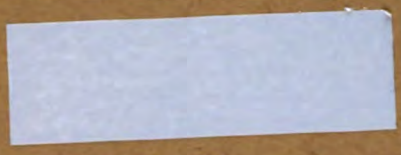
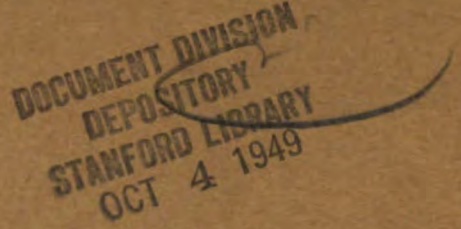
TM 11-1075

WAR DEPARTMENT TECHNICAL MANUAL





ANTENNA AN-161

WAR DEPARTMENT 15 JUNE 1944

WAR DEPARTMENT TECHNICAL MANUAL

TM 11-1075 [redacted]

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[redacted]

WAR DEPARTMENT,
WASHINGTON 25, D. C., 15 JUNE 1944.

TM 11-1075, Antenna AN-161, is published for the information and guidance of all concerned.

[A. G. 300.7 (4 Feb. 44).]

BY ORDER OF THE SECRETARY OF WAR

G. C. MARSHALL,
Chief of Staff.

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

DISTRIBUTION:

X

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

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

DESTRUCTION NOTICE

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

WHEN—When ordered by your commander, or when in immediate danger of personal capture by the enemy.

HOW — 1. Demolish—Cause antenna to crash to ground by destroying tower or antenna connections to tower.

2. Smash—Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools, etc.

3. Cut—Use axes, handaxes, machetes, wire cutters, etc.

4. Burn—Use flame throwers, incendiary grenades, etc.

5. Explosives—Use dynamite, TNT, grenades, firearms.

6. Disposal—Bury electrical parts, dipoles, etc. in slit trenches, holes, and streams.

USE ANTHING AVAILABLE FOR

DESTRUCTION OF THIS EQUIPMENT

WHAT—1. Destroy all dipoles, transmission lines, couplings, shorting bars, insulators, and dipole connections.

2. Cut or otherwise damage the reflector screen wires, bury or scatter pieces.

3. Break, cut, bend, or otherwise damage the phasing transformers.

4. Demolish or otherwise dispose of all radio frequency parts of the antenna system.

5. Destroy all technical manuals.

DESTROY EVERYTHING

WARNING

HIGH VOLTAGE

is used in the operation of

equipment associated with Antenna AN-161.

DEATH ON CONTACT

may result if personnel fail

to observe safety precautions.

Be careful not to contact high-voltage connections or 115-volt a-c input connections on the associated equipment when installing, tuning, or servicing the antenna.

Personnel working aloft should exercise extreme caution in moving about on the antenna or tower. Always use a safety belt and check to be sure it is fastened to a secure part of the equipment. Be careful of spots of grease or oil that contribute toward insecure footing. Do not drop tools or other heavy objects that might strike and injure personnel working below. Ground workers should be alert when working directly underneath the tower or antenna to avoid being struck by objects that might be dropped. Injury or death may result if safety precautions are not observed.

FIRST AID TREATMENT FOR ELECTRIC SHOCK

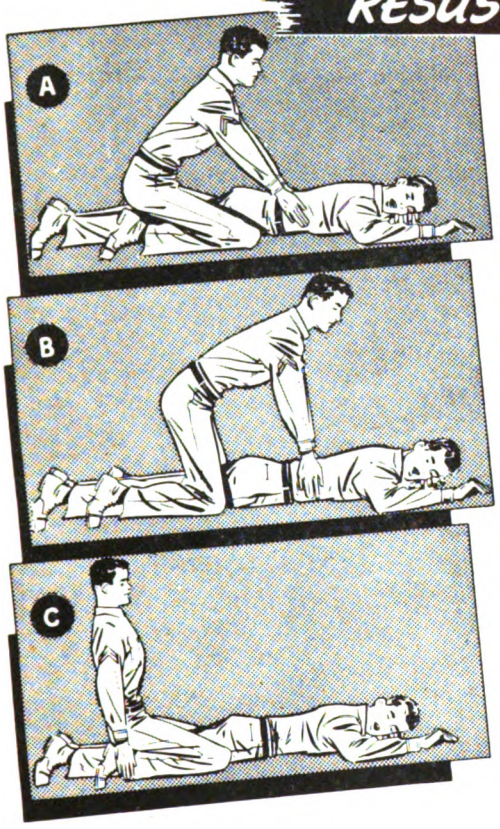
I. FREE THE VICTIM FROM THE CIRCUIT IMMEDIATELY.

Shut off the current. If this is not immediately possible, use a dry nonconductor (rubber gloves, rope, board) to move either the victim or the wire. Avoid contact with the victim. If necessary to cut a live wire, use an axe with a dry wooden handle. Beware of the resulting flash.

II. ATTEND INSTANTLY TO THE VICTIM'S BREATHING.

Begin resuscitation at once on the spot. Do not stop to loosen the victim's clothing. Every moment counts. Keep the patient warm. Wrap him in any covering available. Send for a doctor. Remove false teeth or other obstructions from the victim's mouth.

RESUSCITATION



POSITION

1. Lay the victim on his belly, one arm extended directly overhead, the other arm bent at the elbow, the face turned outward and resting on hand or forearm, so that the nose and mouth are free for breathing (fig. A).

2. Straddle the patient's thighs, or one leg, with your knees placed far enough from his hip bones to allow you to assume the position shown in figure A.

3. Place your hands, with thumbs and fingers in a natural position, so that your palms are on the small of his back, and your little fingers just touch his lowest ribs (fig. A).

FIRST MOVEMENT

4. With arms held straight, swing forward slowly, so that the weight of your body is gradually brought to bear upon the victim. Your shoulders should be directly over the heels of your hands at the end of the forward swing (fig. B). Do not bend your elbows. The first movement should take about 2 seconds.

SECOND MOVEMENT

5. Now immediately swing backward, to remove the pressure completely (fig. C).

6. After 2 seconds, swing forward again. Repeat this pressure-and-release cycle 12 to 15 times a minute. A complete cycle should require 4 or 5 seconds.

CONTINUED TREATMENT

7. Continue treatment until breathing is restored or until there is no hope of the victim's recovery. Do not give up easily. Remember that at times the process must be kept up for hours.

8. During artificial respiration, have someone loosen the victim's clothing. Wrap the victim warmly; apply hot bricks, stones, etc. Do not give the victim liquids until he is fully conscious. If the victim must be moved, keep up treatment while he is being moved.

9. At the first sign of breathing, withhold artificial respiration. If natural breathing does not continue, immediately resume artificial respiration.

10. If operators must be changed, the relief operator kneels behind the person giving artificial respiration. The relief takes the operator's place as the original operator releases the pressure.

11. Do not allow the revived patient to sit or stand. Keep him quiet. Give hot coffee or tea, or other internal stimulants.

HOLD RESUSCITATION DRILLS REGULARLY

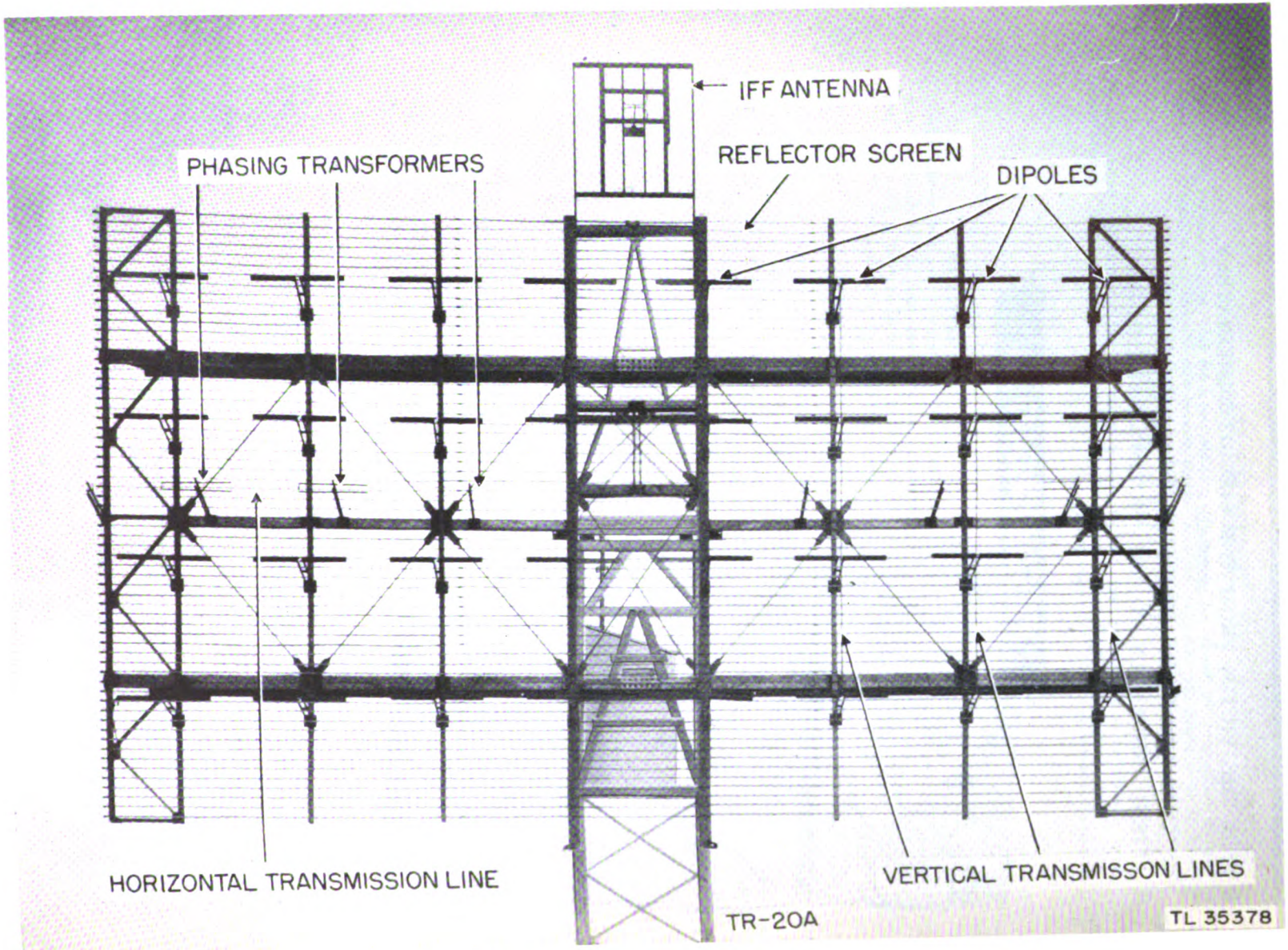


Figure 1. Antenna AN-161, general view

SECTION I

DESCRIPTION

1. GENERAL. Antenna AN-161 is a broadside array antenna, 37 feet 2½ inches wide, and 20 feet 10 inches high, consisting of 32 dipoles arranged in 8 vertical columns of 4 dipoles each. The dipoles are spaced one-half wavelength apart from center to center, and are interconnected by means of eight vertical and one horizontal transmission lines. The reflector screen is formed by strips of ½-inch by ⅛-inch flat steel stretched edgewise between the outer ends of the antenna frame. The antenna is especially constructed to withstand a maximum wind velocity of 125 miles per hour with ½-inch radial ice. The weight of the antenna in normal operating condition is 5,950 pounds. A deposit of ½-inch radial ice increases the weight to 9,340 pounds, and a 1-inch coating of ice will increase the weight to 15,630 pounds. The antenna can support a 1-inch load of ice without damage. Antenna AN-161 is shipped in 8 boxes and 13 bundles, the weights and dimensions of which are as follows:

TABLE I

Weights and Dimensions of Antenna AN-161 Shipping Packages

Pkg. No.	*Type of Package*	*Quan.*	*Contents Item*	*Part No.*	*Package Dimensions*	*Gross Weight (lb)*
1	Box	18	Dipoles	601	3'4"x2'8"x6'8"	330
2	Box	18	Dipoles	601	3'4"x2'8"x6'8"	330
3	Box	76	Back screen wires	1001	8"x8"x12'9"	700
		152	Back screen wires	1101		
4	Bundle	2	Beam assembly	1201	6"x8"x21'	300
5	Bundle	2	Beam assembly	1301	8"x10"x21'	268
6	Bundle	2	Beam assembly	1401	8"x9"x21'	278
7	Bundle	2	Beam assembly	1501	8"x11"x21'	273
8	Bundle	1	Beam	1601	5"x6½"x4'5½"	88
		1	Beam	1602		
9	Box	8	Transformer support	2101	2'0"x3'0"x3'10"	222
		4	Horizontal feeder assembly	2401		
		3	Insulator assembly	2701		
		3	Tubing	2801		
		1	Bent tubing	3001		
		1	Bent tubing	3002		
		3	Tuning stub	3301		
		2	Bent tubing	3401		
		2	Extra tubing	5201		
		18	Vertical feeder	3501		
10	Bundle	1	Beam assembly	3601R	6"x8"x22'3"	384
11	Bundle	1	Beam assembly	3601L	6"x8"x22'3"	384
12	Bundle	1	Beam assembly	3701	6"x10"x19'	369

Pkg. No.	*Type of Package*	*Quan.*	*Contents Item*	*Part No.*	*Package Dimensions*	*Gross Weight (lb)*
13	Bundle	1	Beam assembly	3701	6"x10"x19'	369
14	Bundle	1	Beam assembly	3701	6"x10"x19'	369
15	Bundle	1	Beam assembly	3701	6"x10"x19'	369
16	Box	4	Splice plate	3712	1'1½"x1'1½"x3'2"	448
		4	Splice plate	3713		
		4	Connector angle	3802		
		4	Connector angle	3803R		
		4	Connector angle	3803L		
		8	Connector angle	4201		
		2	Connector angle	4212		
		4	Support angle	4301		
		2	Connector angle	4411R		
		2	Connector angle	4411L		
		2	Connector angle	4412R		
		2	Connector angle	4412L		
		4	Connector angle	4413		
		2	Connector angle	4414R		
		2	Connector angle	4414L		
		4	Connector angle	4415		
		2	Connector angle	4416		
		2	Connector angle	4417		
		6	Connector bar	4501		
		8	Shim plate	4702		
		2	U-bolt	5601		
17	Bundle	1	Angle assembly	3801	11"x1'0"x6'2"	403
		6	Channel	4203		
		8	Brace angle	4312		
		8	Brace angle	4313		
		6	Brace angle	4304		
		1	Pipe guard	4601		
		1	Channel	4701		
18	Bundle	2	Rod brace assembly	3901	11½"x11'2"x7'7"	301
		12	Rod brace assembly	3902		
		2	Rod brace assembly	3903		
19	Box	1	Coupling MC-398-C		1'4"x1'4"x6'2"	120
20	Box	2	Eyebolt, ¾" x 1'2" long		5½"x7"x2'8½"	98
		4	Machine bolts, ¾" x 2'2"			
		4	Machine bolts, ¾" x 2'6"			
		8	Pipe, 1" x 1'4"			
		4	Plate washer, 2½" x 1" x 2½"			
		2	Plate washer, 3" x ¼" x 3"			
		8	Flat washers, ¾"			
21	Box	1500	J-bolt, ¼"	701	1'x2'x2'	561
		1134	Beveled washer, ¼"	801		
		152	Channel connector, ⅞"	901		
		4	Connector angle	1603		
		4	Connector angle	1604		
		4	Brass connector assembly	1701		
		20	Brass connector assembly	1801		
		2	Connector assembly (silver-plated)	3101		
		304	Machine screws, No. 12-24 x ½" long brass			

Description

Pkg. No.	Type of Package	Quan.	Contents Item	Part No.	Package Dimensions	Gross Weight (lb)
		304	Lockwashers, No. 12 Bronze			
		152	Pipe spacers, ½" x 1"	5101		
		152	Steel springs, 11/16" x ⅞"			
		304	Flat washers, ½"			
		152	Hexagonal nut, ½"			
		1500	Square nuts, ¼"			
		1500	Lockwashers, ¼"			
		40	Machine screws, ¼"—20 x ⅜" brass			
		16	Lockwashers, ¼" bronze			
		40	Cotter pins, 3/16" x 1¾"			
		4	Jamb nuts, 1" hexagonal			
		1 lb	Solder			
		500	Rib bolts with Anco nuts, ½" x ⅜" grip structural			
		40	Rib bolts with Anco nuts, ½" x ½" grip structural			
		140	Rib bolts with Anco nuts, ½" x ⅝" grip structural			
		12	Rib bolts with Anco nuts, ½" x ⅞" grip structural			
		90	Rib bolts with Anco nuts, ¾" x ⅝" grip structural			
		18	Rib bolts with Anco nuts, ¾" x ¾" grip structural			
		156	Rib bolts with Anco nuts, ¾" x ⅞" grip structural			
		15	Machine bolt with Anco nuts, ½" x 1¾"			
		10	Machine bolt with Anco nuts, ¾" x 2"			
		8	Machine bolt with Anco nuts, ¾" x 2¼"			
		3	Machine bolt with Anco nuts, ¾" x 2½"			
		3	Machine bolt with 2 hexagonal nuts, ⅞" x 3¾"			
		10	Beveled washers, ¾"			
		1	Check List			
		2	Technical Manual			

NOTE: All package dimensions and weights are estimated.

2. PURPOSE. Antenna AN-161 is used in conjunction with Radio Set SCR-271-L and is designed for mounting on wind-resistant Tower TR-20-A. The antenna should afford trouble-free operation during high winds and heavy icing conditions severe enough to restrict operation of ordinary equipment.

3. MECHANICAL CONSTRUCTION (fig. 1). The basic framework of Antenna AN-161 consists of four 10-inch I-beams 18 feet 7¼ inches long, bolted together in pairs to form the two main horizontal beams. The completed horizontal beams are 37 feet 2½ inches in length. Two 8-inch I-beams 20 feet 10 inches long form the two main vertical members. Also bolted in a vertical position on each side of the two main vertical beams are six 3-inch I-beams which form the additional dipole supports. These beams are bolted at a right angle to the two main horizontal members. Two 3-inch I-beams are fastened to the extreme outer ends of the main horizontal beams and serve to stiffen the ends of the antenna. These two I-beams are diagonally braced to the adjacent vertical beams by means of short angle-iron members. Interconnecting channels provide suitable support for transmission-line transformers and form the center beams of the antenna. Diagonal rod bracing is fastened between the main frames of the antenna structure by clevises to complete the reinforcing. Framework thus erected is self-supporting during assembly.

4. ELECTRICAL CONSTRUCTION. Electrical components of the antenna consist of the reflector screen, dipoles, transmission lines, transformers, and Coupling MC-398-C.

a. Reflector Screen. The reflector screen is made of 63 flat steel strips ½ by ⅛-inch stretched edgewise across the vertical beams of the antenna frame. These strips are inserted through the slots in the outer vertical beams. A collar and spring slipped over the outside end, secured with a hexagonal nut, holds the reflector strips taut. A system of J-bolts holds the reflector strips to the vertical beams.

b. Dipoles. The dipoles are bolted in a horizontal position on the eight vertical I-beams. These beams are pre-drilled to fit the dipole bases. The dipoles are spaced one-half wavelength apart.

c. Vertical Transmission Lines. Sixteen phosphor-bronze wires make up the eight pairs of vertical transmission lines, and are used to interconnect the four dipoles in each of the eight columns.

d. Horizontal Transmission Lines and Transformers. The horizontal transmission lines are composed of two parallel wires of phosphor bronze and six pairs of quarter-wave phasing transformers. The horizontal transmission lines stretch from their outer supports across the center of the antenna. The transformers are mounted on supports to keep the lines from sagging. The transmission lines are spaced 3 inches apart. Two shorting bars are provided at the end of the lines to maintain the spacing and to insulate the lines. The transmission lines pass through the center of the transformers and are center-spaced within, by means of spacers. The lines are brazed at the center of the spacers, and the spacers are brazed into the transformers. The first pair of quarter-wave transformers is spaced a little over one-half wavelength from the feeding point at the center of the antenna. These transformers have a ¼-inch outer diameter and a 3-inch spacing between centers. The second pair of quarter-wave transformers is brazed to the transmission lines at a distance of one-half wavelength from the first pair. This pair of transformers has an outer diameter of 9/16-inch, and is mounted upon the vertical supports. The third pair of quarter-wave transformers is installed one-half wavelength from the second pair toward the outer supports. These transformers have an outer diameter of ½-inch and are mounted on vertical supports. Shorting bars are mounted between the horizontal transmission lines one-quarter wavelength outside this pair of transformer tubes, at both ends of the antenna. These horizontal transmission lines interconnect the vertical transmission lines of the eight columns of dipoles. These lines are strung between the top and bottom lines of the eight pairs of vertical transmission lines and are connected to them by connector clamps at the outer ends of each of the six pairs of phasing transformers. The horizontal transmission line is center-fed by transmission line tubing from Coupling MC-398-C through the center of the antenna.

e. Summary. The horizontal transmission lines and the eight pairs of vertical transmission lines which connect the dipoles, are an integral part of the antenna. The directivity of radiation from the antenna system is determined by the current distribution and phase relationship of the dipoles. The desired phase relationship is obtained by the spacing of the dipoles one-half wavelength apart, and alternating the antenna transmission line connections of the dipoles. The desired current distribution is obtained by fitting the horizontal transmission lines with six pairs of quarter-wave phasing transformers.

SECTION II
INSTALLATION

5. GENERAL.

a. A crew of no less than eight men is needed to erect Antenna AN-161. No attempt should be made to hoist the antenna to its operating position on the tower unless a full and competent crew is available.

b. The following tools and equipment should be ready for use at all times during assembly and erection:

8 Wooden blocks 3 feet x 4 inches x 4 inches(or larger).
2 Crescent wrenches, adjustable 12 inches.
2 Socket wrenches, 7/8 inches, for 1/2-inch bolts.
2 Tapered-end construction wrenches (or equivalent), 1 1/8 inch jaws.
6 End wrenches, 7/16 inch.
1 Pipe wrench, 12 inches.
2 Box wrenches, 1 1/4 inches, for 3/4 inch bolts.
2 Pliers.
2 Screw drivers, for No. 8 and No. 10 brass machine screws.
2 Drift pins, 3/4 inch.
2 Sledges, 6 pound.

Sufficient 3/4-inch rope should be available to provide guy lines from U-bolts at the bottom of the two main vertical beams, to a ground crew stationed at least 150 feet away. The guy lines should be led through a block and tackle to assure sufficient purchase to hold the antenna away from the tower when hoisting.

Two lines of 3/4-inch rope each at least 150 feet long must be available to be used as direct guy lines to steady the antenna laterally. Fasten these lines to the outer ends of the main lower horizontal beams. This equipment will assist a crew to erect Antenna AN-161 quickly and efficiently.

6. PREPARATION FOR ASSEMBLY. Check all material with the check list contained in Box No. 21. Place all the materials bearing the same marking in individual piles. This will expedite the erection of the antenna, and provide an easy means of identifying and locating each part as needed.

CAUTION: It is necessary to construct the antenna in a position that is in a definite relation to the tower. Figure 5 shows the ground plan of this position. It will be noted that the two 3601 vertical beams, right and left, have one end rounded. These beams must be placed so that the rounded end is next to the ground and faces away from the tower. This layout places the top of the antenna next to the tower. The antenna must also be located on the side of the tower directly opposite the winch.

7. STRUCTURAL ASSEMBLY. The following steps constitute the proper procedure for assembling Antenna AN-161:

a. Lay out two 3701 horizontal beams, block them level, and place in position as shown in figure 2 (the splice ends butting together at the center of the antenna). Place the other two 3701 beams in a similar position, 11 feet away from and parallel to the first pair. Splice the beams together at their centers using the splice plates and bolts as in figure 3 and drawing 3, detail 22.

b. Starting at line 10 drawing 1, slide beam 3601R toward the center of the antenna to line 6 so that beams 3701 pass through the T-slots in beam 3601R. The beveled end of 3601R must be underneath (fig. 2). Bolt 3601R to 3701 at points 6B and 6F, drawing 1, with the connectors and bolts as shown in figure 4, drawing 3, detail 13, and figure 5. Beam 3601L is attached in the same manner.

c. Place beams 1501 on top of beams 3701 at lines 4 and 7, drawing 1, and bolt beams 1501 to 3701 as shown in drawing 3, detail 11.

d. Place beams 1401 on top of 3701 at lines 3 and 8, drawing 1, and secure according to drawing 3, detail 9, and figure 6.

e. Place the beams 1301 on top of 3701 at lines 2 and 9, drawing 1, and secure according to drawing 3, details 7 and 8, and figure 7.

f. Place beams 1201 on 3701 at lines 1 and 10, drawing 1, and secure according to figure 8 and drawing 3, detail 3.

NOTE: The welded steel plate located at center line of beams 1201 must be outside of the antenna.

g. Attach 4601 pipe guard between 3601R and 3601L at the top of the antenna as shown in figure 9 and drawing 3, detail 21. Secure 1601 between 3601R and 3601L, drawing 3, detail 15.

h. Secure 3801 between 3601R and 3601L, drawing 3, detail 17.

i. Secure 1602 between 3601R and 3601L, drawing 3, detail 16.

j. Fasten clip angle 3802 so that it is under 3601R and 3601L as shown in figure 10 and drawing 3, detail 18.

k. Attach U-bolts 5601 to the bottom end of main vertical beams 3601R and 3601L so that guy lines may be attached at these points. These U-bolts are visible in figure 1 and drawing 1.

l. Bolt six channel members 4203 in place on line D, drawing 1, according to figure 10 and drawing 3, details 10 and 12. Transformer mounting holes should be toward the outside of the antenna.

m. Assemble 4304 at the top and bottom of the antenna, and bolt the end with the connectors and bolts. See drawing 3, details 1 and 6 and figure 11.

n. Insert brace angles 4313 and 4312 between lines 1 and 2, and lines 9 and 10 in order shown on drawing 1. Refer to drawing 3, details 2, 5, 6, 7, and 8, and figure 12.

o. Install diagonal rod braces 3901, 3902, and 3903 as shown in drawing 1 and figure 13, (dwg. 3, detail 8, 9-13) (12). Note that rod braces have a right-hand thread on one end for clevis 4001 and a left-hand thread for clevis 4002 at the opposite end. Install bracing by passing the clevis over the connector plate and inserting clevis pins 4101 and securing with 3/16- by ¾-inch cotter pin. Adjust and tighten the diagonal braces by turning the rods with a pipe wrench. Details of the diagonal braces are plainly shown in figure 13.

p. Fasten six transformer supports 2101 to channels 4203 and secure on line D, drawing 1, and as shown in figure 10, also drawing 4, detail 27.

q. This completes the structural assembly of Antenna AN-161.

8. ELECTRICAL ASSEMBLY.

a. Electrical Assembly of Antenna AN-161. Carry out according to the following directions with reference to accompanying drawings and photographs.

b. Reflector Screen. Reflector wires are made up of three strips joined together end-to-end to form one reflector wire. The strips are joined in the following manner:

(1) Slip the flat ends of back screen strips 1101 through the slots in the vertical beams along lines 1 and 10, drawing 1, and drawing 3, detail 3, and figure 8.

(2) Connect each end of back screen strips 1101 to the flat ends of 1101 using channel connectors 901, drawing 3, detail 20, and figure 14.

(3) Turn the flanges of channels 901 toward the bottom of the antenna so as to provide proper drainage.

(4) Slip compression springs and flat washers 5101 over the end of the stud welded to the end of the reflector strips, drawing 3, detail 3, and figure 8. Secure with ½-inch hexagonal nut. Do not tighten the nut all the way; leave the spring about half open. This position will maintain about 75 pounds pressure on the back screen reflector wires.

(5) Repeat this procedure for the remaining back screen strips.

(6) Clamp the back screen strips to the vertical beams with J-bolts 701 on lines 2 to 9, drawing 1, as shown in figure 6 and drawing 3, detail 11. Use beveled washers 801 at lines 2, 3, 4, 7, 8, and 9, on drawing 1, and lockwashers only at lines 5 and 6.

c. Dipoles. (1) Bolt dipoles 601 to the antenna frame (fig. 14) so that the top transmission line connectors slant upward to the right along lines A and G, drawing 1. (2) On lines C and E, fasten the dipoles so that the top connectors all slant upward toward the left (fig. 15, and drawing 4, detail 25).

d. Transmission Line Supports. (1) At points 1D and 10D, drawing 1, attach transmission line supports 4301 as shown in drawing 4, detail 26 and figure 16.

(2) Secure feed support marked 2701 for the horizontal transmission line on beams 1601 and 1602 as shown in drawing 4, detail 30.

e. Horizontal Transmission Line Assembly. (1) Stretch both of horizontal transmission lines 2401 between transmission line supports 4301 at line D, drawing 1, and refer to drawing 4, detail 26, and figure 16. The transformers slip into place on the transformer supports.

(2) Stretch the lines taut by means of adjusting studs visible in figure 16 and drawing 4, detail 26.

f. Center Feed Line Assembly. (1) Thoroughly clean the inside of the open ends of center transmission line tubes 3001 and 3002, and apply a solder flux.

(2) Clean the outside of the joining studs at center feed supports 2701.

(3) Slip the open ends of 3001 and 3002 over studs 2701 so that opposite ends of the transmission feed lines 3001 and 3002 are in a position to clamp to the horizontal transmission line, are lined up vertically in respect to each other, and are directly opposite on transmission line (fig. 17 and dwg. 4, detail 24).

(4) Solder 3001 and 3002 to 2701, and clamp opposite ends to the horizontal feeder transmission line.

g. Vertical Transmission Line Assembly. (1) Starting at the dipole at point 2A, drawing 1, attach the lower vertical feed line, marked 3501, to all the lower dipole connections along line 2, general assembly drawing.

(2) Connect top vertical feed line 3501 along line 2 to the top connections of these dipoles. Draw lines taut, and tighten connections securely. Repeat this process for the remaining lines (fig. 15).

(3) After the lines have been installed and are drawn tight, the connections should be securely soldered and a spot of solder should be placed outside the end dipole connections to prevent the line from losing tension if the set screw should slip. All portions of the feed lines that extend beyond the ends of the end dipole connections should be clipped off a ½ inch from the end, and twisted away from each other after the solder has cooled.

(4) Connect vertical and horizontal feed lines at points 2 through 9 on line D, drawing 1, by means of connectors 1801. These must be connected so that they are alternately reversed (dwg. 2, and fig. 16).

9. PREPARATION OF TOWER FOR HOISTING ANTENNA (dwg. 1, dwg. 3, detail 18). The end channel, marked S-292, on turntable of Tower TR-20-A, must be replaced with the channel supplied marked 4701. The stiffening member S-293 is removed from S-292 and inserted in channel 4701. Hoisting cable CA-1 is to be reeved through the sheaves on top of the tower in accordance with instructions with Tower TR-20-A (TM 11-1110M). It is important that all precautions specified in the handling of the antenna and erection of the tower be observed.

WARNING: No attempt should be made to raise or lower the antenna when it is covered with more than ½-inch of radial ice!

10. HOISTING OF ANTENNA. The concrete counterweight should be constructed according to drawing 1, and secured in position on the tower. Parts shipped in Box No. 20 are supplied for this purpose. Concrete and reinforcing steel are not furnished with antenna. Before hoisting the counterweight, the turntable should be rotated so that the position for the counterweight is directly opposite the winch. In this position the line from the winch can be run over the sheaves at the top of the tower and the weight hoisted to position. When the counterweight has been secured, rotate the turntable 180° so that the antenna side is directly opposite the winch. Continue with the following instructions for hoisting the antenna.

a. Attach the sling at the end of cable CA-1 to the rear flange of upper beam 3701 as shown in drawing 3, detail CC. Attach two ¾-inch guy lines to the outer end of lower antenna beam 3701 at points 1F and 10F, drawing 1. Attach two guy lines, preferably tackles to the U-bolts at the lower ends of main center beams 3601R and 3601L.

b. Raise the top of the antenna about 5 feet off the ground and attach the IFF antenna according to instructions supplied with the IFF unit and figure 9, and drawing 3, view CC.

c. Refer to figure 18. Hoist antenna to the top of the tower, holding it away from the tower by the guy lines attached to the U-bolts at the lower end of 3601R and 3601L. If at all possible, these guy lines should be attached to a truck, car, or some other source of power. Steady the antenna laterally by means of the outside guy lines. Do not attempt to hold the antenna away from the tower with these lines.

d. With the antenna at the top of the tower, attach steamboat ratchets H-231 as shown on drawing 3, detail 17, so that the antenna may be positioned accurately for bolting to the tower.

e. Connectors 3802 connect to tower channel 4701, drawing 3, detail 18.

11. COUPLING CONNECTION AT TOWER. After the antenna is secured to the tower, the transmission lines and coupling must be installed.

a. Thoroughly clean all transmission line joints before assembling, and apply a coating of solder flux as these joints will be soldered later.

b. Slip lines 2801 into place while attaching rear support 2701 to beams 1601 and 1602 according to drawing 4, detail 30.

c. Attach bent transmission line tubes 3401 to the studs on 2701 and to the studs projecting from the coupling box, drawing 4, detail 32.

d. Solder all the transmission joints (dwg. 4, details 29, 31, and 32).

12. TUNING STUB. Open the split fittings on the end of tuning stub 3301 and attach to transmission tubes 3401 in a vertical position as shown in drawing 4, detail 28, and figure 19. The top of the tuning stubs is joined with shorting bar 3101 (dwg. 4, detail 28, and fig. 19). The proper length to set the shorting bar is given in the section of this manual dealing with the tuning (section III).

CAUTION: Rotate antenna slowly, being careful to check clearance at the edges of the tower and at transmission line chute.

This completes the erection and assembly of Antenna AN-161 on Tower TR-20-A.

SECTION III
TUNING AND ADJUSTMENT

13. GENERAL. The method of connecting and tuning Antenna AN-161 to the connecting transmission line of Radio Set SCR-271-L is similar to the procedure used in the tuning and adjustment of Antenna AN-140. This procedure is fully described in the instructions for Antenna Conversion Kits B70-A3 and D71-A2. When Antenna AN-161 is correctly assembled and installed on a set that has been operating efficiently on the desired frequency, adjustment of the antenna tuning stub above is necessary to tune the antenna to the set. No changes should be necessary in the trransmission line below Coupling MC-398-C except when changing the operating frequency. The only element requiring tuning is matching stub 3301, located on the transmission line at the rear of the antenna (fig. 19).

14. TUNING PROCEDURE. The adjustment of tuning stub 3301, is made in the following manner:

TABLE II
Table of Adjustments for Tuning Stub 3301

Frequency (mc)	*Stub Length (x) (in.)*	*Stub location (y) (in.)*
101	18	36¾
102	19⅜	31¾
104	19⅜	26⅝
106	20⅜	16⅛
108	19¼	7½
110	17⅛	4¾
112	17⅝	1¼
114	16¾	3⅜

a. Consult the table above and figure 20, for correct setting for frequency to be used. Set the tuning stub dimensions to these measurements. The stub length (x) is measured from the top of the feed line to the inside edge of the shorting bar. The location of the stub (y) on the transmission line is measured from the outside edge of half-wave metallic insulator support 2701 to the nearest side of the mounting stub. The negative value of 3⅜ inches given in the table is for a location inside the half-wave insulator and is also measured from the outside edge of the half-wave insulator to the nearer edge of the stub.

b. Disconnect cable PT-5 to the receiver.

c. Place the set in operation at a transmitter plate voltage of approximately 7,000 volts. Be sure that all the spark gaps on the transmission line are operating.

d. Rotate the transmitter plate line until the operating frequency, as determined by the frequency meter, corresponds to the desired frequency to which the antenna is to be tuned.

e. Measure the standing wave ratio on the transmission line above the antenna coupling by the use of Test Set I-148 in the following manner:

(1) Place the probe of the test set instrument at the right angles to the transmission line with the test set adjusted to give a good reading on the scale. Adjust the instrument to the desired frequency by means of the knob on the right-hand side of the meter. The tuning is critical and should be performed slowly. Use this adjusting screw to adjust the capacitance coupling of the instrument to the transmission line in order to obtain a good meter reading.

(2) Slide the probe along the transmission line (fig. 21) being careful not to force a change in the spacing of the lines. Measure the maximum and minimum r-f voltages. Compute the standing wave ratio by the formula:

$$\text{Standing wave ratio} = \frac{\text{minimum voltage}}{\text{maximum voltage.}}$$

The standing wave ratio is the ratio in per cent of the minimum r-f voltage along the transmission line to the maximum r-f voltage.

f. Sixty percent or higher is considered a satisfactory standing wave ratio. It is possible, however, to obtain a ratio of 70 percent on the transmission line above Coupling MC-398-C. If the standing wave ratio is below 60 percent, the antenna tuning stub must be readjusted.

g. Turn off the high-voltage supply and readjust the

position of the stub. Reapply the high voltage, and again measure the standing wave ratio. If it is necessary to readjust the position (y) of the stub several times, then it is advisable to change the length of the stub (x) in order to assist in securing an optimum standing wave ratio.

15. SUPPLEMENTARY ADJUSTMENT. If the standing wave ratio remains low (below 60%) the following points should be checked:

a. Adjustment of Coupling MC-398-C (fig. 22). Coupling MC-398-C is an inductive rotating coupling located between the rotating antenna transmission line and the stationary transmission line. The air space between the two flat coils of the couplings should be set at 3/8 inch. Check the alignment of the Faraday shield between the two coils of the antenna Coupling MC-398-C during one complete revolution to be sure that none of the wires of the shield is touching either of the coils, and that the plane of the Faraday shield is parallel to the coils.

b. Quarter-wave Insulators. Check to be sure all quarter-wave insulators are set to the proper length for the frequency being used. Formula L (length = 2940/f where f is the frequency in megacycles per second) will determine the distance from the end of the stand-off insulator to the center line of the shorting bar. At the lower frequencies it may become necessary to remove the shorting bars from some of the stand-off insulators.

c. Spark Gaps. With the radio set in operation place a short circuit across the transmission line at the spark gap positions by using a screwdriver. If the spark gap is in the optimum position, the operation of the spark gap at the screwdriver should not affect the operation of the air gap or the plate current. If sparking at the screwdriver affects the gap or plate current, move the spark gap assembly to the spot where the screwdriver short was created.

16. TRANSMISSION LINE BALANCE.

a. The procedure for measuring the standing wave ratio on the transmission line described in paragraph 14 is important because the standing wave ratio is a measure of the transmitting efficiency of the radio frequency system. However, it is also important that the voltage on both transmission lines be checked to make sure they are balanced-to-ground.

b. If the points of maximum and minimum r-f voltage on the two lines fall within 6 inches of each other and the value of the voltages does not differ by more than 10 percent, the lines may be considered balanced-to-ground. Considerable power loss due to transmission line radiation can be caused by an unbalanced line. If the line is found to be unbalanced, the trouble can generally be traced to the following causes:

(1) Poor connection along one or both transmission lines.

(2) Improper connection or installation of antenna transmission lines.

(3) Transmission lines are of unequal length.

(4) Unsystemmetrical transmitter tube connections.

(5) Mismatched transmitter tubes.

17. FIELD STRENGTH PATTERN. A field strength pattern provides an additional check on the operation of Antenna AN-161 and can be obtained in the following manner:

a. Place Field Strength Meter I-149 (fig. 23) approximately 500 feet away from the antenna at an elevation of 20 to 30 feet.

b. Place the radio set in operation.

c. Rotate the antenna and observe the readings on Field Strength Meter I-149.

d. The readings obtained should be approximately 70 percent of those given in table III and figure 24. Trees, hills, buildings, and other objects in the immediate vicinity of the antenna will affect the pattern and their presence should be allowed for.

TABLE III

Frequency (mc)	*Beam Width (.707)*	*Side Lobes (%)*	*Back Radiation*
101	18.00	1—1	less than 2%
102	17.8	2.5—2	less than 2%
104	17.5	2—2.5	less than 2%
106	16.8	5.5—3	less than 2%
108	16.6	2—2.5	less than 2%
110	16.3	1—3.5	less than 2%
112	15.8	1—2	less than 2%
114	15.3	2.5—22	less than 2%

18. SUMMARY. When a standing wave ratio of 60 percent or better and a field strength pattern closely approximating that given in the preceding paragraph has been obtained, the antenna may be considered satisfactorily tuned. Reconnect cable PT-5 to the receiver. The antenna is now ready for operation.

SECTION IV
MAINTENANCE

19. GENERAL. Antenna AN-161 when properly assembled and connected to Tower TR-20-A should require little maintenance. In general, keep the antenna free of rust, corrosion, and foreign deposits of any kind. Remove any such accumulations promptly and clean the antenna thoroughly. Chip rust spots clean and repaint the surface immediately. Reflector wires, dipoles, and transmission lines must be kept clean and tight. Special attention should be given to keeping the connections between horizontal transmission lines and vertical transmission lines secure. These connections can be kept tight by soldering the joints after they have been mechanically fastened. It is important in the interest of safety and efficient operation that all gear and tackle, such as the lines used in guying the antenna during hoisting, be kept in a neat and orderly manner.

20. ROUTINE ANTENNA CHECK. A general performance check should be made on the operation of the antenna at frequent intervals. With the radio set operating in a normal manner, the following steps will provide a quick check on the operation of Antenna AN-161:

a. Measure the standing wave ratio according to the instructions given in paragraph 14*a*(1). A standing wave ratio of 60 percent or better should be obtained.

b. The balance-to-ground of the transmission line should be measured according to the instructions given in paragraph 16. If the points of maximum and minimum voltage on the two lines fall within 6 inches of each other and do not differ by more than 10 percent, the balance can be considered satisfactory.

c. A field strength pattern should be made using Test Set I-149 in the following manner:

(1) At each test, place the meter in the same position as the previous test.

(2) Proceed as instructed in paragraph 17.

(3) Take readings with the antenna in the same position at each reading.

(4) No large metal objects should be introduced into the field of the antenna. Any abnormal decrease in the reading of Test Set I-149 when the antenna and transmission lines have checked satisfactorily warrants an investigation of the radio set.

21. ADJUSTMENT AND CARE OF SPARK GAP GA-6-A. Because it may have been necessary to change the position of the spark gaps during the tuning of the antenna, their care and adjustment must be considered. The air spark gap is composed of two 5/32-inch diameter tungsten rods inserted in a hollow screw which permits adjustment of their spacing (fig. 24). The round polystrene disk is designed to prevent the sputtering of the tungsten on the polystrene insulator bar which holds the entire assembly together. This disk should be kept thoroughly clean. The polystrene bar should be cleaned whenever an accumulation of tungsten is apparent.

a. To clean either of the polystrene parts proceed as follows:

CAUTION: Do not remove either of the main clamps from transmission line.

(1) Remove the two screws attaching the polystrene bar to the main clamps.

(2) Clean the part thoroughly and replace.

b. To set the spark gap adjustment proceed as follows:

(1) Turn the electrodes down until they meet.

(2) Back one screw away one-quarter of a turn. This will create a spacing at the gap of about 0.008 inch. The gap should be located directly over the center of the disk.

(3) In cases where the tungsten electrodes have burned down to the point where only 1/8 inch is visible beyond the knurled nuts, loosen the knurled nuts, move the screws back, and remove the tungsten. Replace with a new electrode, and set the spacing as described above.

(4) The electrodes should be aligned as perfectly as possible by tightening one of the main clamps to the transmission line and then aligning the other side before securing the screws.

SECTION V
SUPPLEMENTARY DATA

22. LIST OF PARTS FOR ANTENNA AN-161.

Quan.	*No. Extra*	*Description*	*Mfg. No.*
32	4	Dipole assemblies	601
1008	492	J-bolts	701
756	378	Bevel washers	801
126	26	Wire splicers	901
63	13	Reflector wire	1001
126	26	Reflector wire assembly	1101
2		I-beam assembly, 3"	1201
2		I-beam assembly, 3"	1301
2		I-beam assembly, 3"	1401
2		I-beam assembly, 3"	1501
1		I-beam, 4"	1601
1		I-beam, 4"	1602
4		Angle 5" x 3½" x 5/16"	1603
4		Angle 5" x 5" x 5/16" assembly	1604
2	2	Shorting-bar assembly	1701
16	4	Clamp assembly	1801
6	2	Trans. support	2101
2	2	Feeder assembly, horizontal	2401
2	1	Tower transmission support	2701
2	1	Tower transmission line	2801
1		Tower transmission line	3001
1		Tower transmission line	3002
1	1	Shorting-bar, stub	3101
2	1	Stub assembly	3301
2		Tower transmission line	3401
1		I-beam assembly, 8"	3601R
1		I-beam assembly, 8"	3601L
4		I-beam assembly, 10"	3701
4		Splice plates	3712
4		Splice plates	3713
1		Angle 5" x 3½" x 5/16" assembly	3801
4		Angle 3½" x 3½" x ⅜" assembly	3802
4		Angle 5" x 2⅝" x 5/16"	3803R
4		Angle 5" x 2⅝" x 5/16"	3803L
2		Tie rod	3801
12		Tie rod	3902
2		Tie rod	3902
16		Clevis pin	4001
16		Clevis pin	4002
8		Angle 5" x 4½" x 5/16" assembly	4201
2		Angle 4" x 2½" x ¼"	4212
6		Channel	4203

Supplementary Data

Quan.	*No. Extra*	*Description*	*Mfg. No.*
2	2	Bent assembly	4301
8		Angle 1½" x 1½" x 3/16"	4312
8		Angle 1½" x 1½" x 3/16"	4313
6		Angle 1½" x 1½" x 3/16"	4304
2		Angle 4" x 1½" x ¼"	4411R
2		Angle 4" x 2½" x ¼"	4411L
2		Angle 4" x 2½" x ¼"	4412R
2		Angle 4" x 2½" x ¼"	4412L
4		Angle 4" x 2½" x ¼"	4413
2		Angle 4" x 2½" x ¼"	4414R
2		Angle 4" x 2½" x ¼"	4414L
4		Angle 4" x 2½" x ¼"	4415
2		Angle 4" x 2½" x ¼"	4416
2		Angle 4" x 2½" x ¼"	4417
6		Bar assemblies	4501
1		Pipe assembly, 4"	4501
1		Ship channel 6"	4701
8		Plate	4702
1		Coupling	MC398-
16	2	Wires, vertical feed	3501
252	52	Machine screws, round head, No. 12-24 x ½", brass	
252	52	Lockwashers, No. 12	
126	26	Pipe spacers	5101
126	26	Spring 11/16" OD	
252	52	Cutwashers for ½" bolt	
126	26	Hexagon nuts, standard, for ½" bolt	
1008	492	Square nuts, standard, ¼" bolt	
1008	492	Lockwashers, bolt	
32	8	Machine screws, round head, 4" 20" x ⅜", brass	
32	8	Lockwashers, 4", bronze	
	16	Cotter pins, 3/16" x 1¾", steel	
16	4	Jamb-nuts, standard hexagon, for 1" bolt	
2		J-bolt assembly	5601
368	132	Rib bolt, structural, 3½" x ⅜" grip, anchor nuts	
28	12	Rib bolt, structural, ½" x ½" grip, anchor nuts	
92	48	Rib bolt, structural, 1" x ⅜" grip, anchor nuts	
8	4	Rib bolt, structural, ½" x ⅜" grip, anchor nuts	
60	30	Rib bolt, structural, ¾" x ⅜" grip, anchor nuts	
12	6	Rib bolt, structural, ¾" x ¾" grip, anchor nuts	
104	52	Rib bolt, structural, ¾" x ⅜" grip, anchor nuts	
12	3	Machine bolts, ½" x 1¾" long anchor	
8	2	Machine bolts, ¾" x 2" long anchor	
6	2	Machine bolts, ¾" x 2" long anchor	
2	1	Machine bolts, ¾" x 2½" long anchor	
2	1	Machine bolts, ⅞" x 3¾" long 2 hexagonal nuts	
8	2	Bevel washers, for ¾" bolt	
1 lb		Solder	
	2	Brass tubing, ⅝" x 2'9" x 1"	5301
4		Machine bolts, ¾" x 2'2"	
4		Machine bolts, ¾" x 2'6"	5301
8		Pipe, 1" x standard 1'4"	5102
2		Eyebolts, ¾" x 1½" one square nut	
4		Angle 2½" x 2½" x 1" thick	5401
2		R 3" x 3" x ¼" thick	5501
8		Cutwashers for ¾" bolt	

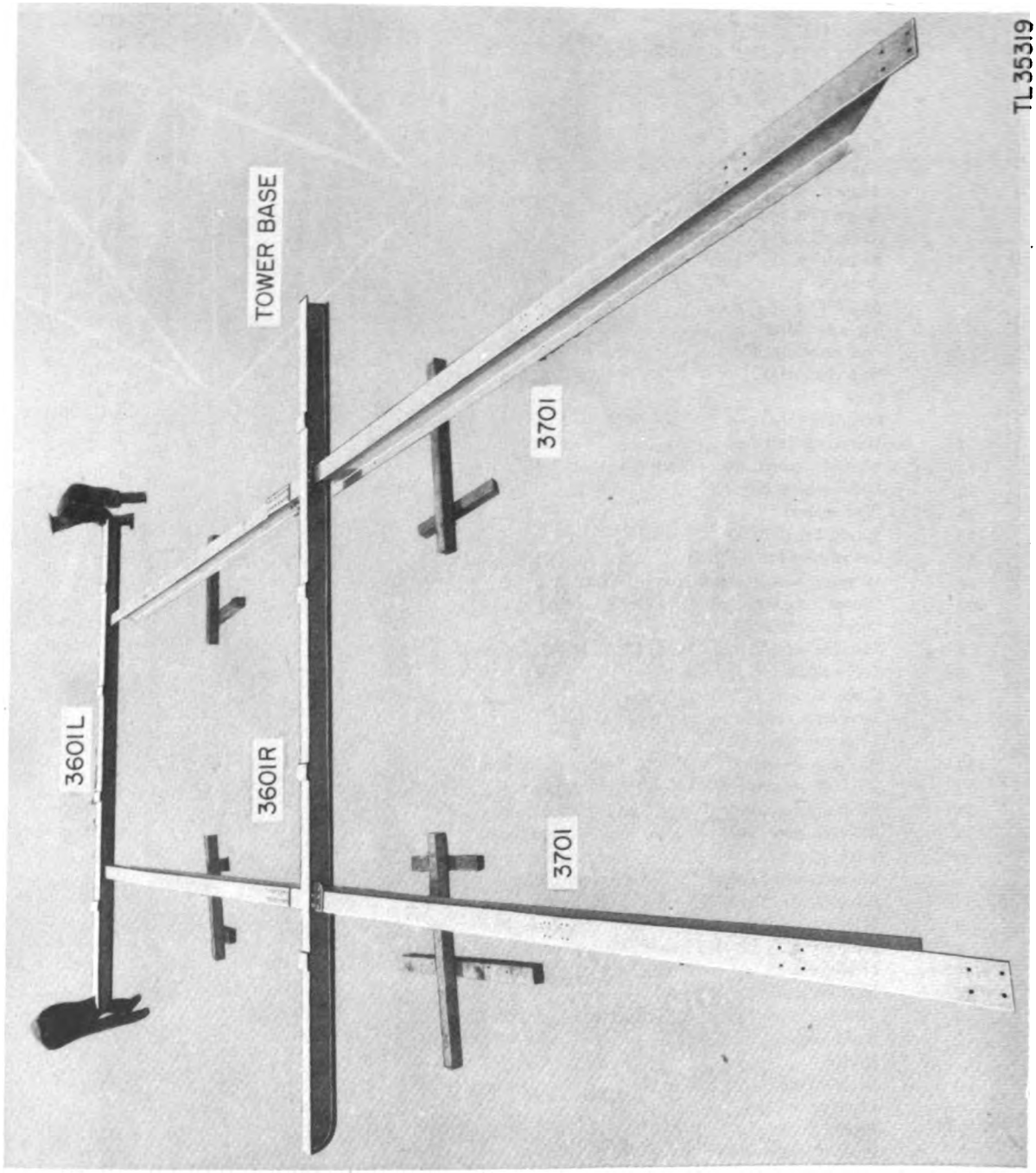


Figure 2. Sliding on vertical beams 3601

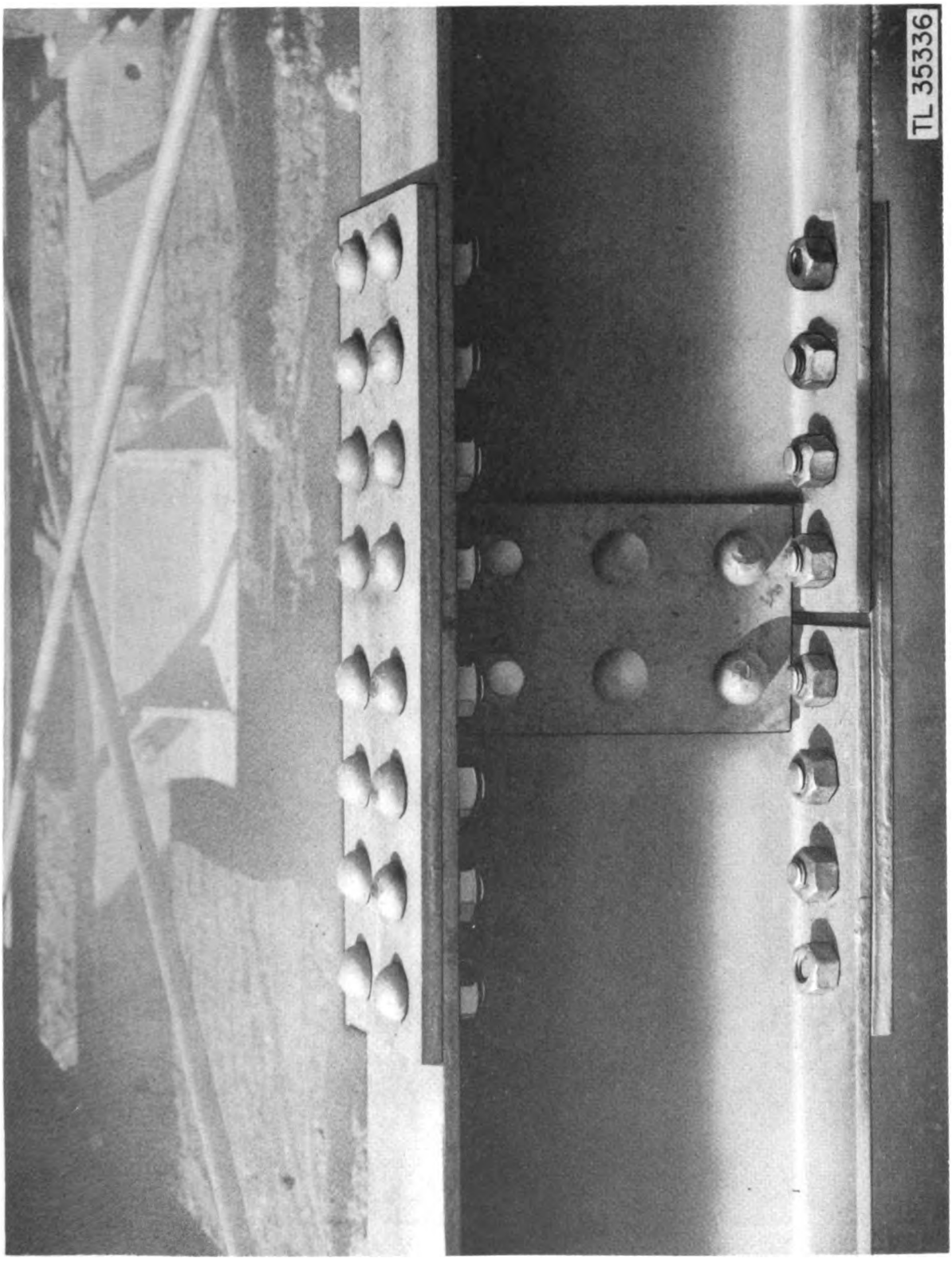


Figure 3. Junction of main beams

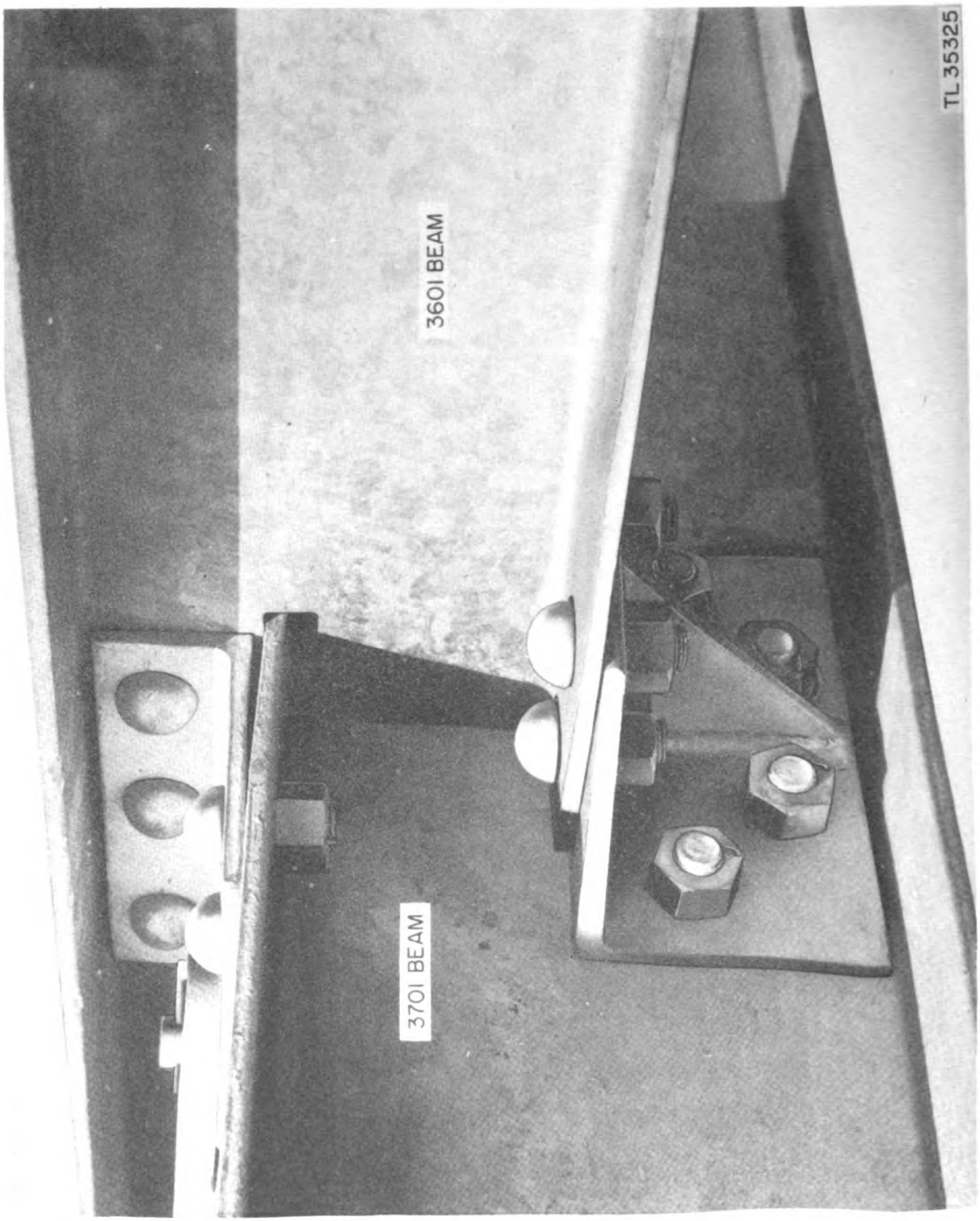


Figure 4. Junction of 3601 and 3701 beams

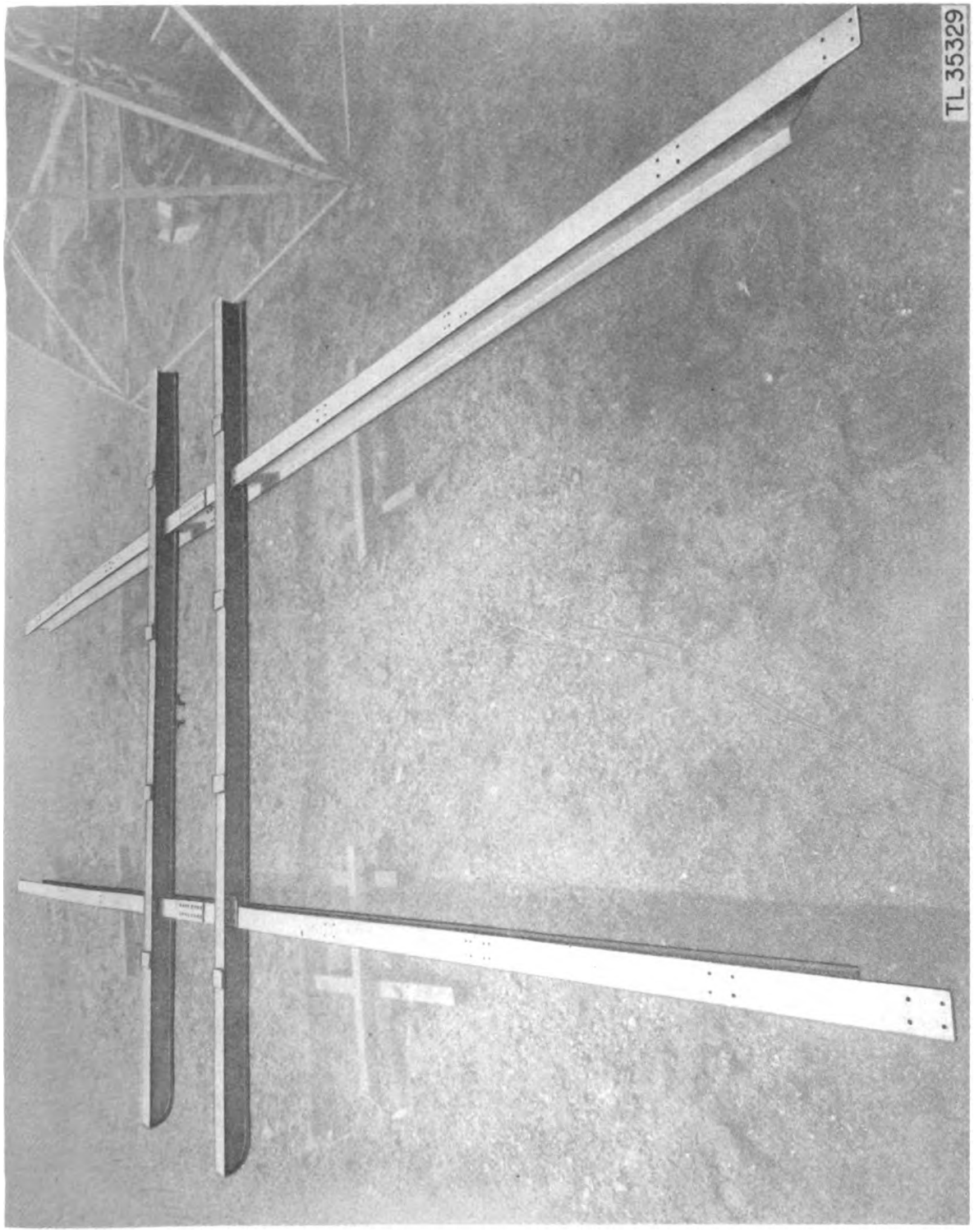


Figure 5. General view of main frames assembled.

Figure 6. View of detail 9.

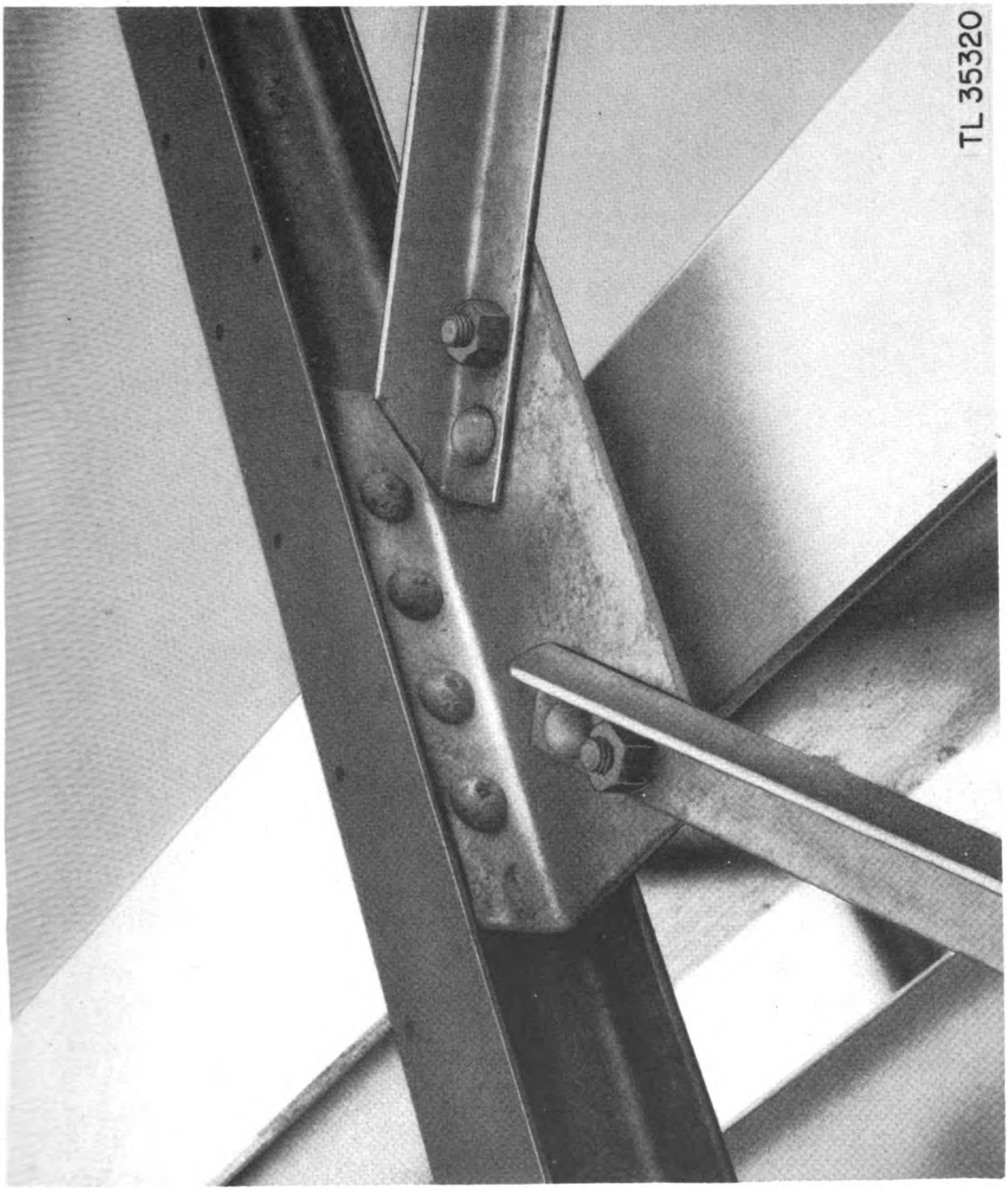


Figure 7. a. View of detail 7

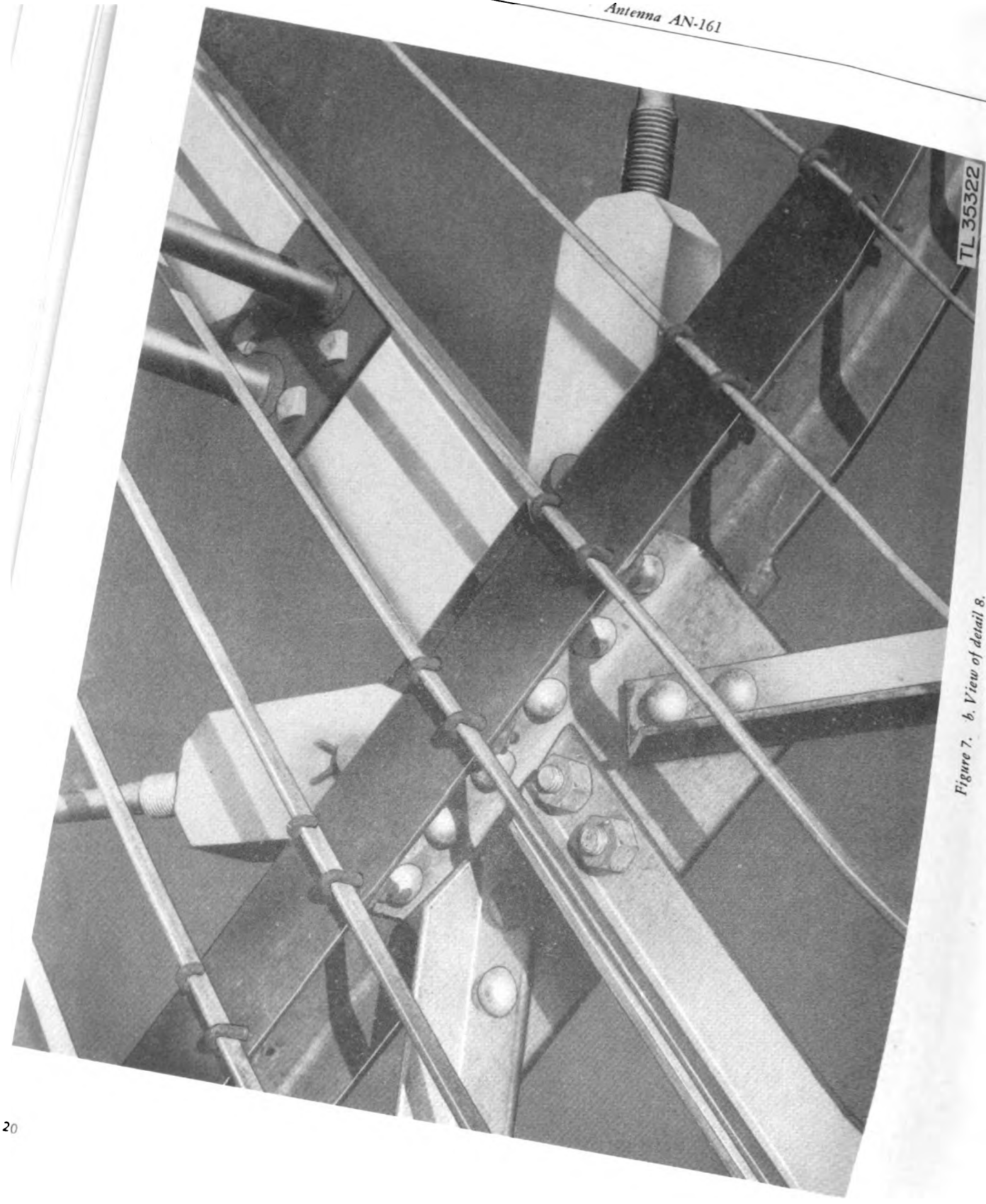


Figure 7. b. View of detail 8.

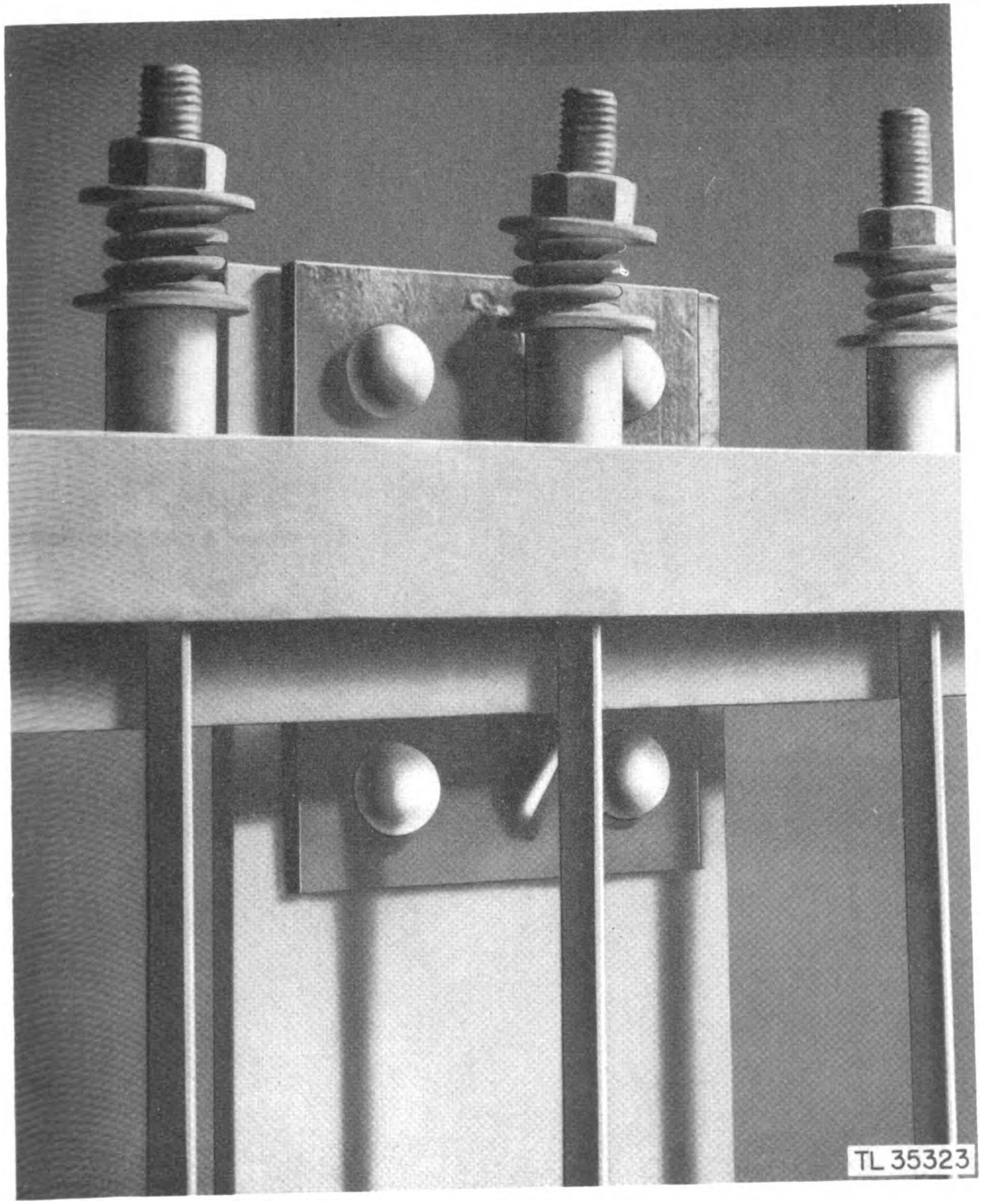


Figure 8. View of detail 3

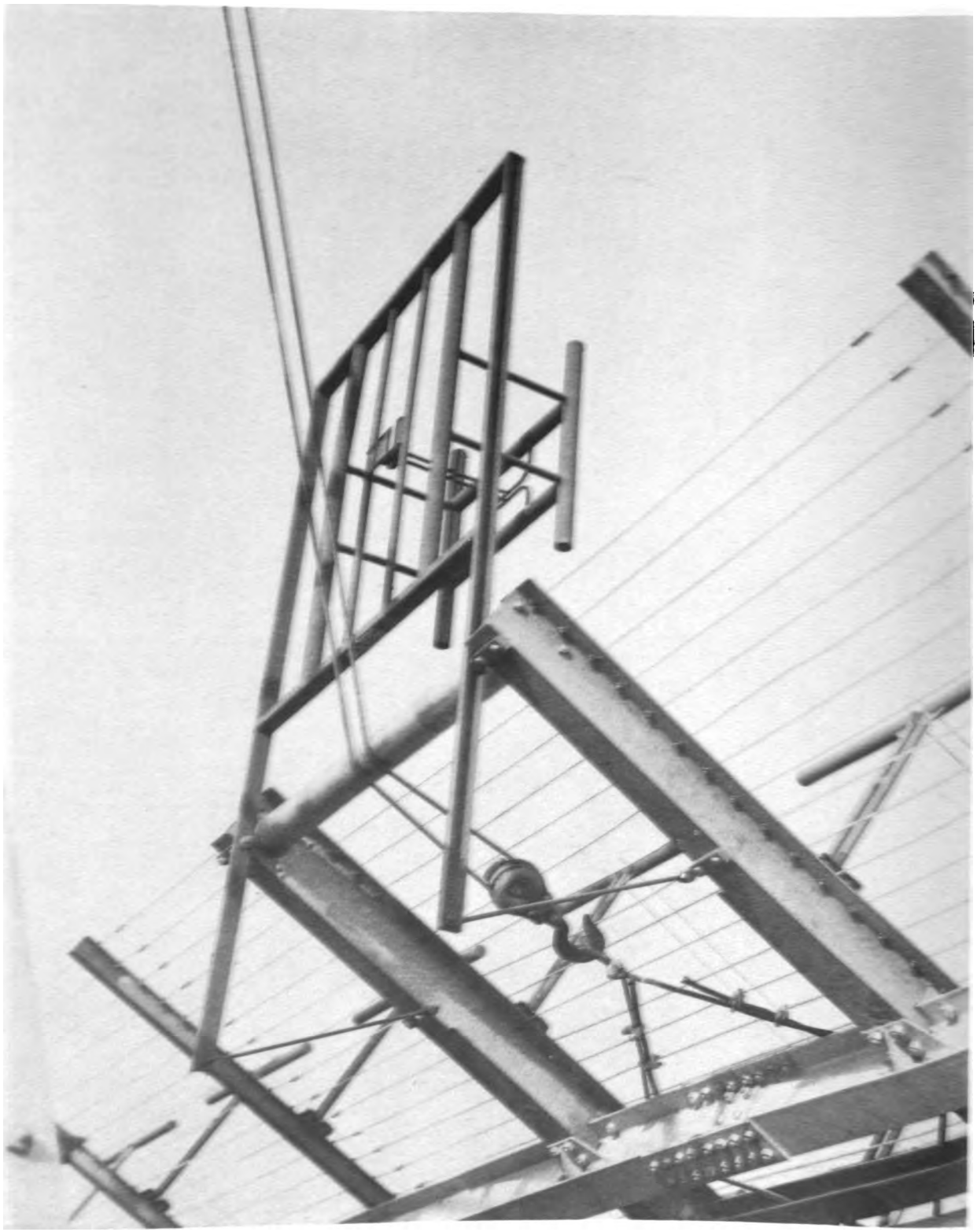


Figure 9. Antenna AN-161. IFF installation, hoisting sling attached, rear view

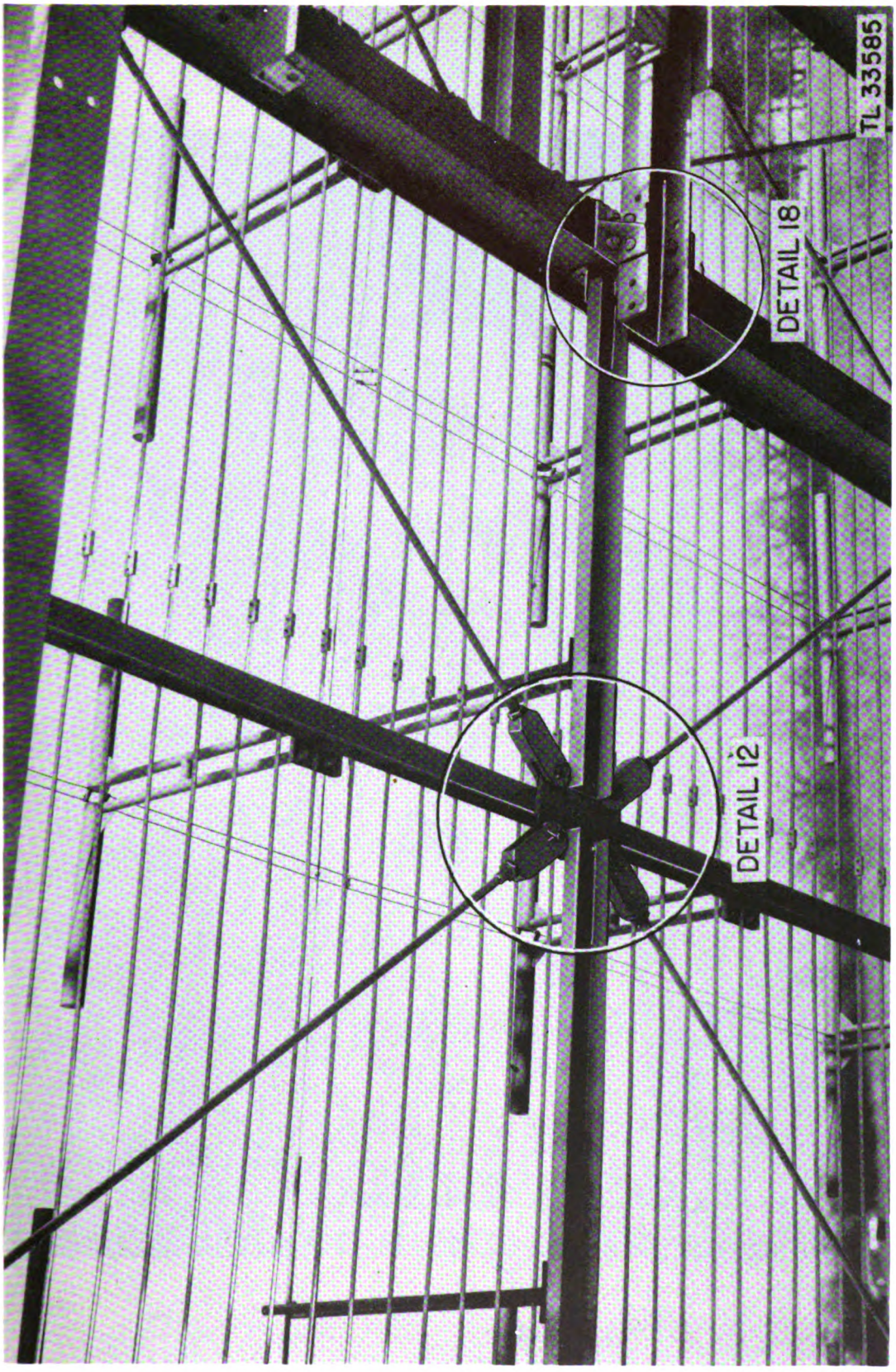


Figure 10. a. Antenna AN-161, rear view, details 12-18

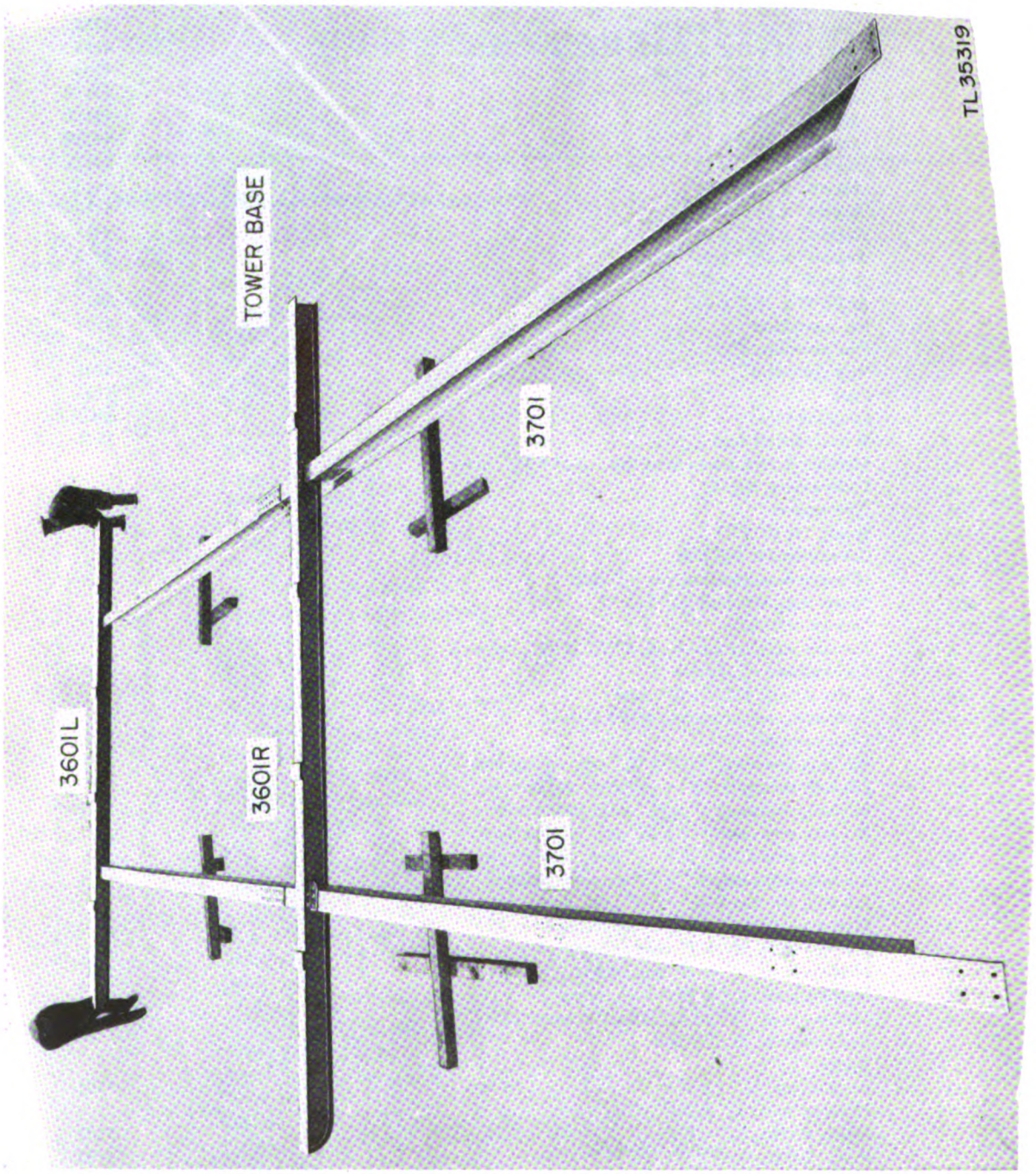


Figure 2. Sliding on vertical beams 3601

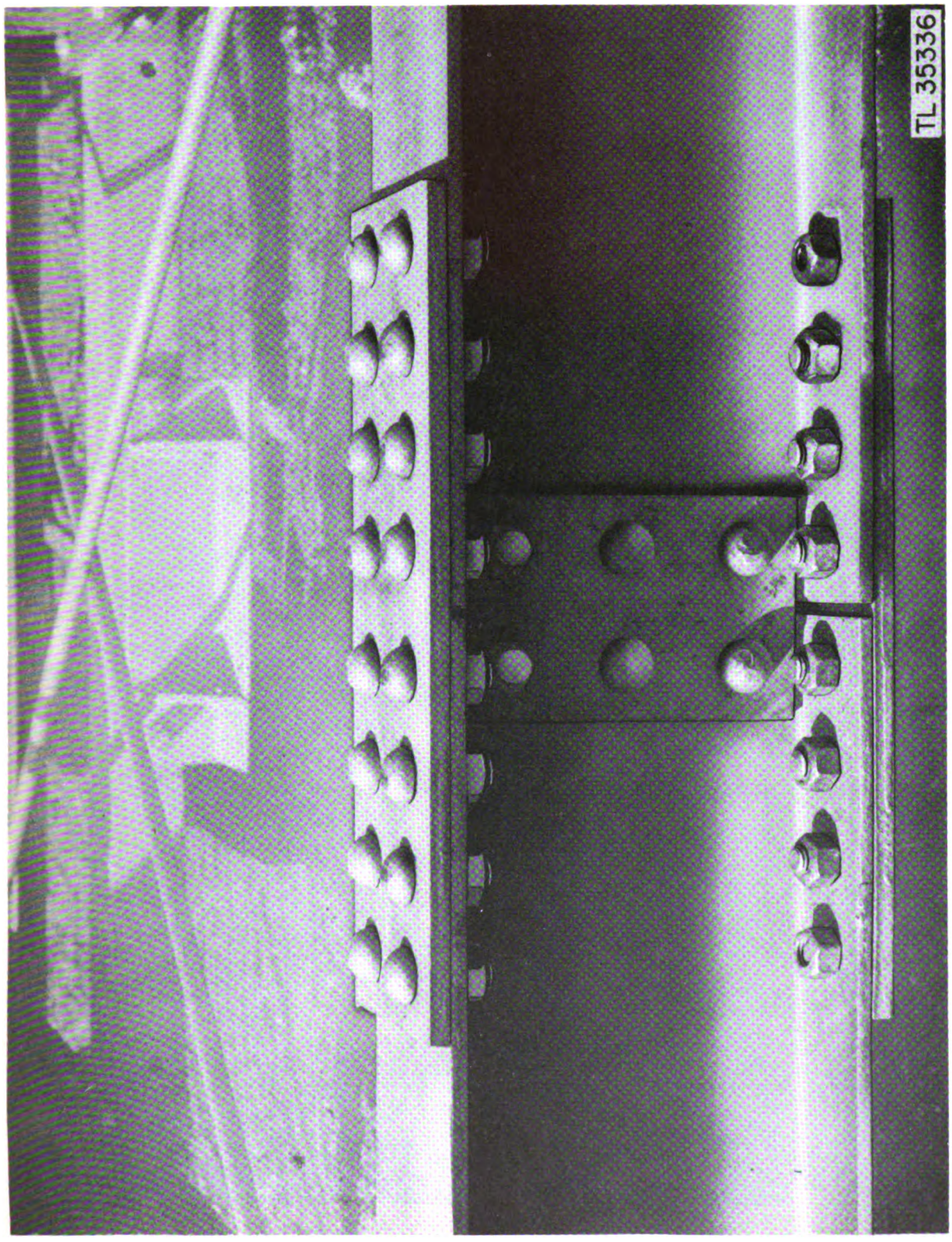


Figure 3. Junction of main beams.

