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OPERATION OF THE SCR-296-A

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OPERATION OF THE SCR-296-A

GENERAL. The SCR-296-A is a radar set assigned to modern seacoast batteries of 6-inch caliber or larger. Its function is to provide present azimuth and range of surface vessels with sufficient accuracy for direction of gun fire. The operation of this set is not limited by darkness, haze, smoke, or other atmospheric characteristics that render optical methods of observation ineffective.

Normally, the SCR-296-A will be operated only when the battery is assigned a target. Approximate data on present position are supplied through the chain of command to the SCR-296-A by the surveillance set SCR-582, these data being sufficiently accurate to place the SCR-296-A on the target. The present position data from the SCR-296-A are telephoned to the battery plotting room on time-interval signals or, as projected for the future, are sent directly to a computer by a data transmission system.

The set utilizes short pulses of high-frequency radio energy. The time interval from the emission of a pulse to the reception of the reflected energy from a target determines the range to the target. A highly directive antenna is used to determine the azimuth of the target.

The complete range of the set appears as a horizontal base line or sweep on an oscilloscope. The center portion of the sweep may be expanded so that four inches represent about 5,000 yards, thus allowing accurate determination of target range and facilitating discrimination between targets differing slightly in range. Echoes, called pips, appear as vertical displacements of the sweep. In the center of the expanded portion of the sweep a section of the base line, having a width which represents about 600 yards, is lowered to form a "notch," and the range to any target centered in the notch may be read from range dials. (See fig. 1.)

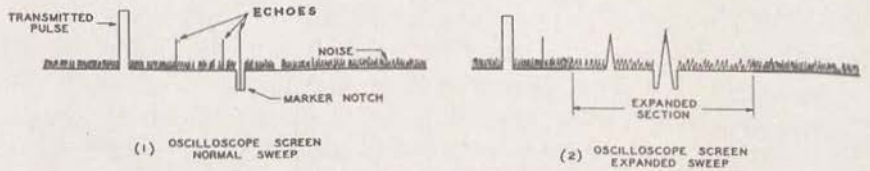


FIGURE 1.—Sweep form as it appears on Range Oscilloscope BC-719-A.

The echo in the notch, and only this echo, appears on the azimuth oscilloscope. This single echo is made to appear as two pips, side by side. When the antenna is directed at the target, the pips are of equal height and the azimuth of the target may be read from azimuth dials; if the antenna is displaced in azimuth, the pip heights are unequal. (See figs. 2*a*, 2*b*, 2*c*.) When two or more targets at nearly the same azimuth are separated by less than about 500 yards, signals from all of them may appear in the notch. This condition is discussed later under "Interference."

At any given instant the azimuth operator "sees" targets only in an area a few hundred yards long in range by 10 to 15 degrees wide in azimuth, and there is no interference by targets outside this area. However, the range operator at all times can see targets at all ranges up to the maximum range within the same angle.

While the set is normally used only when the target cannot be seen by optical instruments, its range accuracy is such that even when visibility is good, tracking by radar range and optical azimuth is preferred to optical vertical base tracking from low heights of site, and to tracking by coincidence or stereoscopic range finder.

DESCRIPTION OF THE SET. The SCR-296-A includes the following units:

1. *The Main Unit.* The main unit, shown in figure 3*a*, consists of the Modulation Generator BC-720-A (fig. 3*b*), the Radio Receiver BC-716-A (fig. 3*c*), the Power Control Panel BD-108-A (fig. 3*d*), the Radio Transmitter BC-717-A (fig. 3*e*), the High Voltage Rectifier RA-50-A (fig. 3*f*), and the Duplex Panel BD-106-A (fig. 3*g*), all in the cabinet BE-82-A. This cabinet is about 6 feet high, 2 feet 9 inches wide, and 20 inches deep.

2. *The Indicating Equipment.* The indicating equipment, shown mounted on the operating table in figure 4, includes the Regulated Rectifier RA-49-A (fig. 5), the Azimuth Indicator I-110-A (fig. 6), the Azimuth Oscilloscope BC-718-A (fig. 7), the Control Unit RM-36-A (fig. 8), the Range Oscilloscope BC-719-A (fig. 9), and the Range Unit BC-723-A (fig. 10).

3. *The Antenna.* The antenna proper is a directive array with a parabolic reflector. It is about 6 feet high by 6 feet wide and is housed at the top of a tower that may be from 25 to 100 feet high. The antenna is traversed by remote control from the operating position. Part of the traversing mechanism, the Motor-Amplidyne Gen-

erator MG-16-A, is normally placed on the floor of the operating room. Cylinders of nitrogen, for keeping moisture from the antenna feed line, are also located in the operating room (fig. 11).

4. Various switches for transferring the set from commercial or fortification power to emergency gasoline-electric generators, together with the main power switch and fuse boxes, are located conveniently near the set. (See fig. 11.)

5. Two 25-kw gasoline-electric generator sets PE-84-C are supplied with each set for emergency operation. They are normally housed in two prefabricated buildings separated from each other and from the set to minimize damage from bombs or shell fire. Two 1,000-gallon gasoline tanks are buried in the close vicinity of the power units.

MAINTENANCE. Radar equipment, while reliable when properly maintained, is so complicated and relatively fragile in the hands of inexperienced personnel that only qualified maintenance men should be permitted to make other than minor adjustments. In addition, in the SCR-296-A, lethal voltages are present throughout the set and only thoroughly experienced maintenance men can be trusted to work on the interior of the units.

ADJUSTMENT. The maintenance personnel assigned to the set will normally tune and adjust the set for highest efficiency twice daily. They are also charged with keeping a log on maintenance and making complete periodic checks on all components of the set. The maintenance sergeant may delegate certain duties of the daily adjustment to trusted members of the operating personnel, and the following brief summary of the adjustment routine is therefore given here. These adjustments should not be made except under the supervision of the maintenance personnel.

For the location of the controls and meters listed, see figures previously referred to, particularly figure 11. Designations used on the name plates of controls and meters are capitalized.

Turn to ON the wall switches which select the proper power source. These supply 115-volt AC power to the set, and the drying heaters in the units are now ON. The following operations, with their results, are then accomplished.

CABINET BE-82-A

Control	*Result or Adjustment*
RADIO SET switch ON	Transmitter blower and external blower operate. Heaters are off. Pilot light above switch is on.
LOAD control	Adjust this control for LOAD VOLTAGE of 115 volts. This voltage will drop slightly in the first minute or two and must be again adjusted to 115 volts.
MOD GEN switch ON	About one minute after switch is operated, modulation generator PLATE CURRENT rises from 125 to 200 milliamperes, PLATE VOLTAGE drops to about 550 volts, and the modulation frequency tone is audible at the ventilation louvres in the cabinet.
TRANS switch ON	This supplies power to the transmitter filament, heater circuits, and transmitting tube field supply.
MAG FIL switch ON	This supplies power to the filament of the transmitting tube. The filament voltage appears on a meter seen through the window in the transmitter cabinet and is adjusted to 13.5 volts by means of the MAG-FIL adjustment on the Control Panel BD-108-A.
INDIC EQUIPMENT switch ON	This supplies power to the indicating equipment. Meter on regulated rectifier should indicate 250 volts with TEST

Control	*Result or Adjustment*
	METER switch in VOLTS position. All pilot lamps and dial lights on indicator equipment should be illuminated. After a short warm-up period, sweeps should appear on both azimuth and range oscilloscopes. The azimuth sweeps will not be normal unless the LOBING switch is ON. (See below.)
MONITOR switch OFF	This switch is kept off except when checking transmitter frequency.
PLATE switch ON	This supplies power to the high voltage rectifier. (The TRANSMITTER switch on the range oscilloscope must also be ON. The pilot light above the PLATE SWITCH is now illuminated.)
PLATE control	One minute after PLATE is switched ON, turn control *counterclockwise* to the stop. The relay in the power control panel should operate. Turn control *clockwise* to stop or until PLATE VOLTAGE is 12,000 volts. Watch PLATE CURRENT meter carefully. The PLATE CURRENT MUST NOT EXCEED 34MA. The current will normally be between 25 and 30 milliamperes.
FIELD CONTROL	Adjust for PLATE CURRENT of 25 to 30 milliamperes.

Control	*Result or Adjustment*
RECEIVER switch ON	This supplies power to the radio receiver. The meter in the receiver should indicate about 12.5 milliamperes when the tubes have warmed up. Noise should appear on the oscilloscopes with the RECEIVER SENSITIVITY control near maximum.
REMOTE-LOCAL switch	With switch in LOCAL position, the receiver gain is controlled by the SENSITIVITY control on the receiver. In the REMOTE position, receiver gain is controlled by the RECEIVER SENSITIVITY control on the range oscilloscope. Both controls should be checked for appearance of noise on the oscilloscope.
Indicating Equipment	
VOLTAGE ADJ control	With TEST METER switch in VOLTS position, adjust this control for voltage of 250 volts. The *lower* of the two voltage scales on the meter is used.
FOCUS and INTENSITY controls	Adjust these controls for clear, sharp traces on the screens of both oscilloscopes.
HOR and VERT controls	Adjust these controls until the sweeps of both oscilloscopes are centered horizontally and are set somewhat below the center of the screens.
SWEEP GAIN control	Adjust this control so that the sweep line is about four inches long.

