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:11-254

# TM 11-254

R DEPARTMENT TECHNICAL MANUAL



## RADIO SET SCR-292

(DIRECTION FINDING)



**RESTRICTED. DISSEMINATION OF RESTRICTED MATTER.**  
No person is entitled solely by virtue of his grade or position to knowledge or possession of classified matter. Such matter is entrusted only to those individuals whose official duties require such knowledge or possession. (See also paragraph 23b, AR 380-5, 15 March 1944.)

R DEPARTMENT

• 28 AUGUST 1943



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**WAR DEPARTMENT,**

WASHINGTON 25, D. C., 28 August 1943.

TM 11-254, Radio Set SCR-292 (Direction Finding) is published  
for the information and guidance of all concerned.

[A. G. 300.7 (28 Aug 43).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,  
*Chief of Staff.*

OFFICIAL:

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

**RADIO SET SCR-292**  
**(Direction Finding)**

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## DESTRUCTION NOTICE

**WHY** —To prevent the enemy from using or salvaging this equipment for his benefit.

**WHEN**—When ordered by your commander, or when you are in immediate danger of capture.

**HOW** —1. **Smash**—Use sledges, axes, hand-axes, pick-axes, hammers, crowbars, heavy tools, etc.  
 2. **Cut**—Use axes, hand-axes, machete, etc.  
 3. **Burn**—Use gasoline, kerosene, oil, flame-throwers, incendiary grenades, etc.  
 4. **Explosives**—Use firearms, grenades, TNT, etc.  
 5. **Disposal**—Bury in slit trenches, fox-holes, other holes. Throw in streams. Scatter.  
 6. **USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.**

**WHAT**—1. **Smash**—(from the rear of the equipment) the two radio receivers, the crystal frequency indicator, and the two power units; (at the top of the equipment) the brush holder assembly and the loop drive assembly; (in front of the equipment) the recording mechanism, the panels and the time clock, the power unit in the power unit shelter, and the target transmitter.  
 2. **Cut**—all cords and cables.  
 3. **Bend and/or Break**—the loops, the boom and the vertical antenna.  
 4. **Burn**—the direction finder shelter and the power unit shelter, with all instruction books, diagrams, calibration charts, etc. within the shelter.  
 5. **Bury or scatter**—Any or all of the above pieces after breaking.

**DESTROY EVERYTHING**

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## SAFETY NOTICE

The highest voltage available in this equipment is 300 volts. Such voltages are not usually dangerous to human life but can cause injury to a person coming in contact with them. Be careful when handling the equipment.



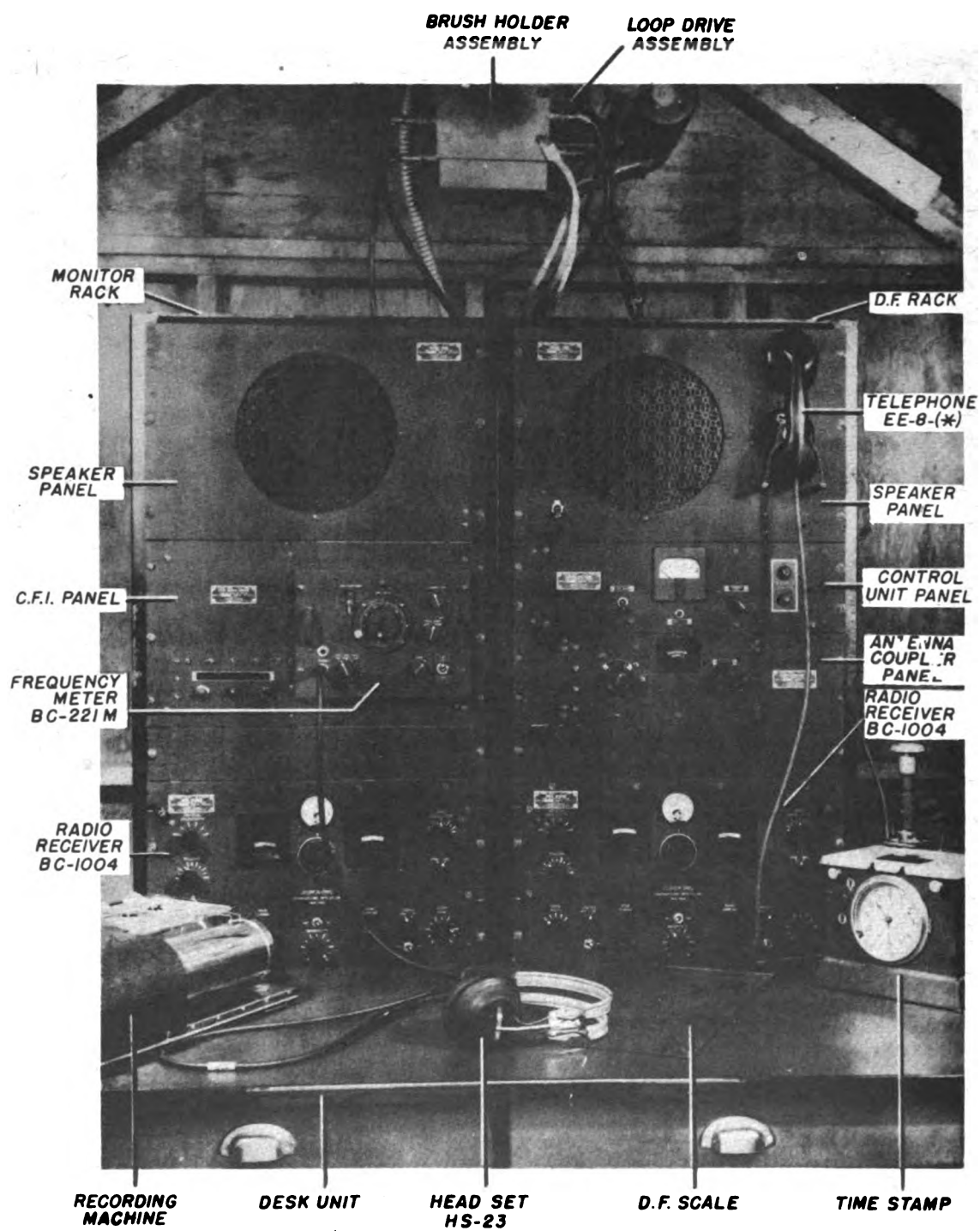


Figure 1—Radio Set SCR-292, Inside D/F Shelter View

Correct nomenclature for Radio Receivers is BC-1004-C

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**SECTION I  
DESCRIPTION**

Use . . . . .	Paragraph
Components, Dimensions and Weights . . . . .	1
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**1. Use.**

Radio Set SCR-292 (Direction Finding) is a semi-fixed ground station direction finder of the spaced-loop type. It is designed for long-range direction finding over the frequency range 2 to 12 megacycles. While the frequency range of the radio receivers is 550 kilocycles to 20 megacycles, its operation as a direction finder is limited by the frequency range of the antenna coupling unit. The power required for operation of Radio Set SCR-292 (approximately 2 kilowatts peak) is supplied by Power Unit PE-95-(\*). The complete equipment weighs approximately 7500 pounds.

The principal components of the radio set are:

- 2 Loops
- 1 Boom
- 1 Gear Box
- 1 Rack Assembly
- 1 Radio Transmitter BC-1149-A, (Target)
- 1 Direction Finder Shelter
- 1 Radial Ground System
- 1 Power Unit PE-95-(\*)
- 1 Power Unit Shelter
- 1 Set Interconnecting Cords
- 1 Tool Chest
- 1 Spare Parts Chest

**2. Components, Dimensions and Weights**

<i>Quan.</i>	<i>Description</i>	<i>Approx. Overall Size (Including Projections)</i>	<i>Approx. Wt. Lbs.</i>
1	Antenna equipment, including: 1 Vertical antenna 2 Loops 1 Boom 1 Top plate with insulator 1 Boom Support plate and hub 1 Rain shield	22' x 5' x 11' 10' x 2" diam. 5' x 5' x 3' 22' x 4" x 4"	200
1	Loop Drive assembly, including: 1 Brush holder assembly 1 Gear box 1 Main drive motor, 1/2 horsepower 1 Synchronizing alternator 1 Slip ring assembly	3' x 3' x 4'	600
1	Power Unit PE-95-(*)	5' x 4' x 4'	1600
1	Direction finder shelter	8' x 8' x 7' (knock-down)	1500
1	Power unit shelter	7' x 6' x 5' (knock-down)	400
2	Relay racks	2' x 1' x 6'	70 ea.
2	Radio Receivers, BC-1004-C	19" x 15 3/4" x 10 1/4"	52 ea.
2	Power Supply Unit, RA-84	19" x 8 3/4" x 8 3/4"	42 ea.

\* Throughout this manual an asterisk within parenthesis indicates that items so designated are interchangeable with those marked with different suffix letters.

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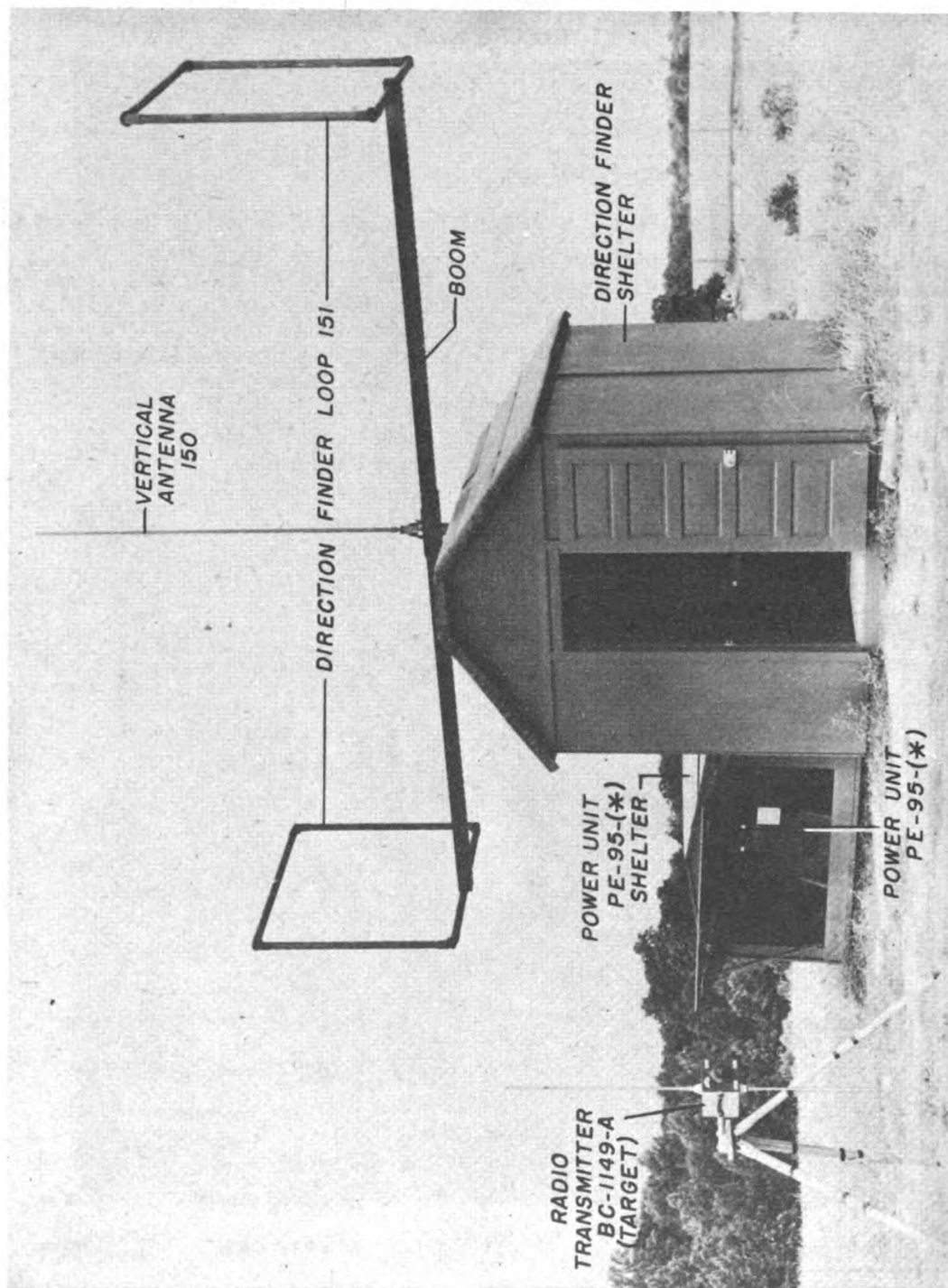


Figure 2—Radio Set SCR-292, Outside View

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Quan.	Description	Approx. Overall Size (Including Projections)	Approx. Wt. Lbs.
1	Speaker panel, including: 1 Speaker, 10 inch, with transformer 1 Telephone EE-8-(*)	19" x 8" x 12 1/8"	20
1	Crystal frequency indicator, including: 1 Pilot lamp 1 Frequency Meter BC-221-M, (Modified)	19" x 10 1/8" x 12"	20
1	Antenna coupling unit	19" x 8" x 5 1/8"	10
1	Signal Generator I-72-(*)		
1	Radio Transmitter BC-1149-A (Target) including: 1 Tripod 2 Telescoping antennae rods	3' x 3' x 8'	30
1	Control Unit	19" x 10" x 5 1/8"	20
1	Primary power panel contains:  1 Allen-Bradley combination fused switch and motor starter	19" x 7" x 14 1/4"	25
1	Recording machine, including: 2 Inking pens	16" x 9 3/4" x 5 1/2"	25
1	Radial ground system, including: 1 Ground rod 20 Radial wires with clamp	200' diameter circle when installed	60
36000	Sheets recording paper	24 1/4" x 22" x 18 1/2"	50
1	Desk unit	54" x 23" x 6 1/2"	30
1	Tool chest, containing: 1 Roll roofing paper 1 Set Erection and maintenance tools 1 Tool Equipment TE-48	40" x 20" x 15"	250
1	Spare parts chest, containing 100% expendable spares, also containing: 1 Headset HS-23 1 Time stamping clock Oil for gear box 2 D/F scales 1 Set power and interconnecting cords		
2	Cord, ref. no. 101, including: 2 Plugs, PL-85 1 Length co-axial cable	48" long, 1/2" diam.  4' x 1/2" diam.	2

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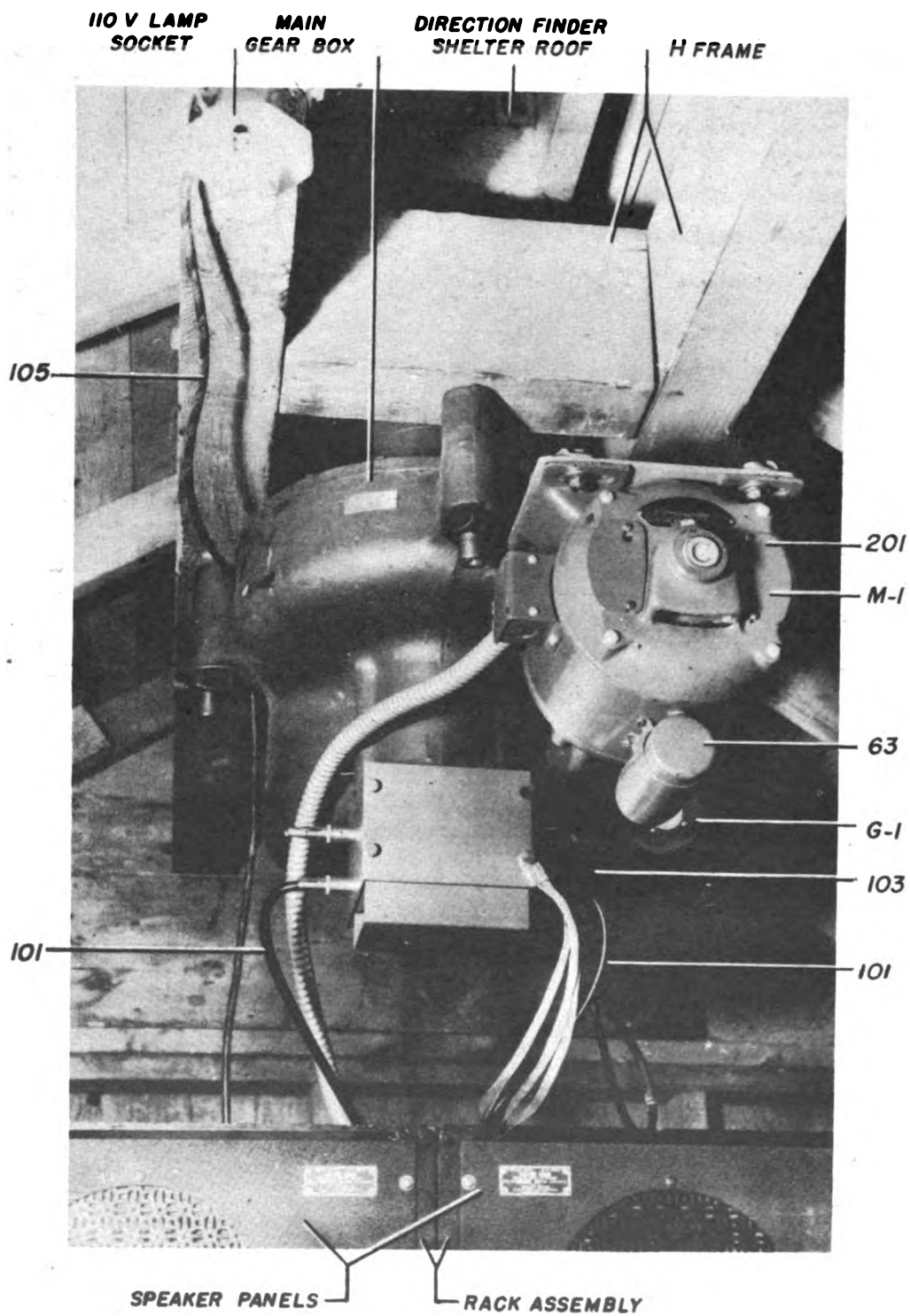


Figure 3—Gear Box Assembly

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Quan.	Description	Approx. Overall Size (Including Projections)	Approx. Wt. Lbs.
1	Cord, ref. no. 102 including: 1 Plug, ref. no. 85 1 Shielded cord 1 Receiver terminal strip	3' long $\frac{1}{2}$ " diam.	1.3
1	Cord, ref. no. 103, including: 1 Plug, ref. no. 85 1 Shielded cord 1 Receiver terminal strip	56" long $\frac{1}{2}$ " diam.	2.6
2	Cord, ref. no. 104, including: 1 Tirex cord 1 Convenience plug 1 Receptacle plug	30" long $\frac{3}{8}$ " diam.	2
1	Cord, ref. no. 105, including: 1 Tirex cord 1 Convenience plug 1 Receptacle for lamp	5' long $\frac{3}{8}$ " diam.	5
1	Cord, ref. no. 106, including: 1 Lacing bracket	5' x 12" x $\frac{3}{4}$ "	6
2	Cord, ref. no. 107, including: 2 Terminal strips	30" x $\frac{3}{8}$ " diam.	3
1	Cord, ref. no. 108, including: 2 Lugs	20" x $\frac{3}{8}$ " diam.	1
1	Main power cable, including: 1 60 ampere weatherproof plug 1 Two conductor no. 8 wire	12' x $\frac{3}{4}$ "	22
1	Compass USSC no. 140 L.C., complete with Jacobs Staff no. 146		

Instruction books included with the principal components are:

Instruction Book for Radio Transmitter BC-1149-A

TM 11-904, Technical Manual for Power Unit PE-95-(\*)

Preliminary Instructions for Frequency Meter Set SCR-211-M

"Super-Pro" Receiver Instruction Manual.

### 3. Additional Equipment Required.

In addition to the components listed above, wiring must be provided for the field telephone unit so as to transmit information from the direction finder site to the control center. No other additional equipment is required.