TL 35325

Figure 4. Junction of 3601 and 3701 beams

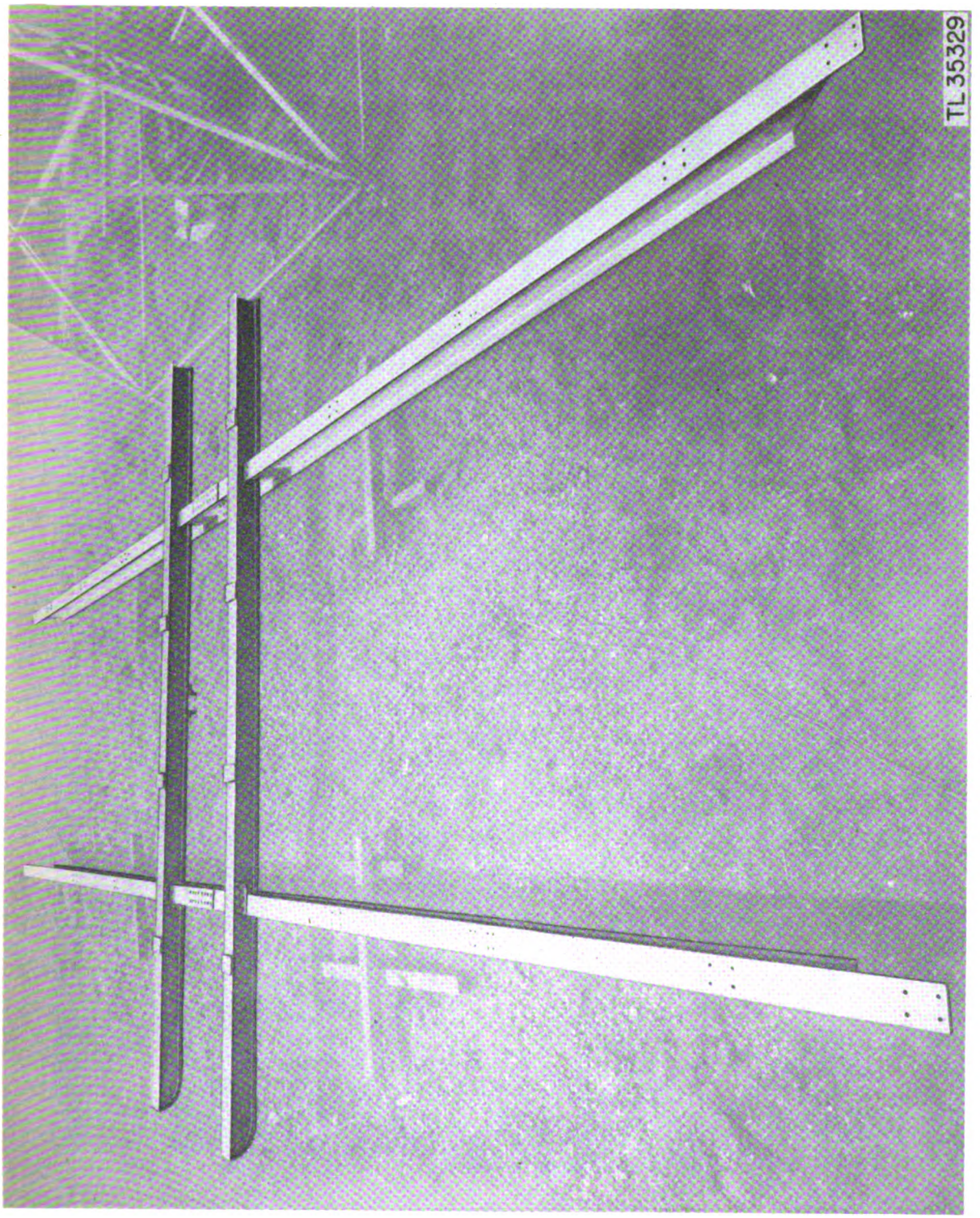


Figure 5. General view of main frames assembled.

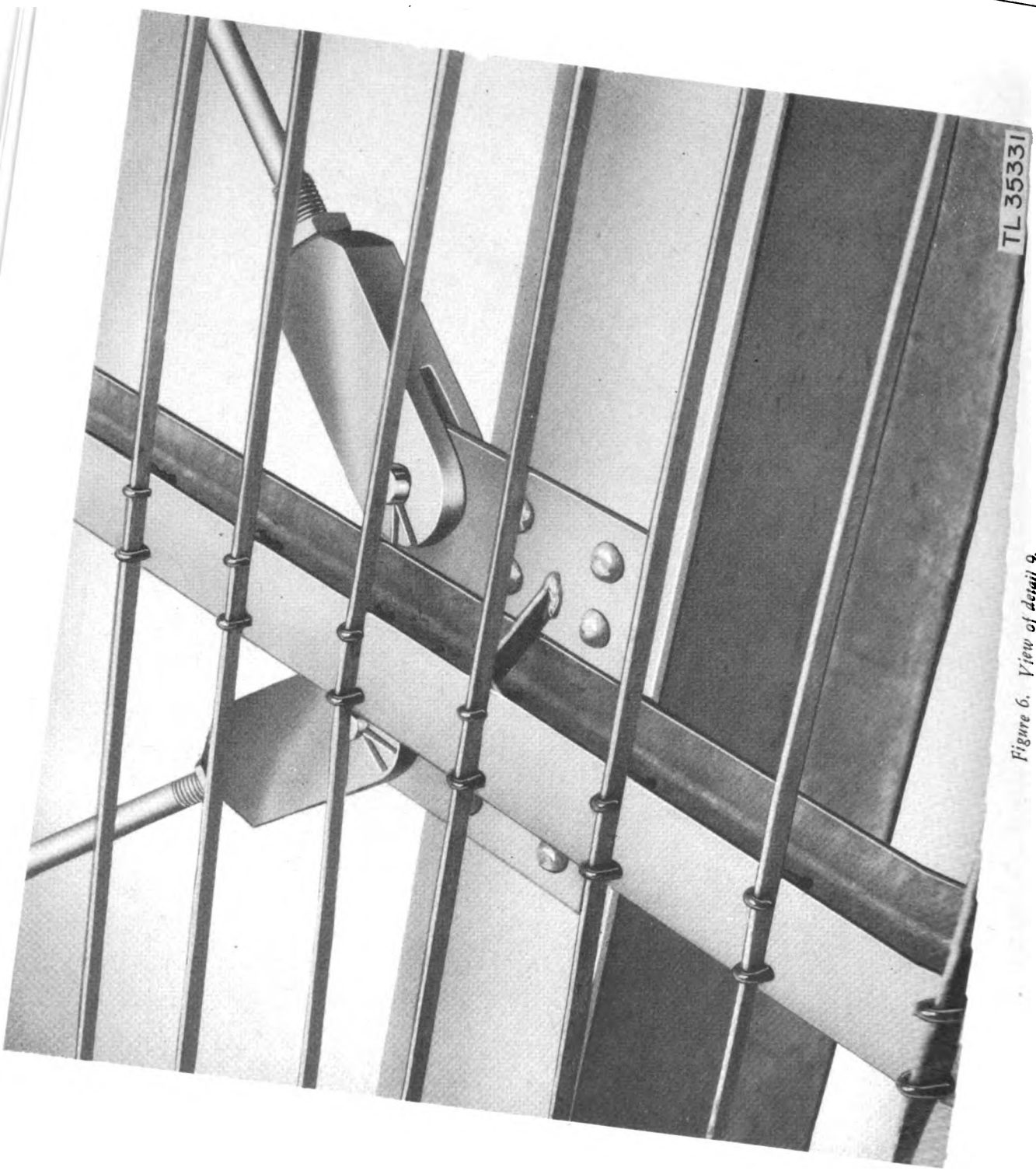


Figure 6. View of detail 9.

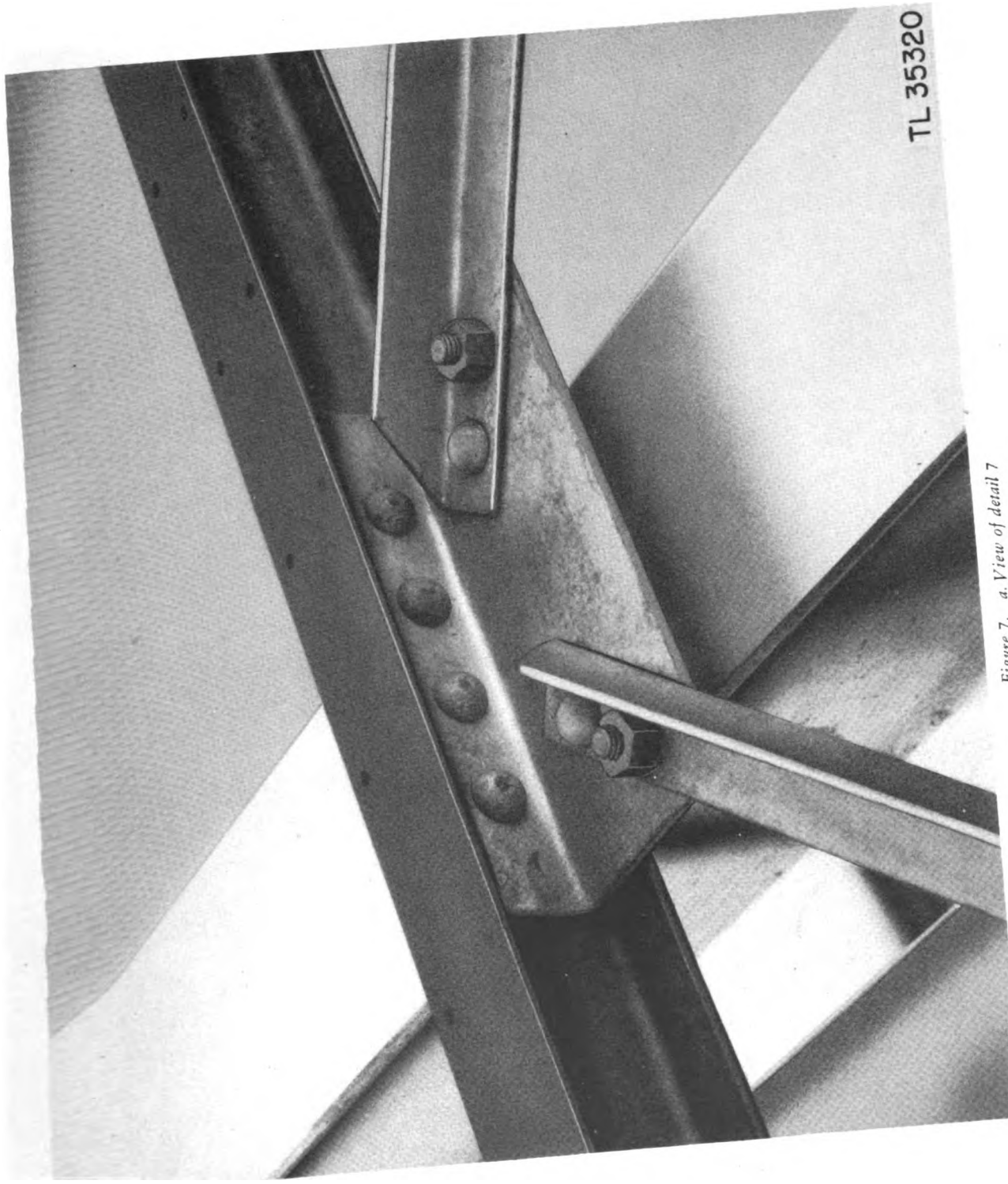


Figure 7. a. View of detail 7

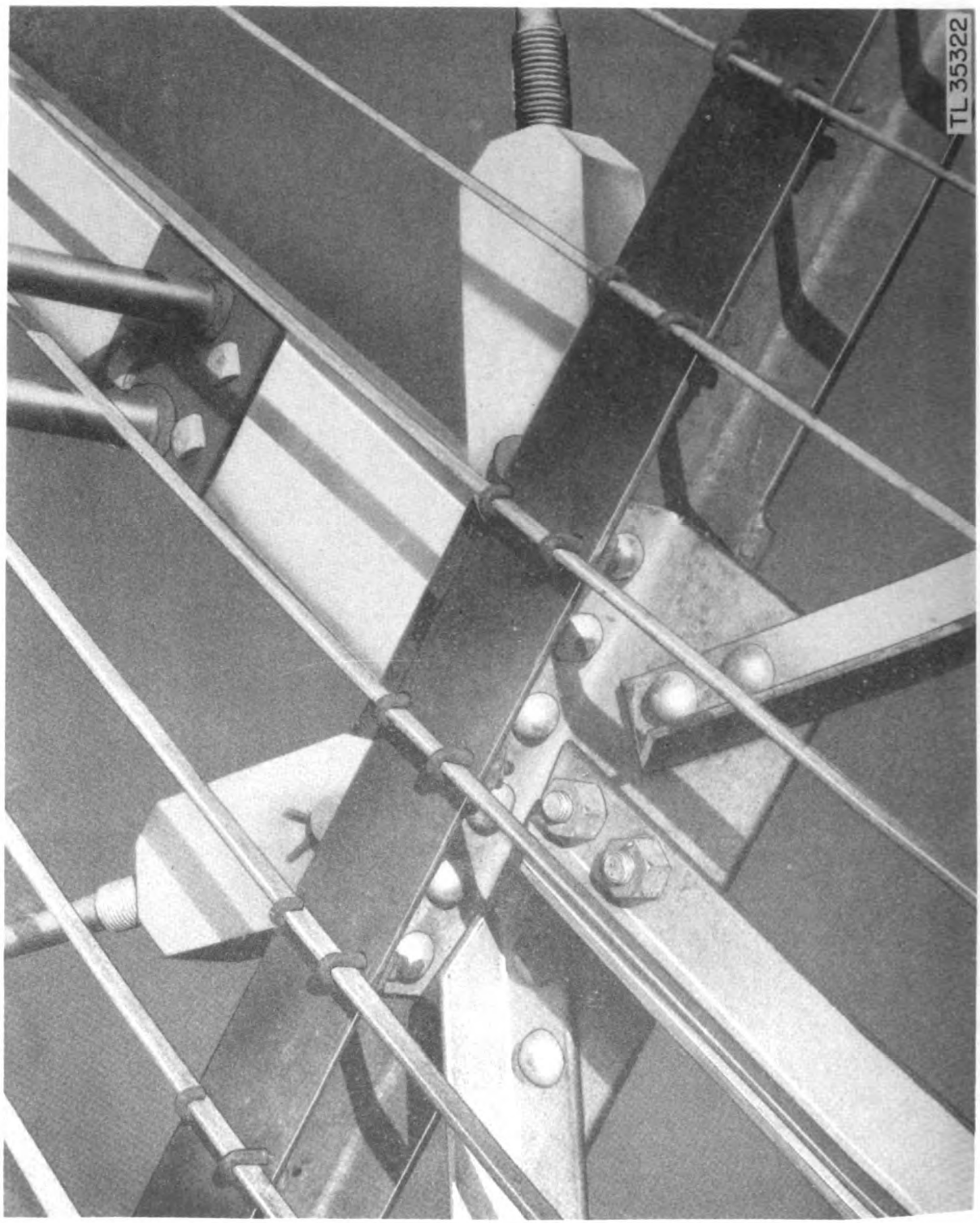


Figure 7. b. View of detail B.

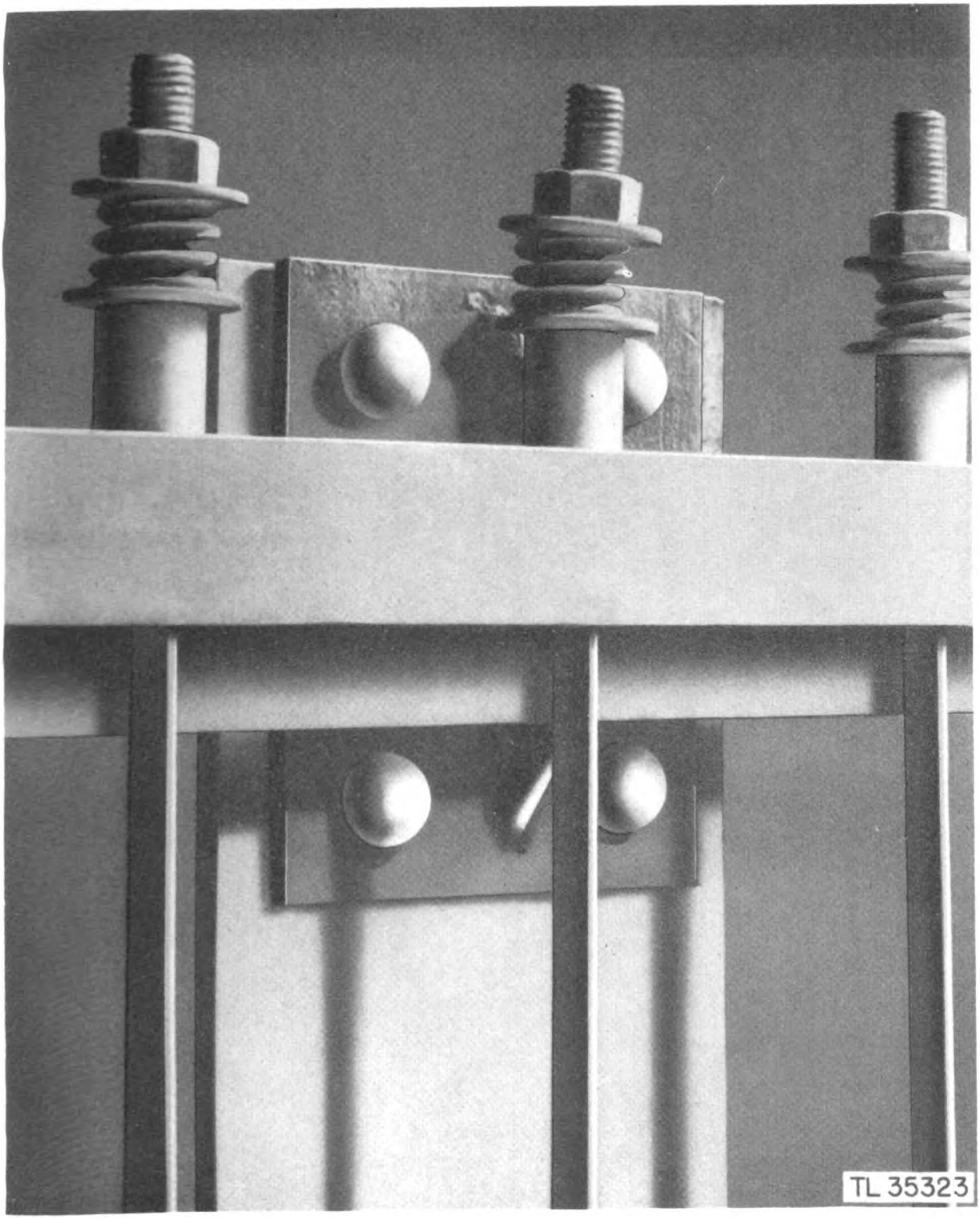


Figure 8. View of detail 3

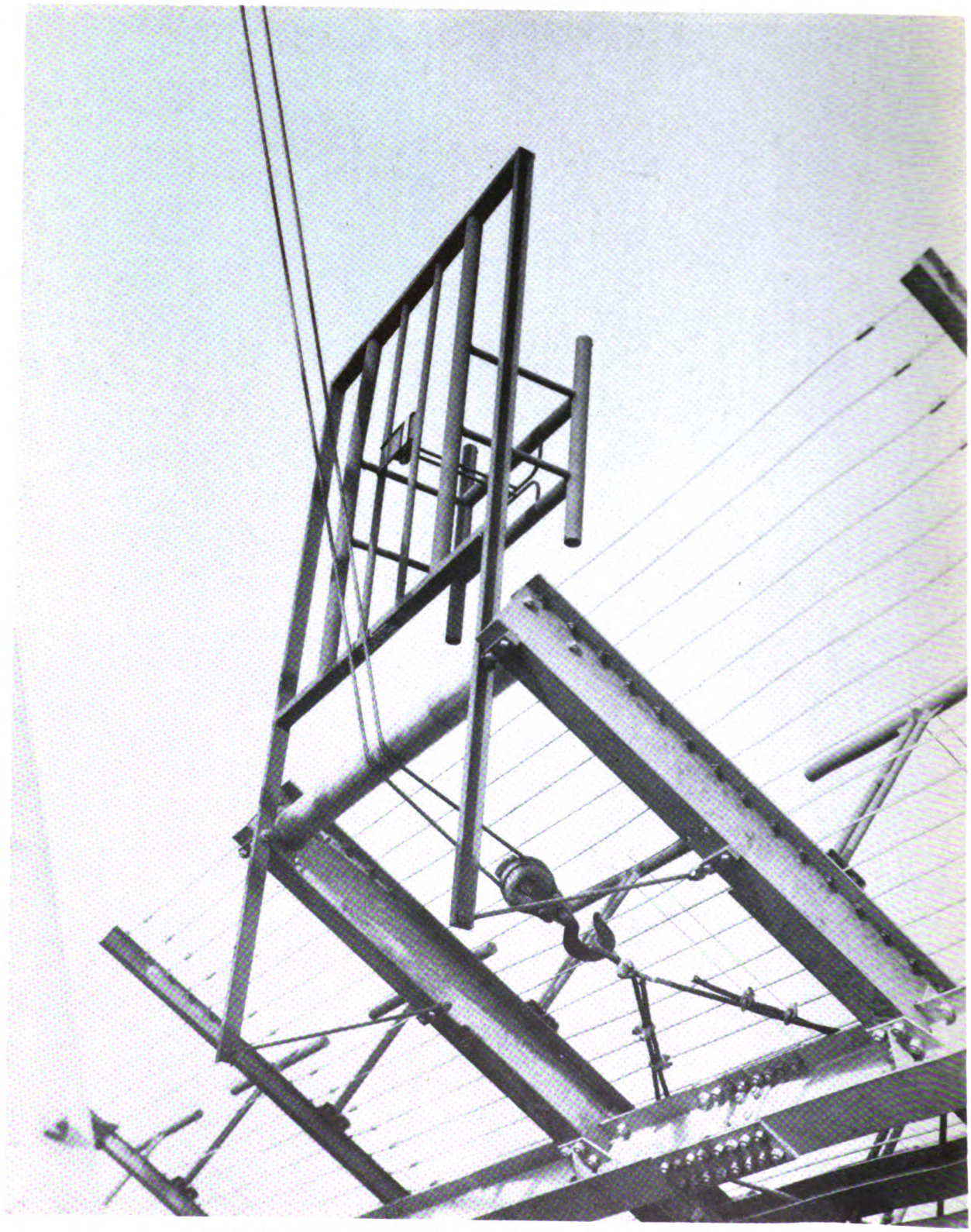


Figure 9. Antenna AN-161, IFF installation, hoisting sling attached, rear view

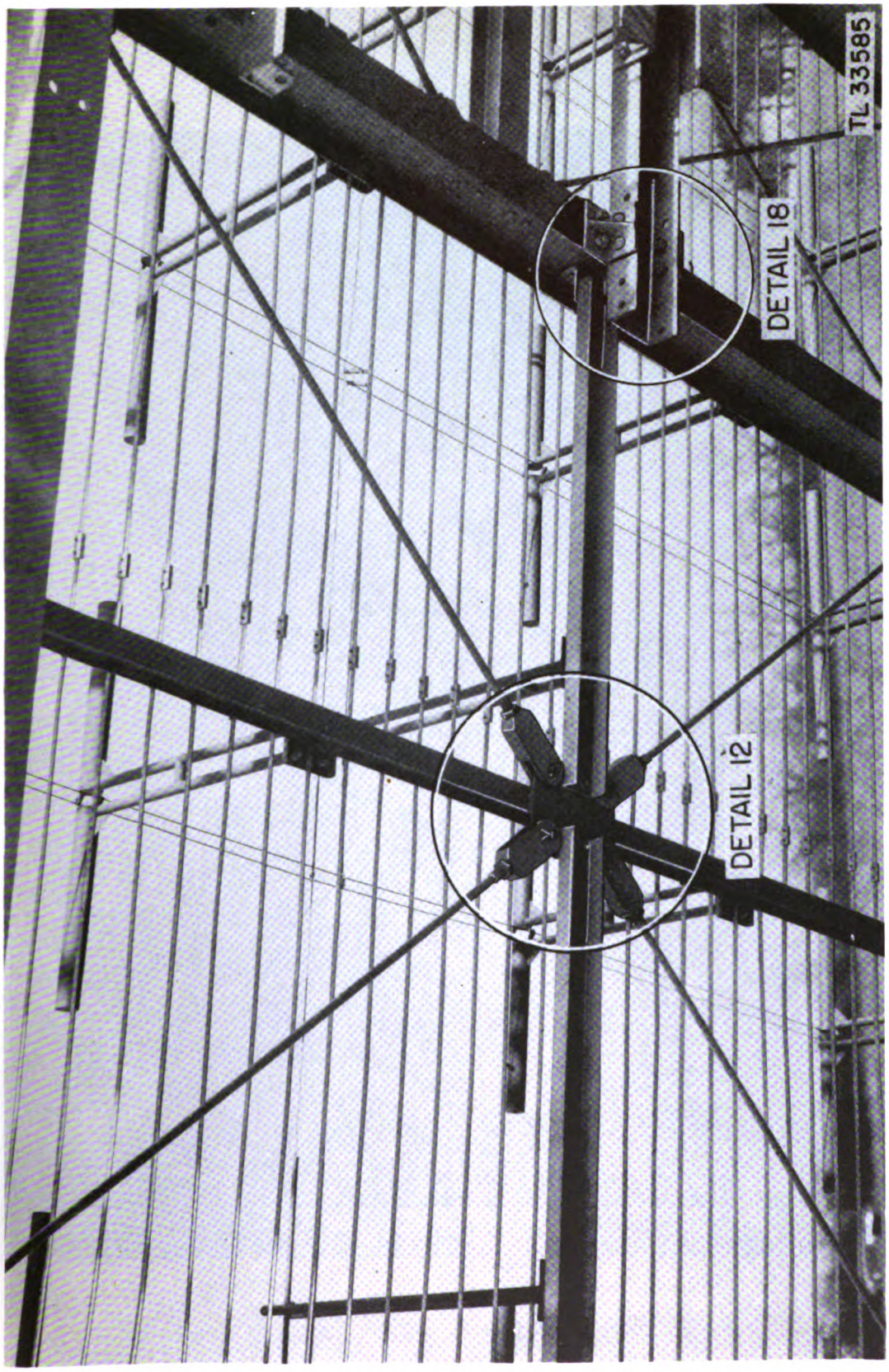


Figure 10. a. Antenna AN-161, rear view, details 12-18

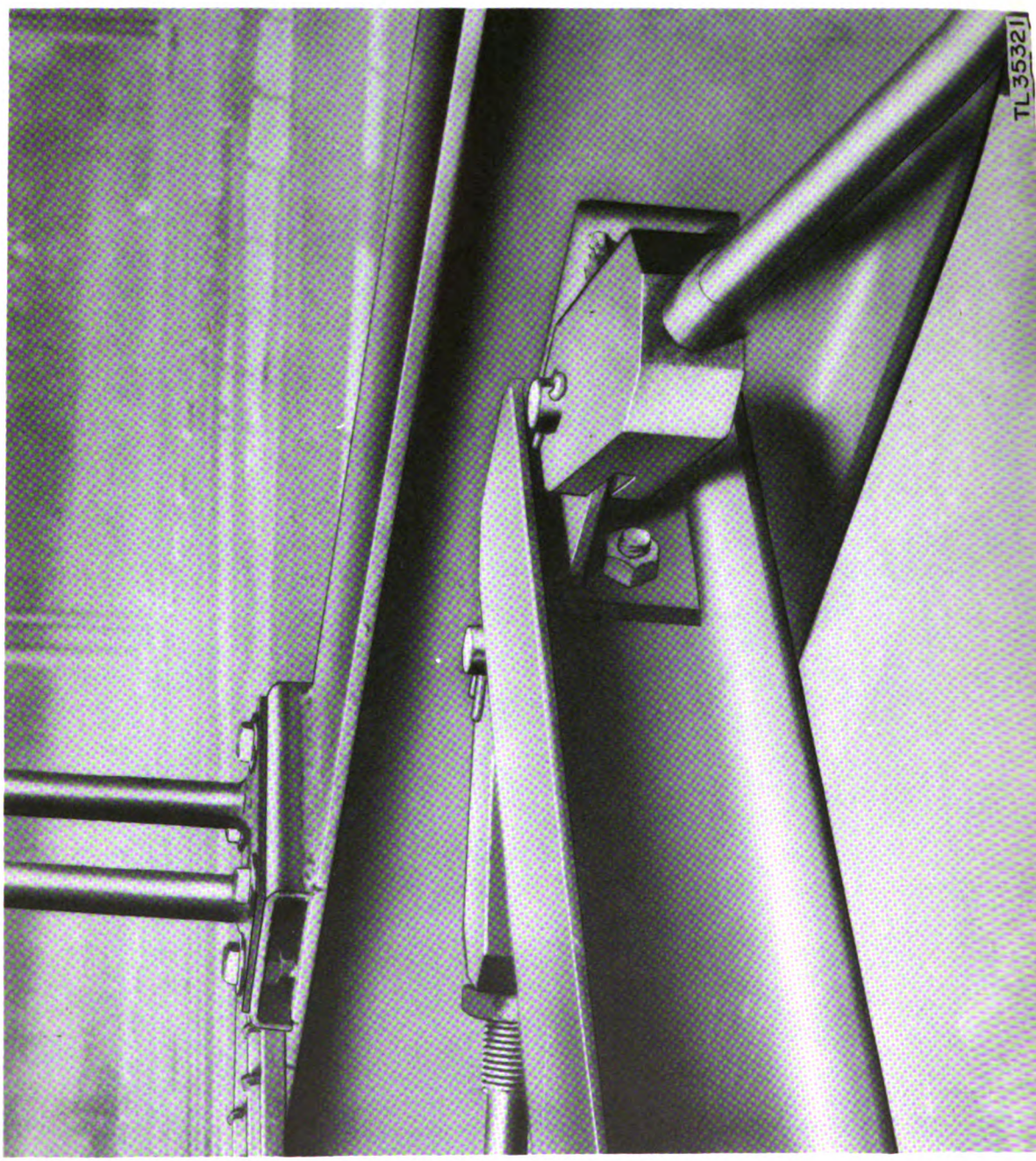


Figure 10. b. View of detail 16.

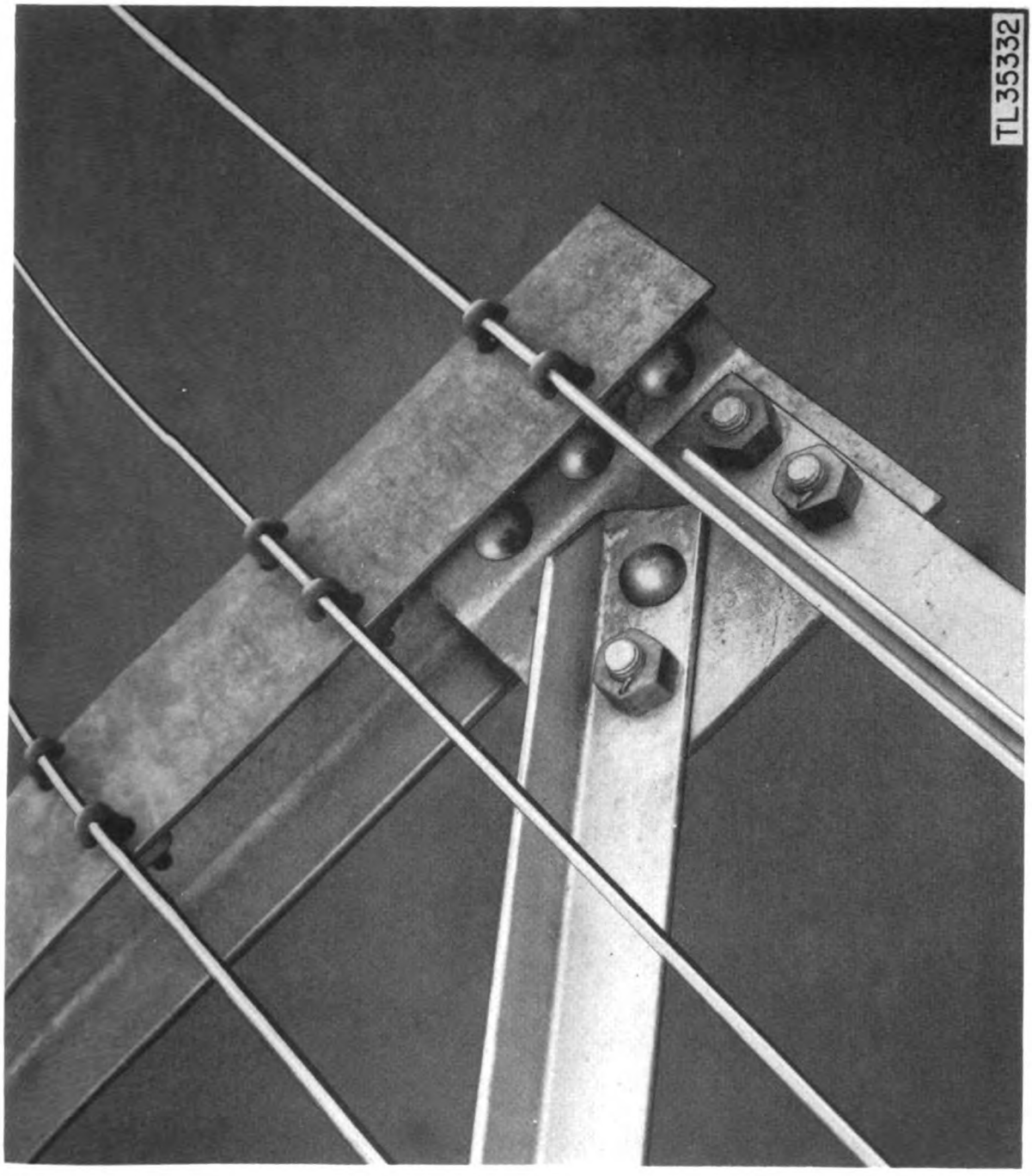


Figure 11. a. View of detail 6.

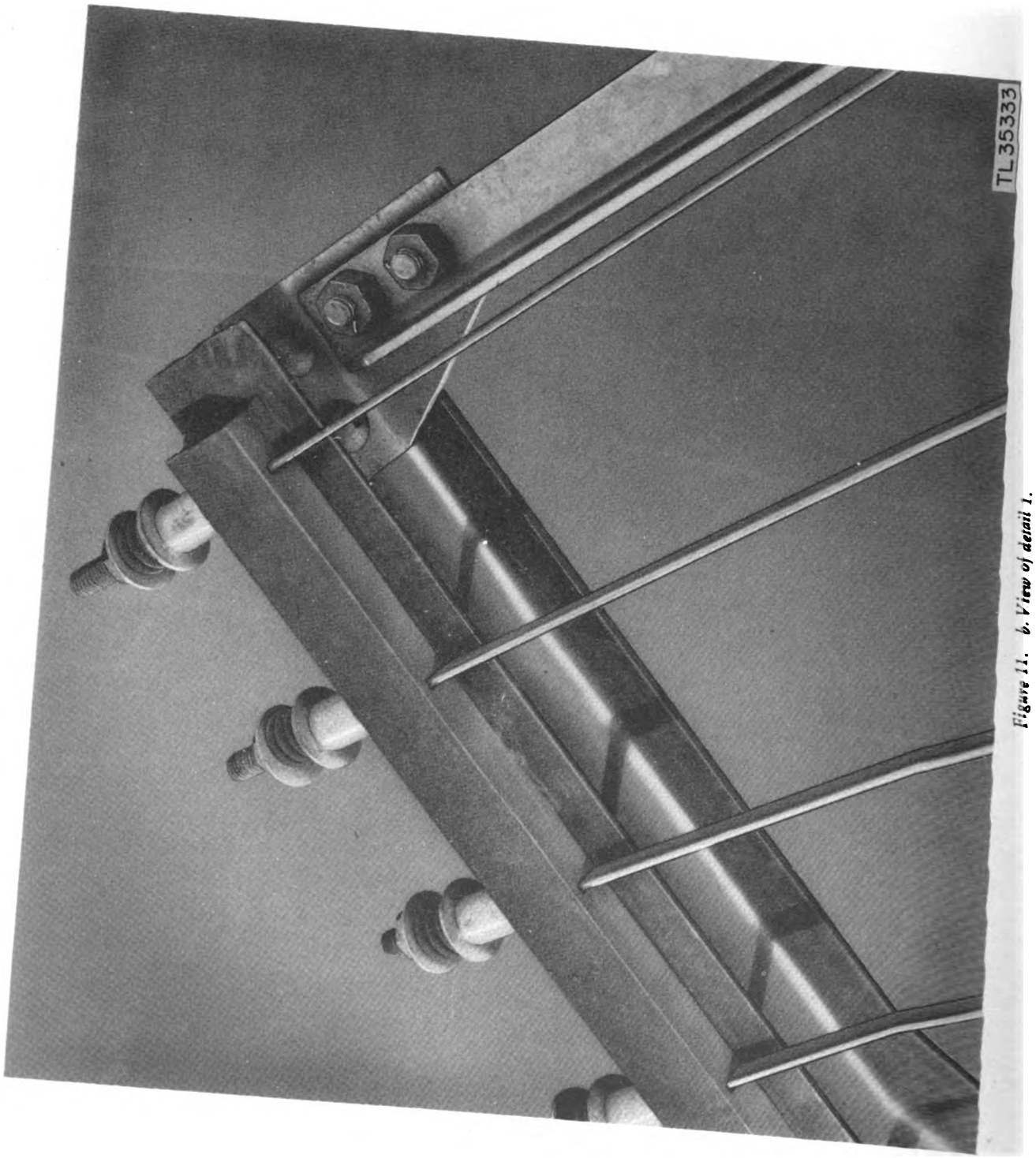


Figure 11. b. View of detail 1.

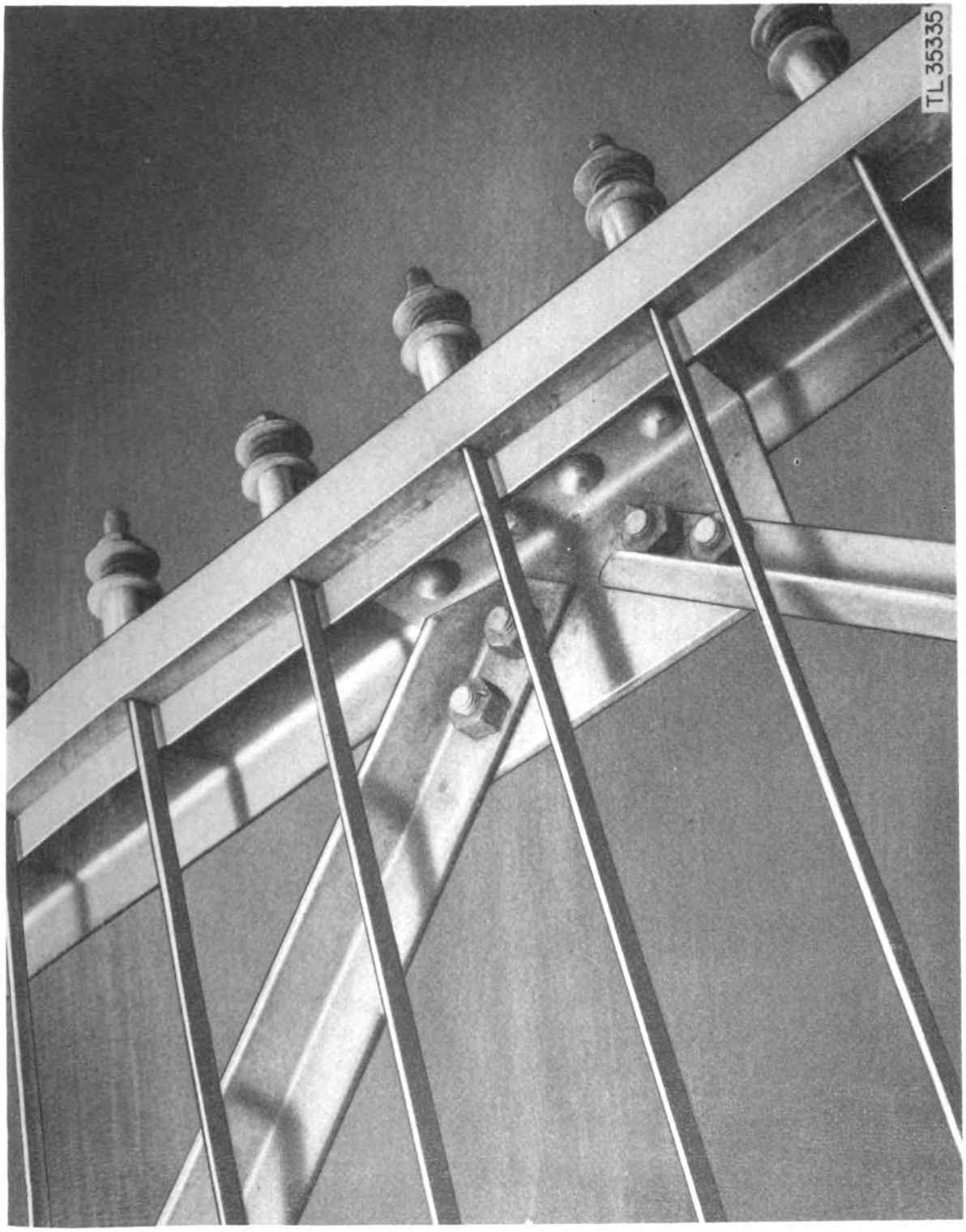


Figure 12. a. View of details 2 and 4.

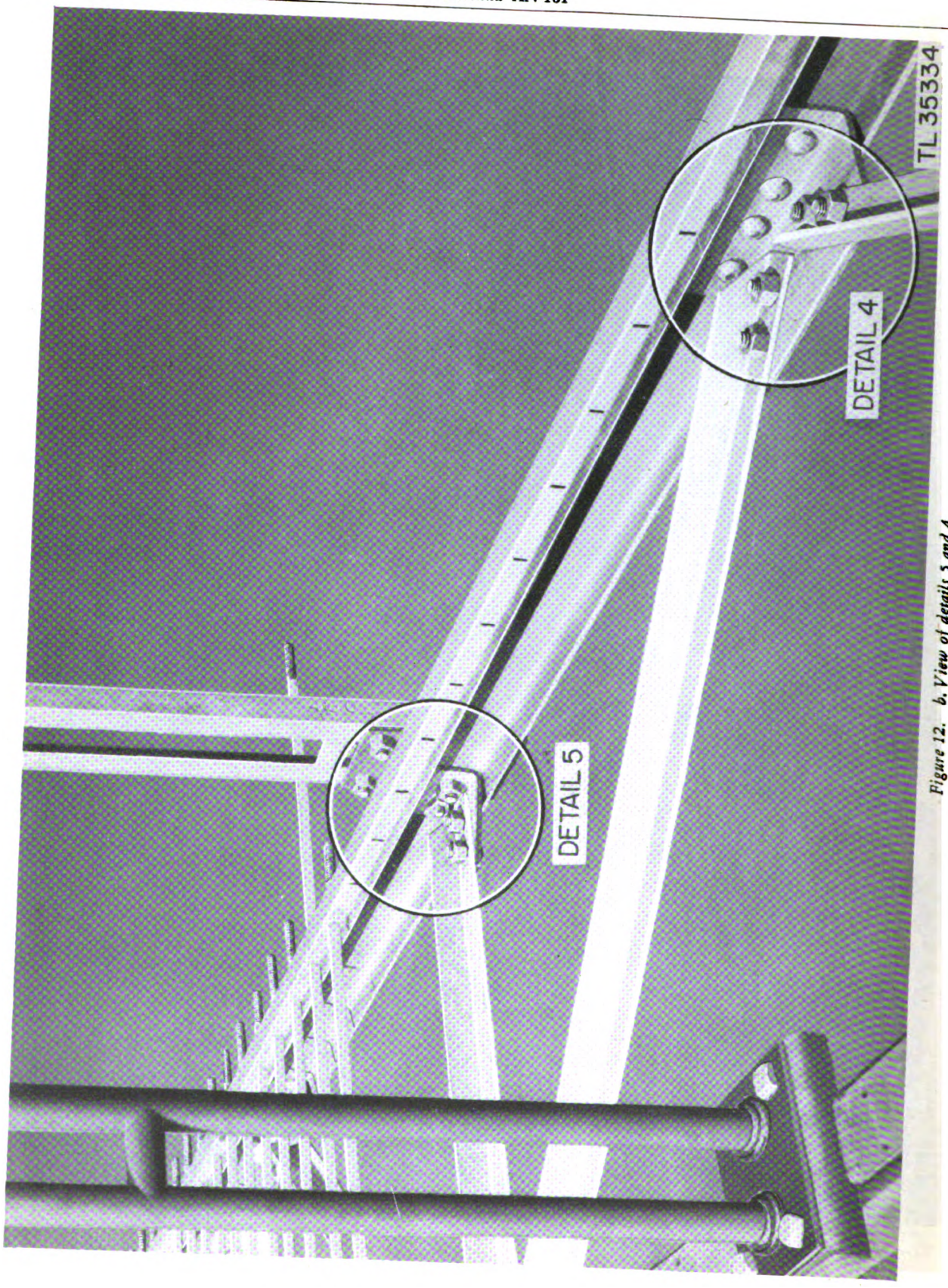


Figure 12. b. View of details 5 and 4.

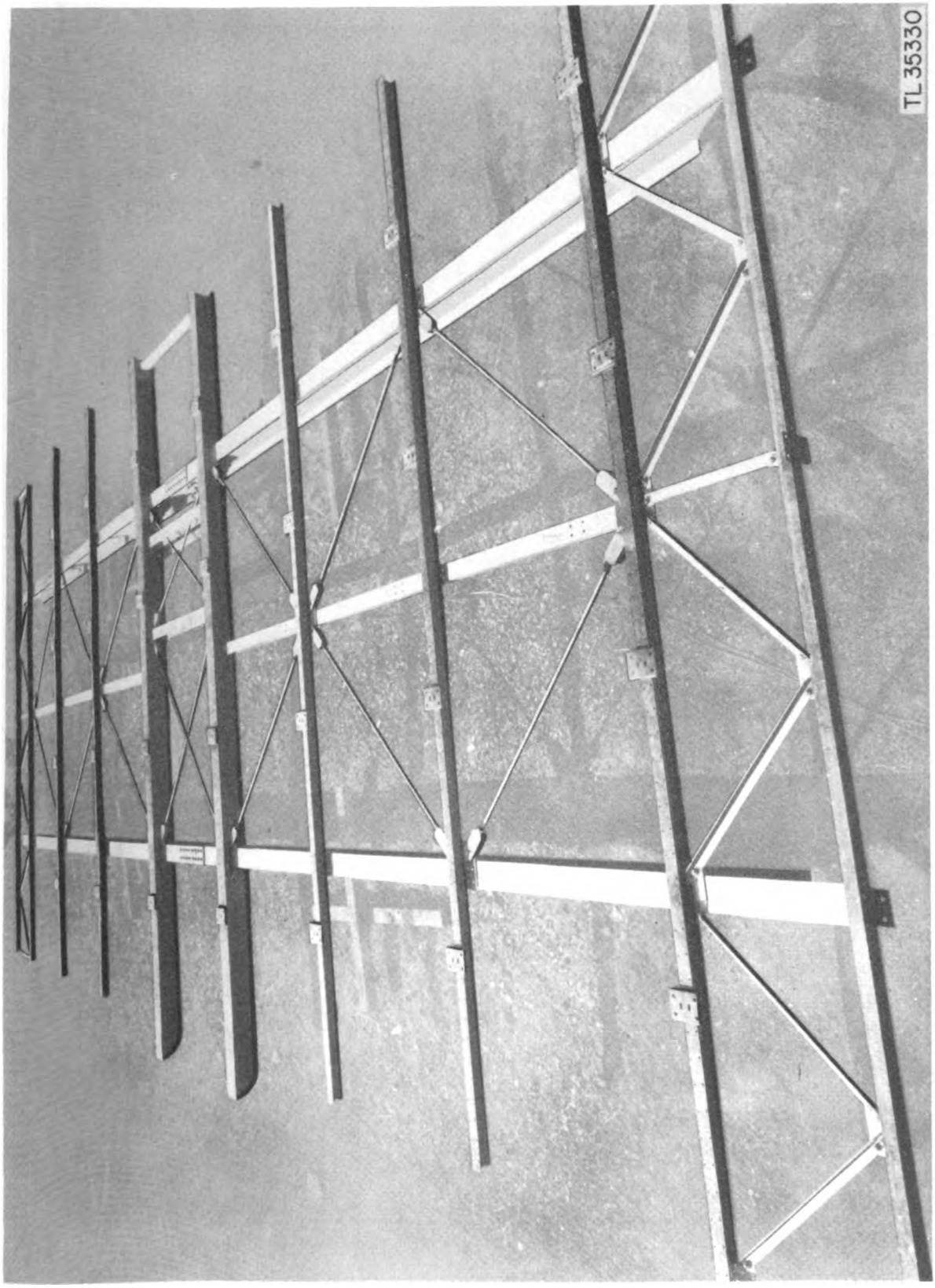


Figure 13. Antenna AN-161, main frame assembled

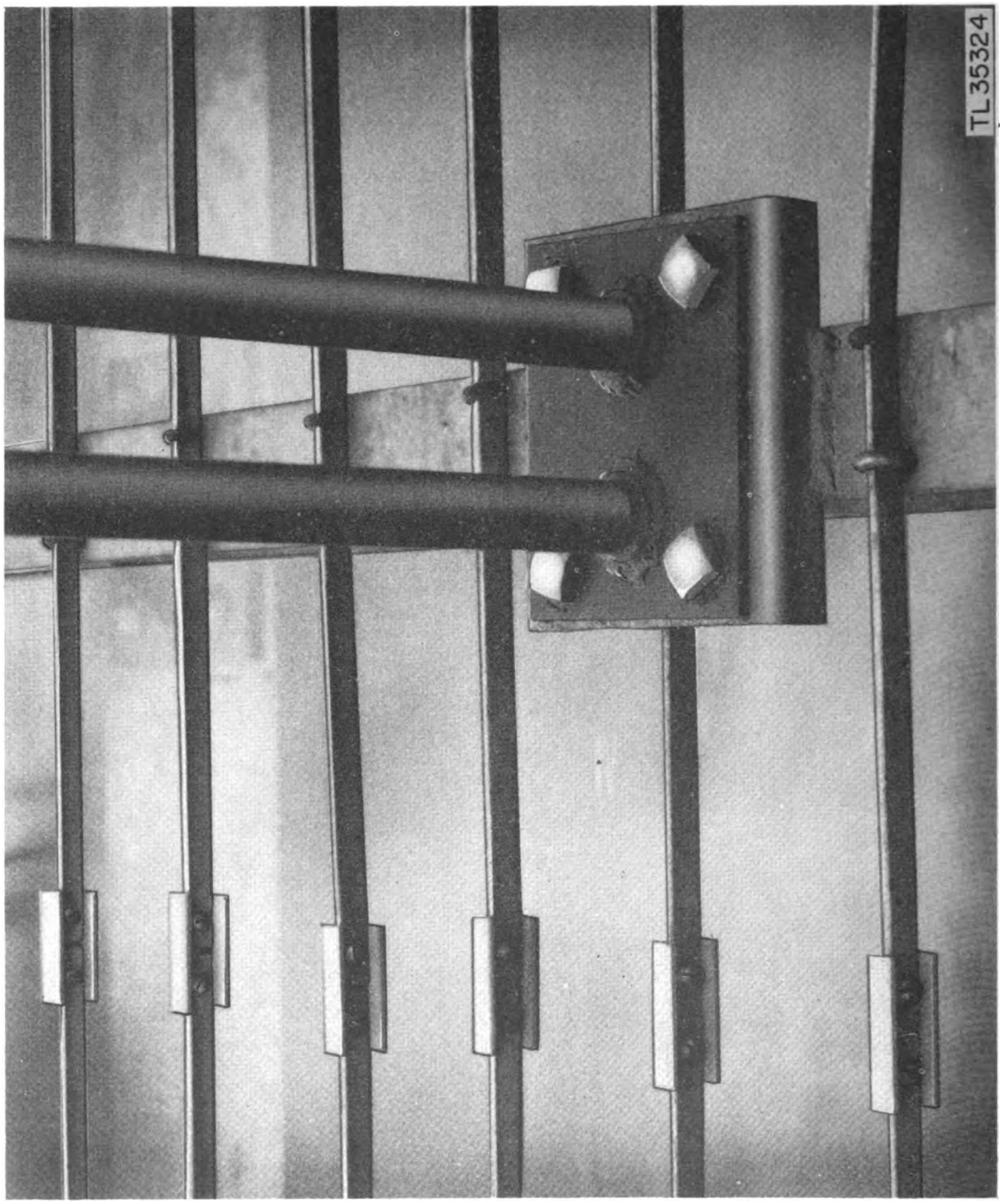


Figure 14. View of dipole connection and reflector screen connections, detail 20

Figure 15. Antenna AN-161, vertical transmission line connections.

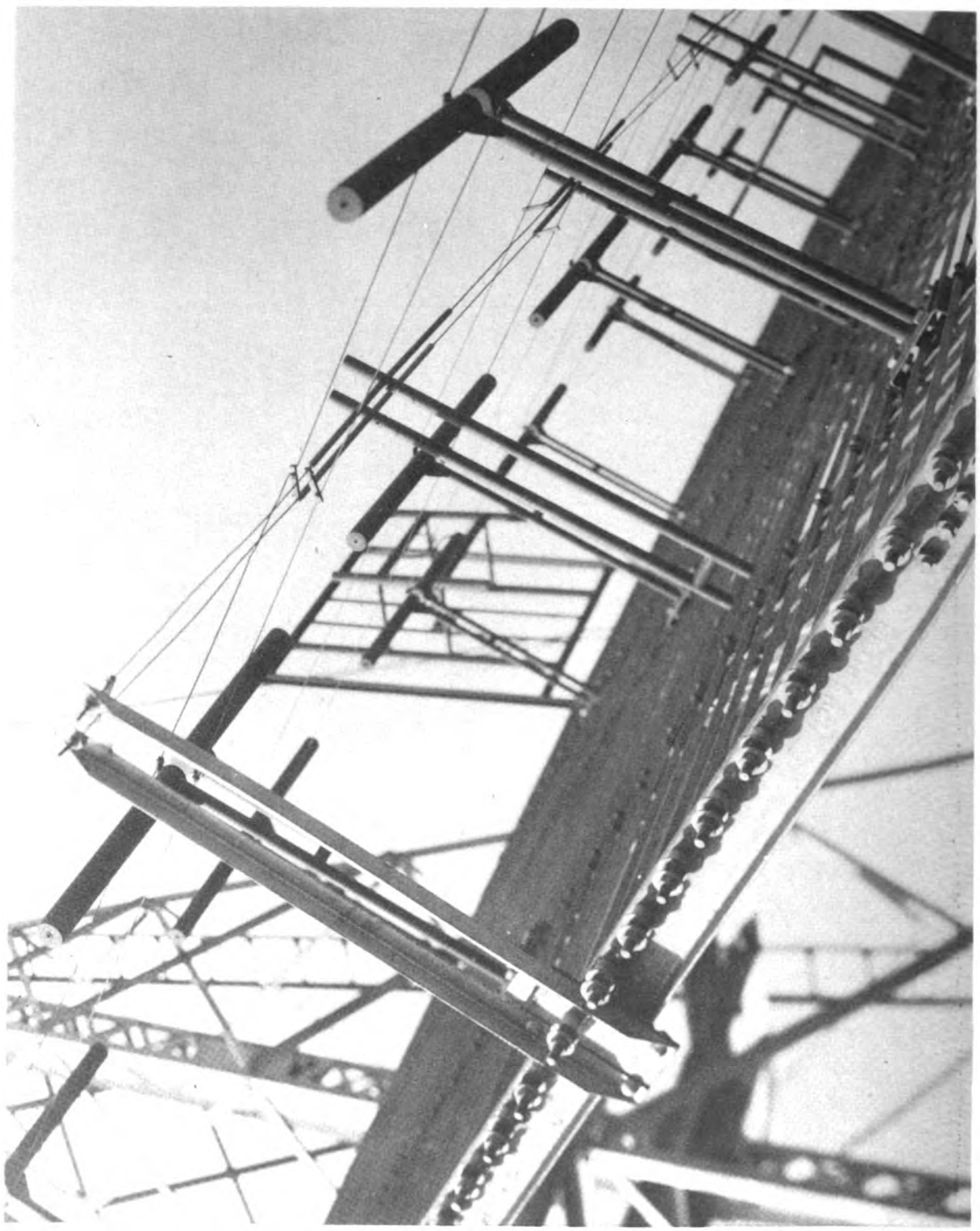


Figure 16. View of transmission line support and vertical connection to horizontal transmission line

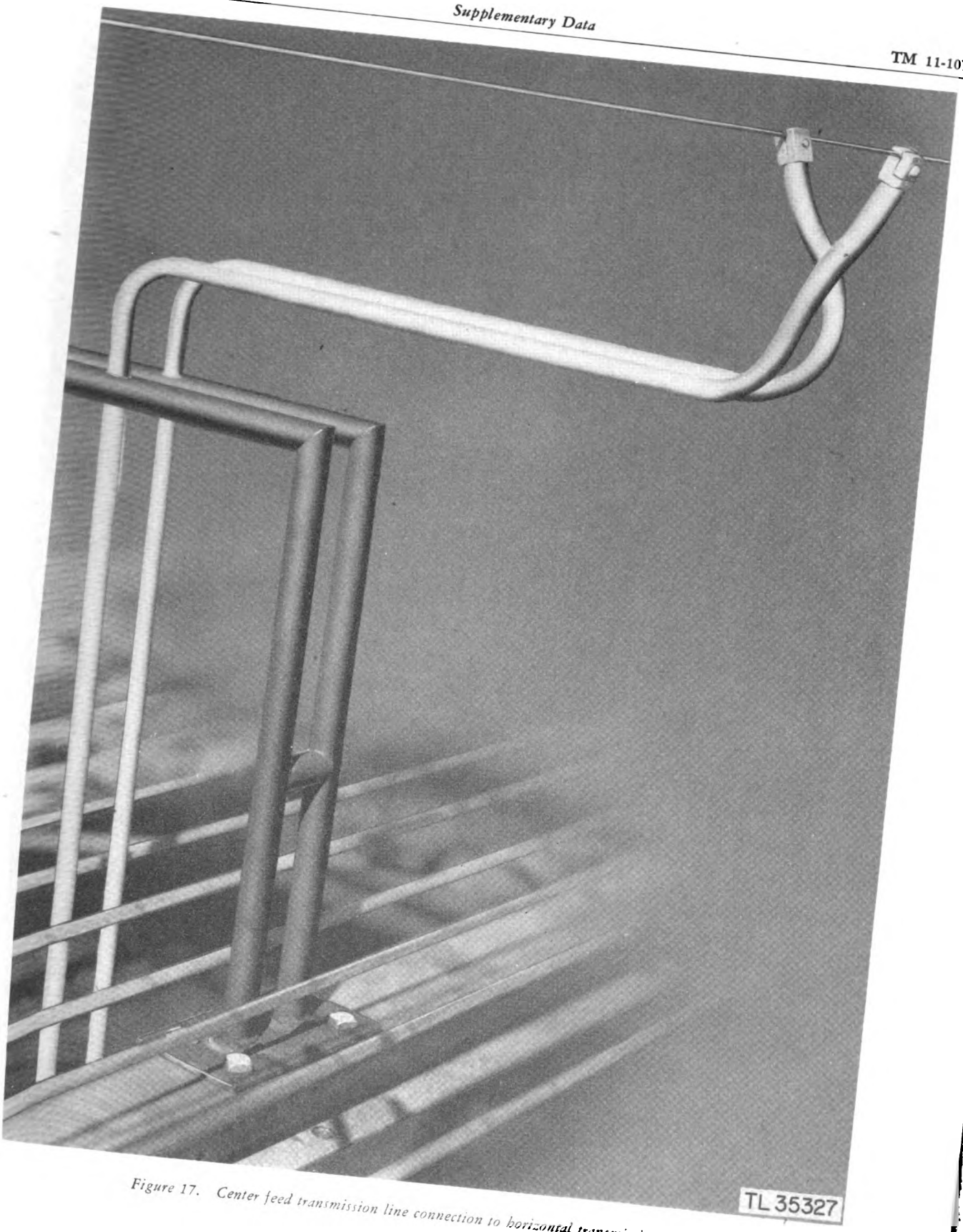


Figure 17. Center feed transmission line connection to horizontal transmission line.

Figure 18. Antenna AN-161 in hoisting position at Tower TR-20A

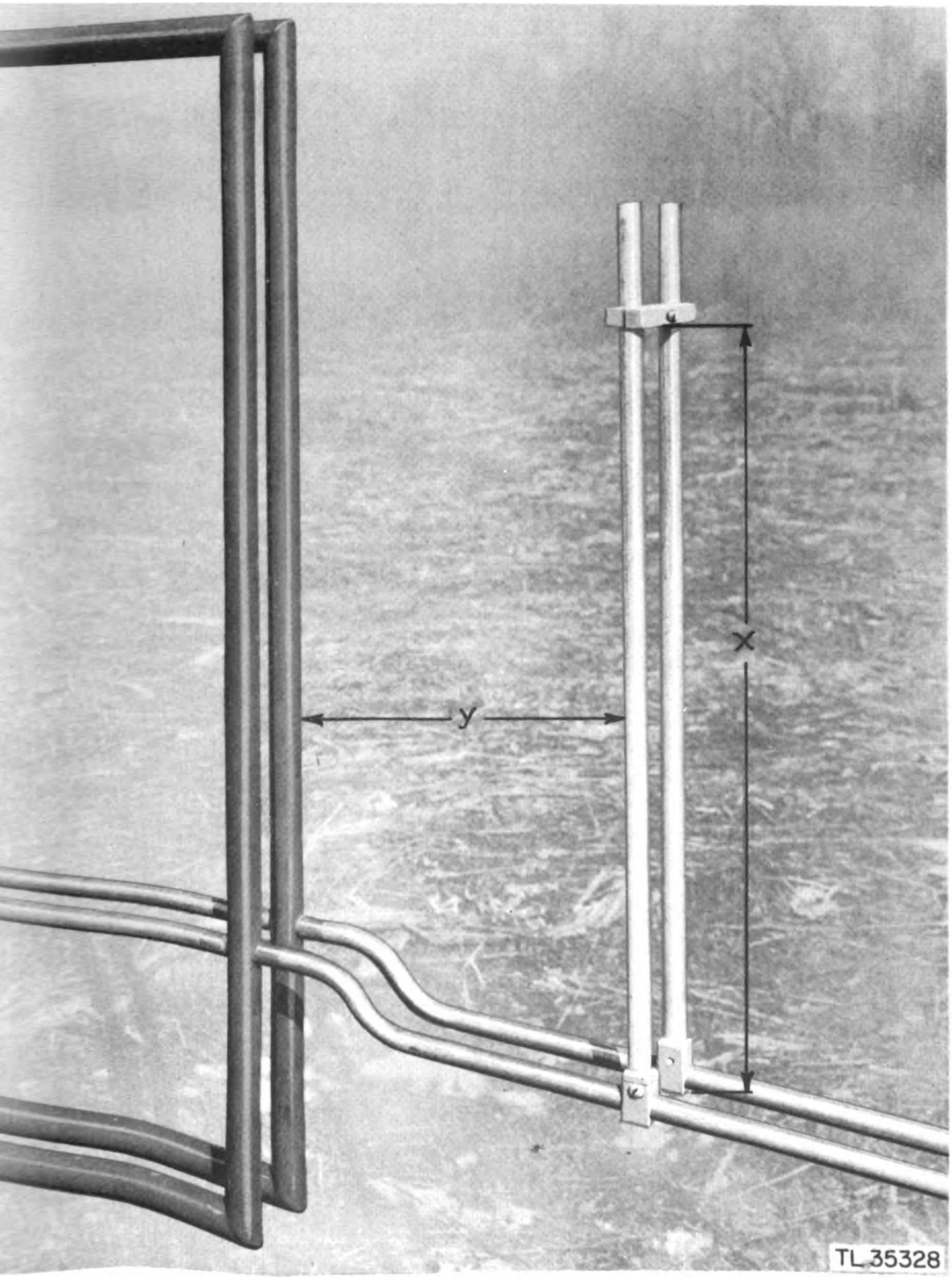


Figure 19. Antenna AN-161, antenna tuning stub.

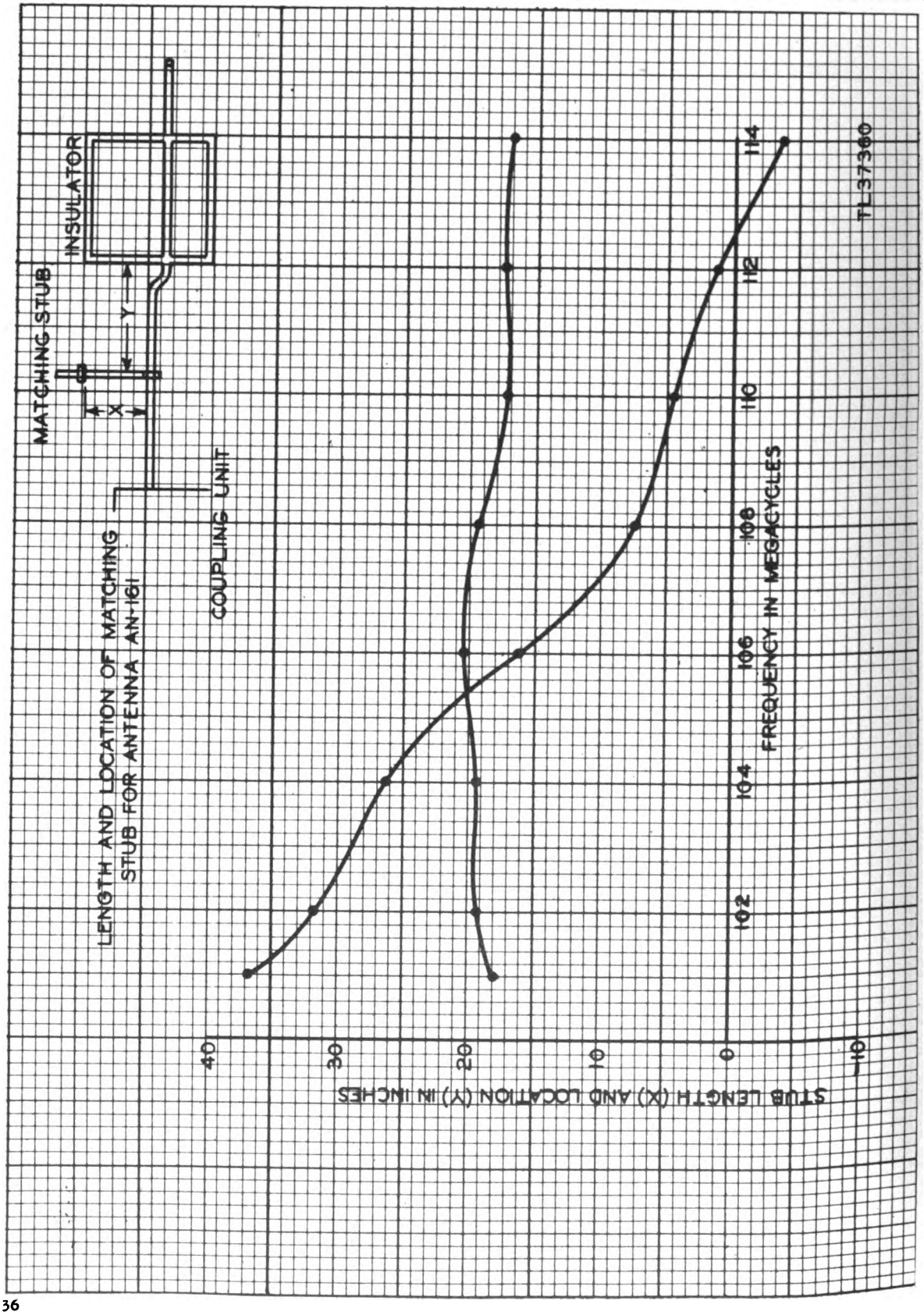


Figure 20. Length and location chart, antenna tuning stub.

Figure 21. Test Set I-148 showing correct usage.

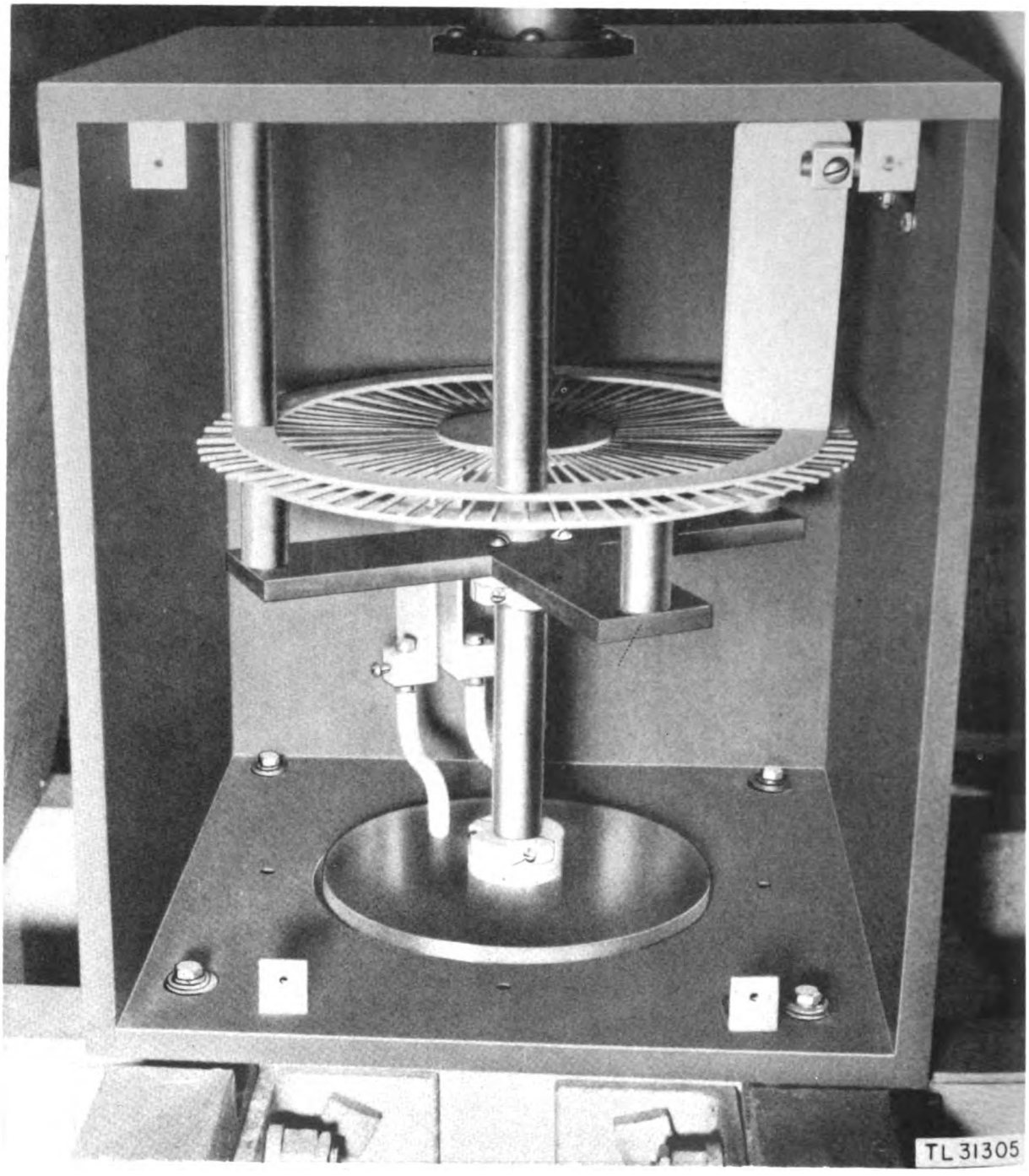


Figure 22. Coupling MC-398.

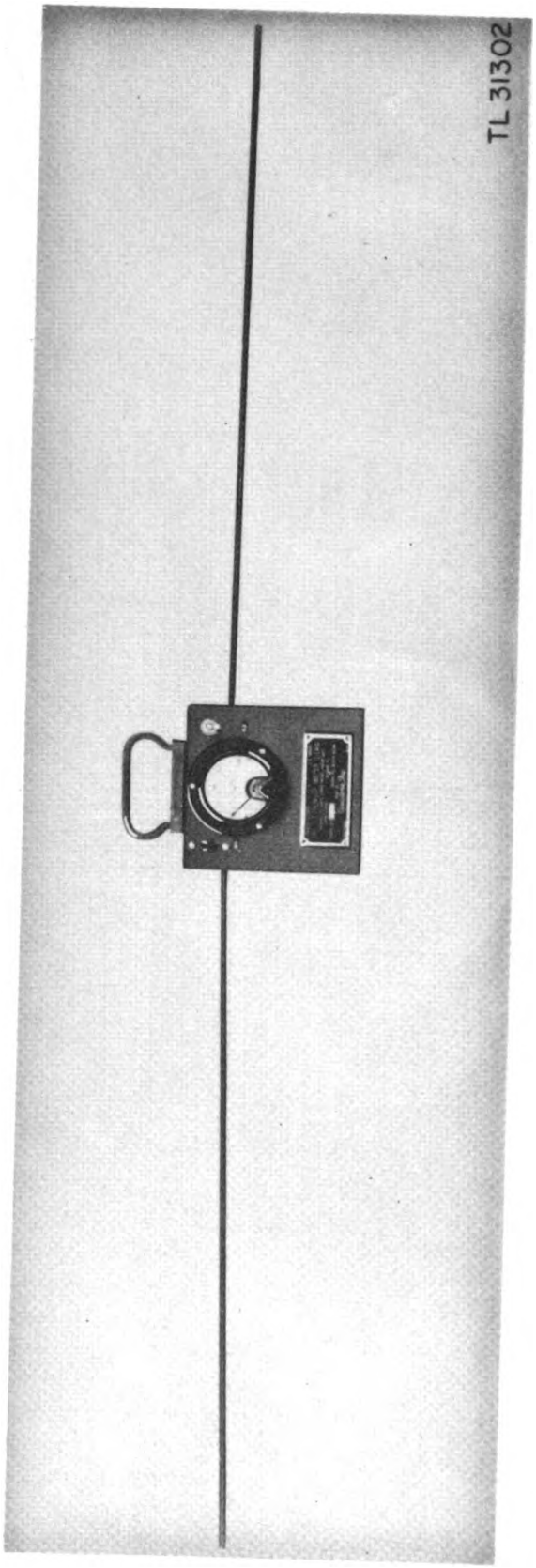


Figure 23. Test Set I-149.

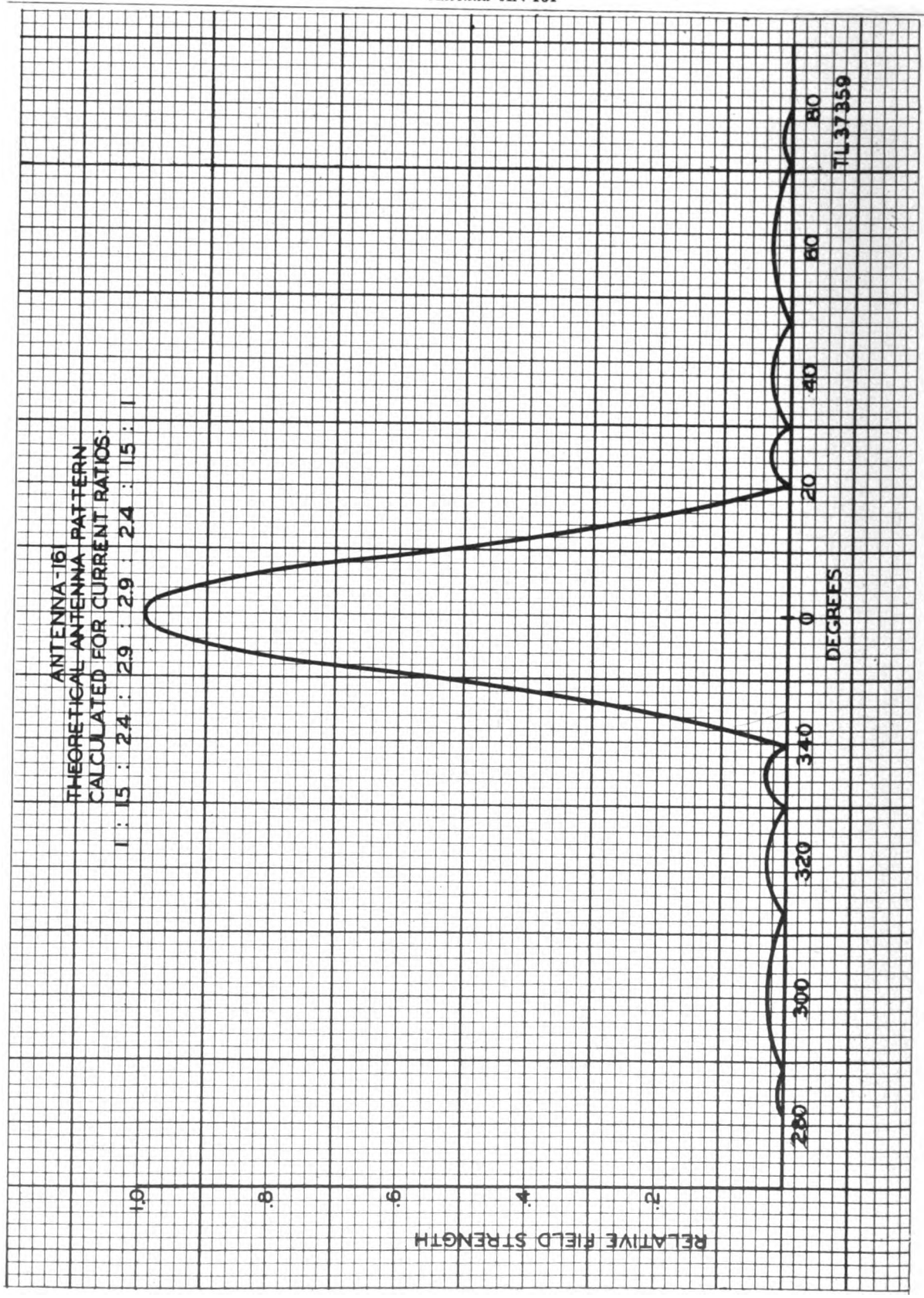


Figure 24. Antenna AN-161, theoretical pattern.

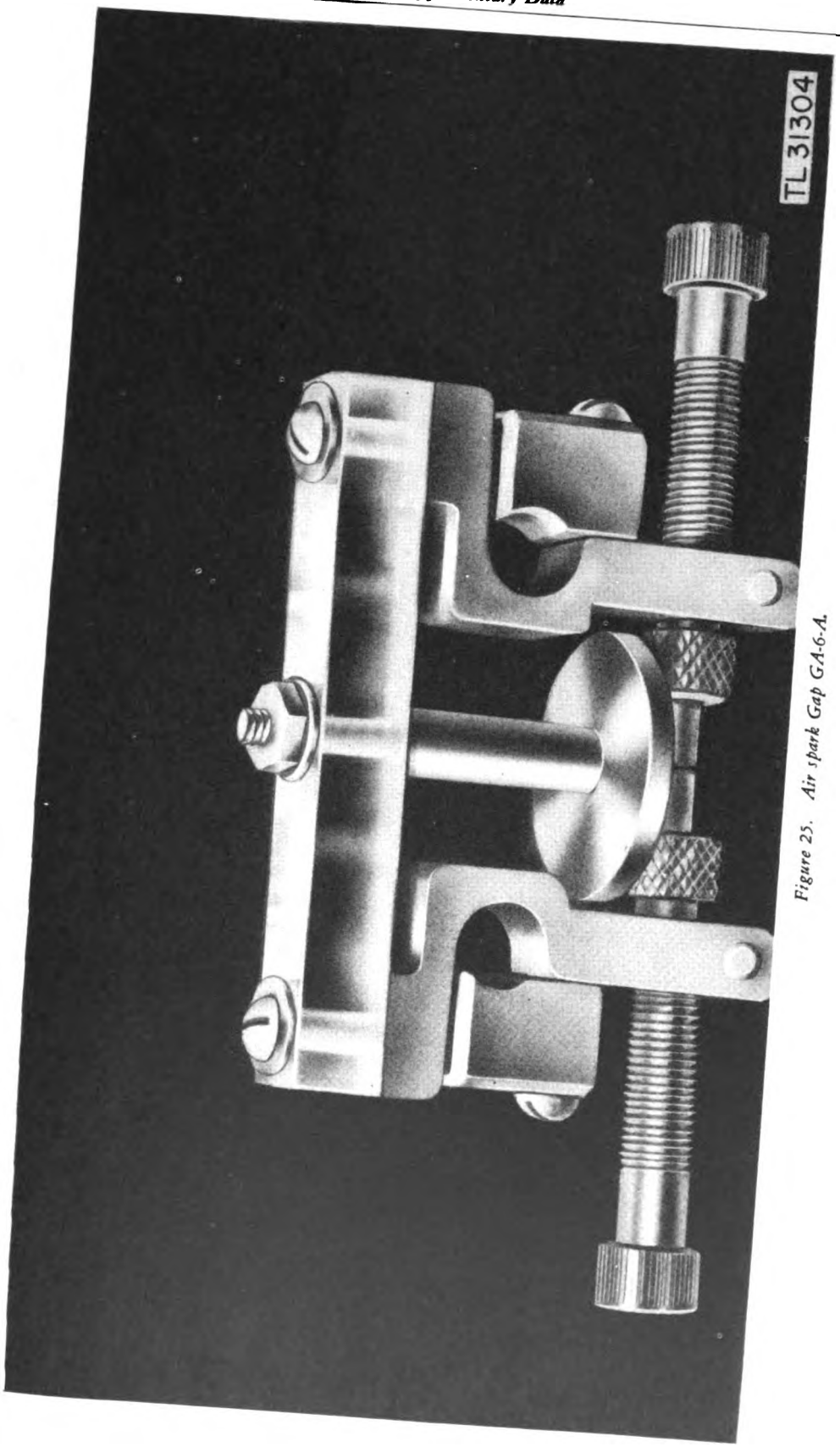
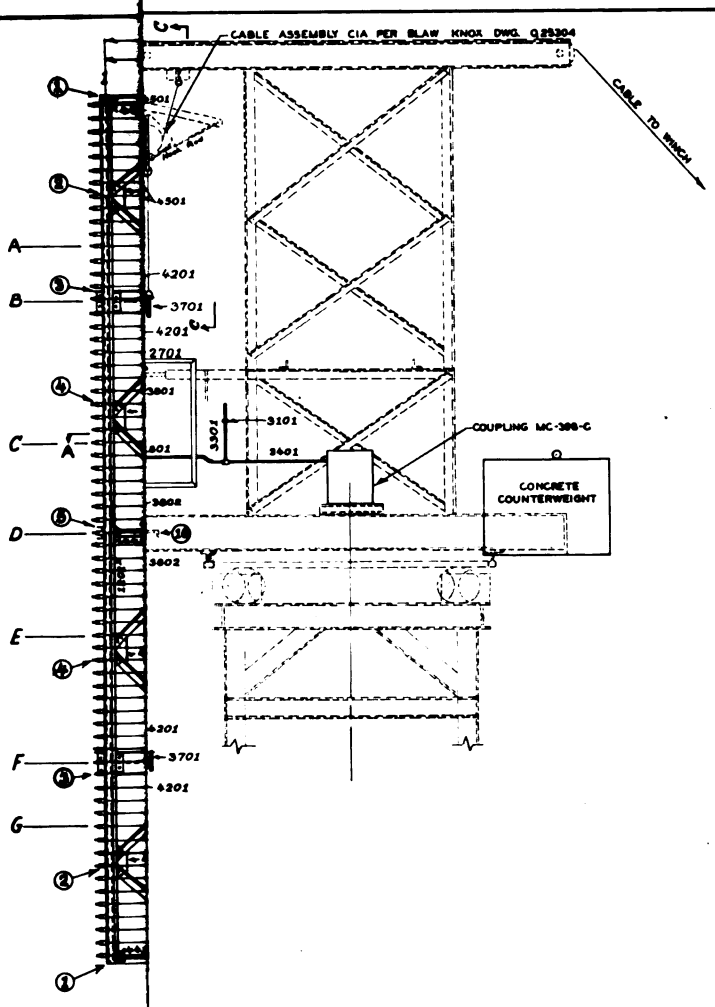


Figure 25. Air spark Gap GA-6-A.



SECTION B-B

ERECTION NOTES

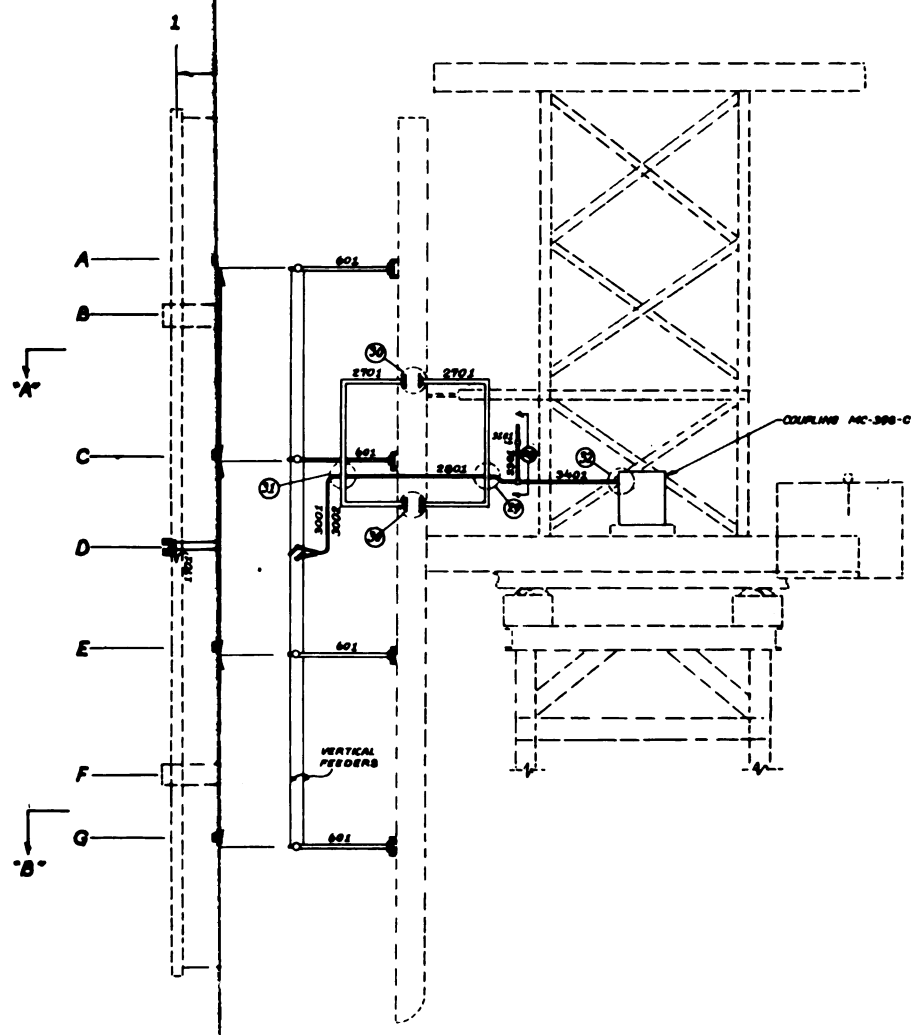
BOLTS STRUCTURAL RIB DRIVE BOLTS UNLESS OTHERWISE NOTED.
BOLTS HAVE ANCO LOCKNUTS UNLESS OTHERWISE NOTED.
UCTURAL STEEL H.D. GALVANIZED AND PRIMED FOR PAINT.
CRETE AND REINFORCING STEEL FOR COUNTERWEIGHT NOT FURNISHED WITH ANTENNA MATERIAL.
ROX. 1½ CU. YD. CONCRETE REQUIRED FOR COUNTERWEIGHT.
ROX. 240 LINEAL FEET ½"ϕ ROD REQUIRED FOR COUNTWEIGHT.

5301 — 2-¾"ϕ x 2'-6" BOLTS

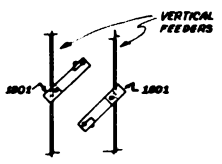
CONFIDENTIAL

DWG. No. 80692 - E1
GENERAL ASSEMBLY
ANTENNA AN-161
U. S. SIGNAL CORPS.

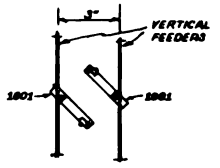
NOTES:



SECTION AT C-C



VIEW AT D-D



VIEW AT E-E

A & G
C & E

NOTES:

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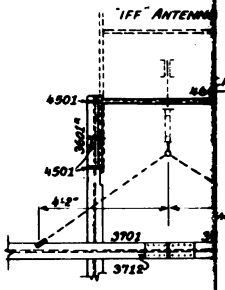
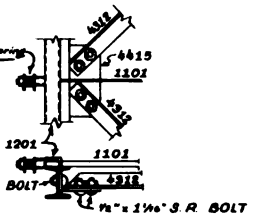
DWG. No. 80692 - E2
TRANSMISSION LINE ASSEMBLY
ANTENNA AN-161
U. S. SIGNAL CORPS.

C

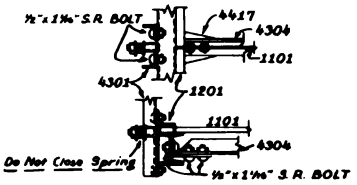
35:11- 1076



VIEW C-C



DETAIL (4)



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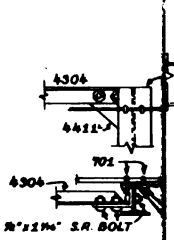

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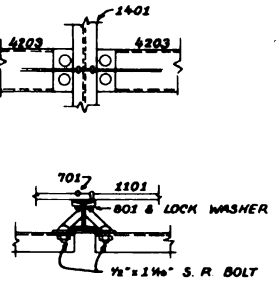

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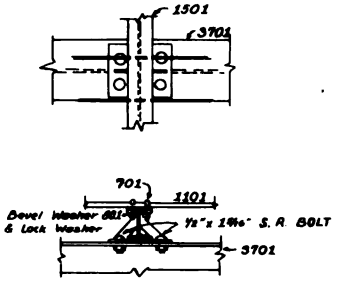

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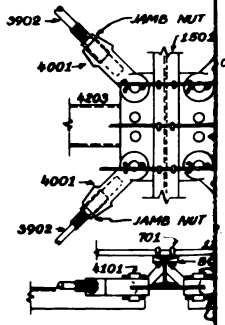

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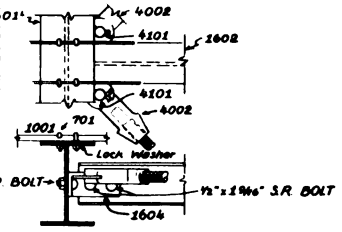

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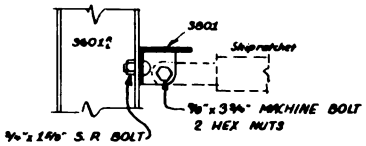

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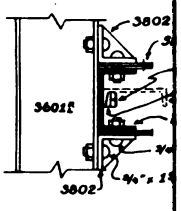


DETAIL

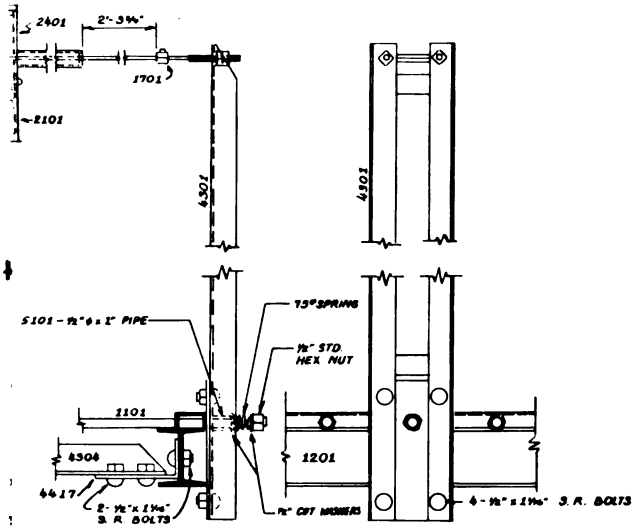
NOTES:

CONFIDENTIAL

DWG. No. 80692 - E3

GENERAL ASSEMBLY DETAILS
ANTENNA AN-161
U. S. SIGNAL CORPS.