Control	*Result or Adjustment*
IMAGE SPREAD control	Adjust this control for expansion of marker notch on the sweep line as desired.
RECEIVER SENSITIVITY control...	Adjust this control for amplitude of signals on the range oscilloscope. When tracking, the amplitude of the signal in the notch determines the proper control setting.
TRANSMITTER switch ON	This turns on the high voltage supplies for the transmitter. Both the PLATE switch on the Power Control Panel BD-108-A and the TRANSMITTER switch must be ON for plate power.
CONTROL switch ON	This switch supplies power to the antenna traversing circuits. After a warm-up period of about a minute, operation of the RATE control and the MANUAL azimuth control should be checked by rotating individually in both directions. If the system is operating properly, the azimuth dials will so indicate.
LOBING switch ON	Power is supplied to lobe-switching motor on the antenna. With RECEIVER SENSITIVITY control at maximum or with echoes in the notch of the range oscilloscope, operation of the IMAGE SPACER control should show two pips, movable with respect to each other, on the azimuth oscilloscope.

Control	*Result or Adjustment*
RANGE control	The operation of this control moves the echoes along the base line on the range oscilloscope, permitting the placing of the desired echo in the notch.
ZERO ADJ clutch	This clutch is loosened while the range dials are being set to the known range of an orienting target centered in the notch.
SWEEP EXPANSION control	Adjust this control for the desired length of sweep on the azimuth oscilloscope.
IMAGE SPACER control	Adjust this control for the desired spacing of the two pips on the azimuth oscilloscope.
ZERO ADJ control	There is a mechanical centering adjustment screw on the meter of the INDICATOR I-110-A by means of which the meter needle must be set at the center index prior to making the ZERO ADJUSTMENT. Adjust the ZERO ADJ control to bring the needle to the center index. While this adjustment is made, the receiver SENSITIVITY control is turned to minimum.

ORIENTATION—GENERAL. In addition to the adjustments and operations given, the operating personnel assisted, if desired, by the maintenance personnel, will normally check orientation and slewing of the antenna. The slewing of the antenna is checked by placing an echo in the notch of the range oscilloscope, as explained later, and observing the height of the resulting two pips on the azimuth oscillo-

scope. If the relative heights of these pips change smoothly when the MANUAL azimuth control is rotated smoothly in either direction, the antenna slewing is satisfactory.

To check range and azimuth orientation, a target at known range and azimuth from the set is brought onto both oscilloscopes. With the echo centered in the notch and the pip heights equal, the range and azimuth readings on the dials should be those of the known target. If they are not correct, the maintenance personnel will adjust them. With this same adjustment, the AZIMUTH INDICATOR should be checked for proper operation. The needle on the azimuth meter usually fluctuates continually. The mean position of the needle is determined by observation.

ORIENTATION IN RANGE. *On target of known range.* Within the range of most SCR-296-A sets there will be several reflecting objects whose ranges either are known or may easily be determined by survey. In case there are none, a vessel may be used for the purpose, its range being calculated from optically obtained data.

The modulation (audio) frequency is checked and set accurately, as outlined under CALIBRATION IN RANGE. The echo from the target of known range is centered in the marker notch by operation of the range handwheel. If the range indicated by the range dials does not correspond to the actual range, the ZERO ADJ clutch is loosened, disconnecting the range dials from the range unit. The handwheel is rotated until the dials indicate the true range, and the ZERO ADJ clutch is tightened. The set is now oriented in range.

On the transmitted pulse. Range orientation may occasionally be required when there is no target of known range available or when it is considered desirable for purposes of security that the set should be silent in certain sectors. Under these conditions, the antenna may be traversed until the transmitted energy is emitted in non-critical direction. The RECEIVER SENSITIVITY is reduced until the main pulse, which is the only echo appearing on the oscilloscope with RECEIVER SENSITIVITY near minimum, is sufficiently narrow to be contained in the notch. The handwheel is rotated until this echo is centered in the notch. The ZERO ADJ clutch is loosened, the range dials are set to indicate the "range" of the main pulse, and the clutch is tightened. This "range" varies slightly with different sets and is determined as follows. After orientation in range on a target of known range, the main pulse is centered in the notch. The "range," which may be either positive or negative, is

read from the dials. This method may be used only when the set has on some previous occasion been oriented on a target other than the main pulse. It is of great value for checking the range orientation under the conditions described.

ORIENTATION IN AZIMUTH. *Azimuth Oscilloscope.* For orientation in azimuth, an isolated target at known azimuth is necessary. The range to the target must be sufficiently great that the main pulse does not appear in the notch, and the target must be at such azimuth and range that no echo other than that from the orienting target appears in the notch on the range oscilloscope. If no fixed target of known azimuth from the set is available, a vessel whose azimuth is determined by triangulation or by direct optical observation from the antenna may be used. The orienting echo is centered in the range notch, and the pip heights on the azimuth oscilloscope are equalized by means of the traversing handwheel. If the azimuth indicated on the azimuth dials is not the true azimuth, the cover on the Control Unit RM-36-A is removed and the safety switch is held in by suitable means. The three clamp screws holding the two azimuth receiver Selsyns are loosened, the Selsyns are rotated until the azimuth dials indicate the true azimuth of the target, and the clamp screws are tightened. This operation must be performed carefully to avoid damaging the dials. With the antenna still directed exactly at the target, the azimuth ring on the antenna pedestal is loosened and rotated until the antenna pointer indicates the true target azimuth on the azimuth ring. The ring is then tightened. One setting of this ring will usually be sufficient.

With the azimuth ring set as outlined, azimuth orientation checks may be made by comparing the readings on the azimuth dials with the reading on the azimuth ring. This check should not be considered other than approximate, and owing to the relative inaccessibility of the antenna would rarely be made except under unusual conditions. Azimuth orientation checks should be made whenever possible on targets of known azimuth.

Azimuth Indicator. With the antenna pointed at a target by means of the azimuth oscilloscope, the meter reading fluctuates equally on both sides of the zero index if the ZERO ADJUSTMENT has been made correctly.

CALIBRATION IN RANGE. For accuracy of range determination by the SCR-296-A, it is necessary that the frequency of the voltage generated by the modulation generator be fixed. The Calibrator

BC-726-A (fig. 12) supplies a voltage within ± 0.25 cycle of the frequency required in the set for accurate determination of range. It is important that the frequency generated in the modulation generator be compared at frequent intervals with the standard frequency obtained from the calibrator. To accomplish this, the OUTPUT jack on the calibrator is connected to the right-hand (or horizontal) input terminals of the Cathode Ray Oscillograph RCA-155-A (shown in fig. 13), and the AUDIO jack in the modulation generator is connected to the left-hand (or vertical) input terminals of the oscillograph. If the modulation frequency is correct, an ellipse that rotates no faster than once in five seconds appears on the oscillograph.

The maintenance personnel will adjust both the oscillograph and the modulation generator and instruct the operating personnel in the technique of checking the modulation frequency. This check should be made hourly or whenever range orientation is lost.

ERRORS. The SCR-296-A is subject to certain limitations by both its design and its location peculiarities, such as the terrain surrounding the set. Every effort should be made to determine the errors rising from these limitations as accurately as possible, so that appropriate corrections may be made to orientation and fire control data. These errors and their determination are discussed below.

Range unit. Due to the tolerances that must be allowed in the manufacture of mechanical parts, each range unit will introduce errors in range which vary sinusoidally as a function of range; in other words, these errors will vary in a regular fashion and will be repeated at regular intervals as the range is increased from the minimum to the maximum. The maximum error so introduced will be confined to limits varying from about ± 15 yards to about ± 50 yards or more, depending upon the particular range unit in use at the time. The value of this error for each of the two range units furnished with the SCR-296-A should be determined for all ranges. This may be done by tracking a target simultaneously with the radar set and with the two observing instruments of a horizontal base visual system, plotting corresponding points on a plotting board, and measuring the range differences using the SCR station arm on the board. Range error should then be plotted as ordinates against range as abscissae. A mean line drawn through this curve will represent the errors not due to the range unit, such as orientation error. By subtracting the mean error from the individual range errors, data for a calibration curve for the range unit will be ob-

tained. The calibration curve will be identical with the error curve plotted first but will be displaced vertically by the amount of the mean error.

Audio frequency. If the audio frequency is not maintained at the proper value, error will be introduced in the measurement of range. This error will increase in direct proportion to the range to the target. Since this error is variable with changes in frequency, it is impracticable to correct it by calibration. Therefore this error should be avoided by maintaining the audio frequency constant at all times at the proper value, using the Calibrator BC-726-A.