### 4. Description of Principal Components.

a. *Loops.* The loops used on Radio Set SCR-292 are 5 feet square and consist of a single turn of wire suspended on isolantite insulators within a shield of aluminum tubing of 2-inch outside diameter. At the top center of the shield is an insulated gap which prevents the outer tubing from forming a closed circuit.

b. *Boom.* The boom is a 4-inch square aluminum duct 22-feet long which contains a transposed transmission line connecting the two loops which are mounted vertically at either end. Mounted at the center of the boom is an insulator for supporting the vertical antenna for the monitor receiver, see figure 4.

c. *Gear Box.* The gear box assembly, figure 3, consists of a large cast iron housing containing a series of gears for reducing the speed of the main antenna

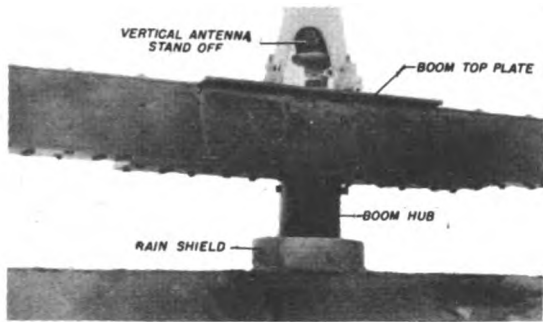


Figure 4—Boom Assembly

drive motor from 1750 rpm to approximately 15 rpm. A large hollow shaft mounted through the center of this gear box causes the boom to rotate at 15 rpm. Mounted on the gear box is a small gear case used to raise the speed of the motor from 1750 rpm to 3500 rpm to drive the synchronizing alternator which supplies the voltage for the recorder drum drive motor.

*d. Slip Ring Assembly.* The slip ring assembly, figure 5, consists of a bakelite shaft carrying six slip rings and one cam ring mounted at the lower end of a copper pipe 28 inches long through which runs a pair of coaxial lines. Another pipe of smaller diameter carries a single coaxial line. This slip ring assembly slides up through the large centrally located shaft in the gear box and fastens in position. It carries the voltage down from the loops and the vertical antenna.

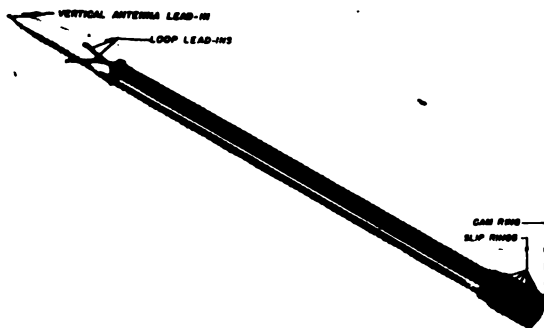


Figure 5—Slip Ring Assembly

*e. Brush Holder Assembly.* The brush holder assembly, figure 6, contains four shielded brushes, a cam operated micro-switch, a slider resistor and a terminal board with associated wiring. It mounts on the bottom of the gear box. The purpose of this brush assembly is to carry the voltage out from the slip rings to receptacles provided at the outer ends of the shielded brushes. Cables plugged into these receptacles carry the voltage to the antenna coupling panel and thence to the monitor receiver. The cam operated micro-switch mounted in this assembly is used with the cam on the slip ring assembly to provide an indication on

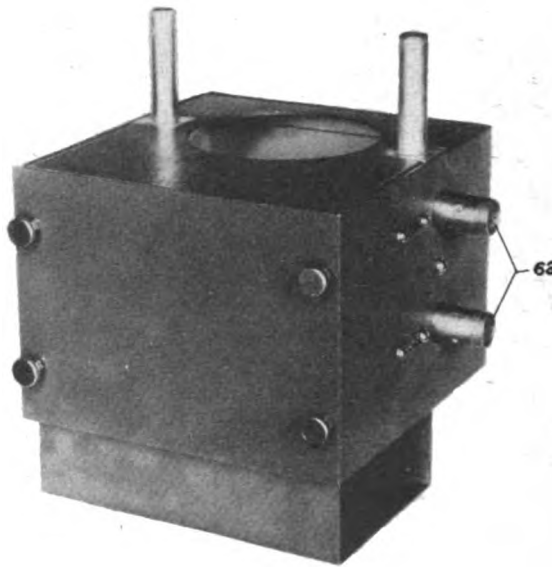


Figure 6—Brush Holder Assembly, Front View

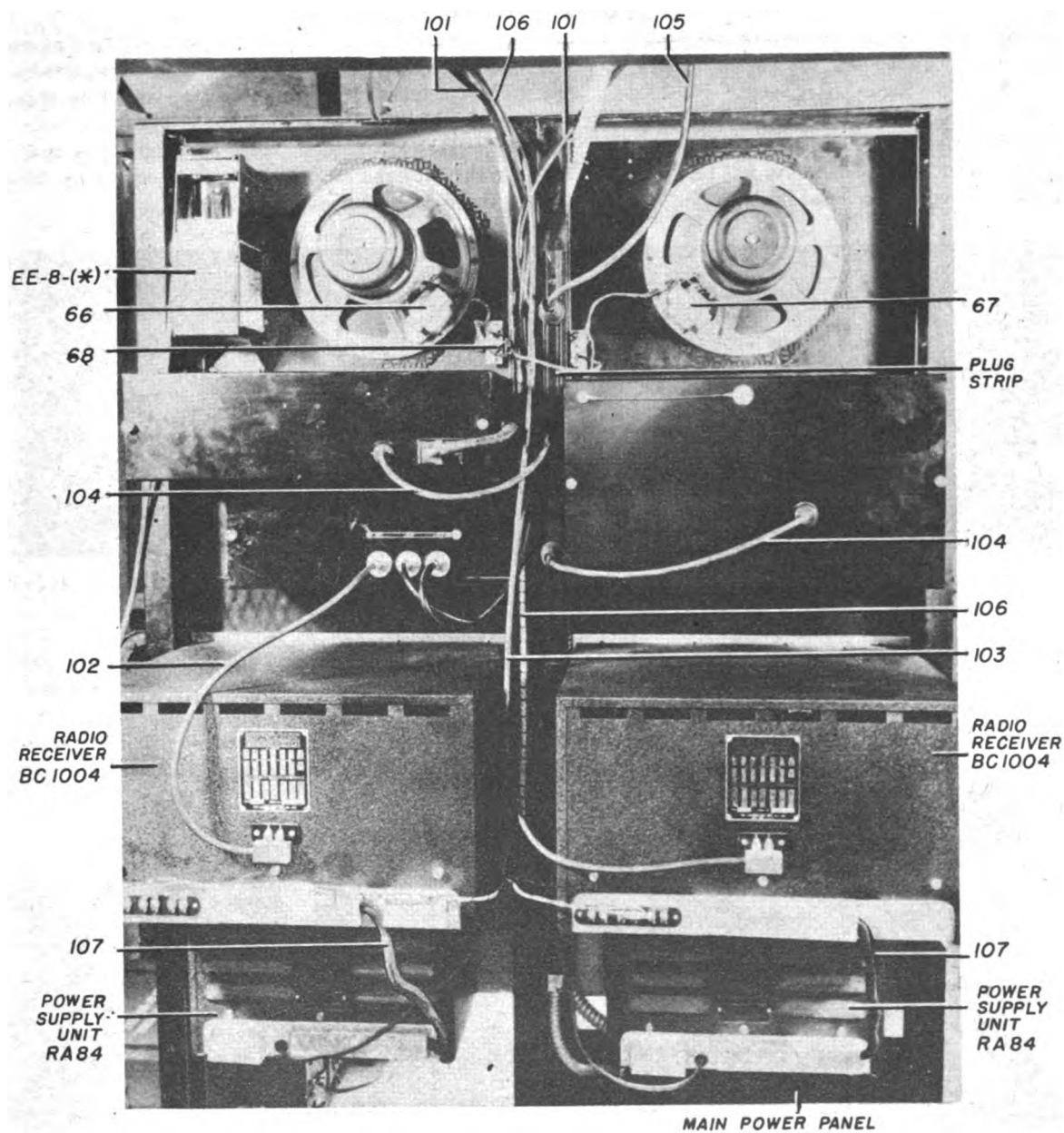
the record produced by the recorder of some reference direction such as true North or magnetic North. The slider resistor is set to provide sufficient voltage to operate the index pen.

*f. Rack Assemblies.* All of the equipment inside the direction finder house, figures 1 and 7, is mounted in two standard 6-foot steel relay racks. These racks contain the following equipment:

(1) One antenna coupling panel, figure 8, containing resonating circuits and plugs. This unit, which is continuously tunable in three overlapping bands over a range of 2 to 12 megacycles, provides a means of

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**Figure 7—Rack Assembly, Rear View**  
Correct nomenclature for Radio Receiver is BC-1004-C



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matching the impedance of the loop to the input impedance of the receiver. The output from the antenna coupling panel is carried to the direction finding receiver in a shielded, twisted pair, low impedance line.

(2) Two Radio Receivers, BC-1004-C, not modified in any way. One of these receivers (in the right hand rack) is the direction finder receiver. The other receiver, mounted in the left hand rack, is the monitor receiver which is fed from the vertical antenna

atop the boom through a shielded cable leading from the brush assembly on the gear box.

(3) Two Power Supply Units RA-84 are mounted directly below the receivers on their respective racks. They connect to their respective receivers through short multi-wire cables.

(4) One speaker panel, see figure 1, is mounted on the left hand rack at the top and carries the 10-inch speaker for the monitor receiver.

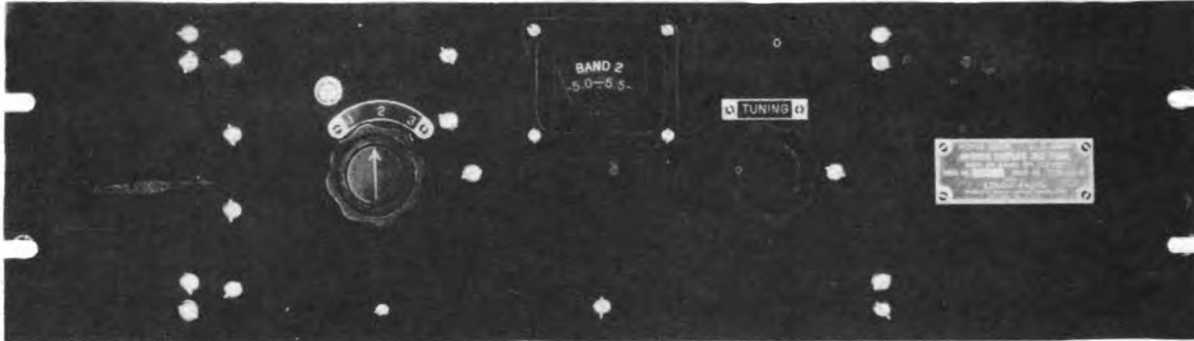


Figure 8—Antenna Coupling Panel, Front View

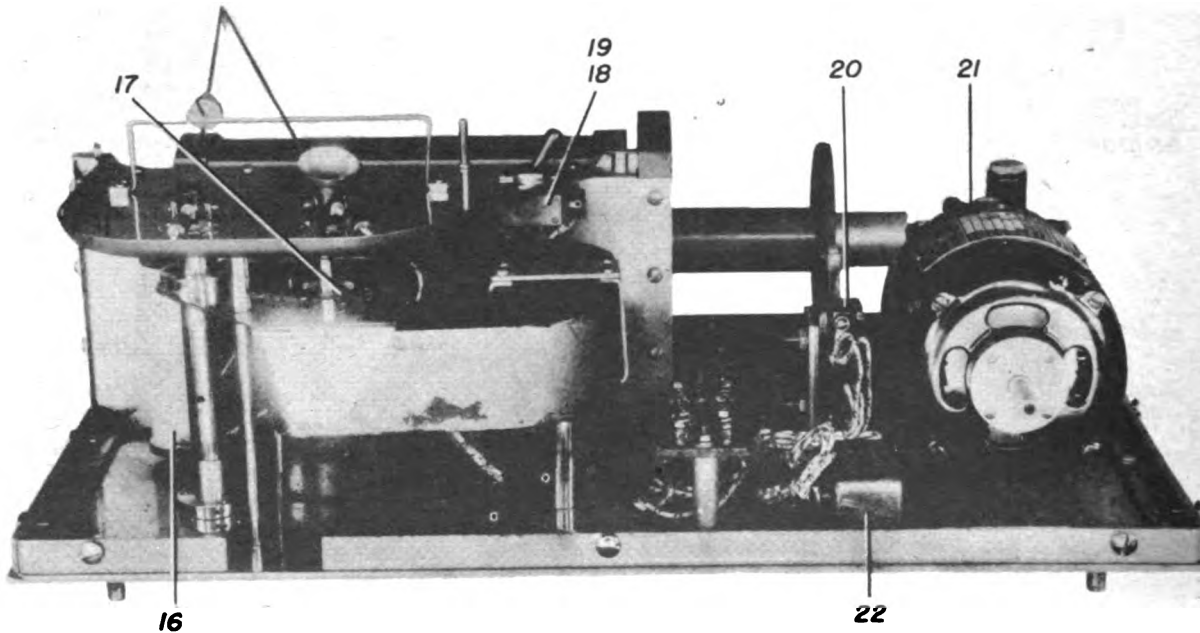


Figure 9—Recording Machine, Rear View

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(5) One speaker panel, see figure 1, is mounted on the right hand rack at the top and mounts the 10-inch speaker for the direction finder receiver, along with a switch for turning this speaker on and off, and Field Telephone EE-8-(\*) so mounted that the magneto handle projects through the front panel. The hand set is held on the front panel by a spring clip when not in use.

(6) One operating shelf across the front of both racks, see figure 1, so mounted that the top is in line with the bottom of the two receivers. This is at a convenient level that allows operation of the equipment with the operator either standing or sitting. It also provides a base for mounting the recorder mechanism and the time stamping clock (used for marking the time of receiving on the graphs). Two drawers in this shelf provide space for ink, paper, bearing scales, miscellaneous maps, etc.

(7) One recorder mechanism, figure 9, which contains a small drum driven by a 1/75 horsepower synchronous motor, an indexing relay which drives the index pen, and a recorder pen. Also in the recorder mechanism is a cam actuated micro-switch which stops the rotation of the drum in a position that simplifies the changing of the recorder paper. The recorder is controlled by a switch mounted on the recorder mechanism.

(8) One control panel, see figure 10, contains the circuits which couple the receiver to the recorder mechanism. These circuits comprise a low-pass filter for

limiting the amount of "hash" and high frequency noise getting to the pen element and a rectifier circuit for rectifying the receiver output to produce the direct current that may cause recorder pen deflection. Also in this unit is the power supply which supplies direct current for excitation of the field of the synchronizing alternator. Mounted on the front of this control panel is a meter for indicating the level of the signal being fed to the recorder pen, a control for setting the level of the signal being fed the recorder unit and a phone jack which allows monitoring of this channel when the use of the loud speaker would be objectionable. Also on the panel is a switch which controls starting and stopping of the main drive motor through its actuating relay. Fuses for this unit are panel mounted and are accessible from the operating position.

(9) One crystal frequency indicating unit, see figure 11, which provides standard frequencies in the range of 2 to 12 megacycles to allow presetting of the receiver to any desired signal frequency and also allows checking frequency of received signals. This unit consists of Frequency Meter BC-221-M (modified); for modification see figure 33 and for other drawings see Preliminary Instructions for Frequency Meter Set SCR-211-M. This unit is mounted behind a rack panel, along with a power supply for the unit. The front panel controls, other than the standard frequency meter controls, are ON-OFF switch, fuse and pilot

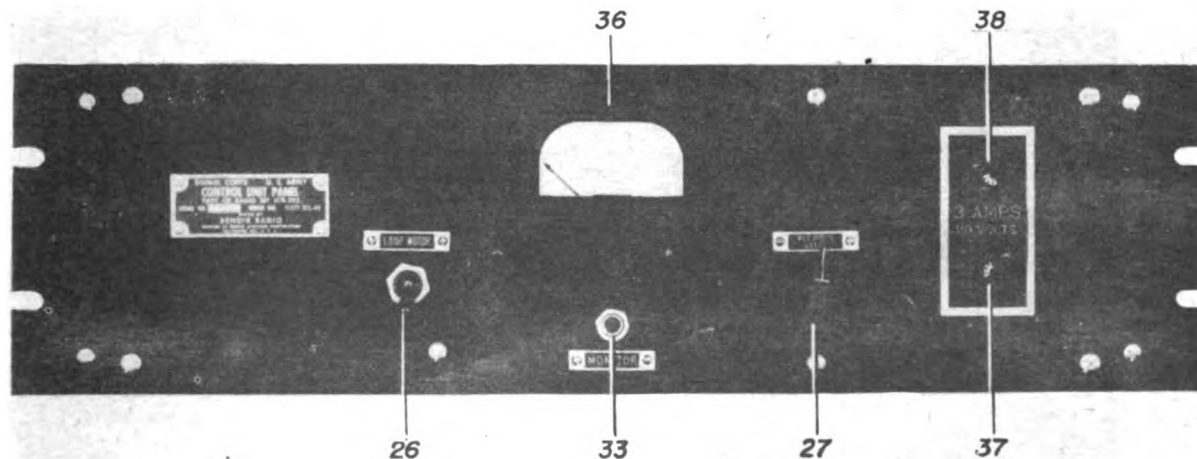


Figure 10—Control Panel, Front View

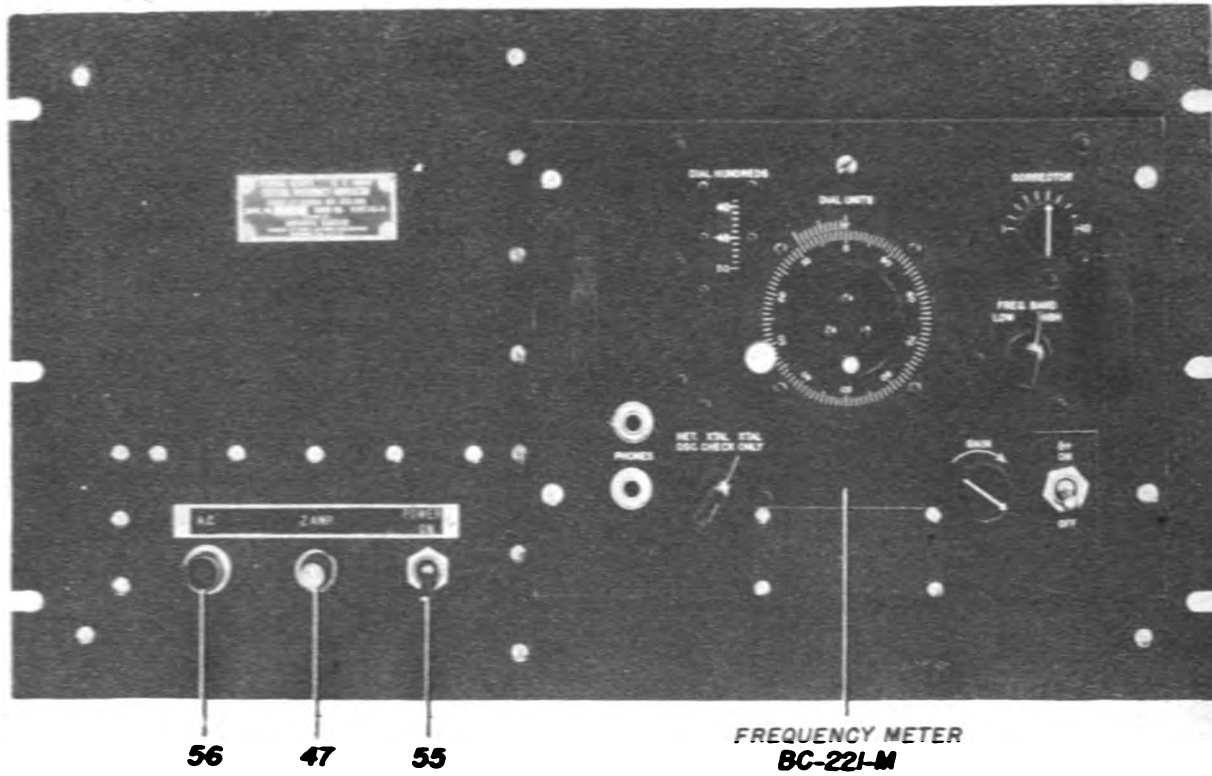


Figure 11—Crystal Frequency Indicator, Front View



Figure 12—Main Power Panel, Front View

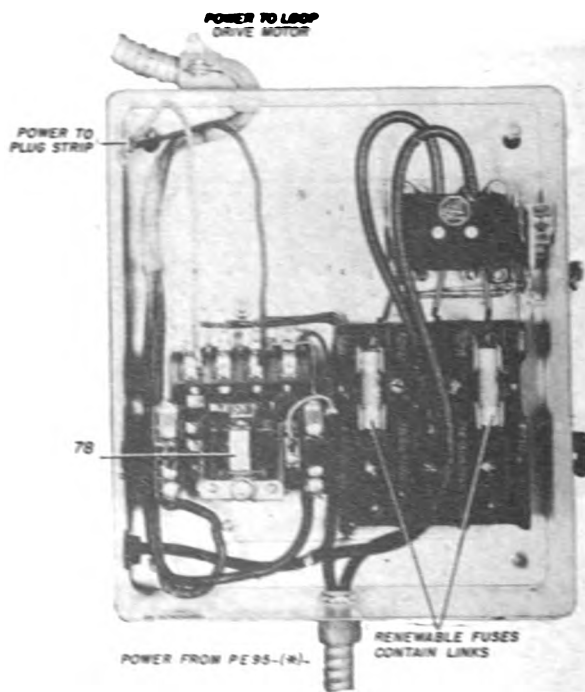


Figure 13—Main Power Panel, Inside View

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light. The switch on the frequency meter is used as a B+ switch for stand-by service. The output of the frequency meter is coupled to the receivers through a short antenna mounted behind its dust cover.

