraph 37.

At the command, CEASE TRACKING,

C repeats the command.
1 and 2 lay the director and telescopes on azimuth and range from which next target may be expected.
3 sets horizontal range at 14,000–15,000 yards.
3 zeroes range rate.
4 sets altitude dial to altitude of expected target, or to average altitude.
4 zeroes altitude rate.
4 turns altitude motor switch ON.
C decides parallax to put in–director-dp for day firing (or night searchlight firing) or radar-dp for unseen firing.
C or CS set in corrections on spot dials and wind dials for zone in which target may be expected.

■ 90. Rest.

At the command, REST

C repeats the command.
C commands: SECURE EQUIPMENT.
3 sets range rate dial slightly off zero.
4 sets altitude rate dial slightly off zero.
C checks that all prediction has settled out, waits 10 seconds, turns OFF motor switch.

When directed by CS,

C commands: COVER DIRECTOR.
1 depresses telescopes to zero mils.
4 and 5 cover director and lash down canvas cover.
Pp shuts power plant OFF.

Section V

MARCH ORDER

■ 91. March Order.

At the command MARCH ORDER,

C commands: PICK UP CABLE.
3 disconnects the cables at the director.
Pp disconnects the cables at the power plant.
5 disconnects the cables at the junction box.
1, 2, 3, 4, and 5 join the detail from the height finder squad and other personnel assigned by CS in reeling the director-junction box cable and the power plant-junction box cable.
D Ch drives truck from motor park to loading position, designated by C, shuts off motor, dismounts and lowers tailgate.

NOTE.—The loading position may be closer to the emplacement than was the unloading position. This depends upon whether the emplacement is to be left as a dummy position, whether march order is being conducted at night and other factors.

D Ch unloads telescope case, carries it to director position, opens lid.
C removes azimuth telescope, places it in case.
C removes elevation telescope, places it in case.
D Ch unloads porter bar box and carries it to position.
C loosens three clamping screws in pedestal from holes in base of director.

C and D Ch cover director with canvas cover lashing it securely.

92. Load Telescope.

It is assumed that all cable is reeled.

CS commands: LOAD TELESCOPE.

1, 2, 3, 4, and 5 (Pp if the height finder is an M2) go to the height finder position. They work under the supervision of the height finder sergeant until dismissed.

D Ch and T1 insert porter bars in director.

D Ch carries empty porter bar box back to truck position.

93. Load Director.

C commands: LOAD DIRECTOR.

1, 2, 3, 4, Pp, D, Ch 5, and T1 take assigned positions at porter bars.

Each holds porter bar in crook of his two arms.

C commands: READY, LIFT.

All raise director off pedestal and carry it toward truck.

C commands: READY, LOWER.

All lower director porter bars to more comfortable arm's length carrying positions.

All carry director to truck position.

C commands: READY, SHOULDER HIGH, LIFT.

All shift grips simultaneously.

T2 and E1, aboard truck, reach down to grasp porter bars of T1 and 5.

C commands: READY, LIFT.

All lift director high, setting front edge on truck body as T2 and E1 grasp front bars and T1 and 5 duck out of way.

T1 and 5 run around to help 1 and 2 support rear weight of director.

Pp and D Ch disengage and remove front side porter bars as all lift director further into truck.

3 and 4, when they progress as far as the tailgate, remove rear side bars.

T2 and E1, on front bars and,

1, 2, T1, and 5 on rear bars, slide director completely onto truck.

94. Load Tripod.

C commands: LOAD TRIPOD.

1, 2, 3, and 4 return to tripod position.

Pp returns to power plant position to raise rear jacks of trailer.

T1, 5, T2, and E1 slide director to its position in front of truck.

E1 bolts director to floor at front end of truck.

T2 removes porter bars from front end of director.

5 bolts director to floor at rear end of truck.

T1 removes porter bars from rear end of truck.

2, 3, and 4 carry tripod to truck and load it.

1 carries telescope case to truck and loads it.

1 picks up porter bar box and places it in truck opening lid.

T2 hands porter bars to T1.

T1 loads porter bar box and stows it.

C commands: MOUNT TRUCK.

All take assigned positions.

D Ch raises tailgate.

D Ch drives to location of alternate power plant.

D Ch lowers tailgate.

C commands: LOAD REELS.

1, 2, and 3 dismount, hand up two cable reels to 4 and 5 on truck who stow them.

1, 2, 3, and C mount truck.

D Ch raises tailgate.

D Ch drives to power plant position.

95. Hitch Power Plant.

D Ch lowers tailgate.

C dismounts and commands: LOAD REELS.

2, 3 dismount.

2, 3, and Pp hand up two cable reels to 1 and 4 on truck who stow them.

D Ch raises tailgate.

C commands: HITCH POWER PLANT.

D Ch backs truck at signal directions of C until lunette of trailer is connected to pintle hook.

3 connects pintle hook.

Pp and 2 raise front jacks of trailer.
3 connects breakaway chain and jumper cord.
2 releases hand brake on trailer.
C commands: MOUNT TRUCK.
3 and Pp mount truck on left.
2 mounts truck on right.
C reports to CS that director truck is ready for march, CS gives instructions for further movement.
C mounts truck on right rear, fastens safety strap, D Ch takes seat in cab.