Azimuth error. Large reflecting objects in or close to the beam of the antenna may cause a deflection of the beam, resulting in erroneous azimuth readings in portions of the field of search. These errors may be sufficiently large to warrant the application of corrections to the radar azimuth data. Whether such obstacles are known to be present or not, exhaustive tests should be made over the whole azimuth field of the set and at various ranges throughout the field. The data for this determination are obtained as previously explained in the determination of the error of the range unit. From plots of simultaneous radar and horizontal base visual observations, the azimuth difference for each observation is determined. Since the horizontal base system is the most accurate means of azimuth determination available, the azimuths obtained by relocation from these observations must be assumed as the true azimuths from the SCR-296-A position. The difference between these and the radar readings then will be the SCR-296-A azimuth errors. These errors should be plotted as ordinates against azimuth abscissae. If a large number of such determinations establishes the existence of an azimuth error in any part of the field of search, a calibration curve should be plotted and corrections should be applied to the azimuths read on the SCR-296-A.

Orientation. After range and azimuth errors have been determined in accordance with the methods described above, proper correction must be applied to the geographical range and azimuth of reflecting objects used as orienting points for the SCR-296-A before the dials are reset during the orientation process.

General. In case azimuth errors in a particular sector are so large as to make application of corrections difficult, consideration should be given to the use of the SCR-296-A of another battery, when it is required to track targets in this sector.

OPERATION. *Operating Personnel.* The operating personnel for the SCR-296-A normally consists of five men per section, as follows:

1. Chief of section.
2. Range operator.
3. Range reader.
4. Azimuth operator.
5. Azimuth reader.

In addition, when the gasoline-electric power plants are in use, a power plant operator must be included in the section.

Each section will normally operate 8 hours of the 24. Since the SCR-296-A normally is not used for surveillance, it will be in operation only part of the time. It is believed that two reliefs should be able to operate the set in a satisfactory manner. To relieve eye fatigue, the range and azimuth operators should exchange duties with the range and azimuth readers every half-hour.

Assignment of target. The following tactical method is to be considered only as a recommended outline of procedure. Seacoast fire control by radar sets is of too recent origin for rigorous rules, and experimentation is to be encouraged. It must be remembered that the SCR-296-A can usually "see" only one target at a time and, in contrast to an optical fire control system with good visibility, is virtually "blind" to the situation as a whole. Under conditions of good visibility, an enemy formation of several ships is resolved easily into single ships by optical methods, but radar fire control sets will not be used under such conditions except for the determination of accurate range. Since the radar set is normally used under conditions of poor visibility, it will be the rule that the make-up of the targets tracked at normal ranges by the SCR-296-A will be obscure.

While some information as to the enemy formations may be obtained through the Navy, Air Force, or other radar sets, the SCR-582 surveillance set may be considered the main radar source of detecting the enemy. Close formations cannot be resolved by this set, particularly at long ranges, and for this reason a single ship of the formation cannot be selected for attack.

The SCR-296-A is capable of much greater resolution than the SCR-582, and it will be desirable, at least in some cases, that one of the SCR-296-A sets available, after being directed to the target by the SCR-582, resolve the formation into its component units. Such resolution involves plotting the position of each unit, a slow process.

Consequently it is desirable that full use of other radar sets in the vicinity be made and that liaison and coordination between the intelligence facilities be developed to the fullest extent. When an SCR-296-A is used for this purpose, it should be connected by telephone directly to the HDCP.

The technique outlined in the preceding paragraph may invite "jamming," or radar interference, by the enemy, because he may be able to detect the presence of the set before guns are fired. Its use, therefore, will depend upon the situation and upon the history of enemy countermeasures.

The radar intelligence net. The approximate present position data for a battery target normally comes from the SCR-582 through the intelligence net.

Figure 14 shows in block diagram form the communication lines necessary for the assignment of the target and adjustment of fire by radar. It is to be noted that when visibility is poor, the SCR-582 is the only effective means of observation in the HDCP and that the SCR-296-A furnishes present position data not obtainable from base-end stations or single station optical position finders.

The operating crew of the SCR-582 consists of a chief of section and an operator. The operator observes the oscilloscope of the set and reads the range and azimuth of any targets indicated thereon. The chief of section may plot the positions of the targets on an overlay over a map upon which is superimposed the local Joint Army-Navy Grid. He reports the positions of the targets to the operations room of the harbor defense command post in terms of their grid coordinates. Alternatively, the operator telephones the azimuth-range data to the HDCP, where it is plotted on a map-square overlay. In this case, it is desirable that the data be also plotted at the SCR-582 to aid in identification of targets. Frequent plotting is necessary for continuous identification of targets. Targets will normally be given serial numbers or letters to aid identification.

From the HDCP the present position of the selected target in terms of map squares is transmitted in the usual manner through intermediate headquarters to the battery command post, where it is converted to the azimuth and range of the target from the SCR-296-A assigned to the battery.

The battery CP telephones to the chief of section of the SCR-296-A a command: TARGET, AZIMUTH 230 DEGREES; RANGE, 28,000

YARDS. TRACK. These data should also be given to the range officer by connecting his telephone in parallel with that to the SCR-296-A.

Operation of set. It is presumed that the battery has been alerted well before the assignment of target. After the alert, all adjustments outlined under ADJUSTMENT will have been made, and all switches are ON except the TRANSMITTER switch.

At the command giving the present position of the target, the chief of section of the SCR-296-A records the data and repeats them to the operators of the set. The range operator snaps the TRANSMITTER switch to ON, putting the set on the air. The azimuth and range readers repeat the azimuth and range data received from the chief of section and order, respectively, "Traverse right (left)" and "Increase (decrease) range."

At the azimuth reader's command, TRAVERSE RIGHT (LEFT), the azimuth operator turns the azimuth handwheel rapidly until the azimuth given him appears on the azimuth dials. At the same time the range operator increases (decreases) range until his dials indicate the range given the reader. In both cases, the readers indicate orally to the operators the appearance of the assigned azimuth and range by calling "Steady." Just before the dials reach the required settings, both operators will have seen the target echoes. The range operator adjusts his IMAGE SPREAD control until the notch is about 3/16 inch wide and centers the echo in the notch, reporting "On target" to the azimuth operator and to the range reader. He sets the pip height at about one inch with the RECEIVER SENSITIVITY control, continually adjusting it to this height. The azimuth operator adjusts his SWEEP EXPANSION and IMAGE SPACER controls until the two pips appearing on his oscilloscope are separated and are of the proper width to suit his taste. By rotation of the MANUAL azimuth handwheel, he equalizes the heights of the two pips and reports "On target." Both operators track until ordered otherwise.

As stated, when the desired echo is in the notch of the range oscilloscope and when the pip heights on the azimuth oscilloscope are matched, the report, "On target," is made by both operators. These reports are transmitted to the plotting room over the reader's telephones and to the battery CP by the chief of section in the same manner as when optical observation is used. In placing the set on the target, the range and azimuth readers check the range and azimuth as received from the SCR-582 through the battery against

the settings on their dials. Normally, the data from the SCR-582 are sufficiently accurate enough to require very little searching at the SCR-296-A.

Tracking. In tracking, the range operator keeps the echo accurately centered in the notch on the range oscilloscope, and the azimuth operator keeps the pips on his oscilloscope of equal height using either the MANUAL or RATE control, tracking as smoothly as possible. The range operator keeps the echo in the notch of the proper amplitude by varying the RECEIVER SENSITIVITY control. This amplitude must be constantly kept between half and maximum amplitude, as the height of the pips on the azimuth oscilloscope is determined by the height of the pip in the range notch.

To equalize the pip heights, the azimuth operator normally turns the top of his handwheel toward the larger pip or, if he is using the azimuth RATE control, turns this control in the same direction. The choice of which azimuth control to use depends upon the preference and skill of the azimuth operator and upon the angular rate of the target. On time-interval signals, the azimuth and range readers transmit the present position data on their dials directly by telephone to the azimuth and range setters, respectively, at the plotting board. To be certain that the assigned target is being tracked, the range officer should check the first data received from the set against the data originally given the chief of section for the target. At the time-interval signal, tracking normally is not interrupted while the reading is made. The azimuth dials are so constructed that the reader can report the data without such interruption in tracking. Tracking is continued until the target is lost or until "Cease tracking" is ordered. At the command, CEASE TRACKING, it is necessary only to place the TRANSMITTER switch in the OFF position. The set is then ready for instant action. When a computer is being used, the tracking operation is the same as on the TI bell, aided tracking is to be available, and tracking can be sufficiently smooth for use in the computer. When aided tracking attachments are provided, special instructions for their use will be furnished.

The chief of section verifies the target, supervises the tracking, and checks the operation of the equipment. It is also desirable that a map-square plot be made at the set in order to facilitate relocation of lost targets. In case fixed objects or other vessels confuse the indicator displays, the chief of section will obtain, through channels or by direct telephone connection, fresh data for resetting from the SCR-582. In view of the fact that the SCR-296-A has no general

view of the situation, and that data transmitted through channels are relatively slow, it appears desirable that direct telephone communication be available between the SCR-582 and the SCR-296-A.

In the center of the RANGE control on the range unit is a push button switch that may be used to operate the "call" bell for the telephone communication.