(10) One main power panel, see figures 12 and 13, which contains the antenna-drive motor-starter-relay actuated by the switch on the control panel and a fused 30-ampere safety switch controlling all power supplied to the equipment inside the house.

(11) Auxiliary equipment is supplied in the spare

parts chest and consists of oil for the gear box, ink for the recorder, headset and various miscellaneous equipment.

(12) In addition, an erection equipment chest contains the various tools for erecting and maintaining the equipment, and a recorder paper chest contains the paper for the operation of the recorder along with Signal Generator I-72-(\*) and the brush holder assembly.

(13) Separately crated is the Radio Transmitter BC-1149-A, (Target), with the tripod, spare parts and technical manual for its operation and maintenance.

SECTION II  
INSTALLATION AND OPERATION

	Paragraph
Installation . . . . .	5
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**5. Installation.**

*a. Selection of a Site.*

(1) Before the direction finder is erected, examine as many sites as time permits and choose the best available. In choosing a site, look first for uniformity of conditions in all directions. Avoid sites with prominent obstacles such as antennas, buildings, overhead power and telephone lines, railroad tracks, rivers, shore-lines, or mountains.

(2) A good site should be practically level near the direction finder, for approximately the first 100 feet, and should have only a gentle slope for several times that distance beyond. A slope of 2 feet in 100 which continues the same for a quarter mile is preferable to perfect flatness for the first 100 yards, with a steep slope just beyond. A broad, flat hilltop is better than a valley.

(3) Radio reception will be better where there is good soil conductivity. In general, the conductivity of soil may be judged by its moisture content; thus good farm land has high conductivity, while sand and rocks have very low conductivity. The radial wires in the ground system of Radio Set SCR-292 are used partly to raise the average conductivity of the ground near the direction finder, so that good results may be obtained even on a site with fairly poor soil.

*b. Installation of Radio Ground System.*

(1) When the site has been chosen, remove all trees and bushes within 100 feet of the center, and as many as possible within 1000 feet. Prepare a space at least 10 feet square for the D/F shelter making the ground there exactly level. Smooth out any humps or hollows in the ground for at least 100 feet in all directions.

(2) Open the GROUND ROD crate, and remove the 10-foot length of 3/4-inch copperweld rod. Drive this rod into the ground as far as possible, at the center of the leveled space. In soft ground, drive the ground rod down, until only 18 or 20 inches of it remains above the ground; in hard ground, drive it until the top mushroomed end with a hacksaw leaving only 18 inches of rod above the surface of the earth.

rooms badly and bends under the hammer. Cut off the mushroomed end with a hacksaw leaving only 18 inches of rod above the surface of the earth.

(3) Open the RADIAL FOR GROUND SYSTEM crate, and remove the radial assembly. This consists of 20 coils of No. 14 copper wire, each 100 feet long, with one end soldered to a central clamp. Bolt the clamp to the top of the ground rod. Uncoil the 20 wires, one at a time, while walking away from the ground rod, and lay them flat and as nearly straight as possible on the ground. Anchor the ends temporarily with stakes, stones, or piles of dirt. Wrap tape (from the spare parts chest) around the whole group of wires, at ground level, to keep them close to the ground rod as they pass downward from the clamp. When all 20 radial wires have been laid out, adjust their spacing to be as nearly equal as possible. The outer distance between the wires will be a little more than 31 feet, or a little more than 10 paces.

(4) Beneath each wire dig a trench deep enough to reach moist soil. In territory where the ground freezes in the wintertime, dig below the deepest frost line, if possible. In all but the coldest climates, 18 inches will be deep enough. Lay each wire in the bottom of its trench, and replace the dirt on top of it.

(5) Tamp the earth level again in the 10 foot space around the ground rod. If cinders or light gravel are available, spread a thin layer over the leveled space, to serve as a foundation for the shelters. This will lengthen the life of the floor joists, by keeping them from direct contact with the soil.

*c. Erection of Shelter.* Uncrate the direction finder shelter which is contained in the crates marked DF SHELTER. Determine the directions from which most rain, snow, and prevailing winds arrive and, if possible, place the house so that the door will not face these directions. Failure to follow this precaution will mean that the operator and equipment will be subject to much unnecessary wetting. Before laying the floor, remove the pipe cap that plugs the end of the 3/4-inch

pipe under the floor near the left front edge of the house. Remove the power cable from the crate marked MAIN POWER CABLE. Disassemble the power plug by turning the coupling nut between the two nameplates. When the nut is free, pull plug apart. Remove the phosphor bronze spring wire inside the male plug. Now pull the inner plug assembly out, thereby removing the plugs, insulators and the two no. 8 wires. Put this in a safe place. Now take the remaining shell of this male plug and screw it onto the  $\frac{3}{4}$ -inch pipe, first painting the threads to insure a water tight joint. Tighten the assembly by bringing the lock nut on the  $\frac{3}{4}$ -inch pipe up tight against the plug. Reassemble the plug without replacing the inside of the male plug, to keep dirt out of the assembly. Now place the floor section in position with the large center hole fitting over the ground rod clamp assembly. When the floor is approximately in the right position, make sure that the fill underneath the house will support the floor and hold it level. It is important that the floor be accurately leveled with the level provided in the tool chest. After the floor is accurately leveled, tip up one end and insert one of the ground screws (contained in the bundle marked GROUND SCREWS) through the 1-inch hole near the corner. Repeat this procedure with the other three corners. Turn the floor slightly, if necessary, so that these ground screws can be turned down into the ground without danger of cutting radial wires. When all four screws are in position, place the eye provided in position on the top of one of the screws. Using one of the small wrecking bars provided in the tool chest, turn the screw down into the ground, press down heavily to start the screw, and keep turning until only about 4 inches of the thread remains above the floor sill. Repeat this with the other three corners; then remove the eye from the last bolt tightened down. Next, place a wall section into position. The front wall contains a door and the rear wall a window. Place these on the sides of the house which parallels a line through the holes near the center of the floor. Begin with the wall which is to the right of the door looking into the house. Securely fasten this first section to the floor by the lag screws provided. While two men hold this wall section in position, lift the attaching wall section (front or back) in place and anchor it by a bolt in the corner and by the floor lag screw. Do not tighten these bolts until all sections of the house are assembled. This will allow a certain freedom of motion for properly aligning the bolts and holes. After all four walls are up and all the bolts are in place, the nuts can be tightened moder-

ately to make the building more substantial. Next, the roof section should be installed. Uncrate the BOOM ASSEMBLY and place the two large wooden sides of the crate on the ground at the rear right corner and rear left corner of the house so that they are parallel with the sides of the house. Next, lift the ends of these beams closest to the house so that they are resting on the rear wall 5 feet apart, equally spaced from the center. The two beams now form an inclined plane on which the roof section is to be slid up into position using the three lengths of iron pipe 10 feet long as rollers. The proper position for the roof section is with the flat sides at front and rear, with the slope at the sides.

**CAUTION:** While the roof is being slid up the incline, put one man inside the house with a  $\frac{3}{4}$ -inch rope which runs over the top of the rear wall and around the roof through the center hole. As the roof is pushed up the incline, have the man inside the house keep the rope taut and snubbed over the edge of the building. This is to prevent anyone from being hurt should the roof slip while being pushed into position. When the roof is nearly in position, remove the rope and push the roof into its final position by means of the wrecking bars. Insert all the bolts into their holes, place nuts in position and tighten. Lift the motor mount spacers (2-inch x 10-inch members), which form an H frame, into position so that their bottom rests on the tops of the two heavy blocks at the front and rear of the roof. Place the  $1\frac{1}{4}$ -inch bolts (in the gear-box crate) through the holes provided in the H section with the threaded ends down. Slightly loosen the lag bolts which hold the H section together. Now the H frame is ready for the gear box.

*d. Position of the Gear Box.* Carry the gear box in its crate into the house so that it is underneath the hole in the roof. Take the crate apart and position the gear box so that the three lugs are beneath the three bolts in the H frame. Remove the hub top plate and rainshield from the top of the gear box by loosening the 8 hub set screws and lifting the assembly off. Remove the pins that hold the frame on the gear box. Now take the boom assembly (previously uncrated) and lean it against the rear of the house so that the upper end is directly over the hole in the center of the roof. It is important that the boom make as steep an angle as possible with the house. Secure the end that is on the ground in position, either by allowing two men to sit on it or by staking it down. Wrap three turns of the  $\frac{3}{4}$ -inch rope around the boom, carrying one rope

through the holes in the side of the boom, being careful not to bend the boom link and allowing enough slack in the center turn to fasten the top block of the block and tackle. Tie the ends of this rope securely. **CAUTION: Take great care to have this rope secure since the entire weight of the gear box assembly is carried by this rope.** Place the lower block of the block and tackle directly over the center of the hollow shaft of the gear box. Now take the length of the  $\frac{3}{4}$ -inch rope supplied and make a sling that is long enough to reach through the hollow shaft of the gear box with sufficient clearance for the block at the top and a wooden block at the bottom. This sling, as well as the rope which is around the boom, should have as little slack as possible so as to be certain that the gear box can be hoisted into position. When the sling is ready, place it in position and lift the gear box off the ground slightly. Knock the frame off the gear box and when certain that the rope slings are secure, begin hoisting the gear box. Carefully exert a steady pull on the rope of the block and tackle. **CAUTION: Do not allow the gear box to lurch since this puts great strain on the hoisting rope. Pull the gear box into position with the block and tackle, being careful not to get underneath the gear box while in the process of hoisting.** When the gear box is in position, feed the bolts down through the mounting lugs and tighten the three nuts with the large wrench provided in the tool chest. **CAUTION: Do not remove the block and tackle until the H frame has been tightened and nails have been driven into the ends of the H frame from the outside of the house. Be sure the rope of the block and tackle is tight during this procedure so that if anything should slip, serious damage, to the personnel or the gear box, may be avoided.** When everything is tight, remove the block, tackle, and ropes. The house is now set up with the gear box in position.

*e. Position of the Boom.* The central shaft projecting above the roof carries the 22-foot boom which is fastened to the shaft by eight  $\frac{1}{2}$ -inch set screws in the hub which fits over the shaft. Before assembling this, place the small tin flashing, packed in the GEAR BOX crate, over the projecting shaft. Nail the bottom plate of this flashing to the roof and seal it well with the roofing cement supplied in the tool chest so that rain will not enter the plate. Bolt the hub and bottom plate to the boom. *Do not bend the rain shield mounted on the hub.* Now assemble boom to shaft. The shield and flashing form a baffle to prevent the entrance of water into the shack.

*f. Erecting Power Unit Shelter.* Open the crates marked POWER UNIT SHELTER. Place the floor section in position so that its long side is parallel to the left side of the direction finder shelter and 2 feet away. The front should be about 1 foot behind the direction finder shelter front. Slide Power Unit PE-95-(\*) into position with the radiator toward the rear of the shelter. Assemble the shelter with the attached bolts. The front has a large hinged section that allows access to the instrument panel. This section is removable as is the small hinged section in the rear wall (in line with the radiator). Lastly, lift the roof up and drop it into position. Feed the rubber covered power cable through the hole in the rear right corner, then through the hole in the power unit and bolt the two lugs under the a-c output posts. The power unit is now completely protected and ready to supply power to the equipment in the direction finder shelter.

*g. Assembling Slip Ring Unit.* Remove the slip ring assembly from the crate marked SLIP RING ASSEMBLY. Take the four screws out of the large bakelite hub, then slide the assembly up the hollow shaft of the gear box. Position the slip ring assembly so that the two short leads at the top fall beneath the holes in the cross links. This allows the long lead to be fed up beside the cross links without touching them. One man should be on the roof to help fish the wires up and guide the man below who is pushing the slip ring assembly into position. When the assembly is in position, fasten it with the four screws through the four holes near the bottom of the shaft. Put nuts and lock washers on the top terminals fastening them to their cross links.

*h. Assembling Vertical Antenna And Boom Top Plate.* Take the vertical antenna, which is contained in the boom crate, bolt it to the mounting plate insulator on the mounting plate. Take this assembly to the roof. Feed the remaining wire from the slip ring assembly through the small packing connector. Take the bolts from the attached bag and bolt the mounting plate to the top of the boom. Connect the wire to the strap at the bottom of the large insulator using a 6-32 nut and lockwasher. Tape this wire up to and over the connection with the friction tape supplied in the tool box. Pack the connector with the attached packing tool to make a water tight feed-through.

*i. Brush Holder Assembly.* Next take the brush holder assembly (previously removed from the gear box) and carefully replace it in its original position be-

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neath the gear box. This puts the cover plate with its four knurled screws toward the shelter door. Remove this cover plate. Place four of the shielded brushes, from the spare parts chest, in through the holes at each side of the brush holder assembly. Push these in until the shields are within about  $\frac{1}{4}$ -inch of the slip rings, then tighten the set screws with the wrenches in the tool chest. Cut the string which holds the micro-switch lever arm so that the roller rests on the cam ring. All brushes should be centered on their respective rings. Counting down from the top, ring no. 1 is the antenna ring; no. 2 is the ground ring; no. 3 and no. 4 are not connected, serving merely as isolation rings; no. 5 and no. 6 are loop voltage rings; and ring no. 7 is the cam ring. Ring no. 7 has a flat on one side that actuates the micro-switch, once per revolution.

*j. Loop Assembly.* Remove the two loops from the loop carrying case. Push the boom around until one end is over the power unit shelter, then remove the end plate. Take one loop, remove the outer nut from each insulator, then spring the loop and put in in position so that the insulator screws go through the holes in the strip inside the boom. Holding the loop, bolt it into position. The loop should be as nearly vertical as can be visually determined. Replace the nuts on the strap connections and replace the end cover plate. Repeat with the other loop on the other end of the boom.

*k. Assembly of Rack-contained Equipment.*

(1) Remove the rack assemblies from the cases, and carry them inside the house. Place the rack with the flexible conduit so that the power input pipe is inside its web. Place the other rack beside it, over the ground rod assembly and telephone input pipe (small empty  $\frac{1}{2}$ -inch pipe).

(2) Loosen the lock nut holding the flexible conduit in position in the main power box (Allen-Bradley fused starter) which is mounted on the lowest panel on the rack. Screw this conduit into the floor pipe, after removing the plug from the floor pipe, and tighten the lock nut. Disassemble the main power receptacle, on the  $\frac{3}{4}$ -inch pipe outside the left front edge of the house. Feed the two no. 8 wires through the  $\frac{3}{4}$ -inch pipe, put the phosphor bronze locking ring back in position, and reassemble the receptacle. Connect the house end of the main power cable to the line terminals of the main power panel fuse block, one wire to L1, the other to L2. Bolt the racks together. The flexible braid inside the web of the right hand rack is to be held in place by these bolts, which pass through the straps that are soldered in the braid. Bolt the soldering lug at the bottom of

the flexible braid to the center bolt of the ground rod clamp assembly. Drill four small holes in the floor through the holes in the rack feet, using the wood bit from the tool box, then bolt the racks securely to the floor, with a lag bolt in each of these holes.

(3) Loosen the screws holding the receiver power supplies so that there is about  $\frac{1}{8}$ -inch between the panels and the heads of the screws. Remove the desk unit from the loop carrying case, slide it into the position over these screws, and tighten them. Try the desk drawers to see whether they bind; if so loosen the mounting screws, spread the mounting flanges apart and retighten.

(4) Feed the top phenoflex section of Cord No. 106 up behind the rack. Remove the bottom cover from the brush assembly. This exposes a numbered terminal board. Connect the wires of Cord No. 106 to their numbered terminals. Connect the wires from the small alternator on the gear box to the terminals indicated in circuit diagram, figure 17. Connect the two terminals from each side of Cord No. 106 to the numbered terminal boards on the speaker panels. Feed the lower phenoflex covered branch from Cord No. 106 past the left hand rack (as seen from the front of the shelter) between receiver and power supply, then around the corner, and up through the hole in the desk unit. Remove the recorder from its carrying case and remove its outer cover. Then place the recorder, with the grommet hole in the rear, over the hole in the table. Feed the wires through the hole and connect to the numbered terminals on the terminal board as shown in the circuit label, figure 29. Replace the cover. Feed the tirex cord at the bottom of Cord No. 106 into the main power box, through the bushing near the lower end of the hinge; connect as shown by the circuit label inside the cover for a 2 terminal device (see also Fig. 13), and close the box.

(5) Plug the upper end of the twisted pair of coaxial lines (Cords No. 101), into the brushes of the brush holder assembly mark LOOP 1 and LOOP 2. Plug the ground plug into the brush marked GND and plug Cord No. 103, the long line from the monitor receiver, into the brush marked ANT. Fasten the ground braid under the lower left cover screw of the brush holder assembly. Connect the armored cable which terminates in an angle fitting at the top of the left relay rack to the loop drive motor. Place the 110-volt plugs of the ceiling light, the control unit, the crystal frequency indicator and the two receiver power supplies into the receptacles in the power strip.



(6) Take two pens from the spare parts chest and place them in position on the recorder. The left pen should have a small cup at the top to prevent ink overflow from ruining the meter movement.

#### 6. Preparation For Use.

##### a. Preliminary Adjustment.

(1) Before starting Power Unit PE-95-(\*), be certain that the oil, water, and gasoline are at the levels specified and that all instructions set forth in the technical manual accompanying the power unit are complied with.

(2) Before starting the gear box for the first time, fill the large gear box with oil. The oil fill plug is behind the synchronizing alternator. The level of the oil in this unit should reach half way up a stick poked in the fill hole. About 2 quarts is sufficient. The grade of oil to be used depends on the climatic conditions at the particular location. For moderate temperature (down to zero Fahrenheit) use the heavy oil (No. 70) supplied in the tool chest. For cold conditions, use the lighter oil (No. 30). Put about half a pint of No. 30 oil in the small gear case at the rear right of the large gear box. The fill plug is at the top of the casting. Do not overfill this case or oil will leak out around the shaft of the small alternator. Oil the main drive motor with the No. 30 oil, using the small oil can from Tool Box TE-48.

(3) Take one of the bottles of ink from the spare parts chest and fill the cups of the pens using an ink dropper. To prime the pens, take the small pen syringe supplied. Place this with its flat side on the recorder drum and drop the pen to be primed into the small hole on top of the rubber tip. Draw ink through the pen into the rubber bulb of the syringe, until the pen makes a line on a piece of recorder paper pulled between it and the drum. Keep a piece of paper always between the pen being primed and the recorder drum, to prevent smearing ink on the drum. When both pens feed ink freely, raise the lift bar under them so that they stay clear of the drum. Remove the ink-stained paper before the recorder is actually placed in operation.

##### b. Final Adjustments.

(1) Starting equipment for first time:

(a) Raise the doors (or remove the doors, preferably) on the power unit shelter.

(b) With the circuit breaker on the power unit control panel off, press the START button and hold until engine starts (this will be about five seconds under ordinary climatic conditions).

(c) When the generator comes up to speed see that the voltmeter reads 120 volts, the ammeter reads 0 and the other gauges read as they should; see TM 11-904, Technical Manual for Power Unit PE-95-(\*).

(d) All switches inside the direction finder shelter should be OFF. These are the main power switch, recording machine switch, monitor receiver (on left hand rack) power switch, direction finder receiver (on right hand rack) power switch, crystal frequency indicator POWER switch, and LOOP MOTOR switch (on control panel).

(e) Trip the circuit breaker on the power unit to ON. The ammeter on the panel should continue to read zero. Again be sure that all meters and gauges read as they should; see TM 11-904, Technical Manual for Power Unit PE-95-(\*).

(f) Turn the main power switch, behind the monitor rack on the bottom panel, ON.

(g) Put a 100-watt, 120-volt bulb in the socket between the beams that support the gear box. When the main power switch is ON and its line cord is plugged in, this bulb should light.

(h) Remove the dust covers from the equipment in the racks. Make certain that all tubes are in the proper sockets and are well seated.

(i) Following the directions in "Super-Pro" Receiver Instruction Book, make both receivers ready for operation.

(j) Throw the switch on the direction finder receiver speaker panel to ON and turn the RECORDER LEVEL control on the control panel fully to the left.