CHAPTER 8

NOTES ON SERVICE

96. SELECTION OF PERSONNEL.—*a.* The director corporal should be an intelligent leader, a quick thinker, an experienced man familiar with all the duties of the director squad, and some mechanical experience so that he can assist in making minor adjustments or repairs to the director. If possible, he should be a man tall enough to man the spotting scope comfortably.

b. No. 3, the range setter, should be a man with high intelligence and good coordination. He is the logical understudy and substitute for the director corporal. He must be able to set ranges quickly and smoothly into the director.

c. Nos. 1 and 2, the elevation tracker and the azimuth tracker, should be men of average height, with good eyesight, and good muscular coordination. They must be able to pick up the target quickly and track it smoothly, despite the noise and concussion of the guns and the confusion and excitement of battle.

d. No. 4, the altitude setter, should be a man of less than medium height. Like the other members of the squad he should be calm and unhurried under stress, yet capable of thinking quickly and acting decisively.

e. No. 5, the fuze dead time setter, should be a man of great patience. Matching the fuze rate (zebra-striped) drums can be a difficult and exasperating job. A very small man is best suited for the job.

f. Every member of the squad must be extremely conscientious and have a high regard for duty. He must be sold (by instruction) on the accuracy and reliability of the director. He must be thoroughly schooled in the instant recognition of friendly and enemy aircraft from any angle. He should have at least an elementary knowledge of the data transmission system. He must be qualified to take over the job of any other man on the director squad without warning.

g. The efficient operation of the director requires that personnel be carefully selected and thoroughly trained. Intelligence, initiative, judgment, and a certain amount of technical knowledge are required of every director operator. In order to allow for losses due to promotion, sickness, and casualties, each man must have at least one understudy. Also each man should have a working knowledge of every other operator's duties. A rotation of personnel in practice sessions to the various positions not only prepares the men for emergency duties in the field, but also improves morale, relieves the monotony of a never changing duty, and promotes efficiency and appreciation of the part each man's regular duties play in the success of the squad as a whole. Moreover, a shifting of assignment supplies the men with the wider knowledge which is necessary for the making of sound decisions under stress.

h. The members of the squad must be impressed with the importance of their duties. The tracker, the height finder, and the meteorological section may all supply careful and accurate data, the power plant and the data transmission system may be functioning perfectly, the remote control system may be functioning with precision—still if but one member of the director squad is inattentive or careless at the wrong moment while in action, the battery mission may be jeopardized and the accomplishment of the enemy mission facilitated. Teamwork is the keynote for the best performance by director personnel, each man knowing his own duties thoroughly and cooperating to the fullest extent with the other members of the squad.

97. Emplacement and Camouflage.—*a.* The battery commander, in accordance with instructions from higher headquarters, decides the method and type of emplacement and camouflage. The following must be considered as rough notes or suggestions only.

b. The director should be so placed that the telescopes have a full sweep of vision over the entire field of fire of the battery.

c. An emplacement should be prepared just large enough to allow efficient operation of the instrument at every angle of elevation and azimuth. A pit 8 feet in diameter is satis-

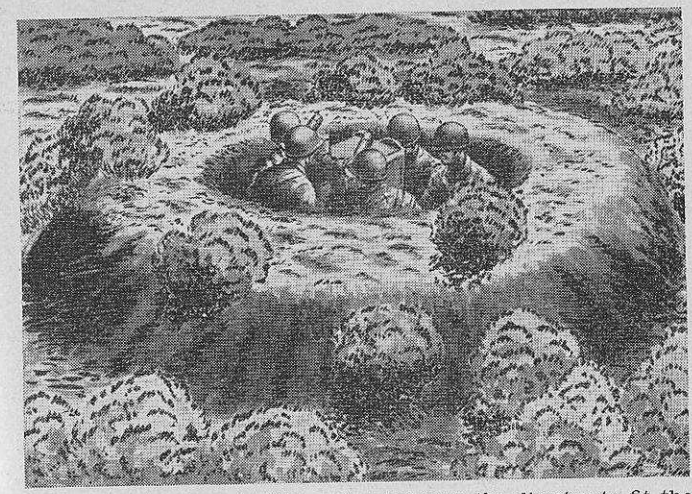


Figure 23.—Emplace, fortify, and camouflage the director to fit the surroundings. This director has not yet been camouflaged.

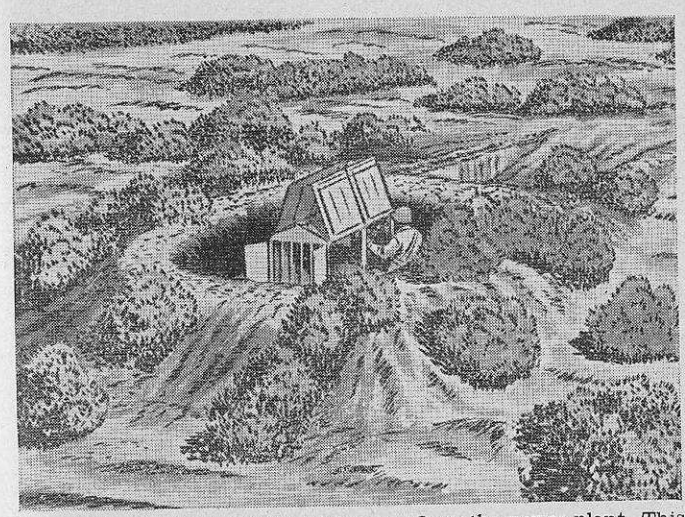


Figure 24.—Emplace, fortify, and camouflage the power plant. This power plant has not yet been camouflaged.

factory. (See fig. 23.) A parapet should be provided around the emplacement as high as possible and yet allowing tracking down to zero mils elevation. The position should be well drained, and the wall reveted.

d. An instantly removable camouflage net or cover should be provided. It should be so constructed that it will not interfere with the operation of the director. It should be so prepared with natural or artificial garnishing that it will blend naturally into the general appearance of the landscape.

e. The power plant frequently can be placed in a natural defilade. Otherwise, it must be dug in for complete protection, reveted, and provided with a parapet. The emplacement should be dug only large enough in length and width to permit entrance of the power plant trailer. It may be as deep as desired and must be well drained. The camouflage provided need not be of the instantly removable type. ***Caution:*** Ventilation is necessary to prevent collecting of carbon monoxide fumes in the pit.

f. The cables may be buried for protection. They should be buried below the frost line in a padded trench, or otherwise protected from possible damage during removal at a sudden MARCH ORDER. The ditch or trench should be well drained and camouflaged.

g. Foxholes may be dug near the director position, one for each man in accordance with the tactical situation. In any area in which tank attack is possible individual protection is always provided by foxholes. Each foxhole should be camouflaged but not covered.