When the field of operation is free from interfering targets, the azimuth operator may prefer to use the azimuth indicator rather than the oscilloscope. When the needle is to the left of the zero index, the azimuth handwheel is rotated clockwise until the needle is at zero and counterclockwise when the needle is to the right.

Interference. It will happen occasionally that when a target is being tracked, another vessel will appear in the field view of the equipment.

If this vessel appears on a course from the flank at very nearly the same range as the target neither operator will detect it, but the set will track a spot between the target and the object. It is one function of the intelligence net that warning of imminent interference, which is normally detectable at the SCR-582, be sent to the battery.

In general, the interfering vessel will not be at the same range as the target and its approach will be seen by the range operator, who will report its approach, and report "Interference" when the interfering echo drops into the notch. With both the target and the interfering echo in the notch, the azimuth operator should increase his SWEEP EXPANSION and track the target until he can no longer distinguish between the target and the interference. He will then report "Interference" and, disregarding his pips, will try to maintain the tracking rate obtaining before the appearance of the interfering vessel. When the pips again separate, the azimuth operator will report "Clear" and resume tracking by the pips. During the period of interference, the azimuth indicator cannot be used as the data are inaccurate. In both of the cases described, the plotting room and battery CP are informed, and the SCR-582 will normally be asked to check the position of the target after accurate tracking is resumed. When the SCR-296-A is equipped with range and azimuth aided tracking attachments, it frequently will be possible to track through interference by leaving the aided tracking controls fixed in the positions set just prior to encountering the interference. The mechanism will maintain the

range and azimuth tracking rates constant until the settings of the controls are changed.

Out of operation. To shut down the set, it is necessary merely to set the main switch to the HEATER STAND-BY position and the CONTROL switch on the control unit to OFF, whereupon all power except that to the heaters is removed. The PLATE VOLTAGE cannot again be applied until the PLATE control is turned counterclockwise to the stop.

ADJUSTMENT OF FIRE. Owing to lack of data on the subject, no rigorous rules regarding the spotting of fall of shots may be made.

In general, the operators of the SCR-296-A of the firing battery can estimate overs and shorts with reasonable accuracy and can sense lateral deviations provided the fall of shot is more than 100 to 200 yards in range from the target.

Sets not engaged in target tracking can be used in spotting. For most effective spotting on the fire of a single battery, each salvo after the first should be fired only after the radar spotting data are estimated and the correction applied. To this end, it is desirable that all spotting radar sets be connected to the battery plotting room, where a detail plots the fall of shot data reported from each set. The battery may thus estimate the proper corrections. In general, range spotting will be more dependable than spotting in azimuth, and some sets will fail to see some splashes. The personnel in the plotting room will make the most reasonable estimates of the target-impact displacement and apply the proper correction.

The fall of shots will be reported as "Over 300," "Short 600," etc., where the deviations are in yards.

The spotting method given may not be applicable when the fall of shot is within about 100 yards short of or 200 yards over the target, as the splash may not be seen by the set, the echoes from the splashes being obscured by the usually larger target echo.

JAMMING. The enemy may transmit radio signals of such character as to seriously interfere with the operation of the SCR-296-A. For a brief discussion of the effects of and remedies for jamming, Coast Artillery Training Bulletin Vol. 2 No. 2, *Radar Interference*, should be consulted.

THE AUXILIARY POWER SUPPLY. Two 25-kw, gasoline-electric generators are supplied with the SCR-296-A and are used when com-

mercial or post power is not available. Operating instructions are provided with the sets, and the operating and maintenance routine given therein should be followed exactly.

THE DAILY LOG. A daily log of targets tracked, the operating times, the roster of the operating personnel and any other desired data will be kept by the chiefs of section. Each 8-hour period of the log is signed by the chief of section for the period.

For further information on radar and its uses, the following Coast Artillery Training Bulletins should be consulted:

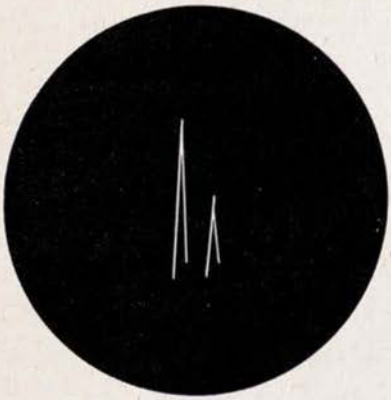
Vol. 1 No. 3 SCR-582: Choice of Site and Installation.

Vol. 2 No. 2 Radar Interference.

Vol. 2 No. 3 SCR-296-A: Choice of Site and Installation.

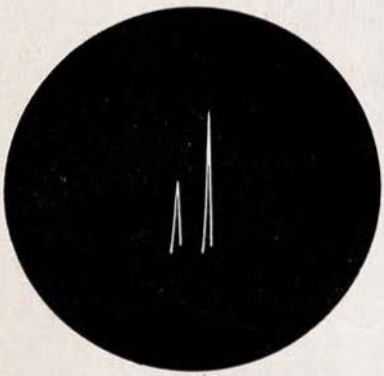
Vol. 2 No. 4 Tactical Use of Radio Sets SCR-582 and SCR-296-A.

Vol. 2 No. 5 General Radar Theory.



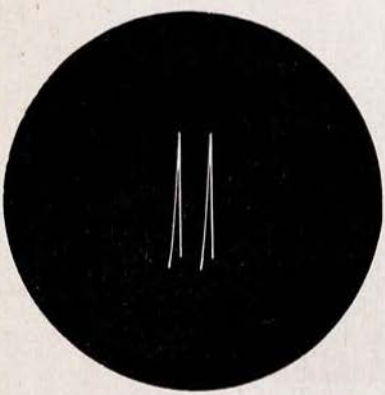
AZIMUTH OSCILLOSCOPE
INDICATES THAT THE
ANTENNA IS DIRECTED
TO THE RIGHT
OF THE TARGET

FIGURE 2a.



AZIMUTH OSCILLOSCOPE
INDICATES THAT THE
ANTENNA IS DIRECTED
TO THE LEFT
OF THE TARGET

FIGURE 2b.



AZIMUTH OSCILLOSCOPE
INDICATES THAT THE
ANTENNA IS DIRECTED
AT THE TARGET

FIGURE 2c.

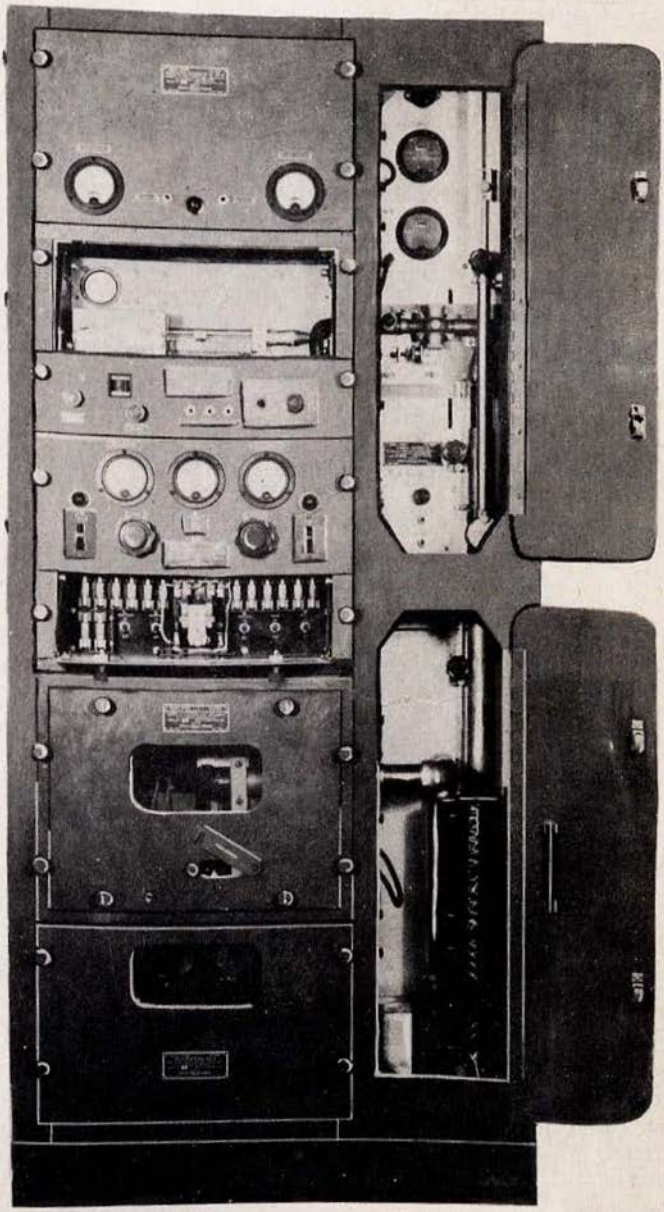


FIGURE 3a.—Cabinet BE-82-A.