C



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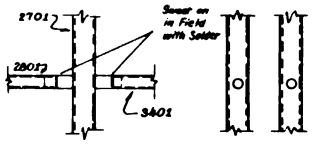

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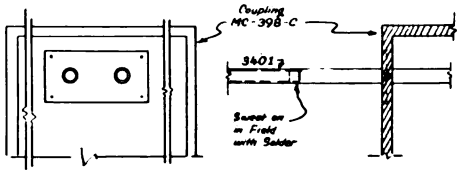

DETAIL (32)

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DWG. No. 80692 - E4

TRANSMISSION LINE ASSEMBLY DETAILS
ANTENNA AN-161
U. S. SIGNAL CORPS.

C

NOTES:

TM 11-1076

WAR DEPARTMENT TECHNICAL MANUAL

ADCOCK RADIO RANGE STATION

Antenna Conversion Kit for Radio Transmitters BC-446-A,-B,-C,-D,-E,-F,-H

Voice Conversion Kit for Radio Transmitters BC-446-A,-B,-C,-D,-E,-F,-H

Impedance Measuring Box Type 470-ZA

Remote Control Unit RM-45-A

WAR DEPARTMENT *1 FEBRUARY 1945*

WAR DEPARTMENT TECHNICAL MANUAL

TM 11-1076

(This Manual supersedes Tentative TM 11-1076, dated 16 February 1944)

ADCOCK RADIO RANGE STATION

Antenna Conversion Kit for Radio Transmitters BC-446-A,-B,-C,-D,-E,-F,-H

Voice Conversion Kit for Radio Transmitters BC-446-A,-B,-C,-D,-E,-F,-H

Impedance Measuring Box Type 470-ZA

Remote Control Unit RM-45-A

WAR DEPARTMENT *1 FEBRUARY 1945*

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 23*b*, AR 380-5, 15 March 1944.)

WAR DEPARTMENT
WASHINGTON 25, D. C., 1 February 1945

TM 11-1076, Adcock Radio Range Station, is published for the information and guidance of all concerned.
[A. G. 300.7 (16 Feb 1944)]

BY ORDER OF THE SECRETARY OF WAR:

OFFICIAL:
J. A. ULIO
Major General
The Adjutant General

G. C. MARSHALL
Chief of Staff

STANDARD DISTRIBUTION FOR T 11-22
TM 11-1076, Dec. 44, Adcock Radio Range Station; Antenna Conversion Kit for Radio Transmitters BC-446-A, -B, -C, -D, -E, -F, and -H; Voice Conversion Kit for Radio Transmitters BC-446-A, -B, -C, -D, -E, -F, and -H; Impedance Measuring Box Type 470-ZA; and Remote Control Unit RM-45-A.

AAF (5); AGF (5); ASF (2); T of Opns (5); Dept (5); Base Comd (5); S Div ASF (1); Arm & Sv Bd (2); Def Comd (2); Tech Sv (2); Sv C (2); PC&S (1); PE (Sig) (2); Gen Overseas SOS Dep (Sig Sec) (2); Dep 11 (2); Gen & Sp Sv Sch (5); USMA (2); ROTC (1); WDGS Lib (5); Lab 11 (2); Rep Shops 11, (2); A (5); T/O & E 1-420-1 (2); 1-447 (2); 11-107 (5); 11-127 (5); 11-237 (5); 11-287 (5); 11-357 (5); 11-587 (5); 11-592; 11-597 (5).

For explanation of symbols see FM 21-6.

TECHNICAL MANUAL
TM 11-1076

WAR DEPARTMENT
Washington 25, D. C., 1 February 1945.

ADCOCK RADIO RANGE STATION

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LIST OF ILLUSTRATIONS

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DESTRUCTION NOTICE

DESTROY EVERYTHING

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

WHEN — When ordered by your commander.

HOW — 1. *Smash* — Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

2. *Cut* — Use axes, handaxes, machetes.

3. *Burn* — Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

4. *Explosives* — Use firearms, grenades, TNT.

5. *Disposal* — Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILBLE FOR DESTRUCTION OF THIS EQUIPMENT

WHAT — 1. *Smash* — Crystals, tubes, transformers, meters, switches, resistors, capacitors, insulators, gasoline engine, fuel tanks, and fuel lines.

2. *Cut* — Antenna loops and all interconnection cables.

3. *Burn* — Buildings, instruction manuals, logs, and papers pertaining to operation of the equipment.

4. *Bend and break* — chassis, case, covers, handles, capacitors, coils, relays, and terminal strips.

5. *Bury or scatter* — All pieces after breaking.

DESTROY EVERYTHING

SAFETY NOTICE

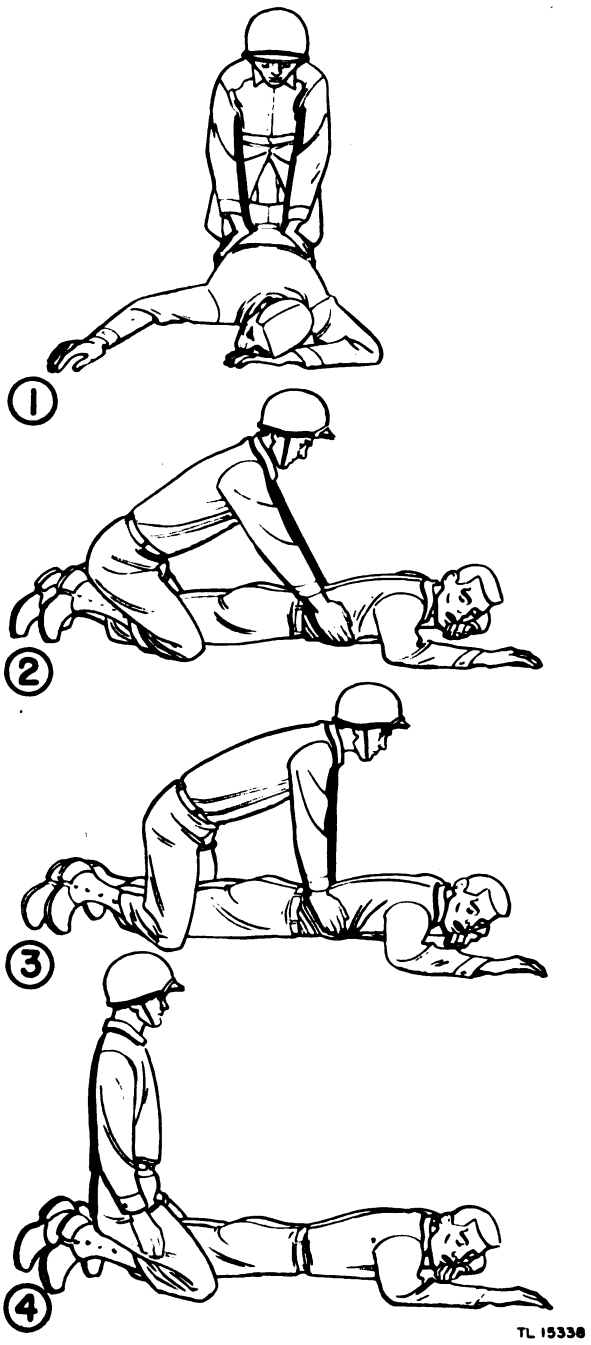
WARNING!

The voltages in this equipment are dangerous to life. NEVER depend upon the action of door interlock switches for safety. Disconnect ALL a-c line voltages beore making repairs or adjustments within any cabinet.

FIRST AID FOR ELECTRIC SHOCK

RESCUE

In case of electric shock, shut off the high voltage at once and ground the circuits. If the high voltage cannot be turned off without delay, free the victim from contact with the live conductor as promptly as possible. Avoid direct contact with either the live conductor or the victim's body. Use a dry board, dry clothing, or other nonconductor to free the victim. An ax may be used to cut the high-voltage wire; however, watch out for wire ends which may spring in any direction when severed.



TL 15338

SYMPTOMS

a. Breathing stops abruptly in electric shock if the current passes through the breathing center at the base of the brain. If the shock has not been too severe, the breathing center recovers after awhile and normal breathing is resumed, providing that a sufficient supply of air has been furnished meanwhile by artificial respiration.

b. The victim is usually very white or blue. The pulse is very weak or entirely absent and unconsciousness is complete. Burns are usually present. The victim's body may become rigid or stiff in a very few minutes. This condition is due to the action of electricity and is not to be considered rigor mortis. Artificial respiration must still be given, as several such cases are reported to have recovered. The ordinary and general tests for death should never be accepted.

TREATMENT

a. Start artificial respiration immediately. At the same time send for a doctor, if assistance is available. Do not leave the victim unattended. Perform artificial respiration at the scene of the accident, unless the victim's or operator's life is endangered from such action. *In this case only,* remove the victim to another location, but no farther than is necessary for safety. If the new location is more than a few feet away, artificial respiration should be given while the victim is being moved. During transportation, other methods of resuscitation may be used, if the method of transportation prohibits the use of the Shaeffer prone pressure method. Pressure may be exerted on the front of the victim's diaphragm, or the direct mouth to mouth method may be used. Artificial respiration, once started, must be continued, without loss of rhythm.

b. Lay the victim in a prone position, one arm extended directly overhead, and the other arm bent at the elbow so that the back of the hand supports the head. The face should be turned away from the bent elbow so that the nose and mouth are free for breathing (figs. ① and ②).

c. Open the victim's mouth and remove any foreign bodies, such as false teeth, chewing gum, or tobacco. The mouth should remain open, with the tongue extended. Do not permit the victim to draw his tongue back into his mouth or throat.

d. If an assistant is available during resuscitation, he should loosen any tight clothing to permit free circulation of blood and to prevent restriction of breathing. He should see that the victim is kept warm, by applying blankets or other covering, or by applying hot rocks or bricks wrapped in cloth or paper to prevent injury to the victim. The assistant should also be particularly watchful that the victim does not swallow his tongue. He should continually wipe from the victim's mouth any frothy mucus or saliva that may collect and interfere with respiration.

e. The resuscitating operator should straddle the victim's thighs, or one leg, in such a manner that:

(1) The operator's arms and thighs will be vertical while applying pressure on the small of the victim's back (fig. ③).
(2) The operator's fingers are in a natural position on the victim's back with the little finger lying on the last rib.
(3) The heels of the hands rest on either side of the spine as far apart as convenient without allowing the hands to slip off the victim (fig. ①).
(4) The operator's elbows are straight and locked.

f. The resuscitation procedure is as follows:

(1) Exert downward pressure, not exceeding 60 pounds, for 1 second.
(2) Swing back, suddenly releasing pressure, and sit on the heels (fig. ④).
(3) After 2 seconds' rest, swing forward again positioning the hands, and apply pressure for another second (figs. ② ③).

g. The forward swing, positioning of the hands, and the downward pressure should be accomplished in one continuous motion, which requires 1 second. The release and backward swing require 1 second. The addition of the 2 second rest makes a total of 4 seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence of the cycle, he should count the seconds aloud, speaking distinctly and counting evenly in thousands. Example: one thousand and one, one thousand and two, one thousand and three, one thousand and four, etc. This method of counting insures accurate timing. The exact frequency of the operating cycle of resuscitation is of utmost importance.

h. Artificial respiration should be continued without interruption until the victim regains normal breathing or until pronounced dead by a medical officer. It may be necessary to continue resuscitation for several hours. For this reason relief operators should be used if available.

METHOD OF RELIEVING OPERATOR

The relief operator kneels beside the operator, assuming the same position on an imaginary victim, and follows the operator through three or four complete cycles. When he is sure that he has the correct rhythm, on the next forward swing of the operator the relief operator places his hands on the top of the operator's hands without applying pressure. This indicates to the operator that the relief operator is ready to take over. On the backward swing, the operator moves off the victim, to the side, and the relief operator takes the position of the operator. On the next forward swing, the operator being relieved assumes the position on an imaginary victim beside the new operator, and follows through two or three complete cycles of the new operator, or until he is sure that the new operator has the correct rhythm. The operator being relieved remains alert to take over instantly if the new operator should falter or hesitate on the cycle. During the process of relief, the original operator should count aloud, by thousands, to give the relief operator the correct timing.

INHALANT STIMULANTS

If an inhalant stimulant is used, such as aromatic spirits of ammonia, the individual administering the stimulant should first test it himself to see how close he can hold the inhalant to his own nostrils for comfortable breathing. Be sure that the inhalant is not held closer to the victim's nostrils and then only for short duration, 1 or 2 seconds every minute.

LIQUID STIMULANTS

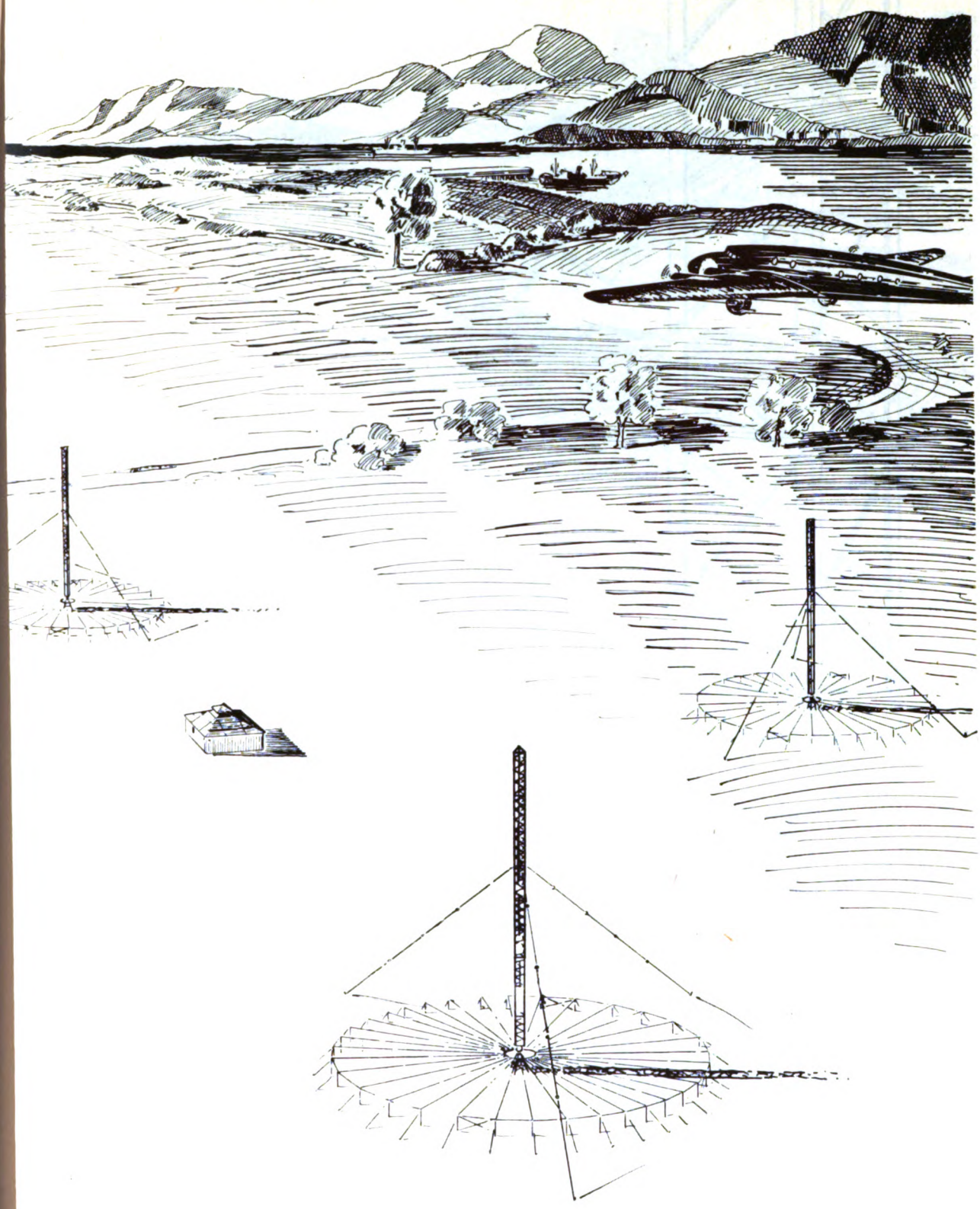
After the victim has regained consciousness, he may be given a glass of water with ½ teaspoon of aromatic spirits of ammonia added, or he may be offered hot coffee or hot tea as a stimulant. DO NOT GIVE AN UNCONSCIOUS VICTIM ANY LIQUIDS.

CAUTIONS

a. After the victim revives, keep him lying quietly. Do not allow him to get up and walk even though he may feel that he is strong enough. Any injury which a person might have received, including electric shock, may bring about a condition of shock or fainting. This condition should be guarded against at all times. Shock is present if the victim is pale and has a cold sweat. His pulse is weak and rapid and his breathing is short and gasping.

b. Keep the victim lying flat on his back, with his head lower than the rest of his body, and his hips elevated. Be sure that there is no tight clothing to restrict the free circulation of blood or hinder natural breathing. Keep him warm and quiet.

c. A resuscitated victim may suddenly stop breathing and require additional artificial respiration. For this reason, he must be carefully watched. NEVER LEAVE A RESUSCITATED PERSON ALONE UNTIL IT IS *CERTAIN* THAT HE IS FULLY CONSCIOUS AND BREATHING NORMALLY.



TL-14201

Figure 1. Bird's-eye view of range.

This manual supersedes Tentative TM 11-1076, dated 16 February 1944.

ADCOCK RADIO RANGE STATION

Section I

DESCRIPTION

1. INTRODUCTION

a. The Adcock Radio Range Station (fig. 1) operates for the guidance of planes which receive signals from a radio range station, by establishing four straight line courses or beams directed radially from the station. The courses are paths along which unbroken tone signals are received. They are separated by regions or quadrants in which either the letter A or N is received, the A or N quadrants alternating around the compass. The transmittal of the two letters is so timed that during the interval between signals for one letter, the signal for the other letter is being transmitted, and vice versa, so that on the course where both signals are received alternately and with equal strength a continuous sound is heard, but off the course either A or N is received with a weaker background tone.

b. Official nomenclature followed by (*) is used to indicate all models of the equipment included in this technical manual. Thus Radio Transmitter BC-446-(*) represents Radio Transmitters BC-446-A, -B, -C, -D, -E, -F, and -H, which are treated together in this manual. Radio Transmitter BC-400-(*) indicates all models of the equipment included in this technical manual.

2. MAJOR COMPONENTS

a. For the installation of an Adcock Radio Range Station, the following component parts are required:

(1) Building, complete with wiring, accessories, etc.
(2) Radio Transmitter BC-446-(*)
(3) Radio Transmitter BC-400-(*)
(4) Antenna, Z marker
(5) Towers
(6) Counterpoise for towers
(7) Engine-generator
(8) Radio receiver (portable)
(9) Antenna Conversion Kit
(10) Voice Conversion Kit. (including Remote Control Unit RM-45-A)

b. The foregoing items comprise the basic equipment of the station, but additional items are furnished, depending upon where and how the station is to be used. For instance, heaters are supplied for temperate or northern zones, but for the tropics these are omitted and a tropical foundation is furnished.

3. OPERATIONAL DESCRIPTION

a. Details of the electrical theory of operation are given in the technical manual or instruction book for Radio Transmitter BC-446-(*) and therefore will not be set forth here. However, it is desirable to bring out a few important points.

b. With a loop antenna, the effective signal sent out is that radiated by the vertical legs of the loop, the horizontal members serving no useful radiation purpose. In the Adcock Radio Range Station, the towers replace the vertical members of the loop and the horizontal members are eliminated.

c. In a loop antenna, when the current is ascending in one leg of the loop, it is descending in the other leg. In other words, the currents in the two legs are 180° out of phase. When Adcock towers are substituted, it is necessary to establish and maintain the same phase relationship between the towers as existed between the legs of the loop.

The transmitter is connected to the towers by co-axial cable which terminates at the tower end in a tuning house placed on the pedestal supporting the tower. Detailed instructions for the use of this equipment are included with the Antenna Conversion Kit.

d. An Impedance Measuring Box is supplied with the Adcock Radio Range Station so that the tuning houses may be properly adjusted and the towers resonated. Instructions for operating the Impedance Measuring Box are included with the box.

e. To minimize variations in the electrical characteristics of the towers and thus to give greater stability to the courses, a counterpoise is erected at the base of each tower.

f. In addition to sending the A and N signals, the transmitters may also be used for voice transmission. The microphones for voice transmission are placed in the control tower at the landing field and from that tower the transmitter may be remotely controlled.

g. The radiation pattern established by the four towers leaves a space immediately over the transmitting station in which no signal is received. Another signal is radiated vertically by a separate Radio Transmitter BC-400-(*) connected to an antenna erected in the attic of the transmitter house to indicate to the pilot that he is directly over the station.

Section II

ERECTION OF BUILDING

4. SELECTION OF SITE (Figs. 1 and 2)

a. Select a field 600 feet by 600 feet, preferably with no elevation differences exceeding 5 feet (differences up to 20 feet may be tolerated if necessary). Cut the tower guys to permit a maximum of 7 feet variation in grade elevations within the guyed area. The range should be 1½ to 4 miles from the landing field, and in line with the main runway. There should be no hills between the landing field and the range. There should be no trees nor other similar obstructions within the range, nor closer than 300 feet to any tower in any direction. Uniform surroundings and limitation of obstructions within a 20 to 1 angle in elevation from center of range are desirable.

b. After the location of the range has been determined, and the center line of the main runway on the airplane field has been extended to the range and staked out, determine the line of towers.

c. If the course is not to be shifted or squeezed, the center line of one set of diagonally opposite towers should coincide with the center line of the runway. If the course is to be shifted, then set the towers in accordance with figure 38. After angle A (degrees the course is shifted toward the angular position of the plane of the stronger loop) has been decided and the angle ½ (90°—A) has been figured, the line of the towers will deviate from the line of the runway by the angle ½ (90°—A), instead of coinciding with it. Further information on course shifting may be found in the technical manual or instruction book for Radio Transmitter BC-446-(*).

5. STAKING OF SITE

a. Place the center stake of the range site, if possible, at a comparatively level spot with as few irregularities as possible between it and the towers and also a point at a distance of 320 feet in line with the location of the towers. Locate the towers 250 feet from the center of the plot and around each tower extend the counterpoise out approximately 62 feet. Locate the tower guys about 70 feet out from the towers (fig. 2).

b. In the selection of the site, use the hand level furnished with the kit.

c. After the approximate location of the center stake is determined, make a check of the entire site by using counterpoise stanchion posts as sighting rods and by stepping off and locating approximately the tower positions. Then by stepping the distances to and approximating the angles to the tower anchor positions, determine whether or not suitable anchorage can be obtained. If the anchor positions fall into a small water course or into rock, *shift the entire range somewhat* to clear these obstacles, but still remain in line with runway.

6. DRAWINGS AND PHOTOGRAPHS

a. Various steps in the erection of the building are illustrated in figures 3 through 16. These illustrations further define and describe various parts of the structure so that it can be assembled by comparatively inexperienced men.

b. The shipment, handling, storage, and protection of the parts have a definite bearing upon the successful assembly of the building. Check and sort properly all parts and tools in accordance with the drawings and packing lists before starting the assembly.

c. Figures 1 to 16 inclusive should be thoroughly studied and referred to constantly during the erection of the building and figures 27, 31, and 32 during the placing of its electrical and mechanical equipment. They are the specific guide to the location and placement of all parts. Each part is given a number or other identification, and care must be taken to see that each part is placed in the position and location shown by drawings. This is extremely important.

7. IDENTIFICATION SYMBOLS

a. The prefixing number on each piece usually indicates the portion of the structure in which the part is to be placed, and the final number indicates the particular part and location of the section. (See paragraph 98, List of Construction Materials.)

b. For example, for the panel numbered 3-1 the prefix number 3 indicates that it is part of the floor system and the number 1 places the panel at the rear left-hand corner of the floor as shown

on figure 7. The prefix number 4 indicates vertical wall and partition members; 6 indicates roof framing and deck, etc.

c. Each part is labeled with a number or series of numbers marked on each part or package or on a tag attached thereto. Check the parts numbering lists for small items such as bolts, screws, anchors, etc.

8. ORIENTATION

a. The building may be located in any one of the range quadrants. The drawings identify each elevation by the terms *front elevation, right side elevation, left side elevation,* and *rear elevation.* They are identified as follows:

(1) *Front elevation* is that face of the building having the exterior door.
(2) *Right side elevation* is the side elevation to the right as one faces the front.
(3) *Left side elevation* is the side elevation to the left as one faces the front.
(4) *Rear elevation* is the side opposite the front elevation.

b. Figure 2 shows dimensions for accurately laying out the range site without the use of a transit. Two 100 foot steel tapes are furnished with the kit.

c. Where a tropical type building on struts is used, reduce the diameter of the range or distance between the towers as indicated on figure 2. This is necessary to permit the use of the standard length r-f cable between the tuning house and lead-in insulators.

9. RADIO RANGE LAYOUT (Fig. 2)

a. Procedure.

(1) Set center stake A.
(2) Set stakes B and C so that stakes A, B, and C are exactly in line.
(3) Set stake D perpendicular to line BAC by swinging arcs of 99 feet from points B and C.
(4) Set stake E perpendicular to line BAC. Stakes D, A, and E are to be exactly in line.
(5) Set stake F in line with BAC and 110 feet from stake C.
(6) Set stakes G and H in line with BACF. Stake G is center of tower.
(7) Set stake J perpendicular to line FGH by swinging arcs of 99 feet from points F and H.
(8) Set stake K by swinging arcs of 36 feet 2¾ inches from F and 70 feet from G.
(9) Set stake L by swinging arcs of 36 feet 2¾ inches from H and 70 feet from G.

b. The variation of ground elevations between the center of the tower and anchor locations will affect the position at which the anchor should be set. If the ground is higher at the anchor site, then set the anchor closer to the tower. If the anchor position is below the elevation of the ground at the tower center, then set the anchor farther away from the tower center. The position of the anchor is not critical and it will suffice to move the tower anchor position 1 foot horizontally for each foot of variation in elevation between the ground at the tower center and the tower anchor locations.

c. Set the tower center stakes and anchor locations for the other towers in the foregoing manner.

d. The laying out of the tower counterpoise is described in paragraph 40, Tower Counterpoise. Do not lay out until ready to be installed.

10. BUILDING LAYOUT

a. The staking for the building is not critical. The building can be set in any quadrant as shown on figure 27, but the corner of the building with the lead-in insulator panels must be closest to the center of the plot. Set the building walls approximately 3 feet from the plot diagonals.

b. The front elevation and the right side elevation are always 3 feet in and parallel to the tower diagonal or r-f line locations, regardless of the quadrant in which the building might be located.

11. PLACEMENT OF BUILDING

a. Place the building near the center of the range and orient as shown (fig. 27). It may be placed in any one of the 90° angles formed by the lines between masts as long as their r-f building entrance point is held near the center point of the range. Before placement, give consideration to the best area for building foundation, drainage, access to fuel oil tanks, etc.

12. LOCATING AND LAYING OUT BUILDING

a. The building placement in relation to the diagonal lines between towers and the center point of range is indicated on figure 3. The method of laying out the building area to determine the lines for the edge of membrane water-

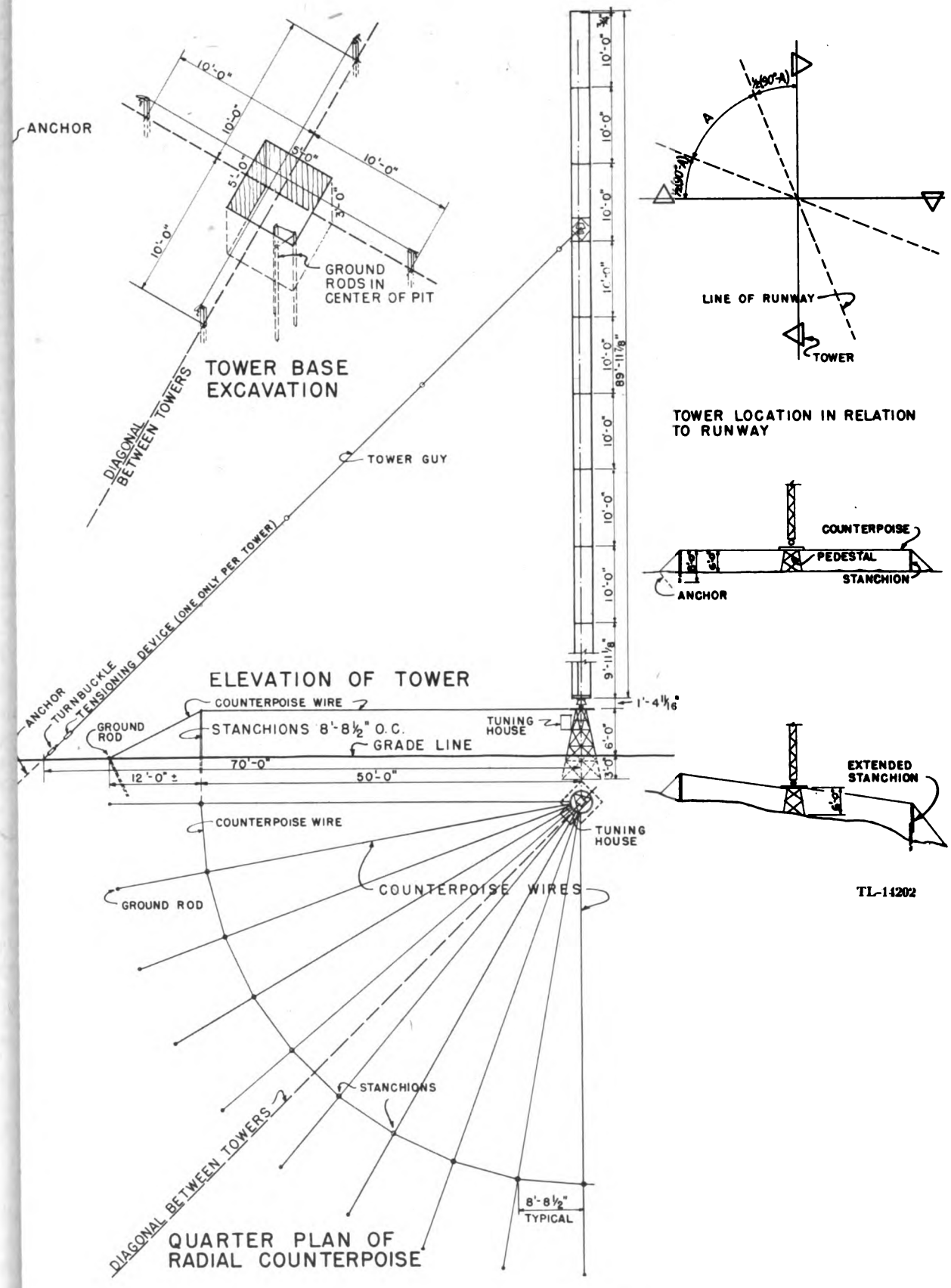


Figure 2. ***Radio range layout.***

proofing, grading, and face of building walls is also shown on the same drawing. Batter boards and stakes can be fabricated from crating refuse. Figures 6 and 8 indicate dimensions and layout methods for buildings with tropical foundations.

b. Exercise special care to determine properly the ultimate finish floor line. If this point is set too low, drainage will be inadequate, and if too high, excess fill will be required. See figures 3 and 4 for erecting batter boards and establishing lines.

13. GRADING

a. Figure 3 outlines the procedure in leveling the earth to receive waterproofing sheets. Carefully follow the notes thereon. Figure 6 indicates the necessary excavation to receive footings for tropical type houses.

b. It is desirable to have a dry and loose fill between the membrane and floor panels. If it is intended to use earth immediately adjoining the building for this purpose, protect such areas from surface moisture previous to and during the grading period, to assure the procurement of dry material.

14. PLACING OF BOLT ANCHORS

a. All field connections are made with bolts, machine screws, or dowels of the metal-to-metal type, with the exception of a small number of wood screws used to anchor a portion of the electric wiring and hoods. To prevent corrosion for future dismantling, first dip all bolt threads of the metal-to-metal type in lubricant 2-15 (lugseal oil) provided in the kit.

b. Field-placed bolts for connecting various parts of the building are packed in bags or boxes properly labeled and identified with their place in the anchorage system and with the particular building parts that they anchor. Use the bolts at the location specified to prevent shortages, damage, etc., and for ease of erection.

c. To anchor the various parts, it should not be necessary to use any nails, bolts, lag bolts, screws, etc., in addition to the connections provided.

d. It will take some practice and care to place the bolts or screws properly and engage them into the adjoining anchor. Use the following general method:

(1) First attempt to place the adjoining parts or panels so that the hole provided for the bolt is over and opposite the metal sleeve that is to receive it. This alignment can usually be secured by pulling the two pieces apart slightly and judging with the eye the proper position. Insert a drift pin or large nail into the hole and anchor to complete the alignment when it is close.

(2) After proper alignment is anticipated, dip the end of the bolt about 1/8 inch into the lubricant provided, and insert it into the hole. Try to engage the thread by lightly turning it with a screwdriver or by hand. Do not force the bolt or hit it with any object, since this may ruin the threads on the bolt or anchor and is likely to throw the concealed anchor permanently out of line. Instead, work the piece of panel slightly in different directions by hand or with slight taps of a sledge or hammer on a block of wood which is held over the area being hit. Never hit the surface of any part of the building without this protection.

(3) After the bolt is started, start all bolts in that panel or piece before any are tightened. All bolts which will be accessible later should be left untightened until all parts are placed and temporarily anchored in that section.

e. Where it is necessary to hit the edge or face of any panel with a hammer or sledge to force the panel into position, place a piece of 2 inch plank on the surface of the panel to protect the area. When striking a panel edge that is rabbeted (with the plywood projecting beyond the core member) place a 2" x 4" piece of wood into the rabbet to hit against.

15. PROCEDURE OF ERECTION

a. Figure 11 indicates the desirable sequence for placing the various parts or sections of the building. The "boxing in" or completion of the generator room enclosure is shown as the beginning of the placement for wall and ceiling panels. This step is desirable during high wind conditions or when there is a possibility that the operation might not carry on to the point of completing all wall and ceiling construction during the day. The box so formed is braced in itself and also serves as a brace for the remaining sections as they are placed.

b. In case it is necessary to stop the erection before free standing walls are covered by, and anchored to, ceiling panels, place temporary bracing.

c. Cover ceiling panels or partly constructed roof with tarpaulin at the end of the day or during rain or wind storms.

16. PLACING WATERPROOFING

a. Details and instructions for placing membrane waterproofing appear on figure 3.

b. Cut felt 1-1 to proper length and re-roll it into loose individual rolls before starting placement.

c. Brushes are provided in the kit for placing compound 1-2 (fig. 4). The material may be poured on the felts sparingly if desired, and then brushed over surfaces. Roll—*DON'T LAY*—felt in place after the compound is spread. Sweep the surface of the felts with a broom to remove air and to secure a bond between plies.

d. The two-ply flashing and termite shield that is cemented to the edge of the base membrane and attached to the floor panel edges is placed immediately after the floor panels are placed. Use care in keeping the portion of waterproofing extending beyond the building line clean until the flashing membrane is cemented; however, after the flashing is placed, immediately cover the waterproofing with at least a thin coat of earth to prevent tracking of compound onto building parts, and to prevent rupturing the felt (fig. 4).

17. PLACING FLOOR SCREEDS AND FILL

a. On account of the probable freshness of the waterproof compound and the light protection at the time placement of screeds 2-1 to 2-10 inclusive is contemplated, assemble and bolt together the screeds forming one-half the building foundation at the side of the building area, and then carry it on to the area (fig. 5). Then bolt the two sections together along the center line of the building. This prevents possible damage to the waterproofing.

b. Throw the earth or gravel fill from outside the building area into piles in the center of the squares formed by the screeds. Level and tamp after the screeds are leveled (fig. 5).

> **CAUTION.**—The leveling of screeds is one of the most important operations in the building erection. It is necessary that the building floor be absolutely level, or else the various parts of the building above this bearing will not fit properly; if the screeds are level, the floor also will be level.

c. Level the screeds with a carpenter's level, and check several times during the filling and tamping process and after screeding of filled surface is completed.

d. After tamping, screed the filled surface with a straight piece of plank so that the surface is level with the top of the screeds. Take care to eliminate any high or low areas on the filled surfaces as the floor panels, when placed, should rest both on the top surface of the fill and on the screeds.

18. TROPICAL FOUNDATIONS

a. Preparation for and erection of foundations for tropical type buildings are shown in figures 6 and 8. Carefully stake out the pier location before excavating for footings 2-T-1. Excavations should be to the depth necessary to permit the finish floor line to be not less than 3 feet above grade. The bottom of such excavations must be level.

b. After placing footings and posts 2-T-2 to 2-T-5, inclusive, attach the connecting braces 2-T-6 and plates 2-T-9 to 2-T-16, inclusive, loosely. Level the plates by removing or filling earth under footings. Keep the earth under the footings uniformly compacted to reduce and equalize settlement when the building is placed on the foundation. Tighten all bolts and proceed to place the floor panels. Re-level the foundation after all floor panels are placed. Assemble stairs 2-T-18 to 2-T-28-B, inclusive.

19. PLACING FLOOR PANELS

a. Walking on the finished fill should be kept to a minimum. Before placing the floor panels, 3-1 to 3-18, inclusive, sweep all earth or dirt from the top edge of the screeds and start laying the panels in the order shown in figure 7.

b. Engage the bolt anchors for the first panel, but do not tighten them until the adjoining panels are placed. If the floor screed at the building line has bulged out because of pressure of the earth fill, carefully realign it by removing some fill back of the screed and then forcing the screed back to its proper place.

c. Before placing floor splines 3-19 to 3-20, inclusive, or adjoining panels, be sure that all dirt, etc., has been swept from the top of the screed and spline, so that a snug fit can be secured.

d. Place the splines at panel joints progressively in strict accordance with plan shown on figure 7. The end of the spline must not project beyond the core of the panel so as to interfere with the placement of adjoining splines.

e. Plywood tie-plates 3-21 to 3-23, inclusive, at interior panel corners should not be placed until all the four panels surrounding the anchor have been laid in place.

f. In placing the plywood tie-plates, adjust the panel position until the tie-plate neatly fits into the square. Place the anchor bolts, but do not tighten them until all adjoining panels are in line and the panel edges fit snugly together (fig. 9).

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LAYING OUT BASE

SET STAKES & BATTER BOARDS AS SHOWN. TAKE CARE TO LOCATE THEM SO THEY WILL NOT INTERFERE WITH EXCAVATING DITCHES. PLACE NAILS IN BATTER BOARDS ON A LINE OF THE DIAGONALS BETWEEN TOWERS AT POINTS 'A'. PLACE NAILS AT POINT 'B' 1'-6" INSIDE OF 'A'. 'B' IS THE LINE OF THE EDGE OF THE WATER PROOF MEMBRANE. PLACE A 3RD NAIL 1'-6" INSIDE OF 'B' AT 'C' ON EACH BATTER BOARD. 'C' IS ON THE BUILDING LINE. BETWEEN THESE NAIL POINTS STRETCH A CARPENTERS LINE TO OBTAIN THE VARIOUS LINES AS REQUIRED.

TO LAY OUT GRADED AREA STRETCH LINES OVER POINTS. FROM 'F' MEASURE OFF AND MARK POINTS 'D', 'E', 'G' AND 'H'. NEXT, USING TWO STEEL TAPES WITH 'D' AND 'G' AS CENTERS AND SWING THEM TO INTERSECT AT 33'-0" ON BOTH TAPES AT 'I'. NOW EXTEND 'I'-'D' TO 'M', AND 'I'-'G' TO 'K'. THEN EXTEND 'M'-'H' AND 'K'-'E' TO 'L'. 'L', 'M', 'I' AND 'K' ARE THE FOUR CORNERS OF THE 36'-0" SQUARE BASE.

THE BUILDING MAY BE PLACED IN ANY ONE OF THE FOUR QUADRANTS MOST CONVENIENT FOR GRADING OR PROTECTION.
FOR ACCURACY - LEVEL STEEL TAPE, PLUMB DOWN POINTS, DRIVE STAKES FIRMLY AND STRETCH LINES TIGHT AND LEVEL.

LAYING WATER-PROOF MEMBRANE

FIRST MAKE SURE THAT THE EARTH BASE IS SMOOTH, FREE FROM STONES, CLODS ETC., AND IS LEVEL.
LAY DOWN THE FIRST STRIP OF ASPHALT FELT ALONG THE LEFT SIDE, LOCATED AS SHOWN IN FIGURE 2, BRUSH ON A GENEROUS COAT OF ASPHALT OVER THE ENTIRE SURFACE, AND ROLL ON SECOND STRIP LAPPED OVER ALL BUT THE LEFT 2" OF THE FIRST STRIP.
REPEAT APPLICATION OF ASPHALT COLD COATING OVER SURFACE OF SECOND STRIP TO BE LAPPED OVER BY THE FOLLOWING STRIP ETC.

CAUTION: LAY EACH STRIP OF FELT AND DO ALL BRUSHING ON OF COATING FROM THE RIGHT, DO NOT WALK ON FELT, PERFORATIONS AND LEAKS MAY BE THE RESULT.
AT INTERVALS DURING THE LAYING OF FELT STRIPS CHECK OVER ALL MEASUREMENTS TO AVOID THE ACCUMULATION OF SMALL ERRORS AND TO MAKE SURE THAT THE WHOLE MEMBRANE WILL FINISH TO PROPER SIZES

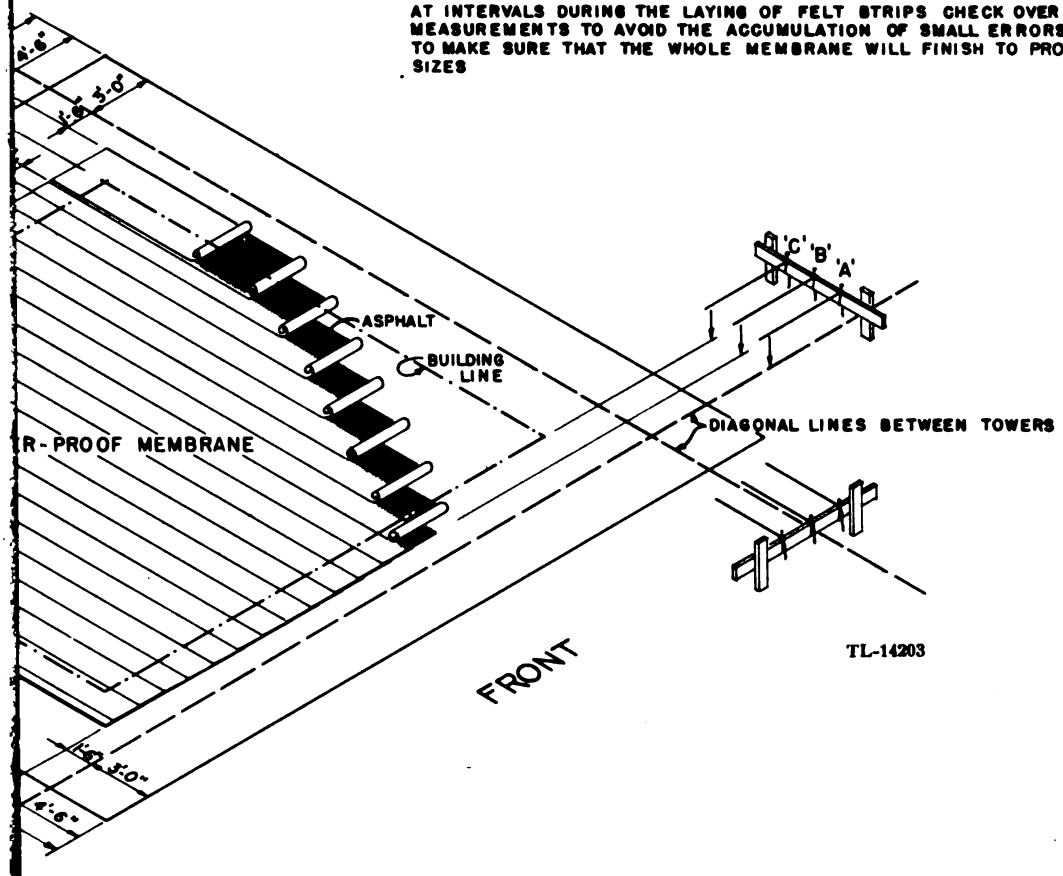
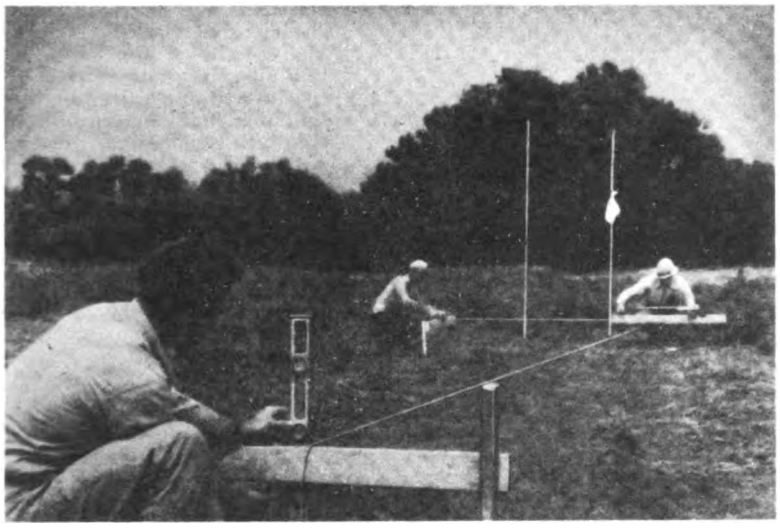
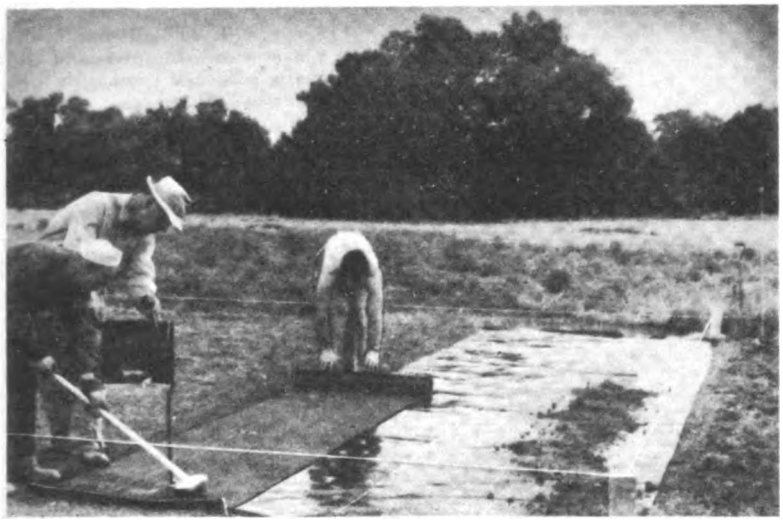


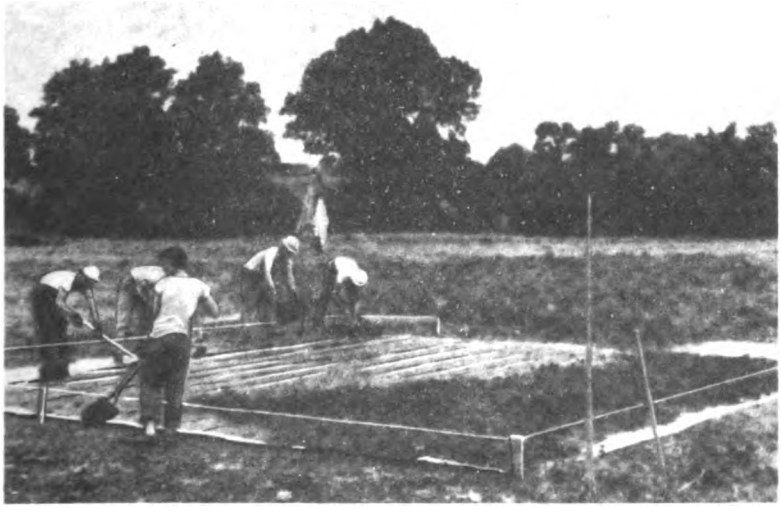
Figure 3. Building base and waterproofing.



Placing batter boards and establishing building line. Note the stanchion bars placed upright which are used as sight guides for establishing tower locations and building lines.



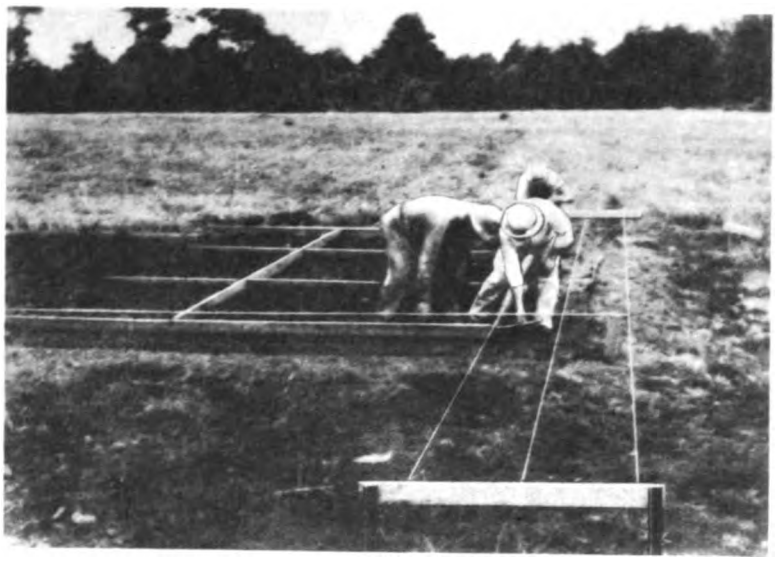
Placing waterproofing after earth has been leveled and tamped. Note that felt is unrolled into place on top of adhesive.



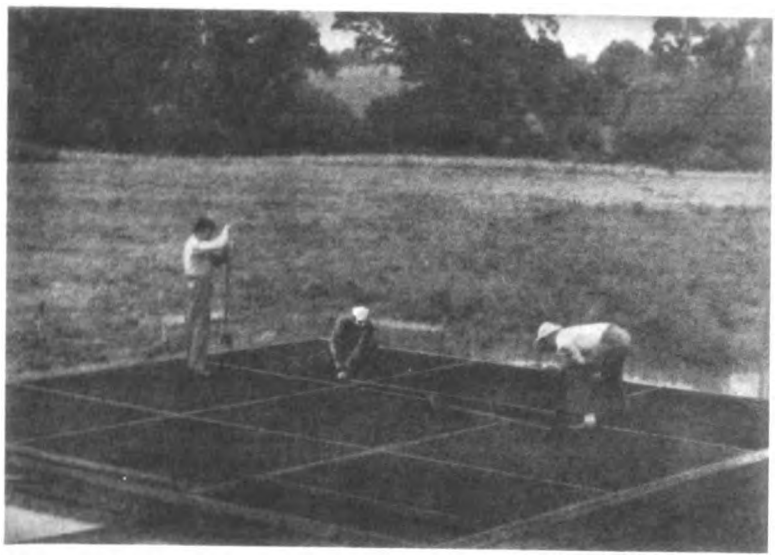
Covering waterproofing. A thin layer of earth has been spread on waterproofing to permit foot traffic and placement of wood screeds.

TL-14204

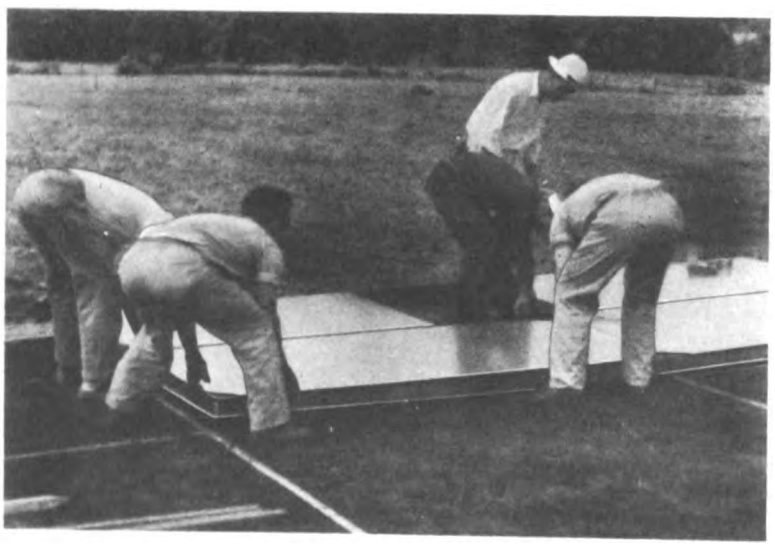
Figure 4. Placing batter boards and waterproofing.



Placing screeds. The screeds are assembled for half the building area and carried to position as one unit. Note the building lines, waterproofing lines, and guide lines stretched between batter boards.



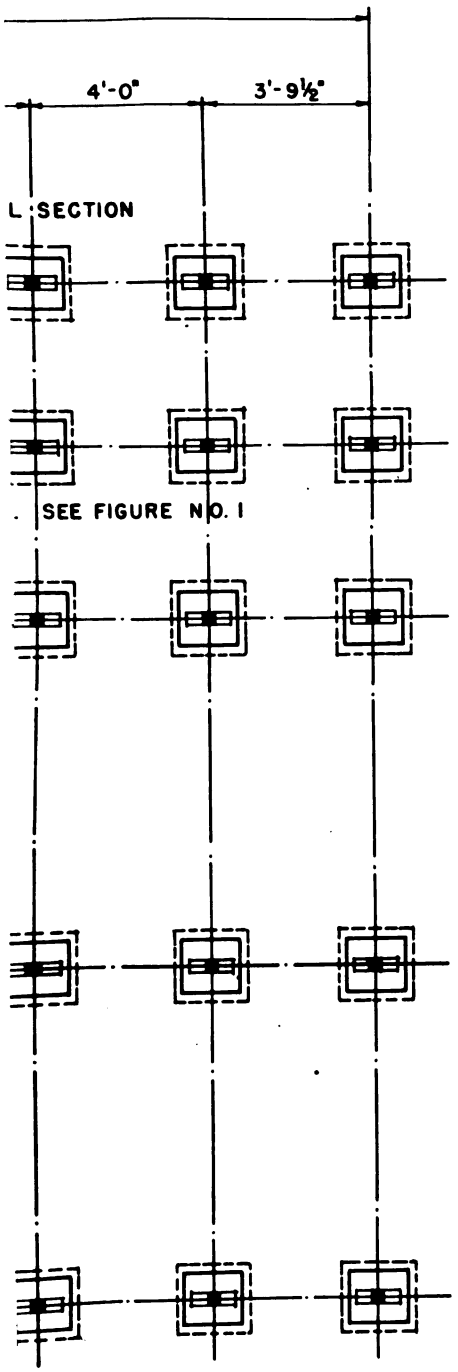
Placing fill. The fill has been placed and tamped and is being screeded level with top of screed members.

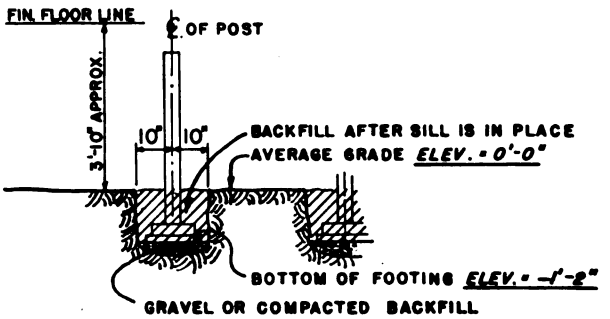


Placing floor panels. Note the waterproof paper layed on previously placed panel to permit foot traffic in placing adjoining panels.

TL-14205

Figure 5. Placing screeds, fill, and floor panels.

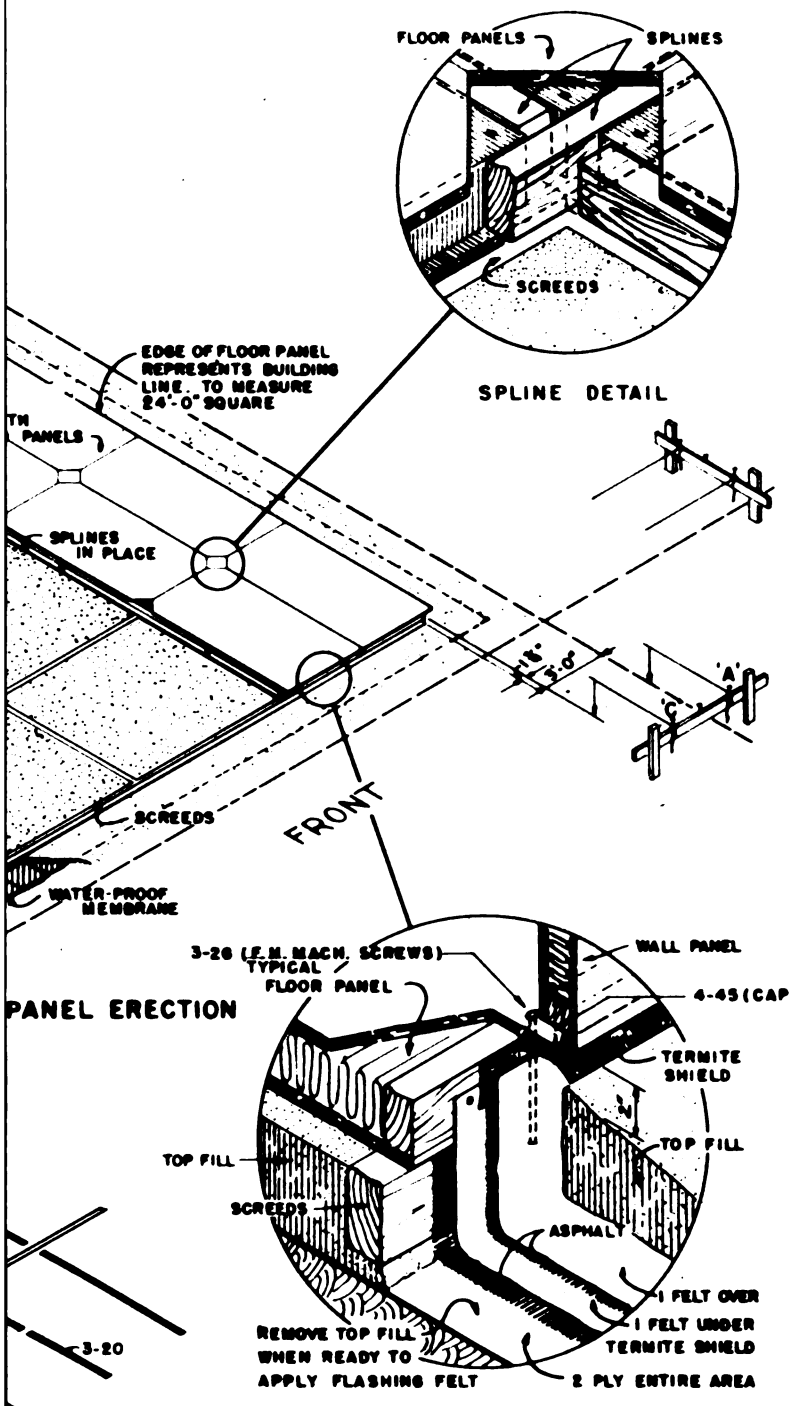




TYPICAL SECTION
OF FOOTING

TL-14206

Figure 6. Tropical foundation plan.



LAYING SCREEDS AND PLACING TOP FILL -

FIRST SIFT ABOUT 1" THICKNESS OF TOP FILL OVER WATER-PROOF MEMBRANE.
TOP FILL TO BE DRY SAND, GRAVEL, SHELL OR SHALE. IF SUCH MATERIAL IS NOT AVAILABLE, USE FINE DRY EARTH.
BOLT SCREEDS TOGETHER OFF SITE INTO TWO ASSEMBLIES AS SHOWN. CARRY EACH HALF ONTO BASE AND BOLT TOGETHER.

LAYING FLOOR PANELS -

PLACE PANELS AS SHOWN IN DIAGRAM- ALL NUMBERS ARE ON THE TOP SURFACE. SINGLE NUMBERS 1,2,3,4 & 5 ARE MATCHING NUMBERS TO BE PLACED CORNERING TOGETHER AS SHOWN. LAY A DOUBLE ROW OF PANELS FROM BACK TO FRONT. PLACE SPLINES ACCORDING TO DIAGRAM, FITTING THEM INTO THE PANELS AS THEY ARE LAID.

APPLYING FELT FLASHING -

PLACE FELT TO OUTSIDE EDGE OF FLOOR AS SHOWN USING 18" WIDE STRIP. MOP THIS FELT WITH ASPHALT TO PROJECTING PORTION OF WATERPROOF MEMBRANE AS SHOWN (NOT TO PANEL) APPLY 2ND FELT AFTER TERMITE SHIELD IS SET. MOP 2ND FELT TO SHIELD & ENTIRE SURFACE OF 1ST FELT.

TL-14207

Figure 7. Screeds and floor.

g. Exercise care in placing the floor panels so that the plywood edges fit snugly together. Excessive joints or openings between the panels will cause an over-run in the size of the building, and lead to trouble in the placing of the wall and ceiling panels and in the roof construction.

20. PLACING WALL PANELS

a. Place wall panels 4-2 to 4-31, inclusive in the order or sequence indicated in figure 10. One of the removable panels in the generator room and one in the transmitter room should not be placed permanently until all heavy or bulky equipment has been moved into the building (fig. 9).

b. First, place the dowel strips 4-1 that serve around the edge of the floor as aligners for the wall panels. In placing the panels it is best to engage the rabbet of the panel into these dowel strips first and then push laterally into the adjoining panel. The tendency to "rack" can be eliminated by tapping the top and open side of the panel lightly.

c. Place termite shields 3-24 and 3-25 and start the bolts that pass through the shield, floor plywood, and bottom of wall panel. These termite shields (or drips) are placed on both regular and tropical type buildings. Do not tighten bolts until after the ceiling panels are placed.

d. As each panel is placed, insert the top dowel strips 4-1 which engage in holes in the top core member of the panel.

21. PLACING POSTS AND BEAMS

Upon completion of wall panel installation, up to the point shown in figure 11⑤, place posts 4-32 and beams 4-33 to 4-35, inclusive, with their clip angle connections 4-36 to 4-38, inclusive, as shown in figure 10. All bolts at the clip angles should be left loose until after the ceiling panels are placed and the bolts from the clip angles engaged to the ceiling panels.

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23. CEILING PANEL ANCHORS

After the ceiling panels are placed, distribute and secure the plywood tie-plates 5-28 and 5-29. These are bolted to the top of the ceiling panels and panel jointings are adjusted in the manner described for the flush type floor tie-plates.

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a. The marker counterpoise must be put down as soon as the ceiling panels are in place and before the roof frame is erected. The marker counterpoise 8-34-A consists of strips of galvanized hardware cloth, bonded together with solderless connectors 8-34-B. Along the ends these strips are grounded to a No. 6 bare copper wire 8-36-B which is part of a continuous ground system, fastened at each corner of the building to a 6 foot ground rod, as indicated in the building corner detail of figure 14.

b. The first strip should be laid in place and stapled to the ceiling panels at just enough points to keep it from moving about. As each successive strip is laid, bond it to the previous strip with solderless connectors spaced at 24 inch intervals. Trim the last strip along its side to lie within the bevel strips of the ceiling.

c. When all strips are down and bonded, fasten one end of the bare copper ground wire to one of the ground rods driven just outside the waterproofing at each corner of the building. Bring the wire up across the waterproof corner, crossing the ceiling bevel strip at the mitered corner. Carry it across the ends of the counterpoise strips, bonding it to the mesh each 24 inches, and holding it back carefully in the corners so as not to interfere with the rafters.

d. The ground wire is then carried down to the adjacent corner of the building to the ground rod. From the second ground rod it goes across the side of the building in a ditch, 4 to 6 inches deep, to the third ground rod, and thence up the corner, and across the second end of the mesh. It continues down the next corner to the third ground rod and across to the first, where it joins the other end and completes the continuous ground system.

e. Lay the counterpoise mesh in a continuous strip across the ventilating opening, and cut an opening only for the access hatch. When cutting the opening for the access hatch, leave enough wire so that it can be bent down and stapled closely into the corner between the panel member and the hatch support. Leave no sharp ends to catch the clothing or person of personnel.

25. ROOF FRAMING

a. The roof framing is shown in figures 12 and 15. The hip rafters 6-5 and 6-6 should be bolted together on the ground and then placed in position on the roof after the posts 6-4 are doweled into the ceiling tie-plate. After the four hip rafters are placed, anchor them loosely at the base with bolt 6-45 and temporarily at the peak with assembly 6-42. The anchorage should not be permanent until after all of the tail rafters and purlins are placed.

b. Place the eight jack rafters 6-7 and 6-8 next, making a temporary bolt connection through the hip rafter, and engage the bolts 6-45 and straps 6-46 at the base. The purlins 6-9 to 6-14, inclusive, are then placed in the yokes. This completes the main roof framing. After this assembly is made, properly align the members and draw up all bolts and anchors to a tight position.

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The roof deck panels 6-15 to 6-18, inclusive, should be placed first. The beveled strip on the under side of the panels, which strip locks into the beveled strip on the ceiling panels, should be carefully engaged, as this serves to hold down the roof panel after the anchor bolts are placed. The anchor bolts into the jack rafters, etc., should be loosely placed. Continue the placing of deck panels following around the building with each successive course until the panels 6-25 are placed. All anchor bolts for the roof panels can then be tightly drawn up.

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The roof battens are parts 6-27 to 6-34, inclusive, and 6-44. After jute and caulking is placed in the joint over the hip rafters, start placing the battens at the bottom course and continue upward.

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b. Before placing the hip roof battens 6-29, 6-30, 6-34, 6-44, place a run of caulking in the small V of the battens over flat surfaces. After the roof battens are placed, to secure and tighten and prevent leakage, carefully caulk all connections of the batten with the roof deck, including the joints at the end of battens where they join. Use only enough caulking to seal the joints and leave a body of caulking that will not flake or scale off. It is advisable to continue the caulking around the building where the termite shield joins the exterior wall plywood at the same time. Place other caulking as indicated by drawings.

c. If leaks occur after the building is complete, carefully inspect all caulked joints for openings and recaulk if necessary.

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a. Assemble and place all vent hoods, dampers, blackout panels, such as parts 7-14, 7-15, 7-19, 7-20, 7-21, 7-22, 7-23, 7-24, as indicated in figure 10.

b. Place, at anchorage provided, door stops and other finished hardware provided with the kit.

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Assemble oil barrel racks 7-1 to 7-13, inclusive, as indicated in figure 10, and place them on termite shields at the proper elevation to fit the fuel line pipe at the extension into the building. The rack should be placed level and moved horizontally to a position to fit the piping lengths.

g. Exercise care in placing the floor panels so that the plywood edges fit snugly together. Excessive joints or openings between the panels will cause an over-run in the size of the building, and lead to trouble in the placing of the wall and ceiling panels and in the roof construction.

20. PLACING WALL PANELS

a. Place wall panels 4-2 to 4-31, inclusive in the order or sequence indicated in figure 10. One of the removable panels in the generator room and one in the transmitter room should not be placed permanently until all heavy or bulky equipment has been moved into the building (fig. 9).

b. First, place the dowel strips 4-1 that serve around the edge of the floor as aligners for the wall panels. In placing the panels it is best to engage the rabbet of the panel into these dowel strips first and then push laterally into the adjoining panel. The tendency to "rack" can be eliminated by tapping the top and open side of the panel lightly.

c. Place termite shields 3-24 and 3-25 and start the bolts that pass through the shield, floor plywood, and bottom of wall panel. These termite shields (or drips) are placed on both regular and tropical type buildings. Do not tighten bolts until after the ceiling panels are placed.

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c. When all strips are down and bonded, fasten one end of the bare copper ground wire to one of the ground rods driven just outside the waterproofing at each corner of the building. Bring the wire up across the waterproof corner, crossing the ceiling bevel strip at the mitered corner. Carry it across the ends of the counterpoise strips, bonding it to the mesh each 24 inches, and holding it back carefully in the corners so as not to interfere with the rafters.

d. The ground wire is then carried down to the adjacent corner of the building to the ground rod. From the second ground rod it goes across the side of the building in a ditch, 4 to 6 inches deep, to the third ground rod, and thence up the corner, and across the second end of the mesh. It continues down the next corner to the third ground rod and across to the first, where it joins the other end and completes the continuous ground system.

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c. If leaks occur after the building is complete, carefully inspect all caulked joints for openings and recaulk if necessary.

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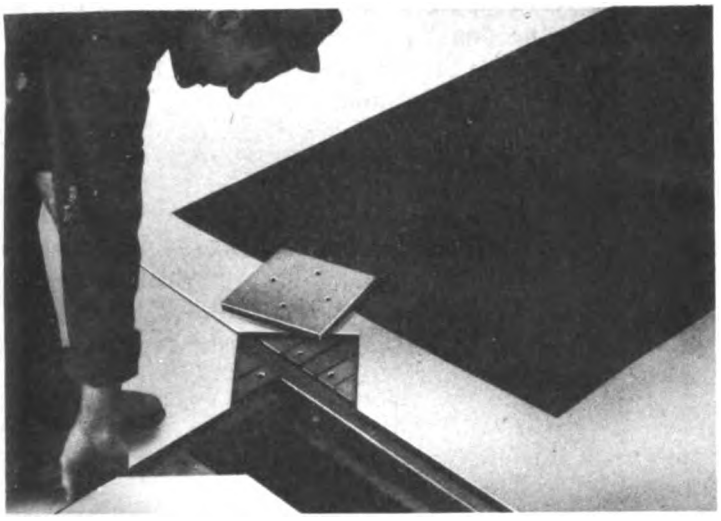
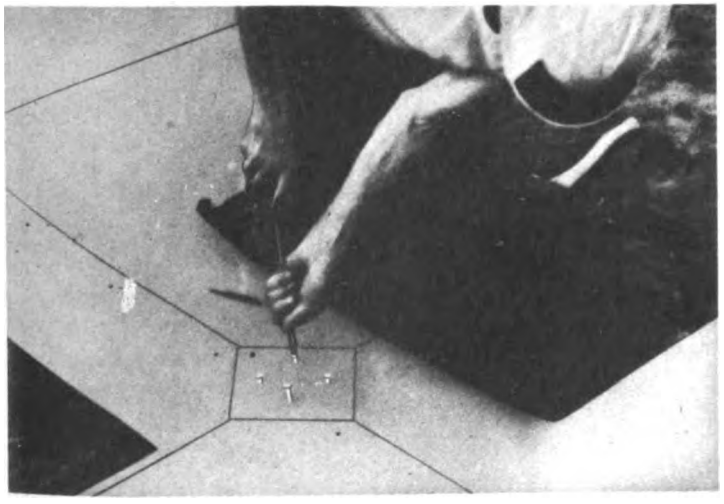
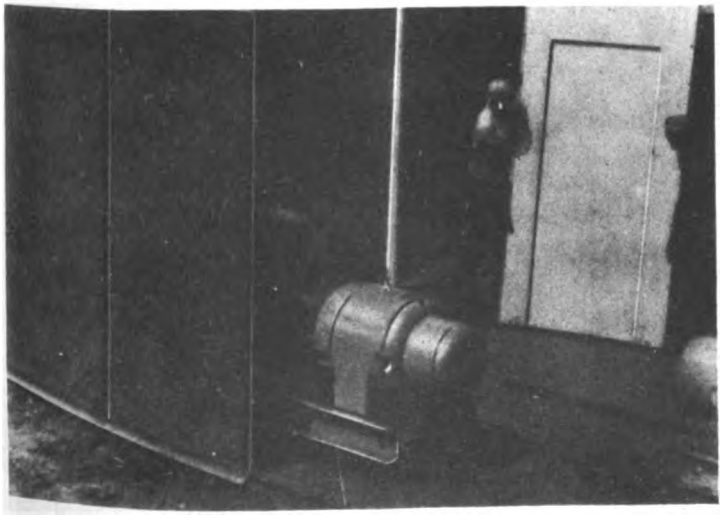


Placing interior floor panel. The rabbets, screeds and splines have been carefully cleaned of earth or gravel before the panel is shoved into place.



Placing floor panel anchor pieces. Bolts are not tightened until all floor panels are in position and checked for position.



Placing partition panel.

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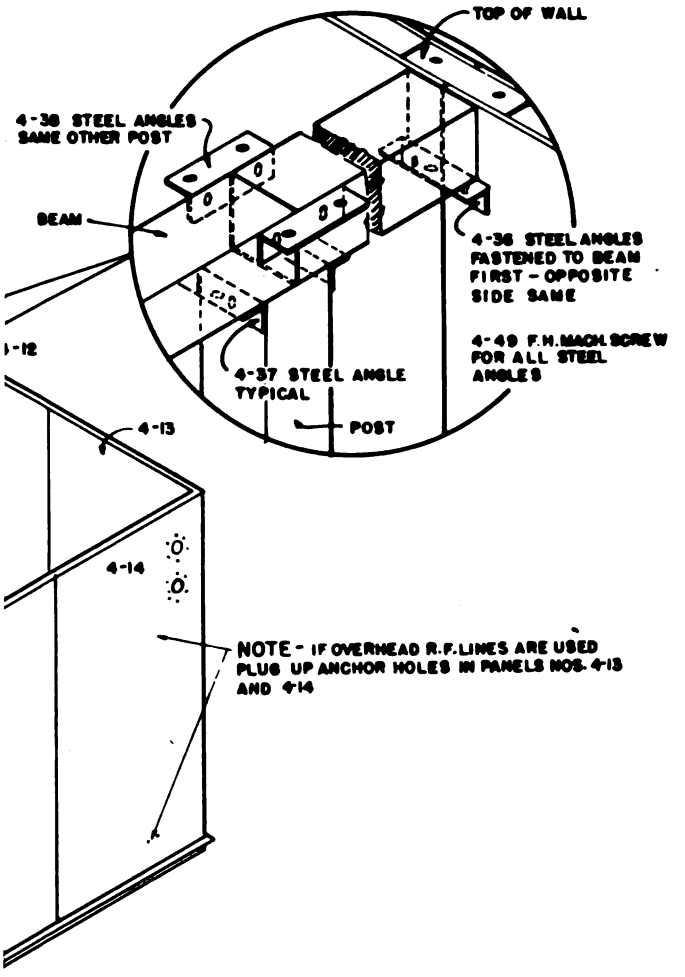
Figure 9. Placing floor panel, anchors, and partitions.

32. PLACING EXTERIOR JOINT TAPE

All exterior joints between the various panels or walls should be covered with tape 4-40 as furnished and as indicated on figure 10. At least 2 hours before placing the tape, apply a brush coat of Brycolac 4-40-A on the wood surfaces that will be in contact with the tape adhesive and extending approximately ¼ inch to ½ inch beyond the edge of the tape. The tape will not adhere to the wood surfaces if this application is not made. The Brycolac must be dry when the tape is applied. Cover the vertical joints following with coverage for horizontal joints, with the tape extending over the top of the tape previously placed for vertical joints. Use care in placing the tape so that the panel joint occurs in the center of the tape. After the tape is placed, rub thoroughly to secure good adhesion.

33. TOUCHING UP

After the entire building is assembled, touch up all damaged or marred surfaces with paint of a similar color and kind as provided in the kit. Check the building to determine if all bolts are placed and tight. Figure 16 shows a completed building.

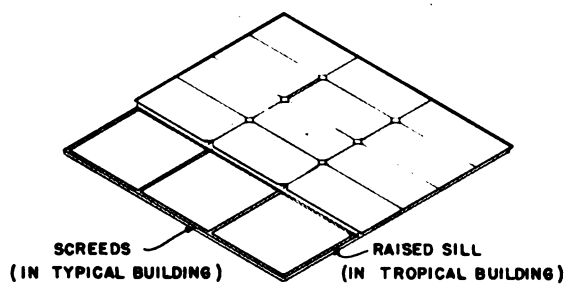


NOTE:
PART NUMBERS ARE PLACED ON UPPER LEFT HAND CORNER INTERIOR FACE FOR WALL PANELS. PARTITION PANELS ARE MARKED UPPER LEFT HAND CORNER GENERATOR ROOM SIDE.

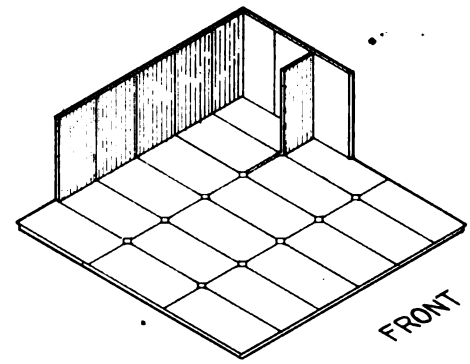
FOR ERECTION SEQUENCE SEE FIGURE 11

TL-14210

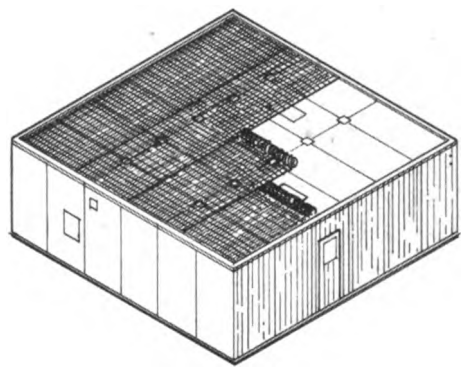
Figure 10.—Isometric of building walls.



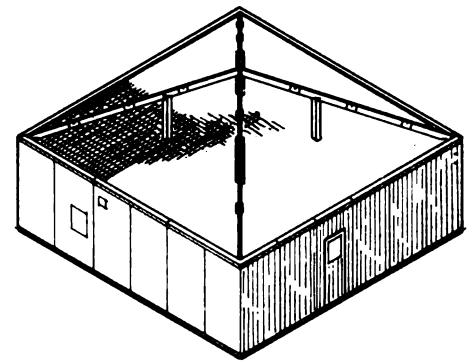
(3) FLOOR PANELS



(4) ERECTING WALL PANELS

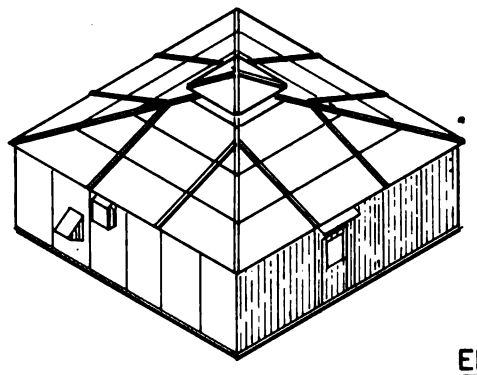


(7) APPLYING COUNTERPOISE WIRE MESH



(8) INSTALLING HIP RAFTERS

TL-14211



(11) ROOF VENT INSTALLED - CAULKING

ERECTION SEQUENCE OF BUILDING

Figure 11. Building sequence.

NOTES:

INSTALL CEILING PANELS AS REQUIRED TO SUPPORT WALL PANELS. AFTER CEILING PANELS ARE COMPLETLY INSTALLED, BOLT DOWN CEILING TIE PLATES MARKED 5-28, 5-29 INTO POSITION SHOWN ON PLAN. NEXT JOIN HIP RAFTERS 6-5 TO 6-6. SET POSTS 6-4 AND ERECT JACK RAFTERS 6-7 & 6-6. THEN PLACE ALL PURLINS 6-9 TO 6-14 INCL. WHEN ALL ARE BOLTED FIRMLY IN POSITION PUT ON ROOF PANELS.

CAUTION -
COUNTERPOISE MESH MUST BE PLACED ON TOP OF CEILING PANELS BEFORE RAFTERS ARE INSTALLED. ALSO PLACE RODS 7-70 AND BOLTS 6-26-D THRU CEILING BEFORE ROOF DECK IS PLACED.

TL-14212

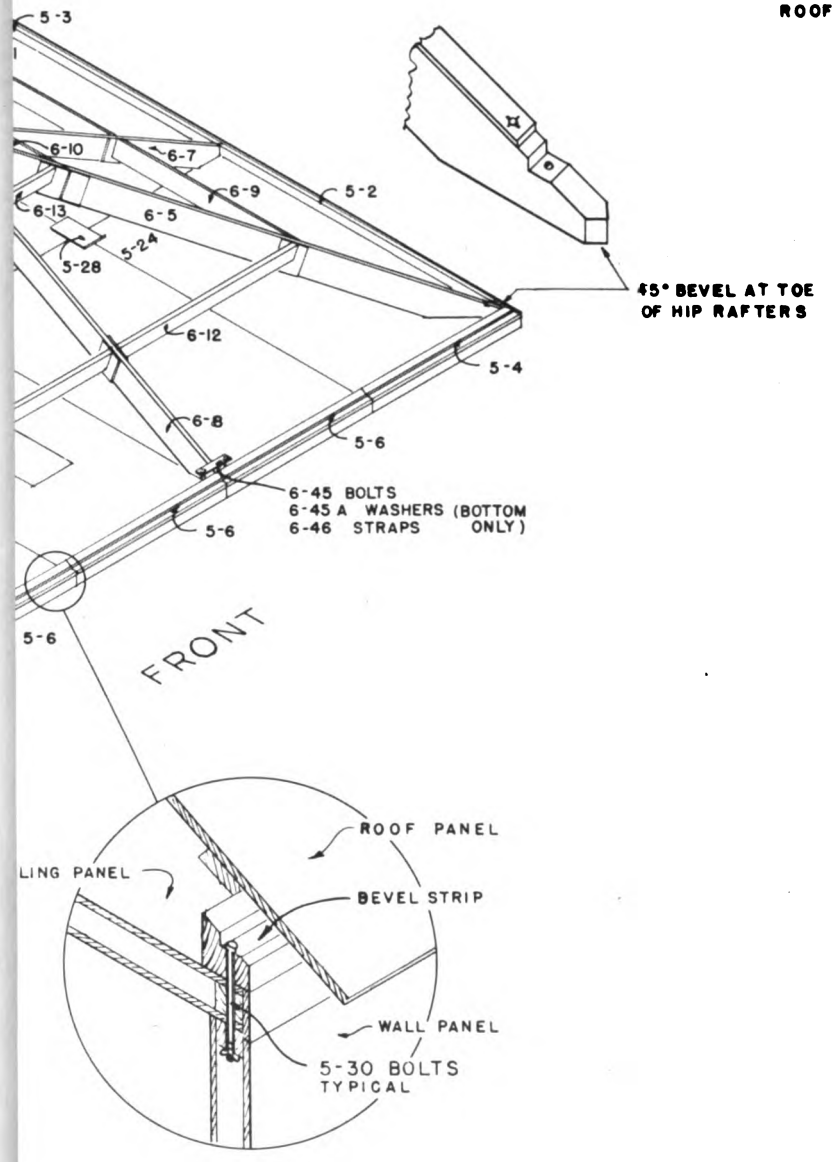
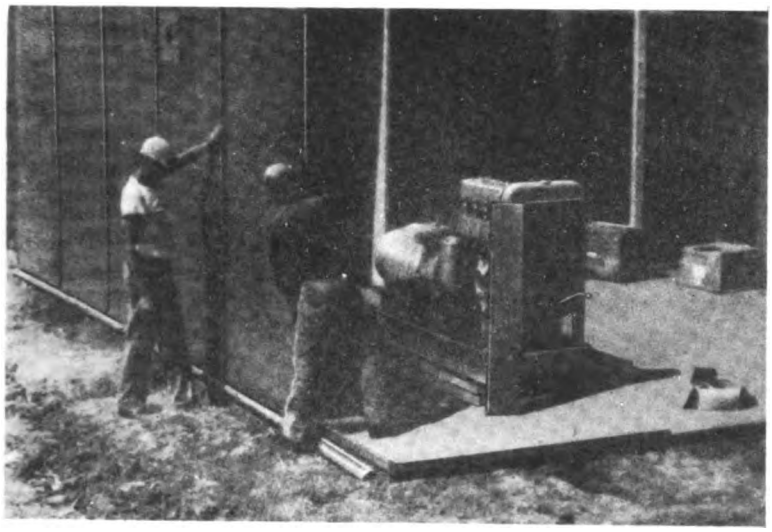
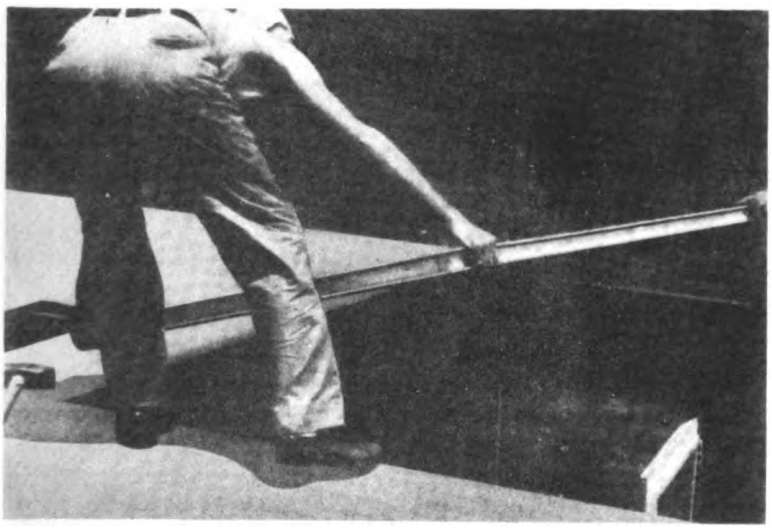


Figure 12. Roof framing.



Placing wall panel.



Placing ceiling panel.

Placing roof rafters.

TL-14213

Figure 13. Placing wall panel, ceiling panel, and roof rafters.

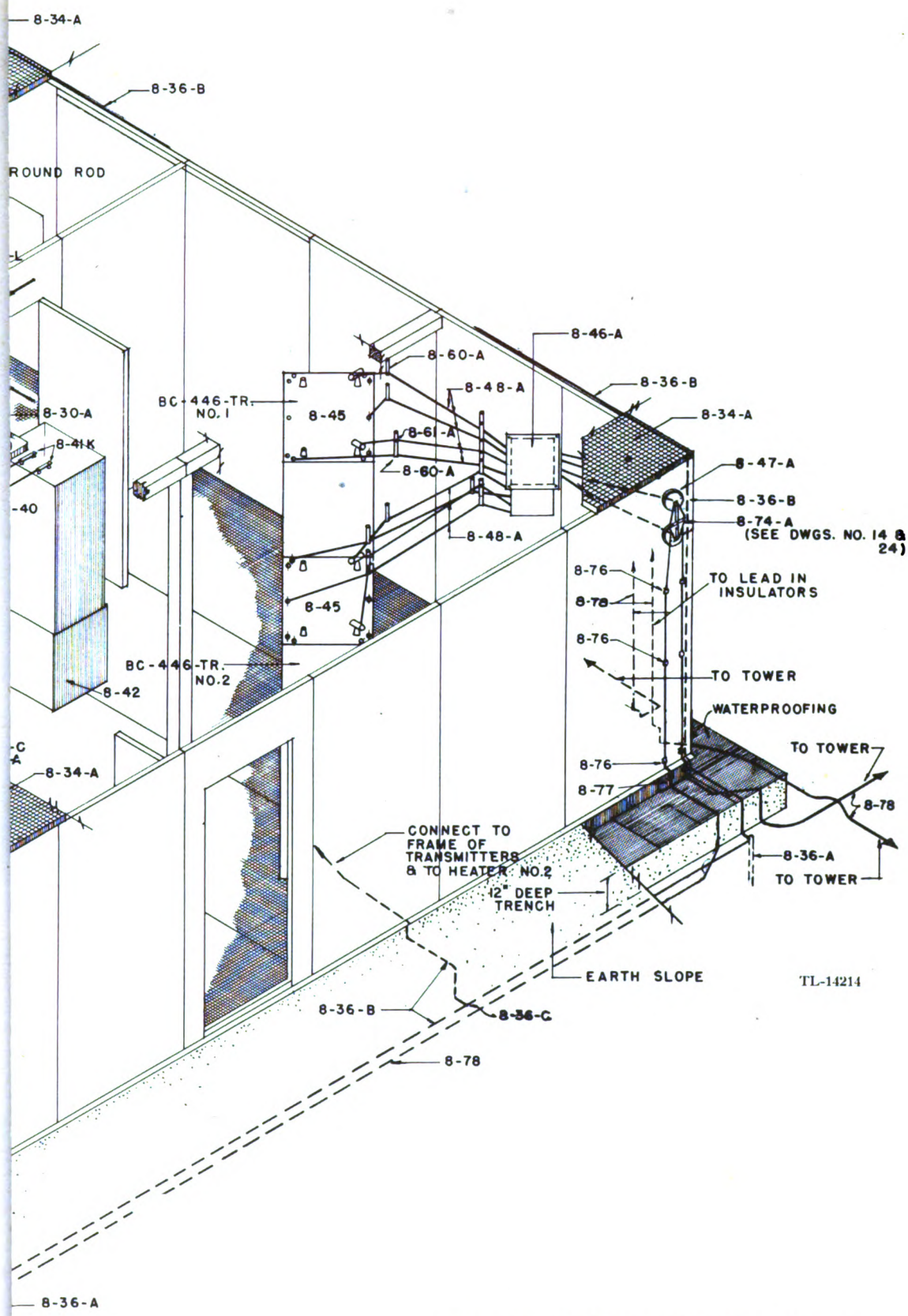
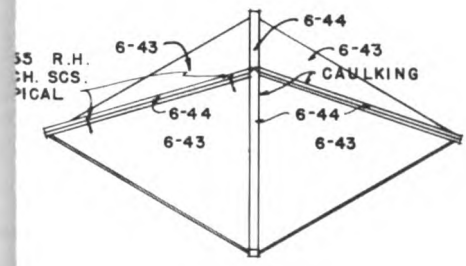
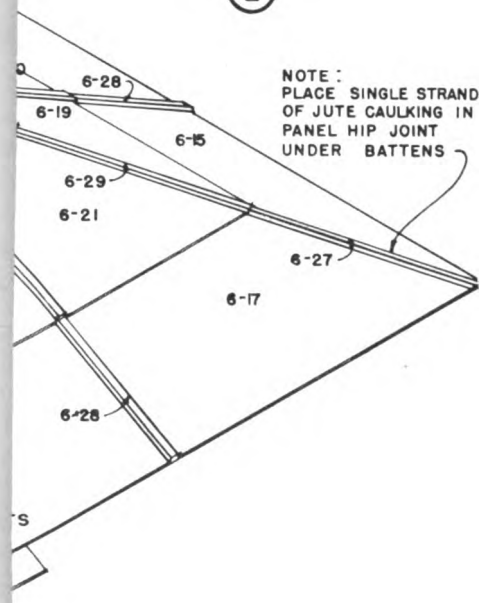


Figure 14. Building showing radio equipment and ground wires.