■ 98. TIPS FOR DIRECTOR OPERATORS.—*a.* The pedestal level screws may be raised or lowered during leveling enough to make a difference between stooping or stretching thus establishing a comfortable, erect position at the telescopes.

b. Smooth target tracking is of utmost importance. The handwheels must be turned carefully, and a uniform steady motion maintained. Watch the down turn, don't speed up on it. Keep the movement even for each complete revolution. If your handwheel gets ahead of the target, don't reverse the cranking of your handwheel; slow your tracking a little and let the target catch up with you. If the target gets ahead of your handwheel catch up to it smoothly, not abruptly.

c. The flight of the target will never be jerky or spasmodic or by fits and starts. The flow of data through the director must be as smooth and even and steady as the flight of the target.

d. Four or 5 inches of dry hay or straw spread over the floor of the director pit in cold weather helps to keep feet warm.

■ 99. DECONTAMINATION OF DIRECTOR MATÉRIEL.—See FM 21–40 and TM 3–series.

CHAPTER 9

CARE AND MAINTENANCE

■ 100. MOVEMENT.—*a.* Handle your director as gently as you do your watch. Care for it as thoroughly as you would your car. Rely on it as assuredly as you do your rifle.

b. The director is provided with shock mounting frame and four hold-down bolts. It should be bolted to the floor of the truck every time it is transported. Holes may be drilled through the truck floor. The bolt nuts may be welded to the underside of the floor, or ½-inch strips may be drilled, tapped, and spot welded to the underside of the floor. In any event a method for firmly securing the director en route must be provided.

c. The telescopes should be removed and placed in their carrying case every time the director is moved.

d. The director should be encased in its canvas cover when not in use, and always while en route.

e. The director should always be lifted by the eight porter bars provided, should always be set down gently, either on its pedestal or the truck body.

■ 101. CLEAN, LUBRICATE, KEEP DRY.—*a.* Keep telescope lenses clean. Take off the rubber eye guard and remove dust from the lenses with a soft camel's-hair brush. Move the brush gently from the center to the outer edge. Remove oil, grease, grit and grime with a camel's-hair brush moistened in ethyl alcohol. Dry with lens paper.

b. Clean dial windows on the director with soap and water.

c. Remove rubber eye guards at least once a month. Wash in warm soapy water, dry, and dust with french chalk or talcum.

d. Clean metal surfaces with a dry cloth. Protect surfaces from which paint has worn off with a thin film of oil.

e. Keep plugs and receptacles clean and, when not in use, covered.

f. Clean handwheel shafts frequently and oil sparingly.

g. Specified oils and greases are:

(1) Oils, lubricating, for aircraft instruments and machine guns.

(2) Grease, special, low temperature (Norma 66, Keystone 84H or Beacon M2 85), for lubrication of cams, ball bearings, and for sealing covers of the director.

(3) Sealube, a waterproofing, sealing compound issued with director. It is used for sealing bezel joints in front and rear cover plates.

h. In the base of the director there is a compartment for the dehydrating agent, 1½ pounds of silica gel, which keeps the director free of excessive moisture. The gel absorbs water from the air and must be reactivated or dried out when it becomes saturated. To inspect the gel, unscrew the container from the base of the director and unscrew the screen cover from the container. When fresh, the gel will be deep blue; when moist, it will be pink. If it is pink, put the gel in a dish or pan and bake it in an oven of not over 350° F. for about an hour or until it becomes deep blue again. Replace the gel. Check it at least once each month.

i. When the director is to be stored in a damp climate or in the Tropics, or is to be used in cold weather, the heater lamp cord must be plugged into its receptacle in the base of the director and into any 115-volt electrical circuit. The heater lamp is either an ordinary 40-watt bulb or a heating element. Check its functioning through the window for the level on the left side of the director. If the bulb is burned out, it can be replaced by removing the cover plate containing the altitude switches on the base of the director. The socket is on the inside of the cover plate.

j. The director should be exercised at least once every 2 weeks to keep its internal mechanisms operating freely. Pull the motor switch ON and operate, one at a time, all handwheels, knobs, handcranks, and parallax screws from minimum to maximum and back. The range and altitude rates and wind and problem target velocity dials should be offset from zero a small amount during storage.

■ 102. STATIC PROBLEMS.—*a.* In the tool box of every director there is an Inspection Report. This is the report on the exhaustive tests and the 92 problems that were applied to the director before it was accepted from the manufacturer.

b. In TM 9–2658 there is a summary of an inspection report. Also there are check or test problems to be set into the director for various guns and ammunition.

c. Working static problems serves a three-fold purpose: it serves to check the accuracy of the mechanisms and predictions of the director; it familiarizes the director squad with the capacities, quirks, and limitations of the director; and it exercises the moving parts of the director.

d. During training, check problems should be applied to the director frequently and regularly. In the field, check problems should be a daily duty, a part of the routine care and maintenance of matériel and the discipline of personnel.

e. (1) In working static problems, be sure to select the proper problems corresponding to the ammunition for which the director is fitted.

Caution: Always set both N-S and E-W problem target velocity dials to zero with motor switch ON after completion of each check problem.

(2) Set in static problems with the following procedure:

(*a*) Zero all spot dials, parallax dials, wind and problem target velocity dials, and range and altitude rate dials.

(*b*) Pull out the motor switch.