(k) Check both receivers for correct operation (see "Super-Pro" Receiver Instruction Manual) in the range of 2 to 12 megacycles. If no other signals are available, set up the target transmitter about 100 feet from the direction finder shelter and turn it ON, ICW, LOW with the switches provided, see Instruction Book for Radio Transmitter BC-1149-A. Set it at any frequency in the range 2 to 12 megacycles and tune it in on the monitor receiver. Always locate the signal first on the monitor receiver, then tune it in on the direction finder receiver. First set the antenna coupler to the approximate frequency of the signal, then tune the direction finder receiver to the signal and finally adjust the antenna coupler for maximum receiver output.

(l) When it is proven that both receivers are in working order, turn their volume down to a low level and throw the LOOP MOTOR switch ON. The loop

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and boom assembly should now rotate continuously about 15 rpm in a counterclockwise direction, (to the left) viewed from below.

(m) *Index Cam Preliminary Adjustment.* While the system is rotating, turn the switch located on the top of the recorder ON. The drum should rotate to the left viewed from the knob end of the drum. The speed of rotation of the drum is the same as the speed of the loop and boom assembly. Once each revolution, the index pen should move slightly with an audible click. If this does not occur, or if there is more than one click per revolution, turn the recorder switch OFF, then remove the front cover from the brush holder assembly. **CAUTION: Don't come in contact with the wiring to the micro-switch and slider resistor while the switch is ON for 150 volts direct current appears at these points.** In making any adjustments inside the brush holder assembly box, always turn the recorder switch OFF. This removes the voltage from the circuits inside the box. Listen closely to the micro-switch as the loop and boom rotates. When the cam on the slip ring assembly passes under the roller of the micro-switch, the switch should click. If it does not, loosen the screws that hold the micro-switch in position and move the switch closer to the slip ring assembly or further away, whichever produces a click when the cam-drop passes under the roller. If another spurious click occurs for some other position of the cam, the slip ring assembly is eccentric. Find the high spot by watching the motion of the lowest brush. The high spot is the spot at which the slip ring is closest to the brush outer shield. Then tap the slip ring assembly near the cam ring using a hammer and screw driver. Hit at (or near) the high spot until the slip ring assembly rotates with the least eccentricity. Now, adjust the cam for a single click and turn the recorder switch ON. Make sure the index pen moves when the micro switch clicks.

(n) *Bearing Check.* Set up the target transmitter some distance away, preferably 500 feet or more, in a known direction. Make sure its antenna is exactly vertical. Turn it ON, ICW, HIGH [see Instruction Book for Radio Transmitter BC-1149-A] and tune it to any convenient frequency between 2 and 12 megacycles not being used by other transmitters. Set the D/F receiver SIGNAL control at MOD. and set the other controls as in 7a(6). Turn the RECORDER LEVEL control (on the control panel) fully to the left. Switch the LOOP MOTOR on, and allow

the boom assembly to come up to speed. Turn up the SENSITIVITY control on the D/F receiver until a "rushing" background noise becomes evident. Tune in the target signal on the D/F receiver, using the MAIN TUNING dial. The target may be identified by its 400 cycle tone modulation. Signal the target operator to turn off the target modulation, by switching from ICW to CW. Thusly a check is made to be sure the D/F is tuned to the target transmitter, for the 400 cycle note will stop, if the signal heard came from the target. Set the receiver SIGNAL control at CW, and adjust the BEAT OSCILLATOR control to bring the beat note frequency below 400 cycles. Reduce the direction finder receiver gain, by turning the SENSITIVITY control to the left, until the volume of sound from the speaker is satisfactory for the operator seated at the desk. The volume should change as the loop rotates. Advance the RECORDER LEVEL, on the control panel, until the maximum swings registered by the meter on the control panel are not past the red line (between 4 and 6 on scale). The best position for this control is three-fourths on. Adjust RECEIVER GAIN to give a level in this region (4 to 6 on the meter). Adjust the antenna tuning for greatest peaks on the RECORDER LEVEL meter, then tune the BAND SPREAD control on the D/F receiver to give maximum reading. Always retard the D/F receiver SENSITIVITY to bring the level back below the red line.

Take a bearing record, as outlined in 7a(11) to 7a(16). The four nulls of the record taken on the target transmitter should be equally spaced 90° apart ( $\pm 2^\circ$ ). The pairs should be 180° apart ( $\pm 1^\circ$ ). The four peaks should be of equal height, that is, the maximum swing of the recorder level meter on the control panel should be equal for each peak within  $\pm 0.4$  MA. If these conditions are not met, the system is unbalanced. Usually this may be corrected by interchanging the two loop plugs on the brush assembly. The system is balanced to ground as closely as is practical; but it sometimes is necessary to interchange the plugs to make the net capacity to ground from each side of the loop circuit the same. If this does not quite clear up the differences, try grounding the top end of the ground strip under one of the other thumb screws on the cover plate of the brush assembly. This changes the path of the circulating ground circuit and its effect on the system. **CAUTION: Always have the ground strap in position and the brush box cover plate securely fastened on before attempting to take bearings.**

Otherwise accurate bearings cannot be obtained. Never take bearings with extremely high amplitude to the recording element. This causes the pen to ride against the stop except at the null points. These null points cannot be relied on since the velocity of the pen is too great at the null, causing it to overshoot.

(o) *Routine starting procedure.*

- (1) Turn OFF all power switches.
- (2) Raise or remove the doors on the power unit shelter.
- (3) Start the power unit.
- (4) Check meters and gauges to make sure all is well.
- (5) Throw the (power unit) circuit breaker ON.
- (6) Turn ON the main power switch in the D/F shelter.
- (7) Turn ON the monitor receiver power switch.
- (8) Turn ON the D/F receiver power switch.
- (9) Check both receivers for correct operation.
- (10) Throw the LOOP MOTOR switch ON, and make sure the boom rotates.

(p) *Orientation.* After the bearing check described in Paragraph 6b(1)(n) is satisfactory, whether on the first attempt or after several adjustments, take another bearing record. This time have a man outside the D/F shelter, on a line between the transmitter and the monitor antenna (the vertical antenna atop the middle of the revolving boom). Each time the boom passes over his head, he should call "check", or give some other signal to the D/F operator. Make a check mark on the record at the null being recorded. The mark need only be enough to identify that particular null. Do this for at least two complete revolutions of the recording machine drum, then remove the record paper. There results a four-null pattern having one pair of nulls checked and the other pair not checked. The pair of nulls checked are false nulls; those not checked are the correct pair. The bearings read by the use of the transparent scale on the correct nulls give one reading which is the angle from the index direction to the target and another reading that is 180° greater. Unless by some rare accident the index cam was set exactly right when the slip-ring assembly was put in place, neither of these readings will be the true bearing, measured from North, of the target. Take the correct null reading nearest to the true bearing, and compute

the error, by subtraction of the recorded bearing from the known bearing. Switch off the LOOP MOTOR, and remove the front cover from the brush holder assembly. Be sure the recorder switch is off, for safety. Loosen the three set screws on the cam ring and turn it through an angle as nearly as possible equal to the error just computed. If the indicated bearing was too small a number of degrees, turn the cam ring to the right; if too large, turn the cam ring to the left, as seen from below. Tighten one or two of the set screws, then take another bearing on the target, to check the adjustment. Repeat the process of shifting the cam ring and checking bearings until the recorded bearings are exactly right. This is a trial and error process but one which must be done very carefully if maximum accuracy is to be obtained. An initial rough set-up, as follows, may expedite the work: First set up the target over the North stake and rotate the boom for a null with the line of the boom (east-west) at right angles to the line from the transmitter to the direction finder. Find the exact null position by rotating the main drive motor shaft by hand while listening to the direction finder speaker. When the point of lowest signal is reached, the system is pointed correctly for a true null. However, there is approximately 20° mechanical lag in the indexing system due to the inertia of the micro-switch, indexing movement and pen. To allow for this, rotate the motor shaft seven complete turns in the normal direction (each full turn rotates the boom exactly 3°). Now, turn the cam ring so that the micro-switch finger has just operated the switch. Tighten one set screw, then check the bearing by operating the system in the normal manner. The bearing obtained should be close to the actual bearing to the station. A final adjustment by the trial and error method, as originally described, will undoubtedly have to be made to set the cam exactly. When this is done, tighten the three set screws holding it in place very carefully, then replace the front cover. The system is now orientated and should give reliable bearings on almost any signals that can be received.

## 7. Operation of the direction finder.

a. *Taking a bearing.*

- (1) Start the power unit and prepare for operation, as outlined in paragraph 6b(2).
- (2) Set the band switch of each receiver to the band containing the desired frequency.
- (3) Set the band switch of the antenna coupling unit to the band containing the desired frequency.

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The approximate limits of each band are:

Band 3 — 1.8 to 4 mc  
Band 1 — 2.7 to 5.5 mc  
Band 2 — 4.4 to 7.5 mc  
Band 3 — 7.0 to 12.5 mc

(Band 3 does double duty, being used both for the lowest and for the highest frequencies.)

(4) Tune the monitor receiver to the desired frequency.

(5) Set the tuning dial of the antenna coupler at approximately the frequency of the signal to be received.

(6) Set the D/F receiver controls as follows:

AUDIO GAIN	10
BANDWIDTH	3
PHASING	at the arrow
SENSITIVITY	0
CRYSTAL SELECTIVITY	OFF
LIMITER	ON

Set the remaining controls at the same positions as those on the monitor receiver.

(7) Turn up the SENSITIVITY of the D/F receiver and tune it to the same frequency as the monitor receiver, comparing the sound from the two speakers to make sure of the correct adjustment (the tuning dial calibrations are not quite accurate enough for this purpose).

(8) Set the SIGNAL control on the D/F receiver to CW, and adjust the BEAT OSCILLATOR to produce a low pitched beat note.

(9) Adjust the BAND SPREAD dial of the D/F receiver, and the TUNING control of the antenna coupling unit, for maximum output, as indicated by the RECORDER LEVEL meter on control unit panel.

(10) During the tuning process, turn down the SENSITIVITY of the D/F receiver whenever necessary to keep the RECORDER LEVEL meter from swinging too high; and finally set the SENSITIVITY to keep the maximum swing of the meter, as the antenna boom rotates, a little below the red line.

(11) If there is no recorder paper on the desk, take a pad from the recorder paper box.

(12) Take a sheet of recorder paper from the pad, and slide one end under the recorder drum. When this end comes up behind the drum, bring it forward on top and place the holes over the two pegs on the drum. Pull the free end to tighten the paper around the drum, then place the holes of that end also over the pegs.

Be sure the proper end of the paper is on top; otherwise the pens may catch and tear the edge of the paper as it passes.

(13) See that the maximum swing of the RECORDER LEVEL meter is OK, then turn the recorder switch ON, and lower the recorder pens onto the paper.

(14) After the drum has revolved 3 or 4 times, lift the pens and switch the recorder off.

(15) When the drum stops, remove the paper; simply pick up the top end, lifting its holes off the pegs, and jerk it forward. The other end will tear loose from the pins and slide around the drum so fast that it never touches the trough below, and the ink will not be smeared as it might be if the paper moved slowly.

(16) Dry the ink on the record, using a blotter if necessary, and immediately stamp the time and date on it with the time-stamping clock.

*b. Interpretation of bearing.*

(1) Bearings taken using Radio Set SCR-292 appear in the form of inked graphs. These graphs consist of two discrete plots. One plot known as the index line, is located near one edge of the chart. It bears an index mark along part of its length. The other plot is a curve whose distance at any point from the index line is a function of the strength of the signal being fed into the direction finding receiver at that instant. The direction to, or from, the station being received is indicated by a null (closest point to the index line).

(2) The bearing scale used with Radio Set SCR-292 consists of a transparent sheet of plastic marked with a series of arcs whose radius is equal to the length of the recording pen. Since the total length of the graph is 360°, once around the drum, the scale is calibrated 0-360 degrees along a length equal to the length of the graph. The index mark mentioned previously is set by adjustment of the index cam to give the base direction (North). The bearing from this base direction is found by placing the direction finder scale over the graph, with the bottom line along the index line, and with either the 0 or 360 arc on the lower left corner of the index mark. The bearing is then read as the angle shown by the scale for the lowest point of the null being measured.

*c. Types of bearing patterns that will be obtained.*

(1) These patterns fall into two general groups. The first group is made up of patterns in which the nulls are evenly spaced 90° apart. These occur mostly

on stations less than 100 miles distant. Usually, if fading is slight, all the peaks between the nulls will have approximately the same height. The second group is made up of patterns in which one pair of nulls, 180° apart, occur regularly at the same place; while the other pair shift and sometimes vanish. This pattern is most common on fairly distant stations.

(2) The two nulls which repeat regularly are known as the "true null" and the "reciprocal null", because one indicates the true bearing (from the D/F to the transmitter), while the other indicates the reciprocal bearing (from the transmitter to the D/F).

The two shifting nulls are known as "false nulls", and their position gives no useful information.

(3) In patterns of the first type, the record gives no clues as to which of the 4 bearings is true, reciprocal, or false, and all 4 must be read, but usually the true bearing can be detected when these bearings are plotted on a map, together with bearings taken by other D/F's on the same transmitter. In patterns of the second type the record is more helpful, since the false bearings can be seen and discarded. Then if the general direction of the transmitter is known, it is obvious which bearing is true and which is reciprocal.

SECTION III  
FUNCTIONING OF PARTS

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8. Theory of Spaced Loop Direction Finding.

a. *General.* Radio waves in space have been called spherical waves. That is, they leave the vicinity of the transmitting antenna in the same fashion as the expanding skin of a balloon being inflated leaves its uninflated position. As these waves of electromagnetic force move away from the transmitting antenna, the radius of the sphere of propagation is growing longer and longer so that insofar as a receiving antenna several miles away is concerned, the portion of the sphere that is affecting it is a plane perpendicular to the direction the wave is traveling.

b. *Simple Loop Theory.* Consider a single loop of wire, arranged in a vertical plane, with a radio wave passing by. The magnetic field of the traveling wave, cutting one side of the loop, induces an alternating voltage; and, a few billionths of a second later, cutting the other side of the loop, it induces a similar voltage there. The difference between these two voltages appears at the terminals of the loop; it is proportional to the amount of magnetic flux linked with the loop at each instant.

Many direction finders use a single loop antenna, and operate quite successfully over short distances. The loop is simply turned until its output, measured by a radio receiver tuned to the desired frequency, reaches a null (zero). Then the bearing of the transmitter is read as the direction perpendicular to the plane of the loop. There are two such directions, 180 degrees apart.

c. *Spaced Loop Theory.* Since the two loops used in Radio Set SCR-292 face the same direction, the magnitude of the output voltage of each loop will vary in the same manner, as they rotate. If the character of the arriving wave is such that there is a null at some direction, both loops will have a null at that direction. These loop nulls are subject to errors, and are unreliable for the same reason that a single-loop direction finder is unreliable when distance is great or when "night effect" (wave coming in at an angle) is present.

Besides the directivity due to each loop, the spaced-loop system has directivity due to the loop spacing, which is *not* affected by "night effect". When the antenna boom points approximately in the direction

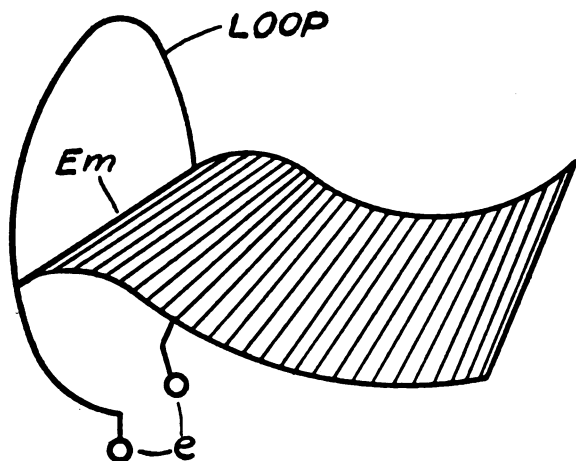


Figure 14—Loop, Cut by Magnetic Field

traveled by a radio wave, the wave will reach one loop several billionths of a second before it reaches the other. As a result, the r-f voltage output of the two loops will differ in phase; that is, one reaches its positive peak while the other is still rising, and drops part way back toward zero by the time the other reaches its peak; but the peak value will be the same for each.

The two loops are connected in opposition, so that the input to the direction finding receiver is proportional to the difference between the two loop voltages. When the voltage outputs of the two loops are out of phase, the difference will have a fairly large amplitude, although still less than the voltage of either loop alone. When the two loop voltages are in phase, as they are when the antenna boom is broadside to the direction the waves travel (since then the waves reach both loops at the same time), the difference is zero. The loops may have maximum output at this position but the two outputs cancel out. The nulls produced are free from "night effect" error.

*d. Need for Averaging a Series of Bearings.* Fading is extremely prevalent on the frequencies for which Radio Set SCR-292 was designed (2 to 12 megacycles), and an erroneous null may be recorded at times when the signal disappears on a bad fade. In Radio Set SCR-292 errors from this cause are avoided by allowing the system to rotate 4 or 5 times without raising the recording pen from the paper. There thus results a repeated pattern on the chart. Usually a false null due to fading will appear only once or twice, at a different location each time. The true nulls, on the other hand, will repeat; and there will never be a peak at their locations.

In some cases fading may cause a null so close to the true null that they cannot be distinguished; or the sides of the curve leading down to the null may be distorted, making it difficult to tell just where the null is. Practically the same effect can be produced by turning the SENSITIVITY control while the recorder is in operation; but if such adjustment is necessary the operator can mark the distorted portion of the curve and disregard it when reading the record. When the distortion occurs from unknown causes, most of its effect may be eliminated by averaging the bearings indicated by the curves which seem most nearly normal. If fading is severe, the best policy is to keep taking bearings, until a record is obtained near the high level rather than in the depths of a fade. This may require several changes of record paper, and adjustment of the SENSITIVITY control between records, but

at least one record of the group should turn out clear and readable. It is important that the operator realize that the direction finder is free from polarization effects only at the true null positions. Off position this does not hold. This accounts for the wide variety of patterns produced.

#### 9. Loops.

Each of the two loops used on the direction finder consists of a single turn of wire stretched taut on isolantite corner insulators, within a shield of 2-inch aluminum tubing, 5 feet square. Continuity of the shield is broken by a short length of bakelite tubing in the middle of the top side. This prevents the aluminum tubing from short circuiting the electromagnetic field that produces the desired voltage in the loop, while allowing complete and effective electrostatic shielding preventing undesired pickup. The voltage induced in each loop appears between the two threaded rods in the stand-off insulators at the bottom of the loop. These insulators fit into the boom through holes where the flanges on the loops are bolted to the sides of the boom.

#### 10. Boom.

*a.* The boom used to support and connect the loops is 4 inches square, in cross-section, by 22 feet long. It is constructed of two thick aluminum channel sections held together at top and bottom by aluminum cover plates. Inside the boom there are two identical transmission lines going from the center of the boom to each end. Each transmission line is made up of two wires which are transposed several times in the length of the boom. This transposition, along with the shielding afforded by the boom, assures that there will be no pickup by the transmission line itself. This is of extreme importance since the voltages being measured and compared theoretically are the loop voltages and any extraneous pickup would give rise to erroneous bearings.

*b.* The far ends of the booms are covered with an aluminum plate. When this plate is removed, the end cone-insulated terminals of the transmission line are exposed. Jumpers are permanently connected to the ends of the transmission lines, and are designed to fit under the terminals of the loops and thus connect the loops to the two transmission lines. At the center of the booms, two permanent jumpers connect the two transmission lines in such a fashion that the voltage produced by one loop opposes the voltage produced

by the other loop. Therefore, when the two-loop voltage is equal in phase and magnitude, no voltage results at the jumpers since the two voltages cancel.

### 11. Vertical Antenna.

The 10-foot vertical antenna mounted on a standoff insulator, figure 4, on a plate covering the center of the boom is used to provide a signal for monitoring purposes. It is in no way a part of the direction finding part of Radio Set SCR-292 but merely provides signal voltage for the monitor receiver.