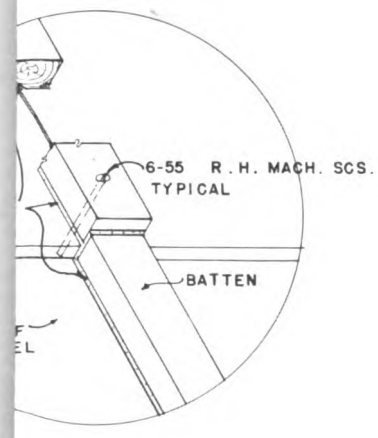


VENT ROOF

(2)



FRONT



LAYING ROOF

FIRST LAY ROOF PANELS 6-15, 6-16, 6-17 & 6-18 FIRMLY INTO POSITION. BOLT THESE TO PURLINS AND LAY PANELS 6-19, 6-20 & 6-21.
CONTINUE LAYING ROOF PANELS UNTIL ALL ARE SECURED IN PLACE EXCEPT 6-25, WHICH ARE NOT TO BE BOLTED UNTIL 6-35 STRUTS ARE IN PLACE.
THEN BOLT ON ALL BATTENS AND MOUNT VENT AND BOLT IN PLACE.
AFTER ALL PANELS, BATTENS & VENT ARE FIRMLY INSTALLED, CAULK JOINTS AS INDICATED IN DETAIL.

TL-14215

Figure 15. Roof panels.

Section III

ERECTION OF TOWERS

34. FOUNDATION

a. At the positions for each of the four 90 foot guyed towers, set reference stakes approximately 10 feet out from the tower center stake, in line with, and at right angles to the plot diagonals. Then lay out a 5 foot square about the tower center stake to outline the area to be excavated for the tower base. This is shown on figure 2.

b. The excavation of the base should be 3 feet deep. If rock is encountered, the base can be made stable by placing as much of the base as possible into the ground and by piling rock around the base to a height of 4 or 5 feet. Do not pile rocks so they will interfere with the tuning house and r-f lines.

c. After excavating and leveling the foundation for the tower, three ground rods are to be driven down 18 inches apart (see figs. 2 and 17), with the tops of the ground rods just above the bottom of the foundation excavation. Care should be taken in locating the ground rods so they will not be under the bearing angles of the tower. Ground rods are to be connected with two No. 6 bare soft drawn copper wire and two leads of wire are to be run up and later attached to the counterpoise ring and to the tuning house as described in paragraph 41**a**.

35. ASSEMBLY OF BASE AND TOWERS

a. Angles, boxes, and crates containing tower, base, and guy parts should be taken to each tower position and unpacked, using care not to damage the shipping containers which are to be used for repacking when the range station is moved to another location. Boxes and crates can be used as benches on which to assemble the tower sections (fig. 17). Make sure that the boxes are set level both ways and at the same heights from the ground. If not, the tower sections will be assembled in a twist which will show after erection.

b. In assembling the towers follow closely figures 18, 19, and 20 which show each part number stamped into each piece. Assembly bolts are in one package and should be placed in one of the long anchor rod boxes in separate piles by sizes to facilitate their selection when needed. Figures 18, 19, and 20 show the proper length of bolts to use for each connection. Speed socket wrenches and crescent wrenches are furnished with the kit. Practically all the bolts are $\frac{3}{8}$ inch size, and lockwashers are used under nearly all nuts. Too much strain must not be used in tightening bolts as it is easy to sheer off a $\frac{3}{8}$ inch bolt with an 8 inch wrench.

c. The base should be assembled complete, except for the counterpoise ring and the tuning house supports. These interfere with the erection and can be bolted in place after the tower is set on the insulator pin. The tower parts should be assembled into 10 foot sections, and the nuts tightened only with the fingers until the section is completely assembled. Then tighten all nuts uniformly with the exceptions hereinafter mentioned.

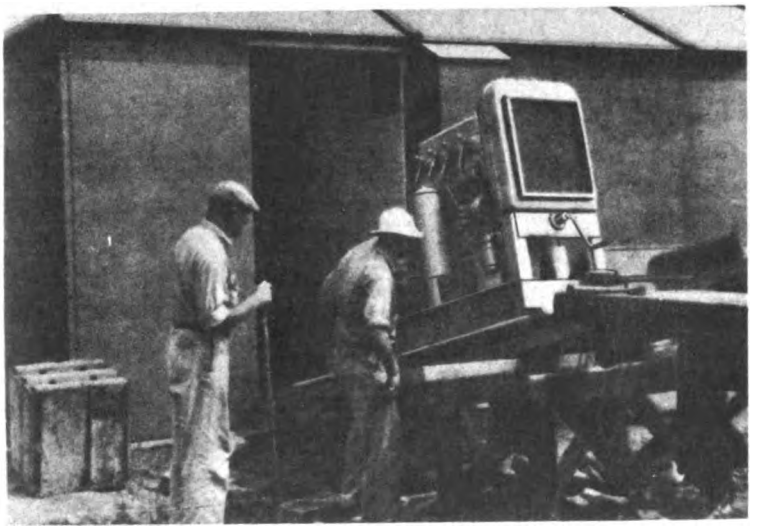
d. To permit the next section to slide into the previous section during erection the splice angles are loosely bolted to the top of each section except at the top insulator section where the splice angles are fastened to the bottom of the section. The next section or fourth from the top is assembled without splice angles. The lower diagonal of each section is bolted only at the upper end.

> **CAUTION.**—Care must be used in unpacking and handling of tower insulators and tower guy lines, as insulators must not be chipped or cracked.

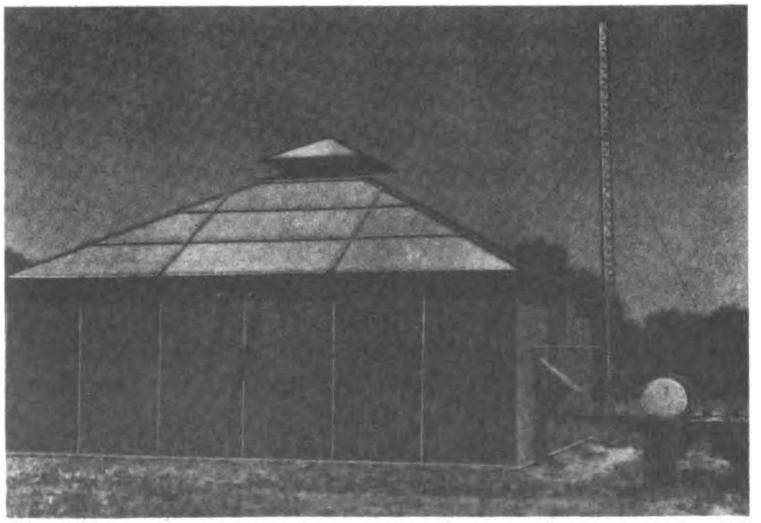
36. TOWER GUY ANCHORS (Fig. 21)

a. The tower guy anchors furnished are suitable only for clay, clay loam, or solid gravel foundations. They are not suitable for loose sand or rock. The anchors are of the expanding type requiring that an 8 to 10 inch hole be dug at an angle of approximately 45°. After the anchor is set in the hole, expand it by using the expanding and tamping bar furnished with the kit. An adjustable auger is furnished with the TE87A kit and in certain types of soil it can be used to dig the hole required. When placing the anchors in soft shale or very hard soil, it may be

Placing roof batten on ventilator.



Unloading engine generator set. (Equipment may be placed either before or after walls are erected.)



Rear elevation of completed building.

TL-14216

Figure 16. Placing roof batten on ventilator, unloading engine, completed building.

possible to dig a vertical trench down approximately at the position of the anchor and then a hole can be bored or pinned through to the trench, permitting the anchor rod to be installed through the hole and the anchor to be attached and expanded in the trench. A 2 inch auger with an 8 foot adjustable handle is provided for this purpose (fig. 17).

b. It is absolutely necessary to obtain a suitable anchorage for the tower guys. If the soil is loose or soft, do not depend on the anchors alone. Put the anchor rod through a "deadman," consisting of a piece of timber, a log, or railroad tie placed in the ground at right angles to the line of pull.

c. In case the anchorage falls into rock and no rock anchors are available, a safe anchorage can be secured by drilling into rock, setting the anchor rod into the hole, and wedging it securely. Test the stability of the tower anchors by putting a heavy strain on the anchor, using a truck and ¾ inch manila rope.

37. INSTALLATION OF TOWER BASE

a. Set the assembled tower base in place so that the tuning house supports and top of the base are level in all directions (figs. 2 and 18). The base should sit so that the tuning house supports face toward the center of the plot, that is, toward the radio range building. If the soil under the base is too soft, additional bearing capacity can be obtained by excavating the hole deeper and backfilling with tamped crushed rock or gravel for a better foundation. The foundation should be well tamped so as to provide a good level bearing for the tower base. Where the ground is very soft and additional bearing area is desired, planks or logs covered with tamped dirt can be placed below the 3 foot depth to provide additional bearing capacity. Concrete can be used where cement and aggregate are available.

b. After the base has been leveled, the hole is backfilled to the ground surface and well tamped during backfilling.

38. GENERAL DESCRIPTION OF ERECTION METHOD

a. The method of erection selected is such that it is not necessary for any person to climb more than 10 to 12 feet above the ground.

b. Assemble three top sections together on the ground and lift this assembly into a vertical position by means of a 20 foot gin pole equipped with a winch and steel cable load line. The 30 foot section is then lifted high enough to permit the installation of another section underneath. This operation is then repeated until the completed mast is lifted and placed upon the tower base.

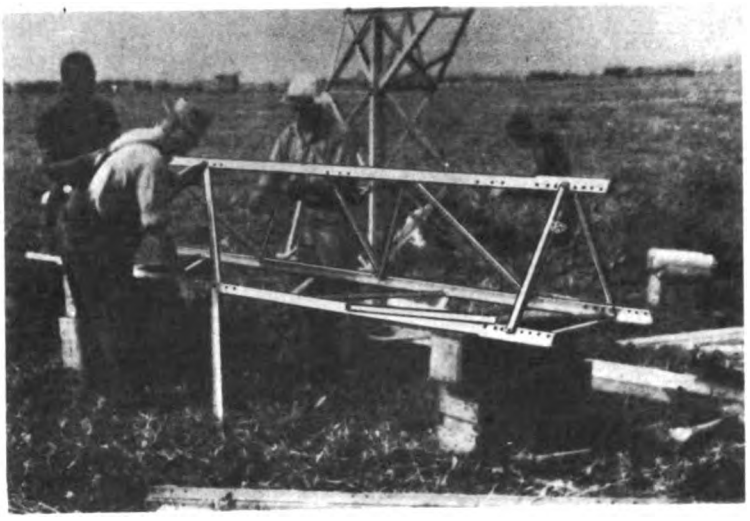
c. Figure 22 shows the position in which the gin pole is to be set, the design and parts composing the gin pole, and its complete rigging. The gin pole guys are attached to the permanent tower anchors by means of pennants and rope falls so that the pole may be leaned properly for lifting the load.

d. Until 60 feet of tower have been raised, temporary guys of ¾ inch rope are used as shown in figure 22. The guys are not to be tied to the top of the tower but are doubled back 60 feet along the rope and then tied with a bowline knot. After 60 feet of the tower have been raised the permanent tower guys are secured with rope falls and the use of a "monkey tail" to the permanent guy anchors. These temporary ¾ inch rope guys should always be tied on before the first 30 feet of tower are raised, making sure that the rope is under the top diagonal and over the top level member. This allows the rope to run around the top member or angle when the temporary guys are pulled down; otherwise the guys are likely to foul at the point where the level angle and diagonal and tower leg angle are bolted together (fig. 22). After 60 feet of tower have been erected, the bowline knot is untied and the rope pulled down, thus eliminating the necessity of climbing the tower to release guys.

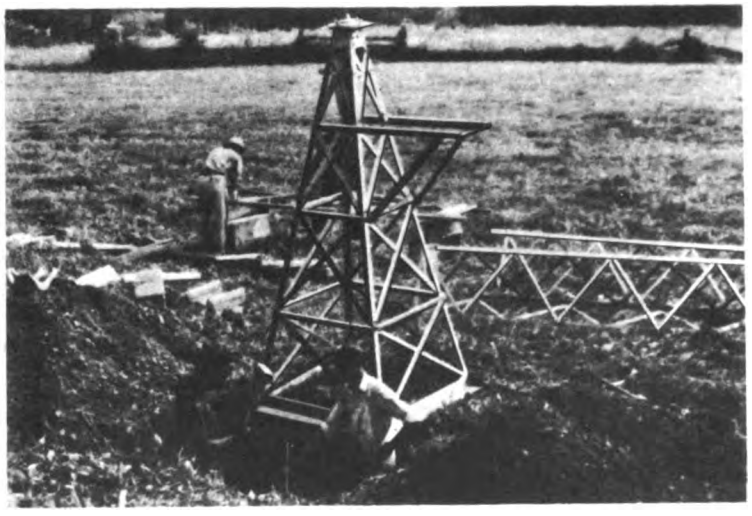
e. Figure 22 shows two sets of falls attached to the two legs to which the load line is also attached. These rope falls are attached to earth anchors set about 14 feet away from the position of the mast. They serve as kick anchors and restrain the tower from kicking inward toward the pole when it is raised off the ground. They also serve to pull the completed tower over to a position above the base for lowering onto the base pin (fig. 25).

> **CAUTION.**—As the tower is raised, be sure to slack off on the guys and on the kick anchors. The tower must be kept in a vertical position and capable men should pay out rope at the guys and kick anchors to maintain the tower in a vertical position as it is raised. The tower should be lifted by two legs.

f. A steel angle stiffener is furnished with the kit and is to be placed between the two legs, and pinned in place with a driving fit (fig. 22). The load line hook is hooked into the ring of the chain sling furnished and the chain with free-running hooks is wrapped twice about the tower legs at



Assembly of tower section. Note that the packing boxes serving as a bench have been placed level.

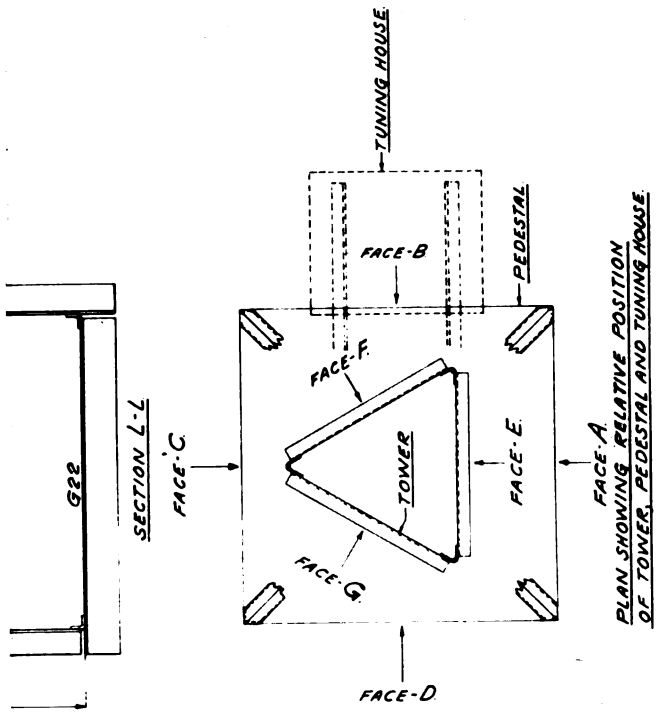


Tower base and its excavation. Note ground rod being driven into place.

Guy anchor. A vertical hole was excavated to permit attachment of anchor wing to anchor rod which was previously run thru a 2" augured hole extending at an angle to the earth surface.

TL-14217

Figure 17. Assembly of tower, base excavation, and guy anchor.



FIELD BOLTS FOR ONE TOWER & PEDESTAL

673 - BOLTS 3/8"Ø × 0:0 7/8"
183 - " 3/8"Ø × 0:1"
87 - " 3/8"Ø × 0:1 1/8"
7 - " 3/8"Ø × 0:1 1/4"
} THDS 3/8"

950 - SAE HEAVY LOCKWASHERS FOR 3/8"Ø BOLTS.
38 - STD LOCKWASHERS FOR 3/8"Ø BOLTS.
5 - BOLTS 3/8"Ø × 0:2 1/2" SQ HD 2 HEX NUTS EACH THDS: 1 1/2"
4 - BOLTS 3/8"Ø × 0:7" SQ HD 2 HEX NUTS EACH THDS 2"
4 - TAP BOLTS 3/8"Ø × 1 1/2" HEX HD.
4 - LOCKWASHERS 1/4 TK FOR 3/8"Ø BOLTS
8 - WASHERS 1 1/4"Ø × 1 1/2"Ø × 1/4 TK.

TL-14218

Figure 18. Tower assembly, pedestal and first section.

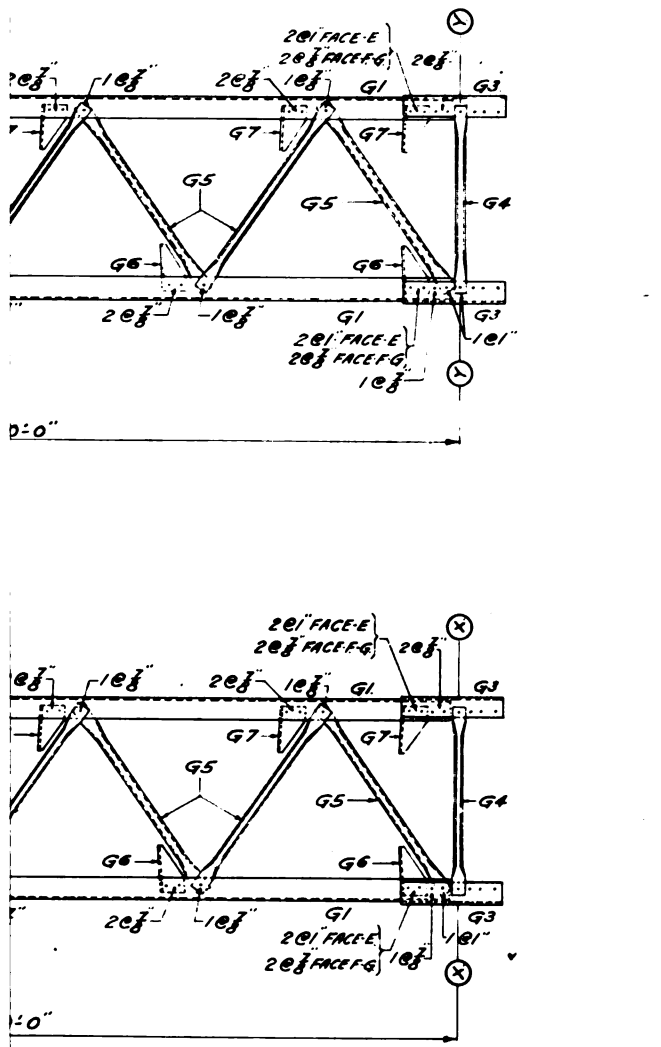
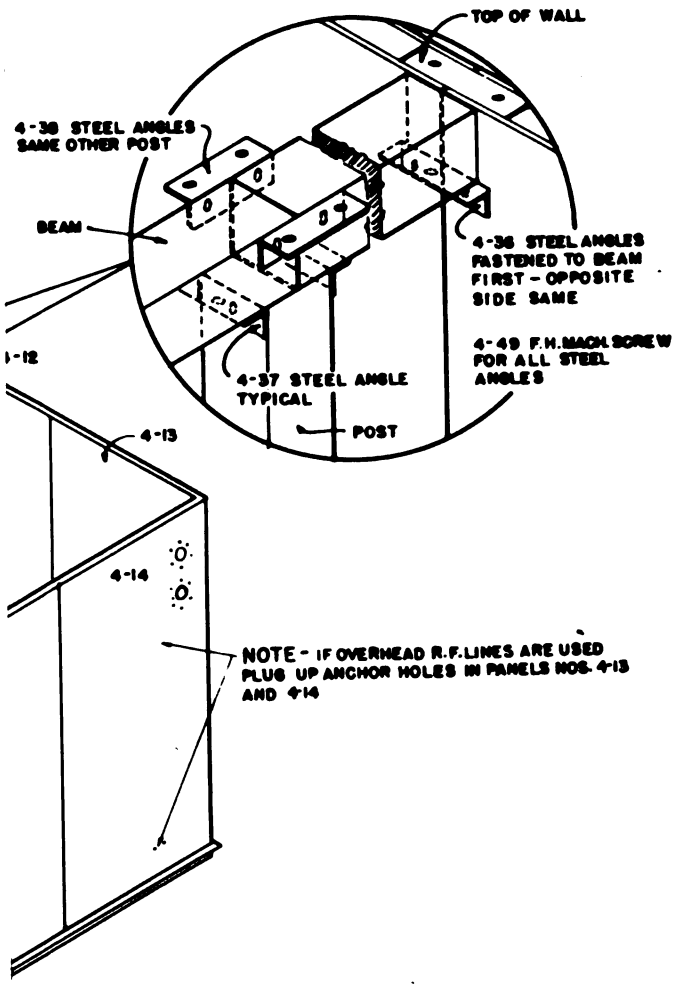


Figure 19. Tower assembly, sections two through seven.

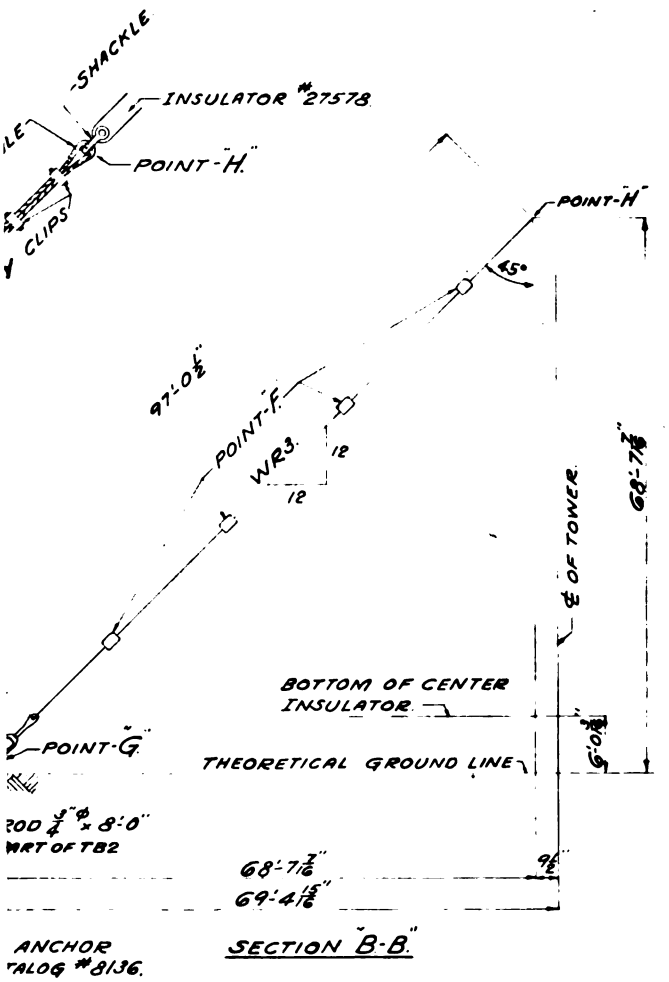


NOTE:
PART NUMBERS ARE PLACED ON UPPER LEFT HAND CORNER INTERIOR FACE FOR WALL PANELS. PARTITION PANELS ARE MARKED UPPER LEFT HAND CORNER GENERATOR ROOM SIDE.

FOR ERECTION SEQUENCE SEE FIGURE 11

TL-14210

Figure 10.—Isometric of building walls.



NGTHS OF GUYS ARE FIGURED FOR LEVEL GROUND AS SHOWN
THIS DWG. ANY DIFFERENCE IN GROUND ELEVATION IS
BE TAKEN CARE OF BY HOLDING THE GUYS AT 45° SLOPE
ID VARYING DIMENSION ACCORDINGLY. SUFFICIENT GUY
NGTH HAS BEEN PROVIDED TO TAKE CARE OF GROUND
EVATION VARYING TO 10'-7½ MAX. BELOW THEORETICAL
ROUND LINE.

TL-14221

Figure 21. Tower assembly, guy, and foundation.

the stiffener angle to prevent the tower legs from buckling. Note on figure 22 how the chains are wrapped around the legs with the hook on the outside of the tower to prevent the lattice diagonals from being crushed.

Note.—When a chain is wrapped around an angle which is likely to crush, bend, or deform, it is customary to use wood blocking under the wraps of chain. Two pieces of oak block, 1 foot long, cut to fit inside the angle legs and painted red, are included in the box containing the chain sling. These have no part numbers.

39. STEP-BY-STEP INSTRUCTIONS FOR TOWER ERECTION (Fig. 22)

a. Step 1.

(1) Assemble the gin pole complete, with the base about 3½ to 4 feet from the tower base and with the top of the gin pole away from the tower base in line with the tower guy. Fasten all three gin pole guys into the turnbuckles of tower guys with shackle and ring as shown. Raise the pole by hand as high as possible. Then use the tackle to raise the pole into a vertical position. Holes are furnished near the bottom of the pole for insertion of a bar and the base of the pole can be easily moved into exact position for the operations. Always set the pole so that the back guy is in line with the tower base and permanent anchor rod, and with the winch away from the tower base.

(2) The pole base should be about 3½ feet from the tower base. If the soil is soft, secure the oak block to a plank a few feet in length with lag screws furnished with the kit.

(3) The pole can also be erected by raising it to an inclined position; attaching the load chain sling to the tower base, and by using the winch, raising it up to a vertical position. Men can hold the guys to restrain the pole from swinging sideways (fig. 23).

b. Step 2.

(1) Assemble together the three top tower sections on the ground between the gin pole and the tower base.

(2) Hook onto the tower about midsection. Place temporary rope tower guys at about the top angle of the tower. Raise the tower about 15 feet. The heavy insulator end will hang near the ground and men can move the insulator end in between the tower base and the gin pole while others pull the tower into a vertical position. Land the splice plates on planks on the earth under the tower. (See procedures 1 and 2, fig. 22.) Secure the temporary guys. Release the winch and load line.

c. Step 3.

(1) Hook the chain sling around the channel supporting the insulator at the bottom of the third section. Raise the tower, maintaining it in a vertical position by paying off the line at the temporary guys, until the tower is about 11 feet above the ground. Fasten the guys. Fasten the permanent guys to the insulator as soon as the first 30 feet are raised. As previously described kick blocks should be used to regulate tower control.

(2) Carry in the fourth section and up-end it into a vertical position below the tower. Hook the upper block of the 4 inch block falls to the bottom of a diagonal of the third section and hook the lower block to the top of a lower diagonal in the fourth section and raise the fourth section into the splice angles which were previously loosely bolted onto the bottom of the third section. Secure with bolts (fig. 24). A structural wrench can be used to help pin and line up holes for bolting. Turn the fourth section before lifting so that the ladder steps are on one of the two sides adjacent to the side at which the gin pole is placed.

(3) Place all other sections so that ladder steps are continuous on the same side. After securing the bolts of the splice angles, including the lower diagonal member, release the pawl and lower the load by the crank of the winch until the tower sets on the planks on the ground. Secure the temporary guys. Release the winch and the load line. Unfasten the chain sling and pull down the load hook for next raise. Drive out the drift pins and bring down the 2" x 2" x ¼" angle for the next raise.

(4) The permanent guys are left lying on the ground laid out toward the anchor so they will not foul the erection work (fig. 22).

d. Step 4. Continue the erection of fifth section as the fourth section was erected.

e. Step 5. Erect the sixth section in same manner. The tower and erection method is shown on figure 22, procedure 4. Before releasing the temporary guys, the permanent guys must be rigged and installed as shown. For additional safety, the long end of the permanent guy is threaded through the eye of the anchor rod to give additional holding power, but care must be taken to see that the guy cable passes freely through the eye and is paid out as additional sections of tower are erected.

f. Step 6. The seventh, eighth, and ninth sections should be erected in the same manner.

g. Step 7. Hoist the completed tower and by means of the kick anchors swing the base of the tower over and above the base pin. Lower onto the base pin. The gin pole should be leaned slightly toward the base before making the final lift.

h. Step 8. When tower is erected on the base, gin pole should be taken down and removed from the site. It may be lowered to the ground in the reverse of the method of erection:

(1) Hook the load hook to the tower base.
(2) Slack off on the side guy lines until the pole leans away from the tower.
(3) Now slack off gradually on the side guys and pay out load line from the winch gradually by using the brake until the pole is low enough so that men can hold it and lower it to the ground.

i. Step 9. The tower is plumbed as closely as possible by adjusting the rope falls on the permanent guys. Fasten the permanent guys, using the clamps furnished with the towers. In order to develop maximum holding power, the safety clips must be installed and tightened properly. Space the clips the correct distance apart, as shown on figure 21, but do not cut off the free end of the cable. The surplus guy cable is coiled up and fastened to the guy above the clips for it may be required at the next site of erection if the ground elevation at the anchor is lower than the ground elevation at the tower. Before tightening the clips, grease the threads and the under side of the nuts. Tighten bolt nuts of the clip equally. Pull the guy cables as tight as possible by hand and fit them evenly on the thimbles. The clamps should be secure before loosening the rope falls. The safest way is to leave the rope falls fastened loosely until all guys are fastened and tensioned properly. The tensioning device (fig. 26) is placed on only one of the guys of each tower.

j. Step 10. It is assumed, that the turnbuckles, when first connected to anchor rods, were in an open or extended position (fig. 21). After the tower is erected, close the turnbuckle and tighten the guy, with a bar or wrench (fig. 26). When the turnbuckle and other connections are made to the ground anchor rods, use caution not to turn the bar to prevent its disengagement with the nut at the buried anchor. Tighten all three guys evenly to maintain and secure a final plumb position of the tower, and to secure an approximate tension of 3,000 pounds in the guys. This tension is obtained when angles Y rest on pipe X (fig. 21). The plumbness of the tower should preferably be checked with a transit, but if a transit is not available, line up the corner posts of the tower with a plumb bob and line held in the hand. The completed tower is shown in figure 26.

k. Step 11. The tuning house platform and counterpoise ring are now fastened to the tower base. The arcing device or spark gap is install on the tower base as shown in figure 27 with 1 inch gap.

l. Step 12. With all guys secure, rope falls a taken down and "monkey tails" removed. The g pole, rope falls, blocks, winch, and tools are r placed with proper maintenance care so they w be in good condition for the next erection job for dismantling of the towers when required.

CAUTION.—Inspect the guys daily for a short time after the towers have been erected. The tension in the guys will tend to slacken off due to elongation of the loops around insulators and compression of the strands. Tighten the turnbuckles as required.

40. TOWER COUNTERPOISE

a. Each tower counterpoise (fig. 2) consist of 36 equally spaced radial wires supported ap proximately 6 feet above the ground surfac These wires are fastened by means of bolts to steel ring around the tower pedestal. Each wire i drawn taut through a clamp on top of a stanchio set in the earth and is fastened to a ground ro driven almost flush with the ground surface. Thi ground rod serves the double purpose of keepin the wire tight and grounding it.

b. The counterpoise equipment is designed s that the counterpoise would, on a level plain, b erected at an elevation of 6 feet above the plane as shown in figure 2. Such plane need not be a right angles to the tower axis. The stanchion 8-85 are 8 feet long but to provide for irregularit of the ground, ten 10 foot stanchions 8-86-A ar supplied. These latter may be used with accom panying U bolts 8-S-86-B and 8-S-86-C to enabl some of the stanchions to be extended, as show in figure 2. Should a larger number of extension be needed, these may also be cut in half, thus af fording additional extension pieces.

c. The stability of the courses will be affected by variations in the characteristics of the counterpoises. It is therefore of the utmost importance that after the counterpoise has once been set up and the towers tuned, the wires of the counterpoise be kept taut and the stanchions remain upright and well tamped in place. The stanchions should be cross-braced at four points 90° apart, as shown, with the extra wire and sets of clamps 8-88-B supplied.

d. Underbrush, weeds, etc., should be kept cut both under the counterpoise and for a considerable additional radius beyond the counterpoise.

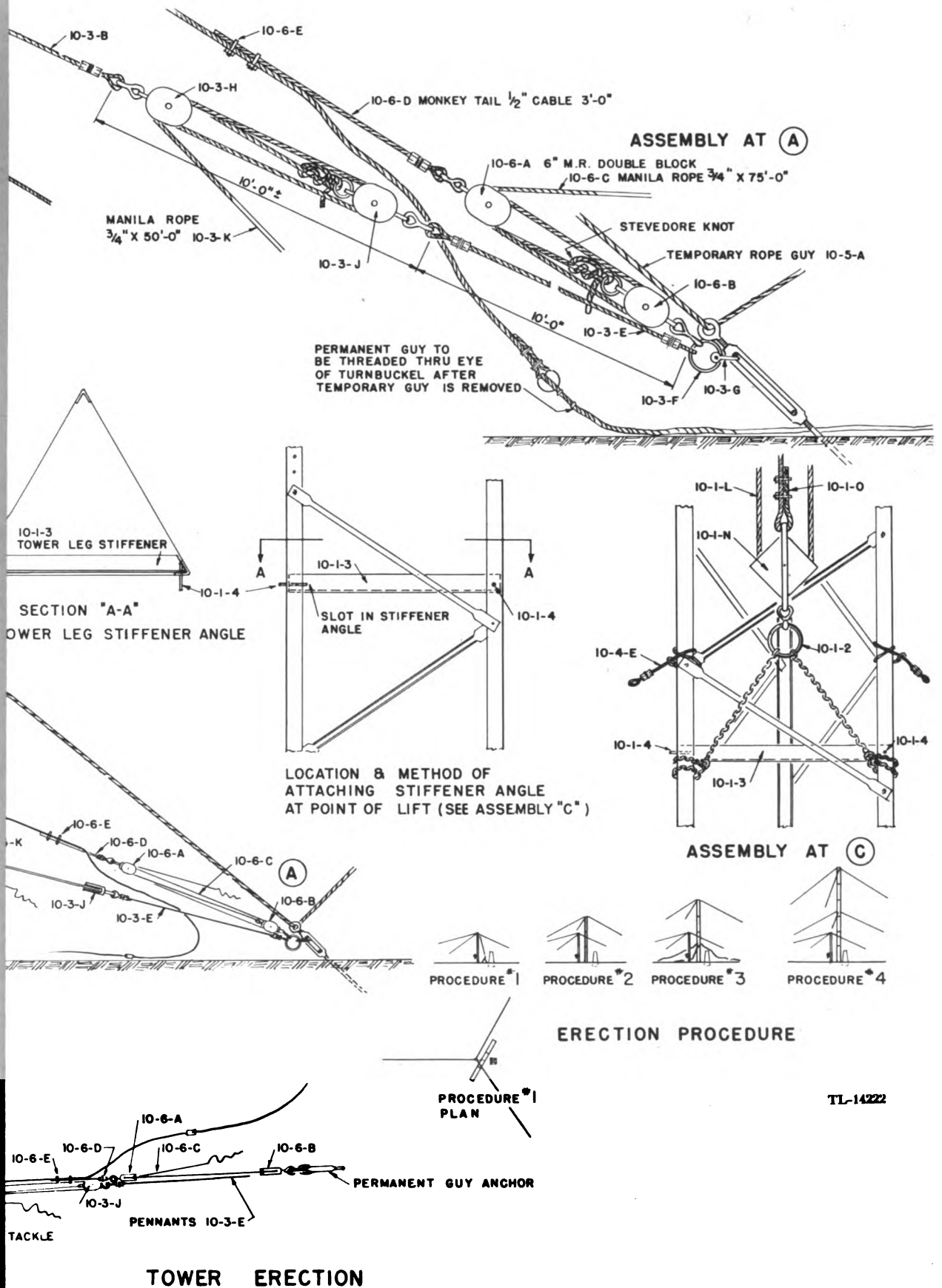


Figure 22. Tower erection details.

e. The counterpoise is laid out by two men in the following manner. Take one of the coiled radial wires 8-83-A of which there are a number of spares, and fasten it around the tower base insulator so that the wire can be rotated completely about the tower. At a point 50 feet from the center of the insulator form a loop about 1 inch in diameter. Then cut the wire at a point 8 feet 8½ inches beyond the loop. The 50 foot leg of the wire is now the measure of the radius of the circle on the circumference of which the stanchion posts are to be set, and the 8 foot 8½ inch leg the measure of the interval between them, that is, of a 10° arc. Put a stanchion post through the loop in the measuring wire and draw the wire taut. One man will sight a line between adjacent towers (not diagonal towers). The first stanchion post is pushed into the ground on this line. Take the loop off the first stanchion post and put another through it. Now, with the long leg of the wire drawn tight from the tower base, measure the 10° arc with the short leg and set the second post temporarily into the ground. Repeat this until ten stanchion posts are temporarily set. The tenth post should fall upon the line of squares between the towers, or upon one of the extensions of those lines. Correct the spacing of the stanchion posts each 90° by sighting between the towers. If the tenth post does not stand upon the line, put it where it should go and make the spaces between the previous nine uniform. Continue until all 36 have been placed in the position indicated on the layout figures 2 and 27.

f. Drive the stanchion posts with great care, for, though fitted with points, they are too light to withstand heavy driving. Therefore, prepare holes for them, using a crowbar, rock point, or some other stout instrument which can be driven without injury. The bull points used in erection of the tower are satisfactory for this purpose. Make a hole about 20 inches deep and set the stanchion, with its cap 8-87-A loosely upon it, in the hole. Make certain that the stanchion is vertical and tap it into the ground until it is solid, but be sure that the stanchion is not upset or bent in the process. Tamp the earth firmly about it. After all the stanchions are in place, tighten the setscrews 8-87-B enough to hold the caps firmly in place, taking care, however, not to crush the wall of the tubing. The clamp fittings 8-87-C, D, and F are next screwed loosely onto the cap fitting.

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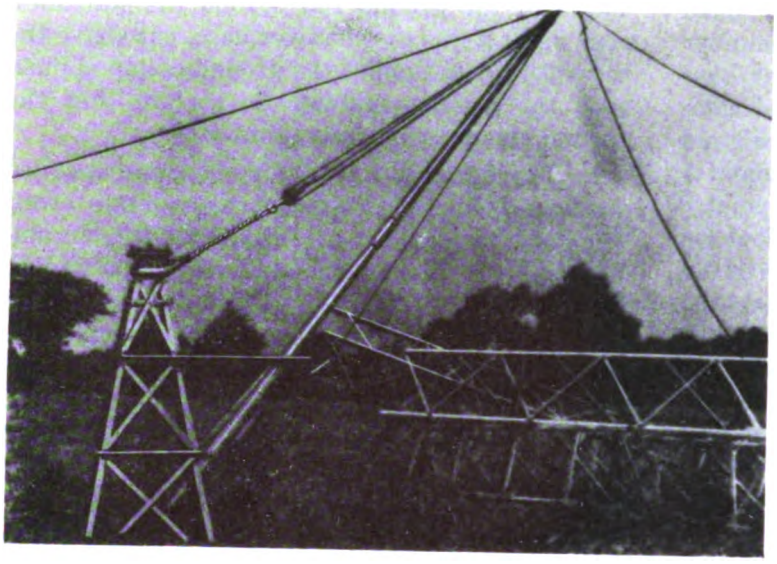
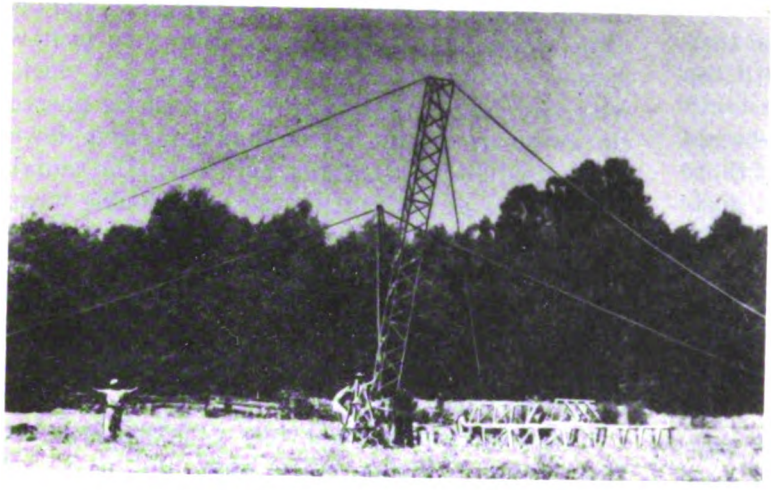
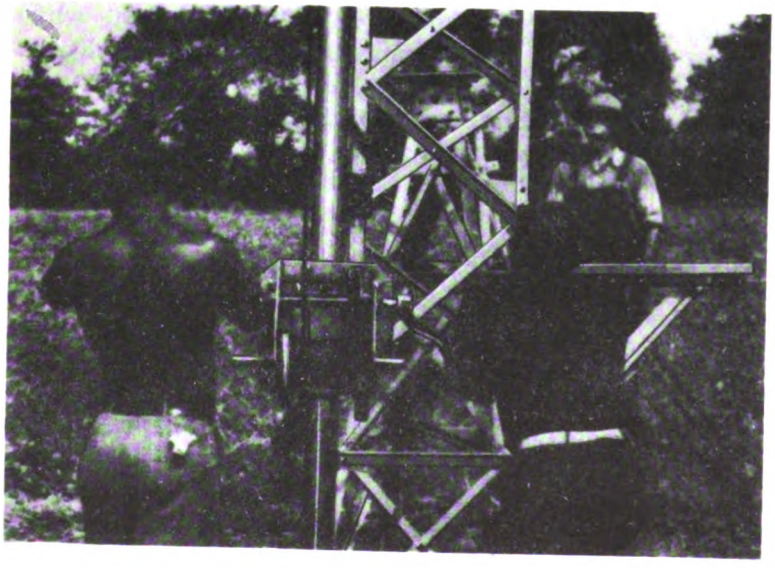


Raising the gin pole with winch.



Tower erection. The first three sections of the tower are attached on the ground and raised in a single unit.



The winch.

TL-14223

Figure 23. Tower erection, first phase.

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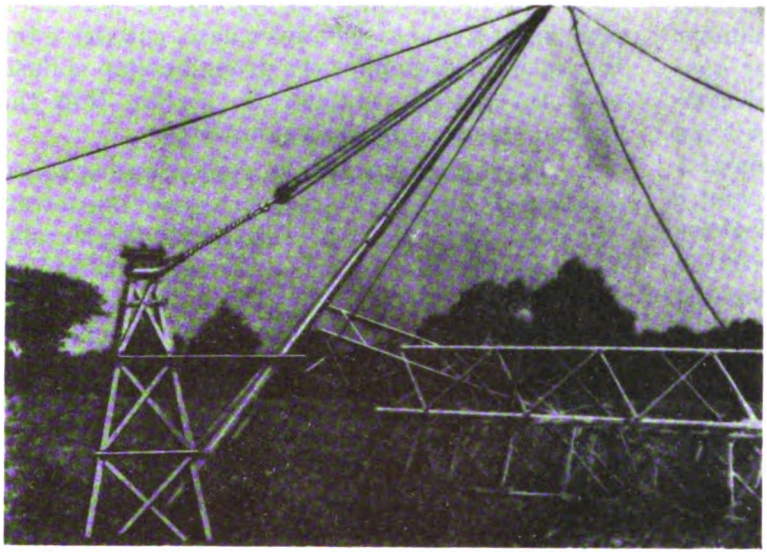
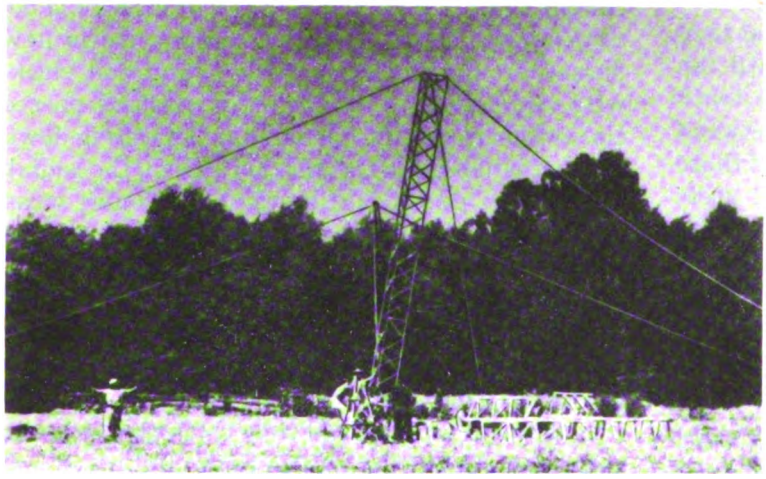
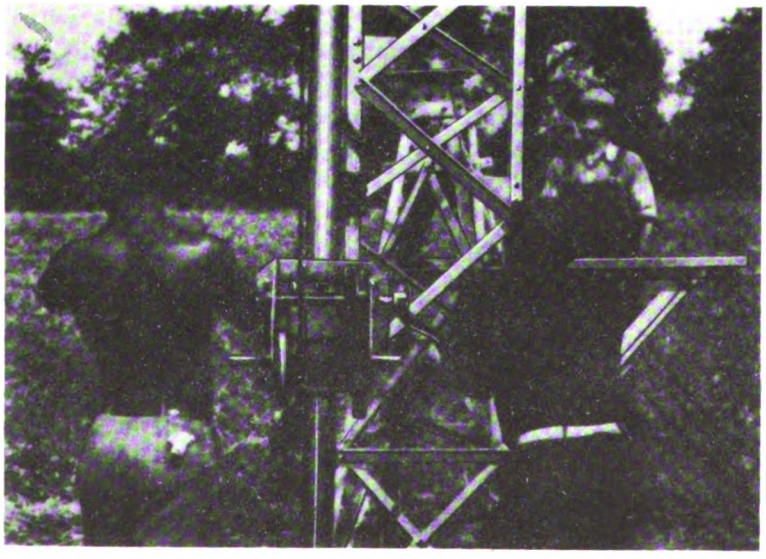


Raising the gin pole with winch.



Tower erection. The first three sections of the tower are attached on the ground and raised in a single unit.



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TL-14223

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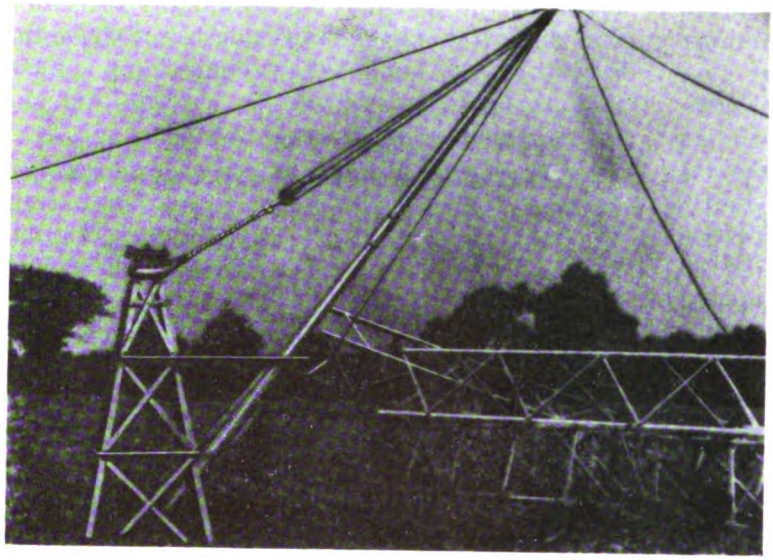
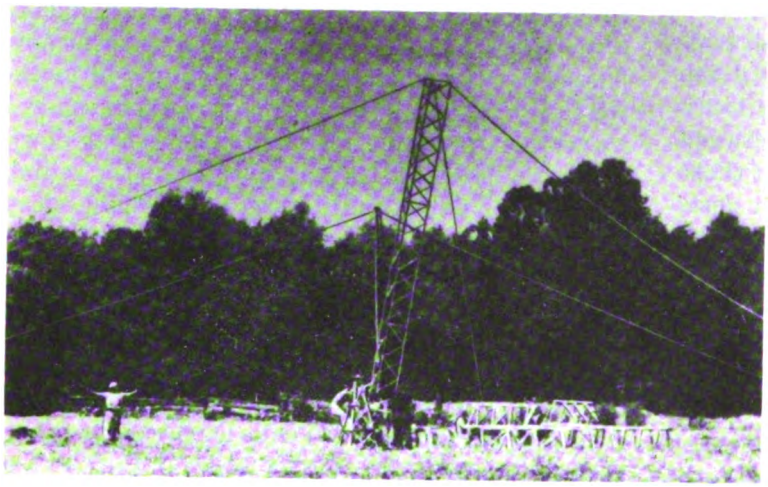
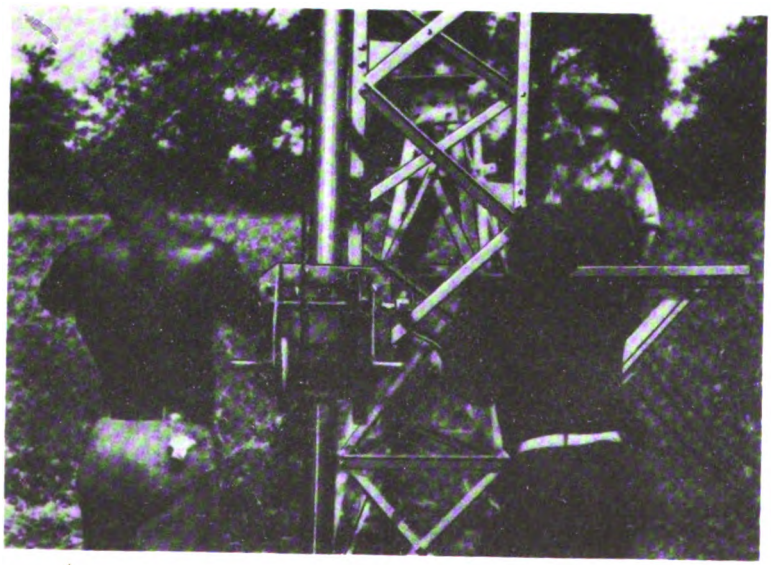


Raising the gin pole with winch.



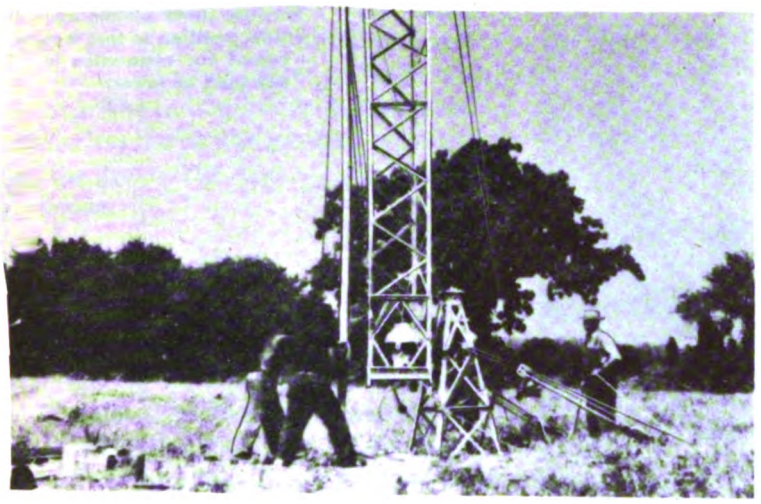
Tower erection. The first three sections of the tower are attached on the ground and raised in a single unit.



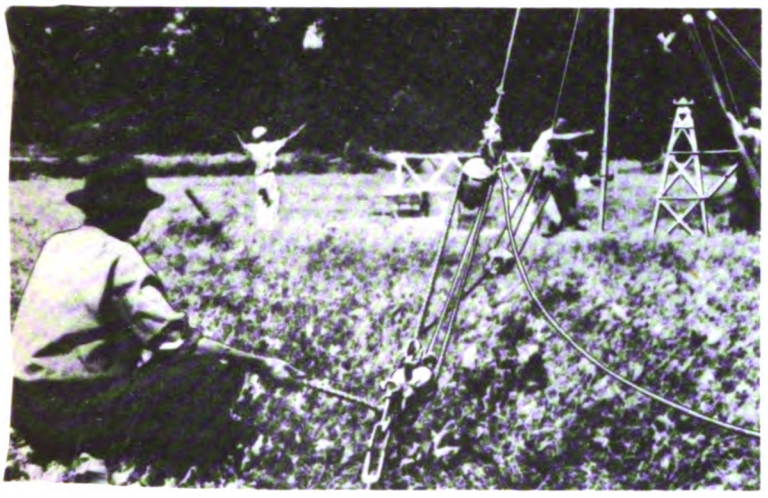
The winch.

TL-14223

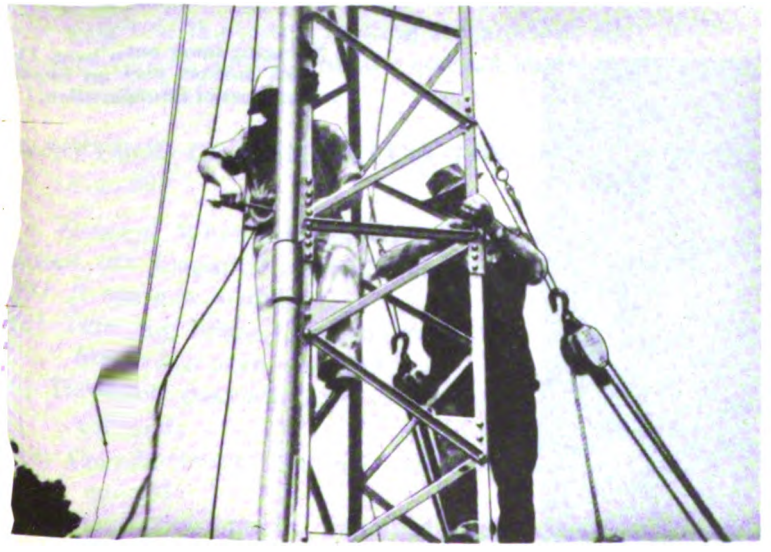
Figure 23. Tower erection, first phase.



Raising tower to permit attachment of another section.



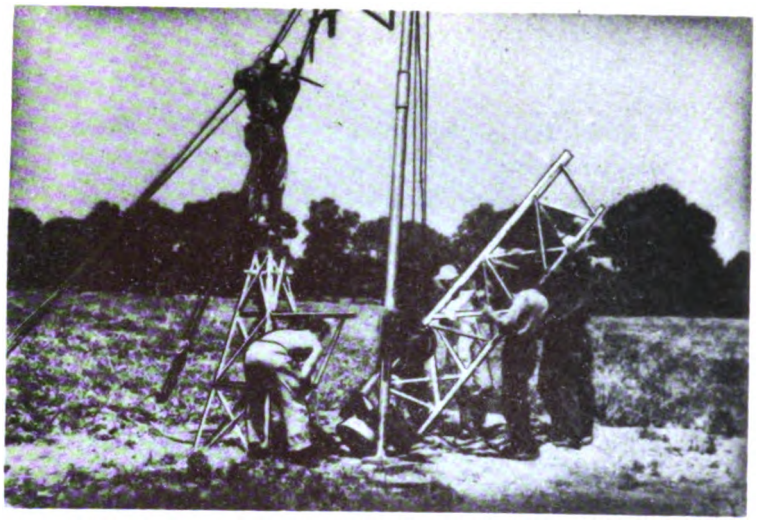
Guys and kick anchors. The man in the left center is signaling to man in foreground and other two men at guys on proper "letting out" of lines to keep guys taut and tower plumb. Note the man at kick anchors near base of tower whose job is to keep the tower from kicking out at bottom.



Attaching a section of tower after it has been raised and engaged into splice angles.

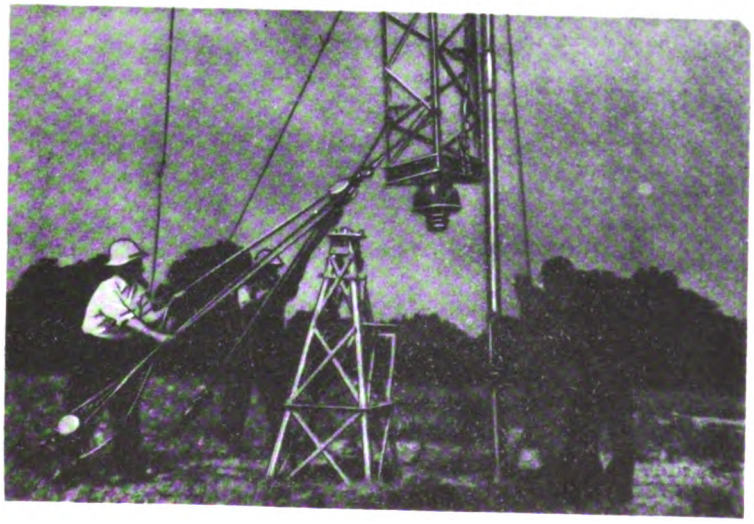
TL-14224

Figure 24. Tower erection, attaching section.



Raising tower section into vertical position so that it can be raised for connection to upper part of tower.

Raising complete assembly of tower after last section has been placed.



Swinging tower onto base. The kick anchors play an important part in this operation.

TL-14225

Figure 25. Tower erection, seating tower on pedestal.

base. The longer wire is used to ground the counterpoise ring, the shorter the antenna tuning house. The ring is grounded in such a manner that the wire passes under bolts in both halves of the ring. The tuning house is grounded by placing a solderless lug on the ground wire and fastening it to the grounding stud on the bottom of the tuning house.

42. COAXIAL CABLE

Before connecting the coaxial cable, on one end to the wall panel insulators at the transmitter house and at the other end to the tuning house at the towers, note the terminations on the cable. The larger terminal wire, which comes off along the axis of the cable, is a continuation of the center conductor, while the smaller one which appears to come off the side of the cable, is part of the grounded sheath. It is essential that these smaller terminals be connected correctly at both ends. Instructions for connecting the cable at the building end are given under the description covering the r-f bus system. At the tuning house, the right-hand terminal marked G takes the sheath connection. Both connections are shown on figure 27. For further details regarding the installation of the coaxial cable, see Section VIII, Antenna Conversion Kit for Radio Transmitter BC-446-(A to H).

43. R-F CONNECTIONS

The copper tubing which is to form the r-f feeder from the tuning house to the radiator is furnished cut to length, flattened, and punched at each end. Form it into the shape indicated on figure 27, and fasten it at the insulator on the bottom of the tuning house and the hole in the lower angle of the tower, making certain that all connections are tight. Clean the contact surfaces of the feeder before placing.

44. METHOD OF DISMANTLING TOWERS (Fig. 29)

a. General. When it is necessary to change the location, or dismantle the radio range station

(1) *It is assumed that:*

(*a*) Tuning house has been removed and r-f line has been removed;

(*b*) Tower coaxials have been dug up and coiled;

(*c*) Counterpoise radials unfastened and coiled;

(*d*) Stanchion posts removed (pull vertically); caps and Burndy fittings boxed safely;

(*e*) Ground rods pulled (use tackle if necessary and pull in line of driving);

(*f*) Counterpoise ring and tuning house platform removed (also spark-gap).

(2) *Concisely, the method of taking down the towers is the reverse of the method of erection with the important exceptions that:*

(*a*) The tower is held in a vertical position during lowering by means of 3 rope guys fastened to the extreme top of the tower and controlled in such a position by these 3 rope guys being connected to a single set of four-part rope falls. In this way the slack of guys is equally taken up as the tower is lowered.

(*b*) The permanent steel cable tower guys and the rope falls used with them in the erection are not used in the dismantling of the towers. After the rope guys described in subparagraph (*a*), are secure, they may be unfastened from the anchors and kept out of the way.

(3) *Figure 29 shows in general the rigging to be used in taking down the towers.*

b. Procedure.

(1) *Erect the gin pole* (refer to par. 39 and fig. 22).

(2) *Install the kick anchors* (follow erection instructions par. 39).

(3) *Install the temporary tower guys.*

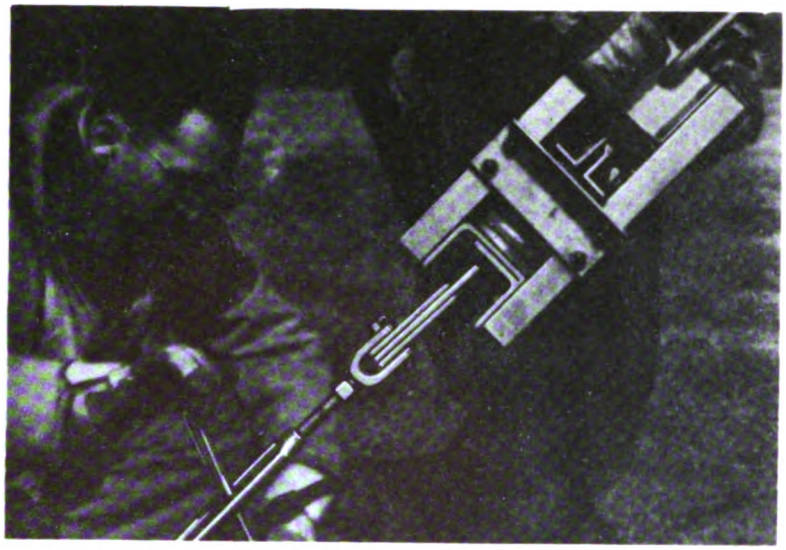
(*a*) Use three ¾-inch ropes, 5A, 225 feet long.

(*b*) Fasten one end of each rope to the top of the tower as shown on the drawing. The bridle hitch and bowline knot should be exactly in position as shown.

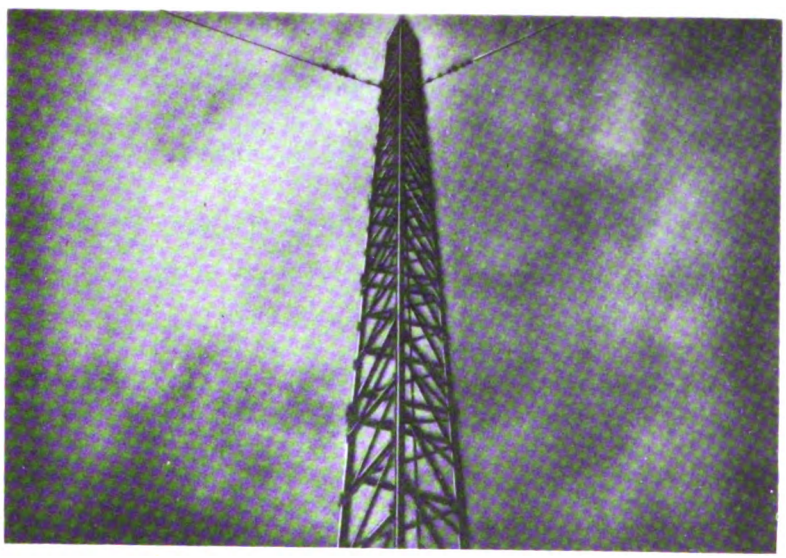
(*c*) Fasten the single blocks 6B with the shackles 36 hooked to the tower anchor turnbuckles and run ¾ inch ropes toward the tower.

(*d*) Fasten the three snatch blocks 8-A, two from TE87A kit and one from this kit, to the corner angle upright of the tower base as shown on figure 29 ① and ②, using one of the 75 foot pieces of ¾ inch rope. To use one rope to tie all three snatch blocks to the tower leg, it will be necessary to use a loop in the rope for the center block (fig. 29 ①). The blocks should be fastened about 5 feet out from the tower base as shown.

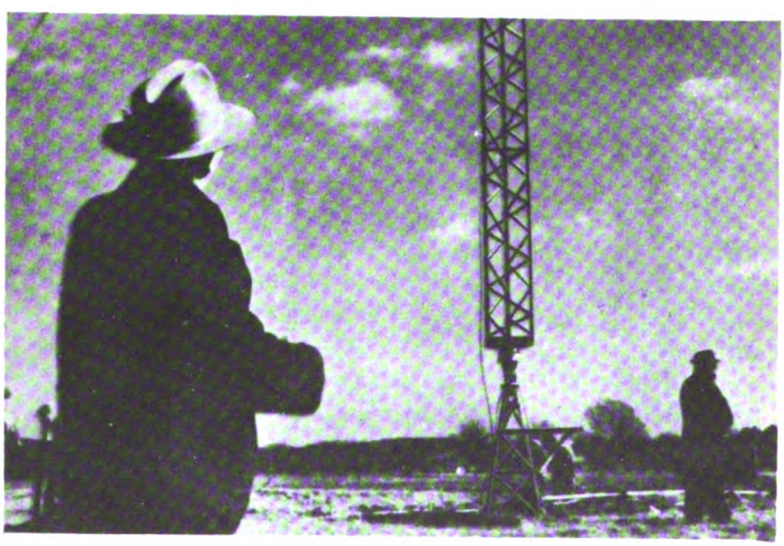
(*e*) Using the ½ inch ropes, 250 feet long (TE87A kit) and two double blocks (one 6-A without becket and one 6 inch double block with becket, from Spares — Part 10-S-3) rig up a set of falls with a four-part line as shown on the drawing.



Tension device on one of th permanent guys.



The completed tower.



The completed tower at base. Note the tuning house sup port on base.

TL-14226

Figure 26. Tower erection, completed assembly.

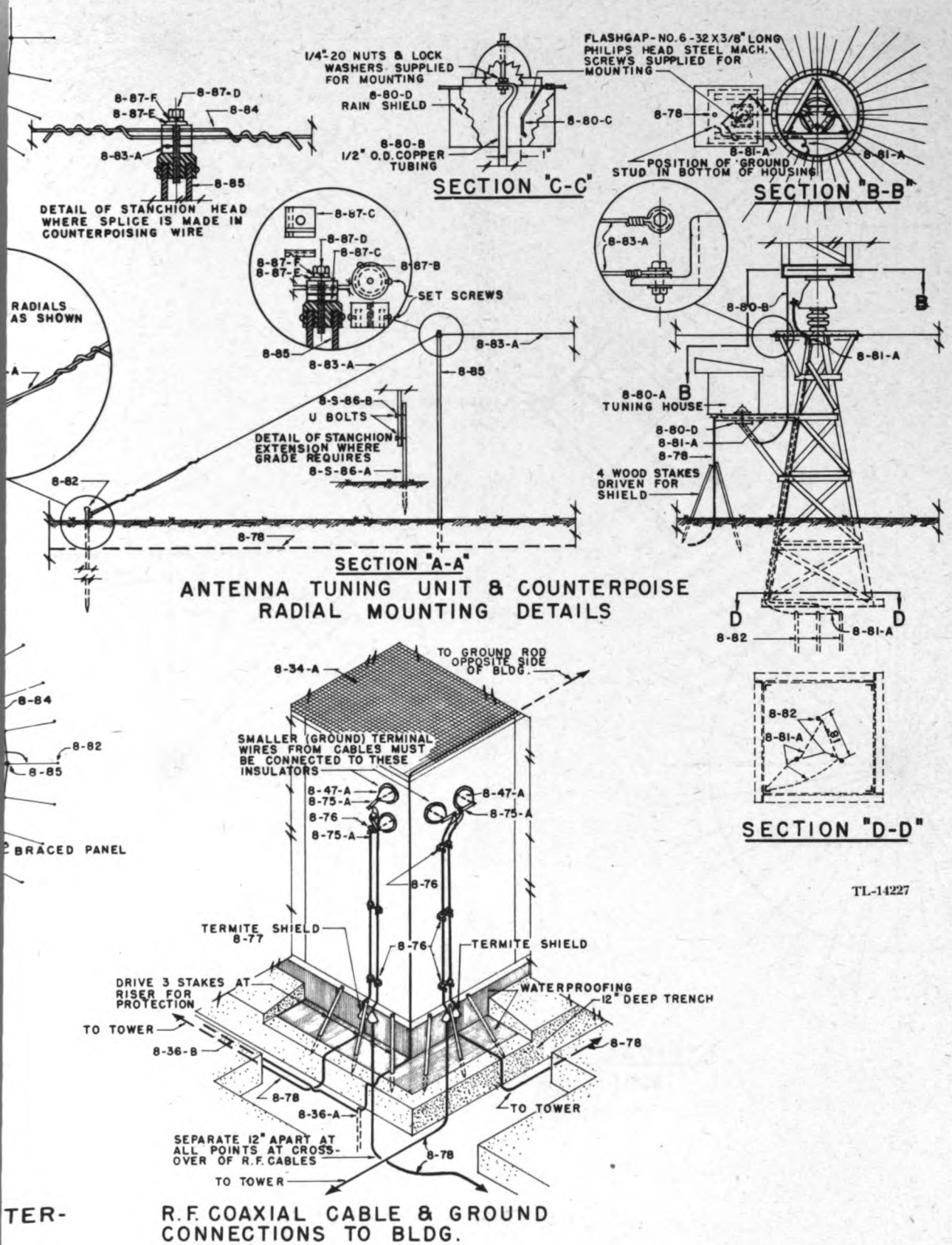


Figure 27. Antenna assembly, electrical cables.

(*f*) Hook block 6A of this set of falls to one of the gin pole guy pennant rings at the tower anchor.

(*g*) Now complete the temporary tower guy assembly by running the loose end of the ¾ inch rope 5-A mentioned in subparagraph (3)(*a*), through the snatch blocks 8-A, mentioned in subparagraph (3)(*d*) and tie all three ropes securely to the hook of the 6 inch double block, with becket, which is a part of the four-part set of falls.

(*h*) Pull the ½ inch rope falls tight and tie off. Check all blocks to see that they hang right and make sure all fastenings are secure.

Note.—Now the assembly is complete and this set of falls will be used as the tower is lowered to take up the slack on all temporary guys equally and to keep the tower plumb. It is essential that the tower be kept plumb.

(4) *Slack off Tower Guy Cables.* It is assumed that the steel guy cables were all tight and tensioned. To dismantle the tower, the guy cables are loosened by opening the turnbuckle, before the tower is lifted off the base pin. Be sure that the temporary rope guys are securely fastened before loosening the steel cable guys.

(5) *Prepare Gin Pole Setting for Lifting.*

(*a*) Lean the top of gin pole about 6 inches toward the tower, and fasten all gin pole guys tight.

(*b*) To make sure the gin pole guy lines are tight, fasten the lift chain onto the tower and hook the load line to the chain lifting ring. Then raise the tower only ¼ inch above base plate. Hold until the gin pole stops settling and the gin pole ropes are stretched out and tight. Tension the rope guys nearly equally except that the back guy away from the lean of the pole should be tensioned more than the other to allow for the greater strain on it.

CAUTION.—Never raise the tower more than ¼ inch until the gin pole guys are tight and the kick anchors are fastened securely and tested. If the gin pole settles, tighten the gin pole guys again.

(6) *Final Preparations.*

(*a*) Slack off the steel tower guy cables until the top of the tower is approximately over the top of the leaned gin pole so that when the tower is lifted off the base and swung towards the gin pole, the tower will be plumb.

CAUTION.—When the steel guy cables are loosened and the tower leaned toward the gin pole, adjust the three temporary rope guys where they are fastened to the hook of the double block with becket in the four-part set of falls, in order to maintain equal tension on these three temporary rope guys while the tower is being lowered.

(*b*) Make sure the temporary guys and rope blocks controlling all three rope guys are secure. Then disconnect the steel tower guy cables. The steel tower guy cables are no longer required.

Note.—If desirable as a safeguard until a section or two of the tower is down, the steel guy cables can be drawn back through the eye of the anchor by a man holding each steel cable guy during the process of lowering. Care should be taken, however, that only slack is taken up, as the real control to maintain the tower in a vertical position is in the four-part set of falls.

(7) *The Tower Now Is Ready to Be Taken Down.*

(*a*) With men holding tight on kick anchors, raise the tower until the insulator clears the base pin. Slack the kick anchor falls carefully until the tower stands plumb.

(*b*) Lower to the ground slowly and take up all slack in temporary rope guys by pulling on the load line of the four part set of falls. This should be done by two or three men keeping the ropes tight at all times during lowering. Set the tower on solid ground or on a wood block.

(*c*) Release the lifting hook and chain. Rehook the lifting chain and ring to the tower above the splice angles connecting the bottom section to the second section as shown in the erection figure 22. Lift the tower about 1 inch off ground. Take out the bolts in the top half of the splice angles and then raise the tower about 6 inches or sufficiently to permit the bottom section to be taken out. Remove the section by hand, or by the set of 4 inch blocks and ½ inch rope used in hoisting sections during erection. Lower the tower to the ground carefully by means of the winch, at the same time taking up slack in the temporary rope guys. Land the tower legs on boards.

(*d*) Now unhook the chain and lifting bar. Pull them up and rehook them to the section preceding. Repeat operation in subparagraph (*c*) foregoing.

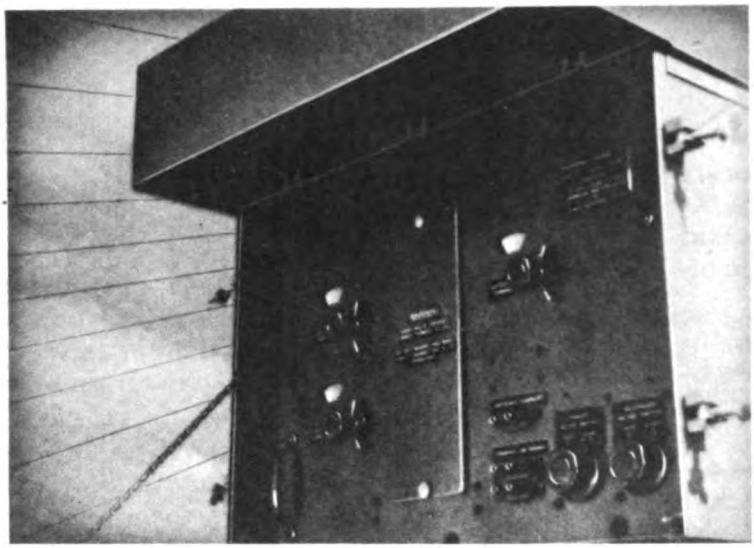
(*e*) Continue lowering as described until the steel permanent guys at the top insulator connection are down to the level of the top of the gin pole. At this point disconnect all steel guy cables from the tower

and lower them to the ground carefully so as not to break the johnny balls (insulators on steel cable guys).

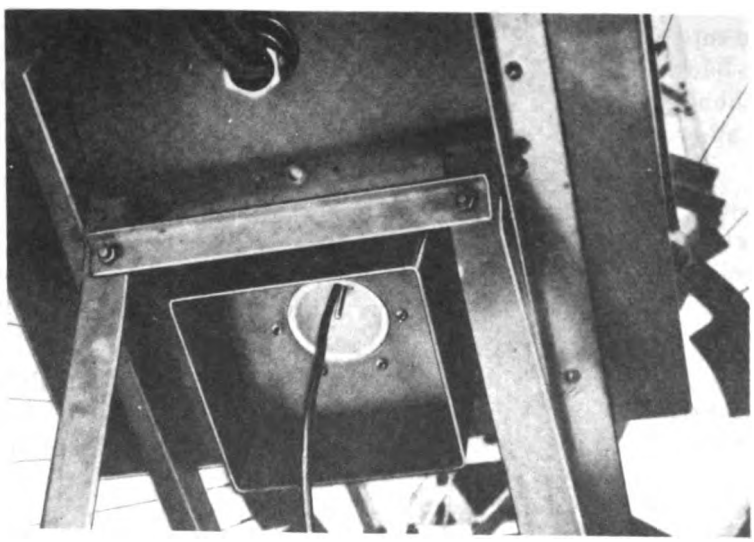
(*f*) The top three sections can be let down in one piece (as they were erected) by hooking the load line on one leg only about 13 feet above the insulator and carrying the base out at the same time the tower is being lowered. Keep the load line as vertical as possible while dragging out the base. Dismantle into the three se

(*g*) Lower the gin pole, Dig up the anch the tower base. Sort the tower b size and length. If the tower i erected at a site which can be r by truck, leave the tower in secti

CAUTION.—Handle insulator sec carefully so as not to chip the porc Proper maintenance should be given to r locks, winch, etc.



The tuning house (w cover removed). N counterpoise radials a



Bottom of tuning hous the r-f line, mounting and the counterpois above to which the ra the counterpoise are at

TL-14228

Figure 28. Tuning house, front and bottom views.

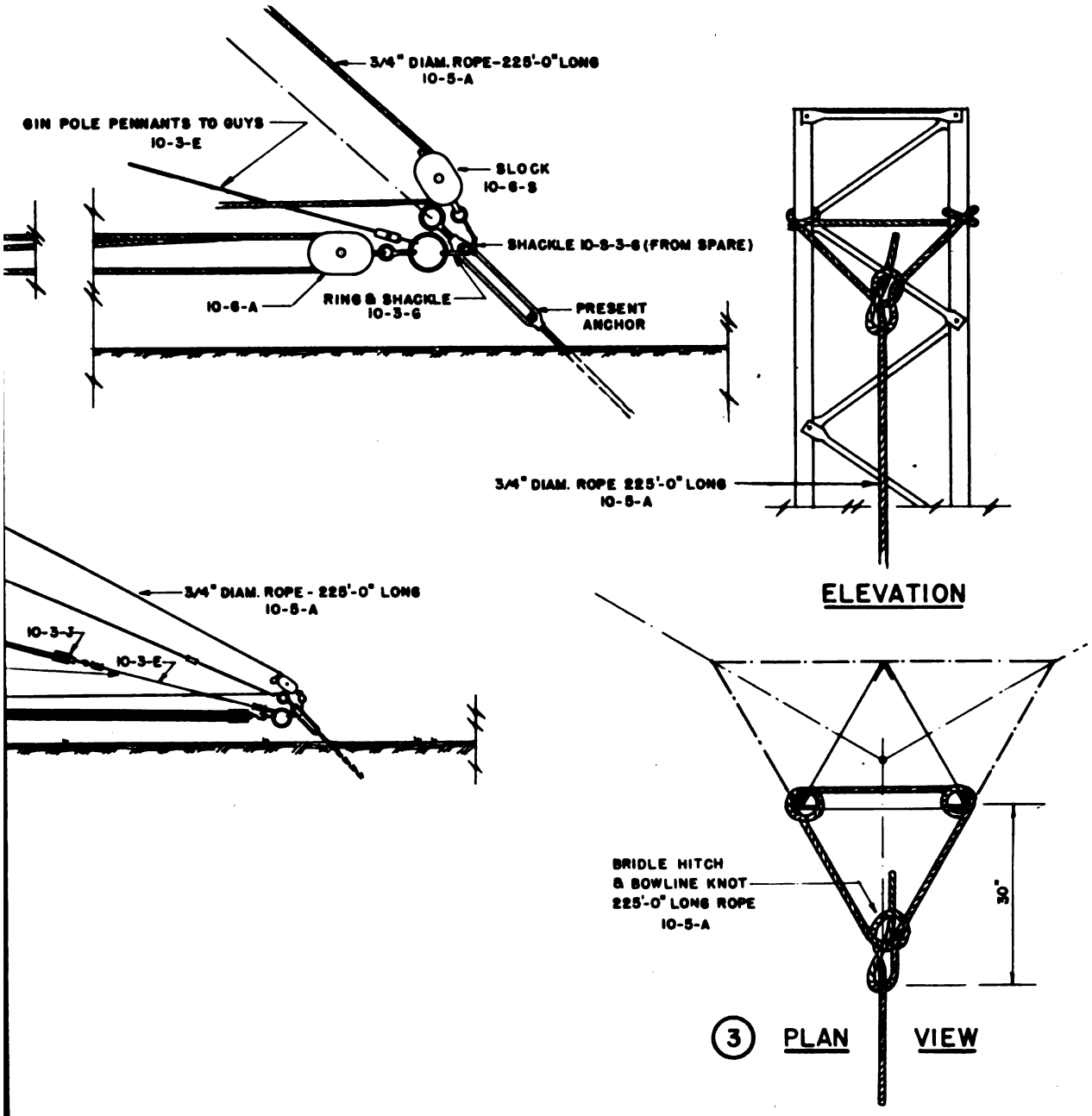


Figure 29. Dismantling of towers.

Section IV

PLACING MECHANICAL EQUIPMENT, WIRING, VENTILATING FAN, AND MOTOR

45. MECHANICAL EQUIPMENT

This includes all fuel line piping, scavenger lines, engine generator sets, exhaust lines, engine silencers, filters, oil tank assembly, etc. Placement of this equipment is indicated in figure 30.

46. PLACING OF ENGINES

Attach isolator bases provided in the kit to the steel channel base of the engines after they are uncrated and placed in proper positions. Removable panels, for the admission of the engines, are provided in the end of the generator room. Planking, blocking, rollers, etc., are provided in the kit for handling of engines from the exterior to their interior location. Plywood panels supplied may be laid on the floor to provide protection between the rollers and the finished floor. The floor of the generator room is marked with an indentation at each corner of the engine base. Place the engine so that these coincide with the corners of the various isolators.

47. INSTALLATION OF FUEL PIPING

Install and assemble the fuel piping in accordance with notations and part numbers in figure 30. The engines must be placed in the location designated and the oil barrel racks correctly placed both horizontally and vertically, so that the piping will properly fit the installation. Anchors in the walls are provided for the pipe supports. The copper scavenger lines supplied with the engine are to be installed as shown, with the outlet running into a gravel bed outside the building. Fuel lines on the interior of the building should be placed over the yellow lines.

48. INSTALLATION OF EXHAUST PIPING

Follow carefully the procedure outlined in figure 30 for the installation of the exhaust piping. Place the silencer first, suspending by bolts extended through the ceiling construction. The bolts are provided separately in the kit. Adjust the bolts to permit the silencer to set plumb and at the proper elevation. Assemble the exhaust connection between the engine and the silencer, and between the silencer and the exterior as shown. The flexible exhaust pieces are provided with the engine.

49. PLACING FILTERS

Place all filters at the air inlet to the generator room, and at the ventilating fan in the transmitter room.

50. CANVAS CONNECTIONS

Place canvas connections between the exterior vent hood and the engine fan outlet.

51. HOUSE WIRING

a. Refer to figures 31 and 32 for details of the house wiring, all of which is exposed. The cables are either of the nonmetallic sheath type or single braid rubber-covered. All of the cables are furnished cut to proper length. Some cables have the outlets or equipment already attached so that cables and equipment need only be fastened in place. The walls and ceiling are marked with lines to indicate the location of the wire runs. The cables are fastened in place by means of one-hole cable straps or by porcelain bushed cable supports anchored by screws 8-12-B and spaced as shown on the drawings.

b. Cable locations are indicated by marks on the walls and ceiling. The cable should cover the colored line when placed. A red line indicates power cables, and a blue line indicates miscellaneous wiring. Bus wiring for transmitters is not marked with colored lines.

c. Buildings for use abroad, or where power is not available, are supplied with two 3-wire, 110/220 v, 60 cycle, 15-kva Diesel-generator sets, one of which serves as a stand-by while the other is in use. They cannot be operated in parallel. Buildings for domestic use are usually furnished with one engine-generator set and one transformer. In the former case, sufficient cable is supplied to make all connections. In the latter case, arrangements should be made locally to obtain the necessary hangers, wire, bushings, insulators, and other equipment for mounting the transformer, and for running the conductors. The local power company or officer in charge of power dis-

tribution should be consulted regarding the proper location of the transformer and the transformer should be checked to see that it corresponds to the voltage of the local primary supply. The transformer secondary should be connected to give the same voltage as that supplied by the generator.

d. Connect each piece of equipment for proper voltage. The first pieces of equipment to be mounted are the double throw service switch 8-8-A and the breaker panel 8-10-A which serves as the distribution center for the building. Do not set up the Diesel-generator control panels until all cables 8-6-A and 8-7-A to the Diesel-generator sets 7-85 and to the double throw switch have been hung and secured by means of the cable supports. Note that there are two sizes of cable supports 8-4-A and 8-5-A and that they must be properly located as noted on the drawings.

e. When these cables have been placed, prepare the generator for the entrance of the power cable by screwing the short 2 inch nipple 8-1-A into the hole provided in the generator junction box. Then screw the fiber bushing 8-1-B tightly on the nipple, and feed the cable through into the junction box, from which the cover has already been removed. The No. 2 conductors are now fitted with the solderless lugs 8-2-B furnished for this purpose. Make these lugs fast to the lugs on the generator leads with the ¼ inch x ¾ inch brass bolts 8-2-C and 8-3-C. Be careful that the leads marked 0, 1, and 2 are matched to the generator leads bearing similar markings. Remove the exciter ventilator band and bring the three small leads marked A2, F1, and "−" (minus) back between stator laminations and generator case. Make the terminals fast to the exciter leads bearing similar markings. Tape all connections with rubber splicing compound and friction tape.

f. After fastening cables at the generators, remove the access panels on the radio-room side of the partition and mount the control panels as shown in the drawing. Terminate all cables at the control panel terminal strips. Be careful that the cable markings are the same as those of the terminals. Replace the radio-room access panels.

g. Place the 1 inch galvanized nipple 8-10-B in the hole provided and draw up the locknuts 8-10-E, having first placed the washer 8-10-C on the generator room side of the wall. Put the bushings 8-10-D on the nipple and feed the end of cable 8-9-A into the breaker panel.

h. Insert the remaining end of cable 8-9-A in the porcelain bushing provided for it at the double throw service switch and make the proper terminations. The wires marked 1 and 2 must be terminated on the outside legs of the switch, which is marked 0 on the grounded center leg. Follow the same procedure in making up the terminations of the feeder cables from the control panels.

i. Hang the branch circuit cables, beginning in each case at the breaker panel and fastening the cable carefully along the straight guide lines provided. Secure the outlet and switch boxes to the walls and ceiling with at least two screws.

j. The branch circuit cable to Radio Transmitters BC-400-(*) runs across the floor in a metal mold, secured to the floor with screws. Continue the circuit to the transmitter bases and extend it up to the transmitter connections. The ground wire for the transmitter runs in the same metal mold.

k. There is no special provision for introducing the power supply cables through the sides of the Radio Transmitters BC-446-(*), and therefore it is necessary to remove the bottom skirt panel from the transmitter on the side from which the cable is brought to the transmitter. Mark the panel at the point at which the cable passes into the transmitter. Using a hacksaw, saw in the panel a slot of sufficient size to permit replacing the panel without injuring the cable.

l. Each major piece of equipment must be furnished with a ground connection. No. 6 bare copper wire in excess of that needed for the Z marker counterpoise is provided for these connections, together with solderless lugs and connectors. Connect a ground wire to the cases of Radio Transmitters BC-400-(*). Run the ground wire back through the cable protector 8-14-D and through the partition wall. The wire is then tied to the control panel ground wire. The control panels may be grounded at the base mounting screw if the paint is carefully scraped away around the hole, so that the solderless lug will make good contact. Ground the generator under the machine screw holding the positive battery lug. In each case the ground wire must be fastened to the common ground lead, which is tied to the frame of the service switch together with the neutrals from the generator and from the distribution panel. This common ground lead is stapled along the partition base and runs out through a hole in the wall. It passes underground until it reaches the buried portion of the marker counterpoise ground system to which it is fastened with a solderless connector (fig. 14).

m. The remaining Deisel-generator and the *two Radio* Transmitters BC-446-(*) are similarly *grounded.* The wires are taken out through holes *drilled for* the purpose and connected to the coun*terpoise g*round system at the closest and most *convenient* place.

52. VENTILATING FAN AND MOTOR

a. Installation. Install ventilating fan and motor as shown in details of figure 31.

Note.—Always remember that although this ventilating set is ruggedly built for hard usage, it is a precision piece of machinery and should be so handled. The set is so constructed that it is easily accessible for maintenance and repair. On all blowers enough clearance space has been provided for the removal of the entire motor without disturbing the fan housing or duct work.

b. Before Starting.

(1) Check the voltage stamped on the nameplate to see that it corresponds with the line voltage.

(2) Check all connections to the motor with the starter wiring diagram.

(3) Check that the fan wheel and the motor armature or rotor turn freely.

(4) See that the setscrew is tight on the fan wheel hub.

c. After Starting.

(1) Check that the fan is rotating in the proper direction as indicated by the arrow on the fan housing or frame.

(2) See that no unusual noises are present before leaving the location of the unit.

(3) If all precautions have been taken, this unit will operate satisfactorily 24 hours a day, with little attention.

(4) If the motor starts unusually slowly, check for low voltage.

d. If the Motor Does Not Start.

(1) Check with a voltmeter to see if there is voltage at the motor terminals.

(2) When using the regulator, turn the arm to the full position.

(3) If the meter does not indicate the proper voltage, check the voltage in the line ahead of the unit.

e. General Instructions.

(1) Keep the motor free from water, dirt, and oil.

(2) Wipe the exterior and clean the interior with compressed air, vacuum cleaner, or hand bellows. Give the motor a thorough cleaning once a year, at which time the windings should be cleaned and painted with a good grade of insulating varnish and the bearings cleaned and re-greased.

(3) Tighten loose motor windings by wedges or other proper means.

(4) Check the air gap between the armature or rotor and the field coil occasionally for uniformity, particularly in sleeve bearing motors.

f. Lubricating Instructions.

(1) The length of operating time and the type of installation determine the frequency of lubricating a motor. The motor is supplied with sufficient grease in the bearings for one year's service eight hours a day under average conditions. Unusually severe service requires more frequent greasing. Extreme temperatures require special greases.

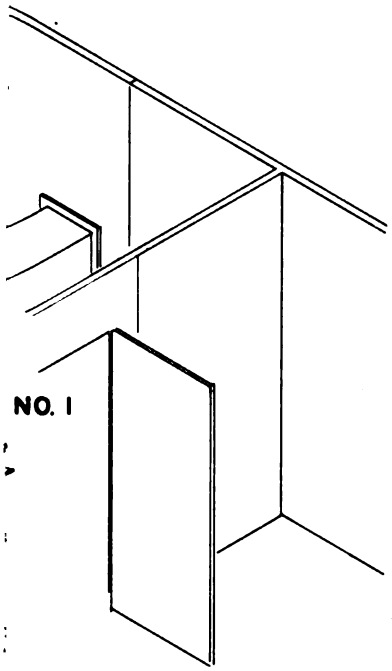
(2) The main purpose of the grease is to protect the polished steel parts from corrosion and not to reduce friction.

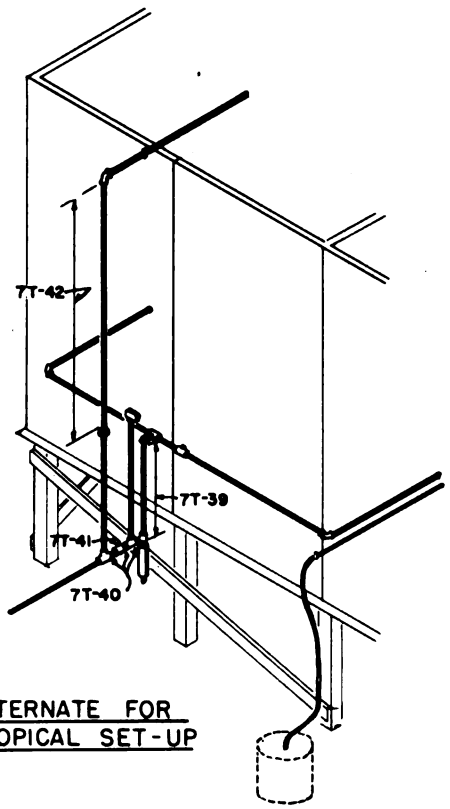
(3) Grease must not contain graphite and must be chemically neutral.