(*c*) Set the dead time dial to 1 second by the dead time knob. Stop the motion of the right dead time matching drum by turning the dead time matching handwheel.

(*d*) Pull out the altitude motor switch to bring the zero any altitude prediction that may have been left in the director (watch the altitude prediction zero indicator). When the dial is at zero, push in the altitude motor switch.

(*e*) Set in present altitude and angular height according to the problem and match the angular height inner pointers to the outer pointers with the range handwheel. Read and record present range.

(*f*) Set in present azimuth and the N-S and E-W components of target velocity according to the problem. If the problem involves a battery displacement, set in the given values of parallax on the respective parallax dials.

(*g*) When the dials come to rest, read and record future range, quadrant elevation in mils, firing azimuth (angle of train) in mils, and the fuze setting.

(3) After running problems always convert "mils error"

(in quadrant elevation and angle of train) and fuze setting error into yards error. To convert "mils error" into yards error, divide the future range reading by 1,000 to obtain yards error per mil. For errors in angle of train use the future *horizontal* range value and for errors in quadrant elevation use the future *slant* range value from the problem reference. Next, multiply yards error per mil by the observed "mils error." The result is the yards error. To convert fuze setting error into yards error multiply the observed error by the yards for 0.1 F shown on problem sheets under reference, and multiply the result by 10.

(4) The following tolerances are prescribed for static test problems run on the director.

(*a*) No error in yards in computed fuze range shall exceed twice a firing table probable error in yards (given in problem reference) along the trajectory and at least 85 percent of the errors shall be less than one probable error.

(*b*) Seventy-five percent of all lateral errors in yards shall be less than 40 yards and no lateral error shall exceed 60 yards.

(*c*) Seventy-five percent of all errors in yards due to errors in quadrant elevation shall be less than 40 yards and no error shall exceed 60 yards.

(5) If the dial readings exceed these tolerances, repeat the test to insure that the proper settings have been made. If the errors are still excessive, proceed with other checks until the error is eliminated.

■ 103. CHECKING THE CONSTANT SPEED MOTOR.—A constant speed motor inside the director powers the range and altitude smoothers, the time of flight mechanism, and the wind and the fuze deadtime mechanisms. The speed of the motor is checked by a stop watch as follows: on the range rate dial, set in a rate of exactly 50 yards a second. The present range should change from 1,000 to 6,000 yards in 100 seconds, with ½ second leeway plus or minus. This check should be made at frequent intervals.

■ 104. CHECKING THE RANGE, AZIMUTH, AND ALTITUDE DIFFERENCE MOTORS.—*a.* The director contains three motors which drive the prediction mechanisms. A quick check on the functioning of the motors can be made.

b. Pull the motor switch ON. A slight clattering will be heard inside the director indicating that the brakes of either or both the azimuth and the range difference motors have been actuated by the contacts.

c. Traverse the director until the present azimuth dial reads 0°.

d. Set altitude to 4,500 yards and present range to 4,200 yards.

e. Set in the maximum north wind on the wind and problem target velocity dials. At the same time watch to see that the future horizontal range dial increases its reading. If the range difference motor is operating the dial reading will change. Return the wind dial to zero. Check that the future horizontal dial reading decreases by setting in maximum south wind.

f. Set in the maximum east wind, and at the same time watch to see that the firing azimuth dial increases its reading. If the azimuth difference motor is operating the dial reading changes. Return the wind dial to zero. Check that the firing azimuth dial reading decreases by setting in maximum west wind.

g. Pull the altitude motor switch ON. Turn the altitude rate knob DOWN 50. Watch for movement of the altitude zero indicator. With altitude rate set in the director and the altitude switch ON, the zero indicator moves to the left if the motor is operating. Turn the altitude rate knob UP 50. The zero indicator moves to the right if motor is operating.

h. The director works within certain limits of range. The limits are 250 yards to 15,750 yards. If an angular height and an altitude are set in the director which give a range outside these limits the difference motors stop and the range handwheel slips. To clear the stoppage, push the motor switch IN, and turn the handwheel until the range is within the limits. Set the range rate knob to zero and pull the motor switch ON.

■ 105. INTERLOCK.—*a. Case I.*—(1) *Symptom.*—Case I interlock occurs when present azimuth and future azimuth are over 1,600 mils apart and the future horizontal range is about 250 yards.

(2) *Cure.*—Turn power OFF (push in the motor switch). With the range handwheel, turn the *future* horizontal range dial to 5,000 yards. Set wind, problem target velocity, range rate, and altitude rate dials to zero. Crank in 1,800 mils with the azimuth handwheel. Turn power ON (pull the motor switch out). When future range starts to increase, the director is out of the locked position.

b. Case II.—(1) *Symptom.*—Case II interlock occurs when present horizontal range is locked at maximum, future horizontal range is locked at minimum, the range handwheel is inoperative, and present azimuth and future azimuth are over 1,600 mils apart.

(2) *Cure.*—The director's cover plate must be taken off to release the instrument from case II interlock. This may be done only by qualified personnel. For detailed instructions see TM 9–2658.

■ 106. TEN "DON'TS" FOR DIRECTOR OPERATORS.—*a.* Don't turn a handwheel, knob, or handcrank until you know its function thoroughly.

b. Don't force any handwheel beyond its limit.

c. Don't turn handwheels with the motor switch OFF.

d. Don't slew the director unless the prediction arresting (red) button is pressed IN. Keep the red button pressed in for 3 seconds after the change has been completed. Don't hold it for longer than 5 seconds after the change.

e. Don't use the red button too freely. It is not a substitute for smooth tracking.

f. Don't use the red button for fuze, vertical or lateral spot corrections, or for dead time settings.

g. Don't turn the handwheels unevenly. If you are lagging, increase your speed gradually; if you are leading, decrease gradually. *Never reverse* direction while tracking. (You may reverse a matching handwheel momentarily to slow an excessive rate.)

h. Don't slew the director continually in one direction; you will kink or twist the cable.

i. Don't keep turning the range handwheel to keep motors running if they continually keep stopping (if the future horizontal range dial returns repeatedly to its minimum value of approximately 250 yards). This indicates case I of interlock. (See par. 105.)