### 12. Slip Ring Assembly.

The slip ring assembly, figure 5, consists of six slip rings and one cam ring mounted on a bakelite tube. This is, in turn, mounted on an assembly of two copper pipes that carry the wires connecting the vertical antenna and the horizontal transmission line to the slip rings. The wire used in this assembly is insulated with copolene "B", for low loss, and shielded with an outside braid. This outside braid is grounded, at one point, at the bottom of the assembly. This one-point ground arrangement eliminates undesired voltages being produced by differences in the paths of the currents draining from the loop boom shield to ground. The same arrangement is also followed out in the grounding of the large copper pipe. The top end is insulated and connected to the top plate at only one point, to eliminate peculiar ground currents which might produce erroneous voltages in the loop circuit by induction. To be certain that erroneous voltages will not be produced by induction, the two shielded, insulated loop voltage cables inside the large copper pipe are twisted along the length of the pipe. The vertical antenna line feeds up through the fitting in the antenna top plate and terminates in a cap with a 6-32 threaded end that bolts to the plate at the bottom of the insulator which supports the vertical antenna. Similar caps on the ends of the loop wires are bolted to the jumpers in the boom. The wires are connected to the slip rings in the following manner: The top ring goes to the vertical antenna, the next to ground, the next two are not used. The fifth ring carries one loop line. The sixth ring is the other loop ring, while the seventh ring is the cam ring used to actuate the micro-switch in the brush holder assembly in the reference direction.

### 13. Brush Holder Assembly.

The brush holder assembly can be broken down into two separate circuits; first, the r-f signal circuits, and second, the various a-c and d-c control circuits. First, consider the r-f circuits. In line with the proper slip rings, there are mounted shielded brushes. These brushes are so constructed (see figure 15) that the signal voltage being measured is conducted through a completely shielded path to a plug, see figure 16, thence into a coaxial line to the antenna coupler and monitor receiver for the loop lines and monitor antenna lines respectively. The ground brush is internally grounded by the ground plug. Ground currents previously spoken of are drained from the brush holder assembly through a triple braid ground line, made up of three  $\frac{3}{8}$ -inch braided lines, that run inside the web of the equipment racks. These terminate at the bottom on a

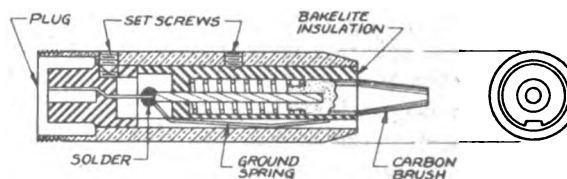


Figure 15—Brush Holder, Detail Diagram

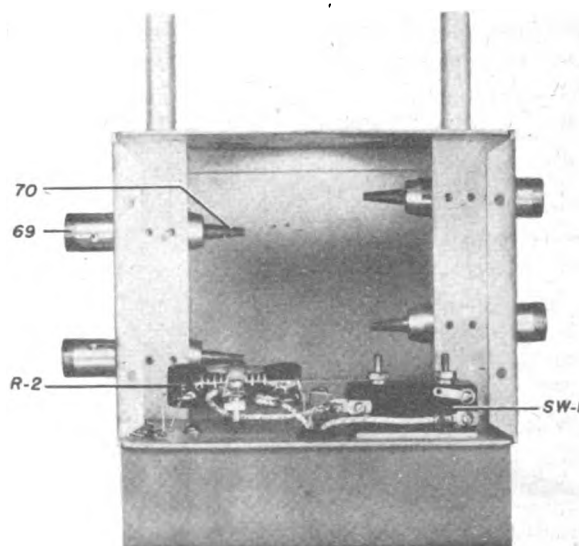


Figure 16—Brush Holder Assembly, Inside View



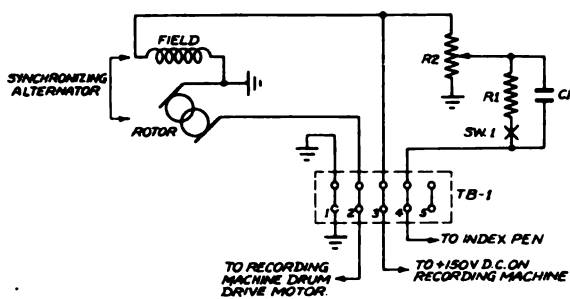


Figure 17—Brush Holder Assembly, Control Circuits

ground clamp that is fastened to a 10-foot ground rod which has twenty 100-foot radial wires soldered to it. This ground assembly provides an extremely low impedance path for ground currents to follow and prevents any erratic voltages being set up due to voltage drop in the grounding system.

The control circuits, centered in the brush holder assembly, are as shown in the functional circuit, figure 17. The terminal block at the bottom of the box, figure 18, provides a convenient termination for the synchronizing alternator wiring. R1, C1 form a click filter, to eliminate any noise due to the operation of the micro switch. R2 provides an adjustable voltage for the actuation of the indexing pen on the recorder.

14. Antenna Coupler.

The loop lines from the brush assembly terminate in receptacles on the antenna coupler. The antenna coupler, see figures 19 and 20, is designed to resonate the entire electrical circuit from its terminals to and including the loops. Because the system is rather large, it tends to become self resonant at two frequencies, roughly 5 megacycles and 10 megacycles.

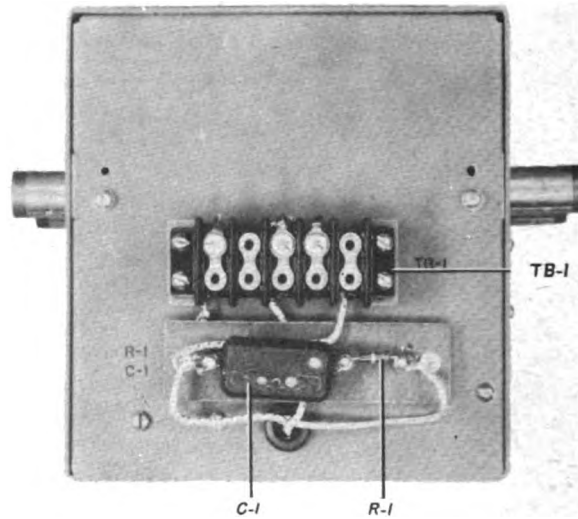


Figure 18—Brush Holder Assembly, Terminal Board Cover Removed

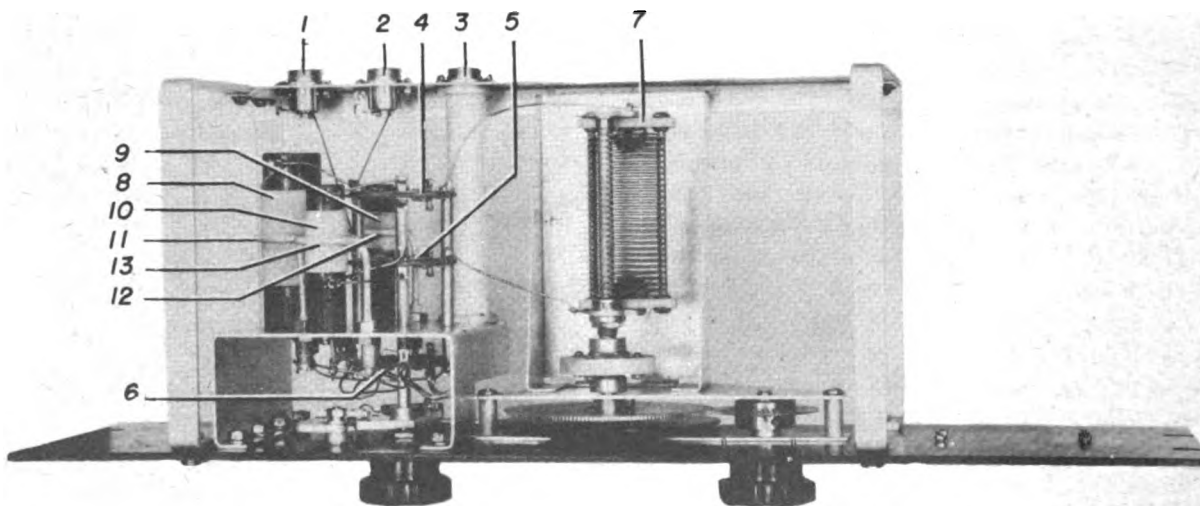


Figure 19—Antenna Coupling Unit, Top View

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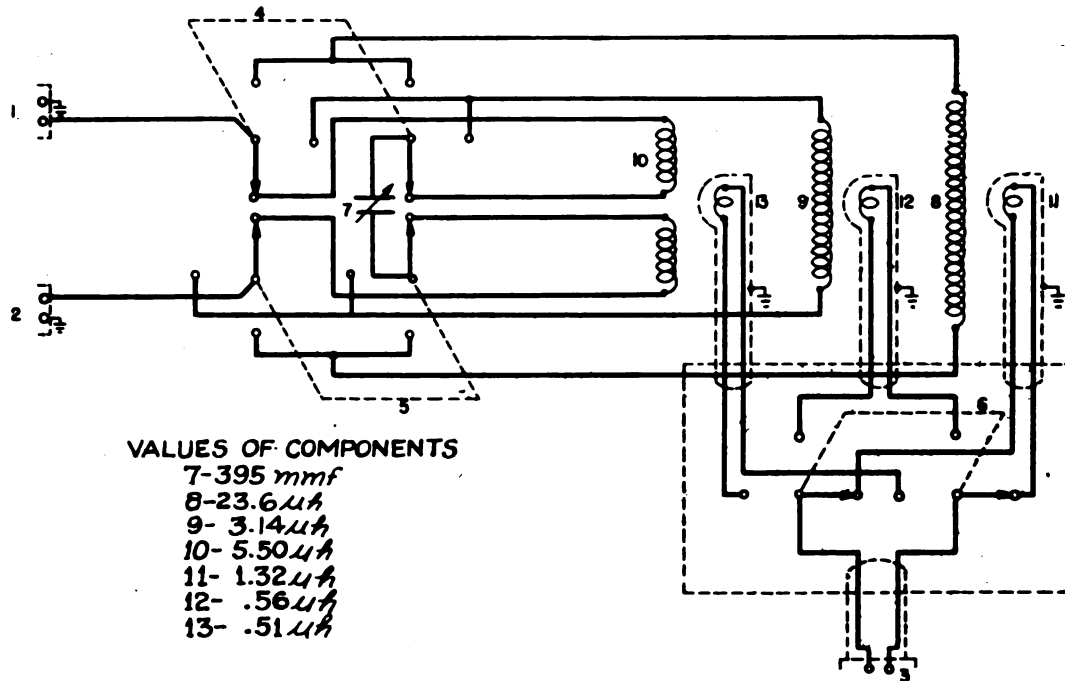


Figure 20—Antenna Coupling Unit, Schematic Diagram

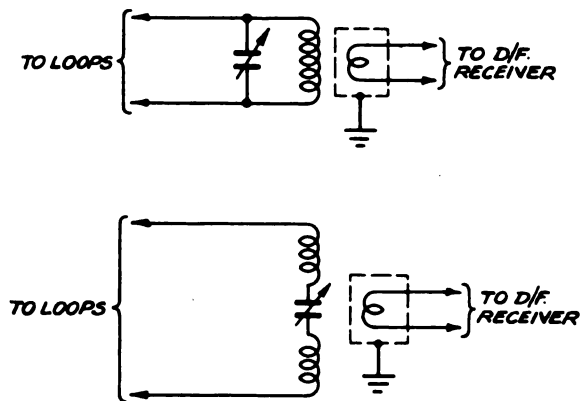


Figure 21—Antenna Coupling Unit, Matching Circuit

Therefore, between 2 and 10 megacycles the coupler must match an unusually wide range of reactances. This necessitates a rather unusual arrangement which can best be shown schematically by two circuits, figure 21. Circuit one is used where a relatively high react-

ance of the system is to be matched, and circuit two when a low reactance is to be matched. The switching and band overlap is so chosen as to afford the optimum circuit conditions for the frequency in use. As shown, the output coils are electrostatically shielded from the input coils to prevent unbalancing the system. The use of the coupler results in an overall gain in signal of approximately 16 db, in the region of 4 megacycles, without the necessity of tubes.

15. Receivers.

The receivers are standard "Super-Pro" Radio Receivers, BC-1004-C, unmodified in any way. For functioning of receivers, see "Super-Pro" Receiver Instruction Manual. The vertical antenna lead from the brush holder assembly goes to the antenna terminals of the monitor receiver and the output of the antenna coupler goes to the antenna terminals of the direction finder receiver.

SIGNAL CORPS

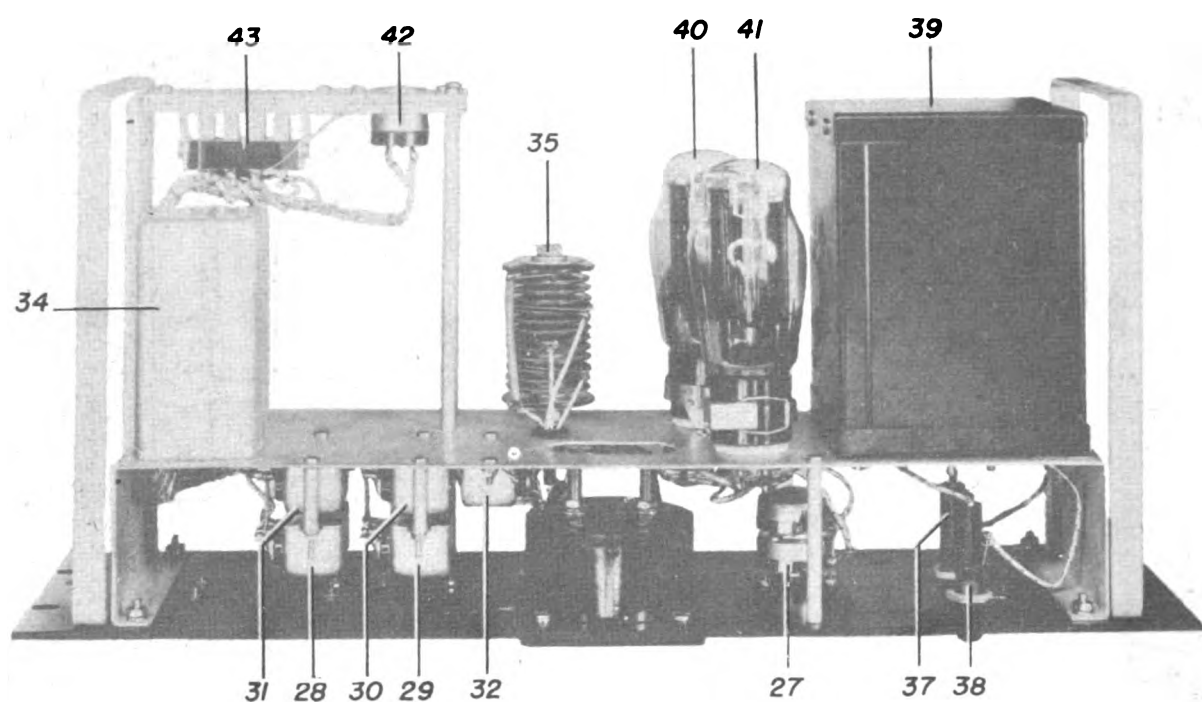
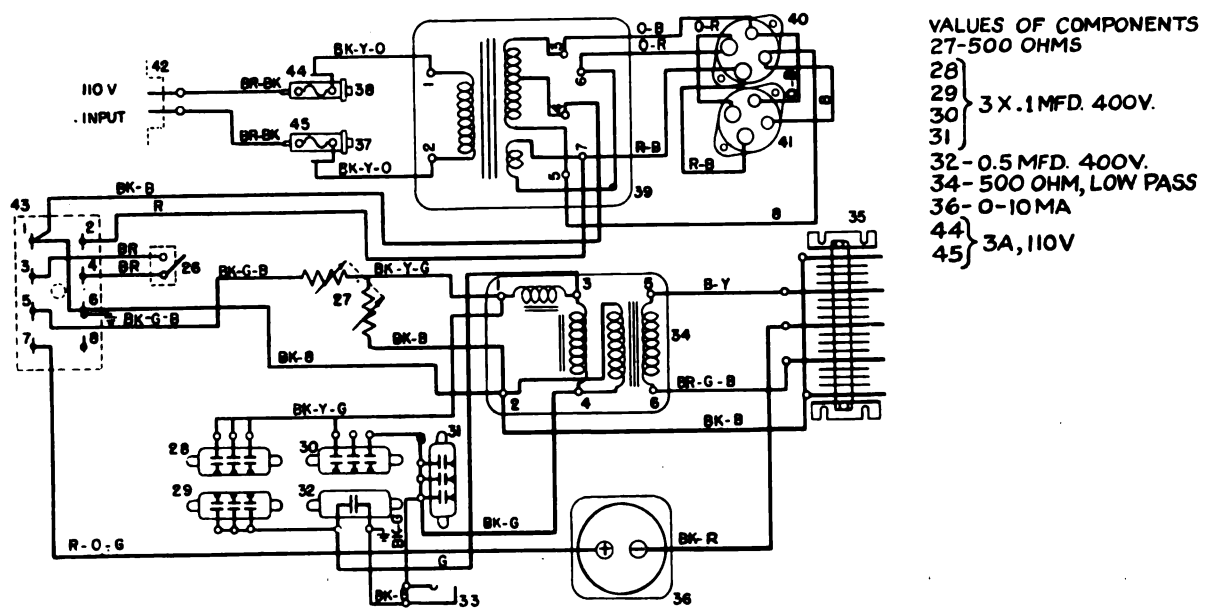


Figure 22—Control Panel, Top View

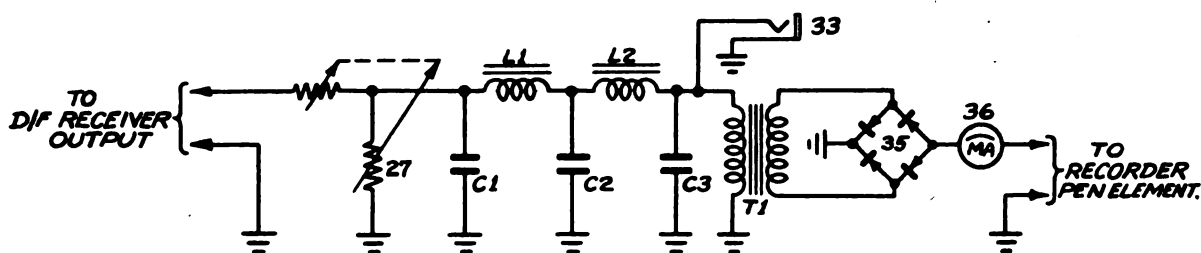


- VALUES OF COMPONENTS  
 27-500 OHMS  
 28 }  
 29 } 3 X .1MFD. 400V.  
 30 }  
 31 }  
 32-0.5 MFD. 400V.  
 34-500 OHM, LOW PASS  
 36-0-10MA  
 44 }  
 45 } 3A, 110V

Figure 23—Control Panel, Schematic Diagram

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NOTE:-L1 & L2 ARE PART OF THE CONTROL UNIT FILTER 34  
C1, C2 & C3 ARE MADE UP OF REF. N° 28, 29, 30, 31 & 32

Figure 24—Control Panel, Filter Circuit

16. The Control Panel.

The control panel, figures 22 and 23, consists of two separate channels with different functions. First, there is the control channel. The output from the direction finder receiver is alternating current of audio frequency, between 20 and 400 cycles, produced by beating the beat frequency oscillator against the signal frequency. In order that this audio frequency shall operate the recording pen, it must be changed to direct current. The value of the direct current produced will then be a direct function of the amplitude of the receiver output, which is, in turn, a function of the amplitude of the input voltage to the receiver or the net loop voltage. This circuit is as in figure 24. L1, L2, C1, C2, C3 constitute a low pass filter whose purpose it is to filter out tube noise, random noise and static by making the control circuit insensitive to frequencies above 400 cycles. Headphones plugged in the monitor jack, 33, allow audible monitoring of the filtered signal; the L pad allows adjustment of the level of the signal reaching the control circuit. Transformer, T-1, matches the impedance of the rectifier and recorder to the impedance of the filter which is matched to the receiver. Meter, 36, is connected in series with the

recording pen element and shows visually the amount of current reaching the element, reading from 0 to 10 milliamperes. A red line is marked on the meter scale to give a rough setting point for proper recording level.

The other circuit in the control panel assembly is a power circuit shown in figure 25. Transformer, T-1, is a heavy duty transformer designed to deliver 150 volts of rectified, unfiltered direct current, under full load of 250 milliamperes. The rectification is carried out in two full-wave rectifier VT-145 tubes, 40 and 41, connected in parallel. The output of this rectifier goes to the recorder and finally to the synchronizing alternator field. In addition to these circuits, there is included in the control panel a switch marked LOOP MOTOR, 26, to actuate the loop drive system.