(4) For extremely low ambient temperature use a grease similar to Standard Oil Superla 4X. For unusually high ambient temperature use a grease similar to Vacuum Oil Company Gargoyle Grade A No. 0.

(5) Before the bearing housings are opened or any grease is added, wipe clean the outside of the motor. Remove the grease cup or alemite fitting, and pour in a small amount of flushing liquid such as alcohol, spindle oil, or flushing oil. Run the motor a few minutes and drain. Repeat until all the old grease has been removed. Carbon tetrachloride is an excellent solvent of caked grease, but it should always be followed by a flushing oil. To prevent contamination of the grease added, loosen or remove the closure to inspect the bearings and make sure that they are free from all old grease and excess flushing oil before re-greasing. Only the proper amount of grease should be put into the bearing as too much increases friction and will cause the bearing to heat.

CAUTION.—Extreme care must be taken that no grit or dirt be allowed to get into the bearing or closure at any time.





ALTERNATE FOR TROPICAL SET-UP

INSTALLING FUEL PIPING

1. ASSEMBLE SUPPLY HEADER (PARTS 7-31, 7-32 & 7-33) AND PLACE IN POSITION AS SHOWN. MAKE-UP ALL SCREWED JOINTS WITH PIPE JOINT COMPOUND MIXED TO A THIN PASTE AND APPLIED TO THE MALE THREAD ONLY.
2. BEFORE FASTENING HEADER PERMANENTLY TO WALL, ASSEMBLE AND CONNECT SUPPLY PIPES (7-34, 7-31, 7-38 & 7-36).
3. FASTEN PIPES TO WALL WITH PIPE STRAPS (7-56) AND MACHINE SCREWS (7-59)
4. FASTEN CEILING PIPE HANGERS (7-57) TO CEILING WITH SCREWS (7-59)
5. ASSEMBLE RETURN PIPING (7-36, 7-31, 7-37, 7-38) AND PLACE IN POSITION ON CEILING PIPE HANGERS.
6. PLACE FUEL DRUM RACKS IN POSITION AND ASSEMBLE EXTERIOR PIPING, BEGINNING AT THE BUILDING WALL AND PROCEEDING IN THE FOLLOWING ORDER (7-39, 7-40, 7-41, 7-42).
7. ADJUST FUEL DRUM RACKS SO THAT HEADER (7-40) IS LEVEL AND PERPENDICULAR TO BUIDING WALL.
8. CONNECT FOUR FLEXIBLE TANK CONNECTIONS (7-44, 7-45) TO HEADER (7-40)
9. INSERT BUSHING ASSEMBLY (7-47) & (7-44) INTO THE $\frac{3}{4}$" TAPPING OF THE FUEL DRUMS.
10. INSERT VENT ASSEMBLY (7-46) AND AIR-COCK (7-43) INTO 2" TAPPING OF FUEL DRUM.
11. CLOSE ALL VALVES AND MOUNT FUEL DRUMS ON RACK, AND MAKE CONNECTION TANK HEADER (7-40)
12. INSTALL FLEXIBLE CONNECTIONS TO ENGINES USING THE $\frac{3}{8}$" TUBING AND FITTINGS PACKED WITH THE ENGINES. SEND TUBES IN PLACE USING LONG SWEEP CURVES, TAKING CARE NOT TO KINK OR FLATTEN THE TUBING.

INSTALLING EXHAUST PIPING

1. INSERT HANGER RODS THROUGH HOLES IN CEILING WITH NUTS & WASHERS ON EITHER SIDE OF CEILING PANELS AND HANG SILENCERS AS SHOWN.
2. INSTALL EXHAUST PIPING WITH ASBESTOS GASKETS BETWEEN FLANGES.
3. ADJUST NUTS ON HANGER RODS SO THAT SILENCERS HANG PLUMB AND SO THAT EXHAUST PIPES SLOPE DOWNWARD TOWARD THE WALL APROX. $\frac{1}{4}$".
4. INSTALL FLEXIBLE CONNECTIONS TO ENGINES WITH ASBESTOS GASKETS BETWEEN FLANGES.

MODIFICATION OF STANDARD FUEL PIPING FOR TROPICAL INSTALLATION

1. REMOVE UPPER SECTION OF PIPE FROM ASSEMBLY NO. 7-42 AND REPLACE WITH PART 7-T-42
2. REMOVE THE 9 1/4" PIPE NIPPLE AND TEE FROM UPPER END OF ASSEMBLY 7-39 AND REPLACE WITH NO. 7-T-39
3. REMOVE THE 11" PIPE NIPPLE FROM END OF HEADER NO. 7-40 AND REPLACE WITH THREE NIPPLES 7-T-40, ONE CHECK VALVE 7-T-41 AND THE TEE FROM THE DISCARDED PORTION OF PART 7-39, CONNECTED AS SHOWN.

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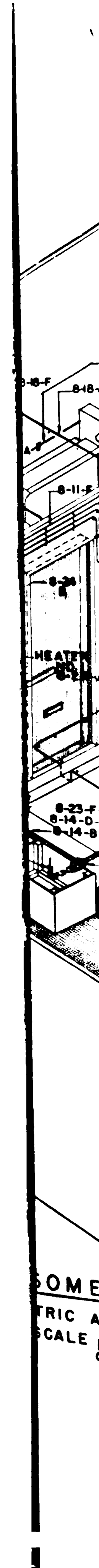
Figure 30. Building, power unit, exhaust and fuel system.



Section V

RADIO EQUIPMENT

53. RADIO TRANSMITTERS

CAUTION.—Do not uncrate radio transmitters until power is available and the ventilating fan in the transmitter room is operating. As the ventilating fan keeps the transmitter room under pressure, the transmitter room doors should then be kept closed as much as possible to keep dust out of the room.

a. The radio equipment consists basically of two Radio Transmitters BC-446-(*) and two Radio Transmitters BC-400-(*). For the location of this equipment see figure 14. In both cases two radio transmitters are supplied so that one may be used as a spare.

b. Radio Transmitters BC-446-(*) operating within the range from 200 to 400 kc supply the radio beam for guiding planes to the landing field. This transmitter approximately 1,700 va maximum at either 110 volts or 220 volts and has a power output of 100 watts. The normal load, however, is 1,300 va, since there is a 400 watt tube heater load for a brief period when starting under temperatures below 15° C. The radio beam is effective for approximately 50 miles, subject to local conditions.

c. Radio Transmitters BC-400-(*) operating at 75 megacycles supplies energy to the Z marker antenna which sends a vertical radio beam into what would otherwise be the cone of silence directly over the range station. This transmitter requires approximately 480 va at 110 volts and has a power output of 5 watts.

54. R-F BUSES

a. The layout of the r-f buses connecting the Radio Transmitters BC-446-(*) to the wall panel insulators is shown in figures 33, 34, and 35. The r-f buses at the transmitter end are terminated in a slightly different manner for each of the three general types of transmitter. These buses are cut to proper length in the field, therefore consult the proper drawing before cutting any bus wire.

b. All the hardware for the proper assembly of the stand-off insulators supporting the r-f bus as well as the hardware and lugs for holding and terminating the bus itself are packed in small cartons, numbered to correspond to the part numbers shown on the drawings.

c. The insulators for this bus are items 8-60-A and 8-61-A (fig. 37). The spare insulators 8-S-60-A and 8-S-61-A are packed separately. The hardware referred to in the foregoing paragraph, however, includes in each carton its quota of spares. Any surplus hardware accordingly should be left in these cartons and carefully kept segregated for possible future use.

d. These r-f buses pass through a selector switch box 8-46-A (fig. 37), mounted on the ceiling back of the transmitters. A schematic drawing of the interior wiring of this box is shown on figure 36. The switches in this box make it possible to connect either transmitter to the coaxial cable and to the antenna.

e. The bus layout is such that two sets of conductors, one set in a horizontal plane and one set in a vertical plane, run from each transmitter to the switch box. From the switch box to the wall panel insulators, there are also two sets of conductors set in planes at right angles to each other.

f. Note that two of the four conductors leading from each transmitter are connected to the ground. It is essential that when the coaxial cable is connected to the wall panel insulators, the sheath conductor of the coaxial cable is connected on the outside of the building to the same insulator to which the grounded bus is connected on the inside of the building. Follow carefully the bus drawing previously referred to in order to make proper connections.

g. When Radio Transmitters BC-446-(A to H) are being used, the r-f bus is terminated at the transmitter end on the goniometer secondary induction coils. Therefore take these coils from the Antenna Conversion Kit and install them on the transmitters before cutting the buses to length and fastening the lugs to them.

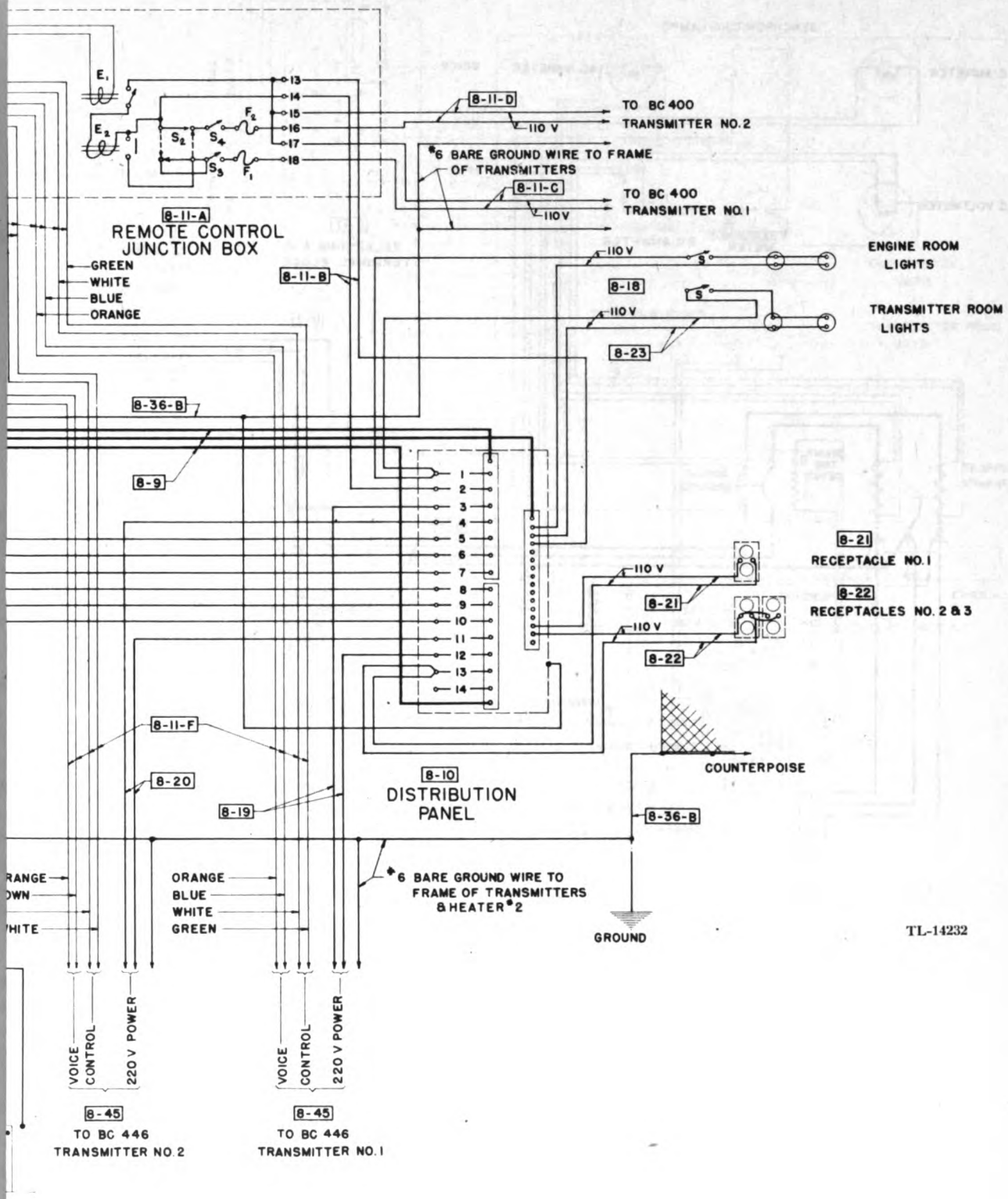


Figure 32. Building, wiring diagram.

55. RESISTOR AND METER FOR TUNING

a. To provide for tuning, there is included in the spare parts of Radio Transmitter BC-446-(*) a 1 ohm plaque resistor. With the Radio Transmitter BC-446-(A to H) there is also included a 0-3 ampere meter with expanded scale, the use of which is explained in Section VIII, Antenna Conversion Kit for Radio Transmitter BC-446-(A to H).

b. For Radio Transmitter BC-446-J this meter is not provided, but the impedance measuring box is so arranged that its 300 milliampere meter may be used instead.

CAUTION.—If the Preliminary Instruction Book for Radio Transmitter BC-446-(A to H) Antenna Conversion Kit is being used, the reference on page 10 to 4 amperes should not be used, but the current should be limited to ½ ampere. If a current greater than ½ ampere is used, the meter will be burned out.

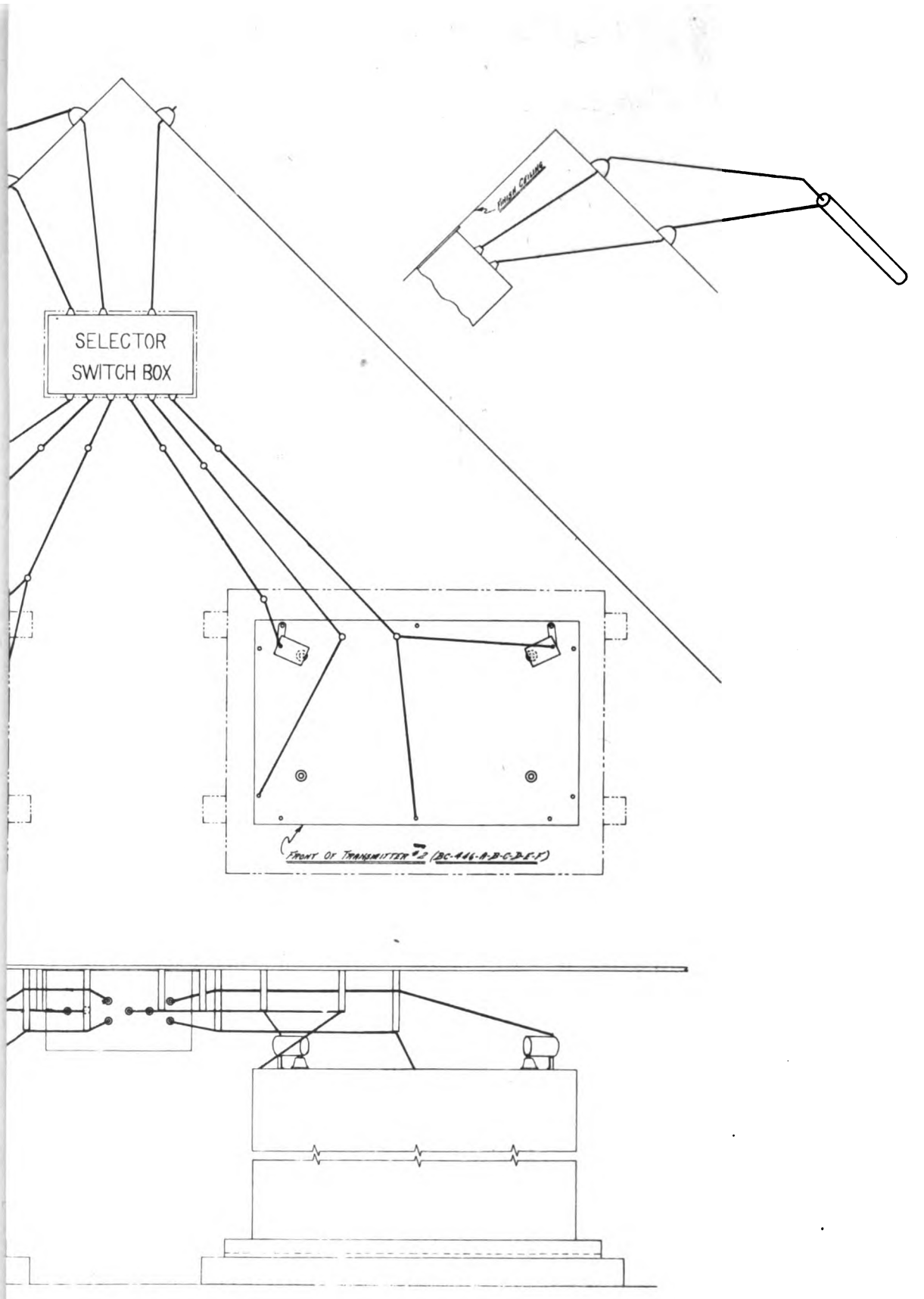


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Figure 33. R-f bus layout for ***Radio Transmitters BC-446-(A to F).***

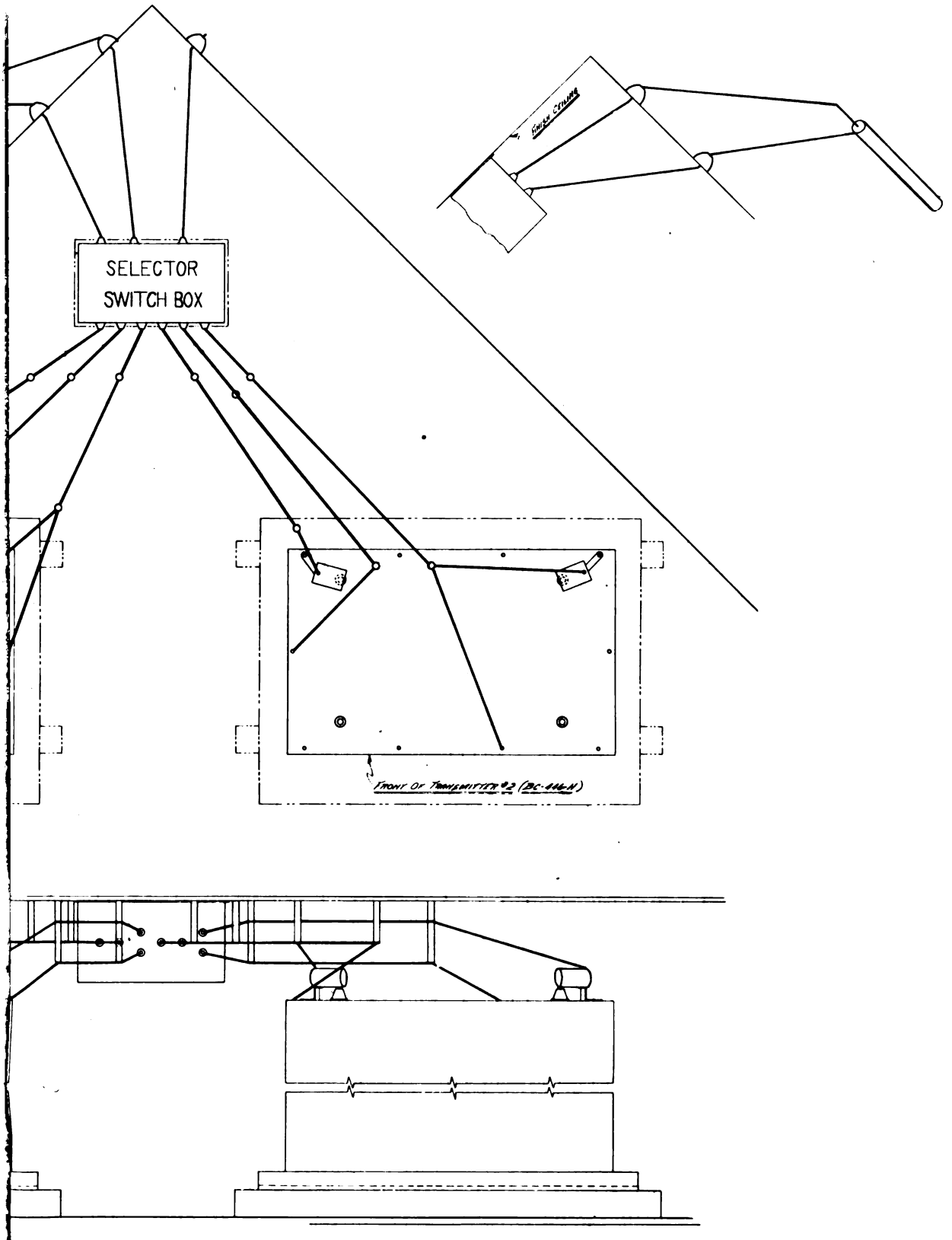

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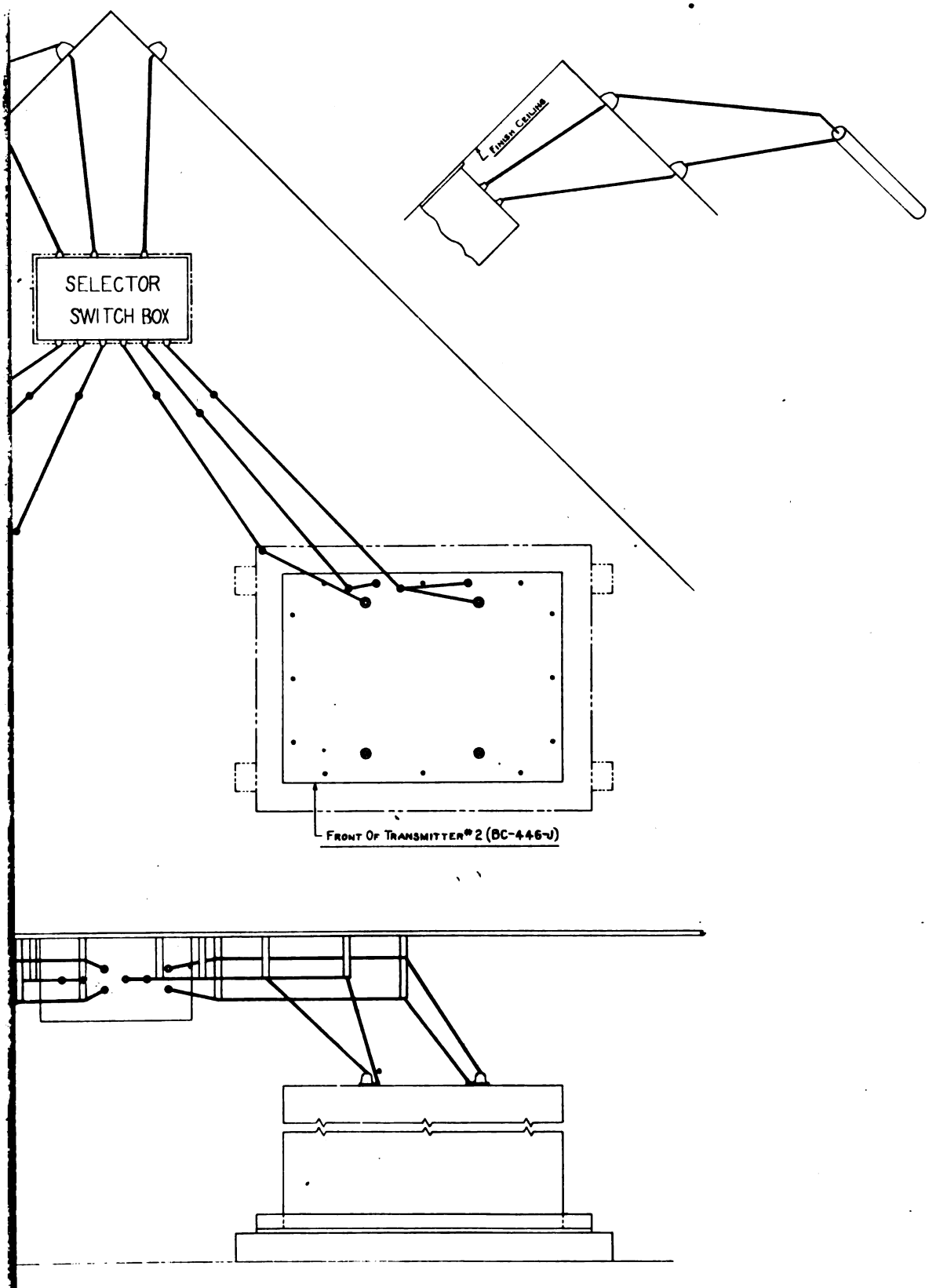
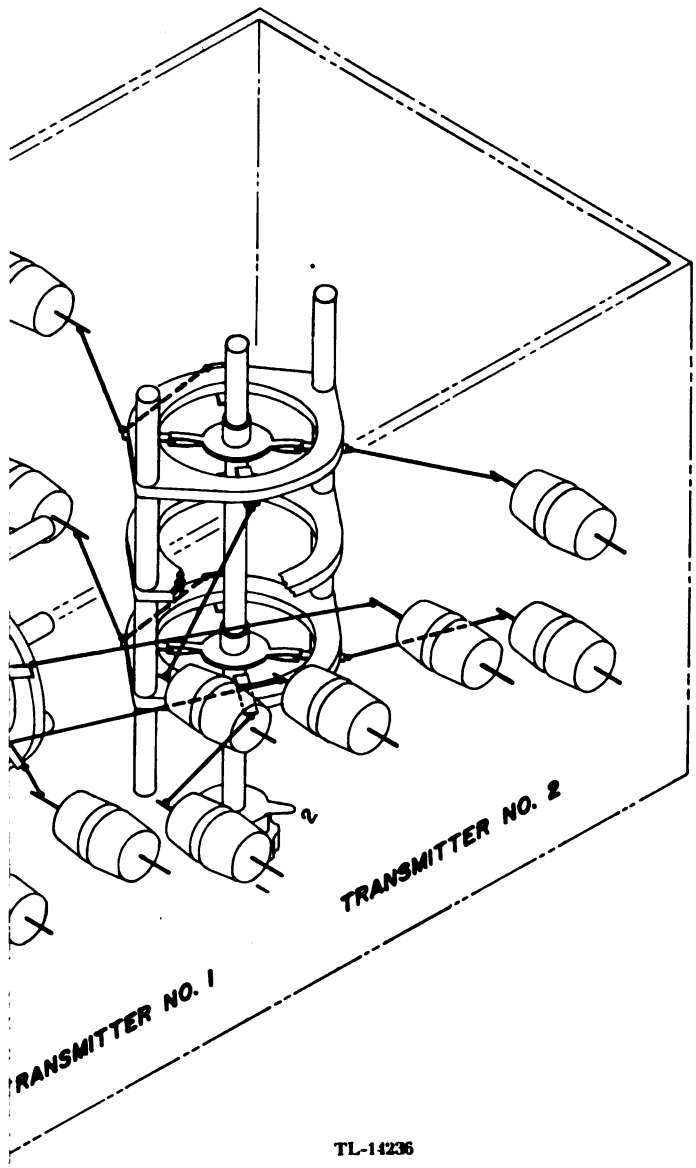
Figure 34. R-f bus layout for Radio Transmitter BC-446-H.



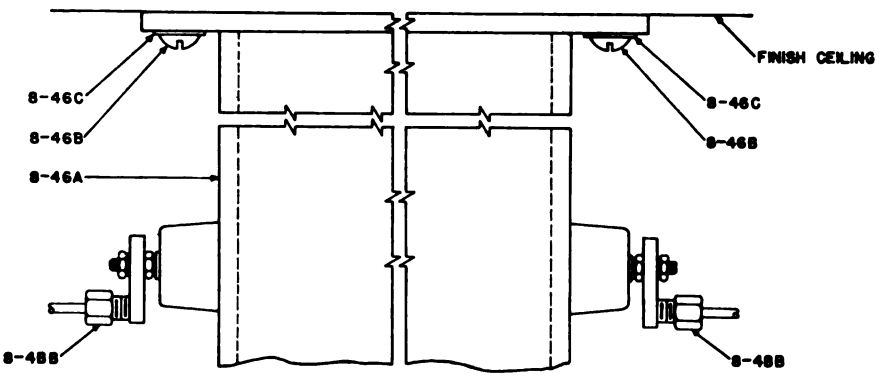
TL-14235

Figure 35. R-f bus layout for Radio Transmitter BC-446-J.

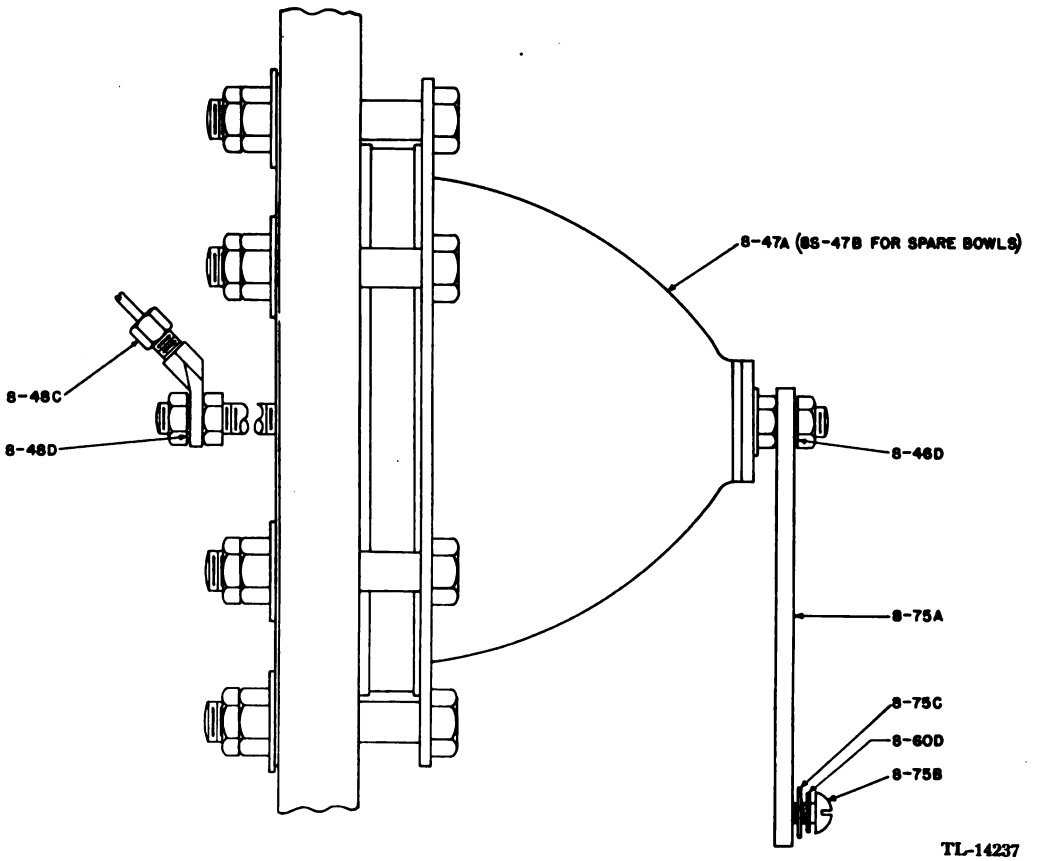


Schematic wiring diagram of Radio Transmitter BC-446-(*) selector switch box.

TRANSMITTER GROUND CONNECTION



SELECTOR SWITCHBOX CONNECTIONS



LEAD-IN INSULATOR ASSEMBLY

Figure 37. R-f bus mounting and connecting details for Radio Transmitter BC-446-(*).

Section VI

RANGE ANTENNA

56. GENERAL

a. The radio range station described in this installation uses four vertical towers to obtain the desired beam pattern of radiation. The towers must be supplied power in a definite phase relation. Adjacent towers are excited with the same signal in a phase relationship such that a continuous signal is radiated along the center line of diagonally opposite towers. This phase relation is obtained in the goniometer circuit of Radio Transmitter BC-446-(*) in conjunction with the tuning unit located at each tower. The procedure for adjusting the system is described in the following paragraphs.

b. After any required circuit changes have been made as given in Section VIII, adjust Radio Transmitter BC-446-(*) according to instructions given in the technical manual accompanying the transmitter.

Note.—All the precautions for protection of the link-circuit given in the section on Adjustment and Operation in the technical manual for Radio Transmitters BC-446-(A to H) should be followed exactly. Before performing the following operations, these instructions should be carefully reviewed.

c. Set the goniometer primary matching transformer taps according to table I.

Table I. GONIOMETER PRIMARY MATCHING TRANSFORMER TAP SETTINGS

Frequency (kc)	Tap used (left and right)
200-240	1st tap down
240-295	2nd tap down
295-380	3rd tap down
380-400	4th tap down

d. Set the goniometer secondary tuning capacitor banks according to table II.

e. Set the course shifting pad connector links so that the pad is out of the circuit. It is not necessary to retune the link circuit.

f. With the goniometer secondaries open, follow the normal tuning procedure for the goniometer primaries. The settings will be higher in dial reading than those previously obtained with the loops. In some instances it may be necessary to use the next higher frequency band for the goniometer primary-capacitor banks. The necessity for this change will be shown by a maximum of link-circuit current with goniometer primary dial at 100.

Table II. GONIOMETER SECONDARY TUNING CAPACITOR BANK SETTINGS

Frequency (kc)	Capacity per side (mfd)	Capacitors connected in parallel	
		Left side	Right side
200-210	0.006	C52, C53, C54, C55, C57, C58, C59, C60	C41, C42, C43, C44, C46, C47, C48, C49
210-220	0.00525	C52, C53, C54, C56, C57, C58, C59	C41, C42, C43, C45, C46, C47, C48
220-240	0.0045	C52, C53, C54, C57, C58	C41, C42, C43, C46, C47
240-260	0.00375	C52, C53, C54, C57, C61	C41, C42, C43, C46, C50
260-290	0.003	C52, C53, C57	C41, C42, C46
290-330	0.00275	C52, C53, C60, C61	C41, C42, C49, C50
330-360	0.0015	C52, C60	C41, C49
360-400	0.001	C52	C41

g. Resonate the goniometer secondaries one at a time with the other secondary open. Open right-hand secondary at the loading coil and apply a good short circuit across the transmission line junction point on left-hand secondary output. With the link-circuit relay blocked to one side, and the goniometer on 45°, tune the left secondary for minimum link-circuit current. If the link-circuit current drops too low for precise reading, rotate the goniometer so as to increase it. By careful adjustment of the goniometer and output coupling dials, the link-circuit current minimum can be located very precisely. *The goniometer secondaries must be precisely resonated.*

h. Repeat the operation with left-hand secondary open and right-hand secondary junction point shorted, meanwhile turning the right-hand secondary at the same time.

57. ADJUSTMENT OF ANTENNA TUNING UNIT PRIMARIES

a. Set the primary capacitor banks (C1 to C4) according to table III.

Table III. PRIMARY TUNING CAPACITOR BANK SETTINGS

Frequency (kc)	Total fixed capacity (mfd)	Capacitors connected in parallel
200-220	0.00275	C1 C2 C4
220-240	0.00225	C1 C4
240-260	0.002	C4
260-280	0.00175	C1 C2 C3
280-300	0.0015	C2 C3
300-320	0.00125	C1 C3
320-360	0.001	C3
360-400	0.00075	C1 C2

b. The primaries are resonated one at a time and only the transmission line leading to the tuning unit being tuned is connected. Connect the line leading to one of the towers to the proper junction point and place a 1 ohm non-inductive resistor across the junction point. (This should be the same point previously shorted to resonate the goniometer secondary.) Note that for tuning the coupling units, the 1 ohm non-inductive resistor found in the spare parts for Radio Transmitter BC-446-(A to H) (intended as a spare part for resistors R32 and R33 of that transmitter) is necessary. Disconnect all other lines. Set the goniometer on 45° and advance coupling until the connected secondary draws about 4 amperes. Set the secondary meter switch of tuning unit to READ position. Connect a 3 ampere r-f meter between the binding posts marked L and P. Set the primary meter switch to READ position. The ammeter leads should be as short as possible, and *in no case over 2 inches long.* Unlock the primary tuning dial by rotating the lock spokes to the left, and carefully tune the dial for an exact maximum ammeter reading. Lock the primary tuning dial and do not disturb it thereafter.

Note.—An ammeter suitable for the above adjustment can be obtained from the spare parts kit of Radio Transmitter BC-446-(A to H). If this meter is not available, provision is made to use the meter contained in the impedance measuring box, section IX. It is supplied with a special patch cord, one end of which is terminated by a plug which fits across terminals L and P and is shunted by a 1 ohm resistor. The other end of the cord is fitted with banana plugs. The latter makes connection to the two terminals marked M on the impedance measuring box. With the test switch in position X, the 0-300 ma r-f ammeter may then be used for carrying out the primary resonating operation; However, with this set-up, the secondary current should be reduced to about 2 amperes, because with the particular shunt used, the range of the impedance measuring box meter is extended to about 1.5 amperes.

c. Repeat the procedure for all of the tuning units, energizing only the transmission line leading to the unit being tuned and placing the 1 ohm resistor across the junction point being used. Before proceeding to tune the secondaries, set the phasing switches on diagonal antenna tuning units to opposite positions, that is, if northwest tower tuning unit is on 1, set southeast tower unit to 2 position.

58. ADJUSTMENT OF ANTENNA TUNING UNIT SECONDARIES

a. The object in tuning the antenna tuning unit secondaries is to reflect 70 ohms pure resistance to each transmission line from the secondary circuits. The resistance ranges from 4 to 15 ohms (that is, ½ to 10 ohms tower resistance plus resistance of tuning unit secondary circuits). Before performing the secondary tuning procedure, determine the total secondary-circuit resistance, as follows: Connect the INPUT of the impedance measuring box to the L and G PRIMARY METERING terminals of antenna tuning unit and the UNKNOWN terminals to the ANTENNA CURRENT terminals, being careful to keep the ground side of the Impedance Measuring Box connected to the G terminal.

b. Set the coupling tap link to terminal 1, and set the ANTENNA COUPLING dial to 0. Set the PRIMARY and SECONDARY METER switches to READ position. Energize the transmission line leading to the antenna tuning unit and resonate the Impedance Measuring Box on the known side (position S of TEST SWITCH), using 10 ohms of resistance. Switch to unknown side (position) and tune the ANTENNA TUNING dial for a MAXIMUM current reading. Adjust the Impedance Measuring Box COUPLING so that the MAXIMUM deflection is about ¼ of full scale. Note the reading, switch back to position S, and find the resistance value necessary to give the same reading. This should be in the approximate range of 4 to 15 ohms. If the value exceeds 15 ohms, additional ground rods must be driven to reduce the resistance.

c. When the secondary circuit resistance is 15 ohms or less, proceed with the secondary tuning as follows: Disconnect the UNKNOWN terminals of the Impedance Measuring Box from the ANTENNA CURRENT terminals and connect them to PRIMARY METERING terminals P and G, again being careful to match the ground connections. Leave the PRIMARY METER switch on READ but turn the SECONDARY METER

switch to SHORT. Set the coupling tap link to terminal 1 and the ANTENNA COUPLING dial to 90. Set the ANTENNA TUNING dial recording to table IV.

Table IV. APPROXIMATE ANTENNA TUNING DIAL CALIBRATION

Loading coil tap (low frequency)		Loading coil tap (high frequency)	
Frequency (kc)	Dial reading	Frequency (kc)	Dial reading
200	15	290	21
210	30	300	30
220	40	310	36
230	47	320	41
240	54	330	46
250	59	340	51
260	66	350	54
270	70	360	58
280	75	370	61
290	81	380	64
		390	67
		400	69

d. Energize the transmission line and resonate the Impedance Measuring Box on position S, using 70 ohms resistance and coupling adjusted for a very low reading. Note the reading. Adjustments of the ANTENNA COUPLING and the ANTENNA TUNING dials are made until resonance on the unknown side, position X, of the Impedance Measuring Box occurs on the same Impedance Measuring Box TUNING dial setting as on the known side and the meter deflection at Impedance Measuring Box resonance is identical on both known and unknown positions. This position is best approached by a series of successive approximations, changing both ANTENNA TUNING and ANTENNA COUPLING dials. Increasing the ANTENNA COUPLING dial reading tends to lower the meter deflection. The correct ANTENNA TUNING dial reading will be slightly higher than that which gives minimum meter deflection. Do not attempt to get the proper meter deflection and then try to correct the resonant point. Rather attempt to move both resonant point and deflection to the desired values in short jumps. When a close approach to the proper settings has been made, advance the Impedance Measuring Box coupling and resonate it on the known side for a higher value of meter deflection at which more precise setting may be obtained. While more precise settings are desirable, the adjustments will probably be satisfactory if the resistance is between 69 and 71 ohms and the residual reactance less than 10 ohms. If the Impedance Measuring Box used does not have a calibration for reactance, attempt to get the resonance setting as close as the maximum meter deflection point permits. If the antenna coupling section has been advanced to 100, and the meter deflection is still too large, try the next higher coupling tap (that is, if on tap 1, try tap 2). Repeat the procedure for each tower, energizing only the transmission line leading to the tower being tuned, and leaving the antenna metering switches on the other towers on READ position.

59. SETTING COURSES

a. Connect all transmission lines, set all tuning unit metering switches to SHORT position, set the goniometer on 45°, and advance antenna coupling. At a p-a plate current of approximately 200 ma, both the link current and antenna currents should be between 1 and 1.5 amperes (without modulation). Apply normal modulation level and release the link-circuit relay for normal operation. With a portable receiver, check for courses on the tower diagonal lines at least 500 feet beyond the nearest tower. If the desired A and N quadrants are reversed, rotate the goniometer to 135°. If random, irregular, and badly misplaced courses are obtained, check each tuning unit for secondary current by inserting a 3 ampere r-f meter in series with antenna current terminals, and then setting the secondary metering switch to READ. If all towers seem properly energized, check for opposite settings on the phasing switches of diagonal towers.

b. If no course shift is required, and only the course in line with the main runway is important, ground check this course on the runway, making any slight goniometer readjustment to locate it properly. All the courses should then be flight checked and reported as to actual location.

c. If course shift is required, the same procedure used in shifting courses with loop antennas is employed. Refer to paragraphs on course setting in applicable technical manuals for Radio

Transmitters BC-446-(*). The only difference is that the link-circuit resistance R_0 is assumed to be 80 ohms at any frequency. If the towers have been properly oriented, the correct alignment of courses will occur with goniometer in 45° or 135°. Note that if the N quadrants are to be squeezed, the pad should be placed in the N or left primary and vice versa.

d. The receiver used for checking courses should have a rod antenna rather than a loop antenna, since the loop antenna will give various course indications, depending on the angle of the plane of the loop with respect to the range towers. However, if only a loop antenna receiver is available, make sure that the plane of the loop is always in a line pointing to the transmitter house. This will give consistent results.

e. When setting courses, if A and N quadrants are reversed, rotate the goniometer from 45° to 135°. If irregular and badly misplaced courses result, test each tuning unit for secondary current using 3-amp ammeter. If all towers seem properly energized, check for opposite settings on phasing switches of diagonal towers.

Section VII

Z MARKER ANTENNA SYSTEM

60. THEORY

a. It is necessary that the Z marker antenna radiate a pattern which in the vertical plane will appear as an egg sitting on its smaller end and in the horizontal plane appear as a circle. This is obtained by the use of two crossed dipoles in space and time phase quadrature plus a galvanized wire netting counterpoise, 24 feet square, located 39 inches below the antenna. This counterpoise contributes materially to the resultant radiation pattern.

b. The marker antenna, consisting of two dipoles normal to each other is installed in the attic, and supplied with energy by a transmission line from the transmitter below. Taking the first dipole separately, we know that upon excitation it will produce a horizontal radiation pattern similar to a figure-8 broadside to the dipole proper. The second dipole likewise displays the same radiation characteristics. If the two dipoles are excited simultaneously in phase, the resultant radiation pattern is a figure-8 due to the vectorial addition of the radiation from each incremental length of the radiators. This resultant pattern is obviously a radical departure from the desired circular pattern. To obtain the desired circular pattern of radiation it is necessary to introduce a time phase displacement of 90° in one dipole with reference to the other. This gives a rotating pattern in the horizontal plane which approaches the desired circular pattern. This time phase displacement is obtained by means of a quarter-wave phasing transmission line which is connected below the transmission line feeder junction point. The physical location of this junction point is given in figure 38.

61. INSTALLATION

a. Before placing the Radio Transmitters BC-400-( ) in position, it is necessary to modify them to permit correct connection of the buses by installing two extra sets of insulators and studs as shown in figure 38. The insulators and studs are identical with those used on the transmitter terminals, but no internal connections are made to the studs. These insulators and studs act as terminals for the buses and in addition make it possible, by means of link connections, either to connect the transmitter to the bus or to short circuit the bus.

b. The insulators and hardware, including spares of both, referred to in the foregoing paragraph, are packed in small cartons numbered to correspond to the part numbers shown on the drawing.

c. Punch two holes in the transmitter case so that the supplementary insulators may be affixed. To avoid injuring the case this should be carefully done with a proper tool, such as a Greenlee punch. While the work is being performed, a protecting layer of cardboard or paper placed inside the transmitter case to prevent any metal cuttings from falling onto the radio equipment.

d. After the insulators and links have been installed, the transmitters are placed back to back on wooden stands provided for that purpose. These stands are shipping cases built so that they may provide the proper elevation for Radio Transmitters BC-400-(G and H). Radio Transmitters BC-400-(B to F) are shorter than Radio Transmitters BC-400-(G and H). Therefore if these former models are supplied, they should be raised to the proper height by means of boards placed under the wooden stands.

e. The dipoles, transmission lines and the accessory insulators, and hardware as shown in figure 38 are installed next. All dimensions should be held exactly to the values shown until it is determined by test that adjustments are necessary. The dimensions given have been found to provide optimum results under normal operating conditions.

f. After all bus connections have been made as indicated, either transmitter may be connected to the antenna. If transmitter No. 1 is to be connected, its two links are arranged to connect the transmitter terminals to the bus while one shorting link on transmitter No. 2 is closed across the two supplementary studs and the second link is left in the open position (fig. 38). By this means transmitter No. 2 is entirely disconnected from the bus system, and it is possible by means of a dummy load, of similar impedance to the antenna, to tune or test the transmitter.

62. ADJUSTMENT

a. After a transmitter has been tuned and connected to the antenna, reduce the coupling dial to zero.

b. Next, place the wooden tower and dipole described in figure 39 atop the roof ventilator on

the Adcock Radio Range Station transmitter house. The detector dipole is to be constructed in the field.

c. Arbitrarily align the dipole detector to a north and south axis and increase the transmitter coupling dial until the dipole detector meter reads about 30 milliamperes. This meter is a thermocouple type with an 0-300 ma scale. The meter should be read at a suitable distance by means of a pair of binoculars, a transit or a telescope. A recording of the foregoing as well as the readings mentioned in the following paragraphs should be made.

d. With a long stick, rotate the detector in increments of 15°. Upon completion of each rotation, the operator should remove himself from the roof and remain under the counterpoise level. It cannot be emphasized too strongly that no person or material remain on the roof or above the counterpoise at any time when readings are taken.

e. After a complete rotation of the detector has been made, with readings every 15°, the degree of uniformity which the readings indicate will be known. If the readings are uniform within 5 milliamperes and if the maximum meter reading is below 40 milliamperes, increase the coupling. This will increase the power output and likewise increase the current reading of the detector meter.

f. When this has been done, take great precautions in adjustment, since a change of a few inches in the quarter-phasing section may greatly increase the radiation in one direction at the expense of such radiation in another direction. This may in some cases exceed the limits of the meter and result in the destruction of the thermocouple.

g. Upon completion of the final adjustments, all antenna system joints must be made mechanically and electrically permanent. This precaution cannot be stressed too highly at this operating frequency. The wooden tower should now be removed from the roof.

63. CHECKING PATTERN

a. The above meter readings should be plotted on polar coordinate graph paper, such as the example shown in figure 40. As previously stated, the specified dimensions of the antenna assembly should give a pattern closely approaching a circle. If maximum and minimum readings differ by more than approximately 10 percent, adjustments may be advisable. Note positions of the maximum readings. They will normally appear reciprocally on a diagonal. If they appear in line with one dipole, a slight adjustment of dipole lengths should improve the pattern. It is important, however, that the dipoles be of equal length. If the maximum readings occur midway between the dipoles, the phasing is incorrect and an adjustment of the phasing section length is indicated. The shorting elements for the quarter-wave sections below should be moved a corresponding amount to maintain the insulating characteristics of these sections.

b. The procedure outlined above gives the operator an excellent conception of the antenna radiation pattern, but a flight check is the only final absolute means of determining the exact pattern which is radiated. It is therefore essential that such a flight check be made.

c. Mark to scale distances easily recognizable structures or land marks on a map of the immediate locality of the marker station. Then make a flight check with suitable receiving equipment. The flight check should be made so that the plane approaches the Z marker and traverses it then makes a turn and flies over the station from another angle of approach. A minimum of six such traverses, uniformly spaced, should be made and observations recorded to determine the over-all degree of uniformity of the antenna radiation pattern. During the flight check the radiated signal which should be monitored aurally (3,000 cps modulation 100 percent) as well as visually (white indicator light). Keep a running record of the aural limits and light operation limits of the signal on each traverse. The beacon should be checked with a stop watch as some aircraft antenna will give an effect of pushing the pattern over the marker. Note the time of traverse on approach from reciprocal bearings. This flight check should be repeated and data recorded at each 1,000 foot altitude from 1,000 to 5,000 feet, respectively.

d. Figure 40 shows a plot of field intensity measurements on the "cone of silence" marker station antenna. This pattern shows actual dimensions in inches of A, B, and C. In relation to the physical structures of the antenna feeder system proper, A is that measurement from the ceiling of the Adcock Radio Range Station transmitter building to the junction point on the feeder system made by the transmission line proper from two Radio Transmitters BC-400-(B to H). B is that measurement from this junction point to the horizontal section of the quarter-wave phasing transmission line. C is that measurement from the horizontal section of the quarter-wave phasing section to the horizontal section of the quarter-wave stub which acts as a metallic insulator.

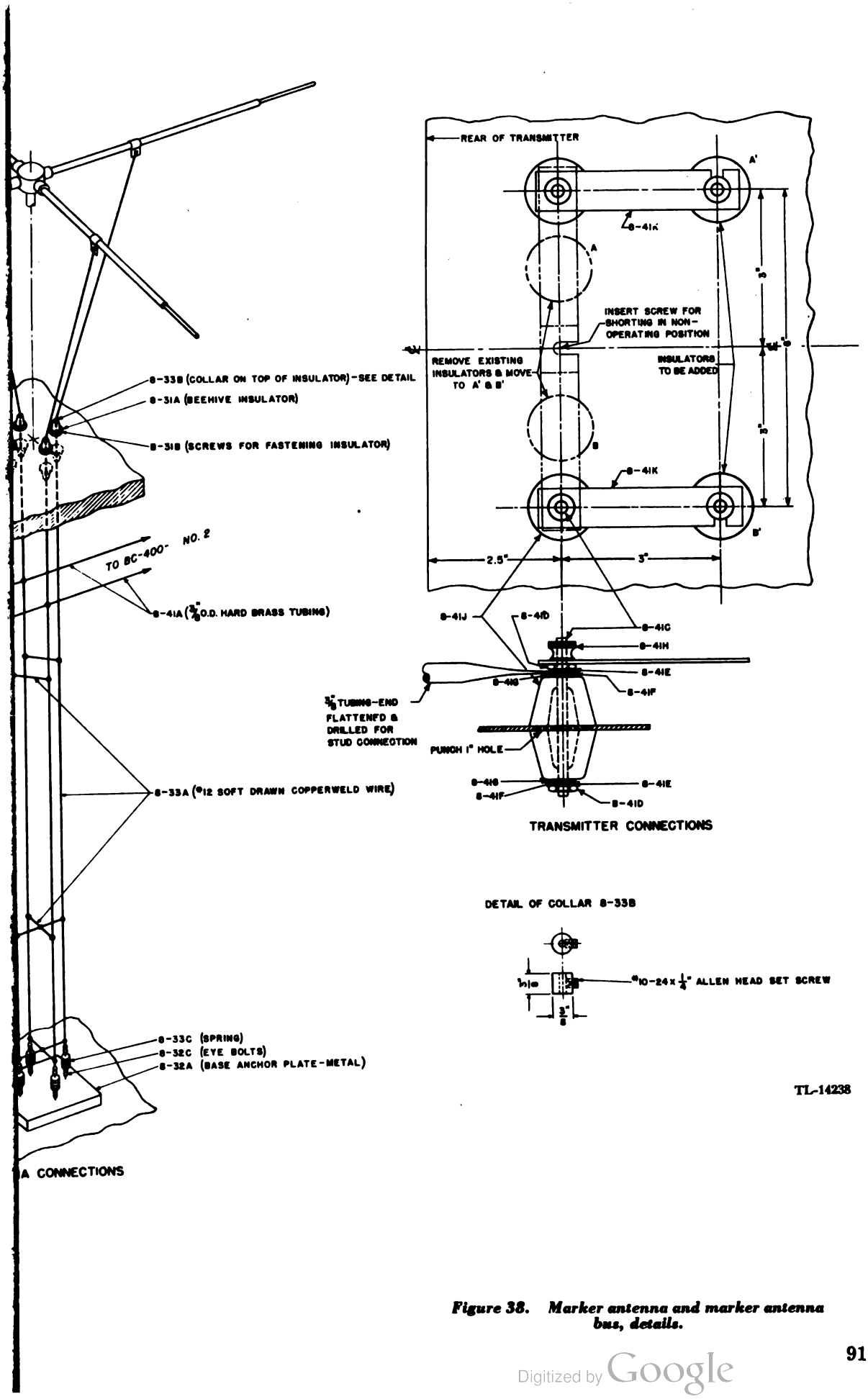


Figure 38. Marker antenna and marker antenna bus, details.

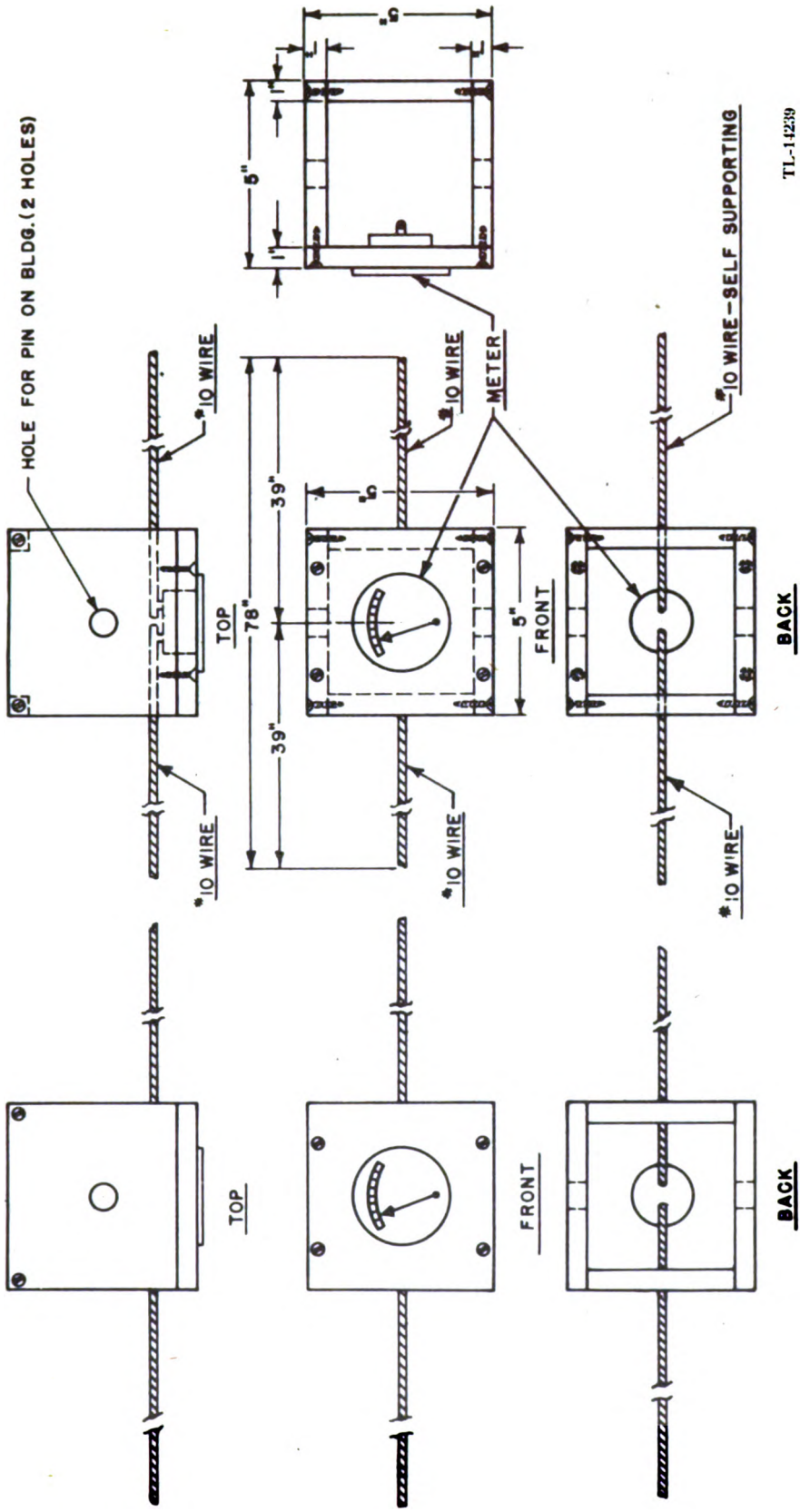


Figure 39. Detail of dipole detector for plotting field intensity of marker antenna.

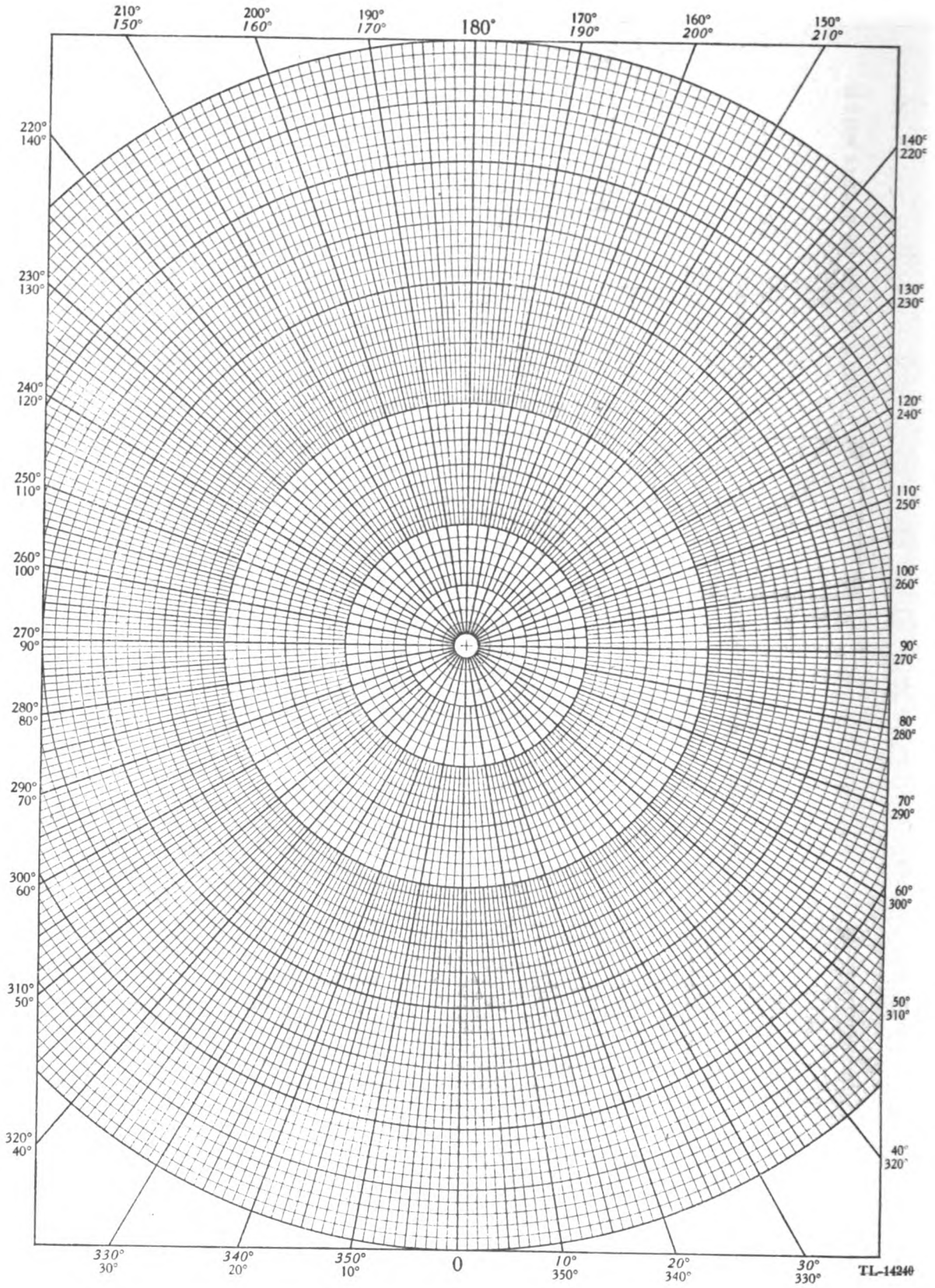


Figure 40. Typical marker antenna, plot of field intensity.

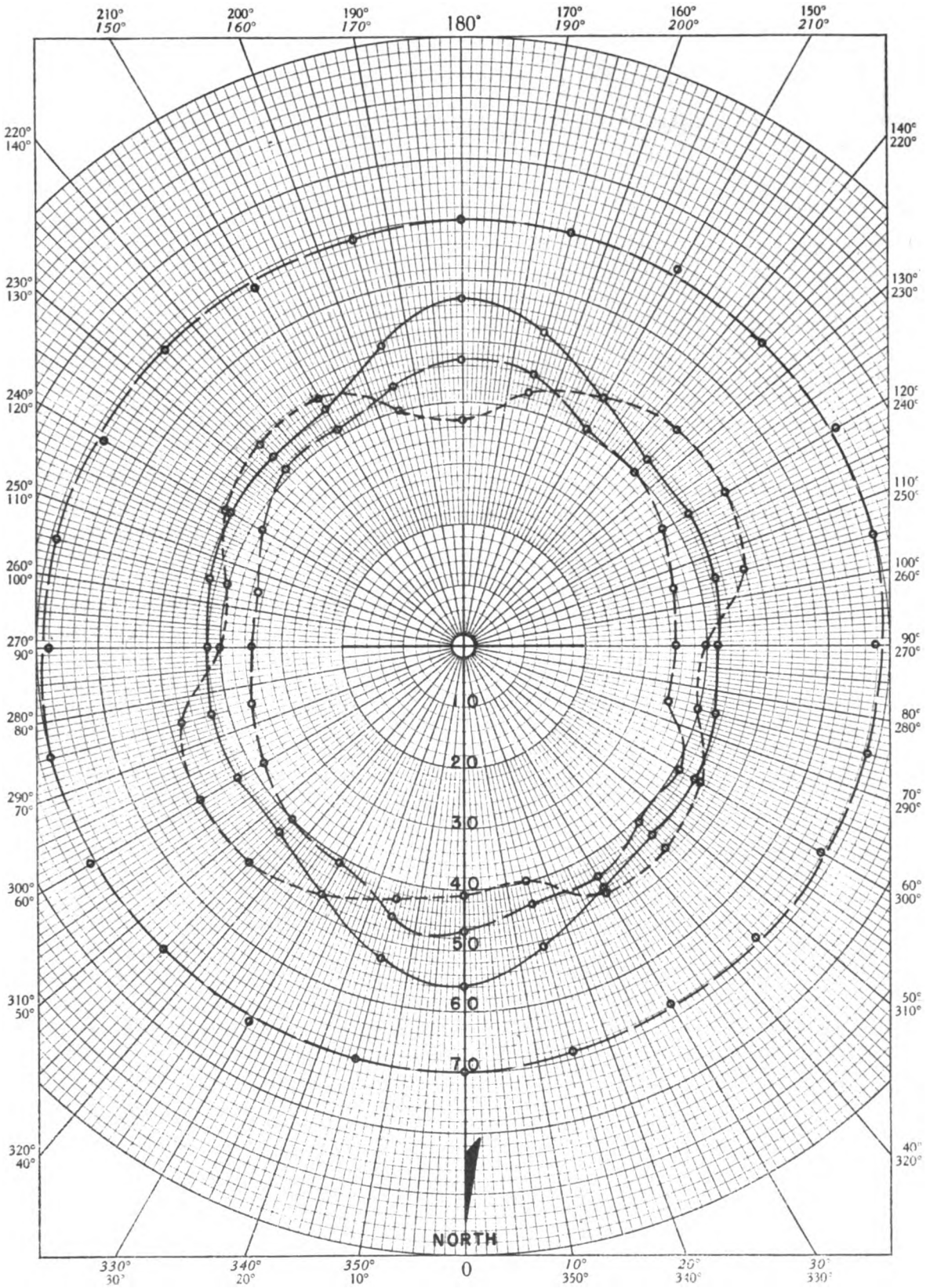


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Figure 40a. Form for plotting field intensity of marker antenna.

Section VIII

ANTENNA CONVERSION KIT FOR RADIO TRANSMITTERS BC-446-(A to H)

64. DESCRIPTION

a. Radio Transmitters BC-446-(A to H) are designed for use with a loop antenna. When they are used with towers, certain changes must be made in the combination of tuning capacitors and additional goniometer primary autotransformers and goniometer secondary inductance coils must be connected. These transformers and coils are a part of the antenna conversion kit which includes the coaxial transmission cable and tuning houses.

b. Radio Transmitter BC-446-J is designed for use with either a loop antenna or with towers, and the technical manual accompanying that transmitter gives information for proper use with either. For tower use, the only additional items of equipment needed are coaxial cables and tuning houses.

c. The antenna conversion kit contains components necessary to convert a loop radio range station using Radio Transmitters BC-446-(A to H) from a loop to a tower antenna system, using towers having a capacitance between 450 and 490 mmfd.

65. CONTENTS OF THE KIT

5 265 foot length of rubber coaxial transmission line, with sealed and lugged terminals (4 used, 1 spare)

5 Antenna Tuning Unit (Radio Receptor Co. Type 465) complete with rainshields, flash-gap arms, and mounting hardware (4 used, 1 spare)

2 Goniometer secondary loading coils for Radio Transmitter BC-446-(A to H)

2 Goniometer primary matching transformers for Radio Transmitter BC-446-(A to H)

66. SUMMARY OF ELECTRICAL CHARACTERISTICS

a. Antenna Tuning Unit (fig. 41).

Frequency range	200-400 kc
Maximum power	75 watt continuous
Antenna required	450-490 mmfd, 0.5 to 10 ohms
Transmission line required	concentric, 70 ohms
Electrical length at 200 kc	approximately 35°

b. Transmission Line.

Characteristic impedance	70 ohms
Attenuation	0.55 db per 1,000 feet at 300 kc
Velocity of propagation	0.55 c
Electrical length at 200 kc	35.2°
Mechanical length	265 feet
R-f power	1 kw maximum continuous at 200-400 kc, matched impedance

c. Goniometer Secondary Loading Inductors.

Inductance	65 microhenries
Q	250 at 300 kc
Maximum current	6 amp at 300 kc

d. Goniometer Primary Matching Transformers.

Inductance	420 mh full winding
Q	300 at 300 kc full winding
Taps	total of 80 turns tapped at 30, 40, 50, and 60 turns
R-f power	300 va continuous between primary impedance of 80 ohms and secondary impedance between 12 and 60 ohms, 200-400 kc

67. ELECTRICAL THEORY

a. General. Figure 42 shows the arrangement of the essential functioning electrical components concerned in the conversion. Banks of capacitors are shown as a single unit, and the meter switching arrangement in the antenna tuning unit has been omitted for simplicity. Note that the goniometer secondaries are reconnected with one end grounded, and that both tuning-capacitor banks for each secondary are connected in parallel. This connection, plus the addition of the goniometer secondary loading inductor, permits series resonating the goniometer secondaries at any frequency in the 200 to 400 kc range. The other change in the transmitter is the connection of the goniometer primary matching transformers as step-down autotransformers between the link-circuit and the goniometer primaries. This connection is necessary to obtain operating impedance levels in the link circuit suitable for the course shifting pad.

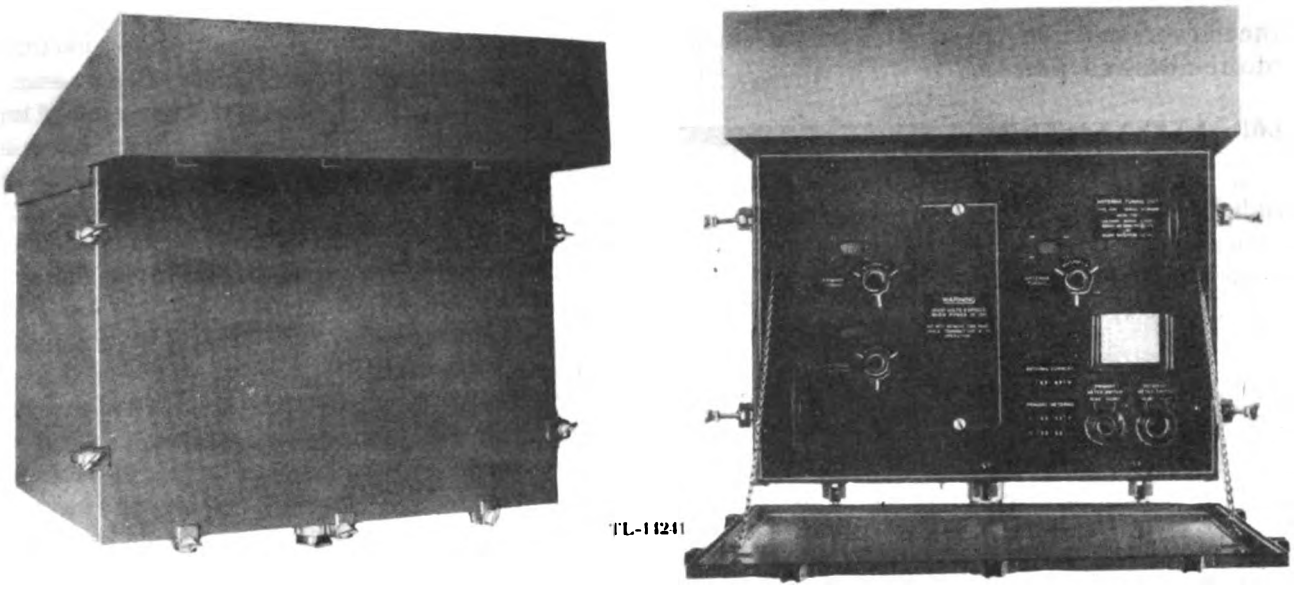


Figure 41. Antenna tuning unit, closed and open, front view.

b. Polarity Reversing Switch. The towers are excited in diagonal pairs, each pair being energized by one goniometer secondary. Since the towers of each pair must be 180 out of phase with each other in order to obtain the necessary figure-8 radiation pattern, a polarity reversing switch is connected between the antenna tuning unit secondary and the antenna ground circuit. Note that the diagonal antenna tuning units are shown with opposite connections of this switch.

c. Tower Detuning. Because the tower antennas used with this equipment have high reactance and low resistance, they may easily be detuned by changes in the weather. As the relative phase and amplitude of the currents in the towers determine the course locations, any tower detuning would render the system useless unless special provisions were made to stabilize the relative phase and amplitude of the tower currents. A rough example of this effect is 1° of course shift for 1° of electrical phase shift between two diagonal towers. (The course shift with changes in amplitude alone is not serious when the goniometer is set at 45°, 135°, 225°, or 315°.)

d. Method of Obtaining Intertower Stabilization. It can be shown mathematically that if the antenna tuning unit primary circuits are so adjusted that with the secondary open, the primary presents a capacitive reactance to the transmission line, equal to the inductive reactance of the transmission line with one end shorted, detuning of any one tower would cause a nearly equal phase and amplitude shift among all the towers. The only limitation to complete stability is the loss in goniometer primary and secondary circuits, and on the transmission line, plus any residual reactance due to improper resonating of those circuits. Complete stability is obtained by the following tuning procedure:

(1) Resonate each goniometer secondary with a short circuit applied *directly* at the transmitter end terminals of the transmission lines. (One secondary should be open while the other is being resonated.)

(2) Replace the short with a 1 ohm non-inductive resistor, energize the goniometer secondaries, and, with the secondary of the antenna tuning unit open, resonate each of the antenna tuning unit primaries for maximum primary current. This establishes the required condition of primary reactance equal to shorted line reactance. *Neither this nor the goniometer secondary tuning should be changed in any subsequent steps.*

(3) Finally, tune the tower by means of the loading coil in the tuning unit and adjust the amount of antenna coupling so that the tuning units present a 70 ohm resistive load to the transmission line. This procedure is explained in detail in paragraph 58a.

(4) Note that some inductive reactance must be coupled from secondary to primary to tune out the capacitive reactance deliberately included in the primary in subparagraph (2).

(5) A further requirement for complete stability is that the goniometer be set close to 45°, 135°, 225°, or 315°. At these points all the towers receive the same excitation and operate equally during both A and N characters. Therefore any weakening of the signal resulting from detuning applies equally to the A and N signals. In order to have the goniometer setting at one of these points,

the towers must be properly oriented with respect to the desired courses.

68. ANTENNA TUNING UNIT CIRCUITS

a. The antenna tuning unit consists, essentially, of a primary and secondary circuit, magnetically coupled (fig. 43). Switching provision is made to permit strategic metering at the terminals on the front panel.

b. In figure 43, the metering switch S1 is shown in READ position. Consider the switches to be in SHORT position. The r-f transmission line sheath connects to ground. The center conductor connects through compensating switch S1 and inductor L5 to the primary capacitor bank C1 to C4. This bank is in series with variable iron core primary inductor L1, which returns to ground. When primary meter switch S1 is thrown to READ position, connection from the center conductor to the capacitors must be made by connecting together the L and P terminals. In this condition, both L5 and C5 are out of the circuit. Inductor L5 and capacitor C5 insure that the inductance of the primary circuit and the stray capacity to ground are identical, whether or not the primary metering terminals are connected. This is essential, since the primary is resonated with metering switch S1 on READ, and an ammeter is connected from L to P. Note that with S1 on READ, the output of the transmission line is available from terminal L to terminal G and the input impedance of the tuning unit may be measured from terminal P to terminal G. This arrangement facilitates the use of an impedance measuring box (par. 64a) to adjust the reflected impedance of the antenna tuning unit.

c. The secondary circuit consists of variable coupling coil L2, in series with fixed coupling coil L3, in series with antenna variometer L4. Provision is made to select all, half, or none of the turns on L3. L4 covers the 200 to 400 kc range in two bands. The phasing switch permits reversing the polarity of coupling from L2 and L3. Secondary meter switch S2 opens the ground side of the antenna circuit across the antenna current terminals, permitting current metering.

69. INSTALLATION

a. Changes in Transmitter.

(1) Refer to figure 44. Remove copper tubing-bus connections which ground the center taps of goniometer secondaries. Use one of the screws which mount the secondary-tuning mica capacitors to disconnect the rear goniometer secondary bus leads from the feed-through insulators which connect into the tuning capacitor compartment and ground the loose bus end.

(2) Refer to figure 45. Connect secondary tuning capacitor banks in parallel by connecting together the capacitor buses, as shown. Use the paralleling connectors provided (figs. 45 and 46).

(3) Refer to figures 45 and 47. Install goniometer primary matching transformers, as shown on drawing. (Only the right-hand components are shown; the operations on the left-hand side are similar.) On Radio Transmitters BC-446-(A to H) these coils are mounted by screws which mount the capacitor-bus supports on the shelf above. Holes must be drilled as shown. Use the nuts and bolts provided in the mounting holes on the transformer feet. Disconnect the lead cable leads from C34 and C39 on the transmitter and connect them to the bottom terminal on each matching transformer. Then connect the flexible lead provided with the matching transformer to the point from which the lead cable is removed.

(4) Refer to figure 48. Install the goniometer secondary loading coils on top of the transmitter, as shown. One end is supported on the rear output feed-through and the other end rests on the mounting foot, which is secured by a top shield screw.

b. Transmitter House Wiring. (Fig. 49.) No exact description is given here, since the installation may vary from house to house. The external bussing from the loading coil and ground to the transmission line terminals should be of low resistance (at least equivalent No. 8) and should be supported so that it cannot shift in position. Run the leads from each secondary as isolated pairs, with a minimum of coupling between them. Note that a separate ground lead is carried out for each secondary. These ground connections are made under a convenient top shield mounting screw. The transmission lines are paralleled at a definite junction point. The goniometer secondary must be series resonated *up to this junction point.* The transmission lines will then be resonated *beyond this junction point.* Any stray inductance in the leads not included in one or the other of these resonating operations would impair the stability of the range courses.

c. Transmission Lines. The length of each transmission line is 265 feet. *Do not cut or splice these lines under any circumstances, because it is extremely difficult to splice this type of line, and because each line must have the same value of electrical length in order to obtain proper course alignment.* Because of this fixed line length, the line junction points must be chosen so that each

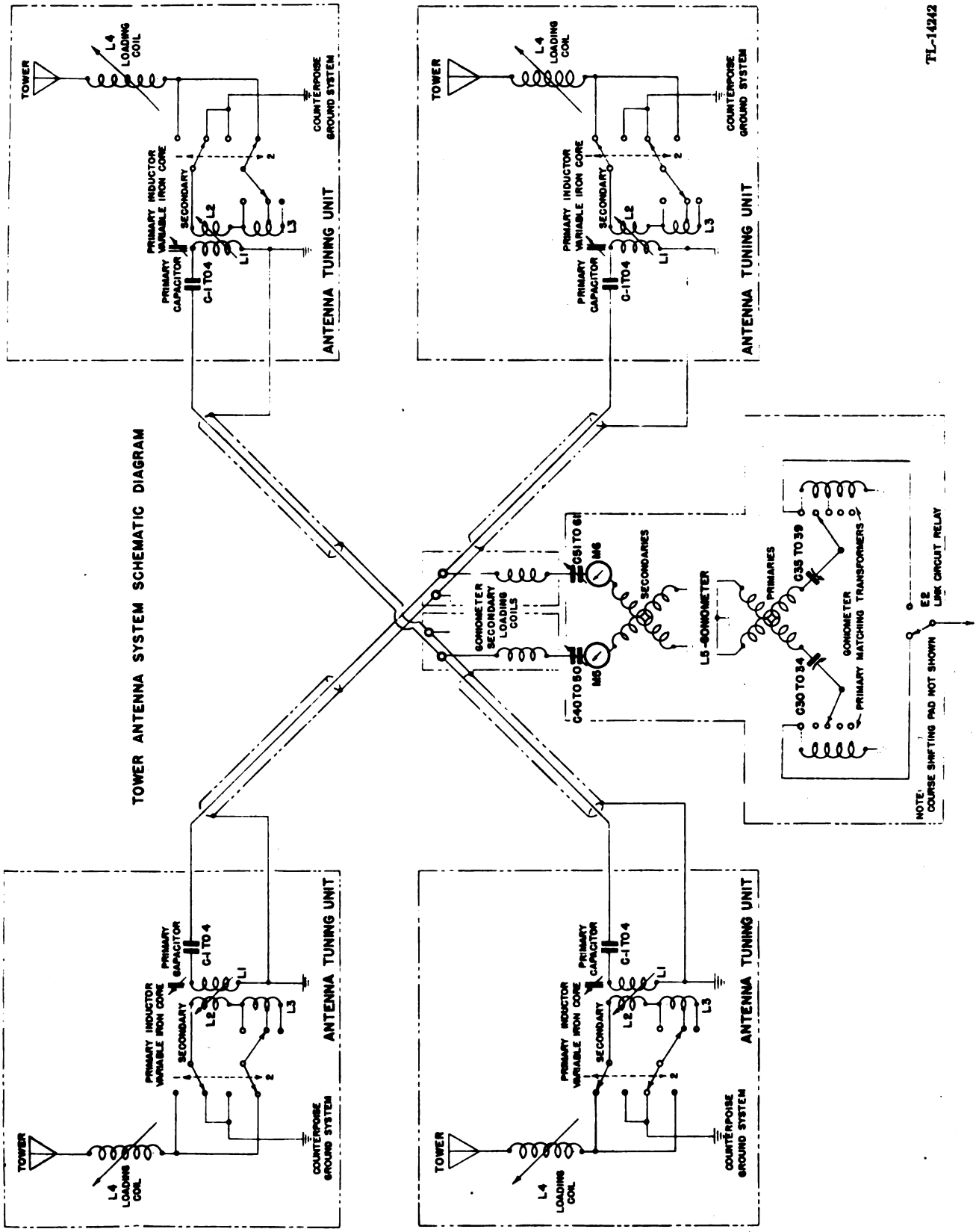


Figure 42. Tower antenna system, schematic diagram.

line can reach its tower and still have adequate slack. (Any excess slack may be taken up in coils of 3 feet diameter.) If necessary, bury the line in trenches 18 inches to 24 inches deep for protection. The transmission line is rugged enough to withstand light rubber-tired vehicles, unless it is laid over jagged rock. The line should not be subjected to abuse, and should be buried when it passes under any well-defined road. The line will withstand water immersion, provided it is not exposed to the flow pressure of running streams. Avoid sharp bends in the line. A desirable *minimum radius* is 18 inches. Figure 49 shows the line end terminal construction. The lead coming straight out of the coaxial line is the center conductor and the lead coming out at an angle is the external sheath. Connect the sheath to the ground side at each end of the line.

d. Antenna Tuning Units.

(1) Refer to figure 50. Mount each unit on the tower base with the four $\frac{3}{8}$"-16 screws provided. Assemble the rainshield and flash-gap arm before mounting the unit (fig. 51). After mounting unit, open the front door by unscrewing all the thumbscrew fasteners and swinging back the fasteners on the side and on the top. Remove the hatch cover on the front panel by rotating the snap-fastener heads 90° to the left (fig. 52). The cable terminals will then be exposed in the lower right-hand corner of the opening. Loosen the hex head clamp ring on the bottom of the brass transmission line entrance bushing (fig. 51), but do not remove it. It is possible to feed the end of the transmission line through the bushing. If it is difficult to work through, further loosen the hex fitting. Feed through enough cable so that the lugs fit neatly into cable terminals. Connect the sheath of the transmission line (lead which comes out at an angle) to the right-hand terminal G. Connect the center conductor to the left-hand terminal. When the line is in place, tighten the hex fitting.

(2) The antenna connection is made with a $\frac{1}{2}$ inch bus tubing. The bus is supplied with Adcock radio range station kit and is drilled and preformed. Install the tubing according to figure 50. Hardware is provided on the stud of the output insulator on the tuning unit for fastening down this end.

(3) Bolt the tower end to the most convenient of the holes provided, using a $\frac{3}{8}$ inch hex head tower-assembly bolt. Keep lead centered between grounded members of the tower it passes through. Center the lead where it clears the cut-out hole in the bottom of the tuning unit cabinet. Bend the flash-gap arm so its position is approximately 1 inch of the tower lead.

(4) Connect the ground stud on the under side of the unit to the counterpoise-ground system by using a piece of the counterpoise wire. (Figures 53 and 54 show the antenna tuning unit removed from the housing.)

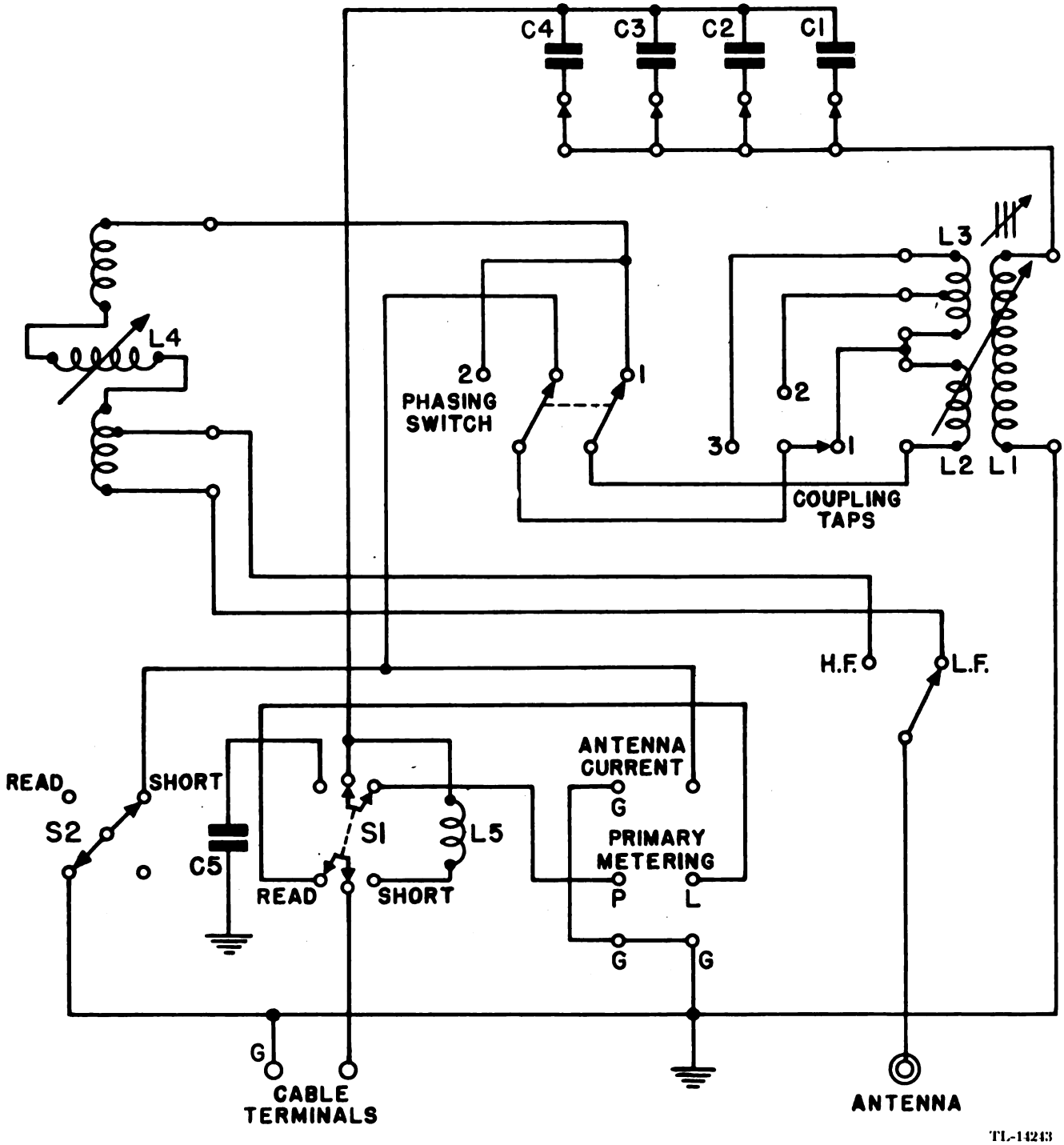
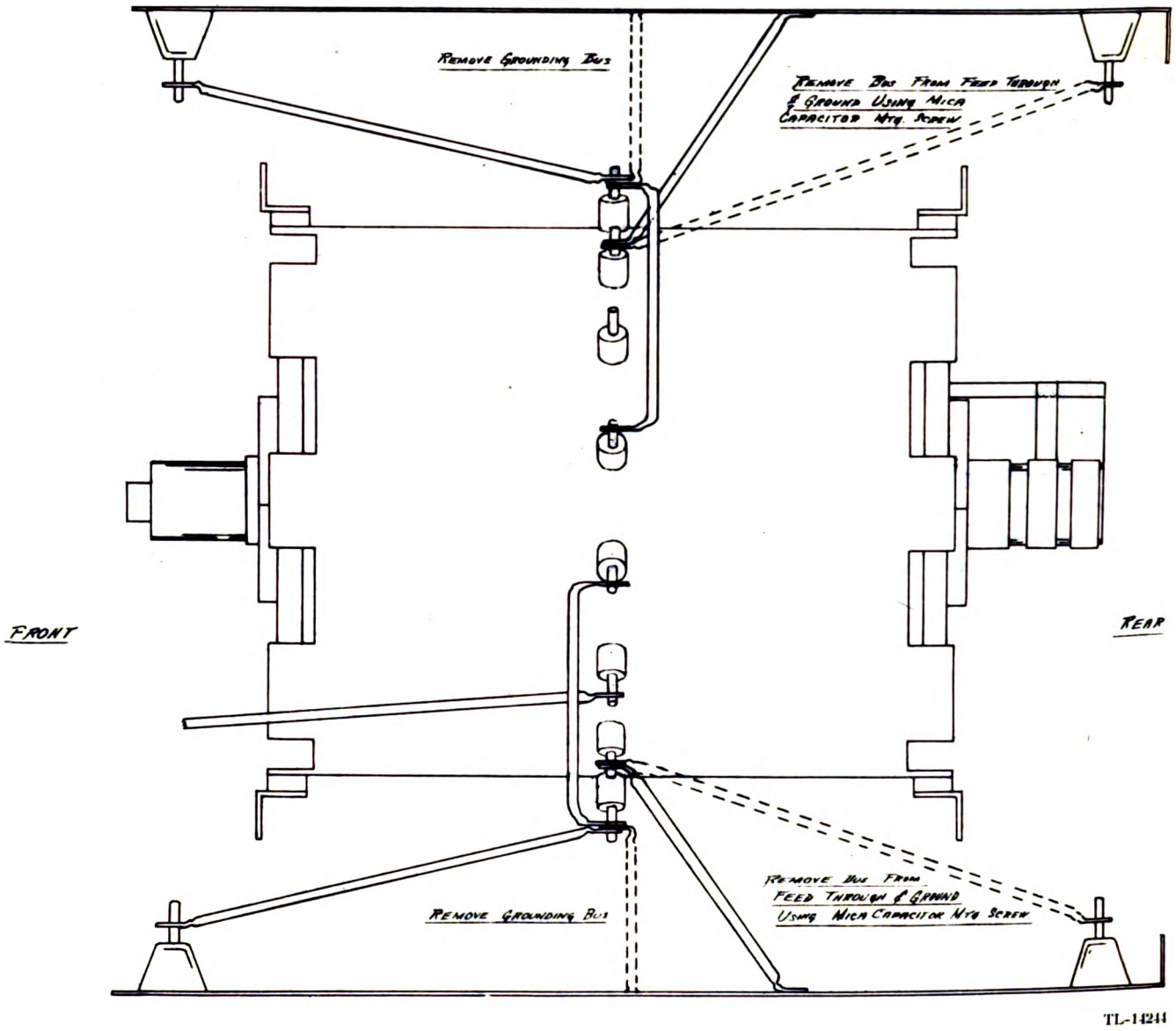


Figure 43. Antenna tuning unit, circuit diagram.



TOP VIEW OF GONIO. COMPARTMENT

NOTE: DOTTED BUS LEADS SHOWN BEFORE MODIFICATION.
SOLID BUS LEADS SHOWN AFTER MODIFICATION.