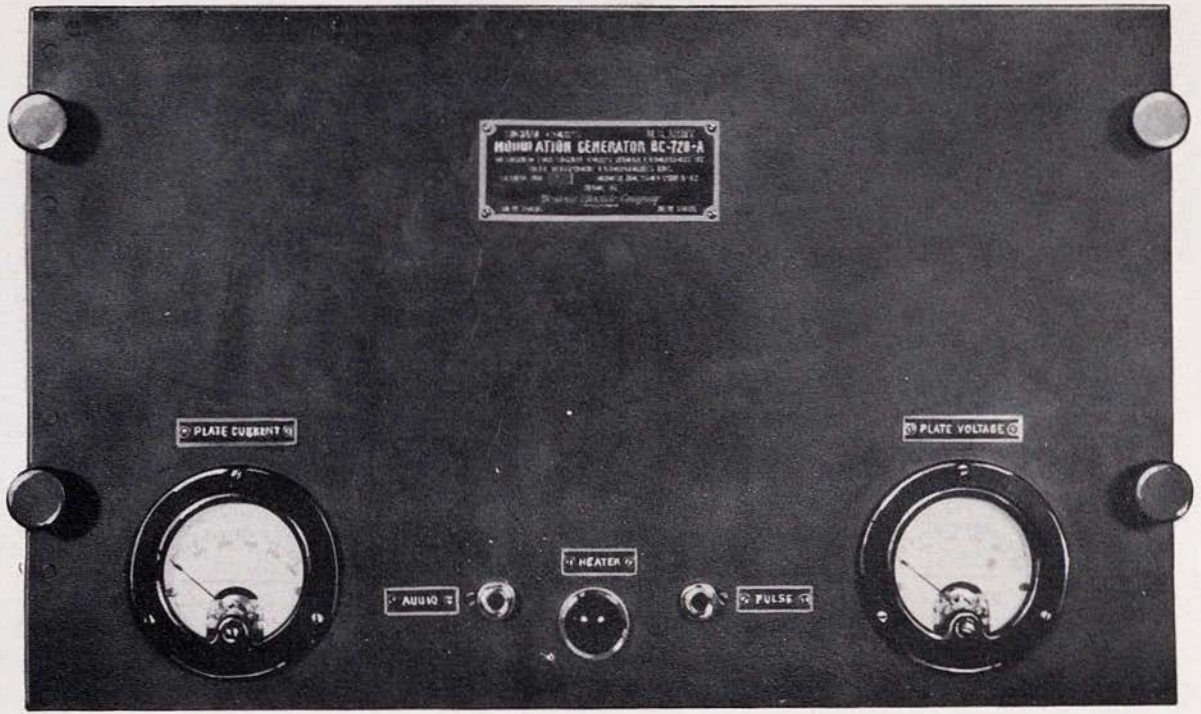


FIGURE 3b.—Modulation Generator BC-720-A.

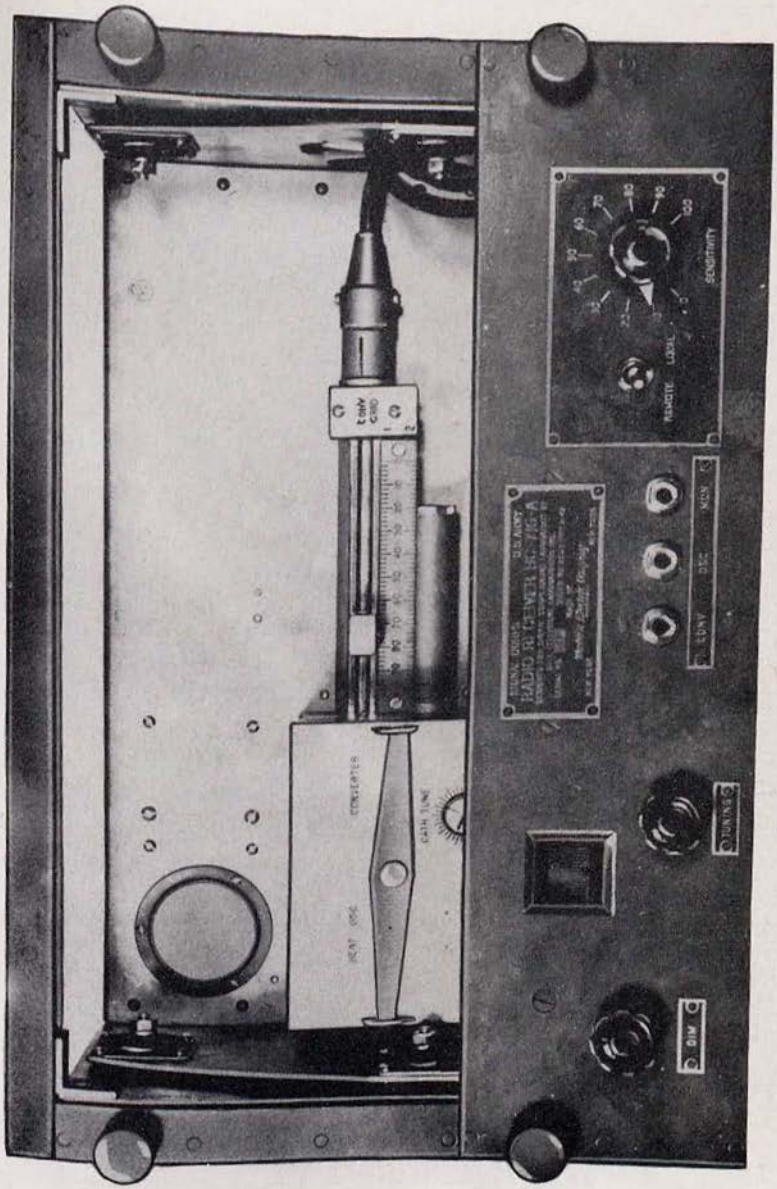


FIGURE 3c.—Radio Receiver BC-716-A.

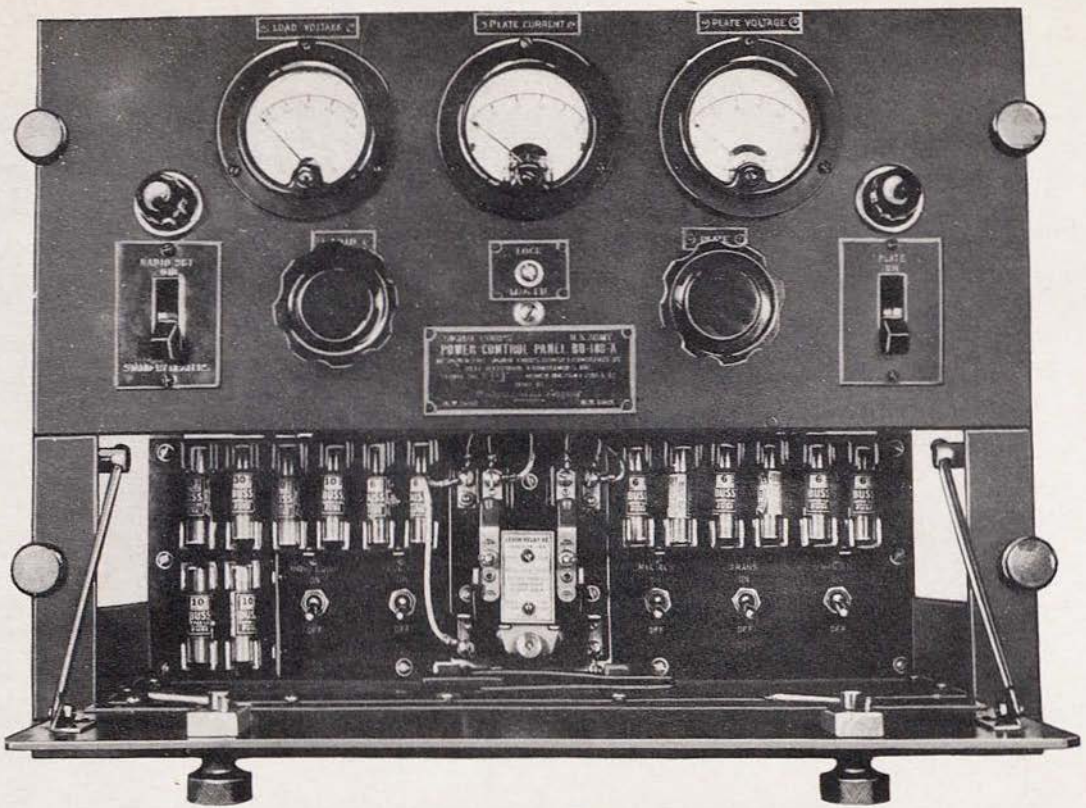


FIGURE 3d.—Power Control Panel BD-108-A.