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j. Don't shut the motor switch OFF at MARCH ORDER until range and altitudes, rates and wind, and problem target velocity dials have been zeroed and all prediction has settled out (about 10 seconds). Then turn each back from zero a small amount so that excessive wear will not groove the mechanisms at exactly the zero positions.

CHAPTER 10

DESTRUCTION OF DIRECTOR MATÉRIEL

■ 107. GENERAL.—All fire control equipment, including the directors M4 and M7, is difficult to replace. It should be the last equipment to be destroyed, if there is any chance of personnel being able to leave. If evacuation of personnel is made, all possible items of fire control equipment should be carried. However, tactical situations may arise when, due to limitations of time or transportation, it is impossible to evacuate personnel or equipment. *The destruction of matériel is a command decision to be implemented only on authority delegated by the division or higher commander.* If evacuation is not possible, fire control equipment must be thoroughly destroyed to prevent—

a. Its capture intact and subsequent use by the enemy against our forces.

b. The enemy's assembly of one complete unit from several damaged ones by "cannibalization."

■ 108. DESTRUCTION METHODS.—*a. Method No. 1.*—Demolition by TNT is the most satisfactory. Remove the telescope sights and smash them. Smash the cable receptacles and plugs. Chop the cables into short lengths, heap them, douse with gasoline, and ignite. Remove the side, front, and rear covers. Place 1 pound of TNT charges in each side, connected together with a detonating cord. Insert a tetryl nonelectric cap with at least 5 feet of safety fuze in one charge. Replace covers as tightly as possible without damaging the fuze. Ignite the fuze and take prearranged cover.

b. Method No. 2.—Remove telescope sights and smash. Smash the cable receptables and plugs. Chop the cables into short lengths, heap them, douse with gasoline, and ignite. Remove side, front, and rear covers. Completely smash the director mechanisms using an axe or sledge. Pour gasoline into the director and ignite.

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Chemical attack, defense against		FM 21–40, TM 3–series
Cleaning and preserving materials		TM 9–850
Commands		FM 4–100, 4–104
Communications		FM 4–104, 24–series
Data transmission:	Cable Systems, M1 and M2.	TM 9–1649
	D. T. System, M4	TM 9–1656
	D. T. System, M6	TM 9–1653
	Remote Control System, M2.	TM 9–1642, 9–2642
Explosives and demolitions		FM 5–25
Field fortifications		FM 4–104, 5–15
Fire control		FM 4–110, 4–121
Formations		FM 4–120
Height finder M1		TM 9–623 (now 9–2623), 9–1623
Height finder M2		TM 9–624, 9–1624
Inspections		FM 4–120
Instruction Guide	Director M4	TM 9–2655
	Director M7	TM 9–658 (now 9–2658)
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	Director M7	TM 9–1658
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Reference Data		FM 4–118
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Service of the Radio Set, SCR–545		FM 4–146
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RESTRICTED

ANTIAIRCRAFT ARTILLERY FIELD MANUAL

SERVICE OF THE DIRECTORS M4 AND M7

CHANGES No. 1

WAR DEPARTMENT,
WASHINGTON 25, D. C., 17 November 1943.

FM 4–136, 13 October 1943, is changed as follows:

■ 5. VISUAL DESCRIPTION.

* * * * *

a. Front side.—The side of * * * arresting (red) buttons. Directors **M4A1B1, M4A1B2, M7A1B1,** and **M7A1B2** have a range rate lever, operation of which simultaneously holds the rate knob stationary and depresses the red button.

b. Left side.—On the left * * * *covered oil cup.* Directors **M4A1B1** and **M7A1B1** have an instruction plate for the rate smoother unit near the wind dials.

* * * * *

e. Base.—On the under * * * agent, silica gel. **Directors M4A1B1 and M7A1B1 have a push-pull type switch near the lamp switch.**

* * * * *

g. (Added) *Top.*—On the top right cover plate of the M4A1B2 and the **M7A1B2** are two rate declutching devices. On the top left there is a control box for the rate smoothing unit.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 20.1. (Added) DIRECTOR RATE SMOOTHER.—*a. General.*—Two models each of the M4 and the M7 directors, the M4A1B1 and the M4A1B2, the M7A1B1 and the M7A1B2, incorporate the principle of rate smoothing to improve prediction. The M4A1B1 and the M7A1B1, the standard directors, offer this improved performance through a mechanical rate smoother; the M4A1B2 and the M7A1B2, the substitute standard directors, offer the same improved performance through an electrical rate smoother.

b. M4A1B1 and M7A1B1.—The M4A1B1 and the M7A1B1 differ from the M4 and the M7 directors in appearance only by the addition of an instruction plate on the left side near the wind dials, a push-pull type switch or button on the under side near

*The individual items in this change will be cut apart and pasted over the specific paragraphs or subparagraphs affected.

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the light switch, and a range rate lever. For normal operation the smoother switch will be in the OUT position. At the command of the Chief of Section, STAND BY, the director corporal checks to see that the control button is OUT. When the director is to be used as a static computor rather than as a dynamic predictor, the smoother switch may be pushed IN to render the rate smoothing mechanism inoperative. This may be done by the range officer, the chief of section, the director corporal, or assigned personnel to set static check problems into the director or to compute firing data for a single predetermined point for barrage fire. The range rate lever depresses the red button while simultaneously holding the range rate knob stationary.

c. M4A1B2 and M7A1B2.—The M4A1B2 or the M7A1B2 differ in both appearance and operation from the standard directors. The top left cover plate has been removed and a metal housing or control box 14 inches long, 8 inches wide, and 7 inches high, bolted in its place. (See fig. 10.1.) On the director's right top cover plate have been installed two rate declutching devices or levers. Each of the rate declutching devices has two labeled positions, MECHANICAL and ELECTRICAL. (See fig. 10.2.) On the left side of the control box there are two direct current zero reading meters, a green pilot light, and three switch knobs.