17. Loop Drive System.

This consists of several parts, see figure 26. Motor, M1, is a 1/2 horse-power, capacitor start, single phase, 110-volt motor which is geared to the loop-boom as-

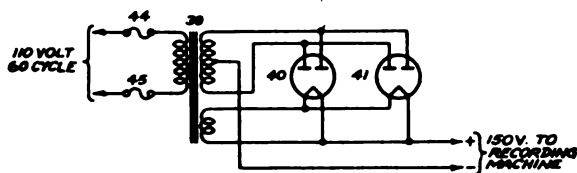


Figure 25—Control Panel, Power Circuit

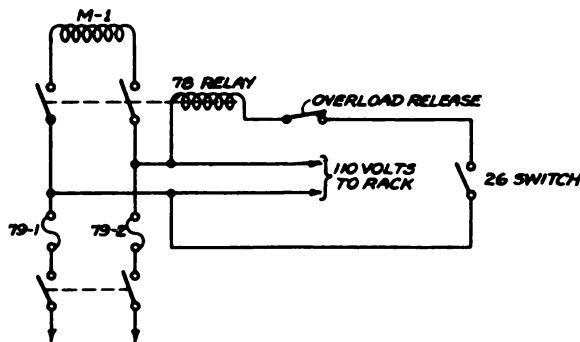


Figure 26—Loop Drive System, Schematic Diagram

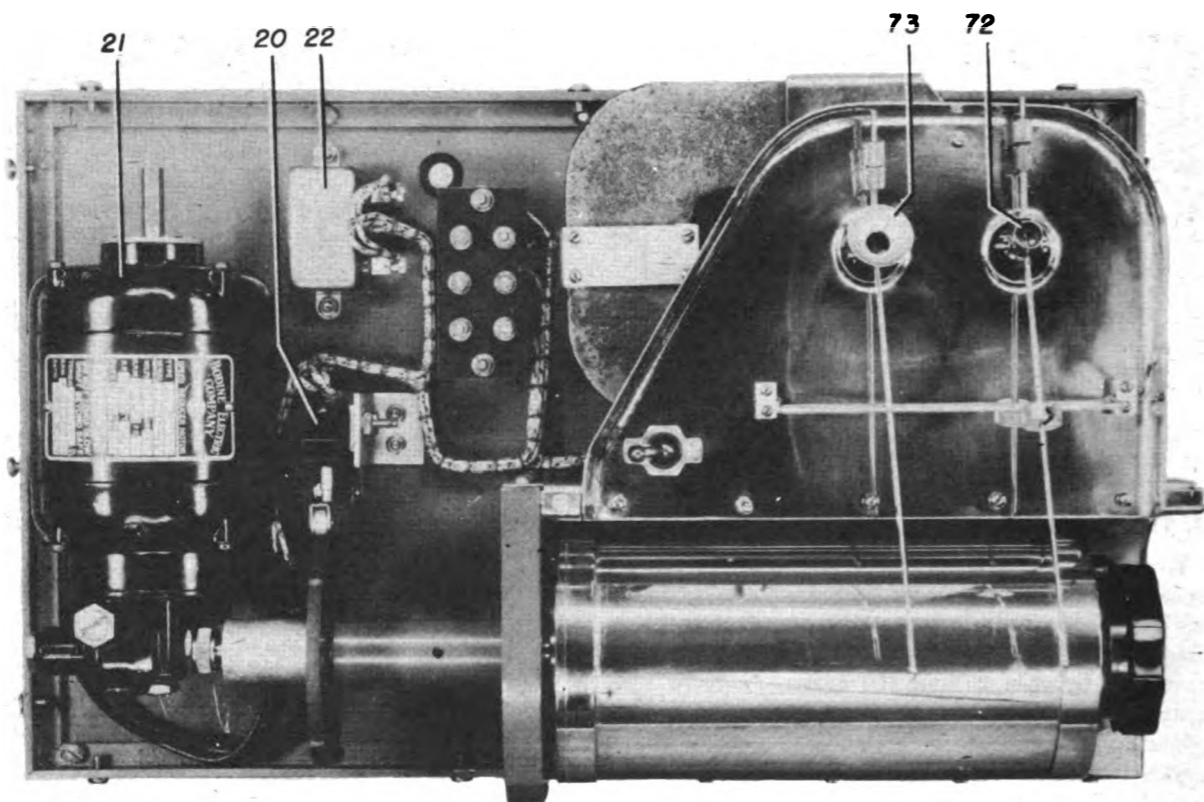


Figure 27—Recording Machine, Top View

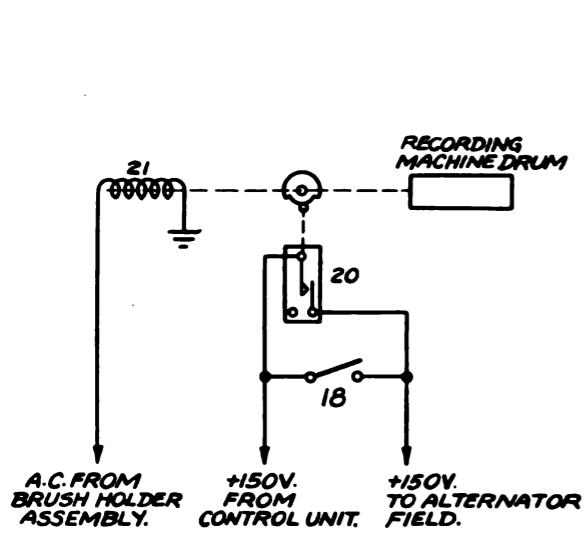


Figure 28—Drum Rotation, Control Circuit

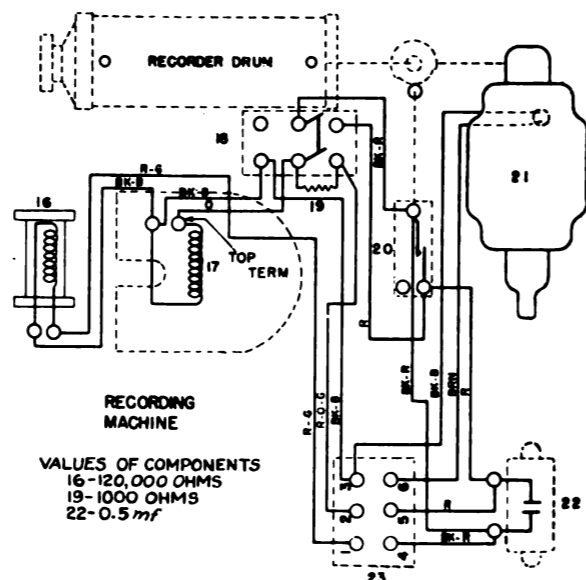


Figure 29—Recording Machine, Schematic Diagram

sembly. The gearing reduces the speed of the motor (1750 rpm) to approximately 15 rpm for the loop drive shaft. Starting and stopping of the loop drive motor is controlled by the relay operated starter on the main power panel. The motor is protected against overloads by the releases which trip the relay if the motor draws an excessive starting current for too long a time. The power unit is protected against equipment short circuits by fuses, 79-1 and 79-2.

18. Recording Machine.

The recording machine, figure 27, consists of a drum on which paper may be fastened, two ink pens which automatically write on the paper, and associated control circuits, figures 28 and 29. Operation is as follows: While the loop-boom system is rotating, switch SW-1, the upper part of switch, 18, is closed (thrown to the right, in figure 29). This applies +150 volts direct current to the alternator field. The alternator begins generating 110 volts at a frequency determined by the rotational speed of the loop-boom

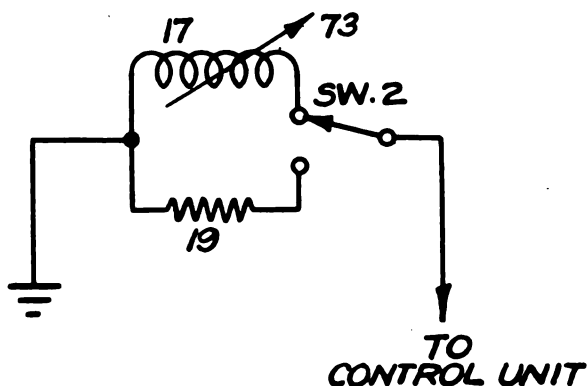


Figure 30—Recording Pen, Functional Diagram

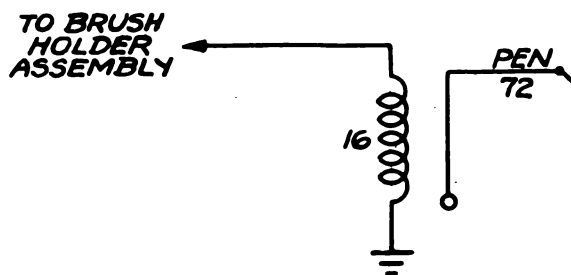


Figure 31—Index Pen, Functional Diagram

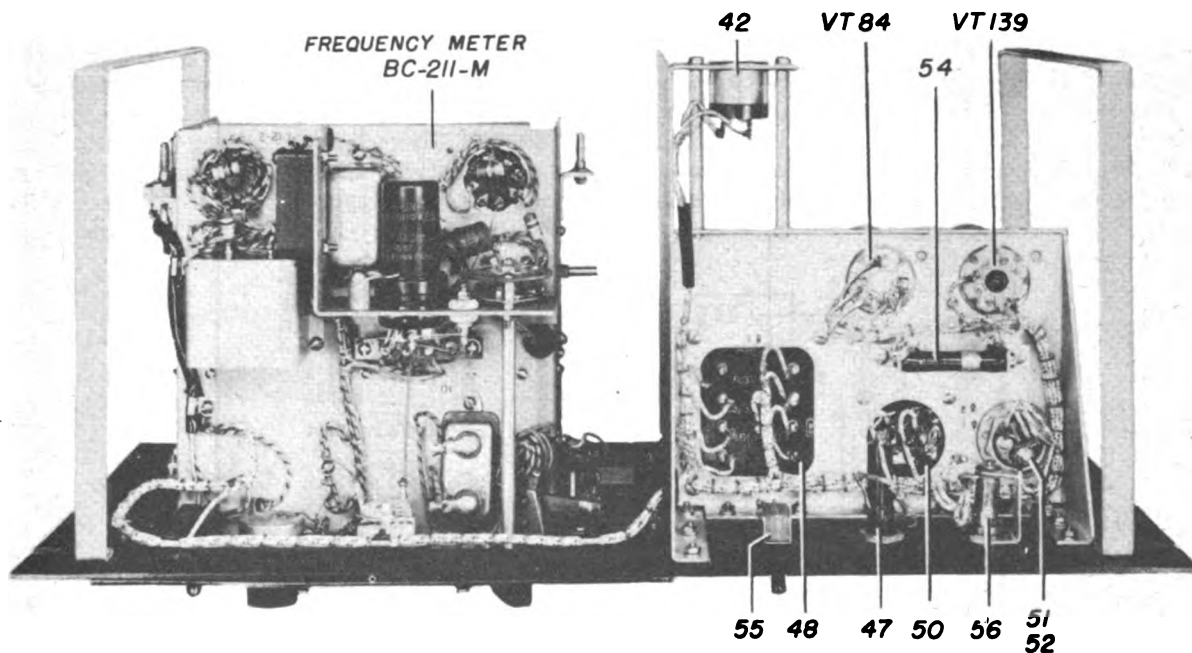


Figure 32—Crystal Frequency Indicator, Bottom View

SIGNAL CORPS

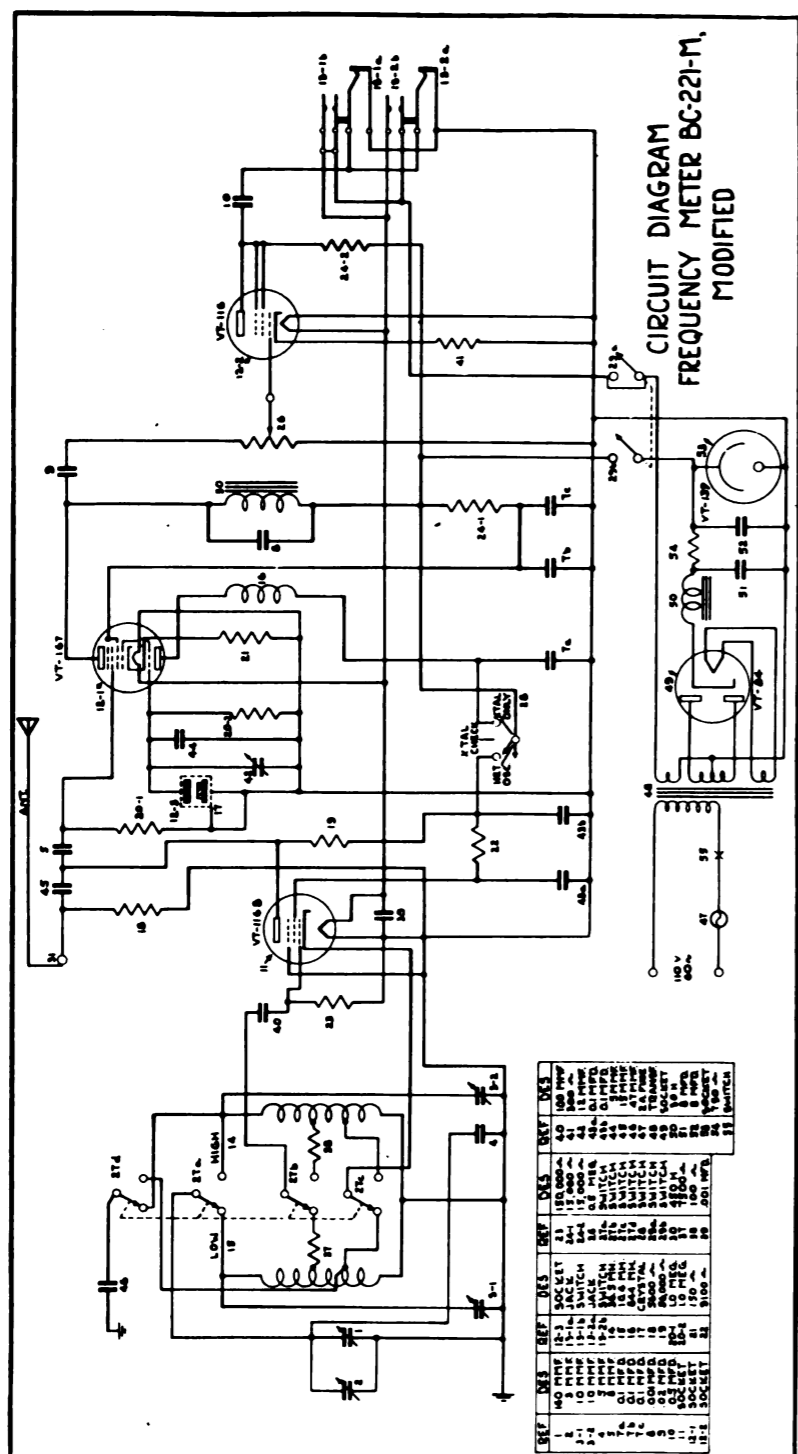


Figure 33—Crystal Frequency Indicator, Modified, Schematic Diagram

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system to which it is geared. This 110 volts alternating current is fed to synchronous motor 21 geared to the recorder drum. The drum then rotates at the same speed as the loop boom system. To stop the system, switch 18 is opened but the circuit remains closed through the cam operated micro-switch, 20, until the drum is in a position that allows quick removal of the record. When the circuit is opened, d-c excitation is removed from the synchronizing alternator which immediately ceases generating, hence the motor, 21, stops and the drum stops.

The recording pen circuit is shown functionally in figure 30. The switch SW-2, is the lower part of switch 18 in figure 29. Thus, when switch 18, is ON the pen element is connected to the control circuit output of the control panel and the pen deflects in accordance with the resultant current which, as has been shown, is in accordance with the loop system resultant output. When switch 18 is OFF, switch SW-2 connects resistor, 19, across the output of the control circuit. Resistor, 19, simulates recorder, 17, insofar as direct current is concerned so that the RECORDER LEVEL meter still shows a reading. The one remaining circuit is the index pen, see figure 31. This consists of a simple telephone type relay, 16, having no contacts but carrying, on its armature, a pen that draws a line on the recording machine chart (graph) near one edge. When the pen relay is actuated by the index cam in the brush holder assembly, the pen moves out away from the edge a greater distance forming a rise on the index line. The index pen is actuated only when the drum of the recording machine is rotating, for only then does d-c voltage appear at the cam switch in the brush holder box.

**19. Radio Transmitter BC-1149-A (Target).**

When using this target transmitter for setting the index cam of the direction finder, the antennae are set in the vertical plane, parallel with the vertical antenna atop the direction finder shelter. For operation and maintenance of the target transmitter, see Instruction Book for Radio Transmitter BC-1149-A.

**20. Signal Generator I-72-(\*).**

This is the standard Signal Generator I-72-(\*), covered by the instruction sheets carried inside the front cover. This generator is used for making routine checks of receiver operation, specifically in troubleshooting.

**21. Crystal Frequency Indicator.**

For complete functional information of Frequency Meter BC-221-M, refer to the Preliminary Instructions for Frequency Meter SET SCR-211-M. See figures 32 and 33 in this book for modification of this unit when used with Radio Set SCR-292.

The r-f output of the frequency meter is radiated from a short antenna mounted behind the dust cover. This emitted signal can be received by either of the receivers and can be used as described in the instruction book for the frequency meter to measure the frequency of any signal being received by the direction finder; it may also be used to set up the equipment on any predetermined frequency. In event the signal reaching the receiver is inadequate, due to receiver aging, it is permissible to fasten a longer wire (2 to 3 feet) on the small antenna to give more field strength. The addition of such a wire does not affect the calibration of the crystal frequency indicator.



SECTION IV  
MAINTENANCE

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**22. Operational Inspection By Using Personnel.**

*a. Overall Test.*

Set up the target transmitter at least 200 feet away from the direction finder shelter, over a stake of known direction. The target dipoles should be vertical. Tune the target to a frequency near 5 megacycles. The control switches on the target transmitter should be set for ICW, HI output.

(1) Check all plugs to be certain that they are making good contact and are securely seated (see cording diagram, figure 34). On the cords interconnecting the brush box, antenna coupler and the receivers, make certain that the outer collar is tight. Check headset cords. Clean all headset plugs and jacks.

(2) Check all pilot lamps.

(3) Take a bearing on the target transmitter. Allow the recorder drum to rotate for three complete revolutions while taking this bearing. Remove the bearing, blot and examine it. The pattern produced should have four nulls, each pair 180° apart with a pair of true nulls giving the true bearing of the target and its reciprocal. The peaks produced should be equal amplitude (closely). In particular, the true nulls should not both be higher or lower than the false nulls.

(4) Take several bearings on weak stations to be certain that the equipment is operating satisfactorily. These bearings may produce either 2 or 4 null patterns depending on conditions and atmospherics. Always allow the system to rotate several times while taking a bearing and observe the bearing as it is being recorded, checking nulls that look good as they are received. (A good null is one that comes from a peak, ends in a peak and is smooth while in the null region.) An effort should be made to average the nulls visually while interpreting the bearing.

(5) Allow the system to rotate about ten times with the recording pen raised. Let the index pen touch the paper for the first and last revolution. The index mark should repeat at exactly the same position.

(6) Open the brush assembly box and inspect. Water should not leak from the boom through the slip ring assembly. If it does, the boom should be painted thickly with the bitumastic paint supplied in the ERECTION EQUIPMENT chest.

(7) To determine if the target transmitter is operating, bring it close to the direction finder shelter (just outside the door) and throw the switches ON, HI, ICW. Set the frequency using the main dial and band switch. If the target is operating, its signal can be picked up by the monitor receiver. If signal cannot be picked up, and the receiver is known to be in operating condition, the target is not operating. Consult the Instruction Book for Radio Transmitter BC-1149-A.

(8) To check for proper operation of Power Unit PE-95-(\*), turn on all the equipment in the direction finder shelter, then check the a-c voltage being generated by the power unit as indicated on the meter provided on its instrument panel. This voltage should be between 115 and 120 volts. If it is not, consult TM 11-904, Technical Manual for Power Unit PE-95-(\*).

(9) To check for proper operation of the crystal frequency indicator, turn the switches on and refer to the Preliminary Instructions for Frequency Meter Set SCR-211-M. The signal radiated at the test frequency should give adequate output from both receivers to enable setting these receivers on the frequency.

(10) The maximum sensitivity of the direction finder is limited only by receiver sensitivity and noise level; see "Super-Pro" Receiver Instruction Manual.

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The average overall sensitivity will run about 25 microvolts per meter from 2 to 12 megacycles with minimum of 50 microvolts per meter as the receiver sensitivity decreases with age.