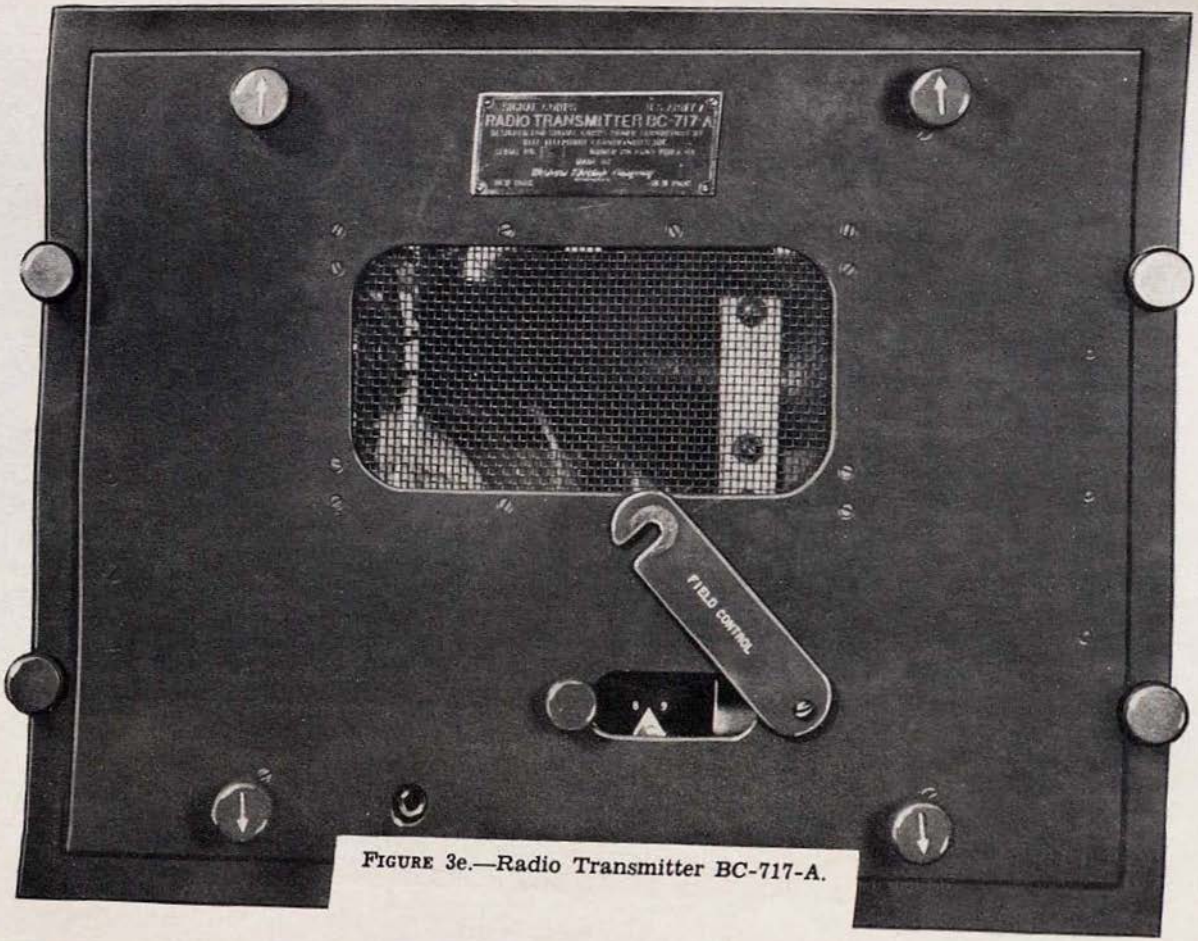


FIGURE 3e.—Radio Transmitter BC-717-A.

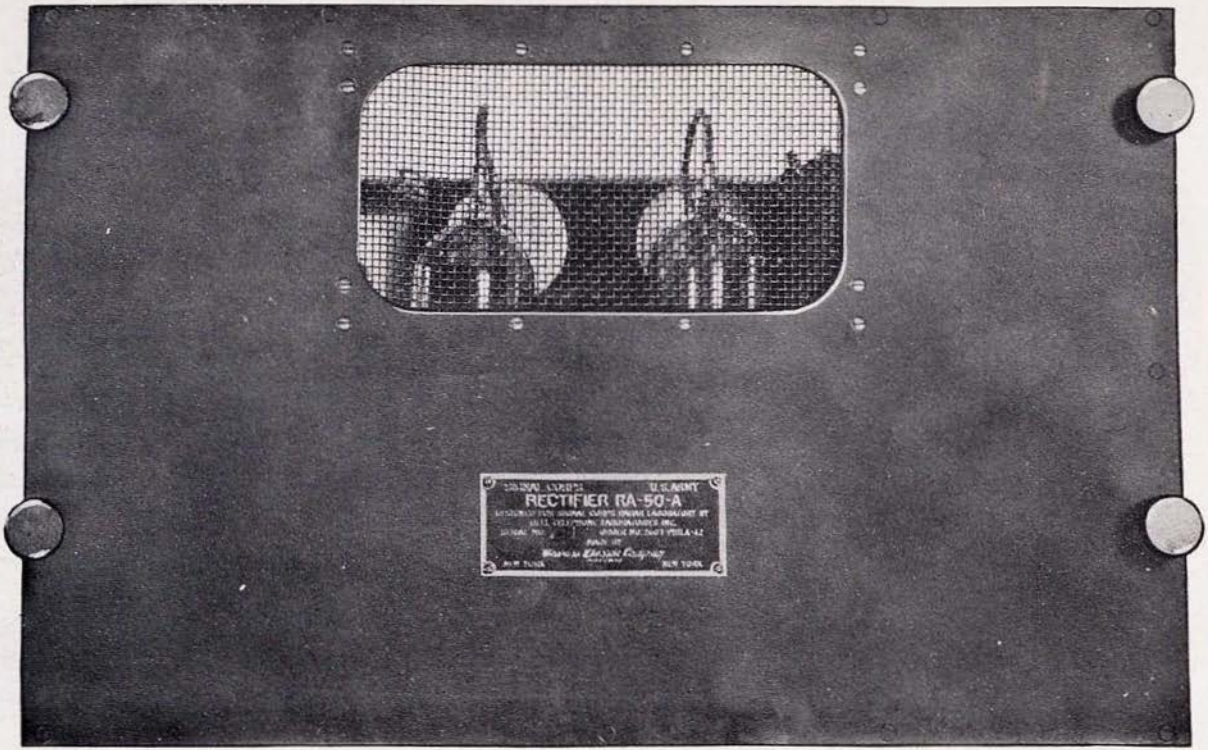


FIGURE 3f.—High Voltage Rectifier RA-50-A.

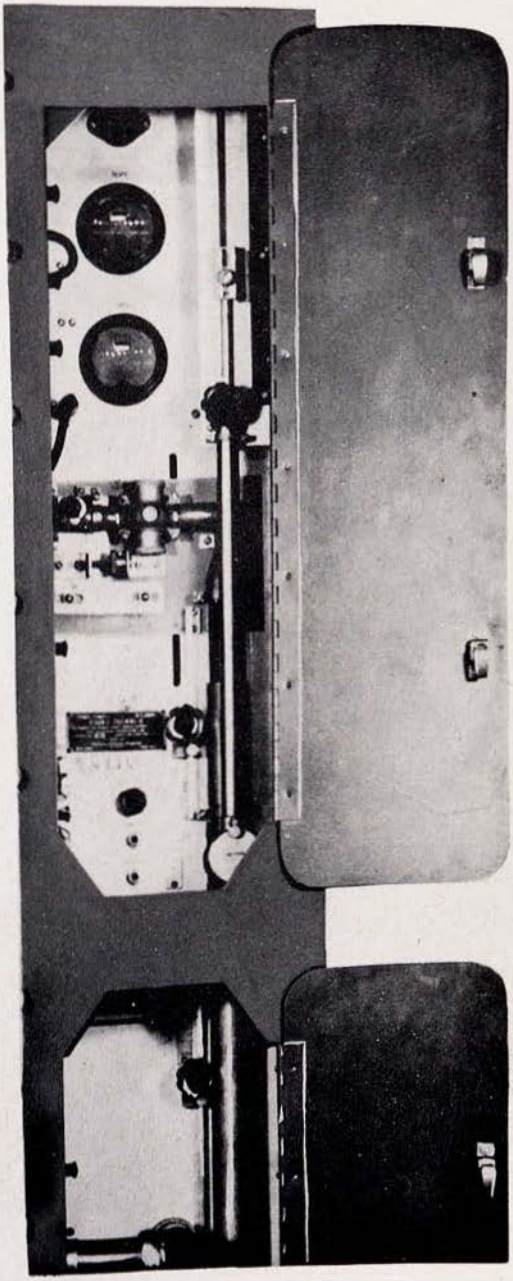


FIGURE 3g.—Duplex Panel BD-106-A.