Figure 44. Goniometer bus changes.

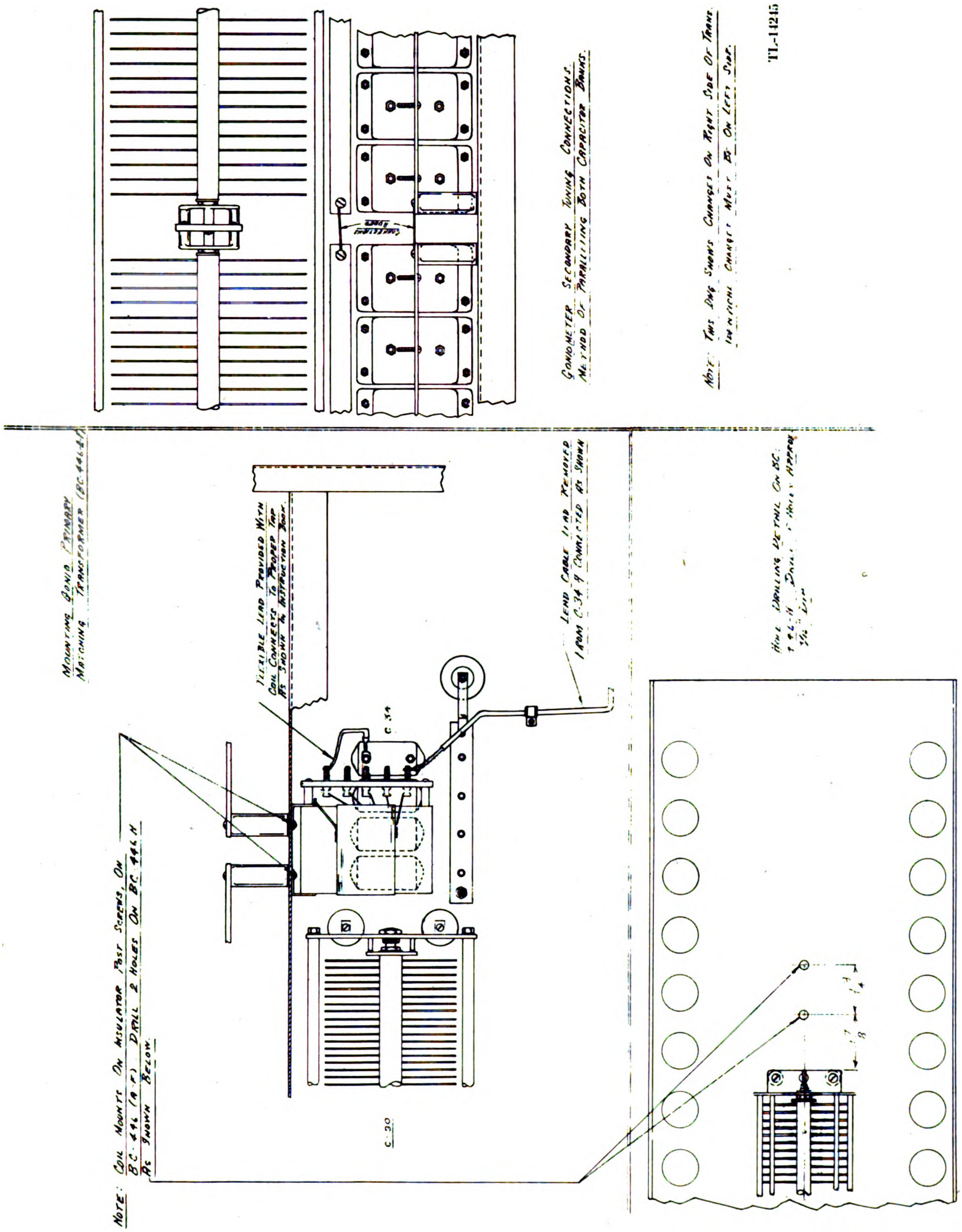
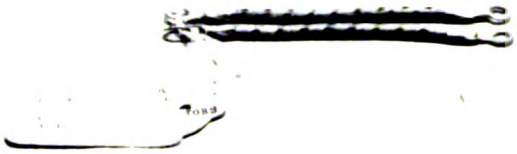
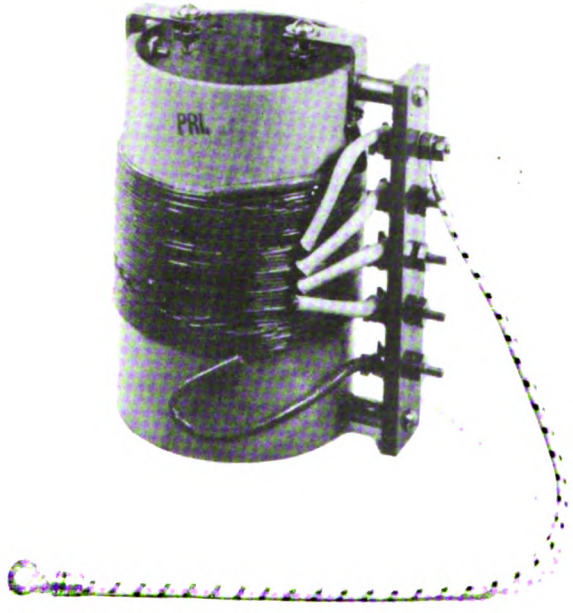


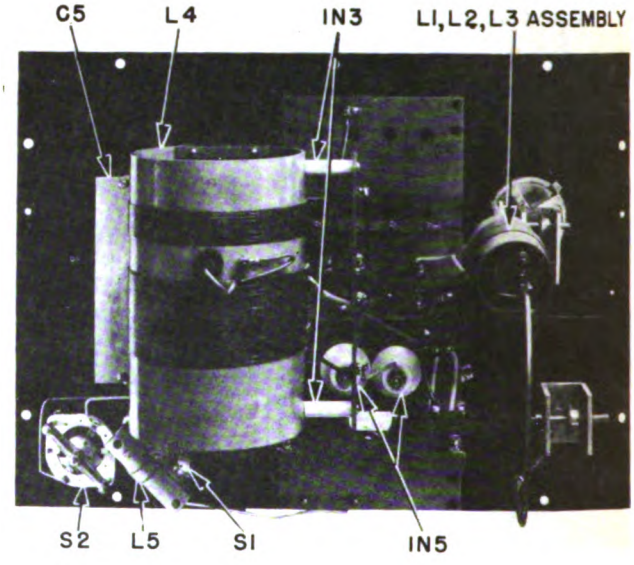
Figure 45. *Matching transformer mounting and capacitor paralleling connections.*



TL-14246

Figure 46. Goniometer secondary loading coil and capacitor paralleling connectors.





TL-14247

Figure 47. Antenna tuning unit, rear view and goniometer primary matching transformer with tap lead.

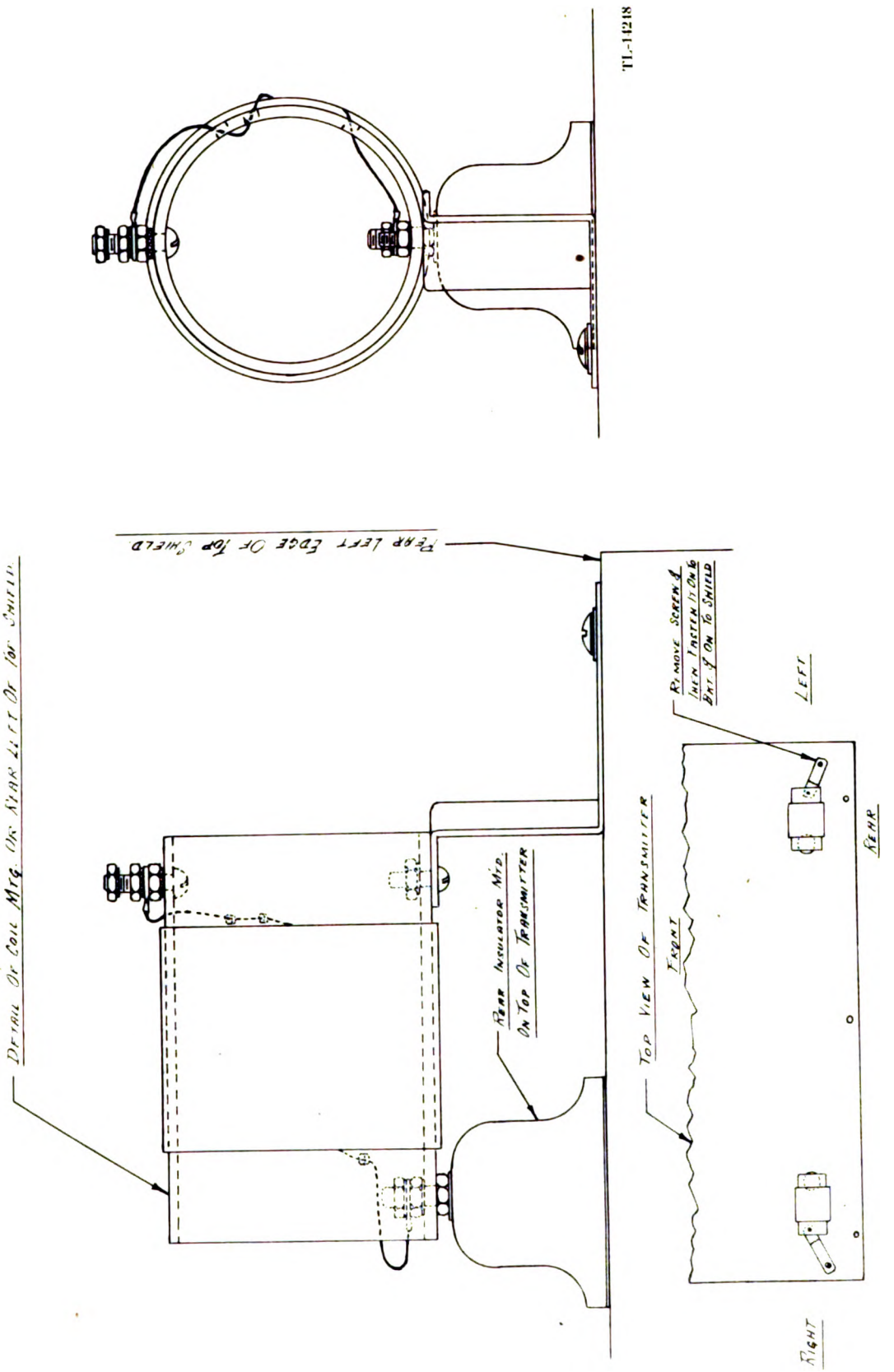
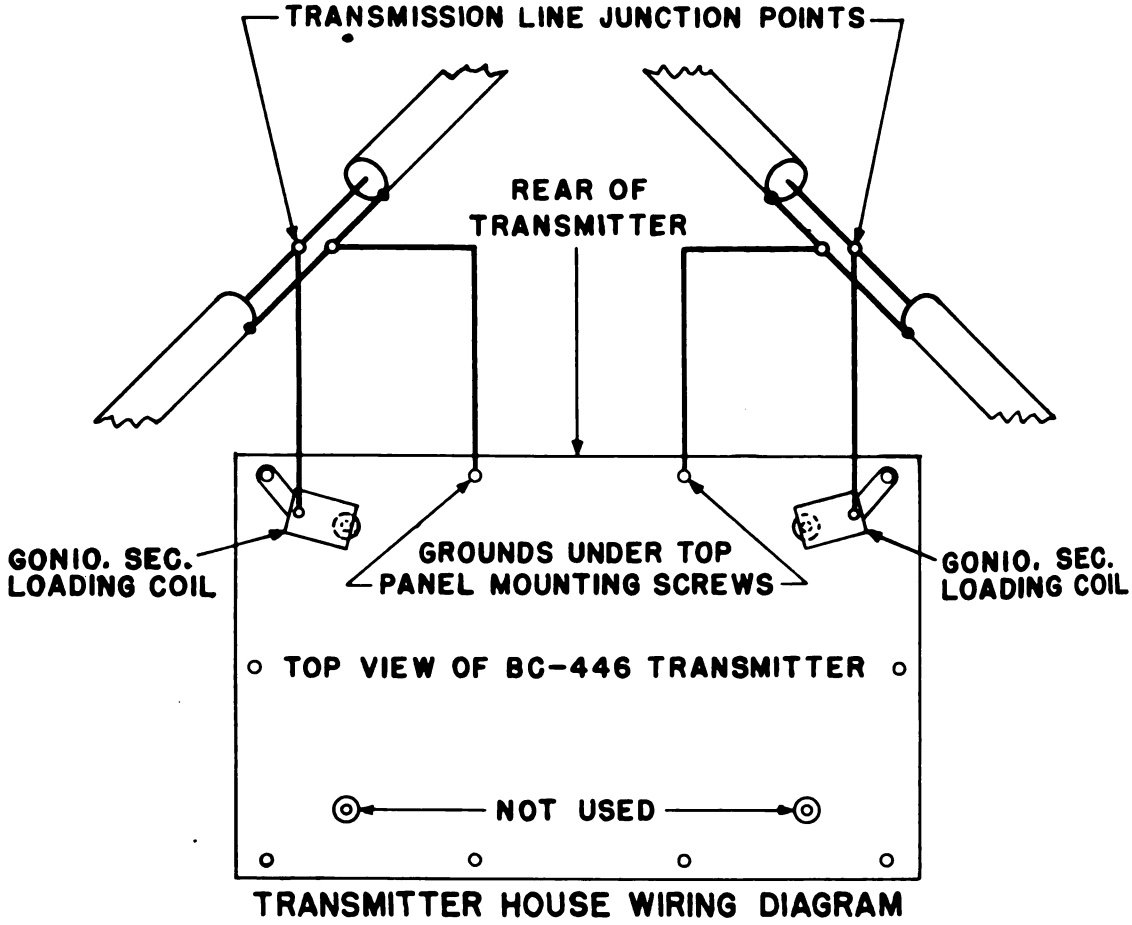
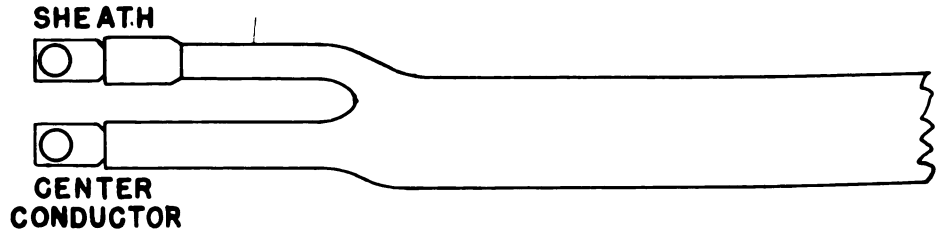


Figure 48. Goniometer secondary loading coil mounting.

NOTES:
1. External bus pairs to be separated from each other for minimum stray coupling.
2. Junction points to be located so that each transmission line has ample length to reach its tower.
3. Paralleled transmission lines go to diagonal towers.



TRANSMITTER HOUSE WIRING DIAGRAM



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CABLE TERMINAL DETAIL

Figure 49. Transmitter house wiring diagram and cable terminal detail.

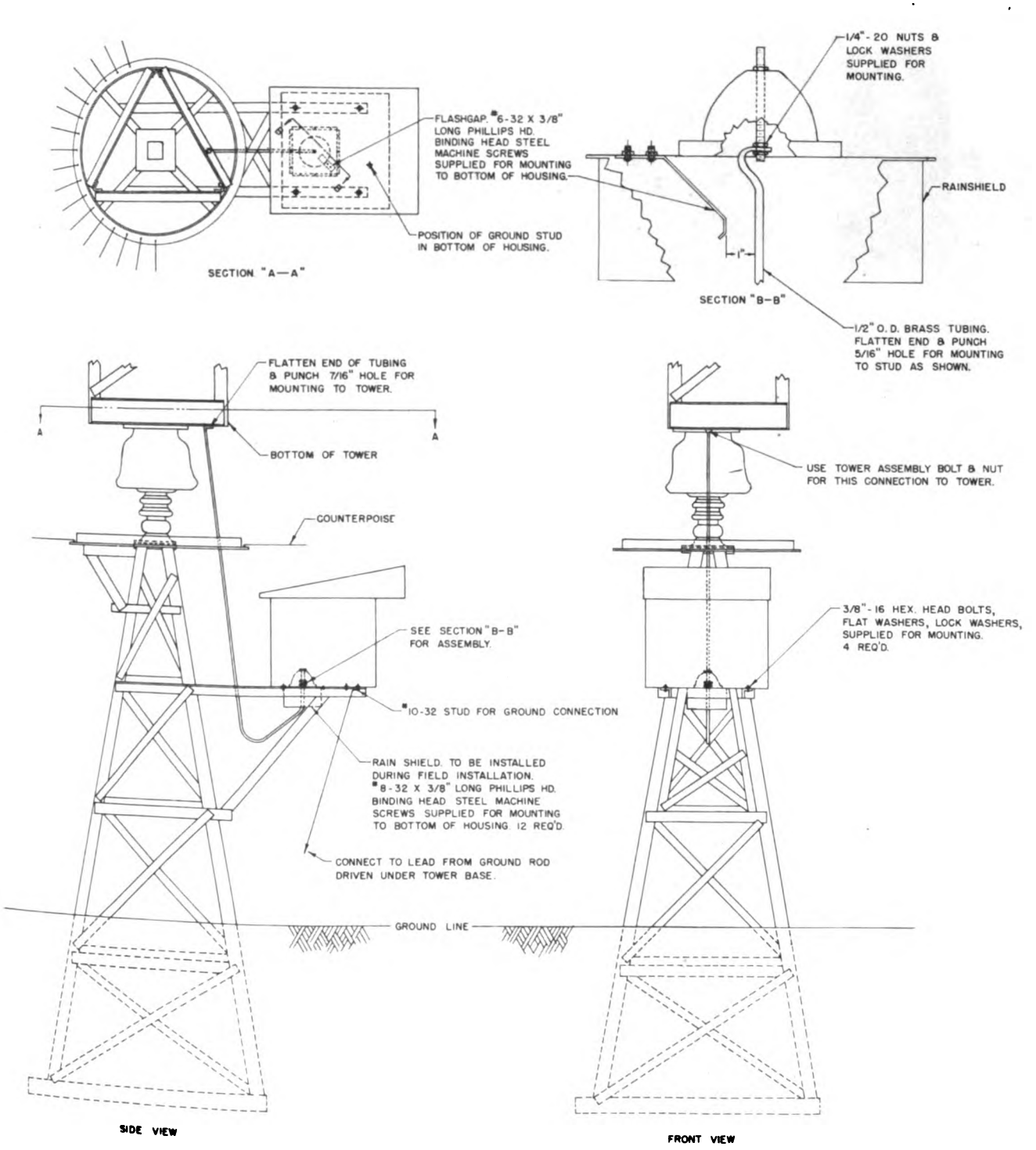
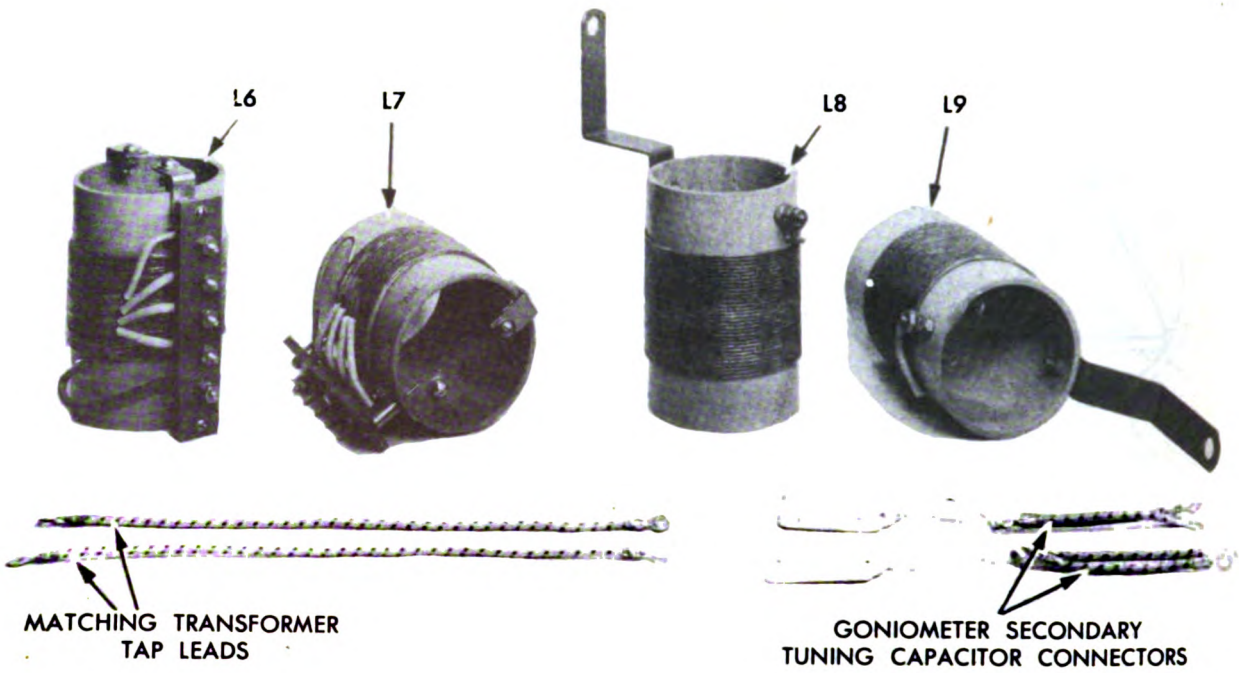


Figure 50. Antenna tuning unit, mounting details.



(Left background) goniometer primary matching transformers; (right background) goniometer secondary loading coils; (left foreground) matching transformer tap leads; (right foreground) goniometer secondary tuning capacitor banks paralleling connectors.

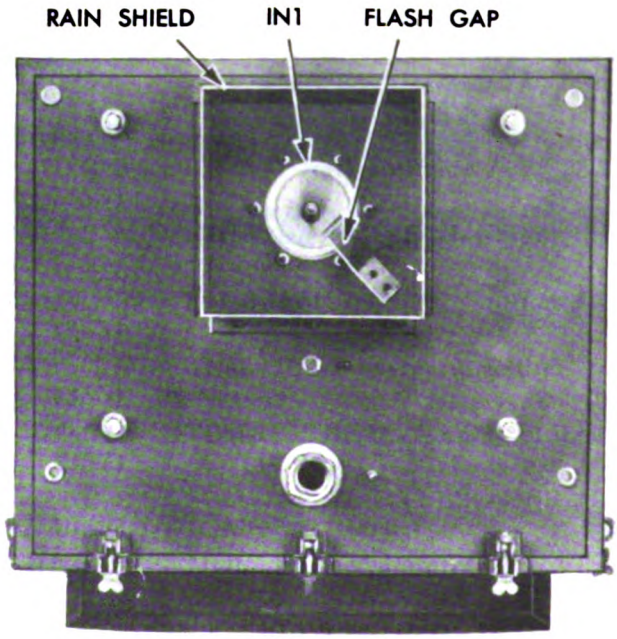


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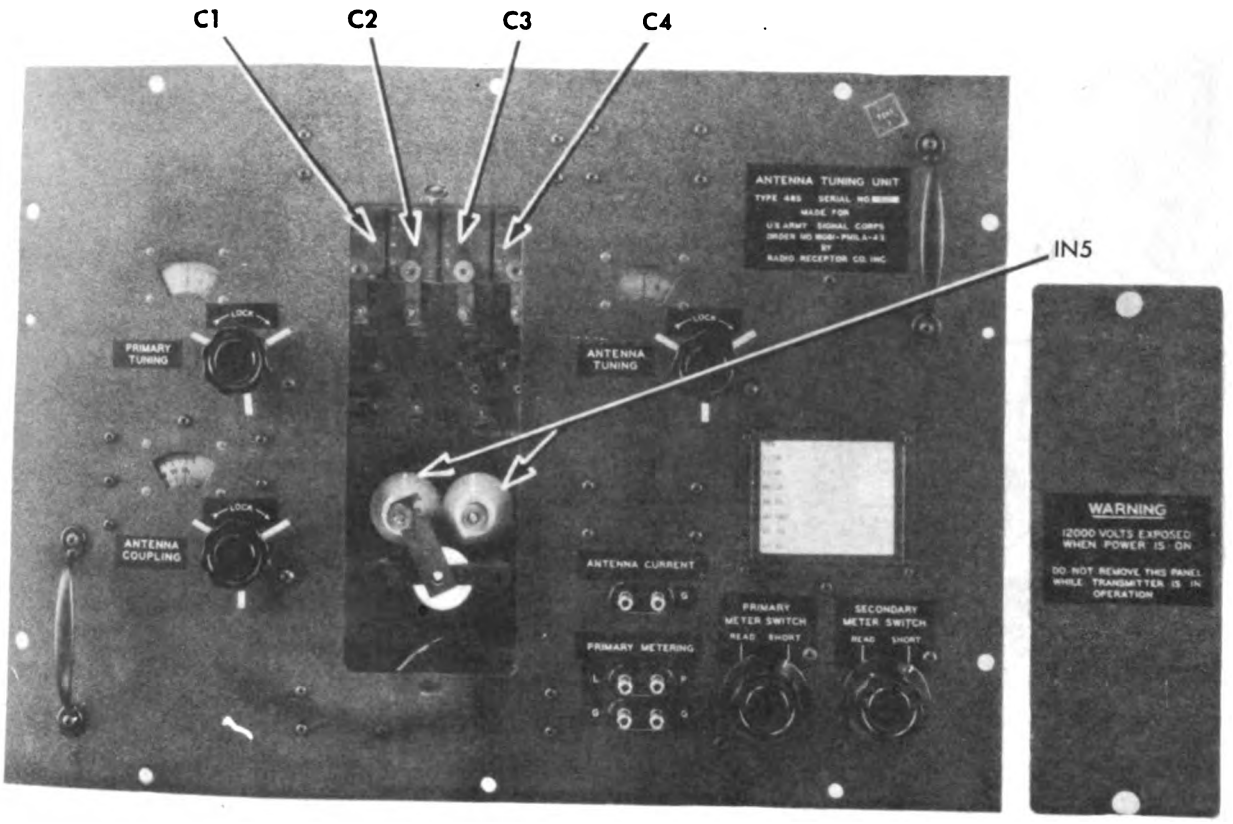
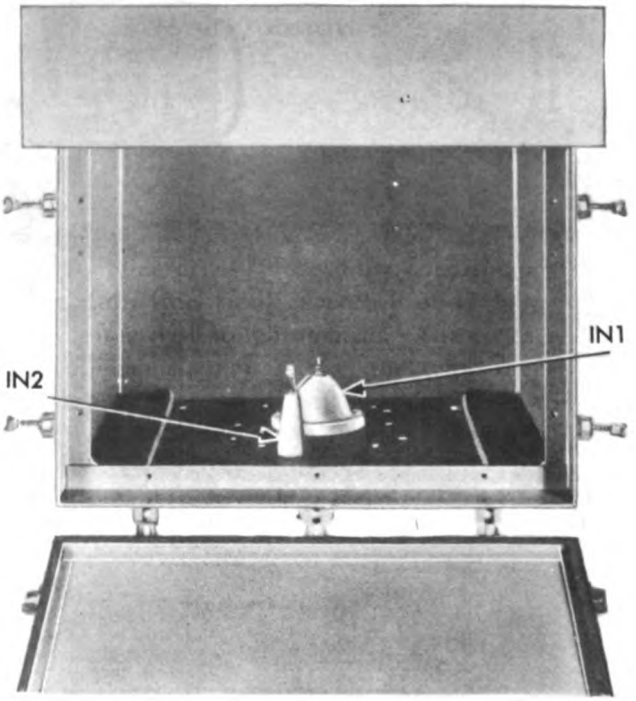
Figure 51. Antenna tuning unit, bottom view and transmitter tuning elements.





TL-14252

Figure 52. Antenna tuning unit, interior, and front view.

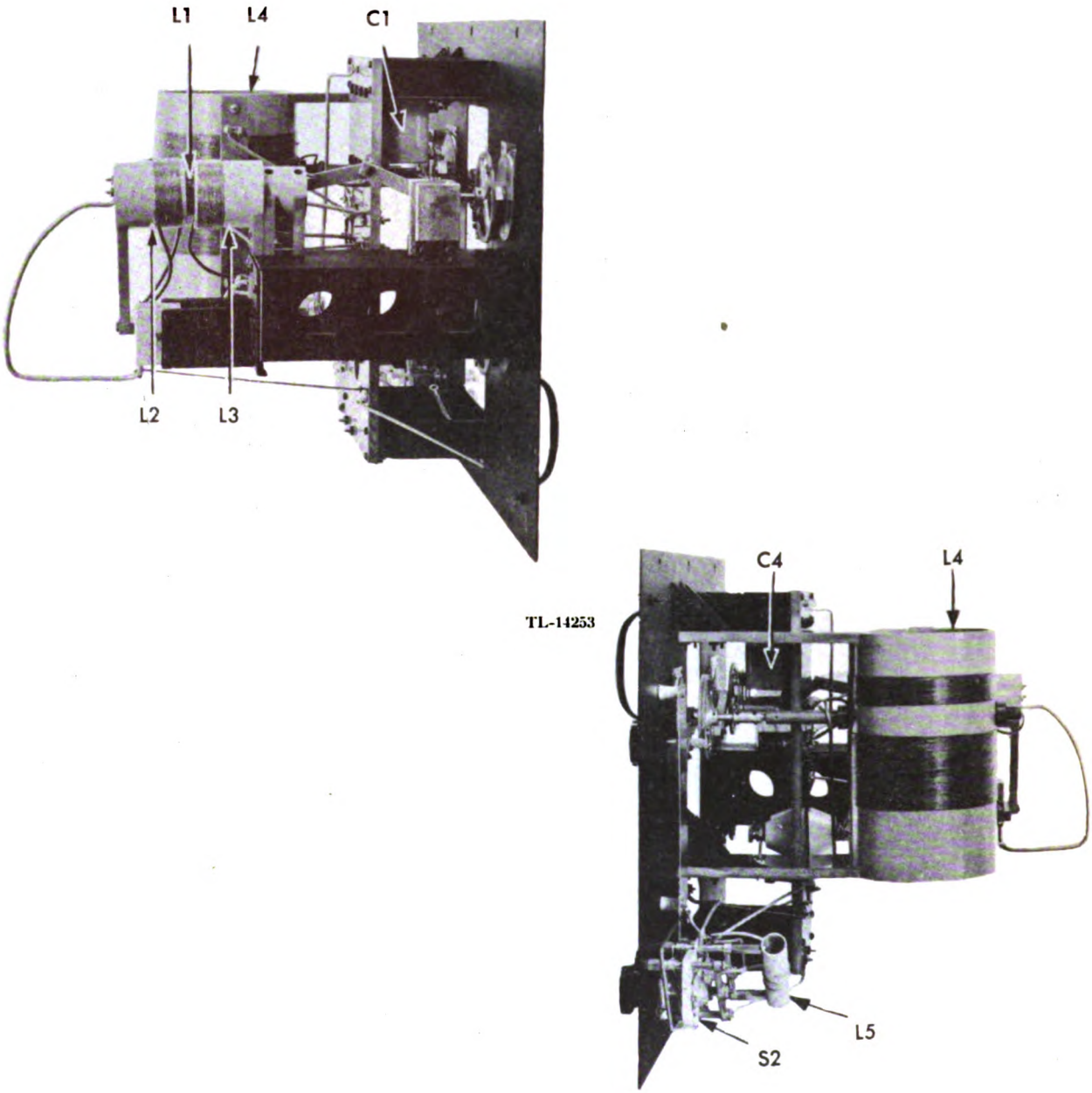
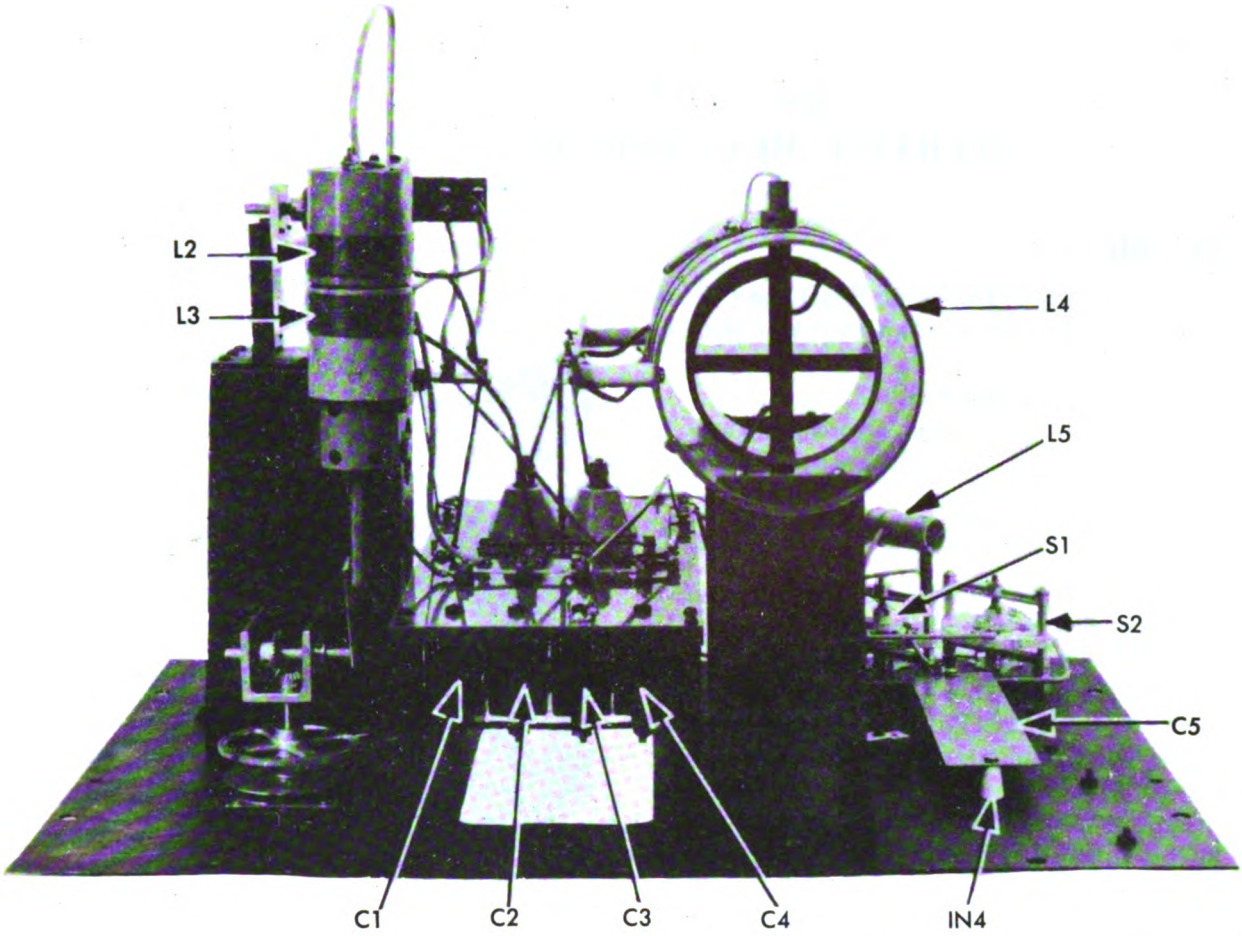


Figure 53. Antenna tuning unit, left and right side views.



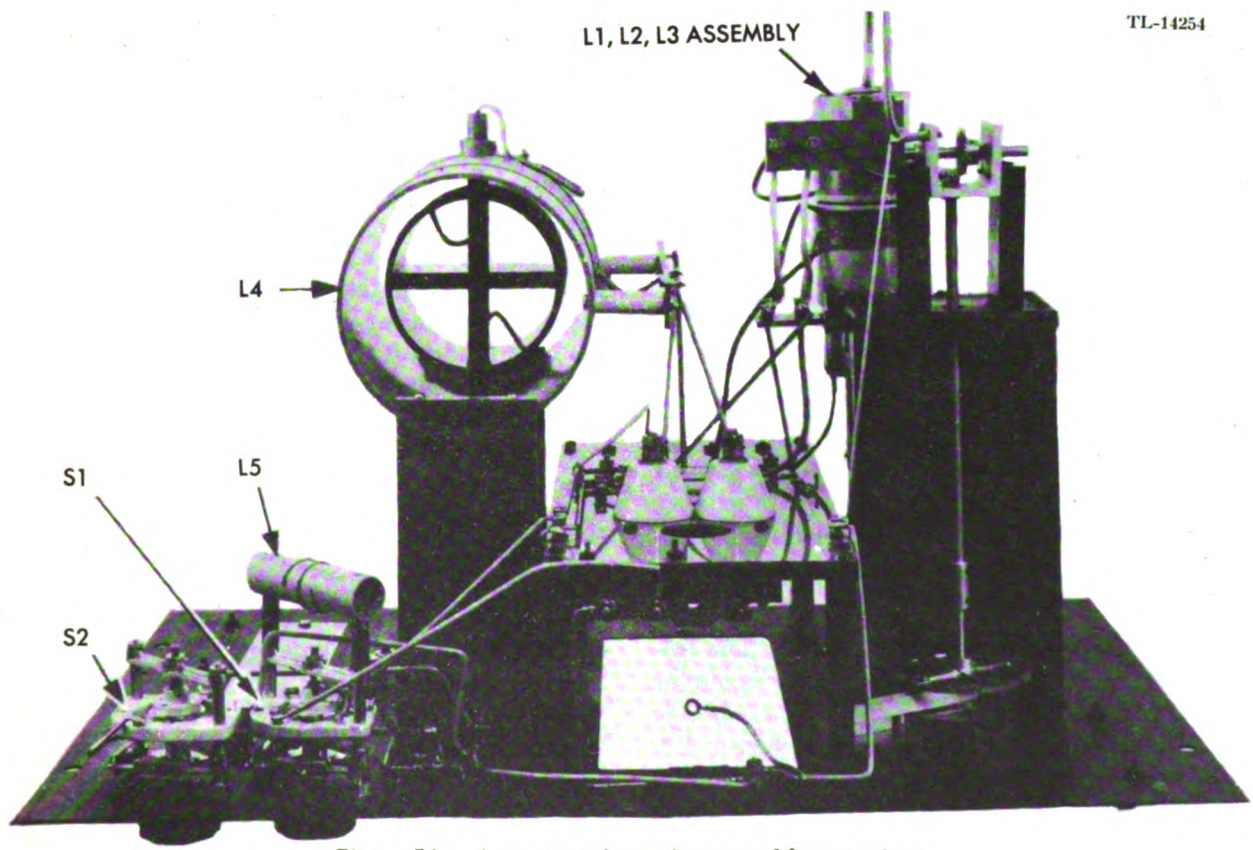


Figure 54. Antenna tuning unit, top and bottom views.

Section IX

IMPEDANCE MEASURING BOX, TYPE 470-ZA

70. DESCRIPTION

a. The Impedance Measuring Box Type 470-ZA is designed to measure impedances within the following limits:

Frequency range . .	200-400 kc
Resistance range . .	0-110 ohms, accuracy ±½ ohm
Reactance range . .	±0-10, ±0-20 ohms, 200-400 kc (for accuracy see subparagraph **b** following)
R-f power required .	10 watts minimum

b. The Impedance Measuring Box (fig. 55) is designed specifically to make impedance measurements in connection with the adjustment of an antenna tuning unit and associated equipment. In this case the impedance to be measured is largely resistive, and in any event the reactive component should be held to less than 10 ohms (capacitive or inductive) in the range 200-400 kc. The actual value of reactance need not be known so long as it is determined to be less than 10 ohms. The 0 to 300 ma r-f meter incorporated in the instrument can be used to measure current in outside circuits.

Figure 55. Impedance Measuring Box.

71. MATERIAL SUPPLIED

1 Impedance Measuring Box
1 Shorting bar
1 Patch cord
2 Patch cord
2 Preliminary Instruction Book

72. THEORY OF OPERATION

a. This instrument measures impedance by comparing the effect of the unknown resistance on the current in a circuit with the effect of a variable known impedance. When the known impedance has been adjusted to give the same current reading as that allowed by the unknown impedance, the latter has then been determined.

b. (Refer to fig. 56, circuit diagram.) The Impedance Measuring Box consists of a variocoupler with primary L1 and secondary L2, secondary resonating capacitor C1, standard inductor L3, meter fuse F1, r-f thermomilliammeter M1, test switch S1, and standard resistor decades R1 and R2. A static shield SH is placed between inductors L1 and L2 to minimize capacitive effects between them.

c. Variocoupler (L1-L2) introduces a current of the desired frequency into the test circuit. The test circuit consists of secondary inductor L2, standard inductor L3, tuning capacitor C1, meter fuse F1, and meter M1 all connected in series. By means of test switch S1, this circuit may then be made to include either the standard resistor decades R1 and R2 (known resistance) or the unknown impedance connected across the terminals marked UNKNOWN, M and G.

d. Inductor L3 is a small variometer designed to give symmetrical changes in inductance on either side of its mean (average) inductance. Assume that L3 is set at its mean inductance and that a pure resistance is connected across the UNKNOWN terminals M and G. The test switch is then thrown to include the standard (known) resistor decades R1 and R2, and the circuit resonated by tuning capacitor C1. By switching between the standard and unknown resistors and increasing the standard resistance, the unknown resistance is determined by adding enough standard resistance to give equal readings on meter M1.

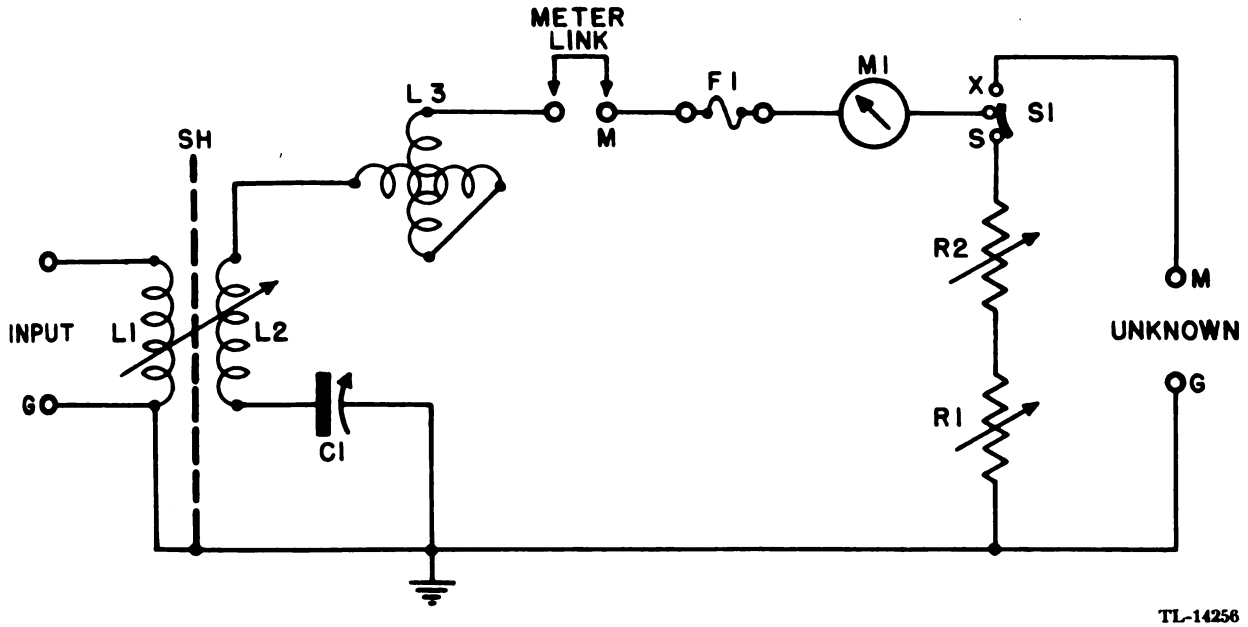


Figure 56. Impedance Measuring Box, circuit diagram.

e. Under these conditions, suppose that the unknown presents a small amount of reactance, either capacitive or inductive. In order to get the same current reading it will be necessary to re-resonate the test circuit. By re-resonating with standard inductor L3, the unknown reactance can be measured directly. If the unknown reactance is capacitive, L3 will have to increase and vice versa. Since in this application it is desired to keep the unknown reactance at 10 ohms or less, it is only necessary to supply a curve showing dial readings of L3 for a reactance of 10 ohms against frequency in the range 200 to 400 kc. This curve is given in the standard reactance dial calibration chart (fig. 57). The dial of the standard inductor L3 is arranged so that the sign of the unknown reactance is indicated directly, e.g., if the standard reactance dial indicates capacitive to secure re-resonance, then the unknown reactance is capacitive.

73. USE OF METER IN EXTERNAL CIRCUITS

a. Where an r-f meter is needed in the tuning procedure for the antenna tuning unit, the meter M1 of the Impedance Measuring Box may be adapted for this purpose by means of the special patch cord (fig. 60 ①), supplied with this instrument. One end of this cord is terminated with individual banana plugs and pig-tails about 4 inches long; the other end is terminated by a double banana plug shunted by a 1 ohm, 2 watt resistor R3 (fig. 60 ①). The double banana plug and shunt are inserted in the proper terminals of the antenna tuning unit. The single plugs are inserted in the two terminals marked M on the METER LINK and UNKNOWN terminal strips. By removing the shorting bar across the METER LINK terminals and throwing the test switch to position X, the meter is then connected to the external circuit.

b. The shunt resistor on the double plug effectively short circuits the patch cord inductance and increases the meter range to about 1.5 amperes. The current in the circuit to be measured should be reduced accordingly to that value and should not be left flowing through the shunt for more than 2 or 3 minutes at a time, since the resistor used will not safely sustain 1.5 amperes continuously.

74. OPERATION OF IMPEDANCE MEASURING BOX

a. **General.** The location of controls and terminals is shown in figure 59. All operations indicated following should be carefully carried out. This procedure is given with particular reference to the tuning of antenna tuning unit.

b. **Connections.** Two patch cords (fig. 60) are supplied with the instrument. These cords are terminated by double banana plugs at each end. The letter G engraved on one side of each of these plugs indicates connection to a ground terminal. In all cases be sure that ground terminals are connected together. Connect one cord from the INPUT terminals of the Impedance Measuring Box to the r-f source of power on the transmitter. Con-

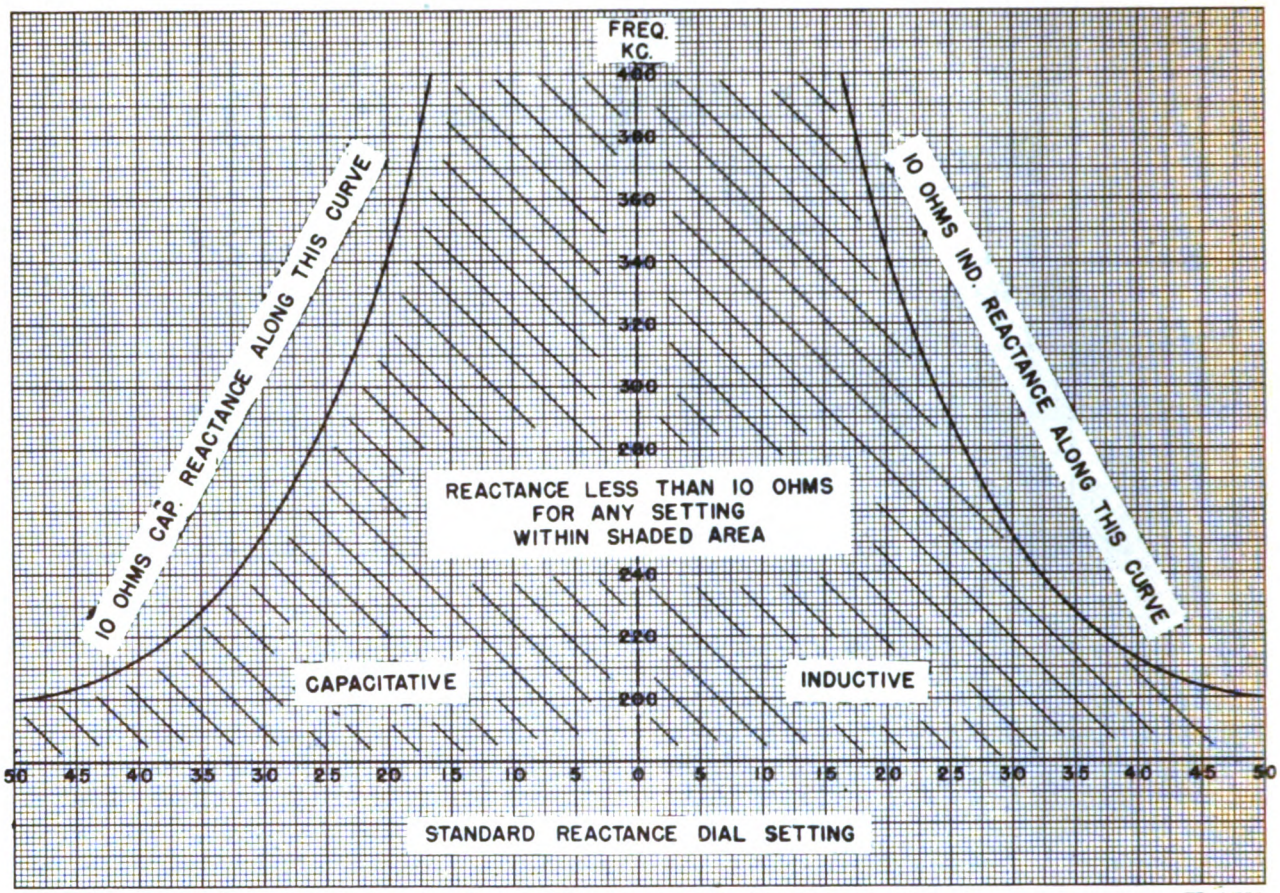


Figure 57. Standard reactance dial calibration chart. TL-14257

nect the other cord from the UNKNOWN terminals to the unknown impedance. Make sure shorting plug is across METER LINK terminals.

c. Resonating Test Circuit.

(1) Set COUPLING dial to zero.

(2) Set STANDARD REACTANCE dial to zero.

(3) Set TEST SWITCH to S (standard or known).

(4) Set STANDARD RESISTANCE to approximate expected resistance (10 or 70 ohms).

(5) Set TUNING dial according to tuning dial calibration chart (fig. 58).

(6) Increase COUPLING until meter reads about one-third full scale. The COUPLING dial increases coupling as it is turned up from zero. Do not attempt to turn it past zero or 50, as it is mechanically stopped at these points.

(7) By means of the TUNING dial, refine the tuning until accurate resonance, as indicated by maximum meter reading, is reached. Back off the COUPLING control if necessary.

d. Resonating Unknown Circuit.

(1) Leave controls as set in paragraph 65c but turn test switch to X (unknown).

(2) Adjust tuning control of unknown for maximum meter reading, indicating resonance.

e. Finding Unknown Antenna Resistance. In this operation the test circuit should previously have been resonated with 10 ohms of standard resistance. To find the unknown antenna resistance, throw the test switch back and forth between the known and unknown positions, raising or lowering the standard resistance until equal meter deflections are obtained in both positions.

WARNING.—Perform the required operations carefully. Make sure that the resonant points are accurately determined, since the validity of the measurements depend on them. Be sure that the expected resistance is in the circuit for any particular setting of the coupling dial, otherwise the meter may be damaged by sudden unexpected current surges. The fuse is only limited protection.

75. MAINTENANCE INSTRUCTIONS

a. The instrument should be handled very carefully to avoid damage by sudden jars and bumps.

b. Blow all dust from the interior of the instrument.

c. Clean the contactors of the standard resistor decades occasionally with carbon tetrachloride, and re-coat with a thin film of Grease, Lubricating, Special, Ordnance AXS-637, GL, or Petro-

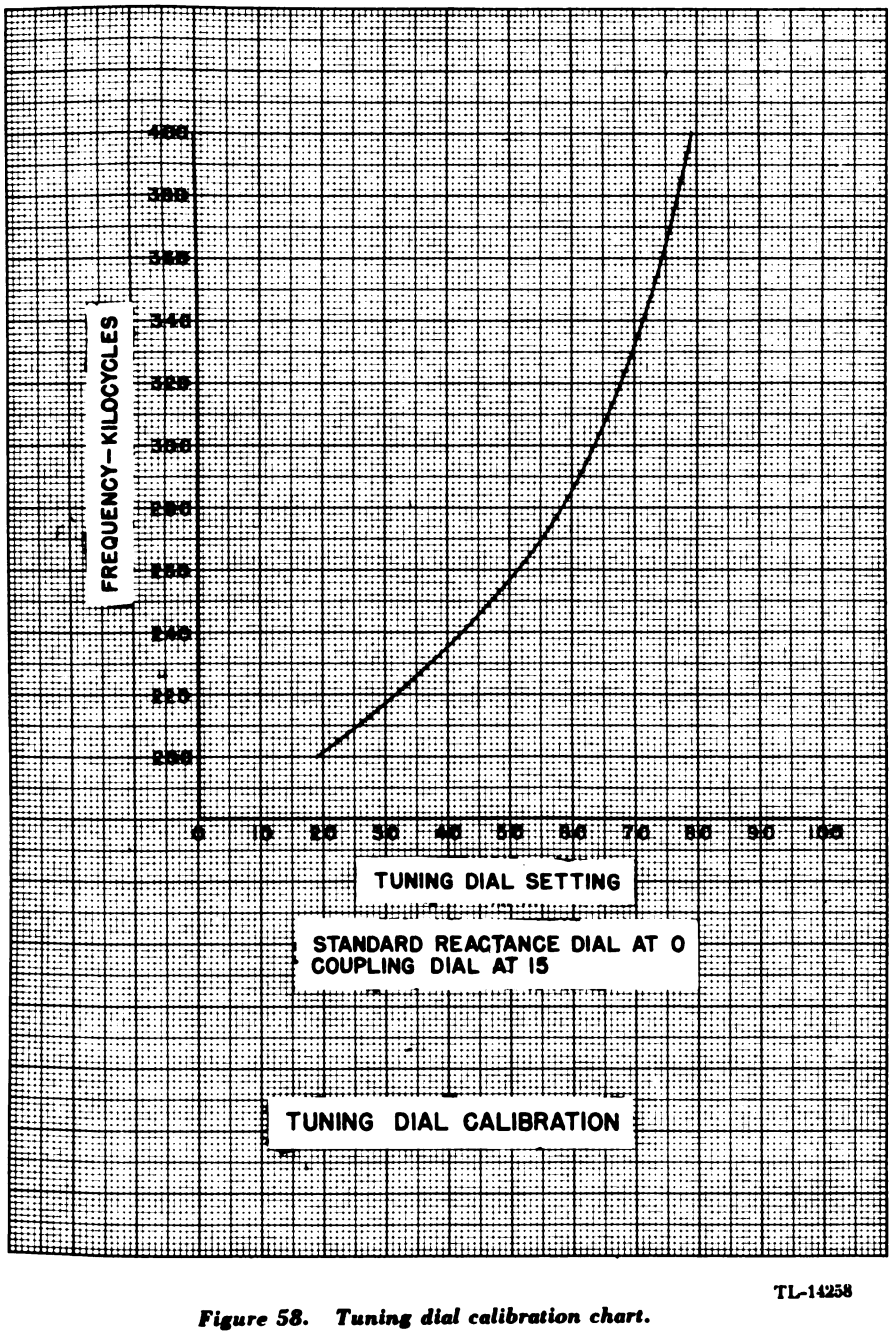


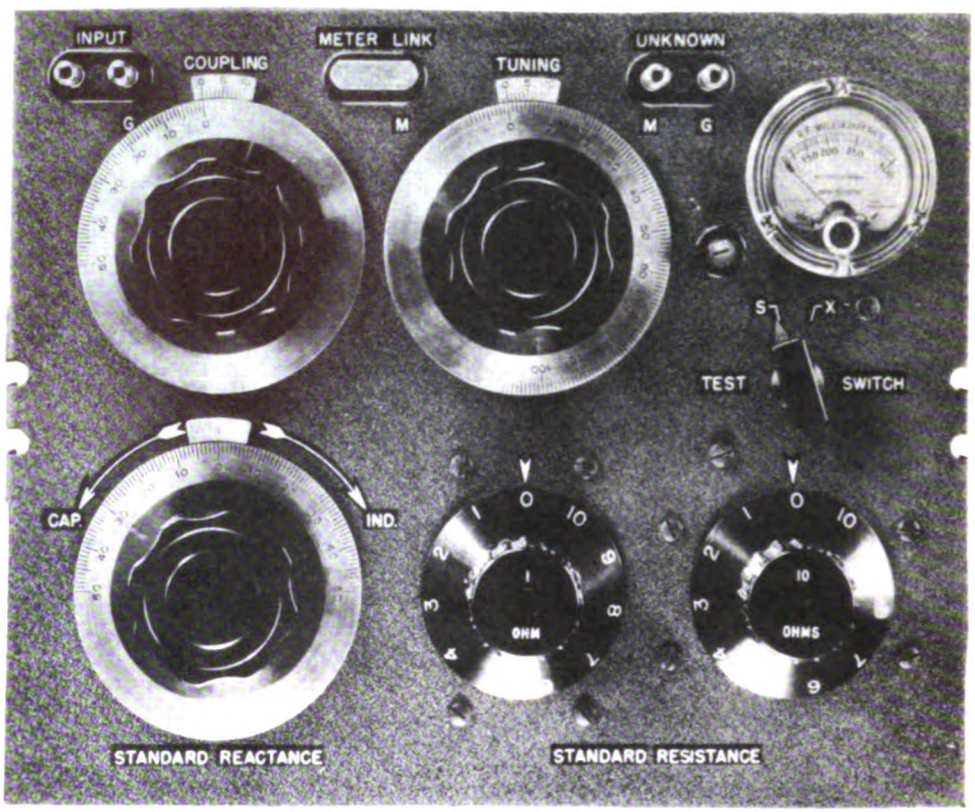
Figure 58. Tuning dial calibration chart.

latum, U. S. Army 2-67A if the former is not available. The switch contactors should not be filed or sanded or the springs adjusted unless an experienced person deems it necessary and performs the work.

d. Do not flex the patch cords unnecessarily. They should be examined for broken strands of wire and any necessary repairs made immediately.

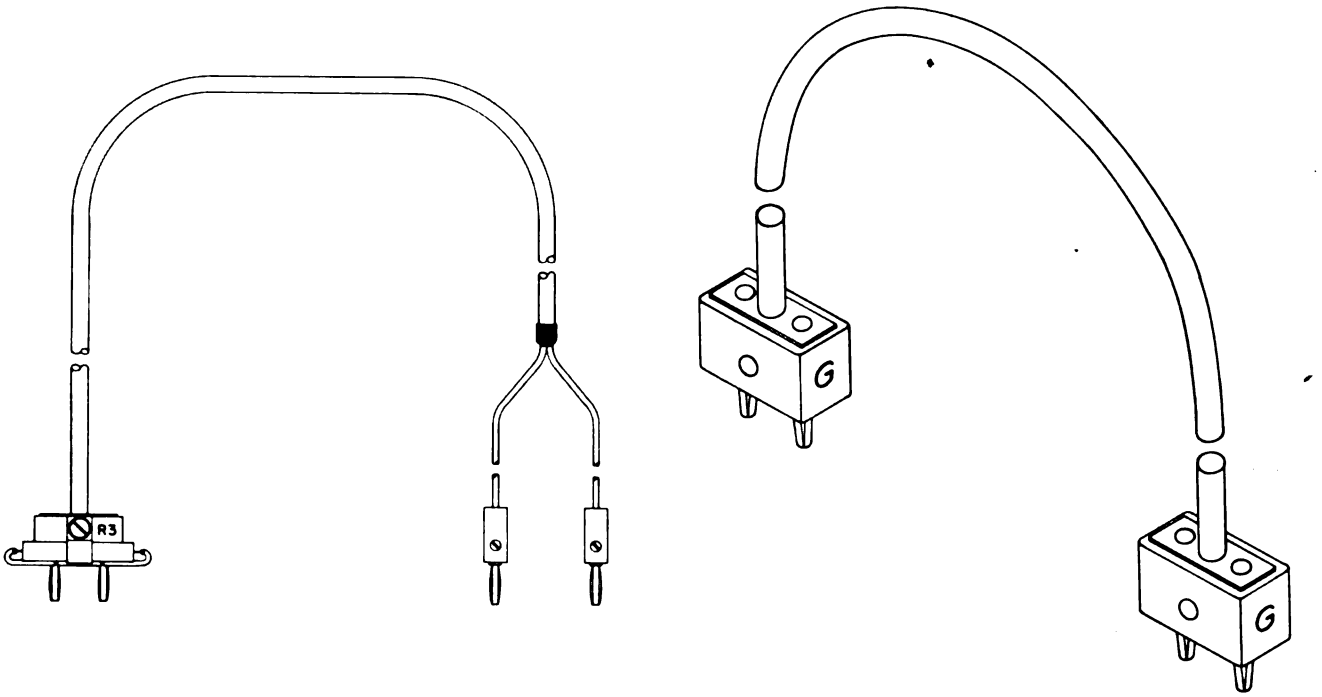
e. Great care should be taken in replacing any parts in this equipment. Any faulty part should be replaced by an identical replacement part and care should be taken that good electrical connections are made. Any deviation from this procedure will result in a change of electrical characteristics and will result in errors in data given by the equipment. *Repairs should be made only by a competent repairman.*

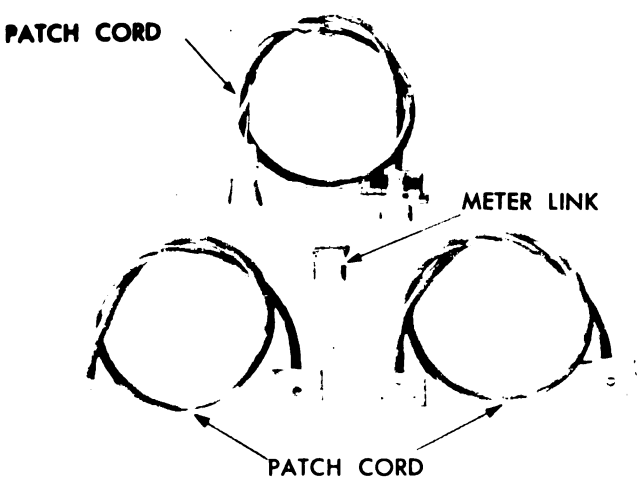
f. Should the instrument become inoperative, and after tests made on it by a trained repairman, it is found that parts are to be replaced, great care should be taken in making any parts replacement. All parts replaced should be exact duplicates of parts removed and no substitutions should be made unless it is definitely known that the substitution to be used has exactly the same specifications as the original. Replacements made with approximate values would render instrument inaccurate as impedance measuring device. Care should be taken in placing parts in same positions as those removed and care should be used in soldering.



TL-14259

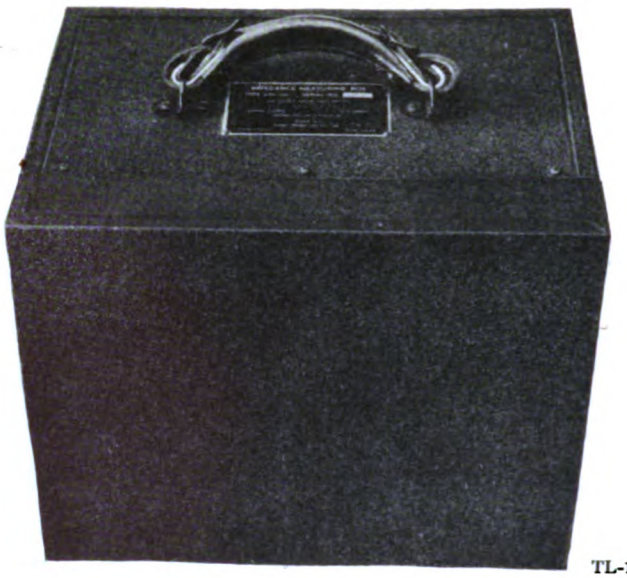
Figure 59. Impedance Measuring Box, panel view.





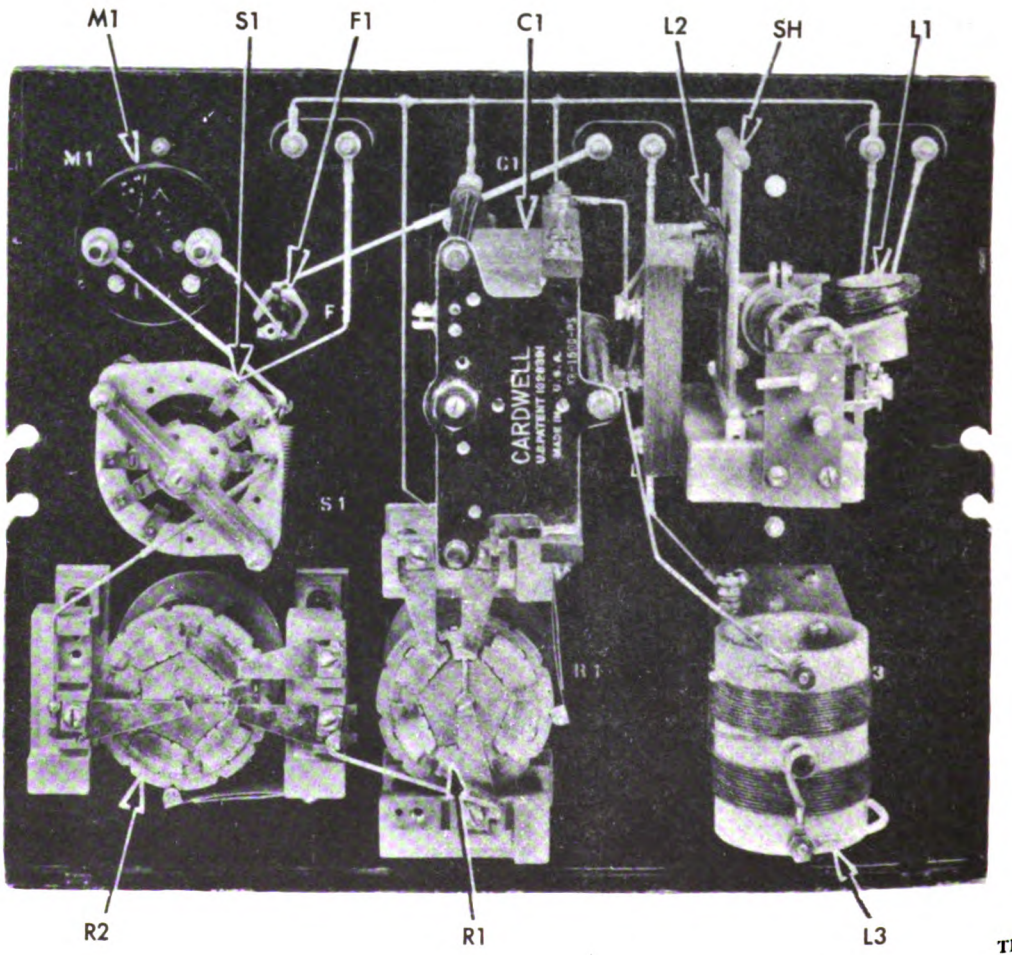
TL-14260

Figure 60. Impedance Measuring Box, patch cords.



TL-14261

Figure 61. Impedance Measuring Box, front cover closed.



TL-14262

Figure 62. Impedance Measuring Box, rear interior view.

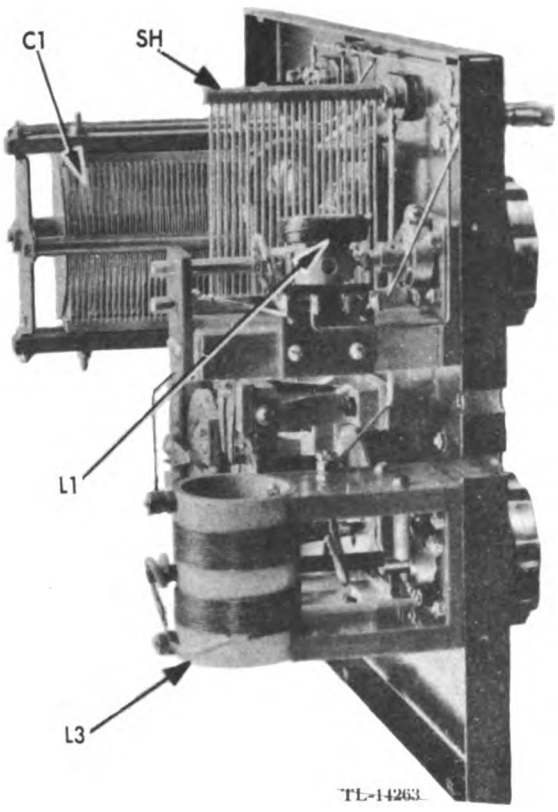


Figure 63. Impedance Measuring Box, left side interior view.

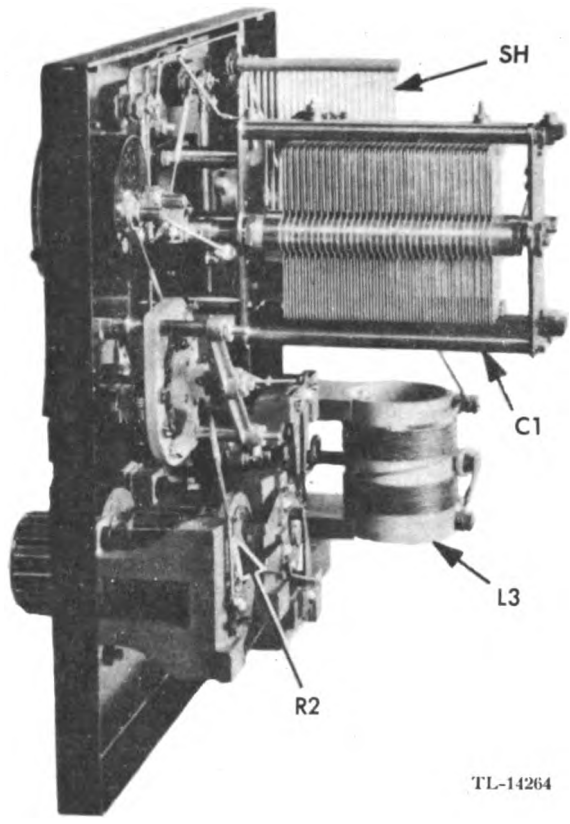
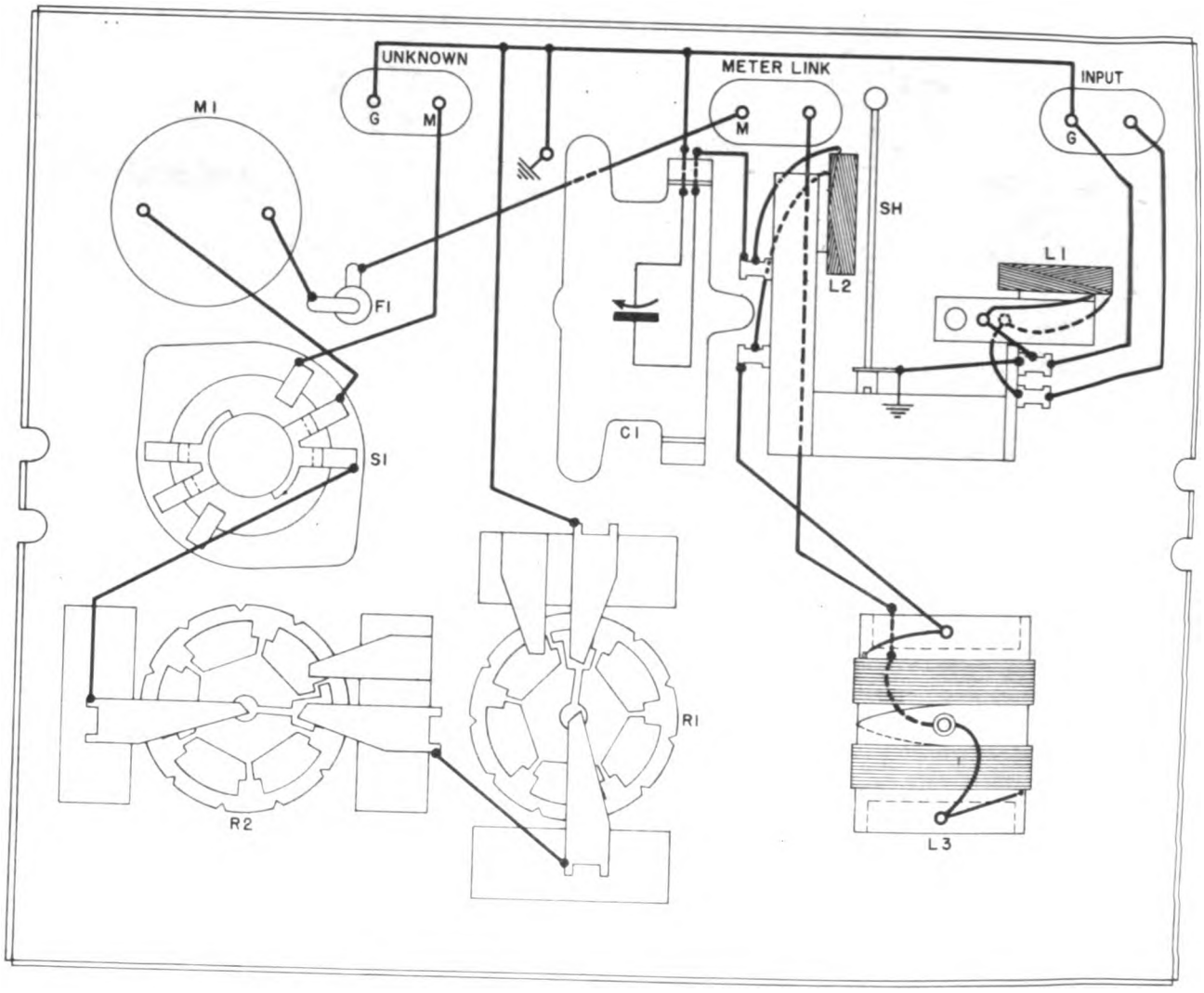
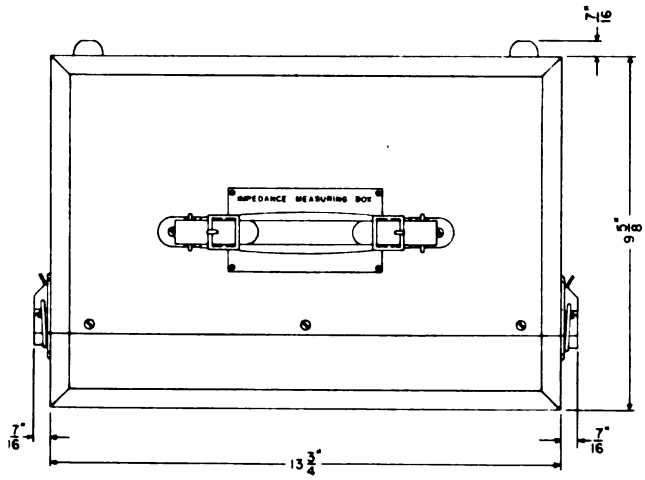


Figure 64. Impedance Measuring Box, right side interior view.

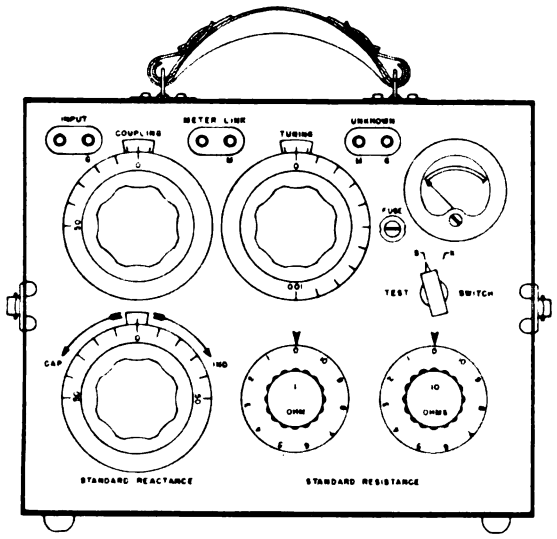


TL-14265

Figure 65. Impedance Measuring Box, wiring diagram.



APPROXIMATE WEIGHT = 22 LBS.



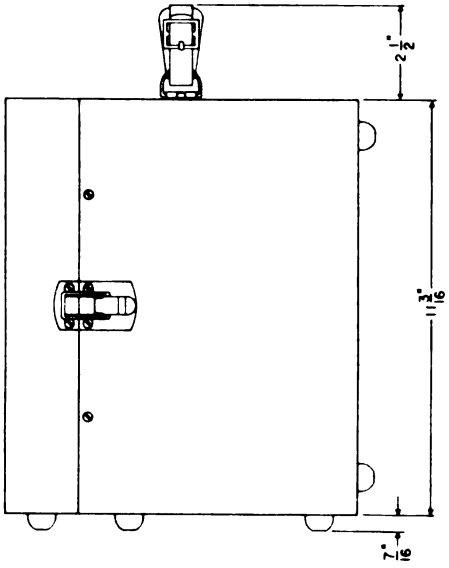


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Figure 66. Impedance Measuring Box, outline diagram.

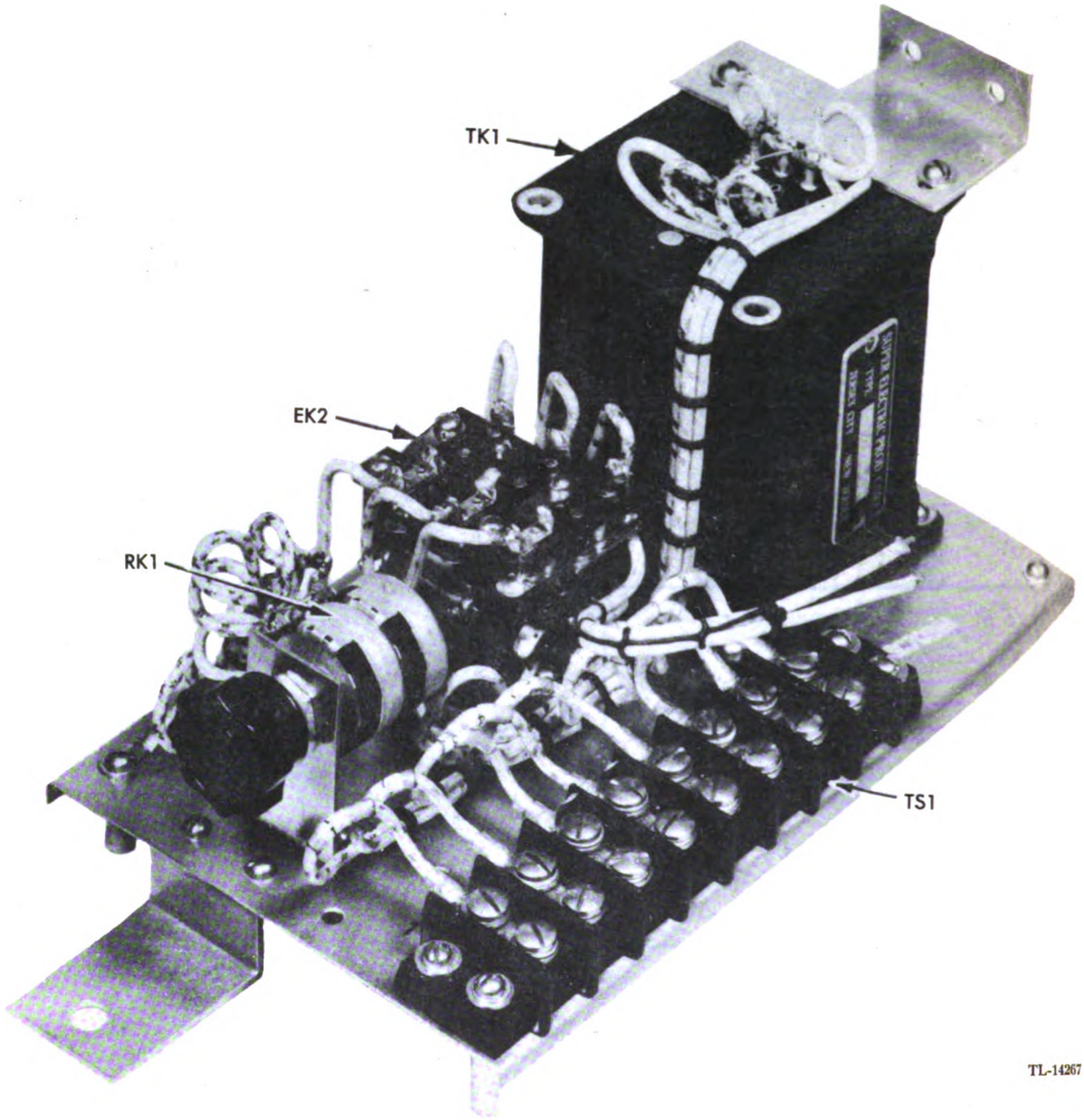

Figure 67. Phone-range selector unit.

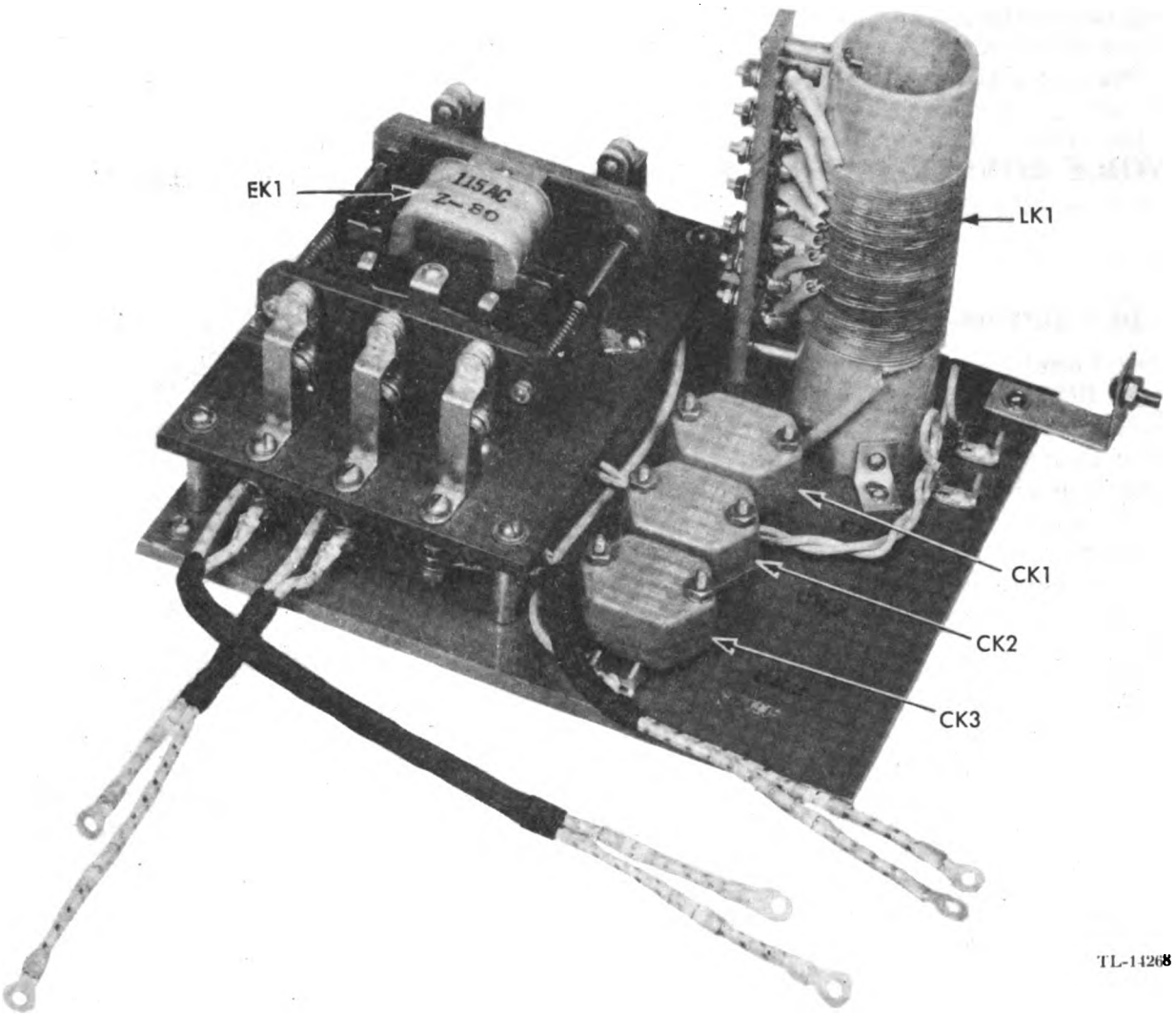

Figure 68. Quarter-phasing unit.

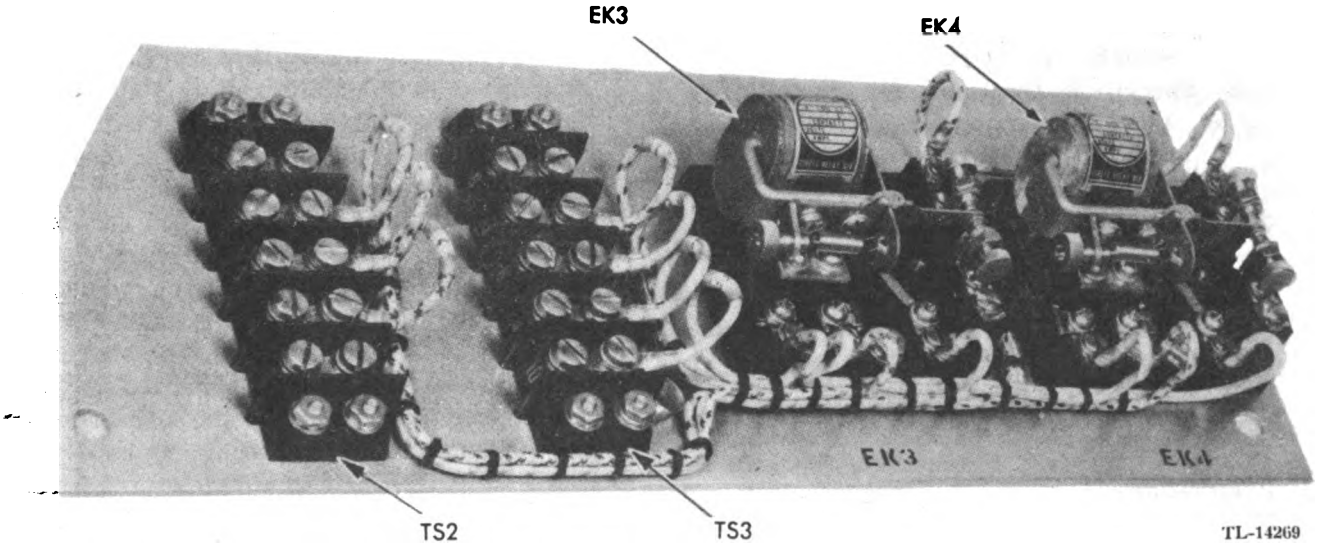

Figure 69. Control relay unit.

Section X

VOICE CONVERSION KIT FOR RADIO TRANSMITTERS BC-446-(A to H)

76. DESCRIPTION

The Voice Conversion Kit for Radio Transmitters BC-446-(A to H) is used to provide voice broadcast operation as well as radio range operation of Radio Transmitters BC-446-(A to H) in conjunction with Remote Control Unit RM-45-A. The component parts of the voice conversion kit are designed to be installed as an integral part of Radio Transmitters BC-446-(A to H) either permanently or to be removed when voice broadcast operation is no longer desired. The Voice Conversion Kit is already incorporated in Radio Transmitter BC-446-J as one of its components.

77. LIST OF MAIN COMPONENTS

A complete Voice Conversion Kit consists of the following items:

1 Control relay unit (fig. 69)
1 Phone-range selector unit (fig. 67)
1 Quarter-phasing unit (fig. 68)
1 Interunit cable No. 1
1 Interunit cable No. 2
1 Interunit cable No. 3
1 Remote Control Unit RM-45-A, complete with vacuum tube VT-145 (JAN 5Z3), fuse, pilot lights, two desk stand Microphones T-32 (Kellogg) with press-to-talk switch, and instruction books
2 Special Instructions for Installation of Voice Conversion Kit in Radio Transmitters BC-446-(A to H)

78. ELECTRICAL CHARACTERISTICS

Frequency range	200 to 400 kc
Power output	0 to 100 watts carrier, as supplied by Radio Transmitters BC-446-(A to H)
Modulation capability	100% modulation, either voice or tone
Control	Local or remote by means of Remote Control Unit RM-45-A
Power requirements	115 v, 60 cycles, a-c, taken from input to Radio Transmitter BC-446-(A to H)
Ambient temperature range	−15 C to +50 C
Audio output	6 milliwatts (zero level) across 600 ohms
Remote operation	Two pairs of 600 ohm telephone lines not over 6 miles long, from Remote Control Unit RM-45-A

79. THEORY OF OPERATION

a. The highly directional field pattern of the standard radio range loop antenna system is unsuitable for voice broadcast operation. This results from the figure-8 pattern produced by a loop antenna which has pronounced nulls at 90° from the plane of the loop. With two loop antennas excited in phase as when the radio range goniometer is set away from 0°, 90°, 180°, or 270°, this same directional field pattern is obtained.

b. Aircraft whose position is in the null of such a directional antenna would receive no signal. However, a circular field pattern without any sharp nulls can be produced with two crossed loop antennas which will be suitable for voice broadcast, if proper phase relations are established between these two antennas. To do this, two crossed loop antennas are fed *equal currents which are 90° out of phase* with each other.

c. This phase relationship can be most easily established in the radio range goniometer primary circuits. With both primaries fed in parallel from the link circuit with a phasing capacitor in series with one primary and a phasing inductor in series with the other, the primary currents will be 90° out of phase when the reactance of the capacitor and the reactance of the inductor each have a value equal to the load resistance reflected into each goniometer primary. The load imposed on the link-circuit by both primaries in parallel will be exactly the same as the load imposed by one primary in normal range operation. The course shifting L pad is not connected when the phasing components are in the circuit.

d. Changing the antenna pattern from the directional four course radio range pattern to the

circular pattern for voice broadcast is accomplished by the quarter-phasing unit components. The phone-range selector unit provides for the change from tone modulation of Radio Transmitter BC-446-(A to H) to a 600 ohm voice input circuit.

e. The relays on the control relay unit are operated by d-c current supplied through the telephone lines from Remote Control Unit RM-45-A. These relays control the START, STOP, and change over from RANGE operation to VOICE operation of the transmitter.

80. UNPACKING

a. Open the packing case carefully to avoid damage to the enclosed cartons. Cut the steel binding strips and pull the nails out which hold down the lid of the wooden case. Remove padding material surrounding the cartons and carefully remove the cartons from the case.

b. Check the contents of each carton against the packing list to be sure that all items are present. Clean off any loose packing material. Brush out or blow off any of this loose packing material from relays and terminal strips. Inspect each item for possible damage.