**23. Lubrication Instructions.**

The following parts require lubrication after the hours of service indicated below:

Part	Time	Lubricant
*Main drive motor Gear Box	Every 500 hours As required	SAE 30 oil SAE 70, or SAE 30 for extremely cold climates
*Small Gear Case Alternator	As required	SAE 30 oil
Recorder drum shaft	Every 100 hours As required	Beacon M285 One drop SAE 30

*\* DO NOT over-lubricate these units since excess oil will drip on equipment and using personnel.*

Do not lubricate the tuning capacitors, volume controls, switches, alternator slip rings or loop slip rings. The recorder motor 21 is permanently lubricated and will not require attention unless disassembled, in which case SAE 30 oil should be used on all bearings.

**24. Replacement of Small Parts.**

*a. Fuses.*

(1) The fuses for the input power circuit are inside the main power panel box. Turn the main power switch off then move the switch handle slightly so that it is in the OPEN position. Open the box. Two 30 cartridge main power fuses are in clips inside. Remove the defective fuse, unscrew its end caps and replace the link with a spare link from the spare parts chest.

(2) The control unit and crystal frequency indicator have fuses accessible from the front panel. They are clearly marked and the fuse size is indicated on the panel. To change fuses, unscrew the bakelite cap, pull the assembly out, remove the defective fuse and replace with a new one from the spare parts chest.

(3) The receiver power supply unit fuses are similar to those used on the units described in paragraph 24a(2). They are located on the rear of the chassis.

*b. Lamps.*

(1) The pilot lamp on the crystal frequency indicator unit is accessible from the front panel. Un-

screw the jewel, grasp the pilot lamp, press in and turn to the left, then remove the bayonet-base pilot lamp and replace.

(2) The pilot lamps in the receiver are accessible after the receiver dust cover is removed (see "Super-Pro" Receiver Instruction Manual).

*c. Tubes.*

(1) To reach the tubes in the crystal frequency indicator and the power supply remove the dust cover from this unit. The power supply tubes are removed by pressing down the tube clamps and pulling out the tubes. To replace tubes, merely plug them in. To replace tubes in the indicator unscrew the tube clamps and swing them out of the way. Put the clamps back in place after new tubes have been inserted.

(2) To reach tubes in the control unit, remove the dust cover from that unit. To remove the tubes, unsnap the "luggage strap" tube clamps. Resnap them when new tubes are in place.

(3) Receiver and receiver power supply tubes are removed and replaced as per instructions in "Super-Pro" Receiver Instruction Manual.

*d. Brushes.*

(1) To remove the main drive motor brushes, remove the cover plates from motor rear end bell. Remove wires from starting assembly. Remove rear end bell. Unfasten screws holding starting assembly in place. Remove and replace. The correct rotation direction of the motor is that giving counter-clockwise rotation of the boom viewed from below. If the direction is wrong, reverse the two leads to the starting assembly.

(2) To remove alternator brushes, remove rear end bell by removing three screws. Unscrew brush caps. Replace brush and spring unit. Clean slip ring with rag. If dull, polish with crocus-cloth, not emery paper.

(3) To remove main slip ring brushes, remove four nuts holding cover on brush box. Remove plug and cable from defective brush. Remove defective brush assembly by loosening two set screws on the brush holder support bar. Replace entire brush assembly and retighten set screws. In addition to replacement brush assemblies, spare brushes are provided. Figure 15 shows how the assembly is constructed. To remove defective brush, remove two set screws in brush shield. Force out bakelite tube by pushing from the front end of the brush. Remove old brush and replace.

(4) To remove main drive motor starting capacitor, remove the four screws holding the capacitor under the motor. Remove the outer clamp by sliding it away from the wired end. Remove the friction tape that holds the end caps on. Remove the end caps. Unsolder the leads from the capacitor and remove capacitor from motor. Replace capacitor with new unit and reassemble.

#### 25. Minor Repairs and Adjustment for Field Upkeep.

*a. Loops.* In moving the equipment from place to place, the loop insulators may be broken or cracked. If so, remove the nut that normally holds the loop wire taut and remove the cracked insulators being careful to keep the wire taut. Insert the new insulator, from the spare parts chest, and replace the nut. Measure the resistance from the loop wire to each end flange. This resistance should be high (over 10 megohms); if it is zero, the wire has fallen from the isolantite pulleys and is resting on the inside of the aluminum-shield. To repair, disassemble the loop as described in paragraph 27a, replace the wire and reassemble.

*b. Boom Insulator Replacement.* If an insulator should be broken in the boom, merely remove the broken unit and replace it with a new unit from the spare parts box. The wire should be adjusted approximately as tight as the other wire, as judged by the tightness of the nut that holds the insulator on.

*c. Boom Painting.* After assembling the direction finder, the entire boom should be given a *thick* coat of bitumastic paint. Particular attention should be given to the boom end covers, the loop flanges, and the removable boom top plate. These are points of possible water entrance, hence be careful to paint all possible openings. The boom bottom hub, which carries the set screws that hold the boom to the gear box shaft, should also be painted with bitumastic to prevent the set screws from rusting fast.

*d. Patching Roof.* To patch holes in the roof, use the roofing paper and nails supplied in the tool box. Nail patch on, then paint well with bitumastic.

*e. Servicing Power Unit PE-95-(\*).* To add gasoline or water to the power unit unlock the roof from inside the generator shelter, then lift the roof section and shove it forward or to the rear, as required. To do minor repair work, enter shelter, and remove side covers from the power unit. In bad weather, repair work may be done without removing the roof but if the power unit is operating, both ends of the shelter should be

wide open to insure ventilation. **Do not attempt to do any repair work not covered by TM 11-904, Technical Manual for Power Unit PE-95-(\*).**

*f. Cleaning Slip Rings On Synchronizing Alternator.* If, on inspection, the alternator slip rings need cleaning, remove the fan from the end of the alternator shaft, then turn the loop motor on. Hold a piece of fine crocus cloth (not emery paper) against the rotating slip rings. **CAUTION: This must be done with the recording machine control switch OFF to prevent the possibility of electrical shock to the operator.**

*g. Adjusting Loop Slip Ring Brush Holder Assembly For Proper Height.* The brush holder assembly should be mounted in such a position that the brush points are centered on their slip rings. Do this by sliding the whole brush holder assembly up or down by first loosening the two set screws holding the brush holder assembly mounting bars in the gear box proper, moving the brush holder assembly to the proper location and retightening the set screws.

*h. Gear Box Mounting Frame.* The H frame that supports the gear box must be kept tight. Periodically check all lag screws and tighten if necessary.

*i. Recording Machine.* If the drum of the recording machine stops in a position that is inconvenient for changing paper, remove the dust covers by removing the binder head fastening screws and loosen the set screws that hold the drum shaft in the cam fitting. Rotate the recorder drum to the desired position by turning the knob at the outer end of the drum. Retighten the set screws and replace the dust cover. If the index pen does not make a high enough indication, remove the dust cover and the chrome-plated cover plate and bend the relay motor arm that moves the pen mechanism to allow more travel. If the pen action is sluggish, increase the voltage to the pen by loosening the slider on resistor in the brush holder assembly and moving it to the right. If the pen tends to oscillate at the indexing point, move the small weight on the pen assembly toward the pen end. To clean the pens, force ink through them by first filling the cups then using the pen syringe to suck ink through the pen tip.

*j. General.* Examine all units periodically, tighten loose screws, clean out dust, and clean plugs.

#### 26. Tube Socket Layout Diagrams.

*a. Control Unit.* The only two tubes are both VT-145, located on rear of the chassis.

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b. For crystal frequency indicator unit and its power supply, see Preliminary Instructions for Frequency Meter Set SCR-211-M. The modified circuit, Figure 33, includes two tubes on the small chassis. These are VT-139, the octal base type, and VT-84 the 5 pin tube.

c. For receivers see "Super-Pro" Receiver Instruction Manual.

**27. Removal and Assembly of Parts.**

a. *Loops.* When assembling or removing the loops used on the direction finder, bear in mind that the weight of the loop is distributed above the points of support. When the flanges are unbolted, there is a tendency for the whole loop to rotate. This must be prevented because it is very easy to snap off the loop insulators in this manner. Therefore, in working on the loop follow this procedure. First, rotate the boom until the desired loop is directly over the power unit shelter. Two men are required. One man is to work from atop the power unit shelter, the other from the ladder supplied with the radio set. Lean this ladder against the power unit shelter and lash it to the shelter. It must not rest on the loop. The man on the ladder removes the end plate on the boom then disconnects the links from the loop by removing the No. 6-32 nuts that hold them on. The man on the roof removes all bolts that hold the loop to the boom except two bolts on each flange. While the man on the ladder supports the loop and prevents it from rotating, the man on the roof removes the remaining bolts and removes the loop by springing the sides apart. In assembling, follow reverse procedure.

To disassemble the loop itself, first remove the two cone insulators from the feed-out screws. Remove all bolts from the flanges at each corner. The loop may then be easily pulled apart. In reassembly, fasten one cone insulator on one lead-out screw in its proper position (approx.  $\frac{1}{2}$ -inch of screw thread past top of insulator) feed the wire in from one end, pass it over the small isolantite corner insulator, then holding the wire taut, pass the side section of the loop shield over the wire. Bolt the first corner, repeat at other corners. After assembly, check the resistance from the center wire to both loop shield flanges which mount the loop to the boom. This resistance should be over 10 megohms. If it measures zero, the wire is off one corner insulator. If it measures less than a megohm the corner insulators should be cleaned with carbon tetrachloride as should the bakelite plate through which the lead out wires pass.

b. *Boom.* The boom should never be removed with the loops mounted. Assuming the loops are off, proceed as follows: Turn the boom until one end is over the power unit shelter. Set up the ladder on the opposite side of the direction finder shelter. Remove the coaxial line from the vertical antenna. Unscrew the top from the feed-through fitting and remove the packing from this fitting. Then remove the whole top plate with the vertical antenna still in position. Next disconnect the loop feed-in lines from the cross links inside the boom. A  $\frac{1}{4}$ -inch spintite wrench will handle the nuts on the links. Then using an Allen wrench, loosen the set screws that fasten the boom hub to the vertical drive shaft. Push upwards on the boom. If it sticks, try hitting the hub. If it still sticks, set up the bracket on which the gear box was shipped over the center of the boom, then rig the block and tackle from a wrecking bar supported on the bracket to a sling around the center of the boom. Pull up while tapping the hub. Take care not to bend the rain shield when the boom is loose.

c. *Synchronizing Alternator.* To remove the synchronizing alternator from the gear box, first drain the oil from the small gear case by removing the top and bottom plugs. Next take the cover off this gear case and remove the gear and oil finger from the shaft of the alternator. Remove the alternator wires from the strip on the brush assembly. Remove the four base screws that mount the alternator to its support plate.

d. *Main Drive Motor.* Before dismantling the motor, open the small connection box on its left side. Untape the leads inside and disconnect the armored power cable from the motor leads. Remove the lock-nut mounting the armored cable to the motor connection box. Remove the cable. Loosen the set screw that fastens the flexible coupling to the motor shaft. Remove the four bolts that hold the motor in position.

e. *Brush Holder Assembly.* To remove the brush holder assembly, first remove the front cover by removing the four knurled screws. Remove the two screws that hold on the bottom cover. Next, remove all wires leading from other equipment to the brush holder assembly. Then loosen the set screws that hold the brushes in position and remove the brush assemblies. Finally remove the two set screws in the main gear box casting that hold the brush support rods and slide the assembly straight down. In re-assembly, be extremely careful to prevent bending the micro-switch arm. Depress this arm to clear the cam ring.

*f. Slip Ring Assembly.* Remove the top link connections inside the boom then remove the four screws near the bottom of the hollow main shaft and slide the slip ring assembly down and out.

*g. Field Telephone EE-8-(\*).* To remove the field telephone, remove the two screws behind the speaker panel that hold the clamp. The telephone may then be lifted out.

*h. Control Unit Panel.* Remove the two plugs from the rear of the control unit. Remove the dust cover by removing the two knurled screws. Remove the panel from the rack by removing the four mounting screws. To service any part mounted on the chassis, unsolder the leads on the fuses from the cable then remove the leads from the fuses to the main power transformer. Remove the chassis from the front panel by removing the seven screws that hold it on. All parts are now completely accessible. To change the main power transformer, unbolt all leads and remove the four mounting screws. Do not attempt to open the unit since it is solidly filled with potting compound.

*i. Crystal Frequency Indicator.* First remove the 110-volt plug. Then remove the dust cover by removing the two knurled screws and sliding the cover straight back. All parts on the power supply are easily accessible. To service the removable crystal frequency indicator unit, remove the three wires from the power supply and remove the four nuts from the panel mounting screws. Now slide out the unit and service as described in Preliminary Instructions for Frequency Meter Set SCR-211-M. Figure 23 in this book shows circuit diagram modification for use of Frequency Meter BC-221-M in the direction finder.

*j. Antenna Coupler Unit.* Remove the three plugs from the rear of this unit then remove the dust cover by removing the two knurled nuts and sliding the cover off. Everything in the unit is now accessible. If, however, it is desired that the r-f chassis be removed, proceed as follows: Unsolder the wires from the two plugs and the capacitor to the switch wafers. Remove the socket that has the pipe behind it by removing the two screws and unsoldering the two wires to the socket. Remove the four screws that fasten the plug mounting bracket to the dust cover bracket. Remove the six screws that mount the r-f chassis to the front panel. Slide the chassis straight back. In reassembly, be certain that the switch sections are all in line and in the same position as the band change shaft.

*k. Receivers.* To repair either receiver, disconnect the plug from the antenna connection then proceed according to "Super-Pro" Receiver Instruction Manual.

*l. Recording Machine.* To service any part of this unit, proceed as follows: Remove the mounting screws that secure the dust cover. The motor, 21, and positioning cam switch, 20, are immediately available as is the capacitor, 22. To service switch, 18, merely remove hex nut and remove switch. To service recorder, 17, or index relay, 16, remove the two pins and the polished top plate. This gives access to these units. **CAUTION: Changing the recording meter frame is an extremely delicate operation and should be done only by an expert serviceman.** Follow this procedure: Unsolder the two leads from the meter and remove the entire meter from the unit by removing the mounting bolts. Remove the moving coil assembly by removing the two screws that mount it to the magnet. Unsolder the instrument springs from the stationary posts and loosen the pivot holding screws. Remove screws holding center pole piece, lift out the recording meter frame and pole piece and replace it, reversing the procedure used in taking it apart.

*m. Desk Unit.* If the drawers should tighten up in this unit, loosen the screws that hold the desk top to the flange and move the flanges to loosen the drawers, then retighten the screws.

*n. Main Power Panel.* To replace the relay coil in this unit, turn the switch OFF, then move the handle back slightly so that it is in line with the OPEN position. Lift the catch at the right hand side of the door and swing the door open. Remove all wires leading to and from the relay unit. Remove the single mounting screw at the top of the plate holding the relay unit to the main mounting plate. Lift the entire relay unit out of the box. Disconnect the leads which connect to the coil and unscrew the mounting screws which hold the coil-core assembly in position. Remove the coil and replace. Reassemble.

*o. Target Transmitter.* Remove the two screws which hold the cover to the case. Slide out the chassis. All parts are accessible.

## 28. Continuity Test Tables.

Resistance measured using test Set I-56-(\*). This meter is 0-1000 ohms, 30 ohms midscale and has multipliers of  $\times 1$ ,  $\times 10$ ,  $\times 100$ ,  $\times 1000$ .

a. Recording machine: Connected to cable, recording machine switch ON. No a-c power.

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From	To	On Ref	Ohms	Scale	Special Conditions	Probable Cause Erroneous Reading
1	3	23	11,000	× 1000	SW-1 off	Relay 16 defective
1	3	23	*2200	× 100	SW-1 on	Relay defective, R-2 defective, SW-1 defective
2	3	23	900	× 100	Resistor 17 clockwise	Recorder Element 17 defective
2	3	23	1000	× 100	Switch 18 off	Resistor 19 defective, Switch 18 defective
4	3	23	600	× 10		Alternator G-1 defective
5	3	23	600	× 10		Alternator G-1 or Switch 18 defective
5	3	23	open	× 1000	Switch 18 off	Switch 18 or Switch 20 defective
					Switch 20 off	
6	3	23	11	× 1		Motor 21 or Alternator G-1 defective

\* Varies with setting of slide on R-2 brush holder assembly.

b. Control Unit Panel. Cable and power cords out, LOOP MOTOR on, RECORDER LEVEL fully clockwise, fuses in place, no headphones in MONITOR jack, tubes in sockets.

From	To	On Ref*	Ohms	Scale	Special Conditions	Probable Cause Erroneous Reading
one pin	other	42	2	× 1		Transformer 39, or Fuses 44 or 45 defective
either pin	gnd	42	open	× 1000		Transformer defective
1	2	43	open	× 1000		Transformer 39, or Tubes 40 or 41 defective
1	gnd	43	0	× 1		Gnd wire to pin 1 open
3	4	43	0	× 1		Switch 26 defective
3	4	43	open	× 1000	LOOP MOTOR off	Switch 26 defective
1	3	43	open	× 1000		Switch 26 defective
1	5	43	45	× 1		L Pad 27 or low pass filter 28, 29, 30, 31, 32, 34 defective
1	6	43	0	× 1		Gnd wire open to pin #6
1	7	43	400	× 100	+lead from ohmmeter to #1	Filter 34, Rectifier 35, or meter 36 defective. Meter 36 should deflect up in this test
1	7	43	80,000	× 1000	+lead from ohmmeter to pin #7	Filter 34, Rectifier 35 or meter 36 defective. Meter 36 should deflect down in this test
Pin 1	Pin 4	40 or 41 socket	0	× 1	Tubes removed	Transformer 39 defective
Pin 1	gnd	40 or 41 socket	open	× 1000	Tubes removed	Transformer 39 defective
Pin 2	Pin 3	40 or 41 socket	50	× 1	Tubes removed	Transformer 39 defective
Pin 2	gnd	40 or 41 socket	25	× 1	Tubes removed	Transformer 39 defective
*B-Y	*BR	35	19	× 1		Filter 34 or Rectifier 35 defective
*BK-B	gnd	35	0	× 1		Gnd wire open to Rectifier 35
*BK-G	gnd	33	16	× 1		Capacitors 30, 31 or Filter 34 defective
*G	gnd	32	32	× 1		Capacitors 32, 29 or Filter 34 defective
*G	*BK-G	32 & 33	15	× 1		Filter 34 defective
*BK-G-B	gnd	27	45	× 1		L pad 27 defective
5	*BK-Y-G	43 & 27	1	× 1		
5	*BK-Y-G	43 & 27	500	× 10	RECORDER LEVEL off (ccw)	
5	1	43	500	× 10	RECORDER LEVEL off (ccw)	

\* Refers to color code of wires. Base color all wires in white.

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c. *Antenna Coupling Panel.* All three plugs removed from rear of dust cover.

Band #	## pin Loop to Loop	ant #1 to ##	ant ## pin to grid	Pin #1 to grid
1	0	2Ω	open	0
2	0	0	open	0
3	open	0	open	0

Erroneous readings can be due only to switch sections or coils being defective.

d. *Brush Holder Assembly.* Unless all wires are removed from TB-1 from main rack cable and alternator, readings cannot be taken that mean much. All following readings are taken with these leads off and with the cam ring so positioned that the index roller is on the flat (this is SW-1 on position).

From	To	On Ref	Ohms	Scale	Special Conditions	Probable Cause Erroneous Readings
Across		R-1	560	×10	SW-1 off	Resistor R-1 defective
Across		C-1	open	×1000	SW-1 off	Switch SW-1 or Capacitor C-1 defective
Across		SW-1	0	×1	SW-1 on	Switch SW-1 defective
Across		SW-1	open	×1000	SW-1 off	Switch SW-1 defective
*BK-B	gnd	any wire	0	×1		gnd open
slider	gnd	R-2	××10000	×100		Resistor R-2 defective
Across		R-2	15000	×100		Resistor R-2 defective
Field	gnd	G-1	550	×10	Not connected to brush holder assembly TB-1	Alternator G-1 defective
Arm.	gnd	G-1	6	×1		Alternator G-1 defective

e. *Crystal Frequency Indicator.* Dust cover removed, power plug out, power supply tubes removed, POWER ON, B + OFF fuse in. No attempt is made to check the r-f portion, for this see Preliminary Instructions for Frequency Meter Set SCR-211-M.