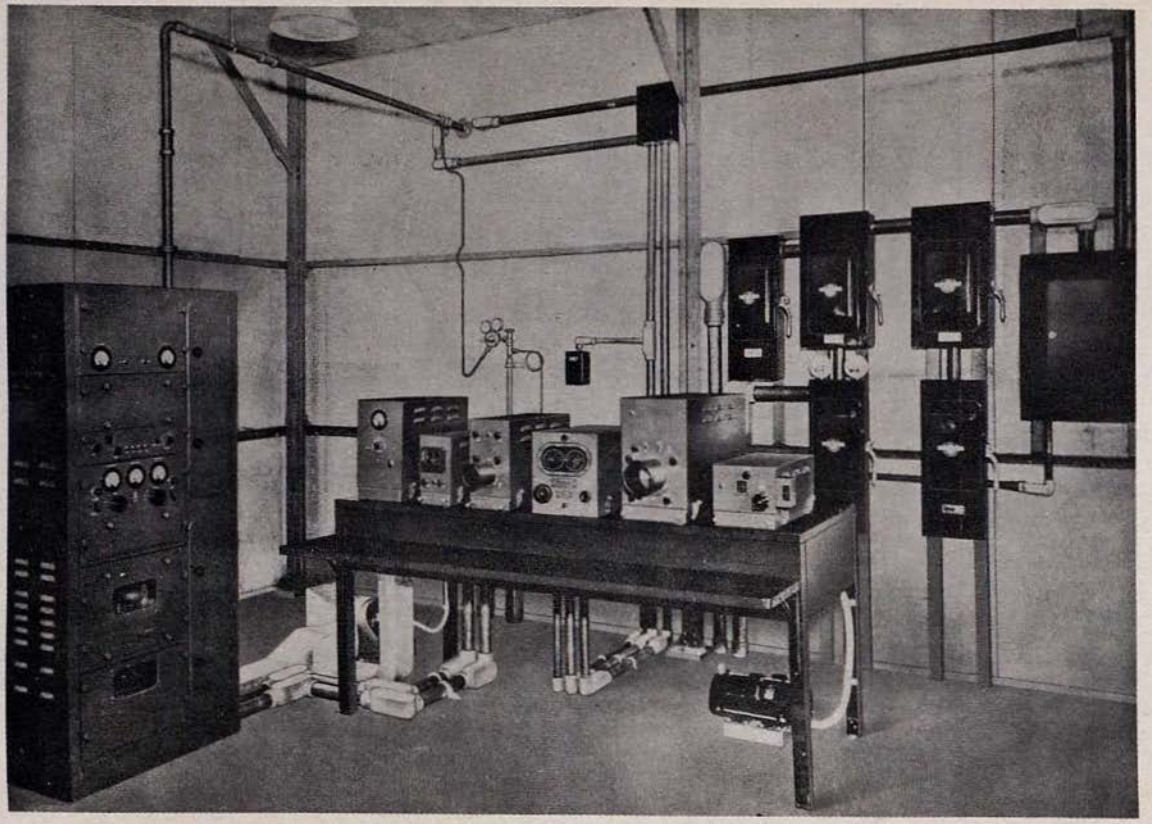


FIGURE 4.—Radar equipment.

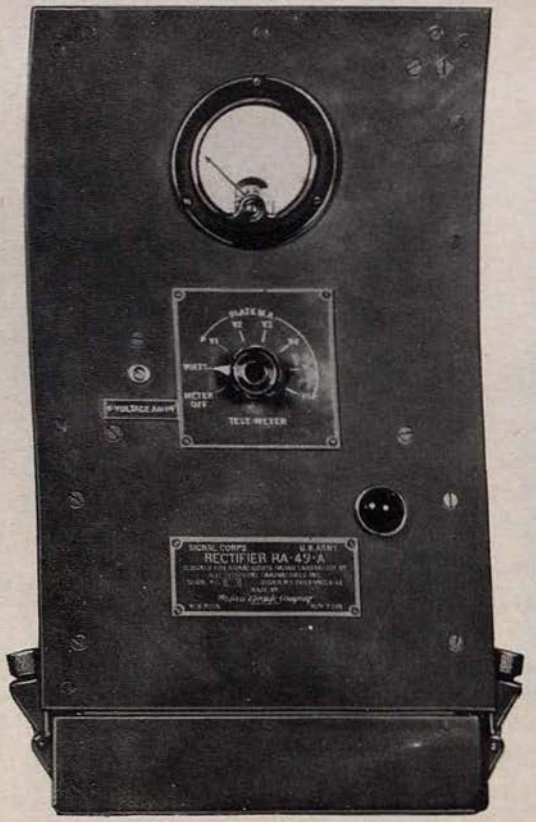


FIGURE 5.—Regulated Rectifier RA-49-A

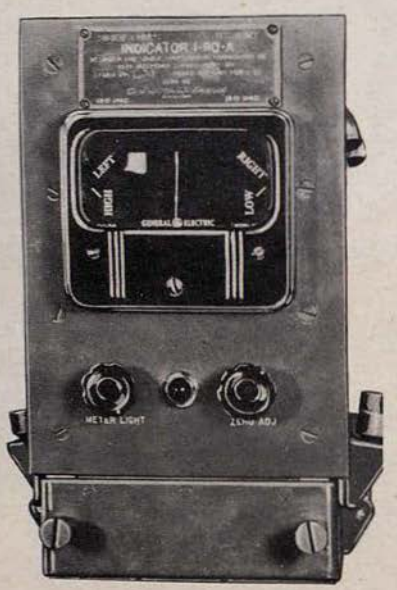


FIGURE 6.—Azimuth Indicator I-110-A.

FIGURE 7.—Azimuth Oscilloscope BC-718-A.

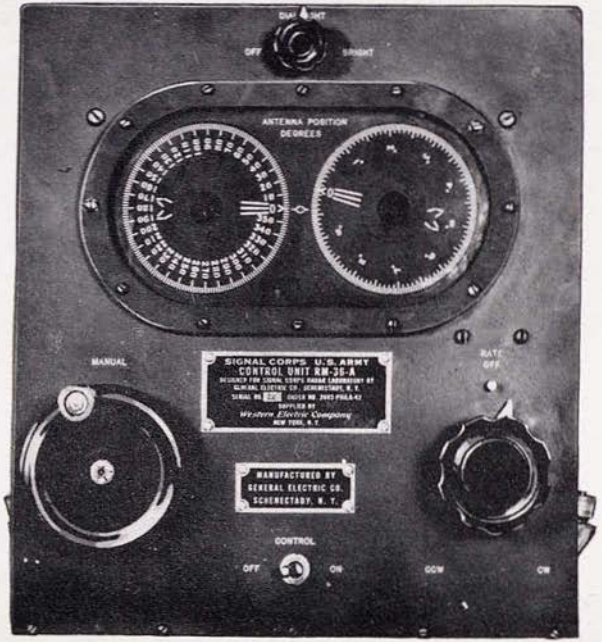


FIGURE 8.—Control Unit RM-36-A.

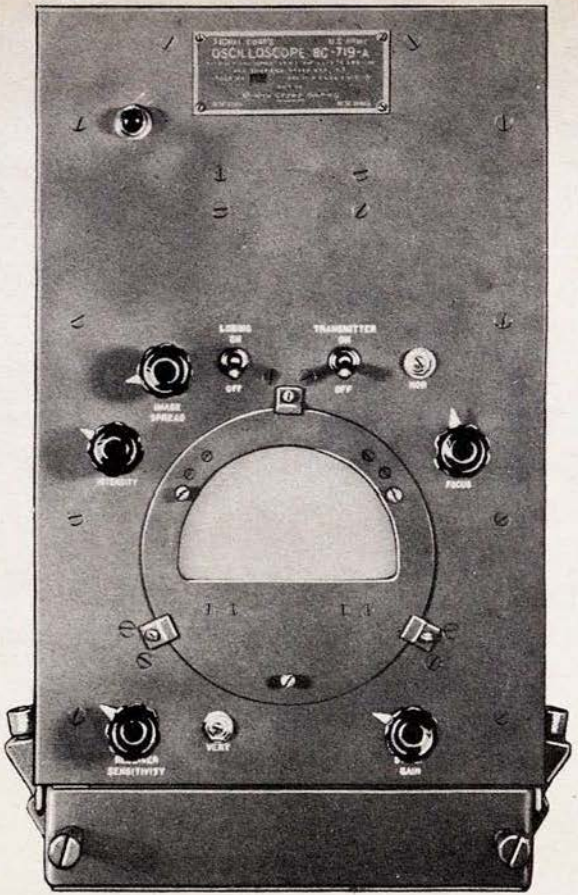


FIGURE 9.—Range Oscilloscope BC-719-A.

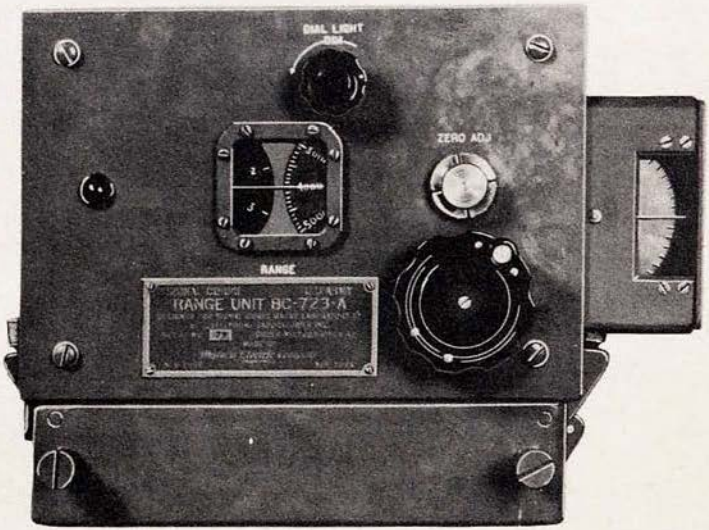


FIGURE 10.—Range Unit BC-723-A.