81. INSTALLATION

a. Tools Required. The following tools are required to install the components of the Voice Conversion Kit in the Radio Transmitter BC-446-(A to H):

Hand drill or small portable electric drill
Twist drills to drill clearance holes for No. 10-32 and No. 8-32 machine screws (not smaller than No. 9 and No. 18)
Countersink
Wrenches, open end, socket or spintite from ¼" hex to 7/16" hex
Screwdriver
Long nose pliers
Soldering iron and solder

Note.—Refer to figures 70 and 71 for location of holes which must be drilled in the frame of the transmitter.

b. Installation of the Quarter-Phasing Unit.

(1) Remove all side and back panels of Radio Transmitter BC-446-(A to H). Figure 70 shows the location of the quarter-phasing unit which is on the right side of the transmitter frame, about 4½ feet up from the floor, just above the L pad resistors R32 to R52.

(2) The r-f switching relay, the phasing capacitors, and the tapped phasing coil are mounted on the front side of the bakelite panel. Terminals 1, 2, and 3 and the phasing capacitor links are on the back of this panel. Looking at the back or link side, terminals 1 and 2 should be in the upper left corner and the mounting spacers with flat head screws are in the top and bottom right-hand corners. Remove the No. 10-32 flathead screws from the mounting spacers before attempting to mount this unit in the transmitter.

(3) Drill and countersink two holes in the back of the vertical frame angle in the rear corner of the compartment which contains the L pad resistors R32 to R52. Remove the nut and bolt (fig. 70) which attaches the angle bracket on the corner of the bakelite quarter-phasing unit panel just above terminal 1.

(4) Fit the quarter-phasing unit in place and insert the No. 10-32 flathead screws through the countersunk holes into the spacers from which these screws were removed. Replace the nut and bolt which hold the angle bracket near terminal 1.

(5) In Radio Transmitter BC-446-H, remove the quarter-phasing coil and the stud terminal 3 from the bakelite panel before installing this unit in the transmitter frame. The coil and the terminal may be replaced after the bakelite panel has been properly mounted.

c. Installation of Phone-Range Selector Unit.

(1) Refer to figure 71 for location of the two holes which must be drilled in the side shield of the goniometer compartment. The phone-range selector unit is held in place by the two mounting screws which attach the angle bracket to this side shield and by the single screw on the edge of the transmitter shelf.

(2) Slots and additional holes are provided to adapt the phone-range selector unit mounting to all models of Radio Transmitter BC-446-(*). Do not bolt this unit in place until all wiring is completed.

d. Installation of Control Relay Unit. The control relay unit is mounted in the bottom of the front compartment of the transmitter just in front of the terminal board and the fuses. Remove the two shelf screws and slide the relay mounting panel into position over the screw holes. If the shelf screws are flathead, they may be replaced by hardware included with this kit.

82. WIRING

Note.—Refer to the schematic diagram (fig. 72) before attempting to install the interconnecting cables.

a. Cable No. 1.

(1) Interunit cable No. 1 must be threaded up in the corner of the left front vertical frame angle in the spaces left for wiring. The tags identify the ends of this cable and the wire ends

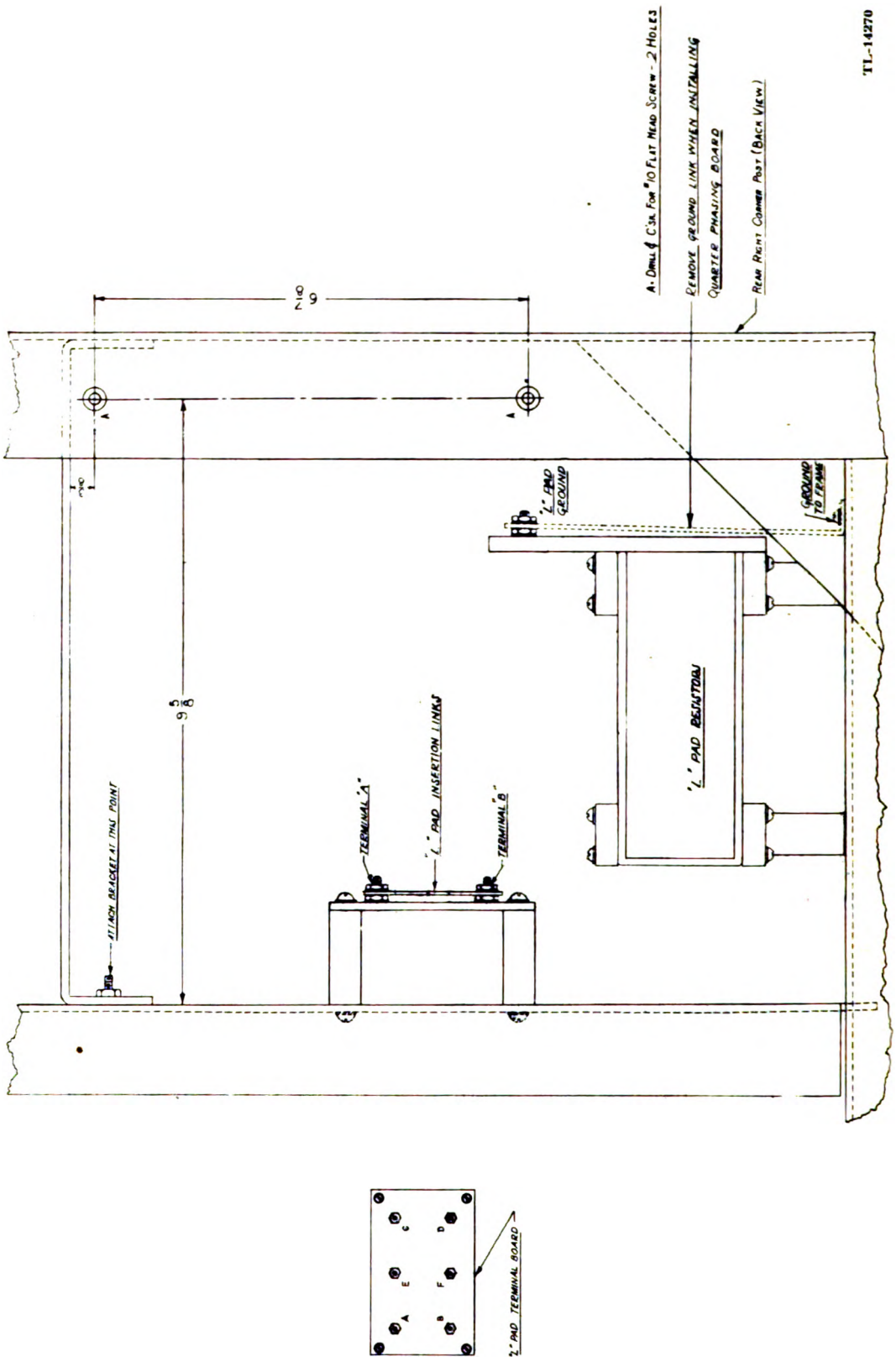

Figure 70. Quarter-phasing unit location.

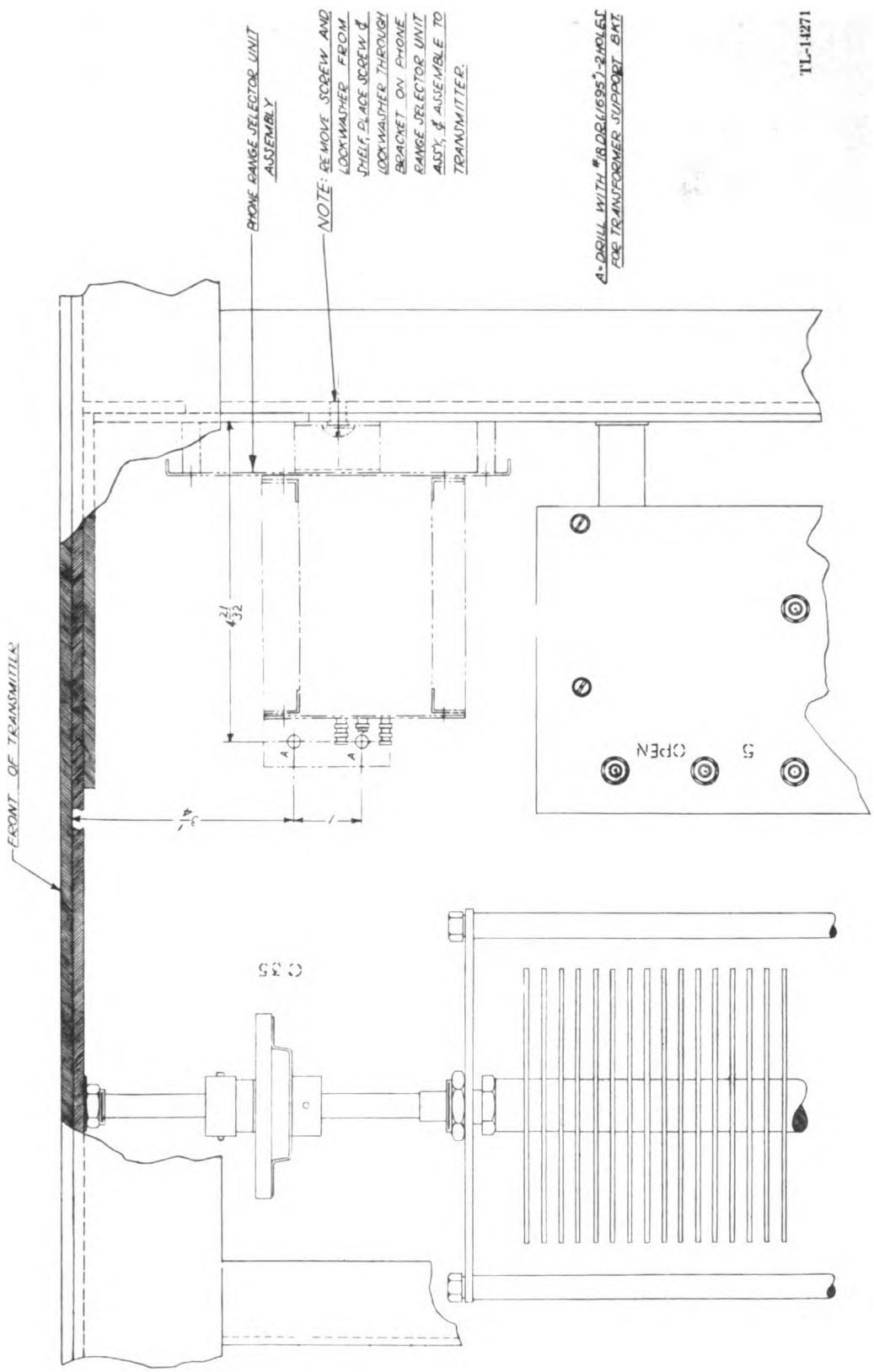

Figure 71. Phone-range selector unit location.

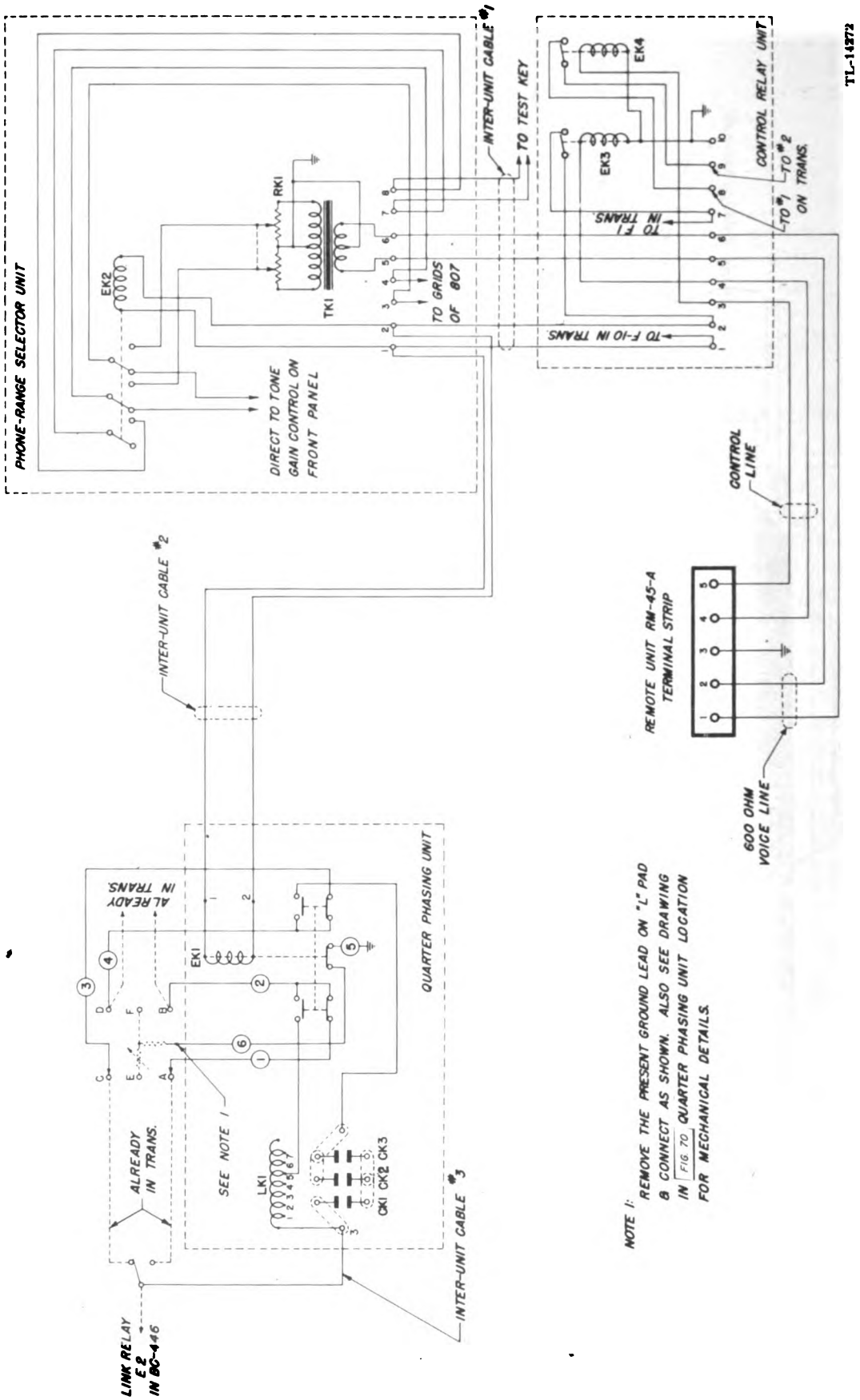

Figure 72. Voice Conversion Kit, schematic diagram.

are numbered to correspond with the terminal numbers on the terminal strips to which they connect. Begin with the phone-range selector unit end of the cable and start threading this end from bottom of the transmitter frame toward the top. The two leads which connect across the test key will run along the bottom of the second shelf and up to the test key beside the wires already present.

(2) When cable No. 1 is in place, connect the lugs to the terminal strip with the wire numbers corresponding to the terminal numbers. Connect the two leads to terminals 1 and 2. Connect the two leads to the top of fuse 1 and fuse 10 at back of the transmitter terminal board. Leave the connections of this cable to the phone-range selector unit until after cable No. 2 and cable No. 3 have been installed.

b. Cable No. 2. Cable No. 2 consists of two wires which parallel the coil of the r-f relay on the quarter-phasing unit with the coil of the relay on the phone-range selector unit. These wires are placed behind the L pad resistors along the bottom of the compartment.

c. Cable No. 3. (1) Cable No. 3 is a 70 ohm, lead-covered wire which connects the center contact of the link-circuit relay (E2) in Radio Transmitter BC-446-(A to H) to terminal 3 on the quarter-phasing unit. Install this cable so that it runs down from the quarter-phasing unit and then forward toward the phone-range selector unit. At the front panel of the transmitter this cable threads through a hole in the corner of the goniometer compartment toward the center of the front panel along with the wiring already in place as far as the edge of the link-circuit relay panel. At this point the cable bends sharply upward and then bends over in a loop to connect to the center contact of the relay.

(2) A cable clamp is supplied with the Voice Conversion Kit to ground the lead sheath to the transmitter frame. This cable clamp can be installed most easily at the bend where the cable coming down from the quarter-phasing unit starts forward toward the front panel of the transmitter. At this bend there are two frame assembly screws, either one of which can be removed and the cable clamp installed by a No. 8-32 nickel plated machine screw with the clamp under the screw head.

d. Grid Connections to Modulator. The wires on the two moving arm contacts on Radio Transmitter BC-446-(A to H) gain control R31 must be unsoldered and connected to terminals 3 and 4 on the phone-range selector unit. These are the grid leads to V7 and V8 (fig. 72). Solder two leads from the relay on the phone-range selector unit to the transmitter gain control where the grid leads were removed.

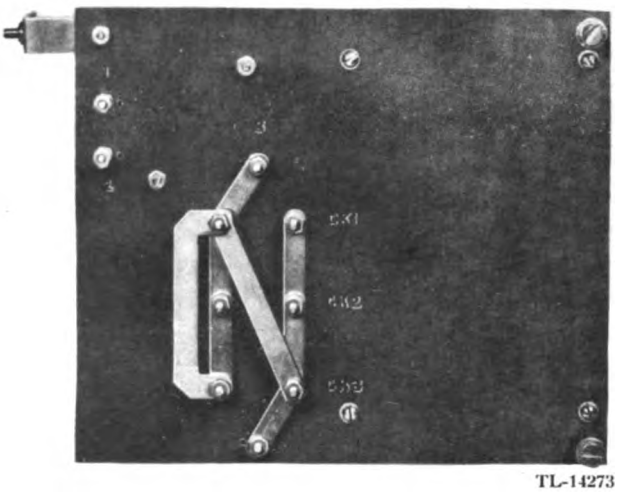

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Figure 73. Quarter-phasing unit, rear view.

e. R-F Connections to L Pad Terminal Board. Refer to figure 75 for proper connections for the wires from the quarter-phasing unit r-f relay to the L pad insertion links. The position of these links can be filled in for future reference on the drawing of the terminal board shown in figure 70.

83. ADJUSTMENTS

a. The installation of the additional wiring and the components of the Voice Conversion Kit may slightly upset the original tuning adjustments of the transmitter. It will therefore be necessary to recheck the tuning of the link circuit, the goniometer primaries and the goniometer secondaries. These tuning adjustments should be made with the Radio Transmitter BC-446-(A to H) local-remote switch in the local position.

b. All tuning adjustments of Radio Transmitter BC-446-(A to H) are entirely independent of the adjustment of the quarter-phasing circuit. When the transmitter tuning has been rechecked, the quarter-phasing circuits can be independently adjusted without fear of upsetting the transmitter tuning.

c. The following table gives the capacity and coil tap which should be selected for the desired operating frequency. Refer to figure 74 for the link combination to obtain the capacity required. Figure 73 shows rear view of panel.

(1) *Quarter-Phasing Circuit Calibration for Loop Antenna Operation.*

Frequency (kc)	Capacity (mfd)	Inductance tap number
200	0.014	6
220	0.014	4
240	0.012	4
260	0.012	4
280	0.008	4
300	0.008	4
320	0.01	4
340	0.0056	4
360	0.004	4
380	0.004	4
400	0.0034	3

(2) *Quarter-Phasing Circuit Calibration for Tower Antenna Operation.*

Frequency (kc)	Capacity (mfd)	Inductance tap number
200	0.006	6
220	0.0047	6
240	0.0047	6
260	0.008	4
280	0.006	4
300	0.004	4
320	0.006	2
340	0.006	2
360	0.004	2
380	0.0027	2
400	0.0027	1

d. When using the above table, select the figures which apply to the type of antenna which is being used. For operation with the tower antenna, the capacity and inductance taps given apply when the towers are tuned with the Antenna Conversion Kit. The capacitor adjustments are made by means of links on the back of the quarter-phasing panel. The individual capacitors can be connected in series or in parallel as desired, by means of the links, to obtain the desired total capacity. Taps on the coil LK1 are numbered left to right.

e. If it is necessary to check this adjustment of the quarter-phasing circuits or to attempt to secure a more perfectly circular radiation pattern, an oscilloscope can be connected to the goniometer secondaries. For this purpose the deflection plates alone with sweep circuits disconnected are used. Connect the vertical deflection plates between one side of the left goniometer secondary winding and ground. Connect the horizontal deflection plate between one side of the right goniometer secondary and ground. Be sure to use identical points for the connections to the right and left secondaries.

f. On range transmission the oscilloscope pattern will be a straight line which will rotate when the goniometer is rotated. On voice transmission the pattern should be circular. If the coupling between the oscilloscope and the transmitter is excessive, this pattern will be deflected off the oscilloscope screen. An elliptical pattern obtained on voice transmission can usually be improved by slight variations in inductance or capacity or both from the valves given in the table. These adjustments are made by trying the next adjoining tap setting to that listed in the table.

84. MAINTENANCE

a. The Voice Conversion Kit is an integral part of Radio Transmitter BC-446-(A to H) and any maintenance or routine inspection for mechanical or electrical defects should include both the transmitter and the Voice Conversion Kit components.

b. Proper maintenance procedures include checking all connections at terminal boards to keep these connections tight and free of corrosion. *Do not attempt to adjust or burnish any relay contacts as long as operation remains satisfactory.*

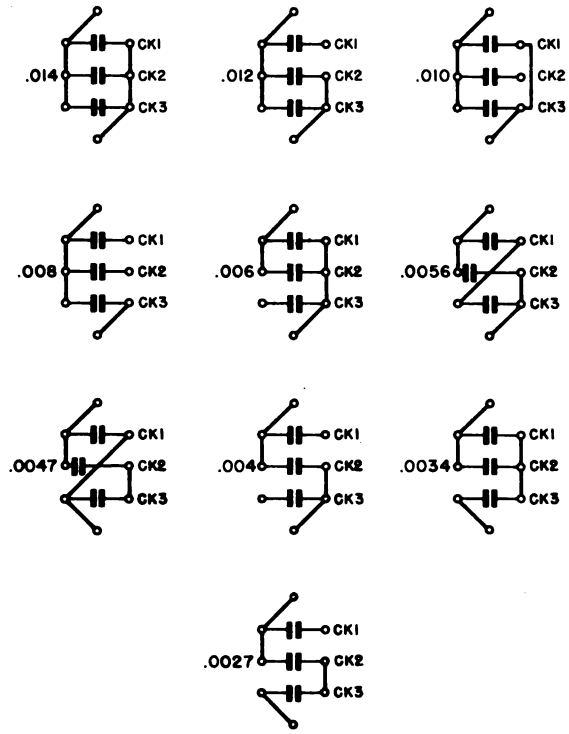

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Figure 74. Diagram of link connections for quarter-phasing capacitors.

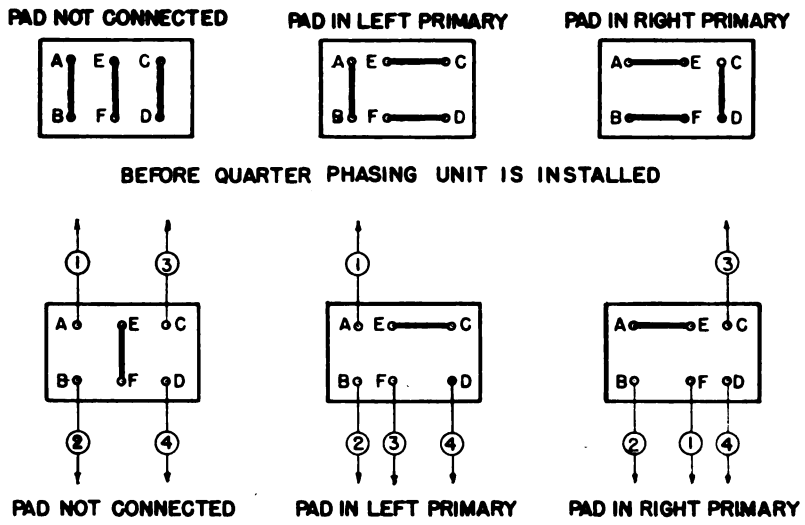

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Figure 75. Diagram of L pad terminal board connections.

Section XI

REMOTE CONTROL UNIT RM-45-A

85. DESCRIPTION

a. Purpose. Remote Control Unit RM-45-A (fig. 76) provides remote control of Radio Transmitter BC-446-(A to H) in conjunction with the Voice Conversion Kit. This remote control unit will also provide remote control with Radio Transmitter BC-446-J in which the provision for voice operation is incorporated in the original equipment. Positive control of the START, STOP, and change from RANGE operation to VOICE operation is obtained over two pairs of 600 ohm telephone wires from a remote operating location which is not over 6 miles away from the controlled transmitter.

(1) For a complete range kit, the two Radio Transmitters BC-446-(*) of any series are provided with two Remote Control Units RM-45-A and four microphones, whereas only one of each of these is actually needed in the control tower. The surplus ones are spares for emergency use.

(2) The Remote Control Unit RM-45-A in the tower is connected to the transmitters through a remote control relay and selector switch junction box 8-11-A, supplied as part of the Adcock Radio Range Station. This box (fig. 78) is mounted near the ventilating fan on the wall separating the engine and transmitter rooms. A schematic diagram of this accompanies the box *and is also* shown on figure 80. In addition figure 82 shows the connections between the junction box and other pieces of equipment. Figure 81 shows wiring color code for the junction box.

b. Mechanical Description. Remote Control Unit RM-45-A is designed to mount in a standard 19 inch relay rack frame. The unit is constructed on a sheet steel chassis which is enclosed in a dustproof cabinet with ventilating louvers in the back. The panel is $\frac{1}{8}$" thick steel with the edges built up to the standard $\frac{3}{16}$" thickness at the edges for mounting with other equipment. The entire unit

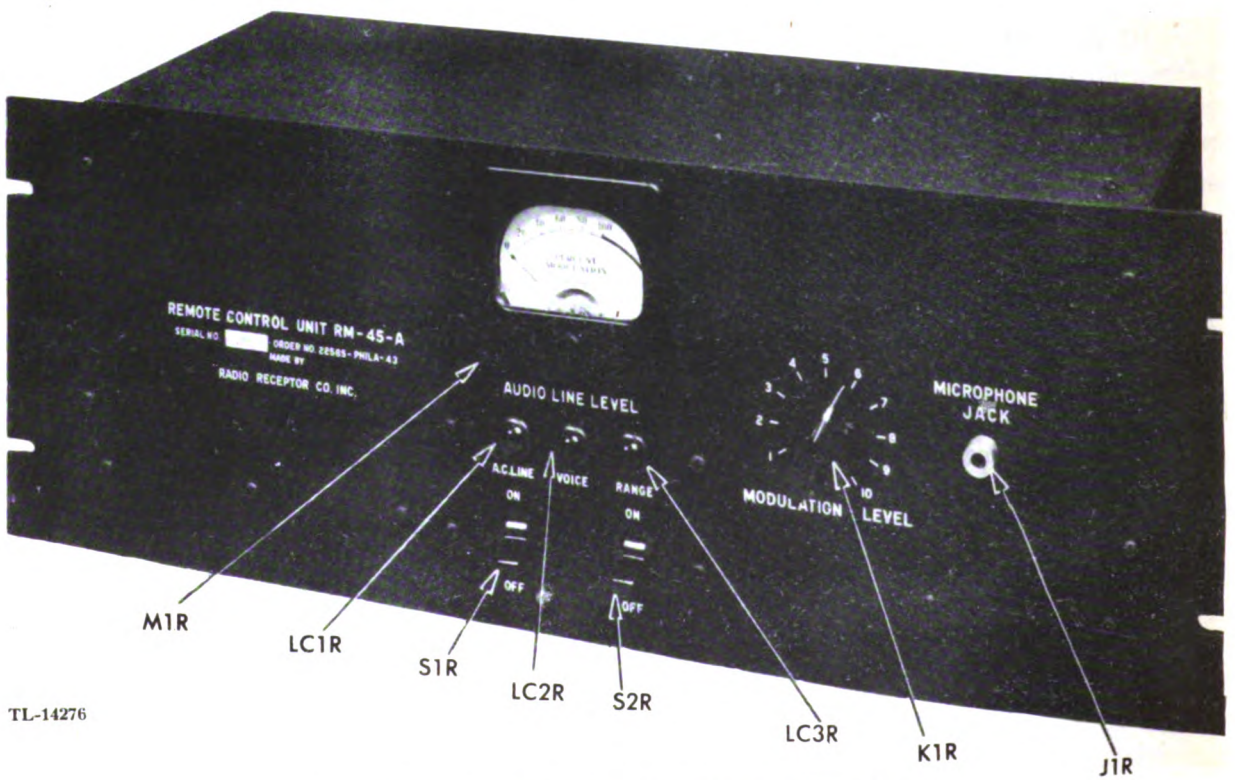

Figure 76. Remote Control Unit RM-45-A, front view.

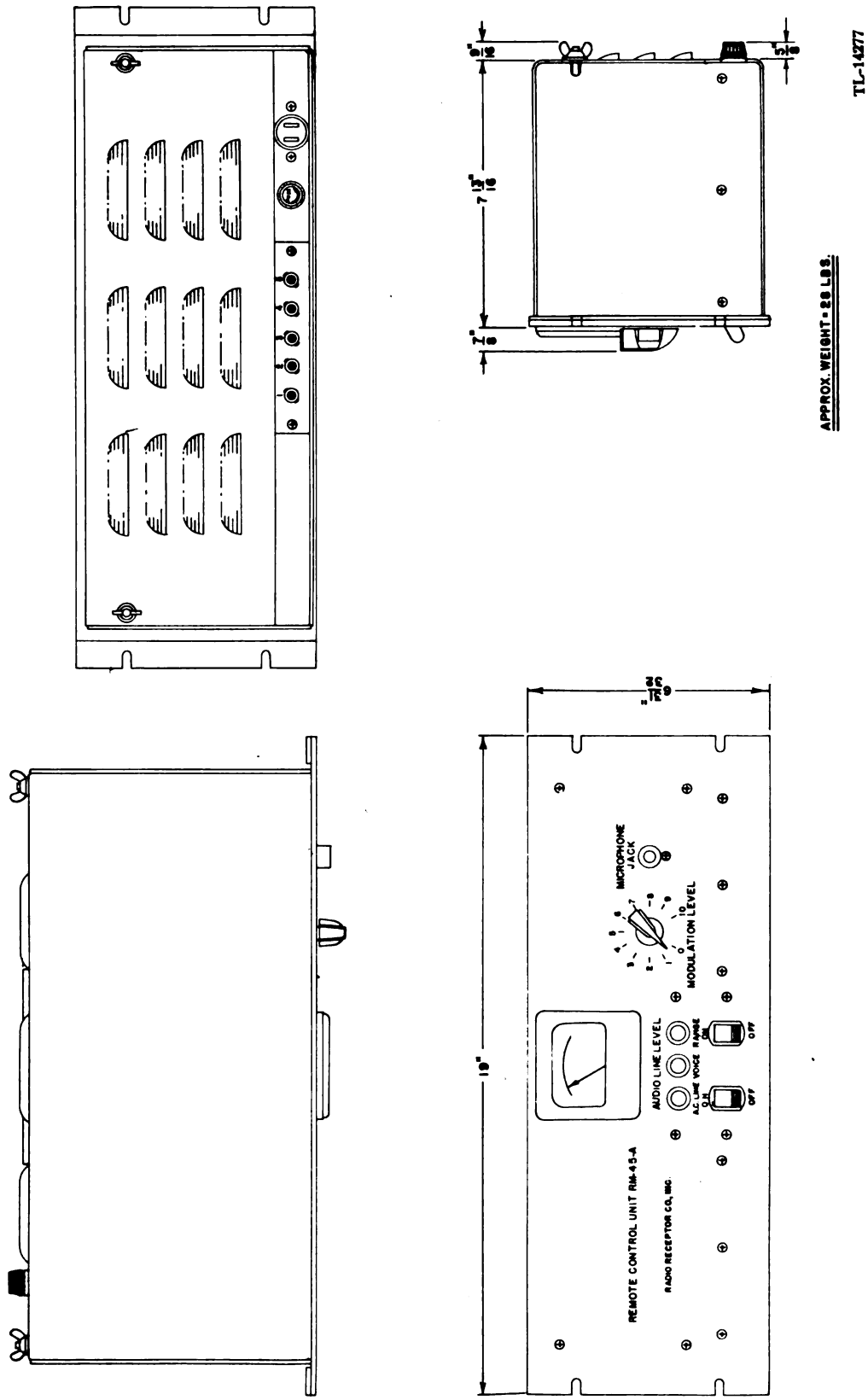

Figure 77. Remote Control Unit RM-45-A, outline drawing.

is rustproofed and finished with a baked black wrinkle enamel.

c. Electrical Characteristics.

Power input . .	115 v, 60 cycles, a-c
Speech input . .	Single button, 50 ohm carbon Microphones T-32 (Kellogg) with push-to-talk switch
Audio output . .	Zero level (across 600 ohms) into telephone line
Control voltage .	35 v open circuit or 35 milliamperes maximum closed circuit into telephone line
Temperature . .	Continuous operation from −15 C to +50 C and 95 percent humidity
Remote operation	Maximum distance 6 miles
Line requirement	Two pairs of telephone lines

d. Electrical Circuits (Figs. 86, 87, and 88).

(1) Remote Control Unit RM-45-A consists of a power supply which furnishes direct current for the microphone and operation of the transmitter control relays. Power transformer T1R and the full-wave rectifier tube V1R supply 110 volts d-c to filter choke X1R through dropping resistor R5R. Two resistors in series, R1R and R4R, form a bleeder network for the power supply output. Plug-in electrolytic capacitor C1R is the power supply filter capacitor. Microphone current is drawn from the center of the bleeder resistor and filtered by a second electrolytic capacitor C2R.

(2) When relay E1R is not energized, one pair of contacts acts to short the microphone voltage. Closing RANGE switch S2R supplies current to the range control relay in the remote transmitter through green pilot lamp P3R. Closing the microphone switch energizes relay E1R and applies current to the microphone through the primary winding of microphone-to-line transformer T2R.

(3) When relay E1R is energized by the microphone switch, the second pair of contacts supplies current to the voice control relay in the remote transmitter through red pilot lamp P2R.

(4) The modulation level control is variable resistor R2R across the primary of the microphone transformer. This control allows the line level as read on M1R to be set for zero level. Blocking capacitor C3R and calibrating resistor R3R are connected in series with this meter.

Note.—Some remote control units are supplied with a cover plate over the panel hole for the AUDIO LINE LEVEL meter. Some early equipments were shipped without these meters to be installed later when they became available from the manufacturer.

(5) Standard microphone plug connections for use with any microphone equipped with a push-to-talk switch are as follows: sleeve, grounded to frame (positive d-c voltage); ring, microphone circuit; tip, relay circuit (fig. 89).

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Figure 78. Remote control junction box.

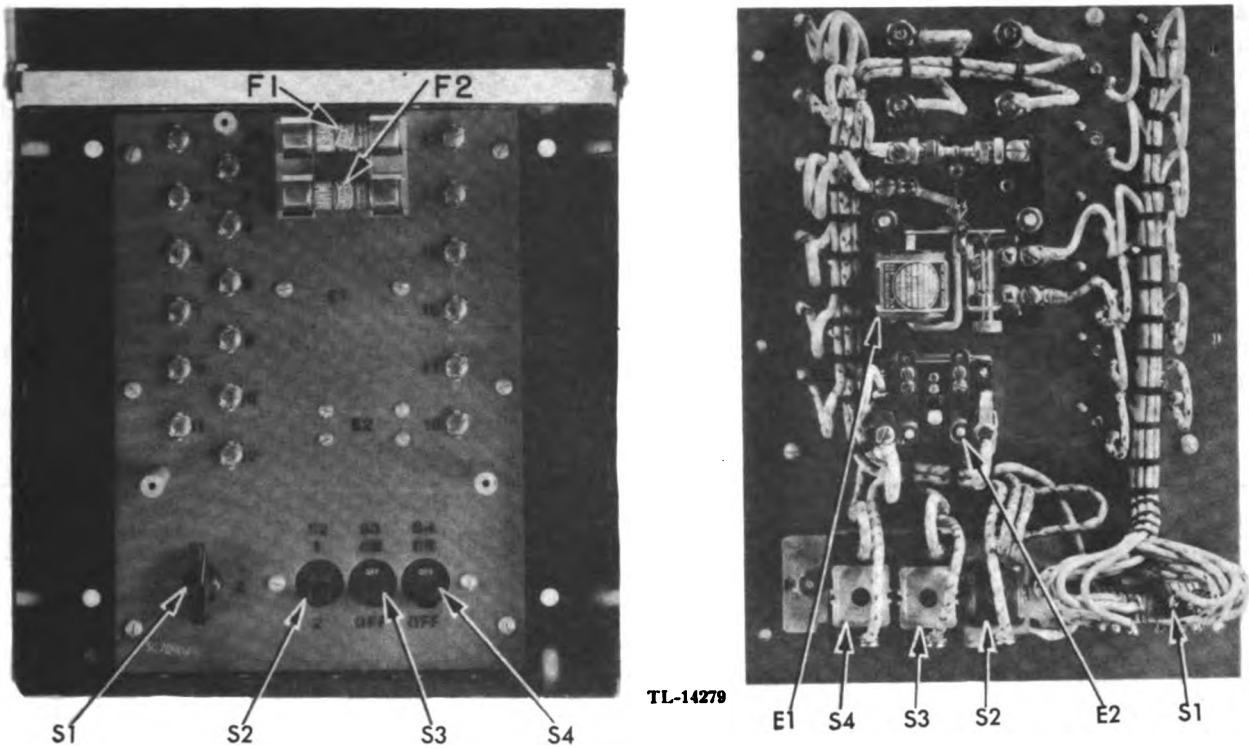

Figure 79. Remote control junction box, terminal panel cover removed, and rear view of panel.

86. UNPACKING

Remote Control Unit RM-45-A is shipped in a corrugated cardboard carton. Rectifier tube (5Z3) JAN-VT-145 and the plug-in capacitors are in their proper sockets. Remove the loose packing material and carefully brush or blow any accumulation of packing material away from the relay. Carefully inspect the unit for damage.

87. INSTALLATION

Place the unit in the operating location. Connect terminals 1 and 2 to the voice pair of telephone wires. Connect terminals 4 and 5 to the control pair of telephone wires. Connect terminal 3 to a nearby ground. Connect 115 volt a-c power to the midget twist lock plug.

88. OPERATION (Fig. 90)

a. Turn A.C. LINE switch to ON. The amber pilot light should glow.

b. To start up the transmitter, turn the RANGE switch to ON. The green pilot light should glow. (This light will not glow if the circuit from terminal 5 is open.)

c. Insert the microphone plug. Set the MODULATION LEVEL to 5 on the scale. Press the microphone switch for voice operation. The red pilot light should glow. (This light will not glow if the circuit from terminal 4 is open.)

d. With the Remote Control Unit RM-45-A in operation, adjust the gain control on the phone-range selector unit so that 100% modulation is obtained when the operator talks into the microphone in a normal manner at the remote location. Set the remote control unit gain control to deliver zero level (6 milliwatts) into the 600 ohm telephone line between the transmitter and the remote location.

89. ADJUSTMENT

Increase or decrease the MODULATION LEVEL control to the point where normal talking into the microphone maintains the AUDIO LINE LEVEL between 80 and 100 PERCENT MODULATION.

90. ROUTINE MAINTENANCE

a. A periodic inspection of mechanical parts should be made to discover loose connections or mounting screws and any signs of corrosion. The chassis (figs. 91 and 92) should be blown out to remove any accumulation of dust. If blowing facilities are not available and it is necessary to remove dust by wiping off with a cloth, care should be taken not to break off any connections or insulations.

b. Do not tamper with relays or their contacts as long as operation remains satisfactory. If it is necessary to clean contacts do not use any harsh

abrasives. Crocus cloth and jeweler's rouge should be used. Thoroughly wash contacts with carbon tetrachloride after polishing. If relays fail to operate the d-c power supply should be checked.

(1) Check tube 5Z3.

(2) Check fuse F1R (fuse in rear of chassis for AC line input).

(3) Check d-c voltage output of rectifier or d-c voltage across relay coils.

c. Any trouble encountered in the rectifier circuit can be quickly localized by means of a volt-ohmmeter. Figure 93 shows tube and capacitor socket connections.

91. TABLE OF OPERATING VOLTAGES

The following table of normal voltages and currents will help in locating any trouble or checking for normal operation:

TABLE OF VOLTAGES AND CURRENTS

The following measurements are volts d-c to terminal 3 or ground unless otherwise indicated.

Symbol	Component	Test Point	Switch Positions		
			A-c ON	Range ON	Voice ON
V1R	5Z3 rectifier	Socket pin 1 (fil)	0	0	0
		Socket pin 2 (plate)	55	52	50
		Socket pin 3 (plate)	55	52	50
		Socket pin 4 (fil)	4.9 v a-c	4.9	4.9
C1R	50 mf plug-in electrolytic capacitor	Socket pin 1 (neg.)	32	27	25
C2R	200 mfd plug-in electrolytic capacitor	Socket pin 1 (neg.)	0	0	4-5
X1R	2.5 henry choke	Red and black wire	31	26	23
		Red and yellow wire	38	33	31
R1R	250 ohms	Across resistor	32	27	21
R4R	250 ohms	Across resistor	0	0	4-5
R5R	100 ohms	Across resistor	13.5	15	15.5
E1R	Relay	Across coil	0	0	24
4	Terminal	Terminal strip	0	0	34
5	Terminal	Terminal strip	0	31	34
E2R	Modulation level control	Clockwise position (across resistor)	0	0	2

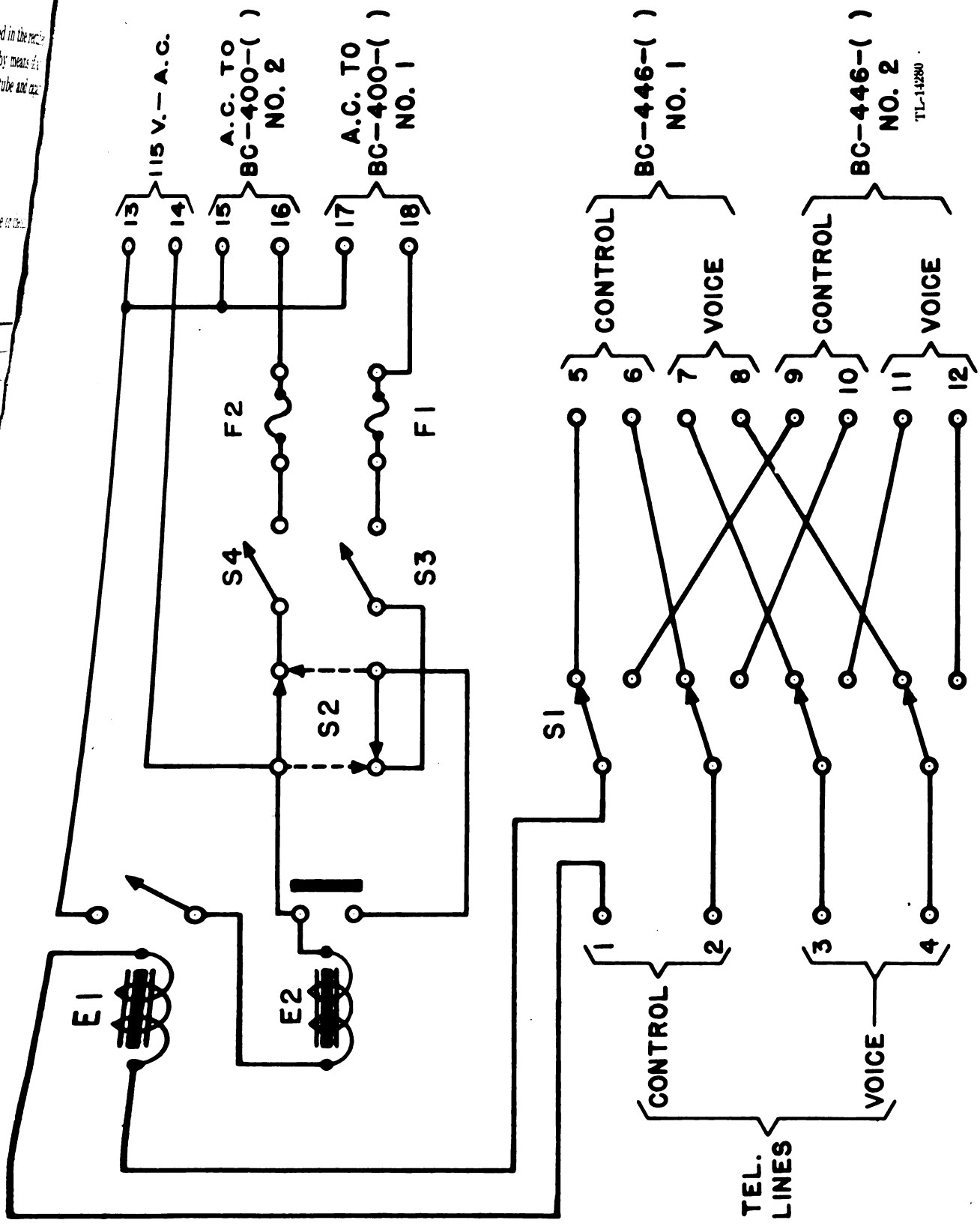

Figure 80. Remote control junction box, schematic diagram.

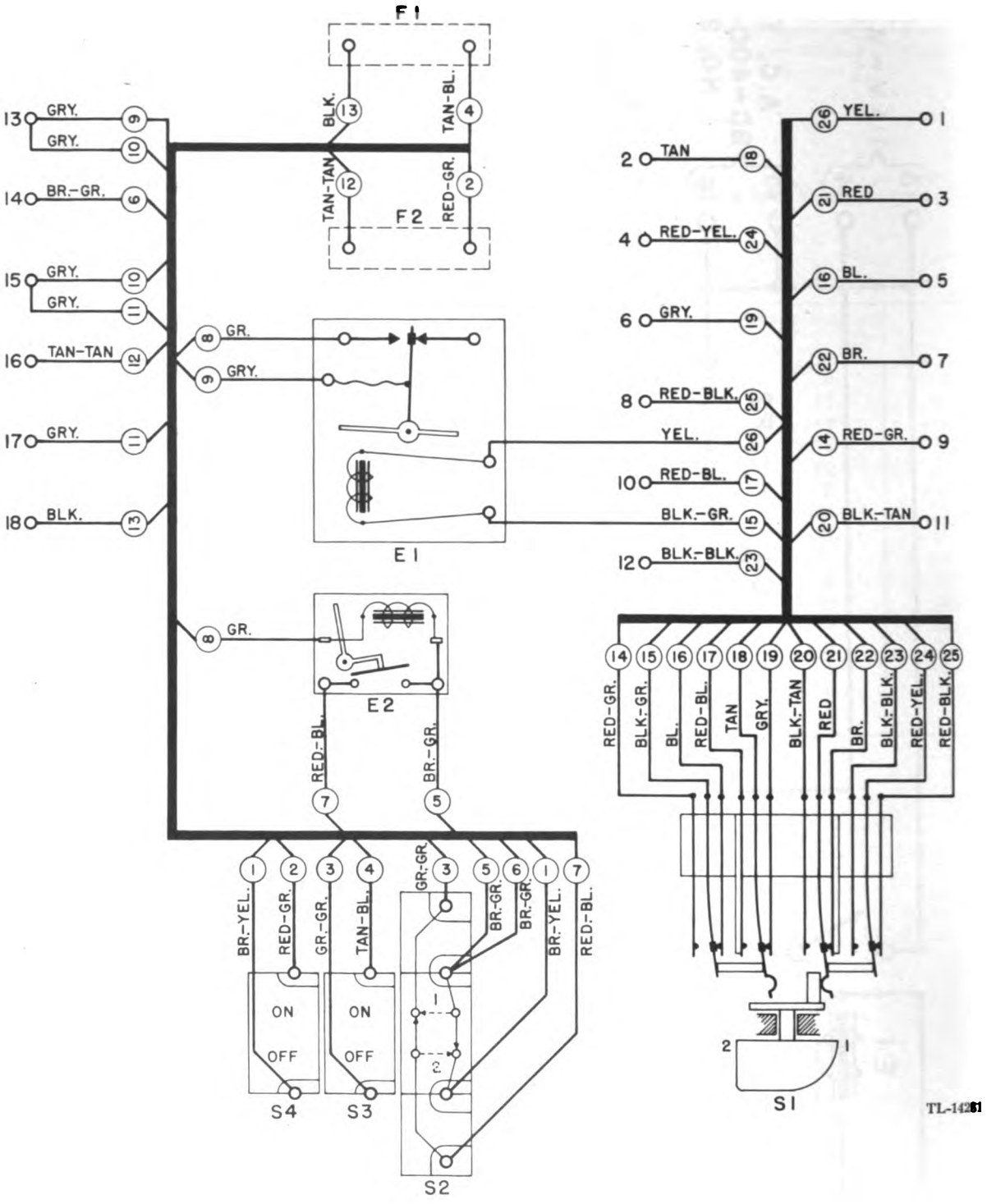

Figure 81. Remote control junction box, wiring color code.

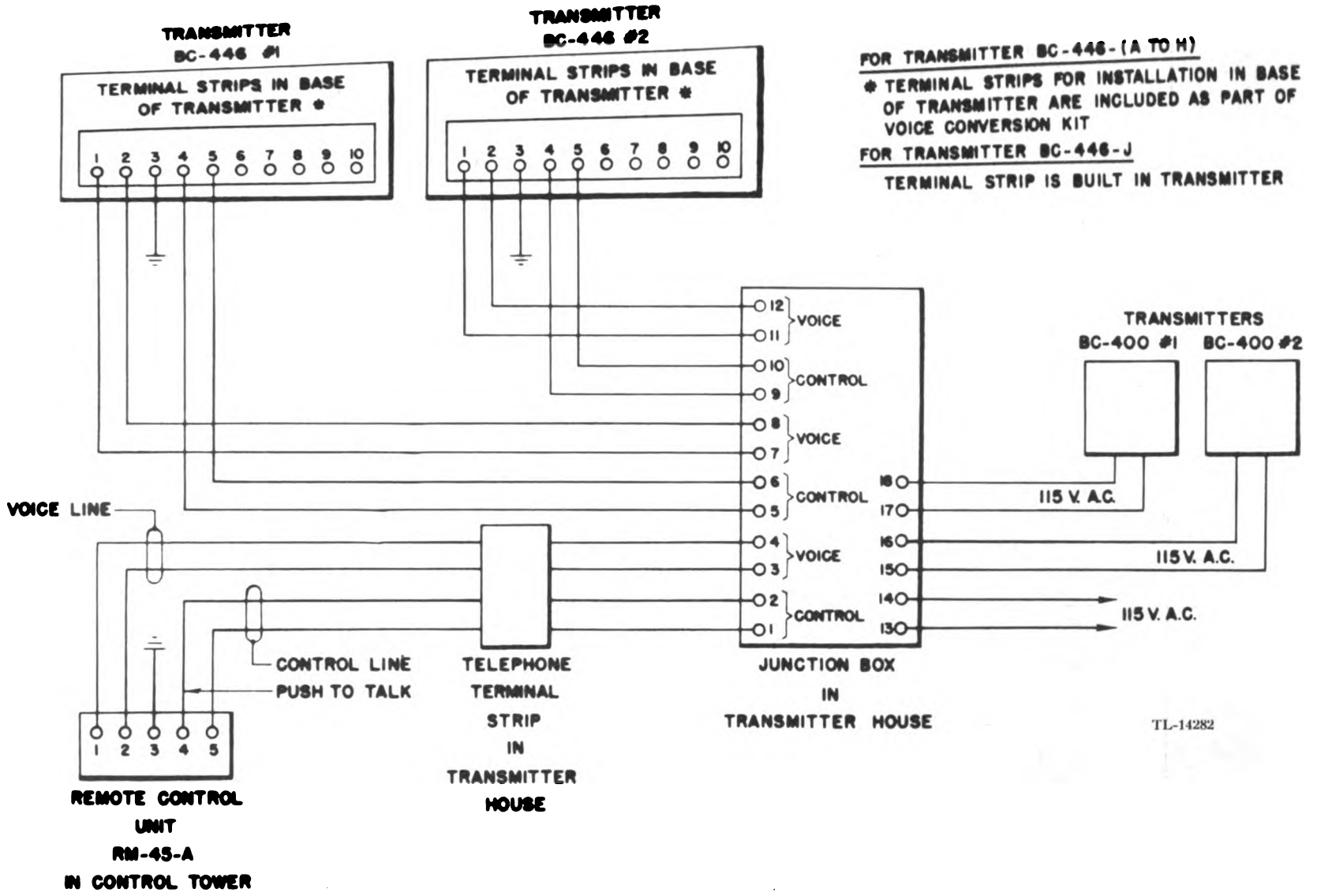

Figure 82. Remote control junction box, interwiring diagram.

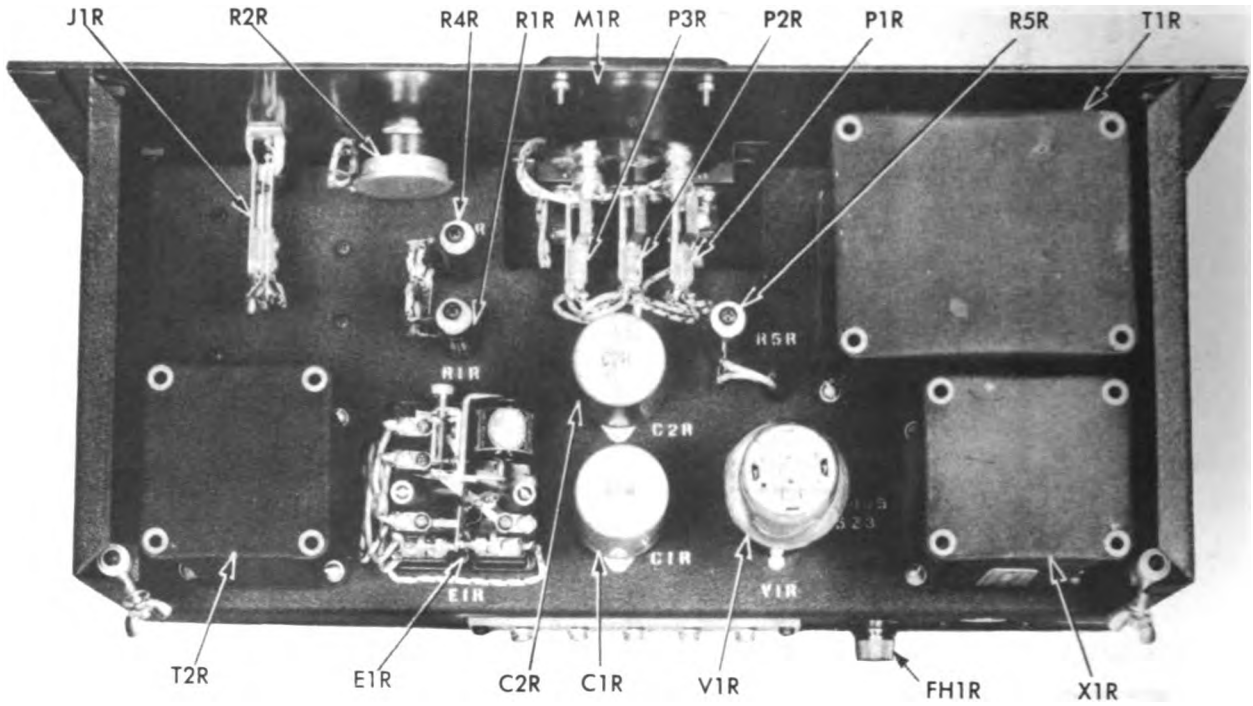

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Figure 83. Remote Control Unit RM-45-A, interior view.

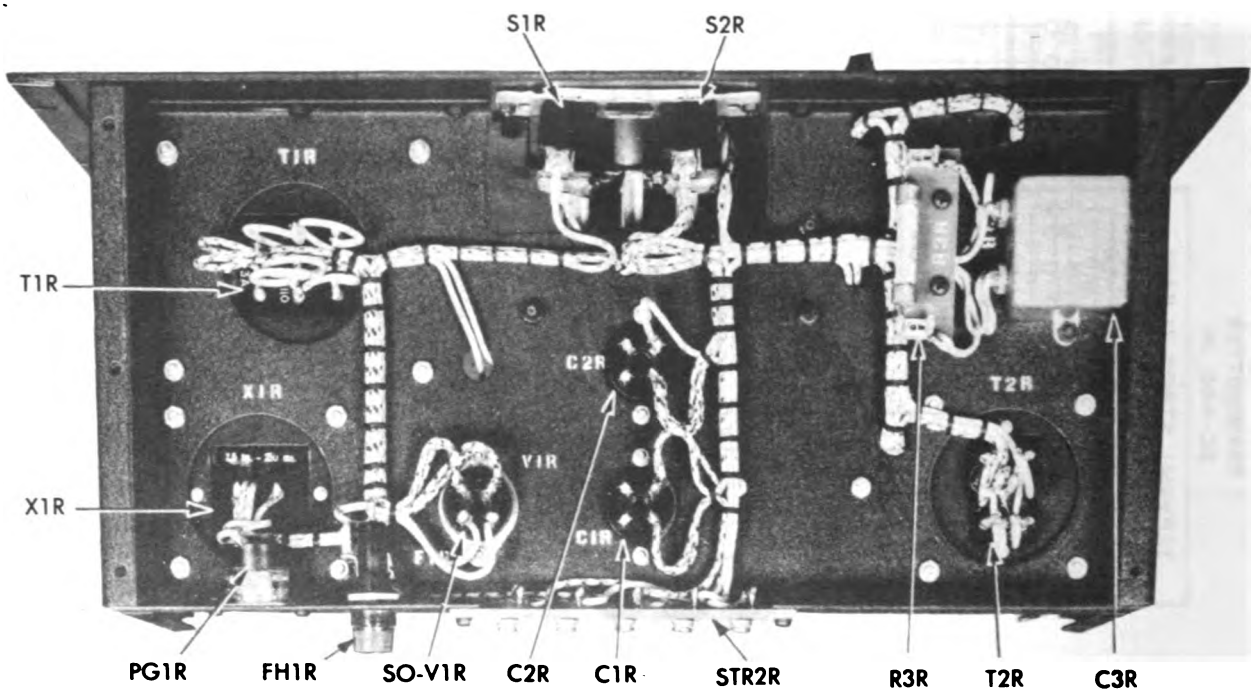

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Figure 84. Remote Control Unit RM-45-A, bottom view.

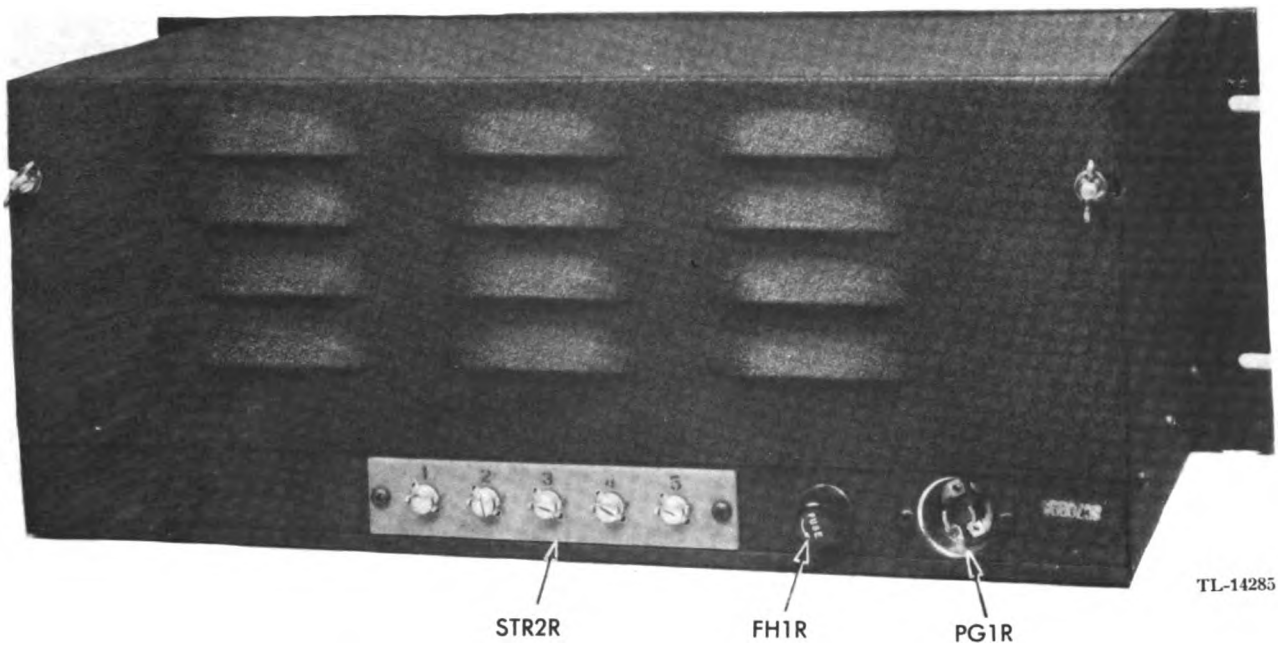


Figure 85. Remote Control Unit RM-45-A, rear view.

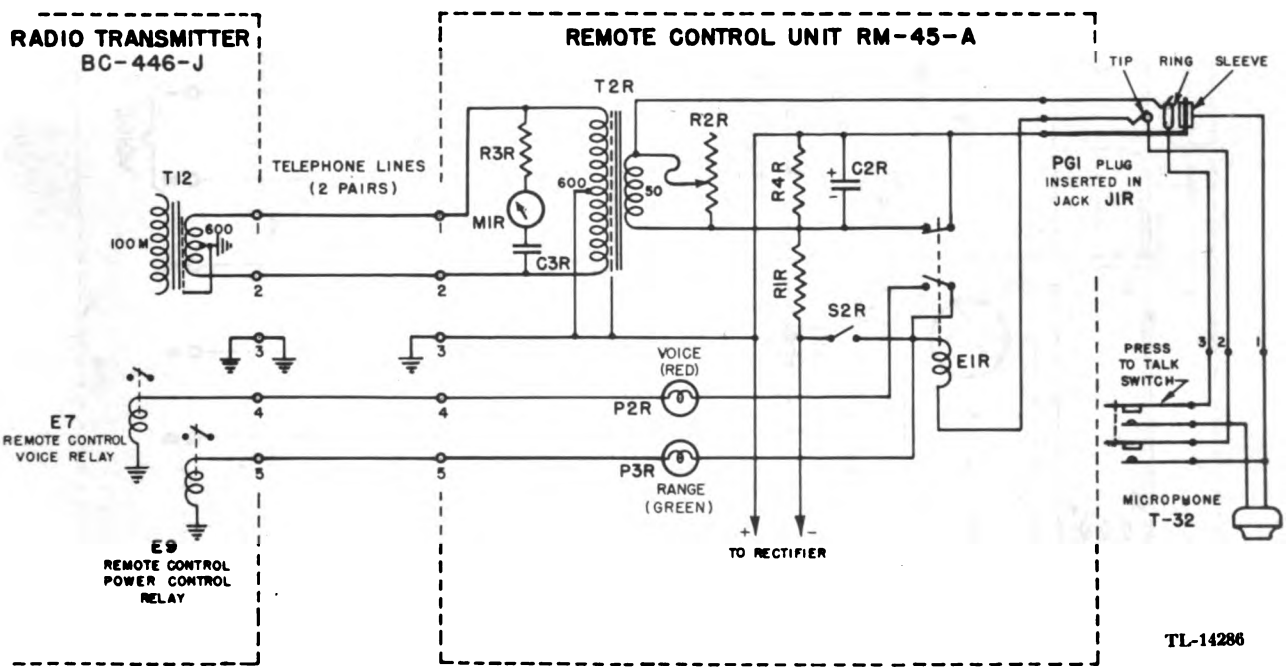


Figure 86. Remote Control Unit RM-45-A, functional diagram.

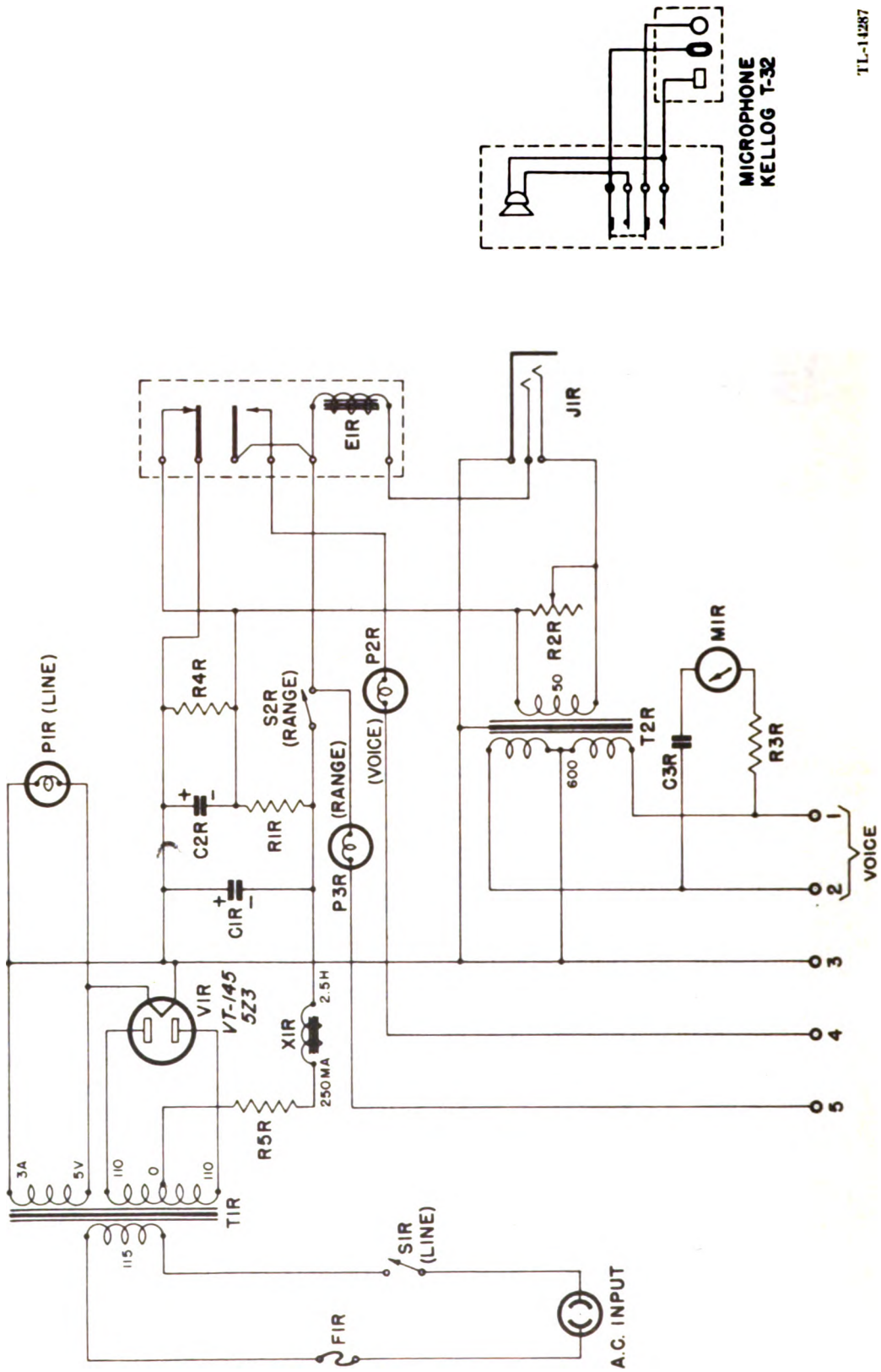


Figure 87. Remote Control Unit RM-45-A, schematic diagram.

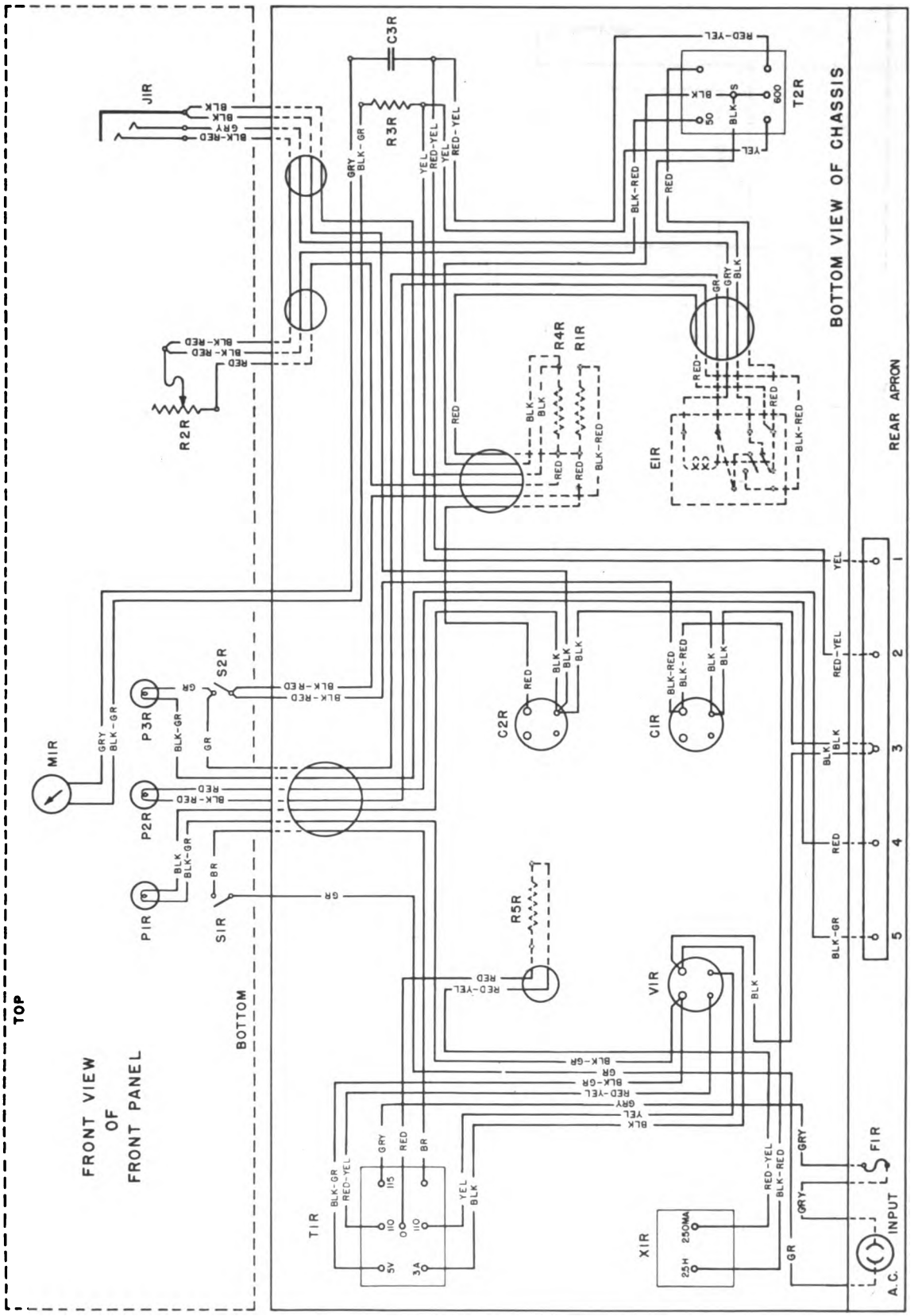


Figure 88. Remote Control Unit RM-45-A, wiring diagram.

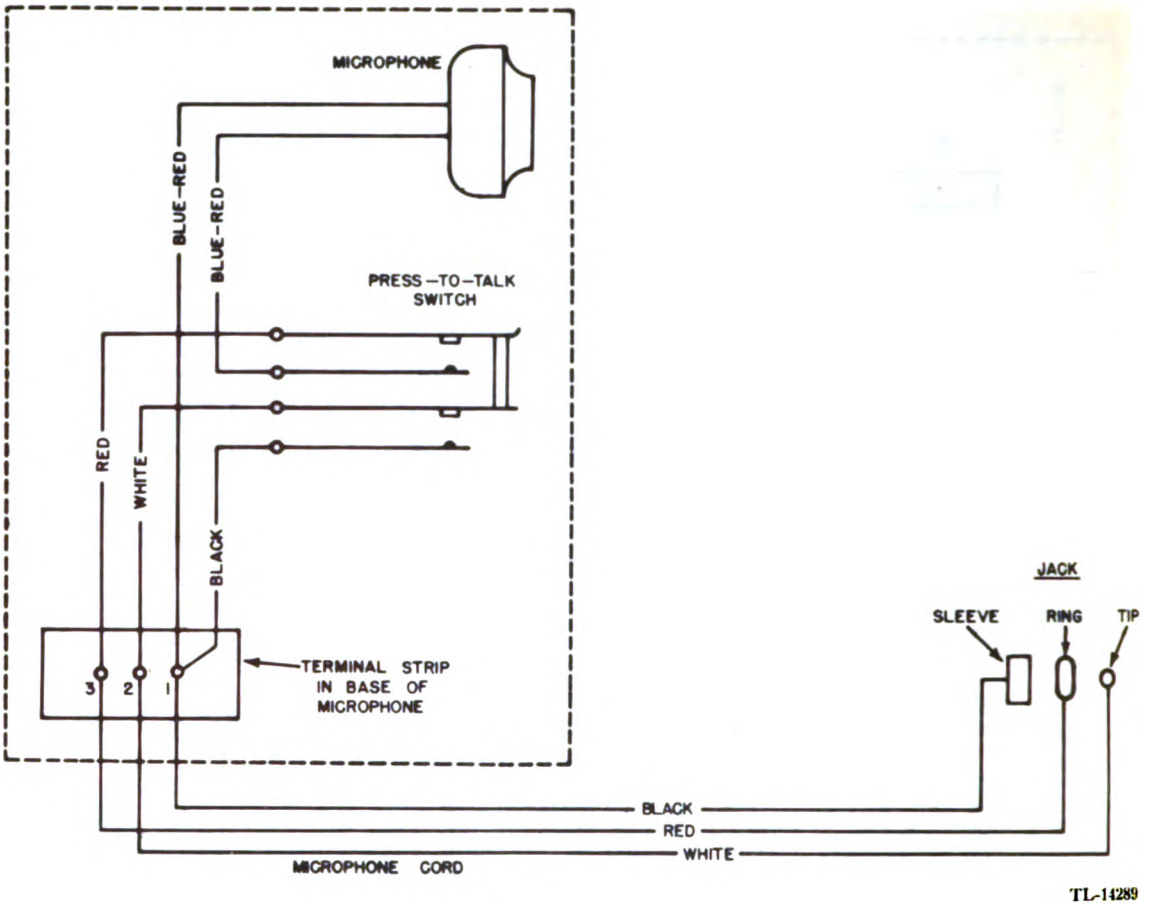


Figure 89. Microphone T-32, wiring diagram.

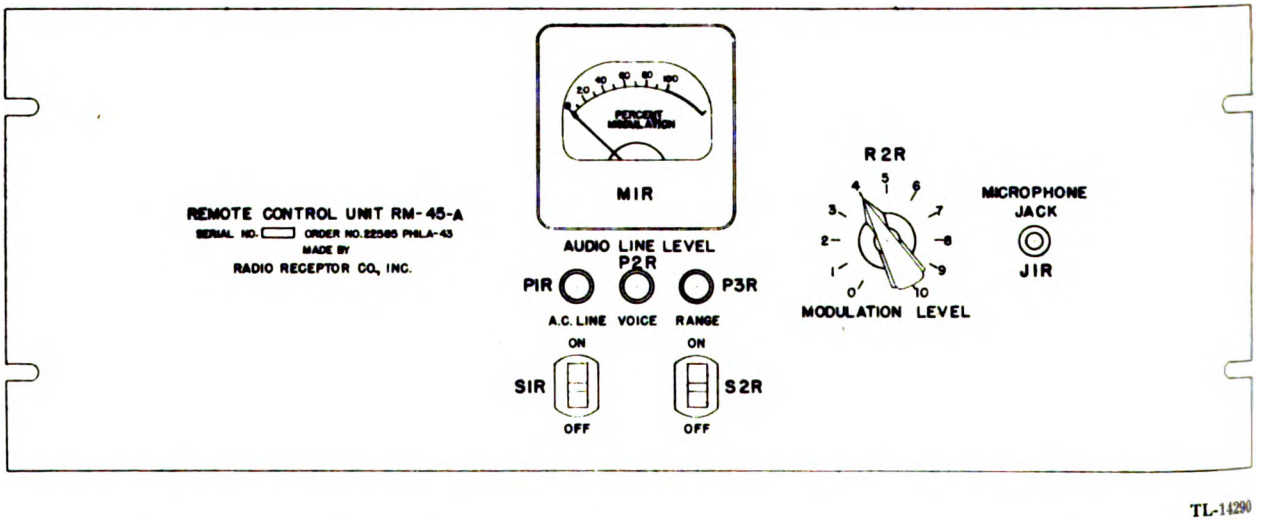


Figure 90. Remote Control Unit RM-45-A, front panel location diagram.

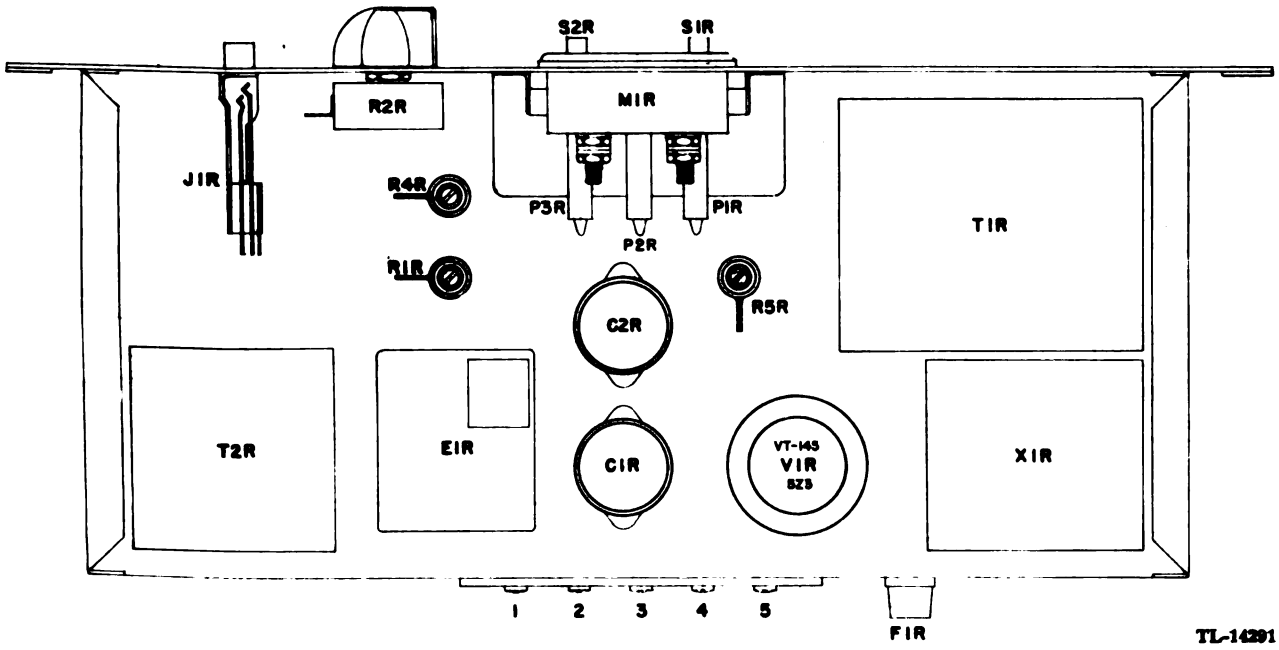


Figure 91. Remote Control Unit RM-45-A, chassis location diagram, top view.

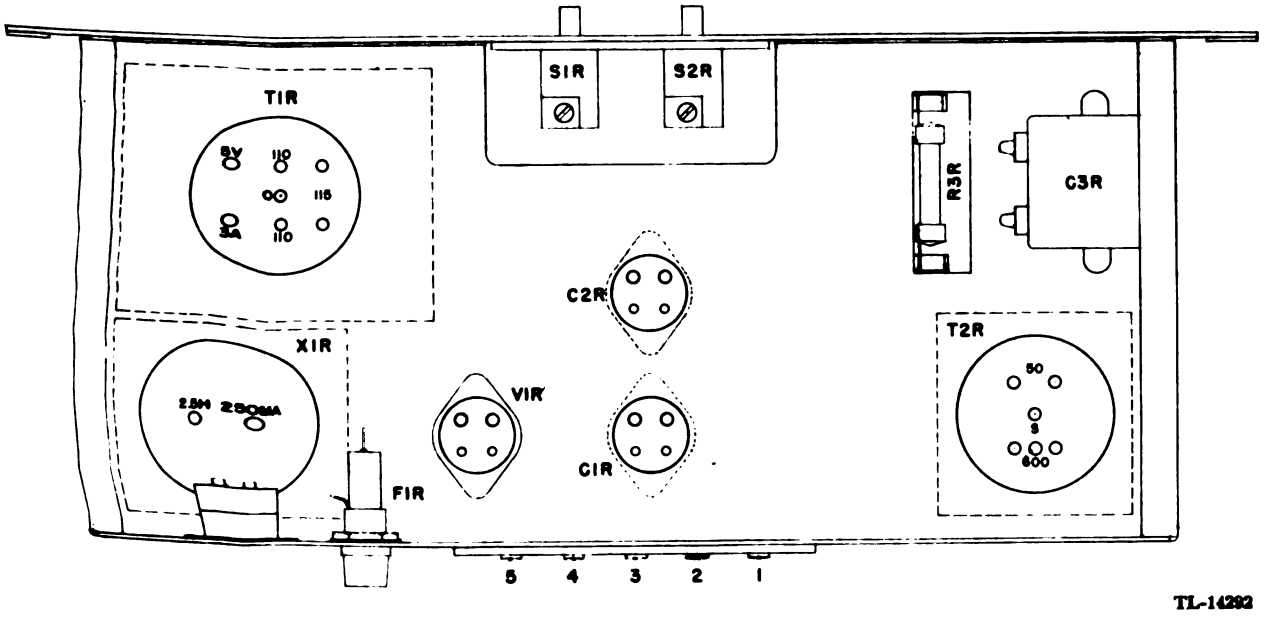
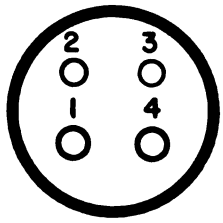


Figure 92. Remote Control Unit RM-45-A, chassis location diagram, bottom view.

ELECTROLYTIC CAPACITOR

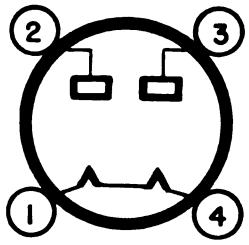
BOTTOM VIEW



PIN 1 - NEGATIVE SIDE OF CAPACITOR
PIN 2 - POSITIVE SIDE OF CAPACITOR
PIN 3 - NO CONNECTION
PIN 4 - NO CONNECTION

JAN-5Z3 (VT-145)

BOTTOM VIEW



PIN 1 - FILAMENT
PIN 2 - PLATE
PIN 3 - PLATE
PIN 4 - FILAMENT

TL-14293

Figure 93. Socket connections.

Section XII

MONTHLY MAINTENANCE SCHEDULE AND CHECK LIST

92. Z MARKER

a. Check transmitter internally, clean with bellows and dust cloth.

b. Check relays. Clean and burnish contacts if necessary.

c. Check radiator system. Clean all stand-off type insulators with carbon tetrachloride (U.S.P.) or alcohol and check security of insulators. Check stand-off insulators. Check stand-off insulators for possible shearing with vibration of radiator elements in wind.

93. RANGE RADIATING SYSTEM

a. Check transmission line termination and tower tuning.

b. Ground check all courses prior to shutting down facilities and note any deviations on station ground-check log.

Note.—It is assumed that properly aligned ground-check stakes to be used for reference in all ground-checking operations are in place on all courses.

c. Record goniometer secondary currents prior to shutting down to have current value references when returning goniometer to original setting.

d. Shut down the facility.

e. Clean all tower base insulators with carbon tetrachloride (U.S.P.) or alcohol. Open all tower tuning house covers.

f. Ground all towers not being checked at output of tower tuning house.

g. Rotate goniometer to 0° or 90° position, and block link-circuit relay to proper side for excitation of tower to be checked.

h. The transmission line to the tower being checked is disconnected at the tuning house and connected to the input circuit of the Impedance Measuring Box. The output or X leads of the Impedance Measuring Box are then connected to the input circuit of the tower.

i. Adjust output coupling for proper indication level on impedance measuring instrument meter, keeping Impedance Measuring Box coupling to an average value between minimum and maximum.

Note.—Use coupling to provide from 7/10 to 8/10 full scale reading on indicating meter in impedance box.

j. Using standard Impedance Measuring Box procedure, measure line terminating resistance and note condition of tower tuning as reflected by reactance components. Record measurements.

k. Repeat for each corner tower the operations outlined above, leaving grounds on all towers not being checked. Unground each tower as it is checked.

Note.—Change the link circuit relay from one side to the other as adjoining towers are checked.

l. Return goniometer to normal setting, checking goniometer secondary currents against recordings under subparagraph b above.

m. Replace tuning house covers.

n. Ground check all courses, recording any deviation within tolerances specified on station ground-check log. Refer all deviations beyond tolerance to the region radio engineer.

94. PAPER WORK

a. Make out maintenance service report, a running log of maintenance duties completed to be submitted following regional maintenance man's tour of duty of each station, monthly in the case of resident maintenance man. There should be one copy for each station concerned and regional office.

b. Make out maintenance log containing items relative to maintenance of equipment and/or minor administrative details to be called to attention of the operator-in-charge and to be submitted by regional maintenance man following tour of duty. One copy is submitted to each station concerned and regional office.

c. Make out vacuum tube log containing all data on serial numbered vacuum tubes replaced or otherwise changed during maintenance man's tour of duty. There should be one copy for each station concerned and regional office.

95. MONTHLY MAINTENANCE CHECK LIST

The following is a suggested check list for use in maintaining equipment. When using such a list, the items listed should be checked and the checker's initials placed in the column provided. An additional column is provided for any remarks the checker may wish to make.

MONTHLY MAINTENANCE CHECK LIST

Initial Remarks

a. With Facilities Operating.

(1) RANGE TRANSMITTER.
- (a) Equipment failure log.
- (b) Test tubes (spares and idle equipment).
- (c) Terminals, mountings, etc.
  1. Transformers.
  2. Fuse mounting clips.
- (d) Relays.
  1. Contacts.
  2. Mechanical assembly.
- (e) Ventilating fan motors.
  1. Lubricate.
  2. Check bearing end play.

(2) Z MARKER.
- (a) Equipment failure log.
- (b) Test tubes.
- (c) Terminals, mountings, fuse clips, etc.
- (d) Relays.
  1. Contacts.
  2. Mechanical assembly.
- (e) Adjust transmitter to 100 percent modulation.
  1. Neutralization
  2. General transmitter tuning.
- (f) Antenna system.
  1. Measure radiator currents.
  2. Adjust both transmitters to the same output.

(3) RADIATING SYSTEM.
- (a) Measure and record radiator currents.
  1. No modulation.
  2. 100 percent modulation.

Note.—Before removing range from service, ground check all courses and record ground check points.

b. With Facilities Shut Down.

(1) RANGE TRANSMITTER.
- (a) Test tubes.
- (b) Terminals, mountings, etc.
  1. Transformers.
  2. Fuse mounting clips.
  3. Clean transmitter.
- (c) Relays.
  1. Contacts.
  2. Mechanical assembly.
- (d) Ventilating fan motors.
  1. Bearing end play.
  2. Lubrication.
- (e) Tube sockets.
  1. Clean contacts.
  2. Tighten contacts.
- (f) Zero all meters.

(2) KEYER (AC-209).
- (a) Motor.
  1. Repack bearing.
  2. Clean starter contacts.
  3. Gear box oil level.
  4. Tag motor.

Initial Remarks

- (b) Contact assemblies.
  1. Disassemble interval switch.
  2. Clean interval switch contacts.
  3. Flexible leads to contacts.
  4. Front and middle contacts.
  5. Rear contacts.
  6. Tag contact assembly.

(3) Z MARKER.
- (a) Equipment failure log.
- (b) Test tubes.
- (c) Terminals, mountings, etc.
  1. Clean transmitter.
  2. Fuse clips and mountings.
- (d) Relays.
  1. Contacts.
  2. Mechanical assembly.
- (e) Adjust transmitter to 100 percent modulation.
  1. Neutralization.
  2. General transmitter tuning.
- (f) Antenna system.
  1. Clean all insulators.
  2. Measure radiator currents.
  3. Adjust both transmitters to the same output.

(4) COUPLING UNIT.
- (a) Connections and terminals.
- (b) Clean.
- (c) Goniometer slip rings.
- (d) Link circuit relay.
  1. Mechanical Assembly.
  2. Clean and adjust contacts.
  3. Oil armature bearing.

(5) RANGE RADIATING SYSTEM.
- (a) Transmission line termination.
  1. Clean tower base insulators.
  2. Measure input impedance of all antenna tuning units.

Note.—Follow instructions carefully. Ground check all courses.

- (b) Gasoline power units.
  1. Test run.
  2. Oil level.
  3. Gas and oil reserve.
  4. Storage battery.
  5. Simulate power failure if commercial power is being used.
  6. Voltage regulation.
  7. Cooling systems.

(6) RECORDS.
- (a) Maintenance service report.
- (b) Maintenance log.
- (c) Vacuum tube log.

SECTION XIII

SUPPLEMENTARY DATA

96. MAINTENANCE PARTS LIST FOR ADCOCK RADIO RANGE STATION

Ref. symbol	Signal Corps stock No.	Name of part and description	Quan. per unit	Mfrs. part and code No.	†Station stock	†Region stock
		ADCOCK RADIO RANGE KIT, INCLUDING IMPEDANCE MEASURING BOX, ANTENNA CONVERSION KIT, VOICE CONVERSION KIT, AND REMOTE CONTROL UNIT RM-45-A; FOR CONVERTING RADIO TRANSMITTERS BC-446(A-TO H) FROM LOOP TO TOWER OPERATION.				
		IMPEDANCE MEASURING BOX				
C1	3DA1.50V-1	CAPACITOR: variable; air-dielectric; 50-1500 mmfd.	1	XR-1500-PS-PL8013 (C2)		
L1, 2	2Z9629-14	COIL: variocoupler; air-core; Faraday shield; rotor and stator 510 μh; Universal winding.	1	D-2611-1 (R5)		
L3	2Z9629-15	COIL: variometer; air-core; stator 28.5 μh; rotor 4.4 μh.	1	D-2612-1 (R5)		
	3E7193-6	CORD: patch.	1	B175-123 (R5)		
	3E7193-5	CORD: patch.	2	B175-124 (R5)		
F1	3Z2588	FUSE: cartridge; ⅜ amp, 250 v.	1	1006 (L3)	*	*
FH	3Z3275-8	HOLDER: fuse; extractor post.	1	1087 (L3)		
M1	3F930-36	METER: r-f; 0-300 ma.	1	DW-52 (G3)		*
R1	3F1800-3.1	RESISTOR: decade; 1 ohm; dial marked 0-10.	1	4745 (L8)		
R2	3F1800-3	RESISTOR: decade; 10 ohms; dial 0-10; two molded bakelite contact supports 2½" long x 2⅜" wide.	1	4745 (L8)		
R3	3Z5991-40	RESISTOR: wire wound; 1 ohm, 2 w.	1	BW-2 (I2)		*
SH	2Z8290-5	SHIELD: Faraday.	1	Dwg. A-175-89 (R5)		
S1	3Z9825-85.3	SWITCH: rotary; double pole, double throw; single ceramic wafer.	1	Dwg. B-175-71 (R5)		
	2A670	ANTENNA CONVERSION KIT	1	(R5)		
C1	3D9250-87	CAPACITOR: mica; 0.00025 mfd; 5,000 v d-c working; 1 amp at 300 kc: AWS CM70D241G.	5	XSCW 5-325-5 (S5)	*	
C2	3D9500-34.1	CAPACITOR: mica; 0.0005 mfd; 5,000 v d-c working; 2 amp at 300 kc; AWS CM70D511G.	5	XSCW 5-35-5 (S5)	*	*
C3	3DA1-43	CAPACITOR: mica; 0.001 mfd; 5,000 v d-c working; 2 amp at 300 kc; AWS CM70D102G.	5	XSCW 5-21-2 (S5)	*	*
C4	3DA2-47	CAPACITOR: mica; 0.002 mfd, 6,000 v d-c working; 4 amp at 300 kc; AWS CM70D202G.	5	XSCW 6-22-2 (S5)	*	*

†Parts not stocked in station or region stock are carried in depot stock.
*Indicates stock available.