From	To	On Ref #	Ohms	Scale	Special Conditions	Probable Cause Erroneous Readings
Across		AC Plug	10	×1		Transformer 48 defective
6.3V at 3A	gnd	48	0	×1		Transformer 48 defective
6.3V at 5A	gnd	48	open	×1000		Transformer 48 defective
110V AC	gnd	48	open	×1000		Transformer 48 defective
Across		54	750	×10		Resistor 54 defective
Pin 1	Pin 5	49	0	×10		Transformer 48 defective
Pin 1	gnd	49	open	×1000		Transformer 48 defective
Pin 2	Pin 3	49	280	×10	Tube removed	Transformer 48 defective
Pin 2	gnd	49	140	×10	Tube removed	Transformer 48 defective
Pin 4	gnd	49	100,000	×1000	Tube removed	Capacitor 51 or capacitor 52 defective
Across		50	870	×10		Choke 50 defective

29. Voltage Test Tables.

For these tests, the equipment is all operating normally. That is, the AC output from the power unit read on its instrument panel is 118 volts, LOOP MOTOR is on. Recording Machine is ON all power plugs are in position but dust covers on Crystal Frequency Indicator, Control Unit, Brush Holder Assembly, and Recording Machine are all removed to facilitate measurements.

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a. Control Unit Panel (Plug #43 cut, tubes in place, fuses in place).

From	To	On Ref #	Volt	Tol.	Scale	Special Conditions	Possible Cir. Trouble
Pin #1	Pin #2	43	215 DC	±15%	250 DC		Transformer 39, Tubes 40 or 41 defective Short check to line from transformer 39
Pin #1	any other pin	43	0		any		
Pin #1	Pin #4	40 and 41	6.0 AC	±10%	10 AC	Tubes removed	Transformer 39 defective
Pin #2	Pin #3	40 or 41	500 AC	±15%	500 AC	Tubes removed	Transformer 39 defective
Pin #1	gnd	40 or 41	0		any	Tubes removed	Transformer 39 defective
Pin #1	Pin #2	43	*320 DC	±20%	500 DC	Receptacle 43 in Recording Machine off	Transformer 39 or tubes 40, 41 defective
Pin #1	Pin #2	43	150 DC	±20%	250 DC	Receptacle 43 in Rec. Mach. on	Alternator G-1 defective

\* High because capacitor ref #22 is across output.  
Approximately 8 volts receiver output gives 7 ma meter reading.

b. Recording Machine. (Cable connected, boom rotating, control unit operating, D/F receiver operating and taking bearing on target.)

From	To	On Ref #	Volt.	Tol.	Scale Used	Special Conditions	Possible Cir. Trouble
3	6	23	122 AC	±10%	250 AC		Alternator G-1 defective, motor 21 defective
3	6	23	65 AC	±20%	250 AC	#21 stalled	Alternator G-1 defective, motor 21 defective
3	1	23	110 DC	*	250 DC	cam switch SW-1 on	Switch SW-1, Resistor R-2 or Relay 16 defective
3	2	23	0-6 DC	**	10 DC	meter on control unit 0-6 MA	Recorder Element 17 defective
3	4	23	155 DC	±20%	250 DC		Transformer 39, Tubes 40 or 41 defective
3	5	23	155 DC	±20%	250 DC		Switches 18 or 20 defective
Across		22	320 DC	±20%	500 DC	Recording Machine OFF	Capacitor 22 defective

\* Depends on position of slider on R-2 in brush holder assembly.  
\*\* Varies with position of boom as boom rotates.

c. Brush Holder Assembly. (LOOP MOTOR on, recording machine ON, Control Unit Operating.)

From	To	On Ref #	Volt.	Tol.	Scale Used	Special Conditions	Possible Cir. Trouble
1	2	TB-1	122 AC	±10%	250 AC		Alternator G-1 or motor 21 defective Resistor R-2 defective
1	3	TB-1	155 DC	±20%	250 DC		
1	4	TB-1	110 DC	*	250 DC	Cam switch SW-1 ON	Switch SW-1, Resistor R-1 or Capacitor C-1 defective

\* Depends on R-2 slider setting.



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d. *Crystal Frequency Indicator.* (Power Unit, Tube in, B + OFF, POWER ON, fuse in.)

<i>From</i>	<i>To</i>	<i>On Ref #</i>	<i>Volt.</i>	<i>Tol.</i>	<i>Scale Used</i>	<i>Special Conditions</i>	<i>Possible Cir. Trouble</i>
6.3	gnd	To BC221M	6.8AC	+0 -10%	10V AC		Transformer 48 defective
Pin 2	Pin 3	VT84	460AC	±10%	500AC	VT84 removed	Transformer 48 defective
Pin 2	gnd	VT84	230AC	±10%	250AC	VT84 removed	Transformer 48 defective
Pin 1	Pin 5	VT84	6.8AC	+0 -10%	10AC	VT84 removed	Transformer 48 defective
Term #1	gnd	50	200DC	±10%	250DC		Tube 49 defective
Term #2	gnd	50	170DC	±10%	250DC		Choke 50 defective
Term	gnd	51	170DC	±10%	250DC		Choke 50 defective
Term	gnd	52	150DC	±5%	250DC	B+ on or off	Tube 53 defective, Resistor 54 defective

\* These may be reversed, this does not affect operation.

Section V

SUPPLEMENTARY DATA

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As a result of shortages of critical materials, it may be necessary for the contractor to substitute less critical materials in some instances. The data supplied in this book regarding electrical parts are correct as of the date of publication. Operating personnel should note that the diagrams attached to the dust cover of the equipment are correct for the particular unit with which they are supplied.

To assure that adequate replacement parts are obtained until Signal Corps stock numbers are available, it is imperative that replacement parts be ordered not only by the contractor's drawing number as it appears in the instruction book but also by the reference number assigned to the particular part.

30. TABULAR LIST OF REPLACEABLE PARTS—RADIO SET SCR-292 (DIRECTION FINDING)

Quantity	Ref. No.	Stock No.	Name	Description	Function	Mfr.	Drawing Numbers	
							Bendiz	Sig. Corp.
LOOP AND BOOM ASSEMBLY								
2	—		Insulator	Cone Insulator, Type XG-1	Loop and Boom End insulators	Nat'l		A9938
LOOP DRIVE ASSEMBLY								
1	M-1		Motor	½ hp 110v 1750 rpm Capacitor Start Motor	Main drive	Century		L74307
1	63		Capacitor	150µf +20% -0% electrolytic Type #EP	Main drive motor starting	Aerovox		A110949
2	64		Switch	SPST Centrifugal	Starting main motor	Century		A32123
1	401		Capacitor	.05 µf 400v ±20%	Spark Suppression	Micamold		A17457-503
1	G1		Alternator	110v 60 cycle 3600 rpm Type DS 305-1	Synchronising	Eicor		L74308
4	65		Brushes	Carbon Type 2-1305	a-c brushes	Eicor		A32122
4 qts.	—		Oil	30w motor oil	Lubrication	Standard		—
2 qts.	—		Oil	70w motor oil	Lubrication	Standard		—
LOUD SPEAKER PANELS								
1	66		Transformer	Potted 600-80	Matching	Jensen		C261579
	67		Transformer	Same as 66				
1	68		Switch	SPST toggle	ON-OFF	Cutler-Hammer		A100456
BRUSH HOLDER ASSEMBLY								
1	R-1		Resistor	5600 ±10% ¼w	Spark filter	A.B.		C56958-501
1	R-2		Resistor	15,000 ±20% 25w with slider	Index Relay voltage divider	Ohmite		A112167
1	C-1		Capacitor	0.1 µf ±20% 400v oil paper in molded bakelite case	Spark Filter	Micamold		A18016-104

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4	69	Brush Assemblies	Shielded Brushes	Main slip ring brushes	Bendix	AA112067-1
8	70	Brush	High copper content with pigtail	Used in brush assembly	Ohio	A112065
1	SW-1	Micro-switch	SPDT 125v 10A roller actuated	Index indication	M.S.	C30040
CONTROL UNIT						
1	26	Switch	SPST Type ZA 115v	Loop motor relay control	Cutler-Hammer	A106072
1	27	L-Pad	5000 continuously variable	Input attenuator	IRC	A110689
1	28	Capacitor	3 x 0.1 mfd. Paper metal hermetically sealed case oil impregnated ±10% 400v DC WV	Low pass filter	Aerovox, C.D.	A25087
	29	Capacitor	Same as 28			
	30	Capacitor	Same as 28			
	31	Capacitor	Same as 28			
1	32	Capacitor	0.5 µf ±10% Paper Oil impregnated metal case	Low pass filter	Aerovox, C. D.	A25085
1	33	Jack	Open circuit phone	Monitoring	Yaxley	A110636
1	34	Filter	Special vacuum impregnated treated term. board	Low pass filter	Bendix	A108166
1	37	Fuse Holder	Panel mounting screw top	Input fuse holder	Littel-fuse	A20003
	38	Fuse Holder	Same as 37			
1	39	Transformer	110v to 5v4A and 150v 250 Ma vacuum impreg.	Alternator field supply	Bendix	A108168
4	40	Tube	VT145, Commercial 5Z3	Rectifier	RCA, Ken-Rad, Sylvania	
	41	Tube	Same as 40			
20	44	Fuse	3A miniature cartridge	Input power	Buss	A11802-1A
	45	Fuse	Same as 44			

30. TABULAR LIST OF REPLACABLE PARTS—RADIO SET SCR-292 (Cont'd)

Quantity	Ref. No.	Stock No.	Name	Description	Function	Mfr.	Drawing Numbers	
							Bendix	Sig. Corp.
ANTENNA COUPLER								
1	1		Receptacle	Miniature, 2 contact	Input and output	Amphenol	A110659	
	2		Receptacle	Same as #1				
	3		Receptacle	Same as #1				
1	4		Switch	2 pole, 3 position rotary special	Band change	Oak	A110648	
	5		Switch	Same as 4				
	6		Switch	2 pole three position rotary	Band change	Oak	A110649	
1	7		Capacitor	Variable max 395 $\mu$ f +3.5% -2% min 17.5 to 20.5 $\mu$ f	Tuning	Hammer	C60004	
1	8		Coil	Band 1 coil wax impregnated	Loop coil	Bendix	AA110661-1	
1	9		Coil	Band 2 coil wax impregnated	Loop coil	Bendix	AA110662-1	
1	10		Coil	Band 3 wax impregnated	Loop coil	Bendix	AA110663-1	
1	11		Coil	5 turn, shielded by silver plated copper tube	Output coupling	Bendix	AA110674	
1	12		Coil	3 turn shielded by silver plated copper tube	Output coupling	Bendix	AA110673	
1	13		Coil	Same as 12				
RECORDING MACHINE								
1	17		Recorder Element	10 Ma wound meter movement with pivots and springs	Recording pen motor	Assoc. Re-search	A32143	
1	18		Switch	DPDT Toggle 2A 115v	ON-OFF	Cutler-Hammer	A3142-3	
1	19		Resistor	10000 $\pm$ 10% $\frac{1}{4}$ w	Dummy load	Allen-Bradley	A32009-102	
1	20		Micro-switch	SPDT 10A 115v with roller actuator	Drum OFF control	M. S. Corp.	C60040-1	
1	22		Capacitor	0.5 $\mu$ f 400v dew paper $\pm$ 10%	Spark elimination	C. D., Aerovox	A104092-1	

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2	72	Pen	Inking pens	Index pens	Assoc. Re-search	A110903
2	73	Pen	Inking pens with splash shield	Recorder pens	Assoc. Re-search	AA110905-1
1	74	Syringe	Rubber bulb with soft rubber end	Pen filler	Easterline Angus	
60	75	Ink	Red recorder ink in 2-3 oz. bottles with eye droppers	pen ink	Easterline Angus	
2	76	Scale	Transparent scale calibrated 0°-360°	Direction Finder bearings	UAL	C80618
36000 Sheets	77	Paper	Paper bound in pads of 750 sheets	Recording	G. K. & Co.	

MAIN POWER PANEL

1	78	Coil	110v 60 cycle	Power relay actuating	Allen-Bradley	
20	79	Fuse links	30A cartridge	Main line fuses	Economy	

CFI POWER SUPPLY

10	47	Fuse	2A110v cartridge fuse	Main power	Bus, Littell-fuse	A11302-13
1	48	Transformer	110v 600 to 6.3v, 6.3v and 275-0-275v	Power	Bendix	A14617
2	49	Tube	VT-84	Rectifier	Ken-Rad, RCA, Sylvania	
2	53	Tube	VT-139	Regulator	Ken-Rad, RCA, Sylvania	
1	50	Choke	30 hy choke	Power choke	Bendix	A27098
1	51	Capacitor	8 $\mu$ f 450v DC WV	Power filter	Aerovox	C80300
	52	Capacitor	8 $\mu$ f 450v DC WV	Power filter	Aerovox	C80300
1	54	Resistor	7500 $\pm$ 20% 10W	Voltage dropping	Ohmite	A13945-31

30. TABULAR LIST OF REPLACEABLE PARTS—RADIO SET SCR-292 (Cont'd)

Quantity	Ref. No.	Stock No.	Name	Description	Function	Mfr.	Drawing Numbers	
							Bendix	Sig. Corp.
CFI POWER SUPPLY (Cont'd)								
1	55		Switch	SPST Toggle Type	Power ON/OFF	Cutler-Hammer	A100456	
2	56		Pilot light	6.3v Bayonet base type 44	Power Indicator	G.E.	A9320	

CORDS

2	101		Cord	4 ft. long, co-axial, type 21B-285-7/30-XV	Brush holder assembly to antenna coupler	Bendix	AA112004-1	
1	102		Cord	3 ft. long, 2 conductor, rubber covered microphone cable, simplex type 106	Antenna coupler to D/F receiver	Bendix	AA112343-1	
1	103		Cord	56 in. long, 2 conductor, rubber covered microphone cable, simplex type 106	Brush holder assembly to monitor receiver	Bendix	AA112344-1	
2	104		Cord	30 in. long, 2 conductor, rubber covered microphone cable, simplex type 106	Power strip to crystal frequency indicator and control unit	Bendix	AA32061-1	
1	105		Cord	5 ft. long, 2 conductor Tirez Type SJ-2 # 18	Power strip to ceiling light	Bendix	AC-61609-1	
1	106		Cord	5 ft. long, multi-conductor cable, phenoflex covered, with lacing	Main power panel to control unit, recorder unit, and brush holder assembly	Bendix	AN-91691-1	
2	107		Cord	35 in. long, 2 conductor, rubber covered	Receivers to receiver power supplies	Bendix	AN91638-1	
1	108		Cord	20 in. long, 2 conductor rubber covered microphone cable Simplex Type 106	Alternator to brush holder assembly	Bendix	AA32126-1	

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**31. INDEX OF MANUFACTURERS**

<i>Abbrev.</i>	<i>Name and Address</i>
A. B.	Allen-Bradley Co., Milwaukee, Wis.
Aerovox	Aerovox Corp. New Bedford, Mass.
Amphenol	American Phenolic Corp., Chicago, Ill.
Asso. Research	Associated Research Inc., Chicago, Ill.
Bendix	Bendix Radio Division of Bendix Aviation Corp., Baltimore, Md.
Buss	Bussmann Mfg. Co., St. Louis, Mo.
C. D.	Cornell-Dubilier Electric Corp., S. Plainfield, N. J.
Century	Century Electric Co., St. Louis, Mo.
Cutler-Hammer	Cutler-Hammer, Inc., Milwaukee, Wis.
Easterline Angus	Easterline-Angus Co., Inc., Indianapolis, Ind.
Economy	G. E. Supply, Baltimore, Md.
Eicor	Eicor Inc., 515 S. Laffin St., Chicago, Ill.
G. E.	General Electric Corp., Schenectady, N. Y.
G. K. & Co.	Griffith Kock & Co., Baltimore, Md.
Hammar	Hammarlund Mfg. Co. Inc., 424 W. 33rd St., New York, N. Y.
I. R. C.	International Resistance Co., 401 N. Broad St., Philadelphia, Pa.
Jensen	Jensen Radio Mfg. Co., 6601 S. Laramine Ave., Chicago, Ill.
Kenrad	Ken-Rad Tube and Lamp Corp., Owensboro, Ky.
Littell Fuse	Littelfuse Laboratories, 4858 Ravenswood St., Chicago, Ill.
M. S.	Micro Switch Corporation, Freeport, Ill.
Micamold	Micamold Radio Corp., 1087 Flushing Ave., Brooklyn, N. Y.
Nat'l	National Co. Inc., 61 Sherman St., Malden, Mass.
Oak	Oak Mfg., 1260 S. Clybourn Ave., Chicago, Ill.
Ohio	Ohio Carbon Co., 12508 Bearea Rd., Cleveland, Ohio
Ohmite	Ohmite Mfg. Co., 4835 Flourney St., Chicago, Ill.
RCA	RCA Radiotron Div. RCA Mfg. Co., 401 Bergen St., Harrison, N. J.
Standard	Standard Oil Co., Baltimore, Md.
Sylvania	Sylvania Electric Products, Inc., Emporium, Penna.
U. A. L.	United Air Lines Transport Co., Chicago Municipal Airport, Chicago, Ill.
Yaxley	Yaxley Mfg. Div., P. R. Mallory & Co., Inc. 3029 E. Washington St., Indianapolis, Ind.



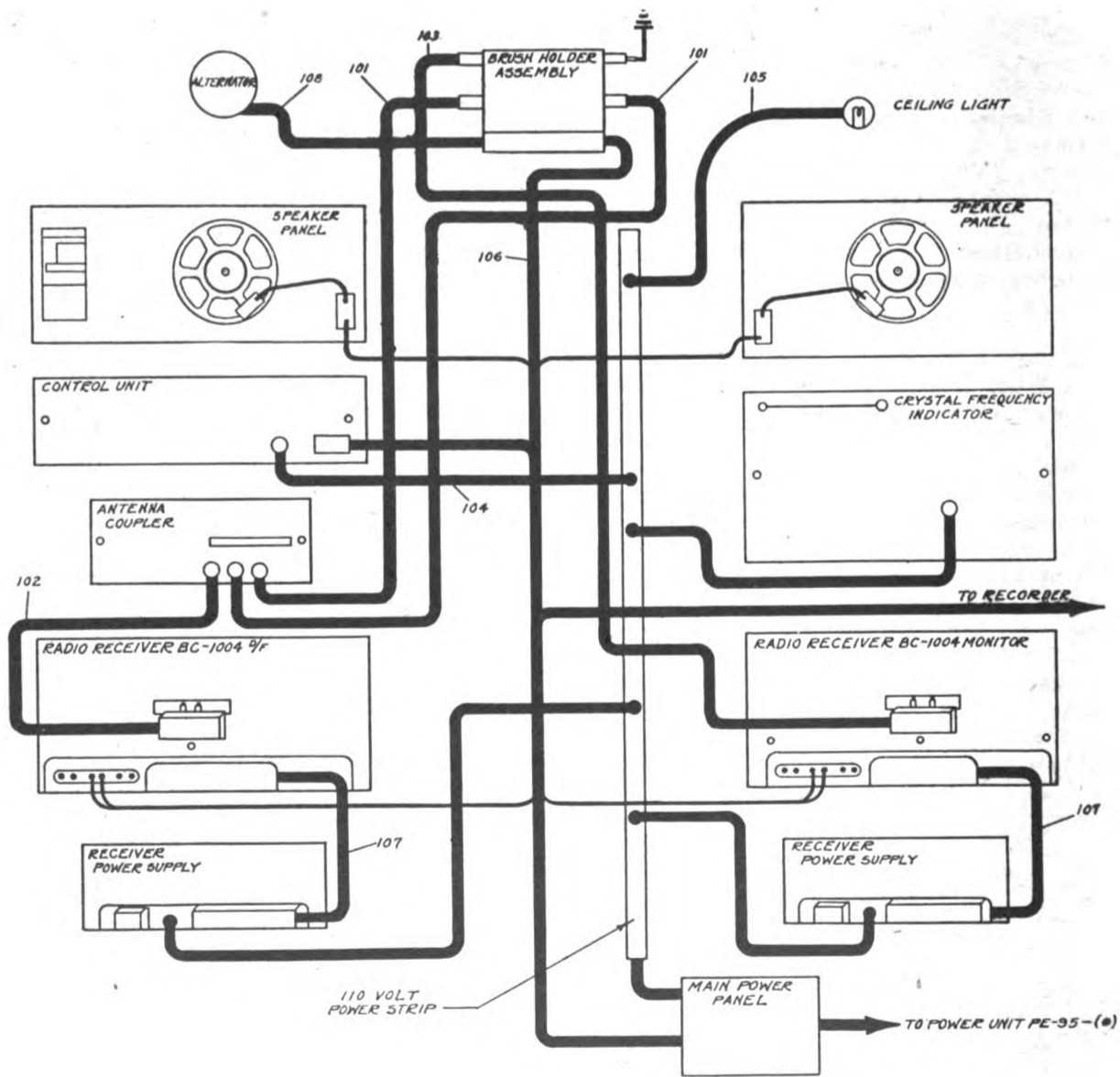


Figure 34—Radio Set SCR-292, Cording Diagram

LOOP  
FACE

VERTICAL ANGLE