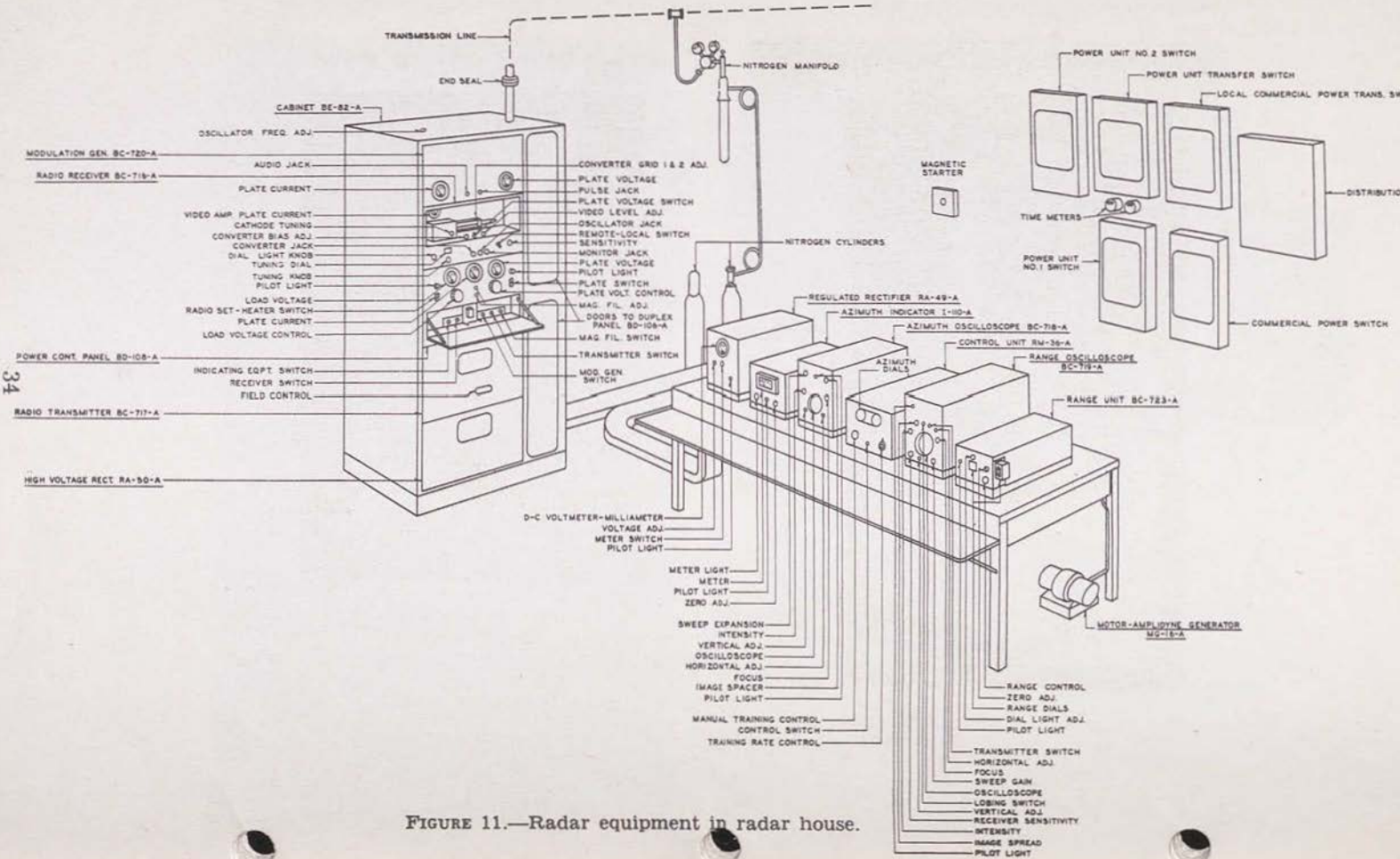


FIGURE 11.—Radar equipment in radar house.

FIGURE 12.—Calibrator BC-726-A.

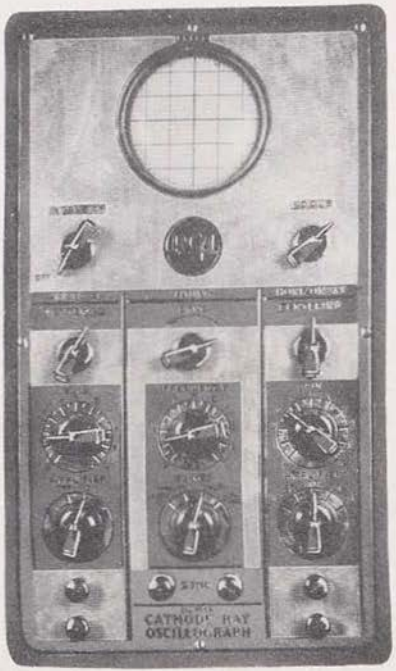


FIGURE 13.—Cathode Ray Oscillograph.

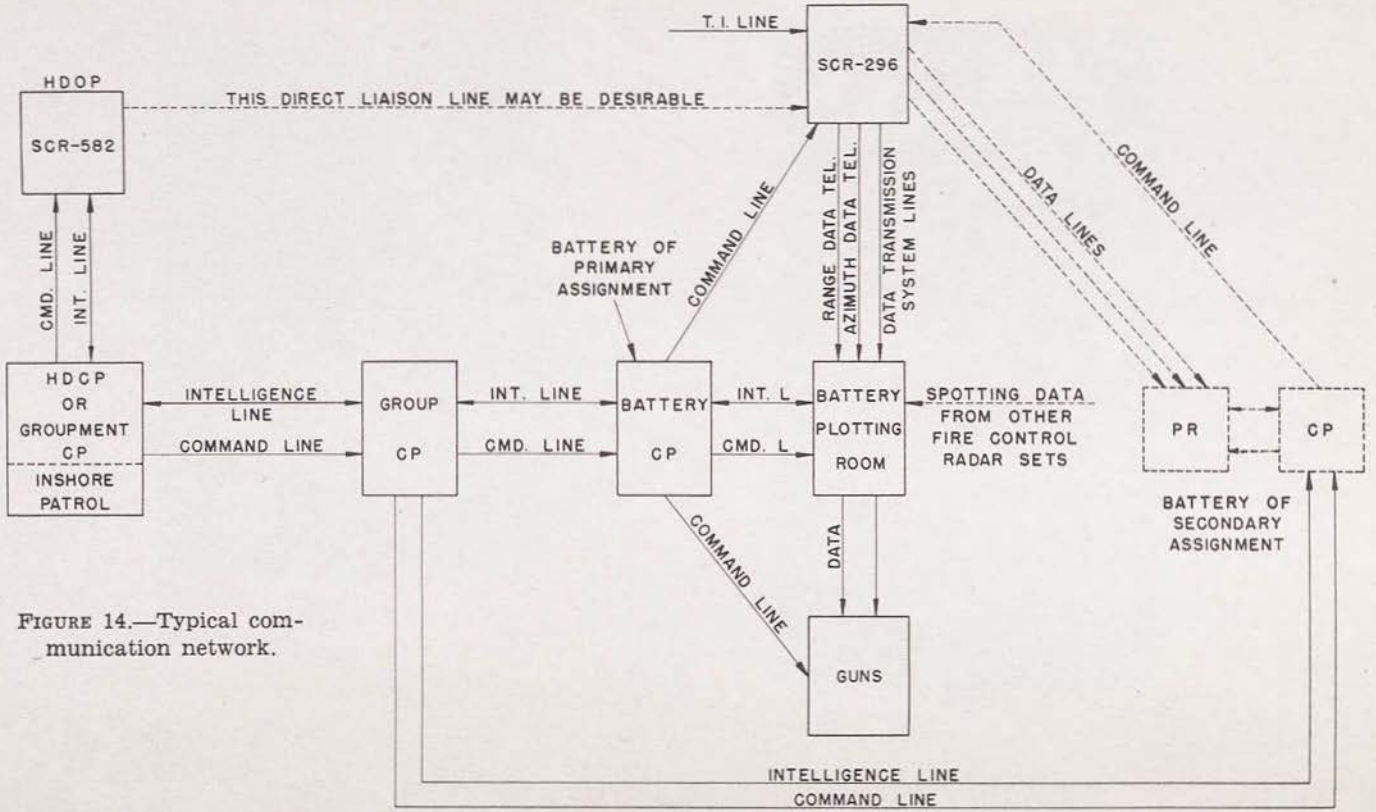


FIGURE 14.—Typical communication network.

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