96. MAINTENANCE PARTS LIST FOR ADCOCK RADIO RANGE STATION (cont'd)

Ref. symbol	Signal Corps stock No.	Name of part and description	Quan. per unit	Mfrs. part and code No.	†Station stock	†Region stock
C5	2C6386A/P1	CAPACITOR: air-dielectric; single-plate; approx. 10 mmfd.	5	465-C5 (R5)		
L4	2Z9629-16	COIL: antenna; variometer.	5	465-L4 (R5)		
L1	2C6386A/C6	COIL: inductor; 100-225 μh; d-c resistance; 0.4 ohm; variable iron core; single layer wound; 75 turns.	5	465-L1 (R5)		
L2	2C6386A/C8	COIL: inductor; single layer wound; 20 turns.	5	465-L2 (R5)		
L3	2C6386A/C7	COIL: inductor; single layer wound; 20 turns tapped at 10 turns.	5	465-L3 (R5)		
L5	2C6386A/C10	COIL: inductor; single layer wound; 2 turns.	5	465-L5 (R5)		
L6, 7	2C6386A/C9	COIL: inductor; tapped; 2 layer bank wound; 80 turns tapped at 30, 40, 50, 60 and 80 turns.	2	465-L6 (R5)		
L8, 9	2C6386A/C11	COIL: inductor; single layer wound; 33⅛ turns.	2	465-L8 (R5)		
IN1	3G1350-33	INSULATOR: bowl; ceramic; 5¼" OD x 2⅝" high.	5	1088-00 (G1)		
IN2	3G3052-24	INSULATOR: stand-off; ceramic; conical; 3" long x 1½" diam base x ¾" diam top; tapped 10-32 both ends; AWS NS3W2024.	5	1049-00 (G1)		
IN3	3G1880-16	INSULATOR: stand-off; ceramic; cylindrical; ½" diam x 1½" long; tapped 8-32 at both ends; AWS NS3W0212.	10	1158-04 (G1)		
IN4	3G1050-12.1	INSULATOR: stand-off; ceramic; conical; ¾" long x ½" base diam x ⅜" top diam; tapped 6-32 at both ends.	10	D-328 (G1)		
IN5	3G3501-02	INSULATOR: bushing; lead-in; ceramic; conical; 1⅛" high x 1¾" base diam x ⅞" top diam; AWS NS3W4502.	20	1253-00 (G1)		
S1	3Z9825-12.19	SWITCH: rotary; double pole, double throw; single Isolantite wafer.	5	465-S1 (R5)		
S2	3Z9825-12.18	SWITCH: rotary; single pole, double throw; single Isolantite wafer.	5	465-S2 (R5)		
TR1	1F4S1-2.3172	TRANSMISSION LINE: coaxial; 70 ohms.	5	CAA-84 (S51)		
	2C6386A/KL	VOICE CONVERSION KIT	1	(R5)		
TS1	2Z9408.17	BOARD: terminal; 8 terminals.	1	8-142 (J5)		
TS2	2Z9405.72	BOARD: terminal; 5 terminals.	1	5-142 (J5)		
TS3	2Z9405.71	BOARD: terminal; 5 terminals.	1	5-142 (J5)		
CK1	3DA2-119	CAPACITOR: mica; 0.002 mfd; 1,200 v d-c working; 1.2 amp at 300 kc; AWS CM60F202J.	1	XMJW 1.2-22-10 (S5)	*	*
CK2	3DA4-45	CAPACITOR: mica; 0.004 mfd; 1,200 v d-c working; 2 amp at 300 kc; AWS CM60F392G.	1	XMJW 1.2-24-5 (S5)	*	*

†Parts not stocked in station or region stock are carried in depot stock.
*Indicates stock available.

96. MAINTENANCE PARTS LIST FOR ADCOCK RADIO RANGE STATION (cont'd)

Ref. symbol	Signal Corps stock No.	Name of part and description	Quan. per unit	Mfrs. part and code No.	†Station stock	†Region stock
CK3	3DA8-13	CAPACITOR: mica; 0.008 mfd; 1,200 v d-c working; 4 amp at 300 kc; AWS CM55F822G.	1	XMJW 1.2-28-5 (S5)	*	*
LK1	2C6386A/C12	COIL: inductor; single layer wound; 60 turns.	1	B-2516-1B (R5)		
EK1	2Z7590-38	RELAY: 3 pole, double throw, 3 contact normally closed; 2 contact normally open.	1	466U-EK1 (R5)		*
EK2	2Z7593-72	RELAY: 3 pole, double throw; 115 v a-c coil.	1	BOX 30 (A37)		*
EK3-4	2Z7587-107	RELAY: single pole, double throw; 50 ohm d-c resistance.	2	BD-330 (A37)		*
RK1	2Z7284.50	RESISTOR: potential dual section; 50,000 ohm per section.	1	37 (C10)		*
TK1	2Z9631.69	TRANSFORMER: a-f input; primary 600 ohms center tapped.	1	466-T-12 (S28)		*
		REMOTE CONTROL UNIT				
C1R	3DB50-15	CAPACITOR: electrolytic; 50 mfd; 100 v d-c working; 4 prong base plug-in.	1	DOA (S5)	*	*
C2R	3DB200-2	CAPACITOR: electrolytic; 200 mfd; 5 v d-c working; 4 prong base plug-in.	1	DOA (S5)	*	*
C3R	3DB4-63	CAPACITOR: paper; oil; 4 mfd; 100 v d-c working.	1	XDRHW1-4 (S5)	*	*
X1R	3C335-6	CHOKE: power supply filter; 2.5 h at 25 ma d-c; 1,600 v insulated.	1	466-X1R (S18)		*
F1R	3Z1964	FUSE: cartridge; non-renewable; 1 amp; 250 v; type 4AG.	1	1091 (B9)	*	*
P1R	4C5491-E3	LAMP: pilot; 0.12-0.16 amp; 6 v.	1	DB-58 (A8)	*	*
P2R, 3R	4C5492-C	LAMP: pilot; 35 ma; 35 v.	2	DB-76 (A8)	*	*
M1R	3F891-25	METER: ma; a-c rect type; special scale, 1 ma full scale at 1,000 cps.	1	453-M3 (R5)		*
PG1R	6Z7591-15	RECEPTACLE: female; 2 wire; 10 amp; midget twist-lock 1" diam.	1	7461 (H4)		
SO-PG1R	6Z815	RECEPTACLE: male; 2 wire; 10 amp; twist-lock, midget, special.	1	7466 (H4)		*
EIR	2Z7588-23	RELAY: double pole, single throw; 1 normally open, 1 normally closed coil; 20 v d-c; contacts 1 amp, 48 v d-c.	1	BD-42 (A37)		
CO1R	2Z7588-23/2	COIL: 20 v d-c; 12,000 ohm d-c resistance.	1	BX-14 (A37)		*
CON1R	2Z7588-23/1	CONTACTS: 1 amp, 48 v d-c.	1	BX-14 (A37)	*	*
1R, 4R	3Z6025-60	RESISTOR: 250 ohm; 25 w; wire wound.	2	2-S (L5)	*	*
2R	2Z7278-5	RESISTOR: potential; 5 500 ohm; L taper, wire wound.	1	P58 (R5)		*
R	3Z6250-4	RESISTOR: 2,500 ohm; 2 w; carbon.	1	F-2 (12)		*
R	3Z6010-116	RESISTOR: 100 ohm; 25 w; wire wound.	1	2-S (L5)	*	*

rts not stocked in station or region stock are carried in depot stock.
icates stock available.

96. MAINTENANCE PARTS LIST FOR ADCOCK RADIO RANGE STATION (cont'd)

Ref. symbol	Signal Corps stock No.	Name of part and description	Quan. per unit	Mfrs. part and code No.	†Station stock	†Region stock
SO-V1R, C1R, C2R	2Z8659-5	SOCKET: tube; 4 prong; bakelite, wafer.	3	MIP4 (A13)		
S1R, 2R	3Z9851	SWITCH: toggle; single pole, single throw; 10 amp at 125 v.	2	1311 (P18)		
T1R	2Z9613.97	TRANSFORMER: power; primary; 115 v, 60 cps; secondary No. 1-5 v; 3 amp; secondary No. 2:220 v center-tapped at 0.225 amp.	1	466-T1R (S28)		*
T2R	2Z9631.79	TRANSFORMER: audio; microphone to line, primary: 50 ohm at 0.15 amp d-c; secondary: 600 ohm center-tapped balanced.	1	466-T2R (S28)		*
V1R	2J5Z3	TUBE, JAN-5Z3.	1	5Z3 (R2)	*	*

†Parts not stocked in station or region stock are carried in depot stock.
*Indicates stock available.

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97. LIST OF MANUFACTURERS

Code	Manufacturer's Name
A8	Automatic Electric Sales Corp., Chicago, Ill.
A13	American Phenolic Corp., Chicago, Ill.
A37	Allied Control Co., New York, N. Y.
B9	Bussman Mfg. Co., St. Louis, Mo.
C2	Allen D. Cardwell Mfg. Corp., Brooklyn, N. Y.
C10	Clarostat Mfg. Co., Inc., Brooklyn, N. Y.
G1	General Ceramics Co., New York, N. Y.
G3	General Electric Co., Schenectady, N. Y.
I2	International Resistance Co., Philadelphia, Pa.
J5	Jones, Howard B., Chicago, Ill.
L3	Littlefuse Lab., Chicago, Ill.
L5	Lectrohm Inc., Cicero, Ill.
L8	Leeds & Northrup Co., Philadelphia, Pa.
P18	Pierce & Seymour
R2	RCA Mfg. Co., Camden, N. J.
R4	Radio Wire & Television, New York, N. Y.
R5	Radio Receptor Co., Inc., New York, N. Y.
S5	Solar Mfg. Corp., Bayonne, N. J.
S18	Superior Electric Co., Bristol, Conn.
S28	Super Electric Products Co., Newark, N. J.
S51	Simplex Wire & Cable Co., Cambridge, Mass.

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS

a. System of Numbering by Symbols.

Series No.	Description
0-00	Installation and maintenance, spare parts
1-00	Building structural—waterproofing
2-00	Building structural—screeds
2-T-00	Building structural—tropical foundation
3-00	Building structural—floor system
4-00	Building structural—wall system
5-00	Building structural—ceiling system
6-00	Building structural—roof system
7-00	Mechanical building parts and equipment
7-T-00	Mechanical building parts and equipment—tropical foundation
8-00	Electrical parts and equipment
9-00	Tools
10-00	Tower erection and dismantling equipment
1-S-00 to 10-S-00	Spare parts (indicated by S following series number)

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS

b. List of Items.

Item No.	Quantity	Unit	Description	Assembly
			ITEM 1: BUILDING, WIRING AND EQUIPMENT	
			Installation and Maintenance—Spare Parts	
0-00	2	Each	Technical Manual TM 11-1076	
0-1	2	Each	Tarpaulins, 16′ x 24′	Protection
0-2	2	Pieces	Plank, 3″ x 10″ x 10′ 0″	Moving equipment
0-3	6	Pieces	Cribbing, 3″ x 10″ x 3′ 0″	Moving equipment
0-4	3	Pieces	Pipe, 2½″ ID x 3′ 0″	Moving equipment
0-5	1	Pieces	Pipe, 2½″ ID x 8′ 0″	Moving equipment and opening anchors
0-6	2	Pieces	Plywood mat, 4′ x 6′ x ⅝″, or 8 pieces 1′ 6″ x 4′ 0″ x ⅝″	Moving equipment (floor protection)
0-7	1	Each	Ladder, 10′ 0″	Installation and maintenance
0-8	4	Pounds	Nails, 8d box, cement coated	Repacking
0-9	1	Pounds	Nails, 6d box, cement coated	Repacking
OS-10	1	Pounds	Nails, 4d box, galvanized	Repacking
OS-11	1	Assorted lot	Nails, 3d fines (0.1 lb) and ⅞″ x 18 brads (0.1 lb)	Maintenance
OS-12	1	Assorted lot	Screws, brass (3 No. 8 x 2″, 3 No. 7 x 1½″, 30 No. 7 x 1″, 6 No. 12 x 2½″, 3 No. 12 x 2″)	Maintenance
OS-13	1½	Gross	Screws, galvanized, wood #10 x 1¾″ (2.2#)	Repacking
OS-14-A	2	Each	Brush, paint, 4″	Maintenance
OS-14-B	½	Gallon	Paint, OD pigmented Firzite	Wood prime coat
OS-14-C	½	Gallon	Paint, OD enamel	Outside of inside finish
OS-14-D	½	Gallon	Paint, olive green enamel	Floor finish
OS-14-E	1½	Gallon	Paint, thinner	Thinner, oil paint
OS-14-F	1	Gallon	Linseed oil, boiled	Utility
OS-14-G	½	Pint	Paint, heat-resisting black	Exhaust pipe finish
OS-15	38	Each	Anchors, Ackerman-Johnson, ¼″ x 20, 2 wing shorts	Screw anchor replacements
OS-16	24	Each	Anchors, Ackerman-Johnson, ¼″ x 20, 2 wing long	Screw anchor replacements
OS-17	18	Each	Anchors, Ackerman-Johnson, ¼″ x 20, 2 wing extra long	Screw anchor replacements
OS-18	1	Each	Asbestos board, 12′ x 12′ x ¼″	Blackout panel over exhaust outlet and spare
OS-19	1	Can	Glue (waterproof)	Wood parts
OS-20	1	Each	Broom	
			Building, Structural—Waterproofing	
1-1	5	Rolls	15-lb asphalt felt (432 sq ft per roll)	Foundation waterproofing and flashing
1-2	4	Cans	Liquid adhesive asphalt (5 gallons per can)	Seal for 1-1
			Building, Structural—Screeds	
2-1	4	Pieces	2″ x 4″ x 4′ 2¼″	Foundation on fill
2-2	6	Pieces	2″ x 4″ x 8′ 8″	Foundation on fill
2-3	4	Pieces	2″ x 4″ x 4′ 2¼″	Foundation on fill
2-4	2	Pieces	2″ x 4″ x 8′ 8″	Foundation on fill
2-5	2	Pieces	2″ x 4″ x 4′ 2¼″	Foundation on fill
2-6	4	Pieces	2″ x 4″ x 8′ 8″	Foundation on fill
2-7	2	Pieces	2″ x 4″ x 4′ 2¼″	Foundation on fill
2-8	2	Pieces	2″ x 2″ x 4′ 2¼″	Foundation on fill
2-9	4	Pieces	2″ x 2″ x 8′ 8″	Foundation on fill
2-10	2	Pieces	2″ x 2″ x 4′ 2¼″	Foundation on fill
2-11	40	Each	¼″ x 20 x 3½″ flat head machine screws	Screed connections
2-12	6	Each	¼″ x 20 x 3½″ flat head machine screws	Screed connections
2-13	40	Each	¼″ washers	Screed connections
2-15	2	Can	Lubseal, 1 lb	Lubricant for all threaded connections

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd).

Item No.	Quantity	Unit	Description	Assembly
			Floor System (Series 3–0)	
3-1 to 3-18 inclusive	1	Each	4′ 0″ x 8′ 0″ plywood panels 3⅝″ thick (as detailed)	Floor panels
3-19	19	Pieces	1½″ x 2⅝″ x 7′ 9″	Floor splines
3-20	4	Pieces	1½″ x 2⅝″ x 3′ 11¾″	Floor splines
3-21	3	Pieces	8″ x 8″ x ½″ plywood	Panel corner tie plates
3-22	2	Pieces	8″ x 8″ x ½″ plywood	Panel corner tie plates (under posts)
3-23	5	Pieces	8″ x 8″ x ½″ plywood	Panel corner tie plates (under partition)
3-24	8	Pieces	Formed 18 ga. metal 8′ 1¾″ long	Termite shields on floor panels
3-25	4	Pieces	Formed 18 ga. metal 8′ 0″ with corners	Termite shields on floor panels
3-26	48	Pieces	¼″ x 6″ flat head machine screws	Floor panels to screeds
3-27	40	Pieces	¼″ x 2½″ flat head machine screws	Tie plates to floor
			Wall System (Series 4–0)	
4-1	50	Pieces	1⁷⁄₁₆″ x 9″ x ⅝″ plywood with 2 dowels	Wall ties to floor and at ceiling. Dowels in floor and top of wall and partition panels.
4-2 to 4-25 inclusive	1	Each	4′ 0″ x 8′ 0″ plywood panels 2″ thick (as detailed)	Wall panels
4-26 to 4-31 inclusive	1	Each	4′ 0″ x 8′ 0″ plywood panels 2″ thick (as detailed)	Partition panels
4-32	2	Pieces	3½″ x 3½″ x 7′ 8½″ with dowel one end	Posts under ceiling beams
4-33	1	Pieces	3½″ x 3½″ x 7′ 10¼″	Left ceiling beam
4-34	1	Pieces	3½″ x 3½″ x 8′ 0″	Center ceiling beam
4-35	1	Pieces	3½″ x 3½″ x 7′ 10¼″	Right ceiling beam
4-36	2	Pieces	2″ x 2″ x 5″ x ¼″ steel angles	Beams to walls
4-37	4	Pieces	2″ x 2″ x 3½″ x ¼″ steel angles	Posts to beams
4-38	4	Pieces	2″ x 2″ x 5″ x ¼″ steel angles	Beams to ceiling
4-39	2	Pieces	1½″ x 1½″ x 7′ 10⅜″ with plywood one face	Tie and filler strip for top of removable panels 4–9, 4–10, 23 and 24
4-40	2	Rolls	Joint tape, 2″ wide (180 ft. per roll)	To cover outside vertical joints and horizontal joints at top of wall panel
4-40-A	1	Quart	Brycolac	Coating under tape
4-41	40	Each	Caulking compound, olive drab color, cartridges	All joints not sealed by 4-40
4-42	1	Each	Caulking gun	For 4-41
4-43	2	Sets	Latch assembly	Front and partition doors
4-44	2	Sets	Door stops, 3½″, single screw	Front and partition doors
4-45	69	Each	¼″ x 20 x 3″ cap screws	Through floor panel into bottom of wall panels
4-45-A	69	Each	¼″ washers	
4-46	8	Each	¼″ x 20 x 2½″ flat head machine screws	Wall panels 4–9, 10, 23 and 24 to partition
4-47	16	Each	¼″ x 20 x 3½″ flat head machine screws	Corner panels to corner panels
4-48	1	Each	¼″ x 20 x 3″ flat head machine screws and nut	Front door threshold
4-48-A	1	Each	¼″ washer	Front door threshold
4-49	30	Pieces	¼″ x 20 x 1½″ round head machine screws	4-36, 37, 38 to posts, walls and ceiling
4-50	12	Pieces	¼″ x 20 x 1½″ flat head machine screws	Access panels 4–9, 10, 23, 24 to 4-39
			Ceiling System (Series 5–0)	
5-1	2	Pieces	2⁷⁄₁₆″ x 3″ x 8′ 0″ (as detailed)	Bevel strips
5-2	2	Pieces	2⁷⁄₁₆″ x 3″ x 8′ 0″ (as detailed)	Bevel strips
5-3	2	Pieces	2⁷⁄₁₆″ x 3″ x 8′ 0″ (as detailed)	Bevel strips
5-4	2	Pieces	2⁷⁄₁₆″ x 3″ x 8′ 0″ (as detailed)	Bevel strips
5-5	2	Pieces	2⁷⁄₁₆″ x 3″ x 4′ 0″ (as detailed)	Bevel strips
5-6	8	Pieces	2⁷⁄₁₆″ x 3″ x 4′ 0″ (as detailed)	Bevel strips

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd).

Item No.	Quantity	Unit	Description	Assembly
5-7 to 5-24 inclusive	1	Each	4′ 0″ x 8′ 0″ plywood panels 2″ thick (as detailed)	Ceiling panels
5-28	6	Pieces	7″ x 12″ x 5/8″ plywood, drilled for machine screws	Panel corner tie plates
5-29	4	Pieces	7″ x 12″ x 5/8″ plywood, drilled for machine screws and post dowels	Same as 5-28 under posts
5-30	72	Pieces	1/4″ x 20 x 5 1/2″ round head machine screws	Through ceiling panels into wall panels
5-30-A	18	Pieces	1/4″ x 4 1/2″ round head machine screws	Ceiling to partition panels for 5-30 and 5-30-A
5-30-B	90	Pieces	1/4″ washers	
5-31	40	Pieces	1/4″ x 20 x 2″ round head machine screws	5-28 and 5-29 to ceiling for 5-31
5-31-A	40	Pieces	1/4″ washers	
			Roof System (Series 6-0)	
6-4	4	Pieces	4″ x 4″ x 3′ 11 3/8″ with dowels both ends	Roof strut
6-5	4	Pieces	2″ x 8″ x 9′ 4 1/4″ with purlin blocks	Hip rafters—lower section
6-6	4	Pieces	2″ x 8″ x 9′ 5 5/16″ with purlin blocks and splice blocks	Hip rafters—upper section
6-7	4	Pieces	2″ x 8″ x 9′ 5/8″ (as detailed)	Jack rafter—right
6-8	4	Pieces		Jack rafter—left
6-9	4	Pieces	2″ x 6″ x 4′ 10 3/4″	Purlin
6-10	4	Pieces	2″ x 6″ x 1′ 7 1/2″	
6-11	8	Pieces	2″ x 6″ x 7′ 10 1/4″	
6-12	4	Pieces	2″ x 6″ x 4′ 10 3/4″	
6-13	4	Pieces	2″ x 6″ x 1′ 7 1/2″	
6-14	4	Pieces	2″ x 6″ x 5′ 2 3/4″	
6-15	4	Pieces	5/8″ plywood panels with cleats	Roof deck (1st course)
6-16	1	Pieces		Roof deck (1st course) (roof canopy)
6-17	4	Pieces		Roof deck (1st course)
6-18	3	Pieces		
6-19	4	Pieces		Roof deck (2nd course)
6-20	4	Pieces		
6-21	4	Pieces		
6-22	4	Pieces	5/8″ plywood panels	Roof deck (3rd course)
6-23	4	Pieces	5/8″ plywood panels with foot cleats	
6-24	4	Pieces	5/8″ plywood panels	
6-25	4	Pieces	5/8″ plywood panels	Roof deck (4th course)
6-26	1	Pieces	1′ 0″ x 4′ 0″ x 5/8″ plywood panel	Door canopy
6-27	4	Pieces	Milled batten, 2″ x 3″ x 4′ 10 3/16″	Roof
6-28	8	Pieces	Milled batten, 2″ x 3″ x 3′ 8″	
6-29	8	Pieces	Milled batten, 4′ 10 3/16″ long	Hip rafter joint roof batten
6-30	8	Pieces	Milled batten, 3′ 8″ long	Jack rafter joint roof batten
6-32	4	Pieces	Milled batten, 2′ 3 1/8″ long	
6-33	4	Pieces		
6-34	4	Pieces	Milled batten, 2′ 5 1/8″ long	Hip rafter joint roof batten
6-35	5	Pieces	1 1/2″ x 1 1/2″ x 1′ 10 3/4″	Ventilator struts
6-36	96	Feet	Jute (single strand)	Filler under hip battens
6-37	1	Assembly	Curb, screen frame, and facia approximately 5′ 0″ 5′ x 0″	Roof ventilator frame assembly
6-39	4	Frames	1′ 1 1/2″ x 1′ 1 1/2″ frames and plastic screen cloth	Roof ventilator screens
6-40	4	Frames	1′ 1 1/2″ x 2′ 3 7/8″ frames and plastic screen cloth	
6-41	4	Pieces	2″ x 2″ x 3′ 8 7/8″	Roof ventilator rafters
6-42	1	Pieces	5″ x 5″ x 5/8″ plywood	Tie plate—top of hip rafters
6-43	4	Pieces	5/8″ plywood triangular with cleats	Roof ventilator roof deck
6-44	4	Pieces	Milled battens, 4′ 2 11/16″ long	Roof ventilator battens
6-45	20	Pieces	3/8″ x 6″ machine bolts and nuts	Hip and jack rafters to ceiling
6-45-A	24	Pieces	3/8″ washers	For 6-45
6-46	8	Pieces	1/4″ x 1″ x 5 1/2″ steel strap	For 6-45 at jack rafters
6-47	16	Pieces	1/4″ x 3 1/2″ round head machine screws and nuts	Hip rafter splice plate
6-47-A	32	Pieces	1/4″ washers	For 6-47
6-48	4	Pieces	1/4″ x 20 x 3″ round head machine screws	Tie plate to top of rafters
6-48-A	4	Pieces	1/4″ washers	For 6-48

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd)

Item No.	Quantity	Unit	Description	Assembly
6-49	8	Pieces	¼" x 20 x 4" round head machine screws and nuts	Jack rafter to hip rafters
6-49-A	16	Pieces	¼" washers	For 6-49
6-50	84	Pieces	¼" x 20 x 3" flat head machine screws	Roof deck to purlins
6-51	8	Pieces	¼" x 20 x 3" round head machine screws and nuts	Ventilator struts to hip rafters
6-51-A	9	Pieces	¼" washers	For 6-51
6-51-B	9	Pieces	5/16" x 1½" washers	
6-52	4	Pieces	¼" x 20 x 3½" round head machine screws and nuts	Roof ventilator frame 6-37 to struts
6-52-A	8	Pieces	¼" washers	For 6-52
6-53	4	Pieces	¼" x 20 x 3" round head machine screws and nuts	Roof ventilator rafters to struts
6-53-A	8	Pieces	Four ¼" washers and four 5/16" x 1½" washers	For 6-53
6-54	3	Pieces	¼" x 20 x 2" round head machine screws and nuts	Door canopy 6-26 to roof 6-16
6-54-A	6	Pieces	¼" washer	For 6-54
6-55	104	Pieces	¼" x 20 x 4" round head machine screws	Roof battens to roof
6-55-A	104	Pieces	¼" washers	For 6-55
6-56	1	Pieces	¼" x 20 x 2" round head machine screws and nuts	Ventilator rafter top tie
6-56-A	2	Pieces	5/16" x 1½" washers	For 6-56
			Miscellaneous and Spare Parts List	
1-S-1	4	Rolls	Waterproof felt, 14 lb (432 sq ft per roll)	Foundation waterproof
1-S-2	4	Cans	Asphalt, liquid adhesive (5 gallon cans)	
1-S-3	2	Each	Brushes, bristle, waterproofing	
1-S-3-A	3	Each	Handles, brush, waterproofing	
2-S-11	6	Each	¼" x 3½" flat head machine screws	Screeds and at corner panels
2-S-12	2	Each		
3-S-26	5	Each	¼" x 6" flat head machine screws	Floors to screeds
3-S-27	4	Each	¼" x 2½" flat head machine screws	Tie plates to floor
4-S-40	2	Rolls	Tape joint 2" wide, 180 linear feet per roll	Wall joints
4-S-41	4	Each	Caulking compound, cartridges, olive drab color	Roof joints
4-S-45	7	Each	¼" x 3" cap screws	Floor to wall panels
4-S-45-A	40	Each	¼" washers.	
4-S-48	10	Each	¼" x 3" flat head machine screws and nuts	Threshold to floor, etc.
4-S-49	4	Each	¼" x 1½" round head machine screws	Clip angles, posts and beam
4-S-50	2	Each	¼" x 1½" flat head machine screws	Access panels
5-S-30	8	Each	¼" x 5½" round head machine screws	Ceiling to walls
5-S-30A	2	Each	¼" x 4½" round head machine screws	Ceiling to partition
5-S-31	4	Each	¼" x 2" round head machine screws	Tie plate to ceiling
6-S-45	2	Each	⅜" x 6" square head machine bolts and nuts	Rafters to ceiling
6-S-45-A	3	Each	⅜" washers	
6-47-S	3	Each	¼" x 3½" round head machine screws and nuts	Rafter splice plate
6-S-49	12	Each	¼" x 4" round head machine screws and nuts	Jack to hip rafter
6-S-51	2	Each	¼" x 3" round head machine screws and nuts	Vent to rafters
7-1	8	Each	4" x 4" x 2' 8"	Barrel rack leg
7-2	2	Each	2" x 6" x 4' 0"	Barrel rack side rail
7-3	2	Each	2" x 7" x 4' 0"	
7-4	4	Each	2" x 4" x 2' 7½"	Barrel rack end rail
7-5	8	Each	1" x 4" x 3' 0"	Barrel rack end brace
7-6	8	Each	1" x 4" x 2' 10½"	Barrel rack side brace
7-7	2	Each	2" x 4" x 5' 6"	Barrel rack pipe support
7-8	8	Each	2" x 3" (beveled) x 2' 6"	Barrel chocks
7-9	2	Each	2" x 6" x 6' 8" (with hooks)	Barrel skid side rails
7-9-A	2	Each	¾" x 2' 0" stud bolts, 4 nuts, 4 washers each	Barrel loading skid
7-9-B	2	Each	¼" x 1½" x 8" bent hooks	Skid hooks
7-9-C	2	Each	⅜" x 2½" bolts and nuts (carriage bolts)	Anchor for skid hooks
7-9-D	2	Each	⅜" x 4" bolts and nuts (carriage bolts)	
7-10	8	Each	6" x 6" x 2" metal pans	Termite shields
7-11-A	4	Each	⅜" x 7" machine bolts, 1 nut, 2 washers each	Fuel drum rack
7-11-B	4	Each	⅜" x 5½" machine bolts, 1 nut, 2 washers each	
7-11-C	24	Each	⅜" x 5" machine bolts, 1 nut, 2 washers each	
7-11-D	8	Each	⅜" x 4" machine bolts, 1 nut, 2 washers each	
7-11-E	4	Each	⅜" x 3½" machine bolts, 1 nut, 2 washers each	

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd)

Item No.	Quantity	Unit	Description	Assembly
7-13	5	Each	1" x 20" x 25" fiberglass filters.	
7-14	1	Each	Plywood hood approximately 1' 4" x 2' 3" x 2' 9"	Ventilator unit intake opening
7-15	1	Each	Plywood box approximately 1' 9½" x 1' 9" x 1' 9"	Ventilator unit enclosure
7-15-A	3	Each	¼" x 20 x 2" round head machine screw, 1 washer each	7-15 to ceiling panel 5-13
7-19	8	Each	Plywood, ⅜" (triangular)	Air intake and outlet hoodsides
7-20	2	Each	Plywood, ⅜" with cleats, 1' 9" x 2' 1"	Outlet hood cover
			Note.—Parts #7-19, 7-20, 7-23 shipped fastened to wall panel openings.	
7-21	2	Each	⅜" plywood with cleats 2' 0" x 3' 3"	Engine room air outlet damper
7-22	2	Each	Box approximately 2" x 2' 0" x 2' 5"	Duct collar and damper slide
7-23	2	Each	⅜" plywood with cleats, 2' 15/16" x 3' 7¼"	Intake hood cover
7-24	1	Each	½" plywood with cleats, 2' 4" x 8' 0"	Air intake baffle
7-24-A	2	Each	⅛" x 1" x 5⅛" steel strap bent and drilled	Baffle hanger
7-24-B	4	Each	¼" eye bolts	
7-24-C	2	Pieces	Sash cord, 6 feet long	
7-24-D	2	Each	¼" x 3" round head machine screws and nuts	
7-24-E	2	Each	¼" x 1½" round head machine screws	
7-25	2	Each	Canvas ducts with two No. 9 wire clamps and two ¼" x 2½" round head bolts and nuts and 4 washers attached.	
7-26	1	Each	No. 8 wire 1' 2¼" (ends bent)	Ventilator unit damper tie rod
7-27	12	Each	¼" x 3" round head machine screws	Damper slides to wall
7-27-A	12	Each	¾" x 5/16" flat washers.	
7-28	24	Each	Flat head wood screws No. 7 x 1"	Engine room air intake and outlet hoods, #7-19 shipped in panels as temporary fasteners
7-29	4	Each	¼" x 3" round head machine screws	Ventilator unit hood to outside wall
7-29-A	4	Each	¾" x 5/16" flat washers	
7-31	4	Each	½" flat head cock	Control valves
7-32	1	Each	Pipe assembly, approximately 3' 1", consisting of one ½" pipe 34⅜" long, one ½" standard tee, one ½" standard 90° ell, one ½" nipple 6" long, one ½" nipple 3" long	Supply pipe to engine No. 1
7-33	1	Each	Pipe assembly, approximately 4' 0", consisting of one pipe 3' 11¾" and one standard 90° ell	Supply pipe to engine No. 2
7-34	1	Each	Pipe 7' 2⅝" long	Supply pipe to engine No. 1
7-35	1	Each	Pipe assembly, approximately 6' 2½", consisting of one ½" pipe 6' 1" long, one ½" standard 90° ell, one ½" x ¼" bushing	Supply pipe to engine No. 2
7-36	1	Each	Pipe assembly, approximately 10' 0", consisting of one ½" pipe 6' 3½" long, one ½" pipe 3' 5½" long, one ½" standard tee, one ½" x 3" nipple	Return line (common)
7-37	1	Each	Pipe assembly, approximately 1' 2½", consisting of one ½" pipe 1' 1⅞" long, one ½" standard 90° ell, one ½" x ¼" bushing	Return line engine No. 2
7-38	2	Each	Pipe assembly, approximately 10' 0", consisting of one ½" pipe 9' 10½", one ½" standard 90° ell, one ½" x ¼" bushing	Return line engine No. 1.
7-39	1	Each	Pipe assembly, approximately 2' 0", consisting of one ½" pipe 9¼" long, two ½" standard tees, one ½" close nipple, two 1¼" x ½" reducers, one 1¼" nipple 8" long, one ½" x ¼" bushing	Water trap
7-40	1	Each	Pipe assembly, approximately 8' 3", consisting of one ½" pipe cap, one ½" nipple 6" long, two ½" standard crosses, four ½" x ¼" bushings, one ½" pipe 2' 10½" long, one ½" pipe 11" long, two ½" standard tees	Fuel tank header
7-41	1	Each	Pipe assembly, approximately 3' 0", consisting of one ½" pipe 1' 10½" long, and one ½" vent cap	Vent

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd).

Item No.	Quantity	Unit	Description	Assembly
7-42	1	Each	Pipe assembly, approximately 6′ 0″, consisting of two ½″ pipes 2′ 10½″ long, one ½″ standard 90° ell, one ½″ ground joint union	Return pipe
7-43	5	Each	¼″ brass pet cocks	Tank vent and trap drain
7-44	8	Each	Shut-off cocks, ¼″ male pipe threaded one end, ⅜″ OD copper other end	Fuel tank shut-off valves
7-45	4	Each	⅜″ OD tubing with 12″ diameter expansion loop	Flexible tank connection
7-46	4	Each	Pipe assembly, approximately 4½″, consisting of one 2″ x ¼″ bushing, one ¼″ 90° street ell, one ¼″ 90° standard ell, one ¼″ pipe nipple 3″ long	Tank vent
7-47	4	Each	Bushing assembly, consisting of one ¾″ x ½″ bushing and one ½″ x ¼″ bushing	Tank outlet bushing
7-48	2	Each	⅜″ OD copper tubing, approximately 5′ 0″	Supply connection
7-49	2	Each	⅜″ OD copper tubing, approximately 5′ 0″	Return connection
7-50	4	Each	⅜″ OD copper x ¼″ male iron pipe thread adapter	Connections between copper and iron supply and return lines, both engines.
7-51	1	Each	⅜″ OD copper tubing approximately 6′ 6″ and ⅜″ OD copper x ¼″ male iron pipe adapter (material furnished with engine)	Vent line engine No. 1
7-52	1	Each	⅜″ OD copper tubing approximately 13′ 0″ and ⅜″ OD copper to ¼″ male iron pipe adapter (furnished with engine)	Vent line engine No. 2
			Note.—Parts No. 7-48, 7-49, 7-51, and 7-52 to be cut to length and bent to shape in field from material furnished and packed with engine.	
7-53	4	Each	50 gallon barrels	Fuel tanks furnished by Government
7-57	5	Each	½″ pipe hanger (ceiling)	Fuel line fasteners
7-58	8	Each	½″ one-hole pipe straps	
7-59	13	Each	¼″ x 1½″ round head machine screws	
7-60	1	Each	2″ pipe nipple	Exhaust pipe engine No. 2
7-61	2	Each	Flexible exhaust pipes	Exhaust pipe engine No. 1 and No. 2
			Note.—Part No. 7-61 furnished and shipped with engines.	
7-64	2	Each	2½″ 45° elbows	Exhaust pipe engine No. 1 and No. 2
7-65	4	Each	2½″ close nipples	
7-66	2	Each	Exhaust silencers—with companion flanges and gaskets (packed with engines)	Engines No. 1 and No. 2
7-68	1	Each	3′ 0″ pipe assembly—2½″ pipe and one 90° ell	Exhaust pipe engine No. 1
7-69	1	Each	5′ 2″ pipe assembly—2½″ pipe and one 90° ell	Exhaust pipe engine No. 2
7-70	8	Each	⅜″ x 2′ 11″ rods with 5 nuts and 2 washers each	Exhaust silencer hangers
7-71	2	Each	¾″ perforated steel straps pre-formed	Exhaust pipe hangers
7-72	4	Each	¼″ x 1″ round head machine screws and washers	
7-73	2	Each	¼″ x 1½″ round head machine screws and nuts	
7-74	1	Can	Pipe joint, compound	Fuel line and exhaust pipe joints
7-81	13	Each	Cork and wood vibration eliminators, 3½″ x 4½″ x 10″ complete with ½″ x 3½″ bolt hex nut, iron washer, and "Fabreeka" washer and sleeve	Bases for engine No. 1 and No. 2
7-85	2	Each	15 KVA Diesel generator sets	Power units No. 1 and No. 2
			Spare Parts—Mechanical	
7-S-10	1	Each	Metal pan	Termite shield
7-S-11-A	1	Each	⅜″ x 7″ machine bolts, one nut, two washers each	Fuel drum rack
7-S-11-B	1	Each	⅜″ x 5½″ machine bolt, one nut, two washers	
7-S-11-C	2	Each	⅜″ x 5″ machine bolt, one nut, two washers	
7-S-11-D	1	Each	⅜″ x 4″ machine bolt, one nut, two washers	
7-S-11-E	1	Each	⅜″ x 3½″ machine bolt, one nut, two washers	
7-S-13	12	Each	1″ x 20″ x 25″ Fiberglass filters	
7-S-24-B	1	Each	¼″ eye bolt	

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd).

Item No.	Quantity	Unit	Description	Assembly
7-S-24-D	1	Each	¼" x 3" round head machine screws and nuts	
7-S-24-E	1	Each	¼" x 1½" round head machine screws	
7-S-28	8	Each	Flat head wood screws No. 7 x 1"	
7-S-30-A	10	Feet	½" pipe threaded both ends	Miscellaneous spare parts—fuel pipe
7-S-30-B	1	Each	Standard ½" 90° ell	
7-S-30-C	1	Each	Standard ½" tee	
7-S-30-D	1	Each	Standard ½" cross	
7-S-30-E	1	Each	Standard ½" cap	
7-S-30-F	1	Each	½" x ¼" bushing	
7-S-30-G	1	Each	1¼" x ½" reducer	
7-S-30-H	1	Each	½" ground joint union	
7-S-30-I	1	Each	¼" standard 90° ell	
7-S-30-J	1	Each	¼" standard street ell	
7-S-30-K	1	Each	¾" x ½" bushing	
7-S-30-L	1	Each	½" x 6" nipple	
7-S-30-M	1	Each	½" x 3" nipple	
7-S-30-N	1	Each	½" close nipple	
7-S-30-O	1	Each	1¼" nipple 8" long	
7-S-31	1	Each	½" flat head cock	
7-S-43	1	Each	¼" brass petcock	
7-S-44	1	Each	Shut-off cock, ¼" male pipe threaded one end, ⅜" OD copper connection on other end	Fuel tank shut-off valve
7-S-50	1	Each	⅜" OD copper x ¼" male iron pipe adapter.	
7-S-57	2	Each	½" ceiling pipe hangers	
7-S-58	4	Each	½" one-hole pipe straps	
7-S-59	6	Each	¼" x 1½" round head machine screws	
7-S-65	1	Each	2½" close nipple, black	
7-S-70	1	Each	⅜" x 2' 11" rod with 5 nuts, 2 washers	
7-S-72	1	Each	¼" x 1" round head machine screws	
7-S-74	1	Can	Pipe joint compound	
7-S-81-A	2	Each	"Vibracork" pads, 3⅝" x 8⅞" x 2"	
7-S-81-B	2	Each	"Fabreeka" washers, 2" OD x ½" ID x ½" thick	
8-1-A	2	Each	2" close nipple galvanized	Building—wiring and equipment
8-1-B	2	Each	2" fiber bushing	
8-2-A	1	Each	8-conductor cable for MG No. 1 (No. 2/3, No. 14/5 rubber covered)	
8-2-B	3	Each	No. 2 solderless lugs	
8-2-C	3	Each	¼" x ¾" round head brass bolts	
8-3-A	1	Each	8-conductor cable for MG No. 2 (No. 2/3, No. 14/5 rubber covered)	
8-3-B	3	Each	No. 2 solderless lugs	
8-3-C	3	Each	¼" x ¾" round head brass bolts	
8-4-A	27	Each	No. 3 Minerallac cable supports	
8-4-B	27	Each	Split porcelain bushings for above	
8-4-C	27	Each	¼" x 1" round head plated bolts	
8-4-D	27	Each	¼" nuts	
8-4-E	27	Each	¼" x 1½" round head machine screws, plated	
8-S-4-A	8	Each	No. 3 Minerallac cable supports	
8-S-4-B	8	Each	Split porcelain bushings for above	
8-S-4-C	8	Each	¼" x 1" round head plated bolts	
8-S-4-D	8	Each	¼" nuts	
8-S-4-E	8	Each	¼" x 1½" round head plated machine screws	
8-5-A	8	Each	No. 2 Minerallac cable supports	
8-5-B	8	Each	Split porcelain bushings for above	
8-5-C	8	Each	¼" x 1" round head plated bolts	
8-5-D	8	Each	¼" nuts	
8-5-E	8	Each	¼" x 1½" round head plated machine screws	
8-S-5-A	2	Each	No. 2 Minerallac cable supports	
8-S-5-B	2	Each	Split porcelain bushings for above	
8-S-5-C	2	Each	¼" x 1" round head plated bolts	

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd).

Item No.	Quantity	Unit	Description	Assembly
8-S-5-D	2	Each	¼" x 1½" round head plated machine screws	
8-S-5-E	2	Each	¼" nuts	
8-6-A	1	Each	No. 2/3 cable for No. 1 control panel	Building—wiring and equipment
8-S-6-B	6	Each	No. 2 solderless lugs	
8-7-A	1	Each	No. 2/3 cable for No. 2 control panel	
			Note.—Assembly 8-8 consists of 8-8-A, -B, -C, -D, -F, -G, -H, -J, and -K, as follows:	
8-8-A	1	Each	100 amp double throw safety switch	
8-8-B	2	Each	1¼" Federal bushings	
8-8-C	4	Each	100 amp replaceable link fuses	
8-8-D	1	Each	1" Federal bushing	
8-8-F	1	Each	¼" x 1" round head plated bolt	
8-8-G	1	Each	¼" nut	
8-8-H	1	Each	Copper strip 1/16" x ¾" x 18" (solid neutral)	
8-8-J	1	Each	Grounding wire No. 6 11¾" long, bent with 2 eyes	
8-8-K	1	Each	¼" washer, plated	
8-S-8-B	1	Each	1¼" Federal bushing	
8-S-8-C	10	Each	100 amp link fuses (renewable)	Building—wiring and equipment
8-S-8-D	100	Each	Fuse links for 8-S-8-C	
8-S-8-E	1	Each	1" Federal bushing, spare for 8-8-D	
8-8-E	4	Each	¼" x 1½" round head plated machine screws	
8-9-A	1	Each	No. 6/3 cable from double throw switch to breaker panel.	
8-10-A	1	Each	Circuit breaker panel, 14-circuit, 20-amp. breakers	
8-10-B	1	Each	1" x 2¾" galvanized conduit nipple	
8-10-C	1	Each	1⅜" ID flat washer, galvanized	
8-10-D	2	Each	1" conduit bushings	
8-10-E	2	Each	1" locknuts	
8-10-F	4	Each	¼" x 1½" round head plated machine screws	
8-S-10-G	3	Each	20-amp breaker for distribution panel	
			Note.—Assembly 8-11 consists of 8-11-A, -E, -F, and -N, as follows:	
8-11-A	1	Each	Junction box and spare fuses for remote control of transmitters	
8-11-E	1	Each	No. 22/8 telephone cable to F-10 block	
8-11-F	1	Each	No. 22/8 telephone cable to Radio Transmitter BC-446-( )	
8-11-N	2	Each	Romex connectors	
8-S-11-G	1	Each	Box 13 coil for allied control relay	
8-S-11-H	2	Each	Sets relay contacts—allied control box 13	
8-S-11-L	1	Each	BD-330 coil for allied control relay	
8-S-11-M	2	Each	Sets relay contacts—allied control BD-330	
8-S-11-K	10	Each	15-amp cartridge fuses	Building—wiring and equipment
8-S-11-N	10	Each	Spare Romex connectors	
8-12-A	250	Each	One-hole Romex cable straps	
8-12-B	2½	Gross	½" No. 8 round head plated wood screws	
8-13	60	Each	One-hole cable straps for telephone cable	
8-S-13	20	Each		
8-15-A	1	Each	Wire mold wire protector No. 500 as detailed, 39 15/16" long.	
8-15-B	2	Each	No. 8 x ¾" flat head brass wood screws	
8-17-A	1	Each	F-10 telephone terminal block	
8-17-B	4	Each	¼" x 1½" round head plated machine screws	
			Note.—Assembly 8-18 consists of 8-18-A to 8-18-L, inclusive, as follows:	
8-18-A	1	Each	No. 12/2 Romex cable to generator room lights	
8-18-B	1	Each	Handy box	
8-18-C	1	Each	½" x 2¾" galvanized conduit nipple	Building—wiring and equipment
8-18-D	2	Each	½" bushings	
8-18-E	1	Each	½" locknut	

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd).

Item No.	Quantity	Unit	Description	Assembly
8-18-F	2	Each	3¼" octagonal boxes	Building—wiring and equipment
8-18-G	1	Each	No. 12/2 Romex cable between lights	
8-18-H	1	Each	Single-pole switch	
8-18-J	1	Each	Switch cover for handy box	
8-18-K	2	Each	3¼" porcelain keyless fixtures	
8-18-L	4	Each	Romex connectors	
			Note.—Assembly 8-19 consists of 8-19-A and 8-19-B, as follows:	
8-19-A	1	Each	No. 12/2 Romex cable to No. 1 Radio Transmitter BC-446-( )	Building—wiring and equipment
8-19-B	1	Each	Romex connector	
			Note.—Assembly 8-20 consists of 8-20-A and 8-20-B, as follows:	
8-20-A	1	Each	No. 12/2 Romex to No. 2 Radio Transmitter BC-446-( )	Building—wiring and equipment
8-20-B	1	Each	Romex connector	
			Note.—Assembly 8-21 consists of 8-21-A to 8-21-E, inclusive, as follows:	
8-21-A	1	Each	No. 12/2 Romex to RR outlet (behind transmitters)	Building—wiring and equipment
8-21-B	2	Each	Romex connectors	
8-21-C	1	Each	Handy box	
8-21-D	1	Each	Duplex receptacle	
8-21-E	1	Each	Duplex handy box cover	
			Note.—Assembly 8-22 consists of 8-22-A to 8-22-H, inclusive, as follows:	
8-22-A	1	Each	No. 12/2 Romex for RR and generator room outlets	Building—wiring and equipment
8-22-B	2	Each	Romex connectors	
8-22-C	2	Each	Handy boxes	
8-22-D	2	Each	Duplex receptacles	
8-22-E	2	Each	Duplex handy box covers	
8-22-F	1	Each	½" x 2¾" galvanized nipples	
8-22-G	2	Each	½" bushings	
8-22-H	1	Each	½" locknuts	
			Note.—Assembly 8-23 consists of 8-23-A to 8-23-J, inclusive, as follows:	
8-23-A	1	Each	No. 12/2 Romex to RR lights	Building—wiring and equipment
8-23-B	1	Each	No. 12/2 Romex to 2nd light	
8-23-C	1	Each	No. 12/2 Romex to switch	
8-23-D	6	Each	Romex connectors	
8-23-E	2	Each	3¼" octagonal boxes	
8-23-F	1	Each	Handy boxes	
8-23-G	2	Each	3¼" keyless porcelain fixtures	
8-23-H	1	Each	Single-pole switch	
8-23-J	1	Each	Switch cover of handy box	
			Note.—Assembly 8-26 consists of 8-26-B and 8-26-C, as follows:	
8-26-B	1	Each	No. 12/2 Romex cable feeder	Building—wiring and equipment
8-26-C	2	Each	Romex connectors	
8-26-A	1	Each	Blower with motor	
8-S-26	1	Each	Blower with motor (spare)	
8-26-D	4	Each	⅜" x 3" plated machine bolts	
8-26-E	4	Each	⅜" nuts, plated	
8-26-F	4	Each	⅜" washers, plated	
8-27-A	1	Roll	Friction tape	
8-27-B	1	Roll	Splicing compound	
8-34-A	4	Rolls	Counterpoise mesh 6' 0" x 23' 6½"	Ceiling counterpoise
8-34-B	40	Each	No. 12 solderless connectors	
8-34-C	¼	Pound	Staples	

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd).

Item No.	Quantity	Unit	Description	Assembly
8-34-D	1	Each	Counterpoise access panel, 2 brass strips 2½" x 28½" long.	
8-36-A	4	Each	6' 0" ground rods	Grounding
8-36-B	250	Linear ft.	No. 6 bare copper ground wire	
8-36-C	40	Each	No. 6 solderless connectors	
8-S-36-C	10	Each		
8-36-D	14	Each	No. 6 solderless lugs	
8-S-36-D	8	Each		
8-45	2	Each	Radio Transmitter BC-446-( )	
8-46-A	1	Each	Selector switch	Radio Transmitter BC-446-( )
8-46-B	4	Each	¼" x 1½" machine screws, round head	
8-46-C	4	Each	¼" washers	
8-47-A	4	Each	Lead-in insulators, including gaskets	
8-S-47-B	2	Each	Spare lead-in insulator bowls	
			Note.—For items 8-48-A to 8-61-B, inclusive, the spare parts are packed with the parts required for original installation.	
			Note.—8-48-A and spare are in one piece totaling 115 feet.	
8-48-A	75	Feet	No. 10 tinned solid copper wire	Radio Transmitter BC-446-( )
Spare	40	Feet		
8-48-B	12	Each	Lugs, for fastening No. 10 bus to No. 8 stud on switch box 90°	
Spare	6	Each		
8-48-C	4	Each	Lugs, for fastening No. 10 bus to ⅜" lead-in stud 45°	
Spare	2	Each		
8-48-D	8	Each	Lockwasher, phosphor bronze ⅜" for holding lug on lead-in and coaxial cable to stud	
Spare	4	Each		
8-52-C	8	Each	Lugs, for fastening No. 10 bus to transmitter	
Spare	4	Each		
8-52-D	16	Each	Clips for holding wire	
Spare	4	Each		
8-52-2	4	Each	Washer, brass nickel-plated 7/16" OD x 0.200 ID for stud on goniometer coil	
Spare	4	Each		
8-52-4	4	Each	Nuts, brass nickel-plated ¼", 20 x 7/16" hex for fastening wire lug on coil to transmitter terminal	
Spare	2	Each		
8-60-A	12	Each	6" stand-off insulators	
Spare	4	Each		
8-60-B	12	Each	Studs, ¼", 20 x 1⅜" brass for fastening insulator to ceiling	
Spare	4	Each		
8-60-C	12	Each	Machine screws ¼", 20 x ⅜" round head for holding clips	
Spare	4	Each		
8-60-D	24	Each	Lockwasher, ¼" steel cadmium plated	
Spare	10	Each		
8-60-E	20	Each	Washers, brass nickel-plated, 11/16" OD x 0.260 ID x 0.051"	
Spare	9	Each		
8-61-A	4	Each	3" stand-off insulators	
Spare	3	Each		
8-61-B	4	Each	Studs ¼", 20 x ⅞" brass	
Spare	3	Each		
8-68	2	Each	66" battery cable (positive) with terminal and clamp lugs	Diesel—generator batteries
8-69	2	Each	8' 7"—battery cable (negative) with terminal and clamp lugs	
8-70	6	Each	12" jumpers with 2 terminal clamps	
8-71-A	6	Each	One-hole cable straps for 8-69	
8-71-B	6	Each	¼" x 1½" round head machine screws	
			Note.—Assembly 8-75 consists of 8-75-A, -B, and -C, as follows:	
8-75-A	4	Each	¼" x 5" brass flats (lead-in insulators to r-f cable)	R-f cable
8-75-B	4	Each	¼" x ½" round head brass machine screws	

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd).

Item No.	Quantity	Unit	Description	Assembly
8–75–C	4	Each	¼" flat brass washers	R-f cable
8–76–A	12	Each	No. 3 Minerallac cable supports	
8–76–B	12	Each	¼" x 1½" round head machine screws	
8–76–C	12	Each	¼" x 1" round head bolts	
8–76–D	12	Each	¼" nuts	
8–76–E	12	Each	Split porcelain bushings for No. 3 Minerallac cable support	
8–77	4	Each	Termite shields at building	
8–80–B	4	Each	½" x 6' 3" copper tube, 8–80–A	To tower
8–S–80–B	1	Each	½" x 6' 3" copper tube, 8–80–A (spare)	
			Note.—8–80–B and 8–S–80–B packed with Building—Wiring and Equipment.	
8–S–100	10	Linear ft.	No. 2 single braid rubber covered wire	General spare parts
8–S–101	30	Linear ft.	No. 6 single braid rubber covered wire	
8–S–103	40	Linear ft.	No. 12/2 non-metallic sheathed cable	
8–S–104	20	Linear ft.	No. 6 soft drawn bare copper wire	
8–S–107	12	Each	60 watt lamp bulbs	
8–S–108	12	Each	100 watt lamp bulbs	
8–S–109	1	Lot	Miscellaneous screws, staples, bolts, etc., (10% original requirement)	
8–S–110	24	Each	No. 12 solderless lugs	
8–S–111	1	Each	25 feet extension cord, 2 female plugs, 1 male, No. 14/2 conductor.	
8–S–112	1	Each	25 feet extension cord, light socket, guard, male plug	
8–120	1	Each	Impedance Measuring Box, with conductors and spare fuses, and spare meter guard.	General electric equipment
8–121	1	Each	Receiver battery, portable	
8–122	1	Each	Voice Conversion Kit	
			ITEM 2: TOWER COUNTERPOISE	
8–78	4	Each	265 feet r-f cable building to towers	Tower counterpoise
8–S–78	1	Each	265 feet r-f cable building to towers (spare)	
8–80–A	4	Each	Tuning house	
8–S–80–A	1	Each	Tuning house (spare)	
8–80–C	4	Each	Flash gap for 8–80–A	
8–S–80–C	1	Each	Flash gap for 8–80–A (spare)	
8–80–D	4	Each	Rain shield for 8–80–C	
8–S–80–D	1	Each	Rain shield for 8–80–C (spare)	
8–81–A	120	Linear ft.	No. 6 bare copper ground wire (tower)	
8–81–B	4	Each	Solderless lugs for No. 6	
8–82	156	Each	Ground rods, 6' 0"	
8–S–82	16	Each	Ground rods, 6' 0" (spares)	
8–83–A	144	Each	65 feet No. 12 copperweld radials	
8–83–B	160	Each	Extra washers for bolts at ring, size ⅜"	
8–S–83–A	16	Each	65 feet No. 12 copperweld radials (spares)	
8–84	4	Each	325 feet No. 12 copperweld outer ring	
8–S–84	1	Each	325 feet No. 12 copperweld outer ring (spares)	
8–85	144	Each	8' 0" stanchion with point	
8–S–85	24	Each	8' 0" stanchion with point (spares)	
8–S–86–A	10	Each	10' 0" tubes for stanchion extensions	
8–S–86–B	48	Each	"U" bolts for stanchion extensions	
8–S–86–C	48	Each	"U" bolts keeper pieces	
8–S–86–D	120	Each	¼" hex nuts for 8–S–86–B	
8–S–86–E	120	Each	¼" lockwashers for 8–S–86–B	
8–87–A	144	Each	Cap, stanchion post fitting	
8–87–B	288	Each	Set screws for 8–87–A	
8–87–C	432	Each	2-wire connector washers, bronze castings	
8–87–D	144	Each	Bolts	
8–87–E	144	Each	Standard washers	
8–87–F	144	Each	Lockwashers	

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd).

Item No.	Quantity	Unit	Description	Assembly
8-S-87-A	20	Each	Cap, stanchion post fitting	Tower counterpoise
8-S-87-B	40	Each	Set screws for 8-S-87-A	
8-S-87-C	60	Each	2-wire connector washers, bronze castings	
8-S-87-D	20	Each	Bolts	
8-S-87-E	20	Each	Standard washers	
8-S-87-F	20	Each	Lockwashers	
8-88-A	384	Linear ft.	No. 12 copperweld wire for braces	
8-88-B	64	Each	Clamps for CP braces	
8-88-C	69	Each	Nuts for 8-88-B	
8-88-D	16	Each	No. 12 solderless connectors for 8-88-A	
8-S-88-B	6	Each	Clamps for CP braces	
8-S-89	15	Each	Reliable double tube copper splice sleeve	
			ITEM 3: SPACE HEATERS	
8-24-A	1	Each	No. 1 heater unit	Space heaters
8-24-B	1	Each	No. 12/2 Romex cable and switch	
8-24-C	2	Each	Romex connectors	
8-24-D	4	Each	¼" x 1½" round head machine screws	
8-24-E	4	Each	½" x No. 8 round head brass wood screws	
8-25-A	1	Each	No. 2 heater unit	
8-25-B	1	Each	No. 12/2 Romex cable and switch	
8-25-C	2	Each	Romex connectors	
8-25-D	4	Each	¼" x 1½" round head machine screws	
8-25-E	4	Each	½" x No. 8 round head brass wood screws	
			ITEM 4: TOWER ERECTION AND DISMANTLING EQUIPMENT PARTS LIST	
0-00	1	Each	Instruction book	
10-1-A	1	Each	Pipe, 3" steel, standard, x 10' 0" with base plate and coupling	Gin pole—lower section
10-1-B	1	Each	Bolt, steel, ½" x 4½" square head bolt, hex nut	Gin pole—winch plate stop
10-1-C	1	Each	Bolt, steel, galvanized, ½" x 5" square head bolt, hex nut	Gin pole—coupling connector
10-1-D	8	Each	Washers, steel rod ½"	Gin pole—for 10-1-B, -C, -F
10-1-E	1	Each	Block, wood, oak, 1½" x 7" x 9"	Gin pole—to base plate of 10-1-A
10-1-F	4	Each	Bolts, steel, galvanized, ½" x 2½" square head bolt, hex nut	Gin pole—10-1-E to 10-1-A
10-1-G	1	Each	Winch, Sasgen No. 110, or equal	Gin pole—with 10-1-L attached
10-1-H	1	Each	Plate, steel, 10" x 5/16" x 1' 3"	Gin pole—winch mounting
10-1-J	4	Each	Bolts, steel, galvanized, ½" x 1¾" square head bolt, hex nut	Gin pole—10-1-G, 10-1-H
10-1-K	2	Each	Bolts, "U", steel, ½" x 11½", 1" thread hex nuts	Gin pole—10-1-H to 10-1-A
10-1-L	1	Each	Rope, wire, ⅜" x 80' 0", 6 x 19 improved plow steel hoisting	Gin pole—mounted on 10-1-G
10-1-M	1	Each	Block, wire rope, double, with hook, 6" for ⅜" wire rope, bronze bushed (diameter reg. pat. or equal)	Gin pole—for 10-1-L at 10-2-B
10-1-N	1	Each	Block, wire rope, single, hook and becket, 6" for ⅜" wire rope, bronze bushed (diameter reg. pat. or equal)	Gin pole—for 10-1-L
10-1-0	2	Each	Clips, wire rope, ⅜", Crosby pattern or equal	Gin pole—for 10-1-L
10-1-2	1	Each	Chain, sling, ⅜" x 6' 0" (Mesaba grade-hoist), ⅝" x 3" ID ring in middle, and 2 sling round hooks	Tower hoisting sling
10-1-3	1	Each	Angle 2" x 2" x ¼" x 2' 3" (with holes for driftpins)	Tower stiffener angle
10-1-4	4	Each	Pins, drift, barrel type, ⅜" diameter	For stiffener angle and tower pinning
10-1-5	2	Each	Screws, lag ½" x 3"	10-1-E to plank (as required)
10-2-A	1	Each	Pipes, 3" steel standard x 10' 0"	Gin pole—upper section
10-2-B	1	Each	Eye bolt, steel, drop forged, 1" x 6", with 2 hex nuts 2½" thread	
10-2-C	1	Each	Washers, galvanized rod, for 1" bolt	

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd).

Item No.	Quantity	Unit	Description	Assembly
			Note.—10–3–A and 10–3–B are assembled together.	
10–3–A	3	Each	Eye bolts, steel, drop forged, 5/8" x 5" with hex nut	Gin pole guy—spliced on 10–3–B
10–3–B	3	Each	Pennants, 3/8", 6 x 19 plow steel flexible hoisting wire rope 50' 0" CC thimbles, each made up with 2 3/8" galvanized W.R. thimbles, 2 3/8" safe-line clamps and 10–3–A attached	
10–3–D	6	Each	Washers, galvanized rod for 5/8" bolts	Gin pole guy
			Note.—10–3–E and 10–3–F are assembled together.	
10–3–E	3	Each	Pennants, 3/8", 6 x 19 plow steel flexible hoisting wire rope 10' 0" CC thimbles, each made up with two 3/8" galvanized W.R. thimbles, two 3/8" safe-line clamps and 10–3–F attached	Gin pole guys
10–3–F	3	Each	Rings, 1/2" stock 4" diameter (spliced on 10–3–E)	
10–3–G	3	Each	Shackles, steel, drop forged screw pin, 1/2" diameter	Gin pole guys 10–3–F to permanent anchor
10–3–H	3	Each	Blocks, wood, double, 6" for 3/4" manila rope, iron bushed with hook	Gin pole guys
10–3–J	3	Each	Blocks, wood, single, 6" hook and becket, for 3/4" manila rope, iron bushed	
10–3–K	3	Each	Rope, manila, 3/4"—50' 0" long	
10–4–A	2	Each	Blocks, wood, double, 6" hook (same as 10–3–H)	
10–4–B	2	Each	Blocks, wood, single, 6" hook and becket (same as 10–3–J)	
10–4–C	2	Each	Rope, manila, 3/4" x 75' 0" long	Kick anchor tackle
10–4–D	2	Each	Anchors, Hubbard steelwing 6", 3/4" x 5' 6", "Open I"	
10–4–E	2	Each	Slings, 1/4", 6 x 37 plow steel tiller rope 4' 0" long and two 1/4" wire rope thimbles, two 1/4" safe-line clamps attached, with hook and ring	
10–5–A	3	Each	Rope, manila, 3/4" x 225' 0" long	Temporary tower guys
10–6–A	3	Each	Blocks, wood, double, 6" with hook (same as 10–3–H)	Tower guy erection tackle
10–6–B	3	Each	Blocks, wood, single, 6" hook and becket (same as 10–3–J)	
10–6–C	3	Each	Ropes, manila, 3/4" x 75' 0"	
10–6–D	3	Each	Monkey tails, each consisting of 1 piece 3/8", 6 x 19 steel hoisting rope 3' 0" long, with 3/8" W.R. thimble attached on one end by 3/8" safe-line clamps	
10–6–E	6	Each	Clips, wire rope, 3/8" Crosby pattern (same as 10–1–0)	
10–7–A	1	Each	Block, pulley, wood, 4" double with hook for 1/2" rope	Tackle for lifting tower sections in place to bolt together
10–7–B	1	Each	Block, pulley, wood, 4" double with hook and becket for 1/2" rope	
10–7–C	1	Each	Rope, manila, 1/2" x 60' 0"	
10–8–A	1	Each	Block, 8" or 6" snatch, for 3/4" manila rope	Dismantling towers (use with item No. 18 tool kit TE87A)
10–S–1	1	Each	Ring, 5/8" x 3" ID	Spare
10–S–2	1	Each	Hook, sling (rd)	
10–S–3–F	2	Each	Rings, 1/2" stock, 4" diameter	
10–S–6–D	2	Each	Monkey tails (same as 10–6–D)	
10–S–3	6	Each	Blocks, wood, 6" double for 3/4" rope, hook and becket	
10–S–1–B	1	Each	Bolt, 1/2" x 4 1/2" square head bolt, hex nut	
10–S–1–C	1	Each	Bolt, 1/2" x 5" square head bolt, hex nut	
10–S–1–D	1	Each	Washers, 1/2" rd	
10–S–1–E	1	Each	Bolt, 1/2" x 2 1/2" square head bolt, nut	
10–S–1–J	1	Each	Bolt, 1/2" x 1 3/4" square head bolt, nut	
10–S–1–K	1	Each	Bolt, "U" 1/2" x 11 1/2", hex nuts	
10–S–1–0	2	Each	Clip, W.R., 3/8"	
10–S–1–5	1	Each	Screw, lag, 1/2" x 3"	
10–S–2–B	1	Each	Eye bolt, 1" x 6" with 2 hex nuts	
10–S–2–C	1	Each	Washer, 1" rd	
10–S–3–A	1	Each	Eye bolt, 5/8" x 5" with hex nut	
10–S–4	2	Each	Thimbles, 3/8" W.R.	

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd).

Item No.	Quantity	Unit	Description	Assembly
10-S-3-D	1	Each	Washers, 5/8" rd	Spare
10-S-3-G	5	Each	Shackles, screwpin, 1/2"	
			ITEM 5: TROPICAL FOUNDATION	
			Building—Alternate Parts List	
2-T-1	35	Each	16 1/2" x 14 1/2" x 5 5/8"	Footing block
2-T-1-A	20	Pieces	4" x 1 1/2" x 1/2" (bevel)	Wood levelling wedges
2-T-2	15	Pieces	3 5/8" x 3 5/8" x 48"	Wood post
2-T-3	1	Pieces		
2-T-4	18	Pieces		
2-T-5	1	Pieces		
2-T-6	16	Pieces	1 5/8" x 3 5/8" x 8' 9 3/16"	Braces
2-T-7	35	Pieces	8 3/4" x 8 3/4"	Metal termite shield
2-T-8	37	Pieces	5/8" diameter x 4"	Wood dowels
2-T-9	4	Each	3 1/2" x 1 1/2" x 9' 11 5/16"	Sill plates
2-T-10	2	Each	3 1/2" x 3" x 9' 11 5/16"	
2-T-11	2	Each		
2-T-12	2	Pieces	3 1/2" x 3" x 7' 8 1/4"	
2-T-13	10	Pieces	3 1/2" x 1 1/2" x 9' 11 5/16"	
2-T-14	2	Pieces	3 1/2" x 1 1/2" x 7' 8 1/4"	
2-T-15	2	Pieces	3 1/2" x 3" x 6' 0"	
2-T-16	3	Pieces		
2-T-17	12	Pieces	3 5/8" x 3 5/8" x 1 1/2"	Caps for posts
2-T-18	1	Pieces	1 5/8" x 7 5/8" x 5' 6 1/4"	Stair carriage
2-T-19	1	Pieces		
2-T-20	1	Pieces	3' 2 3/4" x 9 1/2" x 1 5/8"	Top tread
2-T-21	4	Pieces	3' 2 3/4" x 7 5/8" x 1 5/8"	Stair treads
2-T-22	1	Pieces	48" x 7 5/8" x 1 5/8"	Stair base
2-T-23	2	Pieces	1 5/8" x 3 5/8" x 4' 6 3/8"	Stair ties
2-T-24	2	Pieces	1 5/8" x 3 5/8" x 1' 10"	
2-T-25	5	Pieces	3/8" x 3' 7" rod	Stair carriage ties
2-T-25-A	10	Pieces	3/8" nuts	
2-T-25-B	10	Pieces	3/8" washers	
2-T-26	1	Pieces	1/2" x 8" square head machine bolts	Stair tie to post and brace
2-T-26-A	1	Pieces	1/2" nut	
2-T-26-B	2	Pieces	1/2" washers	
2-T-27	34	Pieces	1/2" x 6" square head machine bolts	Stair braces and braces to posts
2-T-27-A	68	Pieces	1/2" washers	
2-T-27-B	34	Pieces	1/2" nuts	
2-T-28	4	Pieces	1/2" x 4" square head machine bolts	Stair tie and brace to carriage
2-T-28-A	8	Pieces	1/2" washers	
2-T-28-B	4	Pieces	1/2" nuts	
2-T-29	18	Pieces	3/8" x 3 1/2" square head bolts	Sill plates to sill plates
2-T-29-A	36	Pieces	3/8" washers	
2-T-29-B	18	Pieces	3/8" nuts	
2-T-30	35	Pieces	1/2" x 6" lag screws	Plates to posts
2-T-38-A	35	Each	1/2" washers	
			Spare Parts List—Tropical Foundation	
2-TS-25	1	Each	3/8" x 3' 7" rod	Stair carriage ties
2-TS-25-A	2	Each	3/8" nuts	
2-TS-25-B	2	Each	3/8" washers	
2-TS-26	1	Each	1/2" x 8" square head machine bolts	Stair tie to post and braces
2-TS-26-A	1	Each	1/2" nut	
2-TS-26-B	1	Each	1/2" washer	

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd).

Item No.	Quantity	Unit	Description	Assembly
2-TS-27	6	Each	½" x 6" square head machine bolts	Stair braces and braces to posts
2-TS-27-A	12	Each	½" washers	
2-TS-27-B	6	Each	½" nuts	
2-TS-28	1	Each	½" x 4" square head machine bolts	Stair tie and brace to carriage
2-TS-28-A	1	Each	½" washer	
2-TS-28-B	1	Each	½" nut	
2-TS-29	2	Each	⅜" x 3½" square head machine bolts	Sill plates to sill plates
2-TS-29-A	4	Each	⅜" washers	
2-TS-29-B	2	Each	⅜" nuts	
2-TS-30	6	Each	½" x 6" lag screws	Plates to posts
2-TS-30-A	6	Each	½" washers	
			Mechanical Material Required for Tropical Kits Only	
7-T-39	1	Each	Pipe assembly, consisting of one ½" pipe 24½" long and one standard 90° ell	Fuel line
7-T-40	3	Each	½" pipe nipples 2½" long	
7-T-41	1	Each	½" horizontal swing check valve	
7-T-42	1	Each	½" pipe 71¾" long	
7-TS-40	1	Each	½" pipe nipple 2½" long	Spare
7-TS-41	1	Each	½" horizontal swing check valve	
			ITEM 6: TOOL LIST	
9-1	1	Each	Ackerman-Johnson tool (regular)	Installing A-J screw anchors
9-1-A	1	Each	Ackerman-Johnson (extra long)	
9-2	1	Each	Auger, 2", with 2-piece handle adjustable to 8' 0"	Installing tower anchors
9-3	1	Each	Bar, ⅝" x 5' 0" with handle and hook	Closing tower anchors
9-4	3	Each	Bar, 1¼" x 3' 0", bull point	For kick anchors and setting ground rod and stanchions
9-5	1	Each	Bolt cutter, 24"	Towers, etc.
9-8	1	Each	Can gasoline, safety, 5 gallons	Mechanical and cleaning
9-9	2	Balls	Carpenter's chalk line	Building and tower layout
9-10	6	Sheets	Cloth, emery crocus.	
9-11	4	Each	Driftpins, ⅜" bevel	Tower erection
9-12	1	Each	Drill, rock, star point, 1" x 24" (standard)	
9-13	1	Each	Flanging tool, ¼", ⅜" x ½"	Copper tubing
9-15	1	Each	Hammer, sledge, 10-lb regular pattern, with handle.	
9-16	1	Each	Hammer, sledge, 8-lb. double face, regular pattern, with handle.	
9-17	2	Each	Handle, axe, 16" handaxe	Spare
9-18	2	Each	Handle, axe, lineman's hand, 16"	
9-20	1	Each	Handle, hammer, wood	
9-21	6	Each	Handle, hammer, 8-lb sledge	
9-22	6	Each	Handle, hammer, 10-lb. sledge	
9-23	1	Each	Handle, pick and mattock	
9-24	1	Each	Handle, shovel, crooked, "Oshkosh", 10' 0"	
9-25	2	Each	Handle, shovel, short D-handle	
9-26	1	Each	Handle, shovel, long, for No. 2	
9-27	1	Each	Handle, spade (post-hole), short D-handle	
9-28	1	Each	Handle, spoon (post-hole), "Oshkosh" 12' 0"	
9-29	1	Each	Level, sight (Swift and Anderson)	Site layout
9-30	1	Can	Lubseal, 1 lb	Bolt lubricant and corrosive treatment
9-31	1	Each	Mattock, with handle	Site clearing
9-32	30	Sheets	Sandpaper, 6 No. 00, 6 No. 0, 6 No. ½, 6 No. 1, 6 No. 2	
9-33	1	Each	Pick, railroad, with handle	
9-34	2	Each	Screw driver, ratchet, Yankee 131 A heavy	
9-35	1	Each	Screw driver, off-set, 4", Miller Falls No. 797	
9-36	1	Each	Scythe, with handle	Site clearing
9-37	1	Each	Stone, scythe	

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd)

Item No.	Quantity	Unit	Description	Assembly
9–38	4	Each	Shovel, long handle, round point, No. 2.	
9–39	2	Each	Shovel, D-handle, square point, No. 2.	
9–40	1	Each	Spade, tile, 16" D-handle, round point.	
9–41	3	Each	Wrench, crescent, 8".	
9–42	3	Each	Wrench, speed with one 7/16" socket for 1/4" bolt and three 5/8" sockets for 3/8" bolt	Building and tower erection
9–43	1	Each	Wrench, structural (spud) 5/8"	Tower erection
			ITEM 7: Z MARKER ANTENNA	
8–11–B	1	Each	No. 12/2 Romex feeder cable and two connectors	Z Marker "Antenna"
8–11–C	1	Each	No. 12/2 Romex cable to Radio Transmitter BC–400–( ) No. 1 and 1 connector	
8–11–D	1	Each	No. 12/2 Romex cable to Radio Transmitter BC–400–( ) No. 2 and 1 connector	
8–14–A	1	Each	No. 740–A floorduct elbow	
8–14–B	1	Each	No. 733–A floorduct 32 3/4" long	
8–14–C	1	Each	No. 766–BA floor-duct outlet extension cap	
8–14–D	1	Each	No. 711–A floorduct 29 1/8" long	
8–14–E	1	Each	No. 711–A floorduct 11 3/4" long	
8–14–F	2	Each	No. 738–A floorduct elbow	
8–14–G	6	Each	No. 8 x 3/4" wood screws, flat head brass	
8–14–H	6	Each	No. 6 x 1/2" wood screws, round head brass	
8–30–A	1	Each	Condulet pedestal—GHC–333	
8–30–B	1	Each	Pipe standard, 1" x 33 3/8"	
8–30–C	1	Each	Pipe coupling, 1" standard	
8–30–D	1	Each	Conduit reducer, 1" to 1/2"—GHC–RE31	
8–30–E	1	Each	Pipe nipple, 1/2" x 2"	
8–30–F	1	Each	Condulet—GHC–GXA157	
8–30–G	1	Each	Gasket for GXA157	
8–30–H	1	Each	Cover with screws for GXA157	
8–30–J	4	Each	Pipe arms, 1/2" x 29 3/4" copper	
8–30–K	4	Each	Pipe arm extension, 5/8" x 12" brass tube	
8–30–L	4	Each	Clamps, ground, Penn Union, copper	
8–30–M	4	Each	Bolts, 1/4" x 3 1/2" round head, plated	
8–30–N	4	Each	Nuts, 1/4" plated	
8–30–0	4	Each	Washers, flat, 1/4" plated	
8–31–A	8	Each	Beehive insulators	
8–S–31–A	6	Each	Beehive insulators (spares)	
8–31–B	24	Each	Round head screws for 8–31–A	
8–32–A	1	Each	Base anchor plate	
8–32–B	4	Each	1/4" x 2" flat head machine screws	
8–32–C	4	Each	1/4" x 1" eye bolts (1" under "I")	
8–32–D	8	Each	1/4" nuts	
8–32–E	8	Each	1/4" washers	
8–33–A	50	Feet	No. 12 soft drawn copperweld wire	
8–33–B	4	Each	Brass set screw collar	
8–33–C	4	Each	Coil springs	
8–40	2	Each	Radio Transmitter BC–400–( )	
8–41–A	22	Feet	No. 10 hard drawn copper wire	
8–41–B	8	Each	Lugs for No. 10 wire (Zierick-tinned 107, 0.22 hole)	
8–41–C	6	Each	Studs 10–32 x 2 15/16" brass nickel-plated	
8–41–D	12	Each	Nuts, brass nickel-plated, 10–32 x 3/8" hex	
8–41–E	16	Each	No. 10 washers, internal, lock, steel, parkerized	Radio Transmitter BC–400–( )
8–41–F	16	Each	Washers, brass, nickel-plated No. 10	
8–41–G	16	Each	Washers, fiber, black, 1/2" OD x 7/32" ID x 1/32"	
8–41–H	12	Each	Nut, knurled, brass nickel-plated, 10–32	
8–41–J	10	Each	Insulators, entrance cup, American Lava 1155	
8–41–K	2	Each	Link, brass nickel-plated	
8–42	2	Each	Bases for Radio Transmitters BC–400–( )	

98. LIST AND DESCRIPTION OF CONSTRUCTION MATERIALS (cont'd)

b. List of Items (cont'd).

Item No.	Quantity	Unit	Description	Assembly
			ITEM 8: CONTROL PANELS FOR ENGINE GENERATOR	
8-16-A	2	Each	MG control panels (modified)	For engine generator
8-16-B	4	2 sets	¼" x 1½" round head plated machine screws	
8-16-C	2	2 sets	¼" flat plated washers	
8-16-D	1	2 sets	Instruction book for engine generator	
			ITEM 9: TECHNICAL MANUAL	
0-00	250	Each	Technical Manual	Signal Corps depot stock

99. GLOSSARY OF TECHNICAL TERMS

Ackerman-Johnson fittings. A female threaded fitting for the reception of bolts to hold members together or for attaching parts. These fittings are built into the members when the house is fabricated.

aggregate. Sand and broken stone suitable for mixing with cement to form concrete.

antenna. An elevated and/or extended system of conductors used for the transmission of electromagnetic waves, specifically, Adcock towers to send out a beam signal and marker antenna or Z marker to send a vertical signal. A loop antenna is one in the form of a rectangular loop. In a loop antenna radio range, two such are used at right angles.

angle, clip. An angular piece of metal used to fasten vertical supporting posts to floors and ceilings.

angle, splice. A metal angle piece used to connect together the vertical angle members of tower sections.

batten. A strip of wood for fastening two other pieces and to cover the crack between the two pieces.

batter boards. Horizontal boards nailed to posts set near the corners of a building under construction for fastening stretched string to mark outlines.

becket. A metal device on the end of a pulley block by means of which the end of the rope is fastened to the block.

block. A grooved pulley encased in a frame or shell which is provided with a hook, eye or strip by which it may be attached to an object. Single block has one pulley, a double block has two.

block, snatch. A block which can be opened on one side to receive a rope.

bus. Uninsulated, solid wire used to carry electric current between portions of a circuit. For example, bus connects Radio Transmitter BC-446-(*) to the transmission line terminals in the house. This is a general term and covers almost any sort of solid conductor.

carpenter's line. String for fastening to the batter boards.

clip angle. See **angle.**

coaxial cable. A transmission line cable built with a core conductor surrounded by a cylindrical conductor and separated by insulation. Electrical energy at radio frequency is carried on this cable from the transmitter house to the antenna towers.

counterpoise. A system of grounded electrical conductors erected beneath an antenna. The purpose of the counterpoise is to afford an equi-potential ground surface and reduce ground resistance of the antenna.

dipole. An antenna with two relatively short horizontal extended arms stretching out from two center vertical feeder conductors.

drift-pin. A short round metal rod inserted in bolt holes of metal members to assist in aligning two members for the insertion of fastening bolts.

fall (falls). That part of the rope of a tackle to which power is applied in hoisting; also sometimes synonomous with tackle.

flashing. A strip of waterproof felt laid around the junction of two surfaces to make the junction watertight.

footing. A foundation—specifically a wooden block to support the foundation struts in a tropical type building.

grading. Earth leveling.

goniometer. In a transmitter, a device incorporating two stator coils at right angles to each other and two rotor coils similarly wound. The relative position of rotor to stator may be varied.

guy. A wire cable or a rope used as a brace.

ground rod. A pointed rod driven into the ground and used as a terminal for a conductor which it is desired to ground.

header. A pipe to which several other pipes are connected.

impedance box. An instrument for measuring the impedance of electrical circuits.

loop antenna. See **antenna.**

monkey tail. A steel cable made into a loop and tail. The tail portion can be clamped to another longer cable so that the loop of the monkey tail may be used for pulling the longer cable tight.

miter. Term applied to a dovetail joint in which there is only one joint visible and that at an angle.

pennant. A short rope or cable.

phase. That characteristic of alternating currents which is indicative of the angular relationship between vectors representing harmonically varying currents of the same frequency.

purlin. Horizontal members jointing rafters.

quarter wave. A length equal to one-quarter the wave length of the radio wave being transmitted over a line or antenna.

r-f (radio frequency). Specifically here 200-400 kilocycles and 75 megacycles.

rabbet. A channel or groove cut out of the edge of a wooden member, especially one intended to receive another member, as a panel so as to break or cover the joint, or hold the members in place.

rafter. One of the sloping supporting timbers of a roof.

screed. A strip or strips of wood used as a guide for the thickness of proposed foundation fill. Specifically here also the timbers upon which the floor is laid but not in a tropical type of foundation.

scavenger. A pipe used for overflow.

splice angle. See **angle.**

spline. A square or rectangular shaped block of wood which functions as a key in one or more channel-shaped grooves used as keyways or rabbets. (See also **rabbet.**)

stanchion. An upright pipe used as a support for wires.

tackle. An assemblage of ropes and pulleys arranged for hoisting or pulling.

transmission line. Electrical conductors between the bus and the antenna. (See also **co-axial cable** and **bus.**)

winch. A hand power hoisting machine consisting of a rope drum driven through reduction gears by a crank handle.

Z marker. See **antenna.**

Appendix I

MOISTUREPROOFING AND FUNGIPROOFING

100. GENERAL

The operation of Signal Corps equipment in tropical areas where temperature and relative humidity are extremely high requires special attention. The following items represent problems which may be encountered in operation:

a. Resistors, capacitors, coils, chokes, transformer windings, etc., fail.

b. Electrolytic action takes place in resistors, coils, chokes, transformer windings, etc., causing eventual break-down.

c. Hook-up wire and cable insulation break down. Fungus growth accelerates deterioration.

d. Moisture forms electrical leakage paths on terminal boards and insulating strips.

e. Moisture provides leakage paths between battery terminals.

101. TREATMENT

A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant varnish applied with a spray gun or brush. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing, and the supplies and equipment required in this treatment.

CAUTION.—Varnish spray may have toxic effects if inhaled. To avoid inhaling spray, use respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth.

102. STEP-BY-STEP INSTRUCTIONS FOR TREATING HOUSE WIRING

a. Preparation. Clean all wiring with a dry cloth.

b. Varnishing.

(1) Apply three coats of moistureproofing and fungiproofing varnish (Lacquer, Fungus-resistant, Spec. No. 71-2202 [Stock No. 6G1005.3], or equal) with brush. Allow each coat to dry 15 to 20 minutes before applying the next coat.

(2) Give special attention to the power wires where they enter the transmitters to see that varnish is applied up to the contact points.

103. STEP-BY-STEP INSTRUCTIONS FOR TREATING REMOTE CONTROL JUNCTION BOX

a. Preparation. Make all repairs and adjustments necessary for proper operation of the equipment.

b. Disassembly.

(1) Remove the three screws holding the panel cover and remove cover.
(2) Disconnect wires from terminals 1 to 18.
(3) Remove the six screws holding the terminal panel in place.
(4) Remove terminal panel from junction box.
(5) Thoroughly clean the unit by removing all oil, dirt, rust, or fungus adhering to any of the components.

c. Drying.

(1) Place equipment in drying oven and bake from 2 to 3 hours at 160 F. *Do not exceed 160 F.*
(2) If wax should begin to melt on any of the components, decrease the baking temperature and increase the baking time. For each 10° drop in baking temperature increase baking time 1 hour.

d. Varnishing.

(1) Apply three coats of moistureproofing and fungiproofing varnish (Lacquer, Fungus-resistant, Spec. No. 71-2202 [Stock No. 6G1005.3], or equal) with brush to *wiring only*. Allow each coat to dry 15 to 20 minutes before applying the next coat.
(2) Take care not to get varnish on contacts or moving parts of relays.
(3) Spray varnish on cover, and on outside and inside of junction box.

e. Reassembly.

(1) Clean all contacts with varnish remover, and burnish the contacts.
(2) Reassemble equipment by following disassembly instructions in reverse order.

(3) Mark cases "MFP" with date of treatment.

Example.—MFP—8 June 1944.

(4) Check over-all performance of equipment.

104. STEP-BY-STEP INSTRUCTIONS FOR TREATING ANTENNA TUNING UNIT

WARNING.—*Be sure power is off before working on this unit.*

a. Preparation. Refer to paragraph 103a.

b. Disassembly.

(1) Loosen wingnuts on sides of housing and let front panel swing down.

(2) Remove the 10 panel screws (three on top, three on bottom, and two on each side).

(3) Disconnect leads on top side of bottom insulators (antenna and ground leads).

(4) Remove tuning unit from tuning unit housing.

(5) Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed.

c. Masking.

(1) Completely mask both top and bottom of two glazed ceramic insulators in bottom of housing.

(2) No masking is required on the tuning unit itself since it is not to be sprayed.

d. Drying.

(1) Dry tuning unit according to instructions given in paragraph 103c.

(2) The tuning unit housing may be air-dried in the sun since it is outside equipment.

e. Varnishing.

(1) Refer to paragraph 102b(1).

(2) Apply varnish to inside of panel and to lead wires. *Do not apply varnish to coil or switches.*

(3) Spray inside and outside of tuning unit housing with varnish.

f. Reassembly. Refer to paragraph 103e.

105. STEP-BY-STEP INSTRUCTIONS FOR TREATING RANGE SELECTOR UNIT

a. Preparation. Refer to paragraph 103a.

b. Disassembly. Remove phone range selector unit from Radio Transmitters BC-446-(A to H) in the following manner:

(1) Disconnect wires from terminal strip.

(2) Remove screw and lockwasher from shelf and the two screws through the bracket.

(3) Remove dual-potentiometer control knob.

(4) Remove unit from transmitter.

(5) Clean all dirt, dust, rust, fungus, oil, grease, etc,, from the equipment.

c. Masking.

(1) Mask relay completely.

(2) Mask terminals on terminal strip.

d. Drying. Refer to paragraph 103c.

e. Varnishing.

(1) Apply three coats of moistureproofing and fungiproofing varnish (Lacquer, Fungus-resistant, Spec. No. 71-2202 [Stock No. 6G1005.3], or equal) with spray gun. Allow each coat to dry 15 to 20 minutes before applying the next coat.

(2) Inspect treated equipment and apply varnish with a brush to those portions not reached by spray gun. Be sure all components are adequately protected by varnish.

f. Reassembly. Remove masking tape. For other steps, refer to paragraph 103e.

106. STEP-BY-STEP INSTRUCTIONS FOR TREATING REMOTE CONTROL UNIT RM-45-A

a. Preparation. Refer to paragraph 103a.

b. Disassembly.

(1) Remove MODULATION LEVEL bar knob.

(2) Remove top and back panel by loosening wingnuts on each side.

(3) Remove rectifier Tube JAN-5Z3(V1R).

(4) Remove bottom panel by taking out six screws.

(5) Using a Phillips type screwdriver, remove the Phillips screws holding the R3R mounting in place, and lift the resistor and mounting up an inch to facilitate varnishing of the wires underneath.

(6) Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed.

c. Masking. Cover the following components with masking tape.

(1) Meter face.

(2) All pilot lamp jewels.

(3) ON-OFF switches and microphone jack.

(4) Shaft and bushing of MODULATION LEVEL control.

(5) Relay, tube socket, jack, pilot lamps and holders, and switches.

(6) Bottom contacts of tube socket.

(7) Rear terminal strip.

(8) Inside of 110-volt receptacle.

(9) Contacts on sockets of capacitors C1R and C2R.

d. Drying. Refer to paragraph 103c.

e. Varnishing. Refer to paragraph 105e.

f. Reassembly. Remove all masking tape. For other steps, refer to paragraph 103e.

107. INSTRUCTIONS FOR TREATING OTHER COMPONENTS

In treating all of the following components apply three coats of moistureproofing and fungiproofing varnish (Lacquer, Fungus-resistant, Spec. No. 71-2202 [Stock No. 6G1005.3], or equal).

a. Z Marker Antenna. Apply varnish with a brush to the lower 2 feet (below the impedance matching stub section) of the vertical transmission line and the base anchor plate. Do not treat any other portion of antenna.

b. Control Relay Unit (Lower Front of Radio Transmitter BC-446). Apply varnish with a brush to wiring and mounting panel *only*. Avoid splashing varnish on relay contacts. Removal of the unit is not necessary.

c. Quarter-Phasing Unit. Apply varnish with a brush to the relay coil (marked 115 AC, Z-80) and to the rear panel. The unit does not have to be removed from the transmitter. After treating, check operation.