(1) *Switch knobs.*—The left switch knob is labeled FAST-NORMAL. The middle switch knob is labeled OFF–ON. The right switch knob is labeled MECH-ELEC. The middle switch knob energizes the rate smoother. The left switch knob allows a selection of rate smoothing operation: under normal operating conditions it should be left in the NORMAL position; if it is necessary to get approximate data to the guns immediately, the switch is turned to FAST. In this position an electrical filter system in the rate smoother unit is bypassed. The right switch knob controls the electrical circuit to the green pilot light.

(2) *Green pilot light.*—The green pilot light on the control panel is continuously illuminated when the director motor switch is ON, when the middle and the right switch knobs are in the position of ON and ELEC, respectively, and when the left switch knob is in either the FAST or the NORMAL position. At any time the range rate lever or the slewing red button is depressed, the light's circuit is broken, turning it off.

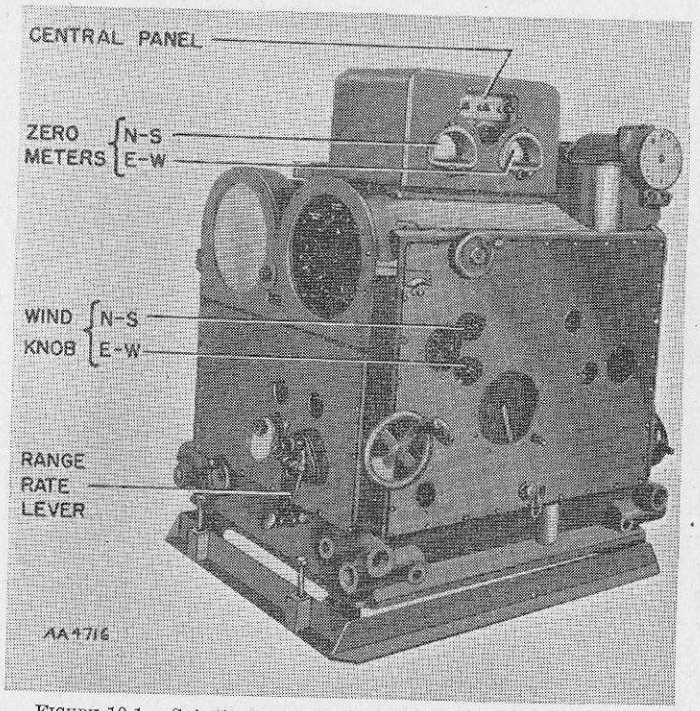


FIGURE 10.1.—Substitute standard director M4A1B2 or M7A1B2.

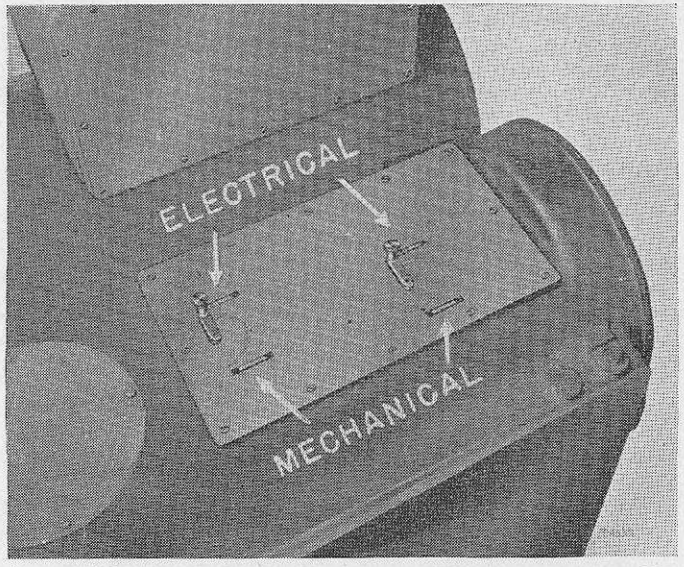


FIGURE 10.2.—Rate declutching levers on the M4A1B2 and the M7A1B2.

(3) *Zero reading meters.*—When the rate smoother is in operation, movements of the range handwheel and/or the azimuth handwheel are reflected by the pointers on the meters. Two additional members to the director squad, called rate smoothers, are essential for the operation of the M4A1B2 or the M7A1B2. During operation one rate smoother is stationed at the north-south wind knob, the other at the east-west wind knob. Twisting the north-south knob moves the north-south meter pointer; moving the east-west knob moves the east-west meter pointer. The duties of the two rate smoothers are to keep the pointers of the meters oscillating equally on either side of the index at all times when the green pilot light is illuminated. The range and the azimuth handwheels tend to move the pointers off the zero positions. The rate smoothers oppose this offset tendency by manipulating their wind knobs so as to keep their pointers oscillating at the zero position.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 22. DIRECTOR SQUAD.—*a.* The personnel of the director squad consists of—

* * * * *

Fuze dead time setter, No. 5.

Two additional operators are required for the operation of substitute standard directors, **M4A1B2** and **M7A1B2.** They are—

E-W rate smoother, No. 6.
N-S rate smoother, No. 7.

* * * * *

[A. G. 300.7 (27 Oct 43).] (C 1, 17 Nov 43.)

■ 32. SETTING WIND CORRECTIONS.

* * * * *

b.

* * * * *

(4) (Added.) A distinct procedure is required in setting wind corrections into substandard directors, M4A1B2 and M7A1B2. The various settings except wind speed are made on the director as usual. When all prediction has settled out, carefully check the range rate knob at the zero position and keep the azimuth handwheel motionless. Set the two declutching levers on the top right side of the director to ELECTRICAL. Set the left switch knob on the smoother control panel to NORMAL, the right switch knob to ELEC and the middle switch knob to ON. Set the wind components on the wind speed dials with the wind knobs. When the pointers on the zero reading meters become motionless in their off-center positions, push in each pointer adjusting button, immediately below the meter, and rotate it until the pointer is zeroed. Shut off the director motor switch.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 37. NORMAL SETTINGS ON DIRECTOR.

* * * * *

i. (Superseded.) On the M4A1B1 and M7A1B1 the rate smoother control button on base of director is left ON (pulled out).

j. (Added.) On the M4A1B2 and M7A1B2 directors the wind components are set in for the zone selected as described in para-

graph 32*b*(4). The pointers on the zero reading meters are left zeroed when power is turned off. (The wind dials (see fig. 16) will be displaced by the amount of the wind components.) The central panel controls are set as follows: Left switch at NORMAL, center switch at ON, right switch at ELEC.

k. The purpose of putting these various settings in ahead of time is twofold. First, when a target does appear it takes less time since the corrections are either correct (if target appears at anticipated altitude) or only small changes in corrections are necessary. Second, since the corrections are placed in when the operators are not under the strain of working against time, there is much less chance of corrections being applied in the wrong direction.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 38. PICK-UP WITH RADAR.

* * * * *

d. Based on the * * * with the altitudes. These values are posted in the director pit, see paragraph 37*f*. On the M4A1B2 and M7A1B2 directors the pointers on the zero reading meters are rezeroed after correcting the wind components if time permits. Fire is never held up to make this minor adjustment.

* * * * *

k. (Added.) The rate smoothers on the M4A1B2 and the M7A1B2 directors keep the pointers of their rate smoother meters oscillating equally on either side of the index at all times when the green pilot light is lit. When the green pilot light goes off each reports to the other, "Light off," and releases his knob. When the light is lit again each reports, "Light on," and resumes his operation of the wind knob. The E-W rate smoother operates the switch knobs on the control panel. He turns the left switch to FAST at the direction of the corporal when it is absolutely necessary to get approximate data to the guns immediately.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 40. AA FIRE WITH RADAR TRACKER—UNSEEN TARGETS.—*a.*

* * * * *

(6) (Added.) In the operation of the M4A1B2 and the M7A1B2, if a surge should accidentally be set up in either range or azimuth, the E-W rate smoother turns the middle switch on the

control panel to OFF momentarily, removing the charge from the circuit.

* * * * *

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 42. HORIZONTAL FIRE—AERIAL TARGETS.

* * * * *

f. (Added.) The rate smoothers on the M4A1B2 and the M7A1B2 perform their normal duties.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 43. HORIZONTAL FIRE—TERRESTRIAL TARGETS.—*a.* Cam limits in * * * director without change. On the M4A1B1, M4A1B2, M7A1B1, and M7A1B2 directors, the rate smoothers are first rendered inoperative by the procedures given in paragraph 44*b*.

* * * * *

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 44. TERRESTRIAL FIRE AT UNSEEN TARGETS.—*a.* When the range * * * radio or telephone.

b. (Added.) On the M4A1B1 and the M7A1B1, before any data are put into the instrument, the director corporal pushes in the rate smoother control button on the base of the director to amputate prediction. On the M4A1B2 and the M7A1B2, the E-W rate smoother turns the middle switch on the control panel to OFF and the right switch to MECH. He zeroes the wind dials. The corporal checks these operations, checks the zero position of the range rate dial, makes sure the azimuth handwheel is inoperative, and then turns the two clutch levers on the top right side to MECHANICAL. After the director motors run a few seconds to obtain seating of the clutches, the director is ready to operate as an M7, without rate smoothing.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 46. STEPS TO BE TAKEN.

* * * * *

d. If further action is not imminent, the telescopes should be depressed, altitude prediction motor switch turned off, the rate smoother control button on base of M4A1B1 and M7A1B1 directors turned OFF, the center switch on the central panel

control of the M4A1B2 and M7A1B2 directors turned OFF, and the director covered with the canvas cover provided.

* * * * *

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 49. ABBREVIATIONS.

* * * * *

5, fuze dead time setter.
6, E-W rate smoother (on M4A1B2 and M7A1B2).
7, N-S rate smoother (on M4A1B2 and M7A1B2).
S, height finder sergeant.

* * * * *

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 52. COUNT OFF.

* * * * *

NOTE (Added.).—On M4A1B2 and M7A1B2 directors 6 and 7 report their numbers after 5.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 53. CALL OFF.

* * * * *

NOTE (Added.).—On M4A1B2 and M7A1B2 directors,
6 reports, "East-west rate smoother."
7 reports, "North-south rate smoother."

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 54. CHANGE ORDER.

* * * * *

NOTE (Added.).—On M7A1B2 director,
1 falls out to rear, takes place of 7.
2 through 6 move to position of next lower number.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 55. MOUNT.

* * * * *

C commands: MOUNT.
7, 5, 1, 3 and P_D mount director truck at left rear in order named.
6, 4, 2 and C mount director truck at right rear in order named.
D Ch raises and locks tailgate.

* * * * *

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 56. DISMOUNT.

* * * * *

C commands: DISMOUNT.
3, 1, 5, 7 dismount from left rear in order named.
C, 2, 4 and 6 dismount from right rear in order named.
All members, having dismounted, form as at the command, FALL IN.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 75. BATTLE STATIONS.

* * * * *

C is stationed at * * * in spot corrections.
6 (on M4A1B2 and M7A1B2) is stationed at the east-west wind knob prepared to keep the pointer of the E-W rate smoother meter oscillating equally on either side of the index at all times, when the green pilot is lit.
7 (on M4A1B2 and M7A1B2) is stationed at the north-south wind knob, prepared to keep the pointer of the N-S rate smoother meter oscillating equally on either side of the index when the green pilot light is lit.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 76. LOOKOUT STATIONS.

CS commands: STAND BY.
C checks all settings quickly. See paragraph 37. Pulls smoother switch OUT (on M4A1B1 and M7A1B1).
3 turns power ON.
All take position at their regular battle stations and scan sky for target.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 78. HEIGHT FINDER DATA (M1 OR M2)—LEVEL ALTITUDE.

* * * * *

5 adjusts the * * * the left drum.
6 and 7 (on M4A1B2 and M7A1B2) keep the oscillations of their zero meter pointers balanced at the index.
C or CS adjusts spot dials * * * to reported altitude.

* * * * *

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 80. HEIGHT FINDER DATA (M1 OR M2)—CHANGING ALTITUDE.

* * * * *

558748°—43——2

3 matches outer **HOR** * * * later the button. On the **M4A1B2** and the **M7A1B2** depresses the range rate lever while matching pointers initially.
4 matches middle to outer pointers on angular height dials.
5 matches rates of fuze rate drums.
6 and 7 release the wind knobs when the green light goes off, resume operations when 3 releases the range rate lever and the green light is lit again.
C or **CS** adjusts spot dials to conform to zone one or zone two.

* * * * *

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 81. HEIGHT FINDER DATA (M1 OR M2)—TERRESTRIAL.

* * * * *

4 changes altitude setting, * * * with permission of **CS**.
5, 6 and 7 have no assigned duties.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 82. HEIGHT FINDER DATA (547)—AERIAL.

* * * * *

5 matches fuze rate-drum rates.
6 and 7 perform their normal duties on the **M4A1B2** and the **M7A1B2**.
C or **CS** adjusts spot dials and the wind dials to conform to correct attitude.

* * * * *

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 83. HEIGHT FINDER DATA (547)—TERRESTRIAL.

* * * * *

4 matches angular height pointers.
5, 6 and 7 have no assigned duties.
CS spots at spotting scope.

* * * * *

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 84. RADAR DATA (268).

* * * * *

5 matches fuze rate drum rates.
6 and 7 perform their normal duties on the **M4A1B2** and the **M7A1B2**, releasing the wind knobs at times when the green light goes off.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 85. RADAR DATA (545 OR 584).

* * * * *

5 matches fuze rate drum rates.
6 and 7 perform their normal duties on the **M4A1B2** and the **M7A1B2**.

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 89. CEASE TRACKING.

* * * * *

4 turns altitude motor switch ON.
6, at the direction of C, turns the middle switch of the **M4A1B2** or the **M7A1B2**'s rate smoother control panel to **OFF**. He zeroes the wind dials and then, under the supervision of C, sets in the proper wind components. He turns the middle switch to **ON**. When the pointers on the zero meters have become motionless in their off-center positions, he pushes in each pointer adjusting button and rotates the button until the pointer is zeroed.
C decides parallax to * * * for unseen firing.

* * * * *

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 90. REST.

* * * * *

4 sets altitude rate dial slightly off zero.
6 on the **M4A1B2** and the **M7A1B2**, does not center the zero meter pointers when 3 sets range rate dial slightly off zero.
C checks that all * * * **OFF** motor switch.

* * * * *

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

■ 96. SELECTION OF PERSONNEL.

* * * * *

i. (Added.) Numbers 6 and 7 on the M4A1B2 and the M7A1B2 should be patient, alert men with quick reflexes. They must be adroit in manipulating the wind knobs and instantly responsive to the demands of the green light. Number 6 is the operator of the three switches on the rate smoother's control panel. He sets into the director ballistic wind components, always under the supervision of the corporal, and zeroes the pointers. During

operation he manipulates the E-W wind knob with either his left hand or his right hand, whichever affords greater ease and accuracy. (See fig. 22.1.)

[A. G. 300.7 (27 Oct 43).] (C. 1, 17 Nov 43.)

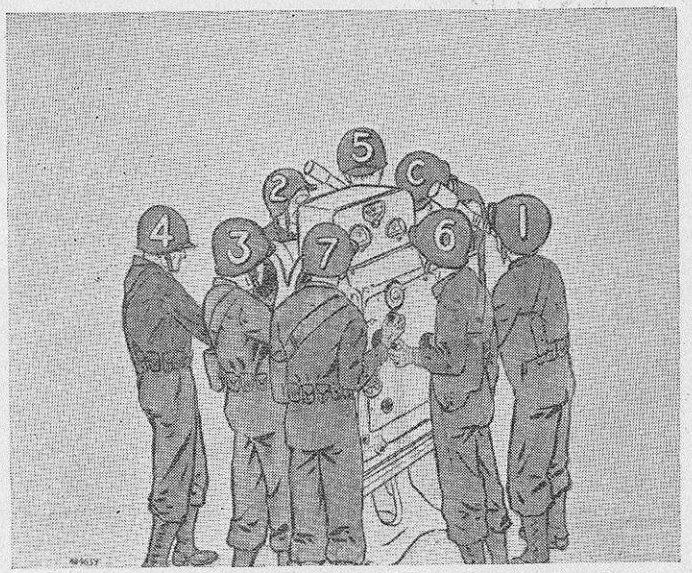


FIGURE 22.1.—The M7A1B2 director squad in operating positions.

NOTE.—No. 7 is placed in this picture to show the position of his right hand. Normally No. 7 faces the left side of the director.

[A. G. 300.7 (27 Oct 43).] (C 1, 17 Nov 43.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

U. S. GOVERNMENT PRINTING OFFICE: 1943